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Ergonomic Principles Needed By Garment Workers for Garment Finishing in South East, Nigeria

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Abstract

The study evolved ergonomic principles needed by garment workers for garment finishing in Southeastern Nigeria. Specifically, it determined important ergonomic principles necessary for garment finishing, ergonomic principles already adopted by garment workers and ergonomic improvement needed by the garment workers. Survey research design was adopted. Population was made up of 267 garment workers drawn from 19 registered garment companies in the area of the study. Questionnaire was used for data collection. Data were analyzed using mean, and improvement need index. Findings show 15 important ergonomic principles for garment finishing which include; improving visibility by contrasting the colour of the garment being inspected from the colour of the work surface ($\bar{X}$= 3.83), titling the work surface towards the operator while pressing to help improve visibility ($\bar{X}$= 3.75), providing adjustable chairs with proper back support and cushioning for hand sewers ($\bar{X}$= 3.74), among others. None of the 15 identified important ergonomic principles were being practiced by the garment workers. Thus, there is need for ergonomic improvement in the 15 identified important ergonomics principles needed for garment finishing. It was thus recommended among others that the needed ergonomic principles should be packaged into a training manual for occupational health and safety education for the garment workers.

Keyword: Ergonomic, Principles, Need, Garment, Finishing, Workers, Workplace, Industry, Workstation.

Introduction

Ergonomics was coined from the word "*ergon*" – work and "*nomous*" – rule, meaning work rule. It is a multidisciplinary science of designing machines, products and systems to maximize safety, comfort, and efficiency of the people who use it (Alan 2008). It is the practice of arranging furniture and equipment considering peoples' sizes, shapes and physical strength limitation to make work comfortable and safe (Occupational Safety Health Administration (OSHA) (2000). Ergonomics endeavours to make a better fit between work and the worker in other to ensure health and safety (Kiron 2023). International labour organization (ILO) (1998) defined it, as the study of work in relation to environment in which it is performed; the work place and those who perform it. Thus, ergonomics can be summarized as the scientific study of human

productivity in the workplace which goal is to eliminate discomfort and risk of injury due to work (Kiron 2023). Ergonomics creates a better work and safety culture in the workplace.

Ergonomics has principles that guide its application which includes; working in neutral posture ie maintaining the "S" curve of the spine, reducing excessive force, repetitive motion and pressure points. Keeping everything within easy reach to preventing reaching, bending and twisting the trunk, working at proper heights, limiting the amount of load that is lifted instead mechanical aids should be used, avoiding static loads on muscles, taking short breaks and regular stretching and exercises among others (Mcleod 2008, Health and Safety Authority 2008). These principles are summarized as principles of maintaining good working posture, safety consciousness in workplace and environment.

Ergonomics is a proactive health measure against induced strains and injuries which results in what is known as repetitive strain injury (RSI) or muscle-skeletal disorder (MSD)(Pascrehi 2008, Scott 2012, Candian Centre for occupational Health and Safety 2014). This occurs when the occupational requirements of the job or task are performed under difficult condition using awkward posture and poorly designed equipment. The resultant effect of the mismatch between the worker and his job is damage to the muscle, tendons and nerves of the neck, back, shoulder, foreman, must and hand (Health and Safety Executive 2013, Environmental Health and Safety2022). These injuries often start as minor aches and pains but can develop into disabling injuries that affect our daily activities or daily living such as house chores, hobbies among others (komal, 2022). The condition worsens, if the job is done repeatedly unless the risk factors are removed.

The garment industry is usually seen as a safe place to work in when compared with other industries because there are relatively fewer major accidents. However, the major health risk does not arise from potentially fatal injury but from more subtle hazards whose effects accumulate overtime (American Appared and Footwear Association AAFA 2005, Kiron 2023). The occupational hazards result from awkward and constrained postures maintained by garment workers during the whole period of work, as well as many repetitive manual tasks involved in the highly fragmental sewing processes.

The primary task in the finishing department of garment production assembly line is pressing, hand sewing, final inspection and packaging (Mudhunham 2013). In the pressing unit workers stand for long hours on a hard floor without anti fatigue mat with flexed back and neck posture where the work surface is low or with elevated shoulder and arm where the ironing surface is higher (Kabir and Armed 2003, Mehta 2012). Also, the input and output movement of picking and dropping the finished garment in pile boxes or cart creates another awkward posture of bending and reaching. A good working height that is easily adjustable will help to reduce strains and stress. Furthermore, the finishing task also involves the hand sewing jobs,

which may include fixing of buttons, eyelets, sequins, beads among others. The work surface and the chair are highly considered. Unfortunately, a non-existence or inappropriate work surface for hand sewing results in the worker using his or her lap as work surface. This creates poor neck and back postures that are maintained for extended periods (Guning et. Al 2001, AAFA 2005). This situation is sometimes further aggravated by inadequate or poor lighting which creates shadow and glare in work surfaces increasing the visual demand on the operators. Finally, workers at the packaging unit also suffer similar ordeals of standing on hard floor for prolonged period of time, bending, reaching in constrained posture for extended periods (Gunning et.al 2001).

Ergonomically designed workstation would ensure that the workers physical biomechanics are considered, taller worker having enough space to perform the work and shorter worker should reach his tools and work surface without reaching beyond comfortable and safe range (Kiron 2023) Titled tables and work surfaces are used to increase visibility, task lightings are used for greater visibility, ergonomic chairs with adjustable heights, antifatigue mats are also used to reduce static load during prolonged period of standing, ergonomic hard tools eg scissors and cutters used to reduce contact pressure in the hand and cornification of skins and fingers, taking short breaks and intermittent periods of rests to allow the strained nerve and muscle to recover among others (Guning et. Al 2001, saving craft and Alliance SC & A 2008, Polajnar, Leber and Herzog 2010, Kabir and Armed 2013, Komal 2022)

Preliminary study carried out by the researcher in (July 2012) in South eastern Nigeria to ascertain ergonomic awareness and compliance of garment workers using Focus Group Discussions. The study revealed the prevalence of symptoms of repetitive strain injury among the garment workers. The respondents complained of pains at the neck, lower back and waist, eye strain, insomnia, numbness, pedal odema, tingling, use of anagelsics to reduce body pain among others. These could have resulted from poorly designed and unorganized workstation and work practice. Several studies have shown that ergonomically optimized workstation can considerably reduce the incidence of RSIS or MSDs (Kelly et al 1992, Gunning et al 2001, American Apparel and footwear Association 2005, Polajnar, Leber and Herzog 2010, and Komal 2022).

The obvious ignorance about ergonomic principles by garment workers and prevalence of RSIs or MSDs is a serious gap that needs to be filled. This cannot be achieved effectively until their workstation and work practice have been carefully studied to determine the ergonomic principles they needed, to make garment finishing unit congenial for the workers.

Purpose of the study

The major purpose of the study was to evolve ergonomic principles needed by garment workers for garment finishing in Southeastern Nigeria. Specifically the study determined:

1. important ergonomic principles necessary for garments finishing.
2. those important ergonomic principles already adopted by garment workers in garments finishing.
3. ergonomic improvement needed by garment workers for garment finishing.

Methodology

Design of the Study: Descriptive survey research design was adopted for the study.

Area of the Study**:** The study was carried out in Southeastern Nigeria. South eastern Nigeria is largely dominated by the Igbo ethnic group which is generally known for their commercial activities. Their entrepreneurship drive has made them to diversify in various areas of manufacturing, including garment production. Most of these garment industries are sited in Aba and Onitsha which are the two major commercial cities in the South Eastern Nigeria. There are many garment companies but only 19 garment companies were registered; ten (10) in Aba and nine (9) in Onitsha (Source: Garment Industries (Ad) www.webcrawler.com) However, for the purpose of this study, only the registered ones were used.

Population for the Study**:** The population for this study was made up of 267 garment workers who were drawn from the 19 registered garment companies in Aba and Onitsha (Source: Garment Industries Ad www.webcrawler.com). These are the two major commercial cities where most garment companies were sited in South East Nigeria. The garment workers or operators within these companies were the respondents for the study, because they are directly involved in the sewing job, drafting, cutting, stitching/assembling, finishing and packaging of garments. The garment workers were mainly young and middle aged men and women who spend 8 hours or more in their job each day. Majority of them were literate who had secondary school education.

Sample for the Study**:** There was no sampling the entire population was used since the size is manageable.

Instrument for Data Collection**:** Data was collected using a structured 15-item questionnaire. The instrument was validated by three experts. Two Home Economics lecturers and one Physiotherapist. The questionnaire items were designed based on the specific purposes of the study. The reliability coefficient of 0.83 was obtained for the instrument. The questionnaire was structured into four responses of Highly Important (HI), Averagely Important (AI), Slightly Important (SI) and Not Important (NI), while the Practiced category was structured into four responses; Highly Practiced (HP), Averagely Practiced (AP), Slightly Practiced (SP) and Not Practiced (NP)

Method of Data Collection**:** Two hundred and sixty-seven (267) copies of the questionnaire were administered by hand to the respondents with the help of five research assistants. A total of 260 copies were returned out of the 267 copies of the instrument administered. This gave 97.3 percent return rate.

Method of Data Analysis**:** The data were analyzed using mean and improvement need index . To determine

the need gap, the following procedures were adopted:
Weighted mean of each item under the needed category (XN) was calculated.
Weighted mean of each item under the performance category (Xp) was calculated.
Difference between the two means for each item (Xn-Xp) was determined.
The decision rules were as follows:

- A zero (0) value indicated that ergonomic principles were not needed because the level at which the item was needed is equal to the level at which the respondents can perform it.
- A positive (+) value indicated that capacity building is needed because the level at which the item was needed is higher than the level at which the respondents perform it.
- A negative (-) value indicated that ergonomic principles is needed because the level at which the item was needed is lower than the level at which the respondents can perform it.

Results

Table 1: Need Gap Analysis (NGA) of Ergonomics Principles Needed by Garment Workers for Garment Finishing in South East Nigeria (N=260)

SN	Ergonomic Principles Needed By Garment Workers For Finishing Garments(EPNGWFG).	NG $\bar{X}n$	$\bar{X}p$	($\bar{X}\bar{X}p$)	R
1	Using an adjustable height for ironing, to accommodate operators with different body sizes.	3.30	2.90	0.40	IN
2	Tilting work surface towards the operator while pressing to improve posture and visibility.	3.75	2.61	1.14	IN
3	Placing anti-fatigue mat at the pressing area to reduce strains on the operator	3.55	2.84	0.71	IN
4	Organizing workstation so that operators can rotate between standing and sitting work positions.	3.61	2.64	0.97	IN
5	Providing a large table slightly above the elbow for finishing tasks such as hand sewing of buttons, sequins or beads, eyelets, etc	3.48	2.53	0.95	IN
6	Providing adjustable chairs with proper back support and cushioning for the hand sewers at finishing tasks.	3.74	2.80	0.94	IN
7	Delivering of garments for finishing jobs to the workers at a height that does not require high extended reaches	3.60	2.61	0.99	IN
8	Providing foot rest for the workers to relieve the stress on their legs and backs while seated.	3.40	2.56	0.84	IN
9	Using of small sharp clippers for cutting thread instead of large heavy scissors.	3.65	3.15	0.50	IN
10	Using an inclined ease with clips to hold the garments for inspection.	3.42	2.78	0.64	IN
11	Storing of hand tools e.g. thread, clipper, needles and notions on a shelf near the	3.57	2.62	0.95	IN

Table 1 continued

	workplace or hung directly beside the work surface for easy access.				
12	Improving visibility by contrasting the colour of the garment being inspected from the colour of the work surface	3.84	2.73	1.11	IN
13	Appropriate height of packaging table with small released area at the front that can hold frequently used items	3.41	2.49	0.92	IN
14	Locating storage bins beside the bagging station to limit reaching and lifting	3.80	3.00	0.80	IN
15	Placing shelf directly beside the operator in other to place the packaged garments.	3.65	2.36	1.29	IN

Note: $\overline{X}_n$ = Mean Needed; $\overline{X}_P$ = Mean Practices; NG= Need Gap; IN= Improvement Needed; R =Remark.

Table 1 shows that all the 15ergonomics principles had their need gap (NG) values ranged from 0.40 to 1.29 which are all positive. This indicated that garment workers in southeast Nigeria need improvement in all the 15 identified important ergonomic principles that are necessary for garment finishing in southeast Nigeria.

Discussion

The findings of the study showed that garment workers identified the following ergonomic principles for garment finishing; improving visibility by contrasting the colour of the garment being inspected from the colour of the work surface, tilting the work surface towards the operator while pressing to help improve visibility, providing adjustable chairs with proper back support and cushioning for the hand sewers at the finishing task since they are seated for long periods, using adjustable height for ironing which allow the operator to change body parts that are carrying greater stress and to accommodate operators with different sizes among others. These corroborates the findings of Gunning et al (2001) and Komal (2022) which emphasized the need for fundamental ergonomic principles as possibilities for optimizing the tasks in the workplace. According to Kiron (2023) he stressed that consideration must be given to the following in applying ergonomic principles; work station height, lighting, intensity, shift length and work rest cycle. Therefore, the physiological and anthropometric features of the workers must be considered in designing a work station.

Furthermore, the findings of the study revealed that the 15 important ergonomic principles identified, none was practiced by the garment workers. This is in line with the findings of Komal (2022) who observed that against the ideal situation of ergonomically optimizing the work station based on workers need the opposite is often the case. Workers are usually forced to work within the confines of the job or workstation that is already in place. Ignorance could be one of the major reasons for this anormaly. Ismaila (2010) in his survey on ergonomic awareness

in Nigeria found that only 3.4 percent of his respondents were aware of ergonomics, which was very low. In addition to ignorance there maybe the possibilities of the finishing section of garment production being neglected, while greater attention and concentration maybe given to the cutting and sewing departments as the hub of the production floor. Komal (2022) noted that thorough analysis must be carried out in the work environment in order to understand each worker's need and in turn apply solutions that will make the work environment conducive.

Finally the findings of the study also showed that ergonomic improvement is needed in all the 15 important ergonomic principles identified; which include using an adjustable height for ironing, which will allow operators to change body parts that are carrying greater stress and also to accommodate operators with different body sizes, tilting the work surface towards the operator while pressing to help improve posture and visibility, placing anti-fatigue mat at the pressing area to help reduce strains on the operator, organizing the work station so that operators can rotate between standing and sitting work positions to reduce fatigue among others. This affirms the findings of Menke (2017) which reported deplorable working conditions of garment workers, wherein their jobs were neither well-structured nor routinely organized. Tasks are generally repetitive and burdensome to the workers; who sit in a constrained posture in a congested workplace. According (DAKs 2021) Absence of a legitimate contract between the garment workers and their employers, make the workers to be exploited. They quietly endure whatever health challenge resulting from their poor work environment. This may probably be out of fear of being fired. Workers hardly report the occupational hazards they pass through. Only the brave ones publicize their own (Loomis 2015). According to Arushi (2020), these workers, work up to 18 hours a day arriving early in the morning and leaving past midnight, working in small chairs that stress their backs and necks. The resultant effect of this is prevalence of RSIs or MSDs as was observed in the preliminary study. However, research has shown that ergonomic interventions including redesign and proper use of ergonomically designed tools and training in low-risk work practice will substantially improve workers well-being and efficiency (Kelly et al 1992, Gunning et al 2001, Polajnar, Leber and Herzog 2010, Komal 2022), hence the need for ergonomic improvement by the garment workers.

Conclusion

The professional touch in garments cannot be achieved without the finishing department of the garment factory. The sewing processes at this unit require significant amount of repetitive and skilled manipulations, requiring visual and tactile dexterity. This often predisposes the workers at high risk of developing occupational injuries. Proactive healthcare in form of application of ergonomic principles in workplace can address this challenge. The application of these ergonomic improvements should be holistic, multidimensional, task related and

transferable with the focus of ensuring sustainable well- being of workers and productivity.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Public enlightenment by Home Economists, occupational health and safety organization professionals, and public health officers on occupational hazards in garment production and the need for ergonomics.
2. Integration of ergonomic principles in Home Economics school curriculum under first and safety education and Home Management.
3. Packaging of ergonomic principles for garment making in training manuals for garment workers by the government and trade unions.
4. Home Economics teachers should educate their students on the application of ergonomic principles in clothing construction practical lessons during the course of their study.

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Evaluation of Growth and Genetic Parameters of Second Filial Generation (F2) Offspring of Crossbreed Exotic and Local Birds

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Abstract

This experiment evaluatedgrowth traits and estimated genetic parameters of offspring (F2)crossbreed of exotic and local birds in University of Nigeria Nsukka farm. A total of 240 F2 hatched chicks from the genotype groups of F1 (offspring of first filial generation)were used for this experiment. The chicks were brooded in groups according to their genotypes for six weeks. Parameters measured include; body weight, body length, thigh length, and shank length from which heritability were estimated. The result shows that *Amo* cock x *Isa* brown hen genotype (AC x IBH f2) was significantly ($p<0.05$) higher in body weight than other genotypes in all the weeks considered with a mean weight of 46.67±0.33 at 1st week and 1365.00±56.75at 12thweeks of age, followed by *Amo* cock x heavy ecotype hen genotype (AC x HEH f2) with a mean weight of 41.00±1.00 and 1253.00±69.51 at 1stand 12thweeks respectively. Heritability in week one were found to be low in all the traits observed except in body weight and body length of AC x IBH f2 with h^2s of 0.941 and 0.360 for body weight and body length respectively. It could be concluded therefore that crossbreeding of Nigeria local birds with a proven exotic birds increases production performance. Also additive gene effect was stronger than the non-additive gene effect, epitasis or even environmental factors.

Keywords: Growth, Traits, Genetic, Parameters, Birds, Crossbreeds, Generations, Heritability

Introduction

The Nigerian population is increasing at an alarming rate, with a projected population growth of 400,000 million people by 2030 (Bot et al., 2021). The continued expansion in urbanization, from 34.8 percent in 2000 to 49.5 percent by 2017, has implications for food availability and affordability (Owoo, 2021). Mubarak *et al*. (2016) noted that protein intake in Nigeria is still far below the suggested dietary allowance 36g per adult per day rather Nigerians' protein intake could be as low as nine g per day for an adult. This lamentable level of protein intake is execrable and may be implicated for high infant mortality, short life expectancy and stunted growth.There istherefore great need for animal scientists to begin to think inwards on how to avertmalnutrition, especially in children, through livestock intensification.

Throughout human history, approximately 40 livestock species have

been domesticated, most of which still contribute to agriculture and food production as domestic animals today (Food and Agricultural Organisation, 2007; Hata*et al.,* 2021).Chicken is one of the most ubiquitous domesticated animals. It is bred for both its egg and meat, and is thought to have originally been domesticated from the red jungle fowl (*Gallus gallus*) native to multiple regions from Southeast Asia to Southwest China (Liu *et al*., 2006; Miao *et al.,* 2013).Commercial chicken breeds, including layers and broilers, have been bred over the last 100 years through selective mating of various indigenous breeds (Rubin *et al*., 2010; Elferink*et al*., 2012; Núñez-León *et al.,* 2019).Over the years, indigenous chickens have acquired diverse genetic characteristics that have aided their adaptation to different challenging conditions in diverse locations such as heat, stress, humidity and disease (Hata*et al*., 2021). Though local/indegenous chickens are slow growers and poor layers of small sized eggs, they are, however, ideal mothers and good sitters, excellent foragers, and hardy and possess natural immunity against common diseases such that the crossbred could form breed complimentarity.

Cross breeding of the local stock with an exotic commercial stock could take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds(Adebambo*et al*., 2009; Ndofor-Folenge*t al.,* 2014).Fulla (2022) reported that the main purpose of crossing the exotic and local chicken is to introduce new genes, to advance fitness and productiveness traits and to produce breeds adapted to local environment. Crossbreeding of indigenous birds with a proven exotic breed could therefore be advantageous and it is getting popularity in Nigeria (Dogara*et al,* 2021, Momoh&Nwosu, 2008). A good breeder must take into cognizance the genetic progress over a period of time while working with first, second or third or any filial generation (f1, f2, f3….fx) to help keep the track record of genetic improvement traits added achieved to the chosen animals.

Knowledge of genetic parameters is also necessary for designing an appropriate breeding plan for producing birds with the best genetic traits and performance. The purpose of animal breeding is not only to genetically improve individual animals, but also to improve animal populations. To improve populations, basic tools are required to identify and utilize genetic differences between animals for the traits of interest. Most of the economic characters in farm animals that are of concern to a breeder normally show continuous variation. Such characters are controlled by a large number of genes, each having a small, similar and supplementary effect on the character (John-Jaja *et al*., 2016). Designing of effective selective breeding programs requires quantitative information concerning nature and scale of genetic and environmental sources of variation and correlation for components of performance. Nwosu (1990) stated that in making breeding plans, it is important to know the relative importance of the heritable and the environmental variation of the characters. Though the poultry industry has experienced tremendous growth in recent years, the growth has been with

exotic chickens only. There is need to improve the productivity of Nigerian local chickens that are up till now, characterized by small body weight, small egg size and few number eggs (Ige, 2013).

Crossbreeding is a method of mating different breeds of animals in order to obtain desirable attributes and complement shortfalls in one breed with those of the other (Ngwogwugwu*et al.,* 2018).This degree of correspondence is measured by genetic parameters such as heritability, repeatability, and genetic correlation as prerequisite for making efficient selection strategies by the geneticists and breeders (Sajjad, 2012). Heritability estimates the degree of variation in a phenotypic trait in a population that is due to genetic variation between individuals in that population (Wray and Visscher, 2008). It measures how much of the variation of a trait that can be attributed to variation of genetic factors, as opposed to variation of environmental factors. Hermiz and Abdullah (2020), reported estimates of heritability for body weights of chicks at different ages to be; 0.42, 0.61, 0.76, 0.71, 0.43, 0.51, and 0.70 for body weight at one day;four;eight; nine;ten and sixteen weeks and at maturity respectively. Their findings indicated that the heritability of bodyweight traits ranged between 42-76 percent and that the rest could be controlled by environment.

This study therefore seeks to explore the growth traits in the local and exotic traits of birds as well as their crossbred within the university farm. The selected population of the animals (first filial generation, f1) were crossbred to generate second animal population (second filial generation, f2) from which data were collected. The finding could help for further strategies in increasing the farm animal population thereby increasing protein intake of the Nigerian populace.

Objectives of the study

This study focusedon growth traits and genetic parameters ofoffspring (f2) crossbreed of exotic and local birds in University of Nigeria Nsukka (UNN) farm: Specifically, it determined:

1. growth traits of f2 offspring of crossbred exotic and local birds in UNN agricultural farm.
2. heritability of F2 generation of crossbred exotic and local birds in UNN agricultural farm.

Hypotheses

The following null hypotheses weretested at 0.05 level of significance:

H_{01}: There is no significant difference in estimate of growth traits of f2 offspring of crossbred exotic and local birds in UNNagricultural farm. The growth traits (body weight and linear body measurements) were measured by sensitive electronic scale and measuring tape.

H_{02}: There is low heritability estimate of heritability of F2 generation of the crossbred exotic and local birds in UNNagricultural farm.

Materials and Methods

***Design of Study*:** The study was an experimental research. The experiment lasted for twelve weeks from brooding to growing stages.

***Materials*:** The experiment was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, UNN, located in the southern eastern part of Nigeria.

Experimental Animals included a total of 240 F2 hatched chicks from four genotype sire families of F1 chicken population from the UNN agricultural farm were randomly selected andused for this experiment.

Other materials include New castle disease virus (NDV) vaccine, Gumboro vaccine and fowl pox vaccine which were all purchased from Farmers Need shop Tectonics Road Nsukka. Feed used include chikun starter, hybrid layer and hybrid grower feeds. Kerosene lantern and charcoal stoves. Sensitive digital scale and measuring ribbon tapes which were sourced from Ogige market Nsukka.

Experimental Procedures: A total of the selected 240 F2 hatched chicks from four genotype sire families of F1 chicken population from the UNN agricultural farm was distributed to the 12 constructed pens. Each sire family was replicated four times with 20 birds per replicate/pen. The chicks were brooded in groups according to their sire families for six weeks, after which the black waterproof were removed to form a deep litter system for another six weeks. Colour markers and cloth ribbon were used to identify each birds in each pen.

Vaccination Schedule was as follows:

Age	Disease	Vaccine	Route
Day old	New castle	NDV- Lasota	Intraocular I/O
Week 2	Gumboro	IBVD	Drinking water
Week 3	New castle	NDV – Lasota	Intraocular I/O
Week 4	Gumboro	IBVD	Drinking water
Week 6	Fowl pox	Pox vaccine	Wing web

Commercial feeds (chikun starter, hybrid growers and hybrid layers as well as clean water were given ad libitum throughout the experiment.Charcoal stove and kerosene lantern were used as sources of heat during the brooding section.

***Instrument for Data Collection*:** Data on body weights and linear body measurements were collected every four weeks' interval from 4th week to 20th week with a sensitive scale (electronic kitchen digital) scale with 5000g x1g capacity. Linear body parameters evaluated were body length, shank length and thigh length. These were measured in cm using cloth tape.

***Data Collection Method*:** The body weight was measured by placing each live bird on the holding tray of the electronic scale and the body weight (bw) for that week was read and recorded from the screen. The body length (bl) of the bird was evaluated from the base of the neck to the base of the tail with a calibrated measuring tape in centimeter (cm).Likewise, the thigh length (tl) was measured from the hip joint to hocks joint while the shank length (sl) was taken as the distance between hocks joint to the tarsometatarus and recorded in centimeter for that week.

***Data analysis technique*:** The experimental design used was a completely randomized design (CRD) and the statistical model is as shown below

$$Y_{ij} = \mu + X_{ij} + e_{ij}$$

Where; Yij= observation/independent variable, μ =overall mean, Xii = Treatment/genotype effect and eij= residual/error

The data collected on growth traits were subjected to analysis of variance (ANOVA) in SPSS (2022) version 22 to access the significance of data and any significant means were separated using Duncan's new multiple range test (DNMRT) Duncan (1955)

***Genetic Parameters*:** Heritability was estimated using the standard formula below.

$$h^2 = \frac{4\sigma^2 s}{\sigma^2 s + \sigma^2 \omega}$$

Where: h^2 = heritability, σ^2 s = variance of sire and σ2ω = variance of error

Unbiased estimate of components of variance from the ANOVA and Restricted Maximum Likelihood (REML) in SAS software wereused to estimate the parameters above.

Results

Table 1: Mean±SEM of Monthly Body Weight of Four Sire Families of Experimental Birds.

Genotypes	Week 1	Week 4	Week 8	Week 12
AC x IBH f2	46.67±0.33^{a}	302.33±4.48^{a}	869.00±10.54^{a}	1365.00±56.75^{a}
AC x HEH f2	41.00±1.00^{b}	293.33±12.99^{a}	761.67±43.21^{ab}	1253.00±69.51^{ab}
HEC x IBH f2	37.33±1.86^{c}	266.67±14.75^{ab}	665.33±45.72^{b}	1158.33±57.17^{bc}
HEC x HEH f2	35.25±0.48^{c}	235.50±19.35^{b}	622.75±57.27^{b}	969.75±52.24^{c}

Means ± Standard Error on the same column with different superscripts are significantly different ($p < 0.05$) while those with the same superscripts are statistically the same or similar. AC x IBH f2 = f2 of Amo cocks and Isa brown crosses, AC x HEH f2 = f2 of Amo cocks and heavy ecotype crosses, HEC x IBH f2 = f2 of heavy ecotype cocks and Isa brown hen crosses and HEC x HEH f2 = f2 of heavy ecotype cocks and heavy ecotype hen crosses.

Table 1 presents the means and the standard errors of means of the body weight of f2 crossbred chicken at different ages. AC x IBH f2genotypewere significantly ($p<0.05$) higher than other genotypes in all the weeks considered with a mean weight of (46.67±0.33)at week 1 and (1365.00±56.75) at 12th week of age followed by AC x HEH f2 with a mean weight (41.00±1.00)and (1253.00±69.51) at first and twelfth week respectively. HEC x HEH genotype has the least weight (35.25±0.48g) and (969.75±52.24g) in first week and 12 weeks respectively.

Table 2: Heritability (h^2s) Estimates for Body Weights and Linear Measurements of F2 Birds.

Age	Traits	AC x IBHf2(h^2s)	ACx HEHf2(h^2s)	HEC x IBHf2(h^2s)	HEC xHEHf2(h^2s)
Week1	**Bw**	0.941	0.244	0.138	0.019
	Bl	0.360	0.186	0.046	0.269
	Tl	0.045	0.008	0.209	0.002
	Sl	0.001	0.001	0.006	0.040
Week4	**Bw**	0.175	0.175	0.000	0.086

Table 2 continued

	Bl	0.003	0.164	0.028	0.017
	Tl	0.032	0.263	0.108	0.003
	Sl	0.234	0.594	0.159	0.159
Week8	**Bw**	0.100	0.052	0.034	0.003
	Bl	0.198	0.074	0.046	0.585
	Tl	0.076	0.044	0.009	0.010
	Sl	0.270	0.245	0.636	0.294
Wek12	**Bw**	0.950	0.365	0.248	0.221
	Bl	0.380	0.296	0.266	0.286
	Tl	0.045	0.008	0.209	0.002
	Sl	0.001	0.001	0.006	0.040

Key: BW= Body weight, BL= Body length, TL=Thigh Length, SL=Shank Length, AC x IBHf2 = f2 of Amo cocks and Isa brown crosses, AC x HEHf2 = f2 of Amo cocks and heavy ecotype hen crosses, HEC x IBHf2 = f2 of heavy ecotype cocks and Isa brown hen crosses and HEC x HEHf2 = f2 of heavy ecotype cocks and heavy ecotype hen crosses, h^2s=heritability of sire/genetic heritability.

Table 2 shows the heritability estimates of body weight and linear body measurements at different weeks of age. The results generally show low to moderate and high heritabilities. Genetic heritabilities(**h^2s**) in week one were low in all the traits observed except in body weight and body length AC x IBHf2 which were high (0.941 and 0.360) in body weight and body length respectively. The heritabilities for other body linear measurements were generally low (<0.20), moderate (>0.20<0.40) except in 12th week for body weight and length.

Discussions

This mean body weights (Table 1) were within the range and agrees with Ilori et al. (2010) who observed 44.27±0.62, 48.57±1.07, and 44.32±0.58, mean body weights of local, exotic and crossbred turkey birds in the first week. The results also fall within the range observed by Chimenem-Amadi et al. (2021) who noted mean weights of 273.22, 689.30 and 1088.00 for 4 weeks, 8 weeks and 12 weeks age of mixed birds. The significant increase in the body weights of Amo cocks and Isa brown hen genotype (AC x IBHf2) than others shows that Amo Cocks which are foreign breeds and Noiler dual-purpose breed of chicken developed in Nigeria by Amo Farm Sieberer Hatchery (Afrimash, 2019) were good for genetic improvement for achieving such qualities of production performance. In the same way, 'Institute de SelectionAnimale'(ISA) Brown birds that were originally from France, and developed as layers in 1978 by ISA and Merck has become a breeding giant in genetic improvement (ISA Poultry, 2022).This confirms that these exotic chicken are dual purpose breeds which were bred to survive on low quality feedstuff to provide good quality meat and egg for small holders to address the challenges of food insecurity and financial dependency among rural populace, especially women (Amo farm, 2018; Dogara*et al.* 2021). The significant increase in AC x IBHf2 shows that this genotype could serve as food security in

animal protein industry. This could also quell the tensionthat the constant increase in urbanization, from 34.8 percent in 2000 to 49.5 percent by 2017, has consequences for food availability and affordability (Owoo, 2021).

The presentresults also show that probably, people patronize exotic breeds of birds because of her quick growth rate compared to the local breed. However, the high and comparable values of 41.00±1.00, 293.33±12.99, 761.67±43.21 and 1253.00±69.51 for weeks 1, 4, 8 and 12 respectively show that when the local breed is sired with a proven exotic breed, the transferred genes continue to have effects on the second filial generation offspring. The high level of improvement recorded in body weight in 8th and 12th weeks by AC x HEH f2 genotype shows that this approach could reduce over dependence of farmers on exotic breeds of chicks.According to Fulla (2022), crossing local and exotic chickens primarily aims to introduce new genes, improve fitness and productivity attributes, and create breeds that are environment-adapted. The amo cocks have definitely introduced new genes that improved fitness and productivity in the heavy ecotype local hens in the f2 offspring. Therefore, it may be beneficial to crossbreed native birds with a recognized exotic breed; this practice is becoming more and more common in Nigeria (Dogara et al., 2021; Momoh & Nwosu, 2008). This improvement when sustained could ameliorate deficient protein intake in the local environment.

The findings in (Table 2) were indication that the parameters such as shank and thigh length were not heritable traits as a result of low heritability of 0.045 and 0.001 for thigh lenth and shank length both in week one and week 12 in this close relatives. According to Wray and Visscher (2008), heritability calculates the proportion of genetic diversity within a population that accounts for variation in a phenotypic characteristic. Therefore it quantifies the proportion of trait variation that can be traced back to genetic variation as opposed to variance caused by environmental influences.

This underscores the fact that heritability could be estimated by comparison of close relatives, parent-offspring regression; that is by comparing parent and offspring traits and by sibling comparison; that is by using full-Sib designs and comparing similarity between siblings who share both a biological mother and a father. Half-Sib designs compare phenotypic traits of siblings that share one parent with other sibling groups (Sajjad, 2012).

However, the heritability results fall within the range of values 0.10 reported by Udeh et al (2022), and Adeleke et al. (2011) for indigenous Nigerian Heavy ecotype at 4th week of age. Thesefindings also agrees with the report of Ugwumba (2020) who recorded 0.07±0.00 and 0.28±0.10 for Isa brown exotic cock and sire + dam cross between Isa brown and Frizzle feathered (IB X F) genotype at 20th week of age. Heritability estimates of body weight were also in agreement with the report of Rotimi et al. (2016) that observed inconsistent increase in the heritability estimates of body weight from sire variance components at

different ages in the breeding groups of local chickens.

There was high to moderate heritability in the 12th week of age. The implication of high heritability is that the additive gene effect was stronger than the non- additive gene effect, epistasis or even environmental factors and could be used as selection index. This shows that before any method of genetic improvement is engaged, the animals in question should be allowed to be of age so as to allow full potentials to be expressed by their genes.

Conclusion

The findings in this work show that crossbreeding of local birds (Nigerian heavy ecotype local hens) with proven exotic cocks (Amo cocks) increased and improved growth traits like body weight and body length even in second filial generation f2. This shows that crossbreeding exercise could be employed to reduce over dependence of local farmers on exotic breeds of birds with better growth performance. This is because such quality growth traits could be transferred to local breeds in a proper designed crossbreeding plans.

The findings also indicated that the genetic heritability estimates of the additive gene effect was stronger than the non- additive gene effect, epitasis or even environmental factors in 12th week life of the genotype chickens. This means that the traits responsible for body weights and body linear measurements become pronounced at that age and shows that before any method of genetic improvement is engaged. It follows that animals in question should be allowed to be of age so as to allow full potentials to be expressed by the genes.

Recommendations

Based on the findings, it is recommended that;

1. farmers could improve the performance of their local chickens by crossbreeding them with a proven exotic chicken (*Amo* cocks) for a good transmission of better genes for production performance.
2. farmers who wish to engage a crossbreeding method should allow their growing birds to be of age at least 12 weeks for full expression of their heritable potentials before any selection is made.
3. thigh and shank length appear not be good selection indices for growth traits and therefore may not be used as such as they exhibit low heritabilities.

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Effects of Adult Fitness Literacy Programme on Promoting Physical Activities among Adults in Oye-Ekiti, Ekiti State Nigeria

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Abstract

This study was to ivestigated effects of adult fitness literacy programme (AFLP) in promoting physical activities among adults in Oye-Ekiti, Nigeria. Specifically, it determined effectiveness of AFLP in increasing participation in aerobic, strength, flexibility, and balance activities. Population was made up of adult 124 participants The study used a quasi-experimental pre-test post-test design.Data were collected with questionnaire. Data were analyzed using mean, standard deviation and t-test at 0.05 level of significance. Results show that for aerobic activities, the mean scores increased significantly from pre-test to post-test. For vigorous activities, the mean rose from 3.5 (SD = 0.82) to 4.2 (SD = 0.63), while for moderate aerobic activities, the mean increased from 2.9 (SD = 0.65) to 3.5 (SD = 0.74). Similarly, self-rated current aerobic fitness improved from a mean of 3.2 (SD = 0.87) to 3.8 (SD = 0.69). Paired t-tests revealed these improvements were statistically significant, with t-statistics ranging from 2.47 to 7.69 and corresponding p-values less than 0.001, except for session duration where $p = 0.004$ ($t = 3.08$). For strength-based activities, participants also showed significant increases, with the mean for weight lifting, push-ups, or sit-ups rising from 3.57 to 4.21, and the mean for activities involving resistance bands or free weights increasing from 2.95 to 3.52, both at the $p<0.001$ level.

Keywords: Adult, Fitness, Literacy, Physical Activity, Chronic, Disease, Exercise, Adherence

Introduction

Physical fitness encompasses the body's ability to perform daily activities, exercise, and maintain health. It is a crucial component of overall well-being, with implications for physical, mental, and social health. Physical activities are central to achieving and maintaining fitness. Physical activity refers to any bodily movement that requires energy expenditure beyond resting levels World Health Organization (WHO, 2019). Common examples include walking, running, swimming, dancing, and sports (Ajani, 2014). Physical activity differs from physical labor,

which involves bodily exertion for required tasks, rather than the sole purpose of improving health and fitness (Chigbu et al., 2020). Key physical activity domains include aerobic, strength, flexibility, and balance exercises.

Aerobic activities are exercises that engage large muscle groups in continuous, rhythmic movements that elevate heart rate and breathing to enhance cardiovascular fitness. These activities elevate heart rate and breathing for extended durations, using large muscle movements and continuous motion to circulate oxygen (Usman et al., 2024). Examples are brisk walking, swimming, and cycling. Regular aerobic exercise decreases chronic disease risk through cardiovascular benefits like lower resting heart rate/blood pressure, enhanced vascular function, and improved metabolism (John et al., 2023). On the other hand, strength activities are those that challenge major muscle groups to build strength, power, and endurance, using resistance from body weight, bands, weights, or machines (Aerenhouts & D'Hondt, 2020). These activities increase muscle mass, bone density, functional mobility, and resting metabolic rate, reducing injury risks and supporting daily living (Adeloye et al., 2021). Furthermore, flexibility activities involve the gentle elongation and stretching of muscles and connective tissues to maintain or improve the range of motion around joints. They are described as exercises that focus on increasing range of motion and lengthening muscles and connective tissues (Ojukwu et al., 2023)These include static, dynamic, and yoga-based stretches that gently elongate tight muscles (Page, 2012;). Flexibility training benefits include improved posture, reduced injury risk, and relief of muscle tension (Marmolejo et al., 2018). Maintaining pliability assists with active movement patterns over sedentary behaviours linked to chronic diseases (Oyeyemi & Adeyemi, 2013).

Finally, balance activities are those activities that challenge the body's ability to maintain stable and controlled posture and movement, particularly during activities that disrupt the center of gravity. These activities enhance neuromuscular control and stability by disrupting one's center of gravity, like standing on one leg or walking heel-to-toe (Lan et al., 2013). Balance training improves reaction times, stability recovery, and movement confidence, especially for fall prevention in aging (Papalia et al., 2020). Developing balance enables assured daily motions and independent living without increased injury (Akosile et al., 2014), preserving quality of life (Langhammer et al., 2018).

Therefore, consistent physical activity can lower the likelihood of obesity, diabetes, cardiovascular diseases, and other non-communicable illnesses by improving blood pressure, cholesterol, blood sugar, weight, and cardiovascular fitness (Myers et al., 2019). Unfortunately, evidence suggests high rates of physical inactivity among Nigerian adults. National surveys indicate approximately 60 percent of individuals aged 15-64 do not meet the WHO's recommended minimum of 150 minutes of moderate physical activity per week (Adeloye et al., 2021).

Research shows inactivity levels have increased, with over 50 percent of adults not engaging in leisure-time physical activities (Oyeyemi et al., 2013). Inactivity rates are highest in urban areas like Lagos and Abuja at around 70 percent, while rural communities observe lower but growing inactivity levels of about 50 percent (Idris et al., 2020). These statistics highlight the rapid decline of physical activity as a way of life among Nigerian adults over the past 30 years, despite public health guidelines on the importance of regular exercise.

Numerous factors contribute to poor physical activity levels among Nigerian adults. Rapid urbanization has led to more sedentary jobs and longer commutes (Adegoke & Oyeyemi, 2011); furthermore, technology proliferation means more leisure time spent on devices rather than active hobbies (Ciochetto, 2015). Additionally, poverty, lack of safe infrastructure, and social barriers like domestic responsibilities for women restrict participation (Elendu & Bright, 2013). Moreover, long work hours, lack of awareness about activity guidelines, and the absence of a national plan to facilitate active living further enable inactivity (Chigbu et al., 2020). Nonetheless, urgent interventions are needed to motivate physical activity among Nigerian adults.

Several prevention interventions have successfully promoted physical activity to prevent non-communicable diseases. Physician-led counseling and customized plans have also yielded 30 extra weekly moderate activity minutes, reduced obesity, and improved fitness (Goldstein et al., 2008). However, no such studies have targeted adults in Oye-Ekiti. The present researchers observed that many Oye-Ekiti adults may not meet recommended activity levels and lack knowledge and skills for optimal physical fitness. An urgent need exists for an adult physical fitness literacy programme in Oye-Ekiti to cultivate healthy lifestyle awareness, change misconceptions, and promote regular physical activity adoption. Based on the above, the present researchers designed an 8-week Adult Fitness Literacy Programme (AFLP) to promote physical activity among adults residing in Oye-Ekiti.. By addressing both knowledge and practical aspects of active living, AFLP intended to empower adults to integrate sustainable physical activity into their daily routines, creating a lasting impact on community health and well-being.

Objectives of the Study

The main objective of this study was to investigate the effects of adult fitness literacy programme (AFLP) in promoting physical activities among adults in Oye-Ekiti, Ekiti State, Nigeria. Specifically, the study determined effectiveness of AFLP in promoting:

1. aerobic activities;
2. strength activities;
3. flexibility activities;
4. balance activities.

Methodology

Design of the Study: The studyadopted a quasi-experimental research design using a single group pretest-posttest design.

Area of the Study: Oye-Ekiti is a rural local government area in the northeastern region of Ekiti State, Nigeria. Farming is being the primary occupation, in the area. Mechanization

has gradually reduced the physical demands of agricultural work, while the lack of formal sports facilities and prevalence of sedentary leisure activities, such as communal wining and dining, have contributed to a rise in inactivity-related health concerns, including cardiovascular diseases, diabetes, and hypertension among residents. Oye-Ekiti provides a relevant case study location for implementing physical activity interventions to address the growing health challenges associated with physical inactivity.

Population for the Study: The study population consisted of adult community members in Oye-Ekiti who participated in the physical activity promotion programme. The majority was between 31-45 years old (39.5%) and 46-60 years old (21.8%), with only a small portion over 60 years (8.2%). Slightly more than half were male (53.1%). In terms of education levels, nearly half had attained secondary education (44.2%) while 25.9% had tertiary education. Most participants were married (69.4%), with 20.4% single and 10.2% widowed. The dominant religion was Christianity (74.8%) followed by Islam (25.2%).

***Sample for the Study*:** The study employed voluntary sampling in recruiting 147 adultdwelling in Oye-Ekiti who participated in the physical activity promotion programme.

Instrument for Data Collection: A 48-item questionnaire to measure the participants' engagement in a variety of physical activities before and after the 8-week intervention programme. The questionnaire was divided into five distinct sections, Section A focused on socio-demographic details, Section B on aerobic activities, Section C strength-based exercises, Section D on flexibility activities, and Section E balance-related physical behaviours. The instrument was validated by three university experts based Health educators. Reliability of the questionnaire was established using Cronbach's alpha, which yielded a coefficient of 0.86.

***Method of Data Collection*:** The 48-item questionnaire was used to measure the participants' engagement in various physical activities, allowing the researchers determined thebaseline activity levels of participants prior to the intervention. The intervention programme was advertised for a period of one month through fliers and town crier announcements, attracting 208 adults, of whom 147 met the selection criteria and consented. Four trained research assistants administered the questionnaire to collect this baseline data (pre-test) before the start of the 8-week intervention.

After the pre-test, an 8-week adult fitness literacy programmewas implemented for the 147 participants. The programmewas designed to train participant on the importance of physical activity and provide them with practical strategies to improve their overall fitness levels. Four weeks after the intervention, the questionnaire was administered again (post-test) to measure the participants' level of engagement in physical following the programme.

***Method of Data Analysis*:** Frequencies and percentages were used to describe the demographic characteristics of respondents.Mean and standard deviation were utilized to analyze physical activity levels before (pre-test)

and after (post-test) intervention. Physical activity was categorized into five levels based on mean scores:0-0.79 = Highly active; 0.8-1.79 = Active; 1.8-2.69 = Somewhat active; 2.7-4.0 = Inactive. The t-testat 0.05 level of significance was used to determine the difference between the pre-test mean and the post-test mean for each item.

Result

Table 1: Effects of Adult Fitness Literacy Programme (AFLP) on Aerobic Activity Levels: Pretest and Posttest Comparison

S/N		$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	t	P-value
1	Vigorous activities occasionally	3.5	0.82	4.2	0.63	7.69	<0.001
2	Moderate aerobic activities	2.9	0.65	3.5	0.74	5.12	<0.001
3	Aerobic sessions last 30 mins	4.1	0.73	4.3	0.58	3.08	0.004
4	Aerobic activities intensity	3.7	0.94	4.0	0.61	2.47	0.020
5	Current aerobic fitness	3.2	0.87	3.8	0.69	4.08	<0.001
	Grand	3.48	0.802	3.96	0.65	-	-

$\bar{X}_1$= Pretest mean; $\bar{X}_2$ = Posttest mean; SD_1 = Standard deviation for pretest; SD_2 = Standard deviation for posttest; t = t-test; Degree of Freedom = 146

Table shows that before the programme, participants reported mean scores for different aerobic activities: engaging in vigorous activities occasionally ($\bar{X}_1$= 3.5, SD_1 = 0.82), moderate aerobic activities ($\bar{X}_1$= 2.9, SD_1 = 0.65), sessions lasting 30 minutes on average ($\bar{X}_1$= 4.1, SD_1 = 0.73), engaging in aerobic activities with moderate intensity ($\bar{X}_1$= 3.7, SD_1 = 0.94), and rating their current aerobic fitness level ($\bar{X}_1$ = 3.2, SD_1 = 0.87). Post-programme, significant improvements were observed across all categories: vigorous activities ($\bar{X}_2$= 4.2, SD_2 = 0.63), moderate activities ($\bar{X}_2$= 3.5, SD_2 = 0.74), session duration ($\bar{X}_2$ = 4.3, SD = 0.58), activity intensity ($\bar{X}_2$ = 4.0, SD_2 = 0.61), and current fitness ($\bar{X}_2$= 3.8, SD_2 = 0.69). Statistical analysis using paired t-tests revealed significant improvements in all measures, with t-statistics ranging from 2.47 to 7.69 and corresponding p-values < 0.001, except for session duration where p = 0.004 (t = 3.08).

Table 2: Effects of AFLP on Strength Activity Levels: Pretest and Posttest Comparison

S/N	Strength Activity	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	t	P-value
1	Weight lifting, push-ups, or sit-ups	4.13	0.75	4.35	0.59	8.12	<0.001
2	Activities involving resistance bands or free weights	2.95	0.67	3.52	0.76	2.09	<0.001
3	Bodyweight exercises like squats, lunges, or planks	4.13	0.75	4.35	0.59	4.78	0.002
4	Activities requiring upper body strength like carrying heavy loads	3.79	0.93	4.02	0.65	3.91	0.045
5	Exercises focusing on lower body strength like squats or lunges	3.24	0.86	3.89	0.67	4.01	<0.001
6	Weight lifting, push-ups, or sit-ups or shoulder presses	3.68	0.87	4.11	0.64	2.09	<0.001

Table 2 continued

7	Yoga, pilates, or tai chi, which involve strength	3.42	0.79	3.91	0.70	4.78	<0.001
	Grand	**3.54**	**0.81**	**4.00**	**0.66**	**-**	**-**

$\bar{X}_1$= Pretest mean; $\bar{X}_2$ = Posttest mean; SD_1 = Standard deviation for pretest; SD_2 = Standard deviation for posttest; t = t-test; Degree of Freedom = 146

Table 2 shows significant improvements in posttest scores, supported by calculated t-values and corresponding p-values. Activities such as weight lifting, push-ups, or sit-ups ($t = 8.12$, $p < 0.001$), exercises involving resistance bands or free weights ($t = 5.43$, $p < 0.001$), and exercises focusing on lower body strength ($t = 4.78$, $p < 0.001$) demonstrated substantial enhancements. Similarly, activities targeting upper body strength ($t = 3.91$, $p < 0.001$) and those involving yoga, pilates, or tai chi ($t = 4.01$, $p < 0.001$) also showed significant improvements.

Table 3: Effects of AFLP on Flexibility Activity Levels: Pretest and Posttest Comparison

S/N	Flexibility Activity	$\bar{X}_1$	$\bar{X}_2$	t	p-values
1	Stretching exercises	3.57 (0.82)	4.21 (0.63)	8.12	<0.001
2	Static stretching	2.95 (0.67)	3.52 (0.76)	5.43	<0.001
3	Dynamic stretching	4.13 (0.75)	4.35 (0.59)	3.27	0.002
4	Hamstring stretches	3.79 (0.93)	4.02 (0.65)	2.09	0.045
5	Shoulder stretches	3.24 (0.86)	3.89 (0.67)	4.78	<0.001
6	Back stretches	3.68 (0.87)	4.11 (0.64)	3.91	<0.001
7	Intensity of muscle-targeted stretches	3.42 (0.79)	3.91 (0.70)	4.01	<0.001
	Grand Mean and SD	3.59 (0.81)	4.00 (0.68)	-	-

$\bar{X}_1$= Pretest mean; $\bar{X}_2$ = Posttest mean; t = t-test; Degree of Freedom = 146

Table 3 shows significant improvements were observed across all activities: stretching exercises ($t = 8.12$, $p < 0.001$), static stretching ($t = 5.43$, $p < 0.001$), dynamic stretching ($t = 3.27$, $p = 0.002$), hamstring stretches ($t = 2.09$, $p = 0.045$), shoulder stretches ($t = 4.78$, $p < 0.001$), back stretches ($t = 3.91$, $p < 0.001$), and intensity of muscle-targeted stretches ($t = 4.01$, $p < 0.001$). These results indicate that all activities led to statistically significant improvements in flexibility levels among participants, underscoring their efficacy in enhancing muscle flexibility and range of motion.

Table 4: Effects of AFLP on Balance Activity Levels: Pretest and Posttest Comparison

S/N	Balance Activity	$\bar{X}_1$	$\bar{X}_2$	t	p-values
1	Activities like yoga that involve balance	3.57 (0.82)	4.21 (0.63)	8.12	<0.001
2	Standing on one foot for periods of time	2.95 (0.67)	3.52 (0.76)	5.43	<0.001
3	Walking heel-to-toe along a straight line	4.13 (0.75)	4.35 (0.59)	3.27	0.002
4	Engaging in dance activities that challenge balance	3.79 (0.93)	4.02 (0.65)	2.09	0.045

Table 4 continued

5	Exercising on an unstable surface	3.24 (0.86)	3.89 (0.67)	4.78	<0.001
6	Engaging in sports or activities	3.68 (0.87)	4.11 (0.64)	3.91	<0.001
7	Walking heel-to-toe along an uneven terrain	3.42 (0.79)	3.91 (0.70)	4.01	<0.001
	Grand	**3.59 (0.81)**	**4.00 (0.68)**	-	

$\bar{X}_1$= Pretest mean; $\bar{X}_2$ = Posttest mean; t = t-test; Degree of Freedom = 146

Table 4 shows statistically significant improvements in posttest scores, as indicated by the t-test statistics and corresponding p-values. Activities like yoga ($t = 8.12$, $p < 0.001$), standing on one foot ($t = 5.43$, $p < 0.001$), and exercising on an unstable surface ($t = 4.78$, $p < 0.001$) demonstrate particularly pronounced improvements in balance. Even activities such as engaging in dance ($t = 2.09$, $p = 0.045$) and walking on uneven terrain ($t = 4.01$, $p < 0.001$) show significant enhancements.

Figure 1: Graphical representation of the effects of AFLP on physical activities level of the participants

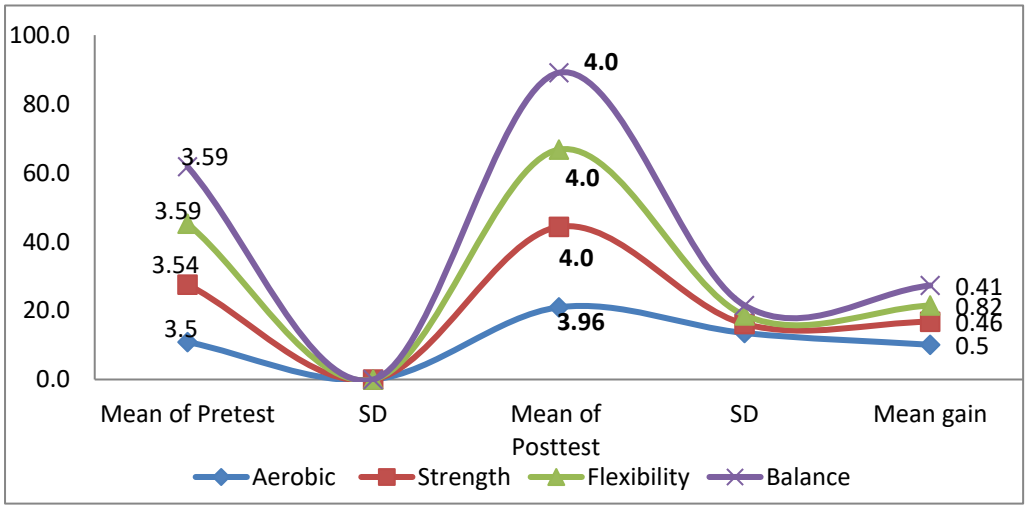

Figure 1 provides a visual representation of the impact of AFLP on the participants' physical activity levels. The graph clearly illustrates positive changes in physical activities across all domains, as evidenced by significant mean gains.

Discussion

The study shows that AFLP positively impacted participants' physical activity levels, with mean gain values increasing across all activity domains. This improvement is attributed to knowledge gained through literacy programmes. Participants learned about benefits like enjoyment, physical wellness, and social cohesion, realizing they can control their health. Thus, the increase in activity scores after AFLP reflects improved understanding and awareness of the risks of physical inactivity. Previous research (Conn,

Hafdahl & Mehr, 2011) supports the effectiveness of interventions that educate and motivate adults to enhance their physical activity independently. Numerous studies confirm intervention programmes effectively promote physical activity among adults.

The study finds that AFLP increased aerobic activities among participants. This aligns with andragogy principles, indicating adults are motivated to learn when content is relevant to their lives (Knowles, Holton & Swanson, 2015). Adults engage more when they see how content connects to personal goals and experiences (Merriam & Bierema, 2014). For example, Yu and Swartwood (2012) noted aerobic exercise benefits older adults with Alzheimer's, improving strength and reducing caregiver stress. Ciairano, Liubicich and Rabaglietti (2010) found such programmes boost older adults' confidence in daily activities. Increasing aerobic exercise in moderately fit adults can enhance mood, motivation, and cognition (Ehirari et al, 2020s). Yao et al. (2021) highlight aerobic exercise's positive impact on older adults' mental health, even at low frequency. Mora-Gonzalez et al. (2020) found gamification interventions improve cardiorespiratory fitness significantly. Chase & Conn's (2013) meta-analysis confirms PA interventions with motivational tools enhance cardiorespiratory fitness effectively (effect size 0.48, 95% CI 0.37–0.60; $p < 0.001$). The study also found that AFLP successfully increased participation in strength activities among participants, as indicated in Table 3. Studies show targeted programmes enhance adult engagement in strength training. For instance, Zanuso et al. (2012) noted significant improvements in muscle strength and well-being with a 12-week programme. Ferreira et al. (2012) found resistance exercises improved strength, balance, and endurance in adults aged 40-65. Hendker and Eils (2021) showed an 8-week interval training programme enhanced physical performance in adults. Mailey et al. (2020) emphasized that framing strength training messages around extrinsic goals can boost motivation and exercise behaviour among Baby Boomers. These findings underscore the physical and psychological benefits of regular strength activities for older adults.

