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Nutrient Composition, Carcass and Organ Characteristics of Broiler Chickens Fed Diets Supplemented with Some Medicinal Composite Plant Leaves

By

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Abstract

Two experiments were conducted to determine the nutrient composition, carcass and organ characteristics of broiler chickens fed diets supplemented with some medicinal composite plant leaves. The medicinal plant leaves used for the experiment were Neem leaf meal (NLM), Pawpaw leaf meal (PLM), Scent leaf meal (SLM) and Bitter leaf meal (BLM). The birds were assigned to 6 treatment diets supplemented with the leaf meals and prepared as follows; T1 (0g/kg NLM+PLM+SLM+BLM), T2 (2.50g/kg NLM+PLM+SLM+BLM), T3 (5.00g/kg NLM+PLM+SLM+BLM), T4 (7.50g/kg NLM+PLM+SLM+BLM), T5 (10.00g/kg NLM+PLM+SLM+BLM) and T6 (12.50g/kg NLM+PLM+SLM+BLM) in a completely Randomized Design. Data collected were subjected to Analysis of Variance. Results of proximate, energy and phytochemical composition of experimental diet containing medicinal plant composite leaf meals revealed that the DM content of the treatments ranged from 91.23% - 91.37%, ash, 4.27% - 4.29%; CP, 21.60% - 22.25%; EE, 3.40% - 3.49%; CF, 4.13% - 4.96%; NFE, 57.03% - 57.95% and ME, 2880.07kcal/kg – 2903.82kcal/kg. Ash content also decreases with increase in inclusion levels. With T1 having the highest ash content (4.29%) and T6, the lowest (4.25). The result of proximate and energy composition of experimental diets fed broiler chickens with medicinal plant leaf extracts revealed the DM content of the diet ranged from 91.28% in T6 – 91.40% in T1 and T3, respectively. The ash content of the diets ranged from 4.22% in T6 – 4.30% in T1, T2 and T5, respectively. The CP of the diets was 21.60% and the EE ranged from 3.39% in T4 – 3.41% in T1 and T3. The CF was between 4.13% – 4.15%. The NFE ranged from 57.93% in T2 - 57.96% in T1 while the ME was between 2897.59kcal/kg – 2899.52kcal/kg. The proximate and energy composition of test ingredients revealed that the crude protein content of neem leaf (11.20%) was higher when compared to the protein contents of other test ingredients. The crude fibre of the four investigated leaves ranged from 8.26% in neem leaf – 8.98% in bitter leaf. The ether extract ranged from 0.09% in scent leaf-0.15% in pawpaw leaf, NFE ranged from 53.89% in bitter leaf-56.70% in pawpaw leaf and scent leaf, respectively. The ME ranged from 2101.81kcal/kg in bitter leaf-2319.65% in neem leaf. Bitter leaf contained higher ash content (15.11%), followed by neem leaf (12.31%) when compared to pawpaw leaf (10.65%) and scent leaf (9.81%). Addition of composite leaf meal in the broiler diet does not have any negative effects on the carcass characteristics of the broiler chicken as there were no significant effect of the leaf meal on carcass parameters. The medicinal plant extracts have a significance difference (P<0.05) on shank, breast and back cut of the birds. No significant difference (P>0.05) were seen in the organ proportions of the birds administered the plant extracts except the kidney which was larger in birds fed T1 and T2 but statistically similar to birds fed T3, T4 and T5.

Keywords: *Carcass, Organ, Broiler Chickens, Fed Diets, Medicinal, Plant Leaves*

INTRODUCTION

The global increase in the population of pathogenic microorganisms of livestock particularly poultry, has resulted in a decrease in animal protein production and availability, particularly in developing countries such as Nigeria (Odoh and Bratte, 2015). As a result of this, concerted efforts are required to search for ways of ameliorating this problem in order to bridge the deficit in animal protein intake (Rahman *et al.*, 2014). Broiler output has increased rapidly during the last two decades, and feed accounts for around 80% of total production expenditures.

