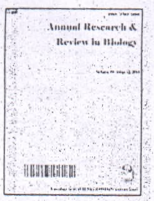

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Response of Broiler Chickens to *Carica papaya* and *Talinium triangulare* Leaf Meal under Normal and Subnormal Diets

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Authors' contributions

This work was carried out in collaboration among all authors. Author ADO designed the study. Authors ADO and GOA supervised the study. Author BEA carried out the feeding trial. Authors BEA and IOA carried out the statistical analyses. Author IOA handled literature and wrote the first draft. All authors read and approved the final manuscript.

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ABSTRACT

The use of locally available and cheap feed ingredients has received particular attention as a viable alternative to the use of conventional feedstuffs in developing countries. Vegetable-based feeds are rich sources of essential plant amino acids, vitamins, minerals, and antioxidants. Further to the rich contents mentioned, it has been established that green vegetable leaves are cheap and abundant sources of protein because of their ability to synthesize amino acids from a wide range of available primary materials. The aim of this study was to investigate the response of broiler chickens to *Carica papaya* and *Talinium triangulare* under normal and subnormal diets. In this study, the effects of *C. papaya*leaf meal and *T. triangulare* chopped leaves were assessed on growth performance and haematological parameters of broiler chickens. Two hundred and seventy 1-d old Arbor acres broiler

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chicks were used for the study. Each treatment had 5 replicates with 6 birds per replicate. Normal diets and subnormal diets were compounded with varying amounts of ingredients. The test ingredients were supplied at the rate of 10% of the main diets. The design of the experiment was a completely randomized design. All the treatments with subnormal diets obtained higher feed intake than treatments with normal diets. Birds on subnormal diet mixed with *C. papaya* leaf meal (24.03%) obtained the highest packed cell volume. The haemoglobin concentrations followed a similar pattern. Normal diets compared with control for feed conversion ratio.

Keywords: Broiler chickens; Carica papaya; haematology; leaf meal; Talinum triangulare; performance.

1. INTRODUCTION

Feeding in poultry production is based on the science of nutrition in which nutritional requirements are mostly known. High cost of feeds and scarcity of essential raw materials have necessitated poultry farmers to look out for systems which could help to identify feed ingredients of lower cost and sound biological values that can partly supplement the conventional protein and energy sources in broiler diets.

The use of locally available and cheap feed ingredients has received particular attention as a viable alternative to the use of conventional feedstuffs [1-5]. Vegetable-based feeds are rich sources of essential plant amino acids, vitamins, minerals, and antioxidants [6]. Further to the rich contents mentioned, it has been established that green vegetable leaves are the cheapest and most abundant sources of protein because of their ability to synthesize amino acids from a wide range of available primary materials [7].

Talinium triangulare is an agricultural product whose nutritional importance on livestock has been ignored probably because little is known about its potential in livestock production. *Talinium triangulare* contributes significantly to the nutritional security in some rural communities in Africa. *Carica papaya*is is popular in the tropics and sub-tropics because of its easy cultivation, rapid growth, quick economic returns and easy adaptation to diverse soils and climates [8,9]. Exposing meat type broilers to a partial scavenging lifestyle may enhance their nutritional requirements. Hence, this study evaluated the performance characteristics and haematological response of broiler chickens scavenging on *C. papaya* leaf meal and *Talinium triangulare* chopped leaves under normal and subnormal diets.

2. MATERIALS AND METHODS

2.1 Experimental Site, Source, and Processing of Test Ingredients

The study was carried out at the Teaching and Research Farm, University of Ibadan, Nigeria. Fresh pawpaw leaves (*Carica papaya*) and water leaves (*Talinium triangulare*) were obtained from the farm premises and identified at the Department of Botany, University of Ibadan. Pawpaw leaves were separated from the stalk and sundried for 5 days on a clean concrete floor. By the 5th day, they had become crispy at constant weight. The leaves were crumbled by hand and were stored in an air-tight container. Water leaves were supplied fresh on daily basis in a chopped form. The proximate composition of the test ingredients was carried out in triplicates according to the method of AOAC [10].