Further, the study confirms AFLP's effectiveness in increasing flexibility activities among adults. Previous studies have explored interventions promoting flexibility with varied results. Stathokostas et al. (2012) noted improvements in range of motion but inconclusive functional outcomes. Ball et al. (2017) demonstrated non-financial incentives' potential in reducing sedentary behavior in middle-aged adults. González-Cutre et al. (2014) highlighted autonomy support's role in promoting physical activity among students. Devereux-Fitzgerald et al. (2016) stressed fun, social interaction, and short-term benefits in making interventions appealing to older adults. These findings suggest a multifaceted approach—using incentives, autonomy support, and emphasizing enjoyment—can effectively enhance interest and participation in flexibility activities among adults.

Finally, the study found an increase in participation in balance activities participation in AFLP participants.

Previous studies have explored interventions that promote interest and engagement in balance activities for adults. Ehrari et al. (2020) and Shubert et al. (2010) demonstrated positive effects of exercise-based balance programs on physical and cognitive performance, with Ehrari highlighting the potential of playful exercises to enhance activity levels and balance. Ball et al (2014) found community-based fall prevention programs improved activity participation and static balance in older adults. Büla et al. (2010) emphasized multicomponent behavioral interventions in enhancing balance confidence and reducing activity avoidance in older adults. These studies collectively suggest that structured exercise plans and engaging activities can effectively increase motivation and participation in balance-enhancing activities among adult populations.

Conclusion

This quasi-experimental study aimed to assess how effective the AFLP was in enhancing physical activity among adults living in Oye-Ekiti, Nigeria. The results show that the AFLP resulted in statistically significant improvements in all aspects of physical activity measured, such as aerobic activity, strength exercises, balance activities, and flexibility. Objective measurements of physical activity demonstrated substantial increases from before to after the intervention. These findings empirically demonstrate that the AFLP effectively promotes increased engagement in various health-enhancing physical activities among adults.

Recommendations

Based on the findings, the following recommendations are made:

1. Adaptations of AFLP targeting specific sub-populations, such as older adults, should be pursued.
2. Refinement of AFLP dosage, intensity, modality and components through iterative program design informed by participant feedback and behavioral theory.
3. Facilitation of knowledge mobilization to stakeholders including community organizations, policy actors, and public health implementers.
4. Elucidation of behavioral and psychosocial mechanisms driving AFLP outcomes through intermediate tracking.
5. Expansion of implementation of the AFLP to enhance population reach, and conducting rigorous evaluation of longer-term outcomes.

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Work Engagement and Commitment of Automobile Technology Teachers as Correlates of Teacher Effectiveness in Technical Colleges in Enugu State, Nigeria

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Abstract

The main purpose of this study was to investigate work engagement and commitment of automobile technology teachers as correlates of teacher effectiveness in technical colleges in Enugu State. Three specific purposes, three research questions, three hypotheses guided the study. The study adopted survey design. Population was made up of 57automobile technology teachers from 13 technical colleges in Enugu State. Utrecht Work Engagement andTeachers' Perceptions of Professional Commitment and Teacher Effectiveness Scales were adapted. Data were analysed using means, correlations and regression analysis. Findings reveal that a moderate relationship (.425) exists between work engagement and teacher effectiveness of automobile technology teachers. Also a moderate relationship (.537) exists between teachers' commitment and teachers' effectiveness of automobile technology teachers. Furthermore, moderate relationship (.433) exist between teachers' work engagement and commitment of automobile technology teachers. The hypotheses tested revealed that teachers' work engagement is a significant predictor for teachers' effectiveness and teachers' commitment, teachers' commitment is a significant predictor for teacher effectiveness. Based on the findings, Enugu State Ministry of Education should among other things, try to improve the work engagement and commitment of their automobile teachers through empowerment, rewards and benefit schemes.

Keywords: Technical, Colleges; Automobile Technology, Teacher, Effectiveness, Engagement, Work, Commitment.

Introduction

Technical education is education that equips individuals with knowledge; attitude and practical skills that can make one live well and contribute to the development of the nation. It is that aspect of education that leads to the acquisition of practical and applied skills as well as basic scientific knowledgeFederal Republic of Nigeria (2013). Technical education is designed to provide theory and practical knowledge to individuals and this type of training is provided to individual who desire to work in an industry or commerce or in any set up that uses machinery and tools for their services (Yaga, 2016). It therefore, equips

students with knowledge, attitude and practical skills required to enter or make progress in a particular occupation or trade. At secondary school level technical education is obtained in technical colleges, prepare students for varied specific occupations. Technical colleges offer training in various programme including electrical/electronic technology, woodwork technology, building technology, metalwork technology, and automobile technology (Adeyemi and Uko-Aviomoho 2004).

Automobile technology is one of the areas of specialization in technical education. It is the practical application of knowledge about self-propelled vehicles or machines. Automobile technology is vocational and technical sub-modular trade subjects offered at technical colleges' level for the purpose of enabling students to acquire further knowledge and develop skills (FRN 2013). Automobile technology comprises of engineering trades such as motor vehicle mechanics works, automobile electrical works, vehicle body building and light vehicle repair works (National Board for Technical Education) (NBTE), (2004),. Students studying automobile technology learn about assembling of engine, engine repair, fuel and ignition systems, power trains, brakes, transmissions, electronic and diagnostic equipment, auto body repair, auto body construction and more. NBTE (2004), stipulates that the aim of automobile technology is to give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant. In other to achieve this aim of technical colleges, the students of automobile technology need to be taught by effective teachers.

Teacher effectiveness is the most important school-related factor influencing student achievement and academic performance.Teachers are one of the most important school-based resources in determining students' future academic success and lifetime outcomes. (Chetty *et al*2014).Darling-Hammond, (2015) observed that teachers are crucial to the education system, and schools are only as good as the teachers within them. Teacher effectiveness can also be defined as the ability of a teacher to utilize approaches, strategies, connections to students, and a particular set of attitudes that lead to improved student learning and achievement (Strong, et al 2011). Various psychological and teacher-related factors might predict teacher effectiveness. These factors are teacher's work engagement and teacher's commitment.

Teacher engagement is linked to increased job satisfaction, workplace productivity, and even student engagementParker let al., (2012),. Teachers who work in schools with positive relationship between colleagues, administration and parents tend to be more engaged in their work (skaalvik & Skaalvik, 2014). In addition, teachers who feel that they have autonomy and control over their work is more likely to be engaged (Liu et al., 2013). Students of disengaged teachers may not receive the supportive and engaging learning environment that they need to thrive (Skaalvik & Skaalvik, 2014). Furthermore, disengaged teachers may be less

effective in the classroom learning, which can negatively affect students learning outcomes (Dickson, 2015).

The study of teachers' work engagement is relevant to every school because the quality of teachers has been recognized as one of the most important factors in developing and improving education. Schaufeli and Bakker, (2010) states that work engagement refers to a positive, affective-motivational state of high energy combined with high levels of dedication and a strong focus on work. It involves a good state of mind relating to ones' job that is characterized by emotion of vitality, devotion and absorption (Katou et al., 2021).It is characterized by a high level of vigour, dedication and absorption with ones' work. Hakanen et al. (2006) maintained that vigour is characterized by high levels of energy and mental resilience while working, the willingness to invest effort in one's work, and persistence in the face of difficulties. Dedication is characterized by a sense of significance, enthusiasm, inspiration, pride, and challenge, while absorption is characterized by being fully concentrated and happily engrossed in one's work, whereby time passes quickly, and one has difficulties detaching from work. These three characteristics are perceived as a dimension for measuring the construct work engagement. Teacher work engagement is a positive, fulfilling, affective-motivational state of work-related well-being that can be seen as the antipode of job burnout. Parker, et al, (2012) noted that teachers work engagement as a multi-dimensional quality that includes job satisfaction, engagement in work activities, optimistic expectations for the future, buoyancy, and minimal absenteeism. According to Timms and Brough, (2013) high degree of work engagement is connected with more commitment, better involvement, and increased productivity.

Teachers' commitment is considered a key factor in achieving high level of performance and low levels of absenteeism and turnover. Committed teachers are determinants of quality education and academic performance of students in schools. Teacher commitment is the emotional bond between the teacher and the school (Mart, 2013). Commitment refers to behavior or psychological state explaining the employee-employer relationship which ultimately affects their tendency to stay or quit the organization (Kotzé and Nel, 2020). Organizational objectives can be attained easily, when employees are committed to their organizations (Ikyangon et al., 2020).Commitment as a stronger attachment results in more favourable job performance and enhances employee performance (Ikyangon et al., 2020).Workers who are highly committed to both the profession and the organization were found to perform better than the less committed ones, a behavior which result in improved overall effectiveness of the organization (Chien et al., 2020). Improved commitment of technical college automobile teachers will increase the value of the college itself, teachers' performance and student's performance as well.

The aim of automobile technology programme in technical colleges is to provide students the competency

needed to enable them perform well in the world of work for paid or self-employed. National Policy on Education stipulates that trainees completing technical college programmes shall have three options: secure employment, set up their own businesses and become self-employed and be able to employ other, and pursue further education (FRN 2013). Students of automobile technology are expected to have good academic achievement and performance in their programme of study. Unfortunately, the performance of Enugu State technical college students of automobile technology in both teacher-made and NABTEB examination have shown progressive deterioration. Uya (2014) revealed that most technical education graduates lack requisite skills, competence as a result of inadequate human resources and material provided to school for the training. Consequently, the students find it difficult to secure employment or set up their own business after graduation.

Automobile teachers in technical colleges seem not to be showing high level of work engagement, commitment and effectiveness in discharging their duties. Many of the automobile teachers go after their private business. Some of them could come to school but neglect their duties. Many people wonder what may be the problem weakening automobile teachers' creativity, enthusiasm and willingness to discharge their duties very well. This study is therefore designed to fill the gap by determining the relationship between automobile teachers' work engagement, commitment and effectiveness in technical colleges in Enugu State.

Purpose of the Study

The main purpose of this study was to investigate work engagement and commitment of automobile technology (AT) teachers as correlates of teacher effectiveness in technical colleges in Enugu State. Specifically, the study determined relationship between teachers':

1. work engagement and teacher effectiveness in AT in technical colleges in Enugu State.
2. commitment and teacher effectiveness in AT in technical colleges in Enugu State.
3. work engagement and teacher commitment in AT in technical colleges in Enugu State.

Research Questions

The following research questions guided the study:

What is the relationship between teachers':

1. work engagement and teacher effectiveness in automobile technology (AT) in technical colleges in Enugu State?
2. commitment and teacher effectiveness in AT in technical colleges in Enugu State?
3. work engagement and teachers' commitment in AT in technical colleges in Enugu State?

Hypotheses (HOs)

The following hypotheses were tested at 0.05 level of significance:

HO_1: Teachers' work engagement is a significant predictor for teacher effectiveness in automobile

technology (AT) in technical colleges in Enugu State.

HO_2: Teachers' commitment is a significant predictor for teacher effectiveness in AT in technical colleges in Enugu State.

HO_3: Teachers' teachers' work engagement is a significant predictor for teachers' commitment in AT in technical colleges in Enugu State.

Methodology

***Design of the Study*:** The study adopted a correlational design. A correlational design seeks to establish the degree of relationship that exists between two or more variables.

***Area of the Study*:** The study was carried out in Enugu State, Nigeria. The state has 17 local government areas and 13 technical colleges. The technical colleges are both state-owned and private owned technical colleges.

***Population for the Study*:** The population for the study was made up of 57automobile technology teachers from all the 13 technical colleges in Enugu State. The technical colleges offer automobile technology.

***Instruments for Data Collection*:** Three sets of instrument were used for data collection in this study. TheseUtrecht included Work Engagement Scale measuring work engagement; Teachers' Perceptions of Commitment scale Ibrahim and Iqbal (2015); Teacher Effectiveness Scale Ogochi (2014).The instruments were appropriately adapted based on the specific purposes of the study. The items were based on a five point Likert scale of Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD) with values of 5, 4, 3, 2, and 1 respectively.

The instruments for data collection were validated by three university experts in Industrial Technical Education. The reliability of the instrument was established using Cronbach alpha reliability method. Fifteen copies of the instrument were administered on fifteen automobile technology teachers in technical colleges in Anambra state. A reliability coefficient of 0.89 was obtained for all the overall reliability.

***Method of Data Collection*:** A total of 57 copies of the questionnaire were administered to the AT teachers by hand. All the 57 copies of the questionnaire were completed and retrieved from the teachers after a week. This represents 100 percent return.

***Method of Data Analysis*:** The statistical method used in the study include: mean, Pearson correlations and regression analyses. Pearson Correlations was used to answer research questions 1-3, while regression analysis was used to test Hypothesis 1-3 and hypothesis will be tested at 0.05. Bivariate correlations and regression analyses were carried out using the Statistical Package for Social Sciences (SPSS v.22). While the decision rule for establishing a relationship via Bivariate correlations was be based on correlation coefficients as follows:

Range of values of correlation coefficient (r): These values ranged from ± 0.00 to 0.19 (Very weak relationship); ± 0.20 to 0.39 (Weak relationship); ± 0.40 to 0.59 (Moderate relationship); ± 0.60 to 0.79 (Strong relationship) and ± 0.80 to 1.00 (Very strong relationship).

Results

Table 1: Mean Responses and Standard Deviation on Work Engagement Indicators

S/N	Teacher s' Work Engagement Indicators	X	SD	Remarks
1	At my work, I feel bursting with energy.	3.55	0.71	Agree
2	At my automobile teaching job, I feel strong and vigorous.	3.80	0.54	Agree
3	When I get up in the morning, I feel like going to work.	4.35	0.98	Agree
4	I can continue working for very long periods at a time.	3.60	0.79	Agree
5	At my automobile teaching job, I am very resilient, mentally.	3.72	0.61	Agree
6	At my automobile teaching job I always persevere, even when things do not go well.	4.20	0.66	Agree
7	I find the work that I do full of meaning and purpose.	3.64	0.80	Agree
8	I am enthusiastic about my automobile teaching job.	3.39	0.86	Agree
9	My automobile teaching job inspires me.	4.29	0.89	Agree
10	I am proud of the automobile teaching job that I do.	3.96	0.71	Agree
11	To me, my automobile e-teaching job is challenging.	3.39	0.86	Agree
12	Time flies when I'm working.	3.55	0.71	Agree
13	When I am working, I forget everything else around me.	4.38	0.54	Agree
14	I feel happy when I am working intensely.	3.35	0.98	Agree
15	I am immersed in my automobile teaching job.	3.60	0.79	Agree
16	I get carried away when I'm working.	3.72	0.61	Agree
17	It is difficult to detach myself from my automobile teaching job.	4.55	0.71	Agree
	Grand Mean	**3.82**		

Keys: X = Mean of respondent, SD = Standard Deviation, A = Agree.

Table 1 shows the 17 teacher work engagement indicators. The mean value of the indicators ranged from 3.35 to 4.55 and the standard deviation values of the indicators ranged from 0.54 to 0.98 indicating that the respondents were close to one another in their opinion. The grand mean of the teacher work engagement indicators is 3.82 which indicate high work engagement from the automobile technology teachers.

Table 2: Mean Responses and Standard Deviation on Teacher Perceptions of Commitment Indicators

S/N	Teacher Commitment Indicators	X	SD	Remarks
1	I am satisfied with teaching automobile to students.	3.39	0.73	Agree
2	I help automobile students out of the class.	3.69	0.62	Agree
3	I accept taking more automobile classes when needed.	3.26	1.03	Agree
4	I collect information about automobile student's family life	2.91	0.77	Agree
5	I have considerable control over the pace of my work.	2.97	0.66	Agree
6	I spend time with students on automobile subjects (activities) related with the lesson inside as well as outside the classroom.	3.42	0.91	Agree
7	I take my automobile classes on time.	2.80	0.69	Agree
8	I accomplish my automobile teaching job with enthusiasm.	3.03	0.76	Agree

Table 2 continued

9	I try to do the best for the unsuccessful automobile students.	3.51	0.81	Agree
10	I enjoy teaching automobile technology.	3.78	0.59	Agree
11	I am satisfied with teaching automobile to the students.	2.78	0.81	Agree
12	I would be very happy to spend the rest of my career with this automobile teaching profession.	3.72	0.60	Agree
13	I really feel as if professional problems are my own	3.52	0.62	Agree
14	I do not feel a strong sense of belonging to my automobile teaching profession.	3.57	0.88	Agree
15	I do not feel emotionally attached to automobile teaching profession.	2.19	0.76	Disagree
16	I do not feel like part of the family at my automobile teaching profession.	2.26	0.76	Disagree
17	This automobile teaching profession has a great deal of personal meaning for me	1.92	0.82	Disagree
18	I do not feel any obligation to remain in my current automobile profession	2.86	0.75	Agree
19	Even if it were to my advantage, I would not have left my automobile teaching profession now.	2.00	0.69	Disagree
20	I would feel guilty if I left my automobile teaching profession now.	3.38	0.85	Agree
21	This automobile teaching profession deserves my loyalty	3.33	1.01	Agree
22	I would not leave my automobile profession right now because I have a sense of obligation to the students.	3.08	0.73	Agree
23	I owe a great deal to my automobile teaching profession.	2.18	0.83	Disagree
24	It would be very hard for me to leave my automobile teaching profession right now, even if I wanted to.	2.66	0.87	Agree
25	One of negative consequences of leaving this profession would be the scarcity of available alternatives.	3.63	0.75	Agree
26	Right now, staying with my automobile teaching profession is a matter of necessity and desire.	3.07	0.87	Agree
27	I feel that I have few options to consider leaving this profession.	3.21	0.81	Agree
28	If I had not already put so much of myself into this profession, I might have considered working elsewhere.	3.04	0.86	Agree
29	Too much of my life would be disrupted if I decided to leave my profession now.	3.13	0.71	Agree
	Grand Mean	**3.05**		

Keys: X = Mean of respondent, SD = Standard Deviation, A = Agree.

Table 2 shows the 29 teacher commitment indicators. The mean value of the indicators ranged from 1.92 to 3.78 and the standard deviation values of the indicators ranged from 0.59 to 1.03 indicating that the respondents were close to one another in their opinion. The grand mean of the teacher commitment indicators is 3.05 which indicate high commitmentfrom the automobile technology teachers.

Table 3: Mean Responses and Standard Deviation on Teacher Effectiveness Indicators

S/N	Teacher Effectiveness Indicators	X	SD	Remarks
1	I always make a deliberate effort to enhance automobile student knowledge	4.16	0.92	Agree
2	I display in-depth knowledge of my automobile subject(s)	4.00	0.88	Agree
3	I present my automobile lessons in a well-organized manner	3.94	0.87	Agree
4	I have always been responsive to automobile students' views and comments	3.74	1.05	Agree
5	I provide clear explanations of important issues in my subject	3.94	0.99	Agree
6	As a teacher I have always prepared well for my automobile lessons	3.66	0.98	Agree
7	I make an effort to stimulate students 'interest in the automobile subject	3.71	0.93	Agree
8	I do my best to deliver on automobile teaching duties because my salary is adequate	3.72	0.97	Agree
9	I participate in co-curricular activities as a result of principal's support	3.69	1.08	Agree
10	I get encouraged to do my best in all my responsibilities in school because there is a clear policy on reward of top achievers	3.42	1.23	Agree
11	My automobile lesson delivery is from simple to complex or from known to the unknown	3.69	1.19	Agree
12	I use periodic questioning to obtain and retain automobile students' attention	3.92	1.09	Agree
13	I make use of appropriate automobile instructional materials	3.91	1.02	Agree
14	I make use of appropriate instructional methods	3.77	1.14	Agree
15	I make improvisation of instructional materials when not available	3.86	0.99	Agree
	Grand Mean	**3.80**		

Keys: X = Mean of respondent, SD = Standard Deviation, A = Agree.

Table 3 shows the 15 teacher effectivenessindicators. The mean value of the indicators ranged from 3.42 to 4.16 and the standard deviation values of the indicators ranged from 0.87 to 1.23 indicating that the respondents were close to one another in their opinion. The grand mean of the teacher effectivenessindicators is 3.80 which indicate high effectivenessfrom the automobile technology teachers.

Table 4: Correlation between Teachers' Work Engagement and Teacher Effectiveness

Variables	TWE	TE	Sig.	R	R^2	B
1.Teacher Work Engagement (TWE)	1		.000	.425	.2566	9.844
2. Teacher Effectiveness (TE)	.425**	1	.000			.429

Key: TWE-Teacher work engagement, TE- teacher effectiveness, **- Correlation is significant

Table 4 shows moderate relationship (.425) between teachers' work engagement and teacher effectiveness of automobile technology teacher. This impact is statistically significant because sig. value p < .000 which is less than .05. Therefore, hypothesis is Not Rejected. This indicated that teachers' work engagement is a significant predictor for the teacher effectiveness of automobile technology teachers.

Table 5: Correlation between Teachers' Commitment and Teacher Effectiveness

Variables	TC	TE	Sig.	R	R^2	B
1. Teacher Commitment (TC)	1		.016	.537.	.331	39.721
2. Teacher Effectiveness (TE)	.537**	1	.000			.639

Key: TC-Teacher commitment, TE- teacher effectiveness, **- Correlation is significant

Table 5 shows moderate relationship (.537) between teachers' commitment and teacher effectiveness of automobile technology teachers. This impact is statistically significant because sig. value p < .000 which is less than .05. Therefore, the hypothesis is Not Rejected. This indicated that teachers' commitment is a significant predictor for the teacher effectiveness of automobile technology teachers.

Table 6: Correlation between Teachers' Work Engagement and Teachers' Commitment

Variables	TWE	TC	Sig.	R	R^2	B
1.Teacher Work Engagement (TWE)	1		.000	.433	.236	76.254
2. Teacher Commitment (TC)	.433**	1	.000			.353

Key: TWE-Teacher work engagement, TC- Teacher commitment, **- Correlation is significant

Table 6 shows moderate relationship (.433) between teachers' work engagement and commitment of automobile technology teachers. This impact is statistically significant because sig. value p < .000 which is less than .05. Therefore, hypothesis is Not Rejected. This indicated that teachers' work engagement is a significant predictor for the commitment of automobile technology teachers.

Discussion

It was found out from the study that a moderate relationship between teachers' work engagement and teacher effectiveness of automobile technology teachers in technical colleges in Enugu State. This is in agreement with Kocak & Nartgun (2020) who carried out a research on the relationship between teacher's work engagement and the effectiveness of school teachers. They observed that personality teachers work engagement had significant relationship on effectiveness. The study is also in line with Kilonzo, et al (2018) who concluded that teachers work engagement had an influence on teacher effectiveness in Secondary Schools. Equally the findings of this study is in line with Gupta, Acharaya& Gupta

(2015) who in their study found that there is a significant mediating relationship between teachers work engagement and effectiveness. Thus this study has shown that work engagement variable is important because it influences teacher effectiveness.

It was found out from the study that there was a moderate relationship between teachers' commitment and teacher effectiveness of automobile technology teachers in technical colleges in Enugu State. The findings of this study are in line with (Ibrahim and Igba 2015), they observed that effectiveness of the teacher's instructional activities had a positive impact on their commitment to the classroom and their teaching profession. The findings are also consistent with those of Ibrahim & Iqbal (2015) who discovered a positive relationship between teachers' professional commitment and effectiveness to school, teaching jobs and commitment. Thus this study has shown that teacher commitment variable is important because it influences their effectiveness.

The study discovered that teachers' work engagement is a significant predictor for the teacher effectiveness of metalwork technology teachers. These findings are in accordance with Kocak & Nartgun (2020) who observed that teachers work engagement had significant difference on effectiveness. Equally Kilonzo, et al (2018) in their study concluded that teachers work engagement had statistically significant influence on teacher effectiveness. Fernandez (2021) also found a significant difference between work engagement and teacher effectiveness. Fernandex (2021) also identified significant relationships between teacher work engagement and effectiveness. Bakker, Albrecht & Leiter (2011) discovered that effectiveness was impacted by work engagement, which is a combination of a person's capacity to work such as energy, strength, and stamina; and willingness to work such as devotion, participation, and commitment.

The findings of the study also revealed that teachers' professional commitment is a significant predictor for the teacher effectiveness of automobile technology teachers. This finding is in agreement Mishra & Mishra (2022) observed that in their study on teacher professional commitment and teaching competency as psychological predictors and primary contributors to teaching effectiveness found that there is a positive and substantial correlation between teacher professional commitment and effectiveness.

Conclusion

Based on the findings of this study, it could be concluded that work engagement and commitment are related to teacher effectiveness. This would, no doubt, result to positive and improved teacher effectiveness. It was noted that there was a moderate relationship between work engagement and professional commitment on teacher effectiveness of automobile technology teachers in technical colleges in Enugu state. Automobile technology was introduced into the technical college programme to equip the students with relevant skills for work after graduation. Effective teaching by

automobile technology teachers is very important to produce automobile technology graduates, who are self-reliant. To maintain progressive quality skills acquisition among automobile students, and improvement in automobile teachers' effectiveness in technical colleges becomes crucial so as to reduce the problem in imparting the knowledge and skills needed by the automobile students to face the challenges after graduation.

Recommendations

Based on the findings it is recommended that Technical college administrators in Enugu State should:

1. organized workshop programmes and conferences for automobile teachers on how they can improve their engagement, commitment and effectiveness.
2. ensure that there is cordial relationship between them and the automobile teachers.
3. improve the work engagement and commitment of their automobile teachers through empowerment, rewards and benefit schemes.

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Effect of Two Processing Methods on Fatty Acid Profile of Three Varieties of African Pear (*Dacryodes edulis*)

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Abstract

The pericarp of African pear (*Dacryodes edulis*) is butyraceous. This study evaluated the fatty acid contents of three varieties of African pear (*Akpabuyo* pear, *Ikom* butter pear and *Ikom* pear).Ripe fruits of the three varieties of pear were purchased from Marian markets Calabar Cross River State, Nigeria. Each sample was divided into three batches. The first batch was left raw, the second was pan roasted till the pulp became soft, and the third batch was immersed into boiled water for 3 minutes. Each batch was prepared by deseeding the soft pulp. They were separately homogenized and stored in an airtight container and refrigerated for fatty acid (FA) analysis. The fatty acid contents of the samples were determined by Gas chromatography-mass spectrometry (GC-MS) methods. Data obtained were analyzed using the mean and standard deviation. Arachidonic acid in raw *Akpabuyo* pear was the predominant (1.55 g/100g) UFA.Saturated Fatty Acids (SFA) were found to be present in a higher percentage compared to the unsaturated fatty acids (UFA) in all the samples. Roasted *Akpabuyo* pear had the highest concentration of SFA (Lauric 28.45 g/100g),Blanched pear samples had lower FA. The consumption of raw and blanched *Akpabuyo* pear was recommended because of the type and concentration of the FA.

Keywords: Fatty, Acid, African, Pears, Profile, Processing, Saturated, Unsaturated, Monoun

Introduction

The World Health Organization has persistently emphasized the importance of fruits, among other foods as life-enhancing medicine with because they are rich in vitamins, minerals, and many phytonutrients {(Word Health Organization (WHO, 2015)}. African pear (*Dacryodes edulis*) is a fruit, and it is also known as African pear, African bush pear or plum or butter fruit. In Nigeria, it is called "*Ube*" in Igbo language, *Atili* in Hausa language, *Elemi* in Yoruba, and *Eben* among the Efiok/ Ibibio (Orwa *et al.,* 2009; Ene-Obong *et al.,* 2019). The major fruiting season is between May and October although fruitingstarts 5-6 years after planting Orwa *et al.,* 2009; Food and Agricuture Organization (FAO), 2014). Pears being a buttery fruit is very important partly because of the public health benefits accrued to fruits and vegetables for their role in chronic disease prevention and mortality reduction WHO 2015; Smith *et al.,* 2022). These health benefits might be attributed to the nutrient and

phytochemical contents (Aguilera *et al.*, 2016). In Africa, Nigeria is not listed among countries that rely on either production or imports of pear, its consumption rate is also negligible. In Africa generally, market reports showed a steady decline in both production and consumption of African pear from 2014 to 2021 (Index Box Market Intelligence Platform, 2023).

African Pear can be consumed in its raw fresh form by leaving it in the mouth to soften. It can be roasted or blanched. It can serve as an accompaniment to fresh and roasted corn during the months of April to November, its butyraceous nature makes it a good spread on bread, yam, and even rice, among others.It is however, most often consumed after cooking by either roasting or blanching in boiled water. With advancements in recent cuisine, it could be sautéed, simmered alongside soups, or even baked. Owing to the report on high bacteria load on uncooked pear, it is imperative that any of the cooking methods should be used to make it more palatable by improving the flavour and safety by reducing the micro-organism load. The absorption of the nutrients in pear might be high as studies have cited very low antinutrients in the pulp (Ibanga and Ekpa, 2009).

Fat contents of African pear is high and ranges from 18 to 36 percent across different varieties, however its proximate composition reveals that moisture is most abundant (36.5% to 53.82%) followed by fat and others (Onuegbu and Ihediohanma, 2008). The importance of fat in this fruit makes it valuable to determine the fatty acid composition because specific fatty acid is unique in its function (Uhunmwangho and Omoregie, 2022; Ene-Obong *et al*. 2019; Ihediohanma and Onuegbu, 2010), for example different types of saturated fatty acids (SFA) uniquely have different effects on the plasma lipoprotein cholesterol fractions concentration. Saturated fatty acids like lauric, myristic and palmitic acids increase low density lipo-protein (LDL) cholesterol whereas stearic acid has no effect (FAO,2010) . It was recommended during the FAO, consultation meeting on Fat and fatty acid in human nutrition held in Geneva in the year 2008 that when saturated fatty acid (SFA) is replaced with polyunsaturated fatty acids (PUFA) LDL cholesterol concentration will be decreased and the total/ high density lipo-protein (HDL) cholesterol ratio will also be decreased. The same is achievable when SFA is replaced with monounsaturated fatty acids (MUFA), although the effectiveness is not as much as that of PUFA. It is important to note that when dietary sources of SFA is replaced with carbohydrates, LDL and HDL cholesterol concentration are decreased but the total/HDL cholesterol ratio is not changed. On the other hand, when SFA is replaced with trans-fatty acids (TFA), HDL cholesterol decreases (Liska *et al.*, 2016; Dhaka, *et* al., 2011; FAO 2010).

Food processing can be broadly defined as the treatments given to agricultural food products after harvest till they are ready for consumption. African pear does not require rigorous processing prior to consumption. The unit preparation and processing of these fruits includes sorting, washing,

blanching and roasting. Blanching and roasting are important household food processing methods. Blanching is a cooking process in which fruits or vegetables are immersed in boiled water and allowed to remain in for a short period of time before the water is discarded and the food quickly cooled (Sunmonu *et al.,* 2021: Fellows, 2017), On the other hand, roasting is achieved in an uncovered pan without water to produce a well-browned exterior and a moist cooked interior (Hotz and Gibson, 2007; Nzewi and Egbuonu, 2011). Nutritional changes during processing are an important consideration when assessing nutrient intake. The effect of processing on the fatty acid composition of *Dacryodes edulis* is an important data that might enhance its use because it faces the danger of extinction if not properly utilized. It is on this background that this study was carried out in order to evaluate the fatty acid content of processed African pear.

Objectives of the Study

The general objective of this study was to assess effects of processing methods on fatty acid content of three varieties African pear.

Specifically, the study determined fatty content of:

1. raw African pear varieties (*Akpabuyo, Ikom* butter and *Ikom* pear)
2. roasted and blanched*Akpabuyo* pear,
3. roasted and blanched *Ikom*butter pear,
4. roasted and blanched *Ikom* pear.

Material and Methods

***Procurement/Preparation of Sample*:**

Mature and ripe pulp of African pear were purchased from Watt market in Calabar Cross River State, Nigeria. They were identified by the locals and market women as popularly known as *Ikom* butter pear, *Akpabuyo* pear and *Ikom* pear. The fruits were washed with tap water and each was divided into three batches of equal weight (1kg). The first batch was left raw for control. The second batch was roasted in a hot pan and a wooden spatula was used to toss the fruits for 3 minutes until they became soft. The last batch was then immersed in boiled water at a temperature of 100°C for 3 minutes. After processing, each batch was separately de-seeded and homogenized using mortar and pestle. Each sample was put in an airtight container and labeled accordingly. They were stored in a refrigerator for fatty acid analysis.

***Analysis of Fatty Acids*:** Oil from 200 g of each sample was extracted with petroleum ether at 60°C for 3 hours using a Soxhlet apparatus on an electro thermal mantle. The extract was concentrated using a rotary evaporator to remove all alcohol. Fatty acids methyl esters (FAMEs) derivatization of the oil sample was carried out. The oil sample was weighed into a 10 mL micro-reaction vessel and 2 mL BCl3-MeOH 12 percent w/w was added. This was followed by the addition of 1 mL 2, 2-dimethoxyproprane. The mixture was mixed thoroughly and then heated for 5 minutes at 60°C. It was then cooled to below 30°C and 1 mL distilled water and 1 mL n-hexane were added and allowed to stand. The GC-MS Analysis of FAMEs described in the work by Igile *et al*., 2018 was used with a slight modification was used to complete the analysis.

***Statistical Analysis*:** Data obtained were expressed as the mean ± standard deviation. The data were analyzed using SPSS version 20. One-way analysis of variance (ANOVA) was used to categorize the means. Significant differences were considered at $p < 0.05$.

Results

Table 1: Fatty acid Compositions of Raw *Ikom*, *Ikom* Butter and *Akpabuyo* Pears (g/100g Wet Weight Basis).

Fatty acids	*Akpabuyo*	*Ikom* butter pear	*Ikom* butter
Capric	0.65±0.00^{b}	0.83 ±0.00^{a}	0.66±0.00^{b}
Caprylic	5.98 ±0.00^{c}	8.44 ±0.00^{a}	6.33 ±0.00^{b}
Caproic	4.34±0.00^{a}	3.78 ±0.00^{b}	3.88 ±0.00^{b}
Lauric	27.05±0.00^{b}	28.05 ±0.00^{a}	26.23 ±0.00^{b}
Myristic	16.87±0.00^{c}	18.55 ±0.00^{a}	17.66 ±0.00^{b}
Palmitic	6.05±0.00^{b}	7.66 ±0.00^{a}	6.25 ±0.00^{b}
Stearic	1.66±0.00^{c}	2.87 ±0.00^{a}	1.88 ±0.00^{b}
Palmitoleic	0.03±0.00^{c}	0.07±0.00^{a}	0.04 ±0.00^{b}
Arachidonic acid	1.55±0.00^{a}	0.07 ±0.00^{b}	0.05 ±0.00^{b}

Data are presented as mean ± SEM. Superscript letter (a-c) means within each row with different superscripts are significantly ($p<.05$) different

Table 1 presents the fatty acid compositions of raw *Ikom* pear, *Ikom* butter pear and *Akpabuyo* pear. Raw *Akpabuyo* pear had significantly ($P<0.05$) higher Caproic (4.34±0.00 g/100g) and *Arachidonic* acid (1.55 ±0.00 g/100g) than other pears, Raw *Ikom* butter pear however, had significantly ($P<0.05$) higher Capric: 0.83±0.00 g/100g, Caprylic: 8.44±0.00 g/100g, Lauric (28.05±0.00 g/100g), Myristic (18.55 ±0.00 g/100g),Palmitic (7.66 ±0.00 g/100g), stearic (2.87 ±0.00 g/100g) and palmitoleic (0.07±0.00 g/100g) than all other studied pear varieties.

Table 2: Effect of Roasting and Blanching on the Fatty Acid Composition of *Akpabuyo* Pear (g/100g) as Consumed.

Fatty acids	Raw	Roasted	Blanched
Capric	0.65±0.00^{b}	0.87±0.00^{a}	0.66 ±0.00^{b}
Caprylic	5.98 ±0.00^{c}	8.87±0.00^{a}	6.33±0.00^{b}
Caproic	4.34±0.00^{b}	4.66±0.00^{a}	3.88±0.00^{c}
Lauric	27.05±0.00^{b}	28.45±0.00^{a}	26.23±0.00^{c}
Myristic	16.87±0.00^{b}	18.88 ±0.00^{a}	16.66 ±0.00^{b}
Palmitic	6.05±0.00^{b}	7.75±0.00^{a}	6.35 ±0.00^{b}
Strearic	1.66±0.00^{b}	2.67 ±0.00^{a}	1.88 ±0.00^{b}
Palmitoleic	0.03±0.00^{c}	0.06±0.00^{a}	0.04 ±0.00^{b}
Arachidonic acid	1.55±0.00^{a}	0.05±0.00^{c}	0.07 ±0.00^{b}

Data are presented as mean ± SEM. Means within each row with different superscripts are significantly ($p<.05$) different

Table 2 presents the effects of roasting and blanching on the Fatty acid compositions of *Akpabuyo* pear (g/100g) as consumed. Roasting significantly (P<0.05) increased the Capric (0.87 ±0.00 g/100g), Caproic (4.66 ±0.00 g/100g), Lauric (28.45 ±0.00 g/100g), Myristic (18.88 ±0.00 g/100g),Palmitic (7.75 ±0.00 g/100g) and stearic (2.67 ±0.00 g/100g) fatty acids contents of *Akpabuyo* pear from the levels in the raw samples. On the other hand, significant decrease was observed in the Arachidonic fatty acid contents of both the roasted (0.05±0.00g/100g) and blanched (0.07 ±0.00g/100g)when compared with the raw sample (1.55g/100g). There was also significant (P<0.05) decrease in the Lauric (26.23 g/100g) and caproic (3.88 g/100g) acid contents of blanched Akpabuyo pear when compared with the raw sample the raw (27.05 g/100g and 4.34 g/100g respectively).

Table 3: Effects of Roasting and Blanching of Fatty Acid Contents of *Ikom* Butter Pear (g/100g) as Consumed

Fatty acids	Raw	Roasted	Blanched
Capric	0.83 ±0.00^{a}	0.54 ±0.00^{c}	0.78 ±0.00^{b}
Caprylic	8.44 ±0.00^{a}	5.98 ±0.00^{c}	7.45 ±0.00^{b}
Caproic	3.78 ±0.00^{b}	4.56 ±0.00^{b}	5.25 ±0.00^{a}
Lauric	28.05 ±0.00^{a}	24.55 ±0.00^{c}	27.67 ±0.00^{b}
Myristic	18.55 ±0.00^{a}	16. 80±0.00^{c}	18.23 ±0.00^{b}
Palmitic	7.66 ±0.00^{a}	5.88±0.00^{c}	7.23 ±0.00^{b}
Stearic	2.87 ±0.00^{a}	1.78±0.00^{c}	2.67 ±0.00^{b}
Palmitoleic	0.07±0.00^{a}	0.02 ±0.00^{b}	0.04 ±0.00^{b}
Arachidonic	0.07 ±0.00^{a}	0.02 ±0.00^{c}	0.06 ±0.00^{b}

Data are presented as mean ± SEM. Means within each row with different superscripts are significantly (p<.05) different

Table 3 presents the effect of roasting and blanching on the fatty acid composition of *Ikom* butter pear. There was significant (P<0.05) decrease in the fatty acid compositions of almost all the roasted and blanched pears when compared with the raw pear. In contrast to this observation, only Caproic acid (3.78 ±0.00 g/100g) contents of the roasted and the blanched samples did not decrease when compared to their raw counterpart, rather, there was a significant increase of the Caproic acid contents of both the roasted and blanched *Ikom* butter pear. The increase was significant (P<0.05). It ranged from 3.78 ±0.00 g/100g in the raw pear to 4.56 ±0.00g/100g in the roasted sample and highest in the blanched pear (5.25 ±0.00 g/100g).

Table 4: Effect of Roasting and Blanching on Fatty Acid Content of *Ikom* Pear (g/100g)

Fatty acids	Raw	Roasted	Blanched *Ikom* Butter
Capric	0.66±0.00^{a}	0.47 ±0.00^{c}	0.72 ±0.00^{a}
Caprylic	6.33 ±0.00^{b}	4.44 ±0.00^{c}	8.24±0.00^{b}
Caproic	3.88 ±0.00^{c}	4.38 ±0.00^{b}	5.12 ±0.00^{a}
Lauric	26.23 ±0.00^{b}	23.35 ±0.00^{bc}	27.45 ±0.00^{a}
Myristic	17.66 ±0.00^{b}	16.66 ±0.00^{c}	18.15±0.00^{a}
Palmitic	6.25 ±0.00^{b}	5.46 ±0.00^{c}	7.34±0.00^{a}
Stearic	1.88 ±0.00^{b}	1.55 ±0.00^{c}	2.47±0.00^{a}
Palmitoleic	0.04 ±0.00^{b}	0.02 ±0.00^{b}	0.08±0.00^{a}
Arachidonic (g/100g)	0.05 ±0.00^{a}	0.02 ±0.00^{b}	0.06 ±0.00^{a}

Data are presented as mean ± SEM. Means within each row with different superscripts are significantly (p<.05) different

Table 4 presents effects of roasting and blanching on the fatty acid composition of *Ikom* pear. The result on the effect of roasting and blanching on the fatty acid contents of *Ikom* pear followed a peculiar trend. Cooking significantly (P<0.05)increased the fatty acid contents of the raw sample from Capric: 0.66 ±0.00 g/100g, Caprylic: 6.33±0.00 g/100g, Lauric (3.88 ±0.00 g/100g), Myristic (17.66 ±0.00 g/100g),Palmitic (6.25±0.00 g/100g), stearic (1.88 ±0.00 g/100g) and palmitoleic (0.04 ±0.00 g/100g) to (Capric: 0.72 ±0.00 g/100g, Caprylic: 8.24±0.00 g/100g, Lauric (27.45 ±0.00 g/100g), Myristic (18.15±0.00 g/100g),Palmitic (7.34±0.00 g/100g), stearic (2.47 ±0.00 g/100g, palmitoleic (0.08 ±0.00 g/100g) in the roasted sample. But blanching caused some significant reduction (P<0.05) in the samples as follows: (Capric: 0.47 ±0.00 g/100g, Caprylic: 4.44±0.00 g/100g, Lauric (23.35 ±0.00 g/100g), Myristic (16.66 ±0.00 g/100g), Palmitic (5.46±0.00 g/100g), stearic (1.55 ±0.00 g/100g), and Arachidonic (0.02 ±0.00 g/100g).

Discussion

The fatty acid profile of raw, roasted, and blanched *Akpabuyo, Ikom* butter pear and *Ikom* pear pulp shows that both saturated and unsaturated fatty acids were present in all the samples, though in varied amounts.The higher concentration of Arachidonic and palmitoleic fatty acids in the raw *Akpabuyo* pear could be advantageous in deciding the best way to process food. These fatty acids may improve heart health (El-Fakharany *et al.,* 2018). There are several reports, suggesting that polyunsaturated fatty acids, enhanced bone formation (Dansgaard *et al.,* 2012). Polyunsaturated fatty acids are also known to possess body weight management properties, including reducing body fat and increasing lean muscle mass. These are some potential benefits that African pears may confer on populations consuming the fruit.

However, saturated fatty acids which do not contain any double bond in their structure are considered to be unhealthy sources of edible oils. These include palm oil (palmitic acid) and refined palm kernel oil (lauric acid) as

well as stearic acid (Carta *et al.,* 2017). A saturated fatty acid structure is fully hydrogenated as in palmitic, lauric, and stearic fatty acids. The molecule issaid to be very stable (usually solid at room temperature) and hard to break up or disintegrate. This allows it to store and provide more energy than carbohydrates and makes it more likely to stick to the body as cholesterol resulting in high arterial and plasma cholesterol, also known as hypercholesterolemia (Carta *et al.,* 2017). High arterial and plasma cholesterol predispose to hypertension. Also, the high content of polyunsaturated fatty acid in African pear pulp oil and its arachidonic acid and palmitoleic contents make it a rich source of essential fatty acids, with great potential to enhance the nutritional value of its food products. African pear pulp oil for margarine and bakery shortening production, and other food product formulations is greatly enhanced by the low free fatty acids value. This discovery is consistent with the values of fatty acids previously found in different oil seeds including, sunflower, soybean, peanut, and olive oil.

The lower contents of these FAs in the blanched *Akpabuyo* pear and *Ikom* butter pear is not surprising because leaching of nutrients is occasioned by blanching (Sunmonu *et al*., 2021; Severini *et al.,* 2016). Contrarily to expectation, the FAs contents of *Ikom* pear were increased, this could be as a result of varietal difference.

The reason for the high fatty acids content in the roasted *Akpabuyo* pearcould be attributed to the heating process, which led to the increase in temperature and release of more fats and also evaporation of moisture, hence concentration of fat. It is however surprising to see a contrasting result in the *Ikom* pear and *Ikom* butter pear, roasting significantly reduced the fatty acid contents of almost all the fatty acids identified except caproic acid. This could be attributed to variety and concentrationof fatty acid. The greater buttery nature of *Ikom* butter this pear must have enabled the result, other reasons for the difference in the contents of these fatty acids may be to climatic variables, soil type, and processing methods. In addition, the results of the present study support the earlier study of Ene-Obong *et al.* (2019), who reported variation in the nutrients and bioactive compounds of different accessions of the West African pear.

Conclusion

This study has revealed and provided information on the fatty acid composition of raw, roasted and blanched African pear fruits. Arachidonic and palmitoleic acids were the only unsaturated fatty acids found among the studied pears. They were more abundant in raw *Akpabuyo* pear. Blanching reduced the FA contents of *Akpabuyo* pears and increased those of *Ikom* and *Ikom* butter pears. Roasting significantly reduced their concentration in *Ikom* pear and *Ikom* butter pears and caused increases in the FA compositions of *Akpabuyo* pears. Saturated fatty acid (capric, caprylic, lauric, palmitic, stearic acids) was highest in roasted *Akpabuyo*pear while stearic acid was more in raw *Ikom* butter pear. These reports therefore imply that roasted *Akpabuyo* pear, which recorded high percentages of saturated fatty acids

should be consumed with care considering the nutritional status of the individual. The study also revealed that variety is a strong determinant of the outcome of FAs compositions of roasted and blanched studied pears.

Recommendations

Based on the findings, it is recommended that:

1. consumers should leverage on the types and distributions of fatty acids present in these pears in making their food choices.
2. consumption of raw and blanched African pears, which had a low percentage of saturated fatty acids with a high percentage of unsaturated fatty acids should be encouraged.
3. presence of caproic acid in *Ikom* butter pear might be considered as a good food additive (flavouring agent)

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Challenges of and Needed Support for Aged in Rural Areas of Enugu State, Nigeria

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Abstract

This study focused on challenges of the aged and their need for support in rural areas of Enugu state. Specifically, the study identified: challenges of the aged that are related to their family relationship and health, their finances and environment, as the support they need. Population for the study was 36,403 elderly individuals and Home Economists in the study area. Simple random sampling without replacement was used to select a sample size of 228 respondents that participated in the study. Questionnaire was used for data collection. Data were analyzed using mean and standard deviation. Findings show 17 family relationship and health challenges, hese include abandonment by children($\bar{X}$= 2.57), declining health condition($\bar{X}$= 3.75),among others. Other findings are 15 finance, shelter and environmental related challenges, include: loss of financial freedom($\bar{X}$= 2.09), problem of good housing($\bar{X}$= 2.63),social isolation ($\bar{X}$= 2.78); among others. Findings also revealed free medical treatment, free transport, moderate exercise, regular payment of pension, encouragement from children as some of the support options for the aged. Based on the findings, eight recommendations were made, that Home Economics practitioners should organize talks, seminars, for rural people include among others, on how to take care of the aged,they should serve as advisory body to law makers to make policies aimed at enhancing the wellbeing of the aged.

Keywords: Aged, Challenges, Need, Support, Rural, Family, Relationships, Health, Environment.

Introduction

There is presently a growth in the aging population. Virtually every country in the world is experiencing growth in the number and proportion of older persons. It is estimated that by 2050, there will be over two billion aged 6o and above in the world more than twice the number measured in 2000 (Shrestha, 2022). The aged pass through various developmental stages which include: the young – old (60-74), the old-old (75-84), the oldest-old (85-99), and the centenarians (100+). Aging is associated with changes in biological, physiological, environmental, psychological, behavioral and social processes (American Psychological Association, 2023). According to Fozard and Wahl (2012) some age-related

changes are benign, such as graying hair, others result in declines in function of the senses and activities of daily life and increased susceptibility to and frequency of disease, frailty or disability. The elderly people need care and comfort to lead a healthy life without worries, anxiety, diseases and other challenges.

In developed countries of the world like Japan, US and others, the elderly are provided with comprehensive medical services that cater for their specific needs. Country like Japan emphasizes family engagement and social support, community programs and government initiative, to combat loneliness among older adults. In developed countries of the world, the average life expectancy of the people is nearly 75years (United National Department of Economics and Social Affairs Population Division, 2017). The increase in life expectancy can be attributed to a number of factors including improvement in public health, nutrition and medicine (World Health Organization, 2022).

In Nigeria, those aged 65 years and above make up 3.13 percent of the total population of 191 million people. (Sonye and Bamson, 2012).The elderly people in developing countries like Nigeria in the past enjoyed considerable status, respect, care, social and psychological support from their nuclear and extended families. Presently, however, migration, urbanization, changes in value system, aspiration and brake down of the system have eroded traditional family support which hitherto took care of the elderly (Abdullahi and Jummar, 2013). In Nigeria, the aged are faced with various challenges which impinge on their wellbeing. Most of them who were working have retired from active service and have to depend on meager pension. Some elderly individuals feel a major sense of loss upon retirement which is viewed as an end to the working years (Ogbuji and Iwuagwu 2014). Mole and Dim (2010) reported that most aged people in Nigeria suffer from loss of steady income, lack of satisfying job after retirement, reduction in status and social identity.

The issue of high cost of health services has affected the zeal in seeking medical attention by the elderly in Nigeria. Aboderin (2013) observed that most elderly persons has preferred to remain in their sick bed at home waiting for death as alternative to unaffordable cost of health services. According to Awosike, et al (2003) access to health care in Nigeria is severely limited both by paucity of health facilities and man power. Nigerian elderly people are usually faced with dwindling financial resources and increased health challenges and this has compounded their hardship. Limited access to health care might help to explain the overall poor health of the aged who need more health care services but often have fewest options and availability (Chark, et al 2012).

Poverty in Nigeria has reduced a lot of elderly persons into a life of financial dependency as there is no social security to provide economic support for the aged. (Adebowale, et al 2012). Abdulazeez (2015) observed that social security system that has been in evolution right from the colonial era have not been effective in Nigeria owing to the administrative negligence,

poor planning and poor policy implementation. Aboderin (2013) observed that Nigerian family values premised on love and empathy are gradually being replaced by materialism and abandonment which account for insecurity as well as increased neglect of elderly. Traditionally, the elderly are expected to rely primarily on their families for economic and emotional support. Most often the needed support are far-fetched because unemployment and accompanying poverty have made it almost impossible for children to provide adequately for their aging parents. According to Satyan (2018) the older population either suffers from harsh treatment on the part of their children or they reduce themselves to minor shells counting out their last days amongst the poor living conditions of care homes.

The aged in the rural areas face more challenges and threat to wellbeing than those in the urban areas. In local government area of Enugu state where the study was conducted, the aged are faced with unique challenges such as transportation problems, fewer housing and challenging renting options, lack of community support. There is also the problem of poor access to social and health services, exclusion, loneliness, problem from caregivers and poverty. There is therefore need to evolve ways of helping the aged in the rural areas and promoting their wellbeing.

Purpose of the Study

The major purpose of the study was to explore challenges of and needed support for the aged in rural areas of Enugu State, Nigeria. Specifically, the study determined:

1. relationship and health related challenges of the aged in rural areas of Enugu state.
2. finance and environment related challenges of the aged in rural areas of Enugu state.
3. various support options (family related and non- family related) for aged in rural areas of Enugu state.

Research Questions

1. What are relationship and health related challenges of the aged in rural areas of Enugu state?
2. What are financial and environment related challenges of the aged in rural areas of Enugu State?
3. What are various support options that could be available to the aged in the rural areas of Enugu state?

Methodology

***Design of the Study*:** The study adopted a descriptive survey design.

***Area of the Study*:** The study was carried out in the rural areas of Enugu east local government area in Enugu state, Nigeria. The aged in the area are composed of both males and females. The area of the study was chosen because majority of their aged people live in the rural area and are faced with various challenges and they needed support.

***Population for the Study*:** The population for the study consisted of 36,281 male and female elderly persons and 82 Home Economists in Enugu east local government area. The aged persons were made up of 17,266.08 male and 19,015 females and they are within the age range of 60 years and above.

(National population commission Enugu state, 2006). Home Economists involved in the study were those teaching in government own secondary schools in the area of the study.

***Sample for the Study*:** Simple random sampling technique was used to select 200 aged, one from each household in Enugu East local government area. The sample was made up of 80 aged males, 120 aged females and 28 Home Economics teachers.

***Instrument for Data Collection*:** Data were collected using structured questionnaire. The questionnaire was divided into two parts. Part one contained three items designed to seek background information about the respondents. The second part was divided into three sections to correspond to the specific purposes. This section consisted of 75 items based on literature review. Response options were based on a 4-point rating scale representing Very serious challenges/support option (4); Serious challenge/support option (3); Not serious challenge/support option (2) and not a challenge/support option (1). The questionnaire was validated by three university experts in Home and Rural Economics, Cronbach reliability index was used to determine the internal consistency of the instrument.Coefficient of internal consistency of 0.78 was obtained.

***Methods of Data Collection*:** A total of 228 copies of the instruments were administered to the respondents. The illiterate aged persons were assisted in interpretation and completion of the questionnaire. All the copies of questionnaires were properly completed and returned giving a 100 percent return rate.

***Methods of Data Analysis*:**The data collected was analyzed using mean and standard deviation for the research questions. The rule of 2.50 was obtained by computing the arithmetic average of the rating values used in the scale. Any item with a mean score of 2.50 and above was regarded as a challenge. Similarly any item scored below 2.50 was disregarded as challenges.

Results

Table 1: Means Responses and Standard Deviation on Challenges Related to Family Relationship, Personal Care and Health of the Aged in Rural Areas of Enugu East Local Government Area.

S/N	**Challenges Related to Relationship and Health**	$\bar{X}_1$	**SD₁**	$\bar{X}_2$	**SD₂**	$\bar{X}_g$	**R**
	Family relationship						
1	Abandonment by children	2.62	.56	2.52	.40	2.57	C
2	Maltreatment and neglect from family members	2.48	.38	2.49	.41	2.48	NC
3	Lack of companionship especially if spouse is dead.	3.62	.78	3.41	.75	3.52	C
4	Problem of being stereotyped	3.02	.51	2.67	.41	2.84	C
5	Problem of being ridiculed by misgiving children	2.49	.23	2.34	.18	2.14	NC
6	Exploitation from children	2.53	.40	2.57	.38	2.55	C

Table 1 continued

7	Verbal abuse from children	2.57	.43	2.51	.65	2.57	C
8	Exclusion	2.41	.40	2.19	.53	3.57	NC
9	Loneliness	3.65	.53	3.50	.69	3.27	C
10	Children migration to urban areas	3.05	.65	3.51	.65	2.66	C
11	Emotional problems as a result ofphysical neglect and indifference by family members	2.72	.49	2.61	.42	2.66	C
	Personal care and health						
12	Inadequate medical attentionwhen sick	3.65	.75	3.61	.79	3.63	C
13	over weight as a result of inactivity	2.53	.41	2.91	.55	2.72	C
14	declining health conditions	3.51	.81	3.24	.69	3.75	C
15	Problem of physical decline	3.05	.70	3.69	.89	3.37	C
16	Limited access to health care	3.25	.77	3.06	.75	3.15	C
17	High cost of health care services	3.61	.65	3.50	.79	3.55	C

Male = N = 90, Female = N = 110; $\bar{X}_1$= mean of male; SD_1= standard deviation of rural males; $\bar{X}_2$ = Mean of female; SD_2= Standard deviation of female; $\bar{X}_g$ = Grand mean; R = Remark; C = Challenge; NC= Not Challenge.

