EFFECT OF DIFFERENTLY PROCESSED LABLAB (*Lablab purpureus*) BEANS ON THEIR NUTRITIVE VALUE AND THE PERFORMANCE OF JAPANESE QUAILS (*Coturnix coturnix japonica*)

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DEPARTMENT OF ANIMAL SCIENCE,
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NOVEMBER, 2015

DECLARATION

I declare that the work in this dissertation entitled‘Effect of differently processed Lablab(*Lablab purpureus)* beans on their nutritive value and the performance of Japanese quails (*Coturnix coturnix japonica*)’ has been carried out by me in the Department of Animal Science. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other Institution.

_____ _____

Blessing Omada LAWANI Date

CERTIFICATION

Thisdissertation entitled '**EFFECT OF DIFFERENTLY PROCESSED LABLAB (*Lablab Purpureus)* BEANS ON THEIR NUTRITIVE VALUE AND THE PERFORMANCE OF JAPANESE QUAILS (*Coturnix coturnix japonica*)'** by Blessing Omada, LAWANI meets the regulations governing the award of the degree of Masters in Animal Science of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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Prof.G.S.Bawa
Chairman, Supervisory Committee

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DEDICATION

With a heart full of gratitude and worship, I dedicated this work to GOD ALMIGHTY in the name of JESUS CHRIST. This work is also dedicated to the best man in the world, my Darling Husband MrEnokela Elias Odumuh.

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ABSTRACT

A laboratory study and two biological studies were conducted to investigate the effect of differently processed Lablab (*Lablab purpureus*)beans on their nutritive value and the performance of Japanese quails (*Coturnix coturnix japonica*). The seeds were treated by boiling for 20 to 50 minutes; fermented for 24 to 96 hours; toasted for 10 to 40 minutes and sprouted for 24, to 96 hours, respectively. All samples were analysed for proximate and anti nutritional factors. As a result of the proximate composition and percentage reduction of anti nutrients, 40 minutes boiled,72 hours fermented, 40 minutes toasted and 96 hours of sprouted lablab were selected for the biological studies. Each processing method at selected time was included at 10and 20%. In the first feeding trial, six hundred and seventy five (675) unsexed Japanese quail chicks with average initial weight of 32.00g were raised in cages for 28 days in a 4 by 2 factorial arrangement plus one control in a Completely Randomized experimental Design. The birds were assigned to nine (9) dietary treatment groups of seventy five (75) quail chicks each with three replicates of twenty five (25) birds per pen. The diets were formulated to be isonitrogenous and isocaloric (24%CP, 2800 ME Kcal/Kg ME). Water and feed were provided*ad libitum.*Whilein the second feeding trial, two hundred and ninety seven (297) female quails from the first feeding trial were used to study the effect of differently processed lablab beans on the laying performance of Japanese quails for a period of 91 days. They were fed nine dietary treatments formulated to be isonitrogenous and isocaloric (22%CP, 2700 ME kcal/kg DM).The result of the first experiment showed that the final weight, body weight gain, feed conversion ratio (FCR) and weight of first egg of quails fed boiled lablab at 10% inclusion level had the best results which

was similar to the control. Significant differences (P<0.05) existed in nutrient retention across dietary treatments with quails fed boiled lablab at 20% based diets having highest values. Blood parameters showed no particular trend among treatment groups and was within acceptable range for healthy birds. There were significant differences (P<0.05) in the carcass measurements, although quails fed boiled lablab at 10% inclusion level had slightly higher live weight and dressed weights. The result of the laying performance of quail birds showed that there were significant (P<0.05) differences across treatments. Quails fed boiled lablab at 20% inclusion level showed a good trend of performance for final weight, daily feed intake, Hen- house and Hen- day egg production as well as average egg weight.Quails fed toasted lablab at 20% based diet had significantly higher (P<0.05) values for all variables of nutrient retention except for ether extract. The result showed significant difference (P<0.05) in egg quality characteristics across the treatments except for egg height. However, quails fed boiled lablab at 10 and 20% inclusion levels were comparable and had significantly improved egg quality measurements. It was concluded that boiled lablab beans at 10 and 20% resulted in optimum performance of Japanese quail chicks and laying quails respectively

CHAPTER ONE

1.0 INTRODUCTION

The poultry industry is characterized by high cost of production as a result of some major conventional feed ingredients that are competed for by both man and animal (Oleforuh-Okoleh *et al*., 2010). The steep increase in human and livestock population which has created increased needs for food and feed in the less developed countries suggest that alternative feed resources be identified and evaluated (Odunsi, 2003).

The recommended daily consumption of animal protein is 53-56g per day per person although Nigerians consume only 8.9-15g of protein per day due to high cost of farm animal products (Ogundipe, 1996; FAO, 1997; Christopher *et al*., 1997; Ojo, 2003). It is therefore important that alternative feed stuffs especially seeds from leguminous plants that have little or no competition for human consumption be incorporated into the diets of poultry to shift attention from the costly, highly competitive and conventional protein feed stuffs such as soybean, groundnut, cotton seed etc. One of such non-conventional plant protein source is *Lablab purpureus* beans.

Lablab seed have low preference as human food unlike soybean and groundnut cake. This suggests the possibility of obtaining large quantities of the seed for use as a source of vegetable protein for the monogastric animals (Bawa *et al*., 2003b). *Lablab purpureus* is considered a suitable source of functional protein, due to its good balance of high bio-available amino acids (Arinathan *et al*., 2003; Ragab *et al.,* 2010). It was considered as a substitute for some of the conventional plant sources in poultry diets (Ragab *et al.,* 2012). However, like other tropical legumes, raw lablab seeds contain anti- nutritional factors that can limit its use in animal feeding (Souza *et al*., 1992; Vijayakumaris *et al.*, 1995; Devaraj

and Manjunath,1995; Ramakrishna, 2008). Reports have shown that boiling, toasting, fermentation, sprouting, decorticating of seeds and chemical treatment, can reduce or eliminate the anti nutritional factors in legume seeds (Shaahu *et al*., 2014). *Lablab purpureus* seed is not an exception. It can be processed using aqueous, heat (boiling), toasting (dry heat) and germination to reduce the anti nutrients content (Osman, 2007; Ramakrishna *et al.,* 2006).

As the search to boost the daily animal protein consumption of Nigerians continues, it is important to foster the production of animals that will produce meat and egg within the shortest possible time alongside the recent trend to increase Nigerian's feedstuff base amidst our vast feedstuff endowments. Therefore, production of meat and egg within the shortest possible time brings to mind the production of Japanese quails.

Japanese quails (*Coturnix coturnix japonica*) are small migratory birds that are widely distributed in Asia, Africa and Europe. Quails belong to the family *Phasianoidea* and order *Galliformes* (Thear, 1987; Anon, 1991). The production of Japanese quails has gained the interest of people today because they are the smallest avian species farmed for meat and egg production (Panda and Srivaster,1990). Quails are known for meat of low caloric values, protein of high biological value, ability to produce 3 to 4 generations per year, depending on the day length, some females start laying at 35 days of age (average 40 days) and in full production by 50 days of age. Under favourable environments, quails produce for long periods, an average of 250 eggs per year (Hassan, 1994; Haruna *et al*. 1997).

1.1 Justification of the study

The Nigerian Poultry industry is faced with a number of challenges and the ever rising pressure on the conventional plant protein sources such as soybean cake, groundnut seed cake, cotton seed cake etc has contributed to such challenges. It is important that agricultural researchers explore and promote from Nigerian's vast feed resource such plant protein as *lablab purpureus* and inculcate it in the diets of poultry. This will go a long way to increase the available feedstuff base and reduce the human-animal competition for the 'conventional' plant proteins as it is presently. Also, drastic measures should be taken to step up animal protein intake within the shortest possible time; such measures include encouraging the raising of animals that will produce meat and egg within the shortest possible time such as Japanese quails. This study is therefore designed to investigate the effect of differently processed Lablab (*lablab purpureu*) seed on their nutritive value and the performance of Japanese quails.

1.2 Objectives of the study

The specific objectives of the study are to determine:

i. Effect of different methods of processing lablab seeds on the proximate composition and anti nutritional factors profile.
ii. Growth performance, nutrient retention and haematological parameters of Japanese quail chicks fed differently processed *lablab purpureus* seed based diets at two inclusion levels.
iii. Effect of differently processed *lablab purpureus* based seed diet at two inclusion levels on the laying performance, egg quality,nutrient retention and haematological parameters of laying Japanese quails.

1.3 Research hypothesis

1. H_0: Differently processed *lablab purpureus* beans do not differ in their proximate composition and anti nutritional factor.

   H_A: Differently processed *lablab purpureus* beans differ in their proximate composition and anti nutritional factors.

2. H_0: There is no significant difference in the growth performance, nutrient retention and haematological parameters of quail chicks fed differently processed *lablab purpureus* seed based diet at two inclusion levels.

   H_A: There is significant difference in the growth performance, nutrient retention and haematological parameters of quail chicks fed differently processed *lablab purpureus* seed based diet at two inclusion levels.

3. $H_{0:}$ There is no significant difference in the laying performance, egg quality, nutrient retention and haematological parameters of laying Japanese quails fed differently processed *lablab purpureus* seed based diet at two inclusion levels.

   $H_{A:}$ There is significant difference in the laying performance, egg quality, nutrient retention and haematological parameters of laying Japanese quail birds fed differently processed *lablab purpureus* seed based diets at two inclusion levels.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 History/Origin and distribution of Quail Birds

Quail bird is believed to originate from South-East Asia even though its first reference can be traced back to the old testament of the Holy bible (Manna from heaven). Quail was brought to Japan from China in the late 11th century (Onyewuchi, *et al*.,2013). Quail belongs, to the Family Phasianoidea of Order Galliformes and of the Class Aves of the Animal Kingdom along with chickens, pheasants and partridges. Species or subspecies of the genus *Coturnix* are native to all continents except America. One of them *Coturnix coturnix* or common quail are migratory birds of Asia, Africa and Europe. The domesticated subspecies, *Coturnix coturnix japonica*, is called Japanese quail but is also known by other names such as Common quail, Stubble quail, Pharaoh's quail, Red-throat quail, Japanese gray quail, Japanese migratory quail, Eastern quail, Asiatic quail, King quail, and Japanese King quail (Shim, 2004).

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

and upper breast that are long, pointed and much lighter cinnamon. Also the light tan breast feathers are characteristically black-stripped. In order to produce fertile eggs, males and females should be enclosed with a maximum of two females per male (Rankling *et al*., 1998).

2.2 Nutrient Requirements and management of Quails

Studies of a number of researchers on the dietary metabolizable energy and protein requirements of Japanese quail was reviewed and summarized by Shim and Vohra (1984). The authors showed that metabolizable energy requirements for laying quail varies between 2600 and 3000 kcal ME, while crude protein content of diets ranged from 16 and 24%. For the growing quail , metabolizable energy ranged between 2800 and 3200 kCal/kg ME, while crude protein content of diets varied from 24 to 32.2 %. Excessive protein intake was reported to result in higher nitrogen excretion and lower feed efficiency for egg production. 20, 22, 24 and 26 crude protein levels were evaluated for Japanese quails and it was concluded that 20% crude protein level resulted in the best performance from 1 to 42 days of age after lysine and methionine plus cystine requirements are met according to Murakami *et al*. (1993). Sangilimadan *et al*. (2012) reported that heavier eggs were laid by quails fed 24, 22 and 20% protein combination for quail chicks, growers and layers respectively. The dietary energy requirement of Japanese quail chicks was also reported to be 2800kcal/kg ME for optimum performance (Bawa, 2012) and the dietary protein requirement of 26% according to Bawa *et al*. (2012).

Japanese quails are hardy birds that thrive in small cages and are low-cost to produce. They require less floor space; about 8 – 10 adult quails can be reared in a space meant for one adult chicken (Haruna *et al*.,1997). They have less feed requirement, an adult quail requires only 20 – 25g feed per day compared to chicken (120 –130g) per day (Ani and Okorie

2009). Quails are reported to be very resistant to the devastating diseases of poultry and most viral diseases (NRC, 1991).

2.2.1 Haematological parameters of Quails

In Japanese quail *(Coturnix coturnix japonica)* the haemoglobin value, red blood cell count, white blood cell and haematocrit (PCV) value improved with increase in age, showing that the values were lowest in chicks and highest in adults. Haemoglobin, red blood cell, white blood cell and packed cell volume showed high significance with the weekly growth performance of the birds (Puspamitra *et al*., 2014). The pack cell volume (PCV) values of quails is between 36%-50% and low PCV values are taken to indicate anaemia and fatique, higher values to indicate dehydration (Terry and Campbell, 1988; Dawn, 2010). Report have also shown that increase in haemoglobin suggests the production of more blood cells in birds as they tried to develop immunity against toxins in the diet. Report by Tuleun *et al*. (2013) showed the effect of different levels of protein diet on the erythrocyte osmotic fragility of quail. The report indicated that high level protein of up to 21% improves haematological parameters in quails immensely.

2.2.2 Quail Eggs

Quail eggs are characterized by various colour patterns; they range from snow white to completely brown. More often, they are tan and dark brown, speckled or mottled brown with a chalky blue covering (Randall and Bolla, 2008). The average egg from mature female weighs about 10grams and contains 158 callories of energy, 74.6% water, 13.1% protein, 11.2% fat and 1.1% total ash. The mineral content includes 0.59mg calcium, 220mg phosphorous and 3.8 mg iron (Shim, 2005). The vitamin content is 300IU of Vitamin A, 0.12mg of Vitamin B1, 0.85mg of Vitamin B2 and 0.10mg nicotinic acid. Coturnix quails can start laying eggs at a young age of approximately 6weeks (Chelmonska

et al., 2008). According to Hemid *et al*.(2010), quail has a high rate of lay. The nutritional value of quail eggs is 3-4 times greater than chicken eggs (Tunsaringkarn *et al*.,2013). Sahin *et al*.(2008) reported that the eggs were rich in vitamin D, antioxidants which improve animal origin food quality in terms of colour, oxidative stability, tenderness, storage properties, and has positive effects on people with stress problems, hypertension, blood pressure, lipid control, migraine, asthma, anaemia, digestive disturbance, gastric ulcer, liver problems, various types of allergies, eczema, heart problems, bronchitis illnesses, depression, panic and anxiety illness . Quail eggs are also known to motivate growth, increase sexual appetite, arouse brain functions thus improving intelligence quotient and generally rejuvenates the body. It is suggested for children whether boiled or raw. The consumption of quail eggs fortifies the woman's body during pre and post-natal periods as well as after surgery and radiotherapy. It also has valuable effects on the foetus (physical and mental balance) and for the mother after delivery (physical rehabilitation and rejuvenation of cells). Quail eggs also improve the quality of breast milk (Igado and Aina , 2010).

2.2.3 Quail Production in Nigeria

The Japanese quail was introduced into Nigeria in 1992 (NVRI, 1994). They have since gained tremendous interest among the Nigerian populace especially because of their short generation interval, fast growth rate and less susceptibility to common poultry diseases. However, commercialization of quail egg production is a recent development in Nigeria (Akpan and Nsa, 2009). Despite the outstanding attributes and reward of keeping Japanese quail, its production in Nigeria is still rudimentary. Among the major challenges of quail production in Nigeria are high cost of concentrates, non-readily available market when the farmers are ready to sell their stock and scarce knowledge and information about the merits of eating quail meat. Domesticated quail do not have the tendency to brood their eggs thus

eggs must be incubated under broody hen or by artificial incubation (Naibi *et al*., 2009). Nevertheless , because of their short generation interval and an average production of 250 – 280 eggs per bird yearly, incubating artificially is the best guarantee for commercial farmers (Owen and Dike,2013) .

2.3 Legumes in animal diets

Legumes are important sources of proteins, carbohydrates, dietary fibre and minerals consumed worldwide (Osman, 2007). They are well adapted to varying climates and environmental conditions. Though thousands of species of legumes are known, just a few have been extensively promoted and used (Emenalom and Udebibie, 2005) The high cost of animal protein has directed interest towards various leguminous seed proteins as potential sources of vegetable protein for human food and livestock feed (Christiana and Marcel, 2008).

