EFFECT OF DIFFERENT DIETARY PROTEIN REGIMES ON THE PRODUCTION INDICES OF JAPANESE QUAIL (*Coturnix coturnix japonica*)

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A PROJECT SUBMITTED TO DEPARTMENT OF ANIMAL PRODUCTION AND HEALTH, FACULTY OF AGRICULTURE, FEDERAL UNIVERSITY OYEEKITI, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR AWARD OF DEGREE OF BACHELOR OF AGRICULTURE (B. AGRIC)

SEPTEMBER 2016

DECLARATION

This is to declare that this work **EFFECT OF DIFFERENT DIETARY PROTEIN REGIMES ON PRODUCTION INDICES OF JAPANESE QUAIL** is the product of my own research work. It has not been presented in any previous application for a degree or any reputable presentation elsewhere and all references made are dully acknowledged.

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CERTIFICATION

This project,Effect of Different Dietary Protein Regimes on the Production Indices of Quail (*Coturnixcoturnix Japonica*) is carried out by Falade Grace Titilayo and it meets the regulation governing the award of Bachelor in Agriculture (Animal Production and Health) of Federal University OyeEkiti (Ikole campus) and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This project is dedicated to the Almighty God. Also to my parents Pastor and Mrs Falade for their prayers, financial and moral support.

ACKNOWLEDGEMENT

I give all the glory to God for his grace, mercies, help, protection and provision during my years of study and for making it possible to complete my project.

My profound gratitude goes to my supervisors Prof. Aganga andDr.Jesuyon, for their invaluable contribution towards the success of this work. Their immeasurable suggestions and contribution have really contributed to the success and quality of this work. May the Lord almighty be with you and your family (Amen).

My sincere gratitude goes to the Head of Department of Animal Production and Health, Dr. Mrs. Orunmuyifor her love, care, help, supportand contribution to the success of this work. Thank you very much may God continue to keep and bless you and your family. (Amen).

I also appreciate the lecturers in my department that have also helped me during the period of my experiment; Prof. Adegbola, Dr. Anthony Ekeocha,Dr.Azuzu, Dr.Adika and Dr.Nwobi. Ialso appreciate the staff of Animal Production and Health department (Mr Adeola, Miss Gode, Copper Micheal, Mrs Ojo, Mr Abiodun,MrsAjifola, Mr Falodun, Mr Dipo, Mrs Morenike) for their advice and contribution to this work.

A big thank you goes to my parents Dr. and Mrs. Falade for their love, care, financial and moral support during my years of study. May Almighty God continue to keep you alive in good health and may you reap the fruit of your labor (Amen).I also appreciate my siblings for their prayers, care and love. My gratitude also goes to my colleague Victor, and my friends who lent a helping hand in the farm (Bukunmi, Odun, Funmi, Ope, Emmanuel, Paul). I also appreciate the 2015/2016 Basic Agric students who helped me in the farm work.

ABSTRACT

The experiment was conducted to determine the effect of different dietary protein regimes on the production indices of Japanese quail. Four Iso-caloric diets were used throughout the experimental periods and a total number of 129 birds were randomly distributed into four experimental treatments namely T1 thirty six (36) birds, T2 thirty eight (38) birds, T3 thirty three (33) birds and T4 twenty two (22) birds. Each group had 4 replicates while T4 has 3 replicates, they were all fed with 24%CP, 22%CP, 20%CP and 18%CP diets respectively for the laying phase. Data collected on the productive performance includes; weekly body weight, daily egg number and weight, daily feed intake. Data was also collected on the egg parameters per week. All data was collected per replicate. After the experiment was conducted, 22%CP was found to be high for egg laying but it is not economical, so 18% CP recommended to be the optimum protein required for laying quail hen in the humid tropics because it has the least cost of feed production. Egg production parameters of quails hens was also found to be influenced by different protein contents from soya bean meal and groundnut cake mixture and were favored by the diets with high protein level, T1. Egg weight,egg diameter, yolk height and albumen weight were significantly ($P<0.05$) higher in T1 (24%CP) than the other CP levels. This implies that the best egg quality parameters in quail can be achieved when the birds are fed with an optimum level of protein.The feed efficiency ratio (FCR) was also found to vary with different levels of the protein content; FCR for egg production was not influenced by the different CP levels. The birds in T1 were found to have the highest final body weight, weight gain, average weight gain and average egg weight.

TABLE OF CONTENT

LIST OF TABLES **PAGE**

LIST OF FIGURES **PAGE**

LIST OF PLATES **PAGE**

CHAPTER ONE

1.0 INTRODUCTION

The Japanese quail (*Coturnix coturnix japonica*) is the smallest avian species reared for meat and egg production and it has also assumed a worldwide importance as a laboratory animal (Vali *et al.,* 2006). The Japanese quail was introduced to Nigeria in 1992. Quail production has shown increasing importance in Nigeria because they demonstrate early sexual maturity and have small body size, which results in lower necessity for housing, space and feed (Shanaway, 2008).

Young *Coturnix* is yellowish in appearance with stripes of brown. The newly hatched weighs about 6 - 8grams (Hall, 2012) but grow rapidly during the first few days and are fully feathered at about 4 weeks of age. The adult male quail weighs about 100-130 grams (Mizutani, 2003). The male birds can be identified readily by the rusty dark brown colour of the breast feather. Males also have a cloaca gland, a bulbous structure located at the upper edge of the vent which secretes a white foamy material. This unique material can be used to access the reproductive fitness of the males. The young male begins to crow at 5 - 6 weeks old. The adult female quail are slightly heavier than the male weighing from 120 - 160 grams (Ortlieb, 2013).

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). The average egg from mature female weighs about 10grams and contains 158 calories of energy, 74.6% water, 13.1% protein, 11.2% fat and 1.1% total ash. The mineral content includes 0.59mg calcium, 220mg phosphorous and 3.8 mg iron (Shim kim fah 2005). The vitamin content is 300 iu of vitamin A, 0.12mg of vitamin B1, 0.85mg of vitamin B2 and 0.10mg nicotinic acid. Coturnix quail make excellent quail for beginners because they start laying eggs at a young age of approximately 6 weeks (Chelmonska, et al., 2008) and can be prepared and eaten at 5 weeks of age.

According to Hemid, *et al.* (2010), quails have early sexual maturity resulting in a short generation intervals, high rate of lay and much lower feed and space requirements than the domestic fowl. There are different housing designs for quail. Rabbit hutch is common in use. Baby quails are fed with poultry starter feed. There are no known morbid diseases affecting them except respiratory disorder with very low mortality rate (Oluwatomi, 2010).

Quail meat is tastier than chicken and has less fat content, so it is good for high blood pressure patient (Bakoji *et al.* 2013). It promotes body and brain development in children. Most of the developing countries are presently at a stage of perpetual protein hunger. Poultry meat and eggs though the major source of animal protein now is still unable to meet up the protein demand of the world (Igado and Aina 2010). Commercialization of quail production is a recent development in Nigeria (Akpan and Nsa, 2009)

Feed intake in birds generally depends on the energy level of the diet. Studies revealed that low energy diet (2200kcal/kg ME) lead to poor performance despite the high quantity of feed consumed by quails. It was also observed that quails fed with low crude protein (18%) diet performed favourably well with those fed the control diet while those fed the high fat (5%) diet effectively utilized the feed conforming to the functions of fat in diet (Akinola and Sese 2012). The body compositions of the quail in the treatments indicated that a certain proportion of fat and protein (3.85%fat, 20.54%CP) is necessary for good performance of quails (Akinola 2012; Animar 2015). Quail can utilize a single diet for its production and ME levels of 2500 – 2800 kcal/kg is recommended in one single diet for Japanese quail (Animar 2015). Protein of high quality with adequate level of metabolizable energy is most important for quail production.

Protein ingredients are very expensive however excessive intake results in higher nitrogen excretion and lower feed efficiency for egg production.

1.1 BENEFITS OF QUAIL REARING

According to Onyewuchi, *et al* (2013), quail farming is more profitable than other poultry. Quail has various benefits such as: early maturity; start of egg lay after 5-6 weeks; laying about 280-300 eggs in a year; egg hatching in16 to 18 days; high immunity against diseases (Shanaway 2008); low feed intake and small floor space requirement. Meat and eggs of quail are very tasty, delicious and nutritious and are a source of high quality protein (Bakoji *et al* 2013). Quails require low capital investment to set up and labour cost is low when compared with other animals, quails are less destructive to the environment. (MOLD, 2012) Quails are very hardy and almost all types of weather conditions are suitable for starting quail farming business As a result, commercial quail farming business can be a great source of food, income and employment for the all types of people (Olielo, 2013). According to Babangida and Ubosi (2005), the Japanese quail has the potential to serve as an excellent and affordable source of animal protein in Nigeria.

1.2 STATEMENT OF PROBLEM

Quail farming is faced with challenges such as lack of adequate information on its farming, management practices, perceived nutritive and medicinal value and access to market in local and developing countries (GoK 2010). The success rate of quail farming remains low because of the low number of quail farmers. Although the demand for quail bird and products has been increasing rapidly due to the perceived medicinal, nutritional and economic benefit, limited research has been done on quail production.

In spite of the exceptional attributes and advantages of keeping Japanese quail, its production in

Nigeria is still comparatively rudimentary. Major challenges of quail production in Nigeria include high cost of concentrates, an un-informed market on its values, low level of patronage, non-readily available market when the farmers are ready to sell off stock and inadequate knowledge and information on the advantages of eating quail meat. Domesticated quail do not have the tendency for broodiness and hence eggs must be incubated under broody hen or by artificial incubation (Naibi *et al.* 2009) Murakami *et al.* (1993b) and Pereira *et al.* (2000) reported better performance of laying quails when the birds were fed 18% CP while Pires Jr (1981) reported that 20% CP determined the highest egg production rate in therefore in this research work the protein requirement for laying quail hen will be determined.

1.3 JUSTIFICATION FOR THE STUDY

Coturnix quail have some advantages over other poultry birds which include less capital requirement, less floor space; about 8 – 10 adult quails can be reared in a space meant for one adult chicken. (Adeogun and Adeoye, 2004), highly nutritious meat; low caloric value, high dry matter (Muthukumar and Dev Roy, 2005), and higher resistance to diseases than domestic fowls (Oluyemi and Roberts, 2000) and less feed requirement. An adult quail requires 20 – 25g feed per day compared to chicken requiring 120 – 130g per day (Ani *et al.* 2009).

Other unique characteristics over other species of poultry include early attainment of sexual maturity and laying as early as 5–6 weeks of age, with short generation interval, making it possible to have many generations in a year, attaining market weight of 150–180g between 5–6-weeks of age and a high rate of egg production between 250–300 eggs in their first year of lay (Chelmonska, *et al.*, 2008). Babangida and Ubosi (2005), concluded that the Japanese quail has the potential to serve as an excellent and affordable source of animal protein in Nigeria, while

Hemid, *et al.* (2010), reported that it is rich in protein, vitamins, essential amino acids, saturated fatty acids, unsaturated fatty acids and phospholipids (Muthukumar and Dev Roy, 2005)

1.4 OBJECTIVES

THE GLOBAL OBJECTIVES

- To determine the effects of different protein levels on the production of laying quails

THE SPECIFIC OBJECTIVES

- To determine the optimum protein requirement for laying quail hen in the humid tropics
- To determine egg production parameters of quails as influenced by different protein contents from soya bean meal and groundnut cake mixture.
- To determine feed efficiency (feed per gain) ratio in reference to the varying levels of (24%CP, 22%CP, 20%CP, 18%CP) protein content.
- To determine feed conversion ratio for egg production for each diet evaluated.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 ORIGIN OF QUAIL

Quail is a collective name for several genera of mid-sized birds generally considered in the order Galliformes. Old world quail are found in the family phasianidae and new world quail are found in the family Odontophoridae (Cox *et al.*, 2007). The king quail, a member of the old world quail is often sold in the pet trade and within this trade is commonly referred to as "button quail". The collective noun for a group of quail is a covey or bevy. There are two main kinds of quails suitable for breeding and they are the "Japanese" quail (*Coturnix japonica*) and the "American" quail (*Coturnix coturnix*).

Japanese quail (*Coturnix* quail) are from pheasant family and are migratory birds which migrate between Asia and Europe. Quails are believed to have originated from south-east Asia (Onyewuchi, U. U.2013). The first record of wild Japanese quail appeared in the 8^{th} century in japan. The quail bird was originally domesticated in the late 11^{th} century as a pet song bird. Quail was brought to Japan from China. It has since gained value as a food animal a (Kayang *et al.*, 2004). The Japanese quail was introduced in Nigeria only in 1992 (NVRI, 1994).

2.2 THE BIRD QUAIL

Quails are small game birds that are used for eggs and meat (DAFF, 2013). Quails became popular initially as game birds but later came into commercial production in 1910 due to their tasty meat, low feed consumption and excellent laying ability (Shanaway, 2008). Females start laying at an average of 40 days, with high egg production. The Japanese quail has a short generation interval, from 3 to 4 generations per year (Kayang *et al.*, 2004; Alkan *et al.*, 2010).

