EFFECT OF SOYABEAN REPLACEMENT WITH LEUCAENA LEAF MEAL ON THE GROWTH PERFORMANCE AND CARCASS QUALITY OF WEANED RABBITS

BY

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DEDICATION

This report is dedicated to the Greatest God of all, for being my overall helper and sufficiency during the period of my project. I also dedicate this report to my indispensable parent and siblings for their love, support and encouragement. It is also dedicated to the Department of Animal Production and Health, Faculty of Agriculture, Federal University Oye Ekiti.

DECLARATION

I, BALOGUN GBEMISOLA OMOLAYO, hereby declare to the Senate of Federal University Oye- Ekiti, that this project is my own original work done within the period of June and July, 2017 and it is neither been submitted before nor being currently submitted in any other institution. All citations and sources of information are clearly acknowledged by means of references.

Balogun Gbemisola Omolayo **Date**

CERTIFICATION

The project titled growth, "**EFFECT OF SOYABEAN REPLACEMENT WITH LEUCAENA LEAF MEAL ON THE GROWTH PERFORMANCE AND CARCASS QUALITY OF WEANED RABBITS**" by Balogun Gbemisola Omolayo, meets the regulation governing the award of the degree of Bachelor of Agriculture in Animal Production and Health of the Federal University Oye-Ekiti. Ekiti State.

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ABSTRACT

There has been a gradual increase of the price of feed resources from conventional protein leading to the inadequate supply of animal protein. *Leucaena leucocephala* (lam) is a leguminous browse plants that can be used in diets to replace or used in combination with protein source conventional feed ingredients. It's use has been imperative / limited to a very low level of inclusion because of inherent anti – nutritional factor (Mimosine) which interferes with feed utilization and affect the health and production of the animal this study was conducted to determine the effect of replacing soya-bean meal (SBM) with leucaena leaf meal (LLM) in the diets of weaned rabbits. Fifteen weaned rabbits of average initial weight of 600-800g were allotted to three treatments, each with five replicates in a completely randomized design were used to determine the growth performance and carcass yield of weaned rabbits. The experiment was carried out at the Animal Production and Health Teaching and Research farm, Federal University Oyẹ- Ekiti. The feeding trial lasted for seven weeks. The treatments were diet 1(control, without LLM replacement) and diet 2 and 3 where soya-bean meal (SBM) was replaced by 50% and 100% respectively. The result showed that substitution of SBM with LLM did not significantly ($P<0.05$) influence the growth performance except for the cost of fẹed intake which was significantly ($P<0.05$) affected, where treatment 3 has the lowest value and the highest recorded in treatment 1(control). The organ weights were not affected by the experimental diets significantly ($P<0.05$). The carcass weight and dressing percentage were also not significantly ($P<0.05$) affected. Result of the study showed that LLM could be used to supplement SBM up to 100% on the diets of weaned rabbits without adverse effect on the rabbits.

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CHAPTER ONE

1.0 INTRODUCTION

The major concentration of animal rearers in Nigeria is basically cattle, sheep, goat, pigs and poultry as potential sources of protein. There has been a dramatic setback in the livestock industry due to the cost implied in raising these animals and inability to meet up with the rise in demand for the required protein of the animal origin. Factors such as; increased competition for basic raw materials which include maize and sorghum by man, animal and industry, inadequate grazing land especially for ruminants, diseases and pest infestation and poor government policies are responsible for the inadequate supply of animal protein and the high cost of the available quantities in the market. Meeting the protein requirement by these animals has been a major problem that needs to be addressed.

In order to confiscate this problem, efforts have been directed towards micro livestock such as rabbits, grasscutters and snails. These animals have been described based on observation to be highly prolific with short generation interval capable of attaining maturity within a short period of time. These animals are associated with great biological efficiency in the utilization of cheap and locally available feedstuffs (Ologhobo *et al.*, 2003) and are therefore potentially capable of playing a key role in solving the problem of inadequate protein intake.

Major considerations were given to rabbit productions in order to solve to solve the problem of shortage of protein to meet the necessary requirements. Rabbits are efficient converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species. Egbo *et al.* (2015).

The growing interest in rabbit production has endeared academic researchers to source for alternative means of high quality plant protein in the rabbit diet. Makinde *et al.*, 2014 have advocated the development of alternative feeding materials that will be relatively cheap when compared with commercial feeds or conventional feedstuffs. Rabbits have the potential of utilizing such unconventional feedstuffs as *Mucuna utilis* leaf meal (Sese *et al.*, 2014), neem leaf meal (Ogbuewu *et al.*, 2008), pigeon pea seeds (Amaefule *et al.*, 2005) and other diverse plant materials.

It is well recognized that malnutrition is a common problem for impoverished people in the lesser developing countries (LDC). For example, per caput animal protein consumption is about 13 g/d in the LDC compared to 60 g/d in developed countries (Sansoucy 1995). Malnutrition, coupled with limited land holdings, high unemployment, and increasing cereal grain costs, have attracted limited-resource farmers to rabbit meat production as an alternative agricultural enterprise in several of the LDC's (Owen 1981; Lukefahr and; Colin and Lebas 1996).

With increasing scarcity of animal protein and the high cost of commercial feed, particularly in the developing countries, forage, after being converted to meat, may play an important role in enhancing the quality of human food. Forage tree legume feeding has been advocated and is being adopted by small to medium scale livestock farmers in the tropics to boost the nutritional regimes of their animals.

Rabbits can be produced on forages alone, although production can improve by adding other feed supplements. The need to explore other less common, but potential, sources of animal protein such as rabbits has been supported (Bamgbose *et al.*, 2004: Maidala and Istifanus,2012). Nutritionally, rabbit has a higher protein (20-21%), low fat content (10-11%), when compared with meat from other species. Rabbit meat has the cholesterol value of 169mg/100g (dry matter basis) when compared with beef (200mg), chicken (220mg), and low sodium content (Janieri, 2003) Soya bean meal and fish meal have been widely used as conventional protein sources for livestock; however, the prices of these feed ingredients have been on the increase with instability in their supplies in the market (Adeokojo *et al.,* 2014)

Currently, research efforts in Nigerian livestock industry are geared towards identifying and exploiting novel feed ingredients which are not in strict competition with man's dietary need. These novel feed ingredients include: industrial by-products and leaf meals of tropical browse plants such as *Microdesmis spp* (Esonu *et al.*, 2002), Paw paw leaf meal (Bitto *et al.*, 2006), *Mucuna pruriens* (Emenalom *et al.*, 2009), *Leucaena leucocephala* (Adekojo *et al.*, 2014) and *Azadirachta indica.* (Esonu *et al.*, 2006; Ogbuewu *et al.*, 2009).

Soybean (Glycine max (L.) Merrill) is a principal vegetable protein source in animal feed industry in Nigeria. The use of soybeans without oil extraction that is full fat soybean has great nutritional properties. It is high in protein with unique biological value, its fat content contribute to the energy required for protein synthesis. Full fat soybean contain between 38-40%CP, 18% fat and 5% crude fibre (Smith, 2001). Soybean can be used as a source of sole source of protein in poultry and swine diets. The quality of protein of soybean can be comparable to that of animal protein sources such as meat and milk (Fabiyi and Hamidu, 2011).

In several separate studies which involved feeding trials, leaf meals from Aspilia africana and Tridax procumbens (Ojebiyi *et al.,* 2013), Leucaena leucocephala (Lamidi and Akilapa, 2013), Balanites aegyptiaca (Saleh *et al.,* 2014) were reported to supply nutrients and improve the performance of rabbits. Similarly, leaf meals from Centrosema, Manihot, Tithonia, Gmelina arborea and M. Puberula have been reported to supply nutrients and improve the performance of pigs (Obua *et al.,* 2013). They thrive throughout the year and readily come to mind as an unconventional protein source with lots of potentials to be exploited in rabbit feeding. The most expensive nutrient in feed ingredient is protein sources such as soybean meal. Alternative protein sources for example plant proteins are more attractive sources to replace soybean meal due to the high protein content and low price. One of such alternative plant protein sources that is locally available and can ensure sustainability of the production is *Leucaena leucocephala* which is common in various locations. Like most legumes, Leucaena leucocephala (Leucaena) and *Macroptilium atropurpureum* (Siratro) are deep rooted legumes which have their origin in Mexico and Jamaica respectively, but have become naturalized in Nigeria (Babayemi *et al.,* 2006). *Leucaena leucocephala* is one the highest quality and most palatable fodder trees of the tropics, often being described as the 'alfalfa of the tropics'. The leaf quality compares favorably with alfalfa or Lucerne in feed value except for its higher tannin content and mimosine toxicity to non-ruminants. Studies on *Leucaena leucocephala* have shown a high nutritional value that could adequately be fed to livestock in place of the conventional protein sources such as soya bean meal, fish meal and groundnut cake for which man and his animals are in keen competition. *Leucaena leucocephala* has been identified to hold the potential to make contributions to rabbit nutrition with the possibility of reducing a total dependence on conventional protein sources (Adama and Adekojo, 2002). Its anti-nutritional factor, mimosine has been reported to cause weight loss, ill health, organ damage and hair loss in rabbits at a level above 7.5 – 20% inclusion when fresh or unprocessed *Leucaena leucocephala* is included in the diet (Fayemi *et al.*, 2011).

