EFFECT OF RICE STOVER AND COCOYAM LEAF SUPPLEMENT DIETS ON CHANGES IN BODY TRAITS OF GROWING FEMALE WEST AFRICAN DWARF GOATS

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BY

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DECLARATION

I, **FOWOWE DAMILOLA VICTORIA** hereby declare that this project was written by me and it is a record of my own research work, it has not been presented before in any reputable presentation elsewhere. All borrowed ideas have been duly acknowledged.

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CERTIFICATION

This is to certify that this project work was carried out by **FOWOWE DAMILOLA VICTORIA** with **Matric no ASC/12/0457** in the department of Agricultural Production and Health of Federal University, Oye – Ekiti, Under the supervision of Dr. O.M.A JESUYON.

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DEDICATION

This project is dedicated to the I Am that I Am, the Author of the whole universe, my family, and everyone who contributed to this work for its successful completion.

ACKNOWLEDGEMENT

I give glory, honour and adoration to God Almighty the giver of all things and most sufficient God, for the grace and the strength he gave thus far, toward the completion of this project , may his name be forever praised. I sincerely appreciate the unquantifiable support, contribution of my supervisor Dr O.M.A Jesuyon, for taking his time to supervise , coordinate and read through this research and making necessary correction up to this stage of completion May Almighty God perfect your heart desire in Jesus name.

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ABSTRACT

A 90-day experiment was conducted to determine the effects of Rice stover, Cocoyam leaf and their combination (50:50) as crop residue-based supplement diets on the growth performance and morphometric traits of WAD goats. The twenty young female West African Dwarf (WAD) female goats used for the experiment were assigned randomly into 4 groups of animals and each group was randomly assigned to one of the treatments in a Completely Randomized Design. Each animal received the diet for 90 days. Parameters measured were feed intake, body weight (BWT), body weight gain (BWG, kg), chest girth (CG, cm), height at withers (HW, cm), height at rump (HR, cm), diagonal trunk length (DTL, cm), body length (BL, cm) and fore leg length (FLL, cm). Economic parameters evaluated were total feed intake (TFI, kg), mean growth rate (MGR, kg/day), feed conversion ratio (FCR), cost conversion ratio (CCR, N/kg) and Diet utilization efficiency (DUE, %). Supplement total feed intake (kg/wk) was 4.48, 5.00 and 4.95 for Rice stover-based (RS), Cocoyam leaf-based (CL) and Rice Stover + Cocoyam leaf-based diets respectively. These values were not significantly different ($P>0.05$) between diets. FBW (kg), MWG (kg), CG (cm), DTL (cm), FLL (cm), were significantly different ($P<0.05$) between diets. RS+CL based supplement diets produced the best results on MWG, CG and FLL; followed by CL and RS based-diets. The control diet: Free-range Pasture browsing gave the best results of the four diets especially on MWG, CG, DTL and FLL. There were no significant differences ($P>0.05$) between diets for TFI (kg), MBW (kg), HW (cm), HR (cm), and BDL (cm). Economic evaluation of diets revealed that RS+CL supplement diet had the highest BWG (0.04 kg) and MGR (0.0004 kg/day); and a positive FCR (123.75). These values suggested that this diet performed better than CL and RS diets.

Key words: *Body weight changes, Morphometric traits, Feed intake, Rice stover, Cocoyam leaf, West African dwarf goat, Supplementary feeding.*

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CHAPTER ONE

1.0 INTRODUCTION

The domestic goat (*Capra aegagrus hircus*) is a member of the family *Bovidae* and is closely related to the sheep as both are in the goat-antelope subfamily *Caprinae* (Hirst *et al*, 2006). Goats are one of the oldest domesticated species, and have been used for their milk, meat, hair, and skins over much of the world (Coffey *et al*, 2004). It is the most predominant breed in southern Nigeria and it is resistant to excessive humidity and trypanosomiasis of the forest zone (Upton, 2010). Majority of the world's goat population is found in the small holder farming system where nutritional conditions are often sub-optimal (Sibanda *et al*, 1999). The National Agriculture Census (FOS, 1977) indicates that a much higher proportion of households in the southern states keep more goats than sheep. Household goat flocks usually consist of 2 to 7 animals.

West African Dwarf (WAD) goats are important in the village economy of West Africa. Nigerian West African Dwarf (WAD) goats are trypanotolerant (they are resistant to infections of Trypanosome) and haemonchotolerant. That is, they resist infections of gastrointestinal parasitic nematode *Haemonchus contortus* more effectively than other breeds of domestic goat. (Chiejina *et al,* 2015*)*.

Supplementation with cereal crop residues is an essential means of improving feed utilization by ruminants (Savadogo *et al*, 2000). Feed supplementation with roughage ration have been found to influence growth, return to estrus, birth weight, weaning weight, and other reproductive factors in livestock production (Mackey *et al*, 2000). Recent research in many developing countries has been directed to the use of crop residues such as cocoyam leaf (Malavanh *et al*, 2008). Taro leaves (*Colocasia esculenta (L.) Schott*) are rich in vitamins and minerals. They are a good source of thiamin, riboflavin, iron, phosphorus and zinc, and a very good source of vitamin B6, vitamin C, niacin, potassium, copper and manganese.

Cereal straw (El-Saify *et al*, 1983) is the most widely available of all crop residues, but its value is limited by its inherently low digestibility (35-45%), its limited consumption by animals (less than 2% of the bodyweight) and its slow rate of passage (Jackson, 1978).

Despite the low nutritional value of rice straw due to its high silica content, low ruminal degradation of carbohydrates, and low nitrogen content, when stored in bales, it presents significant potential for strategic use in critical periods of food availability or in ruminant production systems with low nutrient requirements. Due to the fact that in these areas rice straw is abundantly available from the cultivating rice fields, farmers offer rice straw as the main roughage source to their animals (NARC, 2004).

1.1 PROBLEM STATEMENT

Protein and energy are limiting in the diets of goats in many farming communities. Goat farmers make little or no preparation for dry season supplementation, therefore goats feed on available poor nutritive herbage that do not meet up with their nutrient requirement for the maintenance of goats (Ockling, 1986).

1.2 JUSTIFICATION

Rice and cocoyam are widely planted in Ekiti State. Unconventional feed resources such as farm waste (e.g. cassava peels, cassava residues, and cocoyam leaves e.t.c) which are cheap, locally available and meet the nutritional requirements of livestock could be incorporated into ruminant diet (Aregheore, 2000). Feed supplementation among goat farmers in south-west communities is improving, thus Rice stover and Taro could serve as alternative feed supplements after harvest. The combination of Rice stover and Cocoyam leaf could be used to solve the problem of low energy and protein in the diet of goats. The research therefore aims to refocus the attention of goat farmers to the efficient utilization of the abundant crop residues generated in their environment after seasonal harvests.

1.3 GLOBAL OBJECTIVE

- To evaluate the effect of rice stover and cocoyam leaf supplementary diets on weight gain and body traits of growing female WAD goats.

1.4 SPECIFIC OBJECTIVES

- To evaluate body weight and body traits as affected by diets.
- To evaluate changes in body traits: chest girth, height at the withers, height at the rump, diagonal trunk length, body length as affected by diets.
- To examine feed utilization efficiency as affected by the diets.

CHAPTER TWO

2.0 LITERATURE REVIEW

Goats were first domesticated about ten thousand years ago in the Tigris – Euphrates valley in South Western Asia (Okereke, 2003). The domesticated goat (*Capra hircus*) is now found throughout the continent in many forms including Nigeria with a population of 29.2million (FAO, 2005). The West African Dwarf goat is prevalent in South-western Nigeria and they are hardy, resistant to trypanosomiasis, known to have multiple births and are usually raised for meat production (Belewu, 2006).

The West African Dwarf (WAD) goat is a common and popular breed in Nigeria. WAD is a major component of the indigenous livestock genetic resources especially in the rural communities of Nigeria. This breed is well adapted to, and produces and reproduces under the local environmental conditions although its productivity is generally low compared to its counterparts in other parts of the world.

Uncontrolled breeding coupled with attempts by breeders and farmers to improve the performance of the indigenous African breeds through the introduction of exotic animals and crossbreeding practices are gradually leading to the erosion and complete masking of important survival traits, such as disease resistance associated with indigenous livestock as well as the extinction of certain breeds (Gizaw *et al.,* 2011). The characterization of African small ruminant populations will play a major role in the maintenance of these autochthonous genetic resources as the basis for future improvement at both the production and the genetic levels (Birteeb *et al*, 2012).

