EFFECTS OF INITIAL BODY WEIGHT OF GROUPS AT SEXUAL MATURITY AND FEED QUANTITY ON EGG PRODUCTION OF JAPANESE QUAIL

BY

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A PROJECT SUBMITTED TO THE DEPARTMENT OF ANIMAL PRODUCTION AND HEALTH, FACULTY OF AGRICULTURE IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF AGRICULTURE (B.AGRIC), FEDERAL UNIVERSITY OYE-EKITI.

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DECLARATION

I hereby declare that this project titled **"EFFECTS OF INITIAL BODY WEIGHT OF GROUPS AT SEXUAL MATURITY AND FEED QUANTITY ON EGG PRODUCTION OF JAPANESE QUAIL"** was written by me in the Department of Animal Production and Health, Federal University Oye-Ekiti, Ekiti State under the supervision of Dr. (Mrs) M. Orunmuyi. No part of this work has been presented in any previous work for an undergraduate degree in any University. Information obtained from any literature has been duly acknowledged in the project and a list of references provided.

Idowu Oluwakemi Ruth	[signature]	13/11/2017
Name of student	Signature	Date

CERTIFICATION

This is to certify that this project titled "**EFFECTS OF INITIAL BODY WEIGHT OF GROUPS AT SEXUAL MATURITY AND FEED QUANTITY ON EGG PRODUCTION OF JAPANESE QUAIL**" by Idowu Oluwakemi Ruth meets the regulations governing the award of the degree of Bachelor of Agriculture of Federal University Oye-Ekiti, Ekiti State and is approved for its contribution to knowledge and literary presentation. The above declaration is confirmed by:

Dr. Orunmuyi. M		
Supervisor	Signature	Date
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Acting Head of Department	Signature	Date

DEDICATION

This project is dedicated to the Almighty God and also to my parents, Mr. and Mrs. Idowu for their financial support.

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ABSTRACT

This study was carried out to investigate the effect of different body weight of groups (below 120g and above 120g) and feed quantity (25g and 30g) on performance and egg quality characteristics of Japanese quail birds at six weeks of age. A total of 120 Japanese quails were allocated to four groups with respect to live weight and feed quantity, using completely randomized design in a factorial arrangement, each group consisting of three replicates. The study period lasted for 10 weeks. Data collected on body weight, feed intake, egg weight, feed conversion ratio and egg quality parameters were subjected to analysis of variance using the General Linear Model of SAS. Results showed that differences in the initial live weight at the beginning of experiment significantly affected the final body weight, egg weight, egg mass and hen housed egg production. Average feed intake, feed cost per kilogram of feed, Feed conversion ratio and hen-day egg production were not significant. Effect of differences in feed quantity was significant ($P<0.001$) only on feed intake and feed cost per kilogram. The interaction effect of initial body weight and feed quantity was significant on average feed intake, average body weight gain, average egg weight, feed cost per kilogram and hen housed egg production. For egg quality parameters, difference in initial body weight significantly ($P<0.05$) affected only egg weight, egg length, egg width and yolk weight while difference in feed quantity affected only yolk height and yolk index. The interaction between initial body weight of groups and feed quantity was not significant on all egg quality parameters. It is concluded that initial body weight of 120g and above at onset of lay and minimum of 25g of feed will be sufficient for egg production in quails.

CHAPTER ONE

1.0 INTRODUCTION

Japanese quail (*Coturnix coturnix japonica*) is the smallest avian species farmed for meat and egg production (Vali *et al.*, 2006). Quail production in Nigeria is gradually becoming an important business in poultry industry especially among small and medium scale poultry producers.

Quail possess distinct characteristics which include rapid growth, early sexual maturity, high rate of lay and much lower feed and space requirement than the domestic fowl (Muhammad, 2006 and Hemid *et al.*, 2010). There are no known morbid diseases affecting them except respiratory disorder with very low mortality rate (Oluwatomi, 2010). Other unique characteristics and advantages of quails over other species of poultry include early attainment of sexual maturity, being able to come to lay as early as 5–6 weeks of age, attaining market weight of 120–160g between 5–6- weeks of age and a high rate of egg production between 250– 300 eggs in the first year of lay (Chelmonska *et al.*, 2008). Nutritive and economic benefits can be derived from quail production since the quail is fast growing and resistant to many diseases than domestic fowls (Oluyemi and Roberts, 2000).

The adult male quail weighs about 100-130 grams (Mizutani, 2003). Body weight of 100-140g was reported for adult males by Randall and Bolla (2008) that have not been subjected to genetic selection for body weight. The adult female quail are slightly heavier than the male weighing from 120 - 160 grams (Randall and Bolla, 2008 and Ortlieb, 2013).

The male birds can be identified readily by the rusty dark brown colour of the breast feather. Males also have a cloacal gland, a bulbous structure located at the upper edge of the vent which secretes a white foamy material.

Quail eggs are characterized by a variety of colour patterns; they range from snow white to completely brown. More commonly, they are tan and dark brown, speckled or mottled brown with a chalky blue covering (Randall and Bolla, 2008). It was reported by Kocak *et al.* (1995) that the quail egg weight of the first 10 days of egg production was 10.44g. Camci *et al.* (2002)

studied the relationship between the age at sexual maturity and the performance traits in Japanese quail and reported a 12 g average egg weight for the quails.

The weight of birds and their development during growth phase are factors that influence the weight of the first eggs (Braz *et al.*, 2011). It has been reported that there are relationship between chronological age, body weight, body composition and sexual maturity which are complex processes in determining body weight in quail within generations or lines (Oruwari and Brody, 1988 and Reddish *et al.*, 2002). The initial growth pattern and weight at sexual maturity have been pointed out as the main factors which affect the performance of birds in laying phase (Sezer *et al.* 2006), and these traits must be regarded with special attention in breeding programs. Higher egg production and improved feed conversion ratio in chickens was reported in light weight categories followed by medium and heavy categories (Lacin *et al.*, 2008).

Body weight and egg weight are two relevant productive traits in poultry. (Kirikci *et al.*, 2007) observed that heavy eggs were obtained from the heavy birds and the light eggs were produced by the small size birds.

1.1. STATEMENT OF PROBLEM

Information on the relationship between body weight at onset of lay and subsequent egg production and egg quality characteristics in quails is scanty. Most reports in literature were on chickens (Lacin *et al., 2008*, Braz *et al.*, 2011, Nazligul *et al.*, 2001).

1.2. JUSTIFICATION OF THE STUDY

The weight of birds and their development during growth phase are factors that influence the weight of the first eggs (Braz *et al.*, 2011). Selection for higher body weight has been reported to have negative correlation with production performance, leading to the relatively poor egg production (Nath *et al.*, 2011 and Mielenz *et al.*, 2006).Due to the variations in body weight, feed consumption is reported to be affected (Nazligul *et al.*, 2001).

1.3. OBJECTIVES OF THE STUDY

- To evaluate egg production performance and egg quality parameters of quails with different initial body weight of groups at sexual maturity (below 120g or above 120g).and fed different quantities of feed (25g or 30g per day).
- To evaluate interaction effect of initial body weight of groups fed with different feed quantity.

