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Performance, Organ Weight Dynamics and Economics of Production of Laying Hens Fed Increasing Levels of *Moringa oleifera* Leaf Meal.

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Target Audience: Academics; Researchers; Poultry farmers and extension workers

Abstract

Twelve weeks feeding trial was carried out to investigate the effect of increasing levels of Moringa oleifera leaf meal (MOLM) on the performance, organ weight characteristics and economics of production of laying hens. 160 Harco layers at 5-6 weeks of laying life were divided into 4 groups of 40 layers each and each group replicated four times comprising of 10 birds each. Four diets were formulated such that Diet 1 contained no MOLM, while Diets 2, 3, and 4 contained MOLM at 5.0%, 7.5%, and 10%, respectively. Each group was randomly assigned to one of the four diets in a completely randomized design. Result showed that layers on diet 1 (0%) and 3 (7.5%) had significantly higher (P<0.05) body weight change. Also, birds on diets 3 (7.5%) and 4 (10%) recorded higher (P<0.05) daily feed intake. The control group had significantly (P<0.05) least Hen Day Production and superior feed conversion ratio. There were no significant differences (P>0.05) in the weights of the internal organs except a significant reduction of abdominal fat observed in Diet 2 (5.0%). The control group recorded the highest cost of feed per kg egg. Diet 4 (10%) recorded the best cost per kg feed (₦/kg) ₦124.00 and the best cost of feed per kg of eggs; ₦271.56. These decreased with increased level of MOLM inclusion thereby reducing the total cost of production. In conclusion, Moringa oleifera leaf meal could be included into layers diets up to 10% level without any deleterious effects.

Keywords: Layers, leaf, meal, organ weights, economics of production

1. Description of problem

Poultry products have high potentials for bridging the animal protein intake gap in Nigeria, considering that high yielding exotic poultry adapt easily to our environment and the technology of production is relatively simple with high returns of investment (1). High cost of conventional feed ingredients has however, been identified as major hindrances to expansion of poultry industry in Nigeria and other developing African countries (2). Feed cost accounts for about 70-80% of the total cost of poultry production (1). The revenue accruing from the sales of poultry meat and eggs cannot adequately compensate for the cost of production of the same. The consequence of this precisely, is a decline in intensive poultry production in most countries in the tropics and escalation of the market prices of

livestock products out of the reach of the common man (3).

There is, therefore, an urgent need to investigate alternative feed resources that could effectively replace the expensive conventional feed ingredients in poultry diets. Leaf meals have been identified as alternative feed resources for poultry, particularly in the tropics. One of the tropical plants that have been receiving attention recently in poultry nutrition is *Moringa oleifera* (4). *Moringa oleifera* is a fast growing tree which can reach up to 12m in height at maturity, yielding up to 120 tonnes/ha of leaves when planted very densely for use as forage (5). The leaves are very rich in carotene, ascorbic acid and essential amino acids (6). *Moringa oleifera* leaves are highly nutritious containing significant quantities of vitamins; A, B, C, calcium, iron, phosphorus and protein (7).It is a multi-purpose tree with tremendous variety of potentials. The high pepsin and total soluble protein makes *Moringa oleifera* leaf meal more suitable for monogastric animal feeding (8). It contains 23.25% CP content. It therefore becomes essential to explore the impact of MOLM on production of laying hen. This study therefore aims at investigating the effect of increasing levels of *Moringa oleifera* leaf meal on growth performance, organ weights and the economics of production of laying hens. Organ weights analysis is done to determine the physiological responsiveness of the birds to their internal environment.

Materials and methods

The experiment was conducted at the Teaching and Research Farm of the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Imo State, Nigeria. Owerri is located at an altitude of 90m. The mean annual rainfall, temperature and humidity are 2500mm, 27.5°C and 70–80% respectively. (Atlas of Imo State, 2024). The proximate analysis was done in the Animal Science Laboratory in the School of Agriculture and Agricultural Technology (SAAT) Federal University of Technology, Owerri.

The green leaves were manually harvested and spread in a well-ventilated room to dry within a maximum of 5-7 days. They were considered adequately dried when they became crispy to the touch and still retaining their green colour. The dry leaves were milled using a 2mm stainless steel hammer mill. The *Moringa oleifera* leaf meal (MOLM) produced was stored in air-tight plastic containers under cool dry conditions before usage. Samples of the leaf meal were subjected to proximate analysis according to (9).