This bird is used among others for genetic, physiological, biomedical, behavioural, 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 a good source of meat occupying a relevant place in poultry breeding and contributing to the global poultry industry (Maiorano *et al.,* 2011). Commercial quail farming is becoming more popular and being increasingly promoted in Japan, China, North and South Korea, Hong Kong, Taiwan, Singapore and Philippines.

2.2.1 SEXING OF QUAIL BIRDS

Vent examination technique is the most popular sexing method for quails.

The Differences between male and female quail:

The female birds are slightly bigger in body size than male birds at maturity. The Male birds have slightly reddish colour on their chest whereas female have brownish colour. The male birds produce a solution while applying pressure on the anus whereas the female birds failed to produce such.

2.3 QUAIL BIRD OVERVIEW AROUND THE WORLD

In the USA, commercial quail production is concentrated on a few large farms and the game bird industry in the USA raises 37 million quails. (USDA, 2011). In Europe, common quail is very abundant and widespread (Rodriquez *et al.,* 2012) and the estimated population is 300,000,000. According to a report by Arthur (2013), in North America, duck and quail eggs and egg products are not traditional nor common foods and typically they are found only in metropolitan areas like British Columbia which boast ethnic and immigrant populations from areas of the world that have traditionally used these eggs in their cuisines who represent a strong market opportunity.

The same report indicates that there is little production of fresh quail eggs and duck eggs in British Columbia but on commercial basis, the market for salted and preserved duck eggs as well as processed quail eggs (typically pickled, canned, or smoked) is served by and dominated by imported products from Asia.

In Georgia, Dozier *et al.* (2010) reported that approximately 5 million Bobwhite quail are produced and marketed each year for use at hunting preserves and plantations. According to the same report, the total number of hunting preserves and plantations in the southern region provides an excellent market for Bobwhite quail producers. With recent droughts, volatile market prices and other problems associated with agronomic crops in Georgia, Bobwhite quail production has received attention as an alternative enterprise for many farming operations.

In Japan, the poultry meats and eggs available in pockets in the market are not adequate to meet the increasing demand of the people and poultry eggs are imported from the neighbouring states. Commercial quail farming in Japan has spread tremendously. In a study done in Japan on quail meat and eggs availability by Singh (2005), the study indicated that the present scale of quail industry is far below the potential. According to the same report though quail farming has reached the international markets, the awareness of it is yet to be spread to some states in Japan and the report recommends that there is a need to promote quail production programmes in these regions.

According to prefeasibility study on quail farming in Pakistan, quails have been introduced to the Pakistan in the last ten years as an alternative of chicken to mitigate chronic protein deficiency among the Pakistani population (Government of Pakistan, 2009). The same report states that in Pakistan quail meat is the cheapest source of animal protein available in the country. There are about 3,000 quail farms in Pakistan and a total of 50,000 to 100,000 birds are consumed daily in

Pakistan as cutlets, fingers, noodles, soup powder and egg puff.

Quail production is gaining popularity in the developing countries due to its role in bridging the protein malnutrition, economic empowerment of the resource poor segment of the society and also fits well in the farming systems commonly practiced. Quail production is practiced at levels ranging from subsistence to large scale commercial operations (Kingori, 2011).

In South Africa, eggs are the 4th largest animal product with a total of 24.5 poultry producing127.9 million eggs per week. 97.3% of these eggs are from chicken while 2.7% are from duck and quails (Ministry of Agriculture, fisheries and forestry, 2011). Quails are normally reared by small scale farmers due to the little attention they require.

In Nigeria, more emphasis is laid on domestic fowl to the neglect of other types of poultry. Of the 150 million poultry population, domestic fowl constituted 91 % while guinea fowl, duck, turkey and others were 4 %, 3 % and 2 % respectively. The most commonly used bird eggs are those from chickens. Duck and goose eggs, and smaller eggs such as quail eggs are occasionally used as gourmet ingredients (Adeyeye, 2012). (Bakoji *et al.,* 2013), a large number of poultry farmers in Kaduna, Zaria, Bauchi and Kano states in North Nigeria have embraced quail farming, which is gradually taking over chicken poultry business in most parts of the north.

The continued rise in human population and rampant malnutrition in the developing countries necessitates the need to establish additional and a cheap sources of animal protein. (El-Katcha *et al.,*2015).Animal protein constitutes about 17% of the total protein consumption in the average Nigerian diet compared to other developed nations with 68% in New Zealand, 71% in United States of America, 67% in Denmark and 60% in the United Kingdom (Odunsi *et al.,* 2007).

In Nigeria, with a population of over 170 million, there is deficiency of animal protein security with the consumption put at about less than 10g/head/day as against the minimum daily intake of

65 g recommended by the Food and Agricultural Organisation (FAO) to be the minimum requirement for the growth and development of the body (Adamu *et al.*, 2015). Boosting the poultry *industry* with a short generation interval is an alternative means of alleviating the deficiency of animal protein in Nigeria. Among these are the Japanese quail raised primarily for their meat and eggs (Owen *et al.*, 2013), generally quail production occupies a small but significant segment of the Nigerian poultry industry (Bakoji *et al.*, 2013). The Japanese quail have the advantage of small size, short life cycle, rapid growth rate, good reproductive potential, high fecundity rate, and shorter hatching periods when compared with the different species of poultry (El-Katcha *et al.*, 2015). The benefits of quail meat are known as high protein, essential fatty acids, and minerals such as sodium, potassium, and iron. Owing to high metabolic activity in this animal, the amount of glycogen stored in muscles increases and results in high quality meat (Gecgel *et al.*, 2015). Quail having carcasses made up of 76% of meat, 14% of skin, and 10% of bone, has the highest amount of meat and the least bone ratio among the other poultry products (Gecgel *et al.*, 2015). Japanese quail birds mature in about six weeks and are usually in full eggs production in 50 day of age (Bakoji *et al.*, 2013). The Japanese quails therefore have the potential to complement the obvious gap in the protein needs of Nigerians, necessitating means to improve their productivity and sustainability.

2.4 EFFECT OF DIETARY PROTEIN LEVELS ON GROWTH PARAMETERS OF JAPANESE QUAILS

Baldini *et al.* (1995) studied the protein requirements of bobwhite quail reared in confinement of battery brooders to eight weeks of age. He used 20%, 25% and 28% levels of protein and observed that 28% protein level gave the best growth. Akpan and Nsa (2009) reported that final live weight and average weight gain increased as the level of dietary protein increased in the diet up to 25%. Haruna *et al.* (1997) reported an increase in feed intake as the level of dietary protein increases in the diet of Japanese quail chicks. Bawa et al. (2011) also reported significant increases in feed intake in laying Japanese quails fed 28% dietary protein level compared with birds on 18%, 20%, 22%, 24%, 26% crude protein and attributed it to low level of energy in the diet as birds are expected to consume more of low energy diet in an attempt to meet up their energy requirements. However, Murakarni *et al.* (1993) reported no significant effects of dietary protein levels on feed intake. Akpan and Nsa (2009) fed Japanese quails with 22%, 23%, 24%, 25%, 26% and 27% dietary protein levels and observed the best feed conversion ratio on birds fed 25% crude protein level, an indication that the birds consumed relatively low feed to gain more weight. They recommended dietary protein level of 25% and 2500Kcal /Kg of metabolizable energy in diets of Japanese quail birds. Exceeding this level will only increase feed cost without any significant positive effect on the cost of feed per Kg weight gain. However Sukerai (1979) reported significant efficiency of feed utilization and egg production when quails were fed 28% to 32% protein level with 3.1 to 3.2 Kcal/g metabolizable energy. Birds on 19% crude protein laid 3.44% more eggs compared to birds on 15% crude protein, while increasing the dietary protein level also improved the 32 egg weight and feed conversion ratio of the birds (Rashid *et al.,* 2004). Feed conversion ratio was slightly improved by decreasing dietary crude protein in broiler birds from 23% to 20% (Kamran *et al.*, 2004).

2.5 NUTRITIONAL VALUE OF QUAIL EGG

Quail eggs are rich in vitamin D, antioxidants which according to Sahin, *et al.* (2008) improve animal origin food quality in terms of colour, oxidative stability, tenderness, storage properties, and has positive effects on people with stress problems, hypertension, digestive disturbance, gastric ulcer, liver problems, blood pressure and lipid control, migraine, ashma, anaemia, various types of allergies, eczema, heart problems, bronchitis illness, depression, panic and anxiety illness. The nutritional value of quail eggs is 3 - 4 times greater than chicken eggs (Tunsaringkarn *et al.*, 2013). Quail eggs are also known to stimulate growth, increase sexual appetite, stimulate brain functions which improves intelligence quotient and generally rejuvenates the body. It is recommended for children cooked or raw. The consumption of quail eggs fortifies the woman's body during pre and post-natal periods and after surgery and radiotherapy. It also has beneficial effects on the foetus (physical and mental balance) and for the mother after delivery (physical rehabilitation and rejuvenation of cells). Quail eggs also improve the quality of breast milk.

2.6 NUTRITIONAL REQUIREMENT OF QUAIL PRODUCTION

The nutrient requirements of Japanese quail have been documented to a greater extent in some regions of the world than those of other game bird species (Ayasan and Okan, 2006), largely due to the bird's widespread functionality as a producer of meat and eggs renowned for high quality protein, high biological value, low caloric content, nutritional and medicinal value (Dowarah and Sethi, 2014), their use as research animals and ease in handling, propagation, and reproduction for amateur bird fanciers and hobbyists.

In quail feed production, lowering crude protein reduce feed costs and Nitrogen excretion in poultry production (Nahm, 2002 and Namroud *et al.*, 2008), and this reduce the polluting effect on soil and water by reducing the Nitrogen content of the fecal droppings. Therefore, efforts to reduce CP level in poultry diets without lowering the bird's performance has been the focal point of research.

For quail production, 24 and 20% crude protein has been recommended by NRC (1994) during rearing and production periods, respectively. Thus, nutrient requirements decrease with age. If a single diet is used, birds are either under- or over-supplied with nutrients for most of the growth and production periods, and this might result in lower productivity and poor economic performance. Excessive protein intake increases heat production and water consumption, increases moisture content of litter and increases Nitrogen excretion onto the litter (Firman, 1994) Adequate energy must be supplied in the diet to make efficient use of dietary protein as production results are determined by energy to protein ratio (Zofia *et al.*, 2006). Alaganawy *et al.* (2014) reported that adequate amino acid balance is the most important nutrient for Japanese quails. Reda *et al.* (2015) reported crude protein and energy levels of 22% and 2900 kcal ME/kg, as adequate during the first few weeks of growth. Jahanian and Edriss (2015) reported CP and energy levels of 26% and 3000 kcal ME/kg, for the same rearing period.

To ensure good performance of Japanese quail in warm humid tropics such as Nigeria, diets containing 2500 kcal/kg metabolizable energy (ME) and 24% crude protein (CP) has been recommended (Akinola, 2012, and Sese, 2012).

Fresh clean water should be provided continuously to all birds, especially under the tropical environment. Quails require at least twice the amount of dry feed in water consumption,(Farrell *et al.,* 1982) and may require more water when there are excess salts in the feed or during hot dry season.

Proper nutrition is a first step to optimize growth and productive performance in poultry and animals as well as to decrease the adverse effects on the environment (Namroud *et al.*, 2008; Rama Rao *et al.*, 2011; Zhu *et al.*, 2012; Moraes *et al.*, 2014; Zeng *et al.*, 2015).

Maximization of egg output (egg number, egg weight and egg mass) and profits depends on bird's productive performance, feed, egg prices, and farm management. Several factors have certain impacts on performance of laying birds. These include optimum nutrient concentration of diet to improve returns and economic feasibility (Koreleski and Swiatkiewicz, 2009; Alagawany *et al.*, 2011; Alagawany and Abou-Kassem, 2014). Depending on prices of feed and egg, the maximization of productive performance may or may not result in maximum returns/profits (Alagawany *et al.*, 2014a, b).

The nutrients that comprise quail diet are water, protein, carbohydrate, fat, minerals and vitamins. The requirements of these nutrients in quail diets are as follows:

2.7.1 PROTEIN REQUIREMENT

Protein of high quality with adequate amino acid balance is the most important but most expensive nutrient. Excessive protein intake results in higher nitrogen excretion and lower feed efficiency for egg production.

It is widely recognized that the performance of Japanese quail layer is influenced considerably by variations in dietary protein intake during growth and production. Earlier diet formulation for Japanese quails was based on the NRC (1994) requirements and this has not been ideal for tropical conditions. Maintaining or/and improving performance of birds, may be achieved by improving nutrient utilization of feedstuffs, reduction in the costs of production and environmental pollution (Keshavarz, 2003; Gunawardana *et al.*, 2008; Alagawany and Mahrose, 2014).

According to Oluyemi and Roberts (1988), protein is useful mainly for synthesis of body tissues and also for egg formation. The authors noted that retardation in growth, poor feathering and vice habits can be traced to protein deficiency in the diets. Feedstuffs differ qualitatively and quantitatively in their amino acid composition. Quail diets consist mainly of plant materials. The most commonly used plant products are maize, soyabean meal, groundnut cake, sorghum and rice or wheat bran. Methionine and lysine are generally low in plant products. Animal protein products such as fish meal, meat and bone meal etc., are good sources of most of the essential amino acids, but they are usually more expensive than plant protein ingredients. Tom (2011) reported dietary protein requirement of 24% crude protein for quail starter and 18% crude protein for quail finisher, breeders and layers, respectively.

