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Effect of *Moringa oleifera* Leaf Protein Concentrate Supplemented Feed on Growth and Nutritional Parameters in Broilers

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Abstract: The effect of *moringa oleifera* leaf protein concentrate MLPC supplemented feed on nutritional parameters and growth performance of broiler chicks was investigated. MLPC was prepared by a standardized method and was used to formulate a diet which contained a 20% replacement level of MLPC for soy bean meal. A control diet was prepared as well. Fifty (Sayed type) chicks were feed for four weeks with "Top" commercial feed after which they were starved for twelve hours. Forty of them each weighing 500 g were selected and shared into two dietary treatment groups (test and control groups). Each group contained four replicates of five chicks each. Daily records of feed intake and weekly records of weight gain were taken (and later used to calculate protein efficiency ratio (PER).Dried Feacal samples were weighed. The nitrogen contents of feed and feacal samples were determined. Result of analysis showed that the weekly feed intake for the control and test groups were not significantly ($p < 0.05$) different (1220±2.20 g and 1237.5±1.50 g respectively). Birds in the test group recorded a higher ($p < 0.05$) daily weight gain of 84.6±1.03 g and a better PER of 0.478 compared with the control group which had a daily weight gain of 68.9±0.8 g and a PER of 0.395. The feed nitrogen content for control and test groups were 0.07 and 0.308 % respectively while fecal nitrogen content were 0.07 and 0.0294 percent respectively. True fecal digestibility values for control and test group was 90.0% and 92.0% respectively. Incorporation of MLPC in broiler chicks feed increased the growth performance of broiler chicks.

Key words: Protein efficiency ratio · *Moringa* · Growth performance · Non-conventional protein source

INTRODUCTION

The high cost of protein sources for poultry and live stock is a perennial problem in developing countries like Nigeria. Poultry production in Nigeria has been heavily dependent on imported condiments such as soymeal, fish meal and animal protein concentrates which represent a considerable percentage of the production cost.

Poultry production has attracted the interest of animal scientists, farmers and policy makers. In Nigeria, the high cost of poultry feed and increasing cost of feed ingredients has caused famers to give prime consideration to alternative feed ingredients. Leaf protein concentrate is a very cheap and abundant source of protein for livestock. The rising cost of poultry feed as well contributes to the escalating cost of commercial feeds and consequently on poultry products making it difficult for the average Nigerian to afford. This lends weight to the need for increased research on locally available cheap, safe, abundant and nutritionally adequate substitutes for protein in poultry feed. Agriculturists and nutritionists have generally agreed that developing the poultry industry in Nigeria is the fastest means of bridging the protein deficiency gap presently prevailing in the country [1, 2]. Poultry meat is an important source of high quality protein in the human diet. This is because of their ability for quick growth and high conversion efficiency [2].

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However, poultry feed have remained a significant challenge to the poultry industry. This is because the productivity of poultry feed especially in the tropics has been limited by scarcity and high prices of conventional protein and energy sources [3].

The rapid development of intensive poultry production in Nigeria has been accompanied by an increased competition between humans and animals for the Major staple foods. This competition could be alleviated by replacing some of these products with locally available materials and agricultural by-products that are less exploited by humans as food. One possible source of cheap protein is the leaf meal of some tropical plants [4, 5]. Researches need to be extended towards finding alternative feed ingredients that will improve nutritional composition of formulated feed at low cost.

Moringaoleifera commonly known as drumstick tree belongs to a generic family of shrub trees *Moringacea* and is a small fast growing drought resistant deciduous tree that ranges in height from 5 – 12 m with an open umbrella shaped crown, straight trunk (10 – 30 cm thick) with corky, whitish bark. Depending on the diameter, its foliage is evergreen and length is about 1 – 2 cm. The flowers are white or cream colored. Fruit pods are initially light green and slender, eventually becoming dark green, firm and up to 120 cm long depending on variety. Fully matured dried seeds are round or triangular shaped, the kernel being surrounded by a lightly wooded shell with three papery winge.

The leaves, roots, seeds, bark, fruits, flowers and mature pods have a wide range of ethnobotanical uses.