Table 1 presents the response to the challenges of the aged in the rural areas of Enugu east local government of Enugu state Nigeria. The Table shows that 7 items obtained mean scores above 2.50 ($\bar{X}$= > 2.50) while three items indicated have less than 2.50 ($\bar{X}$= < 2.50). This implied that the aged considered 17 items as challenges while 3 items are not considered as challenges.

Table 2: Means and Standard Deviation of Respondents on Finance, Shelter and Environmental Challenges of the Aged in Rural Areas of Enugu East Local Government Area of Enugu State, Nigeria (N-200).

S/N	Challenges Related to Finance, Shelter and Environment.	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_g$	R
	Finance						
1	Loss of financial freedom	2.75	.39	3.05	.41	2.09	C
2	Financial abuse from children	2.57	.32	2.52	.34	2.54	C
3	Lack of financial support from children	3.65	.40	2.54	.37	3.09	C
4	Inadequate pension	3.05	.31	3.25	.40	3.15	C
5	Delayed pension	2.68	.32	3.05	.45	2.86	C
6	extortion of valuables eg. money and other items of economy importance	2.47	.23	2.49	.42	2.48	NC
7	financial abuse from care givers	3.51	.75	3.60	.65	3.55	C
	Shelter and environment						
8	Problem of good housing	2.58	77	2.69	.52	2.63	C
9	In affordability of housing	2.69	49	2.58	.42	2.63	C
10	Fewer housing and renting options	2.56	.43	2.57	.52	2.56	C
11	Inability to pay for housing repairs and modification	3.25	.72	3.05	.65	3.15	C

Table 2 continued

12	Transportation problem to move about	2.70	.53	2.92	.69	2.81	C
13	Epileptic electricity supply	3.39	.63	3.05	.68	3.22	C
14	Social isolation	2.81	.42	2.75	.65	2.78	C
15	Dilapidated housing	2.76	.61	2.84	.59	2.08	C

Male = N = 90, Female = N = 110; $\bar{X}_1$= mean of male; SD_1= standard deviation of rural males; $\bar{X}_2$ = Mean of female; SD_2= Standard deviation of female; $\bar{X}_g$ = Grand mean; R = Remark; C = Challenge; NC= Not Challenge.

Table 2 presents the response to the challenges of the aged in the rural areas of Enugu East Local Government of Enugu state Nigeria. The Table shows that 14 items indicated have a mean score above 2.50 ($\bar{X}$= > 2.50) while one item indicated have less than 2.50($\bar{X}$= < 2.50). This implied that the aged considered 14 items as challenges while 1 item was not considered a challenge.

Table 3: Mean Responses and Standard Deviation on Family Related Support Options that should be Available to Aged in Rural Areas of Enugu State Nigeria

S/N	Family Related Support Options	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_g$	R
	The aged themselves should:				
1	engage in moderate exercise	2.85	2.92	2.89	SOP
2	avoid smoking	3.01	3.02	3.04	SOP
3	do not drink in excess	2.87	3.01	2.94	SOP
4	avoid sedimentary life style	2.77	2.94	2.86	SOP
5	avoid sexual recklessness	2.91	3.21	3.06	SOP
6	maintain normal weight	3.01	3.07	3.04	SOP
7	socialize with others	3.00	3.01	3.01	SOP
8	have good medical attention	3.25	2.93	3.09	SOP
9	maintain a positive thinking	2.73	3.06	2.89	SOP
10	stay mentally active by keeping the brain engaged	2.69	2.82	2.76	SOP
11	get out in the fresh air	2.71	2.91	2.81	SOP
12	have a safe home	2.69	2.83	2.76	SOP
13	maintain personal hygiene	2.82	3.01	2.91	SOP
14	comply with medical advice	3.01	3.22	3.01	SOP
15	adopt good safety habit	2.77	2.95	2.87	SOP
16	have adequate sleep	2.68	2.77	2.73	SOP
17	maintain proper feeding habit	2.70	2.86	2.79	SOP
	The family members should:				SOP
18	provide love for the aged	3.08	3.10	3.09	SOP
19	show respect to the aged	3.21	3.25	3.23	SOP
20	show aged that they are still relevant	2.75	2.87	2.81	SOP
21	provide security and protection to the aged	2.69	2.76	2.73	SOP
22	arrange regular family visit	3.01	2.99	3.00	SOP
23	make sure they are well catered for	3.03	3.02	3.03	SOP
24	pay for their medical bills	2.90	3.15	3.02	SOP

Male N= 100; Female N = 128; $\overline{X}_1$= mean aged; $\overline{X}_2$ = Mean home economists; R = Remark; SOP = Support option

Table 3 shows the mean responses on various family related options that could be available to the aged in rural areas of Enugu east, local government. The respondents agreed on all the 24 support options ($\overline{X}$= > 2.50). It follows that all the 24 support options could be appropriate support for the aged.

Table 4: Mean Responses on Various Non-Family Related Support Options that should be Available to the aged in Rural Areas of Enugu State Nigeria.

S/N	Non-family Related Support Options	$\overline{X}_1$	$\overline{X}_2$	$\overline{X}_g$	R
	Government should:				
1	provide free medical care	3.27	3.01	3.14	SOP
2	provide suitable transportation services	3.09	3.21	3.15	SOP
3	pay pension on time	3.21	3.08	3.14	SOP
4	pay retired workers their gratuity	3.26	3.17	3.21	SOP
5	review pension scheme to enhance it	2.91	2.95	2,93	SOP
6	provide free transportation services	3.21	2.09	2.65	SOP
7	establish supportive age friendly facilities such as lunch club, older people's forum	2.80	2.85	2.82	SOP
8	health insurance policies should be established	2.71	2.82	2.79	SOP
	Religious bodies and Non-governmental organization should:				SOP
9	provide free medical services	2.70	2.72	2.71	SOP
10	carry out home visits to the aged	2.72	2.76	2.70	SOP
11	offer of gifts to the aged	2.72	2.69	2.70	SOP
	Home economists should:				SOP
12	establish programs that help to bridge the wide generational gap between the young and old in communities in Enugu eastlocal government areas.	2.61	2.68	2.64	SOP
13	serve as an advisory body to law makers to make policies aimed at enhancing the wellbeing of the aged	2.72	2.82	2.77	SOP
14	establish old people's home for the aged who need it.	2.70	2.75	2.72	SOP
15	organize talk, seminars to the rural people on how to care for the elderly.	2.80	2.81	2.76	SOP
16	Organize talk for the aged on how to take care of themselves.	2.92	2.90	2.91	SOP

Male N= 100; Female N = 128; $\overline{X}_1$= mean aged; $\overline{X}_2$ = Mean home economists; R = Remark; SOP = Support option

Discussion

From the data collected and analyzed, the study revealed some of the family relationship, personal care and health challenges of the aged in the rural areas of Enugu east local government, Enugu state. The challenges include abandonment by children, maltreatment and neglet from family members, lack of companionship especially when spouse is dead, inadequate medical attention when sick, overweight as a

result of inactivity, declining health conditions, limited access to health care among others. These findings were in agreement with the opinion of Igbokwe and Asogwa (2010) who posited that the major causes of the seniors include physical decline and increased susceptibility to chronic long term diseases and disabilities thereby making many old persons passive and physically dependent to a reasonable extent. In Nigeria, poverty and poor infrastructural development which perpetrated rural communities where most elderly people reside constrain them from achieving good wellbeing. Study carried out by Animasahum and Chapman (2017) showed that most of the problems faced by the aged include physical and mental health, health care cost, financial security, bereavement, social isolation and loneliness.

The study also revealed finance, shelter and environmental challenges in the rural areas of Enugu east local government, Enugu state. The challenges include loss of financial freedom, financial abuse from children, lack of financial support from children, inadequate pension, problem of good housing, unaffordability of housing, social isolation among others. These findings were in agreement with the opinion of Sonye and Bamson (2012) stated that the major cause of challenges for seniors are low pension, huge family financial demand and lack of financial support from family members. In the study carried by Amune, Adenojie and Obiyam (2015) retirement from work often create a lot of problems for the elderly citizen. These problems range from sudden loss of income, financial insufficiency and anxiety, deteriorating health conditions among others.

The results of this study also identified family support and non-family support options for the aged in rural areas of Enugu east local government which can help to improve their wellbeing which include engaging in moderate exercise, avoiding smoking, not drinking alcohol in excess, avoiding sedimentary lifestyle, avoiding sexual recklessness, maintaining a normal weight, having good medical attention free medical to be provided by the government, free transport services among others. these findings confirmed the report of Ali (2014) who suggested that the economics of healthcare in old age such as good eating plan, self-care programme, acquisition of medical kits (blood pressure machine and glucometer) can aid the proper management of health during retirement.Qualls and Abeles in Amune, Aidenojie and Obanyan (2015) discovered that old age challenges can be surmounted by engaging in different activities such as volunteer work, exercise and continuing education. the study by Kalton (2018) posited that aged should be encouraged to engage in physical activities like walking, clapping hands, to stimulate blood flow, according to him physical activities improves the quality of sleep, builds stamina and can relieve depression. According to him, positive view of life can help to alleviate some of the medical issues that aged face such as cognitive decline and stress, lack of energy and appetite.

The study carried out by Garry (2019) suggests that adults in adapting as they age can achieve the greatest

level of wellbeing by preserving and maintaining their existing sense of self, relationship and ways of doing things. According to Okunola (2002) there should be suitable transportation services for the elderly to facilitate access to shops, keep appointment with doctors. Study carried out by Oladeji (2011) revealed that family care, social services and living arrangement can influence psychological wellbeing of the aged.

On the implication for Home economics and home economics practitioners for the wellbeing of the aged, the study stated that Home economics practitioners can organize talk, seminars to the rural people on how to care for the elderly, they can establish old people's home, for the aged, they can serve as an advisory body to law makers to make policies aimed at enhancing the wellbeing of the aged among others. This is in line with the opinion of Fausset, Kelly, Rogers and Fisk (2011) which states that Home economics practitioners should take action and advocate to government, industry and the community in order to enhance the wellbeing of individuals, and families especially as it relates to food and nutrition and living environment. According to them Home economics practitioners should develop nutritionally balance menus for a range of community settings including aged care centers, retirement village and institutional care. They should also manage food service operations in the community for example childcare centres, aged care centres. Practitioners of Home economics can work with frail old people and their family careers to develop quality cost effective support service that reduce demand on staff while providing benefits to users. According to them, practitioners should focus on policies and practices that support individuals and family wellbeing.

Conclusion

The aged in the rural areas of Enugu east local government of Enugu state are encountering lot of challenges. It was found that abandonment by children, maltreatment and neglect from family members, lack of companionship especially when spouse is dead, inadequate medical attention when sick, overweight as a result of inactivity, declining health condition among others are some of the relationship, personal care and health challenges faced by the aged in rural areas of Enugu east local government area of Enugu state. The study also found out that the aged in rural areas of Enugu east have finance, shelter and environmental related challenges which include loss of financial freedom, financial abuse from children, inadequate pension, delayed pension, problem of good housing among others. The study also established both family and non-family support options for the aged in rural areas of Enugu east local government which include engaging them in moderate exercise, socializing with others, having good medical attention, staying mentally active, complying with medical advice, adopting good safety habit, establishing of age friendly facilities such as lunch club by the communities, among others. It was established that home economics practitioners can serve as an advisory body to law makers to make policies

aimed at enhancing the wellbeing of the aged, establishing old people's home who need it among others.

Recommendation

Based on the finding of the study, the following recommendations were made.

1. Home economics practitioners can organize talk, seminar to the rural people on how to take care of the aged.
2. Home economics and its practitioners can serve as an advisory body to law makers to make policies aimed at enhancing the wellbeing of the aged.
3. Old people's home should be established by government, churches, and homes economics practitioners for people who need it.
4. Government should provide social securities to the aged to help alleviate their challenges.
5. Religious organizations and NGOs should offer support to the aged to help alleviate some of their challenges
6. Government should establish supportive age friendly facilities such as lunch club, old people's forum etc for the aged.
7. Communities should establish age friendly facilities like lunch club for the aged.
8. Communities should exempt the aged from paying levies and other dues to help them.

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Availability of Facilities and Utilization of Instructional Procedures for Implementation of Chemistry Core Curriculum in Senior Secondary Schools in Ebonyi State

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Abstract

This study investigated availability of teaching facilities and utilization of instructional procedures for implementation of Chemistry core curriculum (CCC) in senior secondary schools (SSS) in Ebonyi State. Specifically,it determined level of availability of stipulated facilities and extent of utilization of instructional procedures by teachers for implementation of CCC in SSS in Ebonyi State. Design of the study was descriptive survey. Population was made up of all 216 senior secondary schools in Ebonyi State. Proportionate random sampling was used to draw a sample of 120 schools. Chemistry teachers and laboratory attendants participated in the study. Instruments for data collection were checklist and questionnaire. Results show that good examination halls, chalk board and classrooms were 100% very highly available, standard Chemistry laboratory(16%), projector(16%), chemicals and reagents(14%), water and electricity(33% each) were lowly available. Utilization of lecture and laboratory instructional procedures (IP) was of a very high extent with a mean of 3.78 and 3.70 respectively, activity based IP 2.98 and project IP has a mean of 2.73. Analogy and programmed IPs were very lowly utilized with a mean of 1.20 and 1.08 respectively. The study recommended among others, that government should make available teaching and learning facilities as stipulated in CCC to secondary schools for better achievement and implementation of the curriculum.

Keywords: Curriculum, Chemistry, Implementation, Availability, Utilization, Facilities, Instructional, Procedures.

Introduction

Chemistry is one of the science subjects offered in the Senior Secondary Schools (SSS) in Nigeria. It has beendefined as the study of matter and its interaction with other matter and energy (Helmenstine 2020). There are organic, inorganic, physical, analytical, industrial biochemistry. It has grown from the areas of polymer, environmental and medicinal to pesticide, forensic,computer Chemistry among others. These are important areas and aspects of life. Chemistry is a central subject required at Senior Secondary School Certificate (SSSC) level for entry into nearly all basic and applied science courses at the tertiary level of education in Nigeria, hence the serious concern for appropriate implementation of the SSS Chemistry Core Curriculum (CCC). Curriculum is

a planned sequence of learning experiences, mapped out for students to enable them achieve proficiency in knowledge, values and skills. It determines what is taught by teachers, learned by students and how these are achieved. Mulenga (2019) defined curriculum as embodying the intentions of education. It carries the beliefs, values, attitudes, skills, knowledge and all that education is about. Selvan (2021) observed thatcurriculum is the heart of education. It is the plan or a blueprint of everything that is supposed to happen inside the school. The State of Rhodes Island (2023), opined that the structure, organization and considerations in a curriculum are created in order to enhance learning and facilitate instruction. Like other SSS subjects, CCC according to Federal Ministry of Education (2007) is structured as a 3-year program for Senior Secondary School Students (SSSS). CCC stipulates the goals and objectives of Chemistry education. It also contains the content areas taught to all SSS students, the instructional material used in teaching the contents, the expected ratio of teacher to students in the class, the facilities, instructional procedures for teaching Chemistry and the assessment tools for evaluating students' outcomes. On facilities, a lot of them were listed in the CCC to be made available for the learning of Chemistry in every school in Nigeria. They are: standard and well equipped laboratories with preparatory rooms, chemicals and reagents, well equipped library, regular running taps and electricity supply, among other things. The Instructional procedures stipulated are: activity based, concept mapping, inquiry, laboratory teaching, Simulation and games among many others listed in the result of this study. The CCC focused on practical activities with emphasis on locally available materials for its effective implementation.

Curriculum implementation according to Selvan (2021) is the act of working out the plans and suggestions that have been made by curriculum specialists and subject experts in a classroom or school setting. Selvan opined that teachers are the main implementers of the curriculum There can never be proper implementation of curriculum without due consideration to the learners; how they acquire the skills stated in the objectives, the extent of acquisition, the environment in terms of availability of facilities for learning and the qualified teachers to implement the program and utilization of the right teaching methods by teachers. Appropriate teaching method brings instruction to real life experience while encouraging students to actively engage with content and develop their knowledge and skills. On curriculum implementation in Ebonyi State, Anugwo et al (2023), reported that public school pupils and their parents are bearing the brunt of deplorable classrooms and a shortage of teachers as the state government neglects basic education. Most of the schools in Ebonyi State are reported to be overcrowded, have leaking roofs, dilapidated libraries, toilets and absence of seats and desks for pupils. These reports however need to be verified. Still on the implementation of the Core Curriculum (CC) in Ebonyi State Secondary Schools, Nwakpa (2010) earlier in his study found that

there was inadequate provision of human and material resources, no fire extinguisher and gross inadequate provision of toilet facilities in the schools. Nwakpa reported that while Government recommended one toilet to 40 students (1:40), many schools do not have adequate number of toilets. Teachers occupy uncomfortable offices and in a deplorable condition. The report also noted that Ebonyi State secondary schools have good libraries and classrooms, but the classrooms are overcrowded and there are not enough qualified teachers. These situations caused poor academic achievement of students in public examinations (Nwakpa 2010). Also the study of Anugwo, et al (2022) on the level of implementation of CCC in Ebonyi State reported that although the schools teach approved contents, they made very low use of instructional materials and evaluation procedures by teachers, with reference to the CCC.

Availability and utilization of facilities in schools are so important in teaching and learning as they assist teachers in effective delivery of lessons to the students. Babalola (2023) opined that quality education requires quality infrastructure, excellent and well remunerated teachers and planning, among other things. Bediako (2019) also observed that when facilities are not provided, it implementation of the curriculum is hinderer. The West African Examination Council's Chief Examiners' Report (2022) attested to the poor achievement of students in Chemistry over the years. According to Nbina (2012), the widespread of poor performance and the negative attitude in Chemistry by SSSS have been largely ascribed to teaching problems.

Curriculum implementation requires teachers to feel confident in the delivery procedures and materials they use (Nevenglosky, et al 2019). Aung & Khaing (2016),observed that the salient challenges on implementation of curriculum in the developing countries including Nigeria include the lack of relevant curriculum, lack of infrastructure, lack of ICT knowledge, weakness of content development, educators, among other things. The extent to which poor performance of students in Chemistry in Ebonyi state is attributable to the level of implementation of the curriculum remains questionable. This is a gap this study intends to fill.

Purpose of the Study

The general purpose of this study was to investigate the availability of teaching facilities and utilization of instructional procedures for implementation of Chemistry Core Curriculum (CCC) in senior secondary schools (SSS) in Ebonyi State of Nigeria. Specifically, the study determined:

1. level of availability of stipulated facilities for implementation of CCC in SSS
2. extent of utilization of stipulated instructional procedures for implementation of CCC in SSS in Ebonyi State.

Research Questions: The following research questions guided the study:

1. What is the level of availability of stipulated facilities for implementation of CCC in SSS in Ebonyi State.

2. To what extent are stipulated instructional procedures utilized by Chemistry teachers for the implementation of CCC in SSS in Ebonyi State.

Methodology

***Design of the Study*:** The design of the study was the descriptive survey research design.

***Area of the Study*:** The study was conducted in Ebonyi State of Nigeria. It has three education Zones and 216 senior secondary schools. (Secondary Education Board Abakaliki 2023/2024Academic Session). Ebonyi State is generally regarded as an educationally disadvantaged State.

***Population of the Study*:** The population of the study was all the 216 senior secondary schools (SSS) in Ebonyi State, distributed in the three education zones as follows: Abakaliki-68, Afikpo- 82 and Onueke-66. All the 124 Chemistry teachers (103 males and 21 females) and 228 laboratory attendants (107 males and 121 females) in the 216 secondary schools were all part of the implementation process in each school and were used in the study.

***Sample of the Study*:** The sample was 120 schools, stratified according to the three education zones in the state through proportionate random sampling; 37 schools were drawn from Abakaliki, Onueke 36 and Afikpo 45. Only schools that have laboratories and laboratory attendants were purposively sampled for the study. A total of 120 lab attendants and 120 Chemistry teachers in the sampled schools were used for the study.

***Instrument for Data Collection*:** The instruments for data collection were a checklist and a questionnaire developed from the Chemistry core curriculum (CCC).Section A of the checklist contained the name of school, gender and education zone. Section B has the list of all the instructional facilities stipulated in the CCC. The checklist focused on facilities available for implementation of the CCC in each school and also the number of students in each school. The 4-point scale questionnaire focused on 20 instructional procedures used in teaching Chemistry as stipulated in CCC. It had response options of: Very Often Used, Often Used, Rarely Used and Not Used At All.

The instruments were validated by three experts in relevant fields. It was trial tested in secondary schools in the neighboring Enugu State for reliability. Cronbach Alpha estimate of reliability was used to calculate the internal consistency of 0.78. Both the extent of availability of facilities and utilization of instructional procedures were later classified under the decision rule as: Very High level, High Level, Low Level and Very Low Level.

***Data Collection Methods*:** The checklist was used in the 120 schools sampled for the study by the researchers to collect data on facilities, with the help of laboratory assistants. On the extent of utilization, the researchers developed a scoring guide using the questionnaire with options: Very Often Used, Often Used, Rarely Used and Not Used At All. The Laboratory attendants were trained by the researchers on how to observe the Chemistry teachers when teaching the students. They rated their observations based on the number of times the Chemistry teachers used any

of the instructional procedures listed in the questionnaire. Teachers did not rate themselves to avoid all forms of bias emanating from them (like highly rating themselves even when they are far from being perfect). The observation lasted for a whole school term.

***Data Analysis Techniques*:** Percentage was used to analyze data on facilities.Facilities with percentage score of 70 percent and above wereregarded as "very high level" (VHL) of availability; 50 percent – 69 percent = "high level" (HL); score of 40 percent – 49 percent = "low level" (LL) and a score of 0 percent – 39 percent = "very low level" (VLL). The percentage scores were approximated to the nearest whole number.Mean ($\overline{X}$) and standard deviation were used to analyze data on teachers' utilization of instructional procedures."Very Often Used"(4);"Often Used" (3);"Rarely Used" (2); and "Not Used At All" (1). A mean score of 0 indicated Not Used at all (Decision Rule is Very Low Extent Utilization), 0.1 - 2.4 = Rarely Used (Low Extent Utilization), 2.5 – 3.4 = Often Used (High Extent Utilization) and 3.5 – 4.0 = Very Often Used (Very High Extent Utilization).

Results

Table 1: Percentage Rating on the Level of Availability of Stipulated Teaching Facilities for Implementation of Chemistry Core Curriculum in Senior Secondary Schools in Ebonyi State.

S/N	SFAC	SPSS	ANOF	NOSS	FASR	CCC&	D
1	Standard & well-equipped Chemistry laboratory	1:50	100	32100	1:321	16%	VLL
2	Standard preparatory room in Chemistry laboratory	1:1	45	120	1:3	33%	VLL
3	standard dark room in Chemistry laboratory	1:1	45	120	1:3	33%	VLL
4	Standard preparatory tables in Chemistry laboratory	2:1	90	120	2:3	33%	VLL
5	Chemistry laboratory store	1:1	45	120	1:3	33%	VLL
6	Appropriate chemicals and reagents for Chemistry practical in Chemistry laboratory	1:5	900	32100	1:36	14%	VLL
7	Well-equipped library with appropriate and recommended Chemistry texts.	1:1	90	120	1: 13	76%	VHL
8	Adequate and sizable examination hall.	1:1	120	120	1: 1	100%	VHL
9	Adequate classroom	1:50	650	32100	1:49.4	100%	VHL
10	Chalk Board	1:50	650	32100	1:49.4	100%	VHL
11	White board	1:50	650	32100	1:49.4	100%	VHL
12	Projector	1:50	100	32100	1:49.4	100%	VHL
13	Projector screen board	1:50	100	32100	1:321	16%	VLL

Table 1 continued

14	Constant water system in Chemistry laboratory	1:1	40	32100	1:321	16%	VLL
15	Constant electricity power supply in Chemistry laboratory	1:1	45	120	1: 3	33%	VLL
	Cluster52.13%	**Mean**				**Percentage**	**HL**

S/N = Serial Number. SFAC = Stipulated Facilities. SPSS = Specification Per School or students as the case may be. ANOF = Available Number of Facility. NOSS = Number of Students or Schools as the case may be. FASR = Facility Availability Stipulated Ratio. %CCC = Percentage Compliance to Chemistry Core Curriculum. D= Decision, VHL = Very High Level, HL = High Level, LL = Low Level, VLL = Very Low Level

Table 1 shows that in the schools, the stipulated facilities in items 1 - 6, 12, 13 and 15 have percentage ratings of 16 , 33, 33, 33, 33, 14, 16, 16 and 33, respectively, indicating very low level availability of the itemized facilities with the specification of Chemistry core curriculum. These facilities, though available in some schools, have low percentage compliance to the Chemistry Core Curriculum. The result also showed that the stipulated facilities in items 7 -11 with 76%, 100%, 100%, 100%, 100% respectively were available and had high percentage compliance to CCC. The cluster mean percentage of 52.13% in research question one indicated that the availability of the approved teaching facilities for the teaching of Chemistry in senior secondary schools in Ebonyi State is to a high level.

Table 2: Mean Response and Standard Deviation of Teachers' Utilization of Stipulated Instructional Procedures for the Implementation of Chemistry Core Curriculum

SN	Instructional Procedures	Mean	SD	Decision
1	Activity based teaching	2.98	0.57	HE
2	Concept mapping	1.43	0.56	VLE
3	Inquiry Teaching	2.52	0.50	HE
4	Laboratory Teaching	3.70	0.46	VHE
5	Analogy instructional Procedure	1.20	0.40	VLE
6	Programmed instructional Procedure	1.08	0.28	VLE
7	Team teaching	1.80	0.40	LE
8	Role playing instructional Procedure	1.05	0.22	VLE
9	Simulation and games	1.07	0.25	VLE
10	Guided discovery instructional Procedure	2.30	0.46	LE
11	Scaffolding teaching Procedure	2.52	0.50	HE
12	Cooperative teaching Procedure	2.07	0.31	LE
13	Excursion/ field trip teaching	1.67	0.48	LE
14	Lecture method of teaching	3.78	0.42	VHE
15	Project teaching Procedure	2.73	0.45	HE
16	Demonstration Teaching Procedure	3.92	0.28	VHE
17	Discovery Teaching Procedure	2.47	0.50	LE

Table 2 continued

18	Individualized Teaching Procedure	1.52	0.50	LE
19	Peer tutoring instructional Procedure	2.22	0.42	LE
20	Discussion Teaching Procedure	3.43	0.59	HE
Cluster Grand Mean		**2.273**		**LE**

SN = Serial Number. SD = Standard Deviation. VHE = Very High Extent, HE = High Extent, LE = Low Extent, VLE = Very Low Extent.

Table 2 shows that the extent of utilization of the stipulated instructional procedures by Chemistry teachers (as observed by the Lab Attendants) in the schools, for the implementation of the Chemistry core curriculum, is to a low extent. Items 1, 3, 11, 15 and 20 have mean ratings of 2.98, 2.52, 2.52, 2.73 and 3.43 respectively which indicate high extent utilization of these instructional procedures. Items 4, 14 and 16 have the mean ratings of 3.70, 3.78 and 3.92 respectively indicating a very high extent utilization of the itemized instructional procedures while items 2, 5 - 10, 12, 13, 17 - 19 have mean ratings of 1.43, 1.20, 1.08, 1.80, 1.05, 1.07, 2.30, 2.07, 1.67, 1.52 and 2.22 respectively for the listed instructional procedures and to a very low extent of utilization. The grand mean of 2.273 indicated a low percentage utilization of the stipulated instructional procedures in the senior secondary schools in Ebonyi State..

Discussion

The results of data analysis revealed the information from the schools on the availability of stipulated facilities and also the utilization of instructional procedures in the implementation of Chemistry core curriculum (CCC) in Ebonyi State Secondary schools. The result revealed that there is 52.13% CCC compliance of the available facilities. This means that there is high level availability of learning facilities in secondary schools for teaching and learning Chemistry. From the result, most schools have good examination halls because part of the implementation process requires the visitation of schools from the Ministry of Education team for the inspection of the examination halls. This is the main reason for 100% availability, indicating that every school has a good examination hall. They also have chalk and white boards for writing during teaching. They have libraries, running water in the laboratories. This is in agreement with Nwakpa (2010)'s study. They are good and enhance proper curriculum implementation. However, more facilities are needed for effective implementation of secondary school Chemistry core curriculum. Result showed that there is a very low level availability of standard and well equipped laboratory, chemicals and reagents for Chemistry practical and very low level availability of electricity supply in the schools studied. Bandao (2023) found the current status on the availability of facilities in the Junior High School of Zeneben (Philippines) Integrated School in the first semester of the school year 2022/2023. They found that the physical facilities are generally in good condition and their performance was found in totality to be very satisfactory. This means that

when infrastructural facilities are available in schools, achievements of students are enhanced. Afework and Asfaw (2014) also asserted that significant change in behavior among students cannot take place without the availability and proper use of school facilities and other needed resources. Also the findings of Olelewe & Nzeadibe (2015) in support of the result of the study said that, there was gross inadequacy of material resources in Nigerian secondary schools and this affected the quality of education given to pupils. Igwe (2015) also pointed out that public secondary schools have witnessed great decay in terms of facilities. To Igwe, most schools are a caricature of what schools should be in a modern state because of collapsed buildings, leaking roofs, unkempt surroundings, lack of public toilets, water supply and other facilities. Lack of these facilities will not perfect the implementation process it will rather enhance poor academic achievement. These are basic requirements for the effective implementation of the curriculum. Absence of these facilities is the cause of the poor achievement of Ebonyi State SS students in Chemistry as reported by the WAEC Chief Examiners' Report because availability of these facilities enhances achievement of students. As reported by Andrews (2019), the quality of school facilities affect students in two ways; firstly, a lack of facilities limits the ability of a student to achieve various learning and extra curricula activities. Secondly, a lack of facilities has a negative impact on a teachers' job satisfaction, which undermines their motivation to teach. Octavia, Ismiyati & Sholikan (2019), agreed that school facility is one of the factors supporting students' learning achievement and teacher performance. Therefore learning achievements and school quality can be improved through availability of school facilities.

The findings of research question 2 revealed that, there is low extent utilization of the specified instructional procedures in the secondary Chemistry core curriculum in Nigeria. The findings reported that teachers mostly use Lecture method of teaching in their day to day teaching of students, at the expense of other specified instructional procedures designed for each topic. Pooja (2017) opined that for effective teaching to take place, a good method must be adopted by the teacher. Pooja agreed that teachers often use techniques which take care of multiple learning styles.Also according to Sumera & Mustaq (2017), the recommended teaching procedures were based on curricular provision considering the learner, nature of topic, instructional objectives, instructional settingand resources available.The teaching of Chemistry as science subject requires the use of laboratory teaching and demonstration procedures, concept mapping, project methods and problem solving if the teachers should make meaningful impact in the teaching and learning process. However, the aforementioned teaching procedures were rarely employed by teachers in teaching and learning of Chemistry according to the result. The Chemistry teachers do not use the teaching procedures specified in the curriculum according to topic or content. For example: In Chemistry, topics that

involve collection of gases require laboratory and demonstration method of teaching but most teachers use lecture method. This could make the process unproductive in terms of objectives and goals achievements. According to School Dekho (2023), poor teaching can have a profound effect on a student's academic performance. For one, students who are exposed to poor teaching may not understand the subject matter; leading to lower grades and test scores. They may also lose interest in learning, become disengaged and eventually drop out of school. Khan & Soumya (2016), asserted that superior instructional procedures stimulate students to study and perform at least as expected, while poor teaching unmotivated them which catalyze the process of diminishing interest on the topic. Bilal, Nikulina &Gao (2023) informed that use of appropriate teaching method is important because they determine the practices, approaches and materials used by instructors. Utilization of adequate teaching methods in teaching is essential for effective language learning, students' motivation, quality assessment and personalized instruction. Teachers are therefore encouraged to maximize the teaching process by the use of good teaching methods.

Conclusion

Facilities for effective implementation of the Chemistry core curriculum in senior secondary schools in Ebonyi State are highly available except good preparatory laboratories, standard Chemistry preparatory stores, electricity supply, projector, chemicals and reagents that are of very low level of availability. Non availability of basic facilities for the implementation process affects teaching and learning. It should not be encouraged. Teachers utilize mostly lecture and laboratory methods at the expense of other teaching methods specified in the curriculum like project, problem solving, demonstration, concept mapping, etc. This will inhibit achievement. Hands-on and innovative instructional procedures like project, program instructional procedure, team teaching, cooperative teaching and excursions/field trips be used in teaching Chemistry. This will make the implementation process perfect and done with fidelity.

Recommendation

The following recommendations were made on this study:

1. Government should make all instructional facilities stipulated in the Chemistry Core curriculum available to secondary schools for effective implementation of the (CC).
2. Teachers should utilize instructional procedures like role playing. Simulation/games, scaffolding, guided discovery, peer tutoring, discussions and other learner friendly instructional procedures in teaching, instead of only the conventional methods.
3. Teachers should be exposed to the use of the right instructional procedures as stipulated in the CC for teaching chemistry, through seminars, workshops and other educational programs.

4. Government should not only design good curriculum but should ensure its effective implementation.
5. Governments are encouraged to use experts in evaluating the implementation of all education programs from time to time.

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In-Service Training Needs of Staff in Hospitality Industry in Nsukka, Enugu State

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Abstract

The general purpose of the study was to evolve the in-service training needs of hospitality industry staff in Nsukka, Enugu State. Specifically, the study determined the in-service training needs of staff in food and beverages, lodging, recreational, travel and tourism sections of the industry. The study adopted survey research design. Population was made up of 265 persons consisting of 82 staff in food/beverage, 102 staff in lodging, 21 staff in the recreation and 60 staff in the travel/tourism sections of the industry. Data were collected using questionnaire. Data were analyzed using weighted mean and improvement need index. Findings reveals that food and beverage staff need in-service training in 11 areas including,ability to: generate an attitude of trust among co-workers ($\bar{X}$= 0.72) and others.Lodging staff need in-service training in 13 areas including, ability to: work as part of a team ($\bar{X}$= 0.86), and others. Recreation staff need in-service training in 13 areasincluding, ability to: observe teamwork, cooperation and maximum support ($\bar{X}$= 0.94), and others; while travel/tourism staff need in-service training in 12 areas which include, ability to: show good communication and language proficiency ($\bar{X}$= 0.90), delivery information commentary ($\bar{X}$= 0.79) and so on. Based on the findings of the study, it was recommended among others that restaurant owners should provide funds for in-service training of their staff in areas where they are deficient to enhance customer patronage which in turn leads to higher profit.

Keywords: In-service, Training, Hospitality, Industry, Needs, Staff, Satisfaction, Customer, Performance.

Introduction

Hospitality refers to friendly receptionand entertainment of guests, visitors or strangers. Hospitality involves making guests and visitors feel welcome and happy through service industry that includes lodging, event planning, theme parks, and transportation, (Robert 2016).Hospitality involves the relationship between hosts and guests in all domains, domestic and commercial as well as their cultural settings (Blain & Lashley, 2014). Sheila*et al* (2018) also observed that hospitality is the act of kindness in welcoming and looking after the basic needs of guests or strangers, mainly in relation to food, drink and accommodation. It is a fundamental and ubiquitous feature of human life which entails making visitors or guests feel welcome and at home. Hospitality industry encompasses companies or

organizations or establishments which provide lodging, food, drink, event planning, accommodation or a combination of these services majorly for people away from their homes. It is one of the fastest growing sectors of the economy. The industry is diverse enough for people to work in different segments of interest, these segments include food and beverages, lodging, recreation, travels and tourisms.

The food and beverage industry is a company that involves in processing raw food materials, packaging and distributing them. According to Batinić (2013), food and beverage industry includes restaurants, taverns, grills, pizzerias, bistros, fast food facilities, patisseries, catering and canteens. In the opinion of Kukoyi and Iwuagwu (2015), the food and beverage industry play a significant role in the economic development of countries. According to Popova (2018), food & beverage is a term the hospitality industry uses to refer to all food andbeverage needs for an event, dining experience or general catering. Occasionally, the food industry like restaurants can situated in the lodging/accommodation industry.

Lodging commonly known as accommodation refers to a place to sleep for one or more nights. A business in the lodgingindustry provides a place for people to sleep overnight. According to Popova (2018), the lodging industry provides accommodation (and usually food and drink) topeople who for whatever reason are away from home. According to Tesone and Ricci (2012), the most common example of lodging industry are hotels which provide meals, drinks, attractions, accommodation etc., to the general public or persons in transit especially people travelling to places where they have neither their own homes or any relation to cater for their needs. Those who are lodged away from home could also need a form of recreation.

Recreation is any activity done for rest, relaxation, and enjoyment. In the opinion of Popova (2018), a major aim of recreation is to take time away from stressful activities and refresh aperson's body and mind. According to Batinić (2013), businesses that provide series of activities for rest, relaxation, and enjoyment in order torefresh a person's body and mind is in the recreation business.The author further opined that recreation businesses are incredibly diversebecause individuals have varying ideas on what activities they participate in for rest, relaxation and enjoyment. Popova (2018) further posited that four general types of recreation businesses exist namely:entertainment, attractions, spectator sports, and participatorysports. Usually, the service method with which service in hospitality industry is rendered determines if the customer will be satisfied or not.Asides the recreation industry, the travel industry is also an important part of the hospitality industry.

Travel involves going from one place to another, typically over a distance of some length. According to Medlik (2013), tourism means travelling for pleasure and spending at least one night in a different place, and it tends to be synonymous with holidays. According to Popova (2018), the travel industry is in the business of moving people from place to place while the

tourism industry providesthose people with services that promote travel and vacations (Popova, 2018). The author further opined that planes,cabs, boats, and trainsare all part of the travel industry while travel agencies, tour operators, cruisecompanies and convention planners are all part of the tourism industry. The travel/tourism sector as well as other sectors of the hospitality industry all aim to provide customer satisfaction.

Satisfaction of customer is paramount in the hospitality industry. Customer satisfaction refers to contentment on the part of the buyer of a good or service. In most hospitality industries, many of its current and future challenges in relation to customer satisfaction has to do with human resource issues (Samart, 2014). In line with this, Bilgihan, Peng and Kandampully (2014) stated that the greatest challenge facing hospitality industry today is the inadequate investment in staff training and delivery. According to Hvass and Munar (2012), shortages of skilled employees at all hierarchical levels including management have been reported throughout the food industry in many areas. Hvass and Munar (2012) further posited that the major reason for shortage of skilled employees in the food industry is lack of competency test before employing workers as well as poor assessment of training needs of existing hospitality industries workers needed for the present and the future.

Training is the process of imparting and acquiring skills. Before training hospitality staff, their needs have to be ascertained so as to identify areas they should be trained in. According to Akani (2014), training needs are identified differences between the employees' current performance and the performance that the organization expects of them. In the opinion of McGehee and Thayer (2011), training needs come from under-developed skills, insufficient knowledge or inappropriate worker attitudes. To prevent skill shortages in hospitality industries, there is need for training needs assessment in the work place. Training needs assessment refers to the organizational process of collecting and analyzing data that supports decision making about what type of training and the time of training which is the best option to improve individuals, define who should be trained and exactly what content (Blain & Lashley, 2014). Lack of in-service training has led to the deplorable state of the hospitality industry in many areas in Nigeria and this includes Nsukka. Unfortunately, there is a paucity of information in this regard as little to no evidences exist of the in-service training needs of hospitality industry staff in the area. This is a gap which this study sought to bridge.

Purpose of the Study

The main purpose of the study was to investigate the in-service training needs of staff in hospitality industry in Nsukka. Specifically, the study determines the in-service training needs of hospitality staff in Nsukka in the following areas;

1. food and beverages
2. lodging
3. recreational
4. travel and tourism

Research Questions

The following research questions guided the study;

What are the in-service training needs of staff of the hospitality industry in Nsukkain:

1. food and beverages?
2. lodging?
3. recreational?
4. travel and tourism?

Methodology

***Design of the Study*:** The study adopted a survey research design.

Area of the Study: The area of the study was Nsukka local government area, Enugu State. Nsukka is a town located in Enugu State, South-Eastern Nigeria. It is the location of university of Nigeria.There are many restaurants, hotels and recreational centers which are part of the hospitality industry. The area was chosen due to lack of in-service training programmes for hospitality industry in the local government area.

Population for the Study: The population for the study was made of 265 persons.These included 82 staff in food/beverage (32 males and 50 females). 102 staff in lodging section (40 males and 62 females), 21 staff (18 males and 3 females) in recreation and, 60 staff in travel/tourism section (59 males and 1 female). The age bracket of staff is between 23 –55 years. Highest educational qualification is first university degree certificate mainly for managers, while other categories of staff had senior secondary school SSS) certificate and diploma/National certificate of Education (NCE). The entire population was studied due to the manageable size of the population. In total, managers were 29 in number and 236 other staff which sum up to 265 as a population. Numbers per sections of industry include: 10 of food and beverage; 10 of lodging, 4 of recreational, and 5 of travel sections, all within Nsukka Local Government Area, Enugu State.

Instrument for Data Collection: A structured questionnaire was used to collect data. The instrument was divided into two major parts: I and II. Part I obtained information on demographic data of the respondents, while part II was further sub-divided into clusters A, B, C and D based on the specific purposes. Clusters A – D have response options divided into 2 parts of four columns each. The first four columns contained the "importance" option which had four response options of HI - Highly Important; AI - Averagely Important; SI - Slightly Important and NI - Not Important with values of 4, 3, 2, and 1 respectively. The "Needed" section solicited information from hospitality on the training needs of hospitality industry staff to ensure customer satisfaction. The last four columns contained the "Performance" option which indicated the level to which the hospitality industry staff could perform the training activities and had response options of High Performance (HP), Moderately Performance (MP), Slight Performance (SP) and No Performance (NP) with values of 4, 3, 2, and 1 respectively. The "performance" section would be filled by the other hospitality industry workers asides the managers. The instrument was subjected to face validation by three university experts in Hospitality management education.A

reliability coefficient of 0.76 was obtained.

***Data Collection Technique*:**A total of 265 copies of the questionnaire was administered by personal contact to respondents with the help of four trained research assistants. Out of the 265 copies of questionnaire distributed, 197 copies were retrieved. These included,61 food and beverage staff,75 lodging staff, 15 recreation staff and 46 travel staff.These yielded a return rate of 74 percent.

Data Analysis Technique: Data were analysed using weighted mean and improvement need index as developed by Olaitan and Ndomi (2000). Firstly, to determine the training needs of restaurant staff, the weighted mean of each item under the "Important skill" option ($\overline{X}_1$) was calculated. Secondly, the weighted mean of each item under the "Performance" option ($\overline{X}_2$) was calculated. Thirdly, the difference between the two weighted means of each item ($\overline{X}_1$ – $\overline{X}_2$) was also calculated. In interpreting the results, when the difference is zero (0) for each item, there was no need for in-service training because the level at which the item was needed as indicated by the weighted mean was equal to the level at which the hospitality industry staff could perform the particular task. Where the difference is positive (+) for any item, it indicated that there was need for in-service training because the level at which that item was needed was higher than the level the hospitality industry staff could perform the activity. Where the difference is negative (-) for any item, there was no need for in-service training because the level at which that item was needed was lower than the level the hospitality industry staff could perform the activity.

Results

Table 1: Mean Responses on In- Service Training (skills) Needs of Food and Beverage Sector Staff

S/N	Food and Beverage Sector Skills	$\overline{X}_1$	$\overline{X}_2$	$\overline{X}_3$	R
	Ability to:				
1	convey the exact choice of customer to the kitchen department	3.87	3.91	-0.04	ITNN
2	anticipate guest wants and needs so as to provide service	3.51	3.68	-0.17	ITNN
3	set up the dining room in time	3.64	3.49	0.15	ITN
4	make inventory tracking and stock rotation	3.80	2.51	-0.14	1TNN
5	develop Empathy and active listening skills	3.91	3.27	0.64	ITN
6	generate an attitude of trust among co-workers	3.79	3.07	0.72	ITN
7	handle complaints and needs professionally	3.53	2.08	1.45	ITN
8	develop courtesy and positive attitudes while interacting with guests.	3.50	3.85	-0.35	ITNN
9	handle cash and credit transaction	3.88	3.37	0.51	ITN
10	perform improved serving techniques such as beverage presentation to enhance dining experience.	3.76	3.91	-0.15	ITNN
11	develop skill in wine tasting, pairing suggestions and beverage service protocols	3.78	3.01	0.77	ITN
12	take orders and deliver food on time	3.63	3.55	0.08	ITN

Table 1 continued

13	process payment without compromising accuracy or	3.95	2.65	1.30	ITN
14	quality	3.94	2.64	1.29	ITN
15	plan menu and pricing	3.95	2.65	1.30	ITN
16	Serve nutritional composition of various foods	3.54	2.07	1.47	ITN
	Provide preferred orders to customers				

N (Population) = **82**; $\bar{X}_1$= Mean of important skills Segment filled by restaurant managers; $\bar{X}_2$= Mean of Performance segment filled by other restaurant workers; $\bar{X}_3$= ($\bar{X}_1$-$\bar{X}_2$) the Performance Gap; ITN = In-service Training Needed; ITNN = In-service Training Not Needed, R = Remark.

Table 1 reveals that 11 out of 16 items or areas had performance gap values ranged from 0.08 to 1.47 and were positive.This is indicating that the food and beverage staff need in-service training in those 11 areas or items. The remaining five items had negative and zero performance gaps of - 0.04, -0.17, -0.14, -0.35 and -0.15 indicating that the food and beverage do not need in-service training in those items.

Table 2: Mean Responses on In- Service Training Needs of Lodging Sector Staff

S/N	Lodging Sector Skills	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	R
	Ability to:				
1	groom and make professional image standards	3.66	3.66	0.00	ITNN
2	observe guest services standard	3.97	3.18	0.79	ITN
3	Show respect to every customer including the naughty ones	3.53	3.59	-0.06	ITNN
4	manage business ethics	3.63	3.27	0.36	ITN
5	make bed, handle luggage and serve the table effectively.	3.79	3.07	0.72	ITN
6	organize task efficiently and carry them out				
7	without delay.	3.87	2.85	1.02	ITN
	handle cash and credit transaction.	3.88	3.37	0.51	ITN
8	maintain physical wellbeing through stretching exercise and proper lifting techniques.	3.26	3.27	-0.01	ITNN
9	work as part of a team	3.16	2.30	0.86	ITN
10	listen, verbal and written communication skills	3.84	3.00	0.84	ITN
11	project a professional image	3.72	3.05	0.67	ITN
12	empathize with the guest experience	3.73	2.65	1.08	ITN
13	develop stress management	3.82	3.08	1.00	ITN
14	use card to open hotel door	3.14	2.29	0.85	ITN
15	interact with customers	3.26	3.28	-0.02	ITNN
16	operate lifters to check to different rooms	3.24	3.25	-0.01	ITNN
17	use automatic washing machine	3.83	2.99	0.84	ITN
18	use new gadgets	3.16	2.30	0.86	ITN

Key: N (Population) = **102**; $\bar{X}_1$= Mean of Important skills Segment filled by hotel managers; $\bar{X}_2$= Mean of Performance segment filled by other hotel workers; $\bar{X}_3$= ($\bar{X}_1$-$\bar{X}_2$) the Performance Gap; ITN = In-service Training Needed; ITNN = In-service Training Not Needed; R =Remark.

Table 2 reveals that 13 out of 18 items had performance gap values ranged from 0.36 to 1.08 and were positive.This an indication that the lodging staff need in-service training in those 13 areas/items. The remaining five items had negative and zero performance gaps of 0.00, -0.06, -0.01, -0.02, and -0.01 indicating that the lodging staff do not need in-service training in those items.

Table 3: Mean Responses on In- Service Training Needs of Recreational Sector Staff

S/N	Recreational Sector Skill	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	R
	Ability to:				
1	provide and organize recreational events like sports and outdoor excursion event.	3.72	3.58	0.14	ITN
2	identify potential risks related with recreational activities.	3.17	2.18	0.99	ITN
3	implement safety protocols and how to respond to emergencies.	3.78	2.49	1.29	ITN
4	promote environmental sustainability like waste reduction and energy conservation.	3.06	2.27	0.79	ITN
5	show empathy and active listening skills.	3.87	3.07	0.80	ITN
6	have communication skills and ability to maintain good rapport with participants.	3.30	1.85	1.45	ITN
7	develop customer-centered mindset like friendliness and Hospitality.	3.76	3.27	0.49	ITN
8	observe teamwork, cooperation and maximum Support	3.24	2.30	0.94	ITN
9	develop conflict management	2.73	2.20	0.36	ITN
10	handle first aid treatment and emergency responses.	3.61	3.20	0.41	ITN
11	operate recreational equipment and facilities.	2.15	1.66	1.49	ITN
12	lead and facilitate different recreational activities.	3.73	2.65	1.08	ITN
13	maintain and store recreational equipment	2.92	2.43	1.00	ITN

Key: N(Population) = 21; $\bar{X}_1$= Mean of Important Skills Segment filled by recreation centre managers; $\bar{X}_2$= Mean of Performance segment filled by other recreation centre workers; ; $\bar{X}_3$= ($\bar{X}_1$-$\bar{X}_2$) the Performance Gap; ITN = In-service Training Needed; ITNN = In-service Training Not Needed, R = Remark.

Table 3 reveals that all13 items had performance gap values ranged from 0.14 to 1.49 and were positive.This implies that the recreation staff need in-service training in all the 13 areas / items in the Table.

Table 4: Mean Responses on In- Service Training Needs of Travel and Tourism Sector Staff

S/N	Travel and Tourism Skills	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	R
	Ability to:				
1	understand local service attractions, historical sites and cultural landmarks.	3.97	3.80	0.17	ITN
2	understand logistical aspect of traveling like transport options and accommodation booking,	3.95	3.18	0.77	ITN
3	understand different cultures and their etiquettes.	3.74	2.49	1.25	ITN

Table 4 continued

4	understand laws and regulations governing traveling and tourisms activities.	3.84	3.27	0.57	ITN
5	understand social media engagement	2.42	3.21	1.08	ITN
6	develop friendship with passengers	3.30	2.07	1.23	ITN
7	show good communications and language proficiency	3.75	2.85	0.90	ITN
8	observe good cultural awareness and cultural				
9	sensitivity.	3.75	2.27	1.48	ITN
	develop stress management skills	2.90	1.90	2.23	ITN
10	lead tours and manage groups dynamics.	3.38	2.10	1.28	ITN
11	deliver informative commentary.	3.79	3.00	0.79	ITN
12	read map efficiently	3.17	2.81	0.36	ITN
13	handle online bookings and reservation software	2.66	3.21	-0.21	ITNN

Key: N (Population) = **60**; $\overline{X}_1$ = Mean of Important skills Segment filled by car park managers; $\overline{X}_2$ = Mean of Performance segment filled by other car park drivers; $\overline{X}_3 = (\overline{X}_1 - \overline{X}_2)$ the Performance Gap; ITN = In-service Training Needed; ITNN = In-service Training Not Needed; R = Remark.

Table 4 reveals that 12 out of 13 items had performance gap values ranged from 0.17 to 1.48 and were positive.This indicates that the travel staff needs in-service training in 12 items/areas in the Table. The remaining one item had negative performance gap of - 0.21 indicating thattravel and tourism staff do not need in-service training in the item.

Discussion

The findings of the study revealed food and beverage sector staff in the hospitality industry in the area of the study need in-service training in 11 out of the 16 items/areas identified in Table 1. The findings are in line with Milman and Ricci (2014) who found out that restaurant staff requires knowledge on how to set up the dining room in time. The findings are also in agreement with Kerry (2017) who found out that the in-service skill training needs of restaurant staff include; ability to develop empathy and active listening skills, ability to handle complaints and skills in anticipating guests wants and needs. The findings are in line with Popova (2018) that staff should have dining experience which entails setting up the dining room in time for customer satisfaction. The findings are also in agreement with Eze (2014) who found out that restaurant staff require knowledge of various foods nutritional composition and knowledge of basic terminologies used in the food industry. Hence, it is deduced that the identified items are the in-service training needs of food and beverage staff in Nsukka.

The findings also reveal that the lodging sector staff need in-service training in 13 out of the 18 areas identified in Table 2. Deficiency in these areas could be the reason for low customer satisfaction among lodging staff. The findings are consistent with those of Sommerville (2019) who found out that a major attitude required by hotel staff is training in taking personal pride in satisfying the needs of others and preference in helping others before

satisfying the needs of self. The findings support Tesone *et al* (2012) who found that managing stress improves work satisfaction. For an industry to excel and attract customers, staff needs to be trained on attitude to manage stress. Furthermore, the findings are with Subbarao (2018) who found out that the in-service training needs of hotel staff includes; Training in taking personal pride in satisfying the needs of others, attitude needed to work as part of a team over doing individualizedwork and training to ensure preference for challenging work over regimented work.

The findings of the study further reveal that the recreation staff in the hospitality industry need in-service training in all the 13 areas/items identifies in Table 3. The findings are in line with those of Schulz (2018) who found out that recreation staff need training in communication skills, flexibility, leadership, physical strength, ability to identify recreational risks, and the ability to ensure the safety of participants and conflict management. The findings are in line with Batinic (2013), business that provide series of activities for rest, relaxation and enjoyment in order to refresh a person's body and mind is very important. Recreational sector should provide a comfortable recreational event which will assist the customers to refresh one's body and mind. The findings are also supported by Okonkwo (2021) who found out that the areas where recreation staff need to be trained are skills in; adjusting actions in relation to others' actions, managing one's own time and having a good communication skill.

The findings in addition reveal that travel and tourism section staff need in-service training in 12 out of the 13 items/areas in the Table. The findings are consistent with those of Gary (2016) who found out that travel staff need language skills, culturally sensitive and logical aspect of traveling. The findings support Medlik (2013) who stated that tourism is travelling for pleasure which is away from home. Staff in travelling sector should realize and develop friendship with customers in order to attract patronage. The findings are also in agreement with Cole (2017) who found out that knowledge of global culture is required and that staff of tourism/travel industries need to be skilled.

Eze (2014) reported that although Nsukka has modern hotels in terms of infrastructure, the customer service in many of such hotels are poor leading to reduction in customers and consequently low profit. The author further opined that overtime, the low rate of income can lead to sacking of hotel staff and poor maintenance of hotel facilities. Furthermore, Adaeze (2017) found out that most times, restaurants are not kept in neat and good condition by staff which pushes some customers away. The consequences of poor service delivery to customers include reduction in income generated by hospitality industry, reduced income for hotel and restaurant owners as well as laying off workers to cut cost (Popova, 2018). To avoid this, there is need to address the root cause of the problem which is poor customer service. Poor customer service can be rectified through in in-service training of hospitality industry staff. This is sad

considering the potentials that the hospitality industry has for individuals and as a nation. Akani (2014) reported that the hospitality industry has the potential to boost the economy of the state and promote social integration of people across the world if well harnessed but is currently been hampered by poor training of hospitality industry staff. Having seen that the hospitality industry has a huge potential in boosting economy and encouraging social integration, it becomes necessary to find a solution to the issue of poor training of hospitality industry staff which has continuously hindered the sector. This can be achieved through in-service training of hospitality industry staff.

Conclusion

The study was carried out to identify the in-service training needs of staff in the hospitality industry in Nsukka. The in-service training needs of restaurant staff in food and beverage sector, lodging sector, recreation sector as well as the travel industry were identified. Identification of the in-service training needs of hospitality industry staff is important to ensure customer satisfaction which would lead to higher revenues for the hospitality industry. If stakes-holders in the hospitality industry carry out training for their staff in these areas.This could result in enhancement of the hospitality industry in terms of customer satisfaction and increased revenue.

Recommendations

Based on the findings of the study, the following are recommended:

1. restaurant owners should provide opportunities for in-service training of their staff in areas where they are deficient.
2. relevant research institutions should encourage their staff to carry out research in ways of improving the in-service training requirements for staff in hospitality industry.
3. the staff of the hospitality industry should source for opportunities for self-development in their skills.