For effective feed utilization, reduced production cost and higher economic gain, feed additives are used. These chemicals have become a popular choice for a variety of

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poultry production applications. Antibiotic growth promoters (AGPs) have been utilized for approximately 50 years to improve growth performance. They have been widely used to prevent and treat poultry illnesses, as well as to boost meat and egg production. Antibiotic use is currently restricted, and their use in the livestock and poultry industries has been banned in many countries due to changes in natural gut macrobiotics and drug resistance in animals and humans. The growing interest in the utilization of medicinal plants as alternative feed additives to antibiotics growth promoters (AGPs) in poultry diets following their ban by many countries of the world, has led to the evaluation and use of phytochemicals as feed additives. Various phytochemical individually have been to improve performance of broiler chickens.

Recently, plant based feed additives also recognized as phytogenics have been advocated to be included in broiler chickens feeds as growth promoting feed additives, because of their abundance in our natural environment and the fact that they do not have residual effect (Benjamin, Anucha *et al.,* 2016). Phytogenics can improve feed consumption, feed conversion, feed digestibility and weight gain of broiler chickens as stated by Akande et al. (2017). Bitter leaf (*Vernonia amygdalina*) is a valuable plant with antimicrobial activity that is widespread in East and West Africa (Ahmad, 2015). In Nigeria, it is a common vegetable leaf used to make soup, particularly in the South Eastern region. Bitter leaf contains several chemical components, including steroid glycoside and vernonioside B1, which have powerful anti-parasitic, anti-tumor, and bactericidal activities. Durunna et al. (2011) reported that bitter leaf contained 15.67 % crude protein, 11.53 % crude fibre and 6.95 % ether extract. It has been reported that bitter leaf meal used in poultry production was able to increase feed conversion efficiency of broiler birds without affecting their haematological profile (Aliero *et al.,* 2018). Bitter leaf may provide anti-oxidant benefits (Ani *et al.,* 2012).

Scent leaf (*Ocimum gratissimum*), the African variety of basil (*O. cimum*), is widely grown as a perennial herb in tropical Africa, South East Asia, India and Hawaii. It is highly recognized worldwide due to its versatile nutritional, anaesthetic, and medicinal uses (Abd El-Latif *et al.,* 2012). Benjamin, Anucha and Hugbo (2016) noted that scent leaf is rich in alkaloids, tannins, phytates, flavonoids, oligosaccharides, terpenoids, thymol and saponin, with tolerable cyanogenic content. The proximate composition as reported by Benjamin, Anucha and Hugbo (2016) shows a crude protein of 4.7%, 10.8% crude fibre, and ash content of 12.24%. The essential oil (eugenol) present in scent leaf possesses antimicrobial activities against pathogenic strains of gram-negative and gram-positive bacteria and pathogenic fungus (Botsoglou *et al.,* 2013). Moreover, the leaves of *Occimum gratissimum* can be utilized fresh or dried to serve as flavoring or spices, apart from its medical use. This is because of the adequate level of vitamin, amino acid and mineral. The low levels of phytates, oxalate, tannins, and saponins in the fresh leaves make them safe for ingestion and rarely pose a major hazard even when ingested in large quantities, which is a unique feature of the plant (Ubua et al., 2019). Fresh neem leaves contained 64.0% moisture, 15.5% crude protein, 12.7% crude fiber, 4.2% ether extract, 11.2% ash, 56.5% nitrogen-free extract, 26.5% calcium, and 0.24% phosphorus (Mbata and Asaikia, 2015).

Neem leaves were found to cause nutrient imbalance and improper metabolism in layer birds due to antinutritional factors and toxic elements used as feeding ingredients (Abd El-Latif et al., 2012). Nevertheless, Neem plant contains bioactive compound such as cyclic trisulphide, mamoodin, margolon and other bio actives that are bactericidal, anti-inflammatory and immune modulatory (Nweze, 2020). Neem tree, one of the most researched trees in the world, has gained global prominence due to its wide range of medicinal properties, including antibacterial, antiviral, antifungal, antiprotozoal, hepatoprotective, and other properties that have no adverse effects (Mahejabin et al., 2015).