This study therefore evaluated the effects of dietary replacement of soybean with *Leucaena leucocephala* leaf meal on carcass quality and growth performance of weaner rabbits.

1.1 STATEMENT OF PROBLEM

Findings have certified that there are less forages and pasture plants during the dry season especially in Nigeria. In respect to this, farmers have problems sourcing for forages to be given to their animals in this season and would always resort to giving their animals concentrate based feeds only to provide their animals with the required nutrients.

1.2 JUSTIFICATION OF THE STUDY

There are diverse information on the use of leucaena in animal feeding and due to the recognition of the suitability and unique biological and behavioral attributes of rabbit, gaining popularity in the developing countries (Nigeria), an evaluation of the replacement soy bean with the leucaena leaf meal at different levels in the rabbit feed is imperative. This is the drive of this research.

1.3 OBJECTIVES

1.3.1 BROAD OBJECTIVES

- To determine the effect of mimosine in the growing rabbits fed with leucaena leaves in the compounded feed on their growth performance and meat quality.

1.3.2 SPECIFIC OBJECTIVES

- To measure the daily weight gain of the growing rabbits for 10weeks
- To determine their carcass weight and meat quality.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 SOYABEAN (*Glycine max*)

Soybean is a legume and has been successfully cultivated around the world. Soybeans and soybean products are now used widely in animal feeding. (Leilane *et al.*, 2011)The crop is grown as a source of protein and oil for the human market and for the animal feed market. Soybean meal is generally regarded as the best of plant protein source in terms of its nutritional value. Also, it has a complementary relationship with cereal grains in meeting the amino acids (AA) requirements of farm animals. Consequently, it is the standard to which other plant protein sources are compared (Blair, 2008).

2.1.2 SOYBEAN MEAL

Soya bean meal (SBM) according to Kellems and Church (2006), soya bean meal is the product obtained by grinding the flakes which remain after removal of most of the oil from either whole or dehaulled soya beans by a solvent extraction process. Soya bean meal is a highly favoured feed ingredient because it is quite palatable, highly digestible, has high energy value and results in excellent performance when used for different animal species (Kellems and Church, 2006).

Table 2.1: Crude protein and essential amino acids in soya bean meal (DM basis)

Item	Soya bean meal, solvent extracted
Dry matter, %	89.1
Crude protein	52.4
Essential amino acids (%)	
Arginine	3.8
Cysteine	0.8
Histidine	1.4
Isoleucine	2.8
Leucine	4.3
Methionine	0.7
Lysine	3.4
Phenylalanine	2.8
Threonine	2.2
Tryptophan	0.7
Valine	2.8

Source: NRC (1994)

The protein in soya bean meal contains all the essential amino acids but the concentrations of cysteine and methionine are sub-optimal (McDonald *et al.*,1988). Methionine is the first limiting amino acid and may be particularly important in high energy diets. The quality of protein in soya bean meal is dependent on the cultivar and processing method. Under processing may lead to deleterious level of anti-nutritional factors which may impact negatively on the growth and performance especially in young animals. By contrast, excessive heating reduces the availability of some amino acids particularly lysine in soya bean meal (Parkhurst, 1988). Raw soya bean should not be fed to animals, because of the presence of trypsin inhibitor that must be destroyed by heat or other methods. In the case of young growing chicks, raw soya beans will produce only about two-thirds of the growth achieved with processed soya bean meal (North and Bell, 1990). Say (1987) reported that soya bean meal must be subjected to heat treatment that improves its digestibility and also destroys some of the toxic factors present in the raw soya bean. Apart from problems associated with either under or over processing, a major concern with the use of soya bean meal is its relatively low metabolizable energy content. Soya bean meal is best supplemented with some animal or fish protein to make up its deficiencies of certain amino acids (North and Bell, 1990). Soya bean meal is adequate in magnesium and a good source of potassium and supplies a fair amount of trace elements (Lassiter and Hardy, 1982). According to Say (1995), soya bean meal is very often used in large proportions, of the order of 30% for growing poultry and 20% for layers.

2.1.4 SOYBEAN AND ANIMAL GROWTH PERFORMANCE

The effects of soybean on weight gain, feed intake, and feed efficiency are somewhat variable. Greiner et al. (2001) found that soybean genistein (200 mg/kg) and daidzein (200 or 400 mg/kg) could improve growth in virally challenged pigs.

Kim et al. (2012) reported that feeding of totally mixed ration containing up to 35% raw soybean curd residue enhanced dry matter intake and growth rate of steers without deterioration of meat quality. According Fasina *et al.*, 2004, when lectins are ingested by animals, they can be degraded by intestinal digestive enzymes or survive intestinal digestion and bind to enterocytes on the brush border membrane (BBM). However if bind, lectins may cause antinutritional effects such as disruption of the intestinal microvilli, shortening or blunting of villi, impairment of nutrient digestion and absorption, increased endogenous nitrogen loss, bacterial proliferation, and increased intestinal weight and size (Pusztai, 1993 cited by Fasina *et al.*, 2004).

Trindade Neto *et al.* (2002) observed that pigs fed micronized soybean takes more days to reach 50 and 90 kg of body weight when compared with those fed soybean meal. The soybean hulls can be included up to 10 and 12% for growing or finishing pig diets, respectively, replacing the wheat bran on a weight basis without any adverse effects on palatability of diets and animal performances (Chee *et al.*, 2005). However, Moreira et al. (2009) did not recommend the use of soybean hulls to piglets due to reducing daily feed intake and daily weight gain for the animals fed feed containing soybean hull (15% inclusion in the diet) compared to the control feed without soybean hull. Esonu *et al.* (2005) studying laying hens, found that inclusion of up to 20% soybean hulls, improves the Feed cost/dozen eggs, and when cellulolytic enzyme supplementation at 30% dietary level of soybean hull meal in layer diet could not significantly affect the performance of laying hens. Sandro *et al.*, 2012 reported that Soybean in the diet resulted in poorer animal performance for final weight, total weight gain and daily weight gain, empty body weight, feed conversion, carcass compactness, and hot and chilled carcass weights. The poor performance with the use of soybean can be explained by digestion problems of the protein and/or of the total diet and proved by the lower gross energy contents and metabolizable energy intakes. Moreover, the data from the digestibility trial showed reduced coefficients of protein digestibility and dry matter, in addition to indicating probable hepatic problems occurring in the animals fed this diet

2.1.5 SOYBEAN AND CARCASS QUALITY

Fat sources in the diet can be used to raise the energetic density, improve performance and manipulate carcass quality. Soybean based products have a high percentage of unsaturated fatty acids, and soybean has an average of 75% unsaturated fat (Eifert *et al.*, 2006). However, unsaturated fatty acids can affect the rumen fermentation and the ways of including these ingredients have been constantly assessed for use in ruminant diets.

Grande *et al.* (2009) worked with ¾ Boer + ¼ Saanen goats, slaughtered at 30-kg live weight and did not report differences with oilseed addition (flax seeds, suflower and rape) in the diet for the following characteristics: live weight at slaughter, hot carcass weight, true carcass yield, commercial carcass yield, carcass compactness, leg compactness and confirmation index, compared with the control diet. However, the same authors reported better results in the carcass compactness index, greater fat cover and less loss through chilling in the animals fed the control diet. Felton and Kerley (2004) showed that high-fat diets supplemented with soybean improve both feed efficiency and meat quality in steers. Meat quality grade increases with increased crude fat content, which is negatively correlated with moisture content (Nelson *et al.*, 2004; Lee *et al.*, 2003). In agreement with these data associating feed nutrients with meat quality constituents, supplemental full-fat soybean changed the body composition of Hanwoo steers, allowing them a higher fat content in the study of Sungi *et al.*, 2016.