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Barriers to Succession Planning of Family-Owned Businesses in Abia State

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Abstract

This paper examined barriers to succession planning of family-owned businesses in Abia state. Specifically, the study determined barriers to succession planning related to: founder, family and employees of family-owned businesses. The paper adopted survey research design. A total of 345 family-owned businesses drawn from Ariaria international market and Umuahia ultra-modern market served as the population of the study. Data were collected using questionnaire. Data were analysed using frequency counts, percentages and weighted mean. Findings show that the founder's-related barriers to succession planning ranged from fear of death ($\bar{X}$= 3.5), and reluctance to let go of his leadership position ($\bar{X}$= 3.7). Family-related barrier included the family's unwillingness to relinquish their places in the business ($\bar{X}$= 3.6); as well as, socio-cultural challenges within the environment the business is situated. The employees' disinclination toward formalization of the business ($\bar{X}$= 3.4) constituted employee-related barrier. The paper therefore recommended that owners of family businesses should bring in the successor into the family business as early as possible, and also make available to the would-be successor, vital information that has been used to manage the business right from beginning of the business up to the time of the entrepreneur's exit.

Keywords: Succession Planning, Family-owned Business, Entrepreneur, Barrier, Survival.

Introduction

Succession planning is one of the most critical issues a family business faces. This is because, succession is the key to the survival of the family business from generation to generation; unfortunately, the average Nigerian entrepreneur neglects this process, during the prime of his/her entrepreneurial career. Ungerer & Mienie (2018) argued that, many family businesses do not have a next generation successor available. Sometimes, the next generation carries the burden of stepping into big shoes, and the fear of failure keeps them from taking the necessary risks to grow the business. Mugo *et al.* (2015) define succession as the process through which the leadership of the business is transferred from the outgoing

generation to the successor generation, which can either be a family member or a non-family member. Osita, et al (2020) defines succession planning as a process of identifying, training, mentoring, equipping, recruiting and developing new leaders who could succeed their predecessors. Thus, a key aspect of the succession process is timing. Ungerer & Mienie (2018)indicated that, it is important to ensure that the next generation is both interested in joining the family business and capable of managing it. No two family businesses are the same, and this feature makes it difficult to have one single theory for understanding successions (Blumentritt et al, 2013). However, the success of a succession can be measured by the satisfaction of the stakeholders, with the succession process, as well as a positive performance by the family business after the succession has been completed.

Family businesses have been part of the business world, as they constitute more than 80 percent of all businesses in the world of free economies (Poza, 2010). The term "family" refers to a group of people related to each other by blood or marriage. Combining several variables, Poza (2014) define family business as a unique synthesis of: firstly, ownership control by two or more family members; secondly, managerial influence through active participation, advisory role, board membership or active shareholding; thirdly, concerns for family relationships; and finally, the possibility of continuity across generations. Ayranci (2010) opine that families establish family business to: create opportunities for their children; perpetuate family inheritance; hold the family together; and give the families financial independence and inheritance. The transfer of family business from the founder/Chief Executive Officer (CEO) to descendant/CEO depicts a high possibility of continuity across generations (Segaro, 2012).

Family enterprises contribute 70 to 90 percent of the global Gross Domestic Product, creating more than half of the total employment in the developed countries (Algamy, 2014), and comprise of at least two-third of businesses worldwide (Davis, 2014). The Nigerian business landscape is dotted with several family businesses, which generate 45% of the Gross National Product, provide work for 50% of the labor force, and account for between 70 to 85% of the new jobs created yearly (Louise, et al, 2010). However, family businesses have low survival rates due to various challenges, such as increased market competition and business life cycle maturity, limited capital to satisfy business and family needs, weak leadership in succeeding generations, resistance to change, a lack of entrepreneurship, disputes between family successors and desperate family needs and goals (Oudah, *et al.*, 2017). It is estimated that the average lifespan of a family business is 24 years, and that this is more or less the same number of years the founder remained in control of the business. Sharma (2012) further observed that, only 30% of family-owned businesses transition to the second generation, 10 to 15% transfer to the third generation, and only 3 to 5% survive to the fourth generation (Baron, 2016), hence this study.

There is no doubt that, if a business lacks proper planning, it may lead to business failure. Thus, Blumentritt, et al (2013) assert that, succession is one of the most significant challenges experienced by family businesses. The sudden death of the family business leader/founder will likely cause a dispute between the heirs and potential successors about power, authority and rights, which will create thorny issues. Oudah, *et al*., (2018) believe that, to avoid complications, the family should agree to simplify ownership, governance and management structures by trimming the family tree at the appropriate time to achieve family harmony and longevity of business performance. This study therefore maintains that, not only will planning for succession at the right time establish trust and loyalty among family members regardless of the number of generations present, it will also guide the successor along clearly defined paths, to ensure further growth and development of the family's business.

According to Stalk & Foley (2012), in Brazil, they say, "*Pai rico, filho nobre, neto pobre*," roughly translated as: rich father, noble son, poor grandson. The Mexicans probably say it the boldest: "father merchant, son gentleman, grandson beggar!" (Ungerer & Mienie 2018).Motwani et al. (2010) reported that when owners/managers retire, less than one-third of family-owned businesses are continued by the second generation, and less than half of second generation firms make it into the third generation. Ohuabunwa (2015) cited in Onwuka et al. (2017) stated that many of the world's renowned organisations with most longevity have their successes rooted in effective succession management. These great companies begin planning their exit strategy right at the start of their business endeavours. It is worrisome however, that in Nigeria, most businesses hardly survive the demise of their founders unlike in the developed world where such businesses have survived generations (Lekan, 2012). To address the family business continuity challenges, scholars have suggested that an effective management succession planning may help to upturn the fortune of family business owners. For instance, according to Ukagdon (2013) cited in Onwuka (2017), asserts that management succession planning presents an evidence of the ability of an organisation to continue delivery of its products and services without failure during and after any change in management. This means that continuity in plan, will assist in identifying potential threats that might hinder the organisation from providing its regular services after a major change. This provides the framework that builds organisational resilience with an effective response mechanism that safeguards the interests of the stakeholders, brand, reputation and value creation activities. Hence, previous researchers have discussed the success factors for the long-term sustainability of a family business among which is succession planning (Oudah et al, 2018) Nevertheless, a major gap is that authors have not prioritized the barriers to succession planning among family-owned businesses within the Nigerian context. This paper therefore aims to ascertain the factors that constitute

barriers to the succession and long term sustainability of family-owned businesses in Abia State.

Research Objectives

The general objective of this paper was to investigate the barriers to succession planning among family-owned businesses in Abia state. Specifically, the study determined:

(1) founder-related barriers to succession planning.
(2) family-related problems to succession planning.
(3) employees-related barriers to succession planning in family-owned businesses.

Research Questions

What barriers to succession planning are related to:

(1) business founder?
(2) founder's family?
(3) employees in the business?

Hypotheses

There are no significant differences between the mean responses of the senior male and senior female executives on the following:

HO_1: Founder-related barriers to succession planning

HO_2: Family-related problems to succession planning.

HO_3: Employees-related barriers to succession planning in family-owned business.

Methodology

Research Design: This study adopted survey research design.

***Area of the Study*:** The area of study was Abia State. The capital of the state is Umuahia, while the industrial center of the state is in Aba. There are numerous industries in the state; textile manufacturing, pharmaceuticals, cement, footwear, and cosmetics, among many others. Abia state has three senatorial districts which include Abia South, Abia Central and Abia North. The state has seventeen Local Government Areas.

***Population for the study*:** The population for study consisted of family-owned businesses situated within two major markets in the area of the study: Ariaria international market and Umuahia ultra-modern market. Data from the Abia State Markets Development Committee (2021) indicate that were over22 popular markets in the state at the time of study. The state is known for its long history of family business ownership. Available data from the Ministry of Commerce and Industry revealed that they were 12,659registered family-owned businesses in the area. Senior male and female executives were the respondents for the study.

***Sample for the study*:** This paper adopted purposive sampling. This is a non-probability technique whereby individuals are selected because they have characteristics needed in a sample. The Australian sample size calculator, with a confidence level of 95 percent and a standard error of 0.02 was used to establish the sample size of 373. A total of 28 respondents out rightly declined to partake in the study, consequently, only 345 family-owned businesses, comprising 313 senior male executives and 32 senior female executives participated in the study

Instrument for Data Collection: Questionnaire was used for data collection. It was developed based on literature review and the specific

objectives of the study. It had a 5-point Likert scale, whichenabled the respondents express the degree of their agreement or disagreement with questionnaire items. The questionnaire was validated by three university experts in Business Education. To ascertain the reliability of the questionnaire, a pilot study involving a total of twenty (20) participants, was carried out, to determine if the response would be in line with the expected outcome from the research work. Test-retest technique was used to establish the reliability of the instrument. The sets of data obtained were subjected to a reliability test using Pearson's Correlation Coefficient Statistical Procedure which yielded a correlation coefficient of 0.837.

***Data Collection Method*:** A total of 345 copies of the questionnaire were administered by hand. All the 345 copies were retrieved. This gave 100 percent return.

***Data Analysis Technique*:** The data were analyzed using mean. The benchmark for mean was 3.0. This was derieved from the 5 point Likert scale of the instrument. The 3.0 mean ($\bar{X}$= 3.00): was used for decision making. Therefore the criterion-mean for 5 point-likert scale is 3.00 which is the decisive factor.

Results

Demographic Information on Family-owned Businesses

Data analysis shows that majority of the founders (63.5%) were 50 years and above. This is regarded as valuable to the study because, most parents within this age already have children, who may be involved in the family business, and stand a chance of succeeding their parents. Equally, the results show that majority of the businesses were still in the first generation phase as only 28.4% were being managed by successors of the founder.

Majority of the businesses (85.9%) had between 3 – 5 employees, with 69.8% (241) of the businesses, having about two family members, fully employed. 61.7% had annual turnover of ₦5 – 10 million, 24.8%, accrued between ₦11 - 20 million, while 12.5% had annual turnover above ₦12 million and above. The business sectors were mainly manufacturing (31.6%), pharmaceuticals (13.9%), clothing and accessories (16.8%), restaurants (7.8%), foot wears (8.9%) and cosmetics (20.9%).

Table 1: Mean Responses, Standard Derivation and t-test Results on the Founder-Related Barriers to Succession Planning in Family-Owned Business

S/N	Founder-related Barriers	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_g$	t-test	R
1	Founder's fear of death	3.02	0.19096	0.49	0.0594	3.5	41.958	Accept
2	Inability to act as role model to new generation	3.02	0.19096	0.49	0.0594	3.6	41.958	Accept
3	Non-recognition of cultural values	3.02	0.19096	0.49	0.0594	3.7	41.958	Accept
4	Fear of losing work activity	3.02	0.19096	0.49	0.0594	3.4	41.958	Accept

Table 1 continued

5	Failure to work out governing structure	3.02	0.19096	0.49	0.0594	3.7	41.958	Accept
6	Loss of identity	3.02	0.19096	0.49	0.0594	3.5	41.958	Accept
7	Feeling of rivalry toward successor	3.02	0.19096	0.49	0.0594	2.9	41.958	Accept
8	Rigidity or resistance to change/new ideas	3.02	0.19096	0.49	0.0594	3.7	41.958	Accept
9	Failure to plan for succession early	3.02	0.19096	0.49	0.0594	4.0	41.958	Accept
10	Inability to establish relevant knowledge transfer measures	3.02	0.19096	0.49	0.0594	3.6	41.958	Accept

$\bar{X}_1$ = Mean of senior male executive; SD_1= standard derivation senior male executive; $\bar{X}_2$ = Mean of senior female executive; SD_1= standard derivation of senior female executive; $\bar{X}_g$ = Grand mean of senior male and senior female executives; t-test results, DF = Degree freedom; R = Remark.

Table one indicates that planning for succession among family businesses is hampered by founder's fear of death, inability to mentor new generations, reluctance to let go, as well as being adamant to cultural values. Similarly, the fear of losing work activity, identity, failure to establish an administrative framework, or plan succession early enough, inability to establish relevant knowledge transfer measures, as well as being rigid or resistant to new ideas, received substantial statistical support. Accordingly, the table shows that the calculated t-value of 41.958 is greater than the critical t-value of 3.850 (0.05 level of significance). On this basis, the null hypothesis which state that there is no significant difference in thefounder-related barriers to succession planning is hereby accepted.

Table 2: Mean Responses, Standard Derivation and t-test Results on the Family-related Barriers to Succession Planning in Family-Owned Business

S/N	Family-related barriers	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_g$	t-test	R
1	Spousereluctance to let go of position in the firm.	3.02	0.02424	0.45	0.01275	3.6	37.686	Accept
2	Norms against favouring siblings	3.02	0.02424	0.45	0.01275	3.6	37.686	Accept
3	Fear of parental death	3.02	0.02424	0.45	0.01275	3.2	37.686	Accept
4	Norms against discussing future beyond lifetime of parents	3.02	0.02424	0.45	0.01275	3.5	37.686	Accept
5	Sibling-successor conflict	3.02	0.02424	0.45	0.01275	3.6	37.686	Accept
6	Absence of family council	3.02	0.02424	0.45	0.01275	3.4	37.686	Accept
7	Disparate family goals	3.02	0.02424	0.45	0.01275	3.6	37.686	Accept
8	Non-interest by successor/sibling	3.02	0.02424	0.45	0.01275	3.4	37.686	Accept

Table 2 continued

9	Successor's lack of requisite knowledge/ skill	3.02	0.02424	0.45	0.01275	3.4	37.686	Accept
10	Poor educational level of family members	3.02	0.02424	0.45	0.01275	3.4	37.686	Accept
11	Intentional sabotage by neglected family member	3.02	0.02424	0.45	0.01275	3.4	37.686	Accept

$\bar{X}_1$ = Mean of senior male executive; SD_1= standard derivation senior male executive; $\bar{X}_2$ = Mean of senior female executive; SD_1= standard derivation of senior female executive; $\bar{X}_g$ = Grand mean of senior male and senior female executives; t-test results, DF = Degree freedom; R = Remark.

Table 2 provides the mean scores of family-related barriers to succession planning. The family's norms against favouring a particular sibling, spouse reluctance to let go of position in the business, fear of parental death and the custom of not discussing family future beyond parents' lifetime, obtained high mean scores. Also, factors such as sibling-successor rivalry, divergent family goals, lack of interest in the business, absence of basic skills required to manage the business, including deliberate sabotage by neglected family members, attained the accepted mean scores. Thus, the data indicates that the calculated t-value of 37.686 is greater than the critical t-value of 3.850(0.05 level of significance). Based on this, the null hypothesis which state that there is no significant difference in the family-related barriers is accepted.

Table 3: Mean Responses on the Employee-related Barriers to Succession Planning in Family-owned Business

S/N	Employee-related Barriers	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_g$	t-test	R
1	Unwillingness to let go of personal relationship with founder	2.94	46.384	0.49	0.0276	3.4	0.113875	Accept
2	Fear of differentiating among key managers	2.94	46.384	0.49	0.0276	3.4	0.113875	Accept
3	Reluctance to establish formal controls	2.94	46.384	0.49	0.0276	3.3	0.113875	Accept
4	. Employees' fear or resistance to change	2.94	46.384	0.49	0.0276	3.4	0.113875	Accept
5	Lack of trust in the capacity of successor	2.94	46.384	0.49	0.0276	3.2	0.113875	Accept
6	Unwillingness to respect or recognize new leadership	2.94	46.384	0.49	0.0276	3.4	0.113875	Accept
7	Employees' lack of commitment to the business	2.94	46.384	0.49	0.0276	3.5	0.113875	Accept
8	Inactive role of employees	2.94	46.384	0.49	0.0276	3.5	0.113875	Accept

Table 3 continued

	in decision							
9	Dependence on founder	2.94	46.384	0.49	0.0276	3.7	0.113875	Accept
10	Employees disharmony and instability of firm	2.94	46.384	0.49	0.0276	3.5	0.113875	Accept

$\overline{X}_1$ = Mean of senior male executive; SD_1= standard derivation senior male executive; $\overline{X}_2$ = Mean of senior female executive; SD_1= standard derivation of senior female executive; $\overline{X}_g$ = Grand mean of senior male and senior female executives; t-test results, DF = Degree freedom.

Table 3 shows that employees' refusal to forego personal affiliation with the fonder, reluctance to establish formal control, fear of differentiating among key managers, fear of change, lack of trust in the leadership capacity of the new heir, dependence on the founder, among others, constitute obstacles to succession planning in family-owned businesses. The table therefore demonstrates that the calculated t-value of 3.922 is less than the critical t-value of 0.113875(0.05 level of significance).In line with this, the alternate hypothesis which states that there is a significant difference in theemployee-related barriers is hereby accepted.

Discussion

Findings from the study illustrate a similarity pattern in relationships among family members as well as employees in family-owned businesses. Thus, an attachment to, and the disinclination to give up the position held in the business by the founder's spouse (3.6), employees' unwillingness to let go of personal relationship with the founder (3.4), as well as the founder's reluctance to transfer ownership of the business to the new generation (3.7) constitute a major factor in succession planning. This finding appears valid considering the fact that, Louise, et al., (2010), explain that the quality of the relationship between the two main individuals involved, and among all the members of the family is the key to the success of the transfer of the business to the next generation. Louise, et al., (2010) further add that, no one can ignore the internal and external environment of the business, where significant resistance may come from employees, management personnel, clients, suppliers, etc., who have developed a close and trusting relationship with the predecessor over the years.

Equally, findings show that cultural values largely play out in succession planning among family-owned businesses. Succession as observed in the study is a product of culture, and is shaped by the formal and informal rules of the locale in which families live and set up their businesses. Abia state is situated in the Southeastern part of Nigeria, where the custom and tradition transcends collectivism and favours rank. Agbim (2018) posits that succession in Igbo land follows the primogeniture system, whereby the oldest son succeeds a founder in the ownership and management of the family business. This system does not permit the father to compare and choose between his children (Nwadukwe, 2012). Onuoha (2010) further adds that in Igbo tradition, the

right of the eldest surviving son taking over the family business is automatic. Only the father can prevent such right, on the basis of expertise or level of education. Thus, from norms against discussing family's future beyond lifetime of parents (3.5), to norms against favouring siblings, it is evident that culture needs to be taken into consideration during succession planning. As a result, the price water-house Coopers (PWC) Middle East Family Business Survey stressed that there is a lot of work to be done on the family side because traditional challenges that are pertinent to family businesses around governance, continuity planning, development of the next generation, capability building and the overall professionalization of the business have always been cause of concern (Price Waterhouse Coopers, (PWC) (2021).

Correspondingly, findings indicate that, founders' resistance to new ideas (3.7), as well as employees (3.4) fear of change impacts negatively on succession planning. Some business leaders find it difficult to accept innovations initiated by new generations without recourse to the notion that success requires change; and new entrants will always have different working styles from their predecessors. Hence, one of the reasons why some business owners are apprehensive of planning for succession is because of the fear that the successor may not carry on with the prior vision of the owner. Efferin and Hartono (2015) affirm this position when they put forward that, when family members are sharing the same vision and significance for the family business, they act as custodians who highlight the SME's interest. As a result, the incumbent is more likely to single out a successor sharing that vision.

The result further shows that, diverse family goals (3.6) can topple the success of succession plans, as one family member may want to build the business for future generations, while another may want to reap the already existing equity. Managing the different goals can be a significant challenge; thus, as much as the problem requires bringing in best practices that help families deal with issues relating to the family business; it is expedient to encourage family meetings and provide open communication channels to strengthen the bond among family members and straighten out rough edges.

Lastly, the founder's inability to act as a model (3.6), and launch a functional knowledge transfer mechanism (3.6) attracted high means scores. This implies that there is need for family business owners to spend quality time with the new generation, take them to business meetings, and take steps to ensure that they obtain solid management experience both within and outside the family firms. Thus, findings by Price Water-house Coppers (PWC)(2021) reveal that in Nigeria, though family businesses abound, majority of these businesses have never made it past the 3rd generation. From the family business survey, 77 percent of family business owners in Nigeria expressed their intent to pass their organisations to the next generation (PWC, 2021). Despite this intent, the survey revealed that appropriate structures for ensuring this occurs is

mostly lacking among family businesses (FBs) in Nigeria. Some of these structures include defining how ownership and leadership is transferred. Only 13 percent of FBs revealed they have such structures in place including policies and procedures that have significant impact on business continuity. Furthermore, only 10 percent of Nigerian family businesses have a robust, formalised and communicated succession plan in place (PWC, 2021). The results also aligns with the position of Vignoli et al., (2018), who point out that, education and training facilitate a smoother transition by providing a reference group for the leader to connect with during the transition. In addition, Kusuma and Indarti (2017) believe that, successors improve business competences through the process of preparation, which often include four stages; firstly, business knowledge gained in childhood; secondly, through formal education (Sardeshmukh & Corbett, 2011); thirdly, work experience gained outside the family business (Sardeshmukh & Corbett, 2011); and fourthly, continued development of their knowledge and skills after joining the family business as a full-time employee.

Conclusion

This paper examined the barriers to succession planning in family-owned businesses. The study found that the barriers to succession planning range from the owner's reluctance to let go of his leadership position, fear of death; the family's unwillingness to relinquish their places in the business; the employees' disinclination toward formalization of the business, as well as, typical socio-cultural challenges within the clime the business is situated. Notwithstanding, if planning for succession is neglected, an owner/founder's death or incapacitation can deprive the family business of crucial managerial assets, including strategic information about markets, products, and employees; and critical connections with external stakeholders such as suppliers, clients, and financing sources; hence it becomes imperative for owners of family businesses to plan for succession.

Recommendation

This paper recommends as follows:

1. there is need for owners of family businesses to ensure a crisis-free succession by planning for succession as early as possible.
2. the owner/founder should make available to the would-be successor, the specialized knowledge which he/she, as an entrepreneur, has accumulated over the years.
3. the new manager of a family-owned business should be provided with necessary information about the business right up to the time of the entrepreneur's exit.
4. the business founder, the family members as well as employees should learn to be flexible and give room to change and new developments that will enable a family business survive beyond the first generation.

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Proximate and Functional properties of Pigeon Pea (*Cajanuscajan*) and Sorghum (*Sorghum bicolor*) flour Blends.

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Abstract

The main purpose of this study was to assess the proximate and functional properties of pigeon pea seeds and sorghum grain flour blends. Specifically the study determined the proximate composition and functional properties (bulk density, water absorption capacity, oil absorption capacity, foaming capacity, emulsion capacity, wettability, swelling index, gelation time and gelation temperature) of the flour blends. Composite flour was formulated by blending the pigeon pea and sorghum flour in the ratios of 4:1, 1:1, 3:2 respectively using 100percent wheat flour as the control. The proximate and functional properties were determined using standard methods. Data were analyzed using means and standard deviation. Results for proximate composition of the flour samples show,among others, that moisture content ranged from 6.93-9.13 percent, ash 1.02-3.29percent, fat 1.84--2.81percent. Sample B which is made from100 percent pigeon pea flour was higher than the other samples in terms of ash, fat, protein, and fiber. Results for functional properties, ranged from 0.71-0.85percent, 0.83-1.37percent, 0.67-1.13percent, 17.95-25.16percent, 33.95-45.89percent, 35.33-71.00percent, 1.76-2.23percent, 12.91-23.53percent and 66.00-78.17percent respectively. This finding show that there were variations among the flour samples, however the flour blends possessappropriate functional properties that could make them suitable for use in development of food products.

Key words: Pigeon pea, Sorghum, Composite, Flour, Proximate, Functional, Properties.

Introduction

Legumes are considered as one of the best protein sources in the plant kingdom. They comprise of high nutritional values, extended storage times and are relatively cheaper compared to animal products(Sanchez, Jimenez Davila, Alvarez, &Madrigd 2015). Pigeon pea (*Cajanuscajan (L)* Millsp) is known as *gungo* pea, red gram, no-eye pea and Congo pea which belongs to the Leguminosae (fabaceae) family and is an important grain legume crop (Fuller, Murphy &Nalk, 2019). Pigeon peas thrive well in different kinds of soil, are very resistant to drought and are able to produce a high yield in very low favorable conditions. According to Arukwe &Nwanekezi (2022),Pigeon pea can

survive and produce seeds under hash climatic conditions. Pigeon pea is known for its high adaptation in different soil types and production system at varying latitudes and altitudes and it is attributed to genetic tolerance to various biotic and abiotic stresses particularly insects and drought (Saxena et al 2021). Globally pigeon pea is cultivated on 5.4 million hectare land area with an annual production of 4.49 million tons. In Nigeria pigeon is predominantly grown in the Guinea Savannah agro ecological zones of the Northern and Southern parts of Nigeria (Fatokimi&Tanimonure 2021). Olanipekun, Levbare, Oyelade & Adelakun (2021) noted that pigeon pea is widely cultivated in Nigeria. According to Akubor (2017), presently different varieties of pigeon pea are grown in western and northern states of Nigeria. In Nigeria little consideration has been given to the potential of pigeon pea to contribute to food and income security to poor farming households whose diet is starch based with insufficient income (Esan & Ojemola 2018, Fatokimi &Tanimonure 2021). Recently, National Agricultural Quarantine Service (NAQS) reported that there is an offer of 100billion dollars secured by Nigeria from India to export legumes including pigeon pea and this would help to generate appreciable revenue due to its potentials and nutrition security for households (Ayenan, Danquah, Ofori 2017, Fatokimi&Tanimonure 2021).Despite its significant level of nutrients and strong medicinal properties, pigeon pea is still underutilized (Fatokimi&Tanimonure 2021, Falola, Mukaila, Lawal&Akinsuyi 2022).It is very essential and noted for cheapest sources of protein for majority of people living in developing countries (Maltas, *et al*., 2011, Soris & Mohan 2011).In Nigeria pigeon pea production has been largely at the subsistence level despite the good and ecological and edaphic conditions of the country which can support its production in higher quantities for consumption and commercialization (Ezeaku et al. 2016).The nutritional components of pigeon pea are considered crucial for human nutrition when compared to other legumes and pulses like Africa yam beans, cowpea, soya beans, and kidney beans. It has been reported to possess high anti-nutritional factors, strong biological, pharmacological activities including antioxidant, antibacterial, anti-diabetic, anti-inflammatory and anti-carcinogenic properties (Adebe, 2022).Pigeon pea can be used as a supplement to cereal-based diet that are deficient in protein, vitamin B and beta carotenes. Medically, it is used to treat measles, hepatitis, diabetes and liver dysfunction (Mashifane, Chiulele&Gwata 2024).

Similarly, sorghum (*sorghum bicolor)* belongs to the grass family. It is the fifth most important cereal in the world after rice, wheat, maize, corn and barley (Okeyo,Hezronand Njeru 2020, Naik, Ahmed and Pati, 2016, Adebo, 2020). Sorghum grains have 95% to 98% of the nutritional value of maize. In Nigeria, sorghum is utilizedin different ways, tuwo a delicacy consumed mostly in the Northern areas, sorghum balls, fura balls, fura (ogi), local beverages anddrinks (Abah, Ishiwu, Obiegbena&Oladejo 2020).It is very versatile in the continent serving as a

staple and main meal for millions of people (Adebo, 2020).According to FAO(2019), Nigeria produces sorghum in high quantities 6.9 million tons and 5.4 million hectares of land. Sorghum is the largest staple cereal crop accounting for 50percent of the total output and occupying about 45percent of the total land area devoted to cereal crops production in Nigeria. Sorghum is resistant to drought and heat and can produce marginal soil than other soil playing an important role in food security (Arukwe&Nwanekezi 2022).Utilization of indigenous crops like pigeon pea seeds and sorghum grains as composite flour will help in diversification of our local food crops for sustainability.

Composite flours refers to a mixture of any two or more of these flour obtained from any other local crops like maize, rice, yam, water yam, plantain, cocoyam, millet, kidney beans and so on with or without wheat flour in proper portions to make economic use of locally cultivated crops to produce high quality snacks (Anozie, China & Beleya, 2014). However, in order to improve the utilization of composite flour from locally available food material, it is necessary to carry out evaluation on proximate composition and functional properties analysis on the composite blends.

Proximate composition refers to the six components of food nutrients; they include nitrogen free extract moisture, crude protein, crude fat, crude fiber, crude ash and carbohydrate which are expressed as the content percentage respectively (China 2019). According to Awuchi, Igwe & Echeta (2019), functional properties are physiochemical properties of food that determine how food ingredients behave during processing and cooking, they include water and oil absorption capacity, bulk density, swelling capacity of the particles, solubility and least gelation concentration.. The knowledge of utilization of indigenous crops like pigeon pea seeds and sorghum grains as composite flour will help in diversification of our local food crops for sustainable and healthy households in Nigeria.

Purpose of the study

The general purpose of this study was to assess proximate composition and functional properties of various blends of pigeon pea seeds and sorghum grains flour. Specifically, the study determined:

1. proximate composition of 100 percent (100 %) pigeon pea flour; 100 percent (100 %) sorghum flour, composite flours 4:1 of pigeon pea flour and sorghum, 1:1of pigeon pea and sorghum, 3:2 of pigeonpea and sorghum (Ratios 4:1, 1:1 & 3:2) with 100 percent(100 %) wheat flour as control.
2. functional properties ofthe pigeon pea and sorghum composite flour (bulk density, water absorption capacity, oil absorption capacity, foam capacity, emulsion capacity, wettability swelling index, gelation time and gelation temperature).

Materials and Methods

***Design of the Study*:** The study adopted an experimental research design.

***Procurement of Materials*:** Pigeon pea (*Cajanuscajan)* and sorghum (*sorghum bicolor*) grains and wheat (control) were purchased at Orieugba market,

Umuahia, Abia State Nigeria. Chemicals were obtained from the Food Science Laboratory College of Applied Food Science and Tourism,MichaelOkpara University of Agriculture Umudike (MOUAU).

***Sample Preparation*:** Pigeon pea (*Cajanuscajan)* was sorted to remove impurities. It was washed properly and soaked for 24 hours, dehulled, rinsed, drained and oven-dried for 60^0C for 24 hours to remove moisture. The dried samples were milled into flour using Nutri-blender and sieved with a US70 (180um diameter) sieve. The flour obtained was stored in an airtight plastic polyethylene bag at room temperature 37^0C).Sorghum and wheat were similarly cleaned, oven dried at 50 -55^0C for 4 hours, milled, sieved and packaged.

***Sample Formulation*:** Composite flour blends were formulated from processed seeds of pigeon pea, sorghum grains using the following three formulated ratios shown below:

A. 100 percent (100%) Wheat flour was used as the control
B. 100 percent (100%) Pigeon pea flour.
C. 100 percent (100%) sorghum flour
D. 80 percent (80%) Pigeon pea flour and 20percent (20%) Sorghum flour: 4:1
E. 50 percent (50%) Pigeon pea flour and 50percent(50%) Sorghum flour: 1:1
F. 60 percent (60%) Pigeon pea flour and 40percent (40%) Sorghum flour: 3:2

***Determination of Proximate Composition*:** The AOAC (2016) method was used to determine nutrient contents of the various compositions of the six samples (A, B, C, D, E and F). The contents determined for each sample include moisture, ash, fat, crude fibre, curde protein and carbohydrate.

***Determination of functional properties*:** Functional properties of the six samples (A, B, C, D, E and F) were analyzed using Onwuka (2015). The properties determined include: bulk density, water absorption, swelling index, foaming, oil absorption, emulsion capacity, wettability, gelation time, andgelation temperature. Specific standard operations for each sample was carried out.

***Statistical analysis*:** The statistical package for social science SPSS version 23.0 was used. The data was subjected to analysis of variance (ANOVA) and treatment means were separated using Duncan's multiple range testing at a 95% confidence level ($P<0.05$)

Results

Table 1: Proximate Composition of Composite Flour Blends and Wheat Flour (%)

Samples	A	B	C	D	E	F
Moisture	$9.13^a \pm 0.31$	$9.10^a \pm 0.17$	7.77 ± 0.35	$8.27^b \pm 0.31$	$6.93^d \pm 0.31$	$7.13^d \pm 0.11$
Ash	$1,02 \pm 0.02$	$3.29^a \pm 0.03$	$1.35^d \pm$	$2.62^c \pm 0.03$	$2.49^c \pm 0.17$	$3.02^b \pm 0.06$
Fat	$1.87^d \pm 0.06$	$2.81^a \pm 0.03$	$2.16^c \pm 0.04$	$2.75^a \pm 0.04$	$1.84^d \pm 0.05$	$2.66^b \pm 0.04$
Crude	$11.34^d \pm 0.04$	$23.49^a \pm 0.10$	$10.66^e \pm 0.04$	$21.67^b \pm 0.08$	$9.52^f \pm 0.07$	$18.71^c \pm 0.10$
Crude fiber	$1.82^e \pm 0.11$	$2.73^a \pm 0.30$	$1.94^d \pm 0.11$	$2.36^b \pm 0.29$	$1.62^f \pm 0.29$	$2.18^c \pm 0.11$
Carbohydrate	$74.81^c \pm 0.23$	$58.58^f \pm 0.33$	$76.12^b \pm 0.46$	$62.35^e \pm 0.26$	$77.59^a \pm 0.16$	$66.30^d \pm 0.12$

Values are means of data of duplicate determination. Values with the same superscript in the same column are not significantly different (P >0.05). Key: A = 100pecentWheat Flour, B = 100percentPigeon pea Flour, C = 100percentSorghum Flour, D; 80percentpigeon pea and 20percent sorghum flour,(D= 4:1), E: 50percent pigeon pea and 50percent sorghum flour, (E=1:1), F: 60percentPigeon pea and 40percent sorghum flour(F=3:2).

Table 1 shows the results of the proximate composition of sample A (100% WF), sample B (100%PPF), sample C (100% SF),Sample D (80%PPF: 20%SF), Sample E (50%PPF: 50%SF), and sample F (60%PPF: 40%SF). Values for moisture content ranged from 6.93% in sample E to 9.13 % in sample A. The ash content ranged from 1.02 % in sample A to 3.29 % in sample B, Value for fat ranged from 1.84 % in sample E to 2.81% in sample B. Crude protein ranged from 9.52 % in sample E to 23.49 % in sample B. Crude fiber ranged from 1.62 % in sample E to 2.73 % in sample B, Values for carbohydrate ranged from 58.58 % in sample B to 77.59 % in sample E.

Table 2: Functional Properties of the Composite Flour Blends

Sample	A	B	C	D	E	F
Bulk density	0.78^{d} ±0.00	0.71^{e} ±0.00	0.85^{a} ±0.00	0.78^{d} ± 0.00	0.81^{b} ± 0.00	0.80^{c} ±0.00
Water absorption capacity	0.83^{b} ±0.06	1.27^{a} ±0.15	1.33^{a} ± 0.06	1.37^{a} ± 0.06	1.33^{a} ± 0.12	1.33^{a} ± 0.12
Oil absorption capacity	0.67^{c} ±0.05	0.94^{b} ±0.05	0.82^{b} ± 0.10	1.13^{a} ±0.11	1.09^{a} ±0.05	0.67^{c} ± 0.05
Foam capacity	19.50^{bc}±1.09	21.94^{b}±2.67	17.95^{c}±1.09	20.12^{bc}±1.09	18.24^{c}±1.09	25.16^{a}±1.09
Emulsion capacity	42.26^{b} ±1.03	40.46^{b}±0.87	36.97^{c}±1.05	33.95^{d} ±2.14	33.95^{d}±2.14	42.77^{b} ±.91
Wetability	71.00^{a} ±5.00	51.00^{b}±3.61	35.67^{c}±5.69	39.67^{c} ±3.51	49.67^{b}±6.03	35.33^{c}±4.04
Swelling index	1.81^{d} ± 0.04	1.90^{c} ± 0.04	2.15^{b} ± 0.04	2.21^{ab}± 0.05	2.23^{a}± 0.08	1.76^{d} ± 0.04
Gelation time	17.28^{d} ±0.13	12.91^{f}±0.48	20.29^{b}±0.23	14.68^{e} ±0.36	23.53^{a}±0.55	18.77^{c}±0.37
Gelation temperature	71.48^{c} ±0.08	66.00^{e}±0.76	73.38^{b}±0.17	69.90^{d}± 0.40	78.17^{a}±0.26	73.14^{b}±0.25

Values are means of data of duplicate determination. Values with the same superscript in the same column are not significantly different (P > 0.05). Key:A = 100pecent Wheat Flour, B = 100percent Pigeon pea Flour, C = 100percent Sorghum Flour, D; 80percent pigeon pea and 20percent sorghum flour,(D= 4:1), E: 50percent pigeon pea and 50percent sorghum flour, (E=1:1), F: 60percent Pigeon pea and 40percent sorghum flour(F=3:2).

Table 2 shows the value for bulk density ranged from 0.71 g/ml in sample B to 0.85 g/ml in sample C. Water absorption capacity ranged from 0.83 g/ml in sample A to 1.37 g/ml in sample D. Values for oil absorption

capacity ranged from 0.67 g/ml in sample A to 1.13 g/m in sample D. Foam capacity ranged from 17.95 % in sample C to 25.16 % in sample F, with values for emulsion capacity ranging from 33.95 % in sample D and E respectively to 42.77 % in sample F. Values for wettability ranged from 35.33 sec in sample F to 71.00 sec in sample A. The swelling index values obtained from this study ranged 1.76 ml in sample F to 2.23 ml in sample E. Gelation time ranged from 12.91 min in sample B to 23.53 min in sample E, Values for Gelation temperature ranged from 66.00 ◦ c in sample B to 78.17 ◦C in sample E.

Discussion

The findings on proximate composition in table 1 shows that the moisture content ranged from 6.93% (50%PPF50%SF) to 9.13 %in the control (100% WF) Sample E(50%PPF50%SF) hadthe least moisture content 6.93 % as a result of decrease level of pigeon pea substitution. . The moisture content of all the samples were within the acceptable limit of not more than 10% for long term storage of flour (Awuchi, 2019). The ash content of the samples varied significantly. Sample B had higher ash content which implies the abundance of higher mineral contents in the sample. Ash content of the flour blends increased as the level of substitution with pigeon pea increased. The crude fiber content of sample B (100% PPF) had the highest value. Similar observation of increase in crude fiber content by constant increase in pigeon pea flour was reported by Adepeju, *et al* (2015) and Fasoyira, *et al*(2013). The protein contents of the flour samples ranged from 9.52 to 23.49. The protein contents were significantly different between the formulated flour blends and wheat flour. Sample B (100%)PPF had the highest protein (23.49%) and sample E (50%) PPF and (50%) SF had the lowest protein content (9.52%). The highest protein content observed in sample B for 100% PPF was similar to the value 22-73% reported by Olatunde, *et al*(2019) for cakes from pigeon pea, sweet potato and wheat flour. The fat content of the sample B (2.61%) and sample D (2.75%) were not significantly different ($P<0.05$). The fat value was highest in sample (100%)PPF which scored (2.81 %). The low fat content obtained in this study may indicate that flour blends will not undergo rapid oxidative rancidity during storage if suitably packaged (Adeola*et al* 2019). The carbohydrate content of the flour samples varied significantly ($P<0.05$) ranging from 58.58 % to 77.59 % with sample B(100%) PPF having the least value.

The functional properties of the flour blends showed that the bulk density of sample A (100%) wheat flour and sample D (80%) PPF flour and (20%) SF had the same value of 078.000. This could be as a result of higher addition of pigeon Pea flour to sorghum flour. The bulk density recordedwas higher than the one observed by (Arukwe, *et al* 2022). The blends low bulk densities suggests that the flour will need more packaging space since the smaller the mass, the bigger the space required. Water absorptioncapacity (WAC) of sample D (80%) PPF and (20%) SF had the highest value (1.37) while sample A (100%) WF had the least value of 0.83. The differences observed in the WAC of the

flour samples showed that the flour has a variable degree of availability of water binding sites among the starches and also indicate different protein concentration and their degree of interaction with water (Aburime, *et al* 2020). The oil absorption capacity (OAC) of sample D (80%) PPF and (20%) SF had the highest OAC value of 1.13g/ml. Sample A (100%) WF and sample F (60%) PPF and (40%) SF had equal value and recorded the least. Oil absorption capacity is an important property in food product development because fat improves the flavor and mouth feel of foods. Protein ability to bind fat is shown by its oil absorption capacity (Arukwe, *et al* 2022). The foam capacity of sample F (60%) PPF and (40%) SF had the highest value of (25.16) while the least value was observed in sample C (100%) SF which had (17.95). There was variance in foam capacity. The emulsion capacity of sample D (80%) PPF and (20%) SF with sample E (50%) PPF and (50%) SF had the least value of 33.95. The highest value was recorded in sample F (60%) PPF and (40%) SF having value of (42.77). High emulsion capacity in flour blends showed that the flour samples are excellent emulsifier which may be due to high protein content (Iwe, *et al*, 2016) There was significant difference ($P<0.05$) in the wetability values of the samples. Sample F (60%) PPF and (40%) SF had the lowest value of (35.33) sec while sample A (100%) WF had the highest value of (71.00) sec. The swelling index of the flour sample varies. Sample F (60%) PPF and (40%) SF had the lowest swelling index of 1.76% while sample E (50%) PPF and (50%) SF had the highest swelling index value of 2.23%. The range obtained in this study was higher than the range of 1.21% to 1.4% reported by Bello, Udo&Mbak, (2017) for sprouted sorghum and defatted fluted pumpkin seeds flour blends.

The gelation time of sample B (100%) PPF recorded the least value while sample E (50%) PPF and (50%) SF had the highest value. The gelation temperature of sample E (50%) PPF and (50%) SF had the highest gelation temperature value while the least value was observed in sample B (100%) PPF which recorded 66.00. The observed values will enhance the texture and body of a food product (Peter Ikechukwu, 2020).

Conclusion

In this study, the proximate and functional properties of pigeon pea (*cajanuscajan*) and sorghum *(sorghum bicolor*) flour was extensively examined. The proximate composition of the flour samples of 100 percent (100%) pigeon pea and 100 percent (100%) sorghum flour and their composite flour blends were higher in protein, crude fiber, fat and ash content showing that they are valuable ingredients in food production particularly where protein energy malnutrition (PEM) is prevalent. The significant enhancement of protein content in the composite flour blends suggests a higher nutritional value making them a suitable alternative to wheat flour. The low moisture content observed in the composite flour samples indicates that the products will have a better shelf life and versatility in usage than wheat flour (control) making it a value addition to our indigenous food products. Higher ash content was

recorded in 100 percent (100%) pigeon pea and its composite flour blends than 100 percent (100%) wheat flour. This showed that the composite flour blends will be rich in minerals. The favorable functional properties observed in the flour samples shows that the samples will be utilized in diverse house hold application/meals in Nigeria where they are cultivated. The use of pigeon pea and sorghum flour as functional ingredients in food production could potentially address hunger and house hold food insecurity there by contributing to the achievement of sustainable development goal 2 (zero hunger).

Recommendation

1. Awareness should be placed on the local uses of flour among household in Nigeria.
2. Homemakers should be enlightened on the importance of consuming these two indigenous cops. This could be achieved through formal and informal dissemination methods.
3. Use of products produced from pigeon pea and sorghum needs to be encouraged as an alternative to wheat flour, this will increase consumption in some areas where they are limited.

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Strategies for Improving Female Farmers' Access to Selected Agricultural Input in Rural Areas of Ozubulu, Anambra State

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Abstract

The aim of the study was toevolve strategies for improving female farmers' access to selected agricultural input in rural areas of Ozubulu, Anambra State. Specifically, the study determined strategies for improving female farmers' access to: land, credit, extension services, training and appropriate agricultural technologies. Four research questions guided the study. The study adopted a survey research design. The study involved 291 participants: 282 registered female farmers, seven agricultural extension workers, and two bank executives from microfinance banks in Ozubulu. No sampling was needed due to the manageable population size. Data were collected using questionnaire.Data were analyzed using mean and standard deviation. The study identified nine strategies for improving female farmers' access to land, including the abolition of cultural barriersthat prevent women's access to land($\bar{X}$= 3.52); 11 strategies for improving rural female farmers' access to credit, such as access to loans at low interest rate($\bar{X}$= 3.38); eight strategies for improving access to extension services, like using mass media for information dissemination ($\bar{X}$= 3.26); and nine strategies for access to agricultural technologies, such as providing agricultural research findings ($\bar{X}$= 3.45). Recommendations includeamong others, enforcing policies to protect women's land rights for secure tenure and developing user-friendly manuals for agricultural technologies.

Keywords: Strategies, Rural, Female, Farmers, Access, Productivity, Agricultural, Input, Extension

Introduction

Agriculture encompasses the cultivation of crops and the husbandry of animals, fibers, biofuels, and other essential products. Anyanwu (2018) describes agriculture as a branch of science that sustains people by providing food and fundamental commodities while offering significant employment opportunities. It involves the science and art of soil cultivation, crop production, livestock farming, and the preparation and processing of their outputs (Nwachukwu & Ezeano, 2017). Nwakile, Ejiofor, and Ali (2017) assert that agriculture is vital for human life and the economy, serving as the backbone of a country's economic system. The Food and Agriculture Organization (FAO, 2020) emphasizes agriculture's critical role in food security, poverty reduction, and sustainable development. The World Bank highlights agriculture as key for poverty reduction and economic growth in developing countries, enhancing livelihoods and creating opportunities for small-scale farmers (World Bank, 2021). Agriculture fulfills dietary needs,

supplies raw materials, and serves as a major employment source (Urama & Onyekuru, 2017). It supports farmers' livelihoods, contributes to national income, provides sustenance and fodder, and fosters international trade, especially in developing countries like Nigeria (Uzochukwu & Chikezie, 2018).

In Nigeria, the agricultural sector contributes about 55% of gainful employment and nearly 40% of the GDP(Okeke & Chukwu, 2023). The authors further posited that before the discovery of oil, these figures were as high as 75–80% of the GDP. Currently, this GDP share is significantly higher compared to the average of 27% for low-income nations in Sub-Saharan Africa (Eze & Okeke, 2023). However, the sector still lags in development and industrial contribution, failing to produce a marketable surplus to feed the nation and provide industrial inputs (Onuoha & Okoye, 2019). The authors further posited that emphasizing agricultural development is crucial for Nigeria's overall development, as all other sectors depend on agriculture for sustenance and essential inputs.

Agricultural production measures the quantity of output produced for a given set of inputs (Ezeano & Nwachukwu, 2019). It involves cultivating crops, raising livestock, and harvesting natural resources, encompassing the production of food, fiber, biofuels, and other commodities for consumption or industrial use (Amalu & Anyaeche, 2016). The FAO (2018) defines agricultural production as the output generated from agricultural activities relative to the inputs used, focusing on efficiency and productivity. This relationship between the quantity of goods produced and the resources employed (land, labor, capital, and technology) is crucial. Igwebuike and Okoye (2018) describe agricultural production as output per unit of input, such as tons of wheat per acre. Amalu and Anyaeche (2016) state that if output grows at the same rate as inputs, production remains unchanged, but if output growth exceeds input growth, production is positive. Increasing production output impacts growth, market competitiveness, income distribution, savings, and labor migration (Chigbu & Okoye, 2017).

Enhancing agricultural production requires the effective allocation of limited resources. Adopting innovative methods allows more efficient farmers to improve their well-being (Garcia & Martinez, 2017). Increased productivity means farmers can produce goods at a lower cost, gaining a competitive edge in the global market by offering more products at the same price (Nduka & Ejezie, 2017). This contributes to agricultural expansion and poverty reduction, as agriculture often employs the largest population segment in developing nations (Okoli & Okoye, 2018). Improved productivity raises agricultural workers' earnings, reduces food prices, and stabilizes food supply (Urama & Onyekuru, 2017). The benefits extend beyond the agricultural sector, as individuals in other industries also enjoy lower food costs and more reliable food provision (Liu & Wang, 2018). Enhancing agricultural production among rural farmers supports overall economic growth, necessitating access to resources that can boost their productivity (Urama & Anyanwu, 2017).

Rural farmers are essential to Nigeria's agricultural sector, supplying the majority of the nation's food. Over 63% of these farmers are women (Okoli & Okoye, 2018). They are crucial to the sector, needing support to increase food production, grow raw materials for the agro-industrial sector, and reduce a food supply deficit costing over $500 million annually in imports (Uzochukwu & Nwachukwu, 2022). However, many rural female farmers lack agricultural information, limiting their use of modern technologies (Onuoha & Okoye, 2019). This issue is exacerbated by a shortage of agricultural extension workers, who provide advisory and educational services to farmers (Li & Zhao, 2018). Extension workers facilitate the adoption of innovative technologies and sustainable practices (Onuoha& Okoye, 2019).Additionally, limited access to credit facilities significantly reduces the productivity of rural female farmers (Igwebuike & Anyanwu, 2017). Access to credit often depends on the willingness of microfinance bank executives to provide these services (Li & Zhao, 2018). These executives, including bank managers and chief financial officers, oversee operations and strategic direction, crucial for financial inclusion and poverty alleviation.Despite Nigeria's vast cultivable land, much of it is being repurposed away from agriculture (Eze & Okeke, 2023). A major barrier to productivity is the lack of farm inputs, which discourages production, contributing to low output in many rural areas, including Ozubulu, Anambra State.

Ozubulu, a town in Ekwusigo Local Government Area, Anambra State, is predominantly inhabited by Igbo rural farmers (Ezeano & Uzochukwu, 2018). The main crops grown include cassava, sweet potatoes, cocoyam, tomatoes, okra, pepper, garden egg, fluted pumpkin, ginger, breadfruit, maize, sorghum, groundnut, mango, citrus, pears, coconut, and oil palm. Women in Ozubulu face significant constraints, such as limited access to land, which they can only obtain through fathers, husbands, or community allocation, often resulting in small plots (Chigbu & Okoye, 2017). They also lack access to credit and farm inputs, hindering their production (Uzochukwu & Nwachukwu, 2022).Their access to extension officers is limited due to their multiple responsibilities, including household management and various agricultural activities. Gender inequality further restricts their access to agricultural information and technology, such as improved seeds, fertilizers, and pest management, reducing their productivity and contributing to poverty (Eze & Okeke, 2023). Efforts by national governments and the international community to achieve agricultural development, economic growth, and food security would benefit from addressing these constraints and building on women's contributions. Increasing rural female farmers' access to farm inputs and resources could enhance their production and lead to self-reliance. However, there is a lack of literature on this issue. Therefore, this study aims to evolve strategies towards improving female farmers' access to selected

agricultural input in rural areas of Ozubulu, Anambra State.

Purpose of the Study

The general purpose of the study was to evolve strategies for improving female farmers' access to selected agricultural input in rural areas of Ozubulu, Anambra State. Specifically, the study determined strategies towards improving female farmers' access to:

1. land
2. credit
3. extension services and training
4. appropriate agricultural technologies

Research Questions

The following research questions guided the study:

What are the strategies towards improving female farmers' access to selected agricultural input in rural areas of Ozubulu, Anambra State through improved access to:

1. land?
2. credit?
3. extension services and training?
4. appropriate agricultural technologies?

Methodology

***Design of the Study*:** The study adopted a survey research design.

Area of the Study: The study was conducted in Ozubulu, Anambra State, Nigeria, which comprises four major communities: Amakwa, Nza, Eziora, and Egbema (Planning Department, Ekwusigo LGA Headquarters, Ozubulu, 2023). Although a major town, Ozubulu has rural areas with a significant number of female farmers. Agriculture is the primary occupation for many women, who engage in cultivating crops such as cassava, sweet potatoes, cocoyam, tomatoes, okra, and maize. These women also manage livestock, process food, and contribute significantly to local food security. The area was chosen because there are many female farmers in the area and there is need to help them increase their production and overcome existing constraints.

Population for the Study: The population for the study was 291 consisting of 282 registered female farmers, of 7 agricultural extension workers and two bank executives from two microfinance banks in Ozubulu. Data on population of registered fenale farmers and number of extension workers was collected from Agricultural Extension Office, Ekwusigo LGA (2023) while the data on the number of bank executives was gotten through fiekd survey by going to the microfinance banks to mske enquiries. Due to the manageable size of the population, the entire population was studied. Hence, there was no sampling or sampling technique.

Instrument for Data Collection: Data for this study was collected using a structured questionnaire designed to answer the research questions. The questionnaire had two parts: Part 1 collected personal data on the respondents, while Part 2 gathered information specific to the study's purposes. Part 2 was divided into four sections (A, B, C, and D), each addressing one of the four research questions: improving female farmers' access to land, credit, extension services and training as well as agricultural technology. Each section used a 4-point scale: Very Important Way (VIW) – 4; Important Way (IW) – 3; Less Important

Way (LIW) – 2 and Not Important Way at all (NIWA) – 1. The instrument was validated by five experts and tested for reliability using Cronbach's Alpha, yielding a coefficient of 0.76.

Data Collection Technique: Data was collected by the researcher with the help of three research assistants. Out of a total of 291 copies of questionnaire disstributed to the entire sample, 240 copies were correctly filled and returned (232 from the female rural farmers, 6 from the extension workers and 2 from the banks executives in microfinance banks) yielding a return rate of 82.4%.

Data Analysis Technique: Mean and standard deviation was used to analyze data from Sections A - D. In interpreting data, mean cut-off point of 2.50 was used. Hence, items that had mean values of 2.50 or above were interpreted as an "Important Way" (IW) while items with mean values less than 2.50 were interpeted as "Not an Important Way" (NIW).

Results

Table 1: Mean Responses and Standard Deviation by Female Farmers, Agricultural Extension Workers and Bank Executives on the Strategies for Improving Rural Female Farmer's Access to Land.

S/N	Strategies towards Improving Access to Land	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_3$	SD_3	$\bar{X}_g$	R
1	Abolition of cultures that prevent women's access to land.	3.50	0.58	3.54	0.61	3.52	0.60	3.52	IW
2	Women empowerment for land ownership	3.30	0.56	3.26	0.62	3.28	0.59	3.28	IW
3	Government policy to address women's access and use of land.	3.42	0.59	3.46	0.60	3.44	0.59	3.44	IW
4	Purchasing land through female cooperative.	3.10	0.57	3.14	0.63	3.12	0.60	3.12	IW
5	Use of women groups to state advocate for their cases	3.08	0.55	3.12	0.64	3.10	0.60	3.10	IW
6	Implement policies and programs that aim to redistribute land to rural female farmers	3.12	0.58	3.16	0.65	3.14	0.61	3.14	IW
7	Ensure that rural female farmers have secure land tenure through land ownership or formal land titles.	3.62	0.57	3.66	0.64	3.64	0.60	3.64	IW
8	Establish and enforce laws that explicitly recognize and protect women's land rights.	3.82	0.55	3.86	0.63	3.84	0.59	3.84	IW
9	Provide rural female farmers with training on land management and agribusiness skills	3.73	0.54	3.77	0.62	3.75	0.58	3.75	IW

$\bar{X}_1$ = Mean score of female famers; SD_1 = Standard deviation of female farmers; $\bar{X}_2$ = mean of extension agent/worker; SD_2 = Standard deviation of extension agents/workers; $\bar{X}_3$ = mean

score of bank executives; SD_3 = standard deviation of bank executives; $\bar{X}_g$ = grand mean; R = Remark

Table 1 reveals that one items all nine items had grand mean values ranged of 3.10– 3.84. The values were all above 2.50 which indicates that all the items were theimportant ways of improving female farmers' access to access to land in Ozubulu, Anambra State.

Table 2: Mean Responses and Standard Deviation by Female Farmers, Agricultural Extension Workers and Bank Executives on the Strategies for Improving Rural Female Farmer's Access to Credit

S/N	Strategies towards Improving Access to Credit	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_3$	SD_3	$\bar{X}_g$	R
1	Access to loans at low interest rate	3.38	0.58	3.40	0.59	3.36	0.57	3.38	IW
2	Encouraging women to join cooperative societies for acquisition of loan	3.24	0.56	3.26	0.57	3.22	0.55	3.24	IW
3	Government policy to address women's access to credit	3.26	0.57	3.28	0.58	3.24	0.56	3.26	IW
4	Educating women on the source of credit	3.28	0.58	3.30	0.59	3.26	0.57	3.28	IW
5	Establishment of more banks in the rural area that considers female loan application	3.30	0.59	3.32	0.60	3.28	0.58	3.30	IW
6	Increment in loan size for female farmers applicants	3.10	0.55	3.12	0.56	3.08	0.54	3.10	IW
7	Support microfinance institutions that specifically cater to rural female farmers	3.24	0.56	3.26	0.57	3.22	0.55	3.24	IW
8	Strengthen women's cooperative groups, which can serve as platforms for collective borrowing and lending	3.12	0.54	3.14	0.55	3.10	0.53	3.12	IW
9	Provide financial literacy to rural female farmers to help them make informed decisions about borrowing and managing credit.	3.22	0.55	3.24	0.56	3.20	0.54	3.22	IW
10	Develop innovative collateral alternatives, such as group guarantees to reduce the traditional collateral requirements	3.04	0.52	3.06	0.53	3.02	0.51	3.04	IW
11	Offer flexible repayment schedules that align with the agricultural cycle	3.14	0.53	3.16	0.54	3.12	0.52	3.14	IW

$\bar{X}_1$ = Mean score of female famers; SD_1 = Standard deviation of female farmers; $\bar{X}_2$ = mean of extension agent/worker; SD_2 = Standard deviation of extension agents/workers; $\bar{X}_3$ = mean score of bank executives; SD_3 = standard deviation of bank executives; $\bar{X}_g$ = grand mean; R = Remark

Table 2 reveals that all the 11 items had grand meanvalues ranged from 3.04 to 3.38which were all above 2.59. This indicated that all the items important ways towards improving rural female farmer's access to credit in Ozubulu.

