

**EVALUATION OF SESAME (*Sesamum indicum L*)
SEED MEAL AS A SOURCE OF SUPPLEMENTARY
METHIONINE IN BROILER DIETS**

BY

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MAY, 2014.

DECLARATION

I hereby declare that the whole of this thesis is the result of my investigation and record of my research work, except where reference is made to published literature and where any assistance is acknowledged, it has not been presented partly or wholly for any other qualification previously.

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CERTIFICATION

This thesis titled **Evaluation Of Differently Processed Sesame (*Sesamum Indicum L*) Seed Meal As A Source of Supplementary Methionine In Broiler Diets** by **Olaiya, Olalekan David** meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This work is dedicated to God Almighty and Jesus Christ who gave me the ability to go through this study. To my darling wife Motunrola who encouraged and supported me and to my loving daughter Ibukunoluwa who was born during the course of this study.

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ABSTRACT

Studies were conducted to determine the effect of different methods of processing sesame seed (*Sesame indicum*) on chemical composition and on the nutritional value of sesame seed meal as a source of dietary methionine in broiler diets. The processing methods tested were roasting (ROSSM), Boiling (BOSSM) and soaking (SOSSM). The processed and mealed samples were compared to the raw (RASSM) samples and a control diet. Chemical analyses were conducted for proximate composition, anti-nutritional factors and amino acids, while growth performance studies were conducted with two sets of broiler starters (0-4weeks) and two sets of broiler finishers (5-8 weeks old). The chemical analyses results showed that processing had no significant effect on crude protein, crude fibre and Ether Extract. Marginal effects on Ash content were observed with RASSM containing 5.66% (highest) and SOSSM containing 4.88%. However, NFE was drastically reduced from 8.41% (RASSM) to 4.80% for SOSSM, 2.82% for BOSSM and 2.15% for ROSSM. For anti-nutritional factors, processing tended to increase the content of oxalate from 80mg/100g to 140mg/100g in SOSSM. Drastic reductions were observed for Trypsin inhibitor from 0.62mg/100g in RASSM to 0.16 in SOSSM, 0.14 in ROSSM and 0.10 in the BOSSM but marginal decreases were observed for phytic acid from 102.49mg/100g to 96.12. These results showed that processing significantly reduced the quantity of Trypsin inhibitor which is the most well known anti-nutritional factor in plant protein sources. Processing of sesame seed appears to have only marginal effect on its amino acid content. The effect on Methionine was from 1.35g/100protein of ROSSM to 2.11g/100protein of BOSSM, 1.46 in BOSSM and 1.88 in RASSM which increased the effect on sesame seed. Broiler chicks fed ROSSM outperformed other processing methods in the economic parameters of weight gain and efficiency of feed conversion, resulting in comparable performance to the control diet. This was observed to be the case during the starter and finisher phases. However feed cost/kg tended to be higher during the finishing phase. All

processing methods significantly improved the digestibility of proximate nutrients. Feeding roasted sesame meal up to 15% had no adverse effect on growth performance. It was concluded that processing of sesame seed by either roasting, boiling or soaking significantly reduced the level of anti-nutritional factors, Roasted sesame seed meal resulted in growth performance comparable to that of the control and therefore can be used to replace 100% of protein sources requiring Methionine supplementation. Finally, roasted sesame seed meal can be used at levels of up to 15% without adverse effect or broiler growth performance.

TABLE OF CONTENTS

Contents	page
Title page.....	i
Declaration.....	ii
Thesis certification.....	iii
Dedication.....	iv
Acknowledgement	v
Abstract.....	vii
Table of contents.....	ix
List of Tables	xiii
 CHAPTER ONE	
1.0 Introduction.....	1
1.1 Objectives of the Study.....	3
 CHAPTER TWO	
2.0 Literature Review.....	5
2.1 Nature of Sesame (Benniseed).....	5
2.2 Biology of sesame plant.....	6
2.3 Chemistry and biochemistry of sesame seed	6
2.4 Utilization of sesame seed	8
2.5 Utilization of sesame seed meal to feed animals	9
2.6 Effects of <i>Sesamum indicum</i> Supplementation On Broilers	10
2.6.1 Effect of Sesame Supplementation on Feed Intake	10

2.6.2	Effect of Sesame Supplement on Body weight and Weight gain	11
2.6.3	Effect of Sesame Supplementation on Feed Conversion Ratio	12
2.6.4	Effect of Sesame Supplementation on Blood Parameters.....	12
2.6.5	Effect of Sesame Supplementation on Carcass Characteristics.....	13
2.6.6	Effect of Sesame Seed Meal Supplementation on Cost Benefit Ratio.....	14
2.6.7	Effect of Sesame Supplementation on Mortality of Birds.....	14
2.7	Methionine and Methionine Metabolism.....	14
2.8	Deficiency of Methionine in poultry diets.....	16
2.9	Excess Methionine Supplementation and Implication.....	16
2.10	The use of Methionine as a supplement in Poultry diets	18
2.11	Presence of Phytic Acid in Plant Protein Sources	18
2.11.1	Effect of Processing on Phytic Acid	19
2.11.2	Physical and chemical treatments	20

CHAPTER THREE

3.0	Materials and Methods.....	22
3.1	Experimental Site.....	22
3.2	Source of Sesame Seed	22
3.3	Chemical Analysis	23
3.3.1	Proximate Analysis for Sesame Seed	23
3.3.2	Determination of Amino Acid Profile.....	23
3.3.3	Determination of Anti-nutritional Factors.....	23
3.3.4	Determination of Phytate	23
3.3.5	Determination of Oxalate.....	24
3.3.6	Determination of Tannins	25
3.4	Processing Methods of Sesame Seed	26
3.5	Experiment 1: Effect of processing methods of sesame seed on the performance	

of broiler starter chicks (0-4 weeks)	26
3.5.1 Experimental Diets.....	26
3.5.2 Experimental Design and Management of Birds	27
3.5.3 Data Collection	27
3.6 Experiment 2: Effect of processing methods of sesame seed on the performance of broiler finisher birds (5-8 weeks)	27
3.6.1 Experimental Diets.....	27
3.6.2 Experimental Design and Management of Birds	30
3.6.3 Data collection	30
3.7 Carcass Evaluation.....	30
3.8 Experiment 3: Effect of feeding graded levels of roasted sesame seed on the performance of broiler chicks (0-4 weeks)	31
3.8.1 Experimental Diets.....	31
3.8.2 Experimental design and management of birds	31
3.8.3 Data collection	31
3.9 Experiment 4: Effect of feeding graded levels of roasted sesame seed on the performance of broiler birds (5-8 weeks)	31
3.9.1 Experimental diets	31
3.9.2 Experimental design and management of birds	32
3.9.3 Data Collection	32
3.10 Digestibility Studies.....	32
3.11 Haematological studies	35
3.12 Carcass Evaluation.....	35
3.13 Biochemical Analysis	36
3.13.1 Proximate Analysis of Feed and Faecal Samples	36
3.13.2 Analysis of Blood Samples	36
3.14 Economic Analysis	36
3.15 Statistical Analysis.....	36

CHAPTER FOUR

4.0	Results.....	38
4.1	Chemical Analysis	38
4.2	Performance of Broiler Chicks (0 – 4 weeks) Experiment 1	42
4.3	Performance of Broiler Finisher (5 – 8weeks) Experiment 2	42
4.4	Heamatological Study	45
4.5	Digestibility Study	45
4.6	Carcass Analysis	45
4.7	Performance of broiler chicks fed graded level of roasted sesame seed Meal (0-4weeks) Experiment 3.....	49
4.8	Performance of broiler chicks fed graded level of roasted sesame seed meal (5-8weeks) Experiment 4.....	51
4.9	Digestibility Study.....	51
4.10	Heamatological Study.....	54
4.11	Carcass Analysis	54

CHAPTER FIVE

5.0	Discussion	57
5.1	Chemical Analysis	57
5.2	Experiment 1	58
5.3	Experiment 2.....	59
5.4	Experiment 3	60
5.5	Experiment 4.....	61
5.6	Digestibility Study	62
5.7	Haematological Study.....	62
5.8	Carcass Analysis	63

CHAPTER SIX

6.0	Summary, Conclusion and Recommendation.....	65
	References.....	67

LIST OF TABLES

Table 3.1	Ingredient Composition of Broiler Starter Diets (Experiment 1).....	28
Table 3.2	Ingredient Composition of Broiler Finisher Diets (Experiment 2).....	29
Table 3.3	Ingredient composition of broiler Starter Diets (Experiment 3).....	33
Table 3.4	Ingredient Composition of Broiler Finisher Diets (Experiment 4).....	34
Table 4.1	Proximate Composition of Differently Processed Sesame Seed Meal	39
Table 4.2	Anti-nutritional Factors Present in Differently Processed Sesame Seed Meal	40
Table 4.3	Amino Acid Profile of Differently Processed Sesame Seed Meal Composition.....	41
Table 4.4	Performance of Broiler Birds fed Diets Containing Differently Processed Sesame Seed Meal (0-4wks).....	43
Table 4.5	Performance of Broiler Birds Fed Diets Containing Differently Processed Sesame Seed Meal (5-8wks).....	44
Table 4.6	Haematological Parameters for Finishing Broiler Birds Fed Diets Containing Differently Processed Sesame Seed Meal.....	46
Table 4.7	Nutrient Digestibility of Finishing Broiler Birds Fed Diets Containing Differently Processed Sesame Seed Meal	47
Table 4.8	Carcass Characteristic of Finishing Broiler Birds Fed Diets Containing Processed Sesame Seed Meal (Result are Expressed as Percentage of Live Weight).....	48
Table 4.9	Performance of Broiler Birds fed Diets Containing Graded Level of Roasted Sesame Seed Meal (0-4wks)	50
Table 4.10	Performance of Broiler Birds fed Diets Containing Graded Level of Roasted Sesame Seed Meal (5-8wks)	52
Table 4.11	Nutrient Digestibility of Broiler Finishing Birds Fed Diets Containing Graded Level of Roasted Sesame Seed Meal.....	53
Table 4.12	Haematological Parameters for Finishing Broiler Birds Fed Diets Containing Graded Level of Roasted Sesame Seed Meal.....	55
Table 4.13	Carcass Characteristic of Finishing Broiler Birds Fed Diets Containing Graded Level of Roasted Sesame Seed Meal (Result are Expressed as Percentage of Live Weight).....	56

CHAPTER ONE

1.0 INTRODUCTION

There is rapid population increase without a corresponding increase in food production (Christopher *et al.*, 1997 and Vanderzijpp, 1997). Sobayo *et al.* (2007) reported that the population of developing countries has continued to increase resulting in increased demand for protein of animal sources. The poultry industry occupies a unique position in the livestock sector. The broiler birds are highly prolific and are good feed converters (Obioha, 1992). Acute shortage of animal protein in the diet of average Nigerians requires a logical solution like increasing the production and consumption of poultry (FAO, 1997). Nigeria and other developing countries are experiencing protein deficiencies. Oyawoye (1989) reported that there is protein deficiency gap for which careful attention is necessary to prevent protein deficiency related diseases in Nigerian citizens. Nigeria's population is increasing rapidly and this indicates the need to strategize action and device means of improving the production of animal protein for average Nigerians.

Christopher *et al.* (1997) and Fasuyi (2005) reported that per capita consumption of animal protein has been on the decline over the past decades. This is because the livestock industry in Nigeria has never adequately supplied the Nigerian market with adequate quantity of animal products. In the alternative, plant proteins are deficient in one or more essential amino acids such as lysine, methionine, cystine and tryptophan. Available statistics indicates that Nigeria is one of the countries where average protein intake of the people ranks among the lowest in the world. It is estimated that on the average, Nigerians consume only about 7g of animal proteins on a daily basis as against the minimum requirement of 28g/head/day recommended by FAO (Uchegbu *et al.*, 1995). This indicates a short fall or inadequacy of 75% (Ibe and Ezekwe1994).

Acute shortage and high cost of feed ingredients has been identified as major hindrance to expansion of the poultry industry in Nigeria and other developing nations (Fasuyi, 2005). Feed makes up about 70- 80% of the cost of producing broilers (Aduku, 1992), therefore there is great renewed interest in developing natural alternative supplements to maintain animal performance and wellbeing (Chattopadhyay *et al.*, 2006).