2.2 Management of Experimental Animals

The poultry house was cleaned, washed and disinfected using Polidine Iodophore™ (Animal Care Services Konsult Nig. Ltd) and allowed without stocking for 2 weeks. Two hundred and seventy 1-d old Arbor acres broiler chicks were purchased from a commercial hatchery in Ibadan. After brooding, the birds were randomly allotted to 9 treatments in a complete randomized design in a deep litter system. Each treatment had 5 replicates with 6 birds per replicate. Two main rations were compounded with varying amount of ingredients. One was tagged 'Normal diet' while the other was tagged 'Subnormal diet' (Table 1). The normal diet had 21% crude protein while the subnormal diet had a very low crude protein (15.57%) and metabolizable energy lower than the recommended (Table 1). The test ingredients were supplied at the rate of 10% of the main diets. The treatment diets were as follows:

T_1= Control diet (Normal diet – leaf meal);
T_2= Normal diet mixed with *C. papaya* leaf meal
T_3= Subnormal diet mixed with *C. papaya* leaf meal
T_4= Normal diet separate, *C. papaya* leaf mealseparate
T_5= Subnormal diet separate, *C. papaya* leaf meal separate
T_6= Normal diet mixed with chopped *T. triangulare*
T_7= Subnormal diet mixed with chopped *T. triangulare*
T_8= Normal diet separate, chopped *T. triangulare* separate
T_9= Subnormal diet separate, *T. triangulare* separate

The experimental diets (Table 1) were fed for 28 days and the birds had access to the feed and cool drinking water *ad libitum*. All routine vaccinations and bio-security measures were carried out as recommended. Litter materials were regularly replaced.

2.3 Data Collection

Feed intake was obtained daily by subtracting left-over feed from feed served. Weekly body weight gain was measured using weekly weigh-back mechanism, by subtracting the present week's weight from that of the previous week. Feed conversion ratio (FCR) was obtained by dividing the average total feed intake by the average total body weight gain.

2.4 Haematological Studies

Blood samples were collected from the experimental animals through making incision on the jugular veins and evacuating the blood into heparinised bottles. The haematological parameters were analysed for at the Physiology Laboratory, Department of Animal Science, University of Ibadan.

2.5 Statistical Analysis

The data obtained were subjected to one-way analysis of variance (ANOVA) and the means were compared using the Duncan's Multiple range test as outlined by Steel and Torrie [11].

3. RESULTS

The proximate composition of the experimental diets, experimental leaves, mixed feeds and performance characteristics of broiler chickens fed *T. triangulare* and *C. papaya* leaf meal under normal and subnormal diets are presented in Tables 2, 3, 4 and 5 respectively. No significant differences were observed across the treatments for initial body weights and feed intake. The highest average total body weight gain (2901.05g) was obtained by animals on T_8, with

Table 1. Gross composition of finisher experimental diets experimental diets (normal and subnormal)

Ingredients (%)	Normal	Subnormal
Maize	55.00	50.00
Soya meal	25.00	6.70
Fish meal	2.00	---
Groundnut cake	10.00	5.00
Wheat offal	4.70	35.00
Oyster shell	1.50	1.50
Bone meal	1.00	1.00
Methionine	0.15	0.15
Lysine	0.10	0.10
Premix	0.25	0.25
Salt	0.30	0.30
Total	100.00	100.00
Calculated nutrients		
Crude protein	21.90	15.57
Metabolizable Energy (Kcal/Kg)	2894.50	2672.40

Vitamins and Mineral premix for Broilers and Chicks (2.5kg/ton) Vitamin A12,500.00iu. 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 normal feed and *T. triangulare* leaf separated. All the treatments with subnormal diet except T_7 (i.e. T_3, T_5, T_9) had lower body weight gain ($P = 0.05$). Birds fed the control diet with no experimental leaf had a final body weight gain (2830.05g) which was significantly ($P = 0.05$) lower than those of T_4, T_6 and T_8 (2851.03g, 2880.02g and 2901.05g respectively). All the treatments with subnormal diets obtained higher feed intake than the treatments with normal diets. However, birds in T_7 (subnormal feed mixed with *T. triangulare* leaf) obtained the highest average total feed intake. (6251g). Also, there was no significant difference in the feed efficiency of all the birds fed subnormal diets (T3 (0.43), T5 (0.42), T7 (0.44), T9 (0.42).

Table 2. Proximate compositions of experimental diets

Nutrients (%)	Normal	Subnormal
Dry matter	92.00	90.00
Crude protein	20.63	15.50
Crude fibre	3.62	6.05
Ether extract	4.90	3.80
Ash	4.80	5.00
Metabolizable energy (Kcal/Kg)	2850.00	2610.00

The haematological parameters of broiler chickens fed pawpaw leaf meal and water leaves are shown in Table 6. Birds on T_3 (24.03%) obtained the highest PCV content, followed by those on T_2 (21.93%) while T_6 (17.03%) and T_8 (17.00%) obtained the least values. The haemoglobin concentrations were significantly higher for birds on T_3 than those of the control group, while those on T_2, T_4, T_5, T_7 and T_9 compared with the control group. For white blood cell counts ($X10^3/mm^3$) birds on T_7 (31.20) and T_9 (31.12) obtained the highest values followed by those on control diet (27.85). Birds on T_5 ($4.6410^6/mm^3$) obtained the highest mean value of red blood cell counts followed by those on T_3 ($4.0510^6/mm^3$) while those on T_8 ($1.6110^6/mm^3$) obtained the least values.

