PERFORMANCE OF BROILER CHICKENS FED GRADED LEVELS OF DESERT DATE (*Balanites aegyptiaca*) SEEDS KERNELS.

BY

SHADRACH CHARLES DANIEL

M.TECH/AS/07/0241

APRIL, 2013

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THESIS SUBMITTED TO THE SCHOOL OF POST GRADUATE STUDIES, MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY, YOLA IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY, (ANIMAL PRODUDCTION AND MANAGEMENT), DEPARTMENT OF ANIMAL SCIENCE AND RANGE MANAGEMENT. (SAAT)

APRIL, 2013

Declaration

I, hereby declare that this project was written by me and it is a record of my own research work. It has not been presented before in any previous application for a Degree. All references cited have been duly acknowledge.

Shadrach C. Daniel ______________________________

Signature and Date

Dedication

This research work is dedicated to my family for their love and support

Approval page

This thesis entitled " performances of Broiler chickens fed graded levels of Desert date (*Balanites aegyptiaca)* seed Kernel" have met the regulations governing the award of Master of Technology in Animal Production and Range Management of Modibbo Adama University of Technology Yola and is approved for its contribution to acknowledge and literacy presentation.

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Name and Signature Supervisor	Date
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Name and Signature Co-supervisor	Date
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Name and Signature Internal Examiner	Date
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Name, Address and Signature External Examiner	Date
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Name and Signature Head of Department	Date
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Name and Signature Dean Post-graduate School	Date

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ABSTRACT

This study was conducted to investigate the performance of broiler chicks fed diets with inclusion of graded levels of *Balanites aegypticia* seed kernels cake in broiler starter and finisher diets. One hundred and fifty (150), seven (7) day old unsexed Anak broiler chicks were randomly assigned to five dietary treatment groups consisting of three replicate of 10 chicks each in a completely randomized design (CRD). The treatment consist of a control diet and four other diets with seed kernels included at 5, 10, 15 and 20% replacing maize in the control diet. The nutritional status of seed kernels based on the proximate analysis revealed that it has 29.82% CP, 11.69% lipids (EE), 3.83% crude fibre, 8.72% Ash, 1.92% Moisture, 44.02% carbohydrate and energy of (3613 kcal/kg). The final average body weight change were highly significant ($P<0.05$). Birds on the control diet recorded the highest weight gain (1423.8g) while the lowest value of (1087.0g) was for diet 4 with 15% inclusion. The feed conversion ratio was also significant ($P<0.05$). There were no significant ($P>0.05$) difference in feed intake. The results of the finisher phase shows that the body weight, feed intake and feed convention ratios of broilers fed the tested diets were not affected by the inclusion of the seed kernels cakes. The carcass and internal organs characteristics weighed were not affected significantly ($P>0.05$) among the treatment groups. Also, no significant effect ($P>0.05$) in juiciness, flavour intensity, tenderness and off flavour was recorded among the meat samples from broilers fed the diets. Economically, cost of feed per kg, live weight gain, increases with increasing level of *Balanites aegyptiaca* seed kernels cake.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study.

Poultry production is an increasing important agricultural industry in the world. Poultry meat and egg account for about 10% of the total animal protein produced in the world each year (Onu and Madubuike, 2006). However, as beneficial and interesting poultry seems, this sub-sector is bedeviled by high-off-farm input prices particularly feed prices. This has made a greater number of poultry farmers to produce below capacity. Earlier reports by Ikani *et al*. (2004) showed that about 70% - 80% of the total cost of intensive broiler production is spent on feeds alone. Fanimo *et al*. (2007) also in agreeing with the reports, further stressed that the extremely high cost of conventional feed ingredients in Nigeria has increased the feeding cost to about 80% of the total cost of livestock production, especially poultry and pigs. These have lead to the collapse of many commercial poultry farms and decrease in the growth of the poultry industry in this country (Ogundipe, 2002). It has been identified that the high cost of conventional feed ingredient, such as grains is the major factor militating against increased commercial broiler production in the tropics, more especially in Nigeria. It has become imperative therefore that cheap alternative feedstuffs with components that are of little or no significance be tried and used to replace those scarce and costly feedstuffs used in the formulation of broiler diets.

In view of this, there is need to try alternative local feed ingredients that are less competed for. (Fetuga e*t al,,* 1979 and Oluyemi et al., 2000). To this, Tuleun *et al.* (2007) further stated that the development of alternative plant crops and by products in broilers diet will continue to receive attention in Nigeria as long as the conventional feed ingredients continue to be scarce and expensive. This is inline with the earlier call by Hutagalung (1981) that with the continuing shortage of conventional source of feedstuffs, it is timely to consider the under utilized or little known tree crops which could serve as sources of feedstuffs and feed ingredients for the livestock industry in the tropics.

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1.2 Statement of the problem

The high cost of conventional feed stuff especially protein supplying feed materials and energy giving ingredients is alarming .Likewise the cost of protein resources like soybean meal, groundnut cake, fishmeal (Tuleun, 2007) and fibrous ingredients such as corn bran, rice bran, palm kernel cake etc have been on the increase from year to year (Adejinmi *et al.,* 2007). This situation is of great concern to both poultry producers and researchers and has necessitated the search for suitable alternative feed stuff that is cheap to purchase (Duruna *et al.,* 2007).

1.3 Justification of the research.

Cereal grains are regarded as the most important feed ingredients, and if adequate supplies do not exist within a country, poultry production can not be practiced (Smith 1996). Maize alone account for the largest proportion of about 50% - 55% of poultry feed. (Bamgbose *et al.,* 2004). Unfortunately, maize is being competed for by man and other industries. This results in the increasing cost of the product in the market from ₦270 per ton in 1982 (Tewe, 1999) to its present day market situation of ₦ 100,000 per ton. Therefore, any effort to substitute maize in broiler diet will significantly reduce the cost of production (Afolayan 2002).

The plant, *Balanites aegyptiaca* is found in large quantity in Adamawa state.

It is hoped that the research work will help address the problem faced by commercial poultry producers in Adamawa State and the country at large. Also the result of the study will help in reducing the problem of high cost of livestock (poultry) feeds and feed scarcity.

1.4 Objectives of the study

The main objectives of the research work are:

1. To assess the feed intake and growth performance of broiler chicks fed graded levels of *Balanites aegyptiaca* (L) seed kernel cake in both starter and finisher diets.
2. To determine carcass yield and internal organs characteristics of broiler chicks fed graded levels of *Balanites aegyptiaca*(L) seed kernel cake.
3. To determine the optimum level of inclusion of *Balanite aegyptiaca* seed kernels cake in broiler diets

4. To determine the economics of production of broilers fed with *Balanites aegyptiaca* (L) seed kernel cake.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Development of the broiler industry in Nigeria

According to Smith (1996), the broiler industry is the best integrated enterprise in the whole of the field of animal agriculture. The commercial broiler production started in Nigeria in the 1950's and 60's along with modern agricultural development technologies that were imported by the colonial master during the colonial and post independence era's when technology was regarded as the best method of modernizing Nigeria's broiler industry between 1970 – 1980. This was brought about along several factors including the liberal importation of day old chicks, feeds and equipment, incorporated with favorable government programmes such as the Operation Feed the Nation (OFN) (Dafwang, 2002). Recently, with the application of biotechnology in the poultry industry (Burt, 2002) and the tremendous genetic improvements that have been achieved in many economic trait in egg's and meat strains have advanced the poultry industries worldwide (George, 2008). He went further to express that some novel technologies which are components of biotechnology, such as molecular biology, molecular genetics, genetic engineering, gene cloning, recombinant DNA, gene transfer, genomics, proteomic, transcriptomics and bio-informatis when manipulated will greatly expand the poultry industry.

The broiler industry is still regarded as the fastest means of meat production. Depending on management systems, feed quality and sources of day old chicks used, the production cycle could take 8 – 10 weeks.

2: 2 Environmental factors for broiler and their Management.

In broiler production, Smith (1996) stated that, the main guiding principle of rearing is the all in all art principle so that only birds of the same age are kept on the same site. However, Anon, (2003) argued that for the present time, such system cannot be fully implemented because of the chickens abattoirs limitations.

The essential environmental conditions for broilers are similar to that of the pullet chicks (Oluyemi and Robert, 2002) except that broilers are traditionally reared on deep litter (Smith, 1996). In some areas, the broilers required some special consideration.

2:2:1 Brooding

The brooding system applicable to broilers is the mass brooding as contrasted with group brooding (Oluyemi and Robert, 2000). They went on to suggest that in developing countries where broiler production is a younger industry, brooding methods for pullet chicks are used for broilers MAMR, (2003) have reported that under the brooders, the chicks select their own wanted temperature. If the temperature is high the chicks gasp and the wings dropped and move away from the heat source. The brooder therefore should be raised higher or increased the temperature. If the temperature is normal or good, the chicks are evenly distributed over the floor and are comfortable. In case of draft, the side where draft is coming should be blocked.

2:2:2: Density and litter conditions

Oluyemi and Robert (2000) recommended that broiler chick should be stocked at the rate of $0.06m^2$ from day old to market age. They further explained that this high stocking rate is primarily to ensure maximum profit from floor space and also to restrict extensive movement which is accompanied by the wasteful dissipation of energy by birds. However, MAMR (2003) reported that if broilers are housed at high stocking density, the chicks are trapped or trampled on and do not easily locate feed and water.

Special care should be given to the litter, since caked litter can lead to the formation of breast blisters and the down grading of carcasses. A good litter should be free from moulds, preservative and pesticides (MAMR, 2003).

2:2:3; Temperature

A high starting temperature of about 35^0c is required by broilers chicks, which is gradually reduced to environmental temperature (Oluyemi and Robert, 20002). Smith et al. (1996) have earlier reported that 20 – 25^0c is the ideal temperature for broilers in the post brooding house stage. He further stated that any degree deviation from the optimum may result in a reduction of body weight at eight weeks of about 20g while a degree rise in temperature causes a depression in cumulative food intake of about 50g for bird.

2:2:4 Lighting

It is recommended that broiler chicks receives 23 hours of light per day for the first week to have them accustomed to darkness and will prevent panic, should power fail. After a week, the light intensity is gradually reduced to a level that keeps the chicks quiet and docile, not affecting their eating habits (MAMR, 2003). Oluyemi and Robert (2000) have earlier reported that too much light is moreover depressive of growth rate and therefore recommend low light intensity of 1.076µ or less after an initial intensity of 10.76µ for the first few weeks.

2:2:5: Feeding and water supply

The main objective of broilers production is for rapid growth rate. It is therefore important that good quality and quantity feeds are supplied. Water should be given ad-libitum (Smith, (1996) and Oluyemi et al (2000).

2:2:6 Disease control

A similar control programme is advocated as for layers. Oluyemi and Roberts (2000) further stated that it is more economical in the long run to immunize the birds than to take the risk of sub clinical infection which might drain the profit.

2:3:0 Nutrient requirements of broiler chicks.

The nutrient requirements of domestic fowl are the same as those of other farm animals namely water, carbohydrates, protein, fat, minerals and vitamins. These six nutrients are all essential to life, growth, production and reproduction in all classes of poultry. But certain nutrients are required in higher or lesser quantities for certain categories of poultry, for example, broilers require higher levels of certain nutrients like protein with amino acids and also energy. This is in order to cope with the relatively higher rate of physiological activities related to rapid growth, weight gain and also change of feathers (Oluyemi and Roberts, 2000). Keene [1969] have earlier stated that nutrient requirements for meat type birds are higher than birds grown for egg production because the meat type birds grow at a much faster rate.

2:3:1. Water requirement.

Water is essential to life. Birds can live longer without food than without water. Lack of a consistent supply of fresh water hinders the growth of young poultry, Cavers *el at.* [2002]. Water is a medium in which chemical reactions of metabolism take place in the body .It also plays a significant role in regulation of body temperature,[Anthony, Fred and Ochapo,2000]. The water intake of birds, especially broilers are influenced by many factors which includes environmental temperature, relative humidity, composition of the diet and the ability of the birds to reabsorb water in the kidney.