2.7.2 ENERGY REQUIREMENT FOR PRODUCTION

The amount of feed intake depends upon the metabolizable energy (ME) content of the diet, age of the birds, their reproductive status and the ambient temperatures. An energy requirement of 2,600 to 3,000 kcal ME/kg diet for growing quail has been reported for temperate regions (Farrell et al., 1982), whereas, findings under tropic condition indicated an energy requirement of about 2,800 kcal ME/kg for growing quails and 2,550 kcal ME/kg for laying quails (Shim and Lee, 1982). Though raising the dietary energy levels from 2,600 to 2,800 kcal ME/kg did not influence the gain in weight, it affected significantly the efficiency of feed utilization as the feed consumption was reduced significantly (Shrivastav and Panda, 1982). Shrivastav and Johri (1993) reported 2,750 Kcal/kg metabolizable energy adequate for quail layers and breeders. Olubamiwa *et al.* (1999) observed that dietary energy levels of 2,500-2800 Kcal/kg diet supported optimum performance of growing quail in the tropics while Dafwang (2006) suggested a metabolizable energy of 2,700 kcal/kg for both growing and laying quails. Syed et al. (2000) reported optimum performance of Japanese quail on 24% crude protein and 2800 Kcal metabolizable energy.

2.7.3 WATER REQUIREMENT

According to Smith (2005), water functions in the body of animal include; regulation of body temperature, transportation of nutrient and taking part in numerous chemical reactions in the body. Furthermore, water requirement of poultry are often crudely estimated by multiplying the amount of feed eaten by two. However, under hot conditions, animals drink substantially more water. Water controls the ability of the birds to regulate temperature in hot weather (Dafwang, 1988). Oluyemi and Roberts (1979) reported that, water consumption increases the amount of feed intake by layers which results in increased egg sizes.

TABLE 2.1: NUTRITIONAL QUALITY OF UNCOOKED QUAIL AND CHICKEN MEAT

Meat	Moisture	Protein	Fat	Carbohydrate	Mineral
Quail (%)	73.93	20.54	3.85	0.56	1.12
Chicken (%)	73.87	20.66	3.61	0.78	1.08

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 AREA OF STUDY

The experiment was conducted at the Animal Production and Health Departmental Research Unit in Ikole Ekiti with coordinates (Global Positioning System, GARMIN GPS 72H) on latitude of 07°48.338'N and longitude of 005°29.922' E, average annual temperature of 24.2 °C, and rainfall of 177.8 cm per annum from March to November.

3.2 EXPERIMENTAL PROCEDURE

Two hundred and fifty (250) three-week old male and female quails were purchased at National Veterinary Research Institute, Ikire Outstation in Osun state, Nigeria. Sexing 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). The females birds were randomly grouped into four (4) treatments/diets and four (4) replicates/treatment. Each replicate consisted of 10 birds and were randomized into numbered cages Males maturity was signalled by crowing at 5 - 6 weeks old. This was used at 7th week for the final separation of males and females birds.

3.3 EXPERIMENTAL DIETS

Four Iso-caloric diets were used throughout the experimental periods (Table 3.1). A total of 129 birds were randomly distributed into four experimental groups of one control and three treatments namely T1 thirty six (36) birds, T2 thirty eight (38) birds, T3 thirty three (33) birds and T4 twenty two (22) birds. Each group had 4 replicates and were fed with their respective diets for the laying phase.

TABLE 3.1 COMPOSITIONS OF DIETS FED TO EXPERIMENTAL QUAIL HEN

	Stage of life - Laying			
	Trt 1	Trt 2	Trt 3	Trt 4
Crude protein level (%)	24	22	20	18
Energy (Kcal/kg)	2500	2500	2500	2500

3.4 DATA COLLECTION

Body weights were measured with the use of Camry dial-spring analogue scale (5kg capacity). Data collected included daily feed consumption, weekly body weight, and daily egg production per replicate.

Plate 1. Weighing of birds

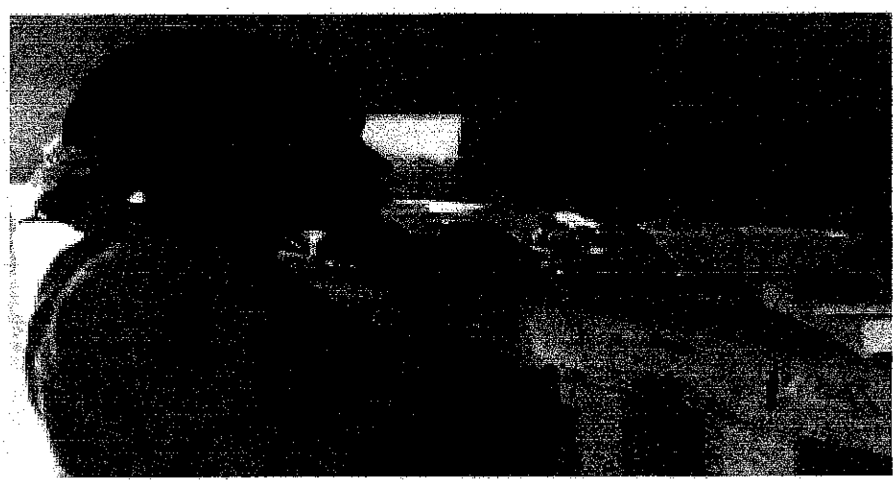


Plate 2. Egg weighing

3.4.1 FEED AND FEED PRODUCTION

Experimental diets were formulated and made into homogenous diets manually and then grinded using the local grinder to obtain the fine mash given to the birds.

Plate 3. Manual mixing of feed

Plate 4. Grinding of feed.

3.4.2 EGG COLLECTION AND EGG TRAITS MEASURED

Eggs were collected daily from the 6th week of age. For each replicate, egg number and weight were recorded daily using a digital sensitive balance (500g capacity).

3.4.2.1 EGG QUALITY TRAITS

Eggs were collected once every week and evaluated for external and internal egg quality traits for 8 consecutive weeks till the 15 weeks. Traits measured were egg weight, albumen weight, yolk weight and shell weight which were recorded to 0.1g accuracy. Length and width of eggs was measured using venier calliper to 0.01 mm accuracy.

Eggs were broken. Albumen height and yolk height were measured to 0.01 mm accuracy using venier calliper while the width of the thick albumen was measured at two places using a venier calliper with 0.01 mm accuracy. Yolk colour was visually compared with the colour numbers in the DSM yolk colour fan. The per cent Albumen, yolk and shell were calculated in relation to egg weight and expressed as percentage.

Plate 5.Equipment for data collection

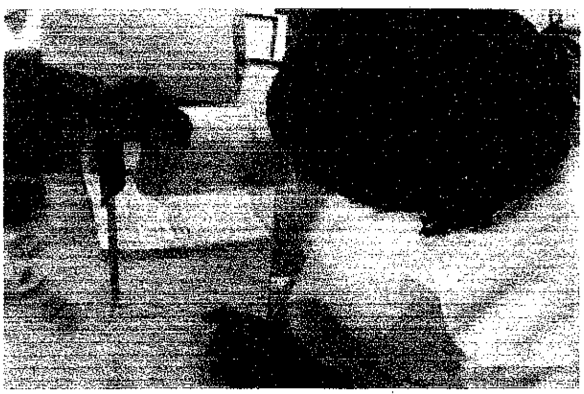


Plate 6. Measurement of Albumen height

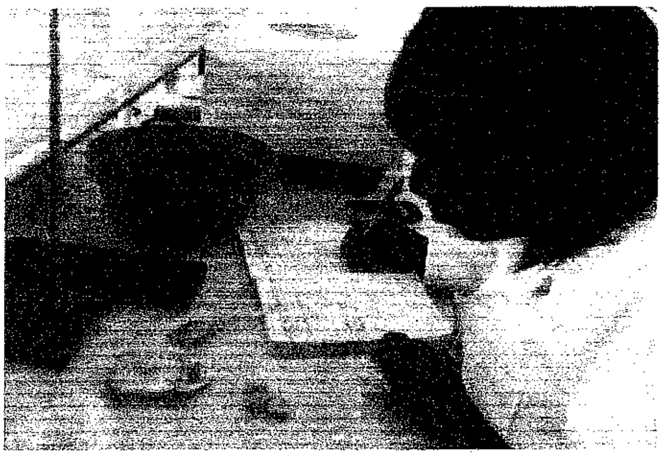


Plate 7. Yolk weighing

Plate 8. Egg weighing

3.5 MANAGEMENT OF EXPERIMENTAL BIRDS

Before arrival of chicks, experimental building in which the cage was placed was cleaned, fumigated and disinfected with royal guard disinfectant. The wooden cages was 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 every two weeks. A foot dip was always placed at the door of the poultry house for disinfection of legs before entering. One hundred and twenty-nine 3-week old chicks were collected and housed in cages. Stress pack (glucose) was administered through water at the point of arrival.

Experimental diets were initially offered at 20g/bird/day and later at 30g/bird/day at 7 weeks.

Birds were adjusted for 3 weeks before the laying phase which started at 6 weeks. Data collection commenced at 6 weeks. Formulated layers mash was offered to birds from the 6th week. The composition of experimental diets is shown in Table 3.1.

Routine management practices were carried out in all replicates. Good hygiene, cleanliness and biosecurity measures were ensured throughout the experimental period.

Birds were reared in a cage system without adverse effect on welfare, growth and development (Adamu *et al.*, 2015, Ojedapo2013)

Plate 9. Quail cage

TABLE 3.2 PERCENT COMPOSITIONS OF INGREDIENTS IN EXPERIMENTAL DIETS

TREATMENT CRUDE PROTEIN %	TRT 1 24	TRT 2 22	TRT 3 20	TRT 4 18
Maize	30.60	33.93	37.26	40.60
Brewer dry grain (BDG)	30.60	33.93	37.26	40.60
Ground nut cake (GNC)	21.21	16.76	12.32	7.87
Soy bean meal (SBM)	10.60	8.38	6.16	3,94
Fish meal 72%cp	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00
Layers/premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated composition of Diet				
Protein (%)	24.00	22.00	20.00	18.00
Energy (Kcal/kg)	2559.75	2562.89	2566.03	2569.43
Calcium (%)	1.59	1.59	1.57	1.57
Total Phosphorus (%)	0.67	0.65	0.64	0.63
Available phosphorus (%)	0.64	0.62	0.61	0.60
Lysine (%)	1.09	0.98	0.89	0.8
Methionine (%)	0.87	0.86	0.85	0.82

3.6 DATA AND STASTICAL ANALYSIS

All data collected were subjected to the analysis of variance (ANOVA) and means of treatments were separated using Turkey's (SAS 2013).

CHAPTER FOUR

4.0 RESULTS

4.1 EFFECT OF DIFFERENT PROTEIN LEVLS ON THE EGG QUALITY PARAMETERS OF JAPANESE QUAILS.

Table 4.1 shows the mean egg parameters of layers quails fed with different protein levels. The results in the table showed that egg weight, egg diameter, yolk height, albumen weight has significant different at ($p<0.05$) between treatments. However other parameters which include the egg height, yolk color, yolk weight, yolk diameter, albumen height, shell weight, yolk percentage, albumen percentage, shell percentage were not significantly different. The different dietary protein has no significant effect on the egg haugh unit

Egg weight and Egg diameter are significantly different between the treatments at ($p<0.05$) with T1 having the highest value. Albumen weight and Yolk height is significant at ($p<0.05$) between the treatments. All the parameters have their highest value under T1 with the highest crude protein level.

TABLE 4.1: MEAN EGG PARAMETERS OF LAYERS QUAILS FED WITH DIFFERENT LEVELS OF SOYA BEAN MEAL AND GROUNDNUT CAKE

PARAMETER	T1 (24%CP)	T2 (22%CP)	T3 (20%CP)	T4 (18%CP)	SEM	LOS
Egg weight	9.45^{a}	9.16^{bc}	8.80^{bc}	8.61^{c}	1.10	**
Egg height	32.55	27.17	29.01	28.77	11.12	NS
Egg diameter	24.03^{a}	23.85^{ab}	23.36^{bc}	23.31^{c}	1.21	*
Yolk colour	4.25	3.86	3.83	3.85	2.03	NS
Yolk weight	2.99	2.88	3.16	2.92	1.09	NS
Yolk height	8.51^{a}	8.34^{ab}	8.07^{b}	8.05^{b}	0.81	*
Yolk diameter	22.03	21.97	22.22	22.41	1.41	NS
Yolk percentage	31.43	31.52	35.55	33.94	10.54	NS
Albumen weight	5.13^{a}	4.94^{a}	4.64^{b}	4.56^{b}	0.52	***
Albumen height	4.29	4.13	4.05	4.04	0.57	NS
Albumen percentage	54.29	53.87	52.72	52.90	3.58	NS
Haugh unit	15.19	14.91	14.80	14.79		NS
Shell weight	0.86	0.85	0.83	0.81	0.13	NS
Shell percentage	9.15	9.27	9.50	9.37	0.79	NS

NOTE: *a,b,c: Means with different superscripts on the same row are significantly different ($p<0.05$)*
LOS: *Levels of significance*
NS: *Non-significant difference ($p<0.05$)*
***:** *Significant difference ($p<0.05$)*
SEM: *Standard error of means*

4.2 EFFECT OF VARYING PROTEIN LEVELS ON THE PRODUCTIVE PERFORMANCE OF QUAIL.

Table 4.2 shows the effect of the different levels of protein intake on the production performance of quail. The results in the table showed that final body weight, weight gain, average weight gain, average egg weight and price per kilogram of feed is significant between the treatments at ($p<0.05$). However, Weekly feed intake (g), Initial body weight (g), Weight gain, Weight gain, Egg number, Daily egg production per hen, Daily egg production per group, Hen day egg production, Hen house egg production, Daily average egg mass, Average egg mass, Total egg mass, Feed conversion ratio(g), Feed conversion ratio (kg), Feed conversion ratio per dozen egg (g), Feed cost per group, Feed cost per bird and Egg feed price ratio were not significantly different.