2.3.1 *Lablab Purpureus*

Lablab purpureus previously classified as *Dolichos lablab*, is known in different parts of the world by different names such as country beans, Egyptian bean, India Butter bean, Poor-man's Bean, Bonavist bean, Tonga Bean, Field bean etc It is a legume very similar in appearance to the velvet bean. It has a number of qualities that makes it useful under various conditions successful. One of such is its adaptability, it is drought resistant and able to grow in a diverse range of environmental conditions worldwide. It also has the ability to out-yield conventional crops, especially during the dry season, and its enhanced nutritive value is of great significance for the tropics (Murphy and Colucci, 1999). Shaahu *et al*. (2014) stated that lablab is rated among the most palatable of legume seeds for animals.

Figure 1: *Lablab purpureus* (Rongai)

2.3.1.1 History and distribution

The wild forms of lablab are believed to have originated in India (Deka and Sarkar,1990) Presently, lablab is common in Africa, extending from Cameroon to Swaziland and Zimbabwe, through Sudan, Ethiopia, Uganda, Kenya and Tanzania (Skerman *et al*.,1991). As early as 1819, seeds of lablab from Egypt were planted in the Botanical Gardens in Sydney, New South Wales. However, it was not until after the release of the forage cultivar "Rongai" in 1962, that lablab became widely used as forage in Australia. Rongai and High-worth cultivars are the only two commercially available lablab amidst the two hundred types of lablab recognized (Cameron, 1988).

2.3.1.2 The rongai cultivar

The Rongai cultivar was derived from material from the Rongai district of Kenya (Cameron, 1988). Its pods are 4-5 cm in length containing 2-4 buff or pale brown seeds. It has green foliage, white flowers and light brown seeds with conspicuous white haulm (Cameron, 1988; Oram, 1990).

2.2.4 Nutrient Composition of Lablab beans

2.2.4.1 Crude Protein

The Crude protein (CP) of lablab seed have been reported to be 26.12, 23.29 and 26.86% by Bawa *et al.*, (2003a), Abeke *et al.*, (2008b) and Osman, 2007 respectively.

2.2.4.2 Crude Fibre

Crude Fibre (CF) of *lablab purpureus* matured seeds is reported to be 7.86% (Bawa *et al.*, 2003a) and 11.19% (Abeke *et al.*, 2008b).

2.2.4.3 Minerals

The ash content of lablab purpureus seed was reported to be 4.48% (Bawa *et al*., 2003a), 3.96% (Osman, 2007) and 3.85 % (Abeke *et al.*, 2008b). Phosphorus content of lablab seed has been report to be 3.66% (Bawa *et al*., 2003a) and 0.11% (Abeke *et al*., 2008b). Calcium in lablab were 1.84 and 1.32 percentages respectively (Bawa *et al*, 2003a; Abeke *et al.*, 2008b). Sodium was reported to be 0.06% in lablab seed (Bawa *et al.*, 2003a).

2.2.4.4 Vitamins

Lablab is reported to have high contents of vitamins A, B and C and lower proteinase activity (2.4-3.2 units/mg seed) compared to most other legume grain (Deka and Sarkar 1990).

2.5 Anti-Nutritional Factors in lablab beans

Anti-nutritional factors (ANF) are compounds said to reduce the nutrient utilization and/or intake of plants or plant products used as human foods or animal feeds. These play a vital role in determining the use of plants for humans and animals (Soetan and Oyewole, 2009). Some of these include tannins, phytates, trypsin inhibitors (protease), and cyanogenic

glycosides, oxalates, flavonoids, haemagluttinins (lectins), alkanoids, gossypol, cardiac glycosides and coumarins. They reduce animal productivity but tend to cause toxicity during periods of scarcity or confinement when feed rich in anti nutritional factors is consumed by animals in large quantities. Effect of oxalates, phytate and tannins can be prevented, provided the plant food is boiled before consumption (Enechi and Odonwodu, 2003). Most anti nutritional factors can be removed by several processing methods such as soaking, germination, boiling, autoclaving, fermentation, genetic manipulations and other processing methods (Soetan, 2008).

Lablab pupureus like other legume seed is characterized with the presence of anti nutritional factors such as tannins, phytate, trypsin inhibitors and polyphenols (Murphy and Colucci, 1999; Ramakrishna *et al.*, 2006). These compounds affect feed intake, palatability and also interfere with the availability of dietary nutrients especially minerals and proteins due to their astringency and bitterness. Lablab is limited in its use in monogastric diet because of its high level of phytic acid and tannins (Igene *et al*., 2002). This limits its use in monogastric diet and thus require suitable processing to reduce the anti-nutritional factors (Shaahu *et al*., 2014). The anti nutritional factors present in legume seeds is said to remain logged in the body of birds for a long time and impart negative effects on performance later in their productive life (Bawa *et al.*, 2003a; Akinmutimi, 2003; Ani and Okeke, 2003). Broiler fed raw legume diets at starter phase had a lower body weight at 8 weeks of age compared to those fed boiled legume (Esonu, 2001; Amaefule and Obioha, 2001).

2.5.1 Effect of Anti-nutritional Factors on performance of animals

2.5.1.1 Tannins

Tannins result in decreased feed consumption in animals and bind protein to form complexes that are not readily digestible. They also cause decreased palatability and reduced growth rate. Their inclusion at 0.5% and above in diet cause reduction in growth and available energy value of feed, decreased availability of protein and severe mortality at 4% and above (Soetan and Oyewole, 2009).

2.5.1.2 Trypsin inhibitory activity (TIA)

Trypsin (protease) inhibitor causes growth depression and hypertrophy of the pancreas (Soetan and Oyewole, 2009). Its presence in diets leads to the formation of irreversible trypsin enzyme complexes. This causes a decrease in trypsin in the intestine and subsequently in digestibility of dietary protein, thus leading to slower animal growth (Mugendi *et al*., 2010).

Marquez and Alonso, (1999) reported a reduction in trypsin inhibitor level during soaking and boiling of chicken pea. Sixty minutes of boiling completely destroyed the protienase inhibitors activity of *Dolichos lablab* (Devaraj and Manjunath, 1995). Trypsin inhibitors are said to be partly responsible for the growth retarding of raw legume seed meal according to MacDonald *et al*. (1995).

The level of trypsin inhibitor activity in lablab seeds have been reported to range from 11.8 to 29.0 TIA/gm (Ahmed and Nour, 1990; Deka and Sarkar, 1990; Devaraj and Manjunath, 1995). Adequate heat processing is essential to deactivate trypsin and chemotrypsin (Osman *et al*., 2002).

2.5.1.3 Phytate

Phytate form complexes with proteins and starch, inhibiting their digestion by enzymes and in legumes, they bind multivalent cations lowering bioavailability of minerals (Mugendi *et al*., 2010). Phytic acid binds trace elements and macro-elements such as zinc, calcium, magnesium and iron, in the gastrointestinal tract making dietary minerals unavailable for absorption and utilization by the body. It can also form complexes with proteins, proteases and amylases of the intestinal tract, thus inhibiting proteolysis. Moreover, the phosphorus in phytate has been considered to be largely unavailable to the organism because of the limited capacity of monogastric species to hydrolyse phytate in the small intestine (Drewnowski and Gomez-Carneros, 2000). Phytic acid level was reported in *lablab purpureus* beans to vary from 100.0 to 313.4mg/100gm by Deka and Sarkar (1990).

2.6 Need to detoxify anti-nutritional factors in feedstuffs

The is need to educate people on the danger in consuming improperly processed food/feed especially legumes which are reported to contain very high levels of anti nutritional factors (Soetan and Oyewole, 2009).

Lablab purpureus seeds are suggested to be processed possibly by boiling before use in monogastric diets. Reports have shown that boiling, toasting, fermentation, sprouting, decorticating of seeds and chemical treatment were effective in reducing or eliminating anti nutritional factors in legume seeds. To improve the nutrient availability and utilization of the seed for better performance in monogastric animals (Shaahu *et al*., 2014). To enhance the nutritional quality and organoleptic acceptability of legume seeds, processing methods are employed to decrease or destroy the anti nutritional factors present in them (Christiana and Marcel, 2008).

It is important to note that some level of boiling is necessary for rendering lablab bean safe to be incorporated into poultry diets (Abeke *et al*., 2008b).

2.7 Effect of processing on the anti-nutritional factors of legume Seeds

Trypsin and chymotrypsin inhibitors affect the digestibility of legumes protein, while other anti nutritional factors like tannins, phytates, cyanide and hemagglutinins impart bitter or unacceptable taste to the legumes, causing decreased protein digestibility and absorption of divalent metal ions in the intestine (Abdu *et al.*, 2008).

2.7.1 Effect of boiling on anti-nutritional factors of legume seeds

Boiling was reported to be most effective in reducing trypsin inhibitor but showed high increase of tannin (Osman, 2007). However, boiling and pressure cooking was reported to decrease the levels of polyphenols and tannins but pressure cooking reduced trypsin inhibitor more compared to boiling. The tannin content of lablab was reported to have reduced by 76.47% on boiling (Ramakrishna *et al*., 2006). Undercooked and overcooked beans will result in undesired performance of birds because anti nutritional factors will not be adequately destroyed and proteins will be denatured respectively. There tends to be a relationship between duration of boiling and efficiency with which legume beans being cooked may be utilized by chickens (Abeke *et al*., 2008b).

Osman, (2007) reported that the reduction in the content of phytic acid was found to be somewhat greater in roasted *Dolichos lablab* bean compared to those soaked, boiled, autoclaved or germinated.

Trypsin inhibitor, tannin, oxalate, hydrocyanic acid and saponin were significantly reduced by boiling except for phytate in pigeon pea. The reductions increased with increase in boiling periods, 60 minutes had the highest reduction (Iorgyer *et al*., 2009). It has been

established that boiling and other processing methods exert beneficial effect by destroying the anti nutritional factors inherent in legume grains (Balogun *et al*., 2001). Boiling or autoclaving was reported to reduce tannin content by 70 and 60% respectively (Vijayakumari *et al*.,1995). Pressure cooking of pigeon pea was reported to have completely destroyed trypsin inhibitor (Duhan *et al*., 2001). Boiling and soaking of African locust bean significantly reduced the levels of anti-nutritional factors which were further decreased by fermentation. Boiling of legumes for about 30 minutes was reported to destroy anti nutritional factors such as trypsin inhibitors, haemagglutinins, phytic acids, lectins and goitrogens, thus improving nutrient availability for better performance of the bird fed such diets (Omeje, 1999). Soybean boiled for 30 minutes was said to improve performance of weaned pigs compared to those boiled for a less time (Kaankuka *et al*., 2000).

2.7.2 Effect of toasting on anti-nutritional factors of legume seeds

Roasting (toasting) significantly reduced the amount of TIA by 23.05% (Osman, 2007). Ramakrishna *et al*. (2006) reports maximum decrease in trypsin inhibitor activity and phytic acid with roasting of *Dolichos lablab*, trypsin inhibitory activity reduced by 45%. Maidala *et al.* (2013) revealed a decrease in tannins (4.57-8.07)mg/100g) for roasted soybean.

2.7.3 Effect of sprouting on anti-nutritional factors of legume seeds

Germination (sprouting) significantly increased tannins content compared to the soaking, cooking, roasting and autoclave (Osman, 2007). However, Ramakrishna *et al*.(2006) reported that germination of *Dolichos lablab* was effective in reducing trypsin inhibitor activity, tannins, polyphenols and phytic acid compared to boiling, pressure cooking and roasting.

Sorghum showed an increase in tannin due to soaking and germination (Al- Jasser, 2005; Ahamed *et al*.,1996). This increase may be as a result of the hydrolysis of high molecular weight insoluble polymer in to small molecular weight soluble polymers during soaking and germination or due to inhibition of polyphenol oxidase which was responsible for the loss of tannin by heat treatment (Osman,2007). Maidala *et al.* (2013) revealed a decreased trypsin inhibitor (3.51-24.54mg/100g) for sprouted soybean.

2.7.4 Effect of fermentation on anti-nutritional factors of legume seeds

Tannins, which were heat stable, were easily removed after fermentation (Osman, 2004). The reduction in trypsin inhibitor at 72hours of fermentation was greater than that of tannins and phytic acid with a reduction level of 89% (Christiana and Marcel, 2008). El-Adawy (2002) reported that tannin content was further reduced to 56% when Africa oil bean seed (*Pentaclethra macrophylla* Benth) was fermented. Phytic acid was also reported to reduce by 75.9% in the fermentation of Africa oil bean seed (Mbajunwa, 1995).

2.8 Effect of processing on nutritive value of legume seeds

Diarra *et al*. (2011) reported that several processing methods have been reported to reduce toxic and anti nutritional factors in feeds. The nutritive value of grain legumes depends primarily on their nutrient contents and presence or absence of anti nutritional and/or toxic factors (Ramakrishna *et al*., 2006). Due to the activities of enzymes during sprouting, it was easier to digest sprouts than dry seeds (Goodwin and Mercer, 1993). Boiling and germination amidst all food processing methods particularly plays an important role in bioavailability and palatability which resulted in enhancement of digestibility and nutritive value (Bakr, 1996; Oboh *et al*., 2000; Ramakrishna *et al*., 2006). Dehusking, germination, cooking and roasting have shown to produce beneficial effects on nutritional quality of legumes (Ramakrishna *et al*., 2006).

2.8.1 Effect of sprouting on the nutritive value of legume seeds

Sprouting is a natural process in which dormant but viable seeds were induced to start growing into seedlings (Ugwu and Oranye, 2006). It is a catabolic process whereby the reserved substance present in the cotyledons was used up for the development and growth of the embryo (Mugendi *et al*., 2010). It also decreases carbohydrate levels in seeds which might be due to increase in à-amylase activity. Amylase breaks down complex carbohydrate to simpler and more absorbable sugars which were utilized by the growing seedling during the early stages of germination (Onwuka *et al*., 2009). Sprouting has been considered suitable for improving the nutritional value of legumes (Hafez *et al*., 2000). Shipard (2005) found that sprouted grains fed to animals provided them with feeds which has a rich supply of enzymes and resulted in all nutritional components being highly digestible and extremely nutritious. Sprouts also provide a good source of enzymes and vitamins which serve as bioactive catalysts to help in metabolism of feed and the release of energy.

Germination (sprouting) significantly increased the protein and moisture content but decreased the crude lipid content of *Dolichos lablab*. Sprouting was most effective in improving protein digestibility when compared to soaking and boiling. No significant difference was observed in the ash content of sprouted seed compared with the raw lablab (Osman, 2007).

2.8.2 Effect of boiling on the nutritive value of legume seeds

Crude protein and lipid content was reported to increase when Bambara nut seeds were boiled. The crude fibre level reduced but ash content and nitrogen free extract were unaffected (Yisa *et al*.,2014). Better results have been reported when boiled legume seeds were fed to broilers compared to those fed raw (Amaefule and Obioha, 2001). Ether extract

was reported to increase significantly by soaking and boiling but ash content and carbohydrate content decreased significantly in an experiment on African locust bean. The loss in carbohydrate was explained to be as a result of leaching of soluble carbohydrate during soaking and boiling according to Christiana and Marcel (2008). Boiling pigeon pea seeds for 30,40 and 60 minutes significantly reduced protein by 5.84, 8.45 and 10.86%; crude fibre by 4.74, 5.99 and 12.98% and ash content by 5.92, 7.42 and 11.84% respectively. There was no significant effect on dry matter and crude fat levels (Iorgyer *et al*, 2009). Increase in crude protein and fat but a decrease in nitrogen free extract was reported when soybean was boiled (Maidala *et al.*, 2013).

Boilng showed no significant difference in moisture content as compared to the raw lablab but significantly decreased the protein content, this decrease might be as a result of leaching of soluble proteins. The crude lipid content was significantly reduced by boiling. Ash content was significantly reduced compared with those soaked, this might be due to leaching out of both macro and micro elements into the soaking and boiling water (Osman, 2007). Rabbits fed boiled lablab seed diet were reported to grow faster than those feed raw and decorticated lablab seed diet (Shaahu *et al*., 2014). Ogundipe *et al*. (2003) reported that boiled lablab seed resulted in better performance of broiler chickens.

2.8.3 Effect of fermentation on the nutritive value of legume seeds

Christiana and Marcel (2008) reported that fermentation significantly increased crude protein content. Ether extract content was further increased by fermentation at 72hours after soaking and boiling but decreased carbohydrate content of African locust bean (*Parkia biglobosa Benth*.) seed. This loss in carbohydrate was suspected to be as a result of the utilization of some of the sugars by fermenting organisms for growth and metabolic activities.

