CHEMICAL AND NUTRITIONAL EVALUATION OF *Moringa oleifera* LEAF MEAL FOR BROILER BIRDS

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ABSTRACT
Two trials were conducted to evaluate the performance of broiler birds fed *Moringa oleifera* leaf meal. *Moringa oleifera* leaves were harvested, sundried for 3 days and milled in a hammer mill to produce *Moringa oleifera* leaf meal**.** In the first trial with broiler starter birds, four experimental diets were formulated such that *Moringa* leaf meal was included at 0%, 2.5%, 5.0% and 7.5% levels, respectively. One hundred and twenty (120), day-old broiler birds of Marshal Strain were divided into four groups of thirty birds each and randomly assigned to the four treatment diets in a completely randomized design (CRD). Each group was further sub-divided into three replicates of ten birds per replicate. There were significant differences (P<0.05) in feed intake and body weight gain among the treatment groups. In the second trial with broiler finisher birds, two experimental broiler finisher diets were formulated such that the processed *Moringa oleifera* leaf meal was included at 0% and 10%, levels respectively. One hundred and two (102), 5 – week – old broiler birds of Marshal Strain were divided into two groups of fifty-one birds each and randomly assigned to the two treatment diets in a completely randomized design (CRD). Each group was replicated three times. The trial lasted 21 days. At the end of the feeding trial, five birds per replicate were starved of feed but not water for 24 hours, weighed, slaughtered and eviscerated for carcass and organ analysis. There were also significant differences (P< 0.05) among the treatment groups in feed intake, body weight gain, feed conversion ratio; and carcass organ weight. However, there, were no significant (P<0.05) difference among the treatment groups in organ weight analysis. The cost-benefit analysis reveal a reduction in feed cost and N/kg meat produced with the inclusion of *Moringa* leaf meal. The results of these trials suggests that inclusion of *Moringa oleifera* leaf meal at 7.5% and 10% dietary levels for broiler starter and finisher birds respectively enhanced the performance of the birds more than the control group and without any deleterious effect.

Keywords: Moringa Oleifera Leaf Meal, Production, Broiler Finisher.

Introduction

Broiler production is an important aspect of poultry production in many developing Countries. However, the recent hike in the prices of conventional feed ingredients is a major factor affecting net returns from poultry business (Esonu et al., 2006). Feed accounts for 70 – 80% of the operating cost of production in poultry (Bolu and Balogun, 2004, Esonu, 2006). The reduction of feed cost using available cheaper and unconventional feed ingredient is an important aspect of commercial poultry production (Bhatt and Sharma, 2001, Udedibie et al., 2002.). The availability and relatively low cost of protein from leaf-meals in the diets of broilers is fast becoming a production practice (Esonu et al., 2004; Udedibie and Opara, 1998). Leaf meals do not only serve as protein sources but also provide some necessary vitamins, minerals and oxy-carotenoids (Esonu et al., 2005). Living organism use minerals for osmotic adjustment and to activate enzymes, hormones and other organic molecules that enhance growth, function and maintenance of life processes (Esonu et al., 2006). Nigeria is rich in nutritional and medicinal flora and there are several plant species that are available for bio prospecting, among such plant is *Moringa oleifera*.

Moringa oleifera is a herbaceous plant, growing up to 15m high, the leaves are usually small in diameter and retain greenish colour when properly dried. *Moringa leifera* leaf meal has a dry matter of 94.6%, crude protein of 24.36% crude fiber of 10.0%, Ether extract of 4.51% ash of 8.41%, calcium of 5.30% and phosphorus of 0.67%. It is also rich in vitamins such as vitamin A, B, C and minerals such as iron and also antioxidants such as alanine, glutathione, palmitic acid produce threonine arginine and many more.(Esonu et-al, 2015).

This work is designed to evaluate the chemical and nutritive value of *Moringa oleifera* leaf meal in broiler diets.

Fresh *Moringa oleifera* leaves were harvested and sun dried for three days until they became crispy while still retaining its g reenish coloration. The dried leaves were ground into meal in a hammer mill and Sample of the leaf meal was subjected to proximate analysis and phytochemical (AOAC, 1995) (Table 1). Four (4) experimental broiler starter diets were formulated such that the processed *Moringa oleifera* leaf meal was included at 0.0%, 2.5%, 5.0% and 7.5% dietary levels, respectively. Other ingredients were adjusted in such a way that the diets were iso-nitrogenous and the nutrient requirements of the broiler birds were met. (Table 3).

