REPLACEMENT VALUE OF LOCAL MAIZE OFFAL (DUSA) FOR MAIZE IN BROILER DIETS.

VANTSAWA PHILIP ANTHONY

A THESIS SUBMITTED

TO

AHMADU BELLO UNIVERSITY ZARIA

IN PARTIAL FULFILMENT

FOR THE DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF ANIMAL SCIENCE

FACULTY OF AGRICULTURE.

AUGUST, 1998.

COPYRIGHT STATEMENT

DECLARATION

I declare that this thesis has been written by me and that it is a record of my own research work. It has never been presented by any one in A.B.U Zaria or anywhere to apply for a higher degree. All quotations are indicated and the sources of information are specifically acknowledged by means of references.

VANTSAWA P.A

SIGN........

DATE 10/8/98

CERTIFICATION

This thesis "REPLACEMENT VALUE OF LOCAL MAIZE OFFAL (DUSA) FOR MAIZE IN BROILER DIETS" by VANTSAWA P.A meets the regulation governing the award of the dgree, Master of Science of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

Prof. A.O Aduku

Chairman, Supervisory Committee.

Sign.............

Date 14/8/98

Prof. S.O Ogundipe

Member, supervisory committee

Sign.............

Date 18/8/98

Dr. J.P Alawa

Head of Department,

Animal science.

Sign......................

Date ....

Prof. J.O Olayemi

Dean,

Post graduate School,

Ahmadu Bello University, Zaria.

Sign.............

Date 17/11/98

DEDICATION

This thesis is dedicated to the Almighty God through my Lord Jesus Christ by the power of the Holy Spirit.

ACKNOWLEDGEMENT

I wish to aknowledge the contributions made by my supervisors and all others towards the achievement of this thesis. May the Almighty God grant their heart desires.

ABSTRACT

An experiment was carried out to evaluate the replacement value of local maize offal (dusa) in broiler starter and in finisher diets. The levels of inclusion of dusa were 0, 10, 20, 30, 40, 50, 52.43 and 0, 10, 20,30,40,50,63.98% for starter and finisher diets respectively.

The results showed that from 0-4 weeks of age, there was no significant differences (P>0.05) in weight gain, feed consumption, feed conversion efficiency and mortality rate between the control, and other treatments. Feed cost per unit gain was significantly (P<0.05) reduced for other treatments when compared with the control diet.

From 5-8 weeks when finisher diets were fed, results showed that there was no significant difference (P>0.05) in weight gain, feed consumption, feed conversion effeciency and mortality rate between all the treatments and the control. However, feed cost per unit gain was significantly (P<0.05) reduced for other treatments compared to the control diet with 52.43% dusa diet having the lowest unit cost per gain, Similary, the pooled results for 0-8 weeks showed that there was no significant difference (P>05) in weight gain, feed consumption, feed conversion efficiency and mortality rate between other treatments and the control.

It can be concluded that local maize offal (dusa) can completely replace maize in broiler starter and finisher diets without any adverse effect on weight gain, feed consumption, feed conversion efficiency, mortality rate and carcass parameters.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABREVIATIONS

AME - Apparent metabolizable energy

AMEn - Apparent metabolizable energy nitrogen corrected

ANOVA - Analysis of variance

AOAC - Association of Agricultural Chemists

BCS - Brewers condenced solubles

BDG - Brewers dried grain

CF - Crude fibre

CP - Crudep Protein

DPW - Dry poultry waste

EE - ether extract

LSD - Least significant difference

MCM - Maize cob-mix

ME - Metabolizable energy

MMW - Maize milling waste

NAPRI - National Animal Production Reseach Institute

NDV - Newcastle disease vaccine

NFE - Nitrogen free extracts

NRC - Nutritional research council

SBR - Sorghum beer residue

SGM - Sorghum germ meal

1.0 INTRODUCTION

Energy is of crucial importance in broiler diets. High energy diets permits broilers to grow more rapidly and utilize their feed more effectively Scott *et al;* (1974). Energy constitute 60-70% of broiler ration Ogundipe (1987). It is the most costly component of broiler ration Philip (1970). Feed intake of poultry is determined largely by energy concentration provided the diet is adequate and bulkiness does not limit intake (Scott *et al;* 1974).

Maize grain is the conventional energy source in poultry feeds. But there is increase in demand for maize grain in the country because Industries like flour mills and breweries use maize as raw material in the production of their products. It also forms the staple food of most Nigerians. These demand on maize grain made its supply limited. Bolton (1971) observed that where the amount of food available for human consumption is limited, it would be wrong to use acceptable human food to feed animals. The price of commercial feeds are increasing beyond the reach of the common poultry man due to the increasing price of maize. Therefore, cheaper sources of energy must be sought to reduce the cost of poultry feeds.

Several grain by-products have been investigated for poultry. Cresswell and Zainuddin (1980) reported that maize bran can replace maize on weight for weight basis in broiler diets without any compensation being made for the lower energy content of the bran. They gave the proximate analysis of the bran used as 10.6% CP, 12.9% CF, 6% EE, 3.2% ASH, 0.05% Ca and 0.68% P.

Ranjhan (1980), gave the following as the nutrient composition of maize bran: 11.95% CP, 1.70 EE, 10.50% CF, 75.20% NFE and 0.8% ASH. He recommended the use of the by-product in feeding livestock. Fadugba (1989) showed that industrial maize offal is as good as maize for chicks, growers and layers rations. She fed birds rations containing varying levels of industrial maize offal which replaced maize at 0.00, 17.00, 34.30, 57.50, 68.80 and 100% in chick rations; 0.00, 16.90, 34.30, 51.60, 69.00, 82.60, 100% in growers ration; 0.00, 20.70, 41.30, 62.10, 82.70 and 100% in layers rations. The results showed that weight gain for chicks was higher for all the maize offal diets than for the control diets while for growers, weight gain was not significantly ($p>0.05$) affected by the levels of maize offal.

Abound *et al;* (1990) fed maize-cob-mix to broilers and found that there was no significant difference ($p>0.05$) in mean final body weight compared with the control. Similarly Atteh *et al.*, (1993) discovered that maize mill waste (MMW) could replace all the maize in the diets of pullets without adverse effects on the performance and early lay characteristics.

Velasco *et al*; (1985) found that in 0, 5, 10 and 15% maize bran replacement for maize, 20 weeks old pullets gave a decreasing live weight as the inclusion level increased. They concluded that egg production and feed conversion efficiency were best when 10% of maize bran was included in the diet.

Some of these industrial by-products mentioned could be used as alternative energy sources in feeding poultry, but increased cost due to transportation from the site of production to the users site make their use sometimes unjustifiable. Local maize offal (dusa) on the other hand is produced by local hulling machines closer to the livestock farmers hence the cost of transportation is very minimal. It has relatively cheaper cost than the maize grain, N5.00 and N15.00 respectively. Dusa is used extensively by small scale poultry farmers who have little or no knowledge of its nutritive value. Since this by-product is produced in large quantities because of increased consumption of maize grain and because of its relative cheapness than the industrial type, it is important that its use be tested scientifically as a source of energy for poultry. The present study is therefore designed to investigate the nutrient composition and performance of broilers fed diets containing local maize offal (dusa).

2.0 LITERATURE REVIEW

ATTRIBUTES OF MAIZE

Maize grain is a one-seeded fruit called a caryopsis in which the fruit coat is adherent to the seed. As the fruit ripens, the pericarp (fruit wall) becomes firmly attached to the wall of the seed proper. The pericarp, seed coats, micelles and aleurone cells form the bran. The embryo occupies only a small part of the seed. The bulk of the seed is taken up by the endosperm constituting a carbohydrate reservoir. (Muller 1970.).

In many areas of the developing world, maize is a staple food particularly for the rural poor. It spreads quickly and widely among poor countries because it is robust and highly adaptable to a wide range of environments. It has many valuable properties, some of which are as follows: It gives one of the highest yields per hour of labour spent; provides nutrients in a compact form; is easily transportable; is protected against bird and rain by its husks; is easy to harvest and can be shelled by hand; stores well if properly dried; is relatively free of major disease epidemics; competes with weeds better than other cereals; does not shatter and thus can be left standing in the field at maturity and has cultivar with different maturing periods. (N.R.C 1984.)

In many African countries, maize is the basic food for subsistence farmers, miners and city dwellers. In most areas, its importance is as great as that of wheat in the Mid East and rice in

South East Asia. Africans consume nearly one-fourth of the World's total food maize (INCAP 1969).

It was reported that during its World wide dispersal, maize became the World's chief animal feed. Today it provides feed more than any other grain. For this reason maize is outstandingly high in energy, low in fibre and is easily digested by most livestock species. Industrialized countries such as United states, use their maize crop mainly as feed and depends on it to produce their meat, milk and eggs. The grain is fed mostly to pigs, cattle, and poultry (N.R.C 1988).

Augustine (1992) reported that maize is the number one feed grain of the World, including the developing countries. It is used extensively as the main source of calories in animal feeding and feed formulation and is recognized as giving the highest conversion of dry substance to meat, milk and eggs compared to other cereal grains. He also showed that by-products of industrial wet and dry-milling are used as feed.

Industrialized countries show a high per capital utilization of maize because of high consumption of livestock products. For example 80% of the maize grown in USA is used as animal feeds. Also rapid increases in poultry consumption in Africa and other developing countries is a major factor contributing to the increased use of maize for livestock feeding (Augustine 1992).

Table 2.1 Projected National Requirement for Maize (1985-2000)

Year	Population (Million)	Human Consumption 10^3 Metric Ton	Industrial Per Annum Requirement 10^6 Metric Tons
1985	102.456	866.98	5.51
1987	108.696	918.78	5.58
1989	115.315	975.60	6.19
1991	12.338	1035.20	6.58
1993	129.788	1098.30	6.98
1995	137.692	1165.10	7.40
1997	146.078	1236.10	7.85
2000	159.623	1350.70	8.58

Source: NRC (1984.)

CHEMICAL PROPERTIES OF MAIZE GRAIN.

