EVALUATION OF SESAME MEAL AND SEED IN DIETS OF BROILER CHICKENS

BY

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DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented before in any previous application for a higher degree.

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Date: August, 1988

THESIS APPROVAL

This thesis entitled "EVALUATION OF SESAME MEAL AND SEED IN DIETS OF BROILER CHICKENS" by SAMUAL WADA OYIBO meets the regulations governing award of the degree, Master of Science of Ahmadu Bello University and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

DEDICATED TO MY BELOVED WIFE, JUMMAI

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ABSTRACT:

Three broiler feeding experiments were conducted. The first two were to determine the optimum level of sesame or Benniseed (Sesamum indicum L.) meal inclusion in corn-soybean diets. There were five graded levels (10, 15, 20, 30 and 40 percent) of sesame meal in diets. The third experiment was to find out if raw sesame seed can be used as substitute for sesame meal in corn-soybean diets. These were four graded levels (5% meal, 5% Seed, 10% meal and 10% seed) in the diets. Triplicate groups of Anak-80 broiler chicks were placed on each of the diets. Carcass and taste panel tests were conducted to determine the effects of sesame treatments on carcass characteristics and broiler meat eating quality.

At 15% meal inclusion, mean body weight. and average daily weight gain/bird were 1477.50g, and 26.63g respectively compared to control with 1307.9g, and 23.40g for the same parameters. Feed consumption and feed efficiency were significantly ($P<0.05$) higher for control diets than 15% meal diets. Levels of 30 and 40 percent meal diets significantly ($P<0.05$) depressed performances of the birds.

There was no significant ($P>0.05$) difference in final weight gains between birds fed graded levels of sesame meal, sesame seed and the control diets for experiment 3. However, feed consumption and feed efficiency were significantly ($P<0.05$) higher for the control diets; 2501.50g and 2.0 than 10% meal diet; 2309.63g and 1.83 respectively.

Results for carcass analysis showed that birds fed 15% sesame meal diet had significantly ($P<0.05$) higher dressing percent than birds fed other dietary treatments

It was found that upto 15% sesame meal could be incorporated in broiler diets without adverse effects on their growth parameters. It was also found that sesame seed can be a good substitute for sesame meal as a source of protein and methionine in the diets for broiler chickens. It was concluded that dietary sesame meal and seed had no influence on carcass quality parameters.

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INTRODUCTION (GENERAL)

One of the main problems militating against the development of poultry industry in Nigeria and other countries is the scarcity of some feed ingredients that are essential for the production of good quality poultry feeds at reasonable costs. Oilseeds have been important as valuable protein sources for farm animals, particularly the monogastric species for many years. Sesame or Benniseed (Sesamum indicum L.) in particular has played a significant role in sustaining the poultry industry in most of the advanced countries of the world. Sesame played its essential role during the second world war when other protein sources for livestock were very scarce (Johnson and Raymond, 1964; Weiss, 1971).

Sesame meal is one of the ingredients that has been recognised as a high quality plant protein supplement for poultry feeds, especially in broiler diets (Almquist, 1953; Cuca and Sunde, 1968; Villegas et al., 1968). Sesame seed is a rich source of oil, protein and methionine when compared to other plant protein sources (Johnson and Raymond, 1964; Weiss, 1971; Rheneen, 1972; Oluyemi, et al 1976) Synthetic methionine, an essential amino acid and ingredient for poultry feed, is not only scarce, but extremely costly when available.

The conventional plant protein source, soybean meal, is largely an imported feed ingredient for most tropical

countries. The importation makes it an expensive and scarce feed ingredient resulting in high feed costs and fluctuating feed supplies to the poultry industry. Research into an indigencus, inexpensive and readily available feed ingredients that avoid costly importation and ensures regular poultry feeds all-year round is therefore necessary.

Although Nigeria used to be a net exporter of sesame seed in the early 1970, but probably due to low industrial development or the discovery of petroleum products as an alternative foreign exchange earner, little attention was paid to the commercial processing of sesame seed to produce both sesame meal and oil. Consequently, information is hardly available on the use of either sesame meal or seed as ingredients for livestock feeds in Nigeria. This fact, coupled with the scarce and exorbitant costs of supplementary protein and methionine sources worldwide, lend credence to any attempt to explore indigenous methods of making protein and methionine sources such as sesame available for use in poultry production.

Considering few or no processing machinery for sesame oil extraction in Nigeria and the absolute necessity for alternative protein and methionine supplements, an evaluation of raw sesame seed for use in poultry diets is imperative.

The need to explore the use of sesame meal and seed in poultry rations is strongly motivated by their high protein, methionine and fat contents. Sesame meal and seed could

therefore serve as excellent supplements to many other feed ingredients that are low in protein and methionine. They could also be a good source of energy, replacing part of the often scarce cereal grain in poultry diets.

The use of sesame meal and seed as a stock feed is governed almost entirely by price and availability. Its greater availability would almost certainly result in reduced price and increased use. Availability, ultimately depends on demands, since demand stimulates production.

The objectives of these studies were:

a) To find out the optimum level at which sesame meal will supplement soybean meal in broiler diets as a source of supplementary protein and methionine. This is measured by growth characteristics, mortality and efficiency of feed utilization.

b) To determine the effect of dietary sesame treatments on carcass characteristics and organ weights of broilers.

c) To assess the economics of the use of sesame meal and seed as a source of supplementary protein and methionine in practical-type broiler diets.

REVIEW OF LITERATURE (GENERAL)

INTRODUCTION.

Sesame or Benniseed (Sesamum indicum L.) is a crop of great antiquity and probably one of the most ancient oilseed crops under cultivation today. Sesame originated from Babylon in Sumeria in 2350 B.C. where it played an important role in ceremonies, culinary uses, preparation of wine and as a price standard in trade (Weiss, 1971; Rheneen, 1972).

Sesame is now cultivated in almost all tropical and subtropical Asian and African countries, the southern European countries, Russia, South and Central America and on a very small scale, in the United States of America. The main sesame producing countries are India, China, Mexico and the Sudan as indicated in table 1.

Sesame is a well established crop in parts of the present eleven northern states of Nigeria. It is also of minor importance in some parts of the country (Rheneen, 1972; Adenaike, 1985). The continuous decline in sesame and other agricultural production in Nigeria has partly been due to the discovery of abundant petroleum products as an alternative foreign exchange earner since early 1970. For instance, table 2 indicate the drastic decline

in production of major cash crops in Nigeria that are particularly relevant to poulty feeds.

Table 1: Production of sesame seed in percentage of India's yield (100,000 MT) during the period 1965/66-1969/70 for principal countries.

Country	Production (%)
China	86.7
Mexico	46.6
Sudan	38.2
Venezuela	19.8
Burma	18.1
Columbia	14.3
Turkey	9.3
Pakisten	8.6
Ethiopia	8.5
Uganda	7.2
Nigeria	3.9

Source: Van Rheen (1972), Major problems of growing Sesame (Sesamum indicum L.) in Nigeria. P.4

Table 2: Estimated output of some major cash crops in Nigeria from 1969/71 - 1983/1984.

('000 MT).

CROPS	1969-1971	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984
GROUNDNUT	1660	701	507	471	419	396	591
COTTON SEED	458	212	125	87	39	120	108
BENNISEED	59	15	7	2	1	n.a	n.a
SOYABEAN	61	111	44	2	5	n.a	n.a

n.a. = data not available.

Sources: FOA Production Year Book, 1980. P. 127 - 136.

It should be noted that most of the sesame seed produced in Nigeria since early 1970 have been consumed domestically due to the low demand for export. The amount entering world trade is therefore not necessarily related to production or area under which the crop is produced in Nigeria (Weiss, 1971; Rheneen, 1972).

The earliest work on the protein of sesame meal was done by Rittenhausen in 1880. Several workers and authors have pointed out that the cake was a good source of methionine and tryptophan. The limiting amino acid in sesame meal appears to be lysine. The oil content of sesame may vary from as low as 35 to 57 percent (Johnson and Raymond, 1964; Weiss, 1971; Rheneem, 1972; and El-Tinay, 1977). Sesame meal is well liked by livestock and keeps well in storage. Rheneen (1972) and Weiss (1971) reported that the oil and protein contents of the Nigerian varieties are relatively high, but the calcium content rather low. They also noted that late planted sesame crops were on average higher in protein and oil contents than those from the early planted crops, but lower in ash and crude fibre.

Sesame meal prtein is low in lysine but rich in methionine and is therefore good for supplementing soybean meal, groundnut meal and other vegetable proteins which

lack sufficient methionine (Daghir et al. 1967; Spensely et al. 1972; El-Tinay, 1977). Sesame protein is over 90 percent digestible (Collister, 1955). The amino acid composition of the protein of black and white Benniseed, compared to other commonly available oilseeds and whole egg is shown in table 3.

Sesame oil has a relatively high percentage of unsaponifiable material containing sesamolin and sesamol. Sesamolin is responsible for the characteristic colour reaction of the Baudouin (Sugar cane) test of sesame oil when shaken with concentrated hydrochloric acid to which a little cane sugar (Baudouin test) is added. The high resistance to oxidative rancidity of sesame oil especially after hydrogenation is due to the presence of sesamol, a component of sesamolin which is liberated from it by hydrogenation with dilute mineral acids. Sesame oil, because of its constituent sesamolin is sometimes used as synergist for insecticides such as pyrethrum and rotenone.

Like all or most agronomic crops Rheneen (1972), El-Tinay et al. (1977); and Godfrey-Sam-Aggrey (1985) reported the oil, protein and chemical contents of sesame seed to be clearly affected by varieties, location and season of the year influences.

In spite of the fact that sesame meal has been reported to be used either as a sole or supplementary protein and methionine sources for livestock in many countries, there is no research information in literature on the nutritional value of sesame for poultry production in Nigeria. This study is therefore conducted to determine the optimum level of inclusion of sesame meal and the comparative evaluation of of sesame meal and seed in poultry rations in Nigeria.

Table 3: Amino-Acid composition of certain proteins (%)

Amino Acid	Black Benni-seed	White Benni-seed	Ground-nut	Soya-bean	Whole egg
Arginine	12.5	11.8	11.3	7.3	6.2
Histidine	2.1	2.4	2.1	2.9	2.1
Hysine	2.9	3.5	3.0	6.8	6.3
Phenytalanine	6.2	6.3	5.1	5.3	5.7
Methionine	3.3	3.8	1.0	1.7	3.2
Heucine	8.9	7.4	6.7	8.0	9.0
Isoleucine	3.9	3.7	4.6	6.0	6.2
Valine	3.5	3.6	4.4	5.3	7.0
Threonine	3.6	3.9	1.6	3.9	4.9

Source: Castor, sesame and safflower by Weiss, 1971. P. 507

EFFECT OF METHIONINE SUPPLEMENTATION ON GROWTH OF BROILERS.

The beneficial effect of supplemental methionine in legumes and oilseed meal-based dicts have been widely investigated and well documented in literature. Methionine is an indispensable amino acid particularly in supplementing most legume and oilseed meal-based diets that are usually deficient in methionine.

Almquist (1953) compared the beneficial effect of dietary and synthetic methionine in broiler diets. In the experiment, he used all-vegetable protein diets containing 22 percent crude protein. The feed ingredients studied were soybean meal, sesame meal and DL-methionine with a broiler ration containing 6% fish meal, 8% sesame meal and 13.3% soybean oil meal serving as the control. The other ingredients of the diets were identical, and all rations contained antibiotics feed supplement. Methionine contributed by the sesame meal was fully equivalent to the synthetic methionine. He obtained satisfactory results with an all -vegetable broiler ration containing soybean oilmeal and sesame meal.

Armas and Chicco (1979) reported from their work with hybrid chickens fed from one day to eight weeks of age on basal diet. The basal diet consisted of sesame meal while in the experimental rations sesame meal was replaced by 8, 16 and 24 percent groundnut meal. The basal diet with sesame

meal was given without methionine while groundnut rations had extra methionine. Another group was fed on a commercial feed for broilers. They observed gain and efficiency of feed conversion with 8 percent groundnut oilmeal were significantly less than all other diets. Extra DL-methionine was effective only with 8 or 24 percent groundnut meal. Sesame meal supplementation gave excellent gain and feed efficiency conversion.

Previously, Armas and Chicco (1972) performed a similar experiment in which they replaced soybean meal with sesame meal at 25 or 50 percent of the diets. The birds were reared on the floor. The birds were reported to have gained from 1249g to 1281g on all diets except that with no sesame meal or methionine, on which the gain was 932g, methionine increased the gain to 1235g.

Hassan (1975) reported the result of dietary supplementation of methionine in a layers diets. He fed the layers from 20 to 47 weeks of age. Each of four (4) isocaloric diets was given to 24 individually caged Thornber 606 pullets in controlled conditions. The respective egg production from birds on diets A to D was 76.5, 67.8, 77.6 and 76.7 per 100 hen-day survivors. The main weights of eggs were 55.4, 55.2, 55.2 and 55.3g. Production efficiency was 2.59, 3.22 2.67 and 2.53kg feed/kg eggs. During the the experiments, birds gained 451, 309, 382 and 493g respectively on the diets. Impliedly, methionine in the dietary sesame meal was a good supplement to soybean meal lysine.

Cuca and Skirde (1968) concluded from two of their studies that supplementation of 0.4 to 0.5 percent synthetic Dl-methionine to soybean meal-corn based diet improved the growth and feed efficiency, but supplementation of sesame - soybean meal diets with Dl-methionine, leucine, arginine or glycine did not improve chick growth or feed efficiency. They noted, however, that when sesame diets were used at 18 percent protein level, methionine significantly improved chick growth but there was no effect at 20 percent protein level. A sesame-soybean ratio of 25:9 gave a better chick growth than all sesame diet.

Other researchers and workers who reported improvement of broiler diets with dietary supplementation of sesame meal include (Kuppuswamy, 1958; Natarzjan and Gama, 1965 and 1967; Ali Shaikh et al. 1969; Weiss, 1971; and Shah et al. 1979). They all unanimously concluded without giving details of their experiments that dietary supplementation of sesame meal with methionine-deficient legume-oilseed based diets improved growth and performance of broilers.

Featherson and Rogler (1979) reported from their work improved performance with broiler chickens when fed wheat and groundnut meal based diets and supplemented with synthetic methionine and cystine. The wheat and groundnut diet had 0.2 percent methionine and 0.26 percent cystine.

They noted that weight gain and feed efficiency increased when these diets were supplemented with 0.3 to 0.6 percent DL-methionine. However, when similar amounts of L-cystine were added to the basal diets with 0.2 percent methionine, growth was depressed. When the diet has 0.4 percent DL-methionine, the growth depressing effect disappeared.

In contrast, Reddy et al. (1979) indicated in their report that supplementation of 0.2 percent DL-methionine gave a significant increase in both growth of chicks and protein efficiency ratio (PER) for methionine deficient feed ingredients tested compared with unsupplemented diets. They concluded that after correcting for methionine, no significant differences were observed in the protein efficiency ratio values for soybean meal.

Syed et al. (1983) working with different alfalfa protein concentrates, observed significant improvements in chick gains when methionine was supplemented to 40 percent alfalfa protein concentrate diets. They observed improved feed efficiency by the addition of methionine to the diets. Similarly, Daghir (1983) observed that neither body weight nor feed efficiency was reduced by feeding either 15 or 12 percent protein diets as long as those diets contained the National Research Council, N.R.C. (1977) recommended level of methionine and lysine. He noted increase in feed consumption without any additional

body weight gain. This observation is in agreement with the findings of Steve et al. (1975); Plavnik and Bornstein (1978) whose findings showed that broilers tend to increase their feed consumption to maintain normal growth when amino acids are marginal or protein is limiting.