However, Yamamoto *et al.* (2005) studied fat sources in feeding Santa Ines lamb reared in confinement and reported better performance for animals fed diet without soybean oil for weight gain compared with the diet with 3% of this ingredient.

2.1.6 SOYBEAN IN RABBITS FEED

Intensive rearing systems are increasingly used at present in commercial rabbit farms. They are associated to weaning at early ages (around 35 days) to reduce parturition interval and to increment numerical productivity of rabbit does. As a consequence, gut pathologies in young rabbits are frequent because of the incomplete development of the digestive physiology at these ages (Gutiérrez *et al.*, 2002).

Soybean oil (SOY) is the main source of vegetable fat used in poultry feeding, because of the favorable fatty acid composition and high content of metabolizable energy (Smulikowska, 2005), but its cost is relatively high. Studies have shown that rabbits have the ability to utilize significant amounts of dietary fat as a source of energy; however, the efficiency of its utilization largely depends on the composition of fatty acids (Zduńczyk, 2001). However, information on the influence of these fat sources on rabbit performance, carcass cuts, visceral organs, and health status of the rabbits is not available. The unsaturated fatty acid enriched vegetable oils are better digested by poultry, compared to fatty acid enriched animal fats (Zduńczyk, 2001; Dvorin, 1998). Full fat soybean contains 38% crude protein (CP) and 3300 kcal ME/kg while soybean cake contains 44% CP and 2420 kcal ME/kg (Aduku, 1992). From this, it is very likely that soybean cheese waste meal might contain adequate amounts of protein and energy that can meet the requirements of weaner rabbits.

Maidala (2016) experimental diets on rabbits contain 16% crude protein which is adequate for growing rabbits in the tropics (Aduku, 2004). The proximate composition of the differently processed soybeans are shown by .There is slight increase in crude protein of cooked and salt-treated soybean, the highest crude protein is obtained in salt-treated soybean and this can be attributed to activity of brine solution on the seed coat of legumes (Maidala, 2013). Maidala (2016) reported that daily feed intake were affected by different processing methods with higher values in raw soybean (95.75g) and lower values in cooked soyabean (88.63g), this suggest efficient utilization, rabbits eat more to satisfied their nutrient requirement when feed materials low in nutrient density, this concurred with the earlier reports of Maidala *et al.*, 2013. Maidala (2016) also reported that daily weight gain were affected by different processing methods. Rabbits on cooked soyabean (43.65g) significantly gained more weight and this can be attributed to efficient utilization of the cooked soyabean. The feed conversion ratio was not affected by the different processing methods.

Maidala (2016) reported that the different processing methods affected the live weight, slaughter weight and eviscerated weight. Rabbits fed differently processed soyabean were better than the control diet, with cooked soybean having the higher values. Raw soybean has significantly higher liver (2.97%) compared to differently processed soybean and this can be attributed to different antinutritional factor in raw soybean (Maidala *et al.*, 2013). The gut characteristic of rabbits fed differently processed soybean were statistically significant. Result of Maidala (2016) showed that all the processing methods of soyabean gave satisfactory performance of rabbits; however cooking was better in enhancing the performance characteristics and carcass yield.

2.2 LEUCAENA

Leucaena (Leucaena leucocephala) is a perennial non-climbing, non-spiny shrub or tree. Native to tropical America, two of the three subspecies now have a pan-tropical distribution facilitated by its use as a fodder, wood source and reclamation species. Described as the 'alfalfa of the tropics', it is considered a versatile and widely used multi-purpose tree legume in the tropics. It is also considered a weed in over 25 countries around the globe (Watson, 2003). Leucaena is distinguished from all other mimosoid legumes by two diagnostic characters—first, its hairy anthers, which are easily visible with a hand lens; and second, its smooth pollen surface, which is finely perforated and lacking ornamentation. The leaves of leucaena are highly nutritious for ruminants and many excellent animal production data have been published confirming the fodder value of leucaena (Benjamin, 1991)

2.2.1 LEUCAENA IN ANIMAL NUTRITION

Agronomists and farmers have recognised for decades that leucaena (*Leucaena leucocephala*) offers considerable potential for improving the productivity of cattle. Trials carried out by the University of Hawaii in the 1930s showed the value of feeding leucaena to both beef and dairy cattle. The leucaena is considered as the most widely consumed legume due to its characteristics such as high supply protein, energy, calcium and sulfur, the latter with a possible potentiating effect on rumen microbial populations (Aregheore, 1999).

Additionally, in recent years some legumes such as leucaena, when used as feed for ruminants, has been attributed the effect of reducing emissions of greenhouse gases, an effect attributed to their content of secondary compounds such as tannins (Jayanegara *et al.,* 2011).

On the other hand, the intake of high amounts of leucaena may have negative impact on the productive indicators of animal's mainly due excess of nitrogen in the diet, which causes an imbalance in protein-energy ratio resulting in an inefficient microbial protein synthesis, and also high levels of ammonia in blood which can affect voluntary intake (Calsamiglia *et al.*, 2010).Presence of secondary compounds, such as mimosine, which can induce toxicity or death in ruminants (Adejumo, 1991; Ghosh *et al.,* 2007; Dalzell *et al.,* 2012), and condensed tannins that form protein-tannin complex, inhibit the activity of rumen microorganisms and results in changes in the ecology of the rumen. These effects limit the degradation of nutrients and can cause a reduction in the production of volatile fatty acids (VFA) (Ramana *et al.,* 2000; Salem *et al.,* 2006; Galindo *et al.,* 2009).

Mimosine is a secondary compound that affects ruminants, can induce toxicity and cause death if animals not adapted to leucaena are feed above 30% dietary DM. Depending of the variety, the foliage of leucaena contains between 2.3 to 12% mimosine (Jones, 1994; Fortes *et al.,* 2003; García *et al.,* 2008).

However, it has been shown that ruminants can tolerate up to 30% of leucaena in the diet without having negative impact on production (Yami *et al.,* 2000; Ghosh *et al.,* 2007). This has been attributed to the benefit obtained by forming tannin-protein complexes in the rumen which provides rumen bypass protein leading to better utilization of protein for animal metabolic processes (Valdivia, 2006) and, ii) the ability of certain rumen bacteria able to degrade mimosine and its metabolites (Klieve *et al.,* 2002).

In the Yucatan Peninsula, Mexico, it has been shown that animals can tolerate high levels of leucaena in the diet (over 50%) without toxic effects attributable to mimosine and its derivatives (Ruiz-González *et al.,* 2011; Arjona-Alcocer *et al.,* 2012; Peniche-González et al., 2014). The leucaena forage in ruminant nutrition is widely used due to its qualities such as a high content of crude protein, which varies between 24 and 30%, depending on the variety and time of year (García *et al.,* 2008). The digestibility of the protein reaches 63% and digestibility of dry matter between 60 and 70% measured *in vivo* (Barros-Rodríguez *et al.,* 2012).

In this sense, the use of leucanea as a protein supplement in livestock farming systems in tropical countries is widely accepted (Galindo *et al.,* 2009). In addition, it is a source of minerals such as sulfur, which is can act as enhancer of rumen microbial populations (mainly cellulolytic fungi and bacteria) (Aregheore, 1999).

An additional possible benefit from utilizing leucaena in ruminant feeding are the effects arising from the secondary compounds it contains (for example, tannins). This compounds when consumed in moderate amounts generally have positive effects and do not reduce voluntary intake. The phenolic hydroxyl groups of tannins bind to the dietary protein in aqueous solution, leading to the formation of a complex with proteins, mainly, and to a lesser extent with metal ions, amino acids and polysaccharides, avoiding their degradation in the rumen, increasing the amount of bypass protein to the lower parts of the gastrointestinal tract (abomasum) and the amount of essential amino acids supply, resulting in higher animal production (Waghorn *et al.,* 1987). They can also be used as a natural anthelmintic agent for gastrointestinal nematodes (Alonso *et al.,* 2010). Additional, research with forage legumes, have suggested that condensed tannins may help to reduce rumen gas production (Monforte-Briceño *et al.,* 2005.