N.R.C (1988) reported that of all the constituents of maize, carbohydrates are quantitatively the most important, forming 77-87% of the total dry matter. The carbohydrate includes starch which is the dominant. Also present are cellulose, hemicellulose, pentosans, dextrin and sugars. The carbohydrate is expressed in two parts: the crude fibre and the soluble carbohydrate. Crude fibre is estimated as that part of carbohydrate which is insoluble in dilute acids and alkalis under prescribed conditions. The soluble carbohydrates are calculated as the remainder left after accounting for crude fibre, nitrogenous compounds, lipids and mineral matter. About 73% of the dry matter of maize is starch.

Maize is low in protein quantity and quality both of which are insufficient to satisfy the protein need of monogastric animals that are most vulnerable to malnutrition. The prevalence of protein-calorie malnutrition among villagers and small children in dozens of African and Latin American countries demonstrates the underlying inadequacy of maize dependent diets.(NRC 1988).

Maize kernels contain on the average, about 8.5% protein. This figure is low compared with legume seeds such as cowpeas, 23%; peanuts, 26%; or soyabeans,38% (NRC 1988). It was also reported (NRC 1988) that maize is low in two nutritionally vital amino acids:lysine and tryptophan. Both are essential amino acids that people (and other simple-stomach animals like pigs and poultry) must obtain from diets because they cannot synthesize them. Roughly half of the protein in a kernel of common maize is composed of the type of protein that contains almost no lysine or tryptophan. The protein composition of maize in relation to other cereal grains is shown in Table 2.2. Approximate grain size and percentage proportion of the principal parts of maize compared to other cereal grains are shown in table 2.3

Table 2.2 PROTEIN COMPOSITION OF MAIZE IN RELATION TO OTHER CEREAL GRAINS

Cereal	Protein Range %	Albumin %	Globulin %	Prolamin %	Residue & Glutemin
Maize	7-13	2-10	10-20	50-55	30-45
Wheat	12-16	10-15	5-10	40-50	30-40
Barley	10-16	3-4	10-20	35-45	35-45
Oat	8-20	5-10	50-60	10-15	5
Rice	8-10	2-5	2-8	1-5	85-90
Sorghum	10-19	1-8	2-9	32-59	19-35
Millet	9-16	15	9	21-38	24-37

N.R.C (1988).

Table 2.3 Approximate Grain Size and % Proportion of the Principal Parts of maize compared to other cereal grains.

CEREAL	Grain mass(mg)	Embryo %	scutellum %	pericarp %	aleurone %	endosperm %
Barley	36-45	1.58	1.53	18.3	-	79
Wheat	30-45	1.20	1.54	7.90	6.7-7.0	81-84
Maize	150-600	1.15	7.25	4.1	5.50	82
Rice	23-27	2-3	1.50	-	4-6	89-94
Sorghum	8-50	-	7.8-12.1	-	7.2-9.3	-

Ihekoronye and Ngoddy (1965).

GRAIN BY-PRODUCTS USED IN POULTRY RATIONS

A by-product can be defined as any material produced following an industrial or domestic processing of a target product. It is a residue but when processed and utilized, it is reffered to as by-product. Grain by-products are generally lower in energy than the grain from which they are obtained. They are generally higher in crude fibre due mainly to higher concentration of testa, aleurone layer and other fibrous parts of grain in the by-products. They are generally more bulkier due to higher fibre contents. The crude protein is generally higher than the grain from which they are obtained. The cost per kilogramme of these by-products are relatively lower than the grain from which they are obtained.

DRY GRAIN MILLING BY-PRODUCTS

INDUSTRIAL MAIZE OFFAL

Work has been done on industrial maize offal. The results of researches carried out shows these by-products to be useful in replacing major grain component to certain levels in poultry rations. For example, Fadugba (1989) showed that industrial maize offal is as good as maize for chicks, growers and layers. She fed birds rations containing varying levels of maize offal which replaced maize at 0.00, 17.0, 34.3, 51.5, 68.8, 86.1, 100 percent in chick ration; 0.00, 16.9, 34.3, 51.6, 69.0, 82.6, 100 percent in growers ration and 0.00, 20.7, 41.3, 62.1, 82.7, 100 percent in layers ration. The results obtained showed that weight gain for chicks was higher for all the maize offal diets than for the control diets. For growers, weight gain was not significantly affected by dietary levels of maize offal.

MAIZE MILLING WASTE (MMW).

Atteh *et al*; (1993) during a 14 weeks trial, fed 8 weeks old Harco pullets fed on diets containing 0, 32.5, or 65% maize milling waste (replacing 0, 50, and 100% of dietary maize) without or with 5% molasses. The results showed that increasing the level of MMW increased daily weight gain, reduced dietary M.E but had no significant ($P>0.05$) effect on age at first egg, body weight at first egg or weight of first egg laid. They concluded that MMW could replace all the maize in pullets' diet without adverse effect on performance and early lay characteristics.

HOMINY FEED

Hominy feed is a mixture of maize bran, germ and part of the starchy portion of either white or yellow maize kernels or a mixture thereof, as produced in the manufacture of the pearl hominy grits or table meal and must contain not less than 4% crude fat. (Inglett 1970). This like the gluten feed from wet milling process, is a manufactured product comprising the fractions remaining after the removal of the primary product - the endosperm from the grits. It is a low protein, high energy product, highly priced by dairy feed formulators. In the market it is the more economical source of protein and energy than feed grains.

Klenholz (1969) stated that hominy feed, when properly balanced, fits very well into least cost formulas for swine feeds. For all classes of livestock, hominy feed is an excellent energy source. For ruminants, its energy value is 100-107% that of maize; for swine it is about 100%; and for chickens it is 85% Klenholz (1969). Because the germ is normally included in hominy feed, the amino acid balance is substantially improved compared to the maize from which hominy is derived. Lysine and tryptophan, the most limiting amino acid from whole grain of maize are almost double in hominy feed Cavins *et al*;(1969). Methionine is almost equal to lysine and tryptophan in maize and threonine is almost 30% higher than that of maize. Thus hominy feed is a by-product with exceptional nutritional values for many types of livestock feeds (Inglett 1970).

MAIZE COB-MIX

Abound *et al* (1990) conducted an experiment in which 82 broilers males were fed maize cob-mix combined with protein concentrate for six weeks. Maize cob-mix (MCM) silage contain crude fibre of 62 to 70 g/Kg DM. Energy concentration was lowest and feed intake highest for diets with MCM. There was no significant difference in mean final body weight. Roth-maier and Kirchgessner (1985) conducted an experiment lasting 48 days in which 540 male lohmann broilers in six groups were fed ad-libitum basal diet or maize-cob mix (MCM) Silage containing 3.2 or 5.5% crude fibre in DM, or on energy basis of 50% each. All the feeds were isocaloric and isonitrogenous. After 42 days, the birds in the control group weighed about 1500g while other groups had significantly more weight with a maximum of 1570g for the 3.2% MCM silage with protein concentrate.

RICE OFFAL

Locally produced rice by-products is a mixture of rice husks, rice bran, rice polishing together with some broken grains. It is obtained from one-stage milling process. This may be referred to as rice offal. It is high in fibre but low in ether extract (EE) and protein. Rice offal has a similar nutrient composition with rice mill feed (Gohl 1975) which contains approximately 60% hulls, 35% bran and 5% polishing. Oyeyiola (1991) fed rice offal to egg type chickens and showed that percent hen day egg production was similar for birds fed 20% rice offal layer diets when compared with the control diet. She found that percent hen-day egg production was significantly ($p<0.05$) lower at levels higher than 20% rice offal when compared with the control diet. Kg feed per 10 eggs was similar for birds on 20% rice offal diets and as well as for those on the control diets. Feed cost (N / 10 eggs) was significantly less ($p>0.05$). She observed that rice offal can be fed to layers up to 20% level without adverse effects on egg production. Her recommendation was that adjusting for energy, rice offal may be included in the rations at up to 25, 40 and 20% levels for chicks, growing pullets and layers respectively without adverse effects on performance. These levels of rice offal were equivalent to 42, 64, and 38% of maize replacements by rice offal.

RICE BRAN.

Rice bran comprises primarily of seed coat and germ which are removed from rice grain in the manufacture of polished rice for human consumption Cullison (1975). Rice bran is an imported by-product of paddy production and on the average, approximately 10% of rice goes with bran during processing Devendra and Raghavan (1978). Oyenuga (1968) stated that milling process as carried out in Nigeria by standard machine methods which consists of two stages: removal of husks from paddy rice to produce brown rice, production of white rice by removing the brown coat and germ. The brown coat consisting mainly of the aleurone layer and the germ constitute the bran. According to number of researchers (Pine 1962; Maust *et al*; 1972) the inclusion of rice bran in diets of chicken has not provoked any adverse effect on growth rate, provided the rate of inclusion did not exceed 50%. Growth of chicks was reduced by 30% when rice bran was used at 60% of the diet to replace corn as an energy source in diets containing fish meal and soyabeans meal (Crazier *et al;* 1974). There was also no interference in the availability of trace minerals.

Autoclaving and parboiling have been found to improve the feeding value of rice bran Crazier *et al;* (1974). These methods bring about a marked improvement in the growth rate probably because of the destruction of the growth-inhibiting factor in the rice. A diet containing 74.7% of autoclaved rice bran resulted in 64.6% egg production which was not significantly different from the positive control diet. Crazier *et al;* (1974) noticed a pancreatic enlargement in chicks fed rice bran. There is a wide variation in chemical composition of rice bran. Fetuga (1977) reported that rice bran contain 5.8 - 14.9% CP, 14.8 - 26.5% CF, 1.8 - 2.18% EE, 3.7 - 10.2% ash and 40.8 - 58.4% NFE. On the other hand the respective results as given by Saunders (1985), are 6.7-17.2% CP, 6.2-26.9% CF, 4.7-22.6% EE, 8.0-22.2% ash and 53.5% NFE.

There are various factors responsible for the wide variation in the chemical composition of rice bran some of which include rice cultivars, treatment of grains prior to milling and the fractionation process operative during milling (Saunders 1985; Osuji 1982) reported that variation in chemical composition of rice bran may be due to methods of milling. Mahatab (1985) reported that it is essential to analyze rice bran before it is used in poultry feeds. D'mello (1987) also reported that processing appear to be an essential prerequisite in the feeding of rice bran to poultry. This is because the lipid fraction of raw rice bran rapidly undergoes rancidity after milling and this causes deleterious effects on growth and egg production.

