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RESEARCH ARTICLE

Performance of Broiler Chicken Fed Diets with Noni (*Morinda citrifolia*) Leaf Meal

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ABSTRACT

This study investigated the effects of noni-leaf meal (NLM) inclusion in broiler diets on growth performance, feed utilization, and profitability. A total of 150-day-old broiler chicks were randomly assigned to five dietary treatments in a Completely Randomized Design (CRD) with three replicates per treatment. The treatments included a control diet without NLM (T1) and diets with 3% (T2), 6% (T3), 9% (T4), and 12% (T5). Key performance metrics such as body weight, weight gain, growth rate, feed consumption, and profitability were evaluated. Results showed no significant differences in initial and final body weights, or dressing percentages across treatments. Weight gain and growth rates were highest during the early weeks but declined in later weeks. Feed consumption showed significant differences in weeks five and six, indicating treatment effects on intake at later stages. The control diet (T1) achieved the highest weight gain and revenue but incurred higher feed costs, reducing profitability. Among NLM diets, 6% NLM (T3) provided the best balance of growth performance and profitability. Higher NLM levels (T4 and T5) resulted in reduced weight gain and profitability, with T4 yielding the lowest return on investment. The result suggests that incorporating 6% NLM in broiler diets optimizes growth performance and profitability, while higher inclusion levels negatively affect economic returns.

Keywords: Broiler chicken, growth performance, non-conventional feedstuff, noni leaf meal.

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1. Introduction

Poultry production has been increasing rapidly worldwide. It has indeed progressed beyond our modest expectations. Its noteworthy development can be attributed, among other things, to the viability of turning over an investment quickly. In addition, many consumers find broiler meat to be wholesome and highly acceptable, contributing to its high demand in the home market. Poultry meat is characterized by its good quality, high level of safety, affordable prices compared to other meat types, and short production cycle [1]. A growing demand for poultry meat, increased production volume, and increased exports and imports have been observed [2]. Thus, it is an easily accessible source of high-quality protein and other nutrients for optimal bodily function.

Despite its tremendous growth, the broiler sector still faces several serious issues. One is the high cost of feeds, since feeds are the largest single-cost item for livestock and poultry production, accounting for 60%–70% of the total cost [3]. As a result, the high cost of feeds makes it difficult for the broiler producers to profit from their business. Because of this, it is necessary to look into utilizing locally available and inexpensive non-conventional feedstuffs to produce broilers.

Today, Herbs' antiviral, antibacterial, antifungal, antiparasitic, immunomodulatory, antioxidant, and body weight growth qualities have been the subject of several research investigating their potential in animal health, [4]. Noni leaf meal is one of the promising non-conventional feedstuffs that could be fed to broiler chickens. The leaf meal could be derived from the leaves of noni (*Morinda citrifolia*). This could be easily made available because its source crop could be grown under local conditions. Thus, it doesn't require high management for establishment. *Morinda citrifolia* commonly known as noni is a perennial plant originating in Southeast Asia, consumed for over 2000 years [5]. Based on several studies, [6], [7] which preserves the integrity of the sample of fresh noni leaves and stems were dried by air drying and oven heating, then ground into a powder and stored. A variety of chemicals,

including steroids, terpenoids, tannins, polysaccharides, alkaloids, flavonoids, saponins, cardiac, and glycosides, were then detected after the sample was extracted using acetone. Various secondary metabolites were also detected in different organic solvents, indicating that *Morinda citrifolia* contains bioactive compounds with potential medicinal applications [6], [8], [9]. Researchers from the food and pharmaceutical industries were interested in noni because of its adaptability and utilization of the plant's structures for various therapeutic applications.

2. Methodology

2.1. Chicks, Diet, and Management

An experimental broiler house equally divided into fifteen (15) pens was used in the study. Each pen measures 1m × 1m with a total measurement of 12 m^2 with an elevation of 1 m above the ground. The house was installed with 15, 100-watt bulbs and covered with sacks to manipulate the temperature inside the house.

A total of one hundred fifty (150) broiler chicks of the strain Cobb 500 were used in the study. The experimental housing was covered with tiers of cartons for two weeks to act as a stepping pad for the chicks and to make dung collection easier.

There were five (5) treatments considered in this study. Except for the control, all others contained varying levels of noni-leaf meal. The designated treatments were the following: T1—Formulated ration (0% noni leaf meal, Control), T2—Formulated ration with 3% noni leaf meal (NLM), T3—Formulated ration with 6% noni leaf meal (NLM), T4—Formulated ration with 9% noni leaf meal (NLM), T5—Formulated ration with 12 noni leaf meal (NLM). All treatments were distributed to the experimental pens following the Completely Randomized Design (CRD). Likewise, each treatment was replicated three times, each of which contained ten 10 (experimental animals).

