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Performance and Cost Evaluation of Broilers Fed Diets Containing Soyabean Meal Replaced with Varying Levels of *Moringa oleifera* Leaf Meal

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Abstract

An experiment was conducted to investigate the effect of replacing soya bean meal with *Moringa oleifera* leaf meal in the diet of broiler birds. A total of 72-day old broiler birds were bought from Fidan Company and were randomly allocated to four treatments (T1, T2, T3 and T4) which were replicated three times with six birds per replicate in a Completely Randomized Design. The birds in T1, T2, T3 and T4 were fed with diets containing soya bean meal replaced with *Moringa oleifera* leaf meal at 0, 15, 30 and 45%, to check the effect on feed intake, weight gain, feed conversion ratio, feed efficiency, feed cost per (kg) weight gain, gross profit, profit, percentage return on investment, and economic efficiency.

The experiment lasted for eight weeks. The data obtained were analyzed using one way Analysis of Variance (ANOVA). The result of the experiment showed that there were significant ($p<0.05$) differences in feed intake, weight gain, feed conversion ratio, feed efficiency of the birds, feed cost per kg weight gain, gross profit, profit, percentage return on investment and economic efficiency.

The above parameters except feed cost/kg weight gain, decreased with increasing level of MOLM. Feed cost/kg weight gain increased with increasing level of MOLM. This implies that MOLM should not be used to replace soya bean meal in broiler diets (especially at 15%, 30% and 45%) since the experiment produced negative results in all the parameters measured except mortality which was not recorded at all. Therefore, MOLM can be included at lesser percentage not as a major feed ingredient but as feed additive to reduce mortality of broilers.

Keywords: Broiler birds; Growth performance; *Moringa oleifera;* Soyabean meal

Introduction

Broiler production supplies the populations with animal proteins, but it is highly constrained by the availability, quality, and cost of feed ingredients regardless of the system of production. According to Wilson and Beer [1], feed cost accounts for 60%-70% of broiler production cost. In Nigeria, commercial poultry meat production is expanding day by day. There is also a tremendous scope and opportunity for the Nigeria poultry industry to make profits. However, the recent hike in the prices of conventional feed ingredients is a major factor affecting net return on investment from the poultry business. This has compelled Animal nutritionists to explore the incorporation of non-conventional feed stuffs in poultry diets. Any attempt to improve commercial poultry production and increase its efficiency therefore needs to focus on searching for alternative and better utilization of feed resources [2].

Soya bean meal is a major source of protein in poultry feeding, but it is getting more expensive due to increased demand resulting from expansion of livestock industry and ethanol production worldwide. Replacing expensive feed ingredients and less available agro-industrial by products by unconventional sources of raw material should be one of the solutions to reduce cost of production and increase supply of animal protein. Among the many products, which could be used to develop feed for poultry is *Moringa oleifera* leaf meal.

Moringa oleifera is from a single genus family Moringaceae with fourteen known species. It is a native of sub-Himalgyan regions of India and is now naturalized in many countries in Africa, Arabia, South East Asia, Caribbean Island, and South America. It is a graceful tree with sparse foliage, white flowers, and long pods, often planted in farms and compounds or used as fence especially in Northern Nigeria. *Moringa oleifera* leaves are highly nutritious, containing significant quantities of vitamin A, B, and C and minerals such as Ca, Fe, P and protein.

Makkar and Becker [3] reported that the protein concentration in *Moringa oleifera* leaf meal is about 27% with negligible amount of tannins in all fractions of the *Moringa oleifera* plant and have high levels of sulphur containing amino-acids. So far, most of the feed processing plants and poultry farmers in Nigeria depends on very few and similar feed ingredients in formulating rations for different breeds and classes of chicken. Such trend may not be economically feasible as most such ingredients used as poultry feed are also common food for humans and can be utilized for other purposes such as bio-fuel. Although, *Moringa oleifera* leaf meal is a potential resource that can possibly be used as soya bean substitute to formulate broiler ration, appropriate information for the utilization of this resources in the literature is quite scanty.

Materials and Methods

Experimental site and duration of study

The study was carried out at the Poultry unit of the Teaching and Research farms of the Department of Animal Science and Technology, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra state.

