Journal of Agriculture and Food Sciences
Volume 5 Number 1, April 2007, pp. 21-28

ISSN 1597 - 1074

OPTIMUM SUBSTITUTION LEVEL OF MAIZE WITH SPENT GRAIN IN BROILER FINISHER PRODUCTION

F. N. Madubuike, B.U. Ekenyem and V.N. Obidimma
Department of Animal Science and Fisheries,
Imo State University, P.M.B. 2000 Owerri, Nigeria

ABSTRACT

Sixty 28 - day old Anak broiler chicks were used in a 42 – day feeding trial to assess the performance of finisher broiler chicks fed varying dietary substitution levels of spent grain for maize. The birds were grouped into four treatments. Each treatment was further replicated three times in a completely randomized design. The substitution levels of spent grain for maize were 0%, 5% 10% and 15% for treatments T_1, T_2, T_3 and T_4 respectively. Response parameters were, initial body weight, weekly body weight gain, daily body weight gain, final body weight, breast width, thigh/shank length thigh circumference, wing length, feed intake, feed conversion ratio and mortality. Other parameters include, dressed weight, breast weight, thigh weight, drumstic weight, and wing weight. Liver, gizzard, heart, lung and intestine weights were also measured. The internal organ weights were expressed as percentage of live weights. Cost of total feed intake per bird, cost of per kilogram weight gain per bird were also calculated. Results revealed that there were significant differences ($P<0.05$), between treatments on average weekly body weight gain, total feed intake, feed conversion ratio, final live weight, dressed weight, thigh weight, thigh/shank length, internal organ weights, cost of total feed intake and cost per kilogram weight gain per bird.. However, treatment means for average cost total feed intake per bird, breast weight, drumstic weight, thigh circumference, breast weight, gizzard weight and wing length were not statistically difference ($P>0.05$).

INTRDOUCTION

Livestock constitutes a prominent source of livelihood in Nigeria and accounts for more than 60% of household revenue (Gardiner and Devendra, 1995). Thus, sequel to the rapid increase in human population of Nigeria, it is imperative that animal protein production increases adequately to meet this increased demand, achievable by addressing the major constraints to livestock production in Nigeria.

However, to attain this plan of increased animal protein production has become increasingly difficult because of high cost of conventional feedstuffs, notably the protein and energy concentrates. Thus the cost of maize has this feedstuff, which makes its production grossly inadequate to meet demand. Establishment of feed mills and importation of day old chicks were ordered to achieve adequate production of poultry (Yar'adua, 1977) while president Shehu Shagari, 1980 under the green revolution programme approved the importation of N900,000 worth of vaccines and drugs. These efforts, though commendable, needed to be complemented with cheaper feed production in order to reduce cost and made livestock

products affordable to the consumers. The need to use agro-industrial by-products such as brewer's dried grain (spent grain) as substitute to maize becomes necessary to save the Nigerian Poultry Industry from collapse and to make animal protein adequately affordable by Nigerians.

Brewer's Dried grain (spent grain) is a cereal by-product derived during brewing. It was hitherto disposed as wastes. Presently, it is gaining popularity as a source of energy in poultry and livestock feed, but yet the price is very low compared to maize. This with 1980 kcal/kg ME, 18% crude protein and good mineral profile, spent grain seems to have, the potentials to effectively substitute maize as energy source in poultry production.

This trail is therefore aimed at evaluating the optimum substitution level of spent grain for maize in performance, organ and carcass characteristics of finisher broiler chicken as well as its economic effectiveness.

MATERIALS AND METHODS

The study was conducted at the livestock unit of the Teaching and Research Farm, Imo State University, Owerri.

Sixty (60), 28 – days old Anak broilers were used for the experiment after brooding them for 4 weeks (28 days). The 60 birds were randomly allocated to four (4) treatment groups of 15 birds per group using the completely randomized CRD design. Each treatment group was replicated 3 times (5 birds per replicate).

Spent grain used for the experiment was sourced from the consolidated Breweries Awomamma, in ORU East L.G. A, Imo State. Spent grain collected was subjected to standard proximate analysis according to (AOAC, 1984), to determine the levels of carbohydrate, crude protein, crude fat, crude fibre, Ash, water and mineral content. The comparative nutrient values of spent grain and maize were carried out, (Table 1).