1.4. HYPOTHESIS

1.4.1. Null hypothesis

H_{O1}: There are no significant differences in egg production and egg quality parameters of quail birds with different initial body weight at sexual maturity.

H_{O2}: There are no significant differences in egg production and egg quality parameters of quail birds with different feed quantity.

1.4.2. Alternative hypothesis

H_{A1}: There are significant differences in egg production and egg quality parameters of quail birds with different initial body weight at sexual maturity.

H_{A2}: There are significant differences in egg production and egg quality parameters of quail birds with different feed quantity.

CHAPTER TWO

2.0. LITERATURE REVIEW

Japanese quail (*Coturnix Coturnix japonica*) are from pheasant family and are migratory birds which migrate between Asia and Europe. The Japanese quail was introduced in Nigeria only in 1992 (NVRI, 1994). At first, quails became popular as game birds but at later stage in 1910 the commercial keeping of quail kicked off because of their tasty meat, low feed consumption and excellent laying ability (Shanaway, 2008). The Japanese quail has a short generation interval, from three to four generations per year (Kayang *et al.*, 2004; Alkan *et al.*, 2010). Furthermore the quail is efficient converter of feed, with each egg a female deposits an edible package of 8 percent of her own body weight as compared to 3 percent in case of chicken (Martin *et al.* 1998). In addition to the nutritional value of the eggs, quails are precocious birds and display a high egg production ratio (Kaur *et al.*, 2006; Barreto *et al.*, 2007).

This bird is used among others for genetic, physiological, biomedical, behavioral, and embryological studies (Huss *et al.*, 2008). In the poultry world, quail-meat production is negligible when compared with that of broiler chickens, but nevertheless quail is a good source of meat and occupies a relevant place in poultry breeding and contributes to the global poultry industry (Maiorano *et al.*, 2011). According to Onyewuchi, *et al.* (2013), quail farming is more profitable than other poultry.

2.1. SEXUAL MATURITY IN JAPANESE QUAIL

Quails attain sexual maturity early and come into lay between five to six weeks of age (Anon, 1991). There are numerous reports on the physiologic relationships associated with the onset of sexual maturity in avian females (Marks and Kinney, 1964; Dunnington and Siegel, 1984; Hocking, 1993; Eitan and Soller, 2001). Previous reports have shown that a number of factors contribute to the considerable variability observed in the onset of egg production in chickens, turkeys, and Japanese quail. The variability is thought to be a result of environmental, genetic, and physiologic factors including photoperiod, nutrition, body composition and age of the bird. Oruwari and Brody (1988) concluded that the interaction between chronological age, body weight, and body composition for the onset of sexual maturity are inseparable.

Lima *et al.* (2011), show that lighter and heavier birds achieved sexual maturity at the same time. Sexual maturity also influenced body weight gain in female chicks. Females that did not reach sexual maturity remained as small as males Polly *et al.*, (2000).

2.2 BODY WEIGHT

The weight of the birds and their development during the growth phase are factors that influence the weight of the first eggs (Braz *et al.*, 2011). Studies show that the ideal weight for Japanese quails aged 31 days is around 105 g (Silva, 2009). An adequate body weight at the end of the rearing and pre-laying phases is of paramount importance so as to guarantee the full development of their reproductive system (ovary and oviduct), and maintaining satisfactory egg production levels throughout their reproductive period (Garcia *et al.*, 2001).

The composition of the body at the end of the breeding phase determines alterations in productive indicators such as physiological and sexual maturity in commercial laying birds (Neme *et al.*, 2006). The relationship among egg production, egg weight and mature body weight follows the same pattern as observed in the body weight at sexual maturity (Oke *et al.*, 2004).

2.3. FEED QUANTITY

Feed consumption during the laying period is influenced not only by the body weight but also on account of the bird's genetics and the season of the year (Jatoi *et al.*, 2013; Guimarães *et al.*, 2014). These same authors also prove that the genetics of the quails determine differences not only where the body and egg weights are concerned, but mainly in relation to feed consumption. According to Ani, *et al.*, (2009) an adult quail requires only 20 – 25g feed per day compared to chicken (120 – 130g) per day i.e. they have less feed requirement.

Lacin *et al.*, (2008) reported in chickens that as body weight increased, feed consumption of hens also increased. Khaldari *et al.* (2010) reported higher feed intake in the lines selected for higher body weight as compared to non-selected birds, however feed intake / g body weight gain was lower than those of control line. Khaldari *et al.* (2010) further indicated that selected line had better feed efficiency than that of control line.

In relation to feed consumption and final body mass, it was observed that very heavy birds consumed almost 12% more feed (Vieria *et al.*, 2013).

2.4. EGG QUALITY TRAITS

Several authors demonstrated that as layers advances in age, the weight of their eggs increased, while features characterizing the white (index, Haugh units) as well as the shell (thickness, strength) deteriorated (Szczerbinska, 1997; Sahan and Ipek, 2000; Vanden Brand *et al.*, 2004; Akyurek and Okur, 2009). However, González (1995) and Genchev (2012) observed that as the production cycle of quail advanced, the egg weight and eggshell thickness gradually decreased.

Cunningham (1984); Palmer and Bahr (1992) attributed that difference in heavy and older chicken in egg production than the lighter and younger birds is due to physiological changes leading to slow growth of ovarian follicles. Rajkumar *et al.*, (2009) observed that yolk color reduced as birds age increased.

(Vogt, 1968, Uluocak *et al.* 1995, Erensayin and camci, 2002) reported that in quail eggshell thickness, albumen index, yolk index and Haugh Unit varied between 0.20-0.30 mm, 5.77-6.68%, 43.15-48.82%, and 82.75-85.53%, respectively.

It has been reported that egg weight increases with increased dietary protein level%. (Annaka *et al.* 1993; Murakami *et al.* 1994; Babangida and Ubosi 2006 and Bawa *et al.* 2011). These researchers also reported that egg weight varies between 8.25 to 9.78 g for a protein range of 17 to 21. Yamane *et al.* (1979) reported that a good quail egg should weigh about 9.3 g or more.

2.5. FACTORS AFFECTING BODY WEIGHT AT SEXUAL MATURITY

2.5.1 Feeding

Feed utilization is a major constraint towards increased performance of birds in poultry production. The optimum nutrient intake of birds raised commercially will depend on the commercial goal of the poultry enterprise for egg laying birds. The aim is to maximize egg production for mature egg laying birds. This generally entails maintaining a relative stable body weight (Clara, 2010).

Jatoi *et al.*, (2013) reported that feed consumption is a variable phenomenon that is influenced by several factors such as strain of the bird, energy content of the diet, ambient temperature, floor density, hygienic conditions and rearing environments. Jatoi *et al.*, (2013) observed increase in feed consumption as body weight increased because heavy birds consume more feed. Similar findings reported in Hi-sex brown strain of chicken by El-Sagheer and Hassanein (2006); in Pheasant (Aydin and Bilgehan 2007) and in Lohmann laying hens (Lacin *et al.*, 2008).