4. DISCUSSION

The crude protein of water leaf obtained in this study was close to reported by Oguntona [12] but lower than the value reported by Mohammed and Mann [13] for fresh water leaf. The value obtained for crude fibre content of water leaf in the present study was similar to the value obtained by Mohammed and Mann [13]. The value reported in the present study is lower than those of *C. olitorius*, *A. cruentus* and *C. argenta* as reported by Chionyedua et al. [14]. The fibre content of water leaf and other vegetables could be a beneficial factor in aiding effective digestion process. The mean value obtained for ether extract by water leaf is similar to the value reported by Ogbonnaya and Chinedum [15]. Crude protein, ether extract, crude fibre and ash content of the pawpaw leaf are similar for the same leaf as reported in the previous finding Unigwe [16].

Table 3. Proximate composition of experimental leaves

Nutrients (%)	Water leaf (wet)	Pawpaw leaf (sundried)
Crude protein	2.11	23.90
Ether extract	1.50	0.38
Crude fibre	1.03	10.50
Ash	1.38	7.61
Dry matter	9.80	91.60

4.1 Performance Characteristics

The average weight of 3.0Kg at the end of the experiment justifies the recommendation of 1.60 to 2.00Kg body weight at 9 weeks old by Oluyemi and Robert [17] and 1.80Kg to 2.0Kg/bird at 9 weeks projected by Olomu and Offiong [18]. Generally, birds on normal diets had higher live weight and body weight gain than those on sub normal diet because the crude protein, ether extract, metabolizable energy and other nutrients in the normal diets fell within the recommended amount for broiler production and performed better than that of subnormal diet. The highest feed consumption was obtained in the treatments with subnormal diets. The feed consumption pattern is in agreement with the report of Leeson [19] that birds eat more feed as the nutrient level of a diet is reduced. The lowest FCR obtained for T_6 and T_8 is likely due to contribution of the vegetable to proper digestion process. Vegetables act as buffering agents for acidic substances produced during the digestion process [20]. This is likely responsible for the highest weight gain. Generally, birds fed with normal diet with water leaf had better weight gain than birds fed with normal diet with pawpaw leaf. Water leaf extract has appetizing and digestion stimulating properties as earlier observed by Langhout [21]. Nonethelss, Nworgu et al.[22] earlier reported that dietary inclusion of water leaf meal (sundried) in broiler starter diets depressed feed intake.

Table 4. Proximate composition of the mixed diets

Nutrients (%)	Normal diet + water leaf	Subnormal diet + water leaf	Normal diet + pawpaw leaf	Subnormal diet + pawpaw leaf
Dry matter	93.00	90.00	92.00	90.40
Crude fibre	4.52	5.80	4.85	5.95
Ether extract	5.40	3.60	4.60	3.20
Ash	5.00	6.05	7.63	6.46
Crude protein	20.81	16.31	20.51	16.28
Metabolizable energy (Kcal/Kg)	2815.00	2623.00	2802.00	2615.00

Table 5. Performance characteristics of the experimental birds at different treatments

Parameters	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	SEM
Av. Initial body wt. (g)	320.55	320.01	320.00	319.87	320.04	320.08	319.95	319.00	310.00	5.33
Av. final body wt. (g)	3150.60^{d}	3110.00^{e}	2980.02^{g}	3170.90^{c}	2950.10^{h}	3200.10^{b}	3040.00^{f}	3220.05^{a}	2940.02^{i}	42.71
Av. total body wt. gain (g)	2830.05^{d}	2789.99^{e}	2660.02^{g}	2851.03^{c}	2630.06^{h}	2880.02^{b}	2720.05^{f}	2901.05^{a}	2630.02^{h}	51.89
Av. Total feed intake (g)	5860.01^{e}	5790.05^{h}	6210.10^{d}	5808.08^{g}	6219.00^{c}	5830.02^{f}	6251.00^{a}	5860.04^{e}	6250.00^{b}	55.52
Feed conversion ratio	2.07^{bc}	2.08^{bc}	2.34^{ab}	2.04^{c}	2.37^{a}	2.02^{c}	2.30^{abc}	2.02^{c}	2.38^{a}	0.42
Feed efficiency	0.48^{abc}	0.48^{abc}	0.43^{cd}	0.49^{ab}	0.42^{d}	0.50^{a}	0.44^{bcd}	0.50^{a}	0.42^{d}	0.09