Methionine is a sulphur containing amino acid obtained from the hydrolysis of most common proteins. Methionine account for about 5% of the egg albumin. Methionine is also a precursor of other amino acids like Cystine and Cysteine. Methionine may act as lipotropic agent through its role as an amino acid in balancing protein, or through its role as a Methyl donor and it is incorporated into Carnitine and Creatine (Morgan and Bilgili, 1990; Schutte and Pack, 1995). Methionine is required in the diets of birds to meet the increasing tissue demands associated with fast growth rate and high productive performance. The major sources of methionine in diets formulated from conventional feedstuffs are vegetable proteins such as groundnut cake and soya bean meal which contain inadequate amounts. Among the vegetable proteins, sesame seed has the highest content of methionine but its' use as an alternative to synthetic methionine has not been well documented (Diarra *et al.* 2007). Animal proteins contain adequate amounts of methionine but are often too expensive for use in practical rations (Dafwang *et al.*, 1980 and 1983 and Dafwang, 2006).

Sesame (*Sesame indicum L*) is a drought-tolerant crop adapted to many soil types (Ram *et al.*, 1990). In Nigeria, sesame is grown in the northeast, southeast, southwest and North central zones (Presidential Task Force, 1992). According to Ahmed (2005), there are about 335,000 hectares under sesame cultivation in Nigeria with yields of between 1.0– 1.5 tonnes/hectare. The seed contains 22-25%

crude protein while the meal, after oil extraction contains about 46% protein (Peace Corps, 1990). Sesame seed used at right proportions together with soyabean meal results in a balanced diet with respect to lysine and methionine (Olomu, 1995). Sesame seed has been included in rations for poultry and swine (Gohl, 1981). The major factor that limits the use of Sesame seed as source of methionine in monogastric diets has been its high phytic acid content (Mulky *et al*,1989), an antinutrient which reduces biological availability of Zinc, Calcium, Magnesium and Iron (Reddy *et al*.1982 and Mulky *et al*. 1989). This study is aimed at evaluating the use of sesame seed as a source of supplementary methionine in broiler diets.

1.1 OBJECTIVES OF THE STUDY

The objectives of this study were;

- 1 To determine the effect of processing on methionine, proximate composition, amino acid profile and antinutritional factors in Sesame seed.
- 2 To determine the effect of sesame seed meal supplementation on growth performance and carcass characteristics of broiler chickens.
- 3 To evaluate the effect of sesame seed meal supplementation on digestibility and haematological parameters of broiler chickens.
- 4 To recommend the optimum level of sesame seed meal inclusion in broiler diets.

CHAPTER TWO

2.0

LITERATURE REVIEW

In recent years broiler production has undergone some major changes. Genotypes have been improved tremendously in terms of growth rate and feed efficiency. Carcass composition has also been developed towards the production of leaner birds. This has led to substantial increase in the nutrient needs of these birds, particularly for nutrients potentially limiting growth and protein deposition, like amino acids (Ajinomoto Animal Nutrition, 2009). Amino acids are essential building blocks of life and therefore very critical in any animal diet formulation. Protein as the precursor of amino acids is available from many biological sources. Feed proteins are complex amino acid polymers which are broken down in the gut into amino acids. These amino acids are absorbed and assembled into body proteins which are used in the construction of body tissue like nerves, muscles, skin and feathers (Ajinomoto Animal Nutrition, 2009). Of all the essential amino acids required by poultry, methionine and lysine are usually the first two limiting essential in broiler diets and therefore must be supplemented in order to meet the nutritional needs of the birds.

2.1 Nature of Sesame (Benniseed)

Sesame (*Sesamum indicum* L.) has long been cultivated and is thought to have originated in Africa (Ram *et al.*, 1990 and Oplinger *et al.*, 1997). However, Oplinger *et al.* (1990) had indicated it to be a crop in Babylon and Assyria over 4000 years ago.

2.2 Biology of Sesame Plant

Sesame is an annual self pollinating plant with an erect, pubescent, branching stem and 0.60-1.20m tall (Morris, 2002). The leaves are ovate to lanceolate or oblong while the lower leaves are trilobed and sometimes ternate and the upper leaves are undivided, irregularly serrate and pointed (Felter and Lloyd, 1898). The older (shattering) cultivars have smooth and flat leaves while the non-shattering cultivars have cupped leaves with leaf-like outgrowths on their lower side (Peace Corps, 1990). Some cultivars have many branches while others are relatively unbranched (Kinman and Martin, 1954). The flowers are tubular, pendulant, bell shaped, and two lipped with a pale purple or rose to white colour and 1.90-2.50cm long (Martin and Leonard, 1967). In addition, the flowers are borne on short glandular pedicels (Felter and Lloyd, 1898). One flower is produced at each leaf axil and the lower flowers are usually bloom 2 – 3 months after planting with continuous blooming until the upper most flowers are open (Martin and Leonard, 1967). The fruit of sesame is an oblong, mucronate, pubescent capsule containing numerous small, oval, and yellow, white, red, brown, or black seeds (Felter and Lloyd, 1898; Peace Corps, 1990 and McCormick, 2001).

2.3 Chemistry and Biochemistry of Sesame Seed

Sesame seed contains 50 – 60% oil of excellent stability (Brar and Ahuja, 1979 and Sirato-Yasumoto *et al.* 2001). The oil also referred to as teel oil or benne oil is pale yellow, and almost odourless and bland in taste. The oil has excellent stability due to the presence of natural antioxidants such as sesamolin, sesamin and sesamol (Brar and Ahuja, 1979 and Kato *et al.* 1998). Sesamin remains at 90% of the original level after roasting (Abe *et al.* 2001). Sesamin has bactericidal and insecticidal activities (Home Cooking, 1998). Sesamolin also has insecticidal properties (Beckstrom-Sternberg and Duke, 1994) and is used as a synergist for pyrethrum insecticides (Simon *et al.* 1984).

Although the fatty acid composition of the oil varies considerably among the different cultivars worldwide (Yermanos *et al.*, 1972 and Brar, 1982), It is rich in lecithin and myristic acid (Beckstrom- Sternberg and Duke 1994) and contains large amounts of linoleate (Smith and Salerno, 2001). Because of its high oil content, sesame seed has a high metabolizable energy (ME). Metabolizable energy values of 5832 Kcal/Kg (Aduku, 1992), 5190kcal/kg (Olomu, 1995) and 4963kcal/kg (Diarra *et al.*, 2007) have been reported. The crude protein in sesame seed is between 22 – 25% (Peace Corps, 1990; Mamputu and Buhr, 1991; Aduku, 1992 and Olomu, 1995). After oil extraction the crude protein content of the remaining meal is 35 -50% (Ram *et al.* 1990), 43.0% (Peace Corps, 1990), 47.1% (Mamputu and Buhr, 1991) and 46% (Olomu, 1995). However, Oyinbo (1988) reported 29.61% crude protein, ether extract 42.5, 43.4 and 49.3%, crude fibre 4.2, 3.6, and 3.8% and 26.14%CP (Diarra *et al.*, 2007). Seeds with increased oil content have decreased protein content (Oplinger *et al.*, 1997). The protein of sesame differs from that of all food grain legumes and oil seeds (including groundnut and Soyabeans) in that it is well supplied with the essential amino acids, methionine and cystine, but deficient in lysine (Peace Corps, 1990).

Sesame seed is high in calcium, phosphorus and iron (Peace Corps, 1990) and Oyinbo, (1988) reported 0.67% and 0.60% for calcium and phosphorus respectively. The seed contains three times more calcium than a comparable measure of milk (Home cooking, 1998). Seeds with hulls contain 2 to 3% oxalic acid (Mulky *et al.*, 1989) and up to 1.3% Calcium (Johnson *et al.*, 1979). Sesame seed is well supplied with the vitamins thiamine, riboflavin and niacin (Peace Crops, 1990). Crude fibre levels of 2.7 to 6.7% (Beckstrom-Sternberg and Duke. 1994) and 10.3% (Olumu, 1995) have been reported in the seed. Sesame seed is high (50 µg/g) in phytic acid (Mulky *et al.*, 1989). From the foregoing, there are wide variations in the composition of sesame seed probably due to location,

varieties, season of the year, edaphic and climatic differences (Oyinbo 1988; Olumu 1995 and Peace Corps, 1990).

2.4 Utilization of Sesame Seed

Several industrial and food uses have been identified in sesame. African people have used sesame seed to prepare perfumes (The Nut Factory, 1999). Myristic acid (C₁₄:0) is used as an ingredient in cosmetics (Oplinger *et al.*, 1997). Sesame oil is used as a solvent, oleaginous vehicle for drugs, skin softener and used in the manufacture of margarine and soap (Dark and Graham 1998) and paints (Ram *et al.*, 1990). Cèlorosàsamone obtained from the roots of sesame has antifungal activity (Begum *et al.*, 2000). Sesame oil is a pharmaceutical aid used as solvent for intramuscular injections and has nutritive, demulcent and emollient properties (Tyler *et al.*, 1976) and has been used as a laxative (Dark, 1998). Sesame oil is known to reduce cholesterol due to the high polyunsaturated fat content in the oil (Morris, 2002).

Sesame consumption appears to enhance vitamin E activity and prevent heart diseases (Cooney *et al.*, 2001). Chinese have used sesame oil as remedy for tooth-aches and gum disease (Morris, 2002). Similarly, the Indians have used sesame oil as an antibacterial mouth wash to relieve anxiety and insomnia (Annussek, 2001). Recently, sesame oil has been used for treating nasal mucosa dryness due to a dry winter climate (Johnson *et al.*, 2001). Sesame seed is an important source of edible oil and is also widely used as a spice (Ram *et al.*, 1990). Sesame seeds vary in colour and the lighter coloured seeds are higher in nutritional quality (Oplinger *et al.*, 1997). People generally consume more than twice as much white seed as black sesame (International Trade Centre, 1993). African countries use the seed as spice, seed oil for frying vegetables and meat, eaten raw or fried,

and used in confections such as candy and baking (Ram *et al.*, 1990 and Home Cooking, 1998).

2.5 Utilization of Sesame Seed Meal Based Diets by Animals

There are reports on the inclusion of sesame seed meal in monogastric rations (Oplinger *et al.*, 1990). Sesame seed meal produced by extraction of oil without removal of the seed coat is an excellent high-protein feed for poultry, swine and ruminants (Peace Corps, 1990). Olomu (1995) reported that using sesame seed meal in the right proportions together with soyabean meal results in a balanced diet with respect to lysine and methionine. According to Mulky *et al.*, (1989), sesame meal can be fed as protein supplement to pigs and poultry, but should be supplemented with feed ingredients containing lysine. Aduku (1992) recommended up to 10% inclusion of sesame seed meal in broiler diets. The author, however, recommended that the seed be ground as unground seed comes out undigested in pigs and young chickens. Mixed with an equal amount of cottonseed meal, sesame seed meal has been included up to 15% in chick rations (Gohl, 1981). The meal has been used as the principal protein source in both growing and fattening rations for swine (Gohl, 1981). The main factors, which have limited the use of sesame seed meal as the main protein source in monogastric diets, has been its low lysine (Jacob *et al.*, 1996) and high phytic acid content (Mulky *et al.*, 1989).

However, there is a variation in results observed in the literature on dietary SSM utilization in chicken diet. This might be due to greater variability in processing temperature during oil extraction from the seeds. High temperatures (>115 C°) were reported to reduce the availability of lysine (Rama Rao *et al.*, 2008) to an extent of 17.9 to 50% (Mamputu and Buhr, 1991). The method of processing for oil extraction (screw press or solvent extraction) and temperature used for roasting the seed is an important component for the

availability of the basic amino acids (Mamputu and Buhr, 1991) may in turn affect the feeding value of SSM for poultry.

2.6 Effects of *Sesame indicum* Supplementation on Broilers

2.6.1 Effect of Sesame Seed Meal Supplementation on Feed Intake

Ngele *et al.* (2011) reported no significant difference on feed intake across the dietary treatment in all the phases of broiler growth. They also reported that previous works revealed that feed intake of sesame seed meal supplemented and unsupplemented groups were similar. This agreed with Hatem *et al.* (2012) who reported that there was no significant increase in feed intake in sesame seed meal group. However, Oyinbo, (1988), Diarra *et al.* (2007) and Agbulu *et al.* (2010) reported that feed intake were significantly different due to levels of methionine present in the diets. Al-Harhi and El-Deak, (2009) reported that birds consumed less diet containing high amount of sesame.

