THE EFFECT OF TOASTED SOYA BEAN SEEDS (*GLYCINE MAX MERR*.) ON GROWTH PERFORMANCE OF WEANER RABBITS (*ORYCTOLAGUS CUNICULUS*)

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DECLARATION

I declare that the work in the thesis entitled "THE EFFECT OF TOASTED SOYA BEAN SEEDS (*GLYCINE MAX MERR.*) ON THE GROWTH PERFORMANCE OF WEANER RABBITS (*ORYCTOLAGUS CUNICULUS*)" has been performed by me in the Department of Biological Sciences under the supervision of Prof. J. Auta and Prof. P.I. Bolorunduro. The information derived from the literature has been duly acknowledged in the text and list of references provided. No part of this thesis was previously presented for another degree or diploma at any university.

_____	_____	_____
Name of student	Signature	Date

CERTIFICATION

This thesis entitled "THE EFFECT OF TOASTED SOYA BEAN SEEDS (*GLYCINE MAX MERR.*) ON GROWTH PERFORMANCE OF WEANER RABBITS (*ORYCTOLAGUS CUNICULUS*)" by Odiba, Celina Ojoma meets the regulations governing the award of the degree of Master of Science in Biology Education in Ahmadu Bello University, and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This work is dedicated to my beloved husband, Dr. Dick I.Odiba, whose encouragement saw me through, my loving children Jemimah, Queen, Victor and Favour for their love and care and my siblings, Esther and Gideon for their inspirations.

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ABSTRACT

Studies were conducted on the growth performance of weaner rabbits fed with soya beans seed meal. Thirty weaner rabbits of 8 weeks old, with an average weight of 543g were used for the study, which was carried out over a period of 56 days. The rabbits were randomly allotted to five dietary treatment groups having two replicates with three rabbits per replicate in a completely randomized design. Data for each parameter were subjected to Analysis of Variance (ANOVA) and the means were compared for significant differences ($P \leq 0.05$). The raw and toasted (at 30, 40, 50, 60 minutes) soya bean seeds were analyzed for Dry Matter (DM), ash content, Crude Protein (CP), Crude Fibre (CF) and Nitrogen Free Extract (NFE), Ether Extract (EE) and anti-nutritional factors (phytate, hydrogen cyanide, oxalate, saponins and tannins). Each diet was offered ad-libitum for a period of 56 days. Rabbits fed Diet 1 which contained raw soya bean seeds served as the control. Diets 2, 3, 4 and 5 contained soya bean seeds toasted for 30, 40, 50 and 60 minutes respectively. The crude protein and anti-nutritional factors in the raw soya bean seeds decreased with increase in toasted time. There was a significant difference ($P \leq 0.05$) between the anti-nutritional factors of raw and toasted soya bean seeds. The rabbits fed with Diet 2 had the highest total weight gain (454g) than those fed with Diet 1 (354g) while those fed with Diet 5 (136g) had the least. There was a significant difference ($P \leq 0.05$) between the growth of rabbits fed the

experimental diets and in the crude protein contents of the rabbit's carcasses between Diets 2 and 1. The results suggested that 30 minutes toasting of soya bean seeds inclusion in rabbit diet gave the best growth performance.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Nigeria's rapidly growing population has enhanced the need to increase livestock production to satisfy her animal protein requirements. Contributions of beef and poultry products to this national dilemma has been indeed marginal, providing succor to only a select few who mostly are urban and peri-urban dwellers, while leaving about 90% of the populace who reside in hinterlands on consumption of less than 10g as against the recommended 35g animal protein per day (Ahamefule *et al.,* 2008). This leads to malnutrition with regards to inadequate intake of various nutrients, such as protein and calories (Akinmutimi and Anakebe, 2008).

The extremely high cost of feed being experienced by livestock industry in Nigeria has increased the feeding cost to about 70% of the total cost of production particularly for poultry and rabbits. This development arises from explosion of population growth which resulted in competition for available feed ingredient by man and animals (Jegede *et al.,* 2006). The conventional energy feed stuff such as cassava, maize, guinea corn and millet are not only scarce but expensive. They constitute a major regular source of food for humans. Their inclusion in animal diets has made the livestock feeds more expensive (Aderinola *et al.,* 2008).Feed

stuffs that could be used should be one that has very low human food preference and of low industrial usage (Olorede *et al.*2002).

According to Ajayi *et al.* (2007), the possible and most appropriate remedy for the shortage of animal protein for human consumption lies in the production of fast maturing animals like rabbit. This is because livestock like cattle, pigs, goats and sheep take longer period to mature. Animal protein is obtained from various animals and one of such animals is the rabbit which is richer in protein (20.8%) and lower in fat (10.2%) than other animals (Akinmutimi and Anakebe, 2008). The rabbit's rapid rate of reproduction, with short gestation period of 28-32 days has made its production a wise choice for Nigerians as a means of alleviating protein food shortages (Akinmutimi, 2001; Aderinola *et al.*, 2008). Rabbits are monogastric herbivores, they do not compete directly with man for both cereal and legume grains (Taiwo *et al.,* 2004).

Intensive approach to rabbit production would however entail the use of alternative plant protein sources other than the conventional ones to enable keepers produce meat at affordable price. Such alternative plant protein sources are currently under investigation in Nigeria; they are being evaluated for availability, acceptability, affordability and nutritive value (Ahamefule *et al.,* 2008). Utilization of leaf meal such as wild sunflower (Odunsi *et al.*, 1996), mimosa leaf meal (Nworgu and Fapohunda, 2002), *Glyricidia sepum* (Ige *et al.*, 2003),

Calapogonium mucunoides (Aderinola *et al.,* 2008), as source of protein and or energy in livestock nutrition has been investigated and suggested by livestock nutritionist, largely due to the abundant availability of forage crops especially during rainy season (Aderinola *et al.,* 2008).

1.2 Statement of Research Problem

The rapidly growing population of Nigeria demands the production of fast maturing animals like rabbits to satisfy her animal protein requirements. Researchers are faced with searching for alternative non-conventional source of plant protein for animal diets to reduce the competition between man and animals on conventional energy feedstuff. This work is therefore designed to contribute to finding nutritionally balanced diets for laboratory animals. Obtaining these animals of the same age is difficult because the farmers have no records of the days the animals were born/delivered and also it is difficult to obtain these animals in large numbers, give approximate age of the rabbits.