Pawpaw (*Carica papaya*) is a plant endemic to Tropical America. It is known as “Okwuru bekee” in Igboland, “Gonda” in Hausa, and “Ibepe” in Yoruba-speaking regions of Nigeria. It is popular in the tropics and subtropics due to its ease of cultivation, rapid growth, high economic returns, and adaptability to a wide range of soils and climates (Akande et al., 2017). Cultivated pawpaw is an unbranched, dioecious plant, albeit hermaphroditic sex can occur (Baker & Silverton, 2015). However, pawpaw has been naturalized in a number of tropical and subtropical areas (Better Life Health Channel, 2019). Pawpaw leaf meal includes four recognized proteolytic enzymes (Papain, Chymopapain A and B, and Papaya Peptidase) and is high in vitamins (A, B, B_2, and C) and minerals (Ca, P, and Fe). It is also low in sodium and fat, and has almost no starch.

Due to unpleasant side effects occurring from the use of synthetic forms of growth accelerators, consideration should be given to alternative natural supplements such as *Vernonia amygdalina* (bitter leaf), *Ocimum gratissimum* (scent leaf), *Azadirachta indica* (Neem leaf) and *Carica papaya* (Pawpaw leaf). Earlier researches have recounted that bitter leaf (Durani *et al.,* 2018), *Moringa oleifera* (Fanimmo *et al.,* 2015), Rosemary leaves (Doyle, 2017) and scent leaf (Esonu, 2016), are popular medicinal plants for human drug therapy in Nigeria (Bhowmik, 2016). They are widely used because of their bioactive properties in fighting bacterial diseases, anti-inflammatory and immune modulatory agents. However, for the purpose of this study, the researcher anchored it on combination of *Vernonia amygdalina* (bitter leaf), *Ocimum gratissimum* (scent leaf), *Azadirachta indica* (Neem leaf) and *Carica papaya* (Pawpaw leaf) medicinal plants on broiler chicken diets enhancement. Hence, this study was carried out to determine the nutrient composition of these medicinal plants and their effect on carcass and organ characteristics of broiler chickens fed diets supplemented with some medicinal composite plant leaves.

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MATERIALS AND METHODS

Study Area

The experiment was carried out at the poultry farm of Sumed livestock farms, Owaza, Ukwa west L.G. A of Abia State, Nigeria. The area falls within the tropical rain forest zone with an annual average rainfall of 2180mm, temperature of about 26^{0}C, with relative humidity of 71%, depending on season (www.manpower.com.ng, 2023).

Source of Test Ingredients and Feedstuff

Vernonia amygdalina (bitter leaf), *Ocimum gratissimum* (scent leaf), *Azadirachta indica* (Neem leaf), and *Carica papaya* (Pawpaw leaf) were purchased from Oyibo Market in Rivers State. These medicinal plants were washed separately to remove debris. They were subjected to drying at room temperature, after which it was grinded into meal using an attrition mill separately. The respective products were stored in an airtight container and used throughout the period of the experiment. The feedstuffs were purchased from Jocan Store, Umuahia.

Experiment 1: Preliminary

Experiment II: Effect of Medicinal Composite Leaf Meal on Growth Performance of Broiler Chickens Experiment III: Effects of Medicinal Plant Leaves Extract of *Vernonia amygdalina* (Bitter Leaf), *Ocimum gratissimum* (Scent Leaf), *Azadirachta indica* (Neem Leaf), and *Carica papaya* (Pawpaw Leaf) on Broiler Chicken

Experimental diets

Six experimental straight line broiler diets were formulated such that treatment 1 contained no medicinal plant leaf (control) while treatment 2, 3, 4, 5 and 6 contained step-wise addition of medicial plant leaves at the following inclusion order, 2.50 g, 5.0 g, 7.50 g, 10.0 g and 12.50 g respectively of each of the four (4) medicinal plant leaves (*Vernonia amygdalina* (bitter leaf), *Ocimum gratissimum* (scent leaf), *Azadirachta indica* (Neem leaf), and *Carica papaya* (Pawpaw leaf). The composition of the diets, medicinal plant additives and calculated chemical analyses are shown in Table 1.