Water deprivation to >_12 hours has adverse effect on growth of broilers, deprivation for >_36 hours can result in marked increase in mortality of both young and matured broilers. Limitations on water depress animal performance quicker and more drastically than any other nutrient deficiency.

2:3:2 Energy requirements.

Feeds are of great importance in practical broiler diets. The energy requirements of broilers are met by carbohydrates and lipids. The carbohydrates are chiefly represented by starch, sugars and cellulose (Ralph, 1987). According to Cambell and Lesley (1985), carbohydrates are the principal energy sources in poultry diets which they represent 50—75% of the total dry matter.

Sizemore and Siegal (1993) stated that birds tend to satisfy their energy requirement if fed ad-libidum, but Ralph et al (1987) has earlier warned that if energy level is high, consumption and feed conversion rate are small. The authours therefore recommended that energy level of feeds should be flexible.

The energy in feed stuffs fed to poultry is usually expressed in units metabolisable energy per unit weight e.g. kilo joule per gram (kj/g) and kilo joule per day (kj/d). Smith (1996) also defined metabolized energy as that portion of food which is available to the birds for the production of meat and eggs, and for the maintenance of vital functions and of body temperature.

Absolute requirement for energy in terms of kilocalories per kg of diet (kcal/kg) can not be stated because poultry adjust their feed intake to obtain their necessary daily requirement (NRC, 1984). However, some authors recommended a dietary energy value of 3200 kcal metabolisable energy (ME) per kilogram for broilers from 0-8 weeks of age, while NRC (1996) recommended a level of 2800 kcal ME/kg diet. Olomu (1995) recommended energy level of 3000 kcal ME/kg diet for tropical countries. It is generally agreed that in order to keep the feed conversion rate at a satisfactory level, starter and grower feeds should contain not less than 3000 kcal of ME/kg of feed and finishing feeds 3200 kcal ME/kg of feed.

Chickens fed low energy diets about 2600 kcal ME/kg diet have been recorded eating as much as 30% more than similar birds fed diets containing 3200 kcal ME/kg (NRC, 1984). Okoye (1998) confirmed that a low energy high protein diet cause a reduction in growth rate and poor efficiency of feed utilization. Bartor (1992) finally observed that chicks fed high energy diets consumed significantly more feed during finishing period.

2:3:3 Protein requirements.

This is usually the most expensive feed material, but the one most likely to bring profitable results if properly used (Cavers, *et al*; 2002).

Certain levels of protein must be maintained for each growth stage of the birds for optimum performance. It has been reported that lower protein levels not only lead to poor performance but predisposes the birds to common diseases (Olomu, 1995).

As the birds grow, they tend to consume more feed. So if the same quantity of protein level is given to them as when they are young, they will consume more amount of protein there by increasing their cost of production. It was due to that, that Olomu (1995) recommended three crude protein (CP) regimes for broiler chickens at the following stages;-0-3weeks 24%, 3-6weeks 21% and 6-9weeks 18%, at the same ME levels (3000 kcal ME/kg). Kekeocha (1994) earlier recommended 23%CP level for broiler starter and 20% Cp for broiler finisher. NRC (1994) recommended 23% and 18% CP for broiler starter and finisher, while McDonald *et al*.(1987) recommended protein levels of 23% and 19% for both starter and finisher diets respectively. Finally, NIS (1989) and Olomu (1995) recommended protein levels of 24 and 20 % for broiler starter and finisher respectively.

2:3:4 Fats requirement

Fats are present in practically all feed materials .The estimated fat present in the diet of birds is equivalent to the ether extracted material contained in the diet. Utilization of fats and oils of vegetables or of animal in poultry diet has been shown to enhance growth, feed conversion ratio and increase appetite.

Reid *et al* (1995) stated that fats or oils, provide an added energy reserve .If measured by weight, they produce more than twice the energy yielded by carbohydrates or protein. Their cost therefore makes them too expensive to be considered alone.

Excessive inclusion may cause digestive up set in birds, depression in growth, excess body fat accumulation, obesity, reproductive failures and high mortality. Olomu (1995) recommended the maximum fat levels inclusion to both broiler starter and finisher diets as 3-5%.

2:3:5 Minerals and vitamins requirement

The minerals/vitamins requirements of broilers are in two forms, i.e. the macro and micro minerals/vitamins. The macro-elements are those needed in large quantities and they are provided in ample amounts by the usual natural ingredients used in formulating poultry feed. While the micro-elements are those needed in small amount and are often included in most commercial premixes.

Special attention should be given to the actual or recommended levels of specifically calcium and phosphorus levels in the diets because of the role they play in bone development. The recommended level of calcium and phosphorus in the diets of broilers is 1.2-1.3% and 0.85% respectively. Also a range of 0.3-0.35% common salt (Nacl) could take care of the requirement for sodium and chloride by all classes of chickens (Olomu, 1995). This is provided for in commercial premix which forms 0.25% of both the starter and finisher diets

2:4 Balancing energy with protein in broiler diet

There exist inter – relationship between the different classes of nutrients in the diet and their effect on broiler performance. To meet these requirements, the diet must be properly balanced (Oluyemi and Robert, 2000). They went further to explain that the dietary energy must be adopted to arrive at an option dietary energy to protein (calories to protein) ration in the diet. Although they may individually be adequate but may be poorly adjusted to the extent that it redresses the performance of the birds or cause the deposition of fat in their carcasses.

The calories from protein ratio are calculated as calories in (Carbohydrate and fat + crude protein) of crude protein in diet (Oluyemi and Roberts, 2000). For efficient production therefore, there must be a balance between calories and protein.

2:5 Feed and feeding of broiler chicks

According to Dafwang (20002), good quality feed is an absolute necessity for the successful production of broilers and other poultry. He again explained that there are two types of broilers feeds, which are:- the broilers starter which should be feed for the first five weeks of live and the broiler finisher also to be feed from six week to finish. Both feeds have the same energy level (3000 ME Kcal/kg of diet) and that broiler starter should have higher protein (22 – 24%) and the finisher (20%).

Broilers are usually feed ad-libitum. The use of artificial lights to stimulate feeding day and night can increase intake and promote rapid growth (Dafwang, 2002). In regard to the amount of feed required to raise a set of broiler, Dafwang (2002) stated that it would depend on the quality of feed, time of keeping the birds and the amount of wastage. He further recommended that the consumption of starter mash should be between 1.5 – 2.0 kg/bird while broiler finisher 3 -4 kg/bird.

2:6 Feed intakes

Feed intake is important for the production of animals; and this is usually expressed in kilograms of dry matter (DM). According to Smith (1996), voluntary feed intake is the amount of feed that a bird consumes when it has unlimited access to diet. MacDonald *et al* (1995) also refers to it as the weight eaten by animal or group of animals during a given period of time which they have access to feed. If the feed intake is too low, the rate of depression is likely to be depressed and if too high, then fat deposition may occur in some species.

2:7 Body weight change

Body weight gain is one of the essential traits in broiler production. The main objective of broiler production is to grow fast and attain market weight of about 1.5 – 2kg in 8 – 12 weeks of age. Oluyemi and Roberts (2000) reported that the chicks double their body weight three to five times before six weeks of age.

Various reports, (Olomu 1976 and Firman 1993) indicated that body weight change of broilers depend on their feed requirements and the balanced diets containing 3200ME Kcal/kg.

2:8 Feed conversions

This is the rate at which feed is converted into poultry meat in broiler. It is also the ration of feed consumed per unit of increase in weight. The rate at which feed is converted into meat is an important measure of its efficiency (Kekeocha, 1984). Feed efficiency therefore is the quantity of feed required to produce 1kg of meat.

2:9 Mortality rate

This refers to the number of death per given period. This may be due to many factors, but the major causes are due to nutrition, climate and diseases etc. (Sainsbury, 1983). According to Oluyemi and Roberts (2000) the mortality rate of broilers should be low and should not exceed 5% , in order to reduce the cost of chicks as they account for up to 20 -25% of the production cost.

2.10 Non Conventional Feeds

The conventional feedstuffs such as maize, Fish mal, Groundnut cake, Cottonseed cake e.t.c, are used as sources of Protein and Energy in Livestock and Poultry feeds. They are therefore major ingredients for formulating diets in Livestock and Poultry industries. Unfortunately; these ingredients continue to be unavailable. In developing countries of the tropics, they continue to be scarce and expensive (*Bawa et al, 2007*) .This is because they are competed for by humans and other industrial users (Tuleun *et al* 2007). This has hampered the primary aim of producing poultry at minimal cost by farmers (Akinola *et al* 2007).

The high cost of conventional feed ingredients or stuffs, coupled with low nutrients intake, particularly by poultry, is responsible for the keen interest in the search for cheaper feed ingredients as substitute by Nutritionists over the years for optimum production.

Alternative feedstuffs /ingredients have been contemplated to replace the expensive conventional ones. These alternative feedstuffs are known as non-conventional feedstuffs. Gomez (1982) referred to them as agro- industrial by products, crop residues, kitchen waste and milling industries by products.

According to Babatunde and Oluyemi (2000), Nigeria produces large quantities of agricultural and agro- industrial by products, which serves as alternative feed sources to conventional feed ingredients and had been proved valuable in supporting performance of livestock and poultry birds. Among such products are yam peels, cashew waste, full-fat, cashew nut waste, etc, (Alade, 2005; Sogunle *et al*, 2005; Mohammed *et al*, 2003, and Fanimo *et al* 2003). In addition, Sonaiye *et al* (1989) has indicated that there is abundance of tree crop products and by products that can be used as non conventional feedstuffs in poultry diets. This agrees with the earlier findings of Hutagalund (1981), on the potential of some tree crop products and by products for poultry production. Some of these feedstuffs and their optimum level of inclusion are as follows;-

Table 1: Optimum Level in the Diets

Feed Stuffs	Optimum level in the diets (Percentage) Of livestock.
Banana meal	5 – 10
Citrus Molasses	5 – 10
Citrus Pulp	3 – 5
Cocoa bean residue	2 – 7
Cocoa husk	5 -15
Cocoa Shell	5- 15
Coconut Meal Cake	5 – 15
Coffee grounds	3 – 5
Kapok seed cake	5 – 10
Leucaena leaf meal	2 – 5
Oil palm sludge dried	10 – 30
Oil palm sludge, fermented	20 – 40

Palm kernel meal	10 – 40
Palm oil	2 – 10
Rubber seed meal	10 – 30

Source: Hutagalung (1981)

The use of non – conventional feed stuffs is advantageous since they are cheap, easy to procure (Igwebuike *et al.,* 2007). They are at times are regarded as wastes or discarded materials and therefore are not utilized by humans. However the wider use of non- conventional feedstuffs can be limited by the presence of anti – nutritional factors in some of them (Iyayi *et al.,* 1998, Tuleun *et al.,* 2007), their dustiness, milling difficulty (Salami, 1999) and lack of information on their nutritional value (Fanimo *et al.,* 2003).

Hence to use any chosen non- conventional feedstuff as substitute for the conventional areas in livestock /poultry diets, it is necessary to determine their nutritional value, the presence or absence of nutrient inhibitors etc. This will ensure safety and give a dependable and adaptable result.

2:11 Desert date *(Balanites aegyptiaca)*

The desert date, scientifically known as *Balanites aegyptiaca* is a highly valuable tree mainly found in savannahs of tropical Africa (Clement, 2008). Lar *et al* (2000) gave the classification of the plant (*Balanites aegyptiaca)* with the genus and family as Balanitaceae; with synonyms *ximera aegyptiaca* L. (axcl. *Balanites roxyburghii* Planch), *Agialida senegalese* Van Tiegh; *Agialida bartari* Van Tiegh; *Balanites ziziphoides* Milbr.et Schlecter, *Balanites latifolia* (Van Tiegh) choir. The vernacular/ common names are:- English :- Desert date, Soap berry tree, Thorn tree; Arabic;- heglig (Robert, 1998; Lars *et al*, 2000) and in Sudan :p Lalob; Hausa:- Aduwa, Kanuri : - Baize, Bizo (Robert, 1998) and in Fulfude:- Terne, Tsaido.