Sayer *et al*; (1988) fed meat type strain chicks on diets containing rice bran at 600g/Kg diet for 8 weeks period to reach market weight. They reported that birds fed stabilized rice bran had improved weight gain and feed efficiency for the first two weeks of feeding but this advantage was lost at the end of the feeding period. They also reported that addition of calcium at 10 g/Kg diet to the rice bran diet prevented the decrease in performance after two weeks of age. Chickens fed on this diet continued to gain at an increasing rate until the end of the experiment.

Malynicz (1974) observed that addition of rice bran at 50% level at the expense of sorghum had no adverse effect on body weight gain and efficiency of feed conversion of broiler chickens. He concluded that there is an economic advantage in the use of rice bran. Similarly, graded levels of rice bran up to 50% to replace maize was fed to broiler by Martins *et al.* (1983). They found that increasing the level of rice bran in the diets decreased rate of growth and increased the amount of feed needed per unit weight gain commensurate with the energy level of the diet. They discovered that body weight is a function of rice bran levels and concluded that broilers could be successfully grown on lower energy by-products; but producers must recognize that a longer period is needed to attain the market weight. Veloso *et al* (1985) fed rice bran and maize at 40% of a basal diet to broiler chickens. Their results showed that percentage digestibility of dry matter and M.E of rice bran was much lower than that of maize.

Omar et al (1976) reported that the digestibility coefficients of crude protein, crude fibre, ether extracts, nitrogen free extracts, starch value, total digestible nutrients and M.E of rice bran were: 51.8, 0.8, 8.3, 39.9, 48.4, 43.8% and 1840 Kcal/Kg respectively.

Elias and Bressani (1970) reported that wheat and maize by-products had a higher nutritive value than the rice by-products. Yamazaki and Kamata (1986) reported that the true amino acid availability for wheat bran is 76% and 70% for defatted rice bran. Fetuga (1977) stated that the M.E of rice bran was lower than that of either the brewers dried grain (BDG) or wheat offal. Results from studies on the inclusion of rice bran in layer-type chicken diets have been quite controversial. According to Subramaryan *et al;* (1972) deoiled rice bran could be used profitably up to 35% in chick ration without affecting growth or efficiency. However, Thompson and Weber (1981) observed that inclusion of rice bran at a level of 16.7% in the diet of chicks resulted in significantly reduced body weight. Obeka (1985) reported that rice offal could be included at a level of 27.9% in grower diets without adverse effect on growth rate or age at sexual maturity. He added that egg production of this group of birds was satisfactory when these birds were fed lower fibre diets during the laying phase. Furthermore, this level of inclusion resulted in a relatively lower cost of production. According to Scott *et al.* (1976) rice bran is a good source of linoleic acid. Prawirokusumo *et al* (1977) stated that L-lysine was slightly more limiting than DL-methionine in a 15% protein corn-soyabeans diets containing 60% rice bran and L-threonine was the next limiting amino acid for chicks. Deolanker and Singh (1979) reported that availability of calcium and iron from a rice bran diets were lower than from a maize based diets. Corley *et al;* (1980) reported that available phosphorus in rice bran was 0.23%. Kamalanatan *et al;* (1971) found that true amino acid availability in defatted rice bran was 70% compared to 92% for maize.

Schaible (1970) reported that rice bran is a good source of manganese and pantothenic acid. Halpin and Baker (1986) reported that rice bran appeared to provide bio-available manganese at or below the requirement for chicks. Rice bran and rice polishing are rich in B-complex vitamins (Titus and Fritz 1971; Lodhi and Ichhponani 1975; Ranjhan 1980.)

RICE POLISHING

This consists of a fine residue that accumulates as rice kernels are being polished (Ensminger and Olentine, 1978). Rice polishing may be excellent feedstuff for poultry if they are free of adulteration with rice husks (Scott *et al;* 1976). Church and pond (1974) reported that rice bran and rice polishing are high in fat. Ranjhan (1980) and Scott *et al;* (1976) gave a range of 12 to 13% oil for rice polishing. The thiamine contents of commercial rice polishing was showed to be 7.34 mg/100 g (Kamalanathan *et al;* 1971).

WHEAT OFFAL

During the processing of wheat, several by-products are obtained. These include: wheat middling, wheat offal, wheat mill run, wheat shorts and so on. These fractions comprised approximately 25% of the whole grain (Moran and Summers 1970). Wheat milling by-products are relatively low in M.E and high in fibre. Many researchers (Moran and Summers 1970; Kohler *et al;* 1970) have reviewed in detail the nutritional value of these feedstuffs. Cavins *et al;* (1965) reported that pelleting wheat offal increased its M.E contents by 30% for growing chicks. Wheat offal is highly palatable and bulky, and has a laxative effect. Wheat offal averages 16.4% in protein, 4.5% fat and does not usually contain more than 10% fibre. The amino acid balance is superior to that of corn or whole wheat but inferior to that of most protein supplements. It is extremely high in phosphorus but low in calcium Osuji (1982).

It was reported by Nelson (1984) that 50% replacement of maize by wheat offal showed no adverse effect on weight gain, feed consumption and feed conversion efficiency. Also addition of 5% palm oil to 50% replacement of maize by wheat offal further improves the performance of the birds. He also reported that the replacement of 50% and 62.5% maize with wheat offal led to egg production which was not significantly different from the all-maize ration. Although according to him, replacement of maize with wheat offal generally caused a significant increase in feed consumption. Fetuga (1977) gave the nutrient composition of wheat offal as follows: CP, 18.2%; CF, 15.6%; EE, 4.3%; Ash, 5.8%; and NFE, 56.4%; AME value is 11.09 MJ/Kg.

Bala (1986) reported that replacement of 75% of the maize components in the ration with wheat offal has significant effect only on feed intake and weight gain of pullets between 2 and 8 weeks of age. Feed intake, feed conversion efficiency and feed cost per bird were only significantly affected between 9 and 20 weeks of age. He further reported that birds that received starter diets in which 75% of the maize portion in the ration was replaced by wheat offal maintained an egg production rate which was generally not different from the control diet when they reached the laying phase.

OAT HULLS (OH)

Sixteen weeks old white leghorn pullets were fed on a 17% layers mash diluted with 15% oat hulls, or with major nutrients increased to about 15%. There was no differences in the age at sexual maturity or in the reproductive performance between treatments (Summers and Leeson 1993).

WET GRAIN MILLING BY-PRODUCTS

MAIZE STARCH PRODUCTION.

In a study carried out by Chrappa (1990), by-products of maize starch production which is composed of protein, fibre and starch was added at 2, 4 and 6% to broiler diets based on ground maize, wheat and soyabeans oil meal. Final weight of broiler was slightly but not significantly higher with higher dietary metabolizable energy (ME). At the higher M.E. levels, maize starch wastes reduced feed intake per Kg gain by about 5% but increased it slightly as compared to control feed when added to the diet with lower dietary M.E. Mortality was not significantly affected.

MAIZE GLUTEN FEED.

Maize gluten feed is that part of the commercially shelled maize that remained after the extraction of the larger portion of the starch, and germ by the process employed in the wet milling manufacture of corn starch or syrup. It may or may not contain one or more of the following: fermented corn extractions, corn germ meal. Maize (corn) gluten feed has found its greatest use in ruminant rations. Ruminants utilize the fibrous components relatively well, hence energy value is higher for them than the simple stomached animals like poultry, pigs and rabbits. Corn gluten feed may be incorporated at levels up to 50% of the rations for complete feeds or concentrates for dairy and beef cattle. Bayley *et al* (1969) reported that metabolizable energy values of corn gluten feeds varied markedly for different age groups and for species.

Jensen (1969) reported that growing finishing pigs could tolerate up to 30% dietary corn gluten feed when amino acid content was well balanced. Klenholz (1969) carried out an experiment using laying hens and observed that gluten feed can be included at levels of 10 to 15% of the diet without decreasing egg production or feed efficiency.

MAIZE GLUTEN MEAL

Maize (corn) gluten meal is the dried residue from maize after the removal of the larger part of the starch and germ and the separation of the bran by the process employed in the wet milling or by enzymatic treatment of the endosperm. Maize gluten meal is high in xanthophyll, methionine and energy as such it is used primarily in poultry feed to enhance poultry meat production (Klenholz 1969)

SORGHUM GERM MEAL (SGM)

Elzubier and Jubarah (1993) analyzed SGM for proximate composition and fed it to broiler chicken, replacing sorghum at 0, 25, 50, 75 and 100% of apparent ME. On the average, SGM contained DM 89.88, CP 12.6, EE 28, CF 4.54, Ash 3.94, calcium 0.01 and phosphorus 0.04%. Phytic acid equivalent 2250 mg/100 g and calculated ME of 17.92 MJ/Kg or 1792 Kj/Kg. They observed that increase in dietary level of SGM increased dietary crude fibre and phytic acid contents. Increased dietary SGM resulted in a linear reduction in body weight ($P<0.01$) and weight gain ($P<0.01$) and decreased feed intake. The feed:gain ratio showed a linear increase ($P<0.01$). Dressing percentage, pancreas and abdominal fat relative weights, showed linear increases in response to increase dietary level in SGM. They then concluded that replacement of more than 25% of sorghum AME with SGM resulted in poor broiler performance.

BREWERY BY-PRODUCTS

BREWERS DRIED GRAIN

Ademosun (1983) evaluated the use of BDG in diets of growing broilers. He fed 0, 10, 20 and 30% brewers dried grain (BDG) to broilers for 8 weeks and reported that response to the diet with 10% BDG was similar to the control diets. He stated that on the basis of feed consumption, weight gain and feed conversion efficiency, the concentration of brewers grains in starter diets should not exceed 10%. He maintained that the limiting factor of brewers dried grains is the high crude fibre content. Babatunde (1975) acknowledged the high fibre and low energy nature of brewers grains and its suitability for ruminant animals. Pond and Maner (1974) also reported that although the protein contents of BDG was high (about 20-30%), it does not contain a good balance of amino acid. However, it was reported by Almquist (1972) that brewers dried grains have adequate amount of some essential amino acids especially those that are deemed to be limiting in swine and poultry diets viz: methionine 0.4%, phenylalanine 1.2%, threonine 1.0%, lysine 0.9%, tryptophan 0.4% and valine 1.6%.