Abou *et al.*, 2011 reported egg quality traits of Rhode Island Red hens fed on different levels of Leaucena leaf meal and Moringa Leaf Meal, that the treatments had no adverse effects on any of shell proportion in the egg; shell thickness and egg shape index. It is well documented that leaf meals are a good source for yolk pigments. In addition, using L. Leucocephala in the laying hens diets increased significantly the yolk coefficient, which is a good quality trait. Similar results have been observed when hens were fed on different levels of leaf meal of Gliricidia sepium (Odunsi *et al.,* 2002), Siam weed (Fasuyi *et al.,* 2005), Mangrof (Al-Harith 2006), and Tephrosia bractereolata (Akande *et al.,* 2008).

Table 2.2: Proximate Chemical Composition of Leucaena Leaf Meal

Components	%
Crude Protein	21.88
Crude Fibre	13.85
Ether Extract	8.02
NFE	46.33
Ash	9.92

Source: D'Mello, 2002.

2.2.2 LEUCAENA AND ANIMAL GROWTH PERFORMANCE

Leucaena (Leucaena leucocephala), a highly productive and palatable pantropical legume, is one of the most widely used forage trees in agro - pastoral enterprises as it provides a number of other resources apart from its protein rich forage. However, increased levels of leucaena in the diet of large and small ruminants, have in numerous studies, been shown to have a positive impact on forage intake and live – weight gain. (Morris and Toit, 1998).

So far most studies in relation to Leucaena feeding had been conducted to determine the effect of Leucaena on goat body weight gain (Virk et al., 1991; Ndemanisho *et al.,* 1998; Yami *et al.,* 2000; Rubanza *et al.,* 2007. There have been a number of investigations conducted to determine the effect of Leucaena on body weight and performance of goats (Srivastava and Sharma, 1998) and most of these studies showed a linear increase of body weight with days in experiment.

Mtenga and Shoo (1990) studied the growth of indigenous goats and documented that Leucaena supplementation had a significant effect on daily gain. The goats supplemented with Leucaena at the rate of 100g, 200g per day, and ad libitum resulted in a body weight gain of 3, 9, 10 g/day more than the animals on the control diet respectively. Rubanza *et al.* (2007) obtained the same results as Mtenga and Shoo (1990) whereby the Leucaena forage resulted in higher body weight gain of goats as compared to goats on other browse tree fodders. The authors associated this increase of body weight gain with high crude protein intake and improved digestibility of the Leucaena based diet. In contrast, despite the increase in nutrient intake,including CP percentage in response to increasing level of Leucaena inclusion in the diet of goats, Srivastava and Sharma (1998) observed no significant difference in terms of body weight (BW) gain. These authors associated this with poor digestibility of diets in response to increased levels of Leucaena in the diets.

When Leucaena forage was used to supplement poor quality roughages, it resulted in a body weight gain which was similar to that obtained when commercial supplements like full fat soya bean meal, cotton seed oil cake meal and sunflower oil cake (Nyambati *et al.,* 2006) were used. It is not only the leaves which provide the increase in body weight gain but the seedpods are also important when compared to other leguminous trees (Nyambati *et al.,* 2006). The same authors demonstrated that a Leucaena seedpod meal diet resulted in an average daily gain of 486 g per day compared to those fed Acacia pods (250g per day). The increase of body weight gain of goats observed by these authors might be attributed to the high CP value of Leucaena, its protein quality, digestibility potential and N-utilization potential in the rumen (Jones, 1994). Jones (1994) in a feeding trial with L. leucocephala recorded an increase in weight gain of 14%. Leng (1997) observed that feeding goats with P. purpureum as a basal diet and supplementing with dry L. Leucocephala mixed with ground soya gave an average daily weight gain of 45g while L. leucocephala alone gave only 22g/animal/day. These are in good agreement with the present results.

2.2.3 LEUCAENA AND ANIMAL CARCASS QUALITY

The study of Aderonke (2008) shows that the carcass composition indicates that there was increase in all the nutrients in the body of the fish when compared to the initial composition. This shows that Heterobranchus longifilis was able to utilize all the diets however the difference in the values for carcass protein and lipids confirms the fact that there was different levels of utilization.

The works of Sotolu(2010); Sotolu and Sule(2011) when Clarias was fed with Leucaena seed meal and water hyacinth leaf meal followed the same trend.

However Osman *et al.* (1996) observed a decrease in carcass protein and ether extract of Tilapia fed Leucaena leaf meal to be associated with low feed intake at higher inclusion levels.

The increase in carcass lipid when compared with the control could be associated with phosphorus deficiency which is caused by anti-nutrients because of forming complexes with other compounds. This agrees with the report of Osuigwe and Obiekezie (2007) when H. longifilis was fed with jackbean meal and carcass lipid increased at higher inclusion levels. Increased carcass lipid could also be as result of high carbohydrates in the diet as reported by Sotolu (2010).

Eichie (2015) shows that dressed and carcass weights were also reduced. Similarly, Onibi (2008) reported reduced weight of Anak 2000 broiler chicks fed either cassava leaf meal (CLM) or LLM at 30 or 60% replacement for SBM protein. The authors stated that CLM and LLM in a 50:50 combination could replace 9.55% of a SBM based diets from broilers. However, 5% and 10% levels of LLM in diet were reported to be optimum for highest weight gain and feed intake, respectively in Vencobb broilers (Singh 2006).

2.3 SOYBEAN REPLACEMENT WITH LEUCAENA

Eichie (2015) studied the Effect of Replacement of Soybean Meal with *Leucaena leucocephala* Leaf Meal on Performance, Haematology, Carcass Measures and Organ Weight in Broiler Chickens. Substitution of SBM with LLM significantly reduced the performance of the birds at day 0-28 but not at day 29-56. This suggests that high inclusion level of LLM may not

Support growth performance of broilers at starter phase due to the presence of anti-nutritional factors such as mimosine in the LLM because essential anti-nutrients in LLM have been reported to be capable of retarding growth (Martinez, 1995) and lowering the digestibility and absorption of dietary nutrients (Pusztai, 1995).

Supplementation of SBM with LLM did not significantly influence the haematological parameters except ESR concentration, which was significantly affected at the finisher phase. Haematological components of blood are valuable in monitoring feed toxicity especially with feed constituents that affect the composition of blood (Oyawoye, 1998). However, other workers (Zanu, 2012) did not also find any effect of LLM inclusion on haematological variables in Anak 200 broilers. It has been similarly reported that LLM in diets up to 12% had no effect on haematology, glucose and mortality in broilers (Khadija and Mohammed, 2008).

Leucaena contains mimosine, and since LLM substitution did not affect the haematological variables, it is therefore likely that the mimosine factor had no effect on those variables except ESR concentration. The study revealed that broiler finishers fed up to 50% *L. leucocephala* leaf meal-based diets performed better than those on the control. Therefore, up to about 50% replacement of soybean meal with LLM could be used to formulate broiler finisher's diets without adverse effects on their performance.

2.5 IMPORTANCE OF RABBIT PRODUCTION

Rabbits have a potential as meat producing animals in the tropics due to their characteristics such as small body size, short generation interval, rapid growth rate and ability to utilize forage or agricultural by-products. The wastes from products grading before selling to the market, such as vegetable wastes, are well utilized as feed resources for rabbits, and the manure from the animals could be used as an organic fertilizer for crops (Mikled, 2005). Rabbits could contribute significantly to solving the problem of meat shortage (Lebas, 1983; Taylor, 1980). Production systems with small or large ruminants usually need a long time to give a saleable product and with high cost, especially for feeds.

According to Ruiz-Feria et al. (1998) rabbits can subsist on inexpensive diets based on forages under small-scale farm conditions in arid and tropical regions. Agricultural by-products, foliages and weeds such as *Centrosema pubescens*, cassava root meal, rice bran, natural grasses and leucaena can be used as dietary ingredients for rabbits (Lukefahr and Cheeke, 1991; Ha et al., 1996; Ruiz-Feria et al., 1998). The demand for human food from animal products such as meat, eggs and milk is continually increasing. The consumers of today pay great attention to the health aspects of food, such as low fat content and organic origin. Meat from rabbits has a low cholesterol level, high protein/energy ratio and is relatively rich in essential fatty acids (Iraqi, 2003).