Four iso-nitrogenous and iso-caloric layers experimental diets were formulated with 0%, 5.0%, 7.5% and 10% MOLM inclusion levels respectively. Ingredient and calculated chemical composition of the diets are shown in Table 1. One hundred and sixty (160) laying hens at 5–6 weeks of laying life were used for the experiment. The birds were divided into 4 groups of 40 layers in each. Each group was randomly assigned to one of the four experimental diets using a completely randomized design (CRD). Each of the groups was further sub-divided into four replicates of 10 birds each. Feed and water were provided *ad-libitum*. All necessary prophylactic medications and vaccinations were provided. The experiment lasted for 12 weeks.

Table 1. Ingredient and calculated chemical composition of the experimental layers diets

Parameters	Dietary levels of MOLM			
	Diet1 (0%)	Diet 2 (5%)	Diet3 (7.5%)	Diet 4 (10%)
White maize	50.00	46.00	44.00	42.00
Soybean meal	16.00	16.00	16.00	16.00
MOLM*	0.00	5.00	7.50	10.00
Wheat offal's	12.00	11.00	10.50	10.00
Palm kernel cake	7.00	7.00	7.00	7.00
Fish meal	2.00	2.00	2.00	2.00
Blood meal	2.00	2.00	2.00	2.00
Bone Meal	10.00	10.00	10.00	10.00
Common Salt	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Premix **	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated chemical composition (% of dry matter)				
Crude Protein	18.46	18.42	18.44	18.42
Crude Fiber	2.14	3.20	3.17	3.20
Ether Extract	3.93	4.07	4.03	4.07
Ash	3.14	3.40	3.41	3.40
ME (kcal/kg)	2.560	2.500	2.420	2.380

* *Moringa oleifera leaf meal*
** Vitamin/ Mineral Premix

Data collection

Data were collected on the body weight gain, daily feed intake; feed conversion ratio. Daily feed intake per group was determined by difference in weights of feed offered and left over the next morning**.** The birds were weighed on replicate basis at the beginning of the experiment and weekly thereafter. Feed conversion ratio was calculated by dividing average feed intake by average daily egg weight (g feed/g egg). At the end of the experiment, four birds were randomly selected from each treatment, weighed, slaughtered, de-feathered and eviscerated. They were slaughtered by severing the jugular vein and allowed to bleed to death in a slaughter cone, weighed and dressing percentages were determined. The hearts, livers, gizzards and abdominal fat of the dressed bird were cut out into constituent parts following the methods described by USDA (1989) and weighed. The weights of

the organ parts were expressed as percentages of the live weights.

Statistical analysis

The MOLM sample was subjected to proximate analysis using the methods of the Association of Official Analytical Chemists (9).

Data collected were analyzed using the software SPSS statistical package (10). Where significant differences were dictated, means were separated using the Software package (2013).

Results and Discussion

The result of the proximate composition of MOLM is shown in Table 2. It showed that MOLM contained 23.25% CP, 13.19% CF, 6.93% EE, 6.40% Ash and 47.10% NFE

Table 2: Proximate composition of MOLM (100% DM basis)

Variables	Percent
Crude protein	23.2570
Crude fiber	13.1950
Ether extract	6.9324
Ash	6.4071
Nitrogen free extract	47.1095

Table 3 shows the performance of the experimental laying hens fed graded levels of *Moringa oleifera* leaf meal (MOLM). The result showed that average body weight change, feed intake and hen day production were significantly ($P<0.05$) affected by the inclusion level of MOLM. Birds on 7.5% level of MOLM inclusion significantly ($P<0.05$) recorded the highest value of average body weight gain (136.67). This could be due to adequate utilization of the nutrients in the meal that the birds in Diet 3 (7.5%) consumed. This result agrees with the work of (11) who observed similar weights in their trials with laying hens on *Cajanus Cajan* (pigeon pea) and *Calliandra calothyrsus* leaf meals. The birds on 10% level consumed significantly ($P<0.05$) more feed than others. The feed intake of the treatment groups increased as the level of inclusion of MOLM increased. This result agrees with the findings of (12) who reported an increase in feed intake of layers as the level of inclusion of MOLM increased. This could be due to increased bulk (13). It could also be attributed to the peculiar high metabolizable energy content of *Moringa oleifera* leaves as detected in the proximate composition analysis; birds eat to satisfy their energy need. Older birds tend to tolerate high dietary fiber.