2.6.2 Effect of Sesame Seed Meal Supplementation on Body Weight and Weight Gain

Agbulu *et al.* (2010) reported significant difference in weight gain in starter phase could attributed to methionine level. Diarra *et al.* (2007), Yasothai *et al.*, (2008) and Al-Harhi and El-Deak, (2009) also reported that significant response of birds to sesame meal supplementation in terms of body weight and body weight gain in starter and finisher phases. Olomu, (1978) also reported that chicken fed on sesame seed meal diet as source of methionine compared with synthetic methionine supplemented diet. Oyinbo (1988), Bell *et al.*, (1990) and Pan *et al.*, (1992) reported that sesame seed meal may provide an acceptable alternative to soybean meal in broiler rations when fed at 15% of the diet or less. Sesame

seed meal may not be suitable as a sole source of vegetable protein but could be employed at levels not greater than 30% of total dietary protein for broilers and 23.6% for laying hens to achieve optimal performance (Oyinbo 1988 and Reddy *et al.*, 1999). These results agreed with those reported by El-Husseiny *et al.*, (2001) and Ravindran and Blair, (1992) that incorporating sesame seed meal in duck diets at levels greater than 15% of the diet significantly reduced body weight. However, Diarra *et al.*, (2007), Al-Harhi and El-Deak (2009) and Hatem *et al.*, (2012) reported decreases in weight gain of 50% as the amount of sesame seed meal increased. Rama Rao (2008) also reported that the non-linear decrease in feed efficiency in broilers fed diets containing higher levels of sesame seed meal may have been due to a reduced utilization of nutrients at higher levels of sesame seed meal in diet.

2.6.3 Effect of Sesame Seed Meal Supplementation on Feed Conversion Ratio

Supplementation with sesame seed meal improved feed conversion ratio compared to control (Agbulu *et al.*, 2010 and Diarra *et al.*, 2007). However, Ngele *et al.*, (2011) on the contrary, reported that the feed conversion ratio (FCR) was not significantly influenced by dietary treatment. Yosathai *et al.*, (2008) also reported no significant variation in feed efficiency and protein efficiency ratio among various treatment groups. Similar observation was recorded by Dagher, (1995) in broilers fed sesame meal replacing 50% of soya beans meal.

2.6.4 Effect of Sesame Seed Meal Supplementation on Blood Parameters

Hatem *et al.*, (2012) reported a normal range of total proteins as well as other blood parameters in both starter and finisher phases on sesame seed meal supplemented diets. This was similar to the findings of Yasothai *et al.*, (2008) who reported that, there were no significant differences among treatment groups with packed cell volume (PCV) and mean corpuscular hemoglobin concentration (MCHC). They further reported PCV values of 31 to 36% were within the normal range of 31 to 38% (Yasothai *et al.*, 2008). This suggests that the processing method was good enough for detoxification of sesame seeds as may be demonstrated in the normal PCV range of values observed for chicken on diets containing sesame seed meal. PCV is an index of toxicity reduction in the blood usually and suggests presence of a toxic factor which may have adverse effect on blood formation (Oyawoye and Ogunkunle, 1998). However, Njidda *et al.* (2006) reported that the hemoglobin (Hb) increased with increase in the levels of sesame seed meal with the lowest value of 10.67g/dl and highest values of 12.60g/dl. On the other hand, cholesterol level reduced as dietary SSM increased in comparison to the control diet (Al-Harthi and El-Deak, 2009).

2.6.5 Effect of Sesame Seed Meal Supplementation on Carcass Characteristics

Diarra *et al.*, (2007), observed significant differences on the effect of sesame seed meal on carcass yield. This observation compared favourably with values 65-75% reported by Oluyemi and Roberts (1988), Deschepper and Degroote (1995) and Nwokoro and Tewe (1998). However, El-Husseiny *et al.*, (2001) reported that percent breast meat was significantly decreased when ducks were fed 30% SSM diet compared with that obtained from the groups fed the control diet.

However, Kaneko *et al.*, (2002) reported reductions in relative weights of breast, thigh meat, abdominal fat and fat content of breast meat with an increase in SSM levels in broiler diets. The weight could be due to reduced feed efficiency and possibly poor utilization of dietary protein in broilers diets and might be responsible for low muscle protein accretion. Recent research results suggested that levels of lysine and methionine in excess of NRC (1994) recommendation may result in enhanced performance especially with regard to breast meat yield (Hickling *et al.*, 1990; Morgan and Bilgili, 1990 and Schutte and Pack, 1995). Hickling *et al.*, (1990) suggested that the response of breast meat production to methionine and lysine levels might result in economic benefits that would obviously depend on the cost of the supplemented amino acid and the price of the broiler meat.

2.6.6 Effect of Sesame Seed Meal Supplementation on Cost Benefit Ratio

Diarra *et al.* (2007) observed no significant differences among the experimental treatments; however, the cost of the diets (₦/kg) was reduced from about ₦53.00 for control to ₦51.00 for sesame seed diet. Similarly, there was linear reduction in the cost of feed as the level of sesame seed increased in the diet. This agreed with Turaki, (2005) who asserted that it was cheaper to use sesame in formulating the diet than using synthetic methionine. However, this was not supported by Oyinbo (1988) and Agbulu *et al.* (2010) who reported that feed cost continued to increase as the inclusion level of sesame seed meal increased. The cost of diets (₦/kg) increased from ₦72.89 for the control diet to ₦145.76 for sesame diets and this could be attributed to the location and period the sesame seeds were bought.

2.6.7 Effect of Sesame Supplementation on Mortality of Birds

Ngele *et al.* (2011) reported a non significant difference among sesame meal supplemented groups, indicating that dietary treatments had no effect on mortality or survivability of the birds.

2.7 Methionine and Methionine Metabolism

Methionine is a colourless or white crystalline powder that is soluble in water. It is classified as an amino acid and considered to be an essential amino acid that is regulated as an animal feed nutritional supplement by the Food and Drug Administration (NOSB, 2003). Therefore, methionine must be supplied in the diet of the chicken as poultry birds are unable to synthesize adequate amounts necessary to sustain life and growth. Amino acids occur as D- or a L- isomers or mixture of the two products. All amino acids occurring in animal tissues are the L- isomers because D- isomers have no biological function.

Methionine may donate sulfur groups, methyl groups or serve as a building block for proteins. Methionine participates in transmethylation reaction where amino acids are metabolized to form energy. Methionine has main role in energy production, protein synthesis; it also helps in enhancing egg production with optimum egg size, overall growth performance, feed conversion ratio and livability in broilers and layers (Binder, 2003 and Aerni *et al.*, 2005). Methionine primarily serves as a methyl donor for transmethylation reactions, especially in the biosynthesis of lipids and other compounds and is involved in lipid transport in the blood (Patterson and Kung, 1998).

This methyl donation may extend further as one of the sources for newly replicated DNA. Methionine also serves as a sulphur donor (Pesti *et al.*, 1981). As a methyl donor and sulphur donor; these two roles of methionine is a major component of protein synthesis. In addition to these fundamental roles, N-

formylmethionine is the amino acid that corresponds with codons (AUG) in the translation of mRNA to protein. In protein synthesis, methionine availability is essential (Kim *et al.*, 2006). When methionine serves as a carbon donor some accessory cofactors are required. In order to transfer one carbon unit synthesized *de novo* to homocysteine for methionine formation, vitamin B₁₂ must be involved (Pesti *et al.*, 1981). In addition folate or folic acid is needed for the methylation of homocysteine for the *in vivo* formation of methionine (Ryu *et al.*, 1995). Methionine can serve as a methyl donor for creatine, choline and carnitine (Lesson and Summers, 2001). Many related nutrients found within feeds can influence methionine levels because of their relationship to methionine and its metabolic cycles. Cystine, vitamin B₁₂, arginine, choline, sulphate, total dietary protein and dietary energy can alter the apparent methionine requirement of chicks (Pesti *et al.*, 1981). It is also known to spare nutrients ranging from choline to sulphate and selenium and counters the deleterious influence of copper sulphate exposure (Beck *et al.*, 1998).

2.8 Deficiency of Methionine in Poultry Diets

Deficiency of Methionine in broiler diets could lead to the following; low feed intake, ruffled appearance of birds, lean tissue weight, fat accumulation and poor carcass quality. In severe and chronic cases it could impair immune response and increase susceptibility to infectious diseases affecting broiler growth and performance. In a layer flock, methionine deficiency could lead to decrease in egg production, poor quality eggs and shell less or thin shelled eggs (Bishnol, 2008).

2.9 Excess Methionine Supplementation and Implication

Methionine is a primary limiting amino acid and is often supplemented to balance the ratio of amino acids. Methionine can however be supplemented in excess which can lead to deleterious consequences. A deficiency of the nutrient has been an historical problem of nutritional interest (Kim *et al.*, 2006), but Harper

et al., (1970) proposed two distinct and polar theories dealing with excess amino acid supplementation: anabolic and catabolic physiologically dependent status. In an anabolic state, an amino acid surplus stimulates the synthesis of protein and represses the breakdown of protein in the liver. In this case the more limiting amino acid is retained in the liver while in the plasma, the concentration of the limiting amino acid is reduced, leading to an altered plasma amino acid pattern and subsequently a depressed feed intake (McNab, 1994). Depressed feed intake is characteristic of an amino acid imbalance because the ingestion of excess individual amino acids during low protein intake often results in the accumulation of these amino acids and a homeostatic response by the animal to prevent undue loss of the limiting amino acid (Kim *et al.*, 2006).

The second theory known as the catabolic theory as proposed by Lewis and D'Mello (1967) suggested that an excess of a specific amino acid enhances general catabolism and excretion of amino acids resulting in the loss of the target amino acid. A pattern of free amino acid in the serum, plasma and tissue that is not equivalent to the needs of the animal may in fact be due to mechanisms that support the catabolic theory. A depression of growth rate and feed intake is also an implication of excess methionine; this is brought about by excess doses of a single amino acid, particularly methionine, lysine, leucine, isoleucine and threonine. In such instances the limiting amino acid is lost through the renal or oxidative pathway.

Chi and Speers (1973) and Waldroup and Hellwig (1995) found that excess methionine supplementation to a diet containing 14% corn depressed growth. Methionine toxicity targets the liver as well as the kidney and pancreas. Just like other amino acids supplied in excess, deamination occurs and highly toxic uric acid forms when the nitrogen is in excess and not incorporated with other amino acids or proteins. In addition to the ammonia emissions, sulphur is also in excess when methionine is catabolised in excess. This sulphur can form sulphides and even sulphuric acid in the blood stream of the birds. In reaction to these

contaminants one sees depression in feed intake and growth as initial signs of toxicity (Dibner *et al.* 1994). On the contrary others are of the view that adding methionine over and above the recommended requirement of broilers improves their performance in terms of body weight gain and food conversion efficiency (Ozturkan *et al.* 1993; Simone *et al.* 1995 and Ohta and Ishibashi 1995).

2.10 The use of Methionine as a Supplement in Poultry Diets

A number of poultry trials have been conducted previously to establish the dependency, functionality and requirements for methionine supplementation in animal diets. The animal response to methionine depends upon the presence of the other dietary constituents. For example, a combination of methionine and vitamin B₁₂ supplementation can significantly reduce the percentage of liver adipose tissue (Schexnailder and Griffith, 1975). Methionine has been supplemented to overcome growth depression even when caused by dietary tannic acid and mild arginine toxicity (with methyl donors in general) (Chang and Fuller 1964; Fuller *et al.* 1967; Rayudu *et al.*, 1970 and Pesti *et al.* 1981). Methionine is normally supplemented only when crude protein cannot provide the required levels of methionine.

2.11 Presence of Phytic Acid in Plant Protein Sources

Phosphorus (P) is an essential nutrient in several metabolic processes, but a high proportion of vegetable P (50-70%) present in most feedstuffs, used in poultry diets is in the form of phytate (Reddy *et al.*, 1982). The National Research Council (NRC, 1994) reported that the availability of phosphorus from vegetable protein supplements or plant sources for broilers is only 30% and Rao *et al.* (1999) attributed the poor availability of phosphorus from phytate to chickens to the lack of phytase in their digestive tract. These animals lack the enzyme Phytase, which hydrolyses phytic acid into 6-inorganic phosphate (Zanini and Sazzad, 1999).

Phytate or phytic acid (PA) is a polyanionic molecule with six phosphate groups which form insoluble complexes with divalent cations (calcium, magnesium, iron and zinc) in weak acidic to neutral pH conditions and consequently reduces their availability to chickens (Davies and Nightingale, 1975). Phytic acid greatly influences digestion and absorption of calcium and phosphorus in poultry (Leeson and Zubair, 2005). Davies and Oplin (1979) and Brink *et al.* (1991) reported that phytate has the highest binding affinity for copper, zinc and manganese. A dietary molar phytic acid/zinc ratio superior to 10:15 affects negatively zinc utilization in rats (Davies and Oplin, 1979). Manganese forms complexes with phytate resulting in poor solubility (Mohanna and Nys, 1999). The reduction in zinc availability due to binding of zinc by phytate decreases chicken growth rate (O'Dell and Savage, 1960 and Davies and Nightingale, 1975) and reversely, Lonnerdal *et al.* (1989) demonstrated that dephytinization of soyabean meal increases zinc availability to chickens. Also, phytate has the potential to bind with proteins at low and neutral pHs and reduce protein digestibility (Reddy *et al.*, 1982).

