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Economic Importance and Growth Rate of Broiler Chickens Fed with Water Leaf (*Talinum triangulare*) Meal Supplements

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Authors' contributions

This work was carried out in collaboration between all authors. Author GNE designed the study, wrote the protocol and supervised the work. Author FCN carried out all laboratories work and performed the statistical analysis. Author PCNA wrote the first draft of the manuscript. Author EIO managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

An 8-week experiment was conducted to assess the weight gain and the economic importance of broiler chickens fed with Water Leaf Meal Supplements (WLM). One hundred and fifty day-old Anak 2000 broiler chicks were randomly distributed to 5 treatments which contained 0, 3, 6, 9 and 12% of WLM for A, B, C, D and E, respectively, in a completely randomized design. Each treatment was

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replicated three times. The birds were fed with the same starter and finisher diets. The feed and water were served *ad libitum*. The WLM is fairly rich in protein (19.8%), ash (10.00%) and low in oxalate and tannin. Results show that the feed intake (FI), weight gain (WG), feed conversion efficiency (FCE) and water intake (WI), the cost of feed per kg live weight gain and final body weight were significantly affected (P<0.05) by the dietary treatments at both starter and finisher phases. At the starter phase, increasing concentration of WLM in the diets led to significant (P<0.05) proportional increase in FCE. But at finisher's phase, increasing the dietary concentration of WLM led to significant (P<0.05) improvement in the FCE of the broiler. The cost of feed consumed was least on birds fed with 12% WLM (N165.31) while the highest was on the birds fed control diet (N189.85). The cost of live weight gain/kg varied from N93.96 in birds fed 12% WLM supplement to NI19.60in control, while the cost of feed consumed was least on the broiler finisher fed 12% WLM (N165.31) and highest in the control (N 189.85). Least feed cost was recorded on the birds fed with 12% WLM (N217.78/bird) and highest in the control diet (N249.97/bird). The highest profit margin was made on the birds fed with 12% WLM followed by the control diet (N 135.07/bird) and least on those fed with 9% WLM (N 119.36). The cost of feed per kilograms live weight (CFPKLW) at starter phase increased with higher concentration of WLM compared to the control, but at finishers phase, CFPKLW decreased with progressive increase in the concentration of dietary WLM. The highest profit of N145.10/bird was made by the birds fed with12% WLM while the control was N135.07/bird and 3-6%.WLM was N133.82. The benefit cost ratio followed a similar trend, it varied from 1.34:1in control to 1.40:1 in birds fed 12% WLM supplement. The study indicated that WLM is cost effective in the replacement of GNC and SBM in broiler feed without deleterious effect on performance.

Keywords: Economic importance; broiler chickens; water leaf meal; weight gain; profitability ratio.

1. INTRODUCTION

The importance of poultry to the national economy cannot be overemphasized. Poultry has become popular industry for the small holders that have great contribution to the economy. The profession has assumed greater importance in improving the employment opportunity and animal food production in Nigeria. Poultry have a significant effect on national economy. Okonkwo and Akubuo [1] showed that about 10% of the Nigerians are engaged in poultry production, mostly on subsistence and small or medium-sized farms. The economic efficiency of poultry production is not only dependent on productivity but also on the relationship between inputs and outputs. Feed inputs, such as protein supplements, are usually expensive, especially for rural poultry producers in developing countries, because of an increasing human demand for protein, and the relatively high cost of imported ingredients. Rural producers usually have limited access to capital, and therefore, the exploitation of the non-conventional ingredients and by-products has attracted attention [2]. Efficiency of feed and labour utilization is a very important means of increasing profit in any poultry enterprise. Nworgu and Egbunike [3] revealed that profit margin in poultry production depended mainly on feed utilization, cost of day old chicks and efficient management of resources. These authors further stated that the economy of new technologies should be assessed to determine how much productivity needs to be increased or what risk needs to be reduced and that diet formulated must be directed towards profit maximization, which is accomplished by relating inputs to some economic measures of broiler performance. Poultry production is regarded as a means of sustainable livelihood and a way of achieving a certain level of economic independence. Oluyemi and Roberts [4] and Kekeocha [5] noted that feed cost was over 70% for broiler production, while Nworgu and Egbunike [6] reported that feed utilization accounted for 60-70% of the total cost of broiler production. The authors further stated that profit margin in broiler production in Ibadan ranged from N3.15 – N51.36 per bird compared to N30.80 in Zaria [7] and N44.60 in Owerri [8]. Profit margin in broiler production is sensitive to time of sales [9]. Water leaf (*Talinum triangulare*) is a leafy vegetable which contain minerals, proteins and vitamins, thereby complementing the inadequacies of most feedstuffs [10]. One of the ways of improving the standard of living of the poultry farmers is to increase their profit margin through the application of simple, affordable, easily available and sustainable technology such as the use of leaf meal