Final body weight is significantly ($p<0.05$) different between the treatments with T1 having the highest final body weight. The weight gain is significantly ($p<0.05$) different between the treatments as T1 has the highest weight gain than other treatments. Average weight gain and average egg weight is also significantly ($p<0.05$) different between the treatments. Price per kilogram of feed is very significantly ($p<0.05$) different between the treatments with T4 having the highest as result of the high protein intake of 24%. The price of feed thereby decreases down the treatment as the crude protein levels decreases.

TABLE 4.2: PRODUCTIVE PERFORMANCE OF LAYING QUAILS FED WITH DIFFERENT LEVELS SOYA BEAN MEAL AND GROUNDNUT CAKE

PARAMETER	T1 (24%CP)	T2 (22%CP)	T3 (20%CP)	T4 (18%CP)	SEM	LOS
Initial body weight (g)	146.52	146.31	144.72	146.30	12.42	NS
Final body weight (g)	149.15[a]	147.53[ab]	144.39[b]	145.47[b]	8.36	*
Weight gain (kg)	0.023[a]	0.011[ab]	-0.0025[bc]	-0.0052[c]	0.04	*
Average body weight (g)	150	150	150	150	0.01	NS
Average weight gain	0.0026[a]	0.0011[ab]	-0.00036[b]	-0.00083[b]	0.00	*
Egg number/bird/period	33.00	38.72	33.28	33.33	18.68	NS
Daily egg production per hen	0.59	0.69	0.59	0.60	0.34	NS
Daily egg production per group	5.36	6.56	4.92	4.38	4.78	NS
Hen day egg production	58.93	69.14	59.43	59.52	33.81	NS
Hen house egg production	58.93	69.14	59.43	59.52	33.81	NS
Average egg weight (g)	9.58[a]	9.38a	8.94[b]	8.83[b]	0.95	*
Daily average egg mass	10.07	11.58	9.47	9.38	5.26	NS
Average egg mass	563.98	648.26	530.54	525.33	294.47	NS
Total egg mass	5125.20	6154.00	4388.20	3880.00	4288.54	NS
Weekly feed intake (g)	210.00	210.00	210.00	210.00	0.00	NS
Feed conversion ratio(g)	2911.90	2436.30	2909.00	2841.20	1582.48	NS
Feed conversion ratio (kg)	2.91	2.44	2.91	2.84	1.58	NS
Feed conversion ratio per dozen egg (g)	623.97	522.06	623.35	608.83	339.10	NS
Feed conversion ratio per dozen egg (kg)	0.62	0.52	0.62	0.61	0.34	NS
Feed cost per group	1750.4	1779.8	1464.3	1898.2	789.60	NS
Feed cost per bird	31.26	31.78	26.15	33.90	14.10	NS
Egg feed price ratio	10.51	12.23	12.75	9.97	5.39	NS
Price per kilogram feed	115.76[a]	111.52[b]	107.27[c]	103.04[a]	0.00	**

NOTES: *[a,b,c]: Means with different superscripts on the same row are significantly different ($p<0.05$)*