Moringaoleifera has a high nutritional value. It is considered to have the highest protein ratio compared with any plant so far studied. Nutritional analysis reveals that *Moringa* leaf powder (Dried) contains 27.1 g protein/100 g edible portion and 19.2 g fiber per 100 g edible portion [6]. The use of leaf meal as feed is limited by their high fiber content and in some cases the presence of toxic factors or metabolic inhibitors [7, 8]. Therefore, the idea of extracting protein from leaves is to obtain a product that is high in protein but low in fiber and antinutrients. Thus leaf protein concentrates will have a higher feeding value and can be included at high levels as a substitute for other protein sources.

There are various methods of determining protein quality. These include Biological value (BV), net protein utilization, nitrogen balance, protein digestibility, protein efficiency ratio, protein true fecal digestibility and protein digestibility corrected amino acid score. Protein efficiency ratio (PER) is based on the weight gain by a test object divided by its intake of a particular food protein during the test period. The PER has been a widely used method of evaluating the quality of protein food.

Protein digestibility corrected amino acid and score (PDCAAS) percentage is calculated as mg of limiting amino acid in 1 g of test protein/mg of same amino acid in 1 g of reference protein multiplied by true fecal digestibility percentage. Limiting amino acid in Moringa is lysine followed by isoleucine and leucine[9]. PDCAAS value of 1 is highest and zero lowest.

This work was aimed at using a simplified extraction technique to obtain leaf protein concentrate from Moringa, using the concentrate in poultry feed formulation and assessing growth rate and some nutritional parameters of birds fed the formulated ration.

MATERIALS AND METHODS

Collection of Plant Material: The *Moringa oleifera* leaves used in this study were harvested from Oko in Orumba North Local Government Area of Anambra State. The leaves were air-dried at ambient temperature for one week.

Preparation of Moringa Leaf Protein Concentrate: Preparation of leaf protein concentrate was done using a modification of the method of Aletor and Fasuyin [9].

Formulation of Experimental Diets: Two experimental diets were formulated (Table 1), diet 1 was the control diet while diet 2 contained 20% replacement level of Moringa leaf protein concentrate(MLPC) for soybean meal. Feed formulation was isocaloritic and isonitrogenous.

Animal Treatment/Experimental Design: Fifty sayed chicks (day old) were fed for four weeks with Top commercial feed (starter) after which they were starved for 12 hours. The chicks were weighed and 40 of them each weighing 500 g were divided into control and test groups (Group 1 and group 2 respectively). Chicks in the first group were fed with formulated control diet throughout the period of the experiment while Group 2 were fed with feed formula containing 20 % replacement of *Moringa oleifera* crude protein extract for soybean meal. Each group had four replicates with each replicate containing five (5) chicks. Both groups were allowed free asses to food and clean water throughout the period of the experiment. The Deep liter system was used. The same vaccination and drug treatment regimen was administered to both groups.

Table 1: Ingredient composition of experimental feed

Ingredients	Crude protein content	0.00% Replacement level (Diet 1)	20.00% Replacement level (Diet 2)
Maize	10.50	45.00	45.00
Palm kernel cake	13.50	6.00	6.00
Groundnut cake	45.00	12.00	12.00
Soybean meal (full fat)	28.00	20.00	16.00
Moringa leaf protein concentrate	28.00	0.00	4.00
Rice ofal	12.6	8.00	8.00
Fish meal	68.0	5.00	5.00
Bone meal	-	3.00	3.00
Salt	-	0.50	0.50
Vitamin premix	-	0.25	0.25
Lysine	-	0.125	0.125
Methionine	-	0.125	0.125

Grow fast from animal care supplied/kg: Vit. A = 3,200,000.000I11; Vit. D3 = 610,000.00I11; Vit. E = 2,000.00I11; Vit. K = 800,00g; Vit. B1 = 600.00mg; B2 1,600.00mg; Vit. B 6 = 600.00mg; Naicin = 6,000.00 mg; Folic acid = 2,000.00 mg; Biotin = 8.00 mg; Choline chloride = 80.00 mg; Manganese = 32.00g; Zinc = 20.00 g; Iron = 8.00 g; Copper = 2.00 g; Iodine = 0.18g; Selenium = 8.00 mg; Cobalt = 80.00mg and Antioxidant = 50.00 mg.