Rabbits utilize waste products more effectively thus offering an alternative to other producing species for the improvement of protein supply to the human population and the realization of monetary income by putting into effective use the waste materials that are inedible for humans (Schlolaut, 1985). The rabbit offers a role as an alternative food source, particularly for people in developing countries (Owen, 1981). Rabbit manure has also been experimentally fed to rabbits (Swick *et al.*, 1978) and could be fed to ruminants as well. Rabbit and other animal manures can be used to produce methane gas as a household source of alternative energy (Sicwaten and Stahl, 1982; Jacobs, 1986; Trujillo *et al.*, 1991). Scientists use the animals in experiments dealing in nutrition and medical research; manufacturers use them for testing products and in addition animals are sold as pets.

2.6 NUTRIENT REQUIREMENTS OF WEANED RABBITS

Since rabbit production makes up only a very small percentage of the total animal production in the world, there is little information available or research performed on the nutrition of the rabbit.

2.6.1 CRUDE PROTEIN

Protein is perhaps the most frequent nutrient lacking in rabbit diets primarily because the common energy sources such as maize and other cereal grains and tuber crops are low in protein. The rabbit makes its own particular proteins from the proteins and amino acids it obtains from its food (Fielding, 1991; Kellems and Church, 2006). This protein synthesis uses up energy. The ten essential amino acids which must be provided in the diet if the rabbit is to survive and grow are: lysine; methionine; arginine; phenylalanine; histidine; valine; threonine; tryptophan; leucine; iso leucine (Fielding, 1991). Essential amino acids need to be included in the ration for rabbits. Lysine and methionine are usually the amino acids that are found to be deficient in rabbit ration (Gillespie, 1998). While there is some bacterial protein synthesis in the caecum, it is not enough to meet the essential amino acid requirements of rabbits. For rabbits the recommended crude protein level in the dry matter of the ration is over 18% for newly weaned rabbits; 16-18% for rabbits from 12-24 weeks; 15-17% for breeding does; and 12-14% for all other stock (Fielding, 1991). Several researchers have investigated the protein requirement of growing rabbits.

In an experiment in which Martina and Damianan(1983) fed rabbits with decreasing crude protein levels of 18.08, 16.32, 14.22 and 12.50%, they found that crude protein could be reduced to 16.32% with lysine and methionine supplementation without affecting weight gain and feed efficiency. Different results were obtained when Carregal and Nikuma (1983) used diets with increasing crude protein levels, 14.3, 17.2 and 21.4%, as they found no significant difference among groups of rabbits with regard to body weight, feed intake or feed conversion efficiency.

Abdella *et al.* (1988) conducted an experiment and observed that there were no differences in final body weight, live weight gain and feed intake when diets containing 16, 18 and 20% crude protein were fed to five week-old rabbits. Abdel-Salem et al. (1972) using mash diets containing crude protein ranging from 11.63 to 26.85% reported that the diets containing 20.74% crude protein recorded the highest final live body weight and live weight gain.

Gillespie (1998) has shown that soya bean meal or fish meal promotes better growth rates than other protein supplements when the alternative supplements do not have essential amino acids added. He further reported that when essential amino acids were added to protein supplements such as cotton seed meal, rapeseed meal, horse beans, and peas, growth rates similar to those achieved with soya bean and fish meals were attained. According to Pond et al. (1995) dietary protein quality is particularly important for rapidly growing weanling rabbits, which may not have well developed caecal fermentation. Recent research has demonstrated that the amino acid requirements are age dependent and change during the reproduction cycle of the doe. In early growth stage (4-7 weeks of age), rabbits need a higher dietary amount of digestible crude protein and amino acids. Also, during peak lactation the response to higher amino acids is more pronounced (Taboada *et al.*, 1994; Taboada *et al.*, 1996).

Many research reports have shown that a reduction of the level of protein and essential amino acids in the diet, from an optimum level for growth in animals, is associated with a decreased growth rate and efficiency of feed utilization and a concomitant increase in body fatness (Russell *et al.*, 1983). Dietary protein level is one of the several non-genetic factors that influence the amount of body fat in animals (Marks, 1990; Wang *et al.*, 1991). Forbes (1995) reported that if the amino acid content in the feed of animals differed widely from the animal's requirement for amino acids, feed intake would be depressed and that if the deficient amino acid was supplemented, intake would be increased.

2.6.2 ENERGY REQUIREMENTS

Although energy is not a nutrient, it is a property of carbohydrates, fats and proteins when they are oxidized during metabolism. The energy needed by rabbits for organic synthesizing is usually supplied by carbohydrates and a lesser extent by fats. Where there is an excess of protein, these also help to supply energy after deamination. Rabbits adjust their feed intake as a function of their dietary energy concentration (Partridge, 1989)

According to Partridge (1989), this regulation of intake to achieve constant daily energy intake is only possible at a dietary digestible energy (DE) concentration above 2250kcal/kg. Several factors influence the energy requirements of rabbits (Kellems and Church, 2002). These include productive function (growth, lactation, maintenance, etc), age, sex, body size and environment (temperature, humidity, and air-movement). As temperatures decrease, the rabbit requires more energy to maintain normal body temperature, and to compensate for this increased energy, either the intake level of feed must be increased or the energy content of the ration must be increased. Rabbits require a diet of 2200kcal/kg of diet or 2.2kcal/g of diet. For breeding rabbits (Fielding, 1991), a general recommendation is that the food should contain: 65-66%TDN; or 2600-2700kcalDE/kgDM; or 2.4-3.5 MJ DE/kg DM; or 2.0-3.0 MJ ME/kg DM.

2.6.3 CRUDE FIBRE

According to Maertens (1988) although fibre is not considered a real nutrient in rabbits because of its low digestibility (average dietary digestibility is less than 20%), it is considered a nutrient to maintain the gut motility. Cell-wall constituents from feedstuffs having low lignin content or young plants have a considerable higher digestibility than highly lignified sources, 40 -70% versus 5-20% respectively. It is not clear what the minimum fibre intake for prevention of diarrhoea in rabbits should be. Research reports from Blas et al. (1994) and Gidenne and Jehl (2000) examined the effect of low fibre diets to rabbits, and observed that a sharp decrease in fibre level from 1.9-9% in the diet doubled the risk of digestive trouble. The population of cellulolytic bacteria decreased in the caecum, and the microbial ecology system in the caecum became unbalanced, which may cause death from diarrhea. Feeding rabbits with a diet low in fibre and high in energy or a finely ground concentrate diet; can result in high mortality due to intestinal disorders, such as enterotoxemia (Lukefahr and Cheeke, 1991). The significant role of dietary lignin (ADL) on the rate of passage and its protective effect against diarrhoea has been demonstrated by the French INRA (Institut National de la Recherche Agronomique) team (Gidenne and Perez, 1994). The mortality rate as a result of digestive disorders was closely related (r= 0.99) to the ADL level in their experiments. The relationship was expressed as follows: Mortality rate (%) = 15.8- 1.08 ADL (%); n >2,000 rabbits. Rabbits use crude fibre less efficiently due to a faster rate of passage of digesta and smaller holding capacity, compared to grazing ruminants. Rabbits are therefore more selective in their diets than ruminants (Jarvis, 1976). Optimal fibre balance also includes a dietary recommendation for particle size. A sufficient amount of large-size particles is required for optimal performance and to reduce the risk of digestive disorders. According to De Blas et al. (1999) a minimum proportion of 25 % of large Particles (>0.315 mm) is required

2.6.4 MINERALS AND VITAMINS

Pond *et al.* (1995) stated that the major mineral elements of concern in rabbit diet formulation are calcium and phosphorus (Ca and P), and that the other minerals are usually provided in adequate amounts by the ingredients used plus the addition of trace-mineralized salt. Studies on the calcium and phosphorus requirements of growing rabbits have shown that they need these minerals much less than lactating does. The amounts excreted through the milk are significant. However, excesses of calcium (> 40 g/kg) or phosphorus (> 19 g/kg) induce significant alteration of fertility and prolificacy or higher proportions of stillbirths. Total dietary phosphorus intake ranging from 0.45 to 0.76% did not affect any of the does' reproduction performances.