supplements. Hence, the aim of the study is to evaluate the economic importance of using WLM as supplements in the diet of broilers.

2. MATERIALS AND METHODS

2.1 Animals and Their Management

One hundred and fifty (150) day-old broiler chicks of Anak 2000 strain were bought from Zartech Farms Limited, Ibadan. The birds were randomly allotted to five dietary treatments A, B, C, D, and E of 30 chicks per treatment and each treatment was replicated 3 times, with 10 birds per replicate and each diet contained 0, 3, 6, 9, 12% WLM (0, 30, 60, 90, 120g WLM/kg feed). The WLM was used in partial replacement of soya bean meal (SBM) and ground nut cake (GNC) in the broiler feed. Every other ingredient remained constant. The chicks were weighed at the beginning of the experiment and on weekly basis. The starter and finisher phases lasted for 4 weeks each. At the end of the starter phase, the experiment proceeded with the birds from the original treatments without re-arrangement. The broiler starters were fed the same starter diet, while broilers finishers were equally fed the same finisher diet (Table 1). Feed and water were served *ad-libitum*. Data on feed and water intake were recorded on daily basis, while weight gain was determined on weekly basis. Throughout the period of the trial, leftover feed and water were determined on daily basis. Other management practices such as routine vaccination, drug administration and maintenance of cleanliness within and outside the poultry pens/house were observed.

2.2 Experimental Site

The experiment was carried out at the Research Farm of Federal College of Animal Health, Production and Technology, Ibadan during the early dry season. Ibadan is located in the Southern Western part of Nigeria, lying between latitude 70 and 90N of the equator, longitude 30E and 50E Greenwich meridian. It has an average rainfall of between 1250mm and 1800mm. The temperature range is between 27ºC and 32ºC with relative humidity of about 75% to 90%.

2.3 Collection and Preparation of Water Leaf

The water leaf was harvested from around the paddock of the Institute of Agricultural Research and Training (IAR&T), Ibadan. The leaves were detached from the stems and were air and sun dried on concrete floors for 5 days. The leaves were dried to about 12% moisture content as stipulated by D'Mello [2]. The dried leaves were milled using a hammer mill with a sieve/screen size of 3.36mm to produce leaf meal which was then incorporated into the diet.

2.4 Ration Formulation

The diets were formulated fortnightly at Dominion Livestock feed milling industry at Owode estate Ibadan. The WLM was used in partial replacement of SBM and GNC in the diet. Every other ingredient remained constant. The five treatments A, B, C, D and E contained 0, 30, 60, 90, 120g WLM/Kg of the feed respectively. The duration of the experiment was for 4 weeks each for the starter and finisher phases.

2.5 Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) in SPSS 10 computer programme and errors were calculated as standard errors of the mean (SEM), while Duncan's Multiple Range Test (DMRT) [11] was used in assessing the significant differences among the treatment means. Significance was accepted at 0.05 level of probability.

2.6 Economic Analysis

An economic appraisal was done to highlight the efficiency of the WLM in terms of profit margin. The cost of labour and depression was calculated according to WBTP [12]. Some data were analyzed using descriptive and budgetary techniques [13]. The total cost of production, net profit and cost benefit ratio were determined as presented below:

$$TCP = TFC + TVC \quad (1)$$

Where TCP = total cost of production, TFC = total fixed cost of used resources whose quantities were fixed during the production period and TVC = total variable cost of used resources whose quantities varied during the production period.

$$NP = TR - TCP \quad (2)$$

Where NP = net profit in Naira and TR = total revenue.

$$NP = NR = NFI \quad (3)$$

Where NR = net return and NFI = net farm income.

$$GM = TR - TVC \quad (4)$$

Where GM = gross margin.

