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Effect of Black Plum Leaf Meal on the Growth Performance Characteristics, Cost Benefit Evaluation and Serum Biochemical Indices of Finisher Broiler Birds

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ABSTRACT

Background and Objective: Synthetic feed additives have raised and generated a lot of questions and concerns regarding the safety of their uses. Hence a need to look for alternatives which is considered safe for the end users which are humans. The main objective of the study is to determine the effect of black plum leaf meal on the growth performance characteristics, cost benefit evaluation and serum biochemical indices of finisher broiler birds. **Materials and Methods:** A total of ninety-six, four weeks old Agrited broiler birds were used for the research. The birds were randomly distributed into four dietary groups, which were replicated three times with eight birds per replicate in a Completely Randomized Design (CRD) setup. Four different diets were formulated, such that the processed black plum leaf meal was incorporated into the diets at the rate of 2, 4 and 6%, with diet one serving as the control diet with 0% level of processed black plum leaf meal. Feed and water were also given to the birds for the experimental period of twenty-one days. **Results:** It is obtained for growth performance revealed that birds on diet 4 had a better value in terms of final body weight, body weight gain and feed conversion ratio with 2520, 1539.83 and 1.79 g, respectively. Cost-benefit evaluation was higher in treatment 4 with values of #4788.00, #1081.37 and 3.43 which was reflected for revenue, benefit/net profit and cost-benefit ratio. Serum biochemical indices values were highest in diet 1 with 3.58, 1.97, 8.24, 0.89 and 182.44 mg/dL corresponding to total protein, albumin, urea, creatinine and cholesterol respectively. **Conclusion:** Thus, it can be concluded that processed black plum leaf meal can be incorporated into the diet of broilers at the finisher phase up to the level of 6% without any negative or detrimental impact in terms of growth and serum biochemistry values.

KEYWORDS

Growth performance, feed additives, serum biochemistry, broilers, black plum, leaf meal

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INTRODUCTION

The use of synthetic growth promoters to improve the growth performance and the overall health of broiler birds has been for a long time. However, concerns about antibiotic resistance pathogens, microbial proliferation with intestinal walls and the blood of farm animals have increased the need to identify and look for alternatives that could help in ameliorating and improving broiler performance and also reduce the rate of morbidity and mortality[1]. Also, the ban placed on the use of antibiotics growth promoters (AGP) and some other synthetic feed additives used as growth promoters to stimulate growth calls for concerted efforts to search for alternatives using natural plant materials which have little or no side effects or zoonotic factors. Herbs and plant extract represent a class of additives in poultry feed usually referred to as phytogenic feed additive[2].

It should be noted that phytogenic feed additives applied in livestock production not only contribute to profitability and superior quality of animal-derived products but also satisfy food safety and environmental regulations. Different nutritionists have used phytogenic plant materials as natural growth promoters in farm animal production over the years and have been proven to yield positive results on investment over time. Plant-based additives have also been proven to reduce ammonia methane gas and other greenhouse gas emissions in their course of usage. Thus, phytogenic are known to have a range of biologically active properties that are beneficial in modern livestock production including antioxidative, anti-inflammatory, anti-microbial and digestion enhancing effects[3]. However, it is important to note that achieving consistent and reliable results with plant-based substances in animal diets requires a well-defined formulation, standardized raw materials and effective quality control. The phytogenic feed additives are capable of reducing microbial threat and promoting intestinal health, which is imperative for optimal performance and profitability[4].