Aduku *et al.* (1988) fed weaner rabbits peanut meal, sunflower meal and palm kernel meal diets containing 14.84, 23.24 and 38.89% crude fibre respectively and observed that feed consumption was significantly ($p<0.05$) higher with the palm kernel and sunflower meal diets than with the pea nut diet. This was however, attributed to the rabbits having to compensate for their energy requirement. In the same experiment they found feed to gain ratios to be significantly ($p<0.05$) poorer on the palm kernel and sunflower meal diets than on the pea nut meal diet. Vitamin K and the B vitamins are not required in the diet, since they are synthesized through coprophagy and fermentation in the caecum or hindgut; likewise vitamin C (Lukefahr and Cheeke, 1991). Under practical conditions, the B-complex vitamins are not dietary essentials for rabbits; however, under stress situations and at high performance levels deficiencies can occur (Ismael, 1992).

2.6.5 WATER REQUIREMENTS

Water is normally considered a nutrient, although its properties and functions are quite different from those of other nutrients found in feeds. Water is the major component of the rabbit body, making up 70% of the lean body mass (Maertens, 1992). Maertens (1992) further indicated that rabbits will die more rapidly from water deprivation than from food deprivation. Restricted drinking water or limited drinking time leads to reduced feed intake that is directly proportional to the amount of water being consumed (Szendro *et al.*, 1988).They further reported that water and feed consumption varies with changes in environmental temperature and humidity.

As the temperature rises above 20^{0}C day and night, feed intake tends to drop while water consumption increases. At high temperatures, (30^{0}C and over) feed and water intakes decline, affecting the performance of growing and lactating animals (Femandez- Carmona *et al.,* 1996). According to Pond *et al.* (1995) water plays an essential role in a number of functions vital to an animal such as digestion, nutrient transport, waste excretion and temperature regulation. One of the most important properties of water in nutrition is its remarkable ability to dissolve substances.

It is said that this property is due to its dielectric constant, which in turn is due to its hydrogen bonding (Lassiter and Edwards, 1982).

CHAPTER THREE

MATERIALS AND METHOD

3.1 LOCATION OF THE RESEARCH/ AREA OF STUDY

The experiment was conducted at the rabbit unit of the Animal Production and Health Department Teaching and Research Farm, Faculty of Agriculture, Federal University Oye-Ekiti. With the following GPS coordinates; latitude 7^0 28^0N and longitude 4^0 34^0E

3.2 EXPERIMENTAL MATERIALS

The experimental animals comprise of 15rabbits of the same breed within the body weight range of 600-800g. These rabbits were purchased from local farmers with mixed sex range. The rabbits were housed using the battery cage system, each placed at different single compartment. Concrete feeders and drinkers which were hand made by students were used to administer feed and water to these animals within the period of the research. The feed ingredients were gotten from Ado market at an animal feed store according to the proportion needed. The test ingredient which is Leucaena leucocephala L. was gotten from Federal University Oye-Ekiti premises.

3.3 EXPERIMENTAL PROCEDURE

3.3.1 SOURCE AND TREATMENT OF *LEUCAENA LEUCOCEPHALA L.*

The test ingredient which is Leaucaena leucocephala leaves used for this experiment were harvested from the L.leucocephala trees found in the faculty of agriculture, Federal University Oye-Ekiti premises. The leaves were harvested using sickle attached to a long rod and packed into about 20 different sacks. These were moved to the site for soaking where the sacks were being emptied in a big drum. About 25 buckets of water were fetched to fully submerge the leucaena leaves in water for proper soaking. Since the leaves would tend to float, a solid block structure is used to apply pressure on the leaves for complete soaking. This is left to soak for about 48hours and after soaking, the water was observed to have changed for the light crystallized colour to a light reddish colour. The soaked leaves were removed and spread immediately under a direct sunlight on a flat surface. The leaves were turned intermittently for uniform sun drying. The leaves were allowed to attain complete dryness (leaves became crispy). The dried leucaena leaves were then milled to attain fine structure for homogenous mixture with the other feed ingredients.

3.3.2 FORMULATING THE DIETS

The ration were formulated as shown in Table 3:1. Diet 1 was the control and it contained soybean as source of protein, while diet 2 and 3 contain 50% and 100% replacement of soybean with *Leucaena leucocephala* leaf meal respectively as sources of protein. The ingredients used, both fixed and variable were measured accurately with the use of the the *weighing scale for the variable and the sensitive weighing scale for the fixed ingredient. The floor mixing method was adopted. The variable ingredients were milled into fine particles for homogenous mixture and are weighed on a platform according to their surface area. The fixed ingredient were also weighed separately and mixed before being added to the fixed ingredient. The ingredients were mixed thoroughly to ensure a homogenous mixture. Proximate analysis were done on the different diets following A.O.A.C (2003). The different diets were packed into three different sacks and labelled according to the diet number. The weaned rabbits were fed *ad-libitum* according to their treatment numbers.

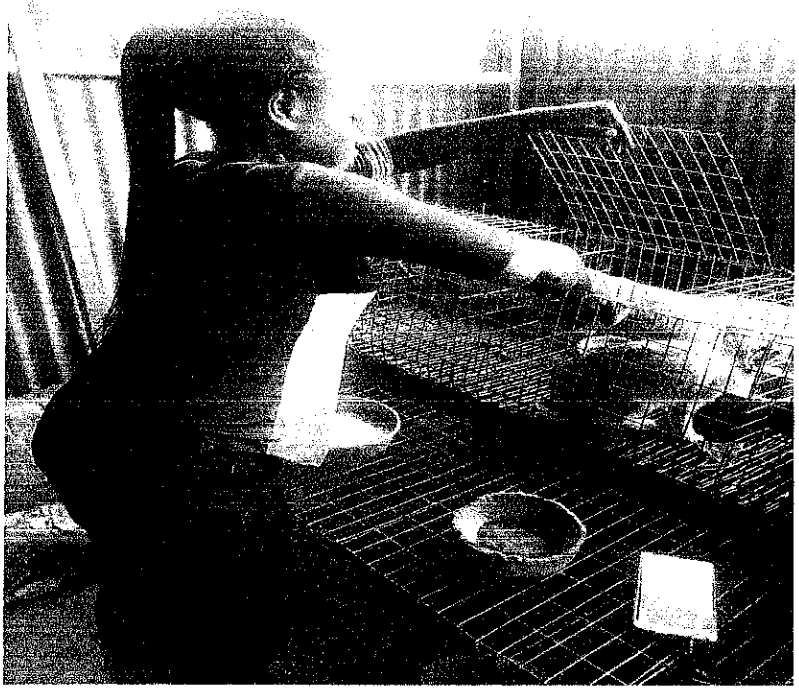

PLATE 3.1 Administration of experimental feed and water to rabbit *ad-libitum*

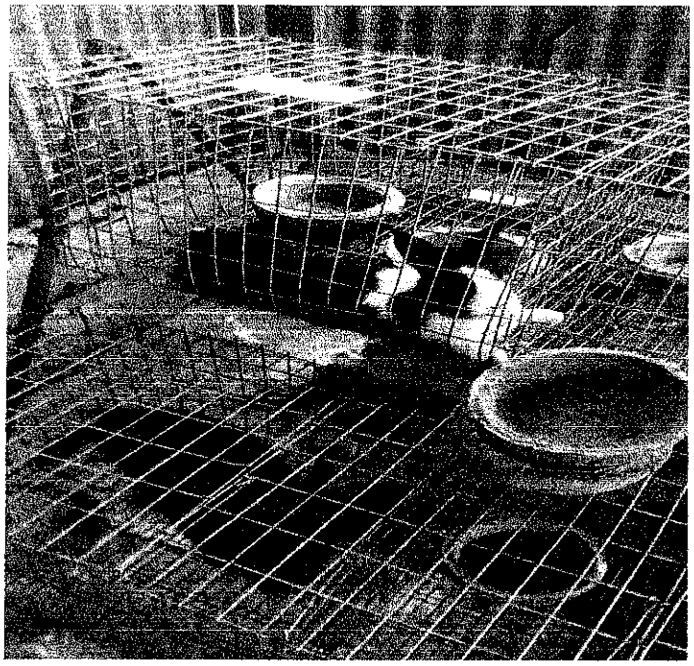

PLATE 3.2 Weaned rabbit in wired mesh cage with the display of their concrete feeder and drinker

3.4 EXPERIMENTAL DESIGN

A total of 15 weaned rabbits were used for the experiment. Prior to the arrival of the rabbits, all necessary operations like cleaning and disinfection of the cages and pen were carried out. The experimental design is a completely randomized design. The weaned rabbits were fed the formulated diets; control, 50% leucaena based diet and 100% based diet. The weaned rabbits were randomly distributed into 3 treatments, there are five replicates per treatment.