In the comparative analysis of the nutrient contents of spent grain with maize, it is clear that spent grain, compares favourably with maize in terms of nutrient values, and therefore can be partially used to replace some quantity of maize in poultry diets so as to reduce cost of production.

TABLE 1: COMPARATIVE NUTRIENT VALUES OF SPENT GRAIN AND MAIZE

NUTRIENT	SPENT GRAIN	MAIZE
ME (kcal/kg)	1980	3434
Crude Protein (%)	18	10
Lysin	0.90	0.25
Crude fibre	20.00	2.00
Methionine (%)	0.40	0.18
Calcium (%)	0.16	0.10
Ether Extract (%)	6.00	4.00
Dry Matter (DM) (%)	90.	88
Water	6.00	9.60
Tryptophan	0.34	0.09

Source: C.T.A 1992

EXPERIMENTAL DIETS

Four (4) different broiler finisher diets were formulated using the ingredients listed in table 2 below. The four treatment diets contained 0%, 5% 10% and 15% levels of spent grain respectively as T_1, T_2, T_3 and T_4. The quantity of spent grain in each treatment was used to replace the same quantity of maize in the treatment diet. Treatment 1, (T1), contained no spent and served as control or commercial diet.

TABLE 2: COMPOSITION OF THE EXPERIMENTAL DIETS (BROILER FINISHER DIETS)

INGREDIENTS %	T_1	T_2	T_3	T_4
Yellow maize	56.5	51.5	46.5	41.5
Spent grain	0	5	10	15
Soya bean meal	16.5	16.5	16.5	16.5
Palm kernel cake	9.5	9.5	9.5	9.5
Fish meal	4.5	4.5	4.5	4.5
Blood meal	4.5	4.5	4.5	4.5
Oyster shell	5.5	5.5	5.5	5.5
Common salt	0.3	0.3	0.3	0.3
Vitamin premix	1.7	1.7	1.7	1.7
L-lysine	0.5	0.5	0.5	0.5
DL-Methionine	0.5	0.5	0.5	0.5
Total %	100	100	100	100

Maize has a higher bulk density than spent grain. Weight to weight basis was used in working out the percentage equivalent of spent grain at the various substitution levels.

In the proximate chemical analysis of the experimental diets, the fibre content of the diet of treatment four (T_4) is very high while metabolizable energy is very low. This is because spent grain contain higher amount of fibre than maize, while maize contain higher amount of metabolizable energy than spent grain. In commercial diet (T_1), the crude protein content, metabolizable energy, ether extract, nitrogen free extract and phosphorus are slightly higher when compated to T_2 and T_3.

TABLE 3: PROXIMATE CHEMICAL COMPOSITION OF THE EXPERIMENTAL DIETS %

	(T_1)	**(T_2)**	**(T_3)**	**(T_4)**
CRUDE PROTEIN	20.5,	20.0,	19.5,	19.00
ETHER EXTRACT	4.546,	3.5,	3.23,	3.26
ASH	3.446,	3.5,	3.23,	3.26
NITROGEN FREE EXTRACT	66.97,	55.9,	63.5,	59.5
(ME) KCAL / KG	2939.77,	2684.77,	2538.67,	2443.28
CALCIUM	1.46,	1.47,	1.47,	1.47
PHOSPHORUS,	1.13,	1.10,	0.98,	0.97
CRUDE FIBRE	4.946,	6.46,	7.5	9.68
LYSINE	1.13	1.20	1.28	1.36
METHIONINE	0.41	0.43	0.46	0.48

The 28 days old birds were randomly assigned to the four treatment diets as in table 2. The birds were subjected to standard broiler management procedures. Initial body weights of the birds in each replicate were taken at the start of the experiment with weighing balance and weekly thereafter. Feed intake was recorded daily as the difference between the quantity of feed offered daily and the left over the following day. Feed conversion ratios of the birds were calculated by dividing the total feed intake by the total weight gain of the birds in each group. The breast width, thigh/shank length, thigh circumference, wing length were measured using Tailors measuring tape. Mortality was checked one daily basis as when any bird dried in each treatment. At the end of the experiment, twelve (12) birds were randomly selected, one from each replicate, slaughtered, eviscerated and weighed to obtain the dressed weight and eviscerated weight with weighing balance. Thigh, breast, drumstick and wing were weighed with electronic balance. Internal organs such as liver, gizzard, heart, lung and intestine were also weighed with electronic balance to obtain internal organs weight, and their weights expressed as percentage of the live weights.