Table 2: Experimental design of the feeding trial with sayed chicks

Diets	Replacement level of MLPC for soy bean (%)	Replicate	Chicks per replicates	Total chicks per treatment group
Group 1 (control)	0.00	4	5	20
Group 2 (Test)	20.00	4	5	20
Total (n)			10	40

Data Collection and Analysis: Record was made of the daily feed intake; daily feacal output and weekly body weight (B.W) throughout the feeding trial and these were used for nutritional analysis to assess the following nutritional parameters: feed consumption, weight gain, growth rate, true feacal digestibility and protein efficiency ratio.

Determination of Daily Weight Gain: A weighed quantity of feed was fed daily and the remnant deducted from the quantity fed the previous day to account for the feed consumed. The chicks were weighed on weekly basis from the beginning of the experiment to the end of the feeding trial. The daily weight gain was calculated by dividing the weekly value by seven.

Determination of the Protein Efficiency Ratio: Protein efficiency ratio (PER) was calculated as the ratio between the weight gain (In grams) of a test subject in a specified time to its intake of any food or a particular food protein (In grams).

Determination of the Feed Consumption: The feed consumption was calculated as the difference between the remaining and the distributed feed.

FC(g) = QDF(g) — QRF(g)

FC = Feedconsumption
QDF = Quantityofdistributedfeed
QRF = Quantityofremainingfeed

Determination of Average Feed Consumption: The average feed consumption (AFC) is the ratio between the average daily total quantity of feed consumed (QFC) over a given period divided by the number of subjects fed within the same period.

Determination of Average Weight (AW): The average weight was calculated as the ratio between total weight of subjects (TWS) in a batch and the number of subjects (NS) in the batch.

$$AW(g) = \frac{\text{TWS(g)}}{\text{NS}}$$

Determination of Average Weight Gained (AWG): The average weight gained was determined weekly. It was calculated as difference between the average weight of the current week (AWC) and that of the previous week.

AWG = AWC — AWP

Determination of the Growth Rate (GR): The growth rate represents the ratio between weight gained and growth period

(g) weightgained (g)
GR
week) Growthperiodweek

Determination of Rate of Mortality: The mortality rate was calculated as the ratio between the number of the dying animals and the initial total number of subjects in the batch multiplied by 100.

Determination of Total Nitrogen in Feed and Stool Sample: Total nitrogen content of feed and stool samples were determined by the Macro Kjeidahl method Pearson [10] and the values obtained were converted to protein content by multiplying with a factor (6.25). The protein contents obtained were then used to calculate true feacal digestibility (TFD) values

Determination of True Feacal Digestibility (TFD) Values: TFD was calculated using equation

Statistical Analyses: Data was subjected to one way analysis of variance (ANOVA) with the statistical package for social science (SPSS) version 17. The data were expressed as Means ± Standard deviation (SD)and significant differences were made at $p< 0.05$.

RESULTS

Growth rate of broilers in the test group was higher compared with the control group.

DISCUSSION

The result of this experiment (Table 3) showed that broiler chicks fed with diet containing moringa leaf meal had a higher mean final body weight of 2869 g compared with the group fed on the control diet which had a mean final weight of 2430 g. A better weekly weight gain per bird was recorded in the group fed with moringa leaf meal.

These findings are in line with the report of Fuglie [7], who reported high performance of livestock's fed on moringa based diet. [11], also reported that moringa has a natural enzyme which facilitates digestion of fibrous food in animals and improves bioavailability of nutrients. This could explain the higher protein efficiency ratio (0.478) observed in the test group. The control group had the protein efficiency ratio of 0.3 95. [1] (Morton, 1991) reported that moringa leaf protein concentrate enrich broiler diet because of its rich content of calcium, iron, magnesium, phosphorus, potassium, zinc and vitamin. The growth performance indices recorded from mean weight gain and protein efficiency ratio proved that the moringa supplemented diet supports growth rate of broiler chicks more than the control diet.