2.7 Profitability Ratios

Profitability ratios were employed to explain vividly the extent to which the factors of production were used for profit maximization:

Benefit cost ratio (BCR) or capital turnover = TR / TCP (5)

Rate of returns on investment (RRI) (%) = NP / TCP x 100 (6)

Gross ratio (GR) = TCP / TR (7)

Profitability index (PI) = NFI / GR (8)

= NP / TR

GR = gross revenue = total return

3. RESULTS AND DISCUSSION

Tables 1a and 1b revealed that the nutrient status of the experimental diets was adequate for the broiler chickens in both phases. The chemical composition of the main ingredients (Table 1a and 1b) used to compound the experimental rations show that the crude protein content of the starter diet ranges from 21.05 to 22.75%, while that of the finisher ranges from 19.40 to 19.94%.The crude fibre ranges from 4.00 to 7.70% in the starter diet while that of the finishers ranges from 4.90 to 6.50% which is a bit high and indicated that the formulated feed was fairly adequate for broiler chickens. It was observed that as the level of WLM supplement increased, the percentage of crude fibre and crude protein decreased in the finisher diet.

Table 1a. Gross composition of experimental diets (Starter phase)

Ingredients	A(0%)	B(3%)	C(6%)	D(9%)	E(12%)
Maize	47.00	47.00	47.00	47.00	47.00
Corn bran	10.00	10.00	10.00	10.00	10.00
Palm kernel cake	5.00	5.00	5.00	5.00	5.00
Soybean meal	20.00	18.50	17.50	16.50	14.00
Fishmeal	4.00	4.00	4.00	4.00	4.00
Groundnut cake	10.25	9.25	7.25	6.25	5.75
Waterleaf meal	0.00	3.00	6.00	9.00	12.00
Vitamin Premix	0.30	0.30	0.30	0.30	0.30
Bone meal	2.50	2.50	2.50	2.50	2.50
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Calculated composition					
Crude Protein (%)	22.31	21.86	21.17	20.75	20.11
Crude Fibre (%)	4.59	4.77	4.94	5.03	5.18
M. E (Kcal/Kg)a	2897.73	2881.83	2853.03	2828.88	2799.18
Determined proximate composition of experimental starter diet (%DM Basis)					
Dry matter	87.00	90.00	90.00	88.00	90.00
Crude Protein	22.75	21.24	21.25	21.21	21.05
Crude fibre	4.00	7.70	4.50	4.61	6.50
Ash	8.00	11.00	12.00	15.00	14.00
NFE	65.25	60.06	62.25	59.18	58.45
M.E (Kcal/Kg)	2984.70	2975.21	2970.65	2971.88	969.10

Bimba Agro-mix. Vitamins and Mineral premix for Broilers and Chicks (2.5Kg/ton) Vitamin A 12,500.00iu. Vitamin D3 2,5000.00iu. Vitamin E= 35,000iu Vitamin K=200g, Thiamine B1=200g, Rlbloflavin B2= 5.00g, Niacin B3 = 40.00g, D-Calpan B5 11.00g, Pyridoxine B6=400g, Biotin=0.10g, Folic acid= I.50g Vitamin B12=0.012g, Manganese= 70.00g, Zinc=50.00g, Copper = 6.00g: Iron = 40.00g, Iodine = 1.00g: Cobalt = 1I.25g. Selenium = o.15g: Choline chloride = 500.00g, a. Panzenga (1985)

Table 1b. Gross composition of experimental diets (Finisher phase)