Balanites aegyptiaca is a widely growing desert plant with multi-use potential and is found in most of African continents, Middle East and South Asia (Bishnu *et al.,* 2005). The plant has wide ecological distribution and is believed to be indigenous to all dry lands of the Sahel, a low-land species (Lars *et al.,* 2000). The plant is found in large quantities in the northern parts of Nigeria (Robert, 1998) and more abundant in the study area Adamawa state.

In Nigeria, the plant starts flowering between November and April with ripe fruits becoming available in December and January and occasionally March to July at 5 – 7 years of age (Lars *et al*, 2000). He further describes the fruits as green when young and turns yellow bitter-sweet when mature. The fruit known as drupe is 2.5 – 7cm long and 1.5 – 4cm in diameter, while seed known as pyrene is 1.5 – 3cm long.

2:12 Uses of desert date (*Balanites aegyptiaca)*

Recent research to investigate the primary metabolites of the plant shows that it contains certain protein, lipid, starch, phenol and carbohydrate in different parts of the plants (Rekha *et al*, 2007). Clement (2008) also reported that in some parts of Uganda, Balanites trees are essential because they provide important nutrients and vitamins to diets that are dominated by cereals. He stated further that the leaves are also valued for livestock feed. According to Robert (1998), the fruits, seeds, seed oil, flower and resin are eaten in Nigeria, more especially in Kano and some other Northern parts of the country. The authour further explains that the plant has Ethno-medical uses. Various researches conducted; have indicated that, this resilent tree could be the solution to famine in areas prone to drought and famine (Clement, 2008). Despite these multi –use potentials, this plant remains one of the most neglected plant species (Bishnu *et al* 2005) and utilized as feed ingredient for animals production (Hutagalung, 1981).

The recent report by panel of experts from various African countries, released in January, 2008, indicted that Balanites is included among the 24 indigenous fruit chosen for their potential to boost nutrition, environmental stability and economic development if given the right scientific and agricultural support (Clement 2008).

2:13 The seed of *Balanites aegyptiaca*

The seed of Balanites are light – brown, fibrous and extremely hard. They make up to 50 – 60% of the fruits (Lars *et al*, 2000). The seeds of Balanites are enclosed within the hard stones of the fruit and are edible and nutritious. The seeds are particularly rich in oil and protein.

The processing of the seed provides two major components which are kernels and oils. However, clement (2008) stated that the process of extracting the kernel from within the seed is by cracking of the hard seed and seed kernel is rich in oil (60%) and protein (30%). This agrees with the reports of Mohammed *et al* (2004) on the physical, chemical and morphological characteristics of *Balanites aegyptiaca* L. seed kernel which contain oil 49.0% and crude protein 32.4%.

2:14 Chemical composition of the seeds components

The chemical analysis of the seeds component was carried out with the Sudan sample (Robert, 1998), and the results obtained are summarized as in Appendix 42.

These values correspond equally with other trees crops and by –products exploited as non – conventional feed ingredient for animals (Hutagalung, 1981). Clement (2008), in describing the Balanites oil compared it with olive as largely consisting of linolectic and oleic acid, unsaturated and most describable in foods.

The chemical composition of the dry seeds of *Balanites aegyptiaca* L. as determined by Robert (1998) is as follows in Appendix 43.

From the above results on the nutritive value of Desert date (*Balanites aegyptiaca)* seeds and its products, it can be summarized that the seed and its products can be regarded as a moderate source of protein and be excellent energy source because of the high fat content.

All researches carried out on Desert dates (*Balanites aegyptiaca)* seeds and its products indicated that the protein has relatively good amino acids profile and mineral than other legume meals. These percentages are very similar to those in the tables from Nutrient requirements of poultry, National Academy press (1984) Washington DC. The essential amino acid profile for growth requirement of broilers is compared with the levels found in *Balanites aegyptiaca* seeds. (See Appendix 44). Another research work on the traditional food plants of Kenya (National Museum of Kenya, 1999) gave the nutritional composition of the edible parts of the plants as

Shown in Appendix 45.

2: 15 Anti-nutritional factors in *Balanites aegyptiaca* Seeds

The anti-nutritional factors present in this plant species are phytic acid and saponins found in both the seed kernel and oil (Mohammed *et al*, 2004). This however, has limited the wider use of the plant species. Mohammed et al (2004) however noted that the antitryptic activities of the kernel flour were very low. Bishnu *et al*. (2005) also reported that the oil cake from *Balanites aegyptiaca* seeds is unsuitable for feeding because of the presence of many toxic substances but with good processing methods such as boiling and several washing with clean water, the anti-nutritive factor is reduced as suggested by Emiola *et al.* (2003). Recent report by Clement (2008) stated that saponions are non-toxic to human and moreover, the unsaturated fatting acids are the most desirable in food. This proves the suitability of the products in monogastric feeding. .

2:16 Effect of processing methods on the utilization of *balanites aegyptiaca* seeds kernel.

Processing feed ingredients usually reduces the level of anti-nutritional substances in them. Processing methods such as cooking, boiling, washing in water, heat treatment, defattening etc as well as duration of treatment usually decrease the concentration of the anti-nutritive factors e.g. Phytic acids. This agrees with the result of Sutardiand Buckle (9185) who reported that the loss of phytic acids was due to oil solubility in processing water during cooking. Also the report of Emiola *et al* (2003) proves that heat treatment can improve the nutrient utilization of legumes by animal.

2:17 Economic factors of the production of broiler chickens fed graded level of *balanites aegyptiaca* seeds kernel Cake

The research will determine the performance of broiler chicks fed graded level of *Balanites aegyptiaca* seed kernels and oil, chemical composition of the Nigeria *Balanites aegyptiaca* seeds, acceptable level of inclusion as well as the economic factors of its inclusion in broiler diets as source of carbohydrate.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study area

The research was carried out at the poultry production unit of the Farming Skills Acquisition Centre, Demsa, a training and demonstration centre of the Ministry of Agriculture, Yola, located at Demsa, Adamawa State. Demsa the Headquarters of Demsa Local Government Area is located on latitude 9 – 10^{0N} Demsa Local Government has an approximate Land Area of $1756.25km^2$ with a population of 95, 149 (NPC, 2006).

In the study area, rainfall starts in May and ends around November. The mean annual rainfall ranged from 700 – 800 mm. Rainfall lasts for 4 – 5months from June to October. The climatic condition with respect to temperature usually varies from place to place and from time to time depending on the weather condition.

3.2 Collection of Seed/Nuts and Extraction

The nuts or seeds of *Balanites aegyptica* were collected from Dowaya Fulani along Numan – Jalingo road of Adamawa State where the seeds are found in large quantities. The dried nuts or seeds after cleaning were cracked using the traditional method with stones in order to obtained the kernel.

3.3 Seed Processing

The seeds/nuts were processed by soaking them in cold water with continuous changing of the water at the interval of 3 – 5hours for 24hrs in order to debitter the seeds. It was later removed and allowed to dry and then fried. After cooling, the kernels were pounded to paste using mortal and pestle. Some little amount of boiling water was added and stirred until the oil is separated from it. Samples of the seed kernel cake were analyzed for their proximate composition according to the method of AOAC (1995).

3.4 Experimental Birds

A total of one hundred and fifty (150) day old broiler chicks of Anak strain were used for the research. The chicks were purchased from CH1 LTD, AZANLA HATCHARY FARM Ibadan through Silas Farm, Yola. The chicks were given water and commercial boiler starter *ad-libitum* for seven (7) days. At eight (8) days, the chicks were ready for the commencement of the research.

3.5 Management of the Birds

The birds were managed on traditional deep litter system. Before the arrival of the chicks, the poultry house and equipments were thoroughly washed and disinfected using Izal. The poultry house was partitioned into 15 separate pens using wire mash and the sides covered with polythene sheet to reduce wind, sun rays and to conserve heat. Wood shavings were used as litter materials to cover the floor of the house. Electric bulbs and kerosene lanterns were used as sources of heat during the first two weeks of the experimental period. Also adequate number of feed and watering troughs were placed in each pen.

The chicks were administered antistress drugs on arrival. On the eight (8^{th}) days of the arrival of the chicks, the birds were weighed and randomly distributed into five treatment groups. The birds were fed with the experimental broiler starter for four (4) weeks (from week 1 to week 4) and broiler finisher for 4weeks (from week 5 to week 8). Routine poultry management practices were maintained. All necessarily vaccinations and medications were duly carried out.

3.6 Experimental Design and Treatment

A completely Randomized Design (CRD) was used for the experiment. The feeding trial lasted for 56 days (8 weeks). There were five tr76zTGYAhzeatments and each treatment had 30 birds for the starter and finisher period. The diets were formulated such that *Balanite* aegyptiaca seed kernel cake was used at 0, 5, 10, 15, and 20% graded levels. The formulated diets corresponded to treatment diets 1, 2, 3, 4 and 5 respectively. Treatment I served as the control. The diets in each case (starter and finisher) consisted of 23% and 19% CP respectively. The ingredient composition of the experimental diets is shown in Table 1 and 2 for broiler starter and finisher respectively.

The seven – day old boiler chicks were weighed and randomly assigned to each of the five treatment diets, giving 10 birds per replicate. They were given their respective experimented diet and clean water *ad – libitum*.

Table 1: **Percentage Composition of Broiler Starter Diets**

	Dietary Treatments				
Ingredient	**T1**	**T2**	**T3**	**T4**	**T5**
Maize	52	49.5	47	44.5	40
Balanite seed kernel cake	0	5	10	15	20
Maize offal	9	9	9	9	10
GNC	30.5	28	23.5	24	20
Fish mean	5	5	5	5	5
Bone meal	2.5	2.5	2.5	2.5	2.5
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25

Lysine	0.25	0.25	0.25	0.25	0.25
	100	100	100	100	100
Mekcal/kg	2958.0	3035.0	3111.18	3187.3	3206
CP %	23.03	23.04	23.14	23.26	23.06
Fiber	3.69	3.71	3.62	3.79	3.82

Premix Bio mix® (Broiler starter) Vit. A – 1,000,0000.00 iu, Vit D - 2,000,000.00 iu, Vit C – 23,000.00mg, Vit k_3 – 2000mg Vit. B_1- ,1,800mg, Vit. B_2 – 5,500mg, Niacin – 27,500.00mg Pantothemic acid 7,500mg, Vit. B_6 – 3000 mg, Vit B_{12} – 15.00mg Folic Acid – 750 mg, Biotic H_2 – 60mg, Chorines Chloride – 300,000mg, Cobalt – 200mg, Copper – 3000mg, Iodine – 1000mg, Iron – 20,000mg Maganese – 40000 mg, Selenium – 200mg, Zinc – 30000mg, Antioxidant – 1250mg

Table 2: **Percentage Composition of Broiler Finisher Diet**

	Dietary Treatments				
Ingredient	**T1**	**T2**	**T3**	**T4**	**T5**

Maize	62	59.5	57	52	47
Balanite seed kernel cake		5	10	15	20
Maize offal	9	9	9	11	13.5
GNC	20.5	18	15.5	12.5	9.5
Fish mean	5	5	5	5	5
Bone meal	2.5	2.5	2.5	2.5	2.5
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
	100	100	100	100	100
Mekcal/kg	3038	3114.4	3190.6	3217.6	3257
CP %	19.4	19.5	19.6	19.5	19.4
Fiber	2.39	3.41	3.43	3.61	3.85

Premix Bio mix® (Broiler Finisher) Vit. A 10,000,000.00 iu, Vit D - 2,000,000.00 iu, Vit C – 23,000.00mg, Vit k_3 – 2,000mg Vit. B_1 –1,800mg, Vit. B_{2-} 5,500mg, Niacin – 27500.00mg Pantothemic acid – 7500mg, Vit. B_6 – 3000 mg, Vit B_{12} – 15.00mg

Folic Acid – 750 mg, Biotic H_2 – 60mg, Choline Chloride – 300,000mg, Cobalt – 200mg, Copper – 3000mg, Iodine – 1000mg, Iron – 20,000mg Maganese – 40000 mg, Selenium – 200mg , Zinc – 3,0000mg, Antioxidant – 1250mg

3.7 Data Collection

The following parameters were determined which include. feed intake, body weight gain, feed conversion ratio and mortality.