1.3 Justification

Various authors (De Blas, 1975; Bakut, 1987) pointed out that rabbits are suitable to raise for meat because of their high fecundity and short gestation period and high feed conversion efficiency. Research studies also demonstrated the

enormous theoretical potential value of the rabbit as a food producer for man in a world facing starvation. Since animal protein is expensive in Nigeria and almost absent in the daily meals of the average Nigerian, there is need, to encourage rabbit meat consumption. Rabbit meat, like that of chicken, has a high amount of essential amino acid and can be a good substitute for chicken meat.

1.4 Aim

To determine the effect of toasted soya bean seeds on the growth of weaner rabbits.

1.5 Research Objectives

The general objective of the study is to determine the growth performance of rabbits fed raw and toasted soya bean seeds meals. The specific objectives therefore are:

i. To determine the effect of feeding raw and toasted soya bean meals on the growth performance of rabbits.
ii. To determine the anti-nutritional content of raw and toasted soya bean meals.
iii. To determine the effect of the various experimental diets on the proximate content of the various experimental rabbits carcass.

1.6 Research Hypotheses

The null hypotheses stated for the study are as follows.

i. There is no significant difference on the effect of feeding raw and toasted soya bean meals on the growth performance of rabbits.

ii. There is no significant difference in the anti-nutritional content of raw and toasted soya bean meals.

iii. That the experimental diets have no effect on the carcass composition of the rabbits.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Rabbit as an Experimental Animal

The rabbits have been used in a wide variety of research studies in genetics, nutrition, toxicology, physiology, immunology and reproduction. Classically, rabbits have been utilized in human medicine to determine pregnancy women by injecting the serum from the patient into the rabbit and thereby inducing ovulation in the doe. The pharmaceutical industry uses rabbit widely to test toxic effects of cosmetics and pharmaceutical in their evaluation for new drugs (James, 2003). The rabbit is the standard animal for pyrogen testing of all solutions for human medical use and also the rabbit is also widely used by the research community for the production of antibodies and antiserum (James, 2003).

2.2 The Growth and Protein Requirements of Rabbit

Rabbits are usually born naked, blind and helpless. Mothers are remarkably inattentive to their young and are almost absentee parents, commonly nursing their young only once per day and for just a few minutes (Wikipedia, 2008).

To synthesize proteins, rabbits simultaneously require all constituent amino acids; those that the animal does not synthesize are defined as essential and have to be supplied by the diet. The requirements of animals therefore are for amino acids rather than for protein (Fraga, 1998).

Thus, the dietary protein level necessary to meet the requirements of rabbits vary according to its amino acid profile, the degree to which the protein is digested, the amount of feed ingested which, in turn, depends on the dietary digestible energy concentration (Fraga, 1998).

According to King (1971), rabbits fed urea as a protein supplement or as a partial protein substitute, grow significantly less than those in which the protein source was casein, supplemented with yeast extract. The rabbit has an unusually high arginine requirement that resembles that of the young chick (Adamson and Fisher, 1971).

The level of protein in the diet is determined by its percentage of total diet, its bio-availability and its amino acid profile. Amino acids are the building blocks the body needs to create and repair tissue. Young, pregnant and lactating animals require higher levels of protein in the diet. Rabbits are obligate herbivores which mean they obtain their protein requirement from plant material, mainly grasses, roots and wild plants.

2.3 Caecotropy Mechanism and Nutritional Significance

Rabbits produce two distinct kinds of faecal pellets, soft ones (caecotrophes) which are reingested directly from the anus and hard ones which are voided. The formation of each type alternates in a precise circadian rhythm, with caecotrophy usually beginning around sunrise and continuing until early

afternoon. The caecotrophy are packages of caecal contents surrounded by mucus envelop and have a high content of vitamins, protein and minerals. In contrast, hard faeces are lower in minerals and protein and a relatively high fibre content. The differences in composition are as a result of retardation and retrograde transport of fine particles (including micro-organisms and water soluble substances) which takes place in the proximal colon, sweeping these particles back into the caecum while large particles (7.0.3mm) continue towards the anus. The site of secretion of the mucus envelope appears to lie in the caecum itself or the distal colon (Lang, 1981).

Caecotrophy appears to be somewhat of an evolutionary relic which aids the animal particularly during times of nutritional adversity. In production situations (e.g. growth, lactation) with relatively high protein and energy intakes, its contribution to over all nutrient requirements is relatively small (Lebas *et al*., 1986).

2.4 Non-Conventional Feedstuffs for Rabbits

Bamikole *et al.* (2004) who used *Chromolaena odorata* in feeding rabbits reported that it contains 29.76% crude protein and it can be used up to 30% of the dry matter and can be fed to rabbits to obtain weight gain, feed conversion efficiency and feed digestibility that are comparable to that of a standard concentrate. Bamikole *et al.* (2005) worked on the nutritive value of mulberry

leaves containing 76.33% to 84.00% crude protein reported that comparable dry matter intake, digestibility and weight gain could be achieved with up to 50% substitution of concentrate in rations and rapid growth rate of rabbits can be achieved at less cost.

Tegbe *et al.* (2006) fed weaner rabbits graded levels of dried and milled *Ficus thonningii* leaves and measured the growth performance, carcass characteristics and organs weights, reported that *Ficus thonningii* had 18.51% crude protein and that *Ficus thonningii* leaf meals could be included up to 15% level in rabbit diets without any debility effects on growth performance, organs and carcass characteristics. Akinmutimi *et al.* (2006) reported that diet containing toasted Lima bean (*Phaseolus innatus*) fed to rabbits had no significant differences in the growth performance parameters except for feed-to-gain ratio and meal could be included up to 30% in weaner rabbits diets. Omoikhoje *et al.* (2006) when working on the response of weaner rabbits fed concentrate supplemented with varying levels of *Syndrella nodiflora* forage which contained 22.32% crude protein concluded that the forage could be used to supplement rabbit diets up to 50% to enhance performance without any adverse effect.

Jegede *et al.* (2006) showed that the dry matter, crude protein and crude fibre digestibility significantly declined as the level of malted sorghum sprout inclusion decreased and also less cost was incurred in producing a kilogram of

rabbit when fed 20 and 30% malted sorghum sprout. Therefore, 20% level of inclusion in rabbit diet could be of benefit in terms of cost reduction and better growth. Aziza *et al.* (2007) substituted dietary soybean meal with different levels of rapeseed meal in the diet of rabbits. It contained 34.9% crude protein and digestibility, performance and carcass characteristics were highest at 14% inclusion level.