2.8.4 Effect of toasting on the nutritive value of legume seeds

Toasting (Roasting) of legume seeds was less effective in the removal of anti nutritional substances and thus performance of animals than wet heating. (Kaankuka *et al*., 2000).

Amaefule and Nwagbara (2004) observed better performance in birds fed boiled legume seeds compared to those fed toasted seed diets. Crude protein and lipid contents were reported to increase when Bambara nut seeds were roasted. The crude fibre level reduced but ash content and nitrogen free extract were unaffected (Yisa *et al*., 2014). Increase in crude protein and fat but a decrease in Nitrogen free extract was reported when soybean was roasted (Maidala *et al.*, 2013).

Roasting decreased the protein, moisture content and crude lipid content of *Dolichos lablab* (Osman, 2007). No significant difference was observed in the Ash content of roasted seed compared with the raw lablab. Rabbits fed toasted lablab seed diet was reported to grow faster than those feed raw and decorticated lablab seed diet (Shaahu *et al*., 2014).

2.9 Effect of processing legumes on performance characteristics of poultry

No significant difference in feed intake of pullets fed differently processed pigeon pea (*Cajanus cajan*) based diets were reported by Amaefule *et al.* (2006). Sprouted grains may improve weight gain in broiler chickens by up to 8%, digestibility of nutrient has been increased by using sprouted grains in the diet of broiler chickens (Muhammad *et al.*, 2013). Scott (2002) and Fafiolu *et al.* (2006) revealed no effect on feed intake of sprouted grains in poultry but they also reported that the inclusion of sprouted sorghum in the diet of pullets at the levels of 0,150 and 300 g/kg of diet did not affect daily feed consumption, average weight gain and feed to gain ratio. Weight gain reduction was reported when the level of sprouted grains was increased in pullet's diet (Adebule, 2002).

Ragab *et al.* (2012) reported feed conversion ratio and weight gains to be significantly high for the 10% inclusion level of a lablab based diet with seeds soaked for 48hours and boiled for 30 minutes. Feeding up to 22.5% boiled lablab did not significantly affect final weight, feed intake and feed efficiency of grower birds when compared to the control (Abeke *et al*., 2008a). The performance of broiler finisher birds (final weight, weight gain, feed intake, feed efficiency and mortality rate) was reported to do better when boiling lablab beans was increased to 30 minutes. Beyond this time, performance was said to decline as boiling time increased (Abeke *et al*., 2008b). Incorporation of 30 minutes boiled lablab in pullet diet gave best results in terms of growth and feed efficiency according to Ogundipe *et al*. (2003). In an experiment with layers fed boiled *lablab purpureus*, significant decrease was reported in final weight, percent change in body weight, feed intake, and feed efficiency as the level of lablab seed in the diet increased (Abeke *et al*., 2008b).

2.10 Effect of processed lablab beans on haematological parameters of poultry

Serum glucose was reported to be significantly low in laying Hisex white hens fed diets with 5,10,15 and 20% inclusion levels of 48hours soaked and 30 minutes boiled lablab beans. Nevertheless, serum cholesterol was insignificantly reduced for all lablab inclusion (Ragab *et al.*, 2012). Abeke *et al.* (2008a) reported that graded level of boiled lablab based diet for pullets had no significant effect on packed cell volume, haemoglobin and total protein. Higher levels packed cell volume, haemoglobin and total protein were reported for broiler finisher birds fed 30 minutes boiled lablab based diets than those fed raw or less than 30 minutes boiled lablab based diet (Abeke *et al*., 2008b).

2.11 Effect of processed lablab beans on egg qualities

Ragab *et al.* (2012) reported significantly high hen-day egg production, egg weight, and egg mass for 10% inclusion level of lablab seed Soaked for 48hours and boiled for 30 minutes in an experiment with Hisex White laying hens. The least egg production was

from were those fed 15 and 20% lablab dietary inclusion. They also reported percentage shell and thickness significantly high at 20% inclusion level of lablab, 15 and 20% level had high egg albumin index and percentage but the highest yolk index and percentage was shown in 15 and 10% lablab inclusion level. Feeding boiled lablab based diet up to 22.5% had no adverse effect on percent hen day, hen housed egg production, haugh unit, yolk index, percent production at peak, kilogramme feed per twelve eggs. It was reported that up to 7.5% of lablab seed meal could be fed to layers without adverse effect on percent hen-day and hen-house egg production. However there was decrease in percent hen-day and hen-house egg production, percent production at peak, average egg weight as the level of lablab beans in the diet increased. Yolk index, Haugh unit, percent shell and shell thickness were not significantly affected by feeding graded dietary inclusion levels of lablab beans in the diet of laying hens. (Abeke *et al*., 2008a). A 10% inclusion of 48hours soaked and 30 minutes boiled lablab was recommended for laying performance of layer birds without detrimental effect (Ragab *et al.*, 2012). Sprouted grains in the diet of layers have also reduced egg production. It is also reported to increase feed efficiency in terms of kg feed consumption for one kg egg produced (Muhammad *et al.*, 2013). Fafiolu *et al.* (2006) also reported that the inclusion of sprouted sorghum in the diet of pullets at the level of 0,150 and 300 g/kg of diet did not affect age at first egg during growing phase. But reduced egg production during the laying phase, However, feed efficiency in terms of kg of feed consumed per kg of egg produced reduced.

CHAPTER THREE

MATERIALS AND METHODS

3.1 The experimental site

The experiment was conducted at the Quail Unit, Department of Animal Science Teaching and Research Farm, Ahmadu Bello, University, Zaria. Zaria is within the Northern Guinea Savannah zone of Nigeria with latitude, $11^0$14' 44' N and longitude $7^0$38' 65' E, at an altitude of 610mm above sea level. The climate is relatively dry, with a mean annual rainfall of 700-1400mm, occurring between the months of April and September (Ovimaps, 2014).

3.2 Source of *lablab purpureus* beans.

The Rongai variety (milky white) of *lablab purpureus* was purchased from Sabon Gari market, Zaria, Kaduna State. The seeds were thoroughly cleaned by winnowing and sieving.

3.3 Experiment 1: Effect of different processing methods on the proximate and anti-nutritional factors of Lablab (*Lablab purpureus*) beans

The seeds were processed as follows:

3.3.1 Boiling method: Two litres of water was poured into a four litre aluminium capacity pot and brought to boil over an open stove flame. Three hundred (300) grams of lablab seed was weighed and poured into the already boiling water and then covered. At every stipulated time of 20, 30, 40 and 50 minutes, an aluminium spoon of about 50g capacity was used to remove a portion. Each portion removed at the respective time was

drained and sun-dried until it was well dried, milled and taken to the laboratory to analyse for proximate composition as described by A.O.A.C. (2005) methods and anti nutritional factors according to the standard methods (Sutardi and Buckle 1985, Earp *et al*. 1981, Kakade *et al* 1974 and Cooke and Maduagwu 1978).

After the preferred boiling time was selected based on nutrient composition and percentage reduction of anti nutritional factors, 25kg of lablab seed was then boiled in 50 litres of water in a 100-litre capacity pot for the selected boiling time following the procedure stated above.

3.3.2 Sprouting method: A two litre capacity bowl containing one and a half litre of water was used to soak three hundred (300) grams of lablab seed for two hours. Afterwards, it was drained and spread over a wet jute bag and covered with another wet jute bag on a shaded cemented floor. Sample was collected after 24, 48, 72, and 96 hours respectively. It was sundried, milled and taken to the laboratory to test for proximate composition as described by A.O.A.C. (2005) and anti nutritional factors according to the standard methods (Sutardi and Buckle 1985, Earp *et al*. 981, Kakade *et al* 1974 and Cooke and Maduagwu 1978). After the preferred sprouting time was selected based on nutrient composition and percentage reduction of anti nutritional factors, 25kg of lablab beans was then sprouted for the selected sprouting time following the procedure stated above.

3.3.3 Fermentation method: Three hundred (300) grams of lablab beans was soaked for 24 hours and then drained. 50g portion was weighed in four polythene bags respectively and left to ferment for 24, 48, 72 and 96 hours respectively. After each stipulated time, the seeds were sundried until it was well dried (15% moisture content), milled and taken to the laboratory to test for proximate composition as described by A.O.A.C. (2005) and anti nutritional factors according to the standard methods (Sutardi and Buckle 1985, Earp *et al*.

981, Kakade *et al* 1974 and Cooke and Maduagwu 1978). After the preferred fermentation time was selected based on nutrient composition and percentage reduction of anti nutritional factors, 25kg of lablab seed was then soaked in a 200-litre capacity drum and all other procedures stated above was followed.

3.3.4 Toasting method: Three hundred (300) grams of lablab beans was weighed, toasted in a metal frying pan containing sand and heated by a kerosene stove. It was constantly stirred to prevent charring. Samples of about 50g were taken at 10, 20, 30 and 40 minutes period, respectively. The sampled lablab beans were sieved out immediately, cooled, milled and taken to the laboratory to test for proximate composition as described by A.O.A.C. (2005) and hydrocyanide, phytic acid, tannin and trypsin inhibitory activity were determined using the standard methods (Sutardi and Buckle 1985, Earp *et al*. 981, Kakade *et al* 1974 and Cooke and Maduagwu 1978). After the preferred toasting time was selected based on nutrient composition and percentage reduction of anti nutritional factors, 25kg of lablab seed was then toasted in 50-litres capacity pot for the selected toasting time following the procedure stated above.

3.4 Determination of the chemical composition of feed samples

Three samples each of the processed lablab beans and diet were taken to Animal Science Biochemical Laboratory for proximate analysis using the methods described by A.O.A.C. (2005). The analyses were done to obtain the nutrient composition (dry matter, crude protein, ether extract, crude fibre, ash, and nitrogen free extract) of the diets. Protein was determined by Kjedahl procedure, Ether extract was determined by subjecting the samples to petroleum ether extraction at 60-80°C using the Soxhlet extraction apparatus. Dry matter was determined by oven drying the samples at 100°C over a 12-hour period. Crude fibre was determined by boiling the sample under reflux in weak sulphuric acid (0.255N $H_2S0_{4)}$,

then in weak sodium hydroxide (0.312N NaOH) for 1 hour. The residues which consist of cellulose, lignin and mineral matter was dried and weighed. The ash content was determined by igniting a weighed sample in a muffle furnace at 500°C. The nitrogen free extract (NFE) was obtained by the difference after the percentages of the other fractions have been subtracted from 100%. Gross Energy (GE) was calculated by using the Pauzenga formular:

Metabolizable Energy (ME kcal/Kg) = 37 (% CP) + 81.8 (% EE) + 35.5 (% NFE)

3.5 Determination of Phytic acid content of differently processed lablab beans

Ten grammes each of defatted finely ground differently processed lablab beans samples were soaked in 200ml of 2% HCL solution for 3 hours and then filtered through two layers of hardened filter paper. In a 400ml beaker, 50ml of the filtrate was placed and 107ml distilled water was added to give it proper acidity and therafter titrated with a standard ferric chloride solution containing 19.5mg Fe/ml until a brownish yellow colour persisted for 5 minutes. Phytic acid was therafter determined using the method of Sutardi and Buckle (1985).

3.6 Determination of Tannin content of differently processed lablab beans

Ten grammes of each of the differently processed lablab beans was defatted and later extracted with 5% ethyl ether and ethanol. Tannin was estimated using the method of Earp et al. (1981). The method employed the vanillin HCL procedure based on acid catalysed addition of vanillin to flavonols and their polymers aw well as other phenolic compounds such as dihydrocalcone and flavones. These reactions were determined colometrically at 500mm using a spectrometer (spectronic 20).

3.7 Determination of Hydrocyanic acid content of differently processed lablab beans

The hydrocyanic acid of differently processed lablab beans were determined using the procedure of Cooke and Maduagwu (1978) as modified by Ikediobi and Fashagba (1985). Two grammes of each sample were extracted with 15ml of 0.1m sodium phosphate buffer pH 6.8 for 30 minutes using a shaker. The mixture was centrifuged at 100rpm and the supernatant was pippeted into a test tube and the volume made up to 2ml with 0.1m phosphate buffer pH 6.8. four milliliters of alkaline picrate was added and then mixed thoroughly. The mixture was incubated at 95°C in a bath for 10 minutes. It was allowed to cool and absorbance was read at 490nm. Total cyanide content was obtained by extrapolation from standard curve of potassium cyanide.

3.8 Determination of Trypsin inhibitory activity content of differently processed lablab beans

Ground samples of differently processed lablab beans were extracted for three hours with petroleum ether (b.p 60-80°C) at room temperature. The defatted material was sieved through a 40mm mesh screen. One gramme of each sample was suspended in 20ml of 0.05N HCL and kept over night at 4°C in a refrigerator. The insoluble matter was removed by centrifugation at 800 rpm for 20 minutes in a unipan centrifuge model No.310. The supernatant was used as trypsin inhibitor (TI) extract and diluted 1:1000 with water before use. The trypsin inhibitor activity (TIA) on sample extract was assayed according to the method of Kakade *et al* (1974) with modification described by Liu and Markakirs (1989).

3.9 Experiment 2: Nutritive value of processed *lablab purpureus* beans on the performance of quail birds (2-6weeks)

3.9.1 Source of experimental Birds

One week old unsexed Japanese quail chicks were purchased from National Veterinary Research Institute, Vom, Jos, Plateau State, Nigeria and were used for the study.

3.9.2 Experimental Design

Six hundred and seventy five (675) unsexed Japanese quail birds were used in a 4 by 2 factorial arrangement plus one control in a Completely Randomized Design. The birds were alloted to nine (9) dietary treatments of seventy five (75) birds with each treatment having three (3) replicates each. There were twenty five (25) birds per replicate.

3.9.3 Experimental diets for experiment One

Nine iso-nitrogenous (24%) experimental diets were formulated and are shown on table 3.1

Treatment 1: control diet contained 0% lablab

Treatment 2: Contained boiled lablab at 10% inclusion level

Treatment 3: Contained boiled lablab at 20% inclusion level

Treatment 4: Contained fermented lablab at 10% inclusion level

Treatment 5: Contained fermented lablab at 20% inclusion level

Treatment 6: Contained toasted lablab at 10% inclusion level

Treatment 7: Contained toasted lablab at 20% inclusion level

Treatment 8: Contained sprouted lablab at 10% inclusion level

Treatment 9: Contained sprouted lablab at 20% inclusion level

3.9.4 Management of experimental birds

On arrival to the farm, the quail chicks were counted and supplied with a common diet for one week. The initial weights of the birds were taken at the beginning of the experiment and weekly body weights were subsequently taken. The birds were randomly allotted to nine dietary treatments of three replicates with 25 birds per pen. The birds were reared in cages and all routine management practices were strictly adhered to.

The experimental birds were brooded at a temperature of 36-37^{o} C for a week using electric bulbs located at different points inside the pens as sources of heat. In addition to these, kerosene stoves and charcoal pots were used to supplement the ambient temperature and maintain the brooding temperature.

Feed was supplied in round chick tray feeders. Chick drinkers with small pebbles put all around to prevent the chicks from drowning was used to supply water. The feeder was changed to grower feeders at the end of the second week and the stone was removed from the drinkers when the birds were big enough to use the chick drinkers. A known amount of feed was weighed for each replicate at the beginning of each week and left over feed was weighed at the end of the week. Feed and water was provided *ad libitum* throughout the experimental period. During this growing phase, the birds were weighed on weekly basis and the following measurements were taken; average daily feed intake, average daily weight gain, feed conversion ratio, mortality rate and cost per kg weight gain.

3.9.5 Nutrient Retention Studies

Nutrient retention trial was carried out at the last week of the experiment. This was done by selecting twenty one (21) birds from each treatment i.e. seven per replicate. The birds were housed in individual cages for excreta collection after giving a known amount of experimental diet daily. Excrete samples were collected, air dried, thoroughly mixed, weighed and oven dried at 65°C for 24 hours. The dried excreta samples were assayed for their nutrient contents using the methods described by A.O.A.C. (2005). Apparent Nutrient retention was determined for crude protein, ether extract, crude fibre, ash and nitrogen free extract using the formula:

$$\% \text{ Nutrient retention} = \frac{Amount\ of\ Nutrient\ intake - Amount\ of\ nutrient\ output\ in\ excreta}{Amount\ \ 0f\ Nutrient\ intake} \times 100$$

Where; Nutrient intake (g) = Dry feed intake × Nutrient in diet (%)

Nutrient output (g) = Dry excreta output × Nutrient in excreta (%)

3.9.6 Haematological Parameters

At the end of the growth phase, 2 mls of blood was collected from the birds that were slaughtered for carcass via the jugular vein. A total of nine birds per treatment were used. The samples were collected with EDTA (ethylene diamine tetraacetic acid) bottles and taken to the laboratory for haematological study. The samples were analyzed for packed cell volume (PCV), Haemoglobin (Hb) count and total proteins (TP).