3.7.1 Feed intake

A known quantity of feeds was given to the birds for twenty four hours. The left over feeds, were collected the following day and weighed. The weight of the left over was then subtracted from the weight of the initial feeds to the birds. The difference is the feed intake. The amount consumed was then divided by the number of birds per pen in order to determine the feed intake per experimental bird. This was done for both starter and finisher.

Feed intake(g) = Feed supplied(g) – Feed left over(g).

3.7.2 Body Weight Change

The body weight change was determined by weighing the birds at intervals, i.e. on weekly basis and the difference in weight at weekly intervals were calculated as body weight change.

Weight change = Wt, at the end of the week(g) – Wt, at the beginning of the week(g).

3.7.3 Feed Conversion Ratio (FCR)

This parameter was calculated as the feed intake per unit rate of gain using the formula described by Abubakar and Oni (2002).

$$\text{Feed Conversion Ration} = \frac{\text{Feed Consume(g)}}{\text{Weight gain(g)}}$$

3.7.4 Mortality

All records of mortality was taken as they occurred throughout the experimental period and was calculated using the formula described by Oluyemi (2000) and Abubakar and Oni (2002).

$$\text{Mortality} = \frac{\text{Number of dead chicken}}{\text{Total number of the chicken}} \times 100$$

3.8 Carcass Evaluation

At the end of the 8weeks period, 3birds were randomly selected from each treatment. The birds were weighed and starved off feed over night but only water was provided. The slaughtered birds were defeaters after scalding in warm water. They were then cut into retail parts and weighted. Live weight, dressing percentage, weight of cut – up parts and internal organs were expressed as percentage of the live weight.

3.9 Sensory Evaluation

For the sensory evaluation, the meat samples from each treatment were cooked with oil and onion added, later removed and allowed to cool for 10 – 25mins. They were served to 15 member trained panel. A modified hedonic scoring scale was employed (Williams and Damrun, 1998). They were instructed to score each samples for juiciness, flavor intensity, tenderness and off flavor. Eight point scales was employed for juiciness, flavor intensity and tenderness while six – point scale was employed for off – flavor.

3.10 Economic of Production

The economic analysis of the feed were determined to assessed the economic of production that may be derived in using *Balanite aegyptiaca* seed kernel cake in the diets of broilersl. The prevailing market prices of the ingredients as at the time of the study were used to calculate cost benefit parameters.

3.11 Chemical Analysis

The chemical analysis *Balanite aegyptiaca* seed kernel cake was done using A.O.A.C (1990) methods.

3.12 Statistical Analysis

The data generated were subjected to analysis of variance (ANOVA) using a completely randomly design as described by Gomez and Gomez (1984). Difference between treatments means were separated using Duncan Multitude Range Test. (Duncan;,1955)

CHAPTER FOUR

4.0 RESULTS

4.1 Chemical composition of *Balanite aegyptiaca* Seed Kernel Cake.

The proximate analysis of *Balanite aegyptiaca* seed kernel cake is presented in Table 3. The proximate composition of *Balanite aegyptiaca* seed kernel cake revealed that it has a high level of Crude protein and lipids as compared to some popular conventional sources of protein such as cotton, peanut, soybeans and papaya. It has a moderate level of fats about 11.69% which increases its calories. The crude fiber level of 3.83% is below the standard 0f 5% level recommended for broilers. This suggests it usefulness for monogastric animals. Moisture content is low (1.92%) which falls within the range reported for most seeds and nuts.

Table 3: Proximate analysis of *Balanite aegyptiaca* seed kernel cake

Nutrient	Percentage %
Dry matter	98.07
Moisture	1.92
Crude Protein	29.82
Lipids	11.69
Crude Fibre	3.83
Ash	8.72
Carbohydrate	44.02
Calculated Energy	3613 ME Kcal/kg

4.2 Experimental Diets

The percentage composition of the experimental broiler starter and finisher diets are presented in Tables 1 and 2 respectively. The calculated analysis of the experimental diets, reveal the crude protein levels of 23% for starter ration and 19% for finisher rations (Tables 1 and 2). The crude protein values ranges for 23.04 – 23.26% for starter ration and 19.4 – 19.6% for finisher rations .The experimental diets were formulated in such a way that the diets would be isonitrogenous The values in all the experimental diets fall within the requirements of the birds (NRC, 1996). The energy values ranges from 2958.00 – 3200 kcal/kg for broiler starter phases and 3038 – 3257 kcal/kg for finisher phase. The experimental diets 5 of both the starter and finisher rations had the highest metabolizable energy of 3206 kcal/kg and 3257 kcal/kg respectively, while the lowest metabolizable energy of 2958.08 kcal/kg and 3038 kcal/kg were recorded for diets I of both the starter and finisher rations respectively (Tables 1 and 2).

4.3 Performances of broilers during the starter phase

The results presented in Table 4 indicate that the inclusion of *Balanite aegyptiaca* seed kernel cake in a broiler starter diets have significant effects on the performance parameters of the birds. The commutative feed intake is significant (P < 0.05). The highest feed intake of 1196.67/bird) was recorded in T_3 while the least feed intake of (916.29/bird) was recorded in T_1 which is the control. The mean daily feed intake per bird per day for the starter rations are shown in Table 5. There is significant differences (P <0.05) between treatments in body weight change as shown in Table 4 during the starter phase. The mean daily body weight change per bird per day is presented in Table 5.

The feed conversion ratio was significantly (P < 0.05) higher as compared to the rest of the other treatments whose values did not differ significantly between each other. T_1 has a better feed conversion ratio of (1.66) follow by T_2 (2.77), 7_4 (2.83) T_5 (3.24) and T_3 with (3.45) (Table 4).

Table 4: **Effect of Graded Levels of *Balanite aegyptiala* Seed Kernel cake on the Performance of Broiler (Week 2 – 5)**

	Treatment Groups					
Parameters	T1	T2	T3	T4	T5	SEM
Initial bodyweight (g/bird)	70	70	70	70	70	
Cumulative feed Intake	916.29^{a}	1018.95b^{c}	1196.67^{a}	1055.68b^{a}	1114.39b^{a}	86.48*

(g/bird)						
Total weightgain (g/bird)	622.2^{a}	439.1^{b}	431.0^{b}	429.2^{b}	413.1^{b}	21.96^{**}
Body weight change (g/bird)	552.20^{a}	367.43^{b}	354.33^{b}	372.95^{b}	343.09^{b}	21.95^{**}
Feed conversion ratio	1.66^{b}	2.77^{a}	3.45^{a}	2.83^{a}	3.24^{a}	0.41^{*}
Mortality percentage	6.67	6.67	11.11	13.33	13.33	

a, b, c = Means within the same raw bearing different superscripts differ significantly ($P<0.05$)

* * highly significant, * significant

4.4 Performance of broiler, the finisher phase

The results of the performance of broiler during the finisher phase are presented in Table 6. The results indicate that there were no significant differences ($P > 0.05$) between treatments in terms of feed intake, body weight change and feed conversion ratio.

The lowest feed intake was in T_4 (2807.5). The mean daily feed intakes, body weight change per bird per day are shown in Table 7. The body weight change obtained were 871.60, 866.79, 743.17, 714.09 and 775.01 g/bird for T_1, T_2, T_3, T_4 and T_5 respectively. The feed conversion ratios for the finisher phase were 3.43, 3.33, 4.04, 3.95 and 3.84 for T_1, T_2, T_3, T_4 and T_5 respectively (Table 6 and 7).

Table 6: **Effect of graded levels of *Balanite aegyptica* seed kernel cake on the performance of boiler finisher (week 6 – 9).**

	Treatment Groups					
Parameters	T1	T2	T3	T4	T5	SEM
Initial bodyweight (g/bird)	622.2	439.1	431.0	429.2	413.1	
Cumulative feed Intake (g/bird	2988.0	2831.6	3011.8	2807.5	2946.3	257.39^{NS}
Total weight gain (g/bird)	1493.8^{a}	1307.9^{b}	1167.5^{b}	1143.3^{b}	1188.1^{b}	97.09^{*}
Body weight change (g/bird)	871.60	866.79	743.17	714.09	775.01	102.72^{NS}
Feed conversion ratio	3.43	3.33	4.04	3.95	3.84	0.40^{NS}
Mortality percentage	3.57	7.14	8.33	7.41	11.54	

a, b, c = Means within the same raw bearing different superscripts differ significantly (P<0.05)

* - Significant, ** highly significant.

4.5 Performance of broiler chickens from [wks 2-9].

The overall results of performance of broiler chicks fed graded levels of seed kernel cake of *Balanite aegyptiaca* from weeks 2 to 9 are shown in Tables 8 and 9. The results indicated that there were no significant (P>0.05) differences in feed intake. Birds on treatment diet 2 had the lowest feed intake (Table 8).

With regards to body weight change and feed conversion ratio, a highly significant differences (P<0.05) was recorded.

Birds on diet 1 had the highest body weight change (1423.8) with better feed conversion ratio of (2.74), while birds on diet 4 had the lowest body weight change (1087.0) and feed conversion ratio of (3.56) (Table 8).

Table 9: **Effect of graded levels of *Balanite aegyptica* seed kernel cake on pooled performance of boiler chicks (week 2 – 9).**

	Treatment Groups					
Parameters	T1	T2	T3	T4	T5	SEM
Initial Body Weight (g)	70	70	70	70	70	
Final body weight (g)	1493.8	1307.9	1167.5	1143.3	1188.1	97.10^{**}
Total body weight change (g)	1423.8^{a}	1235.2^{b}	1097.5^{b}	1087.0^{b}	1118.1b	96.45^{*}
Average body weight change/day (g)	25.42	22.06	19.60	19.41	19.97	
Total feed intake (g)	3904.3	3850.5	4208.5	3863.2	4060.7	331.23^{NS}
Average feed intake/day	69.72	68.76	75.15	68.98	72.51	
Feed conversion ratio	2.74^{c}	3.14^{bc}	3.83^{a}	3.55^{ba}	3.62^{ba}	0.32
Cost of feed /kg (₦)	66.06	70.59	74.75	76.53	82.01	-
Cost of feed /kg weight gain	44.33	53.88	63.89	67.13	68.91	-
Cost savings ₦ /kg	-	-	-	-	-	
Mortality percentage	10.00	13.33	18.52	20.00	23.33	-

4.6 Carcass and internal organs characteristics of broilers fed graded level of seed kernel cake of *Balanite aegyptiaca*

Result of the carcass characteristics is shown on Table 10. The result indicated significant ($P < 0.05$) differences in the average live weight and dressed weight (Table 10) among the treatment group. The dressing percentage and other cut-up parts, head, neck, breast, and drumstick. Thighs, shanks, wings, backs and internal organs, the liver, kidney, heart, lungs, gizzard, small intestine, large intestine, did not differ ($P > 0.05$) significantly.