Result obtained by Daghir (1983) indicated two things: (a) that the body weight gains were not significantly affected by reducing the protein level of the diet during the broiler growth period when these diets are adequately supplemented with methionine and lysine. (b) that the National Research Council, N.R.C. (1977) recommendation of 18 percent protein for 6 to 9 week-old broilers may be reduced by providing adequate amino acid supplementation.

Perhaps the diets that need more supplemental methionine is legume-corn based diets. The aim is to improve the nutritive value of these diets since most legume-corn based diets are mostly deficient in methionine. Offiong (1984) reported 0.3 percent methionine supplementation of raw or cooked soybean meal to be effective in improving performance of broiler chicks while 0.3 percent cystine was not as effective. He concluded that methionine at that level could replace cystine but not vice-versa. When fed raw soybean, methionine addition resulted in increased weight gain, feed intake, efficiency of feed utilization and protein retention.

Ogundipe (1973) also reported the beneficial effect of methionine supplementation to chicks, especially pullets. He observed that 0.5 percent supplemental methionine improved body weight of egg-type pullets at 20 weeks of age. He concluded that 0.5 percent methionine addition to raw soybean based diets also improved significantly the subsequent hen-day egg production of birds.

From the fore-going review, there is abundant evidence which indicate the beneficial effect of supplementing legumes and oilseeds meal based diets with adequate dietary or synthetic methionine which is usually the first limiting amino acids in such diets. However, supplementation of synthetic methionine should be done with caution as it is one of the most toxic amino acids (Youssef, 1978). He reported that as little as 3 percent methionine included in a 10 percent protein diet depressed food intake and decreased growth rate of rats and chickens. He concluded that higher levels caused serious tissue damage.

EFFECTS OF PROCESSING ON QUALITY AND UTILIZATION OF OILSEED PROTEIN IN BROILER RATION.

Since early reports of Eckay (1954) and Johnson and Raymond (1964) that sesame seed contains high oil, protein and some antinutritional factors, many processing methods have been adopted to improve the nutritional value for human and monogastric animals.

Weiss (1971) and Spensley et al.(1972) noted that the sesame seed cuticle especially the black and white varieties have bitter taste. They pointed out that decortification of the seeds produced a less bitter taste and therefore a more palatable foodstuff for man and animals. On chemical analysis, however, they observed that the decortification process considerably reduced the mineral, calcium and oxalic acid content of the seed but has little effect on the fat and protein contents.

Working on the chemical and nutritional composition of sesame seed, Shin (1976) reported similar results. He observed that the crude fibre, total ash and acid-insoluble ash contents of seed and meal of Korean whole white sesame, and for oil, specific gravity, refractive index, iodine value, unsaponifiable matter, insoluble impurities and unsaturated fatty acid content were significantly higher than from decorticated sesame samples. The protein content was higher in decorticated meal, but amino acid content of both meals was about equal. He concluded that the sesamol, sesamolin and sesamin contents of both oils were similar. However, he noted that oxalate and calcium contents of whole seed and decorticated meals were significantly lower than in the whole meal.

Lease et al.(1960a) reported the detrimental effects of dehulled sesame seed meal to monogastric animals especially poultry. They noted that chicks fed purified rations

containing decorticated sesame meal as the sole source of proteins, showed gross signs of zinc deficiency. This is in spite of the fact that their experimental diet contained 52ppm of zinc. They observed that growth was significantly improved and leg deformities greatly reduced when 60-120ppm of zinc were added to the ration.

In another experiment, Lease et al. (1960b) noted that autoclaving of sesame seed significantly improved growth of broiler chicks but did not prevent leg abnormalities. They concluded that addition of EDTA (ethylenediamine-tetraacetate) to the sesame meal or ration greatly reduced leg deformities and resulted in as good growth as 120ppm zinc.

Armas and Chicco (1972) performed an experiment in which they used expeller and solvent-extracted sesame meal. The percentage compositions of dry matter (d m), expeller first, were protein 41.5 and 44.03; fat 11.12 and 2.77; fibre 10.99 and 8.72; Ca 2.33 and 2.16; P 1.48 and 1.50 with Zn, 73 and 91 ppm. Each meal was given as 25 percent of the diet, replacing soybean meal in the control diet, and with 0.1 and 0.25 or 0.4 percent extra lysine. Body weight gains at 8 weeks of age with expeller meal and increasing amounts of lysine were 1268, 1437 and 1500g for intake of 2.37, 2.26 and 2.02 kg/kg gained. They concluded that undehulled sesame meal with little lysine supplementation was adequate for good broiler production. Extra zinc was not supplemented in the experimental diets.

Natarajan and Cama (1961 and 1965) opined that controlled conditions of solvent-extraction had no deleterious effect on sesame proteins. They further reported that heat treatments-autoclaving, toasting and moist boiling had no beneficial effects either. They concluded from their two separated experiments spanning over four years that high-steamed sesame meal had lower nutritive value than raw sesame meal.

They however, observed significantly lower vitamin A in the livers of rats and chickens and lower calcium and phosphorus in the bones of those animals tested. There was higher vitamin A, calcium and phosphorus in unddehulled and untreated sesame oilmeal basal diet. Syed et al. (1983) explained the effect to be due to the fact that lysine and methionine are sensitive to temperature changes and can bind to aldehydes produced by peroxidizing polyunsaturated fats during excessive heat treatment.

Dey et al. (1984) also reported non-beneficial effect with heat processing of sesame seed or meal. Tabekhia and Mohammed (1971) reported that preparation of sesame meal using water and brine stepping followed by roasting caused remarkable losses of riboflavin and nicotinic acid.

Similarly, Sastry et al. (1975) observed that processing of sesame involving treatment with hot 0.6% NaOH before dehulling, then drying, screw pressing and solvent extraction had no beneficial effect. They noted however,

that enzymic digestion of protein was improved by dehulling and lysine in the meal was remarkably stable with only 15 percent lost after autoclaving at $1kg/cm^2$ for 1 hour. They concluded that supplementation of the meal with 1.25g L-lysine hydrochloride per 100g flour enhanced the nutritive value of protein in milk powder.

Summarizing results of previous investigations, Weiss (1971) recommended no specific heat treatment of sesame meal before being fed to monogastric animals.

In contrast, Villegas et al. (1968) observed increased availability of methionine in two of their experimental samples as a result of heat treatment. The nature of the heat treatment and the temperature were not specified. Scott et al. (1969) reported that autoclaving improved the nutritive value of sesame meal to chicks.

Similarly, Herrera et al. (1977) conducted experiments with 4 groups of 250 day-old broiler chicks each. They were given experimental diets with 10 percent sesame protein except the control diet for twenty eight days. They concluded that autoclave heating for 90 minutes at $121^{o}C$ of the meals obtained with solvents improved the protein quality of sesame and soybean, but impaired that of cottonseed meal.

Balloun (1980) also reported the detrimental effect of untreated sesame meal in poultry diet. He observed that when untreated sesame meal was fed to broiler chickens, they showed poor growth, leg deformities and low zinc in

the tibia ash. He concluded that autoclaving sesame meal for two to four hours reduced the phytin phosphorus, increased the growth of chicks and increased the zinc in the tibia ash.

From the work of Spensley et al. (1972); Balloun (1980) and Godfrey-sam-Aggrey et al. (1985) sesame seed contains phytates and oxalates as the only toxic (anti-nutritional) factors. These two toxic substances are not known to be heat labile. Consequently, heat treatment of sesame seed in any form might not be the appropriate processing method before sesame seed or meal could be used as a dietary component for poultry diet. Thus, considering the evidence available from the foregoing review, heat processing of sesame seed or meal may not be the necessary prerequisite for the use of sesame in poultry diets.

IMPORTANCE OF VEGETABLE PROTEIN IN BROILER RATION.

Considerable interest has been shown by poultry nutritionists from various parts of the world on the nutritive value of vegetable proteins in rations for chickens. This is probably due to occasional shortages and exorbitant prices of animal protein sources for poultry ration formulations. Legumes and oilseeds have been important as valuable protein sources for farm animals, particularly the monogastric species. Sesame, soybean, groundnut and cottonseed meals in particular have played a significant role in sustaining the poultry industry in

most of the advanced and developing countries of the world (Dafwang, 1979; Ogundipe, 1980; Offiong, 1984).

Using all-vegetable protein diets, Almquist (1953) reported the result of broiler experiments he conducted to test efficacy of vegetable proteins. The feed ingredients studied were soybean oilmeal, sesame meal and DL-methionine with a broiler ration containing 8 percent sesame meal, 13.3 percent soybean oilmeal and 6 percent fish meal serving as control. Methionine contributed by the sesame meal was fully equivalent to synthetic methionine. He concluded that good results were obtained with an all-vegetable broiler ration containing soybean oilmeal and sesame meal.

Dafwang (1979) citing several authors, concluded that all-vegetable rations with approprate amino acid supplements gave equivalent growth rate and other broiler production parameters to those containing 6 percent or more fish meal. In a separate experiment, Shaikh et al. (1969) prepared a protein concentrate containing 72 percent protein from commercial sesame seed cake and soybean oilmeal. When fish protein concentrate was supplemented with skimmed milk powder, so that equal quantities of proteins were derived from each sources the net protein utilization and protein efficiency ratios of the broiler birds were improved almost to the level of the animal protein used.

In two separate experimental trials, Al-Chalabi and Taha (1973) fed broiler chickens with vegetable proteins that were cheaper than imported soybean oil meal. The

cheapest meal tested was cottonseed. In the first trial, some chickens had 18 percent groundnut meal with 5 percent cottonseed oilmeal. Others had 23 percent sesame meal with 5 percent cottonseed meal or 18 and 10 percent of the two. Each combination was supplied alone or with 0.5 percent L-ylsine hydrochloride.

In the second trial, 18 percent groundnut meal was given with 5 percent cotton seed meal, alone or with 0.5 percent DL-methionine or with the methionine and 0.5 percent lysine. They concluded from the trials that replacement of groundnut by sesame and cottonseed protein improved results significantly and added lysine improved them further. Methionine alone or with lysine had only a slight effect.

Working with starting pullets, Olomu (1985) fed groundnut, soybean and fish meals as supplementary proteins in the diets of the pullets. He observed that pullets offered unsupplemented diets of groundnut meal performed satisfactorily upto the point of lay, but not better than those on fish meal control diet. He noted, however, that unlike results of fast-growing broiler chicks, pullet chicks fed unsupplemented groundnut meal diets containing fish meal performed satisfactorily well compared to those on control diets. He concluded that the deficiencies of lysine and methionine in the unsupplemented groundnut meal was not severe enough to cause serious depressed feed intake and growth rate.

Ogundipe (1980) and Offiong (1984) used raw and cooked soybean meal diets supplemented with 0.3 percent methionine in broiler chicks rations. They concluded that 0.3 percent methionine was effective without animal protein sources such as fish meal and meat meal in the diet of the broiler chicks.

Contrarty results have, however, been reported. Dafwang (1979) citing Cowper (1972) reported that even when all - vegetable protein diets were supplemented with synthetic methionine and lysine, it resulted in higher mortality rates, poorer feed efficiency and in case of layers, few eggs per hen-housed than when diets were supplemented with animal protein particularly fish meal.

Similarly, Mathur and Ahmed (1973) reported a relatively poor performance of vegetable protein diet for broiler chickens. Using diets with yellow maize 30%, broken wheat 20%, rice polish 15% and different proportions of groundnut cake, sesame cake, fish meal and blood meal, with minerals, all with 20.5 percent crude protein content were given to 200 Abor Acres chickens for five weeks from one day-old. When all fish and blood meals were completely replaced with soybean meal, final weights dropped from 318.8g to 260.5g per bird.

Regardless of the contrary reports, there are ample evidence which indicate that if all-vegetable proteins are adequately supplemented with either dietary or synthetic methionine, they will be important, cheaper and readily

available sources of protein for poultry production in most tropical and subtropical countries.

USE OF RAW SEEDS - DEHULLED AND UNDEHULLED.

Research information on the use of raw seeds for livestock nutrition are scanty for three main reasons:-

a) Most of these legume and oil seed crops are grown primarily for industrial and domestic purposes. Consequently, the whole seeds are generally regarded as too valuable to be fed to livestock. As such, only the crushed and oil extracted by-products are used as livestock feed.

b) Most legume and oilseeds contain toxic substances that inhibit optimum utilization of organic and inorganic nutrient constituents of the seed by the livestock.

c) Most of the seeds of the leguminous plants consist of hard testa. These hard seed cuticle are hardly digested when ingested whole. Consequently, they are of little nutritional value to the livestock.

In spite of the foregoing exeptions, there are reported instances where raw seeds have been fed to domesticated birds with beneficial effects. Weiss (1971) reported that the whole raw sesame seed used to be included in the higher qualities of domestic pet food. He noted that many of the domestic birds ate the seeds with avidity without any detrimental effect.

In a comparative study, Chowdhurry and Latif (1985) evaluated the effect of processed (steamed) and raw sesame seed on the growing broiler chicks. The broiler birds were fed for 6 weeks. They observed that body weight gain was greatest with steamed sesame than raw. They, however, concluded that there was no significant difference between the groups in feed intake.

Daghir et al. (1980) conducted a study on the utilization of full fat raw sunflower seeds in broiler rations. They incorporated crushed, heated and raw sunflower seeds at 0, 10 and 20 percent. They concluded that no significant differences were detected with respect to average body weight gain, feed consumption, feed efficiency, mortality or organ weights.

Noland et al. (1980) substituted unextracted raw sunflower seeds for either 0, 25, 50 or 100 percent of the soybean meal in pig diets. They reported that the diets produced no significant differences in digestible energy or apparent nitrogen retention. They noted that all diets containing unextracted sunflower seeds had significantly higher digestible nitrogen than the diets containing soybean meal as the protein source. They concluded that heating and crushing the sunflower seed reduced rate of gain and increased the feed/gain ratio.

Waldroup et al. (1985) incorporated amaranth seed varieties at 20 and 40 percent raw and autoclaved form in

broiler diets. They reported that weight gains of chickens fed diets with 20 percent amaranth seed did not significantly differ from the chickens fed a corn-soybean meal control diets, whether grain was fed raw or autoclaved. They concluded that feed intake was reduced slightly at the 20 percent level of inclusion of both raw and autoclaved seeds. About 40 percent inclusion reduced weight gains, depressed feed consumption and other broiler performance parameters.

When raw seeds contain little or no antinutrients, soft testa and small in size, efficiency of their utilization by birds is governed by two main factors.

a) Age of birds. Fonolla et al. (1981) opined that age of birds is an important factor in influencing the digestion and nutritive value of seeds in ration mixtures.

b) Addition of grit. Onwudike (1986) and Hoodege and Rowland (1978) reported that dietary addition of sand or grit is important in the digestive process in poultry especially when the diet is of a coarse nature. Their results showed that the effect of grit in gizzard of growing birds depends on age of birds. They concluded that starter chicks appeared to derive the most benefit from the addition of grit in the diet containing whole seeds or higher crude fibre than older birds, thus agreeing with Fonolla et al. (1981).

FACTORS AFFECTING OILSEED AND LEGUME PROTEINS

Factors that effect oilseed and legume proteins that are widely used for human consumption or as a concentrate

for farm animals are toxic substances commonly called antinutritional factors. According to Balloun (1980), the presence of toxic (antinutritional) factors in feeds and food of both plants and animal origin has been well known since the beginning of recorded history. Many plants, for instance, in their native state contain toxic factors in all or parts of the plant. Thus, the antinutritional factors found in a number of oilseeds and legumes are not unique.