Vitex doniana is a tree that is native to the Afrotropics. Its fruit is one of several fruits called black plums. The tree is often grown for its fruits[1]. The fruit is oblong and about 3 cm long. It is green when young, turning purplish black when ripe. It is sweet and eaten fresh or made into jam or wine. The fruit contains vitamins A and B. The young leaf is highly rich in nutrients and eaten as a leafy vegetable[4]. Young twigs and leaves are consumed as a vegetable. The tree is propagated from seeds, root suckers and cuttings, as coppicing and pruning are used to control tree shape. It is also used in traditional medicine for dysentery, diarrhea, anemia, jaundice, gonorrhea, rickets, fever, respiratory diseases, headache, stiffness, measles, rash and coli etc[5]. Vegetables like *Vitex doniana* are important sources of protective foods, which are highly beneficial for the maintenance of good health and prevention of diseases. *Vitex doniana* is largely cheap and available and also a good quality nutritional plant source for poor segments of the population especially where malnutrition is widespread in Nigeria. The chemical composition of *Vitex doniana* revealed an ash content of 1.63%, fat and fiber content of 2.92 and 2.75%, crude protein content of 8.10% and carbohydrate value of 7.57% respectively[5]. Vitamin analysis of *Vitex doniana* young leaf confirmed the presence of vitamins A, B1, B2, B3, C, D, E and K. It was reported from literature that the value of vitamin C is highest in back plum leaf, while that of Vitamin K is the least. The nutrient analysis of *Vitex doniana* showed that the nutrient content of the young leaves is similar to those of edible vegetables[6]. To this end, this study intends to assess the effect of including black plum leaf meal in the diet of finisher broiler birds on the growth performance, cost benefit evaluation and serum biochemical indices.

MATERIALS AND METHODS

Experimental site: The research work was carried out at the Poultry unit of the Animal Production Department, Federal College of Agriculture, Ishiagu, Ebonyi State from July 2022 to September 2022.

Source and processing of black plum leaf: The black plum leaves were sourced within the college environment. The leaflets were stripped from the petioles and sorted out to remove dirt. Then shade-dried for about a week, after which they were allowed access to direct sunlight for two hours to make it crispy and then ground to powder using the hammer mill machine.

Table 1: Experimental diets for finisher broiler birds

	Treatments			
Ingredients	T1	T2	T3	T4
Maize	58.00	58.00	58.00	58.00
Wheat offal	6.90	5.90	4.90	3.90
Fullfat soya	5.00	5.00	5.00	5.00
Groundnut cake	14.00	14.00	14.00	14.00
Fish meal (72%)	1.50	1.50	1.50	1.50
Blood meal	3.50	3.50	3.50	3.50
Palm kernel cake	6.00	5.00	4.00	3.00
Black plum leaf meal	0.00	2.00	4.00	6.00
Limestone	1.50	1.50	1.50	1.50
Bonemeal	2.50	2.50	2.50	2.50
Methionine	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20
Finisher premix	0.35	0.35	0.35	0.35
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated value				
Crude protein (CP)	19.75	19.72	19.70	19.66
Metabolizable energy (Kcal/kg)	2950.67	2946.87	2941.21	2937.19
Methionine (%)	0.63	0.63	0.63	0.63
Lysine (%)	1.10	1.10	1.10	1.10

Experimental design and management of birds: Ninety-six, four weeks old broiler birds were used for the experiment. The birds were randomly distributed into four treatments. Each treatment was replicated three times in a Completely Randomized Design (CRD) with eight birds per replicate. The birds were purchased from Cosin farm in Enugu, Enugu State. Feeders and drinkers for the research work were thoroughly washed and cleaned. The birds were raised on a deep litter system with wood shavings which served as a source of litter. The birds were randomly distributed to their different pens. Feed and water were given *ad-libitum*. All the routine vaccinations and medication necessary for the bird's welfare during the entire growth cycle from five weeks old to the end of the experiment were strictly adhered to according to laid down standards.