Ingredients	A(0%)	B(3%)	C(6%)	D(9%)	E(12%)
Maize	49.00	49.00	49.00	49.00	49.00
Corn bran	11.00	11.00	11.00	11.00	11.00
Palm kernel cake	6.00	6.00	6.00	5.00	5.00
Soybean meal	19.00	17.50	16.50	15.50	13.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
Groundnut cake	8.25	7.25	6.25	5.25	4.25
Waterleaf meal	0.00	3.00	6.00	9.00	12.00
Vitamin Premix	0.30	0.30	0.30	0.30	0.30
Bone meal	2.50	2.50	2.50	2.50	2.50
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Calculated composition					
Crude Protein (%)	20.83	20.38	20.63	19.61	18.97
Crude Fibre (%)	4.78	4.88	4.98	5.07	5.21
M. Energy (Kcal/Kg)a	2904.60	2888.86	2861.46	2837.31	2807.61
Determined proximate composition of experimental Diet (%DM Basis)					
Dry matter	91.00	91.00	88.00	91.00	90.00
Crude Protein	19.94	19.53	19.46	19.44	19.40
Crude fibre	5.00	6.50	5.50	5.00	4.90
Ash	10.00	13.00	14.00	15.00	14.50
Nitrogen free extract	65.06	60.97	61.04	60.56	61.20
M. Energy (Kcal/Kg)	2985.00	2988.12	2975.00	2979.01	2981.05

Bimba Agro-mix. Vitamins and Mineral premix for Broilers and Chicks (2.5Kg/ton) Vitamin A 12,500.00iu. Vitamin D3 2,5000.00iu. Vitamin E= 35,000iu Vitamin K=200g,Thiamine B1=200g, Rlbloflavin B2= 5.00g, Niacin B3 = 40.00g, D-Calpan B5 11.00g, Pyridoxine B6=400g, Biotin=0.10g, Folic acid= I.50g Vitamin B12=0.012g, Manganese= 70.00g, Zinc=50.00g, Copper = 6.00g: Iron = 40.00g, Iodine = 1.00g: Cobalt = 1I.25g. Selenium = o.15g: Choline chloride = 500.00g, M. Energy= Metabolizable Energy, a. Panzenga (1985)

Tables 2a and 2b shows that WLM is a fairly good protein supplement for broilers more especially broiler finishers. Feed intake (FI), weight gain (WG), feed conversion efficiency (FCE),water intake (WI) and cost of feed per kg live weight gain and final body weight were significantly ($P<0.05$) affected by the dietary treatments at both starter and finisher phases.

Average total feed intake (ATFI) in both starter and finisher phases varied from 1374.16 to1529.59 and 4182.11 to 4504.15g/bird, respectively (Tables 2a and 2b). At starter phase, broilers fed 12%WLM had significantly reduced ($P<0.05$) feed intake of 3.68%and 10.16% compared to the birds in the control and 9% WLM respectively. But at finishers' phase, broilers placed on 3 to 12% WLM supplements had significantly reduced feed intake of 2.30-7.15% compared to control.

Final live weight ranged from 630.56g/bird in 12%WLM diet to 872.50g/bird on the broilers fed with the control diet at the starter phase. Weight gain followed a similar trend (Table 2a). Reduction in growth of the broiler starters was proportional to the dietary concentration of the WLM supplements. However, at Finishers phase, dietary increase in concentration of WLM supplements led to increase in both final live weight and weight gain (Table 2b). Mean body weight gain was 1486.84g/bird for the birds placed on 12% WLM compared to the control (1587.50g/bird).

Feed conversion efficiency for broiler starter ranged from 1.72 in the control to 2.33 in the birds fed with 12%WLM supplement in the starter phase, but in the finisher phase, it ranged from 2.84% in the control to 2.95 for chickens fed with 9% WLM. At starters phase, increasing concentration of WLM in the diets led to significant ($P<0.05$) proportional increase in FCE. But at finisher's phase, increasing the dietary concentration of WLM led to significant ($P<0.05$) improvement in the FCE of the broiler.

Water consumption for broilers starters and finishers significantly ($P<0.05$) increased with higher concentration of WLM in the diets, most

especially at 12% inclusion level (Tables 2a and 2b). Water intake ranged from 2861.32ml/bird in control to 3137.57ml/bird in birds fed with 12% WLM supplement (Table 2a), while at finisher phase (Table 2b) it varied from 8679.28ml/bird in birds fed with 3%WLM to 9303.92ml/bird for those fed with 12%. Control was 8867.80ml/bird. Feed and water intake ratio had a similar trend.

The above observations are contrary to the findings of Nworgu and Fapohunda [14] and Nworgu et al. [15, 16],who reported a decrease in water intake in broiler finishers fed *Mimosa invisa* leaf meal (MLM) supplements, where reduction in growth rate of the birds fed MLM supplement was very drastic, in contrast to the present study. Water intake reported in this study is higher than the values reported by Sainsbury [17].