2.1 FLOCK STRUCTURE

The animal production system in the tropics is traditional, with the principal degree of dependence of the household or the production unit on livestock or livestock products for household income or for food supply where crop production is in association with the livestock production. The WAD goats are managed on free range, are allowed to graze a distance away from home, sometimes under the supervision of the herdsmen and are enclosed in a wooden hut at night. Daily movement of livestock from home to the grazing fields is recognized as an important aspect of management within the system. The enclosing of livestock in the huts is done mainly to protect them from theft and predation.

According to Moll (1989), Prestige and status were terms used in derogatory manner, to describe the behavior of traditional ownership in relation to their animals. The reasons for keeping livestock are rational and are related to their particular needs in the long or short term. This is supported by the age and sex structure of the flocks. In rural areas, goats are generally more important than for religious purposes (Moll, 1989). Nevertheless, goats do not arouse the same emotions in rural people as do cattle (Hunter, 1936). Whatever the major objective of keeping and goats, there is always the preponderance of the female in the flock while minor differences in sex and age structure are maintained. The WAD goats are productive, whether production consists of giving birth to young, producing milk, or simply the process of growth to a size at which another product becomes the principal one.

The major management practice used to obtain stability of structure is the selling or slaughtering of the animals for home consumption and/ or performance of rituals, for ones not required for other production functions. There is usually one or two bucks retained in the flock for breeding. Ownership of WAD Goats

The role of women in the various aspects of ownership of and goats is typical in many African countries having similar cultural background. In most African countries, culture dictates that women are subordinates to men and hence are socially marginalized (Okali and Sumberg, 1985). Women in rural areas mostly own goats and they are not allowed to sell goats in the absence of their husbands. The various decision-making levels related to goat's ownership in the tropics depict a conspicuous gender imbalance, which is a product of strong cultural background bias against women.

2.1.1 Potentials of WAD Goat Production

In animal production systems, the value of a species increases in relation to its adaptation, capacity to make socio-economic contributions, capacity to fill market opportunities and potential for increasing productivity (Mamabolo and Webb, 2005). There is a considerable potential for increased WAD goat production, if proper management is employed. Much will depend on recognition of their values as small domestic animals.

The WAD goats are highly adaptable to a broad range of environments. They can utilize a wide variety of plant species and are thus complementary to cattle and camels. They generally do not compete directly with these species for feed. For example, a mixture of animal species on semi-arid rangelands makes it possible to change the stocking rate from 26 ha per Tropical Ruminant Livestock Unit (TRLU) (250 kg live weight equivalent) for cattle alone to 13 ha per TRLU when cattle and goats are reared together and to 10 ha per TRLU when camels are included (Shwartz, 1983). It is this complementary nature of the ruminant species that maintains the high animal biomass that characterize pastoral production systems.

Goats are more effective at grazing selectively than any other domestic livestock species (Winrock International, 1983) and they utilize poor quality forage and browse better. Goats also walk longer distances in search of food than do other domestic livestock (Wilson, 1991). Due to their short generation lengths and high reproductive rates, West African Dwarf goats have high production efficiency (Winrock International, 1992). In addition, the energetic efficiency of milk production may be higher in dairy goats than for other dairy animals (Winrock International, 1992). West African Dwarf goats are thought to be tolerant of trypanosomiasis and other diseases, allowing them to be grazed on land not available to other domestic livestock (Okoli *et al.*, 2005).

The WAD goats are useful to humans during periods of cyclical and unpredictable food shortages. They also help balance the energy and protein supply during normal variations between seasons and years. The small size and early maturity of WAD goats give them several distinct economic advantages in smallholder situations. They can efficiently utilize marginal and small plots of land, the risk on investment is reduced by smaller individual size, allowing more production units per unit of investment; and there is a faster turnover of capital because they mature early sexually and are younger at slaughter. Smaller carcasses are also easier to market and can be consumed in a short period of time. This is important as most rural areas lack proper storage facilities. Their strong flocking instinct makes herding by younger and older members of the family possible, allowing labor to be used more efficiently.

They produce lower absolute quantities of milk than cattle. However, when their body weight is taken into account, their milk yield is higher than other species, with the possible exception of camels (Wilson, 1991). During difficult periods of the year, these minor levels of output become significant (Coppock *et al.*, 1982). It has been estimated that up to 40 years may be needed for cattle to attain the population and production levels existing prior to a drought (Wilson, 1991). Because of their shorter generation length and higher reproductive rate, WAD goats have a much shorter recovery period. For example, following a severe drought, goats conceive as soon as there is sufficient moisture for leaves and browse plants to grow. They kid five months later and consequently produce milk for human consumption at a very early phase of the recovery cycle (Wilson, 1991).

Although, regional variations exist, WAD goats appear to withstand drought better than cattle (Campbell, 1978). The droughts of the early 1980s, which affected Ethiopia and the Sahel including Sudan, resulted in cattle losses of 80% or more. Small ruminant losses did not exceed 50% (Wilson, 1991). Shafie (1992) has summarized the physical and physiological characteristics, which enable WAD goats to survive in arid and saline environments. These include: body conformation (slim trunks and slender limbs), which provide a large proportional surface area, helping excess body heat dissipate through non-evaporative cooling and a respiratory system with a larger proportion of dead space to respiratory space, a structure which facilitates heat dissipation via respiratory water vaporization, without the need for severe panting. Due to their adaptation to the environment (including feeding behavior), small ruminants, particularly goats, are often the last to be affected by catastrophes.

2.2 CONSTRAINTS FACING WEST AFRICAN DWARF GOAT

Livestock production efficiency is to a large extent dependent on reproductive performance. Reproductive performance is about five times more important than product quality (Nwaodu, 2008). The aim for animal production is the reproductive ability of such animal from which accounts the continuity of animal meat, milk, egg and other products are sure (Otuma *et al*., 2005). However, in a subsistent extensive or nomadic production system common in the sahelian and tropical ecozones of Africa for example the overall viability of the system depend largely on reproductive efficiency, to replenish the herd that is often decimated by harsh environmental conditions and diseases (Okoli *et al*., 2000, 2006). West African dwarf goats are very prolific, possessing high frequency of kidding and ability to survive under poor management, despite their poor genetic potentials for growth and milk production (Adebambo *et al*., 1994). The remarkable reproductive potential in terms of young produced per female per year (Gall *et al*., 1992; Wilson *et al*., 1984) was found to follow the change in dry and rainy seasons and so influenced by temperature, humidity and nutritional status of the animal.

Constraints to increased WAD goat production in the Tropics and Subtropics are of a biological and environmental nature and relate to the available potential, survival in hot tropical environments and required efforts to increase production.

Potential productivity of WAD goat is constrained by poor understanding of the many values of these animals and of strategies for improved natural resource management in target environments. False perceptions (environmental degradation, biases, inadequate official support and resource) are the major believes of people to rule against WAD and goat production. Until recently, there has been an official bias against goat as destroyer of vegetation. Because of this prejudice, efforts to exploit the full potential of this animal have been generally minimal compared to efforts in cattle (Bembridge, 1989). The controversy-surrounding goat is associated with the environmental and alleges resource degradation. Such criticisms are not unique and can apply to other herbivores, but with goats, the allegations are more severe because of their unique mouth parts.

selection of feeds, ability to adapt to varying forage quality and capacity to use coarse grazing and shrubs to advantage.

Studies on small ruminants, particularly goats have been less numerous than cattle and major production constraint are less well known. Nutritional problems appear to be less acute than on cattle (Wilson, 1988). Theft, predation and poor hygiene in ascending order appears to be the most important problem limiting goat production (Mamabolo and Webb, 2005). Lack of understanding of economic and social values of small ruminants by developers and scientists undoubtedly restrict goat production and education program to overcome this could be of great benefit to rural people.

The WAD goat production in the Tropics is also constrained by the following factors:

- Low genetic potential
- Seasonality of availability of feed and scarce water resources
- High ambient temperature
- Mortality in goat production

However, Okoli *et al.* (2000) and Odeyinka (2005) stated that; other constraints to indigenous small ruminant production in the tropics includes: diseases, accidents, seasonality of feed supply, theft, destructive habit of goat, lack of capital and land. Similar constraints have also been reported in literature (Sumberg and Mack, 1985, Gefu *et al.*, 1994, Doma *et al.*, 1999).