Reports of antinutrients in sesame seed or meal in literature are scanty and conflicting. Several early work on sesame oil meal done by Rittenhausen, 1840; Eckay, 1954; Johnson and Raymond, 1964 reported of the good chemical property of sesame. They particularly reported of its excellent protein quality and balanced amino acid profile. Using sesame meal in rats and chicks bioassay, several workers have similarly confirmed excellent chemical qualities of sesame in many countries.

Similarly, contrary deleterious constitutents in sesame have been reported. Spensely et al. (1967) reported the presence of oxalic acid while Godfre-sam-Aggrey et al. (1985) reported presence of phytate and oxalate salt complexes in sesame seed. They noted that these salt complexes in sesame seed bind the calcium and phosphorus content of sesame, thus making these minerals either completely unavailable or partially available when fed to farm animals or as component of human food.

Balloun (1980) citing Lease (1966); Cuca and Sunde (1967) reported that calcium in sesame meal has a low availability. In their separate trials with laying hens, calcium availability was about 40 percent while it was less than 40 percent in broiler chickens. With respect to phosphorus, they pointed out that sesame meal contained 1.4 percent of total phosphorus and 1.0 percent phytin phosphorus. These workers and Agarwal et al. (1974) reported effects of sesame meal on zinc availability to birds. They concluded from their separate findings that sesame binds zinc strongly. They thus advised that careful attention should be paid to zinc levels when using sesame meal in poultry diets.

Gossypol is a typical example of toxic substance that occurs exclusively in the cottonseed. In an experiment to determine the deffect of gossypol in raw cottonseed meal on the performance of broiler chickens, Atuahene et al. (1986) used 5, 7.5 and 10 percent levels in experimental meal diets. They noted that 10 percent level significantly depressed average weight gains and decreased feed intake. They concluded that feed efficiency and mortality showed no significant dietary effects.

It appears factors that limit proper utilization of legume oilmeals have more pronounced effect on soybean meal than any other plant protein. Several workers and authors have reported the antinutrients in soybean meal to include trypsin (Kurnitz) inhibitor, antichymtrypsin, antiamytase

and nonsepcific protein inhibitors (Ogundipe, 1973 and 1980; Balloun, 1980; Offiong, 1984; Waldroup, 1985). They reported most of these factors to be heat labile and adequate heat treatment destroys most of their inihibitory properties. Appropriate heat treatment thus renders suffur amino acids more available and increase the energy value of raw soybeans.

Ogundipe (1973 and 1980) reported soybean in its raw state to decrease protein and fat digestibility and reduce the availability of some trace minerals especially zinc, manganese, copper and iron due to their phytic acid composition. He concluded that susceptibility of chicks to raw soybean decreased with age. He suggested adequate supplementation with DL-methionine could improve the nutritive value of raw soybean meal.

The body of evidence available with particular reference to sesame seed does not indicate that the nutritive value of raw sesame seed is influenced by heat treatment or other processing methods. However, appropriate heat treatment appears necessary for other oilseeds and legumes used as components of poultry diets. Temperature of heat and the extent of heat treatment are important considerations in the heat treatment of soybean meal for poultry diets.

PROBLEMS OF SESAME IN POULTRY DIETS.

One of the main problems limiting the large-scale use of sesame meal or seed in livestock feed is its exorbitant

cost which probably arises from the fact that sesame is grown almost exlusively in countries with a small peasant type of agriculture. As a result, its cultivation is carried out without the use of much machinery (Weiss, 1971; Rheneen, 1972). Secondly in countries of high sesame production, substantial quantities are used for domestic consumption with relatively small amount for industrial processing. Since it is the by-product of the industrial processing that is normally used for livestock feeds, only very small quantities are thus available for poultry feed formulation.

When the main industrial product, oil, is extracted, the by-product, meal, has been reported by several workers to contain varied antinutrients (toxic substances) that hinder optimum utilization of the meal or seed as livestock feed. For instance, Spensley et al.(1967) reported presence of oxalic acid while Godfrey-sam-Aggrey et al. (1985) reported presence of phytate and oxalate salt complexes in sesame. Balloun (1980) citing several workers reported sesame meal and seed to have a low availability of calcium, phosphorus, zinc and other trace minerals. He concluded from their results that birds fed sesame meal as feed components developed leg abnormalities.

In areas of high lead (Pb) concentration in the soil, sesame readily absorbs lead (Pb). For instance, in an

experiment conducted by Yanni and Haas (1974), they pointed out that the high content of lead in canned sesame paste, about 2.2 mg/kg was not due to contamination from solder used in manufacture of cans. They noted that whole seeds from lead (Pb) high concentration in soil from Israel, Ethiopia and Tanzania contained, respectively, 1.74, 1.70 and 1.55 mg Pb/kg. They concluded that sesame has an unusual capacity for accumulating Pb from the soil. As the maximum acceptable intake of Pb from food set by FAO/WHO is 5ug/kg body weight, excess Pb in sesame seed and meal could be disastrous to human and animal health.

Sesame meal is deficient in lysine, and must be mixed with other meal containing higher quantities of the amino acid, lysine or supplemented, if poultry are to make normal growth or remain healthy. However, a combination of sesame meal with other legume and oilseed meals could exert a marked mutual supplemental effect in weight gain or efficiency of food utilization in chicks.

FACTORS INFLUENCING EATING QUALITY OF BROILER MEAT.

Meat is an excellent source of high quality protein, B-complex vitamins, and of certain minerals, especially iron. It is easily digested, and when cooked, meat supplies nutrients which contribute significantly to the dietary balance of meals. As little as 100 gram of meat provides half of the protein needed for a day, and the amino acid contents of this protein could adequately compensate for

deficiences common in the proteins of vegetables and cereal products that constitute the main bulk of foodstuffs in the developing countries(Price and Schweigert, 1971; Lawrie, 1979; Ogundipe, 1980).

Broiler meat constitutes those broiler flesh or tissues that have undergone physical or biochemical changes which are suitable for use as human food. Quality grades of meat are primarily intended to reflect differences in eating quality. According to Ogundipe (1980); Price and Schweigert, 1971) quality, as is used in grading meat, refers to its expected palatability, flavour, tenderness, colour or appearance, juiciness and odour or aroma. In fact, meat quality implies enjoyment of eating meat.

Quality of broiler meat and indeed other meat, is markedly influenced by species, sex, age and level of nutrition of the animal. Price and Schweigert (1971) concluded that consumers studies have shown tenderness to be the most important palatability factor in the acceptance of livestock meat.

Ogundipe (1980) pointed out that level of nutrition influences meat quality remarkedly. He contended that tissue lipids are derived from dietary lipids as well as from lipogenesis. Therefore, fat intake influences not only the quality of lipogenesis but also the quality of lipids in various tissues. He concluded that significant amounts of dietary lipids could change the fatty acid

composition of tissue lipids to a large extent.

If a feed contains too much oil or too much of the highly unsaturated fatty acids from sesame meal or seed or any other source, the broiler meat may develop unacceptable or off-flavours. Factors that may influence meat tenderness include processing procedures such as the time for ageing before cut-up, scalding temperatures and time.

MATERIALS AND METHODS (GENERAL)

A. OIL EXTRACTION FROM SESAME SEED

Ten (10) bags of approximately 80kg weight each of sesame seeds (Sesamum indicum L.) were purchased from local Zaria market in Kaduna State. The sesame seeds were of the early variety grown in parts of Kano State.

The ten (10) bags of the seeds were taken to the United Oil Mill Limited, Zaria, for mechanical crushing and oil extraction. The machine used was Rosedowns D-type maximum oil expeller manufactured by Rose, Downs and Thompson, Limited, Hull, England. It was originally designed to crush and mill groundnut seeds, cottonseeds, soybean seeds and other seeds larger than sesame seeds. However, adjustment was made to enable the machine handle small sesame seeds to a reasonable level. The milling crusher and crank had to be changed to the smallest size to enable it crush and extract oil efficiently from the small-sized sesame seeds.

Seed crushing and oil extraction took place simultaneously. Initial crushing and oil extraction was poor. The poorly crushed seeds had to be poured back. With increase of temperature from 52°C to 72°C and pressure of 58kg/cm^2, crushing of the seed and oil extraction improved. Even with the adjustment, some seeds got lost in the machine resulting in low crushing and oil extraction.

The crushed seeds and extracted oil came out from the

machine separately. The oil were collected in a 32 - litre aluminium bucket while the milled seeds were collected on a clean aluminium flat sheet and later packed into jute bags. The meal was later spread out in an open room to cool down the temperature. Cooling was necessary to prevent the high temperature from denaturing the protein and loss of heat labile amino acids such as lysine and methionine (Ranjhan, 1980).

The cooled sesame meal was thoroughly mixed on the clean flour and four representative samples were taken from different parts. About 500g of the bulked sample were then taken and finely ground in a Willey hammer mill using a 400mm - sieve. They were stored in an air-tight bottle and later used for proximate analysis.

Representative raw seed samples from the Kano and Yandev (Benue) varieties were taken for proximate analysis. The raw seeds could not be ground using Willey hammer mill as the crushed seeds became sticky probably because of the high oil contents. They were separately pounded in a porcelain mortar to fine particles and weighed on a metler balance max. P 163. All the samples were prepared for proximate analysis according to methods of (A.O.A.C., 1975)

B. CHEMICAL ANALYSIS.

Out of this stored samples, 5g of each sesame meal and seed were weighed into 250 ml kjeldahl flask for the determinatior of calcium (ca), phosphorus (p) and magnesium (mg) contents of the sesame meal and seeds. Six glass beads were added to

each of the sesame meal and seed samples in order to increase the surface area for the reaction. After the reagents were added, the samples were digested in a fume cupboard until a colourless digest was obtained. The digest of each sample was leached with 10 ml nitric acid ($HN^{O}3$) then filtered into a beaker and washed with small quantities of hot deionised water. The filtrate of each sample was evaporated to dryness and excess sulphuric acid (H_2So_4) was fumed off on sand bath. The residue of each sample were then dissolved with 25 ml deionised water into 100 ml volumetric flask and made up to the mark.

For phosphorus (P), Vanadium molybdate was added which formed a complex with the phosphorus. A yellow colour developed 30 minutes later. The phosphorus was determined with the use of Spectronic 20 machine made by Baush and Lomb while atomic absorption spectrophotometer Sp 192 Unicam was used to determine calcium and magnesium according to (A.O.A.C., 1975).

C EXPERIMENTAL PROCEDURE

i) CHICKS: The broiler chicks used in the trials of the experiments were Anak-80 strain purchased from a local hatchery, Niger First Farms Limited, Kaduna at one day-old of age. Fourteen (14) chicks were used per replicate and

three replicates were used for each dietary treatment in the first and second experiments. A total of 252 chicks were used for each of the six treatments in the first two experiments. Eleven (11) chicks were used per replicate and three replicates were used for each dietary treatment in the third experiment. A total of 264 chicks were used for the six treatments in the third experiment. The chicks were randomized at one day-old for all the three feeding experiments such that the number and mean weights of all the chicks within a trial were similar. The chicks were individually wing-banded at one day-old with aluminium tags. Clean water and mash feed were provided ad libitum throughout the experimental period.

ii) Management: The birds were brooded on wood-shavings as the litter material in a tropical-type opensided poultry house with equal-size pens. Each of the pens measured 3.25 x 1.22 metres separated by wooden partitions and wire netting. Hurricane lanterns and electric light provided continuous light and heating during the brooding period of four weeks. One lantern or a 100-watt electric bulb was used per pen or replicate.

Open-sided portions of the house were covered with plastic sheets for the brooding period of four weeks.

Weekly records of weight gains of individual birds, feed consumptions, feed efficiency and mortality for the corresponding period were kept for each replicate groups. The birds were vaccinated against Newcastle disease with freeze dried Newcastle disease virus given intra-occularly at one day-old. At three weeks of age, lasota was given according to the National Veterinary Research Institute, Vom (1986) recommendations.

Three feeding trials were conducted. The first was a preliminary investigation in which the responses of broiler birds to graded levels (10, 15, 20, 30 and 40 percent) of sesame meal in diets was determined. The second was the confirmation of the preliminary trial. The third experiment was to find out if sesame seed could substitute for sesame meal in corn-soybean diets for broilers. Four graded levels (5% meal, 5% seed, 10% meal and 10% seed) of diets were used. Synthetic methionine was not used in the dietary treatments.

The broiler feeding trials were evaluated by measuring body weight gains, weight gains/bird, daily weight gain/bird, feed consumption, feed efficiency and mortality on weekly basis.

Carcass analysis was determined to evaluate the effects of the various dietary treatments on carcass characteristics. The cost of experimental diets were calculated and compared to the cost of the control diet.

iii) Feeds: All diets were isonitrogenous and almost isocaloric for each study. Diets were formulated to meet a standard of 2860 Kcal metabolizable energy per kilogram feed (M.E./kg) and 23 percent crude protein for starter rations; 2900 Kcal ME/kg and 20 percent crude protein for finishers in accordance with the recommendations of Olomu and Offiong (1980) for broilers raised in the tropics. The levels of sesame meal and seed, soybean meal, maize (corn) and bone meal were adjusted to maintain similar levels of protein, energy, calcium and phosphorus in the rations.

iv) Data Analysis: The data collected in the trials were subjected to analysis of variance (ANOVA) and significance of differences between means was determined by applying Duncan multiple range (DMR) test at the 5 percent level of significance according to Steel and Torrie (1980). Details of analysis of variance are presented in the tables and appendices enclosed.

D. BROILER PROCESSING TECHNIQUE FOR CARCASS ANALYSIS.

At the end of the third feeding trial, eight broiler birds were randomly selected from each of the dietary treatments for carcass analysis. The birds were placed

head downwards in slaughtering cones on a rack in the Animal Products Laboratory, Animal Science Department. The heads were severed from the neck one after the other with a sharp knife and the dead birds allowed to bleed for a few minutes. The dead birds were scalded in hot water and mechanically defeathered. The carcasses were then eviscerated. The carcasses with necks were weighed together for each group and expressed as a percentage of the liveweight. Similarly, the liver, thigh and drumstick, back, breast, and wing, neck and gizzard were removed and weighed separately and their relative weights calculated, that is calculated based on each of the carcass weights.

SECTION 1: OPTIMUM LEVEL OF SESAME MEAL IN A CORN-SOYBEAN MEAL DIET FOR BROILER CHICKENS

ABSTRACT.

Two feeding experiments were each conducted for eight (8) weeks to determine the optimum level of sesame (Sesamum indicum L.) meal inclusion in a corn-soy-bean meal diet for broilers. The experimental arrangement was a completely randomized design involving six experimental diets. These were five graded levels (10, 15, 20, 30 and 40 percent) of sesame meal diets. Each diet was fed to three replicate groups of fourteen Anak-80 broiler chicks. A total of 252 chicks were used for each of six treatment for the first and second experiments. Feed and water were provided ad libitum.

Results showed that broilers fed upto 15 percent sesame meal diets performed significantly ($P<0.05$) better than those fed the control diets for all the parameters studied in the two experiments. At 15 percent inclusion, final weight of broilers and mean daily gain/bird were 1477.50g and 25.63g respectively compared to control with 1307.9g and 23.4g for the seme parameters.

Mean feed consumption and feed gain ratio were, however, significantly ($P<0.05$) higher for the control than other experimental diets. The control values were 2550.4g and 1.83 compared to 15 percent sesame meal diet with 2239.30g and 1.78 respectively. Levels of 30 and 40 percent sesame meal in diets depressed body weight gains, weight gain/bird, feed consumption and feed gain ratio probably as a result of

high level of methionine which caused imbalance. It was concluded that the optimum level of sesame meal inclusion in broiler diets for maximum response without adverse effects in the two studies was 15 percent.

INTRODUCTION.