Seker *et al.* (2009) reported that increased stocking density of Japanese quails result in a linear reduction of feed intake.

The differences in feed intake by birds could be attributed to variations in the prevailing maximum ambient temperatures and relative humidity Tuleun *et al.*, (2013). Consequently, this may have accounted for the lower feed intake at higher temperature when birds tend to consume less feed in an attempt not to exceed their energy requirements.

The optimum performance of livestock depends largely on the quality and quantity of their dietary nutrients. Currently, there is no commercial feed for quails in the Nigerian livestock feed industry as against chickens so as a result, most quail farmers, have to use commercial turkey and layer's feeds containing 26-28 % and 17 % Crude protein (CP) to feed quail chicks and quail layers respectively (Bawa *et al.* 2011), while other farmers produce their own feed based on recommended nutrient requirement for temperature regions of the world.

2.5.2 Breeds or strains of birds

Two strains of poultry may have the same body weight but their growth may differ because they reach maturity at different ages. The rate of growth or time taken to reach mature body weight is another variable that describes the growth of birds (Rose, 1997). Considerable differences in feed intake were observed in different breeds of chicken due to the differences in the genetic background of the breeds (Akhtar *et al.*, 2007). Feed consumption was reported to be higher in the exotic Fayoumi birds than that of local Lyallpur Silver Black (Akhtar *et al.* 2007) which is positively correlated to body weight of birds. Jaroni *et al.* (1999) observed strain difference in feed efficiency.

The effects of strains and generations on body weight of Japanese quails at different ages have been reported (Mohammed *et al.* 2006) indicating that selection could increase body weight in Japanese quails (Varkoohi *et al.*, 2010).

2.5.3 Disease

Incidence of disease condition on laying birds such as intestinal parasites, ecto parasites, contaminated feed and water could affect the body weight and egg production parameters of the birds (singh *et al.*, 2007). Housing for laying birds must be designed in such a way to balance the health and welfare of the birds thereby protecting them from any type of stress or situation that will make them prone to disease. (Adamu *et al.*, 2015; Ojedapo, 2013).

2.5.4 Stocking density

Albentosa *et al.*, (2007) reported that stocking density influences birds' behaviour. Overcrowded birds have the tendency to peck at each other which is cannibalism behaviour. Stocking density for laying birds and even birds in general have considerable effects on performance and production such as egg weight, daily feed intake, mortality and feed efficiency.

Abdel-Azeem, (2010) reported that in high stocking density, airflow at the level of the birds is often reduced resulting in reduced performance and poor air quality due to inadequate air exchange, increased ammonia and reduced access to feed and water.

Also Feddes *et al.*, (2002) showed that feed consumption decreased in broiler chickens when density increased from 14.3 to 23.8 bird /m2. Al-Homidan and Robertson (2007) indicated that increasing stocking density of Hybro broiler chicken from 10 to 15 bird /m2 resulted a reduction of feed consumption.

Erensayin (2001) found that feed conversion ratio decreased in quails with increasing group size. Davidson and Leighton (1984) indicated that high population density caused lower feed efficiency than did a relatively low population density.

Seker *et al.* (2009) they indicated that live body weight of Japanese quails was higher for quail stocked at 3 birds per cage as compared with those stocked at 10 birds per cage at 42^{nd} days of age. Davidson and Leighton (1984) indicated that higher population density caused lower body weight gain in turkeys birds than did a relatively low population density.

Kestin *et al.* (1994) found that high stocking density rates lead to reduce growth rate and increased incidence of diseases especially leg problems and various types of dermatitis. Martrenchar *et al.* (2000) reported that high stocking density have been shown to induce poor leg condition ,a decrease in locomotion behavior, condition, frequent disturbances in growth rate and a high incidence of dermatitis attributable to deteriorating litter condition.

2.5.5. Photoperiod

Polly *et al.* (2000) showed that photoperiod, by determining the period in which daily activity and feeding can occur had major effects on body weight gain in young birds. Polly *et al.* (2000) also reported that longer photoperiods are related with both higher energy intake and energy expenditure levels, resulting in larger weight gains. Polly *et al.* (2000) observed that a daily feeding period of 12 h or less is too short to enable quail chicks to store enough food in their crop (and digestive tract) to prevent them from reaching a post-absorptive state during the next dark (fasting) period.

The effect of photoperiod on food intake reported by Polly *et al.* (2000) was opposite to the effect of photoperiod on food intake as found in pigeons that were gradually transferred from a 12-h to a 3-h light period with only ad lib food during the light period: food intake increased when the birds were gradually subjected to shorter light periods Basco *et al.,* (1996).

Photoperiod also affected sexual development. In quail, sexual development is known to depend on the length of the daily light period Follet and Maung, (1978), King *et al.*, (1997), Brain *et al.*, (1988), Oruwari and Brody, (1988) and Stein and Bacon, (1976).

2.6 EFFECT OF BODY WEIGHT AND FEED QUANTITY OF BIRDS ON EGG PRODUCTION AND EGG QUALITY PARAMETERS

2.6.1 Egg number

North and Bell (1990) and Ipek and Sahan (2004) reported that egg production has been shown to be affected by breed, body size, feed, season and breeder age. North and Bell (1990) and Ipek and Sahan (2004) observed maximum egg production in the small weight category and minimum in the heavy size birds in poultry birds. The low egg production in heavy quails in comparison to small quails could be due to less number of mature ovarian follicles in heavy quails Jatoi *et al.*, (2013).

It was also reported by Marks (1979) that egg production decreased depending on selection as to body weight of quails as the body weight increased. Other studies reported no change in egg production depending upon body weight (Harms *et al.*, 1982; Cerolini *et al.*, 1994; Harms *et al.*, 2000; Kirikci *et al.*, 2004).

However, Harms and Russell (1996) and Akbas and Takma (2005) found that body weight was positively related to egg production. El-Sagheer and Hassanein (2006) reported that the medium and heavy size strains of chicken had higher egg production than those of light strains.

2.6.2 Egg weight and egg mass

Lin *et al.* (2004) and Bawa *et al.* (2011) reported that egg mass or weight can be used as criterion in assessment of nutritional status, especially if they are obtained from birds of the same age, breed and health status. Nazligul *et al.* (2001) also reported that the egg mass in quail is influenced by body weight. Shoukat *et al.* 1988 reported that the size and weight of an egg do not only depend upon the breed and strain but also it varied to great extent from one individual to another.

Hagger (1994) and Leeson *et al.* (1997) indicated that egg weight increase was associated with increase in body weight and age of the breeder. Lacin *et al.* (2008) also pointed out that egg weight was lower in the group with low body weight than those of medium and heavy hens in chicken. Percentage laying, average weight and egg mass are all also influenced by the weight of the birds at the end of the rearing stage Vieria *et al.*, (2013).

2.6.3 Feed conversion ratio (FCR)

The maximum mean FCR (g feed/egg) was recorded in the heavy weight category and minimum in the small size birds Jatoi *et al.*, (2013). The better FCR (g feed/egg) in small size quails could be attributed to less feed requirement of these birds which was supported by Leeson *et al.* (1997) who observed that the smaller birds consistently ate less feed throughout laying regardless of the strain.