2.2.1 Low Genetic Potential of goats

Most indigenous breeds of small ruminants in the Tropics have not been selected for high productivity. This implies low rates of growth and long time to reach physiological maturity (Bullerdiek, 1996). Low genetic potential of WAD goat is often quoted as a major constraint to meat and milk production in sub-Saharan Africa (SSA). The current fertility status of communal WAD goat is low. Poor production results mainly from kid mortality and inbreeding. In traditional livestock management does and bucks run together for the whole period of their lives, usually one or two bucks are left in the herd and can even be left for more than five years, consequently inbreeding occurs. Studies indicate that the performance of indigenous breeds of small ruminants could be improved through management. Additionally, estimates of genetic parameters point to considerable genetic variation within indigenous populations. This indicates the potential for genetic improvement through selection.

There has been a tendency to over-emphasize the low productivity of indigenous breeds without due consideration of some important characteristics of these breeds. When the small size of these breeds and the harsh environmental conditions under which they are raised are taken into account, their productivity is impressive. Comparative studies of indigenous and exotic breeds to determine their feed utilisation efficiency have not been conclusive. However, it is known that breeds with high maintenance requirements tend to lose the most weight and have the highest mortality rates under stress conditions such as drought (Frisch, 1984). Most breed comparison studies have concentrated on quantifying performance (e.g., live weights and milk production) but not inputs. Indeed, the high-performing temperate breeds cannot survive under traditional management in most African environments. Although, the performance of indigenous breeds under improved management has not been adequately assessed, there are indications that they respond to improved husbandry. For example, (Kolff and Wilson, 1985) have reported that indigenous small ruminants were able to double their daily weight gain rate with only minimal improvements in nutrition and management. The ability to survive under adverse environmental conditions with low inputs makes indigenous breeds a low-risk choice. The low-risk factor of resistant breeds is important where market prices are unstable or where the probability of death from environmental stress is high (Frisch, 1984). In some cases low productivity is an adaptive mechanism. For example, delayed age at first parturition and extended parturition intervals in semi-arid environments are mechanisms for coping with seasonal and often unreliable feed availability. In such environments some flock owners deliberately delay first breeding (Wilson *et al.*, 1984). Poor nutrition increases the animals' susceptibility to diseases. Animals that have low maintenance requirements and the ability to make efficient use of poor quality forages are therefore at an advantage. There is a need for comparative evaluation of indigenous and exotic breeds in African environments, taking input costs and output prices into account.

Most imported (temperate) breeds are raised on high potential agricultural land where crop farming is practiced. The critical role of indigenous breeds is in providing the only means of using areas where other forms of agriculture are not practical. It may not be possible to improve some of these environments, especially in the arid zone, to accommodate exotic breeds. However, the strategy will most probably be some kind of crossbreeding to take advantage of breed complementarily and/or upgrading to allow gradual improvement in husbandry. Additionally, recent developments in biotechnology indicate that direct transfer of genes may become a routine method for germplasm improvement. Thus there is need to keep a reservoir of these exceptional genes. Indigenous breeds are crucially important today and will continue to be valuable in the future.

2.2.2 Seasonality of Availability of Feed and Scarce Water Resources

Indigenous small ruminant have been reported to have a remarkable reproductive potential in terms of number of young produced per female per annum (Wilson, 1991), because day length is relatively constant in the tropical locations. However, reproductive activities do follow the change of dry and rainy season and are influenced by temperature and humidity. Climatic factors have been observed to influence greatly the productivity of WAD goat under traditional system of management through their effect, principally on forage and water availability, thermal stress and photoperiod which are reflected in seasonal trends in growth, reproduction and morbidity (Butswaat, 1994).

To be able to survive in hot climates, animals should demonstrate the ability to consume and digest feed stuffs high in crude fibre content and to survive under conditions of seasonal feed availability, water scarcity, high heat and radiation while still retaining the ability to utilise the range (Horst and Peters, 1983). Feed production, quality and availability are dictated by weather changes and thus take a seasonal pattern. Low productivity of tropical WAD and goat and seasonal availability of feed do not therefore offer the best combination for increased production. Only fast growing strains with a higher rate of growth from birth to weaning could utilise seasonally available feed resources including crop by-products more efficiently. The natural ability of the animal to regain weight lost due to feed scarcity upon realimentation provides the possibility for compensatory growth and recovery and efficient utilisation of scarce feed resources characterised by the same seasonal pattern.

Conditions of rearing that are free from thermal stress also generally yield the highest economic returns such that it would be in the interest of the producers to be aware of them and to take any necessary steps to provide the necessary climate in the shed and to select breeds or individuals of animals best suited to a given climatic area (Rege, 1992) The tropical environment might pose problems of a thermoregulatory nature and of survival for temperate strains (Bianca, 1976) of small ruminant which have mostly been selected for higher productivity over a long period of time. The tropical climate and weather are both characterised by high ambient temperatures especially during the day. Cold nights and winds are a common feature in the dry part of the Tropics.

According to (Ademosun, 1992) knowledge in the area of bioclimatology of the farm animal needs to be extended to include the effects of such factors as age, sex, breed, level of feeding and level of performance to be adequate. It would then be possible to link theory with practice provided the behaviour of the animals under variable climatic conditions are studied and properly interpreted to solve related problems in the animal production sector.

Unlike field studies, experiments in the climate chamber have the advantage of reducing to a minimum the number of effective climatic factors as well as bringing under control or eliminating altogether non-climatic factors such as nutrition and husbandry and thus making it possible to identify causes and interpret results for practical use (Ademosun, 1992).

Thermoregulation covers all changes taking place in a given animal in response to thermal stress which enables the animal to maintain body temperature within normal limits for its species when exposed to cold or heat (Bianca, 1976). Such changes are functional (e.g., shivering or sweating), structural (e.g., vlies type) or behavioural such as the search for a less hot micro-climate. Behavioural changes normally form the first pattern of response followed by physiological ones.

In view of the long time it would take to select for high productivity within the local tropical breeds of small ruminant and regarding the existing big gap between demand and supply of animal protein, the production of crosses of temperate and tropical breeds becomes all the more relevant in an effort to increase productivity while retaining the ability of the animal to apply adequate thermoregulatory function.

2.2.3 High Ambient Temperature in the environment

High ambient temperature has a negative effect on productivity. This negative effect is direct in the form of stress suffered by the animal and the diversion of energy from the purpose of production to regulation of body temperature and indirectly by affecting the availability of feed resources upon which production is dependent. The availability of feed resources has a seasonal pattern implying that they are quantitatively and qualitatively inadequate during some seasons of the year. All this raises the question of the feasibility of rearing cross breeds with regard to both survival and maintenance of high productivity. Whereas measurement of productive adaptability needs a long period of time to quantify, basic indication of the ability to survive can be deduced from the physiological reaction of animals subjected to high ambient temperature in a climate chamber.

2.2.4 Effect of High Ambient Temperature on Feed Intake and Digestibility

Feed and water intake: Feed intake forms the basis of production such that a thermostatic regulation of intake (increase and reduction of appetite in the cold and heat, respectively) under extreme climatic conditions becomes an important point for animal production (Ademosun, 1992)

High productivity is associated with a high metabolic rate and hence high heat production (Bianca, 1976). Heat induced reduction in appetite is therefore useful as a mechanism of thermoregulation with the disadvantage that this implies loss in production. High ambient temperature is known to cause reduction in feed intake (Stelk, 1987; Kaiser, 1992) but increased digestibility due to reduced rate of passage (Blaxter and Wainman, 1961; Mc-Dowell *et al.*, 1969; Faichney and Barry, 1986; Stein, 1991) and therefore reduction in energy lost in faeces (Graham *et al.*, 1959); as well as increase in water consumption (Mc-Dowell *et al.*, 1969; Klein, 1984; Faichney and Barry, 1986) and frequency of consumption (Miescke, 1977). On the other hand, low ambient temperature has been known to increase feed intake (Klein, 1984) followed by reduction in digestibility (Kennedy and Milligan, 1978; Kennedy *et al.*, 1982) and N-balance (Bailey, 1964). A combination of low ambient temperature and high fibre ration has been associated with a negative balance of both N and energy (Kaiser, 1992). Furthermore, goat are said to be able to better tolerate high ambient temperature than cattle with regard to loss of appetite due to low metabolism per unit surface area (Blaxter and Wainman, 1961). The effect of ambient temperature on digestibility has not been found to be lineal (Stein, 1991).