Increased concentration of WLM led to improved performance in terms of weight gain, FCE and profit margin. This observation is in agreement with the observations of FAO [18], who revealed that older animals tolerated leguminous leaf meals more than younger ones. Generally, with elevated concentration of WLM supplement dietary inclusion in broiler finishers, TFI and ADFI significantly (P<O.05) decreased. This observation disagreed with the reports of Esonu et al. [19], but agrees with the report of Nworgu et al. [15], who observed a decrease in feed intake when broiler finishers were fed diets containing graded levels of *Mimosa invisa* leaf meal. Average total feed intake for broiler finishers in this study is higher than the report of Adetunji and Ologhobo [20] and Nworgu et al. [15]. Decreased feed intake in both phases could be attributed to reduction in acceptability, which could be caused by anti-nutritional factors in WLM, though in low concentrations. Ngodigha [21] and D'Mello [2] made similar observations. Compared to the starters, broiler finishers fed diets containing WLM supplements had a higher degree of elevation in weight gain which was significant (P<O.05).The increase in the weight gain of the broiler finishers fed graded levels of WLM indicated non-hazardous effects of feeding WLM supplements at 3-12% (30 - 120g WLM/kg feed), which suggests that WLM is a fairly good feedstuff and protein supplement for broiler finishers. This observation is in harmony with the submission of FAO [17]. The appreciated growth rate also indicated that the feeds were properly utilized since WLM is fairly rich in minerals and vitamins and moderate in methionine and tryptophan with low concentrations of oxalate and phytate.

The cost of feed per kg live weight gained (WLM) for broiler starters (Table 2a) was least on birds fed with control diet (N72.38/kg)followed by birds fed 6% WLM supplement (N78.48/kg), while the highest was on the broiler chicks fed on 9%WLM (N89.41/kg). The cost of feed consumed was least on birds fed with 12% WLM (N165.31) (Table 2b), while the highest was on the birds fed the control diet (N189.85). Cost of live weight gain/kg varied from N93.96 in birds fed 12% WLM supplement to NI19.60 in the control, while cost of feed consumed was least on the broilers fed 12% WLM (N165.31) and highest in the control (N 189.85) (Table 3).The cost of feed (N217.78 -N249.97/bird) out of total cost of production (N361.17 - N393.20/bird) varied from 60.29%to 63.57%. The least feed cost was recorded on the birds fed with 12% WLM (N217.78/bird) and highest on those fed control diet (N249.97/bird). The cost of feed, day old chicks and medication represented 60.29- 63.57, 21.62-23.53% and 3.83-4.17%, respectively, out of the total cost of production. The profit margin ranged from N119.36 to N145.10/bird. Highest profit margin was made on the birds fed on 12% WLM followed by the control diet (N135.07/bird) and least on those fed 9% WLM (N119.36). The benefit cost ratio followed a similar trend and varied from 1.34:1 in the control to 1.40:1 on birds fed 12% WLM supplement. The cost of feed/kg live weight gain (WLM) for the broiler starters varied from N72.38 to N89.41/kg and increased progressively with increasing concentration of WLM supplements, but at finisher phase, WLM varied from N93.96 toN119.60/kg and decreased with increasing the concentration of WLM supplement. The feed cost out of total cost of production varied from 60.29 to 63.57%. The highest profit/bird was recorded in the broilers fed 12% WLM, followed by those fed with control and 3 - 6% WLM, while the least was on the birds fed with 9% WLM.

Cost of feed per kilogram live weight (CFPKLW) at starter phase increased with higher concentration of WLM compared to control, but at finishers phase, CFPKLW decreased with progressive increase in the concentration of dietary WLM.

The degree of the reduction in the cost of feed consumed at the finishers phase was proportional to the amount of WLM in the diets. In this study, it was observed that the cost of

feed varied from 60.29 to 63.57% of the total cost of production. Similar observation was made by Nworgu and Egbunike [3]. The cost of day-old chicks and medication represented 21.62-23.53% and 3.83- 4.17% respectively, of the total cost of production. These results are in line with the observations of Nworgu and Egbunike [3]. Profit made in this study ranged from N119.36-N145.10/bird The high profit in all the treatments is an indication of good quality diets which led to improved growth performance. The highest profit ofN145.10/bird was recorded for the birds fed with 12% WLM, while the control was N135.07/bird and 3-6%.WLM was N133.82.