Less food was consumed by the test group (3000 g) compared with the control (3200 g). This could be an indication that diet 2 was less palatable due to the inclusion of the MLP extract. This notwithstanding, the growth rate of birds in group 2 was much better compared with the control group (Figure 1). It should also be noted that the total weight of stool passed out by the test group (2600 g) was less than that of the control group (3200 g). The nitrogen content of the test ration was higher (0.3 08 %) compared with the control (0.07 %). The true feacal digestibility values of the test (92.0%) and control group (90.0 %) revealed that the nutritional value of the test ration in terms of protein utilization was better (Table 5). The result of this work revealed that 20 % inclusion level of *Moringaolifera* protein concentrate in poultry (broiler) diets improved the performance of the chicks. It is however recommended that the antinutrient content of the leaf protein concentrate be assessed in order to find out if the processing method used in the preparation of the protein concentrate has any effect on the antinutrient content of the preparation. Nevertheless, the result of this work shows that adding Moringa leaf protein concentrate up to 20 % inclusion level produced no adverse effect on the performance of the broiler chicks. Moringa leaf protein concentrate therefore has great potential as an alternative protein source for broiler feed production and had no negative impact on their mortality rate. This is in agreement with the work of some other researchers [12] who found out that including moringa leaves meal up to 30% in the diet of growing traditional Senegal chicken had no negative impact on average weight gain, feed conversion ratio and mortality rate in birds compared to their controls.

Table 3: Performance characteristics of chicks fed 20% replacement of Moringa Leaf Protein Concentrate

Parameters	Group 1 (control)	Group 2
Number of chicks	30	30
Initial body weight of chicks (g)	500	500
Mean final body weight (g/chick)	2430±1.03	2868±0.843
Daily feed intake (g/chick)	*174.29±0.32	*176.79±0.21
Daily weight gain (g/chick)	68.9±0.265	84.6±1.03
Mortality (%)	0.00	0.00
True feacal digestibility (TFD) (%)	90.0	92.0
Protein efficiency ratio (PER)	0.395	0.478

*Weekly feed intake (g/chick/week) was obtained by multiplying the values by 7

Table 4: Nitrogen content of feed and feacal samples used for true feacal digestibility calculation (TFD)

	Nitrogen contect (%)	
Experimental	Feed	Droppings
1	0.07	0.07
2	0.308	0.0294

Table 5: Total Nitrogen content (feed and feacal samples) and TFD values for control and test groups

	Total nitrogen			
Groups	Feed	Droppings	Endogenous nitrogen	TFD (%)
Control	*224	*22.40	0.25	90.0
Test	*92.4	*7.64	0.25	92.0

*The values were calculated and converted to protein content by multiplying with the factor 6.25

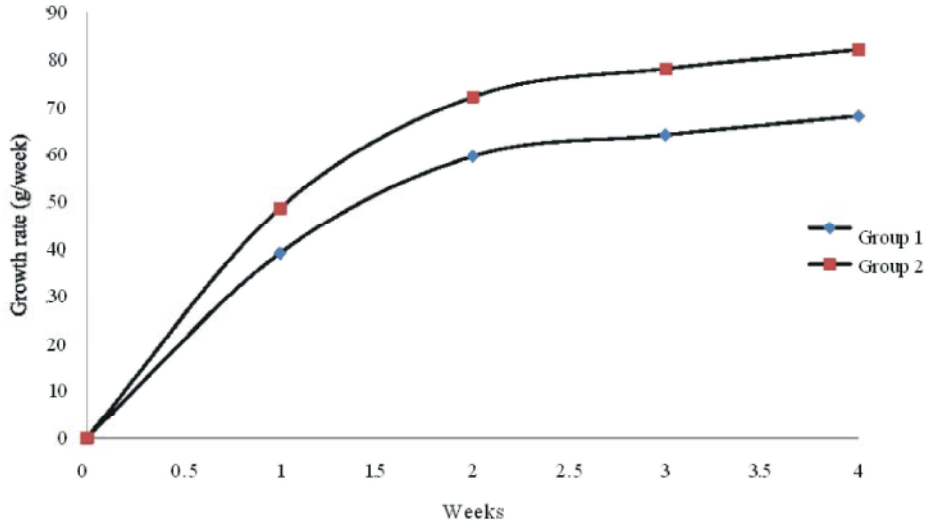

Fig. 1: Growth rate for the two experimental groups

CONCLUSSION AND RECOMMENDATION

The result of this work showed that feeding of Moringa diet to broiler chicks, improved the performance of the chick and increased their body weight. Therefore, the use of leaf protein concentrates especially the Moringa leaves in poultry nutrition is recommended. Research institutes and livestock nutritionist should carry out further research on the level of inclusion of moringa leaf protein concentrate that will optimize growth performance in broiler chicks. The use of protein leaf concentrate from leaf meals is expected to reduce the fiber content and antinutrient of leaf meals, which were considered as a problem as it affects monogastric animals negatively.

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