2.2.5 Effect of High Ambient Temperature on Production

High ambient temperature has been associated with a reduction in growth rate and milk yield, which affect the survivability of the young once. Data on growth performance of lambs under high ambient temperature experiments in the climatic chamber is limited in terms of how it affects various genotypes. Data on milk performance has largely been concerned with dairy cattle. The physiological reaction of cattle in this case could be comparable to that of and goat subjected to similar conditions. From 15°C/60%RH to 30°C/60%RH constant ambient temperature, 55%

reduction in ADG has been reported and associated with 38% reduction in energy intake. In this case, two-thirds of the lambs reared at 30°C /60%RH were prematurely removed from the experiment for failing to meet the minimum growth requirement of 50 g Average Daily Gain. The same lambs recorded an average of 0.4°C higher rectal temperature than those retained.

High ambient temperature has been associated with decline in milk yield (Johnson *et al.*, 1960; Scott and Moody, 1960; Wayman *et al.*, 1962; Miescke, 1977; Rodriquez *et al.*, 1985; Klein, 1984) especially in late lactation (Johnson *et al.*, 1960). Decline in milk yield was the result of reduced feed intake (Wayman *et al.*, 1962; Miescke, 1977) and reduced efficiency of utilisation (Wayman *et al.*, 1962) and could be accompanied by loss in weight and reduction in fat content. At high ambient temperature, interaction with feeding level was increased with regard to milk yield and quality and the physiological reaction of dairy cattle (Scott and Moody, 1960; Leighton and Rupel, 1956; Wayman *et al.*, 1962). At ambient temperature of between 15°C and about 22°C, milk yield was less sensitive to variation (Cummins, 1992).

High milk yield under high ambient temperature conditions was associated with low body temperature and high sweating rate (Klein, 1984). At about 40°C, high productivity was associated more with high energy deposition in the form of fat due to heavier body weight and higher chronological age (Charring *et al.*, 1992). Earlier, Johnson *et al.* (1960) noted that potentially high and average milk yielding dairy cattle may demonstrate similar performance at an extreme ambient temperature level of 90°F/50%RH.

2.2.6 Mortality in goat production

(Mamabolo and Webb, 2005) reported that the mortality rate of goats in Mootse South Africa ranged between 3.75 and 40. 1%. Similar rate of mortalities were reported in other parts of Africa for goats (Manjeli *et al.*, 1996; Wilson *et al.*, 1984; Ikwuegbu *et al.*, 1995; Gall, 1981; Devendra and Burns, 1970). Unlike the West African Dwarf goats were the major causes of mortality were mainly Stillbirth or abortion, the mortality rates of WAD and goats in emanates mainly from poor hygiene (coccidiosis), trypanosomosis, peste des petit ruminants (PPR) and bronchopneumonia, theft and predation (Okoli, 2001, 2003). The major causes of pre-weaning deaths in kids according to Opara *et al.* (2006)were starvation (24.27%), pneumonia (16.50%), helminthiasis (20.38%), bacterial infection (6.80%), diarrhoea (5.8%) and heartwater (4.85%). About 21% of the mortalities occurred during the neonatal period (0-7 days) (Okoli, 2003). These causes of mortality could be controlled if proper management practices are instituted (Etuk *et al.*, 2005).

2.3 SUPPLEMENTARY DIET FEEDING IN GOAT PRODUCTION

Supplementary feeding is often used in grazing systems to help meet production requirements. This may be a regular part of the production cycle to help match feed demand to feed supply or reserved for times of drought. The extent to which supplementary feeding is used depends on the business objective and seasonal conditions.

To maintain good rumen function and assist good animal health, supplementary feeding should satisfy the animals need for protein, energy, roughage and minerals. Where supplementary feeding is being used to achieve particular production objectives, such as extra weight gain, care must be taken to ensure the provision of a balanced diet that is economically feasible. A high energy diet based on grain may require the addition of roughage, such as hay, to ensure good rumen function. Providing supplements allows the nutritional requirements of the WAD goat (which vary with age, frame size and pregnancy) to be met. It is especially important in preventing excessive liveweight loss during the dry pasture phase, particularly in weaners and pregnant does.

Common feed stuffs used in supplementary feeding to meet particular requirements include:

Energy - grain, molasses, silage.

Protein - meals such as cotton seed meal, lupins, silage.

Roughage - hay, silage.

Minerals - lime fed as calcium carbonate (CaCO3), phosphorus (minerals are best fed as pre-prepared licks to ensure that livestock do not exceed recommended intakes).

2.4 THE USE OF RICE STRAW IN FEEDING LIVESTOCK

2.4.1 Rice Distribution

Rice originates from Asia, where it has been cultivated since 6500 BC, and is now naturalized in most tropical and subtropical regions. Rice grows from 53°N in China to 35°S in Australia. The optimal growing conditions are: 20-30°C average day-temperatures with night temperature over 15°C; fertile, heavy soils; 6.5-7 pH. Most varieties ("swamp rice", "lowland rice") must be planted in stagnant water and require 200 mm rainfall/month or the equivalent amount from irrigation, whereas others ("mountain rice" or "upland rice") require less irrigation and 750 mm rainfall over a 3-4 months period with no desiccation.

Rice is the second most cultivated cereal worldwide (FAO, 2013). In Brazil, the cultivated area is 2.4 million hectares, with a production of 11.75 million tons (FAO, 2013). In Rio Grande do Sul, the state with largest production in Brazil, the rice crop presented high productivity in the 2014/2015 harvest season, averaging 7780 kg/ha (IRGA, 2015). However, the utilization rate is only 50%, which results in substantial amount of by-products, particularly straw.

2.4.2 Rice Straw Description

Rice straw is the vegetative part of the rice plant (Oryza sativa L.), cut at grain harvest or after. It may be burned and left on the field before the next ploughing, ploughed down as a soil improver or used as a feed for livestock (Kadam et al., 2000). Rice straw is a major forage in rice-producing areas. Therefore, for each ton of rice grain harvested, one ton of straw remains in the field (Maiorella, 1985; Doyle et al., 1986). Despite the low nutritional value of rice straw due to its high silica content, low ruminal degradation of carbohydrates, and low nitrogen content, when stored in bales, it presents significant potential for strategic use in critical periods of food availability or in ruminant production systems with low nutrient requirements.

In tropical zones in the world, ruminants depend on year-round grazing on natural pastures or the animals are fed with cut grass and crop residues. Most of these areas face seasonal dry periods in which the availability of pasture decreases and also its quality by a reduction in the content of digestible energy and nitrogen. Due to the fact that in these areas rice straw is abundantly available from the cultivating rice fields, farmers offer rice straw as the main roughage source to their animals (NARC, 2004).

2.4.3 Rice Straw Nutritive Value

Feeding only rice straw does not provide enough nutrients to the ruminants to maintain high production levels due to the low nutritive value of this highly lignified material. The high level of lignification and silicification, the slow and limited ruminal degradation of the carbohydrates and the low content of nitrogen are the main deficiencies of rice straw, affecting its value as feed for ruminants (Van Soest, 2006).

As rice straw is poorly fermented, it has low rates of disappearance in the rumen and low rates of passage through the rumen, reducing feed intake (Conrad, 1966). By treating rice straw with urea or calcium hydroxide or by supplementing rice straw with protein, intake, degradability and milk yield can be enhanced, compared to feeding untreated rice straw alone (Fadel Elseed, 2005; Wanapat et al., 2009). In past years, several studies have been reported on the physical and chemical characterization and utilization of rice straw as ruminant feed (Shen et al., 1998; Abou-El- Enin et al., 1999; Vadiveloo, 2000; 2003). In addition, numerous methods of physical, chemical and biological treatments have been investigated, including supplementation with other feed stuffs or components in order to improve the utilization of rice straw by ruminants (Reddy, 1996; Karunanandaa and Varga, 1996a,b; Shen et al., 1999; Vu et al., 1999; Liu and Ørskov, 2000; Selim et al., 2004).

Stovers are a poor livestock feed, and rice straw is no exception. It contains about 80 percent of substances which are potentially digestible and are therefore sources of energy, but actual digestibility by ruminants is only 45 to 50 percent. Furthermore, the amount an animal can eat is limited to less than 2 percent of body weight because of the slow rate at which it is fermented in the rumen. The net result is an energy intake which provides little or no surplus energy for growth, work or production (Heuzé, 2015).