One hundred and twenty (120), day-old broiler chicks of Marshal strain were divided into four groups of thirty (30) birds each and randomly assigned to the four treatment diets in a completely randomized design (CRD). Each group was further sub-divided into three replicates of ten (10) birds per replicate and housed in a deep litter pen measuring 4 x 6m. Feed and water were provided ad-libitum during the trial period.

The birds were weighed at the commencement and at the end of the trial and feed intake recorded daily by

obtaining the difference between the quantity of the feed offered and the quantity left-over after 24 hours the next morning. Feed conversion ratio was computed thereafter.

Data collected were subjected to analysis of variance as outlined by Snedecor and Cochran (1980). Where significant differences were observed, treatment means were compared using Duncan's New multiple range test as outlined by Obi (1990).

In the second experiment, with broiler finisher birds, two experimental broiler finisher diets were formulated such that the processed *Moringa oleifera* leaf meal (as in experiment one) was included at 0.0% and 10% dietary levels respectively. Other ingredients were adjusted in such a way that the diets were iso-nitrogenous and nutrient requirement of broiler finisher birds met. (Table 5) One hundred and two (102), 5 – week – old broiler chicks of Marshal strain were divided into two (2) groups of fifty-one chicks each and randomly assigned to the treatment diets in a completely randomized design (CRD). Each group was further sub-divided into three (3) replicates of seventeen birds each and kept in a compartment measuring 6 x 8m. Feed and water were provided ad-libitum and other poultry management practices maintained.

The birds were weighed at the beginning and at the end of the trial and feed intake recorded daily by obtaining the difference between the quantity of feed offered and the quantity left-over after 24 hours the next morning. Feed conversion ratio was thereafter computed. The trial lasted 21 days.

At the end of the feeding trial, five birds per replicate were fasted for 24 hours, weighed and slaughtered. The carcass were de-feathered (scalding) after dipping in hot water (60^{oc}) and eviscerated. The neck and shank were cut-off and carcass weighed to obtain the dressed weight. The weight of the kidney, gizzard, heart and liver were recorded and expressed as percentage of the live weight. Data on carcass characteristics were subjected to statistical analysis using T-test as outlined by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

The proximate and phytochemical analysis of *Moringa oleifera* leaf meal are presented on Table.1. While the mineral composition of the Leaf Meal is presented on Table 2. The ingredient composition and analysed chemical composition of the experimental diets are presented on Table 3. While the performance of the broiler starter birds is presented on Table 4.

The crude protein of *Moringa oleifera* leaf meal (24.36%) was higher than that reported for some other leaf meals (Congronoma latifolium (14.25%) Velvet beans (22.34%), Neem (20.68%) Microdemis puberula (17.32%) and Oil Palm (12.79%) (Esonu et al, 2004, Emenalom et al, 2009).This protein value makes *Moringa oleifera* leaf meal a probable supplement to cereal based diet with crude protein 8.55% or below (Sagarika et al, 1996) and alternative vegetable protein source than most other unconventional tropical leaf meals.

The high fibre content of the meals is as a result of the moderately high fibre content of the leaf meals. The crude fibre is lesser than other leaf meals (12.93 - 24.84) (Esonu et al., 2003).

Table 1. Proximate and Phytochemical Analysis of *Moringa oleifera* Leaf meal (% DM)

Moisture Content	13.49%
Dry Matter	86.51%
Crude Protein	24.36%
Ether Extract	4.51%
Crude fibre	10.10%
Ash	8.41%
Nitrogen Free Extract	44.13%
Phytochemicals Analysis (%)	
Tannin	0.43
Alkaloid	1.10
Flavonoid	0.92
Saponin	6.63
Oxalate	1.22

Table 2: Mineral Composition of *Moringa oleifera* leaf Meal (%DM)

Sodium	0.27
Potassium	0.30
Calcium	5.29
Phosphorus	0.67
Micro Minerals (Mg/100g)	
Iron	15.58
Copper	1.33
Manganese	1.34
Zinc	2.92
Lead	4.70
Cobalt	0.19
Chromium	0.88