However, the control group recorded significantly ($P<0.05$) less Hen day egg production (HDEP) while the birds on 10% had the highest value (68.44%). This result could be that laying hens were able to tolerate or utilize MOLM better at higher levels. Hen-day production of other treatment groups

Table 3: Performance of laying hens fed graded levels of MOLM

Parameters	Dietary levels of MOLM				SEM
	Diet 1(0%)	Diet 2(5.0%)	Diet 3(7.5%)	Diet 4(10%)	
Initial body weight (g)	1776.66	1753.33	1723.33	1750.00	31.71
Final body weight (g)	1903.33[a]	1853.33[b]	1860.00[b]	1850.00[b]	18.10
Body weight change (g)	126.66[a]	100.00[b]	136.67[a]	100.00[b]	3.11
Daily feed intake (g)	124.95[b]	123.05[b]	130.55[a]	132.43[a]	3.19
HDEP (%)	56.83[b]	64.67[a]	64.23[a]	68.44[a]	2.30
Egg weight (g)	60.25	58.03	60.16	60.34	2.50
FCR (g feed/g egg)	2.07	2.11	2.16	2.19	0.83
Mortality (%)	3.00	-	-	-	-

a,b Means within a row with different superscripts are significantly different (P<0.05). HDEP-hen day egg production; FCR feed conversion ratio; SEM standard error of the mean.

were similar (P>0.05).

The effects of *Moringa oleifera* leaf meal on internal organ weights of the experimental laying hens are summarized in Table 4. The weights of the hearts and livers ranged from 0.46 to 0.53% and 1.41 to 1.52% respectively. There were no significant differences (P>0.05) in the weights of hearts and livers among the treatment groups. The control group recorded the lowest heart weight. No trend of values was observed. The non-significant differences observed in liver weights between the control group and the MOLM groups are indication that dietary MOLM did not present any specific nutritional challenges that could have reflected in the internal organ weights. It also showed that all the groups had a balanced availability of proteins; hence the liver maintained normal weights (40-60 grams or 2.5-3.5% of body weight). The result agrees with the earlier report of (14) who recorded no significant differences (P>0.05) in heart and liver weights when *Moringa oleifera* leaf meal was fed to finisher broilers.

There existed no statistical differences (P>0.05) among the groups in both gizzard weights and abdominal fat weights. The non-significant differences in gizzard weights indicated that the fiber content of the treatment groups were within normal range.. The values tended to contradict literature claim of *Moringa oleifera* leaves as hypocholesterolemic agent (15)

The economics of production of the experimental laying birds is presented in Table 5. The costs per kg feed (₦/kg) for the treatment groups were 138.85, 131.20, 127.6 and 124.00 for Diet 1 (0%), Diet 2(5%), Diet 3(7.5%) and Diet 4 (10%) respectively. The cost per kg feed decreased with increased level of *Moringa* inclusion. The cost of production per kg of eggs were ₦287.41, ₦276.83, ₦275.61 and ₦271.56 for Diet 1(0%), Diet 2(5%), Diet 3(7.5%) and Diet 4 (10%) respectively. The cost of production decreased with increase in dietary levels of MOLM. The control group recorded the highest cost of production per kg eggs The reason for this could be due to the fact that no

Table 4: Internal organ weights of the experimental laying hens fed dietary MOLM

Parameters	Dietary levels of MOLM				
	T_1 (0.0%)	T_2 (5.0%)	T_3 (7.5%)	T_4 (10.0%)	SEM
Live weights (g)	2300.52	2266.66	2233.33	2300.18	37.26
Dressed weights (g)	1300.48	1313.33	1333.33	1363.33	34.76
Dressing out percentage (% of LW)	56.55	58.04	59.70	59.20	3.81
Hearts (% of LW)	0.46	0.53	0.52	0.47	0.50
Liver (% of LW)	1.52	1.49	1.41	1.50	0.07
Gizzard (% of LW)	1.96	1.67	1.74	1.83	0.12
Abdominal Fat (% of LW)	3.06	2.81	3.57	3.12	0.59

Moringa leaf meal was included in diet 1. This agrees with the reports of different researchers on various leaf meals (16 and 17). A reduction in the cost of production will directly reduce the cost of purchase of the product.

Table 5: Economics of production of the experimental laying hens fed graded levels of *Moringa oleifera* leaf meal

Parameters	Dietary levels of MOLM				
	T_1 (0%)	T_2 (5%)	T_3(7.5%)	T_4 (10%)	SEM
Feed cost (₦/kg)	138.85	131.20	127.60	124.00	-
Cost of production (₦/kg egg)	287.41	276.83	275.61	271.56	-

Conclusion

It is therefore concluded that;

1. *Moringa oleifera* leaf meal is effective as a nutritious feed ingredient for laying hens and could be included in the diet of layers up to 10% without any adverse effect.
2. At 10% level of inclusion of MOLM, the internal organ weights of the birds did not undergo any hypertrophy
3. MOLM effectively reduced the total cost of production of the laying hens.

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