LOS: *Levels of significance*

NS: *Non-significant difference ($p<0.05$)*

: *Significant difference ($p<0.05$)*

SEM: *Standard error of means*

FIGURE 1. EGG WEIGHT

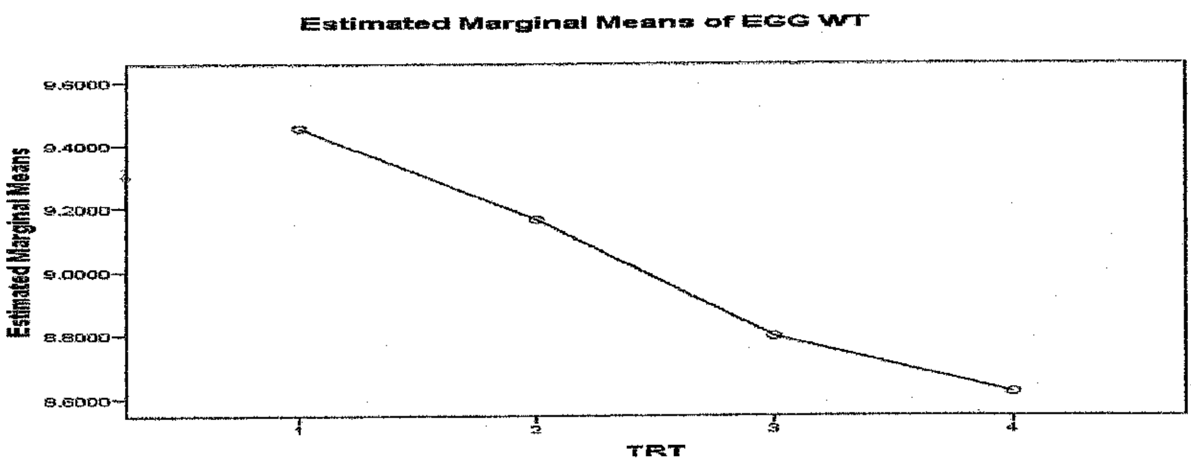


FIGURE 2. EGG HEIGHT

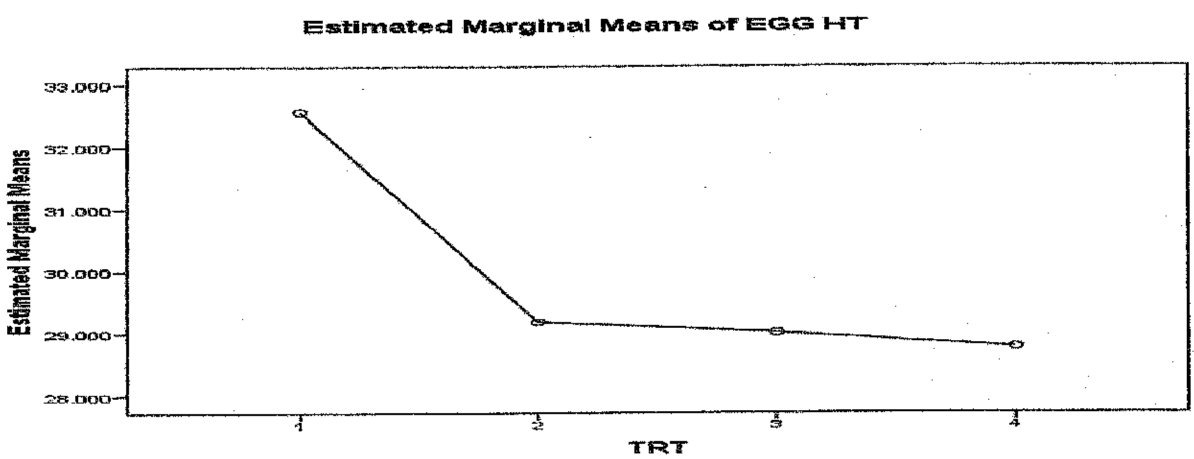


FIGURE 3. EGG DIAMETER

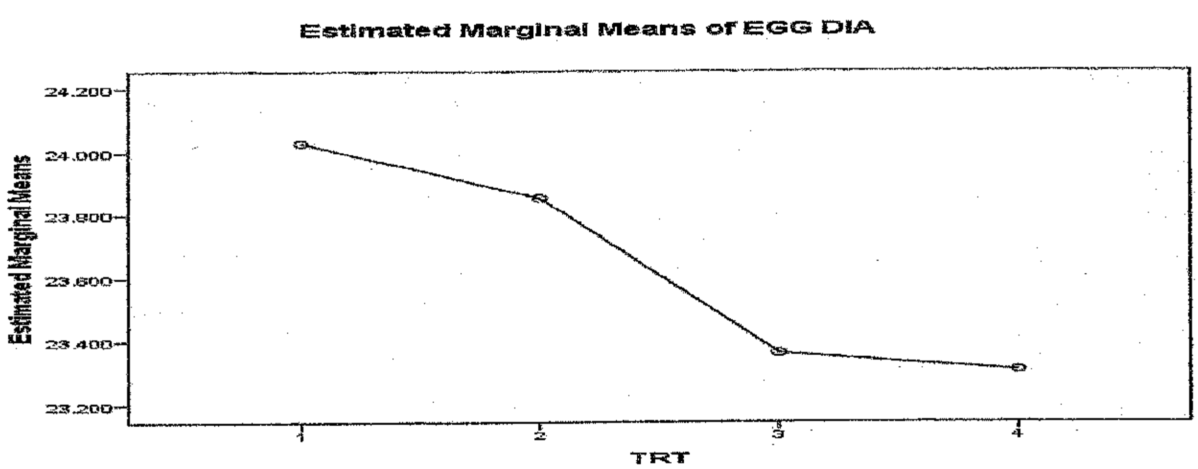


FIGURE 4. YOLK COLOUR

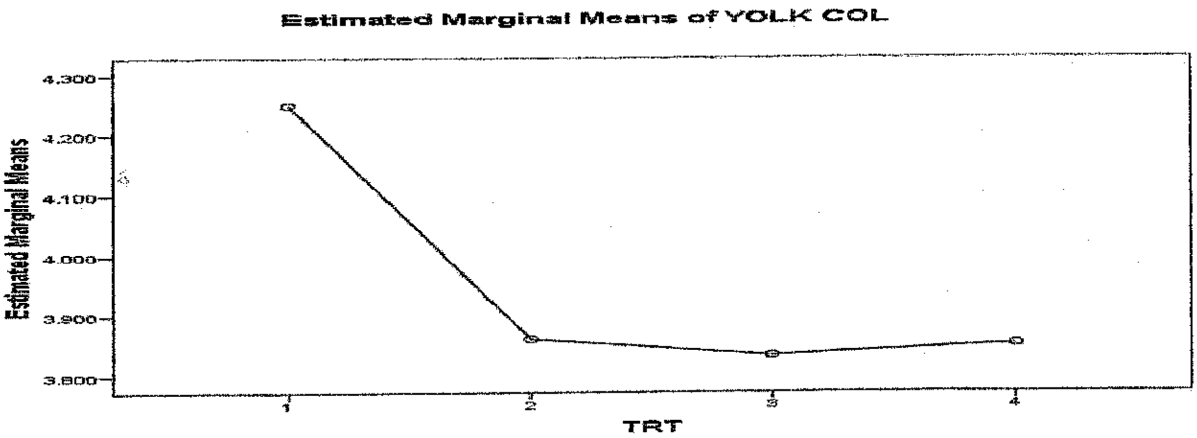


FIGURE 5. YOLK WEIGHT

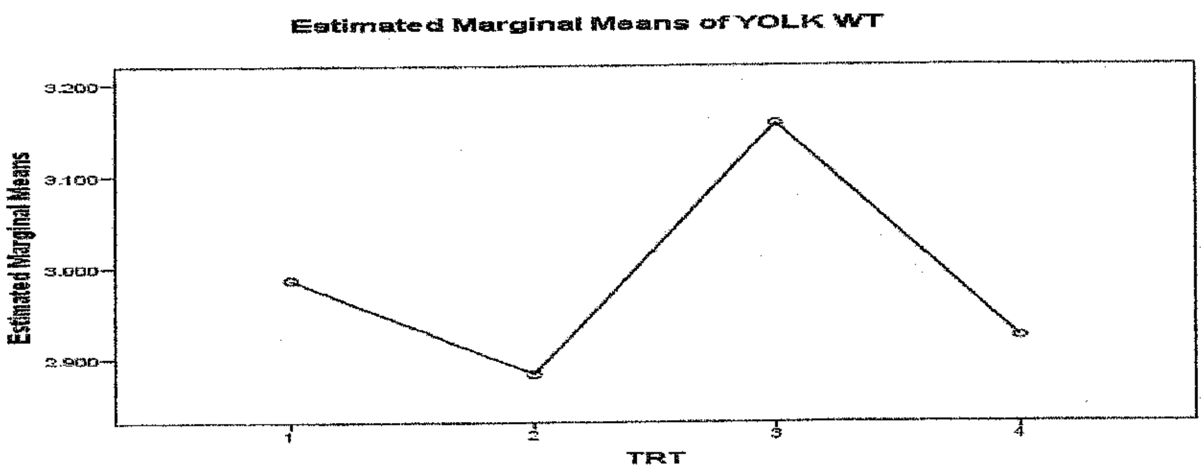


FIGURE 6. YOLK HEIGHT

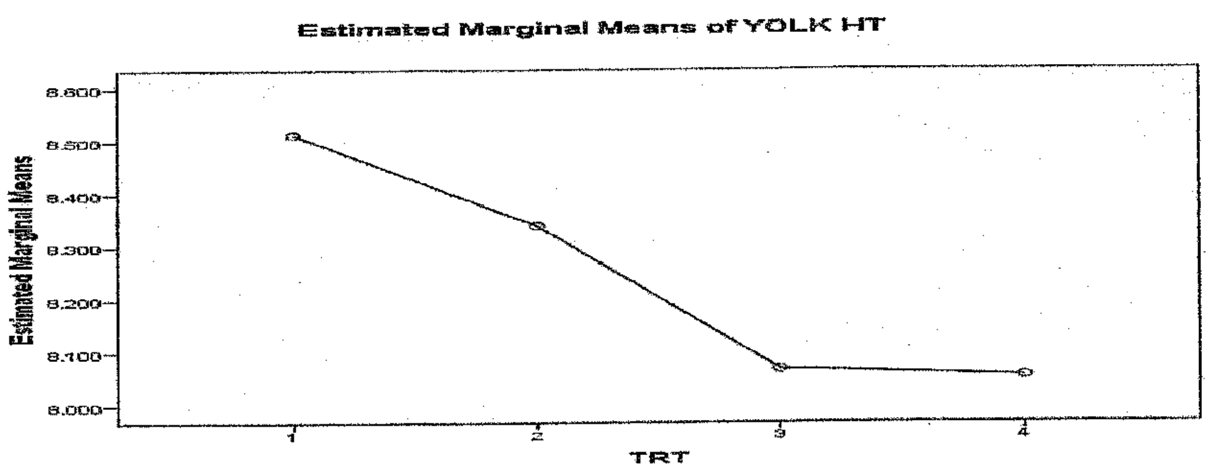


FIGURE 7. YOLK DIAMETER

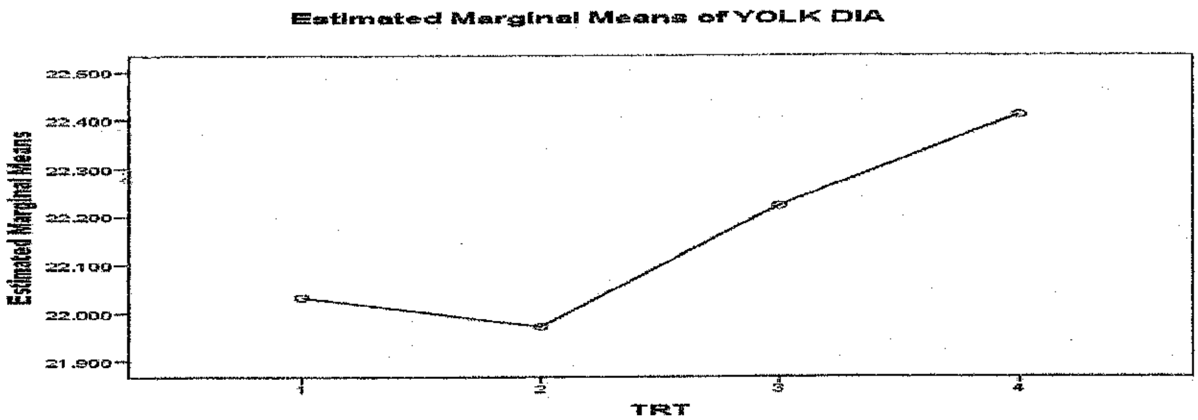


FIGURE 8. ALBUMEN WEIGHT

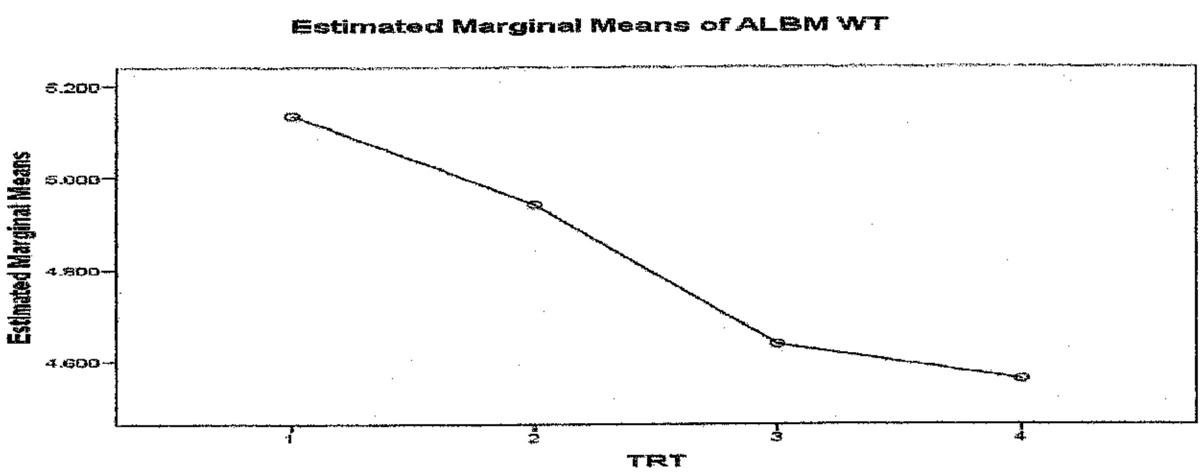


FIGURE 9. ALBUMEN HEIGHT

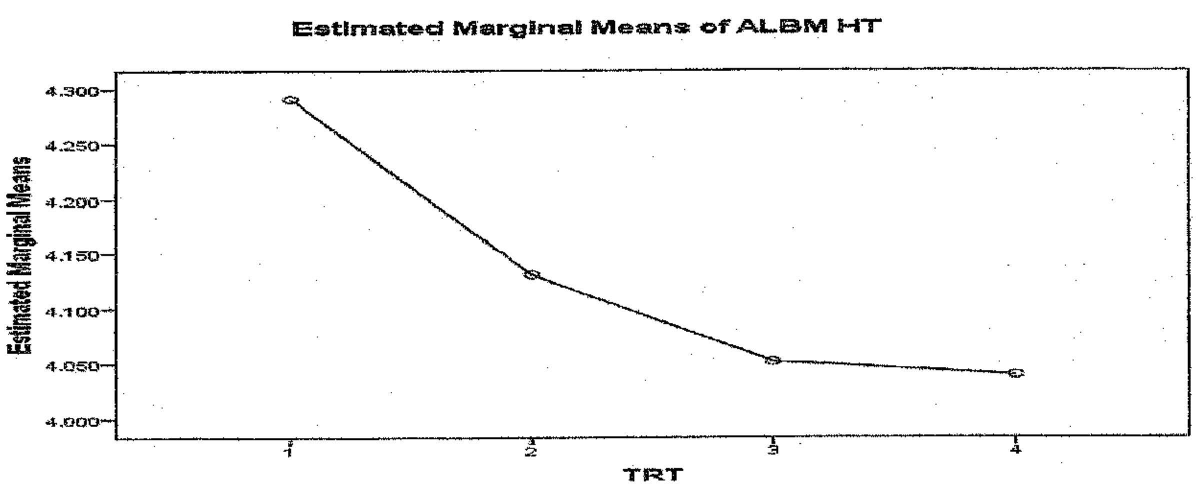


FIGURE 10. SHELL PERCENTAGE