Best FCR to a certain body weight could be partially due to lower maintenance costs and lower fat deposition of birds with higher growth rate (Pym, 1990).

2.6.4 Egg quality characteristics

Egg quality traits are affected by factors such as genetic structure of the flock (Hermiz and Ali 2012 and Rajkumar *et al.* 2009), nutrition (Güçlü *et al.* 2008), bird origin (Lewko and Gornowicz 2009), and living conditions (Holt *et al.*, 2010). Egg morphology and quality is also significantly influenced by layer age (Genchev 2012; González 1995; Nowaczewski *et al.*, 2010; Philomina and Pillai Ramakrishna, 2000 and Tserveni-Gousi, 1987).

Egg quality determines the acceptability to consumer. The internal and external egg quality traits are of great importance to poultry breeders because of their influence on the yield of future breeding performance. (Jacob *et al.*, 2000) identified external qualities to include egg weight, the strength of the shell and shell cleanliness. Du Plessis and Erasmus (1972), Harms *et al.* (1982) and Leeson and Summers (1987), also reported that higher body weight resulted in large egg length, width and mass, all factors affecting egg weight. However, Harms and Russell (1996) and Akbas and Takma (2005) found that body weight was positively related to egg production. Alkan *et al.* (2010) reported decrease in yolk index of female Japanese quail selected to high body weight compared to low line body weight.

CHAPTER 3

3.0 MATERIALS AND METHODS

3.1 LOCATION OF THE EXPERIMENT

The experiment was conducted at the experimental site of Teaching and Research Farm of the Department of Animal Production and Health, Faculty of Agriculture, Federal University Oye-Ekiti, Ikole Campus, Ekiti State, Nigeria. The farm in which the experiment was conducted is situated at latitude of 7.7982661° N and longitude of 5.514493° E. It has an average annual temperature of 24.2 °C.

3.2 EXPERIMENTAL BIRDS

Two hundred (200) three weeks old male and female quails were bought at National Veterinary Research Institute, Ikire outstation in Osun state, Nigeria. They were fed with growers mash until the 5th week before sexing and separation into different treatment. Sexing of the birds was done based on plumage differences at five (5) weeks old; using breast coloration (which were reddish brown with speckled pattern in males and the female has a creamy coloration with black spot).

Sexing was also done again after discovering some males birds at six (6) weeks using vent sexing (males have a cloaca gland and a bulbous structure located at the upper edge of the vent which secretes a white foamy and the females do not possess this unique characteristic) which was also used for the final separation of birds.

3.3 EXPERIMENTAL LAYOUT

$T1^{1}$	$T4^{1}$	$T2^{1}$	$T3^{1}$	$T1^{2}$
$T4^{2}$	$T1^{3}$	$T3^{2}$	$T2^{2}$	$T4^{3}$

CAGE 1 (2 TIERS)

$T3^{3}$
$T2^{3}$

CAGE 2 (2 TIERS)

Treatment 1 (T1) = 120g below, diet 1(25g)

Treatment 2 (T2) = 120g below, diet 2(30g)

Treatment 3 (T3) = above 120g, diet 1(25g)

Treatment 4 (T4) = above 120g, diet 2(30g)

3.4 EXPERIMENTAL DESIGN

The experiment was conducted using the completely randomized design in a factorial arrangement. A total of 120 Japanese quails at 5 weeks of age were assigned to 4 experimental groups according to body weight and feed quantity.

Statistical model

$Y_{ijk} = \mu + b_i + t_j + bt_{(ij)} + e_{ijk}$

Where;

Y_{ijk} = Individual observation k in the ith treatment and jth treatment

μ = common mean

b_i = the effect of body weight at sexual maturity

t_j = the effect of feed quantity

$bt_{(ij)}$ = the effect of the interaction of body weight at sexual maturity with feed quantity

e_{ijk} = random error with mean 0 and variance

Each experimental group consisted of 3 replicate. Feeds were offered as measured with regular water supply.

3.5. MANAGEMENT OF BIRDS

The building in which the cage was placed was cleaned fumigated and disinfected with royal guard disinfectant. The wooden cage used for rearing the birds were also cleaned and disinfected to accommodate the birds throughout the experimental period. Wood shavings was collected and used as bedding materials for the birds and the litter is usually changed twice in a week. The birds were fed ad-libitum from three (3) weeks to six (6) weeks of age with grower mash containing 2900 ME Kcal/kg and 22% protein. The laying phase started at six (6) weeks of age. At this period the birds were being fed with layers mash containing 18% Crude Protein and 2900ME Kcal/kg. The composition of the experimental diets is shown in Table 1.

Table 1: Composition of experimental diet

Ingredients	(kg)	%
Maize		58.4
Soybean meal		21.15
Wheat offal		14.25
Limestone		1.5
Salt		0.25
Fishmeal		2
Dicalcuim phosphate		2
Premix		0.25
Lysine		0.1
Methionine		0.1
Calculated analysis		
M.E.Kcal/kg		2900
Crude protein	%	18
Calcium	%	2.5
Phosphorus	%	0.60
CF	%	3.78
Lysine	%	0.59
Methionine	%	0.45

*Biomix premix supplied per kg of diet: vit. A 10000iu; vit D 2000iu; vit E 23mg; vit k 2mg; calcium pantothenate 2.5mg; vit B_{12} 0.051mg; Folic acid 0.75mg; Chloride 300mg; vit B_1 1.8mg vit B_2 5mg; manganese 40mg; iron 20mg; zinc 30mg; copper 3mg; iodine 1mg; cobalt 0.2mg.

Routine management including feeding, water supply, medication and egg picking at regular intervals were carried out.

3.6. EXPERIMENTAL PROCEDURE

Feed of different quantities were weighed and given to the birds of different replicate. The leftover were usually measured on weekly basis and then subtracted from feed offered to the birds to get the feed intake of the birds. Leftover per day was gotten from division of the leftover per week by seven (7) and later divided by the number of birds per replicate to get leftover per day per bird, in order to get feed intake per day per bird by dividing feed offered per day per bird with leftover per day per bird. Feed conversion ratio was expressed as kilograms of feed consumed per kilogram of egg produced.

Egg collection was done twice daily in the morning at 7.30-8.00am and in the evening at 4.00pm. A total of 36 eggs were randomly collected from 4 treatments to assess egg quality parameters which were shape index, shell thickness, yolk index, yolk colour and Haugh unit.

Yolk colour was determined with a commercially available "yolk colour fan" according to the CIE standard colorimetric system (Yolk Colour Fan, the CIE standard colorimetric system, F. Hoffman-La Roche Ltd., Basel, Switzerland). Shell thickness (mm) was measured using a micrometer screw gauge.

The size of the egg (length and width), yolk height, yolk diameter and albumen height was measured using venier caliper. The yolk diameter was obtained by getting the average measurement in mm from two (2) different points. The average taken from three (3) points as albumen height was recorded.