Data collection: Feed intake of the birds was obtained as the difference between the quantity of feed supplied the previous day and the quantity of feed left the next day. The feed conversion ratio was obtained as the ratio of feed consumed divided by the body weight gain of the birds. Blood samples of 3 mL per bird were drawn from each replicate into specimen bottles without Ethylenediaminetetraacetic Acid (EDTA) to determine the serum biochemical indices of the birds. Data collected were subjected to Analysis of Variance (ANOVA) at $p<0.05$, while significant difference mean was carried out according to the method of Duncan multiple range test as outlined by Yan *et al.*[7]. Cost benefit analysis was calculated using the following formula as outlined by Olabode *et al.*[1]:

- **Cost of bird:** Amount expended or spent on purchase of bird
- **Cost per kg of feed:** Cost of feed/25 kg
- **Cost of feed consumed:** Total feed intake x cost per kg of feed/1000
- **Other cost**
- **Total cost of production**
- **Revenue:** Average final weight of birds x cost per kg of the current market price of 1 kg meat of broiler/1000
- **Benefit/profit:** Revenue-cost of production
- **Cost benefit ratio:** Cost of production/benefit

Experimental diets: Four experimental diets were formulated with diet 1 containing 0% black plum leaf meal, which served as the control. Diets 2, 3 and 4 contained black plum leaf meal at the levels of 2, 4 and 6%, respectively. The composition of the experimental diet is shown in Table 1.

RESULTS AND DISCUSSION

Table 2 displayed the results of finisher broilers fed supplemental levels of processed black plum leaf meal at the finisher phase. The results of final body weight revealed that birds in treatment 4 had a superior value of 2520 g, which was similar to those in treatments 2 and 3 with values of 2475.21 and 2490.11 g, respectively. While the lowest value of 2469.50 g was observed in treatment 1. The significant increase in the final body weight across the treatments could be a result of the high level of amino acids, minerals and vitamins found in the black plum leaves. Also, the antioxidant factor and bioactive compounds could be contributing factors. This accession was supported by the work carried out by previous studies[1,5], where they reported increased final body weight of cockerels and broilers fed increasing levels of black plum leaf meal. Also, Oloruntola *et al*.[8] observed an increased body weight when pawpaw (*Carica papaya*) leaf meal was used to fortify broiler diet.

The average daily feed intake value showed a significant ($p<0.05$) effect. Similar values of 137.76, 135.50 and 134.36 g were obtained in treatments 1, 2 and 3, while the least value of 131.20 g was seen in treatment 4. This was similar to the accounts of previous researches[1,8-10] where they observed significant differences in daily feed intake of leaf meals fed to broiler birds and quails, respectively. Revenue values were better in treatments fortified with black plum leaf meal. A superior revenue value of #4788 was obtained in treatment 4, while the least value of #4692.05 was obtained in treatment 1. Net profit had a better value of #1081.37 in treatment 4, while the lowest value of #855.45 was observed in treatment 1. The better benefit obtained in treatments fortified with black plum leaf meal as the level increases in the diet of the birds were similar to the results obtained by previous studies[1,8,11] where they obtained better cost-benefit analysis when phytobiotic substances were used in diets given to broiler birds. Serum biochemistry values (Table 3) showed a significant ($p<0.05$) effect in total protein, albumin and cholesterol. While urea and creatinine values did not differ across the treatment group. Values obtained for total

Table 2: Growth performance characteristics and cost benefit evaluation of finisher broiler birds fed supplemental levels of black plum leaf meal