The location lies between Latitude 6.24°N & 6.28°N and longitude 7.000°E and 7.08°E on the South Eastern part of Nigeria. The climate is the tropical wet and dry type with a clear season. The mean daily maximum temperature is usually 27°C all-round the year although it could reach 34°C in March and lowest during the harmattan months of December and January. The mean annual rainfall according to the Local Meteorological Station which has maintained records since 1978 is about 1600 mm with a relative humidity of 80% at dawn [4]. The study lasted for 56 days and that was from 5th April to 31st May.

Collection and processing of *Moringa oleifera* leaf meal

The *Moringa oleifera* used was got from Asaba, Delta State. The *Moringa oleifera* leaves were air dried for two weeks, after which it was ground and stored until the following day when it was incorporated into the ration which was used to feed the animals during the period of the experiment.

Experimental diets

Four experimental diets were used for the experiment. The four experimental diets were derived by replacing Soya bean meal with *Moringa oleifera* leaf meal at 0, 15, 30, and 45% that formed four treatment diets of T1, T2, T3, and T4 respectively. The materials used for feed formulation were purchased from Nnobi Animal feed market in Idemili South Local government of Anambra state. Each component was weighed using a sensitive weighing balance. The measured feed components were grinded and mixed using shovel. The percent composition of starter and finisher diet are presented in **Tables 1 and 2.**

Table 1: Composition of starter diet for broilers fed different inclusion levels of *Moringa oleifera* leaf meal.

Ingredients	T_1 (0%)	T_2 (15%)	T_3 (30%)	T_4 (45%)
Maize	44	42	40	38
Wheat offal	8	8	8	8
Rice bran	6	6	6	6
Soya bean meal	20	17	14	11
Moringa oleifera leaf meal	-	3	6	9
Fish meal	4	4	4	4
Groundnut cake	10	12	14	16
Oyster shell	3	3	3	3
Bone meal	3	3	3	3
Salt	0.5	0.5	0.5	0.5
Premix	0.5	0.5	0.5	0.5
Methionine	0.5	0.5	0.5	0.5
Lysine	0.5	0.5	0.5	0.5
Total	100	100	100	100
Crude protein	22.16	22.11	22.05	22
Composition of premix (Real agromixTM) per Kg: Vit. A-3200000 IU, Vit. D3-640000 IU, Vit. E-2000 IU, Vit. K-800 mg, B1-600 mg, B2-1600 mg, Pyridoxin-600 mg, Niacin-6200 mg, Vit. B12-4 mg, Panthothenic acid-2000 mg, Folic acid-200 mg, Biotin-8 mg, Cholin chloride-80 mg, Manganese-32 g, Zinc-20 g, Copper-2 g, Iron-8 g, Iodine-0.46 g, Selenium-80 mg, Cobalt-80 mg.				

Table 2: Ingredient composition of broilers finisher diet.

Ingredients	T_1 (0%)	T_2 (15%)	T_3 (30%)	T_4 (45%)
Maize	49	47	45	43
Wheat offal	9	9	9	9
Rice bran	6	6	6	6
Soya bean meal	20	17	14	11
Moringa oleifera leaf meal	-	3	6	9
Fish meal	4	4	4	4
Groundnut cake	4	6	8	10
Oyster shell	3	3	3	3
Bone meal	3	3	3	3
Salt	0.5	0.5	0.5	0.5
Premix	0.5	0.5	0.5	0.5
Methionine	0.5	0.5	0.5	0.5
Lysine	0.5	0.5	0.5	0.5
Total	100	100	100	100
Crude protein	20	20	20	20
Composition of premix (Real agromixTM) per Kg: Vit. A-3200000 IU, Vit. D3-640000 IU, Vit. E-2000 IU, Vit. K-800 mg, B1-600 mg, B2-1600 mg, Pyridoxin-600 mg, Niacin-6200 mg, Vit. B12-4 mg, Panthothenic acid-2000 mg, Folic acid-200 mg, Biotin-8 mg, Cholin chloride-80 mg, Manganese-32 g, Zinc-20 g, Copper-2 g, Iron-8 g, Iodine-0.46 g, Selenium-80 mg, Cobalt-80 mg				

Vaccination

Vaccines against infectious diseases like infectious bursal disease and Newcastle disease were given. On day 12th, Gumboro was administered through their drinking water. On the 15th day, Lassota was administered through their drinking water. On the 19th day, second Gumboro was administered to them. Coccidiostat drug was administered through drinking water from 23rd-27th day. On the 35th day, second lassota was administered.