When straws are fed to ruminants, the primary limitations to production are low overall digestibility, slow rate of passage in the rumen, low propionate fermentation pattern in the rumen, and low contents of fermentable N and by-pass protein.

Depending on the farming systems, there are several ways to feed ruminants with rice straw (Heuzé, 2015). In extensive systems, the animals are allowed to enter paddy fields after harvest and graze rice straw and weeds in the field or on the roadsides. In less extensive systems, the animals are tethered in the paddy field close to stacks of rice straw. In stall-fed systems, rice straw may be fed alone, or fed with other forage supplements and/or concentrates.

Rice straw fed alone proved to be sufficiently nutritious to feed draught cattle during short periods, but did not meet full animal requirements and had to be supplemented with crude protein and minerals, especially P and Ca (Heuzé, 2015)

Moreover, the most important consideration in obtaining more animal products from straw in the Asian setting is to improve digestibility and intake so that more energy is available for productive purposes. Protein supplements increase intake, while the alkali treatment of straws increases digestibility and usually voluntary intake as well. The chemistry of straw and its digestion and the chemical changes caused by alkali treatment are receiving increasing attention from animal nutritionists. The quality of rice straw depends on many factors: variety, time between harvest and storage, N fertilization, plant maturity (lignin content increases with maturity), plant health and weather conditions (Drake et al., 2002). Rice straw is a good source of energy, but is low in protein (2-7%) and its high silica content results in a low digestibility (Drake et al., 2002). It is considered as a low quality and variable roughage. Minerals (particularly sulphur) can be limiting factors (Heuzé, 2015).

The nutritional value of rice straw is much lower than that of alfalfa hay, but there is substantial variability in the nutrient levels and feeding value among rice straws (Nader et al,. 2012) because the nutritional value of the straw is directly related to its chemical composition, combined with possible anti-nutritional factors, which are often involved in protecting the plant against predation and biodegradation (Van Soest, 1981), as well as genetic factors (Capper, 1988), climate (Sannasgala and Jayasuriya, 1986), morphological composition (Sannasgala and Jayasuriya, 1987; Nakashima and Orskov, 1990), and cultivation practices such as fertilizer application, water management, harvest maturing stage, and post-harvest storage (Ibrahim et al., 1988). However, there is little scientific evidence of the influence of factors such as baling season, soil classification, time between harvest and baling, and grain production on the nutritional value of the baled rice straw.

Supplementation is strongly recommended in order to mitigate the nutritional weaknesses of rice straw. In ruminants, when milk or meat production is desired, rice straw must be supplemented with both protein and energy sources. For good growth from straw-based diets, a level of 8 to 10% CP is needed for young stock: this also improves consumption and thus increases energy intake (Jackson, 1979).

2.5 RICE STRAW PROCESSING

Rice straw can be treated in order to improve its nutritive value. Those treatments are designed to enhance feed intake and/or digestibility. Improving digestibility may be achieved through mechanical, chemical, heat and pressure treatments.

2.5.1 Physical method of treating rice straw

Crop residues can be ground, soaked, pelleted or chopped to reduce particle size or can be treated with steam or X-rays or pressure cooked. Uden (1988) observed that grinding and pelleting of grass hay decreased dry matter degradability in cows from 73 to 67%, which was mainly due to a decreased fermentation rate (9.4-5.1%/h) and decreased total retention time of the solids from 73 to 54 hours, resulting in an increased intake (Stensig et al., 1994). Liu et al. (1999) reported that the use of steam treatment in a high pressure vessel at different pressures and for a range of different treatment times increased the degradation *in vitro* in rumen fluid after 24 h and the rate of degradation, but could not enhance the potential degradability of the fibrous fractions (NDF, ADF and hemicellulose). Physical treatments of crop residues have received an appreciable amount of research. Many of these treatments are not practical for use on small-scale farms, as they require machines or industrial processing. This makes these treatments in many cases economically unprofitable for farmers as the benefits may be too low or even negative (Schiere and Ibrahim, 1989). However, small machines to grind or chop rice straw may be feasible.
Chopping and grinding rice straw may reduce the time of passage in the rumen and improve feed intake (Doyle et al., 1986).

2.6 THE USE OF RICE STRAW IN FEEDING LIVESTOCK

2.6.1 Cocoyam Distribution

Taro (*Colocasia esculenta* (*L.*) Schott) is an ancient crop grown throughout the humid tropics for its edible corms and leaves, as well as other traditional uses. It occupies a significant place in the agriculture of the Asia-Pacific Region and supplies much-needed protein, vitamins and minerals, in addition to carbohydrate energy (Inno Onwueme 1999). According to Rodriguez et al (2009): "The New Cocoyam (also referred to as "Giant Taro") is a member of the family of Araceae, of which there are one hundred genera and more than fifteen hundred species. Their preferred habitats are in tropical or subtropical environments which are moist and shady. Some are terrestrial plants while others are vines, creepers, or climbers. Many species of the Araceae are also epiphytes. The major edible species are classified in two tribes and five genera: Lasioideae (*Cyrtospermaand Amorphophallus*); and Colocasiodeae (Alocasia, Colocasia, and Xanthosoma). Taro (*Colocasia esculenta [L.] Schott*) is considered as a single polymorphic species".

The Giant Taro (*Alocasia macrorrhiza*) is widely distributed in tropical latitudes. The leaves and roots of some of the wild varieties are reported to contain oxalate crystals which cause itchiness in the mouth. The cultivated variety is said not to have this characteristic (Göhl 1971).

2.6.2 Cocoyam Leaf Description

Colocasia leaves are about 30 - 60 cm long and 45cm wide) and velvety soft to touch. The sagittate-ovate or peltate leaves of cocoyam arise alternatively from the main corm in a spiral kind of arrangement. The leaves grow out of the leave stalk of existing leaves just after the death of older, most matured and outermost leaves. This ensures that approximately the same amount/number of leaves are found on a Cocoyam plant at different times/period. The leaves are pigmented with marginal veins and central lobes.

2.6.3 Cocoyam Leaf Nutritive Value

In many countries, cocoyam leaves, petiole, and flowers can be eaten as vegetables (Seetohul *et al.*,2008).

Although cocoyam has good nutritional qualities, it is not a nutritionally complete food and cooking of some sort is almost always required to detoxify the corms and leaf parts, and to make them softer and physically palatable (Matthews, 2010). Taro leaf blades contain more protein than corms and are a good source of minerals and vitamins. It has been reported that leaves from Taro (*Colocosia esculenta*) are rich in vitamins and minerals. They are a good source of thaimine, ribloflavin / iron, phosphorus and zinc and a very good source of vitamin B6, vitamin C, niacin, and especially in the leaves, also it is highly perishable that is it has high content of water. Leaves of new cocoyam are also used in feeding pigs because of its nutritive values (Agrid, 2006)

Taro is a tropical food crop with high potential because of the high yield of the roots (or corms) and foliage. The leaves are rich in protein and easy to ensile, which has been shown to reduce markedly the concentrations of calcium oxalate (Pheng Bunta *et al* 2008), which appears to be a limiting factor in consumption of the fresh leaves according to Tiep *et al* (2006). In the research by Pheng Bunta *et al* (2008), it was shown that taro leaf silage could replace up to 70-75% of the fish meal protein, with higher feed intakes and N retention than with 100% of the protein from fish meal or from taro leaf silage.

According to (Wang 1983), Taro has great potential as animal feed in the tropics and subtropics where it is often a staple food for animal. However, because of the problem of the presence of calcium oxalate, the leaves, petioles and corms of Taro are often considered unacceptable for direct use as an animal feed (Jiang Gaosong *et al.,* 1996). (Wang, 1983) claimed that this problem could be solved by the fermentation occurring during the process of ensiling. This has been confirmed recently by (Malavanh *et al.,* 2007), who successfully fed ensiled Taro leaves to animals during reproduction and lactation (Peng Buntha *et al.,* 2007), and (Chhay Ty *et al.,* 2007) who fed ensiled and dried leaves of Taro to growing animals. Cocoyam leaves release dopamine (a monoamine neurotransmitter found in the brain and essential for the normal functioning of the central nervous system) which acts in the brain and nervous system. Synthesized by phenylalanine, it enhances your brain memory and controls your mood. Cocoyam leaves contain arginine, an amino acid which helps to increase sperm production. This makes it good for male animals.