3.9.7 Carcass evaluation

At the end of the chick phase, 3 male quails per replicate were randomly selected and fasted overnight. The individual live weight of the birds were taken using a sensitive electronic scale called Camry®. They were euthanized, each bird was cut into parts and their relative weights calculated by expressing the weight as percentage of carcass weight. The organs were weighed and the weights expressed as percentages of carcass weight. The carcass weights were measured and the values recorded.

3.10 Experiment 3: Nutritive value of differently processed *lablab purpureus* beans on the performance of laying quails (*Corturnix cortunix japonica*)

3.10.1 Experimental birds and design

Two hundred and ninety seven female quail birds (297) from Experiment 1 were used in a 4 by 2 factorial arrangement plus one control in a Completely Randomized Design. The female quails were mixed up and fed a common diet for 3 days. Thereafter, the birds were randomly allotted to nine dietary treatments of three replicates with eleven (11) birds per replicate. The birds were weighed into each cage and their initial weights recorded. The

nine iso-nitrogenous and iso-caloric diets are shown on table 3.2. Feed and water were provided *ad-libitum*.

The birds were fed and eggs were collected daily. The quantity of feed per bird per day was determined by obtaining the differences between the quantity of feed given and the quantity left over. Egg production was recorded daily while hen-day production (HDEP) and hen-house egg production (HHEP) were calculated using the formulae;

$$HDEP = \frac{\text{Total number of eggs laid}}{\text{Total number of hens in lay} \times \text{number of days in lay}} \times 100$$

Where HDEP – Hen-day egg production

$$HHEP = \frac{\text{Total number of eggs laid}}{\text{Total number of hens housed Initially} \times \text{number of days in lay}} \times 100$$

Where HHEP – Hen-housed egg production

Feed conversion ratio was calculated weekly using the formula:

$$FCR = \frac{\text{Feed intake (Kg)}}{\text{Egg weight (Kg)}}$$

Where FCR - Feed conversion ratio

The birds were allotted to nine dietary treatments, containing three (3) replicates each with 11 birds per replicate.

3.10.2 Experimental diets

Eight experimental diets formulated to be iso-nitrogenous (22% CP) were used for the study. The experimental diets were as follows:

Treatment 1: Contol diet contained 0% lablab

Treatment 2: Contained boiled lablab at 10% inclusion level

Treatment 3: Contained boiled lablab at 20% inclusion level

Treatment 4: Contained fermented lablab at 10% inclusion level

Treatment 5: Contained fermented lablab at 20% inclusion level

Treatment 6: Contained toasted lablab at 10% inclusion level

Treatment 7: Contained toasted lablab at 20% inclusion level

Treatment 8: Contained sprouted lablab at 10% inclusion level

Treatment 9: Contained sprouted lablab at 20% inclusion level

The diets were prepared and all experimental diets for the laying study were analyzed for their proximate composition at the Department of Animal Science Biochemical Laboratory, Ahmadu Bello University, Zaria using the standard methods described by A.O.A.C. (2005).

TABLE 3.1: Gross composition of experimental diet for starter Japanese Quails (2-6 weeks)

INGREDIENTS(%)	T1 Control	T2 Boil at 10%	T3 Boiled at 20%	T4 Ferment at 10%	T5 Ferment at 20%	T6 Toast at 10%	T7 Toast at 20%	T8 Sprout at 10%	T9 Sprout at 20%
Maize	51.56	46.08	40.59	50.25	48.92	46.97	42.37	47.73	43.90
Lablab	0	10	20	10	20	10	20	10	20
Groundnut cake	33.99	29.47	24.96	25.30	16.63	28.58	23.18	27.82	21.65
Soy bean cake	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Limestone	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vit. premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis									
Crude Protein (%)	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Energy (kcal/kg)	2833	2848	2873	2877	2931	2852	2881	2852	2881
Crude Fibre (%)	4.00	4.32	4.73	4.35	4.77	4.22	4.54	4.97	6.04
Ether Extract (%)	4.67	3.79	3.50	3.63	3.17	3.71	3.33	3.70	3.32
Ca (%)	1.05	1.07	1.08	1.06	1.05	1.06	1.06	1.06	1.06
Available P (%)	0.52	0.56	0.57	0.54	0.56	0.55	0.56	0.55	0.56
Lysine (%)	1.10	1.61	2.12	1.57	2.02	1.61	2.11	1.60	2.09
Meth + Cyst (%)	0.95	0.95	0.97	0.93	0.92	0.96	0.97	0.95	0.96
COST/Kg (~~N~~)	74.02	78.70	83.38	75.91	77.80	59.67	65.92	77.60	81.16

*****Biomix premix provide per Kg of diet: Vit. A, 10,000 I.U; Vit. D3, 2000 I.U; Vit E,23mg;Vit.K_3,2mg;Vit B_1,1.8mg; Vit B_2,5mg; Niacin,275mg; Pantothenic acid 7.5mg; Vit.B_{12}, 0.015mg; Folic acid, 0.75mg; Biotin H_2,0.06mg;Cholin Chloride, 300mg; Vit. B_6,3mg; Manganese,40mg;Iron,20mg; Zinc,30mg; Copper,3mg; iodine,1mg; Cobalt, 0.2mg; Selenium,0.2mg, T1-T9 represents treatment1-9 respectively

TABLE 3.2: Gross composition of experimental diet for laying Japanese Quails (7-20 weeks)

INGREDIENTS	T1 Control	T2 Boil at 10%	T3 Boiled at 20%	T4 Ferment at 10%	T5 Ferment at 20%	T6 Toast at 10%	T7 Toast at 20%	T8 Sprout at 10%	T9 Sprout at 20%
Maize	50.66	45.16	39.68	49.32	48.00	46.05	41.46	46.82	42.98
Lablab	0	10	20	10	20	10	20	10	20
Groundnut cake	24.40	19.90	15.38	15.74	7.06	19.00	13.60	18.24	12.07
Soy bean cake	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Limestone	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vit. premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.01	100.01	100.01	100.01	100.01	100.00	100.01	100.01	100.00
Calculated analysis									
Crude Protein (%)	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Energy (kcal/kg)	2692	2717	2742	2746	2800	2720	2750	2721	2750
Crude Fibre (%)	4.39	4.24	4.65	4.26	4.69	4.14	4.46	4.89	5.96
Ether Extract (%)	4.00	4.11	3.82	3.94	3.49	4.02	3.65	4.01	3.63
Ca (%)	3.02	3.03	3.04	3.02	3.01	3.02	3.02	3.02	3.02
Available P (%)	0.51	0.53	0.55	0.53	0.54	0.53	0.55	0.53	0.55
Lysine (%)	1.08	1.60	2.11	1.55	2.01	1.60	2.10	1.59	2.08
Meth + Cyst (%)	0.88	0.90	0.91	0.88	0.87	0.91	0.92	0.90	0.91
COST/Kg (~~N~~)	87.69	91.25	94.79	67.36	64.90	90.42	93.16	89.72	91.74

*****Biomix premix provide per Kg of diet: Vit. A, 10,000 I.U; Vit. D3, 2000 I.U; Vit E,23mg;Vit.K_3,2mg;Vit B_1,1.8mg; Vit B_2,5mg; Niacin,275mg; Pantothenic acid 7.5mg; Vit.B_{12}, 0.015mg; Folic acid, 0.75mg; Biotin H_2,0.06mg;Cholin Chloride, 300mg; Vit. B_6,3mg; Manganese,40mg;Iron,20mg; Zinc,30mg; Copper,3mg; iodine,1mg; Cobalt, 0.2mg; Selenium,0.2mg, T1-T9 representstreatment1-9 respectively

3.10.3 Determination of egg quality parameters

Three fresh eggs were randomly picked from each replicate to determine the egg quality parameters fourth nightly. The eggs were weighed using a sensitive electronic scale called Camry®. Egg length and egg width were measured with Vernier callipers and the values were used to calculate the egg shape index using the formula described by Sauveur (1988).

ESI = EB/EL

Where ESI - egg shape index

EB - egg breadth (mm)

EL - egg length (mm)

Each egg was broken around the equator; care was taken to keep the yolk intact. The albumen heights and widths were measured with the aid of Vernier callipers and the values obtained were used to calculate the Haugh Unit values for each egg according to the formula outlined by Haugh (1937). Also weights of albumen were calculated by subtracting the weight of the yolk and shell from the weight of the whole egg. The thickness of the egg shell was obtained by average measurement of three areas (the blunt end, the pointed end and the middle part of the egg) using a micrometre screw gauge

$HU=100 \log_{10} (h - 1.7W^{0.37} + 7.6)$

Where HU = Haugh unit,

h = observed height of the albumen in millimetres

W = weight of eggs in grams

The management of birds, data collection, digestibility studies and haematological studies were as described in Experiment 1 except that fifteen (15) quail birds per treatment i.e. five(5) per replicate was selected for the Digestibility studies.

3.10.4 Statistical analysis and model

The data generated from this study was statistically analysed using the General Linear Model procedure of SAS 9.0, (2002). Significant differences in means were separated using the Duncan's Multiple Range Test (Duncan, 1955) in the Preliminary work and Tukey's test for the first and second experiments.

Model: $Y_{ijk} = \mu + L_i + M_j + (L \times M)_{ij} + e_{ijk}$

Y - Observation k in i^{th} level of factor L and j^{th} level of factor M

μ - overall mean

L_i - effect of i^{th} level of the differently processed *lablab purpureus*

M- Effect of the two levels of inclusion of *lablab purpureus* (10% and 20%)

$(L \times M)_{ij}$ – effect of interaction of differently processed lablab beans at the varied inclusion levels

e_{ijk} - random error

CHAPTER FOUR

4.0 RESULTS

4.1 Proximate composition and percent destruction of anti-nutritional factors in differently processed *Lablab purpureus* beans

The result of the proximate composition of raw, boiled, fermented, toasted and sprouted rongai *lablab pupureus* seeds at varied durations are shown on tables 4.1 and 4.2. While their anti-nutritional factors and percent reduction is shown on tables 4.3 and 4.4 respectively.

The proximate composition of boiled lablab showed significant differences ($P<0.05$) in Dry matter (DM), crude protein (CP), crude fibre (CF), ash and nitrogen free extract (NFE) except for ether extract (EE). Dry matter, CP, CF and Ash values decreased with increasing boiling time durations. Nitrogen free extract however, increased with increasing boiling time.

The proximate composition of fermented lablab showed that significant differences ($P<0.05$) existed in all parameters. DM, CP, CF, EE ash and NFE measured. DM, CF, EE and NFE values decreased with increasing fermentation. Crude protein and ash content however, increased with increasing fermentation duration.

The proximate composition of toasted lablab showed that significant differences ($P<0.05$) existed in all parameters. DM, CP, CF, EE, ash and NFE measured. DM, ash and NFE values increased with increasing toasting duration.Crude protein, CF and EE content however, decreased with increasing toasting duration. The proximate composition of sprouted lablab showed that significant differences ($P<0.05$) existed in all variables. DM, CP, CF and ash values increased with increasing sprouting duration. Ether extract and NFE content however, decreased with increasing sprouting-duration.

Table 4.1 : Proximate Composition of raw, boiled and fermented lablab beans at various duration

Measurements	Raw	Boiled (Minutes)				SEM	LOS	Ferment (Hours)				SEM	LOS
		20	30	40	50			24	48	72	96		
Dry matter (%)	91.67	90.90^{a}	88.31^{c}	87.56^{d}	90.06^{b}	0	*	91.91^{a}	90.06^{b}	89.52^{c}	88.88^{d}	0	*
Crude Protein (%)	28.06	25.13^{a}	24.39^{b}	24.28^{b}	24.18^{b}	0.168	*	29.85^{d}	31.47^{c}	38.47^{b}	44.49^{a}	0.467	*
Crude Fibre (%)	12.75	9.64^{a}	9.34^{ab}	8.80^{ab}	8.04^{b}	0.449	*	10.86^{a}	10.26^{a}	9.84^{ab}	9.03^{b}	0.347	*
Ether Extract (%)	2.37	2.01	1.97	1.92	1.80	0.140	NS	1.83^{a}	1.25^{b}	1.19^{b}	0.98^{b}	0.118	*
Ash (%)	4.73	4.24^{a}	4.18^{a}	4.14^{a}	3.74^{b}	0.234	*	4.89^{d}	5.09^{c}	5.19^{b}	5.35^{a}	0.005	*
NFE (%)	52.07	58.98^{b}	60.12^{ab}	60.86^{ab}	62.24^{a}	0.673	*	52.57^{a}	51.93^{a}	45.31^{b}	40.15^{c}	0.631	*

a, b, c= Means with different superscripts on the same row differ significantly ($P < 0.05$) SEM – Standard error of means, NFE: Nitrogen free extract, Los: level of significance, NS- not significant

Table 4.2: Proximate composition of toasted and sprouted lablab beans at various duration

Measurements	Toasted (Minutes)				SEM	LOS	Sprouted (Hours)				SEM	LOS
	10	20	30	40			24	48	72	96		
Dry matter (%)	91.68^{d}	91.70^{c}	91.72^{b}	91.74^{a}	0	*	91.17^{d}	91.26^{c}	91.28^{d}	91.57^{a}	0	*
Crude Protein (%)	27.50^{a}	27.49^{a}	27.44^{a}	27.31^{b}	0.084	*	29.04^{d}	27.07^{c}	29.79^{b}	29.93^{a}	0.467	*
Crude Fibre (%)	10.11^{a}	9.13^{ab}	7.85^{b}	7.45^{b}	0.587	*	13.43^{d}	13.92^{c}	14.22^{b}	15.22^{a}	0.347	*
Ether Extract (%)	2.00^{a}	1.99^{a}	1.50^{ab}	1.26^{b}	0.195	*	1.97^{a}	1.95^{a}	1.94^{a}	1.35^{b}	0.118	*
Ash (%)	4.74^{b}	4.83^{ab}	5.23^{ab}	5.29^{a}	0.159	*	5.51^{b}	6.77^{a}	6.77^{a}	7.09^{a}	0.005	*
NFE (%)	55.65^{b}	56.56^{ab}	57.98^{a}	58.69^{a}	0.743	*	50.05^{a}	50.29^{a}	47.28^{b}	46.41^{c}	0.631	*

a, b, c= Means with different superscripts on the same row under a particular processing method differ significantly ($P < 0.05$) SEM – Standard error of means, NFE: Nitrogen free extract

The duration of boiling of lablab significantly ($P<0.05$) reduced the presence of anti nutritional factors (Hydro cyanic acid, Phytic acid, Tannins and Trypsin inhibitory activity). Significant difference ($P<0.05$) existed in hydro cyanic acid (mg/100g) and phytic acid (mg/100g) across boiling duration. However there was no significant difference ($P>0.05$) in tannin (mg/100g) and trypsin inhibitory activity (mg/100g) across boiling durations.

There was significant difference ($P<0.05$) in hydro cyanic acid (mg/100g), phytic acid (mg/100g), tannin (mg/100g) and trypsin inhibitory activity (TIA) (mg/100g) across fermentation time during fermentation. However, there was no further reduction in phytic acid between 72 and 96hrs of fermentation.

Significant decreases ($P<0.05$) existed in TIA (mg/100g) but there was no significant differences ($P>0.05$) in hydro cyanic acid (mg/100g), phytic acid (mg/100g) and tannins (mg/100g) across toasting time from 10 to 40 minutes. There were decreases in the values of TIA across toasting time from 10 to 40 minutes.