2.11.1 Effect of Processing on Phytic Acid

Phytic acid, myo-inositol hexakis (dihydrogen-phosphate) is the main storage form of phosphorus (P) in cereals and oilseeds (Nasi *et al.*, 1995). Phosphorus in the form of phytate is poorly available to non-ruminant animals because they lack phytase, the enzyme that cleaves the O phosphate groups from the phytate molecule (Cromwell, 1979). According to Eeckhout and De Paepe (1992) the available P content of an all-plant pig meal depends on three factors: Phytate-P; non-phytate-P content and the phytase activity of the diet. Different processing methods have been reported to improve the utilization of phosphorus from phytate-rich feeds.

2.11.2 Physical and Chemical Treatments

Cooking and fermentation significantly reduced the PA and phytate phosphorus of oil bean seeds (Maga, 1982; Ologhobo and Fetuga, 1984; Sutardi and Buckle, 1985; Khokhar and Chaulun, 1986; Mbajunwa, 1995). According to Mukhopadhyay and Ray (1999), the PA from raw sesame seed could be reduced below detection limit by fermentation with lactic acid bacteria (*Lactobacillus acidophilus*). The loss of phytic acid is due to its solubility in processing water during cooking, washing and soaking operations (Lolas and Markakis, 1975 and Duhan *et al.*, 1989) and partly due to the combined activities of endogenous phytases of the seeds and the fermenting micro organisms (Mbajunwa, 1995). The fermentation process that distillers' grains undergo seems to increase the P availability of pigs (Cromwell, 1992). Bioavailability of P in high-moisture ensiled maize was 3-4 times higher than that of P in dry maize (Ross *et al.*, 1983). It has been indicated that when the feed is soaked for some time before feeding, a partial hydrolysis of phytate occurs (Nasi *et al.*, 1995). Soaking chickpea in acid solution followed by cooking decreased PA content (Nestares *et al.*, 1999). Duhan *et al.*, (1989) soaked chickpea and black gram seeds for 12 hours and observed that soaking is one of the most effective methods of lowering the PA content of the seeds.

However, the adverse effect of overheating on lysine has been reported in soyabean meal (Parsons *et al.*, 1992), canola meal (Anderson-Hafermann *et al.*, 1993) and sunflower meal (Zhang and Parsons, 1994). Heating induces changes in amino acid other than lysine (Batterham *et al.*, 1993 and Beech *et al.* 1999) and depresses total protein deposition (Van Barneveld *et al.*, 1994). Addition of 1 α -

hydroxylated vitamin D₃ compound has been found efficacious in poultry for releasing P and trace minerals from phytate complexes (Edwards, 1993 and Biehl *et al.*, 1995). According to NRC (1984), the utilization of phytin P, by young or adult poultry, is negligible if dietary Ca concentrations are sufficient to meet the birds' requirements. Gohl (1981) observed that increasing the amount of Ca in sesame seed-based diets will improve their utilization by monogastric animals. However, a high dietary level of Ca may directly reduce the activity of the phytase enzyme and limit phytase efficacy (Bhandari, 1980; Wise, 1983; Fisher, 1992; Jongbloed *et al.*, 1993 and Lei *et al.*, 1994).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Experimental Site

The study was conducted at the Large Animals' Experimental Station, National Veterinary Research Institute (NVRI) Vom, in Plateau State, Northern Guinea Savannah zone of Nigeria, which has two distinct (dry and rainy) seasons. The dry season starts in October and ends in March with a temperature range of 13°C - 26°C. The rainy season is from April-September, and the temperature also ranges from 16°C - 28°C. The geographical location of Vom is 8° 45`E, 9° 43`N and 4200 feet (1280m) above sea level. Mean relative humidity ranges from 14-17% (Knudsen and Soheli, 1970 and NVRI, 2006). The environmental temperature ranges from 13.8°C - 28.5°C (Knudsen and Soheli, 1970). Then temperature rises up gradually to as high as 38°C early in April just before the on-set of the rains (NVRI, 2006).

3.2 Source of Sesame Seed

The Sesame Seed used for the experiments were bought from a local market in Zaria and Giwa, Kaduna State, screened and winnowed to remove sand, chaff and other foreign particles before processing into feed.

3.3 Chemical Analysis

3.3.1 Proximate Analysis for Sesame Seed

The proximate analysis of Sesame seed was carried out according to AOAC (2006) procedure at the Biochemistry Laboratory of the National Veterinary Research Institute Vom.

3.3.2 Determination of Amino Acid Profile

The amino acid profile were determined using methods described by Benitez (1984). The samples were dried to constant weights, defatted, hydrolyzed, evaporated in a rotary evaporator and loaded into the Technicon Sequential Multi-Sample Amino Acid Analyzer (TSM) described by AOAC (2006).

3.3.3 Determination of Anti-nutritional Factors

The anti-nutritional factors determinations were as described by AOAC (1990) and were carried out at the Biochemistry Department, National Veterinary Research Institute (NVRI), Vom

3.3.4 Determination of Phytate

The method used for phytate analysis was as described by AOAC (1990). Two gram of Sesame seed meal was weighed into a glass stopper bottle. Fifty mls of 0.5N HCl was added and shaken on an orbital shaker at 2000rpm (revolution per minute) for about 3hrs to ensure homogeneity and maximum extraction of the phytic acid. The extract obtained was filtered using filter paper. Twelve millilitre of the filtrate was taken and neutralized with 12ml of 10N NaOH. 2ml of 20% FeCl₃ solution was added to the neutralised filtrate and then place in a boiling water bath for 15minutes to precipitate ferric phytate.

Then the solution was removed, cooled and centrifuge at 700rpm for 7 minutes, and the supernatant discarded. The precipitate was washed with 3ml of 0.17N HCl and transferred into a beaker. The precipitate was then heated in water

bath at 80°C for 10 minutes; and 10ml of 0.5N NaOH added to the precipitate and heated further for 15 minutes to precipitate in ferric hydroxide and then it was converted to Sodium phytate. The precipitate was washed with hot water and centrifuged at 700rpm for 7 minutes again. The supernatant was discarded and transferred into a beaker using 5ml hot distilled water. 1ml of concentrated H₂SO₄ and 1.2ml of 60% perchloric acid were added to the residue (filtrate) and the mixture was digested on a hot plate to evaporate the acids. The residual perchloric acid was removed by strong heating on Bunsen burner. It was then cooled and 10-20ml of distilled water was added and neutralized with 10N NaOH (PH 7). The volume was made up to 50ml with distilled water and the concentration of the phytate was calculated.

3.3.5 Determination of Oxalate

The oxalate content of sesame seed meal was determined using the method described by AOAC (1990). Two grams of sesame seed meal was weighed into a 250mls beaker; 190mls of distilled water and 10ml of 6 molar HCL were added to the beaker. It was allowed to stand for 5 minutes while mixing it at intervals of 30 seconds. The volume was made up to 250mls with distilled water, 50mls was measured out and titrated using few drops of methyl red indicator while adding drop by drop concentrated ammonium until the colour became faint yellow. It was then heated on steam water bath to boil, removed and allowed to cool, before it was filtered and heated again to boil. 10ml of 5% CaCl₂ was added while constantly stirring, another 5ml of CaCl₂ was added to give more precipitate of oxalate from the sample; it was then removed and allowed to stand overnight. The following day it was filtered and the precipitate was washed into a beaker using 1:4 H₂SO₄ acids and it was rinsed with 5mls of hot distilled water. The solution was heated and titrated against 0.05N KMnO₄. The titre value of the blank was

subtracted from that of the sample and multiplied by 50 to get the result in mg/100g of the sample.

3.3.6 Determination of Tannins

The method of estimation of tannins content of sesame seed meal was according to the standard method described by Josely (1970), Lohan *et al.*, (1980), Negi (1980) and Santram *et al.*, (1981). Five grams of sesame seed meal was dissolved in 200ml of hot distilled water. It was allowed to stand for 30 minutes after which it was filtered and dried in the ovum, and the filtrate was concentrated. The dried sample was dissolved using 20mls of distilled water, mixed properly and filtered, where a colourless solution was obtained. The solution was made up to 25mls using distilled water in a 25mls volumetric flask.

3.4 Processing Methods of Sesame Seed.

The screened and winnowed sesame seed were subjected to the following processing methods:

- I. Raw sesame seed (RASS): The dried raw seed after screening and winnowing was bagged and labelled RASS
- II. Roasted sesame seed (ROSS): The seed was roasted in a heated aluminium pot while being constantly stirred for 30 minutes, left to cool, bagged and labelled ROSS
- III. Boiled and Dried Sesame seed (BOSS): The seed was boiled at 100°C for 30minutes, sun-dried for 72 hours bagged and labelled BOSS,

- IV. Soaked and Dried Sesame seed (SOSS): The seed was soaked in water for 24hours, sun-dried for 72 hours, bagged and labelled SOSS.

A sample of sesame seed from each of the processing methods was ground and used for chemical analysis (Diarra *et al.*, 2007).

3.5 EXPERIMENT 1: Effect of Differently Processed Sesame Seed Meal on Performance of Broiler Chicks, (0-4 Weeks).

3.5.1 *Experimental Diets*

Five broiler starter diets were formulated such that the control (diet 1) was devoid of sesame meal but supplemented with methionine. The four types of differently processed sesame seed meal were added at 15% each in Diets 2, 3, 4 and 5 as shown in Table 3.1. Diets were formulated to meet the requirements for energy, protein, calcium, phosphorus and methionine that have been recommended for broiler starters in Nigeria by Dafwang, (2006). The birds were supplied with water and feeds *ad libitum* throughout the experimental period.

3.5.2 Experimental Design and Management of Birds

Two hundred and twenty-five day old Anak broiler chicks purchased from a reputable hatchery in Ibadan, Oyo State, were used for this study. The chickens were allotted to five experimental diets. Each treatment was replicated three times with 15 birds per pen in a completely randomized design in deep litter poultry house. The chicks were reared in accordance with the standard procedures for broiler rearing (Oluyemi and Roberts, 2007). Feed and water were provided *ad libitum*. Heat and light were provided regularly throughout the four weeks starter period (0-4 weeks). Feed intake and body weight of chicks were monitored on weekly basis for the starter phase and routine vaccines were administered.

3.5.3 Data Collection

Feed intake, weight gain and feed cost/kg gain were determined weekly. Mortalities were recorded as they occurred. Weighed leftover feed was also subtracted from the total feed supplied for the week to obtain feed consumption per week for each of the replicates. The birds were weighed at the beginning of each of the experiments for the initial weight and thereafter on weekly basis. Previous weights were subtracted from the present weights to obtain the weekly weight gain.

3.6 EXPERIMENT 2: Effect of Differently Processed Sesame Seed Meal on Performance of Broiler Finisher (5-8 Weeks).

3.6.1 Experimental Diets

Five broiler finisher diets were formulated such that the control (diet 1) was devoid of sesame meal but supplemented with methionine. The four types of differently

Table 3.1: Ingredient Composition of Broiler Starter Diets (Experiment 1)

Ingredients	Control	Processing methods			
		RASS	ROSS	BOSS	SOSS
Maize	48.05	43.69	43.69	43.69	43.69
Rice offal	2.00	2.00	2.00	2.00	2.00
Sesame seed	0.00	15.00	15.00	15.00	15.00
GNC	42.39	35.00	35.00	35.00	35.00
Palm oil	3.00	0.00	0.00	0.00	0.00
Bone meal	3.10	3.10	3.10	3.10	3.10
Salt	0.30	0.30	0.30	0.30	0.30
Lime stone	0.50	0.50	0.50	0.50	0.50
Lysine	0.16	0.16	0.16	0.16	0.16
Methionine	0.25	0.00	0.00	0.00	0.00
Premix*	0.25	0.25	0.25	0.25	0.25

Total %	100.00	100.00	100.00	100.00	100.00
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Calculated Analysis

ME kcal/kg	3008	3116	3192	3184	3155
Crude protein %	23.02	23.13	23.25	23.24	23.03
Crude fibre %	4.62	5.26	4.90	5.66	6.02
Ether extract%	7.18	12.03	12.50	11.97	11.57
Calcium %	1.08	1.09	1.23	1.22	1.18
Avil. Phosphorus %	0.53	0.54	0.55	0.54	0.54
Lysine %	1.00	1.00	1.20	1.12	1.13
Methionine	0.82	0.79	0.82	0.82	0.85
Cost/kg	66.84	73.40	75.18	75.03	74.03

*RASSM=Raw sesame seed meal; ROSSM=Roasted sesame seed meal; BOSSM=Boiled sesame seed meal; SOSSM= Soaked sesame seed meal.