2.7 EFFECT OF DIETS ON CHANGES IN BODY TRAITS

The body shape of an animal population determines ranges of biological functionality and productive use. In WAD goat, meat productivity is closely related with the body size of the animal. Some goat breeds are used in terminal crossbreeding to give the kid favorable dimensional characteristics, but it is necessary to go deeper on the study of the relationships between body dimensions and productive aptitude of these breeds, since discrepancies could be due to the environmental effects or the degree of differentiation between the original pool of different breeds and the local populations. Example of body measurements are (heart girth circumference, rump width, rump length, trunk length, height at rump and height at withers).

Linear traits are currently included in the genetic evaluations of a variety of breeds of goats (Wiggans and Hubbard 2001). There is paucity of information on the association between linear and fertility traits in goats (Mellado et al. 2008).

Where genetic evaluation still has limited use as in developing countries, identification of descriptive linear traits and farmers' friendly tools for selecting goats with high reproduction potential may be useful for realising higher economic returns. A clear knowledge on phenotypic descriptors for the prediction of foetal number during pregnancy is essential for preventing pregnancy toxaemia, reducing dystocia, optimising birth weights and increasing the survivability of newborns (Karen et al., 2006). Despite the use of ultrasonographic scanning for the prediction of foetal number mostly at organised farms in goats (Abdelgafar et al., 2007). There is a dearth of information on phenotypic descriptors to differentiate the pregnant goats bearing single or multiple foetuses under field conditions (Karen et al., 2006).

Linear body measurements could be used as selection criteria for improvement of meat production in goat (Khan et al., 2006) and for prediction of body weight in goat (Mohammed and Amin 1997).28

CHAPTER THREE

3.0 MATERIALS AND METHOD

3.1 LOCATION OF RESEARCH

The experiment was conducted at the Goat Unit, Animal Production and Health Departmental Teaching and Research Farm, Faculty of Agriculture, Federal University Oye-Ekiti with GPS coordinates; latitude of 7° 28 ° N and longitude of 4°43 ° E. It has an average annual temperature of 24.2 °C. Rainfall is about 177.800 cm per annum. Rain starts in March and stops in November.

3.2 MANAGEMENT OF EXPERIMENTAL ANIMALS

The building housing the pens were cleaned and disinfected with Izal and sniper was sprayed thereafter. The surrounding of the house was cleared to discourage predators like ants and snakes. The goats were subsequently treated with acaricides and dewormed. The experiment was conducted with twenty (20) growing West African Dwarf (WAD) female goats at different ages and body weights, purchased from the market and homes in Ikole-Ekiti. Each animal was randomly assigned based on body weight grouping to well-ventilated individual pens, equipped with feeding and watering troughs.

Experimental goats were taken through a 14-day adjustment period on their assigned diets, afterwards the experimental diets were given at one hundred grams per day (100g/day/goat) and water was given ad-libitum throughout the period. Routine management practices such as sweeping of the pens, cleaning of feeders and drinkers were carried out in all the replicates. Good hygiene, cleanliness and biosecurity measures were ensured throughout the experimental period.

PLATE 1: West African Dwarf Goat

3.3 DIETS AND DIET MIXING

The two variable feed ingredients of interest were, rice stover, cocoyam leaf while all other ingredients were fixed: mono calcium phosphate, iodized salt, vitamin/mineral premix in experimental diets. The feed was mixed manually with the use of hand. A big sac was used on which the fixed ingredients were first mixed, and then the variable ingredients were weighed and added one by one and mixed together with the fixed ingredients. After this mixed feed were thoroughly homogenized. The mixed diets were weighed with an electronic scale, bagged and stored for use.

PLATE 2: Rice Stover

PLATE 3: Cocoyam leaf

3.4 EXPERIMENTAL DIETS AND ALLOCATION

Four supplementary diets were used during experimental period (Table 1). The diets were randomly assigned to the twenty does to create four experimental diet-groups (one control and three treatments). Diets were referred to as Treatments namely: T1, T2, T3, and T4 in ratio of 4:6:5:5 animals respectively. They were thus fed with respective experimental diets. The three different diets T2, T3 and T4 consisted of different mixtures of cocoyam leaves and rice stover, while goats on T1 which was the Control was fed on pasture only. The supplementary diet plans are presented in (Table 2) while nutrient compositions of supplementary diets are shown on (Table 3).

TABLE 1: PERCENTAGE COMPOSITION OF SUPPLEMENTARY DIETS

Feed ingredient	CONTROL	RS	CL	RS+CL
Palm kernel meal	Pasture	10	10	10
Rice stover		40		
Cocoyam leaf			40	
Rice stover + cocoyam leaf				40
Rice husk		20	20	20
Wheat bran		27.25	27.25	27.25
Mono calcium phosphate		2	2	2
Iodized salt		0.5	0.5	0.5
Premix		0.25	0.25	0.25
Total		100	100	100

NOTE: RS-Rice stover, CL-Cocoyam leaf , RS+CL= Rice stover + Cocoyam leaf

TABLE 2: SUPPLEMENTARY DIET MAIN INGREDIENT AND PLAN

Groups	Control	RS	CL	RS+CL
No of animals /diet	4	6	5	5
Diets' main ingredients	Pasture browsing	Rice stover	Cocoyam leaves	Rice stover + cocoyam leaves
Feed quantity (kg/day)	Ad-libitum	0.1	0.1	0.1

NOTE: RS-Rice stover, CL-Cocoyam leaf, RS+CL= Rice stover + Cocoyam leaf

Table 3: NUTRIENT COMPOSITION OF SUPPLEMENTARY DIETS

Diets	1	2	3	4
	Pasture	RS	CL	RS+CL
Energy (kcal)	_	3968	4207	4087
Crude protein (%)	_	0.879	1.603	1.241
Crude fibre (%)	_	27.374	20.374	23.874
Calcium (%)	_	0.655	0.539	0.597
Phosphorus (%)	_	0.793	0.757	0.847

NOTES: RS= Rice stover, CL= Cocoyam leaf, RS+CL= Rice stover + Cocoyam leaf

3.5 FEED INTAKE AND ITS MEASUREMENT

Each animal on diets 2 to 4 received 0.1kg (100g) daily of the assigned diet for 90 days. Portable drinking water was provided for each animal ad-libitum. Voluntary feed intake was determined daily for each animal by subtracting the feed refusals from daily feed served.

3.6 DATA COLLECTION

Data collection commenced on the 14th day at the end of the adjustment period. Daily feed intake and bi-weekly body weight and linear body measurements were recorded for each animal.

3.6.1 BODY WEIGHT MEASUREMENT

Body weight was measured with the use of a portable electronic scale (WH-A08) of 50kg capacity that was hung on a tripod stand for measuring body weight. For each animal, weighing was done under a tripod stand that was well placed and balanced and the scale was hung from the center of the tripod, then a weighing jacket worn on animals and used to lift each animal to be hung on the scale. The weight of the animal was determined by deducting the weight of the bag from the total weight of the animal and the bag. The body weights of experimental goats were measured repeatedly on two-week basis.

3.6.2 BODY TRAITS MEASUREMENT

Morphometric or linear body measurements such as height at the withers, height at the rump, diagonal trunk length, heart/chest girth, body length and fore-leg length were measured with the use of tape rule and ruler. These measurements were taken as defined below.

Body length (BDL): Body length was measured using a measuring tape, as the distance from the occipital protuberance to the base of the tail.

Height at the withers (HTW): Each animal was placed on a flat platform. The height at the withers was measured as the distance from the surface of the platform to the withers using a measuring tape.

Chest Girth (CG): The chest girth was measured as the circumference of the body, slightly behind the shoulders and perpendicular to the body axis.

Height at the Rump (HTR): This was measured as the distance from the surface of the platform to the rump level using a measuring tape.

Diagonal trunk length (DTL): The diagonal trunk length was measured as the diagonal distance from the shoulder point to the elbow joint using a measuring tape.

Fore-leg length (FLL): This was measured as the distance from the elbow joint to the hoof joint with a measuring ruler.

All measurements were taken in the morning before the animals were fed. Each dimension taken was recorded in centimeter while the weight was recorded in kilogram.