Table 10 **Carcass Characteristics of Broiler Fed Diets Containing Graded Levels of *Balanites aegyptica* Seed Kernels cake**

	Dietary Treatments					
Parameters	T1	T2	T3	T4	T5	SEM
Av.Live weight (g)	1493.80	1307.87	1167.49	1143.29	1188.10	97.10**
Dressed weight(g)	1227.14	1041.23	984.16	976.63	971.44	90.59*
Dressing percentage	82.17	79.37	84.31	85.48	81.80	2.6
Relative weight of the cut up parts						
Head	3.35	2.93	2.57	2.48	3.33	0.81NS
Neck	3.35	2.70	2.58	2.25	3.05	1.01NS
Breast	22.70	17.73	18.26	17.08	16.62	3.50NS
Drumstick	11.58	11.79	11.40	12.38	11.22	2.64NS
Thighs	11.13	10.62	12.84	11.31	11.61	1.97NS
Shanks	3.35	3.61	3.42	3.65	3.89	0.71NS
Wings	8.24	8.04	8.27	8.46	8.16	1.49NS
Back	14.52	11.38	11.98	11.95	14.64	2.17NS
Relative weight of Internal Organs						
Liver	1.45	1.17	1.14	1.29	1.18	0.29NS
Kidney	0.23	0.01	0.01	0.01	0.01	0.01NS
Heart	0.41	0.41	0.35	0.34	0.37	0.05NS

Lungs	0.55	0.40	0.43	0.43	0.45	0.06^{NS}
Gizzard	1.71	1.81	1.71	1.54	1.87	0.43^{NS}
Small Intestine	3.23	3.03	3.14	2.75	2.53	0.30^{NS}
Large Intestine	0.91	0.65	0.75	0.69	0.67	0.12^{NS}

Ns = Not significant (p > 0.05).

4.7 Sensory evaluation of broilers fed graded level of seed kernel cake of *Balanites aegyptiaca*

The results of the sensory evaluation are presented in Table 11. The results shows no significant (P > 0.05) differences on the juiciness, tenderness, flavor intensity and off-flavor of the meat sampled from broilers fed the diets.

Table11 **Sensory Evaluation of Broilers Fed Diets Containing Graded Levels of *Balanite aegyptica* Seed Kernel Cake**

Parameters	T1	T2	T3	T4	T5	SEM
Juiciness	6.68	6.19	6.46	6.35	6.18	0.33
Flavors Intensity	5.80	5.49	5.55	5.61	5.39	0.36
Tenderness	5.64	5.71	5.68	5.54	5.35	0.25
Off - Flavor	5.82	5.52	5.56	5.59	5.56	0.16

Eight point scale were employed for juiciness, flavor intensity and tenderness where 8 = extremely juicy/intense/tender, 7 = Very juicy/intense/tender, 6 = moderately juicy/intense/tender, 5 = slightly juicy/intense/tender, 4 = slightly dry/bland/tough, 3 = moderately dry/bland/tough 2 = very dry/bland/tough and 1 = extremely dry/bland/tough. A six – point scale was employed for off – flavor where 6 = none detected, 5 = threshold, barely detected, 4 = slightly off – flavor, 3 = moderately off – flavor, 2 = strong off – flavor and 1 = extremely off – flavor

4.8 Economics of production of broilers fed seed kernel Cake of *Balanites aegyptiaca*

The result of the economic of production is presented in Table 12, the data showed the total cost of feed per bird of ₦330.33, ₦ 352.97, ₦373.76, ₦ 382.68 and ₦ 410.07 for T_1, T_2, T_3, T_4 and T_5 respectively. The cost of feed per kg and feed cost per kg gain increases with the increase inclusion of the seed kernel cake of *Balanites*, indicating that there was not cost saving (Table 12).

Table 12: **Economics of Production of Broilers Fed Graded Levels of Seed Kernels cake of Balanites**

	Treatment Groups				
Parameters	T1	T2	T3	T4	T5
Cost of feed(₦/bird)	330.33	352.97	373.76	382.68	410.07
Cost of feed (₦ /day)	5.90	6.30	6.67	6.83	7.32
Cost of feed (₦ /kg)	66.06	70.59	74.75	76.53	82.01
Total weight (kg)	1.49	1.31	1.17	1.14	1.19
Feed cost ₦ /kg gain	44.33	53.88	63.89	67.13	68.91
Cost Saving (₦ /kg)	-	-	-	-	-

CHAPTER FIVE

5.0 DISCUSSION

5.1 proximate composition of seed kernel cake of *balanite aegyptiala*

The result of the proximate composition of the seed kernel of *Balanites aegyptiaca* is presented in Table 1. The result revealed that the kernel has 29.82 % crude protein which is lower than the value of 30.41% reported by Nkafamija *et al;* (2007) in Nkafamiya, Wulla areas in Michika Local Govt. of Adamawa State . However, the CP value is higher than those obtained in Kenya (Kenya Museum, 1999).

The CP content of Balanites kernel is comparable to some popular conventional sources of protein such as cotton seed cake (28.72%) and peanut (26.2%) reported by Eka and Isbell (1984). The CP value fall within the values of 17 - 30% for most legumes (Samuel *et al*, 1997, Sagarika *et al,* 1999).The present CP value of the seed kernel suggests that the seed kernels are good potential sources of protein for formulating livestock feeds

The seed kernel has a moderate level of Fats (EE) (11.69%) which increases its calories. The crude fiber (CF) level of 3.83% is below the standard level recommended by NRC ;(1996) for broilers. It is also below the values reported for most legumes (Hosein and Beckers, 2001). The low CF value obtained suggests its possible usefulness for monogastric animals.

The moisture content (1.92%) is however low but falls within the range reported for most seeds and nuts. The low moisture content is an index of stability, quality, shelf life and also high yields (Lohlum *et al,* 2010) . The Ash percentage is high (8.72%) as compared to those reported for tree seeds and nuts (Onyenuga, 1968 and Lohlum *et al*, 2010). The Ash content of any plant materials is a measure of its inorganic level.

The total carbohydrate and energy calories were 44.02% and 3613kcal/kg respectively. The high calories value was due to its high fat content and this agrees with the findings of Lohlum *et al* (2010) who reported that high fats values increases energy calories. . However, based on the nutritional status of the seed kernel (Table I), it seems to suggest that the seed kernel cakes of *Balanites aegyptiale* may be adequate for formulating animal feeds.

5.2 Performance of broiler during the starter phase.

The results of productive performance of broilers during the starter phase (Tables 4 and 5 in Appendix 46) indicate that the inclusion of seed kernel cakes of *Balanites aegyptiaca* in broiler starter diets *influenced* the performance of the birds as compared to the control diet.

The feed intake, body weight change, body weight gain and feed conversion ratio showed high significant ($P<0.05$) differences among the treatment groups. In regard to feed intake, of the starter phase, birds on diets 3 with 10% seed kernels consumed more than those in the control. This was followed by birds on diets 5, 4 and 2 with 20%, 15% and 5% inclusion level of seed kernel cakes of *Balanite aegyptiaca.* Birds on the control diet, consumed the least (916.29). The mean daily feed intake per bird for the starter phase/rations is shown in Table 5. The high intake can be attributed to the fact that the feed was palatable since there was no refusal of the feed by the birds. This agrees with the statement of Wells (1965) that birds are known to increase their feed intake in order to consume an appropriate metabolizable energy level.

There was significant (P<0.05) difference observed in the mean daily feed intake among the treatment groups of the starter phase (32.72g – 42.74g). This observation is lower than the 65.62g/bird – 69.45g/bird reported by Duwa *et-al* (2012) when they fed broiler starter with raw and differently processed sorrel seed meal. This may be as a result of indigestion and presence of some anti nutritive factors which usually decreased feed intake (Onu *et-al,* (2006) .

In regard to body weight change of the birds at the starter phase, there is a highly significant (P<0.05) difference. Birds on the control diet recorded the highest body weight change of 552.20g, followed by those in diets 4, 2, 3 and 5 with 372.95g, 365.43g, 354.33g and 343.09g respectively. There was a marked decreased in body weight change of the birds with inclusion levels of seed kernels of *Balanite aegyptiaca* in the diets when compared to the control diet with 0% level of inclusion. This shows that seed kernels cakes of *Balanite aegyptiaca* do have adverse effect on both the body weight gain and body weight change of the birds.

The feed conversion ratio (FCR) differ significantly (P<0.05) among the treatment groups during the starter phase. Birds on the control diet (T1) recorded the best feed conversion ratio of 1.66 and then followed by diets 2, 4, 5, and 3 with FCR of 2.77, 2.83, 3.24 and 3.54 respectively. Birds on diets 3 and 5 recorded the poorest feed conversion ratio, though; they have the highest feed intake (tables 4 and 5 of Appendix 46).

The FCR values obtained (1.66- 3.45) are similar to 2.13 – 3.11 FCR values of starter phased recorded by Duwa *et-al* (2012).

5.3. **Performance of broiler during the finisher phase**

The result of the performance parameters of broilers during the finisher phase are shown in Tables 6 and 7 in Appendix 47.The result indicates that there were no significant (P>0.05) differences between treatment groups with regards to the cumulative feed intake, body weight gain and feed conversion ratio. This clearly shows that the inclusion of graded levels of seed kernels cake of *Balanite aegyptiaca* at this phase did not have adverse effects on the performance of the birds as compared to the control diets. This may be due to the age of the birds and acclimation to the diet and weather. The cummulative feed intake did not shows any significant (P>0.05) difference. The values were in consistent. Birds on T_3 had the highest feed intake of 3011.8g per bird and T_2 recorded the poorest feed intake of 2832.6g per/bird. The highest feed intakes were followed by those on diets 1,5 and 2 with 2988.0g, 2946.3g and 2831.6g respectively. This observation of increase feed intake agree with the report of Smith (1996) who stated that birds that grow faster than average, normally consume more feed than the average, and that mature birds of broiler strains consume food than laying birds. This is also in line with the report of Oluyemi and Roberts (2000) that, as the birds increase in their body size, the feed consumption increase but its efficiency of feed utilization decreases.

The mean daily feed intake in the finisher phase ranges from 100.27g/bird/day – 107.56g/bird/day (Table 7 of Appendix 47). These values did not compare favorably with the 160g/bird/day recommended by Olomu (2011) for broilers at 9 – 10 weeks of age.

In terms of body weight change, there were no significant (P>0.05) differences between treatment groups. However, birds on diet 2 have the highest weight change per day while those on diet 4 had the poorest of 25.5kg per bird per day (Table 7 in Appendix 47) and despite that they consume more; there efficiency of feed utilization is poor.

The feed conversion ratio of the broiler finisher ration did not show any significant (P>0.05) differences between treatment means The feed conversion ratio is 3.43, 3.33, 4.04, 3.95 and 3.84 for diets 1, 2, 3, 4 and 5 respectively. Generally, the FCR values were poorer than the value of 2.5 recommended as the best conversion ratio (NRC, 1996).

5.4 Performance of broiler chickens [week 2 – 9]

The overall results of performance of broiler chicks fed levels of *Balanite aegyptiaca seed* kernels cake from weeks 2-9 are shown in Tables 8 in Appendix 48 and 9. The results revealed that there were no significant (P>0.05) differences in feed intake, indicating that the graded levels of the seed kernels cake of *Balanite aegyptiaca* did not affect feed intake of the birds as compared to the control.

The increases in feed intake among the treatment groups were not consistent. Birds in diets 3 and 5 recorded the highest feed intake while birds in diet 2 recorded low feed intake. The increase in feed intake at this stage of growth agrees with the report of Smith (1996), that broiler birds at their final stages of growth consumed more feed. Several studies have reported increase feed intake at the finisher stage (Aderolu *et-al*; 2007 and Bolu and Adekeja, 2008).

The increase in feed intake may be due to high fiber content of the diets with the increase inclusion of the seed kernels. This is in conformity with the report of Savory and Gentle (1976) and Fanimo *et al* (2007) that high fiber increase feed intake to allow birds meet their requirement for some dietary component other than energy. Also high feed intake recorded may indicates a reduced utilization of the feed as the level of seed kernels increases in the diet due to the presence of some anti nutritional factors (e.g. oxalate, pyhtate, saponin and tannin). This is in line with the report of Ortiz *et al*, (1994) cited by Fanimo, *et al,* (2007) that anti nutritional factors such as tannin, phytate, saponin etc. had adverse effect on feed intake. However, Nkafamiya *et al,* (2007) reported that the levels of anti nutrients present in the seeds of *Balanite aegyptiaca* are low to significantly interfere with nutrients utilization and that the levels are below the established toxic level.