Sesame or Benniseed (Sesamum indicum L.) is a crop of great antiquity and probably one of the most ancient oilseed crops under cultivation today (Weiss, 1971; Rheneen, 1972). Sesame is cultivated in almost all developed and developing countries of the world. Sesame is a well-established crop in almost all parts of Nigeria (Weiss, 1971; Rheneen, 1972, Adenaike, 1985). Most of the sesame seeds produced in Nigeria since the early 1970 have been consumed domestically due to low demand for export (Rheneen, 1972; N.A.A.S., 1985). For instance, for the years 1971, 1979, 1980, 1981 and 1982 more than 61, 111, 44, 2 and 5 thousand metric tons respectively of sesame seeds were produced in Nigeria.

The earliest work on the protein of sesame meal was done by Rittenhausen in 1880. Several workers have pointed out that sesame meal is rich in methionine and tryptophan thus, a good supplement to soybean meal, groundnut cake, blood meal and other protein sources deficient in methionine. The only limiting amino acid appears to be lysine. The oil content of sesame may vary from as low as 35 to 57 percent (Johnson and Raymond, 1964; Weiss, 1971; Spensley et al., 1972; Oluyemi et al., 1976, EL-Tinay et al., 1972). Weis (1971) reported that the oil and protein contents of Nigerian varieties are relatively high, but the calcium content was rather low.

Sesame meal is reported to be well-liked by poultry and keeps well in storage.

Information on the optimum level of sesame meal inclusion in broiler diets is very limited and contraditory. Almquist (1953) recommended optimum level of 8 percent sesame meal of the diet. Armas and Chicco (1979) reported that broilers fed upto 24 percent sesame meal in a ration gave excellent gain and feed efficiency than groundnut cake supplemented with DL-methionine. Cuca and Sunde (1968) recommended sesame meal inclusion level of upto 18 percent of the starting and finishing broiler diets provided there was adequate lysine supplementation. They concluded that a sesame-soybean ratio of 25:9 gave an excellent broiler performance. However, Daghir and Rottensten (1967) reported that chicks fed a combination of soybean and sesame meals in the proportions of 10:20 plus 0.32 percent lysine attained a significantly higher body weights than those receiving all soybean diet supplemented with DL-methionine.

Though sesame meal has been used either as sole or supplementary protein and methionine sources for poultry in many countries, no research information is available on sesame meal inclusion for poultry in Nigeria. Considering the present exorbitant costs of synthetic methionine and conventional protein sources for poultry feed, a research into an indigenous, cheap and readily available source of methionine is imperative.

This study is therefore designed and conducted to find out the optimum level at which sesame meal (SSM) will supplement corn-soybean meal diets for broilers as a source of protein and methionine.

MATERIALS AND METHODS

The sesame seeds used in the two experiments were purchased from local Zaria market in Kaduna State. The seeds were of early variety grown in parts of Kano State. The seeds were mechanically crushed and the oil extracted at the United Oil Mills, Limited, Zaria, at a temperature and pressure of 72°C and 58kg/cm^2 respectively. The machine used was Rosedowns D-Type maximum oil expeller made by Rose, Downs and Thompson Limited, Hull, England. The warm sesame meal was spread on jute bags in aventilated aread to cool overnight.

The sesame meal was thoroughly mixed and four duplicate samples were taken for analytical preparations. About 500g of the duplicate samples were finely ground in a Willey hammer mill and proximate analysis was determined according to methods of A.O.A.C.(1975).

Two feeding experiments were conducted; each trial involving 252 day-old Anak-80 broiler chicks. The chicks were individually weighed, wing-banded and then randomly distributed in replicate groups of 14 chicks per replicate group at one day-old. Three such replicate groups were randomly alloted to each dietary treatment.

Six dietary treatments were involved in each of the experiments. Each of the experimental rations shown in tables 4 and 5 was fed. All starter diets contained approximately 23 percent crude protein and metabolizable energy (M.E.) of 2800 Kcal/kg while

Table 4: Composition of Broiler Starter diet with graded levels of sesame meal (Experiment'1 and 2)

Ingredients	Levels of Sesame Meal in Diets (%)					
	Control	10%	15%	20%	30%	40%
Maize	54.75	50.25	48.25	46.25	41.25	37.25
Sesame meal	-	10.00	15.00	20.00	30.00	40.00
Soybean meal	45. 0	36.00	33.00	30.00	25.00	19.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Common salt	0.50	0.50	0.50	0.50	0.50	0.50
Vit/Min. Premix*	0.25	0.25	0.25	0.25	0.25	0.25
	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:						
Crude protein (%)	23.10	23.00	23.20	23.20	23.40	23.40
M.E. (Kcal/kg)	2800.	2791.24	2787.8	2784.3	2765.55	2758.54
Ca (%)	1.0	1.20	1.24	1.35	1.50	1.70
P (%)	.80	.87	.90	.98	1.0	1.1
Lysine (%)	1.50	1.59	1.64	1.72	1.8	1.88
Methionine + cys.	.86	1.30	1.7	1.65	2.0	2.50
Fat (EE) (%)	4.0	4.95	5.0	5.90	6.8	7.70

*The commercial premix (David Knight Product) supplied per kg ration: Vit A 1500 I.U. Vit E 5mg, Vit D_3 3000 I.U. Vit. K 3mg, Vit B_1 2mg, Vit B_2 5.5mg Niacin 25mg, Vit. B_{12} 10ug, Choline 120mg, Manganese 5.2mg; Molybdenum 240mg; Zinc 25mg, Copper 2.6g, Folic acid 2mg; Iodine 2mg, Molybdenum 240mg, D.N.O.T. 60mg; Antioxidant 56mg; Iron 5,g; Pantothenic acid 10ug, Biotin 30.5g; Amprolium 12.5mg; Neoterramycin (tetracytline) 100mg, plus limestone flour.

finisher diets contained 20 percent crude protein and M.E. of 2880 Kcal/kg as recommended by Olomu and Offiong (1980) for broiler birds raised in the tropics. Feed and water were provided ad libitum.

Continuous electrical lighting supplemented with hurricane lamps were provided throughout the brooding period of 4 weeks. The birds were vaccinated against Newcaslte diesease (i/o) at one day-old and lasota at 3 weeks of age according to recommendations of Eidson and Kleven (1976) and (NVRI, Vom, 1984). Birds were weighed individually and weekly records were kept on weight gains, and feed consumption but mortality was recorded daily as it occured according to treatment groups thorughout the experimental period. Feed: gain ratio was calculated at the end of each trial.

All data were summarized on the basis of 28-day and 56-day intervals, that is, 0-4 weeks; 5-8 weeks and 0-8 weeks, respectively as shown in tables 6, 7 and 8. Data collected in the two experiments were subjected to analysis of variance, ANOVa, and significant differences between means were determined by applying procedures of Steel and Torrie (1980).

Table 5: Composition of Broiler Finisher diet with graded levels of sesame meal (Experiments 1 and 2)

Ingredients	Levels of Sesame Meal in Diets (%).					
	Control	10% Incl usion	15% Incl usion	20% Inclu usion	30% Inclu usion	40% Inclu usion
Maize	62.25	58.25	56.25	54.25	50.50	46.25
Sesame meal	-	10.00	15.00	20.00	30.00	40.00
Soybean meal	34.00	28.00	25.00	22.00	15.75	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Common salt	0.50	0.50	0.50	0.50	0.50	0.50
Vit/min Premix*	0.25	0.25	0.25	0.25	0.25	0.25
	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:						
Crude protein (%)	20.40	20.40	20.40	20.40	20.40	20.30
M.E.(Kcal/kg)	2890	2902.0	2882.0	2915.0	2885.0	2864.0
Ca (%)	1.0	1.20	1.24	1.35	1.50	1.70
P (%)	.80	.88	.90	.96	1.0	1.1
Lysine (%)	1.30	1.37	1.40	1.44	1.54	1.60
Methionine + Cys(%)	.75	1.20	1.34	1.56	1.97	2.33
Fat (E.E.) (%)	3.97	4.87	5.33	5.79	6.75	7.57

*The commercial premix (David Knight Product) Supplied per kg ration as in table 4.

RESULTS AND DISCUSSION

CHEMICAL COMPOSITION

The proximate chemical composition of the test ingredient is presented in table 6. The analysed crude protein content of sesame meal of 29.61 (% air dry basis) is considerably higher than the values of 19.9, 20.9 and 19.8 (% air dry basis) reported by Rheneen (1972) but lower than value (48.22%) reported by Oluyemi et al. (1976). The extract values of 56.4, 54.8 and 54.6 reported by Rheneen (1972) are remarkedly higher than the values 42.5, 43.4 43.2 and 49.3%obtained in the present study. They are, however, higher than 11.3% reported by Oluyemi et al. (1976). The crude fibre values of 4.2, 3.6 and 3.8% are almost in agreement with values of 3.6, 3.6 and 3.0% obtained by Rheneen (1972) but contrast with that of 6.38% reported by Oluyemi et al. (1976). Calcium and phosphorus values of 0.67 and 0.60% respectively are in agreement with those of Rheneen (1972) but lower than 1.04% reported by Oluyemi et al. (1976).

The variation in chemical compositions of the sesame meal and seed could be due to influences of location, varieties, season of the year, edaphic and climatic factors (Rheneen, 1972; EL-Tinay et al., 1972; Spensley et al. 1972).

PERFORMANCE OF CHICKS DURING 0-4 WEEKS.

WEIGHT GAIN: The results of feeding trials obtained in the two experiments (1 and 2) are summarized and presented in tables 6, 7 and 8. The data showed that treatment had a significant effect on the birds for the parameters studied. The two results agree

Table 6

PROXIMATE CHEMICAL COMPOSITION OF THE SESAME SEED AND MEAL USED IN RATION FORMULATION (% AIR DRY BASIS)

Variety (Type)	Dry Matter	Moisture	Crude protein	Fat Ether Extract	M.E. (Kcal Kg)	Crude Fiber	Ash	Ca	P	Mg
Sesame 'Kano' mealed	95.97	3.47	29.61	42.53	2646	4.20	4.26	0.67	0.60	0.29
Sesame 'Kano' Raw Seed	96.53	4.02	29.44	43.44	2670	3.60	3.49	0.42	0.45	0.29
Sesame 'Kano' Roasted	98.47	1.53	29.29	43.20	2664	3.58	3.68	0.42	0.45	0.27
Sesame 'Yandev' 55	95.88	4.12	29.82	49.29	2670	3.80	3.86	0.48	0.45	0.29

with respect to the response of the birds to the different levels of sesame meal tested for body weights, body weight gains, daily weight gains, feed consumption and feed efficiency.

For periods 0-4 weeks, 15 percent sesame meal diets produced birds with significantly ($P<0.05$) larger mean weight gain (650g) than the control with 592.58g. There was no significant ($P>0.05$) difference in weight gain between the control and 10 percent sesame meal diets. Birds fed the control diets performed significantly ($P<0.05$ better than those diets containing 20, 30 and 40 percent sesame meal diets. These values were 500.86g, 551.95g and 408.15g respectively as compared to 592.58g on control. Birds fed 40% sesame meal diets had the lowest weight gains compared to other dietary treatments in the trial.

Birds fed 15 percent sesame meal diets performed significantly ($P<0.05$) better for mean weight gain probably because of the balanced and stimulatory effect of methionine at this level. Even though the calculated methionine-cystine at this inclusion level appeared high, the actuall availability for proper functioning appeared adequate. This optimum level is contrary to the findings of Armas and Chicco (1972) who reported excellent body weights, body weight gains and feed conversion rate at 24 percent of sesame meal in broiler diets.

Table 6: Performance of broilers fed graded levels of sesame meal in corn-soybean meal diets. (Experiment 1.(0-4 weeks)

Level of Sesame Meal (%)	Av. wt. of broiler at wk 4	Av. wt. gain per bird	Av. wt. gain/ bird/day	Av. feed consumed	Feed/ Gain
0	592.58ab	554ab	19.766^{ab}	1015.87^{ab}	1.98^{ab}
10	585.43^{ab}	542.233^{ab}	19.466^{ab}	962.266^{ab}	1.80^{ab}
15	650^{a}	608.90^{ab}	21.76^{ab}	901.2^{ab}	1.47^{bc}
20	500.86^{cd}	469.423^{cd}	16.65^{cd}	832.7^{cd}	1.53^{b}
30	551.95^{bc}	511.253^{bc}	18.233	841.446^{bc}	1.83^{ab}
40	408.15^{e}	367.233^{e}	13.10^{e}	620.233^{e}	1.38^{c}
S.E.M.	34.88	35.13	1.26	63.14	0.11

*Means within the same column with the same superscript are not significantly different at 0.05 level of probability (P/0.05) while means not having the same letter superscript are significantly different at 0.5 probability (P/0.05).

S.E.M. * Standard error of the means.

FEED INTAKE AND FEED/GAIN RATIO.

There was no significant ($P<0.05$) difference in feed consumption between birds fed the control, 10 and 15 percent sesame meal diets. However, in terms of their mean values, birds fed the control diets consumed significantly ($P<0.05$) more feed (1015.87g) than birds fed 10 and 15 percent sesame meal diets with 962.26g and 904.2g respectively. Birds fed 15 percent sesame meal diets consumed significantly ($P<0.05$) higher feed than 20, 30 and 40 percent sesame meal diets with values of 832.7g, 841.45g and 620.23g respectively.

Reduced feed consumption of broiler chicks fed sesame meal diets at relatively high levels above 15 percent could be attributed to high fat levels of rations and methionine. As broiler chicks consume feed to meet their energy requirements (Scott et al., 1982), the chicks fed 20, 30 and 40 percent meal diets with fat contents higher (5,9, 6.8 and 7.7%) than N.R.C. (1984) recommended level of 3.0%, these birds consumed significantly ($P<0.05$) less feed compared to control, 10 and 15 percent sesame meal diets. The energy requirements of these birds on high sesame meal diets were met.

Ingestion of excess methionine and Lysine as table 4 and 5 indicated, might have resulted in accumulation of these amino acids in body fluids of the chicks (Boomgaardt and Baker, 1972;

1973; Waldroup et al., 1976). This excess amino acids probably triggered the reduction in feed intake that is characteristics of amino acid inbalance or toxicity. This reduced feed intake probably depressed body weight gain

There was no significant ($P/0.05$) difference in mortality due to dietary treatments within this period.

PERFORMANCE OF BROILER BIRDS DURING 5-8 WEEKS

WEIGHT GAIN:

For period 5 - 8 weeks, tables 7 indicated that there was no significant ($P>0.05$) difference in weight gain between birds fed 15 percent and the control diets. However, birds fed 15 percent sesame meal diets performed significantly ($P/0.05$) better than other dietary treatments. There was no significant ($P>0.05$) difference in weight gain between birds fed 20, 30 and 40 percent sesame meal diets.

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Table 7: Performance of broilers fed graded levels of sesame meal in corn-soybean meal diets. Experiment: 1 .(5 - 8 weeks).

Level of Sesame Meal (%)	Av. wt. gain per bird	Av. wt. gain/ bird/day	Av. feed consumed	Feed/ Gain
0	699.933^{ab}	24.966^{ab}	1534.67^{a}	1.80^{a}
10	495.199^{cd}	21.233^{bc}	1277.1^{a}	1.83^{a}
15	803.366^{ab}	28.70^{ab}	1200.7^{a}	1.98^{a}
20	554.033^{bc}	21.00^{cd}	791.25^{b}	1.53^{bc}
30	568.032^{bc}	21.133^{bc}	1136.37^{a}	1.47^{bc}
40	544.156^{bc}	19.433^{cd}	696.383^{b}	1.39^{c}
S.E.M.	77.17	1.76	142.50	.78

*Means within the same column with the same superscript are not significantly different at 0.05 level of probability (P/0.05) while means not having the same letter superscript are significantly different at 0.5 probability (P/0.05).