Significant decreases ($P<0.05$) existed in hydro cyanic acid (mg/100g), phytic acid (mg/100g), tannin (mg/100g) and TIA (mg/100g) across sprouting time from 24 to 96 hours

Table 4.3 : Anti-nutritional factors in raw, boiled and fermented lablab beans and their percent reduction at various time durations

Measurements	Hydrocyanide(mg/100g)	Phytic acid(mg/100g)	Tannin(mg/100g)	TIA(mg/100g)
Raw	5.52	0.45	3.87	332.52
SEM	0.44	0.03	0.18	0.18
Boiled(Minutes)				
20	5.08^{a} (***7.97***)	0.41^{a} (***8.89***)	3.51 (***9.30***)	307.82 (***7.52***)
30	4.94^{ab}(***10.51***)	0.40^{ab}(***11.11***)	3.47 (***3.47***)	301.04 (***9.56***)
40	4.91^{ab} (***11.05***)	0.40 ^{ab}(***11.11***)	3.34 (***13.69***)	297.16 (***10.72***)
50	4.59^{b}(***16.85***)	0.39^{b}(***13.33***)	3.34 (***13.69***)	295.18 (***11.32***)
SEM	0.122	0.006	0.103	6.404
LOS	*	*	NS	NS
Fermented(hrs)				
24	5.33^{a} (***3.99***)	0.42^{a} (***6.67***)	3.23 ^{a} (***13.95***)	324.45 ^{a} (***2.52***)
48	5.18 ^{a} (***6.16***)	0.39 ^{b} (***13.33***)	3.17 ^{b} (***18.09***)	314.35^{ab} (***5.56***)
72	5.11^{a} (***7.43***)	0.38^{b} (***15.56***)	3.05 ^{b} (***21.19***)	293.68^{bc} (***11.8)***

96	4.69 [b] (***14.86***)	0.38 [b] (***15.56***)	2.93 [b] (***24.29***)	267.40 [c](***19.66***)
SEM	0.287	0.006	0.153	8.593
LOS	*	*	*	*

abc Means with different superscripts on the same column under a processing method differ significantly (P < 0.05);SEM: standard mean of error; LOS:level of significance; NS: not significant; TIA: trypsin inhibitor activity *:significant at (P<0.05), values in parentheses were percentage reduction for respective ANFS.

Table 4.4 : Anti-nutritional factors and their percent reduction in toasted and sprouted lablab beans at various durations

Measurements	**Hydrocyanide(mg/100g)**	**Phytic acid(mg/100g)**	**Tannin(mg/100g)**	**TIA(mg/100g)**
Toasted(Minutes)				
10	4.89 (***11.41***)	0.40 (***11.11***)	3.37 (***12.92***)	303.99 [a](***8.67***)
20	4.86 (***11.96***)	0.39 (***13.33***)	3.36 (***13.18***)	303.65[a](***8.77***)
30	4.59 (***16.67***)	0.38 (***15.56***)	3.29 (***14.99***)	293.19[ab] (***11.9***)
40	4.50 (***18.48***)	0.36 (***20.00***)	3.17 (***18.08***)	279.04[b] (***16.17***)
SEM	0.246	0.04	0.35	9.14
LOS	NS	NS	NS	*
Sprouted (hrs)				

24	4.94[a] (***10.51***)	0.42[a] (***6.67***)	3.37[a] (***12.92***)	316.25[a] (***4.99***)
48	4.85[a] (***12.14***)	0.38 [a] (***15.56***)	3.33 (***13.95***)	310.89[a] (***6.60***)
72	4.65 [a] (***15.76***)	0.38 [a](***15.56***)	3.03 [a](***21.71***)	300.97 [b](***9.58***)
96	4.00 [b] (***27.54***)	0.29 [b] (***35.56***)	2.63 [b](***32.04***)	288.13 [c](***13.44***)
SEM	0.277	0.019	0.308	2.423
LOS	*	*	*	*

abc Means with different superscripts on the same column under a processing method differ significantly (P < 0.05);SEM: standard mean of error; LOS:level of significance; NS: not significant; TIA: trypsin inhibitor activity, *:significant at (P<0.05), values in parentheses were percentage reduction for respective ANFS.

4.2 Performance of growing Japanese quail fed differently processed *lablab pupureus* beans at two inclusion levels.

The effect of processing method of lablab beans on growth performance of Japanese quails is shown on Table 4.6. Significant differences (P<0.05) were observed for all measurements taken except initial weight and mortality. Final weight (g), body weight gain (g/bird), feed conversion ratio (FCR) and age at first egg (days) showed similar trend due to singular effect of different processing methods. Quails fed boiled lablab showed higher values for final weight (135.33g), body weight gain (103.33g) and age at first egg (38.17days). They also recorded better FCR

(4.27). Quails fed toasted lablab had lowest feed cost/kg/gain as well as highest values for weight of first egg (7.28g) .

The values obtained for the effect of inclusion levels of lablab seeds on growth performance of Japanese quails at 2-6 weeks of age is shown in Table 4.7. There were no significant differences ($P>0.05$) in all measurements taken. However final weight (g), body weight gain(g) and weight of first egg were slightly higher at 10% inclusion levels of lablab meanwhile FCR, feed cost/kg/gain and age at first egg(day) had slightly higher values at 20% inclusion level of lablab.

The interaction of processing method and inclusion level of lablab seed on growth performance of growing Japanese quails (2-6weeks) is shown on Table 4.8. Interraction between processing method and inclusion level were obtained ($P<0.05$) in final weight(g), total feed intake (g/b), body weight gain (g/bird), FCR, feed cost/kg gain, age at first egg (days) and weight of first egg (g) at 2-6 weeks. Although quails fed the control diet had higher final weight, body weight gain, FCR and weight of first egg, it was similar ($P>0.05$) to quails fed boiled lablab at 10% inclusion level which had final weight (136g), FCR (4.17) and weight of first egg of 7.30g.

Table 4.5 : Nutrient composition of quail starter diet containing different processed lablab beans at varied inclusion levels (2- 6weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted	
	0%	10%	20%	10%	20%	10%	20%	10%	20%
Crude Protein (%)	25.39	25.52	24.88	25.09	24.82	24.76	25.50	24.90	26.04
Crude Fibre (%)	2.68	3.57	4.23	3.73	4.42	3.38	3.04	4.81	4.36
Ether Extract (%)	4.86	5.25	4.33	4.91	5.12	5.19	6.01	5.22	5.36
Ash (%)	6.96	7.58	6.62	7.18	6.95	7.17	7.17	7.69	7.60
NFE (%)	60.11	58.08	59.94	59.09	58.69	59.50	58.28	57.38	56.64
Dry Matter (%)	94.82	94.56	93.88	93.78	94.52	93.87	94.80	94.38	94.56

NFE: Nitrogen free extract

Table 4.6: Effect of processing methods of lablab beans on growth performance of Japanese quails (2-6weeks)

Measurements	Boiled	Ferment	Toast	Sprout	SEM	LOS
Initial weight (g)	32.00	32.00	32.00	32.00	0	NS
Final weight (g)	135.33^{a}	125.33^{b}	128.67^{ab}	128.00^{ab}	2.62	*
Total Feed intake(g/bird)	440.67^{b}	458.00^{a}	454.33^{a}	469.00^{a}	12.16	*
Body wt gain(g/bird)	103.33^{a}	93.33^{b}	96.67^{ab}	96.00^{ab}	2.62	*
FCR	4.27^{a}	4.95^{b}	4.71^{ab}	4.89^{ab}	0.19	*
Feed cost/kg gain	19.17^{c}	15.75^{b}	13.26^{a}	16.54^{b}	0.66	*
Age at first egg (days)	38.17^{a}	40.33^{b}	40.17^{b}	38.67^{b}	0.83	*
Weight of first egg (g)	6.96^{a}	6.50^{a}	7.28^{a}	6.02^{b}	0.52	*
Mortality (%)	0.00	0.00	0.00	0.00	0.00	NS

a,b,c means with different superscript means within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant, FCR: feed conversion ratio,wt: weight

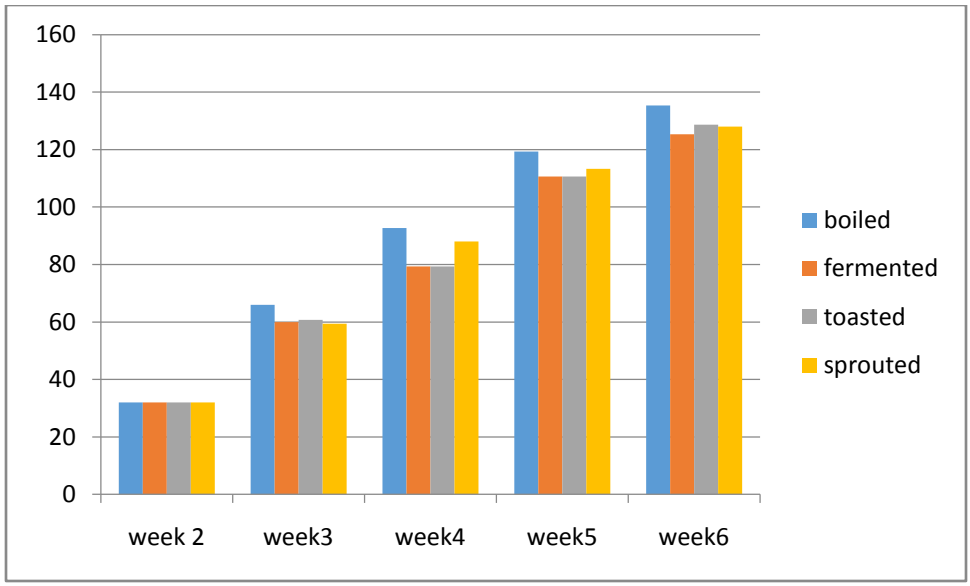

Figure 1: Bar chart showing the weekly growth pattern of quail chicks (2-6weeks) fed differently processed lablab beans.

Table 4.7: Effect of inclusion levels of differently processed lablab beans on growth performance of Japanese quails (2-6 weeks)

Measurements	10%	20%	SEM	LOS
Initial weight (g)	32.00	32.00	0	NS
Final weight (g)	132.33	126.33	3.74	NS
Total Feed intake(g/bird)	455.50	455.50	17.36	NS
Body wt gain(g/bird)	100.33	94.33	3.74	NS
FCR	4.55	4.86	0.27	NS
Feed cost/kg gain	16.17	16.19	0.94	NS
Age at first egg (day)	39.00	39.67	1.18	NS
Weight of first egg (g)	6.90	6.48	0.74	NS
Mortality (%)	0.00	0.00	0.00	NS

a ,b,c means with different superscript within the same row are significantly ($P<0.05$) different.
SEM: standard error mean significance. LOS: level of significance, NS- non significant

Table 4.8: Effect of interaction of processing methods and inclusion levels of lablab beans on growth performance of Japanese quails (2-6 weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted		SEM	LOS
	0%	10%	20%	10%	20%	10%	20%	10%	20%		
Initial weight (g)	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	0	NS
Final weight (g)	141.33^{a}	136.00^{a}	134.67^{ab}	132.00^{ab}	118.67^{b}	132.00^{ab}	125.33^{ab}	129.33^{ab}	126.67^{ab}	2.31	*
Total Feed intake(g/bird)	434.00^{c}	434.00^{c}	447.33^{b}	462.67^{a}	453.33^{b}	453.33^{b}	455.33^{b}	472.00^{a}	466.00^{a}	8.16	*
Body wt gain(g/bird)	109.33^{a}	104.00^{ab}	102.67^{ab}	100.00^{ab}	86.67^{b}	100.00^{ab}	93.33^{ab}	97.33^{ab}	94.67^{ab}	2.31	*
FCR	4.01^{a}	4.17^{a}	4.37^{ab}	4.64^{ab}	5.26^{b}	4.54^{ab}	4.88^{ab}	4.86^{ab}	4.92^{ab}	0.14	*
Feed cost/kg gain	18.75^{ab}	18.89^{ab}	19.46^{c}	16.45^{abc}	15.04^{b}	13.13^{a}	13.40^{a}	16.30^{abc}	16.77^{abc}	0.52	*
Age at first egg(day)	39.67^{c}	38.67^{c}	37.67^{a}	39.00^{c}	41.67^{d}	40.00^{d}	40.33^{d}	38.33^{b}	39.00^{c}	0.60	*
Weight of first egg (g)	7.55^{a}	7.30^{a}	6.62^{b}	6.60^{b}	6.40^{c}	7.27^{a}	7.30^{a}	6.43^{b}	5.60^{d}	0.35	*
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NS

a,b,c means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant, FCR: feed conversion ratio

The values obtained for effect of processing on the nutrient retention of Japanese quail fed processed lablab beans based diet from 2-6 weeks are shown in Table 4.9. Significant differences ($P<0.05$) existed in all parameters measured. Crude protein, crude fibre, ether extract, ash, NFE and dry matter showed a similar trend across processing methods. Quails fed boiled lablab beans based diet had the highest values for measurements taken.

The effect of inclusion levels of *lablab purpureus* beans on the nutrient retention of Japanese quails at 2-6 weeks is shown in Table 4.10. Significant differences ($P<0.05$) existed for all the measurements. Crude protein, crude fibre, ether extract, ash, NFE and dry matter showed that nutrient retention at 10% inclusion level was better ($P<0.05$) than at 20% inclusion level.

The interaction of processing method and inclusion level of lablab seed on nutrient retention of Japanese quails (2-6 weeks) is shown on table 4.11. Boiled lablab at 20% inclusion level had the highest values for all parameters measured. These values (CP 97.11%, CF 95.25%, EE 97.71%, Ash 93.45%, NFE 94.48% and DM 95.38%) were higher than for other treatments.

Table 4.9: Effect of processing methods of lablab beans on Nutrient Retention (%) of Japanese quails (2-6 weeks)

Measurements	Boiled	Fermented	Toasted	Sprouted	SEM	LOS
Crude Protein	95.45[a]	92.88[b]	89.47[c]	93.04[b]	0.14	*
Crude Fibre	89.75[a]	86.15[c]	69.32[d]	88.28[b]	0.03	*
Ether Extract	96.86[a]	94.16[c]	93.63[d]	95.89[b]	0.03	*
Ash	90.70[a]	84.98[c]	78.55[d]	87.88[b]	0.03	*
NFE	90.50[a]	86.02[c]	78.31[d]	86.44[b]	0.03	*
Dry matter	92.31[a]	88.56[c]	82.22[d]	88.95[b]	0.03	*

a,b means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant.

Table 4.10: Effect of inclusion levels of lablab beans on Nutrient Retention (%) of Japanese quails (2-6 weeks)

Measurement	10%	20%	SEM	LOS
Crude Protein	93.27[a]	92.15[b]	0.19	*
Crude fibre	86.38[a]	80.37[b]	0.04	*
Ether Extract	95.59[a]	94.67[b]	0.04	*
Ash	87.69[a]	83.36[b]	0.04	*
NFE	86.85[a]	83.78[b]	0.04	*
Dry Matter	89.29[a]	86.73[b]	0.04	*

a, b means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant.

Table 4.11: Effect of interaction of processing methods and inclusion levels of lablab beans on Nutrient Retention (%) of Japanese quails (2-6 weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted			
	0%	10%	20%	10%	20%	10%	20%	10%	20%	SEM	LOS
Crude Protein	89.82^{d}	93.78^{b}	97.11^{a}	93.64^{b}	92.12^{c}	93.55^{b}	85.39^{e}	92.11^{c}	93.97^{b}	0.09	*
Crude Fibre	71.51^{g}	84.25^{f}	95.25^{a}	87.64^{c}	84.65^{e}	52.72^{d}	87.71^{h}	87.71^{c}	88.85^{b}	0.02	*
Ether Extract	90.84^{i}	96.00^{d}	97.71^{a}	95.50^{e}	92.81^{g}	91.08^{c}	94.68^{h}	94.68^{f}	97.09^{b}	0.02	*
Ash	78.06^{g}	87.95^{c}	93.45^{a}	87.01^{d}	82.94^{f}	68.09^{b}	86.80^{h}	86.80^{e}	88.96^{b}	0.02	*
NFE	79.92^{h}	86.51^{e}	94.48^{a}	87.62^{d}	84.42^{g}	68.28^{b}	84.92^{i}	84.92^{f}	87.96^{c}	0.02	*
Dry Matter	83.33^{g}	89.24^{d}	95.38^{a}	89.88^{c}	87.23_{f}	74.24^{b}	87.83^{h}	87.83^{e}	90.07^{b}	0.02	*

a,b,c Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant

The effect of processing methods of lablab seed on haematological parameters of Japanese quails at 2-6 weeks of age is shown in Table 4.12. Significant differences ($P<0.05$) existed for the packed cell volume with quails fed boiled lablab having the highest value (37.75).

Main effect of inclusion levels of lablab seeds on Haematological parameters is shown in Table 4.13. There were no significant differences ($P>0.05$) observed for all parameters measured. However packed cell volume (PCV), haemoglobin (Hb), total protein (RBC) and red blood cell (RBC) were slightly higher for quails fed lablab beans at 10% inclusion level.