A formulated ration was used throughout the study. The ingredients used were rice bran D1, corn grits, Soybean meal, fish meal, molasses, salt, vitamins, limestone, and noni leaf meal (Tables I and II). The collected noni leaves will be air dried before grinding into powder and carefully weighed using a digital weighing scale then thoroughly mixed with feed formulation using the appropriate amount for each treatment. A combination of formulated feeds and noni-leaf meal will be used. Ad libitum feeding will be used in the study to expedite and maximize experiment time. For eight weeks, the ration will be fed to experimental birds. Clean tap water will be offered to the experimental birds. It will be provided ad libitum and changed as needed to ensure the cleanliness and freshness of the drinking water.

Among the data to be gathered were body weight, gain in weight, feed consumption, the percentage of growth rate, dressing percentage, and income above feed and chick costs.

2.2. Statistical Analysis

All data gathered will be subject to analysis of (ANOVA) following the Completely Randomized Design using the Statistical Tool for Agricultural Research Software (STAR). The Least Significant Differences (LSD) will be used in the comparison of treatment means.

3. Discussion

Growth performance is one main factor influencing broiler chicken production. The initial and weekly body weight of the experimental broiler chicken is presented in Table III. No significant differences in the initial body weight of the broilers were observed. The average initial body weight of the experimental broiler has a mean value of 74.06 g to 74.29 g. The insignificant result indicates the uniformity of the experimental units.

The weekly and total gain in weight of broiler fed diet with noni leaf meal is presented in Table IV. No significant differences were obtained in the broiler chicken's weight gain from the first, third, fourth, fifth and sixth weeks. However, significant differences were observed in the broiler's feed with noni-leaf meal in the second week. Treatment 1, which is the control has obtained the highest body weight of 305.71 g, followed by Treatment 3 with formulated ration of 6% NLM having 262.41 g. It's important to notice that the treated broilers' numerical advantage is not much greater than that of the control, indicating the possibility of noni leaf meal as an indigenous broiler feed source.

The weekly growth rate of broilers is presented in Table V. On the percentage of rate of growth of the broilers fed with noni leaf meal, no significant difference was observed. The broiler growth rate resulted in a conventional descending order trend, peaking during the first week and then progressively declining until the end of the study.

The weekly feed consumption of the broilers is presented in Table VI. No significant differences were obtained in the broiler chicken's weight gain from the first week to the fourth week. The first week starts at relatively from 97.03 g to 104.91 g. Feed consumption increases across all treatments in the second to fourth weeks, which varies based on the noni-leaf meal levels. However some treatments like T4 and T5 show a reduction in consumption, this implies that a difference in the ability of the birds to convert feeds into meat was noticed because birds that were given pure commercial feeds significantly consumed more feeds than those that were given indigenous plant-based feeds. On the other hand, fifth and sixth weeks of the study, significant differences were observed in the broilers fed with noni leaf meal. T1 and T2 maintain higher feed intake, while T3, T4, and T5 show lower intakes indicating that higher levels of NLM reduce feed intake due to the presence of bioactive compounds such as tannins. High inclusion levels of indigenous leaf meals often reduce feed intake due to a combination of low energy density, high fiber content, and the presence of anti-nutritional factors based on the study of [10] revealed that the presence of tannin in *Tithonia diversifolia* leaf meal was attributed to the decreased feed intake and nutrient digestibility in broilers. Protein and digestive enzymes may be bound by tannin to form a complex form that is difficult to digest

TABLE I: The Composition and Calculated Nutrient Analysis of Starter Formulated Ration used in the Study

Ingredients	T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)	T5 (12%)
Noni Leaf Meal (NLM)	0.00	3.00	6.00	9.00	12.00
Rice Bran (D1)	10.00	10.00	10.00	10.00	10.00
Corn Grit	52.95	50.35	47.35	45.05	43.50
SBOM	26.00	26.00	25.00	25.15	23.53
Fish Meal	5.00	5.00	5.00	5.00	5.00
Molasses	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25
Vit/Min Premix	0.5	0.5	0.5	0.5	0.5
Methionine	0.10	0.15	0.10	0.10	0.12
Dicaphos	0.10	0.35	0.60	0.55	0.70
Limestone	0.8	0.10	0.9	0.10	0.10
Toxin Binder	0.10	0.10	0.10	0.10	0.10
Enzyme	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated Analysis					
Crude Protein (%)	20.20	20.44	20.32	20.65	20.45
Crude Fiber (%)	3.00	4.10	4.62	4.94	5.33
ME (Kcal)	2973.40	2932.80	2933.96	2950.28	2980.63
Calcium	0.91	1.55	1.55	0.99	1.03
Phosphorous	0.38	0.40	0.44	0.43	0.45
Methionine	0.50	0.59	0.52	0.52	0.53
Lysine	1.34	1.38	1.34	1.34	1.29