Table 2a. Performance of broiler chicks fed experimental diets (Starter phase)

Parameter	A(0%)	B(3.00%)	C(6.00%)	D(9.00%)	E(12.0%)	SEM
Initial LW (g/bird)	41.91	42.86	41.00	41.00	40.00	
Final BW (g/bird)	872.50a	794.74b	742.11c	713.16C	630.56d	0.92
Mean BWG (g/bird)	830.59a	751.88b	701.11c	672.16d	590.56c	0.73
Average DWG (g/bird)	29.65a	26.85b	25.04c	24.01d	21.09c	0.12
Average TFI (g/bird)	1426.57b	1455.44b	1375.25c	1529.59a	1374.16c	0.73
Average DFI (g/bird)	50.95c	51.98b	49.12d	54.63a	49.08d	
FCE	1.72c	1.94b	1.96b	2.28a	2.33a	0.72
Ave TWI (ml/bird)	2861.32d	3014.75c	3062.17b	3005.04c	3137.57a	0.89
Ave DWI (ml/bird)	103.16d	107.67c	109.37b	107.32c	112.06a	0.02
Feed: W. intake ratio	1:2.03	1:2.07	1:2.23	1:1.97	1:2.28	-
Mortality (%)	5.00	5.00	5.00	5.00	5.00	
Cost of 1Kg of feed (N)*	42.14	41.05	40.01	39.29	38.18	
Cost of 25Kg feed (N) 1053.50	1026.25	1000.25	982.25		954.50	
Cost of feed Con. (N/Kg) 60.12	59.75	55.02	60.10	52.47		
Cost of feed/Kg LWG (N/Kg) 72.38	79.47	78.48	89.41	88.85		

*a. b. c. d. e : Means with different superscripts on the same row differ significantly (P< 0.05) *Feed cost per Kg is high because cost of maize was N41.00 to N42.00/Kg (from July to September) , *A (%WLM), BWG - Body weight gain, DWG - Daily weight gain, TWI –Total water intake, DWI – Daily water intake, TFI –Total feed intake, DFI- Daily feed intake, LWG- Live weight gain, W=Water, Ave.= Average, Con.-Consumed*

Table 2b. Performance of Broiler finisher fed Experimental diets (Finisher phase)

Parameter	A(0%)	B(3.00%)	C(6.00%)	D(9.00%)	E(12.0%)	SEM
Initial (g/bird)	872.50a	794.74b	742.11c	713.16d	630.56c	0.92
Final BW (g/bird)	2460.00a	2360.00a	2380.00a	2390.00a	2200.00b	0.88
Mean BWG (g/bird)	1587.50c	1565.26d	1637.89b	1759.44a	1486.84c	0.81
Ave. DWG (g/bird)	56.70c	55.90d	53.50b	62.84a	53.10c	0.83
Ave. TFI (g/bird)	4504.15a	4182.11c	4396.88a	4379.36b	4327.45d	0.73
Ave. DFI (g/bird)	160.86a	149.36c	157.03b	156.41b	154.55d	-
FCR	1:1.97	1:2.08	1:2.03	1:2.49	1:2.15	-
Ave. TWI (ml/bird)	8867.80d	8679.28c	8922.85c	8999.89b	9303.92a	
Ave. DWI (ml/bird)	316.71d	309.98c	318.67c	321.43b	332.28a	0.12
Feed: W. intake ratio	1:1.97	1:2.08	1:2.03	1:2.49	1:2.15	-
Mortality (%)	3.45	3.45	3.45	3.45	3.45	
Cost of 1Kg feed (N)*	42.15	41.03	40.12	39.35	38.20	
Cost of 25Kg feed (N)	1053.75	1025.75	1003.25	983.75	955.00	
Cost of feed Con.(N/Kg)	189.85	171.59	176.40	172.33	165.31	
Cost of feed/Kg live wt. gain (N/Kg)		119.60	109.62	107.70	115.90	93.96

*a. b. c. d. e: Means with different superscripts on the same row differ significantly (P<0.05) *Feed cost per Kg is high because cost of maize was N41.00 to N42.00/Kg, *A (%WLM)*