The values obtained for the interaction between processing methods and inclusion levels on haematological parameters of Japanese quails at 2-6 weeks of age are shown in Table 4.14. Significant differences ($P<0.05$) existed for PCV, Hb, TP, WBC and RBC. Although there was no particular trend, quails fed boiled lablab at 10% gave the highest values for PCV (37.83), the control had the highest value for TP (2.73) while quails fed boiled lablab at 20% had the highest value for RBC (7.73).

Table 4.12: Effect of processing methods of lablab beans on Haematological parameters of Japanese quails (2-6 weeks)

Measurements	Boiled	Fermented	Toasted	Sprouted	SEM	LOS
Packed cell volume (%)	37.75^{a}	29.75^{c}	30.33^{c}	34.92^{b}	1.29	*
Haemoglobin (%)	12.55	11.67	10.08	11.68	1.33	NS
Total protein (g/dl)	2.4	1.63	1.52	2.03	0.28	NS
WBC$\times 10^{9}$/d	5.28	5.47	4.52	6.62	0.89	NS
RBC$\times 10^{6}$/d	7.00	5.92	5.08	5.80	0.72	NS

a,b,c means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error of mean, LOS: level of significance, *: significant, NS: not significant, WBC: white blood cell, RBC: red blood cell, TP: total protein, Hb: haemoglobin, PVC: packed cell volume

Table 4.13: Effect of inclusion levels of lablab beans on haematological parameters of Japanese quails (2-6 weeks)

Measurements	10%	20%	SEM	LOS
PCV (%)	34.08	32.29	3.71	NS
Hb (%)	12.26	10.73	1.89	NS
TP (g/dl)	2.14	1.65	0.39	NS
WBC×10^9/d	5.32	5.63	1.27	NS
RBC×10^6/d	6.14	5.63	1.03	NS

SEM: standard error of mean, LOS: level of significance, NS: not significant, WBC: white blood cell, RBC: red blood cell, TP: total protein, Hb: haemoglobin, PVC: packed cell volume

Table 4.14: Effect of interaction of processing methods and inclusion levels of lablab beans on Haematological parameters of Japanese quails (2-6 weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted			
	0%	10%	20%	10%	20%	10%	20%	10%	20%	SEM	LOS
PCV (%)	35.33^{ab}	37.83^{a}	37.67^{a}	33.50^{bc}	26.00^{d}	30.50^{c}	30.17^{c}	34.50^{b}	35.33^{ab}	1.94	*
Hb (%)	11.73^{bc}	12.57^{b}	12.53^{b}	14.70^{a}	8.63^{d}	10.13^{c}	10.03^{cd}	11.63^{bc}	11.73^{bc}	0.93	*
TP (g/dl)	2.73^{a}	2.67^{a}	2.13^{b}	2.20^{b}	1.07^{e}	1.67^{c}	1.37^{d}	2.03^{bc}	2.03^{bc}	0.19	*
WBC×10^{9}/d	4.00^{d}	4.17^{c}	6.40^{ab}	5.43^{b}	5.50^{b}	5.23^{bc}	3.80^{d}	6.43^{ab}	6.80^{a}	0.59	*
RBC×10^{6}/d	5.70^{bc}	6.27^{b}	7.73^{a}	7.47^{a}	4.37^{d}	5.10^{c}	5.07^{cd}	5.73^{bc}	5.87^{bc}	0.50	*

a, b, c, d Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant, PCV: Packed cell volume, Hb: haemoglobin, TP: total protein, WBC: white blood cell, RBC: red blood cell

The values obtained for the effect of processing methods of lablab seed on carcass characteristics of growing Japanese quails (2-6weeks) is shown in Table 4.15. There were significant differences ($P<0.05$) in live weight, dressed weight, back, drumstick and intestinal weight. There was however no significant difference ($P>0.05$) in breast, thigh, wings, neck, shank, head, heart, liver and gizzard weights across processing methods. However, quails fed boiled lablab had the highest values for live weight and dressed weight. No particular trend was observed for weight of the back, drumstick and intestinal weight.

The effect of inclusion levels of lablab seeds on carcass characteristics of growing Japanese quails (2-6weeks) is shown in Table 4.16. There were no significant differences ($P>0.05$) in all carcass measurements taken except head and intestinal weight.

The interaction of processing methods and inclusion levels of lablab seed on carcass characteristics of growing Japanese quails (2-6weeks) is shown in Table 4.17. There were significant differences ($P<0.05$) in all carcass characteristics measured. Quails fed control, 10 and 20% boiled lablab diets had the heighest values for live and dressed weight. However, carcass cut and organ weights followed no particular trend except for quails fed toasted lablab at 20% with highest value (6.19g) for intestinal weight and those fed toasted lablab at 10% with highest liver weight (2.45g).

Table 4.15: Effect of processing methods of lablab purpureus beans on Carcass characteristics of Japanese quails (2-6 weeks)

Measurements	Boiled	Fermented	Toasted	Sprouted	SEM	LOS
Live weight (g)	101.40[a]	85.55[b]	91.33[ab]	93.32[ab]	4.17	*
Dressed weight (g)	97.50[a]	82.25[b]	86.37[ab]	88.33[ab]	3.73	*
Prime cuts in percentage of dressed weight						
Breast	32.03	29.06	30.10	34.78	3.61	NS
Back	24.78[a]	25.37[a]	24.16[b]	25.84[a]	0.61	*
Thigh	13.99	13.59	14.04	13.69	0.39	NS
Drumstick	9.30[b]	10.01[a]	9.62[ab]	9.73[ab]	0.19	*
Wings	12.24	13.20	13.06	12.64	0.56	NS
Neck	5.45	5.69	5.64	5.77	0.18	NS
Shank	4.21	4.74	4.61	4.37	0.27	NS
Head	8.81	9.71	9.52	9.28	0.42	NS
Organ weights in percentage of live weight						
Intestinal weight	4.14[b]	5.41[a]	5.82[a]	5.26[ab]	0.36	*
Heart	0.81	0.65	0.67	0.71	0.09	NS
Liver	2.09	2.28	2.27	2.29	0.12	NS
Gizzard	2.86	3.16	2.88	3.25	0.18	NS

a, b,Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant. Carcass cut was calculated as percentage of dressed weight and organ weights as percentage of live weight

Table 4.16: Effect of inclusion levels on lablab purpureus beans on Carcass characteristic of Japanese quails (2-6 weeks)

Measurements	10%	20%	SEM	LOS
Live weight (g)	96.68	89.12	5.96	NS
Dressed wt (g)	92.48	84.75	5.33	NS
Prime cuts in percentage of dressed weight				
Breast	30.55	32.43	5.16	NS
Back	24.65	25.42	0.86	NS
Thigh	13.87	13.78	0.56	NS
Drumstick	9.68	9.66	0.28	NS
Wings	12.47	13.10	0.79	NS
Neck	5.58	5.69	0.26	NS
Shank	4.29	4.67	0.38	NS
Head	8.90^{a}	9.75^{b}	0.59	*
Organ weights in percentage of live weight				

Intestinal weight	4.82[b]	5.49[a]	0.51	*
Heart	0.70	0.72	0.12	NS
Liver	2.21	2.24	0.25	NS
Gizzard	5.32	5.63	0.26	NS

a,b Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant. Carcass cut was calculated as percentage of dressed weight and organ weights as percentage of live weight

Table 4.17: Effect of interaction of processing methods and inclusion levels of lablab beans on Carcass characteristics of Japanese quails (2-6 weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted			
	0%	10%	20%	10%	20%	10%	20%	10%	20%	SEM	LOS
Live weight (g)	100.53^{a}	102.33^{a}	100.47^{a}	94.57^{ab}	76.53^{b}	97.50^{ab}	85.17^{ab}	92.33^{ab}	94.30^{ab}	2.93	*
Dressed weight (g)	94.80^{a}	98.40^{a}	96.60^{a}	91.40^{ab}	73.10^{b}	93.20^{ab}	79.53^{ab}	86.90^{ab}	89.77^{ab}	2.67	*
Prime cuts in percentage of dressed weight											
Breast	31.64^{b}	31.25^{b}	32.80^{b}	30.27^{b}	27.85^{c}	31.61^{b}	28.59^{b}	29.08^{b}	40.49^{a}	2.43	*
Back	23.72^{de}	24.39^{cd}	25.17^{bc}	25.06^{bc}	25.68^{b}	23.30^{e}	25.02^{bc}	25.85^{a}	25.83^{a}	0.42	*
Thigh	13.56^{ab}	13.97^{ab}	14.00^{ab}	13.81^{ab}	13.37^{b}	13.70^{ab}	14.37^{a}	13.98^{ab}	13.40^{b}	0.44	*
Drumstick	10.06^{a}	8.96^{c}	9.65^{b}	9.91^{ab}	10.11^{a}	10.03^{a}	9.22c	9.81^{ab}	9.65^{b}	0.15	*
Wings	12.08^{d}	12.15^{d}	12.33^{cd}	12.93^{c}	13.48^{b}	12.20^{cd}	13.91^{a}	12.59^{cd}	12.69^{cd}	0.37	*
Neck	5.71^{b}	5.23^{b}	5.67^{b}	5.78^{b}	5.61^{b}	5.62^{b}	5.67^{b}	5.70^{b}	5.84^{a}	0.13	*
Shank	4.22^{b}	4.23^{b}	4.18^{b}	4.25^{b}	5.23^{a}	4.18^{b}	5.04^{a}	4.50^{b}	4.23^{b}	0.19	*
Head	9.13^{b}	8.48^{c}	9.14^{b}	8.96^{bc}	10.46^{a}	8.89^{bc}	10.15^{a}	9.29^{b}	9.26^{b}	0.29	*
Organ weights in percentage of live weight											
Intestinal weight	4.25^{bc}	4.00^{c}	4.28^{bc}	4.84^{abc}	5.98^{ab}	5.45^{abc}	6.19^{a}	4.99^{abc}	5.53^{abc}	0.24	*
Heart	0.63^{bc}	0.89^{a}	0.73^{bc}	0.63^{bc}	0.66^{bc}	0.61^{c}	0.72^{bc}	0.67^{bc}	0.75^{b}	0.06	*
Liver	2.28^{abc}	1.87^{d}	2.30^{ab}	2.36^{ab}	2.19^{bc}	2.45^{a}	2.08^{d}	2.16^{bc}	2.41^{b}	0.13	*
Gizzard	3.00^{c}	2.95^{c}	2.77^{c}	2.99^{c}	3.31^{b}	2.77^{c}	3.00^{c}	2.85^{c}	3.66^{a}	0.13	*

a, b, c Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant. Carcass cut was calculated as percentage of dressed weight and organ weights as percentage of live weight

4.3 The performance of laying Japanese quails fed differently processed *lablab purpureus* beans

Proximate composition of laying quail (7-20weeks) diets containing differently processed lablab beans at various inclusion levels is shown in Table 4.18. The treatments consists of differently processed lablab based diets as follows: Soybean-groundnut based control diet, boiled lablab at 10 and 20% inclusion levels, fermented lablab at 10 and 20% inclusion levels, toasted lablab at 10 and 20% inclusion levels, sprouted lablab at 10 and 20% inclusion levels.

Effect of processing methods of lablab beans on laying performance of Japanese quails (7-20weeks) is shown in Table 4.19. Significant difference ($P<0.05$) was obtained for final weight, daily feed intake, total feed intake, hen-house and hen-day egg production. Quails fed boiled lablab based diet had highest values but those fed sprouted lablab recorded least values ($P<0.05$) in all parameters measured. However, there were no significant differences ($P>0.05$) observed for average egg weight, age at peak production, feed conversion ratio and percent mortality.

The result of inclusion levels of lablab seed on laying performance of Japanese quails (7-20weeks) are presented in Table 4.20. There were no significant differences ($P>0.05$) in all parameters measured. However, the final weight, hen-house egg production, hen-day egg production and average egg weight had higher values at 10% inclusion levels.

The result of interaction between processing methods and inclusion levels of lablab seed on the laying performance of Japanese quails (7-20weeks) is shown in Table 4.21. The result showed that there were significant differences ($P<0.05$) for all parameters measured. Quails fed boiled lablab at 20% inclusion level had the highest values for final weight, daily and total feed intake, and average egg weight. However, quails fed boiled and toasted lablab at 20% inclusion level had the highest values for hen-house egg and hen-day egg production.

Table 4.18: Nutrient composition (%) of quail finisher diets containing differently processed lablab beans at various inclusion levels (7-20weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted	
	0%	10%	20%	10%	20%	10%	20%	10%	20%
Dry Matter	93.56	94.04	93.66	93.87	94.09	94.56	94.81	92.87	93.80
Crude Protein	21.28	21.04	20.17	21.18	21.06	20.98	21.66	21.11	21.81
Crude Fibre	6.28	6.05	5.87	6.11	6.04	5.99	7.01	6.41	6.87
Ether Extract	4.78	5.08	5.67	5.68	4.10	4.29	5.87	5.16	5.23
Ash	8.28	7.93	7.89	8.08	7.39	7.88	8.81	8.80	7.98
NFE	59.38	59.95	60.04	58.95	61.41	60.86	56.65	58.52	58.11

NFE-Nitrogen free extract

Table 4.19: Effect of processing methods of lablab beans on laying performance of Japanese quails (7-20 weeks)

Measurements	Boiled	Fermented	Toasted	Sprouted	SEM	LOS
Initial weight (g)	159.82	156.02	156.03	158.30	1.98	NS
Final weight (g)	176.92^{a}	168.25^{a}	170.18^{a}	164.92^{b}	5.04	*
Total feed intake (g/bird)	2614.22^{a}	2368.47^{ab}	2442.43^{ab}	2294.52^{b}	862.55	*
Daily feed intake (g/bird)	28.73^{a}	26.03^{ab}	26.84^{ab}	25.21^{b}	0.83	*
Hen house production (%)	78.86^{a}	70.33^{ab}	72.91^{ab}	64.49^{b}	4.18	*
Hen day production (%)	79.44^{a}	71.35^{ab}	73.18^{ab}	65.49^{b}	3.75	*
Average egg weight(g)	9.77	9.55	9.62	9.50	0.15	NS
Age at peak production(day)	60.00	57.50	70.33	69.50	6.52	NS
Feed conversion ratio	3.71	3.90	3.90	4.32	0.29	NS
Mortality	0.83	1.5	1.17	0.83	0.29	NS

a,b,c Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant

Table 4.20: Effect of inclusion levels of differently processed lablab beans on laying performance of Japanese quails (7-20weeks)

Measurements	10%	20%	SEM	LOS
Initial weight (g)	157.17	157.92	2.82	NS
Final weight (g)	170.98	169.16	7.2	NS
Total feed intake (g/bird)	26317.5	26918.3	1232.21	NS
Daily feed intake (g/bird)	26.51	26.89	1.18	NS
Hen house production (%)	72.92	70.31	5.97	NS
Hen day production (%)	73.59	71.14	5.35	NS
Average egg weight(g)	9.65	9.57	0.21	NS
Age at peak production(day)	62.92	65.75	9.31	NS
Feed conversion ratio	3.87	4.05	0.41	NS
Mortality	1.08	1.08	0.41	NS

SEM: standard error mean significance. LOS: level of significance. NS- non significant

Table 4.21: Effect of interaction of processing methods and inclusion levels of lablab beans on laying performance of Japanese quails (7-20 weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted		
	0%	10%	20%	10%	20%	10%	20%	10%	20%	SEM
Initial weight (g)	162.10^{a}	159.07^{c}	160.57^{b}	157.53^{cd}	154.50^{c}	156.03^{d}	156.03^{d}	156.03^{d}	160.57^{b}	1.35
Final weight (g)	170.93^{bc}	171.67^{b}	182.17^{a}	172.23^{b}	164.27^{d}	173.33^{b}	167.03^{bc}	166.67^{bc}	163.17^{d}	3.44
Total feed intake (g/bird)	2366.6^{ab}	2492.20^{ab}	2736.23^{a}	2372.53^{ab}	2364.40^{ab}	2503.43^{ab}	2381.43^{ab}	2282.53^{b}	2306.50^{ab}	55.04
Daily feed intake (g/bird)	26.01^{ab}	27.39^{ab}	30.07^{a}	26.07^{ab}	25.98^{ab}	27.51^{ab}	26.17^{ab}	25.08^{b}	25.34^{ab}	0.60
Hen house production (%)	78.62^{ab}	76.19^{ab}	81.52^{a}	76.89^{ab}	63.77^{ab}	82.35^{a}	63.47^{ab}	56.24^{b}	72.46^{ab}	2.88
Hen day production (%)	79.52^{a}	76.48^{ab}	82.40^{a}	77.45^{ab}	65.25^{ab}	82.53^{a}	63.83^{ab}	57.92^{b}	73.07^{ab}	2.64
Average egg weight(g)	9.64^{ab}	9.77^{a}	9.78^{a}	7.80^{e}	9.31^{d}	9.63^{ab}	9.62^{ab}	9.42^{c}	9.57^{b}	0.09
Age at peak production(day)	62.67^{b}	59.33^{ab}	60.67^{ab}	52.67^{a}	62.33^{b}	56.67^{a}	84.00^{c}	83.00^{c}	56.00^{a}	4.45
Feed conversion ratio	3.42^{a}	3.66^{a}	3.76^{a}	3.42^{a}	4.37^{b}	3.47^{a}	4.32^{b}	4.91^{c}	3.74^{a}	0.20
Mortality	1.33^{c}	1.0^{b}	0.67^{a}	1.33^{c}	1.67^{c}	1.00^{b}	1.33^{c}	1.00^{b}	0.67^{a}	0.20

a,b,c Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, NS: not significant, FCR: feed conversion ratio

The effect of processing methods of lablab seed on nutrient retention of Japanese quails (7-20weeks) is presented in Table 4.22. The result shows that all nutrient retention parameters on processing methods were significantly different ($P<0.05$). Quails fed fermented lablab had the highest values for crude fibre and ether extract while those fed toasted lablab had the highest values for crude protein, ash, NFE and dry matter.