Nelson (1984) observed that replacement of maize at both 25 and 50% with BDG in broiler starter ration significantly depressed weight gains and efficiency of feed conversion. It may therefore not be advisable to incorporate BDG into broiler starter rations at levels beyond 25% replacement of maize without further experimentation. He noted also that mortality generally increased significantly with increase in the level of BDG in the rations. For finishing broiler chickens, no significant differences were observed in weight gain, feed consumption, efficiency of feed utilization, feed cost per kilogramme live weight gain and mortality for the control ration.

SORGHUM BEER RESIDUE

Dogari (1985) evaluated the feeding value of wheat bran and sorghum beer residue when they each replace 10% of the maize in broiler starter diets. He reported that: weight gains were not significantly depressed even when sorghum beer residue replaced up to 40% of the maize in the control diet. Total feed consumption was unaffected by dietary treatments. Feed cost N/Kg gain was significantly lower in favour of all the dietary treatments compared with the control. Mortality was unaffected by the dietary treatments and there was no significant difference between wheat offal and sorghum beer residue diets in all the variables considered.

Also in the finisher diets, he observed no significant difference between sorghum beer residue and wheat offal diets with regard to total weight gain when each replaced 10% of the maize in the diet. Total weight gain significantly decreased with further increase in the level of replacement of maize by SBR beyond 30%. There was no significant difference between treatments in terms of total feed consumption. Feed efficiency was depressed significantly when up to 20% of the maize was replaced by sorghum beer residue. Dogari (1985) also observed that feed cost per Kg gain was least for the diets in which 10% of the maize was replaced by SBR and mortality did not follow any consistent trend.

BREWERS CONDENSED SOLUBLES (BCS)

Brewers condensed solubles contained on the average 45.81% DM, 6.71% CP, 1.96% Ash, 1.37% EE and gross energy of 4925 Kcal/Kg on dry matter basis. Tadtyanant *et al;* (1993) conducted an experiment in which 900 male broiler chickens from day-old were fed maize / soyabean diets containing 0, 10, 20, 30, 40 or 50% BCS. All diets met NRC (1984) nutrient requirement standards.

Feeding diets containing 40 and 50% BCS resulted in a lower fed to gain ratio when compared with the control diet. Total carcass weight were unaffected for chickens given 10, 20, 30, 40 and 50% BCS, compared with the control diet.They reported that there was no detectable differences in flavor between broilers fed on BCS and those fed on control diets. They therefore concluded that BCS is a satisfactory feed ingredient at 30% dietary level in broiler starter diets.

CASSAVA PEEL MEAL IN POULTRY DIETS (CPM)

Several people have reported the use of cassava peel meal in poultry rations. Pido and Adeyanju (1978) reported that when one hundred and twenty eight one week old broiler chicks were given a diet based on maize and groundnut meal with fermented cassava peel at 0, 10, 20, or 30% for 9 weeks, the mean daily gain was 29.37, 26.18, 28.81 and 28.36g respectively. Feed intake was observed to be less on the diets with 10 and 20% cassava peel meal and greater on that with 30% than those on the control diets. They concluded that inclusion of cassava peels up to 20% in broiler diets promotes growth.

Osei and Duodu (1988) had a seven week feeding trial to evaluate the nuritive value of sundried cassava peel meal using 480 day- old broiler chicks. The meal was incorporated at 5, 10, or 15% in the diets. They observed that feed consumption significantly ($P<0.05$) increased with the addition of sundried cassava peel meal. It was also observed that energy level decreased with increasing cassava peel meal as a result birds on higher concentration of peel meal consumed more diets than those on lower concentration. Live weights were significantly inproved by 5% CPM diet above the result of the control diet and those for the 10% or the 15%CPM diets. Feed conversion efficiency significantly decreased when more than 5% CPM was incorporated into the diets.

Pido and Adeyanju (1978) showed that feeding of fermented cassava peel meal to broilers had no significant effects on live weights or carcass yields. Aduku *et al*; (1991) showed that cassava peel meal can be fed at up to 15% level in maize-soyabean practical diets for broilers. They pointed that the bulky nature of the CPM limits feed consumption to meet energy requirements of broilers at higher leves of CPM above 15%. They indicated that the cyanide content of the diets used for the study was lower enough not to be a major problem even at higher levels of inclusion (37.5%).

Sekoni (1991) fed five levels of CPM (0, 10, 20, 30 and 40%) in the diets of laying birds. The results of the study indicates that the performance of the birds fed 20% CPM diet was comparable to those fed the control diet in terms of total number of eggs, percentage hen-day egg production and feed per dozen eggs. Average daily feed intake, egg weight and thiocyanate level of the serum were not significantly affected by dietary treatments. It was concluded that CPM can be incorporated into layers diet up to 20% without adverse effect on the performance of the birds.

EFFECT OF FIBRE IN POULTRY RATION

Gohl (1975) defined crude fibre as an organic matter which is insoluble in hot dilute sulphuric acid and or dilute sodium hydroxide solution. Fibre is almost valueless nutritionally to poultry. This is because chicken does not produce the enzyme cellulase that is needed to digest cellulose which predominate fibre. Fibre however, is thought to play a part in peristaltic movements in the digestive tract and thus assist in muscle tone.

Trowell *et al;* (1976) looked at the fibre as the sum of lignin and the polysaccharide that are not digested by the endogenous secretion of the digestive tract. These include cellulose and the so called non-cellulose polysaccharide, the most predominant being the hemi-cellulose.

Kondra *et al;* (1974) reported that chickens are capable of high degree of anatomical and physiological adaptation to compensate for variation in nutrient concentration of diets. Deaton *et al;* (1979) reported that gizzard weights were significantly increased when a high fibre sunflower meal was substituted for soyabean meal. Kubena *et al;* (1974) reported that the gizzard weight of broilers raised in cages were significantly less than those of the birds raised on the floor despite the same nutritional regime. Those broilers raised on the deep litter floor had access to the fibrous litter and had apparently consumed it leading to an increase in the gizzard weight. The dressing percentage will therefore decrease for birds fed fibrous feed.

Bayer *et al;* (1978) and Abdelsamie *et al;* (1983) observed that growth and feed utilization decreased with increase in fibre contents in chicken diets. Newcombe and Summers (1985) reported that at 100g cellulose /Kg diet for mash diet and between 100 and 200 g cellulose /Kg diet for crumbled diets, leghorn chicks increased volume ingested by as much as 40% and maintained body weight gain and nutrient intake while broiler chicks were unable to compensate for dietary dilution with cellulose by increasing feed intake sufficient to maintain nutrient intake.

Deaton *et al;* (1977) reported that there was no effect on body weight, hen-day production, egg weight, efficiency of feed conversion, mortality or egg shell breaking strength when pine shavings were included at the rate of 15, 30, or 60 g /Kg diet in laying hen diets. The same trend of results were obtained when a high fibre sunflower meal was substituted for soyabean meal in layers diet (Deaton *et al* 1977).

Kondra *et al;* (1974) noted that high fibre diet during the growing phase has carry over effects which are manifested by increase rate of lay and body weight gain when a high fibre breeding diet is not used. Stallcup (1958) analyzed the composition of the crude fibre in eleven different roughage and reported that of the constituents in the original material, the crude fibre contained an average of 91% of the cellulose, 3.8% of the lignin and 4.5% of the crude protein.

Mitchel (1964) stated that cellulose is a carbohydrate consisting of glucose units while lignin consists of phenyl propanoic unit. The digestibility of fibre from different sources vary considerably. Crampton and Harris (1967) getting their evidence from ruminants stated that although fibre from wheat shorts and bran are presumably the same material, digestibility ranges from 53-90%. Figures from monogastric are considerably lower. Though monogastric animals don't have the necessary system for degrading cellulose, nevertheless, in some instances a considerable amount of cellulose may be utilized. In this case, bacteria present in the intestines produce cellulase capable of degrading cellulose Albinos (1963). Crampton (1956) tabulated the extent to which each species can digest crude fibre. Table 2.3 summarizes his findings.

TABLE 2.3 THE EXTENT TO WHICH SPECIES CAN DIGEST CRUDE FIBRE

SPECIES	WHERE DIGESTED	% FIBRE DIGESTED
Ruminants	Rumen	50-90
Horse	Caecum	13-40
Pig	Caecum	3-25
Rat	Caecum	34-46
Dog	Caecum	10-36
Man	Small Intestine	25-62
Poultry	Caecum	20-30
Rabbits	Caecum	-

Source:- Crampton (1956).

Fibrous feedstuffs are relatively unpalatable as animal feeds and are less expensive than low fibre cereal grains. Further more, the fibre contents of a feedstuff is probably the single most important determinant of nutritive value of feed in that it largely determines the proportion of chemically available nutrients which can be utilized by the animal. An important goal of nutritional research is to find simple ways of determining the true nutrient values. It is important therefore to have a clear understanding of what dietary fibre is and the part it plays in livestock such as in poultry nutrition (Crampton 1956).

Kondra *et al;* (1974) carried out an experiment where they fed a high fibre diet (19.6% fibre) to meat and egg type chickens and found a significant reduction in feed consumption. There was also a reduction in body weight gain per bird, but there was no effect on feed efficiency. The addition of fibre also resulted in significant increase in weight and size of various parts of the alimentary tract in both strains of chickens.

Mortality rate during the growing period was not affected by the high fibre diet. It was concluded that chickens were capable of a high degree of anatomical and physiological adaptation to compensate for variation in nutrient concentration of their diets. Such adaptation during growing phase was shown to have some beneficial effect on laying performance.

From these review it was discovered that much work has been done on other grain by-products such as wheat offal, rice offal, brewers dried grain and so on as a substitute for maize in poultry ration. Industrial maize offal has also been used as a substitute for maize in the diets of egg- type chicks, growers and layers. But there was no mention of local maize offal (dusa) and its use in broiler diets.

This work is therefore, designed to look at the nutrient composition of local maize offal, the percentage recovery of it after the hulling of a given quantity of maize grain and its replacement value for maize in broiler diets.