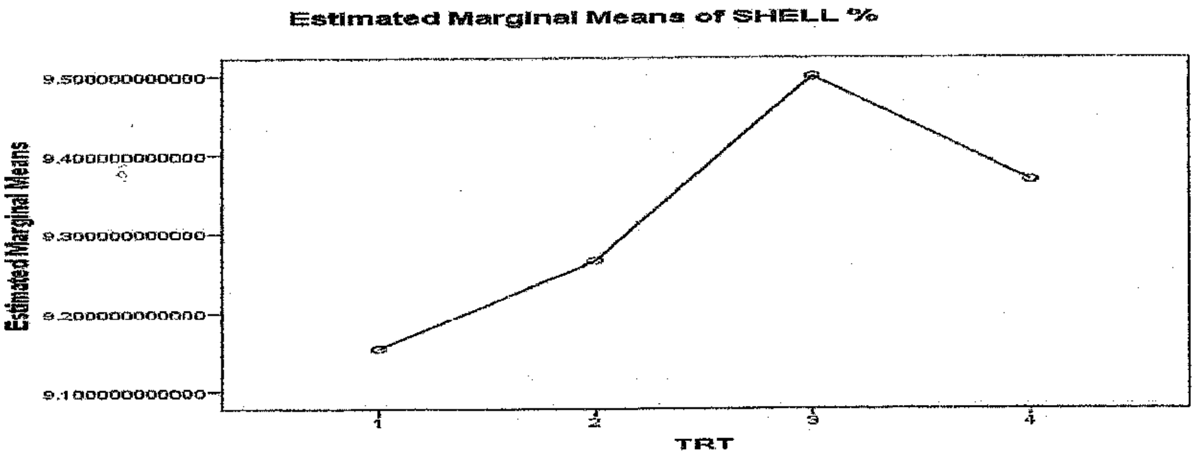


FIGURE 11. HAUGH UNIT

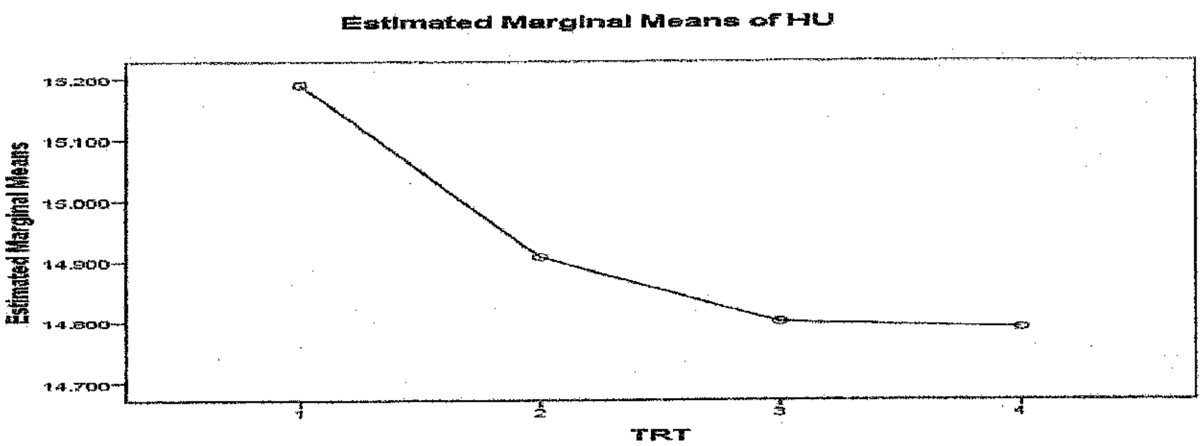


FIGURE 12. YOLK PERCENTAGE

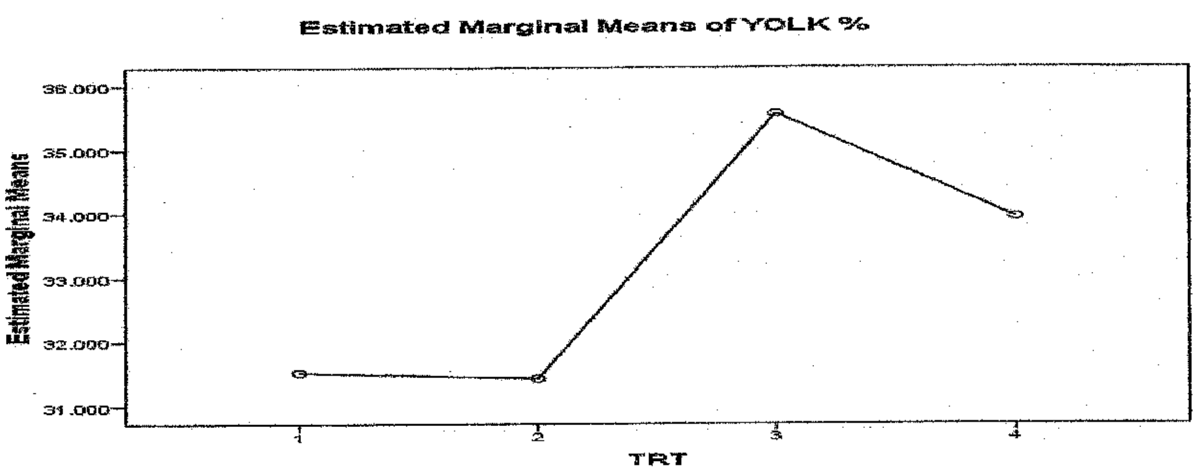


FIGURE 13. DISTRIBUTION OF INITIAL BODY WEIGHT

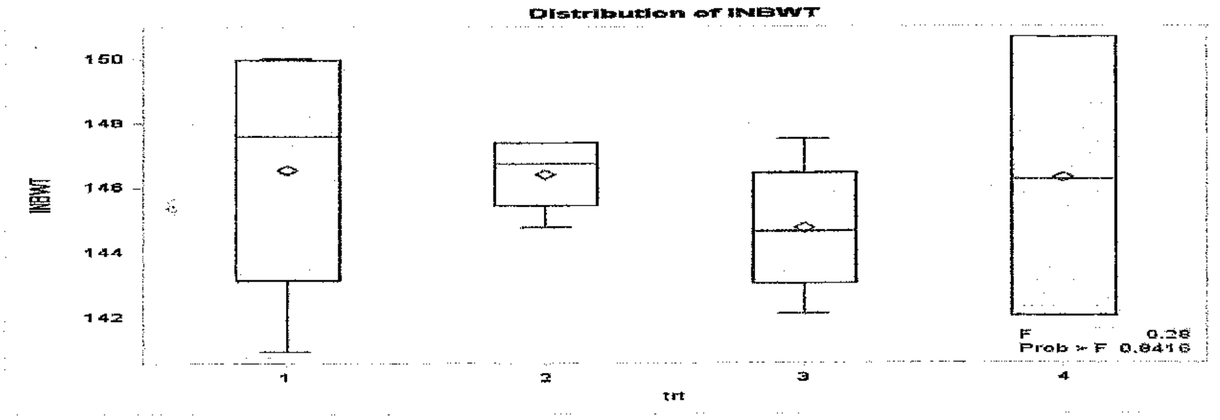


FIGURE 14. DISTRIBUTION OF FINAL BODY WEIGHT

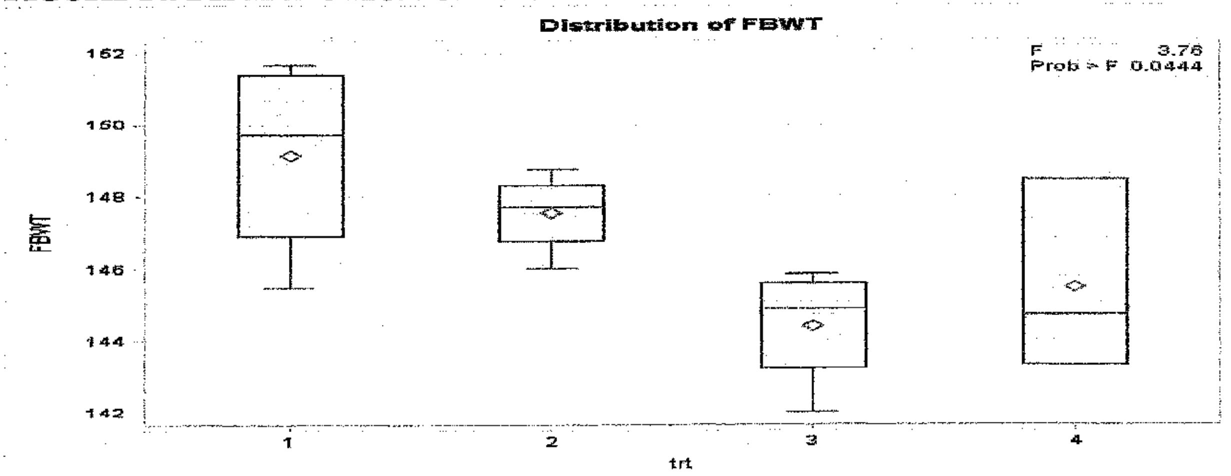


FIGURE 15. DISTRIBUTION OF WEIGHT GAIN

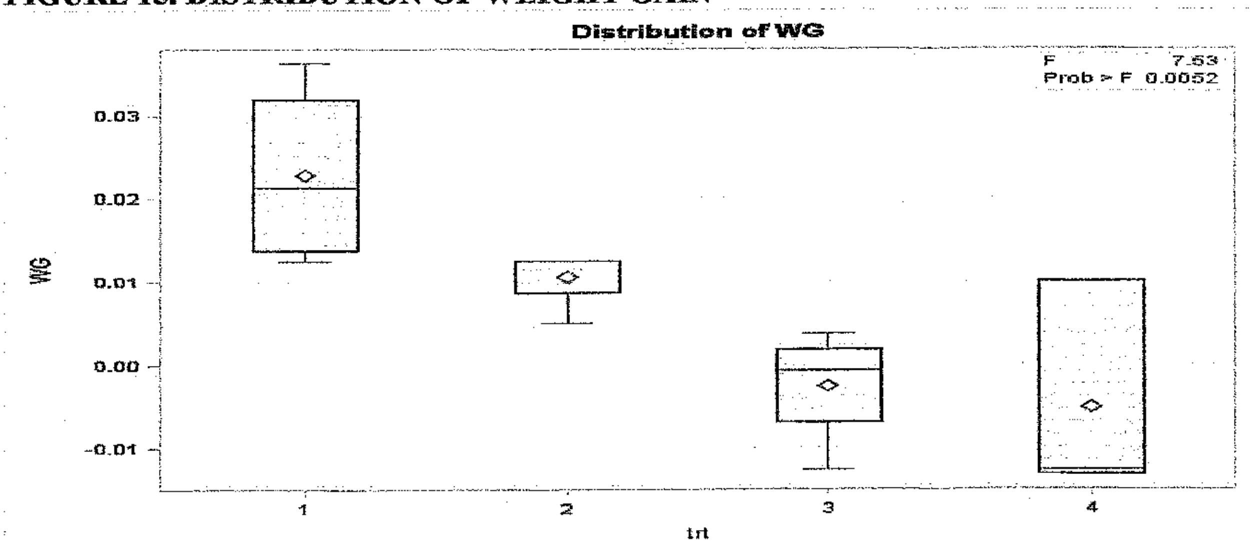


FIGURE 16. DISTRIBUTION OF AVERAGE WEIGHT GAIN

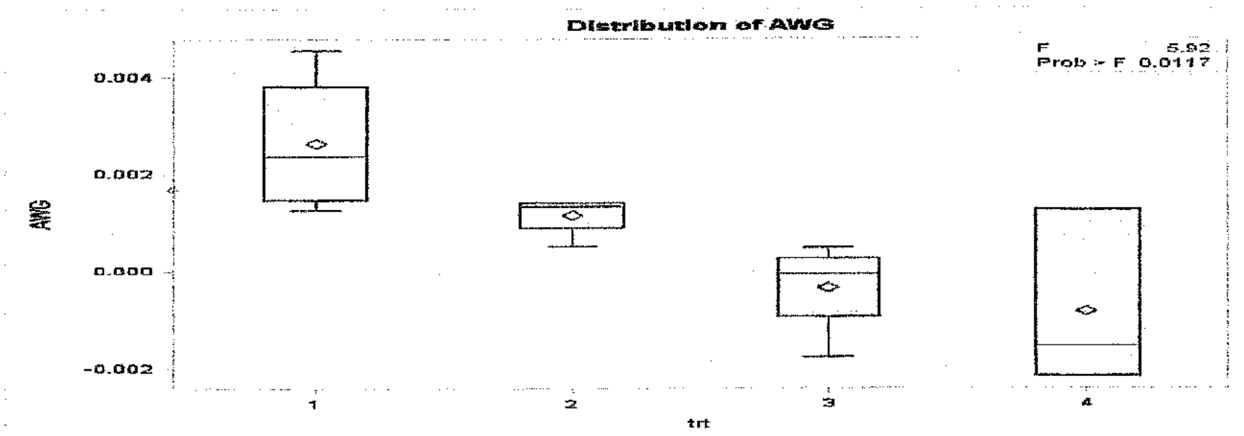


FIGURE 17. DISTRIBUTION OF EGG NUMBER

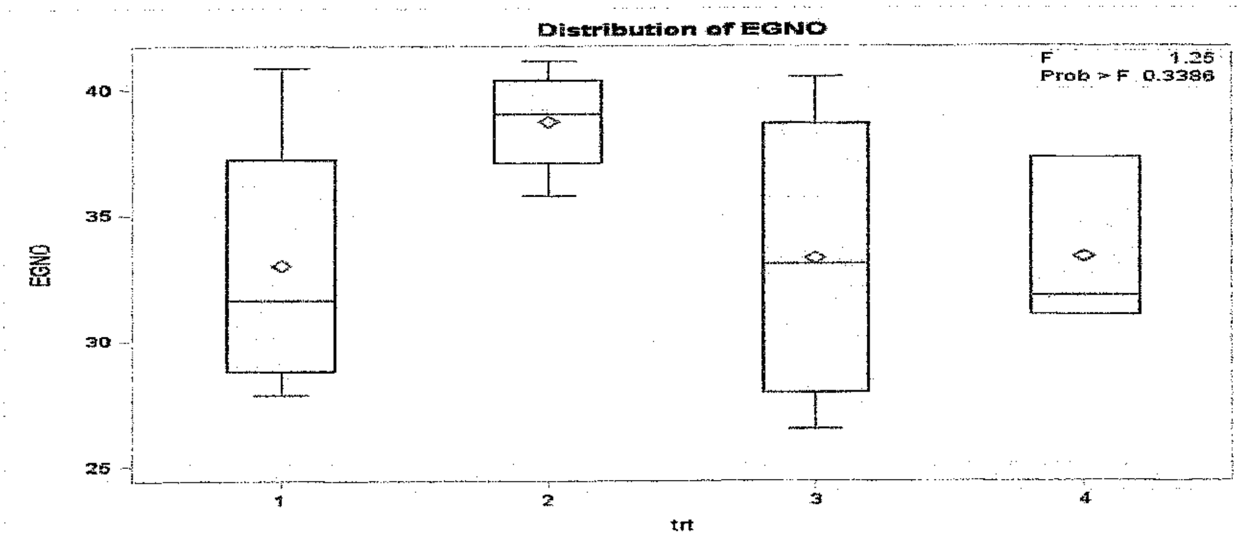


FIGURE 18. DISTRIBUTION OF DAILY EGG PRODUCTION OF HEN.

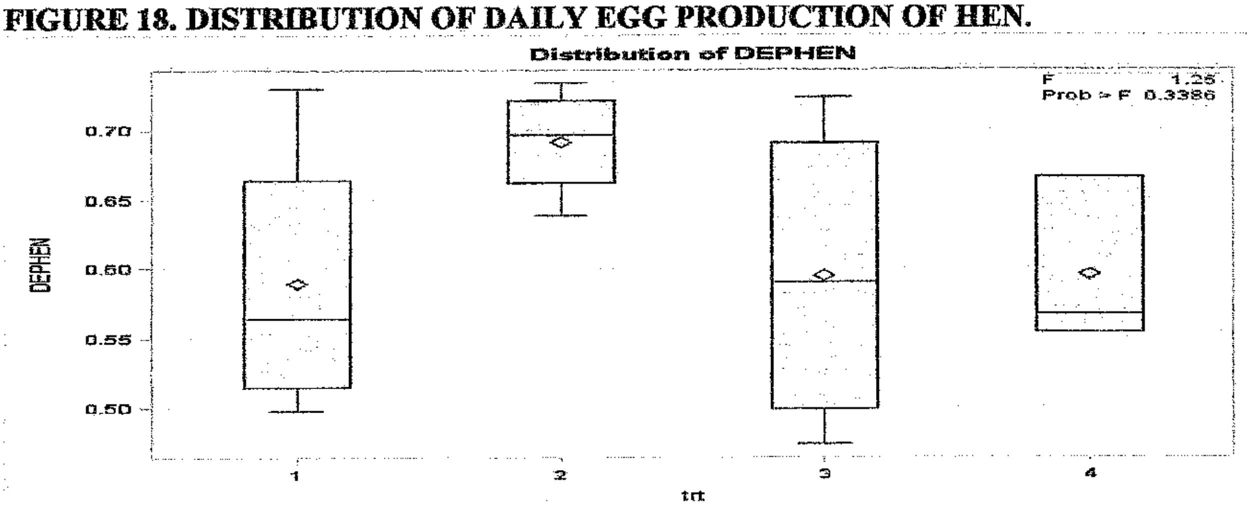


FIGURE 19. DISTRIBUTION OF DAILY EGG PRODUCTION PER GROUP.