**Optimix premix supplied /kg of diet: Vit A- 13340 I.U; Vit. D₃-2680 I.U; Vit. E- 10 I.U; Vit. K- 2.68mg; Calcium pantothenate- 10.68mg; Vit. B₁₂- 0.022mg; Folic acid- 0.668mg; Choline chloride- 400mg; Chlorotetracycline- 26.68mg; Manganese- 13mg; Iron- 66.68mg; Zinc, 53.34mg; Copper- 3.2mg; Iodine- 1.86mg; Cobalt- 0.268mg; Selenium- 0.108mg. ME – Metabolisable Energy

Table 3.2: Ingredient Composition of Broiler Finisher Diets (Experiment 2)

Ingredients	Control	Processing methods			
		RASS	ROSS	BOSS	SOSS
Maize	56.30	47.90	47.90	47.90	47.90
Rice offal	0.00	6.00	6.00	6.00	6.00
Sesame seed	0.00	15.00	15.00	15.00	15.00
GNC	36.39	27.59	27.59	27.59	27.59
Palm oil	4.00	0.00	0.00	0.00	0.00
Bone meal	3.10	3.10	3.10	3.10	3.10
Salt	0.30	0.30	0.30	0.30	0.30
Lime stone	0.60	0.60	0.60	0.60	0.60
Lysine	0.16	0.16	0.16	0.16	0.16
Methionine	0.20	0.00	0.00	0.00	0.00
Premix*	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

Calculated Analysis

ME kcal/kg	3069	3183	3225	3193	3164
Crude protein %	20.90	20.51	20.66	20.75	20.54
Crude fibre %	3.39	6.24	6.21	6.50	6.86
Ether extract%	7.87	12.34	12.34	11.87	11.47
Calcium %	1.10	1.17	1.22	1.22	1.17
Phosphorus %	0.52	0.53	0.54	0.53	0.53
Lysine %	1.02	2.02	1.80	1.91	2.04
Methionine	0.79	0.77	0.69	0.71	0.80
Cost/kg	67.23	70.95	70.94	70.95	70.94

*RASSM=Raw sesame seed meal; ROSSM=Roasted sesame seed meal; BOSSM=Boiled sesame seed meal; SOSSM= Soaked sesame seed meal.

**Optimix premix supplied /kg of diet: Vit A- 13340 I.U; Vit. D₃-2680 I.U; Vit. E- 10 I.U; Vit. K- 2.68mg; Calcium pantothenate- 10.68mg; Vit. B₁₂- 0.022mg; Folic acid- 0.668mg; Choline chloride- 400mg; Chlorotetracycline- 26.68mg; Manganese- 13mg; Iron- 66.68mg; Zinc, 53.34mg; Copper- 3.2mg; Iodine- 1.86mg; Cobalt- 0.268mg; Selenium- 0.108mg. ME – Metabolisable Energy

process sesame seed meal were added at 15% each in Diets 2, 3, 4 and 5 as shown in Table 3.2. Diets were formulated to meet the requirements for energy, protein, calcium, phosphorus and methionine that have been recommended for broiler finisher in Nigeria by Dafwang, (2006). The birds were supplied with water and feeds *ad libitum* throughout the experimental period.

3.6.2 Experimental Design and Management of Birds

One hundred and eighty (180) Anak broiler chickens obtained from experiment 1 were used for this study. At the end of the first experiment, the birds were pooled together, fed a common diet for one week, after which they were randomly allocated to the 5 dietary treatments based on equal weights in 3 lots of 12 birds per replicate in a completely randomized design and housed in pens under the deep litter system. The birds were managed as described in experiment 1.

3.6.3 Data collection

The data collected during this experiment were the same as described in experiment 1.

3.7 Carcass Evaluation

At the end of the experiment, six birds from each treatment (two birds per replicate) were randomly selected based on average group weight. The selected birds were bled, dressed and eviscerated similar to the method for dissection of turkey carcass described by Hann and Spindler (2002); and values were expressed as a percentage of live weight.

3.8 EXPERIMENT 3: Effect of Graded Levels of Roasted Sesame Seed Meal on Performance of Broiler Chicks (0-4 Weeks).

3.8.1 Experimental Diets

Five broiler starter diets were formulated such that the control (diet 1) was devoid of sesame meal but with methionine. Diets 2-5 contained 7.5%, 15%, 22.5%, and 30% roasted sesame seed meal respectively as shown in Table 3.3. Diets were formulated to meet the requirements for energy, protein, calcium, phosphorus and methionine that have been established for broiler starters and finishers in Nigeria by Dafwang, (2006). The birds were supplied with water and feeds *ad libitum* throughout the experimental period.

3.8.2 Experimental Design and Management of Birds

Two hundred and twenty-five day old Anak broiler chicks purchased from a reputable hatchery in Ibadan, Oyo State, were used for this study. The experimental design and management were the same as described in experiment 1.

3.8.3 Data Collection

The data collected during this experiment were the same as described in experiment 1.

3.9 Experiment 4: Effect of Graded Levels of Roasted Sesame Seed Meal on Performance of Broiler birds (5-8 weeks).

3.9.1 Experimental diets

The experimental diets were formulated as described in experiment 3 and as shown in Table 3.4.

3.9.2 Experimental Design and Management of Birds

One hundred and eighty (180) Anak broiler chickens obtained from experiment 1 were used for this study. At the end of the first experiment, the birds were pooled together, fed a common diet for one week, after which they were randomly allocated to 5 dietary treatment based on equal weights in 3 lots of 12

birds per replicate in a completely randomized design and housed in pens under the deep litter system. The birds were managed as described in experiment 2.

3.9.3 Data Collection

The data collected during this experiment were the same as described in experiment 1.

3.10 Digestibility Studies

A digestibility trial was carried out at the end of experiment two. Six (6) birds from each treatment (i.e two from each replicate) were selected for the trial. The birds were housed in individual cages for faecal collection after being supplied their daily requirement of feeds. Faecal sample were collected using polythene bags which were at the bottom of the battery cage for seven days and oven dried at 60°C for 5 days. The faecal samples were subjected to proximate analysis (AOAC, 2006). Nutrient retention were determined for crude protein, ether extract, crude fibre, ash and nitrogen free extract using the equation.

$$\text{Nutrient retention} = \frac{\text{Nutrient intake} - \text{Nutrient out put}}{\text{Nutrient intake}} \times 100$$

Table 3.3: Ingredient composition of broiler Starter Diets (Experiment 3)

Ingredients	Levels of roasted sesame seed meal (%)				
	0	7.5	15	22.5	30
Maize	49.05	46.54	43.00	28.84	21.05
Rice offal	0.00	1.00	3.00	13.20	17.12
ROSSM	0.00	7.50	15.00	22.50	30.00
GNC	42.39	38.55	34.59	31.05	27.42
Palm oil	4.00	2.00	0.00	0.00	0.00
Bone meal	3.10	3.10	3.10	3.10	3.10
Salt	0.30	0.30	0.30	0.30	0.30
Lime stone	0.60	0.60	0.60	0.60	0.60
Lysine	0.16	0.16	0.16	0.16	0.16
Methionine	0.25	0.00	0.00	0.00	0.00
Premix* 0.25	0.25	0.25	0.25	0.25	
Total	100.00	100.00	100.00	100.00	
	100.00				

Calculated Analysis

ME kcal/kg	3008	3125	3229	3208	3236
Crude protein %	23.00	23.00	23.21	23.00	23.02
Crude fibre %	3.62	4.32	5.76	7.42	8.15
Ether extract%	8.01	10.22	12.50	16.55	20.54
Calcium %	1.11	1.17	1.25	1.29	1.35
Phosphorus %	0.53	0.54	0.55	0.56	0.57
Lysine %	1.00	1.47	1.90	2.53	3.06
Methionine	0.80	0.72	0.75	0.80	0.85
Cost/kg	63.52	67.14	72.18	75.71	81.74

*ROSSM=Roasted sesame seed meal

**Optimix premix from Animal care provide/kg of diet: Vit A- 13340 I.U; Vit. D₃- 2680 I.U; Vit. E- 10 I.U; Vit. K- 2.68mg; Calcium pantothenate- 10.68mg; Vit. B₁₂- 0.022mg; Folic acid- 0.668mg; Choline chloride- 400mg; Chlorotetracycline- 26.68mg; Manganese- 13mg; Iron- 66.68mg; Zinc, 53.34mg; Copper- 3.2mg; Iodine- 1.86mg; Cobalt- 0.268mg; Selenium- 0.108mg. ME – Metabolisable Energy

Table 3.4: Ingredient Composition of Broiler Finisher Diets (Experiment 4)

Ingredients	Levels of roasted sesame seed meal (%)				
	0	7.5	15	22.5	30
Maize	56.30	47.90	47.90	47.90	47.90

Rice offal	0.00	6.00	6.00	6.00	6.00
ROSSM	0.00	7.50	15.00	22.50	30.00
GNC	36.39	27.59	27.59	27.59	27.59
Palm oil	4.00	0.00	0.00	0.00	0.00
Bone meal	3.10	3.10	3.10	3.10	3.10
Salt	0.30	0.30	0.30	0.30	0.30
Lime stone	0.60	0.60	0.60	0.60	0.60
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.00	0.00	0.00	0.00
Premix*	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

Calculated Analysis

ME kcal/kg	3069	3183	3125	3193	3164
Crude protein %	20.90	20.51	20.66	20.75	20.54
Crude fibre %	3.39	6.24	6.21	6.50	6.86
Ether extract%	7.87	12.34	12.34	11.87	11.47
Calcium %	1.10	1.17	1.22	1.22	1.17
Phosphorus %	0.52	0.53	0.54	0.53	0.53
Lysine %	1.02	2.02	1.80	1.91	2.04
Methionine	0.74	0.77	0.70	0.72	0.80
Cost/kg	67.23	70.95	70.94	70.95	70.94

*ROSSM=Roasted sesame seed meal

**Optimix premix from Animal care provide/kg of diet: Vit A- 13340 I.U; Vit. D₃- 2680 I.U; Vit. E- 10 I.U; Vit. K- 2.68mg; Calcium pantothenate- 10.68mg; Vit. B₁₂- 0.022mg; Folic acid- 0.668mg; Choline chloride- 400mg; Chlorotetracycline- 26.68mg; Manganese- 13mg; Iron- 66.68mg; Zinc, 53.34mg; Copper- 3.2mg; Iodine- 1.86mg; Cobalt- 0.268mg; Selenium- 0.108mg. ME – Metabolisable Energy

3.11 Haematological studies

At the end of the finisher phases (experiment2&4), blood was collected from the wing vein of the birds. Two birds from each replicate giving a total of thirty (30) blood samples. The birds were randomly selected and a 5ml disposable syringe and needle were used in collecting the blood (bleeding). The blood

parameters considered include; Red Blood Cell (RBC) count, Packed Cell Volume (PCV), Haemoglobin (Hb), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) and Platelets (Plt) for haematological parameters and were Analysed by an auto Haemo Analyser (BC-3000^{plus} Mindray Auto Haematology Analyser). The serum biochemistry parameters analysed included; Total protein; (Biuret method as described by Reinhold, 1953), Glucose and Cholesterol; (enzymatic method as described by Randox kit, 2002).

3.12 Carcass Evaluation

At the end of the experiments, six broilers chicken from each treatment (two birds per replicate) were randomly selected based on average group weight. The selected birds were bled, dressed and eviscerated similar to the method for dissection of turkey carcass described by Hann and Spindler (2002); and values of breast, thigh, back, wing, liver drumstick, gizzard and spleen were expressed as a percentage of live weight.

$$\frac{\text{Carcass Weight} \times 100}{\text{Live weight}}$$

3.13 Biochemical Analysis

3.13.1 Proximate Analysis of Feed and Faecal Samples

Samples of the experimental diets as well as faeces collected during digestibility studies were subjected to proximate analysis using the method of Association of Official Analytical Chemists (AOAC, 1990).

3.13.2 Analysis of Blood Samples

The blood samples were collected in Ethylenediamine tetra acetic acid (EDTA) embedded bottles while those for chemistry were collected in plain bottles. The analyses were carried out at the Haematology laboratory section of the Central Diagnostic Department, National Veterinary Research Institute (NVRI), Vom.

3.14 Economic Analysis

An economic analysis of the profitability of sesame seed over supplementary methionine in broiler diets was carried out based on the cost per kilogram of feed and feed cost per kilogram weight gain were computed for each dietary treatment.

3.15 Statistical Analysis

All the data collected from experiments 1 and 2 were subjected to Analysis of Variance (ANOVA) using SAS (2008) software package and the mean separation was done using Duncan Multiple Range Test (Duncan, 1955).