Ajayi *et al.* (2007) reported that the diets containing blood-wild sunflower leaf meal mixture fed to cross bred (New Zealand X Chinchilla) male rabbits indicated that up to 15% inclusion level could be used in rabbit diet. Yam and sweet potato peels were also used in feeding and incorporated into weaner rabbit's feeding trials. Also mean percentage weight gain showed that the diet with 40% yam and sweet potato peel had the best weight gain which was even higher than the control with 13.585g versus 9.04g respectively. The sweet potato peel meal and yam peel meal contained 6.34% and 11.10% crude protein respectively (Akinmutimi *et al.*, 2008).

Akinmutimi *et al.* (2008) studied the response of weaner rabbits fed graded levels of sweet potato meal in place of a maize based diet found that sweet potato meal contained 6.34% crude protein and the diet containing 11.11% of sweet potato meal was the best based on growth performance, carcass characteristics, organ weights, haemotological and biochemical and economics of the diets, was

recommended. When Aderinola *et al.* (2008) used varying inclusion levels of *Centrosema pubescens* or *Calapogonium mucunoides* in the diet of growing rabbits, the incorporation of *Centrosema pubescens* at 20% inclusion level gave results similar to the control (which contained no forage) and better than the incorporation of *Calapogonium mucunoides*. *Centrosema pubescens* and *Calapogonium mucunoides* contained 19.98% and 22.03% crude protein respectively.

2.5 Soya Bean (*Glycine Max Merr.)*

Soya bean is an annual summer herb that grows up to 1m high, usually erect though some varieties twine. The plant is entirely covered with fine brown or grey hair. Soya bean is commonly considered as one of the oldest cultivated crops, native to North and Central China. Soya bean may have been introduced to Nigeria as early as 1908, but it cultivation as a crop can be attributed to the introduction of the Malayan variety in 1937 by British Colonial Officers in Benue State (Singh *et al.* 1987). Soya bean has been variously described as a "miracle bean" or a "golden bean" because it is a cheap, protein-rich grain. It contain 40% high quality protein, 20% edible vegetable oil and a good balance of amino acids (Singh *et al.* 1997; Weingartner, 1987) and has therefore tremendous potential to improve the nutritional status and welfare of the families of poor farmers. Soya bean can also contribute to the enhanced sustainability of intensified cropping systems by

improving soil fertility through nitrogen fixation, permitting a longer duration of ground cover in the cropping sequence and providing useful crop residues for animal feed.

However, soya bean is relatively new crop in Africa. Until recently, it was seen as being appropriate only for large-scale commercial farming where the crop can be used for industrial processing and for livestock feed (Shannon *et al* 1995). Because soya beans are high in protein, they are a major ingredients in livestock feed. Most soya beans are processed for their oil and protein for the animal feed industry. A smaller percentage is processed for human consumption and made into products including soya milk, soya flour, soya protein, tofu and many retail food products. Soya beans are also used in many non-food (industrial) products (Roger, 2011).

Nearly all soya beans are processed for their oil. Soya processors take the raw soya beans and separate the oil from the meal. The oil may be refined for cooking and other edible uses or sold or biodiesel production or industrial uses. The processors bake the high-protein fiber that is left after the oil is removed and used for animal feed. Soya bean oil is used in cooking and frying foods. Margarine is product made from soya bean oil. Salad dressings and mayonnaises are made with soya bean oil. Some foods are packed in soya bean oil (tuna, sardines e.t.c.), baked breads, crackers, cakes, cookies and pies usually have soya bean oil in them.

The high-protein fiber (that which remains after processing has removed the oil) is toasted and prepared into animal feed for poultry, pork, cattle, other farm animals and pets. The poultry and swine industries are major consumers of soya bean meal. Over half of the soya beans processed for livestock feed are fed to poultry, about one-quarter is fed to swine and the rest is used for beef, cattle, dairy cattle and pet food. Soya protein is increasingly found in fish food, both for home aquariums and for the fish grown for eating. Most marine species were fed fish meal at one time, but the scarcity and increasing cost of fish meal has led producers to switch to high-protein soya meal for a variety of marine species. Around the world, soya protein may be found in feed for most animals. Biocomposites are building materials made from recycled newspaper and soya beans. They replace other products traditionally made from wood, such as furniture, flooring and countertops. Particle board, laminated plywood and finger-jointed lumber are made with soya-based wood adhesives. Soya products are also found in many popular brands of home and commercial carpet and in auto upholstery (Roger, 2011).

Biodiesel fuel for diesel engines can be produced from soya bean oil by a simple process called trans-esterification. This process removes the glycerin from the oil, leaving soya biodiesel. Soya biodiesel is cleaner burning than petroleum-based diesel oil. Its use reduces particulate emissions and it is non-toxic, renewable and environmentally friendly. Soya oil produces an environmentally friendly

solvent that safely and rapidly removes oil from creeks, streams and shorelines without harming people, animals and the environment. Soya is an ingredient in many industrial lubricants, solvents, cleaners and paints. Soya crayons made by the Dixon Ticonderoga Company replace the petroleum used in regular crayons with soya oil making them non-toxic and safer for children. Candles with soya bean oil burn longer but with less smoke and soot. Soya ink is superior to petroleum-based inks because soya ink is not toxic, renewable and environmentally friendly and it cleans up easily. Soya-based lubricants are good as petroleum-based lubricants, but can withstand higher heat. More importantly, they are non-toxic, renewable and environmentally friendly. Soya-based foams are currently being developed for use in coolers, refrigerators, automotive interiors and even foot wear.

2.6 Maize (*Zea mays*)

The American and Indian word for maize literally means "that which sustains life". After wheat and rice, maize is the most important cereal grain in the world, providing nutrients for humans and animals. It also serves as a basic raw material for the production of starch, oil, protein, alcoholic beverages, food sweeteners and fuel. Maize has the highest average yield per hectare (Ranjita, 2004).

Maize is an important food in Asia, Africa, Latin America and parts of the former Soviet Union. Each country has one or more maize dishes that are unique to

its culture. Examples are ogi (Nigeria), kenkey (Ghana), koga (Cameroon), injera (Ethiopia) and ugali (Kenya). Most of these products are processed in traditional ways. In Africa, ground maize is cooked into a paste or mush and eaten while still warm, accompanied by a thick low-alcoholic beer. In some areas of Africa, maize mush is fried or baked. In Central and Latin America, maize is consumed in form of maize bread or tortillas. Many Africans depend on some variation of this mush, which is made with water and ground maize. It can be eaten as a porridge or a dumpling, depending on the thickness of the batter and the cooking method (Ranjita, 2004).