The result of the main effect of inclusion levels on lablab seeds on nutrient retention of Japanese quails (7-20 weeks) is shown in Table 4.23. All measurements taken were significantly different ($P<0.05$). All showed similar trend with values higher for quails fed lablab at 10% inclusion level.

The values obtained from the interaction of processing methods and inclusion levels of lablab seeds on nutrient retention of Japanese quails (7-20weeks) is shown in Table 4.24. All parameters measured were significantly different ($P<0.05$). Crude protein, crude fibre, ash, NFE and Dry matter were higher for quails fed toasted lablab at 20% inclusion level. However quails fed fermented lablab at 10% inclusion level had a higher result for ether extract.

Table 4.22: Effect of processing methods of lablab beans on Nutrient Retention of Japanese quails (7-20weeks)

Measurements	Boiled	Fermented	Toasted	Sprouted	SEM	LOS
Crude Protein (%)	69.46^{d}	86.80^{b}	87.98^{a}	80.56^{c}	0.03	*
Crude Fibre (%)	69.91^{d}	88.76^{a}	86.94^{b}	82.74^{c}	0.03	*
Ether Extract (%)	92.02^{d}	96.64^{a}	95.89^{b}	93.34^{c}	0.03	*
Ash (%)	60.99^{d}	82.58^{b}	84.98^{a}	74.87^{c}	0.03	*
NFE (%)	58.79^{d}	82.25^{b}	82.55^{a}	70.98^{c}	0.06	*
Dry matter (%)	63.66^{d}	83.89^{b}	85.04^{a}	75.21^{c}	0.03	*

a,b,c,d means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant.

Table 4.23: Effect of inclusion levels of lablab beans on Nutrient Retention of Japanese quails (7-20weeks)

Measurements	10%	20%	SEM	LOS
Crude Protein (%)	84.77[a]	77.63[b]	0.04	*
Crude fibre (%)	85.96[a]	78.23[b]	0.04	*
Ether Extract (%)	95.26[a]	93.68[b]	0.04	*
Ash (%)	80.39[a]	71.32[b]	0.04	*
NFE (%)	78.87[a]	64.42[b]	0.09	*
Dry Matter (%)	81.49[a]	72.40[b]	0.04	*

a,b means with different superscript within the same row are significantly ($P<0.05$) different. SEM: standard error mean significance. LOS: level of significance.

Table 4.24: Effect of interaction of processing methods and inclusion levels of lablab beans on Nutrient Retention of Japanese quails (7-20 weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted			
	0%	10%	20%	10%	20%	10%	20%	10%	20%	SEM	LOS
Crude Protein(%)	80.46^{e}	79.94^{f}	58.94^{h}	86.54^{c}	87.06^{b}	86.03^{d}	89.93^{a}	86.57^{c}	74.55^{g}	0.02	*
Crude Fibre (g)	81.36^{g}	83.32^{f}	56.49^{i}	88.11^{d}	89.44^{b}	83.81^{e}	90.06^{a}	88.58^{c}	76.89^{h}	0.02	*
Ether Extract (%)	93.05^{f}	92.50^{g}	91.53^{h}	97.12^{a}	96.16^{d}	95.00^{e}	96.78^{b}	96.41^{c}	90.26^{i}	0.02	*
Ash (%)	75.40^{f}	71.95^{g}	50.04^{i}	83.89^{c}	81.26^{e}	81.63^{d}	88.32^{a}	84.09^{b}	65.65^{h}	0.02	*
NFE (%)	72.41^{f}	73.83^{e}	43.75^{h}	80.64^{cd}	83.86^{b}	80.69^{c}	89.41^{a}	80.32^{d}	61.64^{g}	0.04	*
Dry Matter (%)	75.78^{g}	76.58^{f}	50.73^{i}	83.33^{c}	84.44^{b}	82.94^{e}	87.14^{a}	83.11^{d}	67.30^{h}	0.02	*

a,b,c,d Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant.

The effect of processing methods of lablab seed on egg quality parameters of Japanese quails (7-20weeks) is shown in Table 4.25. There were no significant differences (P>0.05) among variables measured except for egg shape index. Quails fed fermented and sprouted lablab had the highest value of 77.90 and 77.48 for egg shape index respectively.

The values from the observation of the effect of inclusion levels on lablab seeds on egg quality parameters of Japanese quails (7-20weeks) is shown in Table 4.26. No egg quality variable measured was significantly different (P>0.05)

The result of the interaction of processing methods and inclusion levels of lablab seed on egg quality parameters of Japanese quails (7-20weeks) is shown in Table 4.27. Significant differences (P<0.05) were observed for all variables except egg height. A trend showed that quails fed boiled lablab at 10% inclusion level had slightly higher values for egg weight, egg width, yolk weight and yolk index.

Table 4.25: Effect of processing methods of lablab beans on egg quality measurements of Japanese quails (7-20 weeks)

Measurements	Boiled	Fermented	Toasted	Sprouted	SEM	LOS
Egg weight (g)	10.40	9.71	10.32	10.21	0.33	NS
Egg height (mm)	32.33	31.38	32.17	31.73	0.39	NS
Egg width (mm)	26.00	24.28	25.80	25.52	0.83	NS
Albumen height (mm)	3.84	3.69	3.67	4.01	0.16	NS
Albumen weight (g)	4.87	4.66	4.94	4.81	0.14	NS
Yolk height (mm)	8.84	8.65	9.45	8.71	0.52	NS
Yolk width (mm)	22.14	21.71	21.61	21.56	0.42	NS
Yolk weight (g)	3.41	3.29	3.37	3.37	0.09	NS
Shell thickness (mm)	0.13	0.13	0.14	0.15	0.01	NS
Shell weight (g)	1.03	0.93	0.99	1.34	0.22	NS
Yolk index	2.52	2.52	2.35	2.48	0.12	NS
Egg shape index	0.76^{b}	0.78^{a}	0.76^{b}	0.77^{a}	0.64	*
Haugh unit (%)	86.85	86.59	85.93	87.99	0.09	NS

a, b Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant

Table 4.26: Effect of inclusion levels on lablab beans on egg quality measurements of Japanese quails (7-20weeks)

Measurements	10%	20%	SEM	LOS
Egg weight (g)	10.34	9.98	0.47	NS
Egg height (mm)	31.99	31.77	0.55	NS
Egg width (mm)	25.85	24.95	1.18	NS
Albumen height (mm)	3.75	3.85	0.31	NS
Albumen weight (g)	4.83	4.81	0.01	NS
Yolk height (mm)	8.76	9.06	0.22	NS
Yolk width (mm)	21.89	21.60	0.20	NS
Yolk weight (g)	3.40	3.31	0.74	NS
Shell thickness (mm)	0.13	0.14	0.60	NS
Shell weight (g)	0.99	1.14	0.12	NS
Yolk index	2.50	2.42	1.26	NS
Egg shape index	0.77	0.77	0.17	NS
Haugh unit	86.00	87.00	0.91	NS

SEM: standard error mean significance. LOS: level of significance. NS- non significant

Table 4.27: Effect of interaction of processing methods and inclusion levels of lablab beans on egg quality measurements of Japanese quails (7-20 weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted			
	0%	10%	20%	10%	20%	10%	20%	10%	20%	SEM	LOS
Egg weight (g)	10.31^{a}	10.42^{a}	10.38^{a}	10.37^{a}	9.06^{b}	10.42^{a}	10.23^{a}	10.16^{a}	10.26^{a}	0.22	*
Egg height (mm)	31.88	32.21	32.25	32.00	30.77	32.07	32.28	31.67	31.79	0.30	NS
Egg width (mm)	25.77^{a}	26.04^{a}	25.96^{a}	25.92^{a}	22.64^{b}	26.04^{a}	25.56^{a}	25.39^{a}	25.65^{a}	0.56	*
Albumen height (mm)	3.89^{a}	3.87^{a}	3.81^{b}	3.58^{c}	3.79^{b}	3.53^{c}	3.81^{b}	4.03^{a}	3.98^{a}	0.11	*
Albumen weight (g)	4.80^{a}	4.84^{a}	4.89^{a}	4.77^{b}	4.55^{c}	4.97^{a}	4.91^{a}	4.75^{b}	4.88^{a}	0.09	*
Yolk height (mm)	8.87^{b}	8.68^{b}	9.00^{b}	8.87^{b}	8.44^{b}	8.96^{b}	9.94^{a}	8.53^{b}	8.89^{b}	0.35	*
Yolk width (mm)	21.88^{a}	22.11^{a}	22.17^{a}	22.00^{a}	21.41^{b}	22.15^{a}	21.08^{c}	21.33^{b}	21.78^{a}	0.30	*
Yolk weight (g)	3.39^{a}	3.43^{a}	3.40^{a}	3.40^{a}	3.19^{b}	3.39^{a}	3.35^{a}	3.40^{a}	3.33^{a}	0.06	*
Shell thickness (mm)	0.13^{b}	0.13^{b}	0.13^{b}	0.13^{b}	0.12^{c}	0.14^{b}	0.14^{b}	0.13^{b}	0.16^{a}	0.01	*
Shell weight (g)	1.01^{b}	1.01^{b}	1.04^{b}	0.99^{b}	0.87^{b}	1.01^{b}	0.98^{b}	0.99^{b}	1.68^{a}	0.14	*
Yolk index	2.47^{b}	2.55^{a}	2.47^{b}	2.49^{b}	2.55^{a}	2.48^{b}	2.22^{c}	2.50^{a}	2.45^{b}	0.08	*
Egg shape index	0.77^{b}	0.77^{b}	0.76^{c}	0.77^{b}	0.79^{a}	0.76^{c}	0.76^{c}	0.77^{b}	0.78^{a}	0.58	*
Haugh unit	87.23^{a}	87.03^{a}	86.67^{b}	85.35^{c}	87.82^{a}	84.98^{c}	86.87^{b}	88.18^{a}	87.80^{a}	0.60	*

a,b,c Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, NS: not significant

The effect of processing methods of lablab seed on Haematological parameters of Japanese quails (7-20weeks) is presented in Table 4.28. There were no significant differences (P>0.05) among all parameters measured.

The result of the effect of inclusion levels of lablab seeds on Haematological parameters of Japanese quails (7-20weeks) is shown in Table 4.29. There were no significant differences (P>0.05) in all parameters measured. Never the less Hb, WBC and RBC of quails fed lablab at 10% inclusion level had values numerically higher but PCV and Hb of quails fed lablab 20% inclusion levels were slightly higher.

Table 4.30 shows interaction of processing methods and inclusion levels of lablab seed on haematological measurements of Japanese quails (7-20weeks). Significant differences (P<0.05) were observed in all parameters measured. Quails fed toasted lablab at 20% had the highest value for pack cell volume (43.33 %), while those fed sprouted lablab at 10% had the highest value total protein (15.23 g/dl). Those fed boiled lablab at 10% inclusion level had higher values for haemoglobin (15.10 %) and white blood cell while (7.47 10^9/dl) while quails fed boiled lablab at 20% had higher value for red blood cell (8.30 10^6/dl).

Table 4.28: Effect of processing methods of lablab beans on Haematological measurements of Japanese quails (7-20 weeks)

Measurements	Boiled	Fermented	Toasted	Sprouted	SEM	LOS
Packed cell volume (%)	37.53	40.50	43.67	39.67	3.02	NS
Haemoglobin (%)	14.29	13.46	14.32	13.16	0.51	NS
Total protein (g/dl)	9.85	9.48	10.22	11.15	0.69	NS
WBC$\times 10^9$/dl	7.08	6.75	7.03	6.60	1.23	NS
RBC$\times 10^6$/dl	7.48	7.40	7.58	6.47	0.27	NS

SEM: standard error mean, LOS: level of significance, NS: not significant WBC: white blood cell, RBC: red blood cell

Table 4.29: Effect of inclusion levels on lablab beans on Haematological parameters of Japanese quails (7-20weeks)

Measurements	10%	20%	SEM	LOS
Packed cell volume (%)	39.97	40.46	4.31	NS
Haemoglobin (%)	14.18	13.44	0.73	NS
Total protein (g/dl)	6.89	7.60	0.99	NS
WBC×10^9/dl	11.08	9.27	1.79	NS
RBC×10^6/dl	7.06	6.67	0.38	NS

SEM: standard error mean significance. LOS: level of significance. NS: not significant, WBC: white blood cell, RBC: red blood cell

Table 4.30: Effect of interaction of processing methods and inclusion levels of lablab beans on Haematological measurements of Japanese quails (7-20 weeks)

Measurements	Control	Boiled		Fermented		Toasted		Sprouted			
	0%	10%	20%	10%	20%	10%	20%	10%	20%	SEM	LOS
PCV (%)	38.00^{bc}	34.22^{c}	40.83^{ab}	40.67^{ab}	40.33^{b}	43.00^{a}	43.33^{a}	42.00^{ab}	37.00^{c}	2.09	*
Hb (%)	12.67^{de}	15.10^{a}	13.48^{c}	13.45^{cd}	13.47^{c}	14.23^{bc}	14.40^{b}	13.92^{bc}	12.40^{e}	0.39	*
TP (g/dl)	10.67^{ab}	9.57^{ab}	10.13^{ab}	11.60^{ab}	7.37^{ab}	7.93^{ab}	12.50^{ab}	15.23^{a}	7.07^{b}	0.96	*
WBC×10^{9}/d	6.33^{c}	7.47^{a}	6.68^{b}	6.73^{b}	6.77^{b}	7.00^{b}	7.07^{ab}	7.03^{b}	6.17^{c}	0.20	*
RBC×10^{6}/d	6.93^{c}	6.67^{c}	8.30^{a}	8.00^{ab}	6.80^{c}	7.10^{b}	8.07^{ab}	5.70^{d}	7.23^{b}	0.47	*

a,b,c Means with different superscripts within the same row are significantly($P<0.05$) different. SEM: standard error mean, LOS: level of significance, *: significant, WBC: white blood cell, RBC: red blood cell, TP: total protein, Hb: haemoglobin, PVC: packed cell volume

CHAPTER FIVE

5.0 DISCUSSION

5.1 Proximate composition of raw, boiled, fermented, toasted and sprouted *lablab purpureus* beans at different duration of time

The result of the proximate composition of *Lablab purpureus* in this study agreed with the report of Abeke *et al.* (2008b) and Bawa *et al*. (2003a) who had similar values for crude protein, crude fibre, ether extract, ash, nitrogen free extract and dry matter.