The total cost of maize, spent grain and other ingredients were calculated for each experimental diet. The average cost per kilogram weight of broiler was determined at the end of the experiment. All data collected were subjected to analysis of variance according to the methods of Snedecor and Cochran (1980), and significant means were separated using the Duncan's multiple range test as described by Onu and Igwemma (2000).

Results and Discussion

Table 4 below, shows the effects of spent grain meal on performance: average weekly body weight gain (kg), daily body weight gain, average total feed intake, feed conversion ratio, mean breast width (cm), mean thigh/shank length (cm), mean thigh circumference, mean wing length (cm), mean final live weight (kg) and mortality.

Table 4: Summary of Performance Characteristics of the Experimental Birds

Parameters	**T_1**	**T_2,**	**T_3,**	**T_4**
Mean initial body wt (kg)	0.27^{a}	0.25^{ab}	0.24^{ab}	0.21^{b}
Mean daily body wt gain (kg)	0.05^{a}	0.05^{a}	0.043^{ab}	0.04^{b}
Mean weekly body wt gain (kg)	0.34^{a}	0.05^{a}	0.043^{ab}	0.04^{b}
Mean total feed intake (kg)	13.938^{c}	14.032^{b}	14.098^{ab}	14.148^{a}
Feed Conversion Ratio	6.8^{b}	7.1^{b}	7.9^{ab}	9.4^{a}
Mean Breast Width (cm)	28.917^{a}	28.183^{a}	27.570^{a}	27.463^{ab}
Mean thigh/shank length (cm)	24.65^{a}	23.43^{a}	22.87^{ab}	22.12^{a}
Mean thigh circumference	12.87^{a}	11.42^{a}	10.22^{ab}	10.15^{a}
Wing length (cm)	17.067^{a}	16.470^{a}	15.070^{ab}	14.267^{a}
Mean final live Wt (kg)	2.06^{a}	1.980^{a}	1.79^{ab}	1.50^{ab}
Mortality (%)	0.00	0.00	0.00	0.00

Means with the same superscripts are not significantly different (P > 0.05).

Table 5: Effects of spent Grain on Carcass Characteristics of Broiler Birds

PARAMETERS	**T_1**	**T_2**	**T_3**	**T_4**
Live weight (kg)	2.06^{a}	1.980^{a}	1.79^{ab}	1.500^{b}
Dressed weight (kg)	2.45^{a}	2.05^{a}	2.00^{ab}	1.90^{b}
Eviscerated weight (kg)	2.00^{a}	1.85^{a}	1.65^{ab}	1.46^{b}
Breast weight (gm)	240^{a}	239^{a}	237^{ab}	235^{ab}
Thigh weight (gm)	89.5^{a}	77.5^{ab}	75.4^{ab}	72.5^{a}
Drumstick weight (gm)	95.4^{a}	90.5^{ab}	88.8^{ab}	87.5^{ab}
Wing weight (gm)	74.5^{a}	65.5^{ab}	65^{ab}	59.4^{b}

TABLE 6: EFFECTS OF SPENT GRAIN MEAL ON INTERNAL ORGANS OF BROILER BIRDS

PARAMETERS	**T_1**	**T_2**	**T_3**	**T_4**
Live weight (%)	1.1b	1.1b	1.4ab	1.5a
Gizzard weight (%)	1.0ab	1.3a	1.3a	1.3a
Heart weight (%)	0.3ab	0.32ab	0.3ab	0.40a
Lung weight (%)	0.05ab	0.5ab	0.45b	0.6a
Intestine weight (%)	2.3ab	2.4ab	2.5a	2.5a

NB: The weights of Internal Organs were expressed as percentage of live weight.