Experimental design

Each of the four treatments was replicated three times in Completely Randomized Experimental Design. Six (6) birds were randomly placed in each replicate unit.

Management of the experimental birds

The birds were fed twice daily. The litter on the floor was changed three times during the period of the study. The drinkers were washed on daily basis with clean water. The left over feed was also removed on daily basis and new feeds offered to the birds. Bio-security measures were completely observed.

Data collection

Data were collected on daily feed intake and weekly weight gain, while feed conversion ratio, feed efficiency, total feed intake and cost evaluation were calculated.

Data analysis

The statistical analysis tool that was used to analyze the measured parameters was ANOVA, using SPSS Computer Software Package (version 22) at 0.05 significant levels. The significant means were separated using Duncan's New Multiple Range Test.

Results and Discussion

Proximate analysis of test ingredient

The proximate analysis was carried out to determine the crude protein, nitrogen free extract, crude fiber, ash content, fat content, moisture content and dry matter content of both the test ingredient and the treatment diets. The result of the proximate analysis of test ingredient is presented in **Table 3.**

Table 3: Proximate composition of *Moringa oleifera* leaf meal.

Nutrient	Composition (%)
Crude Protein	18.92
Crude fibre	9.31

Ether Extract	2.74
Nitrogen free extract	57.07
Ash content	7.95
Dry matter	85.01
Moisture content	4.09

The proximate analysis results showed that moisture content was slightly lower than 6.60%-6.88% moisture content as reported by Mikore and Mulugeta [5]. Mikore and Mulugeta [5] also reported ash content of between 15.3-15.6, crude fiber content of between 5.51-6.13, crude lipids of between 7.11-7.35 and crude protein of between 24.3-24.8. All these values are higher than the results obtained in this study and it can be attributed to environmental differences from where the *Moringa oleifera* leaf meals were sourced.

Mineral analysis of test ingredient

The mineral analysis of test ingredient was carried out to determine the minerals present as presented in **Table 4.**

Table 4: Mineral Composition of *Moringa oleifera* leaf meal.

Parameter	Composition
Magnesium	0.43
Calcium	2.09
Phosphorus	0.44
Sulphur	0.85
Potassium	1.65
Iron	0.04
Zinc	0.005
Coppers	0.01
Manganese	0.02

Sodamade et al. [6] also reported that *Moringa oleifera* leaf meal contain Mg, Ca, P, K, Fe, Zn, Cu and Mn concentration of 677, 723, 5, 23.2, 187, 548, 55 and 252 mg/100 g respectively. These values are also higher than the mineral concentrations obtained in this experiment. The differences may be due to the difference in the agro ecological zones from where the *Moringa oleifera* leaf meals were sourced.

Phytochemical analysis of test ingredient

The phytochemical analysis of test ingredient was carried out to determine the nutritional and anti-nutritional factors present in the test ingredient and the result is presented in **Table 5.**

Alikwe and Omotosho [7] got saponin content of 0.69%, flavonoids content of 4.9%, cyanogenic glycosides content of 0.25%, alkaloids content of 1.24% and tannins content of 0.03%. These values can compare favourably with the phytochemical composition values that were got in this experiment except for tannins that had significantly higher composition of 9.36.

Proximate composition of the starter diets of broilers fed varying inclusion levels of MOLM

The proximate composition of the starter diets of broilers fed varying inclusion levels of MOLM is presented in **Table 6.**

Proximate composition of the finisher diets of broilers fed varying inclusion levels of MOLM

The chemical composition of finisher diets for broilers fed varying inclusion levels of MOLM is presented in **Table 7.**

The growth performance indices of broilers fed varying inclusion levels of MOLM in replacement for SBM

The growth performance indices of broilers fed varying inclusion levels of *Moringa oleifera* leaf meal in replacement for soya bean meal is presented in **Table 8.**

Table 5: Phytochemical composition of *Moringa oleifera* leaf meal.

Parameter	Quantitative inference	Quantitative (mg/100 g)

Saponin	+ve	1.46
Flavonoids	+ve	3.56
Tannin	+ve	9.36
Anthraquinone	+ve	11.68
Carotenoids	+ve	1.16
Cardiac glycosides	+ve	0.02
Terpenoids	+ve	28.83
Anthocyanin	+ve	0.66

Table 6: Proximate composition of the starter diets of broilers fed varying inclusion levels of MOLM.