Table 1: Nutrient Composition of Straight Line Broiler Diet Containing Graded Levels of *Vernonia amygdalina* (bitter leaf), *Ocimum gratissimum* (Scent leaf), *Azadirachta indica* (Neem leaf), and *Carica papaya* (Pawpaw leaf)

Ingredients (%)	T_1 (control)	T_2	T_3	T_4	T_5	T_6
Maize	50.00	50.00	50.00	50.00	50.00	50.00
Soya bean	20.00	20.00	20.00	20.00	20.00	20.00
G.N.C	10.00	10.00	10.00	10.00	10.00	10.00
P.K.C	7.00	7.00	7.00	7.00	7.00	7.00
Wheat offal	5.50	5.50	5.50	5.50	5.50	5.50
Fish meal	4.00	4.00	4.00	4.00	4.00	4.00
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Salt (Nacl)	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Medicinal Plant Leaf	0.00	1.00	2.00	3.00	4.00	5.00
Calculated Chemical Analyses						
ME/Kcal	2889	2889	2889	2889	2889	2889
Protein (%)	22.31	22.31	22.31	22.31	22.31	22.31
Fat (%)	4.30	4.30	4.30	4.30	4.30	4.30
Fibre (%)	4.70	4.70	4.70	4.70	4.70	4.70
Calcium (%)	1.23	1.23	1.23	1.23	1.23	1.23
Phosphorus (%)	0.61	0.61	0.61	0.61	0.61	0.61

Experimental birds and management

A total of 180 day-old broiler chicks were procured from Agrited farms, Ibadan for this study. The chicks were brooded together with a charcoal pot and electric bulbs in a brooding

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pen for the first seven days, thereafter they were randomly divided into 6 groups of 30 birds each. Each group was further replicated into 3 replicates with 10 birds per replicate. The birds were raised in floor pens with wood shadings as litter material. Each group contained feeders and drinkers for the provision of *ad libitum* access to feed and water respectively for the six weeks period of the experiment. Birds were vaccinated against New Castle disease using Lasota vaccine at 7^{th} and 21^{st} days of life, Infectious Bursal disease using Gumbro vaccine at 14^{th} and 28^{th} days of life. Coccidiostats were also administered to the birds during the experiments.

The infusion levels of the leaves extracts were designated as follow:

Treatment 1 (T_1) without leaf extract, treatment 2 (T_2) contained 25 ml of each of the leaves extracts in 2 litres of water. Treatment 3 (T_3) contained 50 ml of each of the leaves extracts in 2 litres of water, treatment 4 (T_4) contained 75 ml of each of the leaves extracts in 2 litres of water, treatment 5 (T_5) contained 100 ml of each of the leaves extracts in 2 litres of water while treatment 6 (T_6) contained 125 ml of each of the leaves extracts in 2 litres of water. Feed and water infusion of the leaf extracts were given adibitum. Other routine management practices such as vaccination and coccidiostat medication were applied during the period of the experiment. The diet is shown in Table 2.

Table 2: Experimental Diets Fed to Broiler Chickens with Medicinal Plant Leaf Extracts

Ingredients (%)	**T_1 (control)**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**
Maize	50.00	50.00	50.00	50.00	50.00	50.00
Soya bean	20.00	20.00	20.00	20.00	20.00	20.00
G.N.C	10.00	10.00	10.00	10.00	10.00	10.00
P.K.C	7.00	7.00	7.00	7.00	7.00	7.00
Wheat offal	5.50	5.50	5.50	5.50	5.50	5.50
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Salt (Nacl)	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Data collection

Evaluation of carcass and organ characteristics

At the end of the experiment two and three (42 days), 3 birds per replicate with similar body weight were selected from the treatment groups, weighed and slaughtered by severing jugular vein, they were thoroughly bled and scalded by dipping in warm water with temperature of 50-55 ^oC before defeathering. The internal organs were removed. After evisceration, warm carcass was weighed immediately to determine the carcass yield. The weights of the carcass cuts; breast, thigh, drumstick, backcut and wings were recorded individually. These weights of the cut parts were expressed as a percentage of dressed weight, while the weight of organs; gizzard, liver, spleen, heart and proventriculus were recorded and expressed as a percentage of live weight.