Maize is also used as animal feed and raw material for industrialzed countries, a larger proportion of the grain is used as livestock feed and as industrial raw material for food and non-food uses. On the other hand, the bulk of maize produced in developing countries is used as human food, although its use as animal feed is increasing. Maize is the largest food crop of the United States, which is responsible for 40% of the world's production (Ranjita, 2004).

Maize constitutes an important source of carbohydrates, protein, vitamin B and minerals. As an energy source, it compares favourably with root and tuber crops and it is similar in energy value to dried legumes. Furthermore, it is an excellent source of carbohydrate and is complete in nutrients compared to other cereals (Latham, 1997).

Table 2.1: Proximate Composition of main parts of Maize Kernels

Chemical Component (%)	Pericarp	Endosperm	Germ
Protein	3.7	8.0	18.4
Ether extract	1.0	0.8	33.2
Crude fibre	86.7	2.7	8.8
Ash	0.8	0.3	10.5
Starch	7.3	87.6	8.3
Sugar	0.34	0.62	10.8

Source: Watson, 1987 in: FAO Corporate Document Repository (2009).

2.7 Nutritional Requirements of Rabbits

The aim in scientific feeding of livestock is to provide an exactly balanced diet that is, each kind of food stuff in the correct amount for the particular animal

concerned. Rajammal *et al.* (1975) indicated that an adequate diet is one which contains all the required nutrients in proper quantities through foods which are combined in suitable proportions and furnish the number of required calories.

Rabbits are very selective in their feeding behavior and in the wild will nibble and select specific plant parts. They select leaves rather than stems, young plant materials rather than old and green rather than dry materials, resulting in a diet that is higher than the total plant material available (McNitt *et al.,*1996). Fiber plays a vital role in the nutrition of the rabbit. According to Lebas *et al*. (1997), there is a minimum requirement for roughage in order to optimize the digestive processes and the more digestible the fiber the higher is the requirement in order to satisfy the need for 10% of indigestible fiber in the diet.

The fiber fraction of feeds is poorly utilized by rabbits. Rabbit effectively digest the non-fiber fraction such as the protein and soluble carbohydrates and excretes the fiber fraction. The nutritional consequence of coprophagy in the rabbits is that this is a means to provide the requirement for B Vitamins and so they do not require B Vitamins in their diets. Rabbits digest the protein in the forages efficiently compared with other monogastric animals. Due to the coprophage, the rabbits have the ability to digest protein more than swine (McNitt *et al.*, 1996).

2.8 Rearing and Utilization of Rabbit in Nigeria

Rabbit production in Nigeria at present is traditional, non-commercial oriented, family consumption targeted and smallholder type comprising a range of 2-7 does and 3 bucks on average (Onifade *et al.,* 1999).

Rabbit keeping, in Nigeria is both intensive and semi-intensive. Both sexes of rabbit are kept. The ratio of buck to doe differs depending on the scale of production. At the smallholder level of 1:2 or 1:3 is common largely as a result of economic and spatial constraints (Abu, 1995).

Traditionally, most rabbit keepers allow the doe to be introduced to the buck and watch the mating accomplished after which time the doe is immediately separated. In most cases, separation of the doe takes place after fifteen minutes, if the doe urinates, there is a re-mating. Farmers prevent indiscriminate mating once pregnancy is confirmed, the doe is usually separated and feeding or diet allocation is made exclusively. Nigerian does kindle about 5-8 kits per litter and on the average 4-5 kits reach weaning stage. The high mortality is largely attributed to poor nutritional management and housing environment of the does. Poor understanding of ante and post-natal management of does also leads to high peri-natal mortalities of rabbits in Nigeria (Onifade *et al.,* 1999).

Does are usually re-mated between 6-8 weeks post parturition. Thus on the average, the Nigerian doe produces about twenty weaned rabbits per year. The average reproductive life cycle of the buck is longer than the doe. After four

parities most does are offered for sale because of declining fertility, economic reasons or peculiar reasons (Onifade *et al.*, 1999).

Rabbits in Nigeria are either marketed live or processed. The processing involves removal of the skin and the head before refrigeration. Otherwise, the slaughtered animal is singed and roasted on fire without cutting the head or tarsals. For such processing the chest and abdominal compartments are longitudinally incised while short sticks are used to expand the chest. The roasting is effectively completed within 24 hours of continuous exposure to fire. Smoked rabbits are sold best when disguised as game meat. Rabbit meat is not sold in restaurants unlike other delicacies like goat head, fresh fish, cow leg or bush meat (Onifade *et al.,* 1999).

Despite culinary preferences for other meat types and the somewhat non-competitive production and market price of rabbit meat, rearing of rabbits offers a great potential towards attainment of family or household food security in terms of animal protein intake (Abu, 1995).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Source of Rabbits

Thirty weaner rabbits of 6-9 weeks New Zealand white and Chinchilla cross breeds were obtained from a farmer in Samaru, Zaria.

3.2 Source of Major Feed Ingredients

Feedstuffs used in the experiments (soya beans, maize and fish) were purchased from Sabon Gari market, Zaria.

3.3 Processing of Feed Stuffs

Yellow maize was milled into fine particles using hammer mill. The fish was sun dried and milled into fine particles. Soya beans were toasted by using blue flame heat from a stove for 30, 40, 50 and 60 minutes locally and milled hammer mill. Each diet was milled separately and thoroughly mixed to obtain homogeneous mixture; pelleted using flat diet feed pellet mills and sun dried for forty-eight hours, at Rehoboth Feeds Samaru, Zaria.

3.4 Experimental Diet

Five experimental diets were formulated of varying crude protein levels. The percentage inclusion of each ingredient was calculated using Pearson square method. Diet 1 contained raw soya beans and served as the control. Diets 2, 3, 4

and 5 contained locally toasted soya bean seeds for 30, 40, 50 and 60 minutes respectively.

Table 3.1: Percentage Composition of Experimental Diets

	Diets				
Ingredients	D1	D2	D3	D4	D5
Maize	81.22	80.97	80.83	80.53	80.36
Soya bean	14.09	14.27	14.37	14.60	14.73
Fish	4.69	4.76	4.80	4.87	4.91
Total	100	100	100	100	100

D1- Raw soya bean seeds meal
D2- 30 minutes toasted soya bean seeds meal
D3- 40 minutes toasted soya bean seeds meal
D4- 50 minutes toasted soya bean seeds meal
D5- 60 minutes toasted soya bean seeds meal

3.5 Experimental Design

A total of 20 weaner rabbits (8 weeks old) with an average initial weight of 543g were randomly allotted to five dietary treatment groups with two replicates, three rabbits per replicate. Feed and water were given ad-libitum. Wood shavings were spread evenly on the floor of the cage, which were changed after interval of four days. Drinkers and feeders were provided and held in place with the aid of a wire to prevent spilling by the rabbits.