Data collected were subjected to Analysis of Variance (ANOVA) using SAS (2008). Test of significance and difference between means among the dietary treatments were separated using Duncan multiple range test in the SAS package.

The data obtained in the experiments was analyzed using the model:

$$Y_{ij} = \mu + O_i + e_{ij} \text{ where,}$$

Y_{ij} = Individual observation

μ = overall mean

O_i = effect of the i th processed sesame seed meal level

e_{ij} = random error

The data obtained in Experiment 2 was analyzed using the model:

$Y_{ij} = \mu + O_i + A_j + OA_{ij} + e_{ij}$ where,

Y_{ij} = Individual observation

μ = overall mean

O_i = effect of the i th sesame seed meal level

A_j = effect of the j th sesame seed meal level

OA_{ij} = interaction effect of the i th and j th levels of factors O and A

e_{ijk} = random error

CHAPTER FOUR

4.0 RESULTS

4.1 Chemical Analysis

The results of the proximate composition, amino acid profile and anti-nutritional factors of raw and differently processed sesame seed meal were significant and are presented in Tables 4.1, 4.2 and 4.3. The Crude Protein content of sesame seed was found to be 26.51 - 28.10g/100g, Crude Fibre 5.87 – 10.20g/100g, Ether Extract 51.30– 59.11g/100g, Ash 4.88 – 5.66g/100g and Nitrogen Free Extract 2.15– 8.41g/100g. The result of amino acid profile of

sesame seed indicated that sesame seed on the average has methionine 1.88g/100g protein and lysine 8.23g/100g protein. Levels of the anti-nutritional factors in the sesame seed meal were: Oxalate - 80.00- 40mg/100g, Trypsin inhibitor 0.10- 0.62mg/100g, Phytic acid 96.10 - 102.49mg/100g and Tannins 0.73- 3.11mg/100g.

Table: 4.1 Proximate Composition of Differently Processed Sesame Seed Meal

<u>Nutrient (g/100g)</u>	<u>RASSM</u>	<u>ROSSM</u>	<u>BOSSM</u>	<u>SOSSM</u>
<u>Mean</u>				
Crude protein	26.51	27.52	28.10	26.72
	27.21			
Crude fibre	8.04	5.87	7.25	10.20
	7.84			
Ether extracts	51.38	59.11	55.94	51.30
	54.43			

Ash	5.66	5.35	5.36	4.88
5.31				
NFE	8.41	2.15	2.82	4.80

4.57 NFE = Nitrogen Free Extract

*RASSM=Raw sesame seed meal; ROSSM=Roasted sesame seed meal; BOSSM=Boiled sesame seed meal; SOSSM= Soaked sesame seed meal.

Table 4.2: Anti-nutritional Factors Present in Differently Processed Sesame Seed Meal

Parameter	RASSM	ROSSM	BOSSM	SOSSM
Oxalate mg/100g	80.00	85.00	115.00	140.00
Tannins mg/100g	1.10	0.80	0.73	0.11
Trypsin inhibitor mg/100g	0.62	0.14	0.10	0.16

Phytic acid mg/100g	102.49	96.36	96.34	96.12
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SSM: sesame seed meal

*RASSM=Raw sesame seed meal; ROSSM=Roasted sesame seed meal; BOSSM=Boiled sesame seed meal; SOSSM= Soaked sesame seed meal.

Table 4. 3: Amino Acid Profile of Differently Processed Sesame Seed Meal Composition

Amino acid %DM	Raw SSM	Roasted SSM	Boiled SSM	Soaked SSM
Lysine	2.19	1.83	2.00	2.22
Histidine	0.99	0.69	0.78	0.87
Arginine	1.62	1.27	1.47	1.51
Aspartic acid	2.18	1.73	1.92	2.30
Threonine	1.35	1.09	1.25	1.44
Serine	0.97	0.75	0.91	0.97
Glutamic acid	4.51	3.84	4.30	4.84
Proline	1.73	1.28	1.67	1.78
Glycine	1.36	1.28	1.29	1.22

Alanine	1.10	0.75	0.95	1.22
Cystine	0.48	0.49	0.40	0.48
Valine	1.09	1.04	0.99	1.16
Methionine	0.74	0.78	0.77	0.80
Isoleucine	0.93	0.74	0.83	1.01
Leucine	1.65	1.50	1.59	1.83
Tyrosine	0.65	0.52	0.61	0.77
Phenylalanine	0.95	0.78	0.91	1.10

SSM: sesame seed meal

4.2 Experiment 1: Performance of Broiler Chicks (0 – 4 wks)

The performance of broiler starter chicks fed differently processed sesame seed meals is shown in Table 4.4. Final weight, weight gain, feed intake, feed conversion ratio and feed cost per kilogram gain were significantly ($P < 0.05$) affected by dietary treatments. Birds fed 15% raw sesame seed meal inclusion in their diet had reduced feed intake, final weight gain and feed conversion ration across the dietary treatment. However, there was statistical ($P < 0.05$) difference between the birds fed differently processed sesame seed meal and the control. Birds fed roasted sesame seed meal performed significantly ($P < 0.05$) better than those fed with raw, boiled and soaked sesame seed meal. There was significant difference among treatments in feed cost per kilogram gain. However dietary treatments had no significant ($P > 0.05$) effect on mortality. The performances of chicks on differently processed sesame seed meal supplemented diets were similar to those on the control diets for treatments 3 and 4 except for feed cost per kg gain.

4.3 Experiment 2: Performance of Broiler Finisher (5 – 8wks)

The performance of finishing broilers fed differently processed sesame seed meals is shown in Table 4.5. Final weight, weight gain, feed intake, feed conversion ratio and feed cost per kilogram gain were significantly ($P<0.05$) affected by dietary treatments. However, differently processed sesame seed meal supplemented diets enhanced performance in terms of final weight, weight gain, feed intake, feed conversion ratio and feed cost per gain. Inclusion of sesame seed depressed weight gain

Table 4.4: Performance of Broiler Chicks fed Diets Containing Differently Processed Sesame Seed Meal (0-4wks)

Parameters	1(O)	2(RASSM)	3(ROSSM)	4(BOSSM)	5(SOSSM)	SEM
Initial wt (g)	57.15	57.14	57.15	57.14	57.15	0.01
Final wt (g)	478.57 ^a	364.10 ^d	456.00 ^{ab}	430.56 ^{bc}	399.60 ^{cd}	12.03
Wt gain (g)	412.43 ^a	305.77 ^d	397.95 ^{ab}	374.33 ^b	343.65 ^c	12.54
Feed Intake (g)	1036.86 ^a	893.18 ^b	1028.96 ^a	1011.33 ^a	1016.82 ^a	15.27
FCR	2.51 ^c	2.92 ^a	2.58 ^c	2.70 ^b	2.96 ^b	0.07
FCost/Kg gain(₦)	169.39 ^b	158.80 ^a	160.31 ^a	168.15 ^b	169.03 ^b	1.02
Mortality (%)	0.07 ^a	0.04 ^a	0.13 ^b	0.13 ^b	0.13 ^b	0.02

a, b, c = Means in the same row having different superscript are significantly different ($P<0.05$).
SEM = Standard error of means; RASSM=raw sesame seed meal: ROSSM=roast sesame seed meal:
BOSSM=boiled sesame seed meal: SOSSM=soaked sesame seed meal
FCR=feed conversion ratio

Table 4.5: Performance of Broiler Finishers Fed Diets Containing Differently Processed Sesame Seed Meal (5-8wks)

Parameters	1(CONTL)	2(RASSM)	3(ROSSM)	4(BOSSM)	5(SOSSM)	SEM
Initial wt (g)	616.68	616.67	616.68	616.67	616.68	0.01
Final wt (g)	2295.93 ^a	1777.27 ^b	2190.74 ^{ab}	2126.64 ^{ab}	2146.67 ^{ab}	48.07
Weight gain(g)	1679.26	1460.61	1668.07	1548.97	1548.00	46.07
Feed Intake(g)	3425.00	3188.17	3473.61	3423.61	3548.61	27.70
FCR	2.04 ^a	2.18 ^a	2.08 ^a	2.21 ^b	2.29 ^c	0.24
Cost/Kg gain(₦)	399.59 ^a	398.79 ^a	408.36 ^b	408.36 ^b	407.92 ^b	1.12
Mortality (%)	0.19 ^b	0.08 ^a	0.11 ^a	0.19 ^b	0.17 ^b	0.02

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
SEM = Standard error of means; RASSM=raw sesame seed meal: ROSSM=roast sesame seed meal:
BOSSM=boiled sesame seed meal: SOSSM=soaked sesame seed meal; FCR=feed conversion ratio

significantly ($P < 0.05$) for RASSM. Feed conversion ratio was similar on control, RASSM and ROSSM but significantly poorer for BOSSM and SOSSM.

4.4 Hematological Study

The result of the study on blood parameters are shown on Table 4.6. Generally values for Packed Cell Volume, Haemoglobin count and Red blood count, Total White blood Cell and Calcium were similar for all treatments except for Total protein, differences were not significant.

4.5 Digestibility Study

The results for the digestibility study are shown in Table 4.7. The crude protein, ether extract, crude fibre, nitrogen free extract and ash showed relatively higher digestibility values for the processed sesame seed diets than the control treatment. The roasted sesame seed meal (treatment 3) had significantly higher digestibility ($P < 0.05$) for Crude protein (74.42%), Ether Extract (9.49%), Nitrogen Free Extract (72.53%) and Ash (32.86%) than other processed methods.

4.6 Carcass Analysis

The results of the carcass study are presented in Table 4.8. The weights of breast, back, wings, gizzard and spleen expressed as percentage of live weights showed significant ($P < 0.05$) differences among treatments. However, live weight, dressing percentage, heart, thigh and intestinal weight expressed in percentage of live weight were not affected by dietary treatments ($P > 0.05$).

Table 4.6: Haematological Parameters for Broiler Finishers Fed Diets Containing Differently Processed Sesame Seed Meal

Parameters	1(CONTL)	2(RASSM)	3(ROSSM)	4(BOSSM)	5(SOSSM)	SEM
Packed cell vol. (%)	33.07	32.82	31.65	33.03	32.37	1.52
Haemoglobin (g/dl)	11.02	10.95	10.55	11.02	10.80	0.51
Total protein (g/dl)	2.53 ^b	2.67 ^b	3.80 ^a	3.42 ^a	3.45 ^a	0.29
Red blood cell (x10 ¹² /l)	2.54	2.45	2.40	2.51	2.49	0.12
Total white blood cell (x10 ⁹ /l)	6.77	6.93	5.48	6.35	8.12	0.51
Calcium (mg/dl)	6.17	7.32	7.60	7.63	7.47	0.60

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
SEM = Standard error of means; RASSM=raw sesame seed meal; ROSSM=roast sesame seed meal;
BOSSM=boiled sesame seed meal; SOSSM=soaked sesame seed meal

Table 4.7: Nutrient Digestibility of Broiler Finishers Fed Diets Containing Differently Processed Sesame Seed Meal

Parameters	1(CONTL)	2(RASSM)	3(ROSSM)	4(BOSSM)	5(SOSSM)	SEM
Dry matter	58.58 ^b	69.69 ^{ab}	74.00 ^{ab}	87.49 ^a	87.02 ^a	7.86
Crude protein	58.18 ^b	68.81 ^{ab}	70.42 ^{ab}	70.85 ^{ab}	74.39 ^a	8.25
Crude fibre	15.71 ^b	18.34 ^{ab}	27.54 ^a	28.45 ^a	27.94 ^a	2.37
Ether extract	3.15 ^b	7.64 ^{ab}	9.49 ^a	5.04 ^b	8.91 ^{ab}	2.20
Total ash	21.41 ^b	29.77 ^{ab}	29.29 ^{ab}	31.84 ^{ab}	32.86 ^a	4.86
Nitrogen free extract	46.00 ^{ab}	40.67 ^b	61.26 ^{ab}	72.53 ^a	61.46 ^{ab}	7.71

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
SEM = Standard error of means; RASSM=raw sesame seed meal; ROSSM=roast sesame seed meal;
BOSSM=boiled sesame seed meal; SOSSM=soaked sesame seed meal

Table 4.8: Carcass Characteristic of Broiler Finishers Fed Diets Containing Differently Processed Sesame Seed Meal (Result are Expressed as Percentage of Live Weight)

Parameters	1(CONTL)	2(RASSM)	3(ROSSM)	4(BOSSM)	5(SOSSM)	SEM
Live wt (g)	1941.70	1766.70	1950.30	1950.00	2000.00	19.58
Carcass wt (g)	1429.17 ^b	1345.00 ^c	1545.00 ^{ab}	1587.50 ^a	1569.17 ^{ab}	46.87