Chemical and Data Analysis

The experiments were laid out in a completely randomized design (CRD). All data analyses were done using 1BM^R SPSS version 2022. The data were subjected to analysis of variance (ANOVA). Where treatment means are significant separation of means were done using the Duncan's Multiple Range Test (Duncan, 1955) at 5% level of significance. Chemical Analysis of *Vernonia amygdalina* (bitter leaf), *Ocimum gratissimum* (scent leaf), *Azadirachta indica* (Neem leaf), and *Carica papaya* (pawpaw leaf) was determined according to the methods of AOAC (2015). The proximate analysis of the test ingredients, *Vernonia amygdalina* (bitter leaf), *Ocimum gratissimum* (scent leaf), *Azadirachta indica* (Neem leaf) and *Carica papaya* (Pawpaw lea) leaf meals and the six experimental Diets were determined as well as the anti-nutritional factors like saponin, tannin, flavonoids, alkaloids and phenol in *Vernonia amygdalina* (bitter leaf), *Ocimum gratissimum* (scent leaf), *Azadirachta indica* (Neem leaf) and *Carica papaya* (Pawpaw lea) leaf meals using the techniques of the Association of Official Analytical Chemist (AOAC, 2015).

Experimental Design

The design of the experiment used was Completely Randomized Design (C.R.D) and the model shown below;

$X_{ij} = \mu + T_j + e_{ij}$

X_{ij} = Response variables of the observations on the jth treatment.

μ = Mean of the common effects on the whole experiment.

T_j = Effect of the jth treatment

e_{ij} = Random error present in the ith observation and the jth treatment.

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RESULTS AND DISCUSSION

Experiment I

Proximate, Energy and Phytochemical Composition of Experimental Diets Containing Medicinal Plant Leaf Meals

Table 3 presents the proximate, energy and phytochemical composition of the medicinal leaf meal.

Table 3: Proximate, Energy and Phytochemical Composition of Experimental Diet Containing Medicinal Plant Composite Leaf Meals

Parameters	T1	T2	T3	T4	T5	T6
DM (%)	91.37	91.33	91.31	91.26	91.23	91.19
Moisture (%)	8.63	8.67	8.69	8.74	8.77	8.81
CP (%)	21.60	21.75	21.80	21.95	22.15	22.25
EE (%)	3.40	3.45	3.45	3.47	3.49	3.52
CF (%)	4.13	4.26	4.38	4.54	4.72	4.96
Ash (%)	4.29	4.28	4.28	4.27	4.27	4.25
NFE (%)	57.95	57.55	57.40	57.03	56.60	56.24
ME (kcal/kg)	2897.92	2900.35	2900.64	2901.85	2903.82	2880.07

DM= Dry matter, CP= Crude protein, EE= Ether extract, CF= Crude fibre, NFE= Nitrogen free extract, ME= Metabolizable energy

In Table 3, the DM content of the treatments ranged from 91.23% - 91.37%, ash, 4.27% - 4.29%; CP, 21.60% - 22.25%; EE, 3.40% - 3.49%; CF, 4.13% - 4.96%; NFE, 57.03% - 57.95% and ME, 2880.07kcal/kg – 2903.82kcal/kg. The result revealed that the DM content of the diets reduces as the levels of inclusion increases, with T1 having the highest DM content of 91.37% and T6, the lowest (91.19%). Ash content also decreases with increase in inclusion levels. With T1 having the highest ash content (4.29%) and T6, the lowest (4.25). CP, EE, CF and ME increases across the treatment groups as the level of inclusion increases, with T1 having the least means and T6, the highest. The NFE of the diets were seen to be decreasing as the inclusion level increases.

According to PCAARRD (2000), the recommended moisture content of stored feedstuff should be less than 12% to prevent spoilage. Moreover, Mutayoba *et al.* (2011) and Hamito (2010) reported that feedstuff with a dry matter content of less than 85% is not recommended since mold growth will degrade feed quality, especially in tropical areas with high temperatures and relative humidity. The high proteins in the diets are important in the body for the production of hormones, enzymes and blood plasma. They are immune boosters and can help in cell division as well as in growth (Bouttwell, 1998).

The low crude fibre content in diets indicates its poor sources of lipids. Dietary fibre helps in digestion and functions the body to slow down the rate of glucose absorption into the blood stream thereby reducing the risk of hyperglycemia, the levels of plasma cholesterol and hence preventing colon cancer and cardiovascular diseases (Ilodibia *et al.*, 2014). Ash present in food explains largely the amount of minerals found in food or feed substance. The relatively high ash content in the in treatments is an indication of high minerals preserved in it (Awe *et al.*, 2018).