3.6 Feeding

Daily feed intake consumption was measured as the difference between the quantity supplied and the remnant. 0.30g of the experimental diets were offered twice daily. The study lasted for 8 weeks (56 days).

3.7 Management of Experimental Animals

The rabbits were initially fed on commercial poultry grower marsh and water given adlibitum during acclimatization period of ten days. During this period, oxytetracycline and Embazine Forte (to control diarrheoa) were administered to the rabbits for three days each, within this treatment time ten rabbits died. After the acclimatization period the food was withdrawn overnight in order to clear the gut of the rabbits for experiment to commence. The daily feed intake consumption was measured as the difference between the quantity supplied and the remnants. 0.30g of the experimental diets were offered twice daily. The rabbits were weighed fortnightly during this period to determine weight gain by subtracting from the initial weight to get the weight gained/lost per rabbit.

3.8 Weight measurement

Data were collected on initial and final weights of the animals, feed given and the left over. The values obtained were used to obtain the following parameters.

$$\text{Feed intake} = \frac{\text{Quantity of feed given} - \text{Left over (g)}}{\text{Number of rabbits} \times 56 \text{ days}}$$

Daily weight gain/loss per rabbit = $\frac{\text{Final weight – Initial weight(g)}}{\text{Number of rabbits x 56 days}}$

Feed conversion ratio = $\frac{\text{Quantity of feed consumed (g)}}{\text{Weight gain by the rabbits (g)}}$

One rabbit from each of the experimental diets was selected randomly and slaughtered and oven dried, the tissue was subjected to proximate analysis.

3.9:Proximate Analysis

The proximate analysis of the experimental diets and carcasses of the experimental animals were determined through the method of Association of Official Analytical Chemists (AOAC, 1990), in the Department of Animal Science Laboratory Ahmadu Bello University, Zaria.

3.9.1: Ash Content Determination

The term ash refers to the residue left after combustion of the oven dried sample and is a measure of the total mineral content. Three different crucibles pre heated in a muffle furnace to about 525°c. Each crucible was cooled in a desiccator and weighed. Approximately 10g of each sample was weighed into different crucibles. The crucibles and their contents were transferred into a muffle furnace set to 525°c and allowed to stay for one hour. The weights of crucible and content were taken and recorded.

The percentage ash was calculated using the expression

% ash = $\frac{\text{weight of ash (g)}}{\text{Weight of sample (g)}}$ x 100

3.9.2: Determination of Ether Extract

The lipid content was determined using the procedure described in AOAC (1990). A clean dry round bottom flask containing antibumping granules was used. Then 210cm^3 of petroleum ether (60-80°) was measured into the flask and fitted with soxhlet extraction unit. The weighed ground sample was transferred into the thimble which was already fixed into the soxhlet extraction unit and cold water circulation was put on. The heating mantle was switched on and the heating rate adjusted until the solvent was refluxing at a steady rate. Extraction was carried out for eight hours. The sample was removed and dried to constant weight in an oven and reweighed.

$$\% \text{ lipid w/w} = \frac{\text{weight of lipid extracted}}{\text{weight of dry sample}} \times 100$$

Procedure for determination of Ether Extract

The method of Pearson (1976) was employed. A 0.2g of the ground sample was weighed into 100ml Kjeldahl flask. A few antibumping granules was added. One gram of the mixed catalyst ($CuSO_4$ and K_2SO_4 ratio 8:1) and 15ml of concentrated sulphuric acid was added. The flask was placed on a Kjeldahl digestion rack and heated until a clear solution was obtained. At the end of digestion the flask was cooled and the sample was quantitatively transferred to 100ml volumetric flask and made up to mark with distilled water. 10ml of the

digest was pipetted into Markham semi micronitrogen steel and 10ml of 40% NaOH solution was carefully added . The sample was steam distilled liberating ammonia into 100ml conical flask containing 10ml of 4% boric acid and a drop of mixed indicator (methyl red and methyl blue ratio 2:1) until indicator changed colour from pink to green. About 30ml volume of sample was collected. The content of the conical flask was titrated with 0.1M HCl with end point indicated by a colour change from green to pink. The volume of the acid for each distillate was noted. The percentage nitrogen per sample was calculated using the expression

$$\% \text{ Nitrogen} = \frac{M \times V \times 14 \times 100 \times 100}{\text{Weight of sample} \times 1000 \times 10}$$

Where M = molarity of HCl

V = volume of acid used

14 = atomic weight of Nitrogen

100 = total volume of digest

100 = % conversion

10 = volume of digest taken

1000 = to convert to liter

The crude protein was calculated as

% crude protein = 6.25 x %N

6.25 is the conversion factor since it is assumed that protein contains 16% Nitrogen.

3.9.3: Determination of Crude Fibre

The standard method of AOAC (1990) was used to determine crude fibre in the samples.

Procedure for determination of Ether Extract

Two grams of the grounded sample was placed in a round bottom flask. 100ml of 0.25M H_2SO_4 was added and the mixture boiled under reflux for 30 minutes. The insoluble matter was washed several times with hot water until it was acid free. Thereafter, it was transferred into a flask containing 100ml of hot 0.312M NaOH solution. The mixture was boiled again under reflux for 30 minutes and filtered under suction; the insoluble residue was washed with hot water until it was base free. It was dried to constant weight in an oven at 100°c, cooled in a desiccator and weighed (C_2). The weighed sample was incinerated in a furnace at 550°c for 2hours. It was put off and allowed to cool down. It was removed cooled in a desiccator and weighed (C_3). The crude fibre was calculated as shown below:

Weight of the original sample = W

$$\% \text{ crude fibre} = \frac{C_2 - C_3}{W} \times \frac{100}{1}$$

3.10: Determination of the Anti-Nutritional Factors in the Raw and Toasted Soya Bean Seeds

The anti-nutritional factors in the raw and toasted soya bean seeds were determined by the method of AOAC, 1990 in the Department of Animal Science Laboratory Ahmadu Bello University, Zaria.