Dressing (%)	66.59	60.11	68.85	69.81	68.45	1.82
Breast (%)	15.78 ^b	15.92 ^b	18.23 ^a	16.97 ^{ab}	16.40 ^{ab}	0.83
Thigh (%)	11.28	12.33	12.50	12.68	11.05	0.45
Back (%)	13.85 ^{ab}	12.69 ^b	14.24 ^{ab}	14.06 ^b	14.42 ^a	0.37
Wing (%)	8.48 ^{ab}	8.74 ^a	8.59 ^b	8.20 ^{ab}	8.17 ^b	0.12
Drumstick (%)	9.83 ^{bc}	9.70 ^c	10.64 ^{ab}	10.47 ^{abc}	10.74 ^a	0.19
Liver (%)	3.82 ^a	3.25 ^b	3.86 ^a	3.80 ^b	3.93 ^a	0.13
Heart (%)	0.87	0.76	0.79	0.77	0.97	0.05
Gizzard (%)	2.83 ^{bc}	2.87 ^{bc}	3.06 ^{ab}	2.57 ^c	3.39 ^a	0.11
Spleen (%)	0.26 ^a	0.20 ^{ab}	0.21 ^{ab}	0.23 ^{ab}	0.24 ^{ab}	0.03
Abdominal fat (%)	2.44 ^a	2.35 ^{ab}	2.57 ^{ab}	2.17 ^{bc}	2.56 ^{ab}	0.27
Intestinal wt (%)	8.05	10.96	9.60	8.06	10.38	0.88

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
SEM = Standard error of means; RASSM=raw sesame seed meal: ROSSM=roast sesame seed meal:
BOSS=boiled sesame seed: SOSSM=soaked sesame seed meal

Live weight, carcass weight and breast weights were significantly (P<0.05) better for birds fed differently processed sesame seed meals. The differently processed sesame seed meal showed better performance than the control while treatment 2 (raw sesame seed) had the least performance in live weight and carcass weights.

4.7 Experiment 3: Performance of Broiler Chicks fed Graded Levels of Roasted Sesame Seed Meal (0-4wks)

The performance of broiler chicks fed graded levels of roasted sesame seed meal are shown in Table 4.9 Final weight, weight gain, feed intake, and feed cost

per kg gain were significantly ($P<0.05$) affected by dietary treatments. The performance of chicks fed 15% roasted sesame seed meal were similar to those of chicks fed the control diets final weight and weight gain. Feed conversion ratio was significantly better on 15% roasted sesame seed meal diet than the control ($P<0.05$). Although mortality rate on the 15% diet was significantly higher ($P<0.05$), there was no trend in mortality rate with increasing levels of roasted sesame seed meal.

Performance on the 7.5, 22.5 and 30% dietary levels of roasted sesame seed meal were significantly depressed when compared to the control and the 15% roasted sesame seed meal diet ($P<0.05$). As the levels of roasted sesame increased in the diets, the feed cost per kg gain also increased. Diet 5 (30%) had the highest feed cost per kg gain of (₦194) while treatment (7.5%) was the least (₦159.34) even lower than the control diet (₦169.39) treatment. The inclusion of RoSSM beyond 15% depressed growth performance.

Table 4.9: Performance of Broiler Chicks fed Diets Containing Graded Levels of Roasted Sesame Seed Meal (0-4wks)

Parameters	Levels of roasted sesame seed meal (%)					SEM
	(0)	(7.5%)	(15%)	(22.5%)	(30%)	
Initial wt (g)	57.15	57.14	57.15	57.14	57.15	0.01
Final wt (g)	478.57 ^a	389.48 ^b	456.71 ^a	360.64 ^b	346.15 ^b	24.67
Weight gain (g)	421.43 ^a	359.01 ^{ab}	397.57 ^a	332.70 ^b	303.50 ^b	23.84
Feed Intake (g)	1036.82 ^a	1034.24 ^a	940.33 ^b	924.95 ^b	939.55 ^b	21.21

FCR	2.47 ^b	2.37 ^{ab}	2.12 ^a	2.45 ^b	2.59 ^b	0.24
Cost/Kg gain (₦)	169.39 ^b	159.34 ^a	160.80 ^a	173.63 ^b	194.00 ^c	1.06
Mortality (%)	0.07 ^a	0.18 ^c	0.13 ^b	0.11 ^{ab}	0.04 ^a	0.02

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
SEM = Standard error of means; FCR=feed conversion ratio

4.8 Experiment 4: Performance of Broiler Finishers fed Graded Levels of Roasted Sesame Seed Meal (5-8wks)

The performance of broiler finishers fed graded levels of roasted sesame seed meal are shown in Table 4.10. Final weight, weight gain, feed intake, feed conversion ratio and feed cost per kg gain were significantly (P<0.05) affected by dietary treatments. Birds fed 15% roasted sesame seed meal diet significantly (P>0.05) performed better than other sesame diets. The performance of the birds in terms of final weight, weight gain, feed conversion ratio and feed cost per kg gain tend to decrease with increase in level of roasted sesame seed meal. However 7.5% supplementary diet performed better than treatment 4 and 5. Treatment 3 (15% sesame diet) showed similar performance for final weight and gain when compared with the control diet. The feed cost per kg gain was significance (P<0.05) among the dietary treatment, however as the levels of roasted sesame seed increased in the

diets, the feed cost per kg gain also increased. Diet 5 (30%) had the highest feed cost per kg gain of (₦ 418.63) while control diet had the least cost (₦ 395.59).

4.9 Digestibility Study

The results for the digestibility study of graded levels of roasted sesame seed meal in diets are shown in Table 4.11. Dietary treatments had significant ($P<0.05$) effect on ether extract and total ash. Roasted sesame seed meal at (15%) showed highest value of digestibility on Dry matter (74%), Crude fibre (23.54), Crude protein (68.42) and Nitrogen Free Extract (51.26) compared to other treatments. But the level of significance ($P<0.05$) across treatments did follow a definite trend.

Table 4.10: Performance of Broiler Birds fed Diets Containing Graded Levels of Roasted Sesame Seed Meal (5-8wks)

Parameters	Levels of roasted sesame seed meal (%)					SEM
	(0)	(7.5%)	(15%)	(22.5%)	(30%)	
Initial wt (g)	616.67	615.67	616.67	615.00	612.50	0.02
Final wt (g)	2195.93 ^{ab}	2066.30 ^a	2116.64 ^b	1939.59 ^b	1710.68 ^c	52.37
Weight gain (g)	1679.26 ^a	1649.63 ^a	1656.97 ^a	1414.59 ^b	1298.18 ^c	53.49
Feed Intake (g)	3425.00 ^b	3554.17 ^a	3423.61 ^b	3495.83 ^a	3498.96 ^a	33.99
FCR	2.84 ^b	2.83 ^b	2.23 ^a	2.90 ^b	2.96 ^b	0.13
Cost/Kg gain (₦)	395.59 ^a	400.38 ^b	408.36 ^c	414.78 ^d	418.63 ^e	1.15
Mortality (%)	0.19 ^c	0.19 ^c	0.11 ^b	0.03 ^a	0.17 ^c	0.02

a, b, c = Means in the same row having different superscript are significantly different ($P<0.05$).
SEM = Standard error of means; FCR=feed conversion ratio

Table 4.11: Nutrient Digestibility of Broiler Finishers Fed Diets Containing Graded Levels of Roasted Sesame Seed Meal

Parameters	Levels of roasted sesame seed meal (%)					SEM
	(0)	(7.5%)	(15%)	(22.5%)	(30%)	
Dry matter	58.58	67.84	74.00	65.30	66.68	9.20
Crude protein	57.18	65.22	68.42	60.21	53.37	9.72
Crude fibre	18.71	21.61	23.54	20.97	22.80	3.10
Ether extract	3.15 ^b	3.35 ^b	5.49 ^{ab}	6.86 ^a	6.99 ^a	1.80
Total ash	21.41 ^b	33.13 ^a	26.29 ^{ab}	31.36 ^a	31.83 ^a	3.90
Nitrogen free extract	46.00	47.30	51.26	43.85	50.72	5.38

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
SEM = Standard error of means

4.10 Heamatological Study

The results of the heamatological study are shown on table 4.12. There were significant ($P < 0.05$) differences between the treatments means for packed cell volume, haemoglobin count, total protein, red blood cell, total white blood cell and calcium. The values were relatively higher for treatment 2 and 4. Birds fed 30% roasted SSM diet had relatively lower packed cell volume, haemoglobin count and total protein while treatment 4 had higher values than the control treatment.

4.11 Carcass Analysis

The results of the carcass study are presented in Table 4.13. The live weight as well as weights of carcass, breast, thigh, back, wings, drumstick and liver expressed as percentage of live weights showed significant ($P < 0.05$) differences among treatments. However dressing percentage and weight of heart, gizzard, spleen abdominal fat and intestine weights expressed in percentage of live weights were not affected by dietary levels of roasted sesame seeds ($P > 0.05$). Live weight, carcass weight, breast and wings weight were significantly ($P < 0.05$) better for birds fed 15% roasted sesame seed meal diet. Birds fed 30% roasted SSM diet showed the least performance with regards to live weight, carcass weight, breast and wings weights.

Table 4.12: Haematological Parameters of Broiler Finishers Fed Diets Containing Graded Levels of Roasted Sesame Seed Meal

Parameters	Levels of roasted sesame seed meal (%)					SEM
	(0)	(7.5%)	(15%)	(22.5%)	(30%)	
Packed cell vol. (%)	33.07 ^a	34.12 ^a	31.65 ^{ab}	34.53 ^a	30.17 ^b	1.81
Haemoglobin (g/dl)	11.02 ^a	11.37 ^a	10.55 ^{ab}	11.52 ^a	10.07 ^b	0.61
Total protein (g/dl)	2.53 ^{bc}	3.17 ^{ab}	2.80 ^b	3.42 ^a	3.65 ^a	0.25
Red blood cell (x10 ¹² /l)	2.54 ^a	2.65 ^b	2.40 ^{ab}	2.66 ^a	2.33 ^b	0.45
Total white blood cell (x10 ⁹ /l)	6.77 ^a	4.26 ^b	4.48 ^b	3.06 ^b	4.26 ^b	1.11
Calcium (mg/dl)	6.17 ^b	6.80 ^a	7.60 ^a	6.77 ^{ab}	7.05 ^a	0.59

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
SEM = Standard error of means.

Table 4.13: Carcass Characteristic of Broiler Finishers Fed Diets Containing Graded Levels of Roasted Sesame Seed Meal (Result are Expressed as Percentage of Live Weight)

Parameters	Levels of roasted sesame seed meal (%)					SEM
	(0)	(7.5%)	(15%)	(22.5%)	(30%)	
Live wt (kg)	1941.70 ^a	1876.70 ^{ab}	1950.30 ^a	1950.00 ^a	1783.30 ^b	18.48
Carcass wt (kg)	1429.17 ^b	1369.00 ^b	1545.00 ^a	1487.50 ^{ab}	1345.17 ^b	48.86
Dressing (%)	66.59	66.11	68.85	68.81	66.45	1.84
Breast (%)	16.78 ^b	16.75 ^{bc}	18.97 ^a	18.20 ^{ab}	16.40 ^c	0.84
Thigh (%)	11.28 ^{bc}	11.33 ^b	12.50 ^a	12.02 ^{ab}	11.05 ^c	0.47
Back (%)	13.85 ^a	12.69 ^b	14.24 ^a	14.12 ^a	11.42 ^c	0.39
Wing (%)	8.48 ^a	8.02 ^b	8.60 ^a	8.59 ^a	8.00 ^b	0.12
Drumstick (%)	9.83 ^a	9.82 ^b	10.64 ^a	10.47 ^a	8.74 ^c	0.21
Liver (%)	3.82 ^a	2.25 ^c	3.86 ^a	2.82 ^b	2.73 ^b	0.14
Heart (%)	0.78	0.77	0.79	0.78	0.78	0.05
Gizzard (%)	2.83	2.86	2.87	2.87	2.86	0.12
Spleen (%)	0.31	0.20	0.21	0.20	0.21	0.05
Abdominal fat (%)	2.44	2.15	2.57	2.17	2.13	0.37
Intestinal wt (%)	8.05	9.60	9.60	9.60	9.61	0.88

a, b, c = Means in the same row having different superscript are significantly different (P<0.05).
SEM = Standard error of means.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Chemical Analysis

The result of the chemical analysis, analyses for anti-nutritional factors and amino acid profiles of differently processed sesame seed meal were presented in Tables 4.1, 4.2 and 4.3. The result showed that processing methods had no significant effect on these parameters. The crude protein contents range from 26.51-28.10g/100g, crude fibre 5.87– 10.20g/100g, ether extract 51.30– 59.11g/100g, ash 4.88– 5.66g/100g and Nitrogen free extract 2.15– 8.41g/100g.