3.7. DATA COLLECTION

Productive performances such as feed conversion ratio (FCR), hen-day egg production (HDEP), hen-housed egg production (HHEP), average body weight, average egg weight, feed cost per bird per day (FC) and egg mass were calculated.

$$\text{FCR /kg egg mass} = \frac{kg\ of\ feed\ consumed}{kg\ of\ egg\ produced}$$

$$\text{HDEP} = \frac{Total\ number\ of\ egg\ produced\ during\ the\ period}{Total\ number\ of\ hen\ days\ in\ the\ same\ period} \times 100$$

$$\text{HHEP} = \frac{Total\ number\ of\ eggs\ laid\ during\ the\ period}{Total\ number\ of\ hens\ housed\ at\ the\ beginning\ of\ laying\ period} \times 100$$

$$\text{Average body weight} = \frac{Total\ net\ weight\ of\ birds}{Number\ of\ birds}$$

$$\text{Average egg weight} = \frac{Total\ \ weight\ of\ eggs\ produced}{Number\ of\ eggs}$$

$$\text{FC} = \ Quantity\ of\ feed\ consumed\ \times price\ per\ unit\ feed$$

Egg mass = % HDEP × average egg weight

Egg quality parameters were calculated using the following formulas and methods as summarized by Yoruk *et al.* (2004).

$$\text{Shape index (\%)} = \frac{Egg\ width}{Egg\ length} \times 100$$

$$\text{Yolk index (\%)} = \frac{Yolk\ height}{Yolk\ diameter} \times 100$$

Haugh unit = $100 \times \log (AH + 7.57 - 1.7 \times EW^{0.37})$

Where AH = albumen height (mm) and EW = egg weight (g)

3.8. DATA ANALYSIS

All data collected were subjected to the analysis of variance (ANOVA) using the General Linear Model (GLM) of SAS (SAS 2008) and means of treatment were separated using Tukey's Honestly Significant Difference.