3.10.1: Determination of Oxalate

Oxalate was determined by using the method of Oke (1969). One gram of the sample was placed in a 250ml volumetric flask, 190ml of distilled water and 10ml of 6MHCl were added. The mixture was warmed on water bath at 90° for four hours and the digested sample was centrifuged at a speed of 2000rpm for 5 minutes. The supernatant was then diluted to 250cm^3. Three 50cm^3 aliquots of the supernatant were evaporated to 25cm^3. The brown precipitate was filtered off and washed. The combined solution and washing was titrated with concentrated ammonia solution in drops until salmon pink colour of methyl orange change to faint yellow. The solution was heated on water bath 90°c and the oxalate was precipitated with 10cm^3 of 5% calcium chloride ($CaCl_2$) solution. The solution was allowed to stand overnight and then centrifuged. The precipitate was washed into a beaker with hot 25% H_2SO_4 diluted to 125mls with distilled water and after warming for 90°c, it was titrated against 0.05m $KMnO_4$.

Calculation

1ml 0.05M$KMnO_4$ = 2.2mg oxalate

3.10.2:Determination of Percentage Phytate (Reddy *et al.*, 1978)

A known weight of each ground sample was soaked in 100ml of 2% HCl for 5 hours and filtered 25cm^3 of the filtrate was taken into a conical flask 5.0cm^3 of 0.3% potassium thiocynate solution was added. The mixture was titrated with a standard solution of $FeCl_3$ until a brownish-yellow colour persisted for 5 minutes.

The concentration of the $FeCl_3$ was 1.04% w/v

Calculation: Mole ratio of Fe to phytate = 1:1

$$\text{Concentration of phytate phosphorous} = \frac{\text{titrate value} \times 0.064}{1000 \times \text{weight of sample}}$$

Phytic acid content was calculated on the assumption that it contains 28.20% phosphorous by weight.

3.10.3 :Determination of Saponins

The standard method of AOAC (1990) was used to determine saponins in the samples. A known weight of dry ground sample was weighed into a thimble transferred into the soxhlet extraction chamber fitted with a condenser and a round flat bottomed flask, 150ml acetone (to cause a reflux) was poured into the flask. The sample was exhaustively extracted of its lipids and interfering pigments for 3 hours by heating the flask on a hotplate and the solvent distilled off. This was the first extraction. For the second extraction, a preweighed round bottom flask was fitted into the soxhlet apparatus bearing the sample containing thimble and methanol was poured into the flask. The methanol (150ml) was enough to cause reflux. The saponin was then exhaustively extracted for 3 hours by heating the

flask on a hotplate after which the solvent was distilled off. The flask was re-weighed. The difference between the final and initial weights of the flask represented the weights of the saponins extracted.

$$\% \text{ saponins} = \frac{\text{weight of saponins} \times 100}{\text{Weight of sample}}$$

3.10.4:Determination of Tannins

The amount of tannin was determined using the method described by Allen *et. al.* (1974). A 0.5g oven-dried ground sample was weighed into a 100ml conical flask. 50cm^3 of distilled water was added and allowed to gently boil for one hour gently on a hotplate. The solution was then filtered whilst warm in a 50ml volumetric flask. The filter paper was washed, the solution made to mark when cooled. The extract was prepared immediately before use, 0-3ml aliquot of tannic acid was measured into ranges of 0.5cm^3 volumetric flasks giving a standard range from 0 to 0.3mg corresponding to 0.05mg, 0.10mg, 0.15mg, 0.20mg, 0.25mg, 0.30mg respectively. Then 3.0cm^3 aliquot of the sample was pipetted into a 50cm^3 volumetric flask. To both standards and sample water was added until half-full. Then 2.5cm^3 of Folin-Denis reagent (prepared by the addition of 5g sodium tangstate $Na_2WO_42H_2O$). One gram phosphomolbdic acid (H_3PO_4 $12MoO_324H_2O$) and 2.5cm^3 orthophosphoric acid (H_3PO_4) to 35cm^3 of water. The mixture was refluxed for two hours, cooled and diluted to 50cm^3 with distilled water and was added to each flask, followed by the addition of 10cm^3 17% w/v

sodium carbonate solution and diluted to 50cm^3 mark and mixed. It was allowed to stand in a water bath at 25°c for twenty minutes. The optical density (absorbence) readings were taken at 760nm wavelength using water as reference.

$$\text{Soluble tannins (\%)} = \frac{\text{conc. (mg) x extract volume (cm}^3\text{)}}{\text{10 x aliquot vol. (cm}^3\text{) x sample weight (g)}}$$

3.11: Statistical Analysis

The experiment was carried out in a completely randomized design. The data was analyzed using the Analysis of Variance (ANOVA) at 5% probability level ($P \leq 0.05$). The means were separated using Least Significant Difference (LSD) as described by Steel and Torrie (1980).

CHAPTER FOUR

4.0 RESULTS

4.1 Proximate Composition of the Raw and Toasted Soya Bean Seeds

The proximate composition of the raw and toasted soya bean seeds is presented in Table 4.1. The results obtained showed the raw soya bean seeds contained 93.15g/100g Dry Matter, 44.46 g/100g Crude Protein, 4.31 g/100g Crude Fibre, 18.02 g/100g Ether Extract, 5.22 g/100g Ash and 27.99 g/100g Nitrogen Free Extract (NFE). The raw soya bean seeds showed the highest crude protein value. The crude protein value decreased with increase in toasting time.

The soya bean seeds toasted for 60 minutes contained 96.31g/100g Dry Matter, 42.98g/100g Crude Protein, 13.16g/100g Crude Fiber, 9.10g/100g Ether Extract, 5.00g/100g Ash and 29.79g/100g Nitrogen Free Extract (NFE).