Proximate and Energy Composition of Experimental Diets Fed broiler Chickens with Medicinal Plant Leaf Extracts

Tables 4 present the proximate and energy composition of the medicinal plant leaves extract.

Table 4: Proximate and Energy Composition of Experimental Diets Fed Broiler Chickens with Medicinal Plant Leaf Extracts

Parameters	T1	T2	T3	T4	T5	T6
DM (%)	91.37	91.40	91.38	91.40	91.37	91.37
CP (%)	21.60	21.60	21.60	21.60	21.60	21.60
Ash (%)	4.29	4.30	4.30	4.28	4.29	4.30
EE (%)	3.40	3.41	3.40	3.41	3.39	3.40
CF (%)	4.13	4.13	4.15	4.14	4.15	4.13
NFE (%)	57.95	57.96	57.93	57.97	57.94	57.94
ME (kcal/kg)	2897.92	2898.90	2897.69	2899.52	2897.59	2897.63

DM= Dry matter, CP= Crude protein, EE= Ether extract, CF= Crude fibre, NFE= Nitrogen free extract, ME= Metabolizable energy

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In Table 4, the DM content of the diet ranged from 91.28% in T6 – 91.40% in T1 and T3, respectively. The ash content of the diets ranged from 4.22% in T6 – 4.30% in T1, T2 and T5, respectively. The CP of the diets was 21.60% and the EE ranged from 3.39% in T4 – 3.41% in T1 and T3. The CF was between 4.13% – 4.15%. The NFE ranged from 57.93% in T2 - 57.96% in T1 while the ME was between 2897.59kcal/kg – 2899.52kcal/kg.

The results showed no define pattern in the mean percent of the parameters across the treatment groups. The dry matter content was also within the recommended range of >85% recommended by Mutayoba *et al.* (2011) and Hamito (2010) for longer shelf life. Protein content analysis is basic for the characterization of food type (Jones, 1987). Adamu *et al.* (2017) in their study with *Aspillia Kotschyi* plant extract proximate analysis showed that, it contains crude protein (10.39%), crude fibre (9.06%), ash (4.03%) and free nitrogen (70.19%). Except the crude protein and ash, the values of crude fibre and NFE were higher than the values obtained in this study. The medicinal plant extract showed higher crude protein content, which is beneficial as protein contain amino acids utilized by the cells of the body to synthesize all the numerous proteins required for the function of the cell and also to furnish energy (Robinson, 1978 as cited by Adamu *et al.,* 2017). From the results also one can see that the fibre content in the plant extracts compared to the value obtained by Adamu, *et al.* (2017) as higher crude fibre had beneficial effect since it had been reported that food fibre aids absorption of trace elements in the gut and reduce absorption of cholesterol (Adamu, *et al.,* 2017). Crude fibre is also very essential for the digestion of food materials in the food canal of animals (Manalisha *et al.,* 2013). Also from the results Ash content of 4.28-4.30% was obtained. Ash in food contributes for residue remaining after all the moisture has been removed as well as organic material (fat, protein, carbohydrates, vitamins, organic acids etc) have been incinerated at a temperature of about 500^{o}C. Ash content is generally taken to be a measure of mineral content of original food (Onwuka, 2005).

Proximate and Energy Composition of Test Ingredients

The proximate and energy composition of test ingredients is presented in Tables 5.

Table 5: Proximate and Energy Composition of Test Ingredients

Parameters	Bitter leaf	Pawpaw leaf	Scent leaf	Neem leaf
DM (%)	83.61	85.32	83.05	86.66
CP (%)	5.50	9.40	7.85	11.20
EE (%)	0.13	0.15	0.09	0.12
CF (%)	8.98	8.42	8.60	8.26
Ash (%)	15.11	10.65	9.81	12.31
NFE (%)	53.89	56.70	56.70	54.77
ME (kcal/kg)	2101.81	2315.93	2259.05	2319.65

DM= Dry matter, CP= Crude protein, EE= Ether extract, CF= Crude fibre, NFE= Nitrogen free extract, ME= Metabolizable energy