TABLE II: The Composition and Calculated Nutrient Analysis of Finisher Formulated Ration used in the Study

Ingredients	T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)	T5 (12%)
Noni Leaf Meal (NLM)	0.00	3.00	6.00	9.00	12.00
Rice Bran (D1)	10.00	10.00	10.00	10.00	10.00
Corn Grit	57.89	55.99	53.98	51.49	48.48
SBOM	21.82	20.76	19.77	19.01	19.02
Fish Meal	5.00	5.00	5.00	5.00	5.00
Molasses	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25
Vit/Min Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Dicaphos	0.10	0.10	0.10	0.10	0.10
Limestone	0.29	0.25	0.25	0.50	0.50
Toxin Binder	0.10	0.10	0.10	0.10	0.10
Enzyme	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated Analysis					
Crude Protein (%)	18.70	18.76	18.60	18.82	18.74
Crude Fiber (%)	4.27	4.21	4.58	5.25	5.25
ME (Kcal)	2900.62	2900.64	2900.80	2900.87	2900.42
Calcium	1.11	1.03	1.02	1.12	1.12
Phosphorous	0.40	0.35	0.35	0.38	0.38
Methionine	0.84	0.72	0.74	0.75	0.75
Lysine	0.27	0.37	0.36	0.26	0.20

[10]. As a result, the digestibility and utilization of proteins are decreased.

One characteristic of economic significance is the dressing percentage: the higher the dressing percentage the better the monetary returns. The dressing percentage with and without giblets is shown in Table VII. Insignificant differences among treatments were obtained in terms of the dressing percentage with giblets which ranged from 77.16% to 80.71%. Likewise, non-significant results in terms of the dressing percentage without giblets which ranged from 74.29% to 77.16% were recorded. The result of the study was similar to the study of [11] research on the indigenous chicken populations of Southeastern Ethiopia found no significant differences in dressing percentages when chickens were fed indigenous diets versus other management systems. Dressing percentages ranged between 76.8% and 80.9%, with genetic and environmental factors playing a

TABLE III: Initial and Weekly Body Weight (g) of the Experimental Broiler Chicken Fed Diet with Noni (*Morinda citrifolia*) Leaf Meal

Treatments	Initial and Weekly Body weight (g)						
	Initial	First	Second	Third	Fourth	Fifth	Sixth
T1	74.28	236.5	542.21	791.01	1119.7	1530.15	1809.11
T2	74.06	225.62	469.95	731.97	1047.77	1447.68	1698.11
T3	74.17	226.83	489.25	753.58	1089.91	2116.125	166.09
T4	74.17	220.44	450.62	734.55	1023.33	1386.01	1560.41
T5	74.29	221	432.88	679.81	1003.48	1339.62	1531.3
ANOVA	ns	ns	ns	ns	ns	ns	ns
C.V. (%)	0.31	4.08	7.99	7.06	9.70	6.61	5.98

Note: ns= not significant (P > 0.05).

TABLE IV: Weekly and Total Gain in Weight (g) of the Experimental Broiler Chicken Fed with Noni (*Morinda citrifolia*) Leaf Meal

Treatments	Gain in weight of the Bird (g)						
	First	Second	Third	Fourth	Fifth	Sixth	Total gain in weight
T1	162.22	305.71^{a}	242.79	328.69	410.45	263.95	1776.73
T2	151.56	244.32^{b}	244.02	333.8	399.9	250.43	1624.33
T3	152.66	262.41^{ab}	264.33	336	320.83	250.34	1584.65
T4	146.27	230.18^{b}	283.92	288.77	362.68	174.4	1432.48
T5	146.7	211.88^{b}	246.92	323.66	336.14	191.68	1421.94
ANOVA	ns	**	ns	ns	ns	ns	ns
C.V. (%)	5.98	12.65	14.17	18.60	12.29	24.64	2.76
LSD		57.74					

Note: Means with common letters showed are not significantly different using LSD ns = not significant (P > 0.05) ** = highly significant at 1% level of significance (P < 0.01).

TABLE V: Percentage Rate of Growth of the Experimental Broiler Fed with Noni (*Morinda citrifolia*) Leaf Meal

Treatments	Percentage rate of growth (%)					
	First	Second	Third	Fourth	Fifth	Sixth
T1	103.1	78.24	37.25	34.25	31.15	15.94
T2	103.11	68.37	41.19	37.38	32.49	15.87
T3	101.25	71.6	42.63	36.63	25.66	16.34
T4	99.29	68.4	47.97	32.74	30.09	11.86
T5	99.33	66.94	44.38	38.33	28.71	13.35
ANOVA	ns	ns	ns	ns	ns	ns
C.V. (%)	3.20	7.65	13.46	12.76	15.37	24.58

Note: ns = not significant (P>0.05).