Table 4.1: Proximate Composition of the Raw and Toasted Soya Bean Seeds

Parameters (g/100g)	RS0	RS30	RS40	RS50	RS60
Dry Matter	93.15[b]	94.99[b]	94.84[b]	95.38[b]	96.31[a]
Crude Protein	44.46[a]	44.01[a]	43.78[b]	43.27[b]	42.98[b]
Crude Fiber	4.31[d]	5.41[c]	7.96[b]	4.78[d]	13.16[a]
Ether Extract	18.02[a]	11.16[b]	11.09[b]	9.78[c]	9.10[c]
Ash	5.22[a]	5.00[a]	4.80[b]	5.26[a]	5.00[a]
NFE	27.99[b]	34.42[a]	32.37[a]	26.7[b]	29.79[b]

Means in the same row having different superscript are significantly different ($P \leq 0.05$)
RS0 – Raw seeds,
RS30 – 30 minutes toasted seeds
RS40 – 40 minutes toasted seeds
RS50 – 50 minutes toasted seeds
RS60 – 60 minutes toasted seeds

4.2 Anti-nutritional Factors of Raw and Toasted Soya Bean Seeds

Table 4.2 shows the anti-nutritional factors of raw and toasted soya bean seeds. The raw seeds contained the highest concentration of phytate (4.39), saponins (2.46), HCN (1.68) and tannins (0.42) than the toasted soya bean seeds. Heat was found to reduce all the anti-nutritional factors. The seeds toasted for 60 minutes contained the least concentration of anti-nutritional factors. There were significant differences ($P \leq 0.05$) in the values of phytate, saponins, HCN and tannins in soya bean seeds toasted for 60 minutes compared to raw soya bean seeds.

Table 4.2:Anti-nutritional Factors in the Raw and Toasted Soya Bean

Seeds

Parameters (g/100g)	RS0	RS30	RS40	RS50	RS60
Phytate	4.39[a]	2.21[b]	1.29[c]	1.75[b]	0.40[d]
HCN	1.68[a]	1.59[a]	1.23[b]	0.24[c]	0.20[c]
Oxalate	1.04[a]	1.00[a]	0.96[b]	0.94[b]	0.84[b]
Saponins	2.46[a]	1.06[b]	1.04[b]	1.02[b]	0.98[c]
Tannins	0.42[a]	0.36[a]	0.28[a]	0.24[a]	0.18[a]

Means in the same row having different superscript are significantly different ($P \leq 0.05$)
RS0 – Raw seeds,
RS30 – 30 minutes toasted seeds
RS40 – 40 minutes toasted seeds
RS50 – 50 minutes toasted seeds
RS60 – 60 minutes toasted seeds

4.3 Proximate Composition of the Experimental Diets

The proximate composition of the experimental diets (Table 4.3) showed that the diet with raw soya bean seeds meal contained 92.54g/100g dry matter, 1.90g/100g ash, 12.10g/100g crude protein, 1.50g/100g crude fibre, 15.07g/100g ether extract.

The toasted soya bean seeds meals showed a decrease in the crude protein as the toasted time increased. There was a significant difference

($P \leq 0.05$) in the values of crude protein in the toasted soya bean seeds meal when compared with the raw soya bean seeds meal.

Table 4.3:Proximate Composition of the Experimental Diets

Parameters (g/100g)	DIET 1	DIET 2	DIET 3	DIET 4	DIET 5
Dry matter	92.54[a]	91.80[a]	91.86[a]	91.30[a]	91.81[a]
Ash	1.90[b]	0.84[c]	0.93[c]	3.90[a]	0.82[c]
Crude protein	12.10[a]	10.84[a]	10.64[a]	10.12[a]	9.66[b]
Crude fiber	1.50[a]	1.48[a]	1.03[b]	1.02[b]	1.45[a]
Ether extract	15.07[a]	6.12[b]	6.30[b]	6.40[b]	6.10[b]

Means in the same row having different superscript are significantly different ($P \leq 0.05$)
Diet 1- Raw soya bean seeds meal
Diet 2- 30 minutes toasted soya bean seeds meal
Diet 3- 40 minutes toasted soya bean seeds meal
Diet 4- 50 minutes toasted soya bean seeds meal
Diet 5- 60 minutes toasted soya bean seeds meal

4.4 Growth Performance of the Weaner Rabbits

The highest feed intake was in Diet 2 with an intake of 41.96g/day/rabbit, then Diet 1 (40.0g), Diet 4 (34.64g), Diet 3 (36.10g) and the lowest was in diet 5 (27.50g) as shown in Table 4.4.

Differences were observed in the total weight gained with rabbits fed Diet 2 having the highest values which was significantly different from the other diets, followed by Diet 1, Diet 3, Diet 4, and Diet 5 in that order.

Diet 5 had the highest Feed Conversion Ratio (FCR) of 11.32g, the lowest FCR value of 5.17 was observed in rabbits fed with Diet 2 followed by Diet 4 (9.79), Diet 3 (9.63) and Diet 1 (6.33).

Table 4.4:Growth Performance of the Weaner Rabbits

Parameters (g)	DIET 1	DIET 2	DIET 3	DIET 4	DIET 5
Initial weight	540 [b]	540 [b]	520 [b]	500 [b]	613 [a]
Final weight	894 [a]	994 [a]	730 [b]	698 [c]	749 [b]
Total weight gained	354 [a]	454 [a]	210 [b]	198 [b]	136 [c]
Average Daily weight gained	6.32 [b]	8.11 [a]	3.75 [c]	3.54 [c]	2.43 [d]
Average Daily feed intake	40.00 [a]	41.96 [a]	36.10 [b]	34.64 [b]	27.50 [c]
Feed Conversion Ratio	6.33[c]	5.17 [c]	9.63 [b]	9.79 [b]	11.32 [a]

Means with the same superscript across the rows are not significantly different ($P > 0.05$).
Diet 1- Raw soya bean seeds meal
Diet 2- 30 minutes toasted soya bean seeds meal
Diet 3- 40 minutes toasted soya bean seeds meal
Diet 4- 50 minutes toasted soya bean seeds meal
Diet 5- 60 minutes toasted soya bean seeds meal

4.5 Carcass Proximate Composition of the Rabbits

The carcass proximate composition (Table 4.4) of the experimental rabbits showed that rabbits fed with Diet 2 had the highest crude protein (20.64g/100g), followed by rabbits fed with Diet 1. There was a significant difference ($P \leq 0.05$) in rabbits fed with Diet 2 when compared with the control and other diets.

Table 4.5:Carcass Proximate Composition of the Rabbits

Parameters (g/100g)	D1	D2	D3	D4	D5

Ash	1.08[a]	1.26[a]	1.42[a]	1.08[a]	1.42[a]
Crude protein	19.42[b]	20.64[a]	18.42[c]	18.96[c]	18.16[c]
Crude lipid	4.20[a]	3.84[b]	2.62[c]	3.66[b]	3.82[b]
Ether extract	68.9[b]	70.78[b]	72.66[a]	71.56[a]	71.74[a]
Fibre	0.08[a]	0.04[a]	0.02[a]	0.06[a]	0.02[a]

Means in the same row having different superscript are significantly different ($P \leq 0.05$)

D1- Rabbits fed raw soya bean seeds meal
D2- Rabbits fed 30 minutes toasted soya bean seeds meal
D3- Rabbits fed 40 minutes toasted soya bean seeds meal
D4- Rabbits fed 50 minutes toasted soya bean seeds meal
D5- rabbits fed 60 minutes toasted soya bean seeds meal

CHAPTER FIVE

5.0 DISCUSSION

The results of this study clearly showed that the values of crude protein decreased with increasing toasting time. This suggests that high temperature causes damage to the protein. These findings are similar to that of Golema *et al.* (1999); Kricka *et al.* (2001) who reported that high temperature causes damage to the protein which decreases the quality of the final products.