There are high significant (P<0.05) differences observed in final body weight change of the birds fed graded levels of seed kernels of *Balanite aegyptiaca* as compared to birds on the control diets. Birds on the control diet recorded the highest body weight change while birds on diets 4 recorded the poorest. Firman (1993) reported that body weight change of broilers depends on the nutrient requirements of the birds and the balanced diets containing 3200 M.E Kcal/kg. The calculated analysis of the M.E Kcal/kg of the formulated diets are within the recommended value of 3200 M.E Kcal/kg, but yet, poor body weight change is observed. The final weight change of the birds decreased (P>0.05) with increasing levels of the seed kernels. This may be attributed to the presence of anti nutritive factors presented in the seed kernels. This is in line with the report of Fanimo *et al,* (2007) that the presence of these anti nutritive factors can reduce growth rate of broilers due to reduce protein and specific amino acids utilization. The authors went further to state that with the reduced availability of these nutrients and minerals and some levels of anti nutritive factors, animals consuming the diets may not be able to meet their nutrients requirements for tissue building, hence the poor growth rate of the birds fed graded levels of the seed kernels. Also high fibre levels in diets had significant effects on the growth and feed utilization of birds.

The feed conversion ratios were significantly (P<0.05) different. Birds on the control diet had the best feed conversion ratio while birds on diets 3 had the poorest. Generally, the feed conversion ratios were poorer than the recommended value of 2.5 (NRC, 1996).

The poorer feed conversion ratios observed in other treatment diets may be due to the increase in the level of inclusion of the seed kernels cake of *Balanite aegyptiaca.*

The results of the carcass and internal organs characteristics shows that they were not significantly (P>0.05) affected by the graded dietary inclusion level of the seed kernels cake.

The results of cut-up parts and internal organs proportions were expressed as percentage of the live weight (Table 10).

There were significant (P<0.05) differences among the treatment groups for average live weight and dressed weight.

The diets had no significant influence on the juiciness, flavour intensity, tenderness, and non off - flavour of the meat samples from broilers fed the diets. The off – flavour scores were above the threshold value of five (5) indicating that no – off – flavour was detected. This is in line with the findings of Fanimo, *et a*l (2007) who fed broilers with graded levels of cashew nut testa (Table 11) .

The economic analysis of this study (Table 12) reveals that the cost of feed/kg was ₦ 66.06, ₦ 70.59, ₦ 74.75, and ₦ 76.53 for treatments 1, 2, 3, 4 and 5 respectively. Feed cost per kg gain increased with increasing levels of the seed kernels. This is in contract with the need for dietary formulation, which can be used as an alternative non competitive, easily available and cheap ingredient which can partly replace the conventional energy feed stuffs in poultry diets. The total cost of feed consumed per birds showed an increment from ₦ 330.33, in 0% to ₦ 410.07 in 20% inclusion of seed kernels of *Balanite aegyptiaca*. The increment in the cost of production may be due to the cost of processing the test materials which is traditionally done and lack of labor availability.

The results of the mortality rates among the treatment groups are presented in Table 9. A total of 25 birds died during the study period (weeks 2 – 9). The mortality rate was within a tolerable range and did not show any significant difference among the treatment.

The major causes of death were due to indigestion as a result of the inclusion of the seed kernels replacing maize in the broilers diets.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 Summary

The study was aimed at determining the proximate composition of *Balanites aegyptiaca* seed kernel cake and the performance of broiler chickens fed graded levels of *Balanites aegyptiaca* seed kernel cake. The research was carried out at the poultry production unit of the Farming Skills Acquisition Centre, Demsa, a training and demonstration centre of the Ministry of Agriculture, Yola, located at Demsa, Adamawa State.

The nuts or seeds of *Balanites aegyptica* were collected from Dowaya Fulani along Numan – Jalingo road of Adamawa State where the seeds are found in large quantities. The seeds/nuts were processed by soaking them in cold water with continuous changing of the water at the interval of 3 – 5hours for 24hrs in order to debitter the seeds. It was later removed and allowed to dry and then fried. After cooling, the kernels were pounded to paste using mortal and pestle.

A total of one hundred and fifty (150) day old broiler chicks of Anak strain were used for the research. The chicks were purchased from CH1 LTD, AZANLA HATCHARY FARM Ibadan through Silas Farm, Yola. The chicks were given water and commercial boiler starter *ad-libitum* for seven (7) days. At eight (8) days, the chicks were ready for the commencement of the research.

A completely Randomized Design (CRD) was used for the experiment. The feeding trial lasted for 56 days (8 weeks). There were five treatments and each treatment had 30 birds for the starter and finisher period. The diets were formulated such that *Balanite* aegyptiaca seed kernel cake was used at 0, 5, 10, 15, and 20% graded levels. The formulated diets corresponded to treatment diets 1, 2, 3, 4 and 5 respectively. Treatment I served as the control. The diets in each case (starter and finisher) consisted of 23% and 19% CP respectively.

The results show that the seed kernels cake is a potential ingredient for formulating animal feeds based on the nutritional status of the seed kernel.

The results of the productive performance shows that there were no significant (P>0.05) differences in feed intake while body weight gain and feed conversion ratios were generally lower indicating that, the replacement of maize with seed kernels had adverse effects on the body weight change and feed conversion ratio of the broilers compared to control diet.

The carcass and internal organs characteristics revealed they were not affected significantly (P>0.05) by the varying dietary inclusion levels of the seed kernels. The diets also had no significant influence on the juiciness, tenderness and off flavor of the meat samples from the broilers fed the diets.

Economically, the cost of feed per kg and the cost of feed per kg weight gain increased with the increasing levels of the seed kernels indicating that there was no cost savings. The results on mortality shows that birds died as a result of indigestion which is due to increase feed intake with poor utilization and to some extend the presence of anti- nutritional factors in the seed kernels.

6.2 Conclusion

From the results of the study, seed kernels of *Balanites aegyptiaca* can be a potential non – conventional energy feed resource that could be adequate in formulating animal feeds, more especially broilers based on it nutritional status. The effects on the production performances can be improved if an enhanced processing method is adopted thereby bringing about gains comparable to those of the control diet at the cheapest, in terms of economy of feed conversion leading to gain comparable to control diet. It can therefore be concluded that broilers at the finisher stage can utilized and tolerate up to 20% inclusion seed kernel cake of *Balanite aegyptiaca.*

6.3 Recommendation

Considering the above findings, it is clear that the seed kernels can be used in formulating animals feeds more especially for broilers. It has high food energy and can be used to supplement the daily energy intake of broilers. Therefore, it is recommended that about 20% of maize content of broiler diets can be replaced with the seed kernel of *Balanite aegyptiaca* at the finishers stage. This is because at this stage they can utilize the feed effectively. It is also recommended that further study should be carried out and an upgraded processing method should be adopted and recommended. The traditional method of cracking the seeds which is now scarce due to lack of labor should be improved to reduce production cost.

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APPENDIX

Appendix 1: Average Weekly Body Weight Gain Per Bird (g)

Week	T1	T2	T3	T4	T5
1	70	70	70	70	70
2	155	126.7	113.3	124.6	121.7
3	269.3	170.6	155.4	163.8	151.9
4	385.2	361.5	317.5	310.0	292.5
5	622.2	439.1	431.0	429.2	413.1
6	774.1	599.4	570.2	595.8	567.5
7	1075.5	885.4	789.4	803.4	826.5
8	1269.7	1031.5	930.0	948.2	1053
9	1493.8	1307.9	1167.5	1143.3	1188.1

Appendix 2: Average weekly body weight change per bird (g)

Week	T1	T2	T3	T4	T5
2	85	56.7	43.3	54.6	51.7
3	114.3	43.9	42.1	39.2	30.2
4	115.9	190.9	162.1	146.2	140.6
5	237	77.6	113.5	119.2	120.6

6	151.9	160.3	139.2	166.6	154.4
7	301.4	286	219.2	207.6	259
8	194.2	146.1	140.6	144.8	226.5
9	224.1	276.4	237.5	195.1	135.1

Appendix 3: Average weekly feed intake per bird (g)

Week	T1	T2	T3	T4	T5
2	148.4	175.2	216.4	198.6	201.6
3	173.8	207.6	230.9	207.7	204.8
4	231.5	233.5	323.8	279.6	297.3
5	395.6	402.6	425.5	370.6	410.7
6	555.2	506	555.8	509.8	503.8
7	676.9	624.7	612.5	597.1	624.5
8	798.6	734.8	752.7	685.4	757.2
9	957.4	966.1	1090.7	1015.2	1060.8

Total	3937.4	3850.5	4208.3	3864	4060.7
Mean	492.2	481.3	526	483	507.6

Appendix 4: Average weekly feed conversion ratio per bird

Week	T1	T2	T3	T4	T5
2	1.75	3.09	5.00	3.64	3.90
3	1.52	4.73	5.48	5.30	6.78
4	2.00	1.22	2.00	1.91	2.11
5	1.67	5.19	3.75	3.11	3.41
6	3.66	3.15	3.99	3.06	3.26
7	2.25	2.18	2.79	2.88	2.41
8	4.11	5.03	5.35	4.73	3.34
9	4.27	3.49	4.59	5.20	7.85
Total	21.23	28.08	32.95	29.83	33.06
Mean	2.65	3.51	4.12	3.73	4.13

Appendix 5: Body Weight Change per Bird (Cummulative 2-9 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average

T1	1458.55	1407.82	1405.04	1423.80
T2	1021.96	1287.10	1396.62	1235.23
T3	1115.48	1079.80	1097.23	1097.24
T4	1164.03	1055.04	1042.03	1087.03
T5	1057.58	1179.01	1117.72	1118.10

Appendix 6: Feed Intake per Bird (Cummulative 2- 9 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	4035.05	3698.15	3979.71	3904.30
T2	3495.23	3873.55	4182.84	3782.83
T3	4185.25	3799.46	4640.73	4204.48
T4	4020.62	3501.74	4067.19	3863.18
T5	4167.01	3671.39	4343.62	4060.67

Appendix 7 : Feed Conversion Ratio (Cummulative 2-9 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	2.77	2.63	2.83	2.74
T2	3.42	3.01	2.99	3.14
T3	3.75	3.52	4.23	3.83
T4	3.45	3.32	3.90	3.56
T5	3.94	3.11	3.89	3.65

Appendix 8: Body Weight change Per Bird for Starter Rations

(2 – 5 weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	546.64	557.76	552.20	552.20

T2	370.03	363.36	368.91	367.43
T3	380.04	380.04	302.90	354.33
T4	355.72	380.03	383.09	372.95
T5	355.00	330.00	344.28	343.09

Appendix 9: Feed Intake per Bird for Starter Rations (2-5 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	946.76	845.75	965.35	916.29
T2	988.35	1023.67	1044.84	1018.95
T3	1173.71	1074.29	1342.02	1196.67
T4	1033.93	988.18	1144.93	1055.68
T5	1119.81	1022.27	1201.09	1114.39

Appendix 10: Feed Conversion Ratio for Starter Rations (2 – 5 Weeks)

.