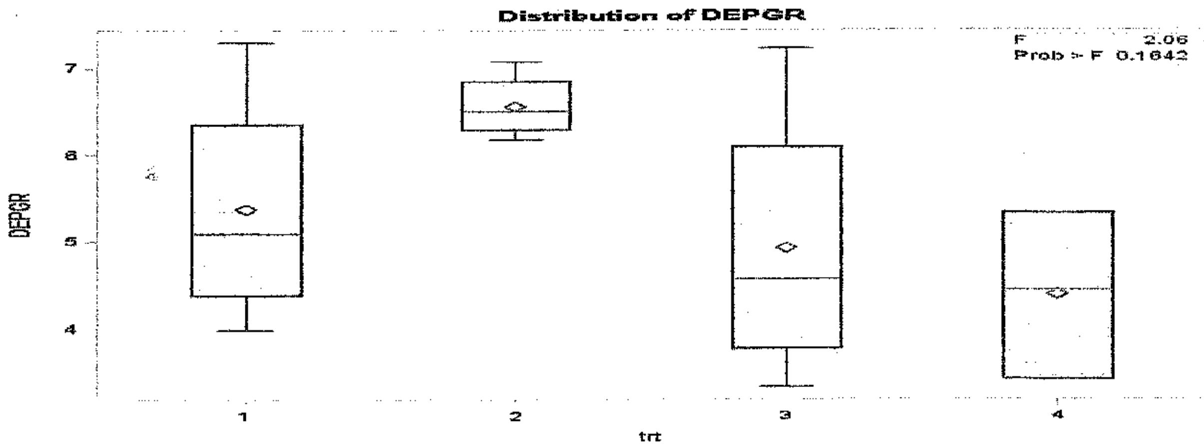


FIGURE 20. DISTRIBUTION OF HEN HOUSE HEN DAY PRODUCTION

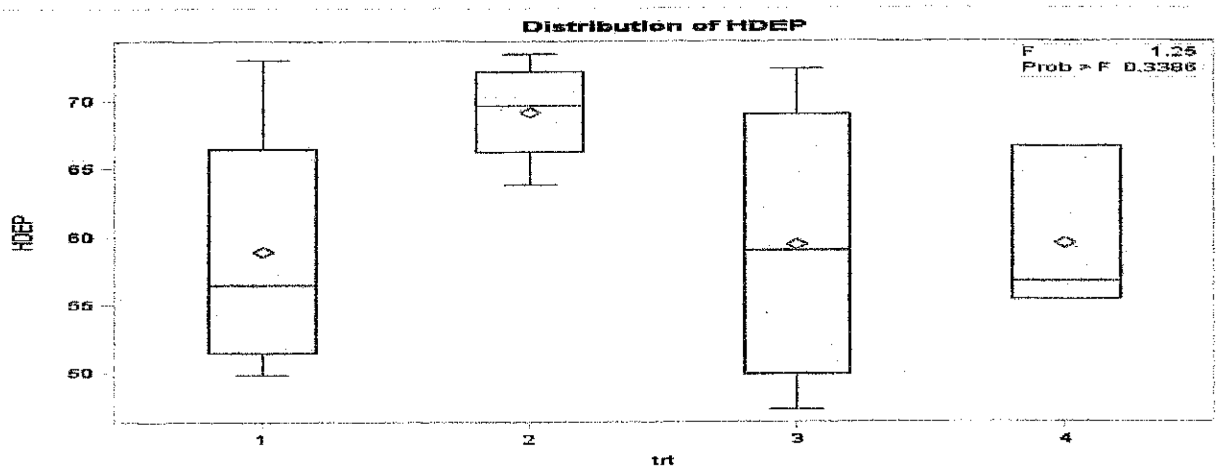


FIGURE 21. DISTRIBUTION OF AVERAGE EGG WEIGHT

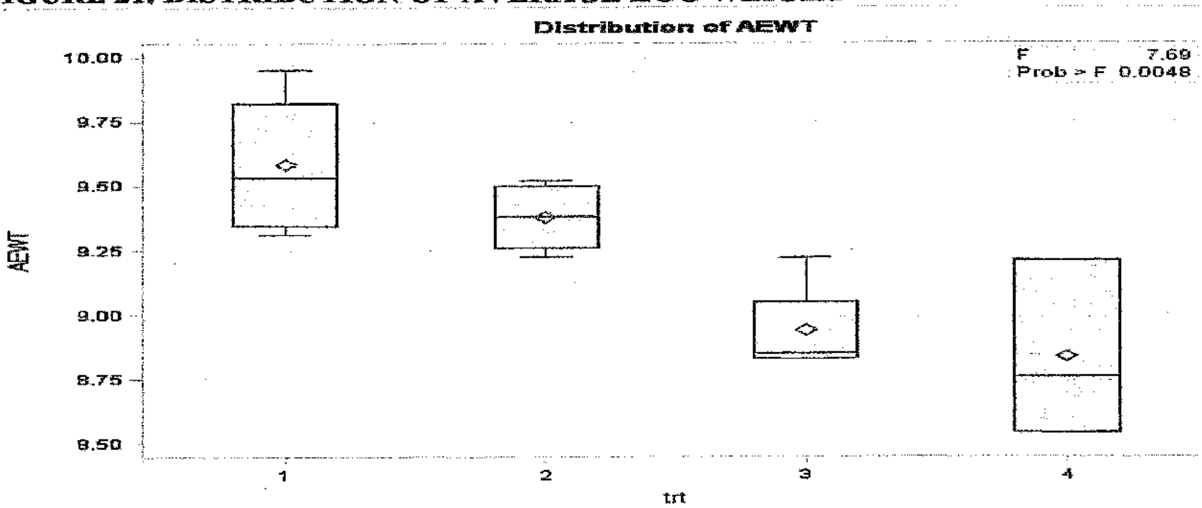


FIGURE 22. DISTRIBUTION OF DAILY AVERAGE EGG MASS

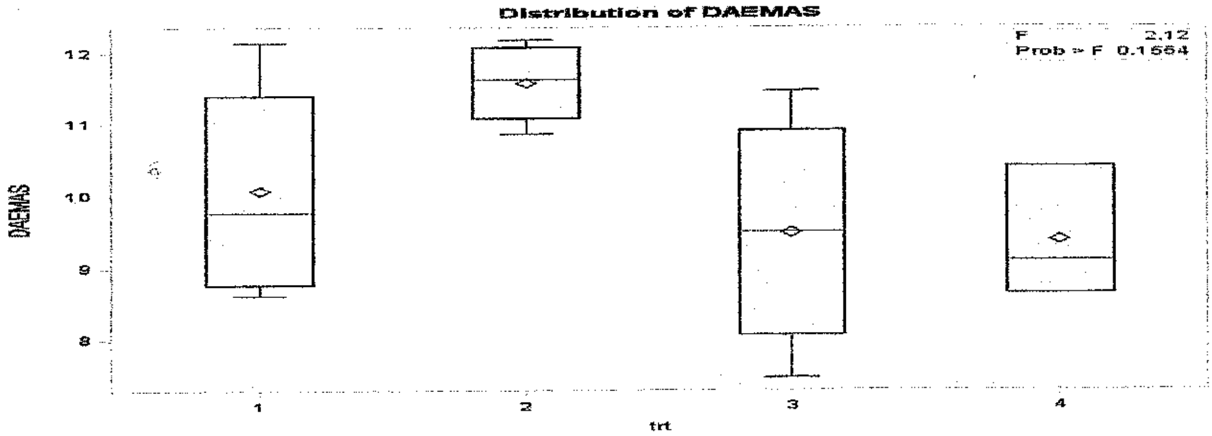


FIGURE 23. DISTRIBUTION OF AVERAGE EGG MASS

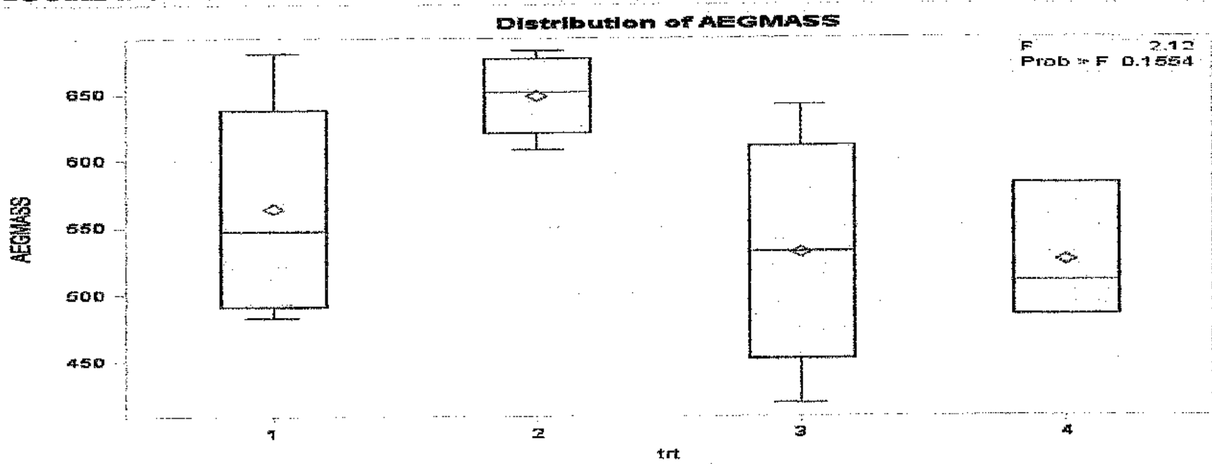


FIGURE 24. DISTRIBUTION OF TOTAL EGG MASS

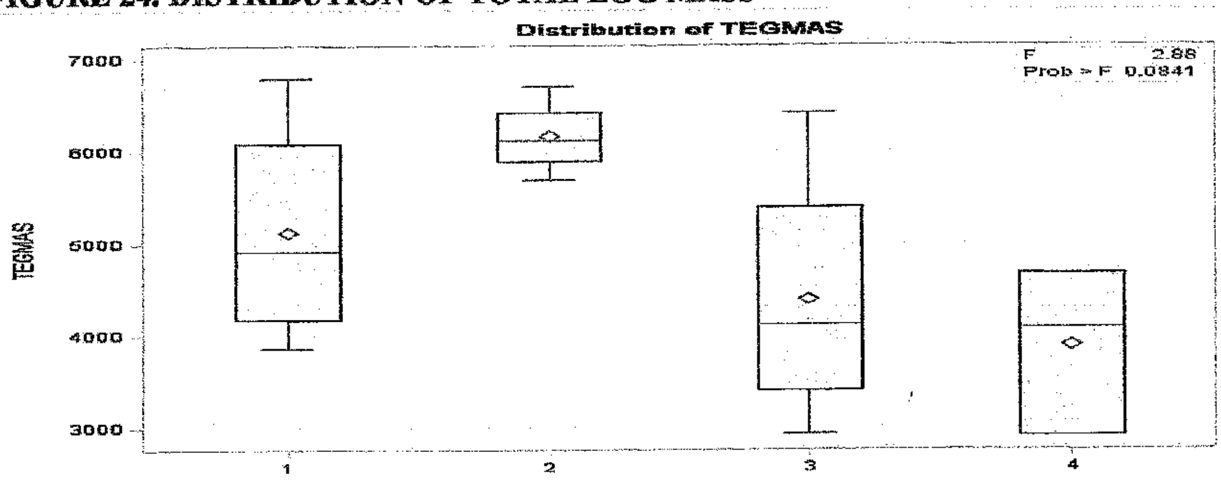


FIGURE 25. DISTRIBUTION OF FEED CONVERSION RATIO (KG)

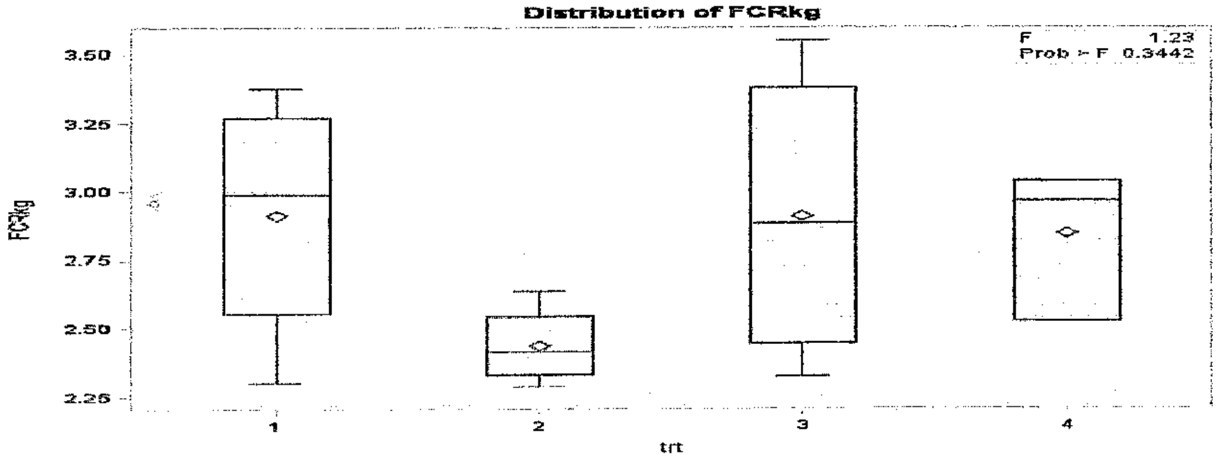


FIGURE 26. DISTRIBUTION OF FEED CONVERSION RATIO PER DOZEN EGG(KG)