Table 3. Production costs and returns for intensive broiler management values per bird (N) and % of total

Item (%)	Diet A	Diet B	Diet C	Diet D	Diet E
	Revenue				
Sale of broiler (2.00/Kg) live wgt					
(2.93Kg)	528.00	517.27	508.20	514.80	506.00
Sale of manure N0.15/Kg	0.27	0.26	0.26	0.26	0.25
Total Revenue (TR)	528.27	517.27	508.46	515.06	506.25
Variable cost					
Starter	60.12	59.75	55.02	60.10	52.47
Finisher	189.85	171.59	176.40	172.33	165.31
Total	249.97	231.34	231.42	232.43	217.78
Day old chick	85.00	85.00	85.00	85.00	85.00
Water 20litre Starter	0.26	0.28	0.26	0.27	0.29
Finisher	0.52	0.50	0.51	0.53	0.56
Total	0.78	0.78	0.77	0.80	0.85
Labour	12.00	12.00	12.00	12.00	12.00
Drugs	9.45	9.45	9.45	9.45	9.45
Vaccine	5.06	5.06	5.06	5.06	5.06
Medication	15.05	15.05	15.05	15.05	15.05
Maintenance & Repairs	0.20	0.20	30.20	0.20	0.20
Transport	0.30	0.30	0.30	0.30	0.30
Tax 3k to one Naira	4.18	4.18	64.18	64.18	34.18
Miscellaneous	4.60	4.60	4.61	4.60	4.60
Total variable cost (TVC)					
Fixed cost of production	374.28	355.63	355.72	356.78	342.23
Housing (Dep. over 10yrs)	12.00	12.00	12.00	12.00	12.00
Interest on loan (@ 30% IR)	6.00	6.00	6.00	6.00	76.00
Equipment (Dep. over 5yrs)	0.92	0.92	0.92	0.92	0.92
Total Fixed Cost (TFC)	18.92	18.92	19.92	18.92	18.92
Total Cost of Prod. (TCP=TVC+TFC)	393.20	374.54	374.64	375.70	361.17
Net Profit/Loss (TR-TCP)	135.07	133.82	133.82	119.36	145.10
Invest (ROI)=SP/TCPx100/1(100)	34.40	35.42	35.42	31.80	33.53
Benefit Cost Ratio (BCR)=TR/TCP	1.34:1	1.38:1	1.36:1	1.37:1	1.40:1
Gross Ratio = TCP/TR	0.74:1	0.72:1	0.74:1	0.72:1	0.71:1
Final weight(Kg) @ 8 weeks	2.46a	2.36a	2.38a	2.20b	2.30a
Weight(Kg) gain in 8 weeks	2.42a	2.32a	2.34a	2.16b	2.26a
Mortality %	6.66(2)	3.33(1)	6.66(2)	6.66(2)	6.66(2)
Dressed weight(Kg)	1.76	1.76	1.76	1.90	1.70
COF/Kg live wgt.gain(N/Kg) starter	72.38	79.47	78.48	89.41	88.85
COF/Kg live wgt.gain(N/Kg)Finisher	119.60	109.62	107.70	115.90	93.96
COF consumed/Kg live (N/Kg) starter	60.12	57.73	55.02	60.10	52.40
COF consumed/Kg live (N/Kg) Finisher	189.85	171.59	176.40	172.33	165.31

*abcd: Means with superscript on the same row differ significantly (P<0.05) + Sale of Broilers @ dressed weight. IR= Interest Rate, Dep.=Depreciation *Figures in parenthesis are number of birds that died during the period of the experiment in both phases, COF= Cost of feed, Wgt=Weight, Invest= Investment*

The benefit cost ratio and gross ratio followed a similar trend. Profit margin reported here is higher than that reported by Ogudipe [7] in Zaria and Nwajiuba [8] in Owerri.