Table 3: Mean Responses and Standard Deviation by Female Farmers, Agricultural Extension Workers and Bank Executives on the Strategies for Improving Rural Female Farmer's Access to Extension Services and Training

S/N	Strategies towards Improving Access to Extension Services and Training	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_3$	SD_3	$\bar{X}_g$	R
1	Organization of workshops to educate female farmers on the use of agricultural technologies	3.20	0.48	3.30	0.50	3.24	0.47	3.25	IW
2	Female rural joining resources to invite extension agents to their farms to teach them	3.18	0.49	3.32	0.51	3.26	0.48	3.25	IW
3	Use of mass media for disseminating information to female farmers	3.00	0.48	3.28	0.49	3.24	0.47	3.17	IW
4	Availability of extension services during female farmers' meetings to teach them.	3.10	0.51	3.42	0.52	3.38	0.50	3.30	IW
5	Adequate welfare scheme to boost the morale of extension workers	3.15	0.53	3.48	0.54	3.42	0.52	3.35	IW
6	Government should employ more extension workers	3.22	0.52	3.46	0.53	3.42	0.51	3.37	IW
7	Develop extension programs specifically tailored to the needs of rural female farmers	3.60	0.55	3.50	0.56	3.14	0.54	3.41	IW
8	Ensure that extension services are gender-sensitive	3.64	0.47	3.28	0.49	3.22	0.46	3.38	IW

$\bar{X}_1$ = Mean score of female famers; SD_1 = Standard deviation of female farmers; $\bar{X}_2$ = mean of extension agent/worker; SD_2 = Standard deviation of extension agents/workers; $\bar{X}_3$ = mean score of bank executives; SD_3 = standard deviation of bank executives; $\bar{X}_g$ = grand mean; R = Remark

Table 3 reveals that all 8 items had grand meanvalues ranged between 3.17-3.41 which were all above 2.50. This indicated that all the items important ways towards improving rural female farmer's access to extension services and training in Ozubulu, Anambra State.

Table 4: Mean Responses and Standard Deviation by Female Farmers, Agricultural Extension Workers and Bank Executives on the Strategies for Improving Rural Female Farmer's Access to Appropriate Technologies

S/N	Strategies towards Improving Access to Appropriate Technologies	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_3$	SD_3	$\bar{X}_g$	R
1	Joining cooperatives to get information on the use of agricultural technologies	3.42	0.50	3.42	0.52	3.38	0.51	3.40	IW
2	Competent extension services to teach female farmers how to use machines	3.20	0.48	3.12	0.50	3.08	0.47	3.05	IW
3	Government policies to regulate standards	3.40	0.49	3.22	0.51	3.18	0.48	3.30	IW
4	Enlightenment campaigns by extension officers	2.76	0.52	2.78	0.54	2.74	0.51	2.76	IW
5	Well-detailed user's manual of agricultural technologies	3.42	0.50	3.24	0.52	3.20	0.49	3.32	IW
6	Availability of agricultural technologies	3.24	0.51	3.26	0.53	3.22	0.50	3.24	IW
7	Provision of competent extension agents to explain user's manual of technologies to farmers	3.36	0.52	3.38	0.54	3.34	0.51	3.36	IW
8	Sending innovative agricultural practices to rural women through extension services	3.44	0.53	3.46	0.55	3.42	0.52	3.44	IW
9	Making available agricultural research findings to rural women	3.45	0.54	3.48	0.56	3.42	0.53	3.45	IW

$\bar{X}_1$ = Mean score of female famers; SD_1 = Standard deviation of female farmers; $\bar{X}_2$ = mean of extension agent/worker; SD_2 = Standard deviation of extension agents/workers; $\bar{X}_3$ = mean score of bank executives; SD_3 = standard deviation of bank executives; $\bar{X}_g$ = grand mean; R = Remark

Table 4 reveals that all the items had their grand mean values ranging from 2.76 to 3.45 which were allabove 2.50. This indicated that all the items were important ways towards improving female farmers' access to to appropriate agricultural technologies in rural areas of Ozubulu, Anambra State in Ozubulu, Anambra State.

Discussion

The study on strategies to improve female farmers' access to land in Ozubulu, Anambra State found that effective methods include abolishing cultural practices that prevent women from accessing land, empowering women for land ownership, implementing government policies to address women's land access, purchasing land through female cooperatives, using women's groups to advocate for their rights, protecting women's land rights, and providing training on land management and agribusiness skills. These findings align with Amalu and Anyaeche (2016), who emphasized abolishing cultures that hinder women's access to land and

using women's groups for advocacy. The study underscores the importance of addressing cultural norms that discriminate against women's land rights, consistent with Anyanwu (2018) and Chigbu and Okoye (2017), who highlighted the significance of women's empowerment and decision-making power over land resources. Empowering women to own and manage land can lead to increased investment in its productivity.

The findings of the study on strategies towards improving rural female farmers' agricultural production in Ozubulu through imrpved access to credit in Ozubulu, Anambra State, found effective strategies such as offering low-interest loans, encouraging women to join cooperative societies, implementing supportive government policies, educating women about credit sources, establishing more rural banks that consider female loan applications, increasing loan sizes for female applicants, and supporting microfinance institutions catering to female farmers. Additional strategies include strengthening women's cooperatives for collective borrowing, providing financial literacy training, developing innovative collateral alternatives like group guarantees, and offering flexible repayment schedules aligned with agricultural cycles. These findings align with Eze and Okeke (2023) on the benefits of cooperative societies and reducing interest rates. They also echo Ezeano and Nwachukwu (2019) on the need for affordable credit options, as high-interest rates are a significant barrier for female farmers with limited resources. Ezeano and Uzochukwu (2018) also support the idea that cooperative groups can enhance credit access by reducing individual risk and increasing loan eligibility.

The findings of the study on improving rural female farmers' production through access to extension services in Ozubulu, Anambra State, identified several strategies: organizing workshops on agricultural technologies, pooling resources to invite extension agents, using mass media for information dissemination, providing extension services during female meetings, implementing welfare schemes for extension workers, securing government funding for more extension workers, developing gender-sensitive extension programs tailored to rural female farmers, establishing demonstration farms, and forming peer learning groups. These findings align with Igwebuike and Anyanwu (2017), who emphasized government intervention in funding more extension agents. The study's emphasis on accurate information dissemination mirrors Ogueri and Chigbu (2019), highlighting the role of extension agents in spreading scientific knowledge. The use of mass media for reaching rural women with agricultural updates is supported by Okeke and Chukwu (2018), who advocate for radio, television, and mobile phone apps as effective tools for modern agricultural extension.

The findings of the study on improving rural female agricultural production in Ozubulu through access to appropriate agricultural technologies identified several strategies. These include joining cooperatives for information on agricultural

technologies, utilizing competent extension services, implementing government policies to regulate standards, conducting enlightenment campaigns, providing detailed user manuals, ensuring the availability of technologies, and sending innovative practices and research findings through extension services. These findings align with Nduka and Ejezie (2017), who emphasized the role of extension services in educating farmers on necessary skills, and with Ogbuabor and Okoye (2018), who advocated for campaigns to encourage the adoption of appropriate technologies. The study's emphasis on cooperatives for technology information is consistent with Okeke and Chukwu (2023), highlighting the importance of collective action and knowledge sharing in technology adoption.

Conclusion

The findings underscore the need for holistic, gender-responsive approaches to address the various barriers faced by these farmers.Abolishing cultural practices that restrict women's land rights and empowering women to own land can significantly enhance their agricultural productivity. Providing rural female farmers with affordable credit options, encouraging their participation in cooperative societies, and implementing gender-sensitive financial policies are essential for their economic empowerment.Extension officers must deliver accurate information, organize educational workshops, and ensure that their services are gender-sensitive. This will help female farmers adopt best practices and improve their productivity. Membership in cooperatives, competent extension services, user-friendly manuals, and access to innovative practices are all necessary to equip female farmers with the tools they need to succeed.

Recommendations

Based on the findings of the study, the following are recommended;

1. Government authorities should enforce policies that protect women's land rights, ensuring secure land tenure for rural female farmers to provide long-term farming stability.
2. Government authorities should implement land redistribution programs targeting rural female farmers to promote equitable access and reduce land inequality, enhancing agricultural productivity and livelihoods.
3. Agricultural extension services should be improved by employing more agents and providing resources to ensure rural female farmers receive accurate information and training.
4. Agricultural technology developers should create user-friendly, detailed manuals to facilitate the adoption and effective use of technologies by rural female farmers.
5. Encourage female rural farmers to join cooperatives and women's groups to enhance collective bargaining, access to credit, resources, and information.

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Evaluation of Response of Selected Watermelon (Citrullus Lanatus) Growth and Yield Attributes to Pig Manure in Owerri, South Eastern Nigeria

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Abstract

The general objective of this study was to evaluateresponse of selected watermelon growth and yield attributes to pig manure in Owerri, South Eastern Nigeria. Specifically, it determined response of watermelon to four rates of pig manure in terms of number of leaves produced per plant, vine length per plant, number of fruits harvested per plant and weight of fruits harvested per plant. The field experiments were conducted in 2020 and 2021 cropping seasons in the Teaching and Research Farm, Agricultural Science Department, Alvan Ikoku Federal University of Education, Owerri, Imo State, Nigeria. The investigation was carried out in a Randomized Complete Block Design with three replications. Treatments were composed of pig manure rates of 0, 5, 10, 15 tons per hectare. Parameters studied were number of leaves per plant, vine length per plant, number of fruits harvested per plant and weight of harvested fruits per plant. Data were subjected to Analysis of Variance (ANOVA) test and significant treatment means were separated using Least Significant Difference (LSD) protocol. Results obtained from the two experiments conducted show plants that received application of pig manure at the rate of 15 tons per hectare were outstanding in terms of vine length at 4weeks after planting (79.96 cm in 2020 and 58.93cm in 2021), 6 weeks after planting (162.46cm in 2020 and 89.73cm in 2021) and 8 weeks after planting (201.36cm in 2020 and 187.06 cm), number of leaves at 4 weeks after planting(25.50 in 2020 and 33.96 in 2021), 6 weeks after planting (28.50 in 2020 and 39.63 in 2021), 8 weeks after planting (31.10 in 2020 and 42.96 in 2021), number of fruits (4 fruits/plant in 2020 and 6 fruits/plant) as well as fruit weight(10kg in 2020 and 8kg in 2021) and is therefore to recommended for watermelon cultivation in Owerri, South Eastern Nigeria.

Keywords: Evaluation, Response, Growth, Yield, Attributes, Watermelon, Pig Manure, Owerri.

Introduction

Watermelon (*Citrulluslanatus*) is a warm season crop in the cucurbit family (Otunaiya and Adedeji, 2014). It is a crop with huge economic and nutritional benefits to man (Schippers, 2000; Schaffer and Paris, 2016). It is a highly nutritious, sweet, thirst-quenching fruit vegetable and it is relished by many people across the world due to its high water, sugar, and

vitamins A, B and C, content (Aniekwe and Nwokwu, 2013; Nthiga *et al.*, 2014). Watermelon contains one of the most important antioxidants in nature called lycopene which has been implicated in preventing cancer attack in humans thus making the watermelon fruit to be classified as anti-cancer (Ezeh, *et al.*, 2021). Potassium is also present in watermelon in huge amounts, which is believed to help in the control of blood pressure and possibly prevent stroke (Enujeke, 2013) Watermelon contains other phytochemicals such as beta - carotene, vitamin C which possess anti – inflammatory properties. These help to reduce hypertension and some coronary heart diseases due to the inhibition of the formation of free radicals in the human body system (Tarazona-Diaz *et al.,2011;* Maoto *et al.*, 2019) Watermelon is a rich source of L-citrulline (Perkins-Veazie, *et al.,2012).* Watermelon is known to reduce the inflammation that contributes to conditions like asthma, atherosclerosis, diabetes, colon cancer, arthritis (Tarazona-Diaz *et al.*,2011). It has diuretic properties (Nthiga *et al.*, 2014). The demand for watermelon for consumption in a fresh form as a thirst quencher and as a source of minerals and vitamins is greatly increasing globally (Dalorima, *et al.*,2022), hence, the need to increase the production of watermelon.

Watermelon like most vegetables is cultivated all over the world. In Nigeria, it is most widely cultivated in the Northern Nigeria but greatly consumed in the Southern Nigeria (Poly-Mbah, *et al.*,2008, 2012b). Farmers incur a lot of losses in transporting watermelon fruits from Northern Nigeria where it is produced to Southern Nigeria where it is consumed (Poly-Mbah, *et al.*, 2010a ,2010b and 2012a) This is responsible for the high market price which vegetables including watermelon command in South eastern Nigeria. There is a need for massive watermelon production in the South Eastern Nigeria where watermelon is highly consumed. One major way of increasing the production of watermelons is through optimum organic fertilizer application. Soil fertility management using organic fertilizer amendment is a relatively new strategy (Eifediyi *et al.*, 2018). Researches have shown that some tropical soils are low in plant nutrients, and proper manuring can truly play a major role in increasing crop productivity (Audi *et al.*,2013).

The use of organic manure in the cultivation of vegetables is preferred to the use of inorganic fertilizers because organic fertilizers have shown some positive results and also prevents any attack from soil micro-organisms that may be harmful to plants (Massri and Labban, 2014). It has been affirmed that organic manure amendment enhances crop growth and development as it is a source of minerals and important nutrients which are capable of releasing adequate nutrients and it aids in binding the nutrient in soils together (Azeez and Van Averbeke, 2010; Miranda *et al.*, 2012). Crops need slow releasing fertilizer so as to increase nutrient availability for the plant and lower the maintenance and labour cost during growing period. The use of inorganic fertilizers in crop production poses health risks as it has been found to be carcinogenic and contributes to environmental issues such as

contamination of the air, water, and soil. Chemical fertilizers use has a negative impact on soil texture and structure, as well as lowering soil organic matter and inhibiting soil microbial activity owing to toxicity (Dalorima *et al.*, 2022).

Some researchers have published reports on the use of poultry manure for the production of watermelon in South Eastern Nigeria (Enujeke, 2013; Dalorima *et al.*, 2022) but the sustained release of nutrients in poultry manure is inadequate. It has been found that poultry manure releases nutrients faster and it does not give the sustained release needed for the yield phase of some crops. Hence, there is a need to investigate the production of watermelon fruits in South Eastern Nigeria using other organic fertilizer sources. One of the other widely used organic fertilizer sources is pig manure. With increased pig farming, pig manure is readily available to crop growers who need them. Use of pig manure in fertilizing crop farms is a major way of controlling the pollution caused by pig rearing industry (Song *et al.*,2012). The difficulty in transferring the pig slurry from the pig rearing factories to farmlands for utilization can be solved by drying it before the transfer.

It has been reported that pig manure is a low cost organic fertilizer and it is effective as a good source of nutrients for sustainable crop production (Lourenzi *et al.*, 2014 ; Enujeke *et al,* 2021and Lijun and Shenfa, 2022). It can be used to replace inorganic fertilizers needed to fertilize crop fields. Pig manure has a more sustained way of releasing nutrients while the poultry manure releases its nutrient faster and may not sustain the plant all through the fruiting stage (Massri and Labban, (2014)).

However, research findings have revealed that the application of swine waste (pig manure) at the rate of 20 tons/ha could lead to toxic levels of sulphate in crop produce (Mbah *et al.*, 2005). There is no documented evidence on pig manure requirement of watermelon in Owerri, South Eastern Nigeria. There is a need therefore to determine the pig manure requirement for watermelon cultivation in Owerri, South Eastern Nigeria

Objectives of the Study

The general objective of the study was to evaluate the response of selected watermelon growth and yield attributes to pig manure in Owerri, South Eastern Nigeria. Specifically, it determined the response of watermelon to four rates of pig manure in terms of:

1. number of leaves produced per plant,
2. vine length per plant,
3. number of fruits harvested per plant
4. weight of fruits harvested per plant.

Materials and Methods

***Design of the Study*:**The two field experiments were laid out using the Randomized Complete Block Design with three blocks (replications) and four (4) treatments. Each replication comprised four plots to give a total of twelve plots in each of the experiments.

***Materials Used for the Study*:** Watermelon seeds were procured from the seeds supplied by the KUCH-99 (Thai Agro) seeds at the State Headquarters of the Agricultural Development Programme, Owerri. Well cured/dried pig manure was collected from a pig farm in Owerri. Equipment

used for the study include a tractor with its implements, weighing balance, measuring tape, spade, hoe and matchet.

***Description of the Experimental Site*:** The two field experiments were conducted in the Department of Agricultural Education Teaching and Research Farm, Alvan Ikoku University of Education, Owerri in 2020 and 2021 late session cropping in a typical humid environment that is characterized by a bimodal rainfall pattern with peaks in July and September and an interrupted dry spell in August otherwise called August break. Alvan Ikoku University of Education, Owerri is located in the South Eastern Nigeria between latitude 5° 15' and 5 ° 45'N and longitude 7 °30' and 6 °45'E. The site has been under the cultivation of vegetable crops for considerable number of years.

***Field Preparation*:**The field for the two experiments were cleared manually, ploughed, harrowed using a tractor and divided into three blocks.Each block wassub-divided into four plotswith each plot measuring 4.5 x 4.0 m with furrow distance of 0.6m and 1.0m between blocks.

The plots were experimental units or seedbeds to which treatments were applied. Raised beds were manually prepared in each of the plots. Treatments comprised four rates of well cured pig manure (0, 5, 10, and 15 tons/ha). Treatments were allocated to plots randomly within each block. The four rates of pig manure were incorporated into the soil two weeks before planting.

***Seed Planting*:**Seeds were planted at the rate of two seeds per stand/hole using 2m x 2m planting spacing. Planting was done using the garden hoe by digging up to 4cm depth and covering the hole gently with soil.

***Agronomic Measurements*:** Selected agronomic measurements taken were;

***Measurement of Vine Length*:**The vine length was measured from the base of plants to the growing tip of the main vine using a flexible metric tape. The main vine was traced from the base of the plant and extending to the tip of the vine. The vine length was measured at intervals of 14 days.

***Number of Leaves and Number of Harvested Fruits*:**Number of leaves per plant and number of mature fruits were obtained by direct counting. Mature fruits were selected based on marketable sizes. Immature fruits as well as malformed and diseased fruits were discarded. Harvestable fruits were counted per plant and recorded.

***Weight of Harvested Fruits*:**Weight of harvested fruits per plant were determined in kilogrammes immediately after harvest using a weighing scale. This is called fresh weight of fruits.

***Data Analysis*:**Data were analyzed using means and Analysis of Variance (ANOVA) test.Significant treatment means were separated using the Least Significant Difference (LSD)protocol. The decision rule is that if the difference between two treatment means is greater than the LSD value, it means that the two treatment means are statistically and significantly different. If the difference between two treatment means is less than the LSD value, it means that those two treatment means are equal or the same.

Results

Table 1: Effects of Pig Manure on Leaf Number at 4,6,8, and Weeks after planting

Manure rates	Expt. 1 4 WAP	Expt.2 4 WAP	Expt. 1 6 WAP	Expt. 2 6 WAP	Expt.1 8 WAP	Expt. 2 8 WAP
0 tons/ha	10.10	13.53	13.30	25.76	16.10	30.40
5tons/ha	16.20	31.63	22.30	33.53	26.50	35.86
10tons/ha	21.10	23.30	26.40	34.43	28.30	38.74
15tons/ha	25.50	33.96	28.50	39.63	31.10	42.96

	4 WAP	6 WAP	8 WAP
$LSD_{0.05}$ for Expt. 1	0.30	0.40	0.30
$LSD_{0.05}$ for Expt. 2	0.52	0.28	0.17

*$LSD_{0.05}$ = Least significance difference at 0.05 level of significance
WAP = Weeks after planting
Tons(tonnes) = Quantity of manure applied. One ton/tonne is equal to 1000kg
Ha = Hectare (10000m^2)
Expt. 1= Experiment 1 carried out in 2020
Expt. 2 = Experiment 2 conducted in 2021

In Table 1, which is a table of means, show that plants that received 15 tons/ha of pig manure were significantly outstanding in terms of number of leaves/plants at 4, 6, and 8 weeks after planting (WAP). Data in Table 1 reveals that the trend in the two experiments conducted was such that as the pig manure rate increased, the number of leaves produced per plant increased, such that the plants that did not receive pig manure (0 tons per hectare) produced the lowest leaf number at 4 weeks after planting(10.10 in 2020 and 13.53 in 2021), 6 weeks after planting (13.30 in 2020 and 25.76 in 2021) and 8 weeks after planting (16.10 in 2020 and 30.40 in 2021), while the plants that received the highest manure rate of 15tons per hectare produced the highest leaf number at 4 weeks after planting(25.50 in 2020 and 33.96 in 2021), 6 weeks after planting (28.50 in 2020 and 39.63 in 2021) and 8 weeks after planting (31.10 in 2020 and 42.96in 2021). There were significant differences among all the treatments as shown when the differences between the means were compared with the $LSD_{0.05}$ values. The differences between the means are greater than the $LSD_{0.05}$value.

Table 2: Effects of Pig Manure on the Vine Length (Cm) of the Watermelon at 4, 6 and 8 Weeks After Planting.

Manure Rate	**Expt. 1**	**Expt. 2**	**Expt. 1**	**Expt. 2**	**Expt. 1**	**Expt. 2**
	4WAP	**4 WAP**	**6WAP**	**6 WAP**	**8WAP**	**8 WAP**
0tons/ha	16.32	25.73	31.21	31.73	41.44	61.40
5 tons/ha	60.38	56.40	117.44	70.30	137.24	148.53
10tons/ha	73.98	34.60	131.30	81.83	155.47	165.20
15tons/ha	79.96	58.93	162.46	89.73	201.36	187.06

	4 WAP	6WAP	8 WAP	
$LSD_{0.05}$ for Expt.1	0.5		0.7	0.8
$LSD_{0.05}$ for Expt. 2	11.02		7.04	14

*$LSD_{0.05}$ = Least significance difference at 0.05 level of significance
WAP = Weeks after planting
Tons(tonnes) = Quantity of manure applied. One ton/tonne is equal to 1000kg
Ha = Hectare (10000m^2)
Expt. 1= Experiment 1 carried out in 2020
Expt. 2 = Experiment 2 conducted in 2021

Results obtained from the two experiments conducted and presented in a table of means , show that there were significant differences in vine length of watermelon as affected by pig manure rates (Table 2).From the research results obtained from the two experiments conducted (2020 and 2021) as presented in table 2, it was observed that as the pig manure rate increased, the vine length of watermelon also increased such that pig manure rate of 0 tons per hectare significantly produced the least values at 4weeks after planting (16.32 cm in 2020 and 25.73cm in 2021), 6 weeks after planting (31.21cm in 2020 and 31.73cm in 2021) and 8 weeks after planting (41.44cm in 2020 and 61.40 cm), while the manure rate of 15 tons per hectare significantly produced the highest values at 4weeks after planting (79.96 cm in 2020 and 58.93cm in 2021), 6 weeks after planting (162.46cm in 2020 and 89.73cm in 2021) and 8 weeks after planting (201.36cm in 2020 and 187.06 cm),. There were significant differences among all the treatmentsas shown when the differences between the means were compared with the $LSD_{0.05}$ values. The differences between the means are greater than the $LSD_{0.05}$value.

Table 3 – Effects of Pig Manure on Number of Fruits and Fruit Weight (Kg) Per Plant at Harvest

Manure	**Fruit Number**		**Fruit Weight**	
Rate	**Expt. 1**	**Expt. 2**	**Expt. 1**	**Expt. 2**
0 tons/ha	1	1	3.31	2.13
5tons/ha	2	2	6.43	5.73
10 tons/ha	3	4	8.74	6.93
15tons/ha	4	6	10.07	8.0

Fruit number	Fruit weight	
$LSD_{0.05}$ for Expt. 1	0.1	0.3
$LSD_{0.05}$ forExpt. 2	0.15	0.2

*$LSD_{0.05}$ = Least significance difference at 0.05 level of significance
WAP = Weeks after planting
Tons(tonnes) = Quantity of manure applied. One ton/tonne is equal to 1000kg
Ha = Hectare (10000m^2)
Expt. 1= Experiment 1 carried out in 2020
Expt. 2 = Experiment 2 conducted in 2021

Data obtained on the number of harvestable fruits and weight of harvested fruits showed that the plants that received 15 tons/ha significantly performed best among other treatments (Table 3). Results in Table 3 reveal significant differences among all the treatments in terms of number of fruits produced and weight of harvested fruits as shown when the differences between the means are compared with the $LSD_{0.05}$ values. The plants that received pig manure at the rate of 15tons per hectare significantly produced highest number of fruits per plant (4 fruits per plant in 2020 and 6 fruits per plant in 2021) and fruit weight (10.07kg in 2020 and 8kg in 2021) while the plants that did not receive pig manure treatment significantly performed poorly.

Discussion

Pig manure use as a fertilizerfor crop production has gained popularity due to its advantage of having slow release of nutrients (Miranda *et al*, 2012; Ibrahim *et al.,* 2021; Lijun and Shenfa, 2022). Results show that plants that received 15 tons/ha of pig manure were outstanding in terms of number of leaves per plants, vine length per plant at 4, 6, and 8 weeks after planting. This may be attributed to the release of nitrogen contained in pig manure which enhanced vegetative growth of watermelon. Increased vegetative growthshows that the manure applied was utilized effectively.

Data collected and analyzed showed that as the pig manure rate increased from 0 tons per hectare to 15 tons per hectare, the pig manure application rate of 15tons/per hectare produced the highest number of leaves of watermelon such that plants that received 15 tons of manure consistently produced highest number of leaves at 4 weeks after planting(25.50 in 2020 and 33.96 in 2021), 6 weeks after planting (28.50 in 2020 and 39.63 in 2021) and 8 weeks after planting (31.10 in 2020 and 42.96) . Similarly, the observed response of vine length of watermelon revealed that watermelon responded significantly to pig manure application such that as the pig manure application rate increased from 0 tons per hectare to 15 tons per hectare, the pig manure rate of 15tons/per hectare produced the highest vine length at 4weeks after planting (79.96 cm in 2020 and 58.93cm in 2021), 6weeks after planting (162.46cm in 2020 and 89.73 in 2021) and 8 weeks after planting (201.36cm in 2020 and 187.06 cm). This confirms the findings of a study carried out by Enujeke *et al.*,2021 in Asaba, Delta State, Nigeria where the effects of pig manure on the growth and yieldof watermelon were studied using five rates of the manure (0.5,10,15 and 20 tons per hectare).Theresults from that study indicated that the assessed parameters increased as manure level increased. Plants that received 20 tons per hectare of manure gave the best performance at 4,6 and 8 weeks after planting with respect to vine length and number of leaves. However, the investigation here reported did not study up to 20 tons per hectare of manure treatment because it has been found out that manure levels up to 20 tons per hectare and above could lead to toxic levels of sulphate in crop produce (Mbah *et al.,* 2005). Similarly, in a work

done by Eze *et al.,* 2021, it was found out that increased manure levels increased the growth and yield parameters studied. The results obtained from the experiment on the number of leaves per plant were in conformity with the studies made by Massri and Labban (2014). The implication of this finding is that watermelon cannot be grown successfully without the addition of organic manure with particular reference to pig manure. This is confirmed by a publication made by Aliyu, 2000 who stated that pig manure contains useful proportions of essential and major nutrients that sustains plant growth. Further researches have shown that tropical soils are low in plant nutrients, and proper manuring can truly play a major role in increasing crop productivity (Audi, *et al.*,2013; Enujeke, *et al.*,2013). The implication is that pig manure contains essential plant nutrients that encourages high photosynthetic rate which results in high vegetative growth (Ibrahim *et al.*,2021).

The significant high number of fruits and fruit weight as a result of manure application such that as manure rate increased, fruit number and fruit weight also increased, in which the number of fruits per plant and fruit weight were significantly increased with increased pig manure application. Watermelon plants that received pig manure application of 15 tons per hectare produced the highest number of fruits in the two experiments conducted (4 fruits per plant in 2020 and 6 fruits per plant in 2021) and also the highest fruit weight (10.07kg in 2020 and 8kg in 2021). This result tallies with the findings made by Mangila, 2007; Jianquang *et al.*, 2011; Aniekwe and Nwokwu, 2013; Enujeke ,2013;Eifediyi , 2018 and Dalorima, *et al.*, 2022) This result shows that application of pig manure at the rate of 15 tons/ha not only improved the soil conditions for watermelon establishment but also released adequate nutrient elements for yield enhancement. This finding is in line with reports made by Jianquang, *et al.*, 2011; Hassan and Solaiman, (2012); Pandolfo and Viega, (2016) and Enujeke *et al.,* 2021 who established through research studies that the use of organic fertilizers promotes vegetative growth in crops and consequently higher yields.

Conclusion

Fourparameters were assessed to achieve the objectives of the study which include vine length, number of leaves, number of harvested fruits and weight of fruits of watermelon. Increased rate of application of the manure resulted in corresponding increases in the parameters study.The findings of tis study confirm that the application of pig manure significantly affected all the parameters studied in the two experiments conducted in 2020 and 2021, such that the pig manure rate of 15 tons gave the highest values in all the parameters studied. It can therefore be concluded that watermelon vine length, number of leaves, number of fruits, and weight of fruits are significantly higher when the soil is treated with pig manure.

Recommendations

Based on the findings of the study,it is recommended that:

1. watermelon should not be grown without the application of organic fertilizer such as pig manure.
2. farmers in Owerri, South Eastern Nigeria should apply pig manure at the rate of 15 tons per hectare for increased growth and yield of watermelon.

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Micronutrient and Phytochemical Composition of Jansa (*Cussonia bateri)* Seed, A Lesser Known and Underutilized Spice in South Eastern Region of Nigeria

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Abstract

The objective of this study was to evaluate micronutrient and phytochemical compositions of jansa (*Cussonia bateri*) seed, an under-utilized spice in South Eastern Region of Nigeria. Specifically, the study determined mineral composition of the *Cussonia bateri* seed, vitamin contents of the *Cussonia bateri* seed, and phytochemical contents of *Cussonia bateri* seed. The seeds of *Cussonia bateri* were procured from Orie Ugba Market in Umuahia. The seeds were sorted, washed with water, oven dried using hot air oven at 55^{o}C for 6 hours and milled into powder. The mineral, vitamin and phytochemical contents of the spice were determined using standard analytical methods. The data were analyzed and presented as means of triplicate analyses. Results showed that the spice contained appreciable amounts of calcium (37.34mg/100g), iron (1.13mg/100g), phosphorus (47.72mg/100g), potassium (69.67mg/100g) and some B group vitamins (2.69mg/100g thiamin, 0.90mg/100g riboflavin, 0.70mg/100g niacin and 0.64mg/100g pyridoxine). It also contained 3.07mg/100g flavonoids and 2.29mg/100g polyphenols. The micronutrient and phytochemical compositions of the spice were comparable to those of many other well-known indigenous spices, and incorporating this spice in dietscan contribute significantly to nutrients intakes of people in South-Eastern Nigeria and beyond. Again, the phytochemicals (flavonoids and polyphenols) contained in the spice are antioxidants that prevent degenerative diseases; hence, creation of awareness of benefits its consumption in diet through nutrition education is recommended.

Keywords: *Cussonia bateri,* Jansa, Seed, Lesser-Known, Underutilized, Spice, Micronutrients, Phytochemicals

Introduction

One of the most challenging issues in the world today is how to provide sufficient food to more than seven billion people around the globe (Perez-Escamilla*et al*., 2017). Food security is a complex, multifaceted concept usually influenced by culture, environment and geographical location. The Food and Agriculture Organization of the United Nations gave a clear definition of food security at five different levels

(individual, household, national, region and global), as when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for active and healthy life (Perez-Escamilla*et al*., 2017).

Underutilized crops are those plant species with their potentials, not fully exploited, to contribute to food security andwhose nutritional or dietetic utility has not been fully documented or understood (Agulanna, 2020). Underutilized crops provide valuable macronutrients such as carbohydrates, proteins, fats, and micronutrients such as vitamins and minerals, as well as bioactive non-nutrients that contribute to dietary health (Fanzo et al., 2013; Dulloo *et al*., 2014). It is however, argued that the potential of most indigenous crops has not been fully exploited, hence their underutilization (Perez-Escamilla*et al*., 2017). Under-valued crops if well-harnessed, can play a great role in promoting food security not only in Africa but also globally (Agulanna, 2020).

Spices are dried components of plants obtained from the seeds, fruits, roots, bark or other non-leafy part which are used for their aromatic and flavorful qualities in food preparation and manufacturing, therapeutic qualities and other beneficial qualities. Spices have been an integral part of culinary culture around the world and have a long history of use for flavouring, colouring, aroma, and as enhancing agents and for preservation of foods (El-Sayed and Youssef, 2019). Spices are popular among Nigerians, although most of the Nigerian spices are grown in the wild (Olife *et al*., 2013).

The immense food applications of spices has resulted in overdependence on convectional spices resulting to underutilization of some novel indigenous spices. However, the possible health risks associated with the consumption of synthetic antioxidants has led to an increasing necessity for utilization and consumption of natural spices not only because of their safety, but also as a result of increased consumer interest and knowledge of health benefits of natural foods. In Nigeria, over dependence on a few available spice remains a major challenge.

Cussonia bateri (C. bateri) is an underutilized crop and its seeds are known in Nigeria as*ugbaokwe* in Igbo,*sigo* in yoruba, *takandagiwa* in hausa, while the seeds are called jansa seeds in Cameroun, *bolo koro* in Senegal and *kokobidua* in Ghana (Nwokonkwo, 2013). *C. bateri* is common in Northern Nigeria; it is a small twisted savanna tree with thick corky bark. The leaves are oborate with lateral nerves; the flowers are greenish-white, with whitish fruits. In some places such as in Northern Nigeria, the seed of *C. bateri* is used in soup and has a pleasant aroma and sweet taste (Nwokonkwo *et al*., 2016).

The phytochemical results on the seeds of *C. bateri* revealed the presence of alkaloid, flavonoid, tannin, saponin, glycoside and phenol which indicated that the seeds could be useful medicinally (Nwokonkwo, 2013). Igbe *et al*. (2018) also reported that *C. bateri* are rich in phytochemicals such as rich in saponins, flavonoids, phenols, and alkaloids. Extracts and components isolated from the plant have

demonstrated neuropharmacological, anti-larvicidal, anti-microbial, anti-inflammatory and antioxidant activities. Ethno-medicinally, *C. bateri* is used in Africa as an analgesic, anti-malarial, anti-inflammatory, anti-anaemic, anti-diarhoea, anti-poison, anti-pyschotic and anti-epileptic agent (Igbe *et al*., 2018).

Despite the health benefits and potential food applications of *C. bateri*, the crop is underutilized (Nwokonkwo *et al*., 2016). There is also dearth of information in literature on the nutrient composition of *C. bateri* despite its health benefits and potential food applications. Its evaluation will therefore, go a long way to promote its utilization in food preparation not only in South Eastern Nigeria but worldwide.

Objectives of the Study

The general objective of this study was to evaluate the micronutrient and phytochemical compositions of *Cussonia bateri,* (jansa) seedan under-utilized spice in South Eastern Region of Nigeria.Specifically, the study determined:

1. mineral composition of *Cussonia bateri* seed
2. vitamin composition of *Cussonia bateri* seed
3. phytochemical composition of *Cussonia bateri* seed.

Materials and methods

***Research design*:** Experimental design was adopted for this study.

***Procurement of materials*:** Wholesome seeds of *Cussonia barteri* were procured from Orie Ugba market, Umuahia, whereas reagents that were used for analyses were obtained from the Biochemistry Laboratory, National Root Crops Research Institute, Umudike, Abia State.

***Sample preparation*:** The method described by Nkwocha et al. (2019) was used in processing *C. barteri* spice. Fresh matured seeds of *Cussonia barteri* (500 g) were sorted, washed with water, oven-dried at 55°C for 6 hours and milled into fine powder using hammer mill and packaged in a polythene pack.

***Micronutrient (mineral and vitamin) determination*:** The calcium, magnesium, potassium, iron, zinc and sodium contents of the spice were determined by flame atomic absorption spectrometric method according to methods ofAOAC (2010). Jaway digital flame photometry was setup according to the manufacture's instruction. Phosphorus content was determined according to the method described by Onwuka (2018) using hydroquinone as a reducing agent. The methods described by Onwuka (2018) were employed in the determination of vitamin contents of the spice.All the determinations were done in triplicates.

***Phytochemical determination*:** Total polyphenols was determined using Folin and Ciocalteu's method as described by Onwuka (2018). Total flavonoids (TF) content of the spice was determined using the modified method of Onwuka (2018). The AOAC (2010) spectrophotometric method was used for the determination of phytate and tannin contents of the spice. All the determinations were done in triplicates.

***Data analysis techniques*:** Data were analyzed using means and standard deviations of triplicate determinations.

Results

Mineral contents of jansa seeds spice

Table 1: Mineral Contents (mg/100g) of Jansa Seeds Spice

Sample	Calcium	Magnesiu	Phosphorus	Potassium	Iron	Zinc
Jansa seed spice	37.34±0.06	22.89±0.07	47.72±0.08	69.67±0.08	1.13±0.04	0.84±0.04

Values are means ± standard deviation of triplicate determinations

Table 1 shows the mineral contents of jansa seeds spice. The calcium content of the jansa seeds spice was 37.34 mg/100g, its magnesium content 22.89 mg/100g, and phosphorus 47.72 mg/100g. The potassium content was 69.67 mg/100g, the zinc content 0.84 mg/100g, and the iron content 1.13 mg/100g. The Table also shows that the zinc content of the jansa seeds spice was 0.84 mg/100g, and its sodium content 34.70 mg/100g.

Vitamin contents of jansa seeds spice

Table 2: Vitamin Contents (mg/100g) of Jansa Seeds Spice

Sample	Thiamin	Riboflavin	Niacin	Pyridoxine	Ascorbic acid
Jansa seed spice	2.69±0.04	0.90±0.05	0.70±0.07	0.64±0.04	4.93±0.04

Values are means ± standard deviations of triplicate determinations

Table 2 shows the vitamin contents of jansa seeds spice. The Table shows that the seed had lowest content of pyridoxine (0.64 mg/100g) and highest content of ascorbic acid (4.93 mg/100g).

Phytochemical Properties of Jansa Seeds Spice

Table 3: Phytochemical Properties of Jansa Seeds Spice

Sample	Tannin (mg/100g)	Flavonoid (mg/100g)	Polyphenol (mg/100g)	Phytate (mg/100g)
Jansa seed spice	6.45±0.06	3.07±0.07	2.29±0.05	0.82±0.05

Values are means ± standard deviation of triplicate determinations

Table 3 shows the phytochemical properties of jansa seeds spice. The Table shows that the spice contained 6.45mg/100g of tannin, 3.07mg/100g of flavonoid, 2.29mg/100g polyphenol and 0.82mg/100g of phytate.

Discussion

The calcium content of the jansa seeds spice (37.34 mg/100g) was lower than 187.33 mg/100g found in aidan fruit spice (Nzebo *et al*., 2019), and 64.80 mg/100g) reported for scent leaf spice (Paul *et al*., 2018). The presence of calcium in the jansa seeds spice is of great benefit since its intake aids in preventing osteoporosis and colorectal adenomas, reducing hypertensive disorders of pregnancy, lowering of blood pressure especially among youths, lowering of cholesterol levels (Cormick and Belizan, 2019).

The magnesium content of the jansa seeds spice (22.89 mg/100g) was lower than 35.54 - 85.66 mg/100g reported for some commonly used spices in the

South-eastern part of Nigeria (Okonkwo and Ogu, 2014). The presence of magnesium in jansa seeds spice is of nutritional importance since magnesium is a vital element required as a cofactor for numerous enzymatic reactions and is thus, essential for several metabolic processes (Gerry and Stephen, 2017).

The phosphorus content of the jansa seeds spice (47.72 mg/100g) was higher than 0.80 - 1.62 mg/100g in ginger, black pepper, African nutmeganduziza seed (Okonkwo and Ogu, 2014). The presence of phosphorus in the jansa seeds spice will be of nutritional benefits considering that phosphorus plays a vital role in human body by activating enzymes catalysis, functioning in critical manner to produce and store calorie in phosphate bonds, and regulating gene transcription (O'Brien *et al*., 2012).

The potassium content of the jansa seeds spice (69.67 mg/100g) was higher than 6.93 - 8.67 mg/100g reported for six genotypes of aidan spice from Nigeria (Chinatu *et al*., 2017). The presence of potassium in the jansa seeds spice will contribute in playing a vital role in maintenance of cell function, lowering the risk of hypertension which cause development of stroke, coronary heart disease, heart failure, and end-stage renal disease and in reduction of risk of diabetes (Stone *et al*., 2016).

The iron content of the jansa seeds spice (1.13 mg/100g) was lower than 2.52 - 3.76 mg/100g reported for some commonspices in the South-eastern part of Nigeria (Okonkwo and Ogu, 2014). Presence of iron in jansa seeds spice will contribute in playing an imperative role in signaling of neuron, as it is needed for myelination of spinal cord and white matter of central nervous system in brain (Soetan *et al*., 2010).

The zinc content of the jansa seeds spice (0.84 mg/100g) was higher than 0.39 mg/100g was reported in *uziza* leaf (Ojinnaka *et al*., 2016), but lower than 135.91 mg/100g reported for African nutmeg spice (Onimawo *et al*., 2019). The presence of zinc in the jansa seeds spice suggests that its consumption will contribute in playing a vital role in human teeth, bones, muscles, nerves and brain function as well in enhancement of growth (Devi *et al*., 2014).

The thiamin content of jansa seeds spice (2.69 mg/100g) was higher than 0.13 mg/100g obtained in Ethiopian pepper (Bolu and Balogun, 2015), and was within the range (1.23 to 6.97 mg/100g) found in selected Nigerian spices (Ameh *et al*., 2016). Presence of thiaminin the jansa seeds spice spice implied that its consumption will contribute in playing a principal role in so many metabolic reactions that occurs in the human body especially, in metabolism of carbohydrate and protein required for energy generation, and functioning of the heart, nervous system and muscles (Chaitanya *et al*., 2012).

The riboflavin content of the jansa seeds spice (0.90 mg/100g) was higher than 0.21 mg/100g reported as riboflavin content of Ethiopian pepper (Bolu and Balogun, 2015), and 0.05 to 0.44 mg/100g reported for selected Nigerian spices (Ameh *et al*., 2016). The higher riboflavin content obtained in the jansa seeds spice suggests that its intake will contribute to preventing a wide array of diseases such as hyperglycemia, hypertension, migraine,

cancer, diabetes mellitus and oxidative stress (Kiran *et al*., 2016).

The niacin content of jansa seeds spice (0.70 mg/100g) was higher than 0.07 mg/100g found in *uziza* leaf spice (Ojinnaka *et al*., 2016). Presence of niacin in food products is vital as it plays a role in metabolic processes which help the body utilize sugars, proteins, and fatty acids to create energy (Wardlaw and Smith, 2011).

The pyridoxine content of the jansa seeds spice (0.64 mg/100g) was lower than 1.34 to 2.20 mg/100g reported for five local spices used in Nigeria (Okorafor *et al*., 2019). However, the presence of pyridoxine in the jansa seeds spice indicated that its consumption will contribute in playing important role in the body as it is needed to maintain the health of nerves, skin and red blood cells (Wardlaw and Smith, 2011).

The jansa seeds spice had ascorbic acid content of 4.93 mg/100g which was within the ascorbic acid content range (1.32 to 4.97 mg/100g) of *Piper guineense, Xylopia aethiopica, Ocimum gratisimum, Ricinus communis*,and *Pergularia daemia* commonly consumed in Nigeria (Dodo *et al*., 2020). Consumption of jansa seeds spice will contribute in maintenance of healthy gums, bone formation, wound healing, and in protection of the body from damage of free radicals.

The flavonoids of the jansa seeds spice (3.07 mg/100g) was lower than values reported in aqueous extracts of ginger (5.10 mg/100g), bird pepper (6.21 mg/100g) and nutmeg [4.18 mg/100g] (Akeem *et al*., 2016). However, the presence of flavonoids in the jansa seeds spice is of immense benefit considering that flavonoids have antioxidant, antifungal and antibacterial properties.

The polyphenol content of the jansa seeds spice (2.29 mg/100g) was higher than polyphenol content of *Zingiber officinale* spice (0.10 mg/100g) and *Allium sativa* spice [0.00 mg/100g] (Ali *et al*., 2018]). The higher the polyphenol content of a food material, the higher its tendency to aid in antioxidant and antimicrobial activities which exert preventive activity against inflammation and allergies via antioxidant, antimicrobial and proteins /enzymes neutralization/modulation mechanisms, and against degenerative diseases (Ozcan *et al*., 2014).

The phytate content of the jansa seeds spice (0.82 mg/100g) was lower than 10 - 60 mg/100 g which can decrease bioavailability of minerals and is also detrimental to human health (Elinge *et al*., 2012). There is evidence that dietary phytate at low levels may have beneficial role as an antioxidant and anticarcinogens and play an important role in controlling hypercholesterolemia and atherosclerosis (Phillippy *et al*., 2004).

Conclusion

This study revealed that jansa seeds, an indigenous lesser known or underutilized spice are a potential source of micronutrients such as calcium, magnesium, phosphorus, potassium, iron and zinc needed for bone health, body development and metabolism. The mineral, vitamin and phytochemical properties of jansa seeds spice compared favourably with other indigenous and well known spices. The phytochemical compounds present in

the spice such as flavonoids and polyphenol make it beneficial for prevention and control of chronic degenerative diseases such as cancer when incorporated into regular foods. The phytate and tannin contents of the jansa seeds spice are low; hence, will not pose any health hazard or decreases bioavailability of minerals, but will be beneficial to health. Incorporatingthis spice in one's daily diet is thus, vital for optimal health, and for protection from harmful effects ofenvironmental pollutants and contaminants in foods.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Incorporation of this spice as integral part of healthy nutritious diets to reduce incidence of non-communicable diseases.
2. Nutrition education of the public on the benefits of consumption of Jansa seed spice is recommended.
3. Further studies should be carried out on Jansa seed spice to confirm its therapeutic benefits.

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Entrepreneurial Readiness of Business Education Students in Public Universities in South-East Nigeria

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Abstract

This study focused on entrepreneurial readiness of undergraduate Business Education students in public universities in South-East Nigeria. Entrepreneurial readiness of the students was based on four indicators.Population comprised 277 final-year Business Education students in all public universities in South-East Nigeria. Questionnaire was used for data collection.Entrepreneurial readiness scores (ERS) were measured using four indicators: entrepreneurial career choice preference, intention, attitudes, and skills. Five research questions and four hypotheses guided the study. Data were analyzed using mean and t-test at a 0.05 level of significance. The indicators and ERS were interpreted based on real limits of numbers. The results indicate that the students had mean scores of 5.71, 5.62, 5.50 and 6.07 for entrepreneurial career choice preference, intention, attitudes and skills, respectively and were 'ready' with an ERS of 5.73. The ERS of the students did not differ significantly based on gender, having a parent/guardian entrepreneur, currently owning/managing a business (business experience), or academic ability level. It was therefore recommended, among others, that an entrepreneurship-friendly environment and provisions should be made available to enable the Business Education students to translate their entrepreneurial readiness into viable enterprises.

Keywords: Entrepreneurial, Readiness, Career, Choice, Preference, Attitude, Family, Intention

Introduction

Business Education is one of the study options provided under technical and vocational education, having entrepreneurship development as one of its core aspects/objectives. It is an academic programme, which is aimed at imparting its recipients with the requisite attributes such as knowledge, skills, and attitudes to become gainfully employed in the world of work (Amesi & Sobere, 2023; Oche et al., 2021). Business education has also been described as a discipline which is geared towards equipping the students with knowledge and employability skills, to enable them to create or acquire jobs (Oguejiofor, 2020).Business Education is defined thus academic and vocational programme which provides knowledge, skills and experiences that will enable its students to create and

manage businesses or to become effective business educators. It is an entrepreneurship-related discipline.

Business Education students are individuals pursuing higher education in the field of business, aiming to acquire the knowledge, skills and competencies needed to succeed in the world of business (Ezeabii et al., 2019). The students are exposed to skills in office practice, bookkeeping, accounting, sales management, business communication, word processing and advertising (Oluwadare et al., 2022). According to the National Universities Commission (NUC, 2014) curriculum document, Business Education students are trained to become effective business teachers, as well as high-calibre professionals in business establishments. This agrees with the tenets of entrepreneurship education which also aims at getting its students ready to engage in entrepreneurial activities after graduating from the university. Business education students are considered to have an advantage over other students in the university, who are only exposed to the compulsory university general Entrepreneurship courses (Ezeabii, & Ohagwu, 2019). Despite this seeming advantage, low levels of entrepreneurial skills and intention, which are crucial for entrepreneurial readiness, have been reported among business education graduates (Edet & Udida, 2019).

Readiness for any given vocation or career path is defined by Villares and Brigman (2018) as possessing requisite cognitive, and social skills or experiences, which can facilitate the transitioning from school into the workplace, and enable the individual to succeed in the chosen career path. In addition, readiness is defined as having the intention, personal beliefs, motivation, abilities, and behaviours that make for building a career that that meets the expectations of the individual (Azhenov et al., 2023). Measures of students' readiness are also employed in assessing the effectiveness of educational programmes (Perera et al., 2018). In the context of this study, entrepreneurial readiness means that an individual has the requisite entrepreneurial choice, intention, attitudes, and skills to successfully pursue an economically viable entrepreneurial activity or career.

Students, especially when close to graduation, are faced with a major decision regarding career choice, either to seek employment in an organization or to become self-employed (Azhenov et al., 2023; Longva, 2018). Entrepreneurial career choice preference refers to the decision to opt for self-employment rather than seek employment after graduation (Bae et al., 2014). Thus, the entrepreneurial career choice preference of students is an important indicator as to whether they are inclined to pursue entrepreneurship after graduation or not.

Entrepreneurial intention has to do with a person's desire to own or set up a business enterprise, which might be at some point in the future, as a part-time engagement or side attraction (Bae et al., 2014; Otache et al., 2021). It is the possession of the objective or plan to launch a business firm, which reflects the extent to which an individual seriously considers becoming an entrepreneur (Lee et al., 2022). Entrepreneurial intention, which is a

precursor to entrepreneurial behaviour, is shaped by attitudes which are in turn shaped by beliefs that certain behaviour will lead to favourable outcomes (Ajzen, 1991; Lee et al., 2022).

Entrepreneurial attitude refers to the personal dispositions and traits that are required for engaging and succeeding in entrepreneurial activities. It is a measure of how a person thinks and feels about entrepreneurship (Amofah & Saladrigues, 2022). According to Amofah and Saladrigues (2022), attitudes may be categorized as instrumental (regarding whether the behaviour is perceived as enjoyable) or affective (regarding whether the behaviour is perceived as beneficial). Attitudes are shaped by beliefs that certain behaviours will lead to favourable outcomes, and the attitude an individual has towards behaviour is a predictor of intention towards such behaviour (Ajzen, 1991). Thus entrepreneurial attitude is a predictor of entrepreneurial intention, which in turn predicts actual entrepreneurial behaviour (Banning & Chinta, 2019).

Entrepreneurial skills are the capabilities that are requisite for an individual to successfully develop original, viable and valuable entrepreneurial projects, products or services (Jardim, 2021). They are regarded as core competencies that are inculcated into the operation of business ventures, which can steer businesses towards success through accurate perception of opportunities and proper usage of resources (Ngele & Nzelibe, 2023). Entrepreneurial skills are essential for an entrepreneurship career or venture creation and occupy a vital place in the journey from being entrepreneurial to becoming a successful entrepreneur (Olorundare & Kayode, 2014). According to Olorundare and Kayode (2014), entrepreneurship traits include the ability to take calculated risks; ability to formulate effective venture teams; evolvement of creative and problem-solving skills; as well as fundamental skills in formulating feasible and sustainable business plans.

Despite the increasing awareness and attention given to entrepreneurship and entrepreneurship education in recent times, there seem to be existing gaps between the entrepreneurial training of students and the eventual translation of this education into the creation of new business ventures by the students after graduation. Business Education students have not been proven to be any better as studies have suggested that the job-seeking mindset still persists in the graduates as they continue to search for not-readily-available white-collar jobs after leaving the university (Edokpolor & Muritala, 2018). According to the National Bureau of Statistics (NBS, 2024), the combined rate of unemployment and underemployment of university graduates, including Business Education graduates, as of the third quarter of the year 2023 was reported to be 17.3%, which is quite high. Lack of entrepreneurial intention, attitude and skills by graduates may be a major contributor to the problem of unemployment in Nigeria since the possession of these entrepreneurship prerequisites would enable the graduates to create jobs rather than roaming the streets looking for non-existing jobs. More so, earlier studies

have shown that only a very low percentage of graduates aspire to start up their own businesses upon graduation. This underscores the need to ascertain the current situation regarding the entrepreneurial readiness of Business Education students, being in an entrepreneurship-related discipline.

Objectives of the Study

The general objective of the study was to assess the entrepreneurial readiness of Business Education students in public universities in South-East Nigeria. Specifically, the study determined levels of Business Education students in public universities based on the following indicators of readiness:

1. career choice preference level
2. intention level
3. attitude level
4. skills level
5. readiness score

Research Questions

What are the entrepreneurial readiness levels of Business Education students in public universities based on the following indicators of readiness:

1. career choice preference level?
2. intention level?
3. attitude level?
4. skills level?
5. readiness score?

Research Hypotheses

There is no significant difference between entrepreneurial readiness mean ($\bar{x}$) scores of Business Education students based on the following:

$H0_1$: gender

$H0_2$: having parent/guardian entrepreneur

$H0_3$: business experience

$H0_4$: academic ability level

Methodology

***Design of the Study*:** The study adopted the descriptive survey study design to assess the entrepreneurial readiness of undergraduate Business Education students in public universities in South-East Nigeria.

***Area of the Study*:** The study was carried out in South-East Nigeria, which comprises Abia, Anambra, Ebonyi, Enugu and Imo States. South-East Nigeria is one of the six geopolitical zones in Nigeria, and is predominantly inhabited by the Igbo speaking Nigerians. The study was conducted in all the (seven) public universities (Federal and State) that offer Business Education programme.

***Population for the Study*:** The study population comprised all 277 final year Business Education students in the above-mentioned seven universities. The entire population was used for the study; no sampling was done because of the manageable size of the population. The population consisted of males (29.11%) and females (70.89%); those who do not have an entrepreneur parent/guardian (22.07%) and those who do (77.93%); those who do not presently own/manage a business (44.60%) and those who do (55.40%); and those at low (20.19%) and high (79.81%) academic ability levels.

***Instrument for Data Collection*:** A seven-point scale questionnaire was used for data collection. It covered the specific objectives and demographic information. Development of items was based on literature review.Questionnaire items response options were assigned numerical values

as follows: highly agree (HA) = 7, agree (A) = 6, slightly agree (SA) = 5, undecided (U) = 4, slightly disagree (SD) = 3, disagree (D) = 2, and highly disagree (HD) = 1 (for positively worded items and reverse-coded as for negatively worded items). The instrument was face-validated by five experts in Business Education.The instrument was also trial-tested prior to the actual study by administering 30 copies to Business Education students outside the study area. Data collected were analyzed and yielded an overall Cronbach's alpha reliability coefficient of 0.94.

***Data Collection Method*:**A total of 277copies of the questionnaire were administered hand to respondents, in their classrooms, with the help of a trained research assistant in each of the seven institutions. Out of 277 questionnaires administered only 213 were retrieved.This represents 77 percent response rate.