The level is moderate and does not make it undesirable and important in diets for farm animals as diluents (Esonu et al, 2004). Its absence in diets leads to diseases such as colondivertical, Diabetes metllitus, obesity and coronary artery disease (Oke et al., 1995). The lipid value of *Moringa oleifera* leaf meal is 4.51%, which is in line with other unconventional leaf meals such as palm oil leaf meal (4.76%) (Esonu et al, 2005) and Neem leaf meal (4.13%) (Esonu et al, 2005). The NFE value (44.13%) recorded compared favourably with oil palm leaf meal (45.15%) and Neem leaf meal (43.91%) (Esonu et al., 2005; Esonu et al., 2008). Ash Content value (8.41%) was higher than that of *Congronema latifolium* leaf meal (6.26%), Velvet bean leaf meal (6.16%) oil plam leaf meal (6.60%) and Neem leaf meal (7.10%) but lower than that of Microdesmis Puberula (12.25%) (Ukorebi et al.,2012, Emenalom et al., 2009, Esonu et al.,2008, Esonu et al.,2004; Esonu et al.,2005). The phytochemical analysis showed that the level of the anti-nutritional factors were within tolerable level by animals (Esonu et al., 2006), *Moringa oleifera* is also rich in minerals

There were significant differences (P< 0.05) in feed intake and body weight gain among the treatment groups (Table 4).

The group on 5.0% dietary level of *Moringa oleifera* leaf meal recorded the best feed conversion ratio (2.70) and feed cost (N/kg) meat produced while the group on 2.5% *Moringa oleifera* leaf meal recorded the poorest feed conversion ratio.

In the broiler finisher trial, the ingredient composition and analysed chemical composition of the experimental diets are presented on Table 5 while the performance of the birds is presented on Table 6. There was significant difference (P<0.05) in feed intake, body weight gain and feed conversion ratio carcass and organ characteristics among the treatment groups (Table 6). The group on 10% dietary level of *Moringa oleifera* leaf meal recorded the best feed conversion ratio, feed cost (N/kg) and meat produced.

Generally, birds on *Moringa oleifera* leaf meal recorded enhanced performance in all the parameters measured than the control (0%) group. The inclusion of *Moringa oleifera* leaf meal in the diet of the birds increased the fibre content of the diets which had an energy dilution effect on the feed and a consequential increase in feed intake (Esonu et al., 2004). Birds must eat to meet their energy requirement to sustain growth and development. Crude fibre activities the intestine and provoke more occurrences of peristaltic movement and enzyme production resulting in efficient digestion of nutrient (Esonu et al., 2003). Adult birds utilize high fibre materials better than chicks because at this stage, they have a more developed gastro-intestinal tract to handle the fibre content of their diets (Adeniyi and Balogun, 2002; Esonu et al., 2008).

These results agree with earlier report in our station (Udedibie and Opara, 1996; Esonu et al., 2004) and D'Mello and Acamovic, (1989). The improved body weight of the groups on the leaf meal diets over the control group could is due to the fact that *Moringa oleifera* contain lower values of inhibitory or anti-nutritional factors than other leaf meals like *leucaena leucocephala* and Jatropha and higher protein content. *Moringa oleifera* leaf meal contain adequate amount of minerals including calcium, phosphorus, magnesium and iron that are required for proper growth and development, blood and bone formation (Esonu et al.,2004; Fanimo et al, 1999). Birds on the leaf meal had significantly higher organ weights than the control (0%) group. Organ weight is an index of nutrients retained by the birds. The cost-benefit analysis reveal a reduction in feed cost and N/kg meat produced with the inclusion of *Moringa Oleifera* leaf meal. These results agree with earlier studies in this station and others with broilers, layers and rabbits (Esonu et al., 2003; Esonu et al., 2004; Esonu et al., 2005).

The results of these trials suggest that inclusion of *Moringa oleifera* leaf meal at 7.5% and 10% dietary levels for broiler starter and finisher birds respectively enhance the performance of the birds more than the control group without any deleterious effect.

Table 3. Ingredients Composition of Broiler Starter Diets

	Dietary Levels (%)			
Ingredients	**0.0**	**2.50**	**5.00**	**7.50**
Maize	55.00	50.00	50.00	50.00
Soy bean Meal	30.00	30.00	30.00	30.00
Moringa Leaf Meal	0.00	2.50	5.00	7.50
Palm Kernel Meal	2.50	1.00	1.00	1.00
Brewer's dried grain	3.00	8.00	7.50	4.50
Fish meal	2.00	2.00	2.00	2.00
Wheat offal	3.00	2.00	0.50	0.50
Bone meal	3.50	3.50	3.50	3.50
Vit/Premix *	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**

Chemical Analysis				
Crude Protein	22.72	22.11	21.67	21.59
Crude fibre	4.06	5.20	5.65	5.98
Ether Extract	3.26	3.98	4.05	4.26
Calcium	1.25	1.35	1.30	1.45
Phosphorus	0.46	0.57	0.55	0.60
Metabolizable	2972.50	2945.0	2855.40	2795.50