Parameter	T_1 (0%)	T_2 (15%)	T_3 (30%)	T_4 (30%)
Crude Protein	21.85	21.54	21.08	20.87
Crude fibre	5	4.89	4.77	4.6
Crude fat	4	3.86	3.73	3.68
Ash Content	9.87	11.84	13.87	14.67
Nitrogen Free Extract	56.33	55.11	54.08	53.18
Dry Matter	97.05	97.24	97.46	97
Moisture content	2.95	2.76	2.54	3
Metabolizable energy	3104.76	2991.14	2987.05	3007.51

Table 7: Chemical composition of the finisher diets of broilers fed varying inclusion levels of MOLM.

Parameter	T_1 (0%)	T_2 (15%)	T_3 (30%)	T_4 (30%)
Crude Protein	18.93	18.88	18.77	18.64
Crude fibre	4.11	5	6	6.88
Crude fat	3.69	3.54	3.48	3.26
Ash Content	10.31	12.89	13.24	13.12
Nitrogen Free Extract	59.03	56.77	55.89	54.99
Dry Matter	96.07	97.08	97.38	96.89
Moisture content	3.93	2.92	2.62	3.11
Metabolizable energy	2800.37	2832.14	2949.06	2983.25

Table 8: Growth performance indices of broilers fed varying inclusion levels of MOLM in replacement for SBM.

Parameter	T_1 (0%)	T_2 (15%)	T_3 (30%)	T_4 (45%)
Initial weight(g)	131.13 ± 25.07	136.47 ± 6.32	142.50 ± 14.36	144.33 ± 14.43
Final Weight(g)	1893.77 ± 50.64^a	1658.10 ± 52.94^b	1611.07 ± 28.14^{bc}	1543.63 ± 42.14^c
Average daily Weight gain(g)	35.98 ± 1.36^a	31.12 ± 1.01^b	29.97 ± 0.30^{bc}	28.56 ± 0.65^c
Total Weight Gain(g)	1762.97 ± 66.88^a	1521.62 ± 54.92^b	146.50 ± 14.69^{bc}	1399.23 ± 31.74^c
Total feed intake(g)	5327.98 ± 17.33^a	5256.16 ± 48.76^b	5180.06 ± 14.69^c	5079.33 ± 39.52^d
Average daily feed intake(g)	108.73 ± 0.35^a	107.27 ± 0.99^b	105.71 ± 0.39^c	103.65 ± 0.81^d

Feed conversion ratio	3.02 ± 0.11^{c}	3.45 ± 0.09^{b}	3.53 ± 0.03^{ab}	3.63 ± 0.06^{a}
Feed efficiency ratio	0.33 ± 0.01^{a}	0.29 ± 0.01^{b}	0.28 ± 0.00^{bc}	0.28 ± 0.00^{c}
Means along rows with different superscript are significantly different from each other				

From **Table 8** above, the study showed that there was significant (p<0.05) difference amongst treatments in average daily weight gain of broilers fed varying inclusion levels of MOLM in replacement for SBM. It recorded a decrease in both weight gain and average daily weight gain as the percentage inclusion of MOLM increased. This could be due to the presence of anti-nutritional factors present in the MOLM as stated by Akande et al. [8] that in poultry, negative effects such as feed intake reduction, poor nutrient utilization, and growth depression have been attributed to the presence of anti-nutritional factors in diets constituting non-conventional feedstuffs. The findings of this study was in agreement with Olugbemi et al. [9], who reported a decline in final weight and weight gain with increasing level of *Moringa oleifera* leaf meal in cassava based diets but contrary to the findings of Du et al. [10], who observed no significant (p<0.05) depression in growth performance of 3 weeks old broilers (Arbor Acres) that were fed diets containing 0.5%, 1.0%, 2.0% and 3.0% levels of *Moringa oleifera* leaf meal. The non-significant depression effect on growth performance was probably due to the low levels of inclusion of *Moringa oleifera* leaf meal.

There was significant (p<0.05) difference amongst treatments in average daily feed intake of broilers fed varying inclusion levels of MOLM in replacement for SBM. The feed intake of the birds reduced with increasing percentage inclusion levels of MOLM. This could also be attributed to the presence of anti-nutritional factors, (tannins, saponins, alkaloids etc.). Reports have shown that the astringency associated with tannins decreases feed intake and negatively affects digestibility [11]. Tannins also reduce feed intake by decreasing palatability and by negatively affecting digestion [12]. Saponins are also known to significantly affect growth, feed intake and reproduction in animals [13].