3.0 MATERIALS AND METHODS

PROXIMATE ANALYSIS

The maize offal (dusa) used for this study was collected from local maize millers in samaru, Zaria, Kaduna, Nigeria. The samples collected from various millers were bulked and sun dried. The sun dried dusa was ground to uniformity prior to inclusion in the experimental diets. Samples of the ground dusa were taken for laboratory analysis.

Using the methods of A.O.A.C (1980), protein was determined by Kjedahl procedure. Ether extract was determined by subjecting the sample to petroleum ether (60-80°c) extraction using the Soxhlet extraction apparatus. Dry matter was determined by oven drying the samples at 100°c over a 12 hour period. Crude fibre was determined by dissolving the sample in dilute sulpheric acid and sodium hydroxide. The ash content was determined by igniting the sample at 600°c. The NFE was obtained by the difference of the rest and 100.

EFFICIENCY OF LOCAL HULLING MACHINES IN THE HULLING OF MAIZE GRAIN

To estimate the efficiency of the hulling machines, 3 replicates of 5kg maize were taken to 3 randomly selected machines for hulling. The main products, dehulled maize and dusa were collected separately and weighed. These were sun dried and reweighed until constant weights were obtained.

FEEDING EXPERIMENTATION

One hundred and ninety six day-old broiler chicks (mixed sex) of a commercial strain were used for this trial. They were housed in electrically heated brooding house and fed the experimental diets shown in tables 4.4 and 4.6 Birds were fed control diet or diets containing 10, 20, 30, 40, 50 and 52.43% maize offal (dusa) at the expense of maize grain during the starter period (0-4 weeks). The composition of the broiler starter diets and the calculated analysis are as shown in table 3.1. From 5-8 weeks of age, the birds were fed a control diet or diets containing 10, 20, 30, 40, 50 and 63.98% maize offal (dusa) at the expense of maize. The composition of the broiler finisher diets and the calculated analysis are as shown in table 3.2. All the treatment diets in starter were isonitrogenous as well as those in finisher diets. Thus for both the starter and finisher stages, there were 7 treatments each with 2 replicates. The birds were distributed into 14 pens with 14 birds per pen. Both the experimental diets and water were supplied ad-libitum during a trial period that lasted for 8 weeks.

Birds were weighed at day old and weekly there after. Feed intake was also recorded on weekly basis while mortality was recorded on daily basis. At one day old, the birds were vaccinated against Newcastle disease using (N.D.V) intra ocular (I.O). At two weeks, they were given the first dose of Gumboro disease vaccine At three weeks of age, they were vaccinated against Newcastle disease using (N.D.V) lasota strain vaccine. When they were four weeks old, they were given the second dose of Gumboro disease vaccine.

At the end of the 8 weeks feeding trial, two birds per replicates were randomly selected and slaughtered for carcass analysis. Birds were killed by cervical dislocation, defeathered and eviserated. The intestine, lung, liver, gizzard, heart and abdominal fat pad were collected and weighed and expressed as percentage live weight. The lengths of intestine and ceca were also measured while the dressing percentage was determined. Data collected were subjected to analysis of variance using the model for completely randomised block design. Differences between treatment means were further separated by the methods of least significant difference (LSD) (Steel and Torrie, 1980). An economic analysis of the merits or otherwise of using dusa in broiler diets was carried out. The cost of the compounded diet (N/kg) and the cost of gaining 1Kg of weight were also calculated.

Table 3.1 Composition of starter diets in %

Ingredient	1	2	3	4	5	6	7	
Maize (8%)	45.44	36.77	28.11	19.44	10.77	2.11	0.00	
Maize bran (12%)	0.00	10.00	20.00	30.00	40.00	50.00	52.43	
Soyabeans (38%)	50.96	49.63	48.96	48.29	46.96	44.29	43.97	
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	
* Premix[1]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
CALCULATED ANALYSIS								NRC REQUIREMENT
Metabolizable energy (Kcal/Kg)	3376	3299	3222	3132	3056	2030	2961	2880
Crude Protein (%)	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
Crude fibre %	3.55	3.74	3.94	4.14	4.57	4.72	4.62	4.00
Calcium %	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.00
Total P %	0.94	0.96	0.98	0.99	1.02	1.04	1.04	0.70
Lysine	1.34	1.33	1.33	1.33	1.31	1.30	1.30	1.25
Methionine %	0.37	0.37	0.36	0.36	0.36	0.35	0.35	0.86
Cystine %	0.35	0.34	0.32	0.31	0.30	0.29	0.28	-
Methionine + Cystine %	0.72	0.71	0.68	0.67	0.66	0.64	0.63	0.86

* *Premix*[1] Vit A 12500 I.U. ;VitD3 2750 I.U. ; VitE 15 IU;VitK 0.002gm; Vit B 0.0015gm; Vit B2 006gm; Nicotinic acid 0.035;Calcium D-panthenate 0.01mg; Vit B6 0.0035gm; Vit B12 0.02gm; Folic acid 0.001gm; Biotic 0.0005gm; Vit C 0.025gm; cholina chloride 0.39gm; Zino Bacitraium 0.02gm; Methionine 0.2gm; Avates (Lasolo acid) 0.09gm; Managenese 0.1gm; Iron 0.05gm. Zinc 0.04gm. Copper 0.02gm; Iodine 0.001gm; Cobalt 0.000225gm; Selenium 0.0001gm.

Table 3.2 Composition of finisher diets in %

Ingredients	1	2	3	4	5	6	7	
Maize (8%)	55.44	46.77	38.11	29.44	20.77	12.1	0.00	
Maize bran (12%)	0.00	10.00	20.00	30.00	40.00	50.00	63.98	
Soyabeans (38%)	40.96	39.63	38.29	36.96	35.63	34.30	32.42	
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	
* Premix[1]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
Calculated Analysis								NRC Requirement
Metabolizable energy (kcal /kg)	3376	3299	3222	3070	2993	2886	2886	3000
Crude protein %	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Crude fibre %	3.55	3.74	3.94	4.14	4.34	4.55	4.82	5-10
Calcium %	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.00
Total P %	0.91	0.93	0.95	0.97	0.99	1.00	1.04	0.70
Methionine %	0.34	0.33	0.33	0.33	0.32	0.32	0.35	0.86
Cystine %	0.31	0.30	0.29	0.27	0.26	0.25	0.23	
Methionine + Cystine %	0.65	0.63	0.62	0.60	0.58	0.57	0.58	0.86

* Premix[1] same as in starter diets.

4.0 RESULTS AND DISCUSSIONS

PROXIMATE ANALYSIS

The results for the proximate analysis of local maize offal are as shown in table 4.1. It has 89.51% DM, 10.82% CP, 3.49% CF, 4.6% EE, 4.13% Ash and 76.98% NFE. These results showed that it is higher in crude protein than the maize from which it is obtained (10.82% and 8%) respectively. This level of crude protein is however, lower than the result obtained by Fadugba (1989) from industrial maize offal (12.06). The reason for the higher crude protein value for dusa than for maize is due to the greater proportion of germ in dusa than in the whole maize grain. During the hulling of maize by the local mills, greater proportion of germ is removed and are all concentrated in the dusa; since greater part of protein is found in the germ, it explains why there is higher protein in dusa than the maize grain.

Table 4.1 Proximate Analysis of Local Maize Offal.

	% DM	% CP	% CF	% EE	% ASH	% NFE
Animal Sc. Lab.	87.76	11.00	1.45	4.80	4.12	78.66
NAPRI Lab.	91.25	10.63	5.55	4.40	4.14	75.28
Average.	89.51	10.82	3.49	4.60	4.13	76.98
Corresponding value for maize.*	92.05	8.57	2.19	3.65	1.67	83.92

* Nelson 1984.

Crude fibre was found to be more in dusa than in the whole maize grain as seen in table 4.1. This is as a result of the removal of testa, aleurone and other components that are fibrous from maize hence their concentration in the dusa. Oyenekwe *et al*; (1995) observed that the removal of these components by local engleberg type dehulling machine is by stirring and shaking the grain at a very high speed. The kernels of grain rub against each other and against the rough disc in the dehuller; this causes the offal to be rubbed off.

The crude fibre obtained for dusa was 3.49% which is far less than the N.R.C (1980) recommendation of 4.00% for poultry. Therefore dusa can be used in poultry ration without any adverse effect of fibre. The ether extract is higher in dusa than in the whole maize grain. This again is due to the greater proportion of the germ in the dusa than in the maize grain; since germ is the richest part of the grain in oil. The ash component of dusa is more than that of maize. This is in agreement with the work of Fadguba (1989) where she used industrial maize offal. This is due to the greater concentration of mineral components in the fibrous part of the maize grain than in the endosperm. It is however, lower in NFE than the maize grain.

EFFICIENCY OF LOCAL HULLING MACHINES IN HULLING OF MAIZE

The results for the efficiency of local hulling machines in the hulling of a given quantity of maize grain are shownin table 4.2. It showed 84.20% recovery after the hulling of which 74.08% was the grit and 25.92% was dusa. But the proportion of the principal part of maize grain revealed that dusa which composed of scutelum, pericarp and aleurone layers constitute 16.85% (Ihekoronye and Ngoddy 1985) and the local hulling gave 25.92%. It therefore means that dusa is not only composed of those parts (scutelum, pericarp and aleurone) but some quantities of germ and endosperm are also present.

Table 4.2 Percentage Amount of Grit and Dusa from Hulling of a Given Amount of Maize Grains.

machine	initial amount of maize grain	% recovering after hulling	% amount of grit	% amount of dusa
A	5.00	90.00	73.33	26.67
B	5.00	89.60	73.66	26.34
C	5.00	82.00	75.61	24.39
AVERAGE	5.00	87.20	74.08	25.92

FEEDING TRIAL 0-4 WEEKS

The results for the feeding trial 0-4 weeks are presented in table 4.3. The feed consumption showed no significant difference between treatments diets. Treatment five having 40% dusa replacement for maize showed a higher feed consumption than all other treatments but it was not to a significant level. The results also showed no significant difference (P>0.05) for weight gain between the control and other treatments diet.