4. CONCLUSION

Due to competition with food sources, animal feeds are becoming expensive. This has spurred research into alternative feedstuffs, especially underutilized crops as potential sources of animal feed supplements. This study focused on the evaluation of WLM as supplements for SBM and GNC in the formulation of feed for broilers. The study showed that WLM is cost effective for the replacement of GNC and SBM in broiler diet without deleterious impacts on performance.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Okonkwo WI, Akubuo CO. Thermal analysis and evaluation of heat requirement of a passive solar energy

poultry chick brooder. Nig. J. Renew. Energ. 2001;9(1):73-78.
2. D'Mello JPF. Leguminous leaf meals in non ruminant nutrition. In: Tropical Legumes in Animal Nutrition. 1st ed., A.B International, Wailing font, Oxon UK.1995;247-280.
3. Nworgu FC, Egbunike GN. Performance and nitrogen utilization of broiler chicks fed full fat extruded soybean meal and full fat soybean Trop. Anim. Prod. Invest. J. 2000;3:47-54.
4. Oluyemi JA, Roberts FA. Poultry productions in warm wet climates 1st ed. McMillan Press Ltd. London. 1979;35-79.
5. Kekeocha CC. Poultry Production Handbook. 1st Ed. Pulb. Pfizer Corp. and Macmillan.1985;92-110.
6. Nworgu FC, Egbunike GN. Performance characteristics of broilers fed diets with soybean meal and groundnut cake as protein sources. Trop. Anim. Prod. Invest.1999;2(1):51-59.
7. Ogundipe SO. Poultry production modules for family economic advancement programme. An invited paper presented at the Silver Anniv. Conf. of the NSAP. Held at Gateway Hotel Abeokuta on the 21st – 26th March. 1998;1-10.
8. Nwajiuba CU. Prospects of improved profitability in the poultry industry in Nigeria. In: The Nigerian Livestock Industry in the 21st Century. Ologhobo AD, Iyayi EA (eds). 1998;18-20.
9. Junaid JO. Constrains of production. Prospects and problems of broiler production in Lagos State of Nigeria; 1984. (Unpublished).
10. Ifon ET, Basir O. The nutritive value of some Nigeria leafy vegetables, particularly vitamin and mineral contents Food Chem. 1980;4(4):263-267.
11. Steel RG, Torrie JH. Principles and Procedures of Statistics. A Biometrical Approach.2nd ed., McGraw Hill Bk Co. Inc NY; 1980.
12. World Bank Technical Paper. No 10 (WBTB). Appraising Poultry Enterprises for profitability: A Manual for Potential Investors.1983;1-120.
13. Akinsoye OF. Profitability of Poultry production in Oranmiyan LGA of Oyo State, Thesis (B. Agric). Department of Agric. Econs, Obafemi Awolowo University. Ile Ife. 1989;25-32.
14. Nworgu FC, Fapohunda JB. Performance of broiler chicks fed mimosa (*Mimosa invisa*) leaf meal supplements Proc. Of 27th Ann. Conf. NSAP, held at FUTA Nigeria on the 17th -21st March, Aletor VA, Onibi GE (eds). 2002;128-131.
15. Nworgu FC, Egbunike GN, Ononogbu CE, Fapohunda JB, Ogbonna JU. Effect of Mimosa (*Mimosa invisa*) leaf meal supplements on broiler finisher performance. Proc of 8th Ann Conf. of ASAN held at Fed. Univ., of Tech., Minna, Niger State on Sept., 16th-18th; 2003.
16. Nworgu FC, Egbunike GN, Ogundola II, Salako RA, Fakeye OE. Effects of different dietary protein levels on the performance and carcass characteristics of broilers. ASSET Series A. 2001;I(2):75-87.
17. Sainsbury D. Poultry Nutrition, In Poultry health and management, 3rd Ed., Blackwell Sci., Ltd London; 1995.
18. FAO. Legume trees and other fodder trees as protein sources for livestock. Anim. Prod and Health Paper. 1992;102:14-18.
19. Esonu BO, Iheukwumere F, Iwuji TC, Akanu N, Nwugo OH. Evaluation of micronutrients of puberula leaf as feed ingredient in broiler starter diets. Nig. J. Anim. Prod. 2003;30(1):3-8.
20. Adetunji C, Ologhobo A. Utilization of full fat sunflower seed in the diet of broiler chicken *Trop.* Anim Sci. 1999;2(2):61-67.
21. Nghodigha LM. Incorporation of Centrosema pubescens in broiler diets. Effects on performance characteristics. Bull. Anim. Hlth. Prod. Afric.1994;42:159-161.

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