	Replicates			Mean
Treatment	R1	R2	R3	Average

T1	1.73	1.52	1.73	1.66
T2	2.67	2.81	2.83	2.77
T3	3.09	2.83	4.43	3.45
T4	2.91	2.60	2.99	2.83
T5	3.15	3.10	3.48	3.24

Appendix 11: Feed Intake per Bird for Finisher Rations (6 – 9 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	3088.29	2852.40	3023.36	2988.08
T2	2506.88	2849.88	3138.00	2831.59
T3	3011.54	2725.17	3298.71	3011.81
T4	2986.69	2513.56	2922.26	2807.50
T5	3047.20	2649.12	3142.53	2946.28

Appendix 12: Body Weight Change per Bird for Finisher (6-9 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	911.91	850.06	852.82	871.60

T2	651.93	923.74	1024.71	866.79
T3	735.44	699.73	794.33	743.17
T4	808.31	675.01	658.94	714.09
T5	702.58	849.01	773.44	775.01

Appendix 13: Feed Conversion Ratio for Finisher Rations (6-9 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	3.39	3.35	3.54	3.43
T2	3.84	3.08	3.06	3.33
T3	4.09	3.89	4.15	4.04
T4	3.69	3.72	4.43	3.95
T5	4.34	3.12	4.06	3.84

Appendix 14: Body Weight Change per Bird per Day for Starter Ration (2-5 Weeks)

Treatment	Replicates R1	R2	R3	Mean Average
T1	19.52	19.92	19.72	19.72
T2	13.21	12.98	13.17	13.12
T3	13.57	13.57	10.82	12.65
T4	12.70	13.57	13.68	13.32
T5	12.68	11.78	12.95	12.47

Appendix 15: Feed Intake per Bird per Day for Starter Ration

(2-5weeks)

Treatment	Replicates R1	R2	R3	Mean Average

T1	33.82	30.20	34.15	32.72
T2	35.30	36.56	37.31	36.39
T3	41.92	38.37	47.93	42.74
T4	36.93	35.29	40.89	37.70
T5	39.99	36.51	42.90	39.80

Appendix 16: Feed Conversion Ratio per Bird per Day for Starter Ration (2-5 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	1.73	1.52	1.73	1.66
T2	2.67	2.82	2.83	2.77
T3	3.09	2.83	4.43	3.45
T4	2.91	2.60	2.99	2.83
T5	3.15	3.10	3.31	3.19

Appendix 17: Body Weight per Bird per Day for Finisher Ration

(6-9 weeks)

Treatment	Replicates R1	R2	R3	Mean Average
T1	32.57	30.36	30.46	31.13
T2	23.28	32.99	51.38	35.88
T3	36.77	24.99	28.37	30.04
T4	28.87	24.11	23.53	25.50
T5	25.09	30.32	27.62	27.67

Appendix 18: Feed Intake per Day for Finisher Ration (6-9 Weeks)

Treatment	Replicates R1	R2	R3	Mean Average
T1	110.30	101.87	107.98	106.72
T2	89.53	101.78	112.07	101.13
T3	107.55	97.33	117.81	107.56
T4	106.67	89.77	104.37	100.27
T5	108.83	94.61	112.23	105.22

Appendix 19: Feed C0nversion Ratio per Bird per Day for Finisher Ratio (6-9 Weeks)

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	3.39	3.35	3.54	3.43
T2	3.84	3.08	2.18	3.03
T3	2.92	3.89	4.15	3.65
T4	3.69	3.72	4.43	3.95
T5	4.37	3.12	4.06	3.85

Appendix 20: Live Weight Gain

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	1528.55	1477.82	1475.04	1493.80
T2	1099.96	1357.10	1466.62	1307.90
T3	1185.48	1149.77	1167.23	1167.49

T4	1233.37	1125.04	1071.47	1143.29
T5	1127.58	1249.01	1187.72	1188.10

Appendix 21: Dressed Weight

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	1228.55	1177.82	1275.04	1227.14
T2	849.96	1057.10	1216.62	1041.23
T3	985.48	999.77	967.23	984.14
T4	1033.37	975.04	921.47	976.63
T5	927.58	999.01	987.72	971.44

Appendix 22: Dressing Percentage

Treatment	Replicates R1	R2	R3	Mean Average
T1	80.37	79.70	86.44	82.17
T2	77.27	77.89	82.96	79.30
T3	83.13	86.95	82.86	84.31
T4	83.78	86.67	86.00	85.48
T5	82.26	79.98	83.16	81.80

Appendix 23: Weight of Head [In Percentage]

Treatment	Replicates R1	R2	R3	Mean Average
T1	3.27	3.38	3.39	3.35
T2	4.54	2.21	2.04	2.93
T3	2.53	3.48	1.71	2.57
T4	2.43	2.22	2.80	2.48
T5	2.66	4.00	3.37	3.34

Appendix 24: Weight of Neck [In Percentage]

Treatment	Replicates R1	R2	R3	Mean Average
T1	3.27	3.38	3.39	3.35
T2	4.54	2.21	1.36	2.70
T3	1.69	2.61	3.43	2.58
T4	2.84	2.04	1.87	2.25
T5	1.77	4.00	3.37	3.05

Appendix 25: Weight of Breast [In Percentage]

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	26.17	20.30	20.34	22.27
T2	22.73	15.47	15.00	17.73
T3	16.87	14.78	23.13	18.26
T4	19.46	17.78	14.00	17.08
T5	18.62	14.41	16.84	16.62

Appendix 26: Weight of Back

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	13.08	13.53	16.95	14.52
T2	13.64	9.58	10.91	11.38
T3	12.65	9.57	13.71	11.98
T4	11.35	14.22	10.27	11.95
T5	15.08	12.00	16.84	14.64

Appendix 27: Weight of Drumsticks [In Percentage]

Treatment	Replicates R1	R2	R3	Mean Average
T1	13.08	11.50	10.17	11.58
T2	15.45	11.05	8.86	11.78
T3	14.34	11.31	8.55	11.40
T4	9.73	11.55	15.87	12.38
T5	13.30	10.25	10.10	11.22

Appendix 28: Weight of Drumstick [In Percentage]

Treatment	Replicates R1	R2	R3	Mean Average
T1	13.08	10.15	10.17	11.13

T2	9.09	12.53	10.23	10.62
T3	13.50	12.18	12.85	12.84
T4	12.16	12.44	9.33	11.31
T5	15.08	8.81	10.94	11.61

Appendix 29: Weight of Shanks [In Percentage]

		Replicates		Mean
Treatment	R1	R2	R3	Average
T1	3.27	3.38	3.39	3.35
T2	4.54	3.21	3.07	3.61
T3	3.37	3.04	3.85	3.42
T4	3.24	4.44	3.27	3.65
T5	2.66	4.80	4.21	3.89

Appendix 30: Weight of Wings [In Percentage]

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	9.81	8.12	6.78	8.24
T2	9.09	9.58	5.45	8.04
T3	10.12	7.83	6.85	8.27
T4	8.11	8.89	8.39	8.46
T5	8.87	7.20	8.42	8.16

Appendix 31: Weight of Liver [In Percentage]

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	1.31	1.69	1.35	1.45
T2	1.36	1.47	0.68	1.17
T3	1.26	1.31	0.86	1.14
T4	1.62	1.33	0.93	1.32
T5	1.33	1.20	1.01	1.48

Appendix 32: Weight of Kidney [In Percentage]

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	0.03	0.03	0.01	0.02
T2	0.02	0.01	0.01	0.01
T3	0.01	0.01	0.02	0.01
T4	0.01	0.01	0.01	0.01
T5	0.02	0.01	0.01	0.01

Appendix 33: Weight of Lungs [In Percentage]

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	0.63	0.52	0.50	0.55
T2	0.33	0.38	0.50	0.40
T3	0.45	0.41	0.43	0.43
T4	0.48	0.43	0.38	0.43
T5	0.40	0.49	0.46	0.4

Appendix 34: Weight of Heart [In Percentage]

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	0.36	0.47	0.41	0.41
T2	0.33	0.42	0.47	0.41
T3	0.37	0.33	0.35	0.35
T4	0.40	0.32	0.30	0.34
T5	0.33	0.41	0.37	0.37

Appendix 35: Weight of Gizzard [In Percentage]

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	1.96	1.69	1.49	1.71
T2	2.73	1.47	1.23	1.81

T3	1.69	2.17	1.28	1.71
T4	1.62	1.60	1.40	1.54
T5	1.77	2.00	1.85	1.87

Appendix 36: Weight of Small Intestine [In Percentage]

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	3.27	3.38	3.05	3.23
T2	2.73	2.95	3.41	3.03
T3	2.95	3.48	3.00	3.14
T4	3.24	2.67	2.33	2.75
T5	2.66	2.40	2.52	2.53

Appendix 37: Weight of Large Intestine [In Percentage]

Treatment	Replicates R1	R2	R3	Mean Average
T1	0.98	0.95	0.81	0.91
T2	0.59	0.74	0.61	0.65
T3	0.84	0.65	0.77	0.75
T4	0.81	0.71	0.56	0.69
T5	0.88	0.64	0.50	0.67

SENSORY EVALUATION

Appendix 38: Juiciness

Treatment	Replicates R1	R2	R3	Mean Average
T1	7.05	6.45	6.55	6.68
T2	6.07	6.15	6.35	6.19
T3	6.58	6.75	6.06	6.46
T4	5.98	6.48	6.59	6.35
T5	5.90	5.98	6.66	6.18

Appendix 39: Flavor Intensity

Treatment	Replicates R1	R2	R3	Mean Average
T1	6.01	5.55	5.83	5.80
T2	5.10	5.45	5.93	5.49
T3	5.45	5.65	5.54	5.55
T4	6.22	5.25	5.35	5.61
T5	5.40	5.02	5.75	5.39

Appendix 40: Tenderness

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	5.55	5.68	5.69	5.64
T2	5.72	5.65	5.75	5.71
T3	6.01	5.85	5.18	5.68
T4	5.88	5.28	5.45	5.54
T5	5.25	5.45	5.35	5.35

Appendix 41: 0ff - Flavor

	Replicates			Mean
Treatment	R1	R2	R3	Average
T1	5.85	5.85	5.75	5.82
T2	5.20	5.68	5.68	5.52
T3	5.73	5.60	5.35	5.56
T4	5.60	5.62	5.55	5.59
T5	5.44	5.55	5.70	5.56

Table 42: Chemical composition of seeds kernel and Oil of *Balanites aegyptiaca*

Components %	Kernels	Oil
Protein	3.3	27.5
Fat	0.1	46.5
Carbohydrate	52.7	11.1
Fiber (Crude)	2.1	1.5
Ash	4.0	2.9
CaO	0.08	0.16
P_2O_8	0.10	1.00

Moisture	37.8	10.5
Kcal	231	591

Sources: Freeman (1998)

Table 43: Chemical Composition of the dry seeds (DM)

Component %	DM
Protein (crude)	2.8
Fat	0.4
Ash (insoluble)	21.2
Fibred (crude)	2.8
Carbohydrate (soluble)	
Starch	31.1
Sugar Sucrose	5.8
D-Glucose	20.6
D-fructose	10.1
Amino Acid (g) (16gN)-1	
Aspartic acid	5.1
Threonine	2.5
Serine	2.0
Glutamic acid	6.3
Proline	35.8
Glycine	3.3
Alanine	3.5
Valine	2.7
Cysteine	1.0
Methione	1.0

Isoleucine	2.7
Leucine	4.1
Tyrosine	2.2
Phenylalanine	2.7
Lysine	1.6
Histidine	1.2
Arginine	2.4
Minerals %	
Sulphur	0.10
Magnesium	0.10
Potassium	0.04
Calcium	0.12
Sodium	0.02
Zinc	10mg/kg
Iron	620mg/kg
Manganese	3mg/kg
Copper	2mg/kg
Specific gravity at 100^0c	88919
Saponification	186.5
Iodine absorption	99.2
Melting point	8891g

Source: Freeman, (1998)

Table 44: Estimated essential amino acid requirements of broilers and the level found in *Balanites aegyptiaca* seeds (DM)