Means with the same superscripts are not significantly different (P > 0.05).

TABLE 7: ECONOMIC ANALYSIS OF BROILER BIRDS FED DIFFERENT LEVELS OF SPENT GRAIN MEAL

	T_1	T^2	T_3	T_4
Total feed intake/bird (kg)	16.726^{ab}	16.838^{ab}	16.90^{a}	16.978^{a}
Cost of total feed intake/bird (N)	791.47^{a}	785.66^{a}	782.30^{ab}	777.59^{b}
Cost of 25kg feed (N)	1183.000^{a}	11665.1^{ab}	1157.25^{ab}	1145.00^{b}
Cost per kg feed (N)	47.32^{a}	46.66^{a}	46.29^{ab}	45.80^{b}
Cost per kg wt gain/bird (N)	482.60^{c}	520.30^{b}	554.82^{ab}	617.06^{a}

Means with the same superscripts are not significantly different (P > 0.05).

Performance Evaluation

Growth performance of broiler birds fed different levels of spent grain (0%, 5%, 10% and 15%) was assessed. The highest mean live weight of 2.06kg was obtained from the group fed 0% spent grain (T1) 1.980kg, 1.790kg and 1.500kg were obtained from T2 fed 5% spent grain, T3 10% spent grain, and T4, 15% spent grain respectively.

The relatively least live weight of 1.500kg obtained from (T4) fed 15% spent grain may be as a result of high inclusion level of spent grain in the diet. Spent grain contains high fibre and at higher inclusion level can reduce growth of birds, Philips (1977). There, were significant differences (P < 0.05) between the values of breast width, thigh/shank lengths between T1, T2 and T3 respectively. The highest (P < 0.05) mean breast width was obtained from birds on diet T1, with 28.463cm followed, by birds on diets T2, = 28.183, T3 = 27.570cm and T4 = 27.463cm. Mean thigh/shank lengths were, T1 = 24.65cm, T2 = 23.43cm, T3 = 22.87cm, and T4 = 22.12cm.

FEED INTAKE

Mean total feed intake were, 13.938kg, 14.032kg, 14.098kg and 14.148kg for birds on T1, T2, T3 and T4 respectively. The mean total feed intake was highest in T4 and least in T1, and both significantly differed (P < 0.05). The values for T2 and T3 also differed (P < 0.05). Thus feed intake increased with levels of spent grain. Diet T1, recorded the highest (P < 0.05) (ME) of 2939.77kcal/kg, followed by T2 with 2684.77 kcal/kg, T3, 2538.67 kcal/kg and T4, 2443.28 kcal/kg respectively. The recorded highest (P < 0.05) feed intake by T4 group was for the fact that the diet contained high amount of fibre compared with the fibre content of other diets (T1, T2 and T3) arising from high fibre content of spent grain. This agrees with Madubuike, (1988), that feed requirement for growth and fattening increases as dietary energy levels decrease. It is now known that broiler eat to meet their energy requirements. Bello (1984), had observed that feed intake of broiler was reduced as the energy density of the diet was increased and vice versa. There were significant differences between the treatments (P < 0.05) on feed conversion ratio. Feed conversion ration appeared

to be highest (P < 0.05) with T4, 9.4% followed by T3, 7.9%, T2, 7.1% and T1, 6.8%. Anderson (1973), observed that certain quantity of fibre is necessary in all animal species for proper functioning of fastro-intestinal track. There was no mortality throughout the experimental period. This could be explained by the observed ability of broiler to tolerate spent grain mean up to 15% in their diets.