*S.E.M. = Standard error of the means.

Birds fed 15 percent sesame meal diets had significantly faster (P/0.05) mean weight gain than the control and other dietary treatements because of the balanced and stimulatory effect of methionine. This inclusion level that supported good weight gains is, however, contrary to the 8 and 10 percent of the broiler diets recommended by Almquist (1953) and Balloun (1980) for broiler chickens. This is probably because the protein level of sesame meal used in their trial was higher than the one used here.

FEED CONSUMPTION AND FEED: GAIN RATIO.

There was no significant (P 0.05) difference in feed consumption between birds fed the control, 10 and 15 percent sesame meal diets. Birds fed 20 and 40 percent sesame meal diets had the lowest (P/0.05) feed consumption with mean values of 791.25g and 696.383g respectively.

In terms of feed gain ratio, there was no significant (P 0.05) difference in feed gain ratio between birds fed the control, 10 and 15 percent sesame meal diets. There was also no significant (P>0.05) difference between birds fed 20 and 30 percent sesame meal diet. However, there was a significant (P/0.05) difference in feed: gain ratio between birds fed the control (1.803) and 40 percent diet (1.38); 40 percent sesame meal diet had the lowest (P/0.05) feed: gain ratio in all the dietary treatments.

Reduced feed consumption by birds on high level of sesame meal diets could be due to high or increased levels

of dietary fat and methionine. Though these birds had significantly (P<0.05) poor weight gains compared to birds on other dietary treatments, it appeared they made use of the little feed they consumed and thus had a significantly higher (P<0.05) feed conversion ratio than birds on low sesame meal inclusion.

There was no significant (P 0.05) difference in mortality due to dietary treatments within this period.

PERFORMANCE OF BROILER BIRDS DURING 0-8 WEEKS

WEIGHT GAIN:

For period 0-8 weeks of age, table 8 indicated that there was no significant (P>0.05) difference in weight gains between birds fed the control, 10 and 15 percent sesame meal diets. However, 15 percent sesame meal diets supported significantly (P<0.05) faster weight gain (1435.8g) than the control (1269.53g) and 10 percent meal diets (1204.52g) There was no significant (P>0.05) difference in weight gains between 30 and 40 percent sesame meal diets. For final weight, there was no significant (P>0.05) difference between birds fed the control, 10, 15 and 20 sesame meal diets. There was also no significant (P>0.05) difference between birds fed 30 and 40 percent sesame meal diets; and they (30 and 40 percent) sesame meal diets performed significantly (P<0.05) lower than other dietary treatments in the trial.

Table 8 : Performance of broilers fed graded levels of sesame meal in corn-soybean meal diets. Experiment 1. (0 - 8 weeks)

Level of Sesame Meal (%)	Av. wt of broiler at wk 8	Av. wt of gain per bird	Av. wt gain/ day	Av. feed consumed	Feed/ Gain
0	1307.93^{ab}	1269.52^{ab}	23.366^{ab}	2550.43^{a}	N.S 2:86
10	1251.72^{ab}	1204.52^{ab}	21.866^{ab}	2239.3^{b}	1.85
15	1477.5^{ab}	1435.8^{ab}	25.633^{ab}	2104.9^{b}	1.49
20	1346.62^{ab}	1306.32^{ab}	23.333^{ab}	2007.28^{b}	1.53
30	1157.62^{b}	1116.37^{b}	19.933^{b}	1977.81^{b}	1.83
40	968.116^{b}	927.399^{b}	16.533^{b}	1399.65^{c}	1.49
S.E.M.	108.68	107.88	1.94	125.776	0.37

*Means within the same column with the same superscript are not significantly different at 0.05 level of probability ($P>0.05$) while means not having the same letter superscript are significantly different at 0.5 level of probability ($P<0.05$).

*N.S. = Not statistically significantly different

*S.E.M. = Standard error of the means.

However, 15 percent sesame meal diets produced birds with significantly (P$<$0.05) higher weight gains (1477.50g) than the control (1307.93g).

The consistent better performances of birds fed sesame meal diets upto 15 percent inclusion and at older age, satisfactory performance at 20% inclusion level could be due to the ability of the older birds to use more dietary fat as a result of their increased physical activity and metabolic rate. Consequently, the birds fed 20% diets consumed more feed and more methionine for stimulatory growth and weight gains. The mean final weights of 1477.50g and 1346.62g obtained at 15 and 20 percent sesame meal diets respectively were significantly (P$<$0.05) higher than 1249g reported by Armas and Chicco (1979) using 24% sesame meal in broiler diet at the same end of week 8.

FEED: GAIN RATIO.

Even though feed: gain ratio. was not significantly (P$>$0.05) different at the end of week 8 for the first experiment, the control diet has a significantly (P$<$0.05) higher feed: gain ratio than other experimental diets, with 2.00 than 15 percent with 1.50. The birds fed 15 percent sesame meal diet had a significantly (P$<$0.05) better feed conversion ratio than the birds fed other experimental diets.

In fact, feed consumption and feed: gain ratio for the two experiments were consistently higher at the lower

levels of sesame meal inclusion. It could also be observed from table 8 that as the dietary sessme meal levels increased, especially beyond 20 percent, weight gains and feed consumption decreases. This is contrary to the findings of Armas and Chicco (1972) and (1979) who reported excellent weight gains and feed conversion rate at 24 and more than 25 percent respectively of sesame meal, in broiler diets. On the basis of their results, these workers recommended that sesame meal could be used upto 25 percent of broiler diets.

On the other hand, the findings of Almquist (1953) and Balloun (1980) that 8 and 10 percent respectively of sesame meal were recommended inclusion levels seemed to be in agreement with 10% level found in these experiments to be as good as the control. They found that 10 percent inclusion level supported excellent broiler performances without adverse effects. This was conformed in this experiment.

The results of these two trials suggest that 10 to 15 percent sesame meal could be included in the broiler diets without any detrimental effects. These results are closely related to the work of Cuca and Skirdo (1968). They reported that 18 percent sesame meal inclusion in broiler diets gave excellent body weight gains and low mortality. They concluded, however, that inclusion at 20 percent or more of the diets were not as good. This was confirmed in these two experiments as well.

From tables 4 and 5 fat levels increased with increased sesame meal levels. Fat levels of 5.9, 6.8 and 7.7 percent at 20, 30 and 40 percent sesame meal inclusion respectively were more than doubled N.R.C. (1984) recommended fat levels of 3.0 for both broiler starter and finisher rations. Since chicken consume feed to meet their energy requirments (Scott et al., 1982), the birds fed 20, 30 and 40 percent sesame meal diets consumed significantly ($P/0.05$) less feed than birds fed the control diet. The birds probably consumed less feed to meet their total nutrient requirments and thus resulted in depressed body weight gains compared to those on 15 percent sesame meal diet with good performance.

Though levels of protein and energy were kept reasonably constant, levels and ratios of the critical amino acids, lysine and methionine, in both the starter and finisher rations at 20, 30 and 40 percent were considerably too high. They were also in disproportionate amounts of 1.72: 1.65: 1.8: 2.0 and 1.88: 2.50 respectively with values recommended by Bornstein (1970) and NRC (1984) as methionine: lysine of 0.86: 1.25 and 0.75: 1.10 for starter and finisher rations respectively.

Ingestion of excess lysine and methionine might have resulted in accumulation of these amino acids in the body fluids of the birds (Boomgaardt and Baker, 1972; 1973; Waldroup et al., 1976; Olomu et al., 1981). This brobably caused the reduction in feed intake that is characteristic

of amino acid inbalance or toxicity. This reduced feed consumption probably depressed weight gains of the birds fed the high levels of sesame meal diets. The reduced feed intake might be a protective mechanism against excess and disproportionate lysine and methionine-cystine, a postulate that had earlier been propounded by Lewis (1963), Steve et al. (1975), Ptavnik and Bornstein (1978) and Daghir (1983).

There was no significant ($P>0.05$) difference in mortality due to dietary treatments within this period. There was also no leg deformities nor symptoms of vitamin A deficiencies due to the inclusion of sesame meal contrary to reports of Lease et al. (1960) and Balloun (1980).

SUMMARY AND CONCLUSION

It was found from the results of the two studies that the optimum level of sesame meal inclusion in broiler diets for maximum response in the two studies was 15 percent. It appears therefore, practicable to incorporate upto 15 percent sesame meal in broiler diets without adverse effects on the growth of broiler birds provided the rations contained other souces of protein with reasonable lysine content.

The birds fed 15 percent sesame meal diets in the two experiments consumed significantly less ($P<0.05$) feed than those birds fed the control diets. It appeared that the higher the level of sesame meal in the diets, the lower the feed consumption. This observation is probably not surprising

because as the sesame meal levels increased, dietary fat level increased. Since dietary fat is a source of energy and chickens consume feed to meet their energy requirments (Scott at al. 1982), birds fed high levels of sesame meal inclusion, consumed significantly less ($P<0.05$) feed compared to other diets in the trial.

The ANOVA for broiler data presented in **Appendices 1,2,3 and 4** showed that eventhough the variates: body weights, body weight gains, daily weight gains, feed consumption and feed gain:ratio responded to treatement, periods or varying age had no **Significant ($P>0.05$)** influence on birds response to the above variates as mean values for each trial of the two experiments followed a consistent pattern.

COMPARATIVE EVALUATION OF SESAME MEALAND SESAME SEED IN A CORN-SOYBEAN MEAL DIET FOR BROILERS

ABSTRACT:

An experiment was conducted for eight (8) weeks to find out if raw sesame seeds or Benniseed (Sesamum indicum L.) can be used as substitute for sesame meal in corn-soybean meal diet for broilers. The experimental arrangment was a completely randomized design involving five experimental diets. These were four graded levels of meal and seed (5% meal, 5% seed, 10% meal and 10% seed) in the diets. Each diet was fed to three replicates groups of Anak-80 broiler birds. A total of 180 chicks were used for the five (5) treatments. Feed and water were provided ad libitum.

Results showed that for periods 0-4 weeks, there was no significant ($P>0.05$) difference in weight gains, between birds fed 10% meal, 10% seed and the control diets. Results also showed that there was no significant ($P>0.05$) difference in feed consumption between birds fed 10% meal and the control diets. It was however, found that feed: gain ratio was significantly ($P<0.05$) higher for the control (2.10) than for birds fed 10% meal diet (1.7) at the end of week 4.

There was no significant ($P>0.05$) difference in weight gain and feed consumption between birds fed 5% meal and 5% seed diets at the end of week 4. However, birds fed 10% seed diet performed significantly ($P<0.05$) better than the two diets with 494.33g, 455.88g and 16.43g for body weight, body weight gain and daily gain respectively while

5% seed diet had 429.67g, 390.17g and 13.94g for the same parameters.

At the end of week 8, it was observed that only feed consumption and feed: gain ratio were the only variates that were significantly different. Feed consumption and feed: gain ratio were significantly ($P<0.05$) higher for control diet; 2501.50g and 2.0 than 10% meal; 2309.63g and 1.83 respectively. Birds fed 10% seed diet had the lowest ($P<0.05$) feed consumption (2065,23g) and best ($P<0.05$) feed: gain ratio (1.4) than the control diet (2501.50g) and 2.0 respectively.

At older age of broiler birds, it was found that sesame seed can be a good substitute for sesame meal as supplementary protein and methionine in broiler diets without adverse effects on their growth.

It was also noted from the study that considering the low level of industrialization in Nigeria, the use of sesame seed would have a ready appeal and acceptance to the local populace with no processing machinery for crushing and oil extraction to obtain the meal.

INTRODUCTION

Since early reports of Johnson and Raymond (1964) that sesame seed contained high oil, protein and some anti-nutritional factors, many processing methods have been adopted to improve its nutritional value for humans and monogastric animals. Weiss (1971) and Spensley et al. (1972) reported that sesame seed cuticle especially the black and white varieties had bitter tastes. They pointed out that decortification of the seeds produced a less bitter taste and therefore a more palatable foodstuffs for man and monogastric animals.

On chemical analysis however, they observed that decortification process considerably reduced the mineral, calcium and oxalic acid contents of the seeds but has little effect on the fat and protein contents, Shin (1976) obtained similar results. He further observed that crude protein, oil, iodine value and unsaturated fatty acids were significantly higher in seed than the decorticated sesame meal.

Lease et al. (1960) reported that broiler birds fed purified rations containing decorticated sesame meal as the sole source of protein, showed gross signs of leg abnormalities and retarded growth. They observed that growth was significantly improved and leg abnormalities or deformities greatly reduced when 60-120ppm of zinc were added to their ration.

Natarajan and Cama (1965) concluded that trypsin inhibitor was absent in raw sesame seed tested. They pointed out that high-steamed sesame meal had lower nutritive value than sesame meal. Dey et al. (1984) also reported non-beneficial effect with heat processing of sesame seed for poultry.

In view of Nigeria's low level of industrialization and its absence of appropriate machinery for milling sesame seed to obtain the meal, sesame meal is often not available in Nigeria. Moreover, it is normally very laborious and expensive to adjust and use the conventional milling machines which result to high sesame seed losses during the milling process. As sesame seeds are rich in protein, methionine and fat, they could be excellent supplements to feed ingredients that are low in methionine and could be a good source of energy, replacing part of the often scarce cereal grain in poultry diets.

Since sesame seed is readily available in Nigeria and the reported absence of antinutrients in the seeds, an evaluation of raw sesame seed for use in poultry diets was undertaken. The experiment described here was therefore, designed and conducted to compare the efficiency of utilization of sesame meal and seed in the diets for growing and finishing broiler chickens.

MATERIALS AND METHODS

The sesame seeds used in this study were purchased from local Zaria market in Kaduna State. The seeds were the early variety grown in parts of Kano State. Some representative samples of the seeds were taken for analytical preparations. The seeds could not be finely ground using Willey hammer mill because as the milling progressed, the seeds became sticky probably because of the high oil content. The seeds were therefore, pounded in a porcetain mortar to a fine texture. Proximate analysis was determined according to methods of (A.O.A.C., 1975) as shown in table 9.

180 day-old Anak - 80 broiler chicks were used in the experiment. The broiler chicks were individually weighed, wing-banded, and then randomly distributed into 15 equal replicate groups of approximately 12 birds per replicate. Three such replicate groups were alloted to each dietary treatment.

Five dietary treatments were involved. Each of the experimental rations shown in tables 10 and 11 was fed. All starter rations contained approximately 23 percent crude protein and metabolizable energy (M.E.) of 2800 Kcal/kg while finisher rations contained approximately 20 percent crude protein and 2850 M.E. Kcal/kg. Two parts of 750g of 2mm size grits were each heated in an electric oven at 120^{o}C for 15 minutes. They were each added to 5 and 10 percent seed seed rations to aid pulverization and digestion of the seeds

Table 10: Composition of Broiler starter diet with graded levels of sesame meal and seed. (Experiment 3).