	Treatments				
Parameter	T1	T2	T3	T4	SEM
Initial body weight (g)	981.50	979.17	980.63	980.17	-
Final body weight (g)	2469.50^{b}	2475.21^{a}	2490.11^{a}	2520.00^{a}	8.36
Body weight gain (g)	1488.00^{b}	1496.04^{b}	1509.48^{b}	1539.83^{a}	7.03
Feed intake (g)	2892.96^{a}	2845.50^{b}	2821.56^{c}	2755.20^{d}	15.17
Daily body weight gain (g)	70.86	71.24	71.88	73.33	0.62
Daily feed intake (g)	137.76^{a}	135.50^{a}	134.36^{a}	131.20^{b}	0.96
Feed conversion ratio	1.94^{a}	1.90^{a}	1.87^{b}	1.79^{b}	0.02
Cost of bird at 4 weeks old (₦)	2300.00	2300.00	2300.00	2300.00	-
Cost of kg of feed (₦)	375.60^{a}	362.70^{b}	356.00^{c}	347.21^{d}	2.67
Cost of feed consumed (₦)	1086.60^{a}	1032.06^{b}	1004.48^{c}	956.63^{c}	5.11
Other cost (expenses) (₦)	450.00	450.00	450.00	450.00	-
Total cost of production (₦)	3836.60^{a}	3782.06^{b}	3754.48^{b}	3706.63^{c}	32.76
Revenue (₦)	4692.05^{d}	4702.90^{c}	4731.21^{b}	4788.00^{a}	43.90
Benefit/net profit (₦)	855.45^{d}	920.84^{c}	976.73^{b}	1081.37^{a}	6.01
Cost benefit ratio	4.49^{a}	4.11^{b}	3.84^{c}	3.43^{d}	1.54

^{abcd}Means on the same row with different superscripts are significantly ($p<0.05$) different

Table 3: Serum biochemical indices of finisher broilers fed supplemental levels of processed black plum leaf meal

	Treatments				
Parameter	T1	T2	T3	T4	SEM
Total protein (g/dL)	3.58^{a}	3.57^{a}	3.51^{a}	3.31^{b}	0.04
Albumin (g/dL)	1.97^{a}	1.86^{a}	1.79^{b}	1.72^{b}	0.03
Urea (mg/dL)	8.24	7.94	8.11	8.16	0.07
Creatinine (mg/dL)	0.89	0.85	0.87	0.83	0.02
Cholesterol (mg/dL)	182.44^{a}	176.33^{b}	161.95^{c}	149.87^{d}	3.84

^{abcd}Means on the same row with different superscripts are significantly ($p<0.05$) different

protein were highest in treatment 1 (3.58 g/dL) followed by 3.57 and 3.51 g/dL, while treatment 4 (3.31 g/dL) was the least. Cholesterol values also follow the same pattern of descending order with the superior value of 182.44 mg/dL observed in treatment 1 which differ from the values of 176.33, 161.95 and 149.87 mg/dL, respectively. Values obtained were within the recommended range as outlined by previous studies[12,13].

This implies that the black plum leaf meal can be included in the diet of the finishing birds at a level up to 6%, of which the birds would gain better weight and equally have a lower cost of production.

Based on the results obtained from this study, it is recommended the inclusion of black plum leaf meal in the diets of birds at finishing stage up to 6%, as the birds at this stage will be able to optimize the bioactive substances and nutrient within to attain to a better growth performance and economy benefit is better at this stage. Also, it is recommended the use black plum leaf meal in other poultry birds like layers, cockerels, ducks etc. It is also recommended another method of processing the black plum leaf meal to ascertain their overall usage and importance.

The main limitation of the study has to do with the timing of drying the black plum leaves. As rainy season poses a problem in getting a better quantity of the dried black plum leaf meal.

CONCLUSION

It can be concluded that the inclusion of black plum leaf meal in the diet of finisher broiler birds at different rates can be tolerated by the birds. Superior performance in terms of growth and cost-benefit was obtained in treatment 4 at 6% level of inclusion. The black plum leaf meal when properly processed can be used in broiler nutrition like other tropical leaves. There was no negative impact of the leaf meal on the bird's health judging from the values obtained for serum biochemistry, which were within the recommended range and from the fact that there was no morbidity and mortality in the treatments fortified with the black plum leaf meal.

SIGNIFICANCE STATEMENT

The study revealed the possibility of using black plum leaf meal in the feeding of broiler birds especially at the finishing phase to improve the growth performance and also to reduce the cost of producing the birds. The study also showed the possibility of the birds accessing more nutrients in the black plum leaf meal at a higher level of inclusion, especially the antioxidants, minerals and vitamins embedded within it. It also showed the possibility of using leaves rather than fruit which have been the main materials used over time, thus reducing the competition created with humans.

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