The initial body weight of the weaned rabbits were taken and recorded before the start of the experiment. A week adjustment period was adopted to acclimatize the newly brought rabbits to the new environment and feed. Feed and water were supplied ad-libitum and records of the weekly body weight, feed intake and mortality were kept. The necessary medications were administered during the period of the experiment.

3.5 DATA COLLECTION

During the 49days of the experiment, the following data were collected on the weaned rabbits placed on *Leucaena leucocephala* leaf meal.

3.5.1 FEED INTAKE

Feed was weighed out on daily basis for the rabbit in each replicate. At the end of each day, the leftover were weighed and summed at the end of the week. Feed consumed for the week was obtained by the difference. Weekly record of feed consumption per rabbits were obtained by the difference in the feed offered and the leftovers daily, which is summed at the end of the week.

3.5.2 BODY WEIGHT

Rabbits were weighed individually at the beginning of the experiment and were subsequently weighed weekly throughout the week of the experiment. The reading for each replicate were added to get the total weight for the treatment and divided by the number of rabbits in the treatment to obtain the average body weight for the week. Average body weight per day was obtained by dividing average body weight for the week by seven.

3.5.3 BODY WEIGHT GAIN

The body weight gain for each week was obtained by taking the difference between the body weight for the given week and the body weight for the proceeding week. Body weight gain per day was obtained by dividing body weight gain per week by seven.

3.5.4 FEED CONVERSION EFFICIENCY (F/G RATIO)

From the weight gained and feed consumed by birds in different treatments, the feed efficiency was computed using the following expression:

$$F/G = \frac{\text{Average feed intake per day}}{\text{Body weight gain per day}}$$

3.6 CARCASS EVALUATION

At the end of the experiment, three of the experimental rabbits were selected based on the treatment mean weight from each of the treatments. They were starved 24hours prior to slaughtering and the starved weight was taken before slaughter. The animals were bled after slaughtering taking note of the bled weight. The rabbit fore leg, hind leg, head and tail were removed and their weight accurately weighed and recorded. The pelt was also carefully removed from the rabbit skin with the use of the surgical knife and scissors and the weight noted leaving the skinned rabbit. The skinned rabbit is then slit open with the use of the surgical scissors to remove the internal organs through the process of evisceration. The warm carcass/ eviscerated weight is taken and recorded. Each of the internal organs; kidney, liver, lungs, stomach, caecum and heart were carefully examined for abnormality with each weight taken accordingly. The length of the caecum was taken with the weight of the fats content. The weight of the organs were expressed in gramme per grammes of body weight. At the end of the experiment, the dressing percentage and the organ percentage to the body weight were calculated as thus;

$$\text{Dressing percentage} = \frac{\text{eviscerated weight}}{\text{Live weight}} \times 100\%$$

$$\text{Organ percentage} = \frac{\text{organ weight}}{\text{Live weight}} \times 100\%$$

Plate 3.3 Carcass evaluation of rabbit at the end of the experiment

Plate 3.4 Gastrointestinal organ of the rabbit and the rabbit carcass

3.7 CHEMICAL ANALYSIS

The proximate composition of the feed was determined at University of Ibadan Animal science Laboratory giving the result stated on table 3.2

3.8 STATISTICAL ANALYSIS

All data were subjected to analysis of variance using and the significance of difference of treatment means were determined by applying Tukey's Honestly Significant Test using SAS (2003).

TABLE 3.1 Gross Percentage Composittion of Experimental Diets

INGREDIENT	PERCENTAGE INCLUSION		
	T_1 (0%)	T_2 (50%)	T_3 (100%)
Maize	20.00	20.00	20.00
Leucaena leaf	0.00	7.00	14.00
Soyabeans meal	14.00	7.00	0.00
Palm kernel cake	27.00	27.00	27.00
Wheat offal	28.25	28.25	28.25
Rice husk	7.00	7.00	7.00
Oyster shell	1.00	1.00	1.00
Premix	0.25	0.25	0.25
Dicalcium phosphate	2.00	2.00	2.00
Table salt	0.25	0.25	0.25
DL-Methionine	0.15	0.15	0.15
L-lysine	0.10	0.10	0.10
TOTAL	**100**	**100**	**100**
CALCULATED ANALYSIS			
Crude protein	17.62	16.45	15.27
Metabolisable energy	2278	2339	2400
Crude fibre	10.06	10.3	10.59
Ether extract	4.59	4.78	4.96
Calcium	0.9	0.92	0.95
Phosphorus	0.53	0.56	0.58
Lysine	0.39	0.39	0.4
Methionine	1.39	1.35	1.32
Total cost of feed	8987.58	8752.38	8517.18
PROXIMATE ANALYSIS			
Dry matter	85.64	87.79	86.86
Crude protein	16.55	16.5	16.01
Crude fibre	16.45	15.64	14.03
Ash	7.1	6.4	7.3
Ether extract	3.87	4.27	4.1

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 PROXIMATE COMPOSITION OF EXPERIMENTAL DIETS

The mean values of the proximate composition of the diets are presented in Table 3.1. The crude fibre values were slightly higher than the calculated analysis. The crude protein values were slightly lower than the calculated analysis and this could be as a result of the loss of some amino groups during the production of the experimental diets. The ether extracts values were also slightly lower than that of the calculated analysis and this can be attributed to the soybean meal which contains less oil compared to the full fat soybean.

4.2 PERFORMANCE CHARACTERISTICS OF RABBIT FED SOYBEAN REPLACEMENT WITH LEUCAENA LEAF MEAL

4.2.1 Feed intake

The data presented in Table 4:2 showed the effects of soybean replacement with leucaena leaf meal on the rabbit feed intake throughout the experiment. There was a gradual increase in the feed intake of the rabbits in all the treatments. The total feed intake of rabbits on T1, T2 and T3 were 6173.5, 6244.67 and 6189.2 respectively. Feed intake of rabbits fed control, partial (50%) and whole (100%) replacement of soybean were not significantly different ($P>0.05$). The result is similar to the findings of Traiyakun *et al* (2011) where he stated that the intake of concentrate (g/day) to all treatments were not significantly different statistically ($P>0.05$). This is as a result of the palatability of the experimental feed used in feeding the rabbits among the treatment groups thereby improving their appetite.

4.2.2 Feed conversion efficiency

There were no significant differences in the feed conversion efficiency among the control, partial (50%) and whole (100%) replacement (P>0.05). Similar trend was obtained by kawe *et al* (2007), when sun-dried leucaena leaf was used to feed rabbit, at different level of inclusion with lowest reported by khan *et al.* (2009) that replacement of the protein by LLM or sesbania leaf meal did not reduce the performance of broilers.

4.2.3 Body weight gain

Results of the effects of feeding rabbits with the experimental diet are shown in table 4:2. The initial body weight of the rabbits showed no significant difference (P>0.05). The final body weight gain decreased from treatment one to three in the order of 1451.8, 1398.3, and 1264.6 respectively. Statistical analysis showed no significant difference in the final body weight gain (P>0.05) among the treatment means. This result is in contrast with Manika *et al.* (2016) where he reported that the total live weight and daily weight gain of rabbit were significantly (P>0.01) different among the treatment groups following the order 11.5 ± 0.8g, 13.77 ± 0.68g and 9.82 ±1.16g when rabbits were fed leucaena and siastro fresh leaves. The difference in body weight among the treatment groups can be attributed to the low value of the feed conversion efficiency obtained from the experiment. The lower the value of the feed conversion efficiency the higher the body weight gain as the animal readily convert the feed to flesh thereby increasing their body weight. Onwudike (1995) recorded 13.5to 14.3 g d^{-1} body weight gains in rabbits feeding more than 50% leucaena leaves.