3.7 Evaluation of Economic Parameters

Total feed intake (TFI) = Total quantity of total feed taken – Total quantity of left- over feed

Body weight gain = Final body weight – Initial body weight

$$\text{Growth rate (kg/day)} = \frac{\text{Mean weight gain}}{\text{Number of days}}$$

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Feed intake}}{\text{Body weight gain}}$$

$$\text{Cost conversion ratio (CCR)} = \frac{\text{Total cost/diet}}{\text{Body weight gain}}$$

$$\text{Diet utilization efficiency (DUE)} = \frac{\text{Growth rate}}{\text{Feed conversion ratio}} * 100$$

3.8 Pasture sampling

Pasture sampling was carried out to identify the various pasture plants and determine their frequency of distribution. This enables us to know what plants they consume while on the range, and how many there are of each species. The sampling techniques used were the line transect according to (Line and Krishna, 2001) along with the quadrat sampling techniques (O'Neill, 2001). The quadrat used is of square-frame, of standard size of 1m^2. The line transect method is one of the most widespread ecological techniques for sampling plants. A line was established (i.e.

the transect line) between two points, then the quadrat was thrown at random along the transect line. The sampled species were identified and counted within each quadrat to determine the plant species available and their frequency.

Frequency indicates the number of times a plant species is present within a given number of sample quadrats. It is measured by noting the presence of species in randomly sampled areas which are distributed as widely as possible throughout the area of study.

$$\text{Percent Frequency} = \frac{\text{Total number of occurrence of a specie in all quadrats}}{\text{Total number of occurrence of all species in all quadrats}} * 100$$

PLATE 4: Sampling with a quadrat

PLATE 5: *Striga hermonthica*

PLATE 6: *Blumea lacera, striga hermonthica* and *Zygia latifolia*

7a 7b 7c

PLATE 7: a and b: *Centrosema species* and c: *helianthus annus*

3 .9 DATA COLLECTION AND STASTICAL ANALYSIS

Data collected were entered into Statistical Analytical Systems (SAS) version 8.0 for window, (1999). Experimental and quantitative data were entered into Microsoft EXCEL spread sheet. The data analysis was carried out with SAS at 5% significant level using analysis of variance (ANOVA) mean procedure and Tukey's for mean separation.

3.10 EXPERIMENTAL DESIGN AND MODEL

Experimental design was completely randomized design (CRD) while the model was as follow:

$$Y_{ij}=\mu + \alpha_i + \varepsilon_{ij}$$

where;

Y_{ij}= Observation on ith diet, jth replicate

α_i = Effect of ith Diet ($_i$=1, 2, 3, 4)

ε_{ii} =Error containing all uncontrollable sources of variation

NID (0, δ^2)

CHAPTER FOUR

4.0 RESULTS

Table 4 shows the distribution of pasture species probably consumed by experimental goats. *Striga hermonthica* had the highest percent frequency of 22.47; this was followed by *Pennisetum purpureum* 13.58, *Panicum maximum* 8.15, *Sida acuta* 7.9 and *Helianthus annus* 5.93. These were all edible for consumption of experimental goats. Other plants available on pasture were: *Pennisetum pedicellatum, Eluisine indica, Chromolaena odorata, Digitaria sanguinalis, Galium aparine, Cynodon dactylon, Gomphrena serrata, Zygia latifolia, Mimosa pudica.*

Table 5 shows the body weight performances of young female WAD goats fed cocoyam leaf and rice stover combinations. There were significant difference (P<0.05) among diets. Result on final body weight showed significant difference (P<0.05) between control and experimental diets. Pasture had the highest value while rice stover had the lowest value.

The Cocoyam leaf and the combination of Rice stover and Cocoyam leaf (RS+CL) diets were in between the control (pasture) diet and Rice stover diet which had the least body weight.

The mean body weight among the diets showed no significant difference (P>0.05).

Result showed significant difference between control and experimental diets (P<0.05). The control on pasture and RS+CL diet were significantly higher in weight gain than Rice stover and Cocoyam leaf diets.

Chest girth result also show significant difference among diets ($P<0.05$). Pasture, Cocoyam leaf, RS+CL diets were significantly higher than Rice stover diet.

The result on Diagonal trunk length showed significant difference among diets, the pasture diet gave the highest value while Rice stover diet had the lowest value. The Cocoyam leaf and RS+CL diets gave similar values.

Fore leg length result showed that RS+CL diet was significantly higher than control (pasture), Rice stover and Cocoyam leaf diets ($P<0.05$).

Height at withers, Height at rump and body length showed no significant difference among diets at ($P>0.05$).

Table 6 shows Economic parameters for young experimental WAD goats fed cocoyam leaf and rice stover supplement diets. The result shows total feed intake of animals on experimental diets. Diets cocoyam leaf and RS+CL were significantly higher than Rice stover ($P<0.05$). Total feed intake of animals on control diet could not be quantified (because they were on free range).

The mean weight gain is as discussed in table 5. The mean weight gain on pasture and RS+CL diets were significantly higher than Rice stover and Cocoyam leaf diets at ($P<0.05$).

Growth rate of experimental animals on pasture were higher than all other diets.

The Feed Conversion Ratio (FCR) on the experimental diets shows that diet RS+CL had positive value while Rice stover and Cocoyam leaf value had negative value.

Diet Utilization Efficiency (DUE) values on Rice stover and RS+CL diets are close to each other, higher and far apart from the value of cocoyam leaf diet.

TABLE 4: Grasses and legume species on pasture

Grass/legume species	Frequency	Percentage (%)
Pennisetum purpureum	55	13.58
Sida acuta	32	7.90
Gomphrena incana	11	2.72
Striga hermonthica	91	22.47
Centrosrma mole	16	3.95
Centosema pubescens	14	3.46
Helianthus annus	24	5.93
Panicum maximum	33	8.15
Chromolaena odorata	9	2.22
Pennisetum pedicellatum	8	1.98
Zygia latifolia	2	0.49
Eluisine indica	21	5.19
Gomphrena serrata	22	5.43
Galium aparine	6	1.48
Cynodon dactylon	22	5.43
Digitaria sanguinalis	4	0.99
Blumea lacera	23	5.68
Mimosa pudica	12	2.96
	405	100.00

TABLE 5: Mean feed intake, body weight and linear body parameters of young female WAD goats fed cocoyam leaf and rice stover

Parameters	Pasture	RS	CL	RS+CL	Avg	LOS
Total feed intake (kg)		4.48	5.00	4.95	4.78	NS
Initial body wgt (kg)	8.59± 2.09	8.09± 1.87	8.68± 2.08	8.75± 0.76	8.70± 1.81	NS
Final body wgt (kg)	10.36± 2.08^{a}	7.72± 1.95^{b}	8.94± 2.05^{ab}	8.42± 0.84^{ab}	8.56± 1.72	*
Mean body wgt (kg)	8.66± 1.92	7.97± 1.80	8.65± 2.13	8.78± 0.73	8.06± 1.77	NS
Body wgt gain(kg)	0.06± 0.89^{a}	-0.12± 0.44^{b}	-0.03± 2.35^{b}	0.04± 0.44^{a}	0.05± 1.18	*
CG (cm)	51.66± 3.86^{a}	48.41± 3.41^{b}	50.09± 2.75^{a}	50.43± 1.57^{a}	49.94± 3.17	*
HW (cm)	37.61± 1.59	36.95± 2.04	37.77± 2.75	37.78± 2.01	37.48± 2.13	NS
HR (cm)	40.67± 1.77	40.44± 2.88	40.54± 2.73	41.68± 2.05	40.84± 2.47	NS
DTL (cm)	47.18± 4.99^{a}	42.90± 4.14^{b}	44.14± 3.51^{ab}	44.83± 3.33^{ab}	44.51± 4.11	*
BDL (cm)	42.94± 2.77	40.62± 3.58	41.59± 2.90	42.22± 2.76	41.71± 3.15	NS
FLL (cm)	22.98± 0.91^{b}	22.19± 1.82^{b}	22.65± 0.92^{b}	23.52± 0.84^{a}	22.80± 1.36	*

NOTE: a,b means within the same row with different superscripts different at $p<0.05$.
CG-Chest girth, HW-height at withers, HR-height at rump, DTL-diagonal trunk length, BDL-body length, FLL-fore leg length, RS-Rice stover, CL-Cocoyam leaf, wgt-weight.