Plate 1: Feed formulation

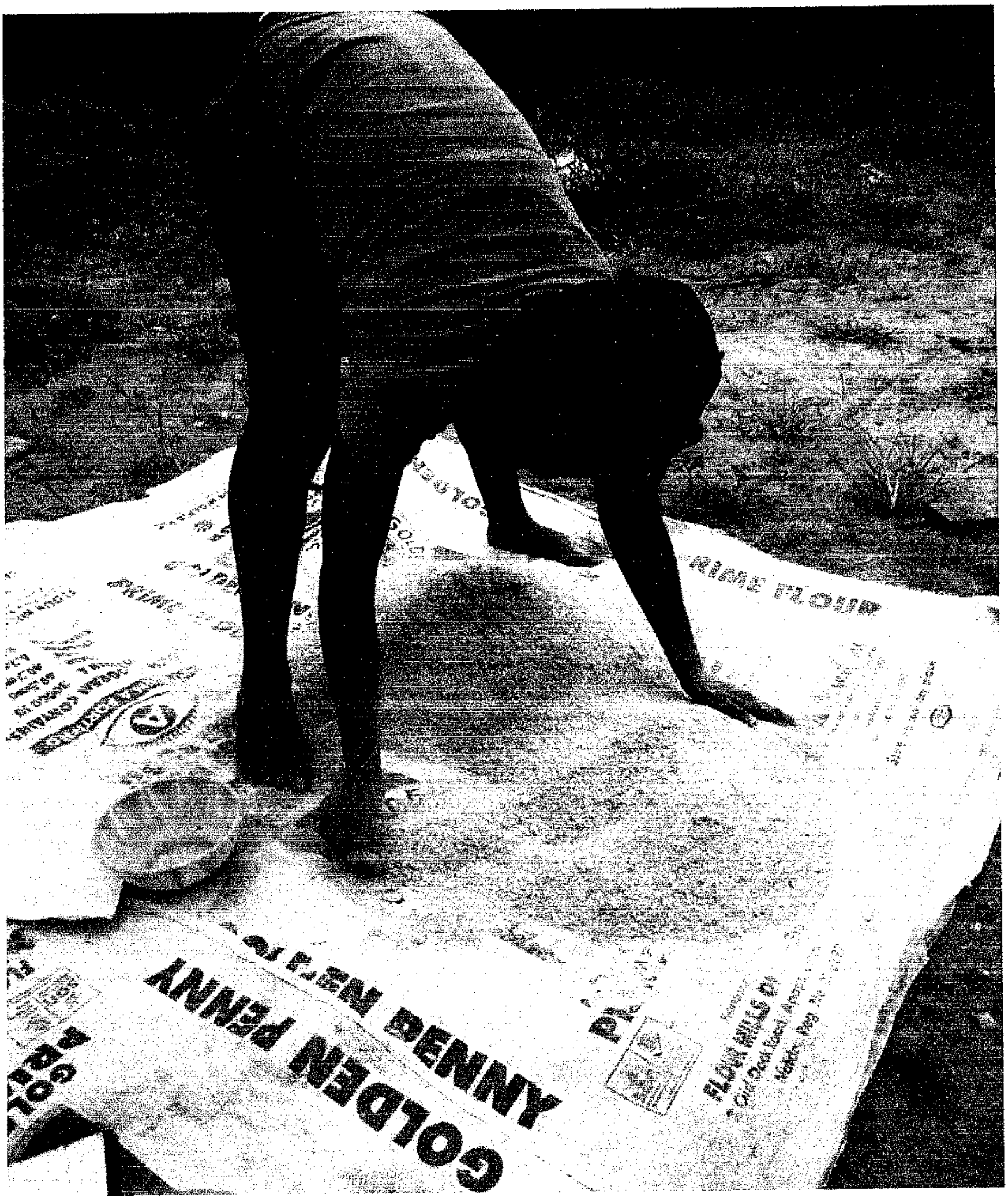

Plate 2: Feed formulation

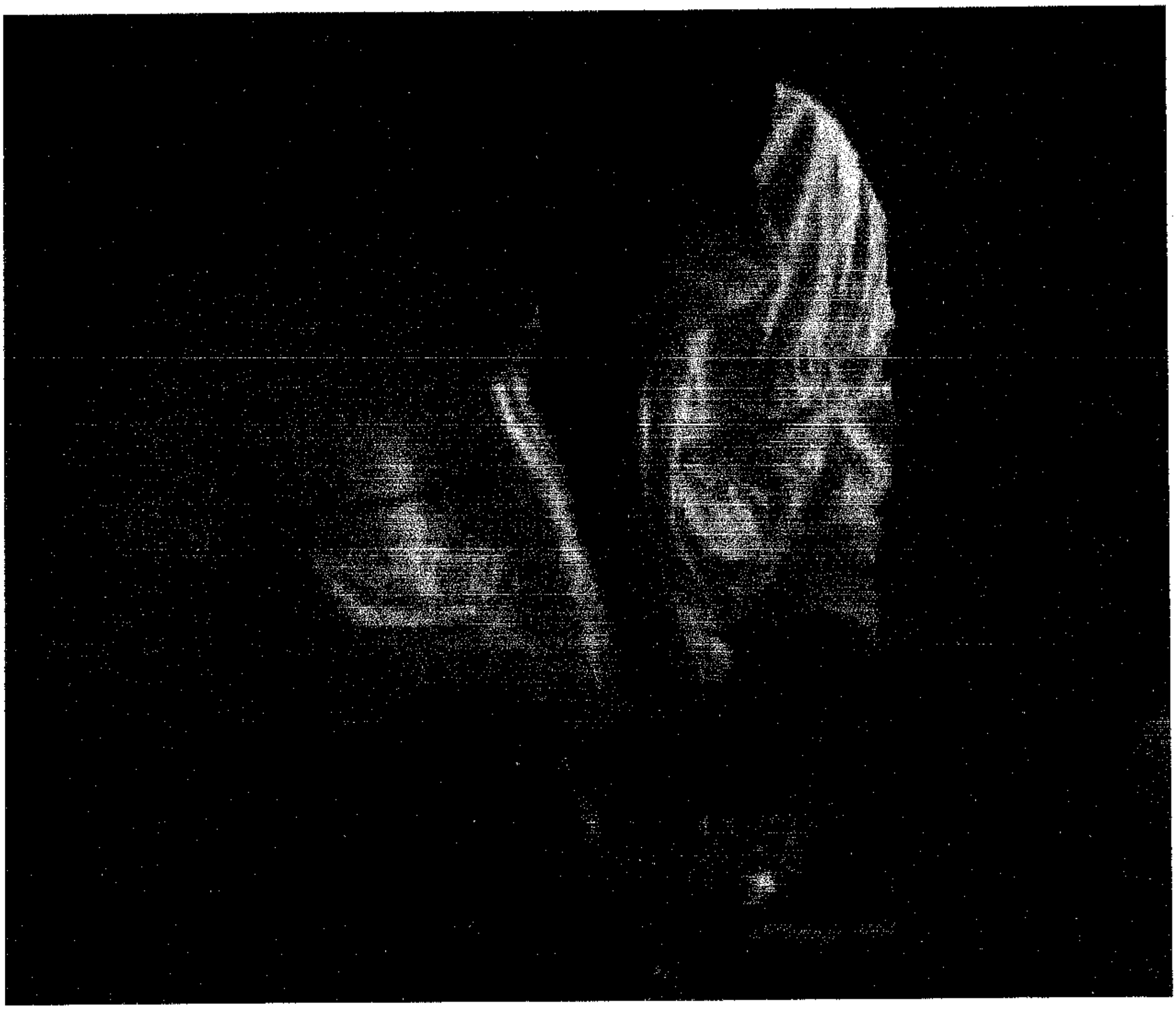

Plate 3: measurement of quail egg external qualities (egg length)

Plate 4: measurement of quail egg external qualities (shell weight)

CHAPTER FOUR

4.0 RESULT

4.1 EFFECT OF INITIAL BODY WEIGHT OF BIRDS AND FEED QUANTITY ON LAYING PERFORMANCE

Table 2 shows the effect of initial body weight on the performance of laying birds. The result showed that there was significant differences of ($P<0.01$) in average body weight, average egg weight, hen housed egg production and ($P<0.05$) in egg mass between treatments. However other parameters which include feed intake per bird, average egg no, feed cost, feed conversion ratio were not significantly different.

Table 3 shows the effect of feed quantity on the laying performances of the birds. The result obtained showed that feed intake per bird and the feed cost were highly significantly different ($P<0.001$). However all other parameters such as average body weight, average egg weight, egg mass, feed conversion ratio, hen-housed egg production and Hen-day egg production were not significantly different.

The interaction effect of body weight and feed quantity on laying performances of the birds is presented in Table 4. The feed intake per bird, average body weight, feed cost, hen-housed egg production were very significant ($P<0.01$) while average egg weight was found to be ($P<0.05$) significantly different. Feed cost per bird per day of group with lower body weight and higher feed quantity (AW2) and group with higher body weight and higher feed quantity (AW4) which was #4.87 and #4.71 respectively were not significantly different but was significantly different from group with lower body weight and lower feed quantity (AW1) and group with higher body weight and lower feed quantity (AW3) which was #3.89 and #4.13 respectively. All other parameters were non-significant. Other parameters such as egg mass, feed conversion ratio and Hen-day egg production were not significantly different.

Table 2: Effect of initial body on laying performance of birds

Variables	<120g	>120g	SEM	LOS
Average feed intake (g)	26.07	26.31	0.51	NS
Average body weight (g)	166.03[b]	175.00[a]	3.36	**
Average egg weight (g)	9.12[b]	10.02[a]	0.32	**
Egg mass	0.34[b]	0.41[a]	0.049	*
Feed cost/bird/day	4.38	4.42	0.15	NS
Feed conversion ratio	0.81	0.57	0.22	NS
Hen-housed production	20.36[b]	28.14[a]	3.31	**
Hen-day production	36.35	40.78	5.08	NS

SEM = standard error of mean, LOS= level of significance.
ab = means with different superscripts on the same row are significantly different
NS= non-significant, * = significant at $p<0.05$, ** = very significant at $p<0.01$

Table 3: Effect of feed quantity on laying performance of birds

Variables	T1	T2	SEM	LOS
Average feed intake (g)	23.87^{b}	28.51^{a}	0.51	***
Average body weight (g)	168.57	172.46	3.36	NS
Average egg weight (g)	9.43	9.71	0.32	NS
Egg mass	0.36	0.39	0.049	NS
Feed cost/bird/day	4.01^{b}	4.79^{a}	0.15	***
Feed conversion ratio	0.64	0.75	0.22	NS
Hen-housed Production	23.81	24.70	3.31	NS
Hen-day production	37.41	39.72	5.08	NS

T1 = feed quantity of 25g, T2 = feed quantity of 30g, SEM = standard error of mean, LOS= level of significance.
ab = means with different superscripts on the same row are significantly different
NS= non-significant, * = significant at $p<0.05$, ** = very significant at $p<0.01$

Table 4: Interaction effect of initial body weight and feed quantity on laying performance of birds

Variables	AW1	AW2	AW3	AW4	SEM	LOS
Average feed intake (g)	23.15^{c}	29.00^{a}	24.59^{b}	28.03^{a}	0.51	**
Average body weight (g)	167.89^{b}	164.17^{b}	169.24^{b}	180.75^{a}	3.36	**
Average egg weight (g)	9.04^{b}	9.20^{b}	9.83^{a}	10.21^{a}	0.32	*
Egg mass	0.31	0.37	0.42	0.40	0.049	NS
Feed cost/bird/day	3.89c	4.87^{a}	4.13^{b}	4.71^{a}	0.15	**
Feed conversion ratio	0.71	0.92	0.57	0.58	0.22	NS
Hen-housed Production	15.97^{b}	24.75^{a}	31.65^{a}	24.64^{a}	3.31	**
Hen-day Production	32.42	40.28	42.40	39.15	5.08	NS

AW1= body weight of below 120g and feed quantity of 25g, AW2=body weight of below 120g and feed quantity of 30g, AW3=body weight of above 120g and feed quantity of 25g, AW4=body weight of above 120g and feed quantity of 30g, SEM = standard error of mean, LOS= level of significance.
ab = means with different superscripts on the same row are significantly different
**= significant at < 0.01, NS= Non-significant

4.2. EFFECT OF INITIAL BODY WEIGHT OF BIRDS AND FEED QUANTITY ON EGG PARAMETERS

Table 5 shows the effect of body weight on egg quality parameters. Egg weight and Egg length at ($P<0.01$), Egg width and yolk weight ($P<0.05$) were found to be significant between treatments. The effect of body weight groups on shell weight, yolk height, albumen weight, albumen height, yolk diameter, yolk colour, shell thickness and yolk index values was found to be non-significant.