a, b, c Means with different superscripts on the same row differ significantly (p = 0.05), T_1= Control diet (Normal diet with no leaf included); T_2= Normal diet mixed with pawpaw leaf; T_3= Subnormal diet mixed pawpaw leaf; T_4= Normal diet separate, pawpaw leaf separate; T_5= Subnormal diet separate, pawpaw leaf separate; T_6= Normal diet mixed with water leaf; T_7= Subnormal diet mixed with water leaf; T_8= Normal diet separate, water leaf separate; T_9= Subnormal diet separate, water leaf separate

Table 6. Effect of waterleaf and pawpaw leaf on haematology of experimental broilers

Parameters	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	SEM
PCV (%)	20.01^{d}	21.93^{b}	24.03^{a}	19.90^{d}	21.02^{c}	17.03^{f}	17.95^{e}	17.00^{f}	18.08^{e}	3.78
Hb (g/100ml)	6.70^{bc}	7.30^{b}	7.98^{a}	6.73^{bc}	7.08^{b}	6.00^{d}	6.17^{cd}	6.01^{d}	6.12^{cd}	1.28
RBC ($10^6/mm^3$)	2.47^{d}	3.43^{c}	4.05^{b}	2.47^{d}	4.64^{a}	1.62^{g}	1.85^{e}	1.61^{g}	1.78^{f}	0.51
WBC ($X10^3/mm^3$)	27.85^{b}	25.70^{c}	18.59^{e}	27.88^{b}	16.85^{f}	22.03^{d}	31.20^{a}	22.03^{d}	31.12^{a}	4.7
MCV(Fl)	81.00^{d}	63.8^{e}	59.30^{f}	80.80^{d}	45.30^{g}	105.20^{a}	97.20^{c}	105.90^{a}	101.70^{b}	15.82
MCHC (%)	33.48^{cd}	32.37^{e}	33.22^{d}	33.83^{b}	33.68^{bc}	35.25^{a}	33.89^{b}	35.34^{a}	33.85^{b}	6.52
MCH (Pg/cell)	27.18^{d}	20.68^{e}	19.70^{f}	27.23^{d}	15.24^{g}	37.00^{a}	33.52^{c}	37.41^{a}	34.43^{b}	5.39

a, b, c Means with different superscripts on the same row differ significantly (p = 0.05), PCV= Packed cell volume; Hb= Haemoglobin; RBC= Red blood cell; WBC= White blood cell, T_1= Control diet (Normal diet with no leaf included); T_2= Normal diet mixed with pawpaw leaf; T_3= Subnormal diet mixed pawpaw leaf; T_4= Normal diet separate, pawpaw leaf separate; T_5= Subnormal diet separate, pawpaw leaf separate; T_6= Normal diet mixed with water leaf; T_7= Subnormal diet mixed with water leaf; T_8= Normal diet separate, water leaf separate; T_9= Subnormal diet separate, water leaf separate

4.2 Haematological Indices

Blood represents a means of assessing clinical and nutritional health status of animals in feeding trial and the haematological parameters and most commonly used haematological indices in nutritional studies include PCV, RBC, HBC, MCHC, MCV and clotting time [23,24]. Highest values of packed cell volume, red blood cell, and haemoglobin were recorded in all the pawpaw leaf-included treatments and the findings are similar to the report by Nodu et al. [25]. This is likely attributed to the chemical and nutritional components found in pawpaw leaves. Pawpaw leaf is reported to be rich in minerals which are useful in the coagulation of blood, proper functioning of the heart and nervous system, useful as both antiseptic and a tonic or blood purifier, as well as the normal contraction of muscles [26]. The pawpaw leaf had better impact on the haematological parameters of the experimental birds than water leaf. The contribution of pawpaw leaf to the pigmentation of the blood was noticeable through recorded highest RBC, Hb and PCV in the pawpaw leaf-supplemented treatments. *C. papaya*has been reported to increase in platelet counts in the patients of dengue [27,28].

5. CONCLUSION

This study concludes that the contribution of pawpaw leaf to the pigmentation of the blood was noticeable through recorded highest RBC, Hb and PCV in the pawpaw leaf-supplemented treatments. Sundried pawpaw leaf meal may however contain some secondary metabolites which raised the white blood cell counts of the experimental animals, which may be investigated through further studies.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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