	(1) Broilers			(2) *Balanites aegyptiaca*
	Wks 0-3	wks 3-6	wks 6-8	Seeds
Energy base Kcal. ME/kg Diet	3200	3200	3200	
Protein	23.0	20.0	18.0	
Essential Amino Acids	Estimated requirement of Broilers at various ages			Level Supplied
Arginine	1.44	1.20	1.00	2.4
Glycine + Series	1.50	1.00	0.70	
Histidine	0.35	0.30	0.26	1.2
Isoleucine	0.80	0.70	0.60	2.7
Leucine	1.35	1.18	1.00	1.6
Lysine	1.20	1.00	0.85	1.0
Methionine + Cystine	0.93	0.72	0.60	1.0
Methionine	0.50	0.38	0.32	1.0
Phenylalanine + Tyrosine	1.34	1.17	1.00	2.2
Phenylalanine	0.72	0.63	0.54	2.7
Threonine	0.80	0.74	0.64	2.5
Tryptophan	0.23	0.18	0.17	
Valine	0.82	0.72	0.62	2.7
Linoleic	1.00	1.00	1.00	

Source:- (1) NRC (2) Freeman (1998)

Table 45: showing the Nutritional parts of *Balanites aegyptiaca*

Sources: Traditional Food of Kenya, National Museum of Kenya, (1999) 288p

Table

Species	plant part	Energy kJ	water %	Protein g	fibre g	ash g	fat g	total CHO g	NFE g	vit C mg	b-carotein eq mg	Na mg	P mg	Ca mg	Mg mg	Fe mg	K mg	thi mg	ribo mg	niac mg	chlorides mg
Balanites aegyptiaca	fruit raw	511	64.0	2.2		1.9	tr.	31.9		14				47							
Balanites aegyptiaca	fruit dried	1151	19.0	5.0	3.1	4.4	0.1	71.5	68.4	35	0		62	141		3.1		0.20	0.11	1.17	
Balanites aegyptiaca	Kernel dried	2289	5.0	23.0	5.4	3.2	43.5	25.3	19.9	0	0		508	172		7.0		1.60?	0.07	1.3	
Balanites aegyptiaca	seeds	2140		27	1.0	3.7	34						720								
Balanites aegyptiaca	fruit	1129		4.9	3.5								58								
Balanites aegyptiaca	fruit	1357		4.1	6.6	3.9							80								

showing the Nutritional parts of *Balanites aegyptiaca*

APPENDIX 46

Table 5: **Effect of graded levels of *Balanite aegyptica* seed kernel cake on the performance of broiler starter per bird per day (week 2 – 5).**

	Treatment Groups					
Parameters	T1	T2	T3	T4	T5	SEM
Mean feed intake (g/bird/day)	32.72^{c}	36.39^{bc}	42.74^{a}	37.70^{ba}	39.80^{ba}	3.09^{*}
Mean body weight change (g/bird)	19.72^{a}	13.12^{b}	12.65^{b}	13.32^{b}	12.47^{b}	0.80^{**}
Mean Feed conversion ratio	1.66^{b}	2.77^{a}	3.45^{a}	2.83^{a}	3.18^{a}	0.40

a, b, c = Means within the same raw bearing different superscripts differ significantly (P<0.05)

* = Significantly different (P < 0.05) ; ** = highly significant P<0.01

APPENDIX 47

Table 7: **Effect of Graded Levels of *Balanite aegyptiaca* Seed Kernel cake on the Performance of Broiler Finisher per Bird per Day (wk 6-9)**

	Treatment Groups					
Parameters	T1	T2	T3	T4	T5	SEM
Cumulative feed Intake (g/bird	106.72	101.13	107.56	100.27	105.22	9.19^{NS}
Body weight change (g/bird)	31.13	35.88	30.04	25.50	27.68	7.17^{NS}
Feed conversion ratio	3.43	3.03	3.65	3.95	3.85	0.59^{NS}

Ns = not significant (P>0.05)

APPENDIX48

Table 8: **Effect of graded levels of *Balanite aegyptica* seed kernel cake on the performance of boiler chick (week 2 – 9).**

	Treatment Groups					
Parameters	T1	T2	T3	T4	T5	SEM
Average Cumulative feed Intake (g/bird	3904.3	3850.5	4208.5	3863.2	4060.7	331.23^{NS}
Average Body weight change (g/bird)	1423.8^{a}	1235.2^{b}	1097.0^{b}	1087.0^{b}	1118.1^{b}	96.45^{**}
Average Feed conversion ratio	2.74^{c}	3.14^{c}	3.83^{a}	3.56^{a}	3.65^{ba}	0.32^{*}

a, b, c = Means within the same raw bearing different superscripts differ significantly (P<0.05)

* - Significant, ** highly significant.

Appendix 49: Mean Square for body weight change per bird (cumulative 2-9 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	243027.33	60756.83	6.53	0.008^{**}
Error	10	93023.03	9302.30		
Total	14	336050.36			

** =highly significant (P<0.01)

Appendix 50: Mean Square for feed intake per bird (cumulative 2-9 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	284443.31	71110.83	0.65	0.64^{ns}

Error	10	1097109.18	109710.92		
Total	14	1381552.49			

ns =not significant (P>0.05)

Appendix 51: Mean Square for feed conversion ratio per bird (cumulative 2-9 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	2.31	0.58	5.67	0.01**
Error	10	1.01	0.10		
Total	14	3.33			

** = highly significant (P<0.01)

Appendix 52: Mean Square for body weight change per bird for starter ration (2-5 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	90785.2	22696.3	47.10	0.0001**
Error	10	4818.83	481.88		
Total	14	95604.02			

** = highly significant (P<0.01)

Appendix 53: Mean Square for feed intake per bird for starter ration (2-5 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	131982.3	32995.57	4.41	0.03*
Error	10	74795.93	7479.59		
Total	14	206778.23			

* = significant (P<0.05)

Appendix 54: Mean Square for feed conversion ratio per bird for starter ration (2-5 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	5.76	1.44	8.53	0.003**
Error	10	1.70	0.17		
Total	14	7.45			

** = highly significant (P<0.01)

Appendix 55: Mean Square for feed intake per bird for finisher ration (6-9 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	10255.40	25630.60	0.39	0.81^{ns}
Error	10	66250.75	66251.08		
Total	14	765033.75			

ns =not significant (P>0.05)

Appendix 56: Mean Square for body weight change per bird for finisher ration (6-9 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	61955.55	15488.89	1.47	0.28^{ns}
Error	10	105522.54	10552.25		
Total	14	167478.08			

ns =not significant (P>0.05)

Appendix 57: Mean Square for feed conversion ration per bird for finisher ration (6-9 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	1.23	0.31	1.90	0.19^{ns}
Error	10	1.62	0.16		
Total	14	2.85			

ns =not significant (P>0.05)

Appendix 58: Mean Square for body weight change per bird for starter ration (2-5 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	113.36	28.34	43.76	0.0001**
Error	10	6.48	0.65		
Total	14	119.84			

** = highly significant (P<0.01)

Appendix 59: Mean Square for feed intake per bird for starter ration (2-5 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	168.55	42.14	4.42	0.03*
Error	10	95.40	9.54		
Total	14	263.95			

* = significant (P<0.05)

Appendix 60: Mean Square for feed conversion ratio per bird for starter ration (2-5 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	5.61	1.40	8.62	0.003**
Error	10	1.63	0.16		
Total	14	7.24			

** = highly significant (P<0.01)

Appendix 61: Mean Square for feed intake per bird for starter ration (2-5 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	184.50	46.12	0.90	0.50^{ns}
Error	10	514.91	51.49		
Total	14	699.41			

ns =not significant (P>0.05)

Appendix 62: Mean Square for feed intake per bird per day for finisher ration (6-9 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	130.74	32.69	0.39	0.81^{ns}
Error	10	845.07	84.51		
Total	14	975.82			

ns =not significant (P>0.05)

Appendix 63: Mean Square for feed conversion ratio per bird per day for finisher ration (6-9 weeks)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal

Treatment	4	1.61	0.40	1.17	0.38^{ns}
Error	10	3.44	0.34		
Total	14	5.05			

ns =not significant (P>0.05)

Appendix 64: Mean Square for live weight (%)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	252914.28	63228.57	6.71	0.0069**
Error	10	94282.71	9428.27		
Total	14	347196.99			

ns =not significant (P>0.05), ** highly significant (P<0.01)

Appendix 65: Mean Square for dressed weight (%)

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	140570.35	35142.59	4.28	0.03*
Error	10	82072.05	8207.20		
Total	14	222642.40			

ns =not significant (P>0.05), * = significant (P<0.05)

Appendix 66: Mean Square for dressing percentage

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	67.51	16.88	2.50	0.10ns
Error	10	67.41	6.74		
Total	14	134.91			

ns =not significant (P>0.05)

Appendix 67: Mean Square for head weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	1.98	0.50	0.76	0.57ns
Error	10	6.55	0.66		
Total	14	8.53			

ns =not significant (P>0.05)

Appendix 68: Mean Square for neck weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	2.16	0.54	0.53	0.71ns
Error	10	10.13	1.01		
Total	14	12.29			

ns =not significant (P>0.05)

Appendix 69: Mean Square for breast weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	61.02	15.25	1.24	0.35ns
Error	10	122.71	12.27		
Total	14	183.73			

ns =not significant (P>0.05)

Appendix 70: Mean Square for back weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	29.20	7.30	1.55	0.26ns
Error	10	47.12	4.71		
Total	14	76.32			

ns =not significant (P>0.05)

Appendix 71: Mean Square for drumstick weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	2.42	0.61	0.09	0.98ns

Error	10	69.96	6.70		
Total	14	72.38			

ns =not significant (P>0.05)

Appendix 72: Mean Square for thigh weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	8.30	2.08	0.53	0.71ns
Error	10	38.95	3.89		
Total	14	47.25			

ns =not significant (P>0.05)

Appendix 69: Mean Square for shanks weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.55	0.14	0.27	0.89ns
Error	10	5.04	0.50		
Total	14	5.58			

ns =not significant (P>0.05)

Appendix 70: Mean Square for wings weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.29	0.07	0.03	0.99ns
Error	10	22.29	2.22		
Total	14	22.52			

ns =not significant (P>0.05)

Appendix 71: Mean Square for live weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.19	0.05	0.56	0.70ns
Error	10	0.87	0.09		
Total	14	1.06			

ns =not significant (P>0.05)

Appendix 72: Mean Square for kidney weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal

Treatment	4	0.0003	0.00008	1.64	0.24ns
Error	10	0.0005	0.00005		
Total	14				

ns =not significant (P>0.05)

Appendix 73: Mean Square for lungs weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.04	0.009	2.77	0.09ns
Error	10	0.04	0.004		
Total	14				

ns =not significant (P>0.05)

Appendix 74: Mean Square for heart weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.01	0.003	1.27	0.35
Error	10	0.03	0.003		

Total	14	0.04

ns =not significant (P>0.05)

Appendix 75: Mean Square for gizzard weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.19	0.05	0.26	0.89
Error	10	1.86	0.19		
Total	14	2.05			

ns =not significant (P>0.05)

Appendix 76: Mean Square for small intestines weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	1.03	0.26	2.79	0.09ns
Error	10	0.93	0.09		
Total	14	1.96			

ns =not significant (P>0.05)

Appendix 77: Mean Square for large intestines weight

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.14	0.03	2.22	0.14ns
Error	10	0.15	0.02		
Total	14	0.29			

ns =not significant (P>0.05)

Appendix 78: Mean Square for juiciness

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.53	0.13	1.24	0.36ns
Error	10	1.07	0.10		
Total	14	1.59			

ns =not significant (P>0.05)

Appendix 79: Mean Square for flavor intensity

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.27	0.069	0.52	0.72ns

Error	10	1.31	0.131		
Total	14	1.59			

ns =not significant (P>0.05)

Appendix 80: Mean Square for tenderness

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.25	0.063	1.03	0.44ns
Error	10	0.62	0.062		
Total	14	0.87			

ns =not significant (P>0.05)

Appendix 81: Mean Square for off-flavour

Source of variation	DF	Sum of squares	Mean square	F-value	F cal
Treatment	4	0.17	0.04	1.54	0.26ns
Error	10	0.27	0.03		
Total	14	0.44			

ns =not significant (P>0.05)