TABLE VI: Weekly and Cumulative Feed Consumption (g) of the Experimental Broiler Chicken Fed with Noni (*Morinda citrifolia*) Leaf Meal

Treatments	Weekly feed consumption (g)						
	First	Second	Third	Fourth	Fifth	Sixth	Cumulative
T1	97.03	233.99	624.28	756.54	1075.96^{a}	1308.99^{a}	4096.79
T2	103.23	215.73	564.9	826.74	1036.25^{a}	1328.66^{a}	4075.51
T3	104.91	217	549.83	482	740.66^{b}	947.96^{b}	3042.36
T4	100.29	214.18	548.14	679.62	824.53^{b}	941.66^{b}	3308.42
T5	99	206.22	525.51	657.48	763.7^{b}	982.85^{b}	3234.76
ANOVA	ns	ns	ns	ns	**	**	
C.V. (%)	6.55	8.98	8.26	9.56	10.41	9.48	
LSD					168.20	270.37	

Note: Means with common letters showed are not significantly different using LSD, ns means not significant (P > 0.05), ** highly significant at 1% level of significance (P < 0.01).

more prominent role than dietary differences. Other treatments T2-T5 provide comparable results, suggesting they could also be viable depending on cost or availability.

The income over feed chick cost was presented in Table VIII. In descending order, the return above feed cost from the different treatments are as follows: T3—69.5, T1—55.65, T5—50.26, T2—47.15 and T4—46.42. The computed income derived from broilers fed diet with the inclusion of noni leaf meal at different levels can reduce feed cost and provide economic value to non-conventional feedstuffs. T1 and T3 had higher profits (Php 55.65 and

TABLE VII: Percentage With and Without Giblets (%) of the Experimental Chicken Fed with Noni (*Morinda citrifolia*) Leaf Meal

	Dressing percentage (%)	
Treatment	With Giblets	Without Giblets
T1	80.71	77.16
T2	77.82	75.6
T3	77.16	74.29
T4	77.56	75.16
T5	77.67	75.04
ANOVA	ns	ns
C.V.%	2.96	2.22

Note: ns means not significant (P > 0.05).

TABLE VIII: Income Over Feed and Chick Cost

Item	Treatments				
	T1	T2	T3	T4	T5
Average final weight (g)	1.8	1.7	1.7	1.6	1.53
Return per broiler	270	254.7	249.15	234	229.65
Price of chicks/head	40	40	40	40	40
Cost of starter feed (1^{st}–4^{th} weeks)	38.21	37.37	36.59	35.81	35.06
Cost of finisher feed (5^{th} –8^{th} weeks)	18.7	18.25	17.8	17.34	16.39
Amount of starter feed consumed (kg)	2.85	2.85	2.26	2.62	2.48
Cost of starter feed (1^{st}–4^{th} weeks)	108.8985	106.5045	82.6934	93.8222	86.9488
Amount of finisher feed consumed(kg)	3.5	3.3	3.2	3.1	3.2
Cost of finisher feed consumed (5^{th}–8^{th} weeks)	65.45	61.05	56.96	53.75	52.44
Total Expenses	174.3485	167.5545	139.6534	147.5722	139.3888
Return above feed cost (Php)	55.65	47.15	69.5	46.42	50.26

Php 69.5, respectively), while T2, T4, and T5 showed lower profits. T3 seems optimal, balancing moderate feed costs with good weight gain and returns, yielding the highest profit. T1, though achieving the heaviest birds, has reduced profitability due to higher feed costs.

Therefore, a rise in feed prices may result in higher overall production costs and a decline in the broiler industry's profit margin. The use of agro-industrial by-products as an energy source in broiler diets is one new attempt to lower feed costs [12]. However, some limitations may exist when using the agro-industrial by-products as the ingredients in broiler rations. The high and low fiber and protein contents in the by-products may limit the digestibility and thus the inclusion level of such by-products [12]. This could help lower the percentage of traditional, expensive, protein-rich feed components in broiler rations.

4. Conclusion and Recommendation

In conclusion, noni leaf meal (NLM) can be included in broiler diets at various levels without significantly affecting key growth metrics such as, dressing percentage, or final body weight. The ideal amount of noni leaf meal (NLM) to include in broiler diets is 6%, as this level offers the best balance of cost-effectiveness, feed efficiency, and growth performance. However, while T1 (the control diet) resulted in higher weight gain and income, its higher feed costs reduced its overall profitability compared to Noni leaf meal (NLM)-based diets. Noni leaf meal (NLM) has potential advantages beyond development, like increased immunity and a decreased need for artificial additives. Finally, determine whether it is economically feasible to source and produce noni leaf meal (NLM) to guarantee its long-term use as a feed ingredient. These suggestions seek to preserve sustainability and cost-effectiveness while optimizing the advantages of employing Noni leaf meal (NLM) in broiler production.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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