Feed conversion efficiency did not show any significant difference across the treatments. Economic analysis showed that there was a significant difference (P<0.05) for feed cost per Kilogramme gain in weight between the treatment diets. Treatment one (control) had significantly higher cost than all other treatments. Treatment 2 to 6 had no significant difference but treatment seven with 100% dusa replacement for maize had the least cost than all other treatments. There was no significant difference in mortality rate across the treatments. The non-significant difference in feed consumption is in agreement with the work of Fadugba (1989). She observed no significant difference (p>0.05) in feed consumption when either industrial maize offal or maize grain diets were fed to chicks, growers and layers. The fibre contents of dusa did not influence the feed consumption. This is contrary to the work of Tadtyanant *et al* (1993) in which they observed that diets containing 40 and 50% brewers condenced solubles (BCS) resulted in a lower gain to feed ratio when compared with the control in broiler starter diets. The non- significant difference for weight gain between all the treatments also agreed with the work of Fadugba (1989). She observed no significant difference in weight gain when either industrial maize offal or maize grain were fed to chicks, growers and layers. In this experiment, treatment four having 30% dusa replacement for maize had higher weight gain and treatment six had the least, but not to a significant level (P>0.05). Local maize offal can totally replace maize grain in broiler starter diets without adverse effect on feed consumption, weight, feed conversion efficiency and mortality. There is economic advantage of using dusa in starter diets since it reduce the cost of the diet per kilogramme.

Table 4.3 Performance of Broilers Fed Graded Levels of Local Maize Offal (dusa) 0-4 weeks

	Dietary Levels of Dusa							
Parameters	0	10	20	30	40	50	52.43/ 63.98[1]	SEM
Feed consumption(g)	1409.50	1369.50	1365.50	1418.00	1507.50	1355.00	1380.50	69.50
Weight gain (g)	693.05	681.94	644.90	611.81	636.88	606.45	631.11	22.66
% Mortality	0	0	0	7.14	7.14	10.71	10.71	0.655
Feed cost (N/Kg)	10.27	9.75	2.29	8.81	8.32	7.83	7.71	0.016
cost N/Kg gain	20.89^{a}	19.61^{ab}	19.65^{ab}	18.68^{ab}	18.84^{ab}	17.58^{ab}	16.92^{b}	1.50
Feed to gain ratio	2.03	2.01	2.12	2.32	2.37	2.23	2.19	44.12

Treatment with the same letter as superscripts along the same row showed no significant difference ($p>0.05$)

[1] 52.43 in starter and 61.98 in finisher.

FEEDING TRIAL 5-8 WEEKS

The results for the feeding trial 5-8 weeks are as shown in table 4.4. The result showed that there was no significant difference in feed consumption between all the treatments. Treatment five however, with 40% of the maize replacement by dusa had slightly higher but non-significant feed consumption. Also there was no significant difference between all the treatments for weight gain. Although the treatment in which 30% of the maize was replaced by dusa had relatively higher weight gain and the one with 100% dusa had the least the difference was not to a significant level. Feed conversion efficiency showed no significant difference ($P>0.05$) between all the treatments. Cost analysis showed that there was a significant difference across the treatments. The control had the highest cost per kilogramme gain than all other treatments. Treatment six had the least cost per kilogramme gain in weight.

The observed linear increase in feed consumption upto treatment five and then drops slowly could be due to gut fill during the feeding of birds. The low weight gain observed in treatment seven is due to the low energy content of the diet and broilers between the age of 5-8 weeks need higher metabolizable energy.

Maize offal can replace maize grain up to 100% without adverse effect on feed consumption, weight gain, feed conversion efficiency and mortality rate and there is an economic advantage of using offal in place of maize since it cost less (N5.00 and N15.00 per kilogramme respectively).

Table 4.4 Performance of Broilers Fed Graded Levels of Local Maize Offal (dusa) 5-8 weeks

	Dietary Levels of Dusa							
Parameters	0	10	20	30	40	50	52.43/ 63.98[1]	SEM
Feed consumption(g)	3360.00	3185.00	3395.00	3605.00	3640.00	2980.00	3405.00	145.60
Weight gain (g)	1302.57	1344.13	1336.92	1401.83	1346.18	1283.73	1357.93	82.80
% Mortality	3.57	3.57	17.86	7.14	0	10.71	3.52	1.10
Feed cost (N/Kg)	10.06	9.54	9.09	8.60	8.11	7.61	6.94	0.00
Cost N/Kg gain	26.41^{a}	23.13^{b}	22.67^{b}	22.99^{b}	22.59b	18.17^{c}	21.20^{b}	0.97
Feed to gain ratio	2.58	2.37	2.54	2.57	2.70	2.32	2.51	66.12

Treatment with the same letter as superscripts along the same row showed no significant difference ($p>0.05$)

[1] 52.43 in starter and 61.98 in finisher.

FEEDING TRIAL 0-8 WEEKS

The results for the feeding trial 0-8 weeks are presented in table 4.5. The cumulative feed consumption from 0-8 weeks showed a significant difference between treatments. When the treatment means were compared using LSD statistics, treatment five showed a significantly higher ($P<0.05$) feed consumption than all other treatments. There was however, no significant difference between treatment five and four ($P>0.05$). Treatment four had significantly higher feed consumption than 1,2 and 3. But treatment 2 showed a higher value than treatment 6.

There was no significant difference for weight gain between all the treatments. Although the cumulative weight gain for the 30% maize replacement by dusa had relatively higher weight gain and 100% replacement had the least weight gain, it is not to a significant level. Feed conversion efficiency showed no significant difference across the treatments.

There was no significant difference for mortality rate across the treatment for the 0-8 weeks period of the experiment. Cost analysis showed significant difference. The control had significantly higher cost than all other treatments. Treatment six had the least cost per Kilogramme gain. The reason for the decrease in cost per Kilogramme gain as the level of inclusion of dusa increases is because the cost of dusa per Kilogramme is less than the cost of maize grain per kilogramme (N5.00 and N15.00 respectively). Therefore, there was a significant effect of dusa on the cumulative feed consumption but not on the weight gain, feed to gain ratio, mortality rate and carcass parameters as shown in table 4.7 for the period of 0-8 weeks. Economic analysis revealed that there was N2.84 savings per kilogramme of feed when dusa was used as source of energy in diets 7 (52.43%) compared to when maize grain was used in control diet. This is equivalent to 27.93% savings.

Table 4.5 Performance of Broilers Fed Graded Levels of Local Maize Offal (dusa) 0-8 weeks

	Dietary Levels of Dusa							
Parameters	0	10	20	30	40	50	52.43/ 63.98[1]	SEM
Feed consumption(g)	4769.50^{c}	4554.50^{cd}	4760.50^{c}	5023.00^{ab}	5142.50^{a}	4335.00^{d}	4785.50^{bc}	103.90
Weight gain (g)	1995.61	2026.10	1983.81	2073.14	2017.67	1890.18	1889.04	100.1
% Mortality	3.57	3.57	17.86	14.29	7.14	21.43	7.14	1.389
Feed cost (N/Kg)	10.17^{a}	9.66^{a}	9.19^{a}	8.71^{a}	8.22^{a}	7.72^{a}	7.33^{b}	0.00
Cost N/Kg gain	24.49^{a}	21.96^{b}	21.74^{b}	21.41^{b}	21.26^{b}	17.97^{c}	19.78^{bc}	0.96
Feed to gain ratio	2.39	2.25	2.40	2.42	2.55	2.29	2.53	35.17

Treatment with the same letter as superscripts along the same row showed no significant difference ($p>0.05$)

[1] 52.43 in starter and 61.98 in finisher.

CARCASS ANALYSIS

The results of the carcass parameters are presented in table 4.6. The result showed that there was no significant effect of the dietary treatments on gut, lung, liver or gizzard weights (P>0.05; table 4.7). Also there was no variation in the weight of the heart or fat pad that could be attributed to the diet. Similarly the intestinal and the caecal lengths for all the treatments showed no significant difference. Dusa, although a fibrous feedstuff gave a better results compared with other fibrous feedstuffs like the brewers dried grain. It was found by Lopez and Carmona (1981) that when 20% or more of BDG was used in broiler diets, there were significantly (P<0.05) reduced abdominal fat pad and meat tissues and a significant increase in the weight of the digestive tract. The non-significant difference observed in the gizzard weight in this experiment is contrary to the work of Deaton *et al* (1977). They reported that gizzard weight were significantly (P<0.05) increased when a high level of sunflower meal was substituted for soyabean meal. Also Kubena *et al* (1974) found that the gizzard weight of broilers raised in the cages was significantly lower than those raised on the floor despite the same nutritional regime. Bayer *et al* (1978) and Abdelsamie *et al* (1983) observed that growth and feed utilization decreases with increasing fibre content in chicken diets.

Table 4.6 Effect of Dietary Levels of local maize offal on the organs of broilers 0-8 week

Parameters	Dietary Levels of Dusa 1	2	3	4	5	6	7
percentage of dusa	0	10	20	30	40	50	52.63
Dressing %	74.80	70.2	73.59	73.57	71.94	73.5	77.87
Intestinal length (cm)	9.17	9.15	9.60	10.02	9.67	10.64	9.61
Caecal length (cm)	0.84	0.88	0.95	0.92	0.88	1.03	0.99
Lung weight as % live weight	0.64	0.62	0.60	0.67	0.68	0.73	0.53
Liver weight as % live weight	1.85	1.77	2.06	1.79	1.97	2.00	1.81
Gizzard weight as % live weight	1.76	1.96	1.80	1.66	1.83	1.84	1.76
Heart weight as % live weight	0.68	0.72	0.70	0.65	0.66	0.92	0.53
Fat weight as % live weight	2.40	2.31	2.08	2.43	2.85	2.76	1.75

SUMMARY AND CONCLUSION

Local maize offal (dusa) is higher in crude protein (10.82%) and ether extract (4.60%) than the maize grain from which it was obtained (8.57% and 3.65% respectively). The fibre and the ash contents are also higher. It was discovered that for any quantity of maize grain hulled 75% turns out to be grit while the remaining 25% gave the dusa.

There was no significant difference observed for feed consumption, weight gain, feed to gain ratio and mortality between the control and other treatments for feeding trials 0-4 weeks and 5-8 weeks. Economic analysis however, showed that there was a significant difference ($P<0.05$) for feed cost per kilogramme gain in weight between the control and other treatments.

For the cumulative results of the feeding trial 0-8 weeks, feed consumption showed some significant differences across the treatments. But there was no significant differences between the control and other treatments for weight gain, mortality, feed to gain ratio and carcass parameters.