The crude protein content of neem leaf (11.20%) was higher when compared to the protein contents of other test ingredients. The crude fibre of the four investigated leaves ranged from 8.26% in neem leaf – 8.98% in bitter leaf. The crude fibre content of the leaf meals fell within the reported values (8.50 – 20.90%) for some Nigerian vegetables (Isong and Idiong, 1997). Dietary fibre helps to lower serum cholesterol level, risk of coronary heart diseases, constipation and diabetes (Ishida *et al.*, 2000). The ether extract ranged from 0.09% in scent leaf-0.15% in pawpaw leaf, NFE ranged from 53.89% in bitter leaf-56.70% in pawpaw leaf and scent leaf, respectively. The ME ranged from 2101.81kcal/kg in bitter leaf-2319.65% in neem leaf. Bitter leaf contained higher ash content (15.11%), followed by neem leaf (12.31%) when compared to pawpaw leaf (10.65%) and scent leaf (9.81%). Ash content is of significant importance in foods as they account for the mineral constituents (Edema and Okiemen, 2000).

According to PCAARRD (2000), the recommended MC of stored feedstuff must be less than 12% to prevent spoilage, this values obtained for MC in this study were higher than the referenced value. . Moreover, Mutayoba *et al.* (2011) and Hamito (2010) reported that feedstuff with a dry matter content of less than 85% is not recommended since mold growth will degrade feed quality, especially in tropical areas with high temperatures and relative humidity. The crude protein content of the PLM used in the current study was lower than the analysis reported by Onyimonyi and Ernest (2009) and Ebenebe *et al*. (2011) who reported that PLM has 30.12% and 28.20% CP, respectively. Moreover, the CP content of PLM is lower than the CP analysis of papaya seed meal reported by Bolu *et al.* (2009) with 30.08%. This CP analysis of neem plant leaf meal is lower compared to *Azadirachta indica* leaf meal with 24.06% CP (Onyimonyi and Ernest, 2009).

Proteins are important in the body for the production of hormones, enzymes and blood plasma. They are immune boosters and can help in cell division as well as in growth (Bouttwell, 1998). The high moisture contents showed that the leaves are more prone to deterioration since foods with

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high moisture are prone to deterioration (Bouttwell, 1998). Moisture dissolves other substances and carries nutrients throughout the systems leading to effective performance of the organs (Okeke and Ekekwa, 2006). Crude Fibre was 7.21 ± 0.01% in *V. amygdalina* and 6.00 ± 0.03% in *O. gratissimum* was reported by Mgbemena and Amako (2020), lower than the values obtained in this study. Generally dietary fibre helps in digestion and functions the body to slow down the rate of glucose absorption into the blood stream thereby reducing the risk of hyperglycemia, the levels of plasma choresterol and hence preventing colon cancer and cardiovascular diseases (Ilodibia *et al.*, 2014). The high crude fibre in the test ingredients makes them a good source of lipids.

Akanmu and Adeyemo (2012) reported that Neem leaf proximate results showed a dry matter, crude protein, crude fibre and ether extract of 92.34, 23.50, 13.40 and 7.1% respectively, Pawpaw leaf gave a lower dry matter content of 86.14%, higher crude protein (27.2%), lower crude fibre (6.0%) and ether extract of 2.4 %. These values were higher than the values reported in this study. It has been reported that neem plant is one of the plant species that do not shed leaves all year round, in this study fresh and blooming leaves from young neem plants were harvested and this is evidenced by the high crude protein, low crude fibre and high ether extract recorded in this study which was in line with the observations of Akanmu and Adeyemo (2012). The proximate composition of paw paw leaf meal showed that the crude protein in this study was higher than the value reported by Onyimonyi *et al*. (2009). The high moisture content found in leaf meals further suggests their capacity to supplying the necessary active ingredients like papain and chymopapain as observed by Akanmu and Adeyemo (2012). Adewole (2014) shows that the moisture content of *Ocimum Gratissimum* was 10.30±0.01%, high moisture content is an index of spoilage, the protein content was (16.51 ±0.40), the high protein content buttressed the use of the plant leaf as flavor soup and spice meat, and also the crude fibre was 9.07±0.27%, which was slightly higher than the values obtained in this study.