The effect of feed quantity on egg quality parameters is presented in Table 6. Yolk height and yolk index were significantly different among body weight groups. All other parameters measured such as egg weight, egg width, yolk height, eggshell weight, egg shape index, haugh units, egg length, yolk weight, yolk diameter, yolk colour, albumen weight, shell thickness and albumen height were not influenced by the feed quantity.

The interaction effects of different body weight groups and feed quantity on egg quality parameters are presented in Table 7. In the effect of weight group by feed quantity interaction, all egg quality parameters were found to be non-significant.

Table 5: Effect of initial body weight on egg parameters of the birds

Variable	<120g	>120g	SEM	LOS
Egg weight (g)	9.59[b]	10.60[a]	0.18	**
Egg length (mm)	30.27[b]	31.56[a]	0.33	**
Egg width (mm)	23.63[b]	24.37[a]	0.18	*
Yolk weight (g)	3.08[b]	3.47[a]	0.09	*
Yolk height (mm)	8.29	8.87	0.14	NS
Yolk diameter (mm)	22.54	23.31	0.31	NS
Yolk colour	1.69	1.45	0.11	NS
Albumen weight (g)	4.96	5.36	0.15	NS
Albumen height (mm)	3.48	3.62	0.12	NS
Shell weight (g)	1.26	1.31	0.04	NS
Shell thickness (mm)	0.31	0.30	0.01	NS
Yolk index	36.83	38.18	0.61	NS
Haugh unit	85.23	84.98	0.68	NS
Egg shape index	78.16	77.38	0.48	NS

SEM = Standard error of mean, LOS= Level of significance.
ab = means with different superscripts on the same row are significantly different
NS = Non-significant, * = significant at $p<0.05$, ** = very significant at $p<0.01$

Table 6: Effect of feed quantity on egg quality parameters

Variable	T1	T2	SEM	LOS
Egg weight (g)	10.22	10.09	0.18	NS
Egg length (mm)	30.96	31.00	0.33	NS
Egg width (mm)	24.12	23.98	0.18	NS
Yolk weight (g)	3.34	3.25	0.09	NS
Yolk height (mm)	8.93^{a}	8.32^{b}	0.14	*
Yolk diameter (mm)	22.69	23.22	0.31	NS
Yolk colour	1.68	1.41	0.11	NS
Albumen weight (g)	5.13	5.22	0.15	NS
Albumen height (mm)	3.68	3.44	0.12	NS
Shell weight (g)	1.32	1.25	0.04	NS
Shell thickness (mm)	0.31	0.3	0.01	NS
Yolk index	39.48^{a}	35.88^{b}	0.61	**
Haught unit	85.75	84.49	0.68	NS
Egg shape index	78.08	77.41	0.48	NS

T1 = feed quantity of 25g, T2 = feed quantity of 30g, SEM = Standard error of mean, LOS= Level of significance
ab = means with different superscripts on the same row are significantly different
* = significant at $P<0.05$, ** = very significant at $P<0.01$, NS = Non-significant

Table 7: Interaction effect of body weight and feed quantity on egg quality parameters

Variable	AW1	AW2	AW3	AW4	SEM	LOS
Egg weight (g)	9.53	9.64	10.70	10.50	0.18	NS
Egg length (mm)	30.17	30.34	31.52	31.59	0.33	NS
Egg width (mm)	23.67	23.60	24.44	24.31	0.18	NS
Yolk weight (g)	3.11	3.04	3.50	3.44	0.09	NS
Yolk height (mm)	8.87	7.83	8.97	8.76	0.14	NS
Yolk diameter (mm)	22.56	22.53	22.77	23.85	0.31	NS
Yolk colour	1.57	1.78	1.30	1.60	0.11	NS
Albumen weight (g)	4.84	5.04	5.33	5.80	0.15	NS
Albumen height (mm)	3.68	3.32	3.69	3.55	0.12	NS
Shell weight (g)	1.23	1.28	1.39	1.23	0.04	NS
Shell thickness (mm)	0.29	0.32	0.32	0.28	0.01	NS
Yolk index	39.39	34.84	39.55	36.81	0.61	NS
Haugh unit	86.50	84.23	85.23	84.72	0.68	NS
Egg shape index	78.60	77.82	77.71	77.52	0.48	NS

AW1= body weight of below 120g and feed quantity of 25g, AW2=body weight of below 120g and feed quantity of 30g, AW3=body weight of above 120g and feed quantity of 25g, AW4=body weight of above 120g and feed quantity of 30g, SEM = Standard error of mean, LOS= Level of significance.
NS = Non-significant

CHAPTER 5

5.0 DISCUSSION

5.1 EFFECT OF INITIAL BODY WEIGHT OF GROUP AND FEED QUANTITY ON EGG PRODUCTION

Egg production was not affected by body weight. Similar to the present study, other studies reported no change in egg production depending upon body weight (Harms *et al.,* 1982; Cerolini *et al.,* 1994; Harms *et al.,* 2000; Kirikci *et al.,* 2004). However, Harms and Russell (1996) and Akbas and Takma (2005) found that body weight was positively related to egg production. Marks (1979) reported that egg production decreased depending on selection as to body weight of quails as the body weight increased.

The mean values of egg weight were 9.12 and 10.02 for T1 and T2 respectively and the differences in egg weight between treatments were very significant. In agreement with the present experiment, Bunchasak *et al.* (2005) reported that higher body weights are generally associated with bigger eggs. Summers and Leeson (1983) reported that an increase in body weight positively increased egg weight. Lacin *et al.* (2008) also pointed out that egg weight in chickens was lower in the group with low body weight than the higher body weight group. El-Sagheer and Hassanein, (2006); Kirikci *et al.,* (2007) also observed that heavy eggs were obtained from the heavy birds and the light eggs were produced from the small size birds. Altan *et al.* (1998) stated that selection of quails for live body weight influenced egg weight due to increase in size of ova produced in the ovaries of females. Ipek *et al.,* (2004) reported increased egg weight with increase in hen weight.

Higher average body weight was recorded in the group with the higher initial body weight of above 120g (T2), which was 175.00g compared to 166.03g of body weight below 120g (T1).