Ingredients	RATIONS Control	5% meal	5% seed	10% Meal	10% seed
Maize	54.75	50.25	50.25	46.81	47.25
Sesame meal	-	5.00	-	10.00	-
Sesame seed	-	-	5.00	-	10.00
Soybean meal	41.50	41.00	41.00	39.44	39.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	.50	.50	.50	.50	.50
Vit/Min Premix*	.25	.25	.25	.25	.25
	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:					
Crude protein (%)	23.10	23.90	23.90	24.30	24.28
M.E. (Kcal/kg) ration	2800.00	2771.4	2771.4	2751.1	2756.24
Ca (%)	1.0	1.18	1.18	1.20	1.20
P (%)	.89	.89	.90	.88	1.00
Lysine (%)	1.50	1.62	1.61	1.64	1.75
Methionine + Cystine (%)	.86	1.04	1.05	0.95	0.93
Fat (EE) (%)	4.00	4.02	4.52	5.00	4.97

* The commercial premix (David Knight Product) supplied the followings per kilogram ration: vit. A, 1500 I.U., vit. B 5mg; vit D_3 3000 I.U., vit. K 3mg; vit. B_1 2mg; vit. B_2 5.5mg; Niacin 25mg; vit B_{12} 10ug; choline 120mg; manganese 3.2mg; cobalt, 0.6 mg; Zinc 25mg; copper 2.6mg; folic acid 2mg; iodine 2mg; molybdenumum 240mg; D.N.O.T. 60mg; Antixidant, 56mg; iron 5mg; pantothenic acid 10ug; Biotin 30.5mg; amprolium 12.5mg; neoterramycin (tetracycline) 100mg; plus limestone flour

Table 11: Composition of Broiler finisher diet with graded levels of sesame meal and seed. (Experiment 3).

Ingredients	Control	5% meal	5% seed	10% meal	10% sad
Maize	61.75	60.75	60.75	58.25	58.25
Sesame meal	-	5.00	-	10.00	-
Sesame seed	-	-	5.00	-	10.00
Soybean meal	34.00	30.50	30.50	28.00	28.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	.50	.50	.50	.50	.50
Vit/Min Premix*	.25	.25	.25	.25	.25
	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:					
Crude protein (%)	20.40	20.25	20.25	20.40	20.40
M.E. (Kcal/kg) ration	2892.0	2894.0	2894.0	2850.55	2850.55
Ca (%)	1.0	1.29	1.20	1.20	1.20
P (%)	.80	.85	.86	.88	.88
Lysine (%)	1.30	1.29	1.31	1.37	1.37
Methionine + Cystine	0.75	0.92	0.92	1.20	1.20
Fat (EE) (%)	3.97	3.89	3.90	4.87	4.87

*Same as in table 10.

according to Hoodge and Rowland (1978); Onwudike (1986).

Continuous electrical lighting supplemented with hurricane lamps were provided throughout the experimental period. The birds were vaccinated against Newcastle d disease (i/o) at one day-old and lasota at 3 weeks of age according to Eidson and Kleven (1976). Birds were weighed individually every week. Weekly records were kept in weight gains and feed consumption but mortality was recorded daily as it occured according to treatment groups throughout the experimental period. Feed: gain ratio was calculated at the end of each trial. Feed and water were provided ad libitum.

All data were summarized on the basis of 28-day and 56-day intervals, that is, (0-4 weeks, 5-8 weeks and 0-8 weeks) respectively as shown in tables 12, 13 and 14. Data collected in the expeiment were subjected to analysis of variance (ANOVA) and significant differences between means were determined by applying procedures of Steel and Torrie (1980).

RESULTS AND DISCUSSION

CHEMICAL COMPOSITION

The proximate chemical composition (% air dry basis) of the sesame meal and seed used in the expeiment is presented in table 9. The analysed crude protein of sesame meal and seed of 29.61 and 29.44 respectively are considerably higher than the reported values of 19.9, 20.9 and 19.8 (% air dry basis) by Rheneen (1972) but lower than 48.22% reported by Oluyemi et al. (1976). The rported other extract value of 56.4 by Rheneen (1972) is remarkedly higher than the values of 42.5 and 43.4 obtained in the present study. They are, however higher than 11.39% reported by Oluyemi et al. (1976). The crude fibre values of 4.2, 3.6 and 3.8% are almost in agreement with values of 3.6, 3.6 and 3.0 obtained by Rheneen (1972) but contrast with that of 6.38% reported by Oluyemi et al. (1976). Calcium and phosphorus values of 0.67 and 0.60% respectively are in agreement with these of Rheneen (1972) but lower than 1.04% reported by Oluyemi et al. (1976).

The variations in chemical composition of the sesame meal and seed could be due to influences of location, varieties, season of the year, edaphic and climatic factors (Rheneen,1972; EL-Tinay et al., 1972; Spensley et al., 1972).

PERFORMANCE OF BROILER CHICKS DURING 0-4 WEEKS

WEIGHT GAIN:

Data on body weight gains, daily weight gain, feed consumption and feed: gain ratio are presented in table 12.

For period 0-4 weeks of age, results showed that there was no significant ($P>0.05$) difference in weight gains between birds fed 10% sesame meal, 10% sesame seed and the control diets. Birds fed the control diet performed slightly better, though not significantly, with values of 544.67g, 506g and 18.1g for body weight, body weight gain and daily weight gain respectively than 10% seed diet with 494.33g, 455.88g and 16.43g for the same parameters. The control diet performed significantly ($P<0.05$) better than 5% meal and 5% seed diets for weight gains but there was no significant ($P>0.05$) difference in weight gains between birds fed 5% meal and 5% meal and 5% seed diets for period 0-4 weeks. Birds fed 5% meal and 5% seed diets performed significantly ($P<0.05$) poorer in weight gains compared to those fed 10% meal and 10 seed diets. There wa no significant ($P<0.05$) difference in weight gains between birds fed 10% meal and 10% seed in the diet.

Birds fed 10% meal diet had faster weight gains than birds fed 10% seed because the meal was already crushed thus enabling easier and more availability of the nutrients particularly methionine and dietary fat which stimulated faster growth and higher metabolic energy.

Table 12: Performance of broilers fed graded levels of sesame meal and seed in corn-soybean meal diets.

Experiments 3. (0 - 4 weeks)

Level of sesame meal (%)	Av. wt of broiler at wk 4	Av. wt of gain per bird	Av. wt gain/ bird/ day	Av. feed consumed	Feed/ GAIN RATIO
0	544.666[a]	506[a]	18.076[a]	1093[a]	2.1[a]
5% meal	420.833[b]	382.666[b]	13.633[b]	624.33[b]	1.626[b]
5% seed	429.666[b]	390.166[b]	13.94[b]	549[b]	1.403[c]
10% meal	570.433[a]	531.266[a]	18.963[a]	919.333[a]	1.703[b]
10% seed	494.333[a]	455.876[a]	16.433[a]	412[b]	1.406[c]
S.E.M.	32.68	32.80	1.19	85.55	0.078

This observation is in agreement with the findings of Renner and Hill (1960) who reported that crushing of seed meals ensured more availability of the oil to the digestive enzymes and thus better performance of the chickens.

Though the calculated analysis in tables 4 and 5 indicated balanced methionine, it appeared the quantity actually provided by 10% seed diet was more adequate and therefore enhanced faster weight gains than the birds fed 5% meal or 5% seed diets. Also at this age, enough seeds may not have been digested at 5% levels of inclusion.

FEED INTAKE AND FEED: GAIN RATIO.

There was no significant ($P>0.05$) difference in feed consumption between birds fed 10% sesame meal and the control diets but they were significantly ($P<0.05$) higher than other dietary treatments. There was also no significant ($P>0.05$) difference in feed consumption between birds fed 5% meal and 5% seed diets. However, birds fed 5% meal and 5% seed diet had significantly ($P<0.05$) higher feed consumption with values of 624.33g and 549g respectively than birds fed 10% seed diet with 412g. Birds fed 10% seed diet consumed the lowest quantity of feed at the end of week 4. This was because as chemical analysis in bable 6 indicate, the seed contained more dietary fat that are sources of energy. As birds consume feed to meet their energy requirements (Scott et al. 1982) and with higher fat content in the 10% seed diet, the birds consumed significantly ($P<0.05$) less feed than birds fed other diets.

Feed: gain ratio was significantly ($P<0.05$) higher for the control (2.1) than 10 percent meal diet (1.7) and other dietary treatments. Birds fed 5% seed diet had the best feed conversion ratio of 1.4 compared to 5% meal with 1.68. There was no significant ($P>0.05$) difference in feed: gain ratio between 5% and 10% meal diets.

There was also significant ($P>0.05$) difference in mortality due to dietary treatments during the period 0-4 weeks of age.

PERFORMANCE OF BROILER BIRDS DURING 5-8 WEEKS
WEIGHT GAIN AND FEED: GAIN RATIO

For the period 5-8 weeks, only daily body weight gain and feed: gain ratio were significant as shown in table 14. There was no significant ($P>0.05$) difference in daily body weight gain between birds fed 5% seed and 10% meal diets but 5% seed (29.50g) and 10% meal (29.65g) diets were significantly ($P<0.05$) higher than the control (26.03g) diets. Birds fed 5% meal diet had the lowest ($P<0.05$) daily weight gain of 23.88g. The control diet performed significantly ($P<0.05$) higher (26.03g) than birds fed 10% seed diet with 25.72g.

The improved weight gains on birds fed 5% seed diet could be due to the development with age of muscular gizzards. The birds were probably able to degradate the raw seeds efficiently thus making methionine and fat more readily available for faster weight gains. In the case of 10% seed diets, less feed was consumed and probably less feed nutrients were

Table 14: Performance of broilers fed graded levels of sesame meal and seed in corn-soybean meal diets (Experiment 3 (5 - 8 weeks)

Level of sesame meal (%)	Av. of gain per bird	Av. wt gain/ bird/day	Av. feed consumed	Feed/Gain ratio
0	731.533	26.033^{b}	1075.14	1.926^{b}
5% meal	668.406	23.876^{d}	1383.15	2.05^{a}
5% seed	578.50	29.50^{a}	1639.95	1.983^{b}
10% meal	830.733	29.65^{a}	1497.97	1.796^{c}
10% seed	720.333	25.716^{c}	1273.64	1.766^{c}
S.E.M.	156.8	0.079	118.42	0.045

available for optimum utilization.

Birds fed 5% meal diet had significantly ($P<0.05$) higher feed: gain ratio (2.05) than the control diet (1.93). There was no significant ($P>0.05$) difference in feed: gain ratio between the birds fed the control and 5% seed diets; but birds fed control (1.93) and 5% seed (1.98) had significantly ($P<0.05$) higher feed: gain ratio than 10% meal (1.79) and 10% seed (1.76) diets. There was also no significant ($P>0.05$) difference between birds fed 10% meal and 10% seed diets.

This parity or non-significant differences in feed: gain ratio at older age of the birds could be due to the development of muscular gizzards. The developed gizzard, according to Onwudike (1986) enhanced efficient pulverization of the raw seeds, availability and abosrbability of the feed nutrients particularly the dietary fat and methionine and thus comparable performance of broiler birds fed seed and meal diets at older age.

There was no significant ($P>0.05$) difference in mortality due to dietary treatments during this period.

PERFORMANCE OF BROILER BIRDS DURING 0-8 WEEKS

FEED INTAKE AND FEED: GAIN RATIO.

For the period 0-8 weeks of age, only feed consumption and feed: gain ratio were significant as indicated in table 15. Birds fed the control diet consumed significantly ($P<0.05$) higher feed (2501.50g) than those fed 10% meal diet (2309.63g).

Table 15: Performance of broilers fed graded levels of sesame meal and seed in corn-soybean meal diets Experiments 3 (0 - 8 weeks).

Level of sesame meal (%)	Av. wt of broiler at wk 4	Av. wt gain	Av. wt. gain/ bird/day	Av. feed consumed	Feed/Gain ratio
0	1273.87	1235.20	22.05	2501.48^{a}	2.00^{a}
5%	1275.98	1237.82	22.103	2217.35^{bc}	1.786^{b}
5%	1321.37	1281.87	22.866	2188.95^{c}	1.693^{c}
10%	1285.03	1245.87	22.10	2309.63^{b}	1.826^{b}
10%	1255.93	1217.53	21.74	2065.23^{d}	1.696^{c}
S.E.M.	26.40	2.628	0.44	46.08	0.036

Birds on control diet also consumed significantly ($P<0.05$) higher feed (2501.50g) than those fed 5% meal diet (2217.85g); while birds fed 5% meal diet consumed significantly ($P<0.05$) higher feed (2217.85g) than those fed 5% seed diet (2188.9g). Birds fed 10% seed diet consumed significantly ($P<0.05$) less feed (2065.23g) than birds on other dietary treatments.

Birds fed control diet had significantly ($P<0.05$) higher feed: gain ratio (2.0) than 5% meal (1.8) and 10% meal diets (1.83). There was no significant ($P>0.05$) difference in feed: gain ratio between birds fed 5% meal and 10% meal diets. There was also no significant ($P>0.05$) difference between birds fed 5% seed and 10% seed diets.

At older age of broiler birds and well developed muscular gizzard, there was high efficiency of utilization of sesame seeds comparable to sesame meal diets. This efficient utilization of sesame seed diets probably resulted to non-significant differences observed in weight gains between birds fed the seed and meal diets. This observation is similar to the findings of Onwudike (1986) and Carew et al. (1961) who reported that developed muscular gizzard caused disruption of the cellular structure of seed diets during digestion. This made the oil and other nutrients more available to the digestive enzymes for faster weight gains of the birds. The relatively poor weight gains of birds fed 10% seed diet compared to other dietary treatments could be due to low level of available nutrients

especially methionine and utilizable calories beacuse of poor degradation, digestion and oil absorption (Carew and Nesheim, 1962).

It was observed that there was no significant ($P>0.05$) difference in mortality due to dietary treatments within this period. There was also no leg abnormalities nor symptoms of vitamin A defciencies due to the use of raw sesame seed as reported by Lease et al. (1960) and Balloun (1980).

CONCLUSION

Results showed that at older age of broiler birds, sesame seed can be a good substitute for sesame meal as supplementary protein and methionine in the diets for broiler chickens.

It was also found that at 5% sesame seed inclusion, the efficiency of utilization tended to be more than at 10% seed inclusion. Considering the high cost of sesame seed, it is reasonable to recommend optimum level of inclusion of the seed to be 5% provided the rations contained other protein sources with reasonable lysine content.

It could be concluded that considering Nigeria's low level of industrialization, the use of sesame seed in poultry diets would have a ready appeal and acceptance to the local populace with no processing machinery for oil extraction to obtain the meal.

The use of the sesame meal and seed would also help in saving of the scarce foreign exchange on importation of synthetic methionine.

EFFECT OF GRADED LEVELS OF SESAME MEAL AND SESAME SEED ON BROILER CARCASS AND ORGAN WEIGHT

ABSTRACT:

At the end of the feeding trial, eight broiler birds were randomly selected from each of the 8 dietary treatments to determine the effects of the sesame meal and seed on the carcass characteristics and organ weights of the broilers. The birds were sacrificed and the carcases with necks were weighed for each group and expressed as a percentage of the live weights.

Results showed that 15% sesame meal diet produced birds with significantly ($P<0.05$) larger dressing percentage (81.22%) than the control diet (75.48) Birds fed 5% sesame meal diet also had significantly ($P<0.05$) large dressing percent (80.44%) than those on control diet (75.48%). Birds fed 5% meal diet was followed in dressing percent by those fed 30% meal and 5% sesame seed diets with 77.48% and 76.77% respectively. There was no significant ($P>0.05$) difference in dressing percent between birds fed 10% meal, 20% meal, 10% seed and those on control diets. There was also no significant ($P>0.05$) difference in dressing percent between wing and back, breast, thigh and drumstick for the birds fed the eight dietary levels.

INTRODUCTION

Nutritionally, meat is an excellent source of high quality protein, B-complex vitamins, and certain minerals especially iron. Meat is easily digested, and when cooked, meat supplies nutrients which contribute significantly to the dietary balance of meals (Ogundipe, 1980; Wronoski, 1984).

Broiler meat constitutes those broiler flesh or tissues that have undergone physical or biochemical changes which are suitable for use as human food (Lawrie, 1979). Quality grades of meat are primarily intended to reflect differences in eating quality. According to Price and Schweigert (1976), quality as used in grading meat, refers to its expected palatability, flavour, tenderness, juiciness and odour or aroma. In fact, meat quality implies enjoyment of eating meat.