***V**itamin/Mineral Premix to Provide: Vit A 12,000,000iu, Vit D_3 3,000,000iu, Vit E, 30000mg; Vit K, 2500mg; Folic acid, 1000mg; Nacin, 40,000mg; Vit B_2 5000mg; Vit $B_{12,}$ 20mg; Vit B_1 2000mg; Vit B_6 3500mg; Biotin, 80mg; Antioxidant, 125000mg; cobalt, 250mg; Selenium, 250mg; Iodine, 1200mg; Iron,40000mg; Manganese, 70000mg; copper, 8000mg; Zinc, 60000mg; Chlorine chloride,20000mg.

Table 4: Performance of the Experimental Broiler Starter Birds

	Dietary inclusion Level (%)				
Parameters	**0.0**	**2.50**	**5.0**	**7.50**	**SEM**
Initial body weight (g)	330.0	330.0	340.0	340.0	0.055
Final body weight (g)	1120.0	1250.0	1350.0	1350.0	5.59
Daily body weight gain (g)	28.57^a	32.86^b	36.67^b	35.71^b	3.55
Daily Feed Intake (g)	86.74^a	105.74^b	97.56^b	100.67^b	4.03
Feed Conversion Ratio (g)	3.00	3.20	2.70	2.80	0.87
Feed Cost (N /g)	102.21	101.40	98.49	97.44	-
Feed Cost Saving (%)	-	100.79	103.78	104.89	-
Feed Cost (N/kg) meat produced	305.86	323.84	266.94	272.50	-

ab means within rows with difference superscripts are significantly difference ($P<0.05$)

Table 5. Ingredient Composition of Experimental Broiler Finisher Diets

	Dietary Levels (%)	
Parameters	**0.0**	**10.00**
Maize	55.0	55.0
Soy bean Meal	25.0	20.0
Moringa Leaf Meal	0.00	10.00
Palm Kernel Meal	4.50	3.50
Brewers' dried grain	4.00	2.00
Wheat offal	5.00	3.00
Fish meal	2.00	2.00
Bone meal	3.50	3.50
Vit/Min Premix*	0.25	0.25
Lysine	0.25	0.25
Methionine	0.25	0.25
Salt	0.25	0.25
Total	**100.00**	**100.00**
Chemical Analysis		
Crude Protein	20.45	20.25
Crude Fibre	4.08	5.05
Ether Extract	3.23	3.38
Calcium	1.23	1.15
Phosphorus	0.51	0.57
Metabolizable Energy	2957.85	2859.75

***V**itamin/Mineral Premix to Provide: Vit A 12,000,000iu, Vit D_3 3,000,000iu, Vit E, 30000mg; Vit K, 2500mg; Folic acid, 1000mg; Nacin, 40,000mg; Vit B_2 5000mg; Vit $B_{12,}$ 20mg; Vit B_1 2000mg; Vit B_6 3500mg; Biotin, 80mg; Antioxidant, 125000mg; cobalt, 250mg; Selenium, 250mg; Iodine, 1200mg; Iron,40000mg; Manganese, 70000mg; copper, 8000mg; Zinc, 60000mg; Chlorine chloride,20000mg.

Table 6: Performance of the Experimental broiler finisher Birds

	Dietary Inclusion Levels (%)		
Parameters	**0.0**	**10.0**	**SEM**
Initial body weight (g)	1100.00	1130.0	3.55
Final body weight (g)	1740.00	2070.0	4.03
Daily body weight gain (g)	30.47[a]	44.76[b]	0.87
Daily Feed Intake (g)	83.86[a]	110.25[b]	6.35
Feed Conversion Ratio (g)	2.76	3.46	0.03
Feed Cost (N /g)	103.30	90.41	-
Feed Cost Saving (%)	-	114.26	-
Feed Cost (N/kg) meat produced	288.67	255.64	-
Carcass and Organ Analysis:			
Live weight (g)	1900.00[b]	2355.00[b]	3.05
Dressed weight (g)	1650.00[a]	1850.00[b]	2.55
Dressed Carcass (%)	72.36[b]	80.26[b]	0.33
Heart (%)	0.42	0.45	0.01
Liver (%)	1.72	1.87	0.003
Kidney (%)	0.05	0.06	0.003
Gizzard (%)	3.68	3.95	0.025

ab Means within rows with different Superscripts are significantly different (P< 0.05)

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