The feed cost per bird per day was found to be non-significant ($P>0.05$) between treatments as a result of the average intake of the birds which was also not significant ($P>0.05$). Irrespective of the different body weight, the feed intake were found to be not significant between treatments i.e. there is no difference in feed intake between lower and higher body weight group of birds.

Nazligul *et al.* (2001) reported that egg mass was affected by both age and body weight in quails.

Kul and Seker (2004) considered that the eggshell quality would be predicted by using the egg weight values due to the positive and significant correlation determined between egg weight and shell thickness, and shell weight.

Significant difference was obtained in egg mass which appeared to be due to non-significant difference in egg production, which was similarly reported by Jatoi *et al.*, (2013). Nazligul *et al.* (2001) reported that egg mass was affected by both age and body weight in quails.

The feed conversion ratio (FCR) was not affected which is in agreement with those of Rehman (2006) who indicated non-significant difference in FCR (g feed/egg) between treatments. As with growing pullet, feed conversion is the best when the hen is young, it then gradually decreases with age (Kingori *et al.* 2003). The FCR (g feed/egg) is best in small size quails which could be attributed to less feed requirement of these birds Jatoi *et al.*, (2013). These findings are in line with those of Leeson *et al.* (1997) who observed that the smaller birds consistently ate less feed throughout laying regardless of the strain.

The effect of feed quantity on feed intake were significantly different ($P<0.001$). Cost on feed consumed by the birds were significant between treatments ($P<0.001$), but the average body weight, egg production, egg weight, feed conversion ratio were not significant ($P>0.05$). This implies that the quantity of feed used did not affect egg production performances of the birds.

The effect of feed quantity on body weight showed no significant differences ($P>0.05$) between treatments. This could be an indication that adult quails are capable of maintaining their body weight at constant rate (Odunsi *et al.*, 2007; Bawa *et al.*, 2011).

Hen-day egg production was generally low because its calculations started from the first eggs laid (Odunsi *et al.*, 2007).

In interaction of body weight of group and feed quantity on egg production performance, the group with lower body weight and high feed intake (AW2), and group with high body weight and feed intake (AW4), were not significantly different ($P>0.05$) in feed intake and feed cost per bird per day but were significantly different ($P<0.01$) from group with lower body weight and lower feed quantity (AW1) and group with higher body weight and lower feed quantity (AW3). This implies that irrespective of the body weight when birds are given opportunity to an increase amount of feed they tend to eat more.

The highest body weight and egg weight in favour of the group with higher body weight and higher feed quantity (AW4) was justified by the highest feed intake. The increase in body weight was positively correlated to feed consumed. Similar results have been reported by; Leeson and Summers (1987) and Harms *et al.* (1982) who noted that there was a significant relationship between feed consumption and body weight.

5.2 EFFECT OF INITIAL BODY OF GROUP AND FEED QUANTITY ON EGG QUALITY PARAMETERS

The significant higher values in egg, egg length and egg width were in favour of the higher body weight group. Similar results were obtained by Alkan *et al.,* (2010). The egg weight 9.59g obtained for the lower body weight group was close to the 9.23g obtained for the low line by Alkan *et al.,* (2010). However the mean 10.60g obtained for the higher body weight group was lower than the 14.14g obtained for high line but close to the 10.49g obtained for the layer line. Santos *et al.* (2015) reported higher values (12.46 - 13.43g). Jatoi *et al*, 2013 also reported values ranging from11.61-12.96g. Farooq *et al.* (2001) reported that egg weight can be easily predicted from egg length and width as positive association among these traits exists. Positive correlations between egg weight, shell weight and shell thickness have also been reported by Farooq *et al.,* (2001).

Egg length and egg width followed the same pattern. Values obtained for the higher body weight (31.56 and 24.37mm) group are close to those of the layer line 31.24 and 24.93mm while the lower body weight group 30.27 and 23.63mm are similar to the low line 30.02 and 23.56mm reported by Alkan *et al.,* (2010). Du Plessis and Erasmus (1972), Harms *et al.* (1982) and Leeson and Summers (1987), also reported that higher body weight resulted in large egg length, width and mass, all factors affecting egg weight.

There was significantly higher yolk weight in the higher body weight group. This result agrees with the report of Altan *et al.* (1998) who reported higher yolk weight in selection group than the control group. The non-significant difference obtained in yolk height, yolk diameter, yolk index, albumen height, albumen weight, haugh unit, shell weight, shell thickness and shape index were contrary to the report of Alkan *et al.,* (2010).

Hens with body weight above 120g had the highest Haugh unit, and the effect of body weight on this parameter was reported by Altan *et al.* (1998) not to be significant.

The effect of feed quantity showed that yolk index which was significant ($P<0.01$), 39.48 and 35.88 of 25g and 30g respectively was as a result of significant differences in the yolk height ($P<0.05$), 8.93 and 8.32 of 25g and 30g respectively. An increase in the yolk height result to an increase in the yolk index.

Yolk index values recorded in this study ranging from 34.84% to 39.55 were observed to be different from values reported for yolk index in quail by Minvielle and Oğuz (2002), Vogt (1968), Erensayin and camcm (2002), Wilhelmson (1980) which was ranged from 43.15% to 49.28%.

Altan *et al.* (1998) reported that eggshell weight was found higher for selection group (0.946 g) than control (0.920 g) group ($P<0.05$). But, Strong and Nestor (1980) reported that differences between selection and control groups in terms of eggshell weight were found to be not significant in turkeys.

Egg shape index values in this study were in agreement with data reported for egg shape index values of between 75.6% and 80.45% in quail by Uluocak *et al.*, (1995), Erensayin and Camcm, (2002), Yannakopoulos and Tserveni-Gous, (1986) and Türkymlmaz, (2005). There was no significant differences in egg shape index between which is in agreement with Odunsi *et al.*, (2002). Yannakopoulos and Tserveni-Gousi (1986) reported that the egg shape index would be used as a criterion for determining the stiffness of eggshell.

The shell thickness values in this research were somehow higher than those reported as 0.206 - 0.220 mm by Altan *et al.* (1998) and Orhan *et al.*, (2001) but close to (0.30 – 0.36mm) reported by Oluyemi and Roberts, (2000) and Chineke, (2001).

None of the treatments recorded values lower than the minimum 75 % Haugh unit required for excellent quality eggs (Bien and Thien, 2005; Babangida and Ubosi, 2006).

The interaction effect of initial body weight of groups and feed quantity were not significant.

CHAPTER 6

6.0 CONCLUSION AND RECOMMENDATION

In conclusion, initial body weight of 120g and above at onset of lay and minimum of 25g of feed will be sufficient for egg production in quails since there is no significant differences in the effect of body weight at sexual maturity and feed quantity on important egg production parameters such as FCR and egg number.

It is recommended that initial body weight of laying hens be taken into consideration for optimal profit. This is because no matter how old the birds are when they do not attain a particular weight needed for egg laying, they cannot come to lay.

The feed quantity for laying birds should also be taken into consideration because this will help the farmer to know the amount to spend or what to budget on feed for the birds to reach the desire weight as this can lead to loss in the farm business if there is no proper budgeting.

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