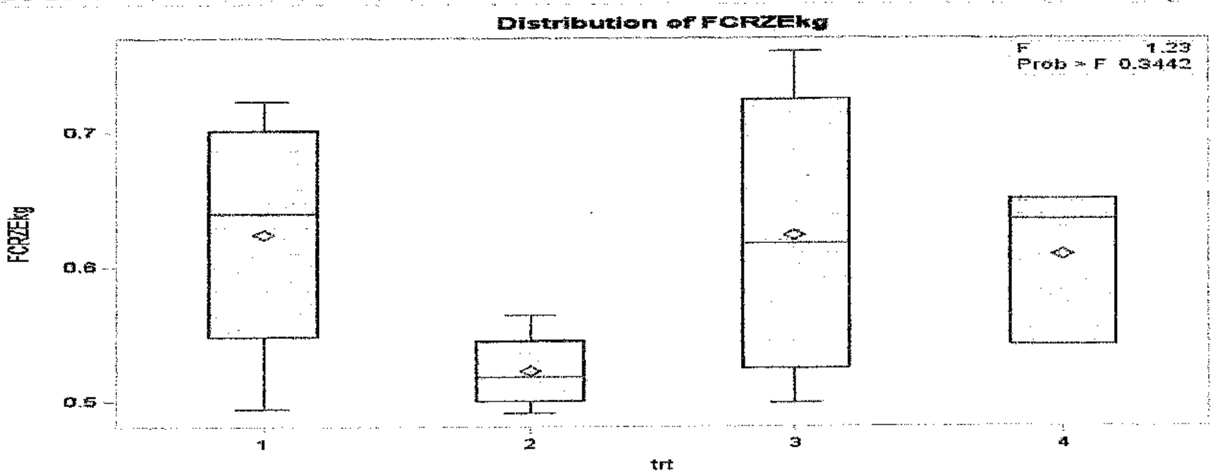
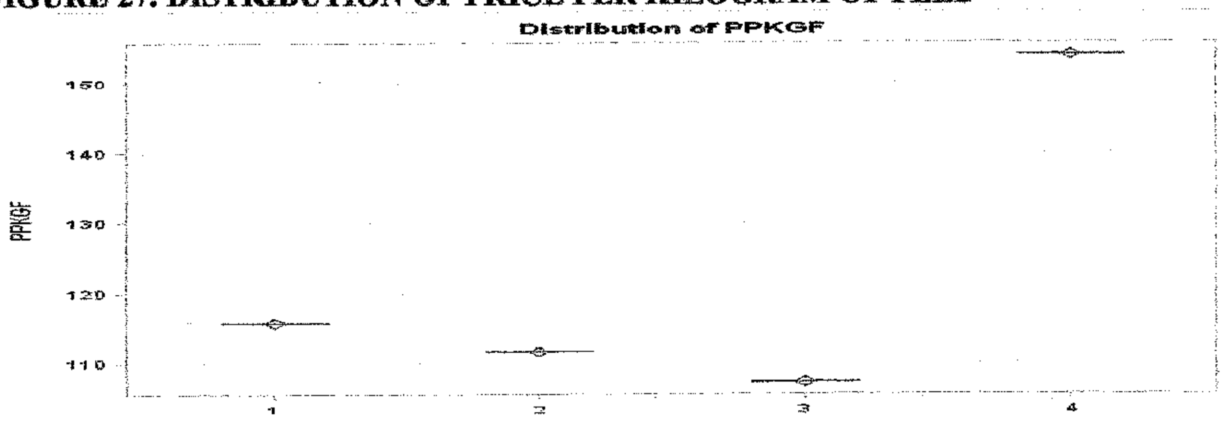


FIGURE 27. DISTRIBUTION OF PRICE PER KILOGRAM OF FEED



CHAPTER FIVE

5.0 DISCUSSION

5.1 EFFECT OF DIFFERENT PROTEIN LEVELS ON THE EGG QUALITY PARAMETERS OF JAPANESE QUAILS.

5.1.1 EFFECT OF CRUDE PROTEIN ON EGG WEIGHT AND EGG DIAMETER.

From Table 4.1 it was observed that egg weight and egg diameter were significantly ($p<0.05$) different between the treatment. The highest egg weight was observed in Trt 1 (24%CP). This result shows that a higher level of protein is required to produce larger eggs; because the treatment with the highest CP produced eggs with maximum weight. Summers *et al.* (1991) and Lopez and Leeson (1995) reported that layer egg weight is strongly related to the content of CP in the diet. Murakami & Furlan (2002) also reported that egg size depends greatly on daily crude protein intake. Novak *et al.*, 2008 also reported that lowering CP in laying hen diets reduced egg weight

5.1.2 EFFECT OF CRUDE PROTEIN ON ALBUMEN WEIGHT AND YOLK HEIGHT.

It was observed from the result that yolk height and albumen weight were significantly ($p<0.05$) different between the treatments which was brought about by the impact of the dietary protein levels. However, highest yolk height and albumen weight were seen in Trt 1 (24%CP). This implies that the parameters increased with an increase in the dietary protein levels and also decrease as the protein levels decrease.

5.1.3 EFFECT OF CRUDE PROTEIN ON HAUGH UNIT.

The different dietary protein has no significant effect on the egg haugh unit. It was also observed by Sehu *et al.* (2005) who studied the effect of diets containing different dietary protein levels of on egg quality of Japanese quails and recorded that there was no significant difference in the haught unit. This also agrees with the findings of Abaza *et al.* 2009, that there was no significant difference in the haugh unit in quail eggs.

5.1.4 EFFECT OF CRUDE PROTEIN ON SHELL, ALBUMEN, AND YOLK QUALITY AND EGG HEIGHT

The result in Table 4.1 shows that there was no significant ($p<0.05$) difference between shell weight, shell percentage and albumen height treatments. This correspond with the findings of De Mendonca and Lima (1999), Junqueira *et al.*, 2006; Alagawany, 2012 who did not observe any impact of dietary CP level on egg shell and egg albumen. Zeweil *et al.*, 2011 also reported that the percentages of wet albumen, wet yolk weight as well as egg yolk diameter and egg height were not affected by dietary CP levels, as observed in this study. The dietary protein levels did not have any significant effect on per cent albumin and yolk which is in line with the findings of Garcia *et al.* (2005) and Abaza *et al.* (2009). Eishu et al.2005 also experimented on varying dietary protein levels in layer Japanese quails opined that dietary protein level did not influence yolk percent. Although, there was no significant difference between the treatments for these parameters but highest yolk color, egg height, shell weight, albumen height and albumen percentage were observed in the treatment with the highest protein level (24% Trt1) and decreased with the treatments with lower protein (22%, 20%, 18%). These conformed to the findings of Novak *et al.* (2006) who reported that the percentage of dry and wet albumen as well as percentage of yolk and albumen protein decreased with low-CP feeding intake. Eishu *et al.*

(2005) also indicated that dietary protein affect the yolk colour score, the yolk colour increased as the dietary protein level increased. Garcia *et al.* (2005) found no significant difference between different dietary protein groups in per cent shell weight as it was observed in this study. The highest yolk weight, yolk percentage and shell percentage were seen in Trt 3 (20%CP) and that of yolk diameter was seen in Trt 4 (18% CP)

5.2 EFFECT OF VARYING PROTEIN LEVELS ON THE PRODUCTIVE PERFORMANCE OF QUAIL.

5.2.1 EFFECT OF CRUDE PROTEIN ON FINAL BODY WEIGHT, WEIGHT GAIN AND AVERAGE WEIGHT GAIN

From Table 4.2 it was observed that final body weight, weight gain, average weight gain, were significantly ($p<0.05$) different between the treatments. The final body weight was influenced by varying levels of protein and Trt 1 with 24% CP has the highest final body weight after the experiment was conducted which correlated with Mosaad and Iben (2009) who reported a linear increase in body weight gain of Japanese quail with increasing dietary crude protein level from 21-27%. This implies, the higher the protein intake the higher the body weight. Although Shayan *et al.* (2013) suggested that lowering dietary crude protein to 21% had no adverse effect on growth performance of Japanese quail.

Moreover, Sharifi *et al.* (2011) fed Japanese quail on high protein diet (24% CP) and low protein diet (22.08% CP) and they found that live body weight, body weight gain were significantly better in quail fed on medium and high protein diets compared with birds fed on low protein diet. Abdel-Azeem *et al.* (2001) also evaluated the response of Japanese quail to feeding diets containing three protein levels (20, 22 and 24% CP) and found that birds fed on high protein diet

(24% CP) exhibited the best growth performance, as measured by live body weight, followed by those of quail fed on the medium (22% CP) and low (20% CP) protein diets.

The present results are also in harmony with the findings of Sherif (2009) who evaluated the growth performance of broiler chicks fed iso-caloric diets containing 18 or 20% crude protein and found that chicks fed the 20% CP diets exhibited superior growth performance (final live body weight, weight gain) as compared to those fed the 18% CP diets. Yakout (2010) also found that the best value of body weight change was recorded by layers fed on diet containing high CP levels. There is a positive relationship between the egg weight and body weight, because the birds with higher body weight in T1 produced the highest egg weight as observed in Table 4.1. Premium is paid on egg weight than egg number.

5.2.2 EFFECT CRUDE PROTEIN ON AVERAGE EGG WEIGHT, EGG NUMBER AND EGG MASS

From table 4.2 significant differences were observed between the treatments for average egg weight and were highest in Trt 1 (24% CP) than other lower protein levels. This means that the average egg weight increases with an increase in the crude protein level and decreases with a decrease in the crude protein level. Harms and Russell (1996) found that birds egg production percentage and egg output (g/hen/day) were influenced ($p<0.05$, significantly) by CP levels in layer (Hy-line brown hens) diets. Since, the high CP level achieved the best values of egg production and egg mass as compared to other levels (Meluzzi *et al.*, 2001). Bunchasak *et al.* (2005) stated that birds received 14% CP had poor egg production, egg weight and egg mass than those received higher protein. Egg number and egg weight were statistically highly improved by increasing dietary protein level from 13-19% in diets of laying hens (white leghorn) (Calderon and Jensen, 1990).

Moreover, Hassan *et al.*, 2000; Yakout *et al.*, 2004; Novak *et al.*, 2006, 2008 stated that egg production and egg weight were improved by increasing dietary CP amounts. In addition Junqueira *et al.* (2006) pointed out that layer-hen performance (egg number, egg weight and egg mass was comparable between the 16 and 20% CP-diets.

5.2.3 EFFECT OF CRUDE PROTEIN ON PRICE PER KILOGRAM OF FEED (PPKGF)

Significant ($p<0.05$) difference was observed in the treatments for the price per kilogram of feed fed to the birds during the experimental period observed from table 4.2. Treatment with the highest protein intake had the highest PPKGF and the one with the lowest protein intake had the lowest PPKGF. This implies that the higher the level of protein inclusion in the diet of birds the higher the cost of feeding. Performance of birds was better when fed with high protein levels (24% and 22%). Therefore 24%CP will be recommended for maximum growth performance and 22% for maximum egg production, since the experimental birds are layers. For profit maximization, 22%CP intake is recommended in order to reduce the PPKGF to a moderate level lowering the cost of production.

5.2.4 EFFECT OF CRUDE PROTEIN ON FEED CONVERSION RATIO

It was observed from table 4.2 that there was no significant ($p<0.05$) difference in feed conversion ratio which was in line with the result obtained from Soares *et al.* (2003) who estimated the protein requirements of Japanese quail using five dietary CP levels and found that dietary protein level had no effect on feed intake or feed conversion. Although in this study the feed conversion ratio was not significantly ($p<0.05$) different but high in treatments with the highest protein (24%) than the one fed with lower protein levels of 22%, 20% and 18%, which correlated with Sharifi *et al.* (2011) who fed Japanese quail on high protein diet (24% CP) and low protein diet (22.08% CP) and they found out that feed conversion ratio were significantly better in quail on medium and high protein diets compared with birds fed on low protein diet.

The present results are also in harmony with the findings of Sherif (2009) who evaluated the growth performance of broiler chicks fed iso-caloric diets containing 18 or 20% crude protein and found that chicks on 20% CP diets exhibited superior feed conversion as compared to those fed the 18% CP diets.

Abdel-Azeem *et al.* (2001) also evaluated the response of Japanese quail to feeding diets containing three protein levels (20, 22 and 24% CP) and found that birds fed the high protein diet (24% CP) exhibited the best feed conversion ratio, followed by those of quail on medium (22% CP) and the low (20% CP) protein diets.

5.2.5 EFFECT OF CRUDE PROTEIN ON EGG NUMBER

There was no significant ($p<0.05$) difference in the number of eggs produced by the birds in the period of experiment, but highest egg number was recorded in Trt 2 on 22%CP. Similar result was reported by Singh & Narayan (2002) who recommended 22% protein for quails in the production (laying) period. Pinto *et al.* (1998) also found levels of protein requirement (22.42%) similar to this study. Although, a higher level of protein requirement was reported by Vilar *et al.* (1991), who observed higher egg production when quails were fed 24% CP in the diet. Result obtained from this study revealed 22%CP for maximum egg production in quail.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

Results from this study shows that the optimum protein requirement for laying quail hen in the humid tropics is Treatment two (21%CP), but the recommended diet in terms of least cost of producing feed and also with the lowest egg feed price ratio is Treatment four (18% CP).

Egg production parameters of quails were influenced by different protein contents from soya bean meal and groundnut cake mixture. Egg parameters were favored by high protein intake. Treatment one (24%CP) has the highest egg weight which decreases as the protein levels decreases. The egg diameter is highest in treatment one. Yolk height and albumen weight decreases with a decrease in level of protein. These outcomes reveal that best egg quality parameters in quail can be achieved when fed with an optimum level of protein.

The feed efficiency ratio varied with the varying levels of (24%CP, 22%CP, 20%CP, 18%CP) protein content. The feed conversion ratio for egg production was not significantly different between the treatments which mean varying CP levels has no effect on feed conversion ratio.

The productive performance of the quail birds were also observed to increase with an increasing level of protein. The birds in treatment one has the highest final body weight, weight gain, average weight gain and average egg weight, with optimum protein intake. T1 (24%CP) has the highest price per kilogram of feed and lower in T2 (22%CP).

6.2 RECOMMENDATION

From the experience gained in this study it is recommended that sexing at 4 weeks old should be carried out to determine growth and laying performance on promising female quail birds.

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