***Data Analysis Techniques*:** Data were analyzed using mean and t-test at a 0.05 level of significance. The mean responses of the respondents were interpreted based on real limits of numbers as follows: 6.50 - 7.0 = HA; 5.50 - 6.49 = A; 4.50 - 5.49 = SA; 3.50 - 4.49 = U; 2.50 - 3.49 = SD; 1.50 - 2.49 = D and 1.00 - 1.49 = HD (for positively worded items and the reverse was the case for negatively worded items). The entrepreneurial readiness score (ERS) was determined as the overall mean of the students' mean scores in entrepreneurial career choice preference, intention, attitude and skills. The ERS was also interpreted based on real limits of numbers as follows: 6.50 - 7.0 = highly ready (HR); 5.50 - 6.49 = ready (R); 4.50 - 5.49 = slightly ready (SR); 3.50 - 4.49 = undecided (U); 2.50 - 3.49 = slightly not ready (SNR); 1.50 - 2.49 = not ready (NR) and 1.00 - 1.49 = highly not ready (HNR). The t-test was employed to test the null hypotheses at the 0.05 level of significance.

Results

Table 1: Mean Responses on Entrepreneurial Career Choice Preference Indicator of Entrepreneurial Readiness

S/N	Indicators of career choice preference	$\bar{X}$	SD	Remark
1.	I prefer entrepreneurship as a career option	6.38	0.82	A
2.	I prefer starting my own business rather than seek for a job	6.28	0.90	A
3.	I consider entrepreneurship as a desirable career option	6.20	1.03	A
4.	I would rather be my own boss than have a secure job	6.26	1.03	A
5.	I would rather found a new company than be the manager of an existing one	5.70	1.24	A
6.	I will choose to be an entrepreneur to have freedom at work	6.02	1.28	A
7.	I will choose a career as an employee in an organization (R)	3.13	1.70	SA
	Cluster mean	5.71	0.62	A

$\bar{X}$= mean, SD = standard deviation, HA = highly agree, A = agree, SA = slightly agree, U = undecided, SD = slightly disagree, D = disagree, HD =highly disagree, R = reverse-coded

Table 1 describes the responses relating to entrepreneurial career choice preference (ECCP). The students' mean response was highest for the statement "I prefer entrepreneurship as a career option" ($\overline{X} = 6.38$), and lowest for the reverse-worded statement "I will choose a career as an employee in an organization" ($\overline{X} = 3.13$). The cluster mean score of the respondents for ECCP is 5.71. This indicates that the respondents "Agree" to the items in the table. The standard deviation of the items ranged from 0.82 - 1.70 showing that respondents were not too far from one another in their responses.

Table 2: Mean Responses on Entrepreneurial Intention Indicator of Entrepreneurial Readiness

S/N	Indicators of Entrepreneurial Intention	$\overline{X}$	SD	Remark
1.	I am determined to create a business venture after graduation from the university	6.40	0.89	A
2.	I am saving money to start my own business	5.93	1.18	A
3.	I am searching for business start-up opportunities	5.98	1.09	A
4.	I spend time learning about starting a business firm	5.94	1.16	A
5.	I already have a business plan for my own business	5.87	1.15	A
6.	I do not see myself becoming an entrepreneur (R)	4.83	2.08	SD
7.	I have never given much thought to starting and owning a business enterprise (R)	4.86	2.09	SD
8.	I do not have plans to launch my own business (R)	5.15	2.01	SD
	Cluster mean	5.62	0.83	A

$\overline{X}$= mean, SD = standard deviation, HA = highly agree, A = agree, SA = slightly agree, U = undecided, SD = slightly disagree, D = disagree, HD =highly disagree, R = reverse-coded

Table 2 describes the responses relating to entrepreneurial Intention (EI). The students' mean response was highest for the statement "I am determined to create a business venture after graduation from the university" ($\overline{X} = 6.40$), and lowest for the reverse-worded statement "I do not see myself becoming an entrepreneur" ($\overline{X}$=4.83). The cluster mean score of the respondents for EI is 5.62. This indicates that the respondents "Agree" to the items in the table. The standard deviation of the items ranged from 0.89 - 2.01 showing that the respondents were not too far from one another in their responses.

Table 3: Mean Responses on Entrepreneurial Attitudes Indicator of Entrepreneurial Readiness

S/N	Indicators of Entrepreneurial Attitudes	$\overline{X}$	SD	Remark
1.	Being an entrepreneur would give me great satisfaction	6.58	0.73	HA
2.	Looking out for business opportunities really excites me	6.14	1.08	A
3.	I am eager to have my own business	6.36	0.94	A
4.	Brainstorming for new solutions to problems is something I really enjoy doing.	5.95	1.11	A
5.	Lack of financial means does not stop me becoming an entrepreneur	5.23	1.66	SA
6.	An unsupportive climate will not hinder my	5.31	1.64	SA

Table 3 continued

	entrepreneurship			
7.	A career as an entrepreneur is totally unattractive to me (R)	5.06	1.99	SD
8.	Amongst various options, I would rather be anything but an entrepreneur (R)	3.83	2.31	U
9.	Being an entrepreneur implies more disadvantages than advantages to me (R)	5.00	2.09	SD
10.	I would abhor stressful situations at work (R)	3.61	1.97	U
11.	I am willing to take investment risks even if I might lose	5.76	1.30	A
12.	I pay attention to details and accuracy	6.23	0.92	A
13.	Problems I encounter do not distract me from achieving my goals	5.98	1.21	A
14.	I easily recognize and handle my own emotions	5.98	1.06	A
	Cluster mean	5.50	0.66	A

$\bar{X}$= mean, SD = standard deviation, HA = highly agree, A = agree, SA = slightly agree, U = undecided, SD = slightly disagree, D = disagree, HD =highly disagree, R = reverse-coded

Table 3 describes the responses relating to entrepreneurial Attitudes (EA). The students' mean response was highest for the statement "Being an entrepreneur would give me great satisfaction" ($\bar{X} = 6.58$), and lowest for the reverse-worded statement "I would abhor stressful situations at work" ($\bar{X} = 3.61$). The overall mean score of the respondents for EA is 5.50. This indicates that the respondents "Agree" to the items in the table. The standard deviation of the items ranged from 0.73 - 2.31 showing that respondents had some level of disparity in their responses.

Table 4: Mean Responses on Entrepreneurial Skills Indicator of Entrepreneurial Readiness

S/N	Indicators of Entrepreneurial Skills	$\bar{X}$	SD	Remark
	I possess the ability to:			
1.	identify business opportunity around me	6.25	0.79	A
2.	write a detailed business plan/feasibility report	5.83	1.08	A
3.	develop network with people from different backgrounds	5.94	0.92	A
4.	work cooperatively with others	6.35	0.76	A
5.	generate new business ideas easily	6.06	1.02	A
6.	practically start a business	6.16	0.93	A
7.	identify different ways of getting things done with limited resources	6.02	0.95	A
8.	lead a business organization	6.23	0.96	A
9.	market my ideas in form of products or services	6.12	1.01	A
10.	be decisive when making important decisions	5.91	1.24	A
11.	create and come up with new ideas	6.16	0.91	A
12.	proffer solutions to business problems	6.15	0.91	A
13.	negotiate my terms with others	6.04	0.91	A
14.	perform multiple tasks	5.88	1.21	A

Cluster mean	6.08	0.61	A

$\bar{X}$ = mean, SD = standard deviation, HA = highly agree, A = agree, SA = slightly agree, U = undecided, SD = slightly disagree, D = disagree, HD =highly disagree

Table 4 presents the responses relating to entrepreneurial Skills (ES). The students' mean response was highest for the statement "I possess the ability to work cooperatively with others" ($\bar{X}$ = 6.35), and lowest for the statement "I possess the ability to write a detailed business plan/feasibility report" ($\bar{X}$ = 5.83). The overall mean score of the respondents for ES is 6.08. This indicates that the respondents "Agree" to the items in the table. The standard deviation of the items ranged from 0.76 - 1.24 showing that respondents were not too far from one another in their responses.

Table 5: Entrepreneurial Readiness Score (ERS) of Respondents

S/N	Clusters of Entrepreneurial Readiness Indicators	$\bar{X}$	SD	Remark
1.	Entrepreneurial Career Choice Preference	5.71	0.62	Agree
2.	Entrepreneurial Intention	5.62	0.83	Agree
3.	Entrepreneurial Attitudes	5.50	0.66	Agree
4.	Entrepreneurial Skills	6.07	0.61	Agree
	Total mean (Entrepreneurial Readiness Score)	5.73	0.53	Ready

$\bar{X}$ = mean, SD = standard deviation

Table 5 presents the entrepreneurial readiness score (ERS) of respondents. The ERS (i.e. overall mean) of the respondents is 5.73. The Table further revealed that the respondents had mean scores of 5.71, 5.62, 5.50 and 6.07 in entrepreneurial career choice preference, intention, attitudes and skills respectively. The standard deviations of the indicators and ERS ranged from 0.53 - 0.83 showing that values were not too far from one another.

Table 6: t-test Results Comparing Entrepreneurial Readiness Scores of Respondents based on Demographic Characteristics

Variables	Categories	n*	ERS	SD	t	df	p	Decision
Gender	Male	62	5.68	0.49	.917	211	.360	Accept $H0_1$
	Female	151	5.75	0.55				
Parent/ guardian entrepreneur	No	47	5.70	0.50	-.454	211	.651	Accept $H0_2$
	Yes	166	5.74	0.54				
Own/ managing a business	No	95	5.72	0.55	-.121	211	.904	Accept $H0_3$
	Yes	118	5.73	0.51				
Academic ability level	Low	43	5.74	0.54	.280	211	.780	Accept $H0_4$
	High	170	5.72	0.53				

n = number of respondents; * Total number of respondents in each case (N) = 213; ERS = entrepreneurial readiness score; SD = standard deviation; t = t-statistic; df = degrees of freedom; p = p-value; significance level = 0.05

Table 6 presents the results of the test of hypotheses. The results show that there was no significant difference ($p > 0.05$) in the entrepreneurial readiness of the students based on gender ($H0_1$), having a parent/guardian entrepreneur ($H0_2$), currently owning or managing a business ($H0_3$), and academic ability level ($H0_4$). Therefore, all the null hypotheses are accepted.

Discussion

The overall positive inclination of Business Education students towards entrepreneurship as a career option, as reflected in their high mean scores for most items, implies that the students desire self-employment. This has implications for their future career paths and their potential contribution to economic growth and job creation. The finding of this study regarding entrepreneurial career choice preference agrees with the reports of other researchers (Ahmed et al., 2021; Lidovolo & Iravo, 2016). Lidovolo and Iravo (2016) reported a significant entrepreneurial career choice preference among polytechnic students in Kenya. They conceptualized that entrepreneurial culture (comprising early exposure to entrepreneurship, and role models), individual preference (comprising desire for profit, desired independence, desired way of life) and individual capabilities (comprising entrepreneurial skills and self-efficacy) were factors affecting the number of students who opt for entrepreneurship as a career.

The findings on the entrepreneurial intention of Business Education students highlight the respondents' proactive and forward-thinking mindset in pursuing entrepreneurship. This bodes well for the future of entrepreneurship, as these students may become the driving force behind innovative business ventures and economic growth. Similar to the findings of this study, Kurniawati et al. (2020) reported high entrepreneurial intention among undergraduate students, which stimulates them for an entrepreneurial career. Moreover, the study of Ugwu and Ugwu (2012) revealed ethnicity as a factor that significantly affected entrepreneurial intention, such that the respondents who were of Igbo ethnicity were shown to have higher entrepreneurial intention scores compared to those of Tiv ethnicity. This could also explain the result of this present study since it was carried out in southeast Nigeria which is predominantly of Igbo ethnicity, and notable for a long history of entrepreneurship and an innate enterprising culture.

The students' positive entrepreneurial attitude as observed in this study is important as favourable attitudes are often considered a precursor of entrepreneurial behaviour and intention (Ajzen, 1991). The finding suggests a favourable inclination towards entrepreneurial endeavours among the respondents. Such positive attitudes are crucial for nurturing and encouraging the growth of

entrepreneurs in society. Several studies have reported a positive connection between entrepreneurial attitudes, intention and behaviour (Kolapo et al., 2023).

The result of this study on entrepreneurial skills indicates a self-perceived proficiency in the identified entrepreneurial skills. Such self-assessment is crucial for individuals considering entrepreneurship as it provides them with confidence and a foundation to build upon. This observation, however, is in contrast with Edokpolor and Muritala (2018), who said that most educated graduates in Nigeria were lacking in the skills that would enable them to confidently engage in entrepreneurial activities in life.

The observed entrepreneurial readiness score (ERS) of Business Education students, which indicated that the students are entrepreneurially "ready", is an interesting finding. It suggests that, on average, the respondents possess the social, knowledge and mental capital (Pardiman & Abs, 2020) for entrepreneurship ventures. It further implies that the students possess the attitudes and skills sets needed to identify business opportunities and to engage them profitably (William & Rodhiah, 2022). These entrepreneurial-ready students thus make up a pool of emerging entrepreneurs, with the potential to create jobs in the near future and contribute to national economic development. The students are therefore an important asset for the nation in the light of the current high level of unemployment National Bureau of Statistics (NBS, 2024). Others studies, such as Samsudin et al. (2016) reported a moderate level of entrepreneurial readiness in University students in Malaysia, while Savellano (2022) reported a high level of readiness in students in the Philippines.

The findings further indicated that the students' entrepreneurial readiness does not vary significantly based on the gender of the students, implying that males do not necessarily have higher entrepreneurial readiness than females. Similarly, Adeniyi et al. (2024) found no gender difference in the entrepreneurial readiness of students of TVET colleges in Lagos, Nigeria. In contrast, some empirical studies have reported that male students generally have a higher inclination or intention to form a new business than females (Hutasuhut et al., 2021). In addition, having a parent/guardian entrepreneur or not, did not affect the ERS of the students. This finding agrees with that of Göksel and Aydintan (2011) who reported no significant influence of family business on individuals' entrepreneurial tendencies. However, on the contrary, Lingappa et al. (2020) and Kusumojanto et al. (2021) opined that the family plays a pivotal role in shaping the entrepreneurial attitudes and intentions of individuals.

Similarly, whether one presently owned or managed a business did not significantly impact the students' entrepreneurial readiness. This finding is in contrast with Ugwu and Ugwu (2012), who reported students' business backgrounds to be a positively significant predictor of entrepreneurial intention. The finding of this study thus suggests that other factors, such as education, training, personal traits, and

experiences, might play a more influential role in shaping the students' readiness for entrepreneurship (Kusumojanto et al).

Finally, the ERS of students with high academic ability levels did not differ significantly compared to those with low academic ability. The academic ability/performance of students has been positively associated with their mental health, well-being and eventual career success (Wang & Sheikh-Khalil, 2014). However, similar to the findings of this study, Panda and Arumugam (2023) found no significant direct impact of entrepreneurial intention on the academic performance of university students. Since the entrepreneurial readiness of the students did not vary based on academic ability level, it implies that students can develop entrepreneurial competencies irrespective of their academic ability levels.

Conclusion

This study provides an assessment of the entrepreneurial readiness of university undergraduate Business Education students and also provides some basis for future research in this area. Based on the findings, the study concludes that undergraduate Business Education students in Southeast Nigeria, are entrepreneurial-ready. The students possess an appreciable level of the requisite entrepreneurial career choice preference, intention, attitudes and skills. Thus, the Business Education students make up a potential pool of emerging entrepreneurs. This indicates an enormous human capital that could be harnessed to drive economic growth, innovation, and job creation.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. government should improve infrastructure such as good road networks and constant electricity supply, among others, to harness the entrepreneurial readiness of the students.
2. Targeted interventions and relevant start-up incentives should be provided by corporate organizations, non-governmental organizations and other stakeholders to enable the students to translate their entrepreneurial readiness into actual business enterprises.
3. students should take practical steps towards translating their readiness into start-ups by developing business proposals with which they can apply for available grants from relevant funding organizations.
4. tertiary institutions should increase awareness of students on available start-up grants and provide coaching/ mentoring programmes that prepare students to write successful grant proposals.

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Effect of Sorghum Leaf Sheath and Extract on Chemical and Sensory Properties of Boiled Cowpea

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Abstract

The study assessed effect of sorghum leaf sheath and extract on the chemical and sensory properties of boiled cowpea. Cowpea seeds, sorghum leaf sheath, salt, pepper and palm oil were purchased from Rumuokoro Market in Port-Harcourt, Rivers State. Materials were sorted, weighed and prepared. Samples were produced using standard methods.Samples were assessed for proximate, energy, mineral, phytochemical content and sensory properties using standard methods of analysis. Data were analyzed using means and standard deviation, analysis of variance and Duncan Multiple Range test. Results show, among others, moisture content was highest (58.27%) in sample boiled with sorghum leaf sheath while ash content did not differ significantly ($p>0.05$) among the samples and ranged between 2.01% and 2.92%. Cowpea boiled with palm oil had the highest fat (10.53%), energy (237.93 kcal) and lowest protein content (8.84%). Crude fibre differed significantly among the samples and was highest in cowpea boiled with sorghum leaf sheath (1.85%). Carbohydrate varied significantly with cowpea boiled with sorghum leaf sheath extract having the highest (31.13%). Calcium (11.94mg) and zinc (1.74mg) was highest in cowpea boiled with sorghum leaf sheath extract while phosphorus was highest (11.41mg) in cowpea boiled with palm oil. Cowpea boiled with palm oil had the highest values for carotenoid (3.34mg) and alkaloid (7.95%) when compared with other samples. Saponin (8.42%) was highest in cowpea containing sorghum leaf sheath. Boiled cowpea samples varied significantly in their colour, flavour, taste and overall acceptability while texture did not vary significantly. Cowpea boiled with palm oil was the most preferred having higher mean scores for all the sensory attributes. Cowpea boiled with sorghum leaf sheath compared favourably with the one containing palm oil in all sensory attributes.

Keywords: Cowpea, Colour, Chemical, Sensory, Sorghum leaf sheath, Extract, Properties.

Introduction

Sensory evaluation is a scientific means of assessing consumers' acceptability of food products by analyzing and interpreting the reactions of consumers in relation to the characteristics of food products as perceived by the sense organs (Mbela, *et al*, 2018). Some of the sensory characteristics of foods include colour, appearance, taste, aroma and texture. Colour is the most important

sensory attribute of foods that affects consumers' preference and acceptability of foods. It is usually the first sensation perceived by the consumer and is used to judge the quality of the food and influences the decision to accept or reject the food. Beleya, Allen and Eke-Ejiofor (2023) noted that sensory appeal has a greater influence on consumers' choice of foods than the nutrient composition. Food manufacturers use different food colours to improve the appearance, increase the colour intensity and obtain a more stable or uniform colour (Farzianpour *et al*., 2013).

Food colour is any pigment which impart colour when added to food (Novais *et al*., 2022).Dey and Nagabadu, (2022) defined food colour as any dye or other substances that produces colour when added to food, drink or beverage. Food colour could be natural or synthetic. Several natural and synthetic food colours are used in the food industry and for home cooking. Synthetic food colours are chemicals obtained from coal tar derivatives, most of which contain dyes from the azo group (Zahra,*et al*., 2015). Synthetic food colours are a major source of food intoxication (Saleem, Umar and Khan, 2013). Some synthetic food colours however, do not pose appreciable risk to the health of the consumer when used within the permissible limits (Mittal, 2020). The use of non-permitted and indiscriminate use of permitted synthetic food colours results in severe health problems such as low haemoglobin concentration, allergic reactions, mutations, cancers, irritability, sleeping disturbances, asthma, various effects on the liver, kidney and intestine and hyperactive effects in children (Bachalla, 2016; Dey and Nagababu, 2022).

Consumers' awareness of the adverse health effects of synthetic food colours has increased the use of natural food colours (Varghese and Ramamoorthy, 2023). Natural food colours can be obtained from plants, insects, algae and fungi (Novais *et al.,* 2022). They are ecofriendly, biodegradable, have no disposal problems and their mode of production involve minimum possibility of chemical reactions (Joshi, *et al*., 2011; Abdeldaiem, 2013). Natural food colours are as effective as synthetic colours; they are safer, provide additional health benefits and organoleptic characteristics (Novais *et al.,* 2022).

One of the natural food colours used traditionally in Nigeria and parts of West Africa is the dye from sorghum leaf sheath. The leaf sheath is the part of the leaf that wraps around the stem. Sorghum leaf sheaths contain bioactive compounds with antioxidant properties such as anthocyanin, phenols and flavonoids (Tugli *et al*., 2019). The colouring ability of sorghum leaf sheath is due to the presence of anthocyanins. Sorghum leaf sheath is used as a food colour either by adding the sheaths to food during cooking or by using the extract as the cooking liquid. Sorghum leaf sheath and its extract are used to add or enhance the colour of foods such as cereals, legumes, fermented cereal-based porridges such as pap and fruit drinks. A popular Ghanaian dish known as 'waakye' is usually prepared with boiled beans and rice with sorghum leaf sheath as a colouring

agent (Tugli *et al*., 2019). The leaf sheath is also used to add colour to boiled cowpea (doungouri) in Benin republic and other parts of West Africa (Akogou,*et al*., 2018).

Cowpea (*Vigna unguiculata*) is a legume which belongs to the family *Fabaceae*. It is amongst the most consumed legumes and one of the cheapest sources of plant protein in the diet of most Nigerians (Barber, *et al*., 2010). It contains two or more times more protein than cereals and root/tuber crops (Goncalves, *et al*., 2016). Cowpea is rich in phytochemicals, minerals and other nutrients that promote health. Studies have been carried out on nutruient composition of cowpea(Omenna, *et al*., 2016).

Cowpea can be processed into different forms for consumption. It is usually boiled alone or mixed with cereals and eaten with stew or sauce or made into pottage and consumed alone or with cereal gruel such as pap. They can also be made into products such *"akara"* and *moi-moi*. Cowpea pottage is usually prepared by adding palm oil to boiled cowpea. The addition of palm oil enhances the colour and sensory appeal and could add other nutrients to the dish.

Palm oil is one of the most widely used edible oils by households.It contains 50% saturated fatty acid, 40% monounsaturated and 10% polyunsaturated fatty acid with palmitic acid being the predominant saturated fatty acid (Tan *et al*., 2021).It is also rich in phytonutrients such as carotenoids, tocopherols, sterols, phospholipids and polyphenols (May and Nesaretnam, 2014). The colouring ability of palm oil is due to the high amount of carotenoid which is a precursor of vitamin A and also responsible for its orange-red colour. The high content of saturated fatty acids in palm oil could be a risk factor for the development of cardiovascular diseases. The saturated fats in palm oil have the same effect on cholesterol (Low density lipoproteins)as that of animal fat (Sun *et al*, 2015). It is appropriate to limit the use of palm oil when preparing meals for individuals requiring low fat diets such as the obese, diabetic, cardiovascular diseases and hypercholesteremia patients. Natural food colours such as sorghum leaf sheath and its extracts add colour without increasing the fat content of the food. Thus, the study aimed at assessing the effect of sorghum leaf sheath and extract on the chemical and sensory properties of boiled cowpea.

Purpose of the study

The broad purpose of the study was to assess effect of sorghum leaf sheath and its extract on the chemical and sensory properties of boiled cowpea. Specifically, the study determined the effect sorghum leaf sheath and its extract on:

1. proximate (moisture, ash, protein crude fibre, carbohydrate) and energy composition of boiled cowpea.
2. mineral (calcium, magnesium, zinc, phosphorus) composition of boiled cowpea.
3. phytochemical (carotenoid, alkaloid, saponin) composition of boiled cowpea.
4. sensory properties (colour, flavour, taste, texture, overall acceptability) of boiled cowpea.

Material and Methods

***Design of the Study*:** Experimental research design was used for the study.

***Procurement of Materials*:** Cowpea (*Vigna unguiculata*) seeds, sorghum leaf sheaths, pepper and salt were purchased from Rumuokoro Market in Port-Harcourt, Rivers State. The chemicals used for analysis wereof analytical grade and were obtained from the Laboratory of the Department of Food Science and Technology, Rivers State University, Port-Harcourt Rivers State.

***Preparation of the Samples*:** Cowpea seedswere sorted, weighed, soaked the in 500ml of boiled water for 10 min and washed.The method described by Omenna *et al*., (2016) with slight modification was used to prepare the four different samples, follows:

(1) Plain boiled cowpea (Negative control) (PBC)
(2) Cowpea boiled with sorghum leaf sheath (SLC)
(3) Cowpea boiled with sorghum leaf sheath extract (SEC)
(4) Cowpea boiled with plain oil (Positive control) (POC)

Similar recipe and preparation method were applied to each of the four samples, except the four sample treatments as follows:

Ingredients	**Quantity**
Cowpea seeds	200g
Dried pepper (ground)	0.6g
Salt	0.6g
Water	1500ml

Preparation Method

1. Put water, salt and pepper into a saucepan.
2. Added the cowpea seeds and placed over medium heat on a gas cooker.
3. Boiled for 70 minutes and removed from the heat source.

***Chemical Analysis*:** The samples were packed in airtight plastic containers and stored in the refrigerator prior to analysis. All analysis was done in duplicate.

***Determination of Proximate Composition*:** The proximate compositions of all the boiled cowpea samples were determined according to AOAC (2012). Appropriate formula was used for calculation of contents:

***Moisture*:** Five grams (5g) of each sample was weighed into a can of known weight and dried in an oven at 105^{o}C for 16 hours. The can and content were cooled in a dessicator and weighed.

***Ash*:** Five grams(5g) of the sample was weighed into a crucible and put in the muffle furnace at 550^{o}C. When ashed, it was cooled in a dessicator, weighed and the percentage ash was calculated.

***Fat*:** The sample (1 g) was wrapped with a filter paper, put in an extraction flask with300 ml of hexane, mounted on the soxhlet apparatus and boiled for 4 hours. The extracted sample was removed, oven dried at 100^{o}C for 30 min, cooled and weighed.

***Protein*:** Micro Kjeldhal method was used to determine total nitrogen by boiling 0.5g of the sample in 10mls concentrated H_2SO_4using selenium ascatalyst. The digest was mixed with 10ml of 45% NaOH, 10ml of 4% boric acid and 3 drops of mixed indicator (bromocresol green/methyl red) added and 50ml of the distillate was titrated against 0.02N H_2SO_4solution until a deep red end point was obtained. The protein content was calculated by multiplying the value for total nitrogen

by 6.25 (protein-nitrogen conversion factor).

***Crude Fibre*:**Defatted sample (1g) was boiled with 150ml of 1.25% NaOH for 30 minutes, filtered, the residue washed severally with hot distilled water, drained, dried at 105^{o}C to a constant weight and ashed in a muffle furnace at 550^{o}C for 6 hours, cooled, weighed. The loss in weight was used to estimate percentage crude fibre.

***Carbohydrate and Energy Content*:** Carbohydrate was calculated by difference by adding the values for moisture, ash, fat, protein and crude fibre and subtracting it from 100. The method described by Eke-Ejiofor and Beleya (2018) was used to calculates energy content by summing the product of multiplying the Atwater factors (4:9:4) for protein, fat and carbohydrate by their percentage compositions.

***Determination of PhytochemicalComposition of the Samples*:** The following contents were determined:

***Carotenoid*:** The spectrophotometric method described by Onwuka (2018) was used. Five grams (5g) of each sample was extracted with acetone and petroleum ether (1:1 v/v) until a colourless residue was obtained. The absorbance was read at 470 nm using beta-carotene for the standard curve.

***Alkaloid*:** The alkaline precipitation method was used (Nwosu (2013). A solution was made with 5 g of the sample, 10% acetic acid and ethanol and kept at room temperature for 4 hours. It was filtered and the filtrate concentrated by evaporation and treated with conc. NH_3, filtered and the precipitate dried at 60^{o}C for 2hours, weighed and the alkaloid content determined.

***Saponin*:** This was determined by the double extraction gravimetric method as described by Nwosu (2013). One gram (1) of each sample was extracted with 20% aqueous ethanol for 12 hours, re-extracted for 30 minutes, evaporated and separated. The aqueous layer was re-extracted, the pH reduced with NaOH, re-extracted with normal butanol, dried at 60°C for 30 minutes and the percentage saponin calculated.

***Determination of Mineral Composition*:** The method described by Eke-Ejiofor, Beleya and Allen (2021) was used. The samples were digested with a mixture of perchloric (HClO4), nitric (HNO3) and sulfuric (H2SO4) acids. The digest was used for the estimation of the mineral content of the samples based on the absorbance at wavelengths of 422.6 nm (calcium), 202.6 nm (magnesium), 766.5 nm (zinc) and 625 nm (phosphorus). The concentration of minerals in the boiled cowpea samples were determined using an Atomic Absorption Spectrophotometer (AAS) (model 5100 PCAAS, Perkin Elmer, USA).

***Sensory Evaluation of Boiled Cowpea*:** The procedure described by Iwe (2010) was modified and used for the sensory evaluation.

***Panel of Judges*:** Twenty member semi trained panel made up of Staff and students of the Department of Home Science and Management, Rivers State University, Port Harcourt evaluated the samples. Participants were chosen based on their willingness and familiarity with the product.

***Instrument for Data Collection*:** instrument used was a scoring sheet based on 9-point hedonic scale of like

extremely (9 points), like very much (8), like moderately (7 points), like slightly (6 points), neither like nor dislike (5 points), dislike slightly (4 points), dislike moderately (3 points), dislike very much (2 points), and dislike extremely (1 point), (Ihekoronye & Ngoddy, 1985).

***Data Collection Procedure*:** The prepared gruels were coded as samples 1, 2, 3, and the control. Samples were randomly served to the panelists. They were to taste, score each sample, and rinse their mouths before proceeding to the next sample. The tasting was carried out in a well-ventilated and lighted place (Home Economics Food Laboratory). The sensory attributes tested and scored were texture, appearance, (colour), aroma, mouth feel and general acceptability.

***Data Analysis*:** Data were analyzed using means and standard deviation. Analysis of variance (ANOVA) was used to test for differences among the means while Duncan Multiple Range Test was used to separate the means for significant differences at $P< 0.05$. The statistical package for social sciences (SPSS) version 21.0 was used for data analysis.

Results

Table 1: Proximate and Energy Composition of Boiled Cowpea (Wet Weight Basis)

Sample	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Crude fibre (%)	Carbohydrate (%)	Energy (kcal)
PBC	$55.06^{b}\pm0.00$	$2.24^{a}\pm0.00$	$1.28^{b}\pm0.00$	$10.21^{a}\pm0.91$	$1.33^{c}\pm0.16$	$29.88^{b}\pm0.75$	$171.88^{b}\pm1.65$
SLC	$58.27^{a}\pm0.33$	$2.92^{a}\pm0.00$	$1.12^{b}\pm0.09$	$10.16^{a}\pm0.01$	$1.85^{a}\pm0.00$	$25.68^{c}\pm0.43$	$153.44^{b}\pm3.22$
SEC	$53.57^{c}\pm0.00$	$2.54^{b}\pm0.00$	$1.30^{b}\pm0.10$	$9.64^{a}\pm0.33$	$1.82^{a}\pm0.00$	$31.13^{a}\pm0.22$	$174.78^{b}\pm3.33$
POC	$50.13^{d}\pm0.01$	$2.01^{a}\pm0.74$	$10.53^{a}\pm1.37$	$8.84^{ab}\pm0.38$	$1.54^{b}\pm0.03$	$26.95^{c}\pm0.97$	$237.93^{a}\pm2.97$

Means with the same superscript along the same column are not significantly different ($p<0.05$)Key: PBC = Plain boiled cowpea, SLC = Cowpea boiled with sorghum leaf sheath, SEC = Cowpea boiled with sorghum leaf sheath extract, POC = Boiled cowpea with palm oil

Table 1 revealed that the moisture and ash contents ranged from 50.13% and 2.01% in sample boiled with palm oil to 58.27% and 2.94% in sample boiled with sorghum leaf sheath respectively. Fat content increased from 1.12% in sample boiled with sorghum leaf sheath 10.56% in sample boiled with palm oil. Protein content was highest (10.21%) in the plain boiled sample while sample boiled with palm oil had the least (8.84%). Crude fibre increased from 1.33% in the plain boiled sample to 1.85% in sample boiled with sorghum leaf sheath. Sample boiled with sorghum leaf sheath had the least carbohydrate (25.68%) and energy (153.44 kcal) values. Cowpea boiled with sorghum leaf sheath extract and the one boiled with palm oil had

the highest carbohydrate (31.13%) and energy (237.93 kcal) values respectively.

Table 2: Mineral Composition of Boiled Cowpea (mg/100g)

Samples	Calcium	Magnesium	Zinc	Phosphorus
PBC	9.45^{c}±0.01	1.64^{a}±0.02	0.91^{b}±0.09	9.42^{c}±0.02
SLC	11.10^{b}±0.01	1.59^{a} ±0.00	1.42^{a}±0.15	8.45^{d}±0.05
SEC	11.94^{a}±0.07	1.68^{a}±0.15	1.74^{a}±0.08	10.36^{b}±0.00
POC	6.15^{d}±0.11	1.61^{a}±0.11	0.93^{b}±0.12	11.41^{a}±0.29

Means with different superscript on the same column are significantly different (P< 0.05).Key: PBC = Plain boiled cowpea, SLC = Cowpea boiled with sorghum leaf sheath, SEC = Cowpea boiled with sorghum leaf sheath extract, POC = Boiled cowpea with palm oil

Table 2 shows the mineral composition of the boiled cowpea. The calcium content ranged between6.15mg in sample boiled with palm oil and 11.94mg in sample boiled with sorghum leaf sheath extract. The magnesium content of the samples did not vary significantly and was between 1.59mg and 1.68mg. Zinc increased from 0.91 mg in the plain boiled sample to 1.74 mg in sample boiled with sorghum leaf sheath extract while phosphorus ranged from 8.45 mg in sample boiled with sorghum leaf sheath to 11.36mg in sample boiled with palm oil.

Table 3: Phytochemical Composition of Boiled Cowpea

Samples	**Carotenoid (mg/100g)**	**Alkaloid (mg/100g)**	**Saponin (%)**
PBC	1.17^{b}±0.03	3.07^{b}±0.25	7.29^{a}±0.11
SLC	1.55^{b}±0.13	2.23^{c}±0.01	8.42^{a}±0.07
SEC	1.75^{b}±0.33	2.16^{c}±0.19	7.24^{a}±0.83
POC	3.34^{a}±2.25	7.95^{a}±0.22	5.10^{b}±0.32

Means with different superscript on the same column are significantly different (P< 0.05). Key: PBC = Plain boiled cowpea, SLC = Cowpea boiled with sorghum leaf sheath, SEC = Cowpea boiled with sorghum leaf sheath extract, POC = Boiled cowpea with palm oil

Table 3 shows the phytochemical composition of the cooked cowpea. The carotenoid content ranged from 1.17mg in plain boiled sample to 3.34mg in sample boiled with palm oil. Sample boiled with sorghum leaf sheath extract had the least (2.16ng) content of alkaloid while sample boiled with palm oil (7.95mg) had the highest. Saponin content varied between 5.10% and 8.42% with sample boiled with palm oil having the least and sample boiled with sorghum leaf sheath having the highest.

Table 4: Mean Sensory Scores of Boiled Cowpea

Samples	Colour	Flavour	Taste	Texture	Overall Acceptability
PBC	5.09^{c}±2.09	5.55^{c}±1.89	6.45^{ab}±1.65	6.81^{a}±1.68	6.05^{b}±1.21
SLC	6.64^{b}±1.62	7.00^{ab}±1.11	7.00^{ab}±1.95	6.27^{a}±1.96	6.73^{ab}±1.22

Table 4 continued

SEC	$5.64^{c}\pm1.56$	$6.27^{bc}\pm1.45$	$6.00^{c}\pm1.51$	$6.36^{a}\pm1.70$	$6.07^{b}\pm1.29$
POC	$7.77^{a}\pm1.15$	$7.36^{a}\pm1.29$	$7.32^{a}\pm1.43$	$6.86^{a}\pm1.39$	$7.32^{a}\pm1.00$

Means with different superscript on the same column are significantly different ($P< 0.05$).
Key: PBC = Plain boiled cowpea, SLC = Cowpea boiled with sorghum leaf sheath, SEC = Cowpea boiled with sorghum leaf sheath extract, POC = Boiled cowpea with palm oil

Table 4 shows the mean sensory scores for boiled cowpea. Colour ranged from 5.09 in plain boiled sample to 7.77 in sample boiled with palm oil. The likeness for flavour of the cowpea samples increased from 5.55 in plain boiled sample to 7.36 in sample boiled with palm oil. Sample boiled with sorghum leaf sheath extract had the least score (6.00) for taste while sample boiled with palm oil had the highest (7.32). The texture of the samples ranged between 6.27 and 6.86. Sample boiled with palm oil was the most liked with an overall acceptability score of 7.32 while the least liked was the plain boiled sample with a score of 6.05.

Discussion of Findings

The result of the chemical composition of the boiled cowpea revealed that moisture content of the samples differed significantly with cowpea boiled with palm oil having the least moisture content. This could be due to the higher fat content of the sample which may have reduced the level of water activity. The lower moisture content of the cowpea with palm oil implies it would store longer than the others samples. There was no significant difference in the ash content of the cooked cowpea. Cowpea boiled with sorghum leaf sheath had slightly higher (2.92%) content of ash. The ash content of the samples were lower than 3.57% reported by Omenna *et al* (2016) for ash content of boiled cowpea. The fat content of the boiled cowpea varied significantly with the sample with palm oil having the highest fat content. This is expected as palm oil is a rich source of fat. Similar finding was reported by Ndife, Nwaubani, and Aniekpeno (2019) for garri incorporated with palm oil. The lower fat content (1.12%) of the sample boiled with sorghum leaf sheath is beneficial as it will be less susceptible to oxidative rancidity. The protein content of the samples boiled with sorghum leaf sheath and extract did not vary significantly with that of the plain boiled cowpea. The values for protein were lower than 17.79% reported for protein content of boiled cowpea by Omenna *et al* (2016) which could be attributed to varietal differences. The fibre content of the boiled cowpea was highest in cowpea boiled with sorghum leaf sheath and was not significantly different from cowpea boiled with the extract. The increase in fibre could be due to the sorghum leaf sheath and its extract as some particles of the leaf sheath may be present in the extract and in the sample boiled with the leaf sheath thus, contributing to higher fibre content. The fibre content of the boiled cowpea samples were higher than 1.00% reported for plain boiled brown-eye cowpea by Abdulazeez *et al* (2019). Carbohydrate varied significantly among the samples which could be due to the amount of other nutrients present

in the samples since carbohydrate was calculated by difference. Omenna *et al* (2016) reported variations in the carbohydrate content of differently processed cowpea. Their values (57.21-59.74%) were higher than what was observed in the present study. The energy content was significantly higher in cowpea boiled with palm oil. This is due to the higher fat content of the sample as fat provides more energy compared to protein and carbohydrate.

The mineral composition of the boiled cowpea showed that calcium varied significantly ($p<0.05$) among the samples. Cowpea boiled with sorghum leaf sheath extract had the highest calcium content (11.94 mg). Affrifah, Phillips and Saalia (2022) reported higher calcium content (24 mg) in boiled cowpea. The magnesium content of the boiled cowpea were statistically similar which implies that the different methods had no significant effect on the magnesium content of the boiled cowpea. Zinc increased from 0.91 in plain boiled cowpea to 1.74 mg in cowpea boiled with sorghum leaf sheath extract. Sorghum leaf sheath is high in zinc and may have contributed to the higher content of zinc in the samples with the sorghum leaf sheath and the extract.Adetuyi, Akpambang, Oyetayo and Adetuyi (2007) reported 7.15mg as zinc content of sorghum leaf sheath flour. Oluwalana and Adedeji (2013) reported 2.50mg of zinc in sorghum leaf sheath beverage. The phosphorus content of the boiled cowpea samples were higher than the values (4.63 -5.92 mg) reported for different cowpea genotypes by Gerrano *et al*., (2019).

The phytochemical composition of the boiled cowpea showed that carotenoid content increased significantly (3.34%) in cowpea boiled with palm oil. Zhu *et al*., (2015) noted that palm oil is a rich source of carotenoids. Alkaloid was significantly higher (7.95mg) in cowpea boiled with palm oil but reduced in cowpea boiled with sorghum leaf sheath and that of the extract. High intake of alkaloids above its lethal dose of 20mg could be toxic to humans (Inuwa, Aina, Aimola and Amao, 2011). Saponin content was significantly lower in cowpea boiled with palm oil. Saponins are hydrophilic and have high foaming properties (Góral and Wojceichowski, 2020). The addition of palm oil may have reduced its foaming ability thus, resulting in the reduction in saponin content.

The result of the sensory attributes of the boiled cowpea samples showed that the mean values varied significantly among the samples in terms of colour, flavour, taste and overall acceptability while the texture did not differ significantly. Adegoke *et al*., (2019) reported that different cooking conditions had significant effect on all the sensory attributes of pressure coked cowpea. Cowpea boiled with palm oil had the highest mean rating for all the attributes assessed and overall acceptability. This could be due to consumers' familiarity with the sample. Also, the high fat content of the cooked cowpea with palm oil may have also contributed to the higher scores for flavour and taste of the sample as fat is known to contribute to the flavour and taste of foods. Fats are precursors of flavour compounds thus, they add flavour to foods and influence the order

in which flavour components are released when food is eaten (Shahidi and Hossain, 2022; Rios *et al.,* 2014). There was no significant difference in the texture of the cowpea samples. The findings is at variance with that of Adegoke *et al*., (2019) who reported significant difference in the texture of pressure cooked cowpea. However, cowpea cooked with sorghum leaf sheath compared favourably with the sample with palm oil for all sensory attributes and overall acceptability.

Conclusion

The findings of the study revealed that sorghum leaf sheath and the extract had no significant effect on the ash, fat, protein, carotenoid, saponin and magnesium contents of the boiled cowpea. Crude fibre, calcium and zinc were higher in cowpea boiled with sorghum leaf sheath and its extract. Palm oil significantly increased the fat, carotenoid and phosphorus contents of the boiled cowpea samples. Cowpea boiled with palm oil was the most acceptable to the consumers in all sensory attributes. However, cowpea boiled with sorghum leaf sheath compared favourably with that of palm oil in all sensory attributes. Besides adding colour, sorghum leaf sheath and its extract enhanced the mineral content and sensory attributes of the boiled cowpea samples without increasing the fat content.

Recommendations

Based on the findings, the following recommendations are made:

1. Sorghum leaf sheath and its extract should be used as food colour instead of palm oil when preparing foods for people requiring low fat diets.
2. Home makers should be encouraged to use sorghum leaf sheath and its extract as food colour as it contributes to the mineral content of foods.
3. The use sorghum leaf sheath and its extract in place of synthetic food colours in the food industry should be encouraged.
4. Further studies should be carried out to assess the effect of sorghum leaf sheath and its extract in beverage production.

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Nutritional Evaluation of Formulated Maize-based, Ready-to-Use Complementary Food and Sensory Properties of the Gruel

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Abstract

The study investigated nutritional properties and sensory attributes of formulated, ready-to-use maize-based complementary foods. The study adopted experimental research design. Three composite flour samples with the ratios of 8:4:2 1:5, 9:5:1:4 and 10:51:1:4 of maize soybean, yeast, moringa seed and date fruit (sample 1, sample 2 and sample 3) respectively were formulated and subjected to nutrients analysis using standard procedures. Twenty-member panel of judges was employed to determine the organoleptic attributes, using a 9-point hedonic scale. Mean, one-way analyses of variance (ANOVA), Fishers Least Significant Difference (LSD) were used for data analysis. Results show that sample 1had highest ash (36.44±0.52g/100g),fat (15.45±0.27g/100g) and protein (3.52±0.44g/100g) content whereas the highest crude fibre (2.37±0.03g/100g),carbohydrate (44.18±0.03g/100g) and moisture (8.82±0.44g/100g) values were recorded in sample 3. Sample 1 had the highest concentration of all the vitamins analyzed with the exception of pro-vitamin A(beta-carotene) which was highest in sample 3 (0.018±0.0mg/100g). Result on mineral composition indicated that sample 1had the highest ($p<0.05$) zinc (3.37±0.14mg/100g), magnesium (383.05±10.07mg/100g and potassium (643.10±4.84mg/100g) whereas sample 3 recorded the highest ($p<0.05$) calcium (232.05±1.01mg/100g) and iron (10.15±0.15mg/100g) values. Sample one formulation yielded the most acceptable gruel (8.20 ± 0.95^{a}).

Keywords: Nutritional, Evaluation, Formulation, Nutrient, Maize, Complementary Food, Gruel

Introduction

Human breast milk, referred to as 'individualized medicine' is ideal to support growth and development of infants and World Health Organization (WHO) recommends that children be breastfed exclusively for the first six months of their life (WHO,2012).It helps in stimulation of the immune system of the infant, maintenance of the microbial modifications in the infant's gastrointestinal system, and stimulation of the epigenetic programming of the infant (Verduci et al;2014). Yaqub & Gul, (2013) however, reported that socio-demographic, environmental, psychosocial and biomedical factors contribute to early cessation of breastfeeding which may pose adverse health outcomes to the infant. This cessation of breastfeeding is necessitated by the nutritional inadequacy of breast-milk alone as the infant advances beyond six months of age.

Complementary foods are foods other than the breast milk or infant

formula (liquid, semisolid or solid) introduced to an infant to provide their nutrient requirements (Weinman,2010). Complementary foods are meant to supplement the nutritional needs of babies and children. Around the age of six months, an infant's need for energy and nutrients starts to exceed what is provided by breast milk, and hence, complementary foods are necessary to meet these needs. An infant of this age is also developmentally ready for other foods.

The choice of complementary foods as well as the nutritional composition of such foods is, therefore, important in fighting against childhood malnutrition which has been implicated in infant mortality and morbidity. The quality of complementary foods is important if infants and young children nutrition is to be improved. Also, most families in low- and middle-income countries because of the perennial problem associated with poverty, cannot afford nutritionally-adequate proprietary cereal-based complementary food. Thus, they resort to using traditional foods such as cereals, legumes or tubers employing different processing approaches for complementary feeding (Tizazu et al 2011).

It has been reported that resort to use of traditional foods as ingredients for complementary foods in developing countries has a number of drawbacks, which could also be mitigated. Such drawbacks include nutrient imbalance (high in carbohydrate, low in essential nutrients like protein, healthy fats and fibre) (Tesfaye, et al, 2020); inadequate preparation (Yitayew, et al, 2017, contamination risks (Tesfaye, et al, 2022), allergenic potential, limited bio-availability, lack of diversity (Lartey, et al, 2018), inconvenient and not tailored to individual needs.

Complementary feeding entails a process which begins when breast milk alone is no longer sufficient to meet with a child's dietary requirements and generally involves foods given to infants between 6 and 24 months of age together with breast milk (Dewey,2009). The choice of complementary foods and improper feeding practices are associated with a high prevalence of malnutrition in children under the age of five years in developing or underdeveloped countries (Park et al;2012). Malnutrition which is often times referred to both under-nutrition and over-nutrition, generally indicates under-nutrition including protein-energy malnutrition and micronutrients deficiency. Globally, severe malnutrition was responsible for greater than 50% childhood mortality of children less than 5 years of age, implying that about 3.5 million children die of malnutrition every year (Park et al;2012).

It has been reported that about 70–80 percent of undernourished children of the world are found in developing countries (Bryce et al, 2008). This could be largely attributed in part, to the nutritional inadequacy of the ingredients used in formulation of traditional complementary foods fed to infants and children. There have been several reports on studies with respect to the use of traditional food ingredients to formulate complementary diets in developing countries including Nigeria with varying levels of nutrients and processing techniques for use in infant nutrition (Lartey et al 2018). In view of

these reports, this work focuses on the observed gap which bothers on nutritional quality of the ingredients used in formulation of traditional complementary foods in developing countries such as Nigeria. It is necessary to ascertain the nutritional quality of complementary foods that are fed to children immediately after cessation of exclusive breasting. Such complementary foods obviously contribute to optimal health of children as they advance in life to adulthood, hence the need for this study.

Objectives of the study

The main purpose of this study was to investigate nutritional and sensory properties of formulated maize-based, ready–to-use complementary food. Specifically, the study determined the following properties of the ready-to-use complementary:

1. proximate (moisture, ash, fat, protein, crude fibre and carbohydrate).
2. vitamin (beta-carotene[pro-vitamin A],B1,B2,B3,B6,B9,C and E) composition.
3. mineral content (calcium, iron,zinc, magnesium and potassium) composition.
4. sensory pattribute.

Materials and Methods

***Design of the study*:** It was an experimental research.

***Materials and Procurement*:** The materials used for the study were maize (base), soybean, yeast, *moringa* seed and date (*dabino*).Soybean (*Glycine max*), maize (*Zea mays*), moringa seed, dates were purchased from the Relief market in Owerri while the yeast powder was purchased from Little Wood Pharmaceutical Company both in Owerri Municipality.

***Processing of the food items*:** Five hundred grams (500 g) each ofsoybean, maize, dates and moringa were separately sorted, washed in portable water. Soyabean was boiled for 3 hours, cooled, dehulled (decorticated) manually by rubbing between the palms. The hulls were separated from the cotyledons by floating in cold water. It was drained and then dried in an oven at 60°C for 24h, cooled and milled in a hammer-mill.It was sieved with a 1-mm mesh-size sieve and stored in an air-tight plastic container, ready for use in formulation.

Maize was boiled for 2h, drained and dried in an oven at 60°C for 24h, cooled and milled in a hammer-mill. Sieving was done with a 1-mm mesh size. The meal was stored in an air-tight container for use in formulation. The same quantity of maize was fermented for 48h,milled,sieved (muslin cloth) and oven-dried as above,to serve as control.

Dates (*dabino*) was de-seeded, dried at 60°C for 24h, milled with a hammer-mill, cooled, sieved with 1-mm mesh size, and stored in an air-tight container for use in formulation.

Moringa seed was air-dried at ambient temperature (28±2°C) for 24h, and milled in a hammer-mill. The flour was sieved with a 1-mm mesh size sieve andstored in an air-tight container for use in formulation.

***Formulation Ratios for Ready-To-Use Complementary Food*:** Three samples of the ready-to-use complementary food were formulated based on the ratios as follows: each formulated sample was put in the Sun-show petrol engine machine and milled for 5min for

homogeneity. Each sample was packaged in a zip- lock and used for chemical and sensory evaluation.

Samples	Maize Flour	Soybean flour	Yeast Flour	*Moringa* Seed Flour	Dates Flour	Total
$CSYMD_1$	40g	20g	10g	5g	25g	100g
$CSYMD_2$	45g	25g	5g	5g	20g	100g
$CSYMD_3$	50g	20g	5g	5g	20g	100g
Control	100g	Nil	Nil	Nil	Nil	100g

Key: $CSYMD_1$: 40g:20g:10g:5g:25g: Maize flour: Soybean flour: Yeast Flour: Moringa seed: dates
$CSYMD_2$: 45g:25g:5g:5g;20g: Maize flour: Soybean flour: Yeast Flour: Moringa seed: dates
$CSYMD_3$:50g:20g:5g:5g:20g : Maize flour: Soybean flour: Yeast Flour: Moringa seed: date

***Proximate Analysis of samples*:** The proximate composition of the formulated complementary food samples and the control (fermented yellow maize) were determined by standard methods (AOAC, 2010). Moisture content was determined by the drying method using hot-air oven circulation (method #925.09). Ash content of a known weight sample was determined through incineration (550° C) using a muffle furnace (method #923.03). Crude protein was determined by micro-Kjeldahl (method #979.09) and calculated by multiplying the corresponding total nitrogen content by a factor of 6.25. The crude fat content of the sample was determined by a Soxhlet extractor (method #930.09). Crude fiber content was determined by the following method #962.09.

Available carbohydrate was calculated by difference, in essence, % Carbohydrate = 100 – (% protein + % fat + % Ash + % Crude fibre).

***Micro-nutrient Analysis*:** Vitamins and Minerals were determined using standard methods:

***Vitamins*:** Pro-Vitamin A (beta-carotene) was determined by spectrophotomertic method (AOAC, 2010).

The results were converted to vitamin A values using the conversion factor of 6 µg β-carotene: 1 µg RE according to (WHO/FAO, 2004). B1(thiamine), B2 (riboflavin), B3 (niacin), B6 (pyridoxine), B9 (folic acid), C (ascorbic acid) and E (tocopherol) were each determined by ultra-high performance liquid chromatography (UPHLC) after the necessary pre-treatments (Nelson *et al*, 2006).

***Minerals*:** The method described by Onwuka (2005) was used in the determination of mineral content of sample. The digest was for the determination of calcium and potassium by the flame photometry method, while iron, zinc and magnesium were determined using the atomic absorption spectrophotometer method.

***Preparation of the complementary gruel*:** Four samples of complementary gruel were prepared as follows:

Recipe of the gruels

Ingredients	Quantity
Formulated sample	100g
Water	300ml

Preparation procedure

1. Put each sample into a bowl.
2. Mix the flour with cold water (300ml) to obtain a slurry.
3. Pour/boiling water gradually it into the bowl, to gelatinize.

Sensory Evaluation

Panel of judges: The panel of 20 judges was selected from staff and students of Department of Home Economics and Hospitality Management of Alvan Ikoku Federal University of Education, Owerri. The selection of judges was based on their sensory acuity. They were trained on the procedures of tasting the gruel and scoring samples appropriately.

***Instrument for data collection*:** instrument used was a scoring sheet based on 9-point hedonic scale of like extremely (9 points), like very much (8), like moderately (7 points), like slightly (6 points), neither like nor dislike (5 points), dislike slightly (4 points), dislike moderately (3 points), dislike very much (2 points), and dislike extremely (1 point), (Ihekoronye & Ngoddy, 1985).

***Data collection procedure*:** The prepared gruels were coded as samples 1, 2, 3, and the control. Samples were randomly served to the panelists. They were to taste, score each sample, and rinse their mouths before proceeding to the next sample. The tasting was carried out in a well-ventilated and lighted place (Home Economics Food Laboratory). The sensory attributes tested and scored were texture, appearance, (colour), aroma, mouth feel and general acceptability.

***Data analysis technique*:** Data generated from proximate, sensory evaluation, vitamin and mineral determinations were all analyzed using mean, one-way analysis of variance (ANOVA) and Fisher's least significant difference (LSD) at 0.05 level of significance ($P < 0.05$).

Results

Table 1: Proximate Compositions (g/100g) and Enenrgy values of the Formulated Flours

Samples	Moisture	Ash	Fat	Protein	CF	CHO	Energy(kcal /100g)
$CSYMD_1$	8.25±0.02^{c}	3.64±0.05^{a}	15.45±0.27^{a}	3.52±0.44^{a}	2.14±0.08^{c}	34.20±1.16^{c}	289.93±2.67^{a}
$CSYMD_2$	8.58±0.03^{b}	3.21±0.16^{b}	14.66±0.32^{b}	3.15±0.11^{a}	2.30±0.03^{b}	39.25±1.69^{b}	301.54±3.1^{a}
$CSYMD_3$	8.82±0.11^{a}	2.90±0.07^{c}	13.39±0.32^{c}	2.28±0.13c	2.37±0.03^{b}	44.18±0.41^{a}	306.35±3.8^{a}
Control	7.8±0.04^{d}	1.96±0.02^{d}	4.58±0.15^{d}	2.98±0.13^{b}	3.70±0.06^{a}	29.75±0.56^{d}	172.14±^{b}
$LSD_{(0.05)}$	0.14	2.11	0.61	0.54	0.11	2.42	10.25

KEY= CF= Crude fibre;Control: I00% fermented yellow maize
CHO = Carbohydrate
Each value is the mean of triplicate determinations. ^{abc}Mean values with different superscripts in the same row are statistically significant.

Table 1 shows that the moisture values of the samples were low, which ranged from 8.25g/100g in sample 1 ($CSYMD_1$) to 8.82g/100g in sample 3 ($CSYMD_3$) . Sample 1 had the highest ash and fat values (3.64g/100g and

15.45g/100g respectively) when compared with the other samples. The protein contents of samples 1 and 2 ($CSYMD_2$), and crude fibre contents of sample 2 and sample 3 were statistically similar; sample 3 had statistically higher carbohydrates value (44.18g/100g), followed by sample 2 (39.25g/100g). The energy values of the complementary food samples ranged from 289.93 to 306.35kcal/100g, with sample 3 being the highest.