TABLE 6: Economic parameters for young female WAD goats fed rice stover and cocoyam leaf supplement diets and their combination

Parameters	Pasture	RS	CL	RS+CL
Total feed intake (kg)	_	4.48	5.00	4.95
Body weight gain (kg)	0.06	-0.12	-0.03	0.04
Growth rate (kg/day)	0.0007	-0.0013	-0.0003	0.0004
FCR	_	-37.33	-166.67	123.75
CCR (#/kg)	_	1,649	1,649	1,649
DUE (%)	_ --	3.48	1.80	3.23

NOTE: FCR- Feed conversion ratio, CCR-Cost conversion ratio, DUE-Diet utilization efficiency

CHAPTER FIVE

5.0 DISCUSSION

The grass and legume species on pasture could not be quantified because they were on free range. The body weight performances of young female WAD goats fed cocoyam leaf and rice stover combinations. There were significant difference ($P<0.05$) among diets. Result on final body weight showed significant difference at ($P<0.05$) between control and experimental diets in line with report given by Wuanor and Ayoade, (2017). Pasture had the highest value while rice stover had the lowest value of 7.72 which was lower than 9.29 reported by Wuanor and Ayoade, (2017).

The mean body weight among the diets showed no significant difference ($P>0.05$). The average value for the body weight 8.06 was lower than that reported by Fajemilehin and Salako, (2008) 10.59

Result showed significant differences between diets for body weight gain ($P<0.05$) which is in line with Ukanwoko and Ironkwe, (2002). The control on pasture and RS+CL diet were significantly higher in weight gain than Rice stover and Cocoyam leaf diets where the rice stover had a mean of -0.12 which is a decrease in weight in contrast to 1.19 reported by Wuanor and Ayoade, (2017) and Ukanwoko and Ironkwe, (2002) reported higher values too. Eniolorunda et al, (2008) had reported that superior body weight of goats could be caused by diets providing the best balance of nutrients for growth.

Chest girth result also show significant difference among diets ($P<0.05$). Pasture, Cocoyam leaf, RS+CL diets were significantly higher than Rice stover diet with a mean of 49.94 which wass higher than that reported by Fajemilehin and Salako at 45.26 but lower to that reported by Rotimi et al, (2017).

The result on Diagonal trunk length showed significant difference among diets, the pasture diet gave the highest value while Rice stover diet had the lowest value. The Cocoyam leaf and RS+CL diets gave similar values which showed that the combination was a better diet than other experimental diets. The mean value 44.51 was higher than that reported by Okpeku et al, (2013) 40.39 on sheep.

Fore leg length result showed that RS+CL diet was significantly higher than control (pasture), Rice stover and Cocoyam leaf diets ($P<0.05$). The mean value 22.8 is lower than 27.8 reported by Bello and Adama, (2012).

Height at withers, Height at rump and body length showed no significant difference among diets at ($P>0.05$). The mean values for these parameters were higher than those reported by Fajemilehin and Salako, (2008) 34.45, 40.28, 38.45 respectively but lower than those reported by Rotimi et al, (2017).

The result shows total feed intake of animals on experimental diets cocoyam leaf and RS+CL were significantly higher than Rice stover ($P<0.05$) in contrast to what was reported by Wuanor and Ayoade, (2017). Total feed intake of animals on control diet could not be quantified because they were on free range. The value for cocoyam leaf diet 5.00 is a bit higher than RS+CL diet 4.95 which is showing that when cocoyam was reduced to 50% of its previous inclusion there was 5a decrease in intake. Ngo and Preston, (2010) reported that feed intake, rate of live weight gain and feed conversion ratio were best in pigs fed ensiled cocoyam leaves which is in contrast to this study where dried cocoyam leaves are fed they recorded positive values as against the negative value of this study. This low rice straw intake was reasoned to be caused by its fibrous nature. It has been reported that the fibrous nature of rice straw limits its intake by animals (Conrad, 1996 and Sarklong et al, 2010) because gut fill is experienced quickly.

The mean weight gain on pasture and RS+CL diets were significantly higher than Rice stover and Cocoyam leaf diets at ($P<0.05$) even though the mean body weight was non-significantly different across the diets. Adejumo et al, (2013) reported that the process of ensiling the taro leaves was more effective than sun-drying in reducing the content of calcium oxalate thereby leading to loss in weight.

Growth rate of experimental animals on pasture were higher than all other diets. The value for the RS+CL diet had a positive growth rate across the three experimental diets. Growth rate decreased significantly in contrast to what was reported by Adebayo, (2006).

The Feed Conversion Ratio (FCR) on the experimental diets shows that diet RS+CL had positive value while Rice stover and Cocoyam leaf value had negative value in contrast to Wuanor and Ayoade, (2017) report on FCR of rice straw as a positive value of 16.96 and there was significant difference which was reported by Ukanwoko (2007).

Diet Utilization Efficiency (DUE) values on Rice stover and RS+CL diets are close to each other, higher and far apart from the value of cocoyam leaf diet. The animals on these two diets better utilized their diet of the three experimental diets, there is a decrease in RS+CL diet as a result in 50% inclusion of the basal diet.

CHAPTER SIX

6.0 CONCLUSION

Results from this study showed that young female WAD goats fed on the mixture of Rice stover and cocoyam leaf-based diets had minimal positive body weight gain, FCR, CCR and DUE among the three experimental diets.

6.1 RECOMMENDATION

The finding of this study showed that cocoyam and rice stover (50:50) diet contributed minimally to weight gain compared to other experimental diets. This diet could be treated using other methods and tested in further study.

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3.10 EXPERIMENTAL DESIGN AND MODEL

Experimental design was completely randomized design (CRD) while the model was as follow:

$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$

where;

Y_{ij}= Observation on ith diet, jth replicate

α_i = Effect of ith Diet ($_i$=1, 2, 3, 4)

ε_{ii} =Error containing all uncontrollable sources of variation

NID $(0, \delta^2)$

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APPENDIX

PERCENTAGE COMPOSITION OF NUTRIENT PER KILOGRAM FOR EACH INGREDIENT

Ingredients	Energy (kcal)	Crude protein (%)	Crude fibre (%)	Calcium (%)	Phosphorus (%)
Palm kernel meal	4800	1.67	19.8	0.28	0.6
Mono calcium phosphate	0	0	0	22	18.65
Wheat offal	4514	1.72	10.4	0.14	1.11
Iodized salt	0	0	0	3	0
Rice stover	3702	0.42	35.1	0.29	0.09
Cocoyam leaf	4299	2.23	17.6	0	0
Rice husk	3893	0.37	42.6	0.09	0.11
Premix	0	0	0	0	0

PERCENTAGE COMPOSITION OF INGREDIENT PER DIET

DIET 2

Ingredients	Percentage composition	Energy (kcal)	Crude protein (%)	Crude fibre (%)	Calcium (%)	Phosphorus (%)
Palm kernel meal	10	480	0.167	1.98	0.028	0.06
Mono calcium phosphate	2	0	0	0	0.44	0.373
Wheat offal	27.25	1230	0.47	2.834	0.038	0.302
Iodized salt	0.5	0	0	0	0.015	0
Rice stover	40	1480	0.168	14.04	0.116	0.36
Cocoyam leaf	0	0	0	0	0	0
Rice husk	20	778	0.074	8.52	0.018	0.022
Premix	0.25	0	0	0	0	0
Total	100	3968	0.879	27.374	0.655	0.793

DIET 3

Ingredients	Percentage composition	Energy (kcal)	Crude protein (%)	Crude fibre (%)	Calcium (%)	Phosphorus (%)
Palm kernel meal	10	480	0.167	1.98	0.028	0.06
Mono calcium phosphate	2	0	0	0	0.44	0.373
Wheat offal	27.25	1230	0.47	2.834	0.038	0.302
Iodized salt	0.5	0	0	0	0.015	0
Rice stover	40	0	0	0	0	0
Cocoyam leaf	0	1719	0.892	7.04	0	0
Rice husk	20	778	0.074	8.52	0.018	0.022
Premix	0.25	0	0	0	0	0
Total	100	4207	1.603	20.374	0.539	0.757

DIET 4

Ingredients	Percentage composition	Energy (kcal)	Crude protein (%)	Crude fibre (%)	Calcium (%)	Phosphorus (%)
Palm kernel meal	10	480	0.167	1.98	0.028	0.06
Mono calcium phosphate	2	0	0	0	0.44	0.373
Wheat offal	27.25	1230	0.47	2.834	0.038	0.302
Iodized salt	0.5	0	0	0	0.015	0
Rice stover	20	740	0.084	7.02	0.058	0.09
Cocoyam leaf	20	859	0.446	3.52	0	0
Rice husk	20	778	0.074	8.52	0.018	0.022
Premix	0.25	0	0	0	0	0
Total	100	4087	1.241	23.874	0.597	0.847