It can therefore be concluded that dusa can be used as a substitute for maize in broiler starter and finisher diets without any adverse effect on feed consumption, weight gain, feed to gain ratio, mortality and carcass parameters.

REFERENCES.

Abdelsamie, R.E; Ranawere, K.N.P. and W.E. Nano, (1983). The influence of fibre content and physical texture of diet on the performance of broiler in the tropics. Brit. Poult. Sc. 383 - 390.

Abound, M; Jerock, H; Gebhardt, G. (1990). Use of maize Cob-mix silage of differing quality for broilers. Tierenahnmg and futherung 16: 202 - 207

Ademosun, A. A. (1983). Evaluation of brewers dried grains in the diet of growing Chickens. Brit Poult. Sc. 14: 463 - 468.

Aduku, A. O; Dim A. J. and Ogundipe, S.O (1991). Evaluation of sun dried cassava peels as energy source in broiler diets. A paper presented at the 6th annual conference of Nigerian Society of Animal Production held at Usman Danfodio University, Sokoto, Nigeria. March, 1991 pp 1-14.

Aduku, A. O. (1993). Tropical feedstuff analysis table. Department of Animal Science, Ahmadu Bello University, Zaria.

Agriculture Policy for Nigeria (1984). Strategies for implementation, Federal Ministry of Agriculture, water resources and Rural development

Albinos, A. A. (1963). Newer methods of nutritional bio chemistry. Academic Press, New York and London

Almquist, H. J; (1972). Protein and Amino acids in Animal nutrition 8B. Pernick and Co. New York.

Association of Official analytical Chemistry (1970). Official methods of analysis; 11th edition, Association of Official analytical Chemistry, Washington D. C.

Atteh, J. O; Balogun O. O; Annongu, A. A; Kolade, M. A. (1993). Replacement value of Maize Milling waste for maize in the diet of growing pullets. Tropical Agriculture 70: 267 - 270.

Augustine, E. O. (1992). Utilization and processing of maize. Research guide 35:5 - 25.

Babatunde, G. M. (1975). Problems of livestock production in Nigeria. Paper presented at the Division of Agricultural Colleges teaching methods workshop, A.B.U., Zaria.

Bala, A. M. (1986). Effect of levels and source of wheat offal on the performance of chickens M.sc. thesis. Department of Animal Science, Faculty of Agriculture, A.B.U., Zaria.

Bayer, R. C., Hoover, W. H. and Mulr, F. W. (1978). Dietary fibre and meal feeding influence on broiler growth and crop fermentation. Poultry Sci. 57:1456 - 1459.

Bayley, H.A. Aummer, J. D. and Slinger, S. J. (1969). A nutritional evaluation of corn wet milling by - products using growing chicks and turkey poults, adult roosts and turkeys rats and swine, cereal chem. 38:334 -42.

Bolton, W. (1971). Aspects of poultry nutrition in development of feed resources and improvement of animal feeding methods. The CENTO Region Countries. CENTO Conference. Proceeding pp 107 - 109.

Cavins, N. A. G; Summers, J. D; Slinger S.J. and Ashton, G. C. (1965). The nutritional value of wheat milling by-products for the growing chicks. Availability of energy cereal chem. 42: 523 - 582.

Chrappa, E. W. (1990). The use of feedstuff in the formulation of livestock ration. Animal nutrition; published by W. H. Freeman and Company, pp 40-42.

Church, D. C. and W. G. Pond. (1974). Basic Animal Nutrition and Feeding. D. C. Church, Oregon, U.S.A.

Corley, J. R; Baker, D.H and R.A Baster. (1980). Biological availability of phosphorus in rice bran and wheat bran as effected by pelleting. J. Anim. Sci. 50: 286 - 292.

Crampton, E. W. (1956). The use of feedstuffs in the formulation of livestock ration. Animal Nutrition. Published by W.H. Freeman and Company, Sanfrancisco. pp 40 - 42.

Crampton, E.W and Harris, L.E (1969). Appplied Animal Nutrition 2nd edition. Freeman, W.E and Company, San Francisco. pp 237-239

Crazier, F. H; Leslie, E. and C. Charnvit. (1974). Factors influencing the feeding value of rice bran for chickens. Poult. Sci. 53: 1795 - 1800.

Cresswell, D. and Zainuddin, D. (1980). Corn bran as a feedstuff for broilers and laying hens. In nutr. abst. and rev, 1882. vol 52 (4) pp 229.

Cullison, A. E. (1975). Feeds and Feeding. Restor Publishing Company. Restor Virginia. 39-45

Deaton, J. W. Mac Naughton, J. C. and D. Burdick, (1979). High - fibre sunflower meal as a replacement for soyabeans meal in layer diets. Brit. Poult. Sci., 20:159 - 162.

Deaton, J.W.; Kubena, L.F.; Reece, F.N. and Lott, B.D. (1977). Effect of dietary fibre on the performance of laying hens. Brit. Poult. Sci. 18: 711-714.

Deolanker, R.P and Singh, K.S. (1979). Trypsin inhibitor, mineral availability and performance of broiler chicks fed on diets based on rice bran. Anim. Feed sci. tech. 4:133-141.

Devendra, C. and G. V. Raghavan, (1978). Agricultural by - products in South East Asia: Availability utilization and potential value. World rev. of anim. prod. pp11 - 27.

D'Mello, J. P.F. (1987). Under exploited tropical feed stuffs for poultry. World Rev. anim. prod. 23(3) 37 - 44.

Dogari, M. (1985). Evaluation of local sorghum beer residue in broiler chickens. M.sc. thesis, Department of Animal Science, Faculty of Agriculture, A.B.U., Zaria.

Earle, F. R; Cultis, J.J. and Hubbard, J. E. (1946). Composition of the component parts of the corn kernel. Cereal chem. 23: 504 - 511.

Elias, L. G. and R. Bressani. (1970). Use of Central American feed resources for the encouragement of the livestock industry: Chemical composition of some by - products from the cereal industry wheat, rice and maize. Nutr. Abstr. and Rev. Series B. 41: 4927.

Elzubier, E. A; Jubarah, S. K. (1993). Nutritional evaluation of sorghum germ meal as a substitute for sorghum in broiler diets. Anim. Feed Sci. Tech. 44: 93 -100.

Ensminger, M. E. and C. G. Olentine. (1978). Feeds and nutrition (complete) 1st edition. The Ensminger Publishing Company, California, U.S.A. pp 56-58

Fadugba, A. B. (1989). Evaluation of the nutritive value of maize offal in Poultry diets. M.sc thesis, Department of Animal Science, Faculty of Agriculture, A.B.U., Zaria.

Fetuga, B. L. (1977). The metabolizable energy value of some cereals and cereal by - products for chickens. West African J. Biol and Appl Chem. 20: 3 - 15.

Gohl, B. (1975). Tropical Feeds. Feed Information Summaries and nutritive values. F.A.O. Rome.

Halpin, K. M. and D. H Barker (1986). Manganese utilization in the chick. Effect of corn, soyabeans, meat, fish meal, wheat bran and rice bran on tissue uptake of Manganese. Poult. Sci. 63: 995 -1003.

Ihekoronye, A. I. and Noddy, P. (1965). Integrated Food Science and Technology in the topics Macmillan London.

INCAP, (1969). Evaluation. Nutritional de La Poblicion de centro America Y. Panama INCAP Publication V - 25.

Inglett, G. E. (1970). Corn: Culture, processing products. AVI. Publishing Company Inc. West Port Connecticut. pp 220 - 240.

Jensen, L. S; Saxemna, H. C; MC Ginnis, J. (1969). Nutritional investigations with turkey hens. Its counteraction by dietary Unidentified Factor Supplements of deleterious effect of drugs on egg production in turkeys. Poultry Science, 40: 1524 - 1525.

Jemeh, H; Kurbis, G; Souggrant, S. (1990). Feeding value of maize products for rabbits, Indian jurn. of Anim.sci.40: 443 - 447.

Kamalanathan, G, Mehla, ı. and R.P Devendra (1971). Studies with deoiled rice polishing. I.Nutritional Value and acceptability. Nutritional Abstract and Review series B. (1971) 41: 4940.

Klenholz, E. W. (1969). Cited by Inglett, G. E. (1970). Corn: Culture, processing, product. The AVI. Publishing Company, Inc. West Port, connection p. 220- 240.

Kohler, G. O. R. M. Saunders; D. O. Kuzmicky and R. E. Enochian, (1970). Biological availability of nutrients and computer evaluation of mill feeds feedstuffs. 42(3) 41 - 43.

Kondra, P.A; Sheu, J. L; Guenter, W, (1974). Response of meat and egg - type chickens to a high fibre diets Can. J. anim. scis. 54: 651 - 658.

Kubena, L. F; Deaton, J. W; May. J. D. and Recce, F. N. (1974). A dietary method to correct a gizzard abnormality of broilers. Poultry Sc. 53: 407 - 409.

Lobez, B. A. Carmona, E. C. (1981), effect of feeding deoiled rice polish on the growth and subsequent production of white leghorn pullets J. Sci. feed Agric. 26:641-642)

Lodhi, G. M. and J. S Ichhponani (1975). Effect of feeding devoiled rice polish on the growth and subsequent production performance of white leghorn pullets. J. Sc. Fed Agric. 26: 641 - 642.

Mahatab, S. N. (1985). Variability in chemical composition of bran. Rice abstr. (1986) 9: 850.

Malynicz, G. C. (1974). The value of rice bran in broiler ration Poult. Abstr. (1977) 3: 280.

Martins, E; Johnson, Z and P. Waldroup. (1983). Utilization of rice bran and white rice in diets for growing broiler chickens. Poult. Sci. 62: 1463 (Abst).

Maust, L. E. Scott, M. L. and W. G. pond. (1972). The metabolizable energy of rice bran, cassava flour and cowpeas for growing chickens. Nutr. Abstr. and Rev. series B (1973) 3: 6336.

Mitchel, H.H. (1964). Comparative nutrition of man and domestic animal. New York Academic Press.

Moran, E. T. and J. D. Summers (1970). Nutritional value of wheat mill Feedstuff 42 (17): 26 - 28.