Quality of broiler meat and indeed other meat, is markedly influenced by species, sex, age, heredity, and level of nutrition of the animal (Nordstrom et al., 1978; Salleh et al., 1976; Becker et al., 1981; Wronoski, 1984). There are, however, other views on factors influencing quality of meat. Tulloh (1964) contended that carcass composition is weight-dependent and largely uninfluenced by age or nutritional regime. In contrast, Harmmon (1982), Lodge (1970), Tourille et al. (1983) and Delica et al. (1985) reported that age had an important effect on meat chemical composition and quality, while growth rate per se had no significant effect. They observed that meat tenderness and juiciness decreased and

flavour increased as age of broilers is increased from 9 to 16 weeks. Delica et al. (1985) concluded that consumer studies showed tenderness to be the most important factor in the acceptance of broiler and other livestock meat.

Summer and Leeson (1980), Ogundipe (1980) and Rosebrough et al. (1982) pointed out that level of nutrition influences meat quality remarkedly. Ogundipe (1980) contended that tissue lipids are derived from dietary lipids as well as lipogenesis. Therefore, fat intake influences not only the quality of lipogenesis but also the quality of lipids in various tissues. He concluded that significant amounts of dietary lipids could change the fatty acid composition of tissue lipids to a large extent. Coon et al. (1981) and Delica et al. (1985) concluded from their studies that widening the dietary energy : protein ratio increase fat deposition in broilers while narrowing the dietary energy: protein ratio decreases fat deposition. Since some feeds such as fishmeal and groundnut cake (Ogundipe, 1980) have a carry-over effect on carcass, the significance of this carcass analysis is to find out if sesame meal or seed significantly improve the carcass quality parameters.

This carcass analysis of broiler meat was therefore, conducted to:

a) determine the effects of the dietary sesame meal and seed treatments on the carcass characteristics and organ weights of broiler chickens.

MATERIALS AND METHODS

Local sesame seeds were mechanically crushed and oil extracted at temperature and pressure of 72°C and 58kg/cm^2 respectively and the meal was obtained. Both the meal and raw seed were ground to a fine texture using Willey hammer mill and porcelain mortar respectively. Their proximate analysis was determined according to methods of (A.O.A.C., 1975) and presented in table 6. Diets were formulated on graded levels (5,10,20 and 30 percent meals; 5 and 10 percent seeds). Each diet was fed to three replicate groups of twelve birds per group from one day-old to 8 weeks of age.

At the end of the feeding trial, eight broiler brids were randomly selected from each of the 8 dietary treatments for carcass analysis. The birds were placed heads downwards in slaughtering cones on a rack. Their heads were severed from the neck one after the other with a sharp knife. The dead birds were allowed to bleed for a few minutes. They were scalded in hot water and mechanically defeathered. The carcasses were then eviscerated. The carcasses with necks were weighed together for each group and expressed as a percentage of the liveweight. Similarly, the liver, thigh and drumstick, back, breast, backwing, neck and gizzard were removed and weighed separately and their percentage relative weights calculated.

RESULTS AND DISCUSSION

CHEMICAL COMPOSITION

The proximate chemical composition (% air dry basis) of the the sesame meal and seed used in the experiment is presented in table 6. The analysed crude protein of sesame meal and seed of 29.61 and 29.44 respectively are considerably higher than the reported value of 19.9% by Rheneen (1972) but lower than 48.22% reported by Oluyemi et al. (1976). The reported either extract value of 50.4% by Rheneen (1972) is remarkedly higher than the values of 32.50 and 43.40 obtained in the present study. They were however, remarkedly higher than 11.39% value reported by Oluyemi et al. (1976). The calcium and phosphorus values of 0.67 and 0.60% respectively obtained in the study are in agreement with Rheneen (1972) but lower than 1.04% obtained by Oluyemi et al. (1976).

The variations in chemical compositions of the sesame meal and seed could be due to influences of varieties, location, season of the year, edaphic and climatic factors (Rheneen, 1972; Spensley et al., 1972).

CARCASS ANALYSIS

The ANOVA table 17 for carcass analysis showed that dietary treatment had significant effect on birds only for dressing percent. Results showed that birds obtained from 15 percent sesame meal diet had significantly ($P/0.05$) larger dressing percent (81.22) than the control diet (75.48). Birds obtained from 5% meal diet also had significantly langer dressing percent with 80.44% than the control diet with 75.48%.

Table 17 : Effects of graded levels of sesame meal and sesame seed on carcass parameters.

Level of sesame meal and seed (%)	Wt. gain at 8 wks	Dressing (%)	Wing and Back (%)	Breast (%)	Thigh and drum-stick (%)
0	1235.20	75.481^{bc}	39.524	20.025	32.85
10	1245.87	74.207^{d}	38.422	20.618	32.103
15	1435.80	81.218^{a}	42.125	20.325	33.387
20	1306.32	76.306^{bc}	38.487	20.162	32.449
30	111.37	77.481^{bc}	38.90	21.337	31.937
5 meal	1237.82	80.443^{ab}	38.262	20.887	32.287
5 seed	1281.87	76.768^{bc}	38.262	21.262	31.137
10 seed	1217.53	74.98^{c}	37.856	21.849	31.775
S.E.M.		2.2	4.70	3.35	4.70

The performance of birds fed 5% meal diet was followed by those fed 30% meal and 5% seed diets with 77. 48% and 76.77% respectively. There was no significant ($P > 0.05$) difference in dressing percent between the birds fed control 10% meal, 20% meal and 10% seed diets. There was also no significant ($P > 0.05$) difference due to dietary treatments in wing and back, breasts, thigh and drumstick percents.

The dressing percent of 81.22 and 80.44 obtained in the study for 15% meal and 5% meal diets are considerably higher than 76.7% reported by Stadelman (1984). However, 77.48% and 76.77% obtained in the study for 30% meal and 5% seed diets respectively agree with 76.7% reported by Stadelman (1984). The value 75.48% obtained for the control diet is slightly lower than 76.7% reported by the same author.

The increased meat yield at 15% sesame meal diet could be due to balanced and stimulatory effect of methione at this inclusion level. Salzer (1985) reported similar non-significant differences in wing and back, breasts, thigh and drumstick percent.

FEED COST PER KILOGRAM WEIGHT GAIN

Feed cost analysis on the use of sesame meal and seed as sources of protein and methione for broiler chickens have shown positive results (Balloun, 1980). Broiler birds on diet 3 of experiments 1 and 2 containing 15 percent sesame meal in-clusions showed a better response in the cost (₦) of feed used to produce one kilogram body weight gain. It cost only ₦1.88 to produce 1 kilogram body weight gain when 15 percent sesame meal was given in both experiments 1 and 2. This value was lower than the cost of feed per kilogram weight gain obtained from the control (₦2.45) and 10 percent (₦2.25) sesame meal inclusion. An increase in feed cost (₦) per kilogram weight gain was observed with increasing levels of sesame meal at 20%, 30% and 40% with values of ₦2.06, ₦2.14 and ₦2.46 respectively. As previously noted, higher levels of sesame meal inclusion (30 and 40 percent) probably resulted in lowered body weight gain. This effect would cause an increase in the cost of broiler production.

In experiment 3, broiler birds fed 5% seed diet, produced a kilogram of body weight gain at lower cost (₦1.90) when compared to those that were fed the control (₦2.47), 5% meal (₦2.0), 10% meal (₦2.24) and 10% seed (₦2.05) diets. It appeared that proper levels of sesame meal and seed inclusions in corn-soybean meal diets tended to decrease the feed cost per kilogram of broiler birds produced in line with Cuca

Table 16 : RELATIVE COST OF EXPERIMENTAL DIETS TO CONTROL

COSTS OF FEED INGREDIENTS AT THE TIME OF EXPERIMENT, AUGUST 1987

1. Maize (White Corn), 1bag Approx. 95kg = ₦65.0 : 1kg = 68k
2. Sesame seed, 1bag Approx. 80kg, ₦180/80kg : 1kg = ₦2.25 including mealing at ₦125 for the ten (10) bags.
3. Soyabean meal, 1ton of 1,000kg = ₦1,800 : ₦1.80/kg
4. Bone meal, 50kg @ ₦25.00 : 50k/kg
5. Table Salt cost ₦30/bag of 18kg: 1kg cost ₦1.67
6. Mineral and Vitamin Premix = ₦750/bag of 25kg : ₦30/kg
7. Methionine = ₦700/bag of 25kg : 1kg cost ₦28.00

RELATIVE COST OF STARTER DIETS (CONTROL TO EXPERIMENT)

FEED INGREDIENTS	Diet 1 (CONTR)	Cost (₦)	Diet 2	Cost (₦)	Diet 3	Cost (₦)	Diet 4	Cost (₦)	Diet 5	Cost (₦)	Diet 6	Cost (₦)
Maize	54.75	37.23	46.81	31.83	28.25	32.81	42.95	29.20	38.45	26.15	34.85	23.70
Sesame meal	.5g*	₦2.24	10.00	22.50	15.00	33.75	20.00	46.00	30.00	67.50	40.00	90.00
Soyabean meal	41.50	74.7	39.44	71.00	33.00	59.4	33.3	59.94	27.8	50.0	21.40	38.52
Bone meal	3.0	1.5	3.0	1.5	3.0	1.5	3.0	1.5	3.0	1.5	3.0	1.5
Salt	0.5	.84	0.5	.84	0.5	.84	0.5	.84	0.5	.84	0.5	.84
Vit/Min. Premix	0.25	7.50	0.25	7.50	0.27	7.50	0.25	7.50	0.25	7.50	0.25	7.50
Total	100kg	124.0	100kg	137.17	100kg	135.8	100kg	143.9	100kg	153.49	100kg	162.06
Cost/25kg Bag	₦31.0		₦34.3		₦34.0		₦36.0		₦38.37		₦40.52	

RELATIVE COST OF FINISHER DIETS (CONTROL TO EXPERIMENT)

FEED INGREDIENTS	Diet 1 (CONTR)	Cost (₦)	Diet 2	Cost (₦)	Diet 3	Cost (₦)	Diet 4	Cost (₦)	Diet 5	Cost (₦)	Diet 6	Cost (₦)
Maize	61.75	42.00		39.27	55.75	37.91	53.75	36.65	50.50	34.0	45.75	31.11
Sesame meal	.5g*	1.60	10.0	22.5	15.0	33.75	20.0	45.0	30.0	67.5	40.0	90.
Soyabean meal	34.0	61.20	28.0	50.40	25.0	45.0	22.0	39.6	15.75	28.35	10	18.0
Bone meal	3.5	1.75	3.5	1.75	3.5	1.75	3.5	1.75	3.5	1.75	3.5	1.75
Salt	0.5	.84	0.5	.84	0.5	.84	0.5	.84	0.5	.84	0.5	.84
Vit/Min. Premix	0.25	7.5	0.25	7.5	0.25	7.5	0.25	7.5	0.25	7.5	0.25	7.5
Total	100kg	114.97	100kg	122.25	100kg	126.73	100kg	131.34	100kg	140.00	100kg	149.2
Cost/25kg Bag	₦28.74		₦30.60		₦31.7		₦32.84		₦35.0		₦37.3	

*Added synthetic Methionine

and Skirde (1968); Balloun (1980). It will be seen that the inclusion of sesame meal particularly at 15 perecent levels in the diets in experiments 1 and 2 drastically reduced the level of incorporation of soybean meal, an expensive protein ingredient which consequently reduced the feed cost per kilogram weight gain of the broiler birds.

SUMMARY AND CONCLUSION

It was found that broiler birds fed 15% sesame meal and 5% sesame seed diets had the lowest feed cost per kilogram weight gain than other inclusion levels in the trials. Higher levels of sesame meal inclusion resulted in lowered body weight gain and increased feed cost per kilogram gain of the birds.

It could be concluded that for sesame meal to be used as a a cheap source of protein and methionine in corn-soybean meal based diets, the inclusion level must not exceed 15 percent. Even though the feed cost per kilogram weight gain for the 5% meal and 5% seed diets seemed closed to each other, considering the scarcity of sesame milling machines in Nigeria, wastage of seeds during milling processes and the labour involved, it is recommended that between 5 to 10% seed be used in corn-soybean meal based diets for broilers.

SUMMARY AND CONCLUSION (GENERAL)

One of the important considerations of a feedstuff that is to serve as a protein source for livestock and in particular, poultry, is its balance of amino acids (Panjhan, 1980; Offiong, 1984). In the protein of plant origin, the amino acid lysine and the sulphur amino acids, methionine and cystine, may be limiting for growth and other productive functions, Although sesame protein may be deficient in lysine (Almquist, 1953; Johnson and Raymond, 1964; Weiss, 1971; Spensley et al., 1972; Balloun, 1980), Armas and Chicco (1979) reported that sesame seed has an excellent amino acid balance. The relative lysine level appears to be limiting. However, the level of critical amino acid, methionine, is high and this suggests that sesame meal or seed can be used as excellent supplementary protein and methionine to other sources rich in lysine.

From the beginning of research on sesame as ingredients for poultry diets by Rittenhansen in 1880 and Almquist in 1953, it had become obvious that optimum level of inclusion and efficiency of utilization of sesame varied and often contradictory. The results varied sometimes because of the variation in chemical composition of the seed which changed freqeuntly depending on varieties, location and climatic factors (Rhenoen, 1972; El-Tinay, 1977; Godfrey-Sam-Aggrey et al. 1985.

Toxic factors have often been incriminated as constituents of sesame meal and seed. There are opinions that these toxic substances or antinutrients hinder officient utilization of some mineral elements when sesame is used as ingredients for poultry feeds. Balloun (1980) reported zinc and phosphorus deficiency and subsequent leg abnormalities in chicks fed sesame meal. Godfrey-Sam-Aggrey et al. (1985) reported presence of oxalic and phytic acids. Balloun (1980) in particular noted that presence of oxalates and phytates in sesame bind zinc, phosphorus and calcium ... comples formation and make these mineral elements unavailable to birds. He concluded that unavailability of these mineral elements cause leg deformities in chicks. Johnson and Raymond (1964) reported low level of vitamin A in sesame seed but without its deficiency symptoms in chicks.

However, chemical analysis on Nigerian sesame varieties done in London by Rheneen (1972) and in Nigeria by Oluyemi et al. (1976) did not indicate presence of any of the above reported antinutrients. Moreover, the bioassay of the present study in chicks did not show abnormalities that could be directly related to dietary mineral and vitamin defficiency symptoms.

This study is therefore conducted to determine the possible use of sesame meal; the optimum level of sesame meal inclusion and the comparative evaluation of sesame meal and seed in poultry rations in Nigeria. The effects of

graded levels of sesame meal and seed on carcass characteristics was investigated in the study. The following results were obtained:-

From the results of the three feeding experiments, it was found possible to use sesame meal and seed in broiler diets without adverse effects on body weights and daily weight gains.

The broiler chicks fed upto 15 percent sesame meal diets performed significantly ($P > 0.05$) better than the control for all the broiler parameters studied. The optimum level of sesame meal in broiler diets for maximum response in the first two studies was 15 percent. This optimum level could be used provided the ration contained adequate sources of lysine.

Higher levels of sesame meal diets above 20% tended to depress body weight, daily weight gain and feed consumption probably as a result of such levels resulting in high levels of methionine and lysine which may not be in balanced proportions to the requirement of the chickens.

The broiler chicks fed the sesame seed diets performed satisfactorily compared to the birds fed the control diet for all the parameters studied in the third experiment. Sesame seed can therefore be a good substitute for sesame meal as supplementary protein and methionine in the diets of broiler chickens. Upto 10 percent seed could be used in broiler diets without detrimental effects provided the rations contain adequate supplementary lysine sources.