Table 2: Vitamin Composition of the Formulated Flours (mg/100g)

SAMPLES	Betacarotene	B1	B2	B3	B6	B9	C	E
$CSYMD_1$	0.015±0.0^{c}	0.67±0.03^{a}	0.82±0.02^{a}	3.34±0.09^{a}	0.58±0.03^{a}	0.98±0.02^{a}	2.27±0.03^{a}	0.44±0.03^{a}
$CSYMD_2$	0.017±0.0^{b}	0.66±0.02^{a}	0.73±0.02^{b}	3.23±0.01^{ab}	0.54±0.01^{a}	0.90±0.03^{b}	2.16±0.05^{b}	0.36±0.02^{a}
$CSYMD_3$	0.018±0.0^{a}	0.64±0.03^{a}	0.67±0.02	3.18±0.04^{b}	0.48±0.05^{b}	0.86±0.01^{a}	2.05±0.03^{a}	0.41±0.25^{a}
***LSD*$_{(0.05)}$**	**0.76**	**0.05**	**0.04**	**0.12**	**0.06**	**0.04**	**0.07**	**0.29**

KEY: B1= thiamine, B2=riboflavin;B3= niacin;B6=pyridoxine; B9=folic acid;C=ascorbic acid;E=tocopherolEach value is the mean of triplicate determinations. Mean values with different superscripts in the same row are statistically significant.

Table 2 shows that sample 3 ($CSYMD_3$) had the highest (statistically) value (0.018mg/100g) in beta-carotene (pro-vitamin A), followed by sample 2($CSYMD_2$) However, sample 1($CSYMD_1$) had the highest vitamins B1,B2,B3,B6,B9,C and E values (0.67mg/100g, 0.82mg/100g, 3.34mg/100g, 0.58mg/100g, 0.98mg/100g, 2.27mg/100g and 0.44mg/100g respectively) when compared with the other samples.

Table 3: Mineral Composition of the Formulated Flours (mg/100g)

Samples	Calcium	Iron	Zinc	Magnesium	Potassium
$CSYMD_1$	210.94±1.41^{c}	7.97±0.04^{c}	3.47±0.14^{a}	383.05±10.07^{a}	643.10±4.84^{a}
$CSYMD_2$	222.43±0.70^{b}	9.08±0.08^{b}	3.32±0.02^{a}	351.06±12.58^{b}	614.64±6.15^{b}
$CSYMD_3$	232.05±1.01^{a}	10.15±0.15^{a}	3.32±0.17^{a}	317.21±4.12^{c}	579.03±18.24^{c}
***LSD*$_{(0.05)}$**	**2.16**	**0.2**	**0.27**	**19.18**	**22.9**

Each value is the mean of triplicate determinations. Mean values with different superscripts in the same row are statistically significant.

Table 3 reveals that sample 3 ($CSYMD_3$) had the highest calcium and iron values (232.05mg/100g and 10.15mg/100g respectively) when compared with the other samples. Interestingly, all the 3 samples had statistically similar values in zinc. However, sample 1($CSYMD_1$) recorded the highest magnesium and potassium values (383.05mg/100g and 643.10mg/100g respectively) in comparison with the other samples.

Table 4: Sensory Properties Gruel

Samples	Texture	Appearance	Taste	Mouth feel	Aroma	O. Acceptability
$CSYMD_1$	8.15±0.88[a]	8.05±0.76[a]	8.15±0.88[a]	7.45±1.15[a]	7.65±1.46[a]	8.20±0.95[a]
$CSYMD_2$	7.15±1.18[b]	8.00±0.79[a]	7.50±1.43[a]	6.95±1.54[a]	7.15±1.58[a]	7.65±1.42[a]
$CSYMD_3$	7.70±1.17[ab]	7.75±0.85[a]	7.75±1.33[a]	7.50±1.19[a]	7.70±1.45[a]	7.55±1.36[a]
Control	7.20±1.09[b]	8.10±0.68[a]	7.01±1.04[a]	7.34±1.09[a]	6.93±1.52[a]	7.01±0.97[a]
***LSD*$_{(0.05)}$**	**0.89**	**0.66**	**1.01**	**1.06**	**1.23**	**1.03**

Table 4 reveals that sample 1 ($CSYMD_1$) had the statistically highest score (8.15) in texture, followed by sample 3 ($CSYMD_3$) which had 7.70.However, it is interesting that all the 3 samples had statistically similar values in the other sensory attributes (appearance, taste, mouth feel and aroma). They all are also statistically similar in overall acceptability.

Discussion

The result on proximate composition of the samples shows that moisture contents were between 8.25% and 8.82% which were below 12%. Mekuria, et al (2021) reported a higher moisture range of 6.04 to 13.36 g/100 g (13.36 g/100 g),due to the high moisture content of 13.36g/100g. Flours above 12% moisture content, flours will be highly susceptible to microbial spoilage arising from water activity [a_w]. The highest value of protein as observed in sample 1($CSYMD_1$) could be attributed to the combined effects of soy bean and yeast flour; however, this value is much lower than 16.6-16.98% reported by Gebrezgi,(2019), who worked on a composite complementary food using maize, soybean and moringa leaf. Soybean added in the formulation is capable of supplying the protein need in calorie (for protein-energy malnutrition) as recommended by Food and Agricultural Organization/World Health Organization/United Nations, (2013).

The fat contents (13.39-15.45g/100g) obtained in the study were higher than the values (10.5-10.7% reported by Gebrezgi,(2019) in the complementary food, . This higher value was due the greater proportion of soy bean with higher fat content (34%),Gebrezgi,(2019), coupled with less proportion of maize in the formulation (sample 1,($CSYMD_1$).On the contrary, Mekuria,Kinyuru, Mokua & Tenagashaw,(2021) reported a much lower (19:53g/100g) fat content of soybean.

The statistically higher ash content of sample 1 ($CSYMD_1$) (3.64g/100g) could be ascribed more to the high ash content (6-12%) of dried yeast used which was in greater proportion than the other formulations. Gebrezgi,(2019) reported a similar result in ash (3.5-4.0%), though he did not add date to the formulation.

Crude fiber result (2.14-2.37g/100g) of this work is much lower (2.96-6.75%) reported by Gebrezgi,(2019). This is good in view of the developing intestine of infants who cannot digest fiber at this stage.

The highest carbohydrate value (44.18g/100g) in sample 3 was expected as it contained the greatest proportion

of maize in the formulation.This value is low when compared with 57.3-66.1g/100g reported by Gebrezgi,(2019). This variation could be due disparities in the formulations.

The energy values (289.93-306.35kcal/100g) obtained in the formulated complementary foods were lower (399.8-429.5kcal/100g) values reported by Gebrezgi,(2019). However,the implication is that it will require about 200g of the complementary food per day to meet the Recommended Dietary Allowance (RDA) (625kcal/day) for the 6-8 months infant;227g of it per day to meet the RDA (710 kcal/day for the 9-12 months infant, while it will require 294g of it to meet the RDA (920kcal/day) (for boys) 1-2 years and 269g to meet the RDA(840kcal/day) for girls.

The result suggests that beta carotene (pro-vitamin A) content, though very low(0.018mg/100g) increased with higher proportion of maize substitution as observed in Sample 3. All the other vitamins decreased as maize quantity in the formulation increased. This implies that the soybean is richer than maize in those vitamins. Sample 1 had the highest values in all the other vitamins, namely vitamins B1,B2,B3,B6,B9, C and E. This is attributed to the yeast and dates which had the greatest proportions in the sample. These vitamins are essential for the growth and development of infants and children.

Sample 3 ($CSYMD_3$) had the highest (232.05mg/100g) value of calcium and iron ($10.15\pm0.15 mg100g^{-1}$); this implies that the formulation had best proportion with respect to calcium and iron, possibly contributed by the ingredients used. Sample 1($CSYMD_1$) which had highest (383.05mg/100g) value of magnesium, zinc (3.47 mg/100g) and potassium (643.10 mg/100g), implies that the proportion had the best in terms of magnesium, zinc and potassium different for the minerals determined in the study except for zinc. It is worthy of note that mineral elements are not affected by any processing unit operation.

The result in Table 5 on the sensory attributes of the samples shows that though the complementary foods were not statistically different with respect to the sensory attributes analyzed, the most preferred was sample 1 ($CSYMD_1$) had the highest score (8.20**)** in all the overall acceptability.

Conclusion

This work revealed that poor nutritional quality of complementary food can be improved through compositing of local, rich, available and affordable foods (maize, soybean ,moringa seed ,date fruit (*Dabino*) and yeast powder). The most preferred sample was the one with the greatest proportion of yeast and date, Therefore, the combination of these local food ingredients in the production of complementary (gruel) food of high nutritional value can be used to remarkably enhance the nutritional status of infants.

Recommendations

1. This work strongly recommends the use of these foods in the production of
2. complementary food for infants since they are locally available and relatively affordable to households.

3. The formulation of the complementary foods should be done using the appropriate proportions of the ingredients to achieve a nutrient-rich and acceptable complementary food.

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Efficacy of Health Literacy Intervention in Fostering Family Quality of Life in Oye-Ekiti Local Government Area, Ekiti State, Nigeria

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Abstract

The family quality of life (FQL) in Nigeria has significantly been compromised by the combined effects of economic hardship, insecurities and other uncertainties. The general objective of this study was to evaluate efficacy of a health literacy intervention (HLI) in promoting FQL in Oye-Ekiti, Ekiti state. Specifically, the study determined extent HLI could improve the following indicators of FQL among study participant: adequate sleep, good nutritional behavior, physical activities and proper hygiene. It was a quasi-experimental research involving pretest, intervention, posttest and comparison of pretest and posttest scores. Participants included community-dwelling parents with at least one child (n = 82) in Oye Local Government, Ekiti State, Nigeria. Family Quality of Life scale was used for assessing FQL participants before (pre-test) and three months after (post-test) treatment. Mean, standard deviation, and t-tests were utilized for data analysis. Cohen's d was calculated to establish the effect size of the difference in FQL between pre-test and post-test mean scores, while multiple regression was used to test the hypotheses of no significant interaction effect of socio-demographic parameters on the outcomes of HLI. Significant improvements in adequate sleep ($p < 0.05$), healthy nutritional choices ($p < 0.05$), regular physical activities ($p < 0.05$), and proper hygiene ($p < 0.05$). It was recommended that further research is required to determine whether gains can be sustained over time.

Keywords: Family, Quality of Life, Health, Literacy, Intervention, Nigeria, Health, Household

Introduction

Family quality of life (FQL) may be referred to as the well-being and life satisfaction experienced by family members in the context of daily family living. Brown and Brown (2014)

described it as the degree to which individuals experience their own quality of life within the family context, as well as with how the family as a whole has opportunities to pursue its important possibilities and achieve its goals in the community and the society of which it is a part. Similarly, Vukićević et al. (2023) described FQL as the degree of what makes life good for families. It follows that FQL encompasses the family's collective well-being, capacity to thrive, and overall satisfaction, reflecting both individual and family-level experiences in the broader social context.Some key aspects that determine FQL include; access to healthcare, nutrition, finances, housing, and transportation, as well as effective bonding, communication, social inclusion and emotional wellbeing within the family (Michaelson, Pilato, & Davison, 2021).

For many Nigerian households today, family life seems to have become a daily struggle. Mounting economic troubles poor public health facilities, food crises, and security threats (Aliyu et al., 2020; Innocent et al., 2017; Obi et al., 2020) have created immense challenges for Nigerian households. Insecurity from insurgencies limits open communication (John, 2022), while high unemployment leads families to forgo nutritious food and medical care (Wulanda et al., 2024). Recurring food crises impact millions due to climate change (Özekan, & Akan, 2023), and escalating costs of living discourage exercise and checkups (Maduakolam et al., 2023; Abubakar t al., 2022). Inadequate access to clean water compromises hygiene and disease prevention (Efe et al., 2023). These socioeconomic stressors undermine well-being of families. However, boosting households' health literacy appears a promising approach for improving circumstances in Nigerian homes.

Health literacy (HL) is an important concept that refers to an individual's ability to find, understand, and use health information and services to make informed decisions and take appropriate actions for themselves and others. It refers to the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Ugwu, 2021). It can be regarded as a multidimensional concept with cognitive, functional, interactive, critical, and social components that impact one's ability to engage effectively in health behaviours and contexts.

Efficacy, in the context of health literacy interventions, refers to the extent to which these programmes can produce the desired outcome, such as improved quality of life, under ideal conditions. In other words, efficacy measures the intervention's ability to bring about a positive change in the targeted health behaviour or outcome. This concept is crucial in evaluating the effectiveness of health literacy interventions, as it helps determine whether the program is achieving its intended goals (see methods for measures of efficacy).

Previous studies have explored health literacy interventions' efficacy on quality of life. For instance, Maškanceva (2020) found that a brief health literacy programme significantly improved

sleep quality and duration. In a similar study, Parekh et al. (2018) found that health literacy interventions increased fruit, vegetable, and fiber intake compared to controls. A community-based nutrition program for low-income Hispanic families showed children preferred healthier foods and parents bought more produce at a six-month follow-up. Additionally, similar interventions have been effective in enhancing various aspects of family quality of life, including regular physical activity (Hutzenbiler, 2023), and proper hygiene (Gupta et al., 2020).

While studies have shown that health literacy interventions can positively impact factors like sleep, nutrition and healthcare utilization individually, there remains a literature gap regarding wholistic programmes addressing multiple intersecting family quality of life factors affecting Nigerian households simultaneously. Therefore, this study sought to address this gap.

Objectives of the Study

The general objective of this study was to evaluate efficacy of a health literacy intervention (HLI) in promoting family quality of life (FQL) in Oye-Ekiti, Ekiti state. Specifically, the study determined extent HLI could improve the following indicators of FQL among study participant:

1. adequate sleep
2. good nutritional behaviour
3. physical activities
4. proper hygiene

Methods

Design of the Study:This study employed a quasi-experimental research design using a single group pretest-posttest approach, consisting of four key components: (i) Pretest-administration of the Family Quality of Life Scale to collect baseline data; (ii) Intervention - implementation of the Health Literacy Intervention (HLI) programme; (iii) Posttest - administration of the same scale to collect follow-up data; and (iv) Comparison - comparison of pretest and posttest scores to determine the effect of the HLI programme on family quality of life, allowing for an examination of the program's impact while acknowledging the design's limitations.

***Area of the Study*:** This study was conducted in Oye-Ekiti, a semi-urban community in Ekiti State, Nigeria, with about 175,000 people. The area blends traditional and modern lifestyles, relying on agriculture and emerging industries. Healthcare access varies, impacting families' ability to maintain well-being.

Population for the Study: The study population consisted of approximately 10,000 parents, (mothers and fathers), with at least one child residing within the Oye-Ekiti Local Government Area (LGA) of Ekiti State, Nigeria, (estimated from the 2020 Ekiti State Census). The population characteristics included parents aged 25-55 years, with varying education levels (primary to tertiary), occupations (civil servants, traders, farmers, artisans), and family sizes (1 and above children per household), who were either married or cohabiting. The parents served as primary decision-makers within their families.

***Sample for the Study*:**The sample consisted of 82 parents (40 fathers, 42 mothers) with at least one child in Oye-Ekiti, LGA Ekiti State, Nigeria.

Convenience sampling technique was used for practicality and efficiency. Local organizations collaborated to disseminate information and invite participants. The sample size was determined through power analysis using G*Power software, ensuring sufficient statistical power to detect significant effects. Characteristics of the sample include: gender (male and female), education levels (from no formal education to tertiary education), household income (low, a medium and high) with varying occupations, and family sizes.

Instrument for Data Collection: Instrument for data collection was a 42-item Family Quality of Life Scale (FQLS) which was developed based on literature review and the specific objectives. It consisted of six sections: Section A focused on socio-demographic information (3 items); Section B focused on sleep patterns (9 items); Section C on nutritional choices and dietary habits (10 items); Section D on communication within participants' families (10 items); Section E on hygiene practices (10 items); and Section F on medical check-ups and health monitoring (8 items). The instrument was validated by three experts in Health education.

Reliability of FQLS was established through a pilot test involving 20 parents, who were not part of the final study sample. Cronbach's alpha coefficient was calculated to assess the internal consistency reliability of the whole instrument and each section of it. The overall Cronbach's alpha for the 42-item scale was 0.92, while Section A (socio-demographic information) = 0.78, Section B (adequacy of sleep) = 0.85, Section C (nutritional choices) = 0.88, Section D (family communication) = 0.91, Section E (hygiene practices) = 0.89, and Section F (medical check-ups) = 0.84.

***Method of Data Collection*:** Data collection involved the following:

***Pre-test*:** Before the intervention, participants completed the 42-item Family Quality of Life Scale to establish a baseline measure of their Family Quality of Life (FQL). This pre-test data collection took place at the Oye Civic Centre, where research assistants were available to provide assistance as needed. The research team ensured participants' privacy, confidentiality, and autonomy throughout the process.

***Intervention*:** Following the pre-test, the Health Literacy Intervention programme was delivered to participants at the Oye Civic Centre. The programme consisted of lectures, discussions, and hands-on activities aimed at enhancing knowledge, attitude, and behavioural intentions related to improving FQL. The research team created an enabling environment conducive to learning, ensuring participants' comfort and engagement throughout the intervention.

***Post-test*:** Four months after the intervention, participants completed the same 42-item Family Quality of Life Scale to assess any changes in their FQL. This post-test data collection took place at the same venue as the pre-test, with research assistants available to provide assistance as needed. The research team maintained the same ethical standards as during the pre-test.

***Method of Data Analysis*:** Mean and standard deviation, were used to analyse both pretest and posttest data.

The mean difference between the pretest and posttest FQL scores was set as the yardstick for measuring improvement or otherwise. Magnitude of intervention's efficacy, was determined using Cohen's d, a measure of effect size, based on the difference in pretest and posttest FQL mean scores.

Results

Socio-demographic Characteristics of the Study Participants

There is a relatively even gender distribution, with 48.8 percent male and 51.2 percent female participants. In terms of education level, the majority of participants had secondary (34.1%) or tertiary (29.3%) education, while 12.2 percent had no formal education and 24.4 percent had primary education. Regarding household income, the largest proportion of participants (34.1%) had an annual income between ₦300,000 and ₦700,000, followed by 31.7 percent with an income between ₦100,000 and ₦300,000. A smaller percentage (22.0%) had a household income below ₦100,000 per year, and 12.2 percent had an annual income above ₦700,000.

Table 1: Mean Scores, and Standard Deviation, t-test Value and Cohen's d on Sleep Behaviours Before and After the HLI

Sleep Behaviour	$\bar{X}_1 \pm SD$	$\bar{X}_2 \pm SD$	δ	t-value	p-value	Cohen's d
Caffeine and Stimulants Avoidance	3.41 ± 1.27	4.72 ± 1.04	1.31	8.32**	0.004	1.12
Bedtime Routine Establishment	2.98 ± 1.42	4.35 ± 1.16	1.37	7.91**	0.021	1.07
Screen Time Limitation	2.84 ± 1.35	4.27 ± 1.09	1.43	8.57**	0.025	1.16
Sleep Environment Optimization	3.12 ± 1.38	4.61 ± 1.07	1.49	8.74**	0.031	1.18
Avoidance of Heavy Meals	3.27 ± 1.33	4.53 ± 1.11	1.26	7.67**	0.006	1.03
Relaxation Techniques Engagement	2.91 ± 1.40	4.42 ± 1.14	1.51	8.73**	0.014	1.18
Consistent Sleep Schedule Maintenance	3.19 ± 1.36	4.49 ± 1.12	1.30	7.87**	0.032	1.06
Sleep Prioritization	3.05 ± 1.39	4.58 ± 1.09	1.53	8.93**	0.001	1.21

Note: ** $p < 0.001$; $\bar{X}_1$ = Pretest mean; $\bar{X}_2$ = Posttest mean; SD = Standard deviation; δ Mean difference

Table 1 presents the results of sleep behaviours before and after the intervention. Pre-test mean scores ranged from 2.84 to 3.41, while post-test means increased to 4.27 to 4.72. The mean differences were substantial, ranging from 1.26 to 1.53, and all were statistically significant ($p < 0.001$). The effect sizes were large, with Cohen's d values ranging from 1.03 to 1.21, indicating a strong and practically meaningful impact of the training.

These findings suggest the targeted intervention was highly effective in enhancing the participants' sleep-related knowledge, attitudes, and practices.

Table 2: Mean Scores, and Standard Deviation, t-test Value and Cohen's d on Nutritional Behaviours Before and After the HLI

Dietary Behaviour	$\bar{X}_1 \pm SD$	$\bar{X}_2 \pm SD$	δ	t-value	p-value	Cohen's d
Fruit and Vegetable Consumption	3.24 ± 1.31	4.68 ± 1.02	1.44	8.84**	0.041	1.19
Whole Grains Intake	2.89 ± 1.37	4.40 ± 1.15	1.51	8.89**	0.001	1.20
Lean Protein Sources	3.15 ± 1.34	4.54 ± 1.09	1.39	8.41**	0.033	1.14
Limiting Sugary Foods and Beverages	3.02 ± 1.38	4.47 ± 1.12	1.45	8.61**	0.021	1.16
Healthy Fat Choices	3.07 ± 1.35	4.51 ± 1.10	1.44	8.62**	0.013	1.16
Hydration Status	3.31 ± 1.30	4.72 ± 1.01	1.41	8.77**	0.002	1.18
Portion Control and Moderation	2.96 ± 1.39	4.43 ± 1.14	1.47	8.65**	0.012	1.17
Dietary Diversity	3.19 ± 1.33	4.62 ± 1.05	1.43	8.71**	0.030	1.17
Minimizing Processed and Ultra-Processed Foods	3.08 ± 1.36	4.49 ± 1.11	1.41	8.48**	0.001	1.15
Nutritional Knowledge and Awareness	3.14 ± 1.35	4.55 ± 1.08	1.41	8.53**	0.003	1.15

Note: ** $p < 0.001$; $\bar{X}_1$ = Pretest mean; $\bar{X}_2$ = Posttest mean; SD = Standard deviation; δ Mean difference

Table 2 shows that there are improvements in all targeted dietary behaviours following the training intervention. At pre-test, mean scores ranged from 2.89 ± 1.37 (Whole Grains Intake) to 3.31 ± 1.30 (Hydration Status), while at post-test, means increased to a range of 4.40 ± 1.15 (Whole Grains Intake) to 4.72 ± 1.01 (Hydration Status). The mean differences were substantial, ranging from 1.39 to 1.51, and all were statistically significant ($p < 0.001$) based on the t-test results. The effect sizes, as measured by Cohen's d, were large, ranging from 1.14 to 1.20, indicating a strong and practically meaningful impact of the dietary behaviour training. These findings suggest the targeted intervention was highly effective in enhancing the participants' knowledge, attitudes, and practices related to a wide range of healthy dietary behaviours.

Table 3: Mean Scores, and Standard Deviation, t-test Value and Cohen's d on Physical Activities Before and After the HLI

Physical Activity	$\bar{X}_1 \pm SD$	$\bar{X}_2 \pm SD$	Δ	t-value	p- value	Cohen's d
1. Aerobic Exercise	3.02 ± 1.38	4.45 ± 1.13	1.43	8.56**	0.0001	1.16
2. Strength Training	2.84 ± 1.41	4.32 ± 1.18	1.48	8.61**	0.0041	1.16
3. Flexibility and Stretching	3.11 ± 1.35	4.51 ± 1.10	1.40	8.38**	0.0001	1.13

Table 3 continued

4. Daily Steps	3.19 ± 1.33	4.59 ± 1.06	1.40	8.49**	0.0203	1.15
5. Active Transportation	2.93 ± 1.40	4.39 ± 1.16	1.46	8.53**	0.0027	1.15
6. Recreational Activities	3.07 ± 1.36	4.47 ± 1.12	1.40	8.41**	0.0013	1.14

Note: ** $p < 0.001$; $\bar{X}_1$ = Pretest mean; $\bar{X}_2$ = Posttest mean; SD = Standard deviation; δ Mean difference

Table 3 show that there are progresses in all targeted physical activities following the intervention programme. At pre-test, mean scores ranged from 2.84 ± 1.41 (Strength Training) to 3.19 ± 1.33 (Daily Steps), while at post-test, means increased to a range of 4.32 ± 1.18 (Strength Training) to 4.59 ± 1.06 (Daily Steps). The mean differences were substantial, ranging from 1.40 to 1.48, and all were statistically significant ($p < 0.001$) based on the t-test results. The effect sizes, as measured by Cohen's d, were large, ranging from 1.13 to 1.16, indicating a strong and practically meaningful impact of the physical activity behavior training.

Table 4: Mean Scores, and Standard Deviation, t-test Value and Cohen's d on Hygiene Behaviour Before and After the HLI

Hygiene Behavior	$\bar{X}_1$ ± SD	$\bar{X}_2$ ± SD	δ	t-value	p- value	Cohen's d
Hygiene	3.24 ± 1.31	4.60 ± 1.04	1.36	8.25**	0.0041	1.11
Dental Hygiene	3.17 ± 1.34	4.54 ± 1.08	1.37	8.27**	0.0041	1.12
Personal Hygiene	3.31 ± 1.29	4.63 ± 1.02	1.32	8.19**	0.033	1.10
Food Hygiene	3.14 ± 1.35	4.51 ± 1.10	1.37	8.28**	0.021	1.12
Respiratory Hygiene	3.22 ± 1.32	4.58 ± 1.05	1.36	8.24**	0.013	1.11
Sleep Hygiene	3.28 ± 1.30	4.61 ± 1.03	1.33	8.21**	0.004	1.11
Skin Hygiene	3.19 ± 1.33	4.55 ± 1.08	1.36	8.25**	0.022	1.11
Toilet Hygiene	3.26 ± 1.30	4.59 ± 1.04	1.33	8.20**	0.030	1.11
Laundry Hygiene	3.13 ± 1.35	4.50 ± 1.11	1.37	8.29**	0.021	1.12

Note: ** $p < 0.001$; $\bar{X}_1$ = Pretest mean; $\bar{X}_2$ = Posttest mean; SD = Standard deviation; δ Mean difference

Table 4 show that there are improvements in all hygiene behaviours following the intervention. At pre-test, mean scores ranged from 3.09 ± 1.37 (Environmental Hygiene) to 3.31 ± 1.29 (Personal Hygiene), while at post-test, means increased to a range of 4.47 ± 1.13 (Environmental Hygiene) to 4.63 ± 1.02 (Personal Hygiene). The mean differences were substantial, ranging from 1.32 to 1.38, and all were statistically significant ($p < 0.001$) based on the t-test results. The effect sizes, as measured by Cohen's d, were large, ranging from 1.10 to 1.12, indicating a strong and practically meaningful impact of the hygiene behaviour training.

Discussion

Findings of this study have demonstrated that the multicomponent HLI led to significant improvements across a range of health-related behaviours and practices among participants, which have the potential to enhance their overall family quality of life.

Previous studies have explored health literacy interventions' effects on quality of life. For instance, Maškanceva (2020) found that a brief health literacy programme significantly improved sleep quality and duration. In a similar study, Parekh et al. (2018) found that health literacy interventions increased fruit, vegetable, and fiber intake compared to controls. A community-based nutrition program for low-income Hispanic families showed children preferred healthier foods and parents bought more produce at a six-month follow-up. Additionally, similar interventions have been effective in enhancing various aspects of family quality of life, including regular physical activity (Hutzenbiler, 2023), and proper hygiene (Gupta et al., 2020).

Specifically, this study demonstrated that there are significant improvements in all targeted sleep behaviours following the training intervention are expected based on previous research in this area, which has consistently shown that sleep-focused interventions can be effective in enhancing various sleep-related habits and practices at the individual level, with educational programs teaching sleep hygiene principles, strategies for establishing consistent bedtime routines, and techniques for improving sleep quality leading to marked increases in sleep duration, sleep efficiency, and overall sleep health (Scott et al., 2021; Steffen et al., 2015). One study revealed that a cognitive-behavioural therapy programme for insomnia resulted in significant improvements in self-reported sleep quality, daytime functioning, and overall sleep satisfaction (Järnefelt et al., 2020).

This study also found that there are improvements in all targeted dietary behaviours following the training intervention. These improvements are expected in that previous research has consistently shown that nutrition-focused interventions can be effective in enhancing various dietary habits and food-related behaviours. For instance, intervention programmes of this nature have previously led to marked increases in the consumption of fruits, vegetables, whole grains, and other nutrient-dense foods (Pretorius et al., 2021; Thompson et al., 2016; Troesch et al., 2015). Similarly, another study has revealed that a community-based nutrition programme resulted in significant increases in the variety and quantity of fruits and vegetables consumed (Ezekekwu et al., 2022).

Furthermore, this study revealed that there are improvements in all targeted physical activity behaviours following the training intervention. This result is expected based on previous research in this area, which has consistently shown that physical activity-focused interventions can be highly effective in enhancing the frequency, duration, and intensity of physical activities (Kilgour et al., 2022; Pfisterer et al., 2022).

Similarly, this study shows that the HLI was highly effective in driving significant improvements across multiple targeted hygiene practices. For example, the data showed substantial increases in mean scores for domains such as Personal Hygiene and Environmental Hygiene, with large effect sizes indicating the training had a

strong and practically meaningful impact on participants' behaviors. These findings build upon prior research showing the efficacy of targeted training programmes in promoting meaningful and lasting changes in individual and community-level hygiene practices (Watson *et al*., 2021). The study contributes valuable evidence supporting the use of health literacy training as an effective strategy for enhancing hygiene behaviours and improving public health outcomes

Conclusion

The findings from this study provide strong evidence for the efficacy of the Health Literacy Intervention (HLI) in driving positive changes across multiple domains critical for promoting family quality of life. The HLI was found to significantly improve participants' sleep behaviours, health nutritional choices, regular physical exercises, hygiene, and regular medical checkups. By targeting an interconnected set of health behaviours through a holistic approach, the HLI appears to have fostered a broader orientation towards health-conscious practices that has the potential to improve overall quality of life in a sustainable manner.

Recommendation

Based on the findings from this study, several key recommendations can be made:

1. Adopting and scaling up holistic interventions like the HLI to empower individuals to manage their health, improving sleep behaviors, preventive care, and health-conscious practices.
2. Future HLIs should prioritize enhancing sleep habits as a core component, addressing bidirectional relationships between sleep and other health behaviours for comprehensive benefits.
3. Conducting longitudinal studies and economic analyses to assess long-term sustainability and cost-savings of HLIs, informing policy decisions and promoting widespread adoption.
4. Designing future HLIs with cultural relevance and accessibility in mind, engaging diverse communities to ensure interventions meet unique needs and preferences.

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Nutrient Composition and Sensory Evaluation of Molded Melon (*Carcubita citrullus*) and Elephant Grass (*Pennisetum purpureum*) (*Achara*) Indigenous Soup (*Ofe Akpuruakpu Mgbam*)

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Abstract

This study investigated nutrient and mineral compositions of elephant grass (*Pennisetum purpureum*) *achara* soup. All ingredients used in the soup preparation were sourced from Watt Market in Calabar, Cross River State, Nigeria. The study adopted experimentaldesign. Standard procedures were employed at all steps of the experiment. A 9-point hedonic scale was used for sensory evaluation to rate the flavor, color, appearance, texture, and general acceptability. Findings nutrient contents reveal moisture 32.10g/100g; protein 22.50 g/100g; fat 34.10g/100g; fiber 2.80 g/100g; carbohydrate 4.74 g/100g; and ash 3.40 g/100g. Mineral composition of the soup include 0.013mg/100g for potassium, calcium 21.40mg/100g, magnesium 138.30mg/100g, iron 0.82mg/100g, and phosphorus 2.84 mg/100g. It was concluded that consumption of the soup can positively impact the nutritional status of individuals. Nutrient and mineral compositionsof the soup can provide essential dietary components that can help address nutrition-related conditions. Encouraging increased consumption of this soup among communities may contribute to the reduction of malnutrition and associated health issues.

Keywords: Elephant Grass, Melon, Indigenous, Soup, Nutrient, Composition, Evaluation, Sensory.

Introduction

Soup is a replenishing, aromatized and a complete meal. In most cases it plays a very important role on the menu and is served as appetizer to stimulate appetite for the rest of heavier foods to follow (Shivesh, 2013). Soups can be classified based on their texture. Some soups are either light or thick hence certain soups are classified into a category called international soups. These soups are essentially national soups of different countries. Soups represent the region of origin therefore that is where African soups especially Nigerian soups fall into. This is because they are garnished or have varied ingredients are added to the soup. For instance, the *ofe* Owerri (Owerri vegetable soup) are garnished with stock fish, smoke fish, big snails, vegetables, crayfish, pepper and palm oil with seasoning (Ukam and Udonwa

2020). The molded-melon (*mgbam*) and (*Pennisetum purpureum*)soup falls into this category.It is prepared with blended melon *achara*(elephant grass) tender stalk and *ukazi* (*Gentumafricanum*) enriched with beef, fish, snail and other ingredient. This soup meal is prepared and consumed on special occasions like traditional and white wedding, funeral and new year ceremonies as a delicacy and a relish among the Ngwa people of Isiala Ngwa and Umuahia in Abia state and some part of Akwa Ibom state in Nigeria. However, as popular this soup meal is among these people, it is not found in the food composition table of Nigeria and West Africa. This is because there is dearth of information on the nutrient profile of this soup meal. Hence this research into the investigation of the nutrient content of molded melon (Mgbam) *Pennisetum purpureum* (Achara, elephant grass) soup.

The consumption patterns of starchy staples, including cassava *fufu, garri,* and *amala*, are highly prevalent different regions in Nigeria and sub-Saharan West Africa. These staples are commonly consumed alongside soups, as they provide incomplete nutrition when consumed alone. In these regions, carbohydrate-rich foods such as fufu (fermented cassava paste), *garri* (fermented cassava granules), and *amala* (yam peel flour) when prepared into a gelatinized paste, are consumed on a daily basis, often multiple times a day, in combination with various soups, particularly the molded melon-*Achara* (Elephant grass) soup. This study aims to assess the nutrient composition of this soup and emphasizes the importance of incorporating standardized recipes of these local soups into the national cuisine. By doing so, Nigeria can attract tourists seeking an authentic taste of Nigerian soup meals, consequently promoting and establishing Nigerian cuisine as an integral part of international or continental culinary traditions.

Chemical analysis investigates the composition of a food usually a 100g portion. This is because the chemical analyses of nutrients present in foods are recorded in food composition table. The food tables are reference sources for estimating the nutrient content of a diet. The information about the energy and chemical composition of a particular food item can be seen in a food composition table (Omaha and Okaka, 2008).

Sensory evaluations are carried out with standardized recipe. United state Department of Agriculture (USDA) defined a standard recipe as one that has been tried, adapted and retried several times for use by a given food service operation and has been found to produce the same good results and yield every time with the same type of equipment and the same quantity and quality of ingredients. USDA also pointed out that it must contain nine compulsory components; recipe title, category, ingredient weight and volume of each ingredient, preparation instructions, cooking temperature and time, serving size, yield, equipment and utensils used. It may also contain other components such as contribution to the food-based menu system/ state/federal reviews, nutrient analysis (nutrient per serving) and market guide (Mellingard, Civille and Carr, 1997).

The appearance of food is crucial in determining its tastiness. It includes color, shape, portion size, greasiness, transparency, and brightness. These aspects should meet consumers' expectations. Once food visually appeals, the evaluation shifts to the sense of smell, taste, and texture in the mouth, collectively known as flavor.The study aimed to investigate the nutrient content and sensory attributes of molded melon-elephant grass soup meal. Specifically, it examined the proximate, mineral, and sensory attributes of the meal.

Purpose of the Study

The general purpose of the study was to investigate attributes of molded melon-*achara* soup meal. Specifically the study determined:

1. nutrient content of *achara* soup meal.
2. mineral composition of *achara* soup meal.
3. sensory attributes of*achara* soup meal.

Materials and Methods

***Design of the Study*:** The study adopted an experimental design. It involved using standard procedures to determine the nutrient and mineral content of the soup meal.

***Materials and Procurement*:** The food crops used in the study were wild spinach (*Gnetum africanum*) also known as *ukazi* or *afan* in southern Nigeria, elephant grass (*Pennisetumpurpurum*) known as *achara* in southern Nigeria, king tuber mushroom known as *usu* (*Pleurotustuber-regium*), *achi* (*Brachystegiaeurycoma*), beef, fish (*Mangala*), fresh chili pepper, crayfish, and salt. All ingredients were purchased from Watt Market in Calabar Metropolis, Cross River State.

***Preparation of Materials*:** The materials were prepared as follows:

Molded Melon: 750g of melon seeds were placed in a wooden mortar with 180g of sliced onions, 11g of fresh chili pepper, 8g of bouillon cubes (*Knorr* brand), 88g of powdered king tuber mushroom (*usu*), and one level tablespoon of salt. The mixture was kneaded until a paste formed. Then, 20ml of hot water was added to the melon paste and kneaded continuously until oil was extracted. The *usu* facilitated the process. The melon paste was then molded by hand into desired sizes. The molded melon was placed in 100ml of boiling water on a gas stove and boiled for 35 minutes.

Elephant grass: The elephant grass (*achara)* (*Pennisetum purpureum*) was peeled, removing the old hard stalks and keeping only the tender stalks. The tender stalks were cut into small pieces of about 1cm. The tender stalks were washed and used for soup preparation.

***Achara* Soup Preparation:** Ingredients (recipe) and procedure for soup preparation are as follow:

Ingredients	Quantity (g)
Achara (Elephant grass) (*Pennisetum purpireum*)	457
Ukazi (*Gnetum africanum*)	217
Melon seeds (for molded melon)	740
Achi (*Brachlystegiaeurycoma*)	26
King tuber mushroom (*Usu)*	88
Snail	282
Mangala fish (Shallow water caught fish)	194
Stockfish (head)	637
Crayfish (*Procambarusclarkia*)	167
Beef	108
Onions	108
Palm oil	256
Salt	4 levels tbsp
Black pepper	8 ½ levels tbsp
Seasoning bouillon cubes	4 cubes

Preparation Procedure

Boil beef, stock-fish, *mangala* (fish), snail with seasoning (billion cubes), till tender.

Add *achara,* pepper boil for 30 minutes.

Add mixed *achi* thoroughly with palm oil and *usu,* boil for 10 minutes.

Add molden melon and *ukazi,* onions and salt to taste, boil for 5 minutes.

Sensory Evaluation: This involved the following:

Panel of Judges: A total of 25 judges, consisting of laboratory attendants and four lecturers of Department of Human Nutrition and Dietetics University of Calabar, were purposively selected and trained.

Instrument for Data Collection**:** A 9-point hedonic scale was developed and used to assess the flavor/aroma, taste, color/appearance, texture, and general acceptance of the soup meal.

Data Collection Procedure**:** This took place in the Department of Human Nutrition and Dietetics laboratory at the University of Calabar, Calabar. To minimize distractions, each panelist was assigned to an individual compartment and served freshly prepared elephant grass soup. The judges evaluated the sample for flavor, taste, color, texture, and overall acceptability using a 9-point hedonic scale, where 9 was the highest score and 1 was the lowest. The method used by Amadi, Agumuo, and Ibegbulam (2004) was adopted.

Chemical Analysis**:** Moisture, protein, fat and ash contents were analyzed using AOAC (2006).Carbohydrates content was obtained by difference, of the sum of percentage of protein, fat, ash, fibre and moisture which was subtracted from 100 percent to obtain the value for carbohydrate.

Mineral composition was determined using the atomic absorption spectrophotometer method as described by International Institute of Tropical Agriculture (2002). The minerals assessed included sodium, potassium, calcium, magnesium, iron, zinc, copper, manganese, and phosphorus.

***Data analysis*:** Data analyzed using mean, standard deviation and analysis of variance (ANOVA) using statistical package for the social sciences (SPSS

Results

Table 1: Proximate Composition of Molded-Melon*Achara* (Soup

Composition	g/100g
Moisture	32.10±0.03
Ash	3.04±0.06
Protein	22.30±0.04
Fat	34.10±0.06
Fibre	2.80±0.06
Carbohydrate	4.74±0.02

*Mean ± standard error mean

Table 1, reveals the following quantitative values: moisture content of 32.10g/100g, ash content of 3.40g/100g, protein content of 22.50g/100g, fat content of 34.10g/100g, fiber content of 2.80g/100g, and carbohydrate content of 4.74g/100g. When examining the proximate composition of the molded-melon *achara* soup, it is evident that the moisture content stands at 32.10g/100g. This measurement indicates the amount of water present in the soup and plays a crucial role in its texture and overall quality.

The ash content, 3.40g/100g, represents the inorganic residue left over after full combustion. The ash content reveals information about the mineral composition of the soup, which might affect its nutritional value and potential health benefits. A notable component of the soup is its protein content, which measures 22.50g/100g. Proteins are essential macronutrients that play a critical role in various physiological processes, such as tissue repair and enzyme synthesis. The substantial presence of protein in the soup suggests its potential as a source of dietary protein. In terms of fat content, the Molded melon-elephant grass soup contains 34.10g/100g. Fats serve as a concentrated energy source and contribute to the overall taste and mouthfeel of the soup. Additionally, fat-soluble vitamins and essential fatty acids are often present in fat, making it an important component of a balanced diet. The soup has a fiber content of 2.80g/100g. Fiber is an indigestible carbohydrate that is essential for promoting healthy digestion and intestinal regularity. The presence of fiber in the soup suggests that it may provide nutritional benefits such as increased satiety and gut health. The carbohydrate content of the molded-melon*achara* soup is 4.74g/100g. Carbohydrates are the body's major source of energy and are required for a variety of physiological activities. The soup's carbohydrate content contributes to its overall nutritional profile and can be a significant source of energy for users.

Table 2: The Mineral Nutrient Composition of *Achara* Soup Meal

Minerals	mg/100g
Sodium (Na)	0.02±0.03
Potassium (K)	0.24±0.0
Calcium (Ca)	21.40±0.04
Magnesium (Mg)	148.30±0.06
Iron (Fe)	0.82±0.06
Zinc (Zn)	0.15±0.02
Copper (Cu)	0.18±0.01
Manganese (Mn)	0.08±0.01
Phosphorus (P)	2.84±0.01

*Mean ± Standard error mean

Table 2 shows the mineral nutrient composition of the molded melon-elephant grass soup meal as follows: mineral content ranged from 0.02 to 148.30g. The mineral values were 0.02, 0.24, 21.40, 148.30, 0.82, 0.15, 0.18, 0.08, and 2.84mg/g for Na, K, Ca, Mg, Fe, Zn, Cu, Mn, and P respectively.

Table 3: Sensory Evaluation of *Achara* Soup Meal

Sensory attributes	Score
Aroma/Flavor	8.40±0.60
Colour/appearance	6.95±0.39
Taste	7.70±087
Texture	7.50±0.95
General acceptability	7.80±1.01

Mean ± Standard error mean

Table 3reveals the mean scores of sensory evaluations carried out on the molded melon-elephant grass soup meals as follows: Aroma/flavor (8.40%) colour/appearance (6.95%), taste (7.70%), texture (7.50%) and general acceptability (7.80%) respectively.

Discussion

This study investigated the proximate and mineral composition of *achara* soup meal commonly consumed by the Ngwa people of Abia state in Nigeria. The protein content was high (22.50±0.02%). The moisture content was very high (32.10±0.1) in comparison to the study carried out on traditional diet soup whose moisture content was 8.41±89% (Amadi, et al, 2018). The high moisture content of the soup may be due to amount of water used in the soup preparation.

The fat content of the soup was high (34.10±0.06). In comparison with a similar study which had a fat content of 22.00±2.00% (Amadi, Eke, Wegwu, and Osuoha, 2018). The high fat content of the soup can therefore be recommended as part of a weight gaining diets both for children and adults. High fatty foods are also said to pose risk of cardiovascular disease and also obesity. However, this may be due to the large quantity of melon used in the soup preparation. It could be recommended for the convalesce, for malnourished people. The carbohydrate content was low (4.74±0.02%), however suggesting that the soup cannot be served alone as food but alongside with a staple (Fufu or Eba). It can be used for weight management.

Ash content of the soup was higher (3.40±0.02%) in comparison with a similar study carried out by Omaha and Okaka, (2008) on nutritive value of four common soups consumed in eastern Nigeria (melon soup) which was 2.42%. This indicates a moderate level of inorganic elements (minerals) such as iron, Zinc, sodium and Potassium in the soup meal. The fibre content in the soup sample was very low (2.80±0.1%) which indicates that the fibre is limited and it is unhealthy to consume the soup frequently because it is unhealthy for the digestive system which can lead to both short- and long-term health complications.

Among all the minerals analyzed in the soup sample, magnesium was the most abundant (148.30±0.1mg/100g) element. Magnesium plays fundamental roles in most reactions involving phosphate transfer. It is believed to be essential in the structural stability of nuclei acids. It plays a significant role in the intestinal absorption of electrolyte in the body. The deficiency in man

includes severe diarrhea and persistent migraines. The calcium content was determined to be 21.40±0.1mg/100g. calcium helps in the regulation of muscle contraction required by children, infants and fetuses for bones and teeth development (Margaret and Vickery, 2008). The concentration of sodium in the sample was low 0.013±0.01/100g. Excess sodium consumption leads to hypertension (NRC, 2011). A meal low in sodium has both the negative and positive implications. It is beneficial because it helps reduce blood pressure and risk of cardiovascular diseases (WHO, 2020). The implication of consuming a low sodium diet is that it may result to hyponatremia. The potassium content was analyzed to be 0.02±0.02mg/100g. Potassium helps to maintain body weight and regulates water and electrolyte balance in the blood and tissues (National Research Council, 2011). The phosphorus content of the soup sample was 2.84±0.02mg/100g. This figure is lower than that reported on processed water leaf and fluted pumpkin by Ukam and Udonwa in 2020. Phosphorus plays a vital role in normal kidney functioning and transfer of nerve impulse. The concentration of zinc in the sample was given as 0.15±0.01mg/100g. It is an essential trace element for protein and nucleic acid synthesis and normal body development (Metaku,2005). Zinc also stimulates the activity of vitamins and the formation of red blood cells (Claude and Paule, 2010), it also plays a role in improving fertility.

The iron content of the sample was given as 0.82±02mg/100g and cannot be compared with the content of a similar study carried out by Amadi, et al (2018). Iron is said to be an important element in the diet of pregnant women, nursing mothers, teenagers and adolescent girls, infants, convalescing patients and the elderly to prevent anaemia and other related diseases (Oluyemi, et al, 2010). The concentration of Manganese in the sample was determined to be 0.08±0.02mg/100g and compares favourably to a similar study on traditional diets (*Achara* soup) 0.08±0.1mg/100g (Amadi, et al, 2018).

Conclusion

This study showed that the proximate and mineral composition of *achara*soup is a rich source of macro and micronutrients. The results appear to suggest that the soup could be a source of essential nutrients (protein, fat fibre, ash and carbohydrate) for instance, e*gusi* (melon seeds) which is used in the meal preparation has a high protein value and its consumption should be encouraged.

It is also noted that the nutrient composition of the soup is dependent on the ingredients used for its preparation. The variety of ingredients makes the soup a rich source of some nutrients. Hence, *achara*soup is likely to contribute appreciably to the daily nutrient requirement of people consuming considerable quantities and good quality soups.

Recommendations

1. It will provide information to the homemakers with the basic knowledge on the nutritional content of the molded-melon*achara* soup meal and method of

preparation especially those who regularly consume the soup
2. Cooking demonstration should be carried out during workshops, seminars on churches, community festivals to popularize the soup meal.
3. This soup meal should be included in Nigerian cuisine at all level such as at homes, hotels and local cafeteria (Bukas) etc.

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Awareness of World Health Organization (WHO) Physical Activity Recommendations among Adolescents in Nsukka Local Government Area, Enugu State, Nigeria

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Abstract

The goal of the study was to assess in-school adolescents' awareness of WHO physical activity recommendations for adolescents and to determine differences in their awareness based on school location and school type. The study used descriptive cross- sectional survey research design.Population was made up of 7740 junior and senior secondary school students in Nuskka local governmentarea (LGA) Enugu state. Instrument for data collection was questionnaire. Data were analysed using frequencies, percentages, and Chi-square test applied at the .05 level of significance.Findings show that adolescents possess low level of awareness of PA recommendations. Adolescents in urban and rural locations, as well as those in single sex and mixed sex schools also possess low level of PA recommendations. The study revealed no significant differences in awareness of PA recommendation for adolescents based on school location but, significant difference existed between school types. The study discussed the implications of adolescents' low level of awareness of PA guidelines to optimal health as well as the health cost impact on the families. To encourage adolescent PA engagement, use of multiple intervention strategies such as incorporating PA guidelines into the school curriculum, use of mass media campaign and community workshops that would cover both rural and urban schools were recommended for the Ministry of education and school administrators.

Keywords: Physical, Activity, Adolescents, Inactivity, Recommendation, Awareness, Aerobics

Introduction

Physical activity refers any movement generated by the body's musculoskeletal system that requires the use of energy for tasks including working, playing, traveling, doing housework, or engaging in leisure activities (WHO, 2022). Regular physical activity (PA) lowers the rate of illness and death and improves wellbeing. Adolescents' can benefit from it in various ways, including their physical, mental, and social health [Pedersen & Saltin, 2015; World Health Organization (WHO), 2022]. Despite these advantages, the WHO estimated that 80.3 percent of teenagers worldwide do not engage in physical activity. The WHO recommended raising PA levels for persons of all ages,

especially adolescents, in order to reap the benefits of PA. WHO recommended that adolescents engage in at least three days a week of muscle and bone-strengthening activities such as lifting weights, doing pushups and sit-ups, climbing stairs, jogging, walking (National Heart, Lung, and Blood Institute, 2022) in addition to 60 minutes of moderate-to-vigorous aerobic PA every day of the week (7 days). For adults aged 18 to 64 years WHO recommended two or more days of muscle and bone building exercises that engage all main muscle groups on two or more days of the week, in addition to 30 minutes of moderate to high intensity aerobic PA five days a week (150minutes). Aerobic activities are activities that use large muscle groups and increased heart rate and oxygen intake (Cleveland Clinic, 2024).

The WHO's recommendations for PA are intended to raise awareness of the amount of PA needed to sustain optimal health and to encourage regular PA behavior in individuals of all ages, including adolescents. According to Csikszentmihalyi (n. d.), adolescents are people between the ages of 10 and 20 who are going through a phase of growth and development between childhood and adulthood. They may have completed their official primary education and are enrolled in post-primary schools or colleges.

Studies show low levels of physical activity among adolescents worldwide, including Nigeria, despite the advantages and WHO PA recommendations (Fan & Cao, 2017; Oyeyemi, 2016 & WHO, 2022). Adolescents with low PA levels may have increased burden of diseases and medical cost (Godino, et al, 2014). Adolescents with low PA levels may not be aware of the WHO (2022) PA recommendations and guidelines. According to Gafoor (2012), to be aware means to know, to realize or interested in knowing about something, or, to know that something is important. Gafoor conceptualized awareness as the state of being informed, cognizant, conscious or knowledgeable. In this study, awareness of PA recommendations refers to being cognizant of or understanding the significance of PA guidelines. In order to take action, manage, uphold, and sustain healthy behavior toward high-quality and optimal health, awareness is essential. The degree of agreement between one's self-rated and officially approved PA levels is known as awareness of PA (Godino et al., 2014). Godino et al. emphasized that people frequently claim to be physically active when they do not meet the corresponding PA prescription for the best possible health benefit, which is likely what led to Oyeyemi's (2016) low PA level among adolescents.

Previous studies conducted worldwide to measure public awareness of the WHO PA guidelines, (et al, 2019 & Chen et al, 2023) were among adult population hence the need to focus this study on adolescents. Adolescents are transitioning into adulthood, and literature suggests that adopting inactive lifestyle at this stage may have detrimental effects on health at adult stage (Moreno, et al, 2024). Research indicates that persons who engage in regular PA are less likely to develop chronic non-communicable diseases

(NCDs). Conversely, inactivity increases the risk of NCDs, mental disorder development, stress buildup, and poor academic performance (WHO, 2022).

If adolescents are aware of the PA guidelines and the health benefits, they are more likely to comply with the recommendations (Fabunmi, 2019 & Wafi et al, 2024). High level awareness of WHO PA recommendations will facilitate PA behaviors and enhance, prolong, and promote adolescents lives. The location and kind of school (mixed or single sex) are two socio-demographic characteristics that may have a big impact on how aware adolescents are of PA guidelines. It was crucial to evaluate these factors in order to identify the subgroups that ought to be the focus of an efficient awareness campaign regarding PA guidelines.

This study was based on Weinstein's (1988) precaution adoption process model (PAPM), which states that people adopt a precaution if the projected benefits outweigh the cost and the balance looks favorable. This paradigm uses seven sequences of stages-aware, uninvolved, uncertain, decided to act, acting, maintaining action, and not acting-to help with behavior change.

Objectives of the Study

The main objective of the study was to assess WHO physical activity (PA) recommendations awareness among in-school adolescents aged 10-20 years in Nsukka LGA. Specifically the study determined:

1. proportions of in-school adolescents who were aware of WHO PA recommendation in Nsukka LGA?
2. differences in WHO PA awareness level among adolescents based on school location in Nsukka LGA?
3. differences in WHO PA awareness level among adolescents based on school type in Nsukka LGA?

Research Questions

1. What proportion of in-school adolescents were aware of WHO PA recommendations for adolescents in Nsukka LGA.
2. Does in-school adolescents awareness of PA recommendations differs according to school location in Nsukka LGA.
3. Does in-school adolescents awareness of PA recommendations differs according to school type in Nsukka LGA.

Hypotheses

In-school adolescents' level of awareness of WHO PA recommendation is independent of:

HO_1: school location at 0.05 level of significance.

HO_2: school type at 0.05 level of significance.

Methodology

***Research Design*:** Cross sectional descriptive survey research design was employed in the study. Knox, et al (2013) employed this design in a related study on lack of knowledge of physical activity guidelines in United Kingdom (UK).

***Area of the Study*:** Area of the study was Nuskka local government area (LGA). The L.G.A. has over 59 government secondary schools located in urban and rural areas. The study covered all the in-school adolescents in junior secondary school (JSS) classes 1 and 2 as well as senior secondary school

(SSS) classes 1 and 2 in government secondary schools in Nsukka LGA.

Population for the Study: The population for the study comprised of 7440 male and female students within 10-20 years in JSS1, JSS2 and SSS1, SSS2 in the 59 public schools located within urban and rural areas in Nsukka LGA who enrolled for 2022/2023 academic year. Students in JS 3 and SS 3 were not included in the study because they were busy with external examinations.

***Sample for the Study*:** Sample for the study (n = 380) was determined using Charan and Biswas (2013) formula (Z_1-$\alpha/2^2$ SD/d_2) for quantitative survey study. To guard against non response rate a 10 percent (0.1) i.e. (380 x 0.1 = 38) of the minimum required sample size was added which gave the final sample for study as 418 participants (Bartlett, et al, 2001). Multistage sampling technique was used which involved, stratifying schools into urban and rural, selecting 10 schools each from urban and rural, and drawing 10 percent of each school student's population from JSS 1and 2 and SSS 1and 2 respectively to arrive at 418 participants.

***Instrument for data collection*:** Questonnaire was used for data collection. The instrument consists of three main items and was adopted from Vaara et al (2019). The first item was a single 'Yes' or 'No' question to ascertain if they have seen, heard or read about WHO PA recommendations for adolescents. The second item was on aerobics recommendation. The third item was on muscles and bone strength recommendations (WHO, 2022). The instrument had a 2-point "Yes"/ "No" response.

***Data Collection Methods*:** A total of 418 copies of the questionnaire were distributed to respondents by hand with the permission of the Principal of each secondary school. Out of 418 copies of questionnaire distributed, 29 copies were lost due to incomplete responses and inability to return the questionnaire. The remaining 389 copies of questionnaire gave a return rate of 93.06 percent.

***Data Analysis Technique*:** Frequencies and percentages were used to find out the proportion of students who were aware of adolescents PA recommendation/guidelines. Level of awareness was in line with (Wafi et al, 2024) based on composite scores of the three items which range from 0 to 3 (awareness, aerobics, muscles and bones strengthening activity). Thus, scores were classified into three levels with a bench mark score of zero (0) as poor awareness level; score of 1 to 2 as moderate awareness level and score of 3 as high awareness level. Chi-square test of independence was used to test for differences between categorical variables with a P-value of < 0.05 as statistically significant.