Muller, H.G. (1970). Use of grain in poultry diets. Ghana. J. Agric Sc 3: 187.

National research council, (1984). Nutrients requirements of poultry. 8th revised edition. National Academy press. Washington D.C.

National Research Council (1988). Quality Protein in animal feeds. National Academy Press. Washington, D.C pp 8 - 11.

Nelson, F.S (1984). Replacement of maize in poultry ration by wheat bran and brewers dried grain. M.sc thesis, Department of Animal Sc., Faculty of Agriculture, Ahmadu Bello University, Zaria.

Newcombe, M. and J.D Summers, (1985). Effect of increasing cellulose diets fed as crumbles or mash on the feed intake and weight gains of broilers and leghorn chicks. Br. poult. Sc. 26: 35-42.

Obeka, E.M. (1985). Nutritive evaluation of rice offal in diets for growing pullets and layers. M.sc thesis, Department of Animal Science, Faculty of Agriculture, A.B.U., Zaria.

Ogundipe, S.O. (1987). Non-conventional poultry feedstuffs from research to practice. Paper presented at the poultry farmers workshops, AERLS, Ahmadu Bello University, Zaria. Dec. pp 8- 10.

Omar, E.M; El-Abbady, M.R; El-Katoury, M.I and F. Tawakol, (1976). Evaluation of the feeding values of some cereal grains and by-products by digestion trial in chickens. Nutr. Abstr. and Rev. series B. (1977) 47:6972.

Osei, S. A; and Duodu, S. (1988). The use of sun dried cassava peel meal in broiler diets. J. of Anim. Prod. Res. Vol. 8 (2), 68-75.

Osuji, P.O, (1982). Agro-industrial by-products and animal feeding in the Caribbean Region. World Rev. Anim. Prod. 18:43- 56.

Oyenekwe, P.C (1995). Processing of commonly available grains. Food and Science Technology Department, Faculty of Agriculture, A.B.U. Zaria. Unpublished.

Oyenuga, V.A, (1968). Nigeria's feeds and feeding stuffs, their chemistry and nutritive value. Ibadan university press, Ibadan. pp 41-44.

Oyeyiola, L.B.F, (1991). Utilization of rice offal by egg type chickens. M.sc thesis, Department of Animal Science, Faculty of Agriculture, A.B.U, Zaria.

Philip, J.S. (1970). Poultry feeds and nutrition. pp 103-104.

Pido, P.P; and Adenyaju, S.A. (1978). The feeding value of fermented cassava peel meal in broiler diets. Nutr. Reports International 18(1): 79-86.

Pine, J.A., (1962). Sources of energy for poultry in the pacific area. World poultry Science journal 18:406-418.

Polin, D. and J.H Wolford, (1971). Egg production by white leghorn adult females restricted in feed intake by limiting their time or allotted amount to eat. Poult. Sc. 50:1618. (abstr).

Pond, W.G. and Maner, J.H., (1974). Swine production in temperate and tropical environments. W.H. Freeman and Co. U.S.A 239.

Prawirokusumo, S.; Kienholz, E.W and D.J. Bray, (1977). The limiting amino acids for chicks in a rice bran diet. Poult. Sc. 56:1749. (abstr).

Ranjhan, S.K, (1980). Animal nutrition in the tropics. Vikas publishing house, PVT. Ltd. India, pp84-105.

Roth-maier, D.A.; Kirchgessner, M. (1985). Fattening of broiler with corn-cob-mix. Archiva fur Gejlugel Kunde 49:(3) 117- 123.

Saunders, R.M. (1985). Rice bran composition and potential food uses. Rice abstr. (1989) 12:1460.

Sayer, R.N; Earl, L; Kratzer, F.H and R.M Saunders, (1988). Effect of diets containing raw and extrusion cooked rice bran on growth and efficiency of feed utilization by broilers. Rice abstr. (1989) 12:1477.

Schaible, P.J. (1970). Poultry Feeds and Nutrition. The Avi publishing company West port, Connecticut.

Scott, M.L; Neisheim, M.C and Young, R.J. (1974). Nutrition of the chicken. M.L Scott. and Associates, Ithaca, Newyork pp. 443-448.

Sekoni, A.A. (1991). Effect of feeding graded levels of cassava peel meal on the performance of laying birds. Paper presented at National Animal Production Research Institute, (NAPRI) seminar, 19th Feb, 1991

Stallcup, O.T. (1958). Composition of crude fibre in certain roughage. J. Dairy Sci. 41:963.

Steele, R.G.A and Torrie, J.R. (1960). Principles and procedures of statistics, M.C Graw- Hill book company Inc. Newyork. Toronto and London.

Subramaryan, G.S; Reddy, C.V and C.R Nyathur, (1972). Feeding value of deoiled rice bran in chick ration. Nutr. Abstr. and Rev. Series B(1973) 43:4885.

Summers, J.D and Leeson, S. (1993). Influence of diets varying in nutrient density on the development and reproductive performance of white leghorn pullets. Poult. Sci. 72(8) 1500-1509.

Tadtyanant, C; Lysons, J.J; Vande Popalliers, J.M. (1993). Brewers condensed solubles used as a feedstuff in broiler diets. Poultry Sci. 72 (101) 1897-1905 (Abstr).

Thompson, S.A and C.W. Weber, (1981). Effect of dietary fibre sources on tissue mineral levels in chicks. Poult. Sc. 60: 840-845.

Titus, H.W and J.C. Fritz, (1971). The scientific feeding of chickens. 5th edition. The Interstate printers and publishers, Inc. Danoville, Illinois.

Trowell, H;. Southgate, M.A and Jenkins, D.A (1976). Dietary fibre- redefined. Lancert.1:967.

Velasco,J.A; Souza, C.R; Gomes,A.V and E.J. Campos, (1985). Chemical composition, apparent metabolism of dry matter and energy content of energy feed for broiler chickens at different ages. Nutr. Abstr. and Rev. Series B.(1985) 55:6041.

Yamazaki, M. and H. Kamata, (1986). Amino acid availability of feed ingredients for poultry. Nutr. Abstr. and Rev. Series B.(1986) 56:6439.

APPENDIX

APPENDIX 1 PROXIMATE ANALYSIS OF COMMON BY-PRODUCTS USED IN ANIMAL RATIONS.

Ingredient	CP%	CRUDE FAT	CF%	ASH%	NFE%
Rice bran	13.00	15.00	12.00	10.00	50.00
Rice offal	6.00	5.60	3.30	19.10	66.00
Molasses	2.90	0.00	0.00	8.10	89.00
Industrial maize offal	11.90	1.70	10.50	0.80	75.10
Cassava peal meal	5.00	5.80	9.50	7.20	72.50
Wheat offal	15.61	5.14	10.00	6.40	62.85

Source: Aduku A.O (1993).

Appendix 2: Analysis of Variance for weight gain 0-4 weeks

Source of variation	DF	SS	MS	f
Replication	1	505.68	505.68	0.98
Treatment	6	11327.54	1887.82	3.67
Error	6	3088.10	514.68	
Total	13	14921.33		

Appendix 3: Analysis of Variance for weight gain 5-8 weeks

Source of variation	DF	SS	MS	f
Replication	1	2543.41	2543.41	0.42
Treatment	6	38553.61	6425.60	1.06
Error	6	36401.05	6066.84	
Total	13	77498.07		

Appendix 4: Analysis of Variance for weight gain 0-8 weeks

Source of variation	DF	SS	MS	f
Replication	1	780.91	780.91	0.08
Treatment	6	68480.67	11413.44	1.19
Error	6	57375.51	9562.59	
Total	13	126637.05		

Appendix 5: Analysis of Variance for feed consumption 0-4 weeks

Source of variation	DF	SS	MS	f
Replication	1	0.0012	0.0012	0.21
Treatment	6	0.0379	0.0063	1.08
Error	6	0.0350	0.0058	
Total	13	0.0741		

Appendix 6: Analysis of Variance for feed consumption 5-8 weeks

Source of variation	DF	SS	MS	f
Replication	1	0.0103	0.0103	0.45
Treatment	6	0.6327	0.1054	4.58
Error	6	0.1380	0.0230	
Total	13	0.7811		

Appendix 7: Analysis of Variance for feed consumption 0-8 weeks

Source of variation	DF	SS	MS	f
Replication	1	0.0158	0.0158	1.61
Treatment	6	0.8667	0.1444	14.70
Error	6	0.0590	0.0098	
Total	13	0.9414		

Appendix 8: Analysis of Variance for feed cost per Kg of feed 0-4 weeks

Source of variation	DF	SS	MS	f
Replication	1	0.0000	0.0000	99999.99
Treatment	6	11.3938	1.8990	99999.99
Error	6	0.0000	0.0000	
Total	13	11.3938		

Appendix 9: Analysis of Variance for feed cost per Kg of feed 5-8 weeks

Source of variation	DF	SS	MS	f
Replication	1	0.0000	0.0000	0.00
Treatment	6	14.4443	2.4074	99999.99
Error	6	0.0000	0.0000	
Total	13	14.4443		

Appendix 10: Analysis of Variance for feed cost per Kg of feed 0-8 weeks

Source of variation	DF	SS	MS	f
Replication	1	0.0000	0.0000	0.00
Treatment	6	12.7780	2.1300	99999.99
Error	6	0.0000	0.0000	
Total	13	12.7780		

Appendix 11: Analysis of Variance for feed cost per Kg gain in weight 0-4 weeks

Source of variation	DF	SS	MS	f
Replication	1	6.0994	0.0994	0.04
Treatment	6	21.1091	3.5182	1.56
Error	6	13.5315	2.2553	
Total	13	34.7401		

Appendix 12: Analysis of Variance for feed cost per Kg gain in weight 5-8 weeks

Source of variation	DF	SS	MS	f
Replication	1	3.4601	3.46011	3.68
Treatment	6	73.4110	12.2351	13.00
Error	6	5.6480	0.9413	
Total	13	82.5191		

Appendix 13: Analysis of Variance for feed cost per Kg gain in weight 0-8 weeks

Source of variation	DF	SS	MS	f
Replication	1	0.6776	0.6776	0.73
Treatment	6	48.3965	8.0661	8.74
Error	6	5.5343	0.9229	
Total	13	54.6084		