The study also recorded significant (p<0.05) difference in the feed conversion ratio of broilers fed varying inclusion levels of MOLM in replacement for SBM. It recorded that the control feed had better feed conversion ratio than the MOLM based diets. This is in agreement with the findings of Onunkwo and George [14], who recorded a significant increase in the feed conversion ratio of the birds, fed *Moringa oleifera* leaf meal, based diets. This however disagreed with the findings of Ayo-Ajasa et al. [15], who reported that feed conversion ratio were significantly (p<0.05) influenced by inclusion levels of MOLM and the birds fed with 20% MOLM inclusion level had the highest value. Atuahene et al. [16] reported no significant effect of diets containing *Moringa* leaf meal at 0%, 2.5%, 5%, and 7.5% levels on feed intake of broiler chickens. There was no significant (p<0.05) difference in the feed efficiency of broilers fed varying inclusion levels of MOLM in replacement for SBM. The feed efficiency reduced with increase in percentage inclusion of MOLM. This could be attributed to the anti-nutritional factors present in MOLM. In chickens, tannin-protein or tannin-carbohydrate combination affects growth rate, feed efficiency, and availability of metabolizable energy, [17]. The findings of this study agrees with the findings of Zanu and Asiedu [18], who recorded that feed efficiency declined significantly (p<0.05) with the dietary inclusion of MOLM.

Cost evaluation of producing broilers with varying inclusion levels of MOLM in replacement for SBM

The cost benefit analysis of producing broilers with varying inclusion levels of MOLM in replacement for soya bean meal is presented in **Table 9.**

The study showed that there were significant differences (p<0.05) amongst treatments in feed cost per kg weight gain, gross profit, profit, percentage return on investment and economic efficiency.

Table 9: Cost evaluation of producing broilers with varying inclusion levels of MOLM in replacement for SBM

Parameters	T_1 (0%)	T_2 (15%)	T_3 (30%)	T_4 (45%)
Feed cost/kg wt(#)	755.83 ± 26.73^{d}	932.27 ± 23.04^{c}	1006.07 ± 7.52^{b}	1090 ± 16.52^{a}
Gross profit(#)	492.38 ± 13.16^{a}	431.12 ± 13.77^{b}	418.86 ± 7.32^{bc}	401.34 ± 10.96^{c}
Profit(#)	232.30 ± 13.16^{a}	161.12 ± 13.77^{b}	133.86 ± 7.32^{c}	101.34 ± 10.96^{d}
Return on investment	23.07 ± 4.17^{a}	12.89 ± 1.10^{b}	9.23 ± 0.51^{bc}	5.63 ± 0.61^{c}
Economic efficiency	0.97 ± 0.05^{a}	0.60 ± 0.05^{b}	0.47 ± 0.03^{c}	0.34 ± 0.04^{d}
Means along rows with different superscript are significantly different from each other				

Feed cost per kg weight gain increased with increasing inclusion level of MOLM. Gross profit reduced with increasing level of MOLM. Profit also reduced with increasing level of MOLM. Economic efficiency reduced with increasing level of MOLM and percentage return on investment also reduced with increasing level of MOLM. This could be due to the poor utilization of (MOLM) because of the presence of the anti-nutritional factors in it. The finding of this research does not agree with Abel et al. [19], who reported that there was reduced feed cost per kg weight gain when an alternative feed ingredient was used in place of conventional feedstuffs. This however may be true if anti nutrient factors are removed from such alternative ingredients or if the levels of inclusions are not high enough to affect growth.

Conclusion and Recommendation

The findings of this study showed that average daily weight gain, average daily feed intake, feed conversion ratio and feed efficiency were negatively affected with increasing inclusion levels of MOLM. The study also showed that using MOLM to replace soyabean at 15, 30 and 45% in broiler diet did not reduce the cost of production. Thus, MOLM may not be recommended in the diet of broiler at those levels of replacement for soyabean (15%, 30% and 45%) for reduced cost and optimum growth rate, but it can be used in lesser percentage to reduce mortality in broiler production since mortality was not recorded during this experiment.

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