From the result, dry matter decreased as the boiling time increased. This may be due to the fact that as the boiling time increased, there was leaching of some nutrients into the boiling water from the beans thus reduced the dry matter content of the beans. Crude protein reduced across the boiling time. This agreed with the reports of Akinmutimi (2003), Bawa *et al.* (2003b) and Iorgyer *et al*. (2009) who reported that protein leached into the boiling water during boiling. The crude fibre content reduced as the boiling time increased. This could be due to breakdown of fibre contents which was altered by heat. Loss in ash content across the boiling time may be due to leaching of soluble inorganic salts into the processing water as explained by Christiana and Marcel (2008) for African locust bean. A similar result was also reported by Bawa *et al*. (2003b) and Osman (2007) for lablab beans.

Dry Matter content decreased as fermentation time increased. This could be attributed to the fact that fermentation would have led to break down of high molecular weight components like fibre components to relatively lower molecular weight simple sugars, hence the lower dry matter content. Also fermentation time resulted in increased loss in carbohydrates such as sugars which invariably decreased dry matter content, These sugars were used up by fermenting organisms for

growth and metabolic activities as explained by Christiana and Marcel (2008) for African locust bean. Crude protein however, increased as fermentation time increased, this was expected because of the increase in protein content resulting from the presence and breakdown of fermenting organisms. The increase in CP in this result agreed with the report of Omafuvbe *et al*. (2004) and Christiana and Marcel (2008) who fermented African locust bean and observed increase in protein content. Decrease in the crude fibre content with increasing time may be due to the decomposing or breakdown activities of fermenting organisms on fibre components such as cellulose and hemicelluloses. There however, was decrease in the ether extract content because there was nutrient loss due to leaching into the water during the first 24 hours of prior soaking of the lablab beans. Nevertheless, the reason for increase in the ash content is not clear.

Dry matter increased as toasting time increased, as expected because as dry heat (toasting) increases, more water content of the seed was lost hence the increase in dry matter. In contrast crude protein reduced with increasing toasting time which may attributed to loss due to violatilization of protein. The reduction in crude protein across the toasting time agreed with the report of Akinmutimi (2003) who stated that nutrient loss was bound to occur under any processing method. Crude fibre content also decreased as toasting time increased, this may be due to breakdown and loss of the fibrous content of the seed due to heat. Ether extract content decreased with increased toasting time. This may be due of loss via volatilization as a result of heat treatment. However, ash content increased with increased toasting time which may be attributed to conversion of other nutrients to ash (minerals) due to charring.

The result showed that dry matter increased as sprouting time increased. This may be due to the catabolic process that occured during sprouting, where the reserved substances present in the cotyledon was converted to cellulose for the growth and development of the embryo (Mugendi *et*

al., 2010). Also, more tissues were formed due to sprouting adding to the DM content. Crude protein also increased with the increase in sprouting time which was in agreement with report by Mugendi *et al*. (2010) who worked with mucuna beans. They explained that increased CP was attributed to extensive breakdown of seed storage compounds and the synthesis of structural proteins and other components during germination. The authors further explained that seedlings were sites of high amino acid biosynthetic activity resulting in high content of free amino acid supporting the synthesis of proteins and the development of the plant. This result further agreed with the reports of Hafez *et al*. (2000), Yagoub *et al*. (2008), Kakati *et al*. (2010) who worked with soyabean, roselle seed and black and green gram seeds respectively. Crude fibre also increased as sprouting time increased which could be due to the fact that sprouting (germination) involved the growth and development of the seed embryo, which involved the increase in cell walls of which cellulose and hemicelluloses were major components. This most likely increased the fibrous content of sprouts with increasing growth time. This result however was contrary to the report of Afaf (2011) in an experiment with sprouted barley. Ether extract decreased and ash content increased.

5.2 Analyzed anti nutritional factors in raw, boiled, fermented, toasted and sprouted *lablab purpureus* beans and percent reduction at various time durations.

The reduction in tannin in this experiment agreed with the report of El-Adawy (2002) who reported 48-50.1% decrease in tannin during different boiling methods of chick pea. The tannin content of lablab was reported to have reduced by 76.47% with boiling (Ramakrishna *et al*., 2006). Boiling was reported to be most effective in reducing trypsin inhibitor but showed high increase of Tannin (Osman, 2007). Iorgyer *et al*.(2009) reported that trypsin inhibitor, tannin, hydrocyanic acid were significantly reduced by boiling except for phytate in pigeon pea. The

reductions increased with increase in boiling periods. Sixty (60) minutes had the highest reduction. It has been established that boiling and other processing methods exert beneficial effect by destroying the anti nutritional factors inherent in legume grains (Balogun *et al*., 2001).

The result showed reduction of the hydrocyanide, phytic acid , tannins and TIA as fermentation time increased. Tannin content was reported to reduce during soaking and fermentation (Ikemefuna *et al*., 1991). According to Christiana and Marcel, (2008) the reduction in trypsin inhibitor at 72 hours of fermentation was greater than that of tannins and phytic acid with a reduction level of 89% in an experiment with African locust bean. Boiling of Africa oil bean seed (*Pentaclethra macrophylla* Benth) resulted to 51.6% reduction in the tannin content but fermentation further reduced it by 56%. Phytic acid was also reported to reduce by 75.9% in the fermentation of Africa oil bean seed (Mbajunwa, 1995). Tannins, which were heat stable, were easily removed by fermentation (Osman, 2004).

This report agreed with the findings that trypsin inhibitor, phytic acid, haemagglutinin and oxalate were significantly reduced by roasting of Bambara nut. Roasting greatly reduced the level of trypsin inhibitor compared to boiling (Omoruyi *et al*., 2007). Ramakrishna *et al*. (2006) reported maximum decrease in trypsin inhibitor activity and phytic acid with roasting of *Dolichos lablab.* Osman, (2007) however, reported that the reduction in the content of phytic acid was found to be greater in roasted *Dolichos lablab* bean compared to those soaked, boiled, autoclaved and germinated. Roasting significantly reduced the amount of TIA by 23.05% and on the contrary, showed moderate increase of tannin (Osman, 2007). Maidala *et al.* (2013) revealed a decrease in tannins (4.57-8.07)mg/100g) of roasted soybean. Roasting was thus most effective in reducing the anti nutritional factors (Yisa *et al*., 2014).

The result indicated reductions of the hydrocyanide, phytic acid, tannins and TIA as sprouting (germination) time increased. Ramakrishna *et al*. (2006) reported that germination of *Dolichos lablab* was effective in reducing trypsin inhibitor activity, tannins, polyphenols and phytic acid compared to boiling, pressure cooking and roasting. Maidala *et al.* (2013) revealed a decrease in trypsin inhibitor (3.51-24.54mg/100g) of sprouted soybean. On the contrary, germination (sprouting) significantly increased tannins content compared to the soaking, boiling, roasting and autoclave (Osman,2007).

5.3 Growth performance of growing Japanese quail chicks fed differently processed *lablab purpureus* beans based diets at varied inclusion levels (2-6weeks).

The result of growth performance of Japanese quails (2-6weeks) showed that quails fed boiled lablab based diets particularly at 10% inclusion level performed better in terms of final weight, body weight gain and feed conversion ratio. This could be as a result of a reasonable reduction in antinutrients present in lablab beans due to boiling plus a minimal inclusion of 10%, such as was tolerable to the quails thus improved palatability and performance. These result agreed with the reports by Ogundipe *et al* (2003) who reported better growth rate and feed efficiency for pullets fed diets with boiled lablab. Abeke *et al.* (2008b) reported better final weight, weight gain and feed efficiency for broilers fed boiled lablab. Ragab *et al.* (2012) reported significant high feed conversion ratio and weight gains for birds fed boiled lablab based diets at 10% inclusion level.

Total feed intake of quails fed sprouted lablab was better than those fed all other processed lablab. This may be as a result that some sprouts were palatable and this is in agreement with the report of Shipard (2005) who reported that sprouts provide a good supply of vitamins and enzymes that serve as bioactive catalysts to assist in metabolism of feed and the release of energy.

Feed cost/kg/gain showed that diet with toasted lablab was less expensive compared to all other diets. This however is contrary to the report of Shaahu *et al*. (2014) who reported a more cost effective diet for boiled lablab than toasted lablab for rabbits.

The age at first egg (days) obtained for quails fed boiled lablab implies that it reached production faster than quails fed other processes lablab diets. This may be as a result of better utilization of the boiled lablab diet.

5.4 Nutrient retention of Japanese quails fed differently processed *lablab purpureus* beans (2-6 Weeks)

Crude protein, crude fibre, ether extract, ash, nitrogen free extract and dry matter retention values for quails fed boiled lablab and particularly at 20% inclusion level were superior to all other treatments. This was as a result of the reduction of reasonable level of anti nutritional factors due to boiling thus making nutrients readily available to the quails. Abeke *et al*. (2008b) authenticates this fact when they reported that there seemed to be a relationship between time of boiling and the efficiency with which the legume beans being boiled were utilized by chickens. Bashar *et al*. (2010) also confirmed that crude protein, crude fibre and ether extract retention of broiler chicks fed lablab seed meal were significantly higher compared to those fed groundnut cake and full fat soya based meals. On the contrary Tuleun *et al*. (2009) reported that the inclusion levels of mucuna seed meal had no significant effect on the nutrient retention by the quails.

5.5 Haematological parameters of Japanese Quails fed differently processed *lablab purpureus* beans (2-6 weeks)

Values obtained for haematological measurements were within the normal range for healthy birds. The result however showed that quails fed boiled lablab gave better results for packed cell

volume (PCV), total protein (TP) and red blood cell (RBC). This was in agreement with the report of Abeke *et al*. (2008b) who reported better TP, PCV, and Hb for broiler finisher birds fed boiled lablab. Oladele (2000) also reported that PCV, TP and Hb content of the blood of chicken were a factor of their health status and nutrient intake. Boiling of lablab will have no doubt destroyed or reduced the presence of a measure of anti-nutrients. Our study therefore shows that the health of birds were not affected by inclusion of processed lablab in the diet of quails.

5.6 Carcass characteristics of Japanese quails fed differently processed *lablab purpureus* beans (2-6weeks)

Results obtained showed that, the live weight and dressed weight of quails fed boiled lablab at 10% inclusion level was better than other diets. This could be because the boiled lablab was most tolerable to the quails thus most efficiently utilized. This however, contradicts the report of Tuleun *et al*. (2011) who reported that dietary inclusion of fermented Mucuna seed meal at 20% inclusion level fed to broilers produced a comparable performance with the control diet and had no effect on organ parameters. Although the result of the weights of the various carcass cut and organ weights followed no particular trend, it was evident that in comparism with reports of other authors as regards carcass cuts of quails, processed lablab seed substantially affected carcass characteristics. The difference in values may be as a result of the use of different legume grains which vary in proximate composition and anti nutritional contents.

Nevertheless, the thigh, and wings of quails fed toasted lablab at 20% inclusion level had higher values than other treatments. This agrees with the report of Tuleun *et al*. (2009) who reported mean weight of quails fed toasted mucuna seed to have better carcass yield. The weight range (9.22-10.11%) for drumstick of quails fed differently processed lablab was higher compared to the report by Tuleun *et al*. (2009) for drumstick when quails were fed toasted mucuna (8.50%).

The weight (5.23-5.84%) for neck of quails fed differently processed lablab was lower than the report by Tuleun *et al*. (2009) for neck when quails were fed toasted mucuna (14.10%).

The weight (4.18-5.23%) for shank of quails fed differently processed lablab was higher than the report by Tuleun *et al*. (2009) for shank when quails were fed toasted mucuna (2.50%).

The weight (0.61-0.89%) for heart of quails fed differently processed lablab was lower than the report by Tuleun *et al*. (2009) for heart when quails were fed toasted mucuna (1.85%).

The weight (1.87-2.45%) for liver of quails fed differently processed lablab was within the range reported by Tuleun *et al*. (2009) for liver when quails were fed toasted mucuna (2.15%) and Makinde *et al.* (2013), reported 2.29% for liver in quails fed brewer's dried grain.

The weight range for gizzard of quails fed differently processed lablab (2.77-3.66%) was within the value report by Tuleun *et al*. (2009) for gizzard when quails were fed toasted mucuna (3.30%) and Makinde *et al*. (2013), reported 3.59% for gizzard in quails.

5.7 Laying Performance of Japanese quails fed differently processed *lablab purpureus* beans (7-20weeks)

Laying quails fed boiled lablab at 20% inclusion level had better total feed intake, daily feed intake, average egg weight and least mortality. This implied that boiled lablab and particularly at 20% may have been more palatable compared to other processed lablab and without any adverse effect. The reduction of anti nutritional factors to the level tolerable to the birds, may have made the feed more palatable especially with the increased level of lablab. This was in agreement with Bakr, (1996) and Oboh *et al*. (2000) who reported that boiling played a vital role because it influenced the bioavailability and utilization of nutrients and also enhanced palatability which incidentally resulted in improving the digestibility and nutritive value. Also, Kaankuka *et al*.

(2000) and Tuleun and Patrick, (2007) reported that heat treatment has been used to reduce or totally eradicate the anti nutritional factors contained in legume seeds.

The report showed that hen-house egg production and hen-day egg production were highest for quails fed toasted lablab at 10% inclusion. This showed that toasted lablab at 10% inclusion level was capable of supporting good laying performance.

5.8 Nutrient retention of Japanese quails fed differently processed lablab beans (7-20weeks)

The results for crude protein, crude fibre, ash, NFE and dry matter were highest for quails fed toasted lablab particularly at 20%. This may be due to the better aroma and improved palatability of the toasted lablab beans. Also, Yisa *et al*. (2014) reported that crude protein and lipid content increased when Bambara nut seeds were toasted. Maidala *et al*. (2013) reported that the crude fibre levels reduced but ash content and nitrogen free extract remained unaffected when soybean was toasted.

5.9 Egg quality parameters of japanese quails fed differently processed *lablab purpureus* beans (7-20weeks)

The result showed significant difference ($P<0.05$) for all parameters except for egg height. Egg weight, egg width and yolk weight were highest for quails fed boiled lablab at 10% inclusion level. It may therefore be infered that processed lablab particularly boiled lablab gave better egg quality when fed to quails. However, Abeke *et al*. (2008b) reported that yolk index, Haugh unit, percent shell and shell thickness were not significantly affected by feeding graded levels of lablab beans in the diets of laying hens. This report agreed with the report of Ragab *et al*. (2012) who observed that processed lablab on the overall performed better than the groundnut-sesame

cake based diet for egg quality parameters when fed to hens. They reported that egg weight was high for 10% inclusion of lablab.

5.10 Haematological parameters of Japanese quails fed differently processed *lablab purpureus* beans (7-20weeks)

Quails fed boiled lablab had better results for haemoglobin (Hb), white blood cell (WBC) and red blood cell (RBC). This was in agreement with the report of Abeke *et al*. (2008b) who reported better TP, PCV, and Hb for boiled lablab fed to broiler finisher birds. Oladele (2000) also reported that PCV, TP and Hb content of the blood of chicken were factors of their health status and nutrient intake. The overall values of PCV, Hb, TP, WBC and RBC were higher across processing methods for laying quails than those reported at 6 weeks of age confirming the report of Puspamitra *et al*. (2014) who observed that haemoglobin content, red blood cell count, white blood cell and haematocrit (PCV) values increased with age. The result showed that there was no detrimental effect of processing methods or inclusion levels on the health of the birds.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

From this study, the following conclusions were made:

- Quails fed boiled lablab at 10% inclusion level had the best performance at the growing phase (2-6weeks).
- For the laying phase, boiled lablab at 20% inclusion level improved the performance of the quails for final weight (182.17g), hen day production (82.40%), hen house production (81.52%) and average egg weight (9.78g). Also, toasted lablab at 10% inclusion level improved performance of quail layers for hen house production (82.35%) and hen day production (82.53%).
- Significant interactive effect was observed for carcass characteristics however, boiled lablab at 10% inclusion level was numerically higher in terms of liveweight and dressed weight.
- Boiling at 10% and 20% were comparable and significantly improved egg quality parameters.
- Haematological indices were within the reference range for healthy birds, This implied that inclusion of lablab in the diet of quails had no adverse effect on the health status of quails.

6.1 Recommendations

From the findings of this work, the following recommendations were made:

1. Boiling lablab beans at 40 minutes was a suitable method of processing.
2. Boiled lablab beans at 10% inclusion level was suitable for optimum performance of quail chicks.

3. Boiled lablab beans up to 20% inclusion level and toasted lablab beans at 10% inclusion level were suitable for optimum performance of laying quails.
4. Further studies on enzyme supplementation of processed lablab should be carried out.
5. Amino acid supplimentation of processed lablab seed should be studied.

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