Table 1: Percentages Responses on Proportion of Students Aware of WHO Physical Activity Recommendation for Adolescents

S/N	Awareness Indicators	Yes (F%)	No (F%)
1.	I have seen, heard or read about PA recommendations for adolescents	45(11.57)	344(88.43)
2	**I know that moderate to vigorous aerobic PA**		

Table 1 continued

	recommendation per week is:		
I	sixty minutes (1 hour) daily per week	81(20.82)	308(79.18)
Ii	one hundred and eighty minutes weekly1 (3 hours)	113(29.05)	276(70.96)
Iii	two hour thirty minutes (2 ½ hour) weekly	117(30.08)	272(69.93)
Iv	three hundred minutes weekly (5 hours) weekly	78(20.05)	311(125.0)
	Total Yes/No	**81(20.82)**	**308(79.18)**
3	I know that muscle and bone strengthening PA recommendation per week is		
I	once in week	133(34.19)	256(65.81)
Ii	three or more times in a week	31(7.97)	358(92.03)
Iii	four times in a week	128(32.90)	261(67.09)
Iv	every day of the week	97(24.94)	292(75.64)
	Total Yes/ No	**31(7.97)**	**358(92.03)**

N = 389; f(%) = frequency and percentage responses of all the participants

Table 1 indicates that only 11.57 percent were aware of WHO PA recommendation, 20.82 percent were aware of the required volume of aerobic activities while only 7.97 percent were aware of the required days to engage in muscles and bones strengthening activities.

Table 2: Percentages Responses on Proportion of Students Aware of WHO Physical Activity Recommendation Based on School Location

S/N	Awareness Indicators	$F(\%)_U$	$F(\%)_R$
1	I have seen, heard or read about PA recommendations for adolescents	19(12.80)	26(10.80)
2	**I know that moderate to vigorous aerobic PA recommendation per week is:**		
i	sixty minutes (1 hour) daily per week	29(19.46)	52(21.67)
ii	one hundred and eighty minutes weekly1 (3 hours)	44(29.53)	46(19.17)
iii	two hour thirty minutes (2 ½ hour) weekly	50(33.56)	88(36.66)
iv	three hundred minutes weekly (5 hours) weekly	26(17.45)	54(22.50)
	Average Yes%	**29(19.46)**	**52(21.67)**
3	I **know that muscle and bone strengthening PA recommendation per week is:**		
I	once in week	55(36.91)	70(29.17)
Ii	three or more times in a week	13(8.70)	18(7.50)
iii	four times in a week	36(24.16)	80(33.33)
iv	every day of the week	45(30.20)	72(30.00)
	Average Yes%	13(8.70)	18(7.50)

N = 149 for urban and 240 for rural; $f(\%)_U$ = frequency and percentage responses of urban schools; $F(\%)_R$ = frequency and percentage responses of rural schools

Table 2 shows that only 12.8 percent of urban and 10.8 percent of rural in-school adolescents were aware of WHO PA recommendation. For aerobics, more proportion of the rural 21.676 percent as against 19.46 percent of the urban was aware of the aerobic guideline. In muscles and bones strength activities, only 8.70 percent of the urban as against 7.50 percent of the rural adolescents

were aware of the number of days required.

Table 3: Percentages Responses on Proportion of Students Aware of WHO Physical Activity Recommendation Based on School Type

S/N	Items	$F(\%)_S$	$F(\%)_M$
1	I have seen, hear or read about PA recommendations for adolescents	19(14.30)	26(10.40)
2	I know that moderate to vigorous aerobic PA recommendation per week is:		
I	sixty minutes (1 hour) daily per week	23(17.29)	58(22.66)
Ii	one hundred and eighty minutes weekly1 (3 hours)	33(24.81)	60(23.43)
iii	two hour thirty minutes (2 ½ hour) weekly	57(42.86)	76(29.69)
iv	three hundred minutes weekly (5 hours) weekly	20(15.04)	62(24.22)
	Average Yes%	**23(17.29)**	**58(22.66)**
3	I know that muscle and bone strengthening PA recommendation per week is:		
I	once in week	51(38.35)	92(35.94)
Ii	three or more times in a week	12(9.02)	19(7.42)
iii	four times in a week	43(32.33)	75(29.30)
iv	every day of the week	27(20.30)	70(27.34)
	Average Yes%	12(9.02)	19(7.42)

N = 133 for Single sex school and 256 for mixed sex school; $f(\%)_S$ = frequency and percentage responses ofsingle sex schools; $F(\%)_M$ = frequency and percentage responses of mixed sex schools.

Table 3 shows that 14.3 percent of in-school adolescents in single sex schools as against 10.4 percent of those in mixed schools were aware of the WHO PA guidelines. More of the adolescents (22.66%) in mixed school had more awareness of the aerobics than those in single sex schools with 17.29 percent. In muscle and bone strength activities only 9.0 percent and 7.42 percent respectively of single sex and mixed sex schools were aware of the required days.

Table 4: Level of Awareness of WHO PA Recommendation by In-school Adolescents (N = 389)

Variable	Low	Moderate	High
Overall	299(76.86)	69(17.74)	21(5.40)
Urban school	118(79.2)	20(13.4)	11(7.4)
Rural school	181(75.4)	49(20.4)	10(4.2)
Single sex school	109(80.5)	16(12.0)	10(7.5)
Mixed sex school	192(75.0)	53(20.7)	11(4.3)

low = no correct answer; moderate -1 to 2 correct answers; high = 3 correct answers; urban school N = 149; Rural school N =240; Single sex school N = 133; Mixed sex school N = 256

Table 4 presents the overall responses to the three items. From the table those with low awareness scored zero in the three items. Those classified as moderate got only 1 or 2 out of the three items correct while those who had high awareness got the 3 items correct. From the Table majority 76.86 percent had

low knowledge, 17.74 percent had moderate knowledge while only 5.40 percent had high knowledge of PA recommendation for adolescents.

Table 5: Chi-square Test of Independence Verifying Differences in Awareness Levels of WHO PA Recommendation Based on School Location, and School Type (N = 389)

Variable	Low O(E)	Moderate O(E)	High O(E)	X^2	Df	P-val
Urban school	118(114.5)	20(26.4)	11(8.0)	4.511	2	.11
Rural school	181(184.5)	49(42.6)	10(13.0)			
Single sex school	107(102.2)	16(23.6)	10(7.2)	5.902	2	.05
Mixed sex school	192(196.2)	53(45.4)	11(13.8)			

N = 389; O(E) = Observed value and Expected value; X^2 = Chi-square; Df = Degree of freedom; P-val = P-value (significant value); urban school N = 149; Rural school N =240; Single sex school N = 133; Mixed sex school N = 256

Table 5 indicates no significant difference in awareness of WHO PA recommendation among adolescents based on school location, X^2 (2, n= 389) =4.51, *P* =.11, phi=.11(small effect, Cohen 1988). However, significant difference existed between school type, X^2 (2, 389)= 5.902, *P* = .05, phi = .12 (small effect Cohen 1988).

Discussion

Awareness of the WHO PA recommendations appears low with only 11.57 percent of the respondents who reported being aware (Table1). Although 20.82 percent reported being aware of the dosage recommendations of moderate-intensity physical activity, only 7.97 percent were aware of the dosage for muscles and bones strength activities (Table 1). Overall awareness level (i.e. the composite of the three items) shows low level of awareness with only 5.40 percent who reported high awareness of WHO PA guidelines (Table 4). Disparities exist across demographic characteristics (school location and school type). Those with moderate level of awareness were aware of the aerobics but lacked awareness of muscles and bones guidelines. The majority of people with low awareness did not know about the aerobics or the muscles and bones guidelines.

The result showed lower awareness of WHO PA recommendation compared to previous studies where proportion ranged from 27- 47 percent (Kay et al, 2014; Vaara et al. 2019, Hunter et al, 2014 & Chen et al, 2023). Although, these earlier studies focused on the adult population, as no previous study was on adolescents, they provide a global overview of the awareness of PA guidelines. The low level of awareness was expected given the absence of PA guidlines in school curricula and Nigeria has not implemented PA surveillance. Probably, internet use may be source of awareness of the few adolescents. Additionally, the University of Nigeria, Nsukka, located in the center of the Nsukka LGA, is home to frequent exercisers who engage in PA on a daily basis. Consequently, there is likelihood that those who were aware had either been exercising regularly or had heard about it from other active folks. There was no

difference between the urban and rural participants, which is in contrast to Chen (2017) finding among Chinese children and Warfi et al (2024) among adults in Jazan region of Saudi Arabia . However, disparities existed between the various school types which suggest a gap in their level of awareness of PA guidelines.

The overall low level of awareness of PA guidelines may be the cause of insufficient PA among adolescents reported by earlier researcher (Oyeyemi, 2016). The plausible explanation to low rates of PA could be attributed to lack of awareness of the guidelines and dose recommendation (Piercy et al, 2020 & Wafi et al , 2024). Most times people who are informed of the myriad benefits of PA tend to overestimate their PA level and exhibit less intension to increase their PA when actually they are inactive (Godino et al 2014). Individuals who were aware of the guidelines are more likely to achieve the required PA volume than those who were not (Abulaet al, 2018 & Wafiet al, 2024). The authors further stressed that raising awareness of the guidelines may not increase PA levels of those who are unaware but it can contribute to the development of PA intentions and PA behavior modification. This in no small measure helps contemplators or those considering to be active (Piercy et al 2020) to overcome insufficient PA.

Adolescents who are aware of PA recommendations are better equipped to make health-related decisions (United Nations International Children's Emergency Fund, n. d). Raising awareness can encourage the intention to start, maintain, or adopt PA activity as recommended by WHO. In line with the tenets of precaution adoption process model (PAPM), adolescents need motivational stages to attain the PA guidelines, even when they are aware of WHO PA recommendations because awareness alone does not transform to action except with a little push. According to Haas (2018) achieving stage 3 (undecided) of PAPM will facilitate progression to stage 5 (acting). This implies that creating awareness and educating the adolescents on the benefits of attaining WHO PA guidelines will facilitate initiation and adherence to it.

Conclusion

In-school adolescents in Nsukka Local Government Area lacked sufficient awareness of WHO PA guidelines, which may increase their risk of developing NCDs as well as raising health expenses. It is likely that insufficient public promotion and more efficient communication technique led to this lack of awareness. In addition, being a very critical health concern, physical education curricula in schools failed to address the WHO PA guidelines. To protect the health of adolescents who are future generations, there is an urgent need for efficient education and awareness-raising initiatives to raise the existing low level of awareness of the WHO PA recommendation among in- school adolescents.

Recommendations

1. To make in-school adolescents more aware of the importance and benefits of following the guidelines

for their health, the government should require curriculum developers to incorporate the WHO PA recommendation and its benefits into physical education and health policy.

2. Awareness campaign on WHO PA recommendation should be carried out targeting all school types both rural and urban schools through Mass media and community workshops.

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Knowledge, Attitude and Practice of Sustainable Fashion Consumption among Young Adults in Ile-Ife, Osun State

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Abstract

The study examined knowledge, attitude, and practice (KAP) of sustainable fashion consumption among young adults in Ile-Ife, Osun State. Survey design was adopted for the study. The sample for the study was made up of 250 respondents who were selected using purposive and convenience sampling technique. Data was collected using a structured questionnaire. Findings show that respondents have good knowledge and a positive attitude towards sustainable fashion. They revealed that sustainable fashion supports consumers to wear and maintain their clothing (85.2%) and that second-hand clothes are more sustainable (64.8%). They selected apparel that they could wear over a longer term ($\bar{X}$= 4.16) and bought products packaged in recycled materials ($\bar{X}$= 3.56). Some young adults choose materials that quickly go out of style, indicating a gap between knowledge and practice. There was a significant relationship between knowledge and practice of sustainable fashion. This study contributes to the growing body of research on sustainable fashion consumption and provides valuable insights for policymakers, businesses, and consumers. The study concludes that there is a need for more public enlightenment programs on sustainable fashion to reinforce young adults' shift towards eco-friendly practices. It is recommended that fashion associations should align fashion businesses with sustainable goals and products. Consumers should leverage social influence to promote eco-friendly materials.

Keywords: Sustainability, Fashion, Knowledge, Attitude, Practice, Eco-friendly, Consumption, Young Adult

Introduction

Sustainable fashion consumption refers to the practice of making socially and environmentally responsible clothing choices while purchasing clothing items (Gupta *et al*., 2019; Okur & Saricam, 2019). It involves opting for clothing items that are manufactured, marketed, and used in ways that minimize environmental impact (Khandual & Pradhan, 2019). This includes selecting items made from eco-friendly materials, supporting brands with transparent and ethical production processes, and

adopting behaviours such as repairing, upcycling, or recycling garments to extend their lifespan. Sustainable fashion consumption is also referred to as ethical fashion or green fashion (Zhang, & Dong, 2020).

There is an increasing global concern for unsustainable fashion consumption as apparel and clothing items are in constant demand. The continuous production, distribution and disposal of textiles induces environmental pollution, waste and climate change (Yeoh, 2020). Fashion brands, consumers and manufacturers in developed countries are creating greater awareness of the practice of sustainable fashion. The trends in developing countries like Nigeria demand stronger advocacy for more eco-friendly textiles.

Young adults (18-26 years) are significant consumers in the fashion industry. Their purchasing decisions and attitudes towards sustainability can drive market trends and influence broader societal shifts towards sustainable practices (Watson *et al*., 2023). Young people have been behind societal transformation being more active on social media (Stepp, 2023). Social media influenced their clothing selection and promoted new fashion trends such as clothing customisation (Diyaolu *et al*., 2019; Diyaolu & Omisaking, 2018).

There is a need to be well-enlightened and equipped for sustainable fashion consumption in Nigeria. Knowledge of consumers about environmental issues was found to have a significant impact on clothing consumption (Kang & Kim, 2013). Understanding the environmental impact of clothing and having a positive attitude toward sustainable practices are crucial steps in fostering change (Connell & Kozar, 2014).

The current clothing consumption habits are heading in a direction that might soon result in negative socio-economic consequences if little or no measures are taken (Joshi & Rahman, 2016). The knowledge, attitude and practice of young adults are significant to achieving Sustainable Development Goal 12 (SDG), promoting responsible production and consumption patterns in the fashion industry. Clothing production in developing countries can leverage digital transformation, total quality management, and sustainable practices (Diyaolu, 2022; Ogunyemi *et al*., 2023).

Even though sustainability is an emerging trend, consumers repeatedly buy clothes that have harmful environmental impacts. Consumers' increasing interest in sustainability is yet to manifest in their knowledge, attitude and practice (McDonagh & Prothero, 2014). Research still lacks a comprehensive approach to explain consumers' purchase behavior of sustainable clothing (Rausch, & Kopplin, 2021). There is a need to obtain data that can be useful in predicting future trends and achievement of fashion sustainability goals, hence this study.

Objectives of the study

The main objective of this study was to assess the knowledge, attitude and practice of sustainable fashion among young adults in Ile-Ife, Osun State. Specifically, the study determined:

1. knowledge indicators of sustainable fashion among young adults in Ile-Ife, Osun State.
2. attitude towards sustainable fashion among young adults in Ile-Ife, Osun State.
3. ways young adults practice sustainable fashion in Ile-Ife, Osun State.

Research questions

1. What is the level of knowledge of sustainable fashion among young adults in Ile-Ife, Osun State?
2. What are the attitudes towards sustainable fashion among young adults in Ile-Ife, Osun State?
3. In what ways do young adults practice sustainable fashion in Ile-Ife, Osun State?

Methodology

***Design of Study*:** The study was a survey to assess knowledge, attitude, and practice (KAP) of sustainable fashion.

***Area of the Study*:** The study was conducted in Ile-Ife, Osun State, Nigeria. Ile-Ife is an urban area situated in southwestern Nigeria situated at 7.4667° N latitude and 4.5667° E longitude. According to the United Nations World Population Prospect, Ile-Ife has a population of approximately 423,000 people with a growth rate of 3.42% from 2023 (United Nations, 2024). It is known for its historical significance, higher educational institutions and teaching hospitals. Young adults dress in local and foreign cultures. It is an economic centre for buying and selling clothing, textiles and apparel in markets like Oja Tutun, New Market, and Ife Resort Centre among others. Administratively, Ile-Ife has two local governments (LGs) namely Ife Central and Ife East. The area is made up of 11 wards.

***Population of the Study*:** The population of the study comprised young adults aged 18-26 years in Ife Central Local Government Area, Ile-Ife, Osun State, Nigeria. These individuals were specifically chosen because they represent a demographic likely to be engaged with sustainable fashion trends, given their proximity to higher educational institutions and urban lifestyles. The population included both in-school (university and college students) and out-of-school (working or unemployed) young adults. The relevant characteristics of this group include their engagement in educational or vocational activities and their exposure to both local and global fashion trends.

***Sample for the Study*:** The sample was drawn using a combination of purposive and convenience sampling techniques. The study targeted young adults from specific wards within Ife Central Local Government Area, namely Iremo/Ajebandele, Iremo/Eleyele, and Moore/Ojaja, because of their high population density of young adults. The selection of participants within these wards was based on their willingness to participate in the study. They were located in their houses, hostels, along the streets and market areas. The sample size was 250 respondents, distributed across the selected wards as follows: Iremo/Ajebandele (90), Iremo/Eleyele (80), and Moore/Ojaja (80).

***Instrument for Data Collection*:** Data were collected using a structured questionnaire. It was developed

through literature review based on the specific objectives of the study. The questionnaire had four sections with three sets of response scales of Yes/No for socio-economic characteristics and specific objective No 1; 5-point scale with Strongly agreed (5), agreed (4), undecided (3), disagreed (2) and strongly disagreed (1) for specific objective No 2; and 3-point scale with Always (3), sometimes (2) and never (1) for specific objective No 3. The validation of the questionnaire was done by three experts in Clothing and Textiles. Cronbach's alpha procedure was used to determine the reliability coefficient. A value 0.79 was obtained.

***Data Collection Methods*:** A total of 250 copies of the structured questionnaire were administered with the help of two trained interviewers who ensured the questionnaires were completed and collected on the spot. All 250 questionnaires were successfully retrieved, resulting in a 100% response rate.

***Data Analysis Techniques*:** Data generated from the study were coded and analyzed using Statistical Package for Social Science (SPSS) version 26. Descriptive statistics: mean, frequency and percentages were used to interpret the findings. Correlation analysis was used to measure the relationship between knowledge, attitude and practice of sustainable fashion.

Results

Respondents' Socio-demographic characteristics

Data analysis on socio-demographic characteristics of respondents shows that the mean age was 26±0.29 years, showing a more vibrant age. A majority of the sample has tertiary education (82.0%). The majority of the sample is single (74.0%) and of Yoruba ethnicity (84.8%). Self-employed individuals make up 54.8% of the sample, indicating a significant presence of entrepreneurial activity.

Table 1: Percentage Responses on Knowledge of Sustainable Fashion among Young Adults in Ile-Ife

S/N	Knowledge Indicators	Yes (F%)	No (F%)
1	Fashion is the art of expressing beauty through clothing	232 (92.8)	18 (7.2)
2	Fashion encompasses many other things in our everyday life, other than clothes and accessories	223 (89.2)	27 (10.8)
3	Fashion is the most change-intense category of consumer products	212 (84.8)	38 (15.2)
4	Sustainable fashion supports proper clothing maintenance	213 (85.2)	37 (14.8)
5	In Sustainable fashion consumers enjoy and become attached to their clothing	176 (70.4)	74 (29.6)
6	In sustainable fashion, consumers give away their clothing	160 (64)	90 (36)
7	Buying second-hand clothes is more sustainable	162 (64.8)	88 (35.2)
8	Buying fashion brand clothes is more sustainable	191 (76.4)	59 (23.6)
9	Sustainable fashion is made from organic raw materials	180 (72)	70 (28)
10	Sustainability does not involve the use of harmful chemicals	183 (73.2)	67 (26.8)

S/N	Knowledge Indicators	Yes (F%)	No (F%)
	Table 1 continued		
11	Sustainable fashion aims at reducing fabrics wastes	176 (70.4)	74 (29.6)
12	Sustainable fashion reduces carbon footprint in production	155 (62)	95 (38)
13	Sustainable fashion promotes fair labour practices	165 (66)	85 (34)
14	Sustainable fashion encourages recycling of materials	172 (68.8)	78 (31.2)
15	Sustainable fashion minimizes water usage during production	158 (63.2)	92 (36.8)

Source: Fieldwork, 2023

Table 1 shows the percentage responses of young adults on knowledge of sustainable fashion. The majority of the respondents understood that fashion is the art of expressing a sense of beauty through clothes (92.8%). They are aware that sustainable fashion supports proper clothing maintenance (85.2%).

They understood that sustainable fashion is made from organic raw materials (72%), and does not involve the use of harmful chemicals (73.2%). There was an awareness that buying fashion brand clothes is more sustainable (76.4%). Most of the respondents stated that sustainable fashion is dependent upon engaging consumers to give away or discard their clothing (64%) and that buying second-hand clothes was more sustainable (64.8%).

Table 2: Mean Responses on Attitude Indicators towards Sustainable Fashion Consumption Among Young Adults in Ile-Ife

S/N	Attitude Indicators	Mean	SD	Remark
1	I value fashion products made or packaged in recycled materials	3.56	1.00	Positive
2	I prefer apparel that I can wear over a longer term	4.16	1.05	Positive
3	I consider apparel that goes out of style quickly	2.99	1.10	Negative
4	I like clothing made of organically grown natural fibers	3.62	1.15	Positive
5	I value clothes with low-impact or no-dye processing	3.58	1.20	Positive
6	I prefer clothes with environmentally friendly packaging	4.12	1.25	Positive
7	I share my experiences about green products with others	3.60	1.30	Positive
8	I enjoy fair trade clothing	3.78	1.35	Positive
9	I actively seek out sustainable fashion brands	4.12	1.36	Positive
10	I consider the environmental impact in fashion purchases	3.62	1.15	Positive

Source: Fieldwork, 2023

Table 2 shows responses to attitude indicators towards sustainable fashion consumption.Yuong adults showed positive attitudes in selecting apparel they can wear over a longer term ($\bar{x}$=4.16). They preferred clothes with environmentally friendly packaging techniques ($\bar{x}$=4.12) indicating a

preference for eco-friendly packaging and materials. There is however a negative attitude towards selecting apparel that goes out of style quickly ($\bar{x}$=2.99). Others enjoyed fair trade clothing ($\bar{x}$=3.78) and shared their experiences and knowledge about green products with friends and family ($\bar{x}$=3.60).

Table 3: Percentage Responses on Practice Indicators of Sustainable Fashion among Young Adults in Ile-Ife

S/N	Practice Indicators	Always F(%)	Sometimes F(%)	Never F(%)
1	I buy new clothing	143 (57.2)	73 (29.2)	34 (13.6)
2	I purchase second-hand clothing	123 (49.2)	90 (36.0)	37 (14.8)
3	I donate clothing items for charity	127 (50.8)	100 (40.0)	23 (9.2)
4	I wear low-maintenance clothes	135 (54.0)	80 (32.0)	35 (14.0)
5	I choose environmentally safe garments	160 (64.0)	80 (32.0)	10 (4.0)
6	I opt for eco-friendly labelled and packed items	141 (56.4)	75 (30.0)	34 (13.6)
7	I wear clothes for longer periods	139 (55.6)	100 (40.0)	11 (4.4)
8	I actively participate in clothing swap or rental programs	130 (52.0)	90 (36.0)	30 (12.0)
9	I avoid purchasing fast fashion items	110 (44.0)	90 (36.0)	50 (20.0)
10	I seek information about fashion brands' sustainability practices	115 (46.0)	90 (36.0)	45 (18.0)
11	I repair or mend clothing instead of discarding	120 (48.0)	100 (40.0)	30 (12.0)

Source: Fieldwork, 2023

Table 3 shows the percentage responses on practice indicators of sustainable fashion among young adults. Majority frequently buy new clothing (57.2%) and choose environmentally safe garments (64.0%). About 55.6% preferred wearing clothes for longer periods and donated clothing items for charity (50.8%). However, only 52.0% always actively participated in clothing swaps or rental programs and avoided purchasing fast fashion items (44.0%).

Discussion of Findings

The knowledge of young adults on the importance of organic materials, reduced carbon footprint, and promoting fair labour practices are worthy of mention. Based on the fact that majority has tertiary education could be responsible. Formal education has been observed to influence level of knowledge in sustainable fashion (Agarwal, 2020). Knowledge can guide policies and business strategies in the fashion industry to skew consumer expectations and promote sustainability. Adjabeng (2022) documented that only two-fifths of the respondents in Ghana had good knowledge of sustainable fashion. Young adults also showed a strong inclination towards environmentally sustainable and socially responsible fashion. Hur, & Cassidy (2019), opined that a lack of knowledge regarding

sustainable design and a lack of design-led approaches can inhibit sustainable fashion.

The attitudes of young adults reflect a favourable disposition towards sustainable fashion. Attitudes can act as a mediator between perceived risks and behavioural intentions in sustainable fashions (Kang & Kim, 2013). The positive attitudes towards recycled materials, low-impact processing, and organic fibers are reflected in their choice of environmentally safe garments. Joshi & Rahman (2016) revealed attitudes as predictors of young consumer's green purchase behaviour in India. This provides opportunities for businesses to cater to these preferences and align their products and practices with sustainability goals. Furthermore, the success of sustainable fashion is dependent upon engaging young adults who wear, maintain, and discard their clothing (Lewis & Loker, 2015). High mean scores are observed in selecting long-term apparel, buying organic fibers, and considering the environmental impact before purchases.

Kam & Yoo (2022), found that most consumers practice sustainable fashion designs that satisfy customer taste and emotions. The practice of selecting environmentally safe garments among young adults in Ile-Ife demonstrated a commitment to sustainability in daily life. Diyaolu *et al*., (2023) and Diyaolu, (2010) highlighted the use of traditional eco-friendly fabrics during the *Ojude-Oba* festival among the male adolescent in Ijebu-Ode.

The choice of eco-friendly labelled and packed items indicates an understanding of sustainable fashion. Granskog *et al*., (2020) reported that consumers are going out of their way to recycle and purchase products in environmentally friendly packaging.

Adjabeng (2022) affirmed that adolescents buy new and secondhand clothes. As observed in this study, buying new clothing items on a regular basis contrasts with sustainable efforts but highlights consumer behaviour trends. In most cases, new clothing was purchased for festive occasions. Brands can address this trend by promoting sustainable alternatives for festive wears. Purchasing second-hand clothing and donating items for charity reflect a growing awareness and participation in sustainable practices that reduce textile waste in landfills (Diddi *et al*., 2019). Reusing and buying second-hand clothing and prioritising clothing longevity are sustainable clothing consumption behaviours (Olwoch *et al*., 2023; Rakhshanpour*et al*., 2021). However, Kang & Kim (2013) opined that social risk could keep young consumers from deciding to purchase environmentally sustainable apparel.

Actively participating in clothing swaps or rental programs by young adults points to innovative approaches to sustainable fashion. The avoidance of fast fashion will reduce the cubic meters of water expected to be utilized in clothing production (Rausch & Kopplin, 2021). Diyaolu (2024) reported that participants showed positive response to upcycled fabrics in a survey conducted in Ile-Ife.

In the Fashion Revolution's 2021 Consumer Survey, 60%of respondents aged 16-25 would like to know how their clothes are manufactured.

Consumersprioritize trends over brands, seeking a particular style rather than a particular name when shopping sustainably (Heuritech, 2022).

Conclusion

This study concluded that young adults had adequate knowledge and a positive perception of sustainable fashion indicating a growing awareness of environmental and social issues related to fashion. They demonstrated positive attitudes towards sustainable fashion practices, as evidenced by their preference for durable clothing, environmentally friendly materials, and participation in fair trade initiatives. There is also a significant implementation of sustainable fashion practices including the purchase of second-hand clothing, donation of clothing items for charity, and preference for eco-friendly garments. The study highlights the active participation of a youthful demographic in sustainable fashion practices, suggesting a potential for continued growth and influence. The dominance of Yoruba ethnicity among respondents underscores the influence of cultural factors on sustainable fashion choices, highlighting the importance of cultural perspectives in promoting sustainable behaviours.

Recommendations

Based on the findings of the study, the following were recommended:

1. More public enlightenment programmes by the National Orientation Agency on fast fashion will reinforce consumers' shift towards more sustainable fashion.
2. Since consumers are conscious of and have a preference for eco-friendly materials, fashion brands should prioritise the use of eco-friendly materials in production.
3. Fashion institutions should incorporate organic materials in manufacturing based on consumers' preferences and highlight eco-friendly dyeing practices.
4. Fashion businesses should align their products and practices with sustainability goals based on the knowledge of respondents provided in the study.
5. Consumers should recommend and share information about eco-friendly products.

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Auto Electrical and Electronic Competencies Needed by Mechanical Work Students for Vehicle Diagnosis and Maintenance in Technical Colleges of Enugu State

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Abstract

The general purpose of this study was to ivestiage the auto electrical and electronic competencies needed by mechanical work students for vehicle diagnosis and maintenance in Technical Colleges in Enugu State. Specifically, it determined important competencies for diagnosing vehicles, important competencies for maintaining vehicles, those important competencies for diagnosing and maintaining vehicles already possessed by mechanical work students, and vehicle diagnosing and maintenance competencies needed by mechanical work students in Technical Collegies. Two hypotheses guided the research. The study adopted a survey research design and was carried out in Enugu State.Population was 56 comprising of motor vehicle mechanical work teachers and instructors. A 5-point Likert Scale questionnaire was used for data collection. Data were analysed using mean and t-test for testing the hypotheses at 0.05 level of significance. Findings include, among others,23 important competences for diagnosis and 21 for maintenance of motor vehicle.These include ability to: perform a scan tester diagnosis on vehcles ways($\bar{X}$= 3.58), define terms associated with OBD II diagnosis ($\bar{X}$= 3.54), connect diadnostic tools to the identified ports ($\bar{X}$= 3.83), repair lighting system ($\bar{X}$= 3.57), and others. Enhance their efforts at equipping the students with the important competencies they need on;y 13 (29.5%) out of the two sets of competencies put together. The students need to acquire 16 (69.57%) and 15(71.43) of the important vehicle diagnosis and maintenance respectively. It was recommended among other things that, mechanical work teachers and instructors should engage in in-service training to acquire the skills.

Keywords: Competencies, Diagnosis, Maintenance, Vehicles, Mechanical Students, Technicalcolleges.

Introduction

The quest for technical college graduates who can transform the knowledge and skills learnt successfully in industries or companies is in high demand. Unfortunately, these graduates are yet to meet up with the required competences necessary for employment. Competency is skill one possesses that enables one to perform a task. Competence is the combination of practical and theoretical knowledge, cognitive skills, behavior and values used to improve performance. Maaleki, (2018), stated that competency could be measured and developed through

training. Stevenson, (2012) noted that competency development process comprises of the mental reflection process as well as the physical action process. These processes are obtainable in various trades in technical colleges.

Technical colleges are training grounds for individuals to acquire technical awareness and useful skills necessary for mastering a particular trade. Ede, et al (2010) describe technical colleges as educational institutions established with the aim of training students to acquire appropriate vocational skills, knowledge, attitudes, that enable them develop their intellectual and economic capabilities, and become self-reliant.The colleges equip individual with practical skills, knowledge and attitude required of craftsmen and technicians at sub-professional level (Okoro 2006). Technical colleges are mainly established for the training of students to acquire practical skills, knowledge and attitudes essential for employment in various trades (Eze and Okafor, 2012a). The various trade areas offered in technical colleges include; furniture making, painting, electrical and electronics repairs and installations, welding and fabrication, plumbing, woodworking, carpentry, and motor vehicle mechanics etc.

Technical College graduates are suppose to gain employment after graduation but the rate the graduates are being unemployed is becoming more critical in Nigeria. This may be attributed to the inability of graduates to possess adequate knowledge and practical skills needed for a gainful employment in different companies and industries across the country (UNIDO, 2020). This is as a result of high rate of technological advancements in companies and industries both in Nigeria and the world at large. Shittu (2014) observed that the products of technical institutions, including technical colleges, are found to possess fewer competencies in their different occupational trades.

Oluka (2016) explained that motor vehicle mechanic work (MVMW) being one of the trade is designed to produce competent auto mechanics craftsmen who acquires necessary skills to test, diagnose, service and completely repair any fault on motor vehicle to the manufacturers' specification (Oluka, 2016). The aim of motor vehicle mechanic work according to National Board for Technical Education (NBTE) (2011), is to give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant. Fadairo (2016) & Roner (2014) stated that the components of MVMW are arranged in modules for easy assimilation to learners of technical colleges. These components include engine maintenance, suspension, auto electrical electronic and transmission work, major engine repair works, service station mechanic, steering and braking system and others. Vehicle electrical and electronic systems being one of the component are crucial and complicated systems in automobile. It is complicated in the sense that it comprises of many sub units such as the charging, ignition, starting systems that work together as component parts of the electrical and electronic system. National Board Technical Education (NBTE) (2011)

&Federal Republic of Nigeria (FRN), (2013), stated that students upon graduation should be able to understand the principles of electricity generation as applicable to automobiles,

Innovation in automobile manufacturing industries has led to the production of vehicles with new technological designs, techniques, methods and ideas in the development and operation of automobile. These set of vehicles normally come with interface or data link connector called On-Board Diagnosis (OBD). OBD is an automotive term referring to a vehicle's self-diagnostic and reporting ability (Donal, 2009 &Medashe, 2020). OBD being a technology that is embedded within an engine control unit (ECU) is connected to this kind of vehicle for onward diagnosis and maintenance of faults and provides easy operation of vehicle. (Igwe et al, 2017).

Wyman (2007) and Dickson & Adu-Agyem, (2018). noted that this technological innovation in automobile have brought comfort, safety, smoothness of operation, ease of maintenance, strength, durability, cleaner and better economic services, among others. In the view of Giri (2010) and Ezeama, et al, (2016), this aspect of innovation in automobile makes the vehicle to perform better in safety and economical than those other vehicles. As these innovations in the automobile industry have equipped vehicles with many good things, these vehicles at one time or the other develop either electrical or electronic faults, which will be repaired or maintained by MVMW students upon graduation (Goldwasser, 2012 & Soni 2013). Unfortunately, MVMW students may not diagnose and maintain vehicles effectively due to lack of adequate training and practices as concern these vehicles. Some of the MVMW students are not even aware of so called auto diagnostic tools, and this has made them incompetent in their field upon graduation there by rendering most of the MVMW unemployed after graduation especially in Enugu state (Mustaphaet al, 2016 & Ogunmilade, 2017). It is also observed by Shittu (2014) that the products of technical colleges are found to possess fewer competencies for employment in industries. This unfortunately is not in line with the major goal of Technical College which is to produce efficient and relevant craftsmen and women that will enhance industrial development in the area of maintenance, goods production and general services (United Nations Industrial Development Organization) (UNIDO,2020). It is against this back ground that this study was constituted to ascertain the auto electrical and electronic competencies needed by mechanical work students for vehicle diagnosis and maintenance in technical Colleges in Enugu State.

Purpose of the Study

This study is designed to investigateauto electrical and electronic competencies needed by mechanical work students for vehicle diagnosis and maintenance in technical Colleges in Enugu State. Specifically, the study determine the:

1. important competences for diagnosis of vehicles for students in Technical Colleges of Enugu.
2. important competences for maintenance of vehicles for students in Technical Colleges of Enugu.

3. those important competences for diagnosis and maintenance of vehicles already possessed by the students in Technical Colleges of Enugu.
4. vehicle diagnosis and maintenance competences needed by students in Technical Colleges of Enugu.

Research Questions

The following research questions were formulated to guide the study.

1. What are the important competences for diagnosis of vehicles for students in Technical Colleges of Enugu?
2. What are the important competences for maintenance of vehicles for students in Technical Colleges of Enugu?
3. What are those important competences for diagnosis and maintenance of vehicles already possessed by students in Technical Colleges of Enugu?
4. What are the vehicle diagnosis and maintenance competences needed by students in Technical Colleges of Enugu?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

There are no significant differences between the mean responses of MVMW teachers and instructors onimportant competences for:

HO_1: diagnosis of vehicles for students in Technical Colleges of Enugu.

HO_2: maintenance of vehicles for students in Technical Colleges of Enugu.

Methodology

***Design of the study*:** The study adopted a descriptive survey research design.

Area of the study: The study was carried out in the two accredited technical colleges in Enugu State, Nigeria. There are Government Technical College Enugu and Government Technical College in Nsukka.

Population for the study: The population of this study was made up of 56 motor vehicle mechanical work (MVMW) teachers and instructors of the technical colleges in Enugu State. The entire population involved in the study.There was no sampling since the population is of manageable size.

***Instrument for data collection*:** A structured questionnaire with 5-points Likert scale was used for data collection. The instrument was validated by three experts. Cronbach Alpha reliability technique was used to determine the internal consistency of the items of the instrument, which yielded an overall reliability coefficient of 0.81.

***Data collection methods*:** The data was collected by the researchers and two research assistants.

***Data analysis techniques*:** The data collected were analysed using mean to answer the research questions Questionnaire. Items with the mean of 3.50 and above were considered as Important, Possessed and Needed while questionnaire items less than 3.50 was considered Not important, Not Possessed and not needed. The two null hypotheses were tested using T-test at 0.05 level of significance.

Findings

Table 1: Mean Responses, Standard Deviation and t-test of MVMW Teachers and Instructors on the Important Competences for Diagnosis ofVehicles for Students in Technical Colleges of Enugu.

S/N	Important competences for diagnosis	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}g$	t	Rem
	Ability to:							
1	define terms associated with OBD II diagnostics	3.59	0.77	3.50	0.76	3.54	0.67	Agree
2	explain the basic format of OBD II diagnostic trouble codes (DTCs)	3.51	0.50	3.54	0.55	3.52	0.93	Agree
3	identify the cause of illuminated malfunction indicator Light (MIL)	3.53	0.62	3.63	0.61	3.58	0.77	Agree
4	conduct preliminary checks on an OBD II system	3.69	0.46	3.59	0.47	3.64	0.62	Agree
5	perform a scan tester diagnosis on vehicles	3.53	0.62	3.63	0.61	3.58	0.73	Agree
6	select the right diagnostic tool to diagnose faults in present day vehicles	3.69	0.46	3.59	0.47	3.64	0.40	Agree
7	enter car details, selecting codes and the letters the codes are represented with	3.52	0.55	3.52	0.56	3.52	0.42	Agree
8	use OBD II scanners to identify anti-lock braking system faults	3.56	0.52	3.55	0.53	3.55	0.78	Agree
9	use OBD II scanners to identify automatic transmission solenoid faults	3.53	0.62	3.63	0.61	3.58	0.95	Agree
10	diagnose electronic power steering (EPS) OBD II scan tool, and repairing it	3.69	0.46	3.59	0.47	3.64	0.73	Agree
11	use OBD II scan tool to diagnose and repair electronic fuel injection system	3.53	0.62	3.63	0.61	3.58	0.88	Agree
12	repair exhaust gas recirculation system	3.69	0.46	3.59	0.47	3.64	0.66	Agree
13	diagnose oxygen sensor to check for malfunction and ensure clean emission of vehicle	3.52	0.55	3.52	0.56	3.52	0.97	Agree
14	test of circuit for excessive resistance	3.56	0.52	3.55	0.53	3.55	1.00	Agree
15	check amperes with digital multi meter (DMM)	3.55	0.55	3.80	0.50	3.67	0.09	Agree
16	check battery condition with appropriate tools and diagnose faults	3.61	0.46	3.63	0.49	3.62	0.56	Agree
17	diagnose current flow or bad connection of instrument panels gauges with OBD II scanners and multi-meter	3.53	0.62	3.63	0.61	3.58	0.69	Agree
18	detect faulty instrument panels sensors and replace it	3.69	0.46	3.59	0.47	3.64	0.55	Agree
19	identify on-board diagnostic ports in vehicles	3.80	0.90	3.60	0.94	3.70	0.98	Agree
20	perform voltmeter test with appropriate tool and diagnose faults in voltages	3.59	0.77	3.50	0.76	3.54	0.99	Agree

Table 1 continued

21	check the functionality of fuses, relays, switches of power windows	3.51	0.50	3.54	0.55	3.52	1.02	Agree
22	inspect switches, fuse and wiring circuit and repair faulty parts	3.53	0.62	3.63	0.61	3.58	0.74	Agree
23	fault trace in light circuit	3.69	0.46	3.59	0.47	3.64	0.68	Agree

$\bar{X}_1$= Mean of teachers; SD_1 = Standard deviation of teachers; $\bar{X}_2$= Mean of instructors; SD_2 = Standard deviation of instructors; $\bar{X}_g$ = Grand mean; t=t-test; REM =Remark.

Table 1 show that respondents agreed to items 1-23 as the important electrical and electronic competences for diagnosis of vehicles for mechanical students in Technical Colleges of Enugu. From the table, it can be deduced that all the items were accepted based on the fact that their grand mean values are above 3.50, which is the cut-off point for the study. Also, the standard deviations (SD) of the items are within the range of 0.46 to 0.94, which indicates that the mean values of the respondents were not far from one another in their responses. The table also presents the t-test between the mean responses of teachers and instructors on the important electrical and electronic competences for diagnosis of vehicle by MVMW students. The t-calculated value of the items ranges from 0.09 to 1.02 which is higher than 0.05 with the degree of freedom of 47. This implies that the null hypothesis of no significant difference between the mean scores of MVMW teachers and instructors on the important electrical and electronic competences for diagnosis of vehicle for students is therefore accepted.

Table 2: Mean Responses of MVMW Teachers and Instructors on the Important Competences for Maintenance of Vehicles for Students in Technical Colleges of Enugu.

S/N	Important competences for maintenance	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}g$	t	Rem
	Ability to:							
1	rectify petrol pump circuit fuel pump	3.53	0.62	3.63	0.61	3.58	0.69	Agree
2	rectify warning light circuit	3.69	0.46	3.59	0.47	3.64	0.99	Agree
3	use scan tool software and hardware to read data from an OBD II compliant car	3.80	0.80	3.60	0.94	3.70	0.46	Agree
4	analyze real-time scan data and to use a symptom chart a problem	3.53	0.51	3.58	0.50	3.55	1.00	Agree
5	maintain safe work environment	3.55	0.55	3.80	0.50	3.67	1.03	Agree
6	perform Load Test to check the load performance of battery	3.61	0.48	3.63	0.49	3.62	0.78	Agree
7	connect diagnostic tools to the identified ports	3.57	0.60	4.07	0.65	3.82	0.83	Agree
8	assemble starter motor components properly	3.59	0.64	3.90	0.67	3.74	0.94	Agree
9	perform Hydrometer Test to check gravity of battery and diagnose faults	3.50	0.73	3.70	0.74	3.60	0.91	Agree

Table 2 continued

10	rectify windscreen wiper circuit	3.59	0.77	3.50	0.76	3.54	0.67	Agree
11	check Ignition System sensors with OBD II scanners and replacing faulty sensors	3.51	0.50	3.54	0.55	3.52	0.68	Agree
12	check solenoid relay and fuses with appropriate tools	3.50	0.64	3.55	0.56	3.55	0.92	Agree
13	repair lighting system	3.55	0.61	3.60	0.54	3.57	0.83	Agree
14	repair heating ventilation and air conditioning of vehicles	3.50	0.57	3.66	0.52	3.58	1.00	Agree
15	diagnose and carry out inspection of blower motor	3.52	0.55	3.52	0.56	3.52	0.98	Agree
16	use the Air Conditioning vacuum pressure gauge	3.56	0.52	3.55	0.53	3.55	0.67	Agree
17	repair vehicles sun roof	3.55	0.50	3.66	0.52	3.60	0.76	Agree
18	repair Security and Immobilizer of vehicles	3.50	0.52	3.64	0.58	3.57	0.82	Agree
19	perform test using voltmeter	3.52	0.53	3.55	0.56	3.53	0.79	Agree
20	check the extent of traction control using traction control tester	3.53	0.64	3.50	0.65	3.51	0.98	Agree
21	perform operations using electronic stability tester	3.55	0.51	3.52	0.50	3.53	0.90	Agree

$\bar{X}_1$= Mean of teachers; SD_1 = Standard deviation of teachers; $\bar{X}_2$= Mean of instructors; SD_2 = Standard deviation of Agree instructors; $\bar{X}_g$ = Grand mean; t=t-test; REM =Remark.

Table 2 shows that respondents agreed to items 1-21 as the important electrical and electronic competences for maintenance of vehicles for students in Technical Colleges of Enugu. From the table, it can be realized that all the items were accepted based on the fact that their grand mean values are above 3.50, which is the cut-off point for the study. Also, the standard deviations (SD) of the items are within the range of 0.48 to 0.90, which indicates that the mean values of the respondents were not far from one another in their responses. The table also presented the t-test between the mean responses of teachers and instructors on the important electrical and electronic competences for maintenance of vehicle by MVMW students. The t-calculated value of the items ranges from 0.46 to 1.00 which is higher than 0.05 with the degree of freedom of 47. This implies that the null hypothesis of no significant difference between the mean scores of MVMW teachers and instructors on the important electrical and electronic competences for maintenance of vehicle for students is therefore accepted.

Table 3: Mean Responses of MVMW Teachers and Instructors on Those Important Competences for Diagnosis and Maintenance of Vehicles Possessed by Students in Technical Colleges of Enugu.

S/N	Important competences for diagnosis and maintenance of vehicles already possessed	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}g$	Rem
	Ability to:						
1	use the air conditioning vacuum pressure gauge	3.52	0.53	3.55	0.56	3.53	P
2	repair heating ventilation and air conditioning of vehicles	3.53	0.64	3.50	0.65	3.51	P
3	diagnose of common electronic ignition system faults	3.55	0.51	3.52	0.50	3.53	P
4	test of circuit for excessive resistance	3.52	0.50	3.55	0.56	3.53	P
5	define terms associated with OBD II diagnostics	3.52	0.53	3.55	0.56	3.53	P
6	carry out inspection of operation of cooling fan, water temperature gauges, and replace faulty parts	3.52	0.55	3.52	0.56	3.52	P
7	repair lighting system	3.56	0.52	3.55	0.53	3.55	P
8	maintain safe work environment	3.55	0.55	3.52	0.50	3.53	P
9	identify on-board diagnostic ports in vehicles	3.53	0.64	3.50	0.65	3.51	P
10	perform test using voltmeter	3.55	0.51	3.52	0.50	3.53	P
11	check the functionality of fuses, relays, switches of power windows	3.80	0.90	3.60	0.94	3.70	P
12	conduct preliminary checks on an OBD II system	3.53	0.51	3.58	0.50	3.55	P
13	faults tracing in light circuit	3.52	0.50	3.55	0.56	3.53	P

$\bar{X}_1$= Mean of teachers; SD_1 = Standard deviation of teachers; $\bar{X}_2$= Mean of instructors; SD_2 = Standard deviation of instructors; $\bar{X}_g$ = Grand mean; REM =Remark, P =Possessed.

Table 3 shows that respondents agreed to 13 items listed as the only possessed competences out of the total of 44 important electrical and electronic competences for diagnosis and maintenance of vehicle. It indicates that MVMW students do not possess enough electrical and electronic competences for diagnosing and maintenance of vehicle.This is indicated from the table, that all the 13 items had their grand mean values above 3.50, which is the cut-off point for the study. Also, the standard deviations (SD) of the items are within the range of 0.50 to 0.90, which indicates that the mean values of the respondents were not far from one another in their responses.

Table 4: Mean Responses of MVMW Teachers and Instructors on the Vehicle Diagnosis Competences Needed by Students in Technical Colleges of Enugu.

S/N	Vehiclecompetences for diagnosis needed	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}g$	Rem
	Ability to:						
1	check amperes with Digital Multi Meter (DMM)	3.86	0.98	3.86	0.98	3.86	N
2	Perform voltmeter test with appropriate tool and diagnose faults in voltages	4.41	0.50	4.41	0.50	4.41	N
3	Perform Load Test to check the load performance of battery	4.04	0.76	4.04	0.76	4.04	N
4	Perform Hydrometer Test to check gravity of battery and diagnose faults	4.49	0.51	4.49	0.51	4.49	N
5	Check Ignition System sensors with OBD II scanners and replacing faulty sensors	4.37	0.49	4.37	0.49	4.37	N
6	Check solenoid relay and fuses with appropriate tools	4.47	0.50	4.47	0.50	4.47	N
7	Check battery condition with appropriate tools and diagnose faults	3.94	0.83	3.94	0.83	3.94	N
8	Diagnose current flow or bad connection of instrument panels gauges.	4.41	0.64	4.41	0.64	4.41	N
9	Detect faulty instrument panels sensors and replace it	4.31	0.62	4.31	0.62	4.31	N
10	Connect diagnostic tools to the identified ports	4.39	0.49	4.39	0.49	4.39	N
11	Diagnose and carry out inspection of blower motor	4.39	0.49	4.39	0.49	4.39	N
12	Use OBD II scanners to identify anti-lock braking system faults	4.39	0.61	4.39	0.61	4.39	N
13	Use OBD II scanners to identify automatic transmission solenoid faults	4.47	0.50	4.47	0.50	4.47	N
14	Diagnose Electronic Power Steering (EPS) OBD II scan tool, and repairing it	4.39	0.61	4.39	0.61	4.39	N
15	Use OBD II scan tool to diagnose and repair Electronic Fuel Injection System	4.35	0.48	4.35	0.48	4.35	N
16	Diagnose oxygen sensor with an OBD II scanner	4.12	0.97	4.12	0.97	4.12	N

$\bar{X}_1$= Mean of teachers; SD_1 = Standard deviation of teachers; $\bar{X}_2$= Mean of instructors; SD_2 = Standard deviation of instructors; $\bar{X}_g$ = Grand mean; REM =Remark, N= Needed

Table 4 shows that respondents agreed to all the items listed as the electrical and electronic competences needed by MVMW students to diagnose vehicles. From the table, it can be deduced that all the 16 items were accepted based on the fact that their mean values are above 3.50, which is the cut-off point for the study. Also, the standard deviations (SD) of the items are within the range of 0.48 to 0.98, which indicates that the mean values of the respondents were not far from one another in their responses.

Table 5: Mean Responses of MVMW Teachers and Instructors on the Vehicle Maintenance Competences Needed by Students in Technical Colleges of Enugu.

S/N	Vehiclecompetences for maintenance needed	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}g$	Rem
	Ability to:						
1	Rectify petrol pump circuit/electrical fuel pump	4.47	0.50	4.47	0.50	4.47	Ne
2	Explain the basic format of OBD II Diagnostic Trouble Codes (DTCs)	4.39	0.57	4.39	0.57	4.39	Ne
3	Identify the cause of illuminated Malfunction Indicator Light (MIL)	4.47	0.54	4.47	0.54	4.47	Ne
4	Rectify of warning light circuit	4.18	0.60	4.18	0.60	4.18	Ne
5	Perform a scan tester diagnosis	4.39	0.53	4.39	0.53	4.39	Ne
6	Select the right diagnostic tool to diagnose faults in vehicles	3.84	0.72	3.84	0.72	3.84	Ne
7	Enter car details, selecting codes and the letters the codes are represented with	4.37	0.49	4.37	0.49	4.37	Ne
8	Use scan tool software and hardware to read data from an OBD II compliant car	4.43	0.50	4.43	0.50	4.43	Ne
9	Analyze real-time scan data and to use a symptom chart	4.47	0.50	4.47	0.50	4.47	Ne
10	Carry out inspection of operation of cooling fan, water temperature gauges.	4.43	0.61	4.43	0.61	4.43	Ne
11	Connect diagnostic tools to the identified ports	4.39	0.49	4.39	0.49	4.39	Ne
12	Assemble starter motor components properly	4.39	0.53	4.39	0.53	4.39	Ne
13	Repair vehicles sun roof	4.53	0.54	4.53	0.54	4.53	Ne
14	Check the extent of traction control using traction control tester	4.37	0.60	4.37	0.60	4.37	Ne
15	Perform operations using electronic stability tester	4.00	0.61	4.10	0.62	4.07	Ne

$\bar{X}_1$= Mean of teachers; SD_1 = Standard deviation of teachers; $\bar{X}_2$= Mean of instructors; SD_2 = Standard deviation of instructors; $\bar{X}_g$ = Grand mean; REM =Remark, Ne= Needed

Table 5 shows that respondents agreed to all the items listed as the electrical and electronic competences needed by MVMW students to maintenance of vehicles. From the table, it can be deduced that all the 15 items were accepted based on the fact that their mean values are above 3.50, which is the cut-off point for the study. Also, the standard deviations (SD) of the items are within the range of 0.46 to 0.98, which indicates that the mean values of the respondents were not far from one another in their responses.

Discussion of Findings

The findings of this study relating to research question one revealed that all the 23 items listed as the important electrical and electronic competences for diagnosis vehicle for MVMW students were accepted by teachers and instructors of MVMW. The findings

were in agreement with the opinion of Giri (2010), who pointed out that there are necessary competences for diagnostic that suit the vehicle faults, which include basic electrical diagnosis, engine systems analysers, On-Board-Diagnoses among others. Simolowo & Oyekola, (2017) also added that vehicle diagnosis and repair can be categorized into two; namely those that can diagnose the entire faults in a car, and those with specific task. It is therefore necessary that MVMW students should possess the important competences. Eze, & Okorafor, (2012a) is also of the view that the major goals of Technical College education include production of efficient and relevant craftsmen and women that will enhance industrial development in the area of maintenance, production of goods and general services.

The findings of this study relating to research question two revealed that all the 21 items listed as the important electrical and electronic competences for maintenance of vehicle for MVMW students were all accepted by teachers and instructors of MVMW. The findings were in agreement with the opinion of Eze, & Okorafor, (2012a) that indicated that the major goal of Technical College education is to produce efficient and relevant craftsmen and women that will enhance industrial development in the area of maintenance, goods production and general services. Olayinka (2009) also explained that MVMW is designed to produce competent auto mechanics craftsmen for Nigeria technological and industrial development. It is therefore necessary that MVMW students should possess the important competences for maintaining vehicles.

The findings of this study relating to research question three revealed that MVMW teachers and instructors agreed to a few items as the only electrical and electronic diagnosis and maintenance competencies possessed by MVMW students. This indicates that MVMW students do not possess enough competence for diagnosis and maintenance of vehicle. This is in agreement with the findings of Muhammad, Azlan Bin & Audu (2014), who asserted that MVMW students possessed little or no competencies in diagnosis of common battery faults and their symptoms; conducting initial battery charge and recharge; breaking down acid to obtain the correct electrolyte and others. It is also observed by Shittu (2014) that the products of technical colleges are found to possess fewer competencies for employment in industries.

The findings of this research work relating to research question four which is presented in table four and five revealed showed that all the 16 items relating to the vehicle diagnosis competencies and the 15 items relating to the vehicle maintenance competences needed by MVMW students were all accepted by MVMW teachers and instructors as needed. These findings agree with Shahbaz (2014), who asserted that MVMW students need competences in demonstrating communication skills, maintaining safe work environment, repairing electrical systems of vehicle and others.UNIDO, (2020) attributed the unemployment of technical college students to the inability of graduates to possess adequate knowledge and practical skills needed for a gainful employment in

different companies and industries across the country (UNIDO, 2020). Wyman (2007), also noted that this technological innovation in competence development in automobile brings about comfort, safety, smoothness of operation, ease of maintenance, strength, durability and others in automobile.

Conclusion

Technical colleges in Nigeria are established to expose individuals to skills in various trades or occupations most especially in MVMW. The main emphasis of the program is the acquisition of skills for employment after graduation. Unfortunately, MVMW students in technical colleges in Enugu State do not possess enough competencies in handling vehicle diagnosis and maintenances. This has posed a serious challenge to them upon graduation. To put an end to this situation, this study has identify the important competences possessed and needed by MVMW students for diagnosing and maintaining vehicles thus the technical college students should be equipped with the identified competences for adequate diagnosing and maintenance of vehicle for employment and self reliance after graduation.

Recommendations

1. Teachers and instructors of should enhance their efforts at equipping the students with the important competencies.
2. School should embrace the identified vehicles electrical and electronic systems diagnosis and maintenance competencies needed by MVMW students and integrated into the curriculum of the technical college program.

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