The anti-nutritional factors in the raw soya beans was higher than the toasted soya bean seeds. There was a general reduction in the quantity of anti-nutrients as a result of toasting (Akinmutimi *et al.*, 2006). The soya beans toasted for 30 minutes gave the best result. As the toasting time increased the anti nutrients decreased. There was significant difference ($P \leq 0.05$) between the anti-nutritional factors.

The results of this study showed clearly that toasting reduced tannin level to a tolerable level. Findings similar to this was reported by Rao and Prabhavathi (1982) in locust bean and soya beans respectively. Tannin binds with soluble protein and inhibits the activities of digestive enzymes in the gastrointestinal tracts (Griffith and Moseley, 1980).

Phytate and Cyanide content of soya bean seeds were significantly ($P \leq 0.05$) reduced after toasting to a safe level. This was similarly reported by Abu *et al.* (2005) in locust bean seeds. Phytate interacts with several mineral

elements, especially calcium, magnesium, iron, zinc, molybdenum, thereby reducing their bioavailability (Maga, 1982). Cyanide have been suspected to have teratogenic effect (Keeler, 1984).

Saponin has been reported to cause decrease in daily weight gain by binding to the cells of the small intestine, thereby affecting the absorption of nutrients across the intestinal wall (Akinmutimi, 2004). Saponins are characterized by a bitter taste and foaming properties which causes retardation of growth rate due to reduction in feed intake (Kumar, 2010). Oxalate was reduced significantly ($P \leq 0.05$) from 1.04g/100g in raw soya bean seeds to 0.84g/100g in soya bean seeds toasted for 60 minutes.

The growth performance result showed that Diet 2 is the choice diet considering from good feed intake, better weight gain and having the least value for Feed Conversion Ratio when compared with other diets. Though rabbits fed with Diet 1 had the highest crude protein than those fed with Diet 2 but Diet 2 rabbits performed better than Diet 1 rabbits. The improved performance of rabbits fed with Diet 2 could be that 30 minutes toasting of soya bean seeds improved the quality of the feed. Udebibie and Mba (1994) and Amaefule and Obioha (2001) reported that toasting of soya bean seeds improved the crude fibre and other contents of the soya bean seeds.

The lower value of Feed Conversion Ratio shows superiority of the diet. This indicates that Diet 2 was the best diet. This implies that rabbits fed with soya bean seeds toasted for 30 minutes utilize the meal better than the Control group and the rest of the Diets. The result of this study is similar to that of Ogbonna *et al.* (2002). In this study, the low weight gain by rabbits fed with Diet 5, i.e. soya bean seeds toasted for 60 minutes could be attributed to protein in the seed becoming useless due to high temperature. Also, at that temperature the seeds were burnt, possibly making the diet unpalatable. The implication is reduction in feed intake causing low growth rate. These findings are similar to that of D'Mello *et al.* (1985) who reported that low weight gain could be partly due to low feed intake.

The crude protein of the rabbit's carcass showed that rabbits fed with Diet 2 had the highest crude protein, followed by rabbits fed with Diet 1, Diet 4, Diet 3 and the least is Diet 5. The carcass proximate composition of the experimental rabbits indicated a significant difference ($P \leq 0.05$) in the crude protein contents of the rabbit's carcass between Diet 2 and Diet 1. Although the values of concentration for ash, crude lipid, crude fibre in all the rabbits carcass were slightly different. There was no significant difference ($P>0.05$) across the treatment means. This suggests that there was a reasonable level of protein retention due to optimal utilization for growth (Alegbeleye *et al.*, 2004).

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 Summary

From the results obtained on the composition of soya bean seeds, this makes it a very good feed alternative as a source of plant protein in livestock feeds. Raw soya bean seeds contained the highest crude protein but the crude protein decreased with increase in toasted time. The anti-nutritional factors of the soya bean seeds revealed the presence of saponins, phytate, oxalate, tannins, hydrogen cyanide which decreased with increase in toasting time to a tolerable level. Soya bean seeds toasted for 30 minutes gave the best performance.

6.2 Conclusion

In conclusion, the result indicated that weaner rabbits can be fed with soya bean seeds meal toasted for 30 minutes without any adverse effect, because rabbits fed with Diet 2 (30 minutes toasted soya bean meal) had the best growth performance, feed conversion ratio, weight gain and feed intake than the control (raw soya bean seeds meal).

From the outcome of the results, it may postulated that all the null hypothesis (H_o) be rejected, because there were significant differences in the effect of feeding raw and toasted soya bean meals on the growth performance of rabbits,

in the anti-nutritional contents of raw and toasted soya bean meals and also on the effect of the experimental diets on the proximate contents of the rabbits carcass.

6.3 Recommendations

The following recommendations can be made from the results of the rabbit's performance.

1. Toasting of soya bean seeds at 30 minutes is recommended in feed inclusion because it gave the best growth performance.
2. Prolonged toasting of soya bean seeds (60 minutes) could be discouraged because it gave a poor performance.
3. The anti-nutritional content of the soya bean seeds could be treated before feeding animals because of its effects on the animals.

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APPENDIX

INITIAL WEIGHT MEASUREMENTS OF EXPERIMENTAL RABBITS AND THE MEANS (g)

	D1	D2	D3	D4	D5
	390	590	587	565	700
	540	630	537	489	760
	690	500	530	477	500
	675	476	494	480	600
	505	590	430	494	565
	440	455	544	497	555
Total	3240	3240	3122	3002	3680
Mean	540	540	520.33	500.33	613.33

FINAL WEIGHT MEASUREMENTS OF EXPERIMENTAL RABBITS AND THE MEANS (g)

	D1	D2	D3	D4	D5
	500	975	719	675	650
	1125	1100	844	600	975
	950	900	658	825	700
	1000	1000	699	690	670
Total	3575	3975	2920	2790	2995
Mean	894	944	730	698	749