CARCASS CHARACTERISTICS

T1, had the highest (P < 0.05) dressed weight of 2.45kg, followed by T2, 2.05kg, T3, 2.00kg and T4 with the least (P < 0.05) dressed weight of 1.90kg. However, there was significant difference (P < 0.05) between T1 fed the usual commercial diet and T4 fed 15% spent grain meal. This showed that above 15% inclusion level of spent grain in broiler diet, there will be reduction in the weight of broiler Carcass. The thigh weights were 89.5g, 75.4g and 72.5g for T1, T2, T3, and T4 respectively. The lowest weight (P < 0.05) was obtained from those birds on T4 and T3. The highest weight (P < 0.05) drumstic value was obtained from birds on T1 (control), but did not differ significantly (P < 0.05) from those of birds on T2 and T3. The values obtained were, 95.4g, 90.5, 88.8 and 87.5, for T1, T2, T3 and T4 respectively. The internal organ weights were expressed as percentage of live weights. The liver weights were; 1.1%, 1.1, 1.4 and 1.5% for T1, T2, T3, and T4 respectively. The highest (P < 0.05) was obtained from birds on T4. This differs significantly (P < 0.05) with birds on T1, T2, and T3. T1, had the least gizzard weight of 1.0% which differs significantly (P < 0.05) from those on T2, T3 and T4, which had 1.3% respectively. T4 had the highest (P < 0.05) heart weight of 0.40%, while T1, T2, and T3 had 0.3% respectively. The observed increased internal organ weights of the birds showed that increase in fibre in broiler diets had significant increase in internal organ weights of the birds. Feed Cost /economic analysis of the experimental birds for six (6) weeks was evaluated. From table 7, it can be observed that control diet (T1) was produced at the highest (P < 0.05) cost of N791.47 per bird, followed by T2, (N785.66), T3 (782.3) and least T4 (P < 0.05) (N777.59). There were significant differences (P < 0.05) between commercial diets and the diets of other groups where maize was substituted with different levels of spent grain in broiler diets. This is because of higher quantity of maize in the control diet. Maize costs higher than spent grain. The cost per kilogram feed were, N47.32, N46.66, N46.29 and N45.80, for T1, T2, T3 and T4 respectively. The lowest (P < 0.05) cost per kg feed was observed on T4 (15% spent grain diet), while highest (P < 0.05) cost was obtained from T1 (commercial diet), followed by T2 and T3.

CONCLUSION / RECOMMENDATIONS

The observed lower cost of broiler production of N45.80 per kilogram live weight with 15% (T4) spent grains resulted from the cheaper cost of the spent grain used to substitute maize at

same level. Maize not only costs higher, it is also scarce because it is consumed by both man and animals, as well serves as raw materials in industries. However, continued increase of spent grain in broiler feed showed a tendency to decrease weight gain, possibly due to higher fibre level. The birds were observed to tolerate spent grain up to 15% without deleterious effects and still not significantly less ($P > 0.05$) than the control on final live weight of the birds. Thus with the difference in cost, it could be recommended that spent grains should substitute maize in broiler diets up to 15% to reduce cost of production and make animal protein affordable by Nigerians.

REFERENCES

Anderson, F.L. (1973). An Induction Training program for County Extension Agents. Cornell University. Ithaca, New York. U.S.A.

AOAC, (Association of Official Analytical Chemists), (1984); Official Methods of Analysis, 14th Edition Washington D.C., 898. pp.

Bello, A. O. (1984). The use of Agro-Industrial by-products in livestock feeding in Nigeria. J. Anim. Prod. 11 (1) 22 – 31.

C.T.A., (Centre for Tropical Agriculture) (1992). The Tropical Agriculturist Poultry. Macmillan Publishers, pg. 47 – 50.

Gardianer, P and C Devendra (1995). Globa; Agenda for Livestock Research. International Livestock Research Institute, Nairobi, Kenya, 146 pp.

Madubuike, F.N. (1988). The Effect of Inclusion of graded levels of Brewer's Dried Grain in the diet of early-weaned pigs on their performance up to 10 weeks of age. Nigerian Journal of Animal Production, Vol. 15 pp. 37 – 42.

Onuh, M. O. and A. A. Igwemma (1998). Applied Statistical Technique for Business and Basic Sciences CRC. Publishers, Owerri, Nigeria 350 pp.

Shagari, S. A. (1980). The Green Revolution, New Times, October 1980. 35 – 36 pp.

Snedecor, G. W. and W. C. Cochran (1973), Statistical Methods, 6th Edition, Lowa State University Press Ames – Lowa.

Yar'adua, S. (1977). OFN (Operation Feed the Nation), Stock-taking time and new plans. New Nigeria, June 10, 1977. 5 pp.