The anti-nutritional factors of the sesame seed meal values were: oxalate - 80.00-140mg/100g, trypsin inhibitor 0.10-0.62mg/100g, phytic acid 96.10 - 102.49mg/100g and tannins 0.73- 3.11mg/100g. These result were observed to be comparable to those with the values reported by Oyinbo, (1988), Peace Corps, 1990; Mamputu and Buhr, 1991; Aduku, 1992, Olomu, 1995 and Diarra *et al.*, 2007. From the foregoing, there are wide variations in the composition of sesame seed probably due to location, varieties, season of the year, edaphic and climatic differences (Oyinbo, 1988; Olomu, 1995; and Peace Corps, 1990).

The amino acid profile of sesame seed indicated of the following values on the average methionine 0.43mg/100g protein and lysine 2.06mg/100g protein. This result is similar to that of (Diarra *et al.*, 2007) in methionine 1.60 but differ in lysine 1.36. Obioha, (1992) also had the following value in g/100g protein, methionine 0.9; lysine 0.65; threonine 0.9; histidine 0.55; valine 1.13; Isoleucine 0.85; leucine 1.78; phenylalaine 1.15 and tryptophan 0.53. The difference in this result can also be attributed to the source, method of processing and storage condition (Oyewole and Ewa, 2005).

5.2 Experiment 1

The chicks fed ROSSM sesame seed meal diet had relatively high feed intake, better feed conversion ratio and consequently higher weight gain and lower feed cost/kg gain. The observed results in feed intake with feed conversion ratio and higher final weight gain at lower feed cost /kg gain of chicks similar to the finding of Bell *et al.*, (1990), Diarra *et al.*, (2007), Yasothai *et al.*, (2010) and Agbulu *et al.*, (2010) who reported that processed sesame seed meal inclusion in the diet led to increase in body weight gain of birds over the RASSM, BOSSM and SOSSM. This increase in performance could be attributed to the role of Methionine present in sesame seeds promoting growth and yielding good feed conversion ratio. However, the high feed intake of these diets is contrary to the findings of Ngele *et al.* (2011) and Hatem *et al.* (2012) who reported that there was no significant difference on feed intake across the dietary treatments. The cost per kg weight gain was better for the differently processed sesame seed meal diets indicating lower cost of N160.31 to N169.39 for the control for one kg body weight. The results were observed to be comparable to those reported by Diarra *et al.*, (2007).

Chick's response to the roasted and boiled SSM diets were close to the control treatment in final weight, weight gain, feed intake and feed conversion ratio. This is in agreement with the report of Diarra *et al.* (2007), Al-Harthi and El-Edeek, (2009) and Agbulu *et al.* (2010). They observed significant increase in growth performance of birds fed differently processed sesame seed meal over the raw sesame seed diet and similar to the control treatment. The inclusion of sesame seed meal diets had no significant effect on mortality, this agrees with the findings of Ngele *et al.* (2011) which indicated the safety of using sesame seed meal diets to broiler chicks.

5.3 Experiment 2

The improved performance as observed in final weight, weight gain, feed intake, feed conversion ration and feed cost per kg gain with same level of differently processed sesame seed meal in diets is similar to the findings of Olomu. (1995), Bell *et al.*,(1990), Diarra *et al.*, (2007), Yasothai *et al.*, (2010) and Agbulu *et al.*, (2010) who reported that processed sesame seed meal inclusion in the diets led to increase in body weight gain of birds. The increase in performance of birds may be attributed to the role of methionine present in sesame seeds meal promoting growth and improving feed conversion ratio.

However the high feed intake of these diets agreed with the findings of Ngele *et al.*, (2011) and Hatem *et al.*, (2012) who reported that there was no significant difference on feed intake across the dietary treatments. Also, it may be attributed to the atmospheric condition during which the experiment was conducted (wet season). The feed conversion ratio recorded in treatment 3 was the least when compared with other treatments. This performance was in agreement with Diarra *et al.* (2007) and Agbulu *et al.* (2010) that reported processed sesame seed meal improved feed conversion ratio but contrary to Yosathai *et al.*(2010) who reported no significant variation in feed efficiency and protein efficiency ratio among various treatment groups.

5.4 Experiment 3

The inclusion of ROSSM at a level of up to 15% had no adverse effect on growth performance but at higher levels, growth performance was depressed. The result obtained from this experiment was in agreement with Diarra *et al.*(2007),

Yasothai *et al.* (2010) and Agbulu *et al.*(2010), who reported significant differences in weight gain during starter phase as attributed to methionine level in the diet. Feed intake showed significant decrease at 4 weeks as the level of sesame seed meal increased across treatment means. This trend was observed by Al-Harthi and El-Edeak (2009) who also reported that birds consumed less diet as the dietary inclusion level of sesame seed meal increased. The level of dietary energy and fibre increased with increase in the dietary level of sesame seed meal in this study, which probably affected the growth performance of the young birds.

Roasted sesame seed meal at levels had significant effect on feed conversion ratio when compared with other dietary treatments. The cost per kg weight gain was significantly better for the 7.5% supplemented diet indicating a lower cost of producing one kg of weight. Meanwhile the higher the inclusion level, the higher the feed cost. This observation was in agreement with Agbulu *et al.* (2010) who reported that feed cost continued to increase as the inclusion level of sesame seed meal increase. However, this was contrary to the observations of Turaki, (2005) and Diarra *et al.* (2007) who reported linear reductions in feed cost as the level of sesame seed increased in the diets. There were significant decreases in the percent mortality of birds across the dietary treatments, except for the birds fed 7.5% roasted sesame seed meal diet. The results obtained from these experiments suggest that roasted sesame seed meal can be fed up to 15% level in broiler starter diets. Higher amount may probably depress growth performance and health status of the birds.

5.5 Experiment 4

The inclusion of ROSSM at a level of up to 15% had no adverse effect on growth performance; however, higher levels depressed growth performance. The

result obtained from this experiment was in agreement with Diarra *et al.* (2007), Yasothai *et al.* (2010) and Agbulu *et al.*, (2010). They reported improved response of birds to sesame seed meal supplementation in diets in terms of body weight gain which is attributed to the level of methionine present both in the starter and finisher diets. There was a significant difference in feed intake between the dietary treatments. However, values in feed intake were similar across treatments. The observed results were in agreement with Diarra *et al.*, (2007) and Agbulu *et al.*, (2010). They reported that feed intake slightly differed significantly due to the amount of methionine present in the diets. On the contrary, Ngele *et al.* (2011) reported no significant difference on feed intake across the dietary treatments in both starter and finisher phases.

There was significant increase in feed conversion ratio across the dietary treatments. Birds fed 15% roasted sesame seed supplementation had the best (2.23) feed conversion ratio compared to 2.96 for the 30% sesame diet. This was in agreement with the findings of Diarra *et al.*,(2007) and Agbulu *et al.* (2010). This is indicative of the high rate of conversion of feed to meat. The cost per kg weight gain was significantly lower for the sesame diets indicating a lower cost of producing one kg of weight. The result was in agreement with Agbulu *et al.*, (2010) who reported that feed cost continued to increase as the inclusion level of sesame seed meal supplementation increased. Turaki (2005) on the other hand asserted that it is cheaper to use sesame in formulating the diet than using the synthetic methionine. Therefore, the use of sesame in formulating broiler diets may depend on the season and location. The mortality recorded during this phase could be attributed to environmental condition and not dietary treatments.

5.6 Digestibility Study

There were better digestibility values for crude protein, crude fibre and nitrogen free extract with 15% graded level of roasted sesame meal in diet compared to other treatments, indicating better availability of these nutrients to the

birds. This was also reflected in their growth performances. The birds fed 7.5% sesame seed meal diet showed higher digestibility for crude protein compared to control diet (0%), 22.5% and 30%. The birds fed 30% roasted sesame seed meal showed poor digestibility for crude protein, ether extract and nitrogen free extract compared to other treatments. This was better reflected in their growth performance as well.

5.7 Haematological Study

It has been established that packed cell volume (PCV), haemoglobin (Hb) count and total protein (Tp) are important blood parameters used in assessing the health status and nutrient intake of animals (Oladele, 2000). Packed cell volume, hemoglobin count and total proteins were significantly different among the treatments. Sesame seed meal diets resulted in relatively higher levels of those parameters over the control. These values indicate better nutrient availability in sesame diets as carriers of oxygen used in the breakdown of feed.

The PCV values obtained (30.17 - 34.53%) fell within the normal values for healthy birds (31.0 - 36.0%) reported by Njidda and Isidahomen (2011) and the values 31-38% reported by Njidda *et al.* (2006). The values were however higher than the range of 23.58 - 27.39% reported by Abeke *et al.* (2008). The Hb count of 10.00 –11.52g/dl obtained fell within the range for healthy birds, the range of 10.30-12.00g/dl reported by Njidda and Isidahomen (2011) and the values of 9.4-11.63g/dl reported by Salome, (2010). The values obtained were however higher than the range of 7.86-9.13g/dl reported by Abeke *et al.* (2008). The Tp values of 2.53 – 3.65 g/dl obtained did not compare well with 5.5 – 6.1g/dl reported by Njidda and Isidahomen (2011) and the value of 4.68 – 5.27g/dl reported by Abeke *et al.*(2008). However the Tp values were comparable with the value of Anon,

(2004) who reported Tp values of 2.5–4.0g/dl for birds from temperate regions. The results showed that the experimental diets of sesame seed meal supplementations met the nutritional requirements of the birds.

5.8 Carcass Analysis

Live weights, carcass and breast weights were significantly affected by dietary treatments. Birds on treatment 3 and the control group were significantly better on those parameters than other treatments. This result was similar to the findings of Oluyemi and Roberts. (1988), Deschepper and Degroote, (1995) and Nwokoro and Tewe, (1998) for 9 week old broilers. The dressing percentage was not significantly affected by dietary treatments. This was similar to the finding of Diarra *et al.* (2007) and Agbulu *et al.* (2010). They obtained non significant differences in dressing percentages of broiler finisher birds fed sesame seed meal and synthetic methionine.

The result was however contrary to the findings of Njidda and Isidahomen (2011) who reported significant difference in dressing percentages of birds fed sesame seed meal diets and the control diet. The percent breast, thigh, back, wings, drumstick and liver were significantly affected across the dietary treatments. However percent organ parts; heart, gizzard, spleen and intestinal weight were not significantly affected. This result was in agreement with Diarra *et al.* (2007) and Agbulu *et al.* (2010). They obtained non significant differences in heart, gizzard, spleen, abdominal fat and intestinal weights. El-Husseiny *et al.*, (2001) on the other hand reported that Percent breast meat significantly decreased when ducks were fed 30% SSM diet compared with that obtained from the groups fed the control diet.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

Studies were conducted to determine the effect of different methods of processing of sesame seed (*Sesamum indicum*) on the chemical compositions and the nutritional values of sesame seed meal as sources of dietary methionine in broiler diets. The processing methods employed were roasting (ROSSM), Boiling (BOSSM) and soaking (SOSSM). The processed and milled samples were compared with the raw (RASSM) samples and a control diet that contained no sesame seed meal. Chemical analyses were conducted for proximate composition, anti-nutritional factors and amino acids. Growth performance studies were conducted with two sets of broiler starters (0-4weeks) and two sets of broiler finishers. (5-8 weeks old). Two further experiments (3&4) were conducted with broiler starter and finishers to determine the optimum level of inclusion of roasted sesame seed on broiler performance.

The results of the feeding trials in experiment 1 and 2, with differently processed sesame seed meals showed that the birds fed roasted sesame seed meal supplemented diets performed better in growth indices measured than those fed other processed methods diets. The birds fed control diet gave similar response in performance as those fed sesame meal supplemented diets.

In experiments 3 and 4, graded levels of roasted sesame seed (7.5, 15, 22.5 and 30%) were fed to the birds. The results obtained showed that the birds fed 15% roasted sesame seed meal supplemented diets gave satisfactory results with similar response as the control diet.

Having considered the conditions under which these experiments were carried out and based on the results obtained, it was concluded that processing of sesame seed by either roasting, boiling or soaking significantly reduced the level of

anti-nutritional factors. Roasted sesame seed meal also resulted in growth performance that was comparable to that of the control diet and therefore can be used to replace 100% of the protein sources requiring Methionine supplementation. Finally, roasted sesame seed meal can be used at levels of up to 15% of the diet without adverse effects on broiler growth performance.

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