4.2.4 Cost of feed intake and cost per kilogram body weight

The costs of these three concentrate mixture were 24.43, 21.48 and 20.21Tk/kg for diet T1, T2 and T3, respectively (Table 4:2). In T1 diet, the cost of feed was the highest than other diets due to high price of soybean (Table 4:2). Among these groups, it has been shown that the cost of T1 diet is highest while the lowest cost per kg feed was T1 diet. The cost of diet T1 was significantly higher than that of diets T2 and T3, respectively. This report is similar to the result stated by Manika *et al.* (2016). It has also found that the cost of fed for per kg live weight gain of rabbit were, 837.3, 915.2, 1106.7 for diet T1, T2 and T3, respectively which were not significantly different statistically. This is in line with the result reported by Khan *et al.* (2009) where it was stated that feed cost per kg live weight gain and per kg dressing yield of birds of different groups throughout the experimental period were not significant. So it can be said that, the cost benefit ratio may be acceptable for including 100% replacement with leucaena in rabbit ration. Ruiz-Feria *et al.* (1998) reported that, the feeding level of leucaena (within a 0 to 30% range) should depend on economics in terms of feed cost savings in relation to growth response for small-scale producers.

4.3 Internal organ weights/ carcass evaluation

The data for the internal organ weights which is relative to the body weight of the rabbit are presented in table 4:3. The value for the carcass/eviscerated weight for rabbits on T_1, T_2 and T_3 are 626.67 ± 50.54, 664.67 ± 85.11 and 524.67 ± 69.80g respectively. Analysis of variance shows that the carcass weight of the rabbit fed the experimental diets shows no significant difference among the treatment groups. This result is contrary to what was reported by Kawe *et al.* (2007) in which the result of the values obtained were lower in the order 457 ± 5.4, 517 ± 5.9 and 383 ± 4.6. This is as a result of the difference in the processing method used in the detoxification of leucaena. It was reported by Adekojo *et al.* (2014) that different methods of processing had significant ($P<0.05$) effects on live weight, slaughtered weight, eviscerated weight and dressing percentage of the rabbits. Also, there were no significant difference in the dressing percentage of the rabbits fed with the experimental diets. The values obtained were lower than the result reported by Makinde, 2016 where he made use of the leucaena and siatro leaves fresh leaves. The increase in the dressing percentage can be attributed to the accessibility to high percentage of crude protein from concentrate, leucaena and siatro leaves in the order 15.75, 17.76 and 18.72.This could also be as a result of the feed conversion efficiency which is lower than the value obtained in this experiment. Liver, spleen and kidney weight of the rabbit fed the experimental diets were not significantly ($P>0.05$) different among the treatment groups. Makinde, 2016 reported that there were significant ($P<0.05$) differences in the organs weights of the rabbits except for lung and spleen when they were fed concentrate, leucaena and siatro fresh leaves. The difference in weight is as a result of the anti-nutritional factors present in these legumes. Weights of some internal organs like the liver or kidneys as indicators of toxicity because they should differ significantly if there was any serious effect of anti-nutritional factors on them being major detoxification organs (Sese *et al.*, 1996). Fayemi *et al.*, 2011 reported that rabbits fed diets containing 20% Sun dried leucaena leaves had alopecia, necrotic spots, liver congestion, edema and highest percentage of mortality. The weight of the organs such as liver, heart and kidney were significantly ($P<0.05$) higher as a result of increased metabolic rate. Other internal organ weights like the gastrointestinal weight, heart and caecum show no significant ($P>0.05$) difference. This result is also the same with the weight of other organs of the rabbit among the treatment groups (no significant difference)

TABLE 4.1 Effect of Soyabean Meal Replacement With Leucaena Leaf Meal on The Growth Performance of Weaned Rabbit

	TREATMENT				
PARAMETER	0%	50%	100%	SEM	LOS
Total Feed intake	6173.5	6244.67	6189.2	4.3	NS
Initial body weight	650.3	678.67	668	11.69	NS
Final body weight	1451.8	1398.3	1264.6	20.73	NS
Weight gain	801.5	719.67	596.6	10.96	NS
Feed conversion ratio	7.83	8.78	10.91	0.16	NS
Daily weight gain (g/rabbit)	16.36	14.69	12.18	0.22	NS
Feed intake (g/day/rabbit)	125.99	127.44	126.31	0.09	NS
Cost of total feed Intake (₦)	660.53^{a}	650.66^{a}	627.55^{b}	0.44	*
Cost of weight gain/Kg (₦)	837.3	915.2	1106.7	16.8	NS

^{abc}: Means in the same row with different superscript differed significantly (P<0.05)

NS: Not significantly different (P>0.05)

*: Significantly different

LOS: Level of significance

TABLE 4.2 Effect of Soybean Replacement With Leucaena Leaf Meal on The Carcass Quality of Weaned Rabbits

	TREATMENT				
PARAMETERS	0%	50%	100%	SEM	LOS
Fasted weight(g)	1338.67	1385.33	1140	80.23	NS
Eviscerated weight(g)	626.67	664.67	524.67	40.37	NS
Dressing percentage(%)	46.67	47.80	45.61	45.61	NS
Ribcage weight(g)	8.32	9.49	8.24	0.28	NS
Fore limb weight(g)	0.78	0.66	0.8	0.05	NS
Hind limb weight(g)	1.79	1.65	1.82	0.15	NS
GIT weight(g)	21.48	19.8	23.12	1.04	NS
Loin weight(g)	4.16	3.97	4.32	0.2	NS
Caecum weight(g)	9.12	8.29	10.09	0.45	NS
Caecum length(cm)	61.67	58.33	60.33	2.58	NS
Heart weight(g)	0.23	0.29	0.24	0.02	NS
Liver weight(g)	2.62	2.59	3.29	0.26	NS
Kidney weight(g)	0.67	0.56	0.71	0.04	NS
Spleen weight(g)	0.05	0.063	0.07	0.007	NS
Bled weight(g)	97.3	97.94	97.52	0.44	NS
Tail weight(g)	0.44	0.43	0.36	0.07	NS
Hind weight(g)	13.94	14.32	13.59	0.45	NS
Forelimb weight(g)	6.33	6.32	6.42	0.1	NS
Abdominal weight(g)	0.85	1.02	0.29	0.29	NS
Full stomach weight(g)	5.38	6.05	6.78	0.46	NS
Lung weight(g)	0.76	1.05	0.81	0.04	NS
Back weight(g)	11.52	10.39	10.49	0.57	NS
Neck weight(g)	1.78	2.17	2.09	0.21	NS
Head weight(g)	9.38	8.8	9.59	0.17	NS
Pelt weight(g)	8.04	9.38	8.51	0.26	NS

SEM: Standard error of mean

NS: Not significantly different ($P>0.05$)

LOS: Level of significance.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

This study determines the growth performance and carcass evaluation of growing rabbits fed soybean and leucaena leaf meal based diets. Results from this experiment showed that replacing soybean with leucaena leaf meal which was processed by soaking and drying improved the nutritive value of the leaves incorporated in treatment one and two and was equally as good as the control diet which is soybean meal based. All the performance parameters measured; weight gain, feed intake, feed/gain ratio, cost of feed intake and cost per kg weight gain were compared.

The provision of dietary protein by the processed leucaena leave gave inferior performance compared to that provided by the control diet. This was possibly due to the inactivation of most of the anti-nutritional and proteolytic factors in the leucaena leaves. These factors reduces the feed intake which result in low weight gain.

The replacement of soybean as a major protein concentrate in the diets of rabbits did not significantly reduce growth rate, feed consumption, and feed/gain ratio and body weight gain. It did not affect the internal organs of the rabbit like liver, kidney, spleen and the lungs. All these were attributed to the low concentration of the anti-nutritional and proteolytic factors in the leucaena leaves. The replacement also did not affect the performance of the rabbits in all the parameters measured and also did not cause any internal organ hypertrophy.

In view of the overall results, processed leucaena leaves at 100% replacement can be adopted by farmers considering the cost incurred in using soybean as their major protein source. Also, the growth response has no significant difference, this shows that leucaena leaf meal at 100% replacement can be used effectively.

5.2 RECOMMENDATION

Given the nutritional potential of the leaves, it is therefore recommend that:

Research effort should be geared towards establishment of *Leucaena leucocephala* plantation in Nigeria.

Research efforts should also be geared towards development (breeding) of strain that will be low in anti-nutritional factors (mimosine) inherent in the plant.

Careful control of processing conditions is essential to prevent both functional and nutritional damage to the protein that may possibly result from excessive heat treatment.

Research efforts should be geared towards the study of the biochemical aspect of processing as it relates to *Leucaena leucocephala* leaves and it's utilization for rabbit diets.

Research should also be geared towards the incorporation of both the leaves and seeds in feeding livestock .

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