Results of the three feeding experiments showed that the higher the inclusion levels of either the sesame meal or seed in the diets, the lower the feed consumption by the birds.

There were no significant ($P>0.05$) differences due to dietary treatments between broiler meat fed the 15 percent sesame meal, control and other dietary treatments for carcass parameters and organ weights of the birds. Sesame meal and seed can therefore, be fed to broiler birds upto 15 and 10 percent respectively without adverse effects on their carcass characteristics.

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Experiment 1. Optimum level of supplementing sesame meal in a corn-soybean meal diet for broilers.

ANOVA SUMMARY TABLE

Appendix 4 : Av. wt. Broilers at wk 4 0-4 weeks.

Source of variation	df	SS	MS	Cal. f	Table f.
Between treatment	5	107131	21426.1	11.74**	3.11 at .05
Within treatments	12	21909	1825.75		
Total	17	129040			

S.E.M. 34.88

**Indicates significant differences due to treatment.

Appendix 5: Av. wt. gain/bird

Source of variation	df	SS	MS	Cal. F	Table f.
Between treatments	5	104336	20867.1	11.27**	3.11 at .05
Within treatments	12	22218	1851.5		
Total	17	126554			

S.E.M. 35.15

**Indicates significant differences due to treatment.

Appendix 6: Av. wt . gain/bird/day.

Source of variation	df	SS	MS	Cal. f	Table f.
Between treatments	5	135.312	27.06	11.36**	3.11 at .05
Within treatments	12	28.5815	2.382		
Total	17	163.893			

S.E.M. 1.26

**Indicates significant differences due to treatment.

Appendix 7 : Av. feed consumed

Source of variation	df	SS	MS	cal. f	Table f.
Between treatments	5	285712	57142.4	9.555**	3.11 at .05
Within treatments	12	71764	5980.33		
Total	17	757476			

S.E.M. 63.14

**Indicates significant differences due to treatment

Appendix 8 : Feed efficiency

Source of variation	df	SS	MS	Cal. f	Table f.
Between treatments	5	.10499	.021	1.2	3.11 at .05 N.S.
Within treatments	12	.2100	.018		
Total	17	.314			

S.E.M. 0.11

N.S. = Not significant

Appendix 9 : Av. wt. gain/bird 5-8 weeks

Source of variation	df	SS	MS	cal. f	Table f
Between treatments	5	203649	40729.7	4.56*	3.11
Within treatments	12	107200	8933.33		
Total	17	310849			

S.E.M. 77.17

*Indicates significant differences due to treatment.

Appendix 10: Av. wt gain/bird/day

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	177.878	35.5756	7.68**	3.11 at .05
Within treatments	12	55.5859	4.6322		
Total	17	233.463			

S.E.M. 1.76

**Indicates significant differences due to treatment

Appendix 11 : Av. Feed consumed

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	1.47×10^6	293864	4.35*	3.11 at .05
Within treatments	12	810560	67546.7		
Total	17	$s.28 \times 10^6$			

S.EM 212.20

*Indicates significant differences due to treatment.

Appendix 12 : Feed efficiency

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	.8514	.1703	18.342**	3.11 at .05
Within treatments	12	.1114	.0093		
Total	17	.962			

S.E.M. 0.78

**Indicates significant differences due to treatment.

Appendix 13 : Av. wt. of broiler at wk 8

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	457282	91456.4	5.161**	3.11 at .05
Within treatments	12	212642	17720.2		
Total	17	668924			

S.E.M. = 10[illegible].68

**Indicates significant differences due to treatment.

Appendix 14 : Av. wt. gain/bird

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	457398	91479.6	5.29**	3.11 at .05
Within treatments	12	209518	17459.8		
Total	17	666916			

S.E.M. = 108.88

**Indicates significant differences due to treatment

Appendix 15: Av. gain/bird/day

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	151.541	30.308	5.37**	3.11 at .05
Within treatments	12	67.725	5.644		
Total	17	219.265			

S.E.M. 1.94

**Indicates significant differences due to treatment.

Appendix 16 : Av. feed consumed

Source of variation	df	SS	MS	Cal. f	Table f.
Between treatments	5	2.16×10^6	431536	18.185**	3.11 at .05
Within treatments	12	284752	23729.3		
Total	17	2.44×10^6			

S.E.M. = 125.78

**Indicates significant differences due to treatment.

Appendix 17 : Feed efficiency

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	96.66	19.332	1.135	3.11 at .05 N.S
Within treatments	12	204.286	17.024		
Total	17	300.954			

S.E.M. = 3.37

N.S. = Not significant.

Appendix 18 : Av. wt. of broiler at wk 4

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	71374	14274,8	2.517	3.11 at .05 N.S.
Within treatments	12	68051	5670.92		
Total	17	139425			

S.E.M. = 61.50

N.S. = Not significant

Appendix 19 : Av. wt. gain/bird

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	20081.5	4016.3	3.6*	3.11 at .05
Within treatments	12	13386.5	1115.54		
Table	17	33468			

S.E.M. = 27.30

*Indicates significant differences due to treatment

Appendix 20 : Av. wt. gain/bird/day

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	25.769	5.154	3.778*	3.11 at .05
Within treatments	12	16.3672	1.364		
Total	17	42.136			

S.E.M. = 0.95

*Indicate significant differences due to treatment.

Appendix 21 : Av. feed consumed

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	177153	35430.6	5.651**	3.11 at .05
Within treatments	12	75236	6269.69		
Total	17	252389			

S.E.M. = 64.65

**Indicates signifidant differences due to treatment

Appendix 22 : Feed efficiency

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	.562	.112	5.93**	3.11 at .05
Within treatments	12	.227	.0189		
Total	17	.788			

S.E.M. = 0.11

**Indicate significant differences due to treatment

Appendix 23 : Av. wt. gain/bird

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	67060	13412	474.761**	3.11 at .05
Within treatments	12	339	28.25		
Total	17	67399			

S.E.M. = 4.34

**Indicate significant differences due to treatment

Appendix 24 : Av. wt. gain/bird/day

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	86.877	17.375	500.0**	3.11 at .05
Within treatments	12	.417	3.475×10^{2}		
Total	17	87.293			

S.E.M. = 0.15

**Indicate significant differences due to treatment.

Appendix 25 : Av. feed e consumed

Source of variation	df	SS	MS	Cal.f	Table f
Between treatments	5	99020	19804	12.346**	3.11 at .05
Within treatments	12	19248	1604		
Total	17	118268			

S.E.M. = 32.70

**Indicate significant differences due to treatment

Appendix 26 : Feed efficiency

Source of variation	df	SS	MS	Cal.f	Table f
Between treatments	5	.152	.030	11.195**	3.11 at .05
Within treatments	12	.033	.003		
Total	17	.184			

S.E.M. = 4.25

**Indicate significant differences due to treatment

Appendix 27 : Av. wt. of broiler at wk 8

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	186582	37316.4	42.189**	3.11 at .05
Within treatments	12	10614	884.5		
Total	17	197196			

S.E.M. = 24.30

Appendix 28 : Av. wt. gain/bird

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	187542	37508.4	42.768**	3.11 at .05
Within treatments	12	10524	877		
Total	17	198066			

S.E.M. = 24.20

Appendix 29 : Av. wt. gain/bird/day

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	59.61	11.92	42.623**	3.11 at .05
Within treatments	12	3.36	.28		
Total	17	62.97			

S.E.M. = 0.43

Appendix 30 : Av. feed consumed

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	5	361344	72268.8	18.991**	3.11 at .05
Within treatments	12	45664	3805.33		
Total	17	407008			

S.E.M. = 50.37

EXPERIMENT 3

Appendix 31 : Av. wt. gain of broiler at wk 4

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	4	53643.5	13410.9	8.368**	3.48 at.05
Within treatments	10	16026	1602.6		
Total	14	69669.5			

72.3

S.E.M. = 32.68

Appendix 32 : Av. wt. gain/bird

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	4	53513.3	13378.3	8.282**	3.48 at .05
Within treatments	10	16151.8	1615.18		
Total	14	69665			

73.1

S.E.M. = 32.8

Appendix 33 : Av. wt. gain/bird/day

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	4	68.68	17.17	8.1**	3.48
Within treatments	10	21.19	2.12		
Total	14	89.86			

S.E.M. = 1.19

Appendix 34 : Av. feed consumed

Source of variation	df	SS	MS	Cal. f	Table f .
Between treatments	4	936357	234089	21.321**	3.48 at .05
Within treatments	10	109791	10979.1		
Total	14	1.04×10^6			

S.E.M. = 85.55

Appendix 35 : Feed efficiency

Source of variation	df	SS	MS	Cal. f	Table f .
Between treatments	4	.978	.244	26.607**	3.48 at .05
Within treatments	10	.092	.009		
Total	14	1.07			

S.E.M. = 0.078

Appendix 36 : Av. wt. gain/bird

Source of variation	df	SS	MS	Cal. f	Table f .
Between treatments	4	102256	25563.9	.692	3.48 at .05 N.S.
Within treatments	10	369111	36911.1		
Total	14	471366			

S.E.M. = 156.8

Appendix 37 : Av. wt. gain/bird/day

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	4	76.8	19.2	2026.85**	3.48 at .05
Within treatments	10	.095	.0095		
Total	14	76.893			

S.E.M. = 0.79

Appendix 38 : Av. feed consumed

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	4	556704	139176	8.138	3.48 at .05 N.S.
Within treatments	10	651586	65158.6		
Total	14	1.21×10^6			

S.E.M. = 208.42

Appendix 39 : Feed efficiency

Source of variation	df	SS	MS	f.
Between treatments	4	.175	.044	
Within treatments	10	.031	,0031	14**
Total	14	.206		

S.E.M. = 0.45

Appendix 40: Ave. wt. of broiler at wk 8 - 0-8 weeks

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	4	7022	1755.5	1.681	3.48 at .05 N.S.
Within treatments	10	10438			
Total	14	17460			

S.E.M. = 26.40

Appendix 41 : Av. wt. gain/bird

Source of variation	df	SS	MS	Calf. f	Table f
Between treatments	4	6764	1691	1.632	3.48 at .05 N.S.
Within treatments	10	10360	1036		
Total	14	17124			

S.E.M. = 26.28

Appendix 42 : Av. wt. gain/bird/day

Source of variation	df	SS	MS	Cal. F	Table f
Between treatments	4	2.08	.521	1.8	3.48 at .05 N.S.
Within treatments	10	2.87	.300		
Total	14	5.00			

S.E.M. = 0.44

Appendix 43 : Av. feed consumed

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	4	316544	79136	24.841**	3.48 at .05
Within treatments	10	31856	3185.6		
Total	14	348400			

S.E.M. = 46.08

Appendix 44 : Feed efficiency

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	4	.19	.047	24.245**	3.48 at .05
Within treatments	10	.019	.002		
Total	14	.208			

S.E.M. = 0.036

EXPERIMENT 4 : CARCASS ANALYSIS

Appendix 45 : Dressing %

Treat-ments	A	B	C	D	E	F	G	H
(Control) 1	74.4	78.9	79.4	75.35	72.5	77.3	73.6	72.4
(10% Meal) 2	73.1	73.7	76.3	75.36	71.3	72.7	74.2	77.0
(15% Meal) 3	79.0	81.8	83.5	85.1	86.4	76.7	79.0	78.25
(20% Meal) 4	77.3	79.7	77.2	78.2	73.95	74.7	71.7	77.7
(30% Meal) 5	80.2	77.7	78.2	80.55	77.0	75.2	77.2	73.5
(10% Seed) 6	88.3	91.0	82.0	75.55	73.6	77.2	74.0	81.9
(5% Meal) 7	80.1	77.3	73.4	79.6	70.0	76.0	78.55	79.2
(5% Seed) 8	76.8	76.8	80.4	79.54	70.4	70.1	67.0	78.8

Appendix 46 : Wing and Back %

Treat-meants	A	B	C	D	E	F	G	H
(Control) 1	37.8	34.3	34.8	43.6	39.0	41.4	40.0	45.3
(10% Meal) 2	35.0	37.83	32.75	35.8	41.1	40.9	41.1	42.9
(15% Meal) 3	53.7	23.7	61.90	33.8	41.1	41.6	40.5	40.7
(20% Meal) 4	34.0	35.8	36.9	34.7	42.6	40.6	42.7	40.6
(30% Meal) 5	34.3	35.9	35.5	34.2	45.3	42.7	42.6	40.7
(10% Seed) 6	35.0	33.0	34.7	39.5	40.6	42.7	38.8	41.8
(5% Meal) 7	37.4	36.6	37.0	30.8	40.0	42.3	41.6	40.4
(5% Seed) 8	35.4	34.5	34.3	32.3	41.0	40.85	42.9	41.6

Appendix 47 : Breast %

Treat-meants	A	B	C	D	E	F	G	H
(Control) 1	22.0	24.0	23.9	20.5	17.8	17.3	18.0	16.7
(10% Meal) 2	23.3	23.65	22.4	21.6	19.4	18.3	18.7	17.6
(15% Meal) 3	24.0	14.7	24.4	24.0	15.9	20.0	21.0	18.6
(20% Meal) 4	22.7	23.2	19.6	23.0	16.5	20.0	17.3	19.0
(30% Meal) 5	29.0	22.4	21.6	23.7	16.7	20.0	17.7	19.6
(10% Seed) 6	21.3	25.8	23.0	22.4	18.8	17.5	17.5	19.6
(5% Meal) 7	22.0	21.0	22.0	22.5	17.8	21.1	23.0	20.7
(5% Seed) 8	21.95	24.0	23.5	22.9	20.55	20.7	24.3	16.90

Appendix 48 : Thigh and Drumstick

Treat-ments	A	B	C	D	E	F	G	H	LIPID
(Control) 1	33.0	28.9	32.6	34.0	32.5	34.5	34.0	33.3	NIL 0.0
(10% Meal) 2	33.0	29.73	32.75	35.0	30.65	32.4	31.3	32.0	NIL
(15% Meal) 3	34.3	22.0	57.0	27.3	33.1	32.2	31.0	30.2	0.5
(20% Meal) 4	35.0	33.0	32.0	31.2	33.5	31.4	32.0	31.5	1.0
(30% Meal) 5	31.5	32.3	34.7	34.2	33.3	29.5	30.7	29.3	1.0
(10% Seed) 6	35.5	51.4	33.0	29.6	30.4	30.7	18.8	28.9	0.5
(5% Meal) 7	31.9	32.5	32.0	35.3	32.8	27.9	28.0	28.7	NIL
(5% Seed) 8	32.9	32.0	33.3	34.4	30.0	31.7	30.7	29.2	NIL

CARCASS ANALYSIS

Appendix 55: Dressing %

Source of variation	df	SS	MS	Cal. f	Table f .
Between treatments	7	356.094	50.87	3.48**	2.21 at .05
Within treatments	56	819.031	14.63		
Total	63	1175.13			

= 3.24

S.E.M. 2.22

**Indicate significant differences due to treatment means

Appendix 56 : Wing and back %

Source of variation	df	SS	MS	Cal.f	Table f .
Between treatments	7	104.328	14.904	.5	2.21 at .05 N.S.
Within treatments	56	1667.44	29.776		
Total	63	1771.77			

S.E.M. = 4.70
N.S. = Not Significant

Appendix 57 : Breast %

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	7	23.02	3.3	.394	2.21 N.S.
Within treatments	56	466.42	8.33		
Total	63	489.44			

S.E.M. = 3.35

Appendix 58 :

Source of variation	df	SS	MS	Cal. f	Table f
Between treatments	7	26.22	3.75	.148	2.21 N.S.
Within treatments	56	1477.02	26.38		
Total	63	1503.23			

S.E.M. = 4.70

*N.S. = Not significant

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