Obikaonu (2012) reported that neem leaf meal contained 18.10% crude protein, 15.56% crude fibre, 2.50% ether extract, 5.26% ash and 58.22% nitrogen free extract. They observed that the neem leaf meal displayed same characteristics as leaf meals from other tropical browse plants – high crude fibre and moderate crude protein content as reported for *Jacaranda mimosifolia* (Okorie, 2006) and for *Microdesmis puberula* (Esonu *et al.*, 2002). With relatively high crude fibre content, (15.56%), the metabolizable energy must be low even though its gross energy content was high (4.16 Kcal/g). Ampode (2019) reported the chemical composition of papaya leaf meal (PLM) to contained 10.72% moisture content (MC), 89.28% dry matter (DM) and 32.13% crude protein (CP). Akinola *et al* (2021) shows the result of the proximate analysis scent leaves to be; 9.98% CF, 2.45%ash and 16.69% CP.

Mgbemena and Amako (2020) showed the result of proximate analysis of *V. amygdalina* and *O. gratissimum* leaves extracts, crude protein was 35.37 ± 0.11% in *V. amygdalina* and 22.20 ± 0.02% in O.gratissimum. The high CP may be due to the processing method, as the once used in this study was leaf meal. Eating of *V. amygdalina* leaves are encouraged because of its high protein content as stated by Mgbemena and Amako (2020). Moisture content was 12.28 ± 0.02% in *V. amygdalina* and 10.80 ± 0.01% *in O. gratissimum*. *O. gratissimum* as reported by Mgbemena and Amako (2020), which was lower than the values obtained in this study. Mgbemena and Amako (2020) also reported the ash contents of 5.87 ± 0.03% in *V. amygdalina* and 3.4 ± 0.03 % in *O. gratissimum.* Ash content obtained in this study was higher. Higher ash content in the leaves of *V. amygdalina* is an indication of high minerals preserved in it (Awe *et al.*, 2018).

Phytochemical Composition of Bitter Leaf, Pawpaw Leaf, Scent Leaf and Neem Leaf

Tables 6 present the phytochemical analysis of the leaves of the test ingredients.

Table 6: Phytochemical Composition of Bitter Leaf, Pawpaw Leaf, Scent Leaf and Neem Leaf

Parameters	Bitter leaf	Pawpaw leaf	Scent leaf	Neem leaf
Saponin (% of DM)	4.88	3.33	5.11	3.55
Tannin (% of DM)	2.66	2.80	3.20	3.10
Flavonoids (% of DM)	2.04	1.50	2.50	4.30
Alkaloids (% of DM)	2.67	3.10	4.80	3.55
Phenol (% of DM)	2.44	2.10	2.33	3.20

The phytochemical analysis in percentages shows that saponin ranged from 3.33% in pawpaw leaf -5.11% in scent leaf. Tannin ranged from 2.66% in bitter leaf- 3.20% in scent leaf, flavonoid ranged from 1.50% in pawpaw leaf-4.30% in neem leaf. Alkaloid was 2.67% in bitter leaf-4.80% in scent leaf, while phenol ranged from 2.10%-3.20% in neem leaf. Mgbemena and Amako (2020) in their study on the qualitative phytochemical analysis of *Ocimum gratissimum* and *Vernonia amygdalina* revealed the presence of saponin, tannin, flavonoids, steroids, terpenoids and alkaloids. The quantitative phytochemical analysis revealed the presence of all the secondary metabolites in varied quantities in both leaves extracts. Saponin was the highest among the phytochemicals determined in both leaves extracts with the

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value 5.71 ± 0.12 mg/g in *V. amygdalina* and 3.52±0.01 mg/g in *O. gratissimum*, this is followed by terpenoids with 3.40±0.11 mg/g in *O. gratissimum*, tannin 4.90 ±0.23 mg/g in *V. amygdalina* and 2.48 ± 0.03 mg/g in *O. gratissimum*, flavonoids 4.60± 0.01 mg/g in *V. amygdalina* and 2.00± 0.03 mg/g in *O. gratissimum*, alkaloids 3.16 ± 0.16 mg/g in *V. amygdalina* and 2.00 ± 0.02 mg/g in *O. gratissimum*, steroids 0.50 ± 0.02 mg/g in *V. amygdalina* and 0.48 ± 0.0 2 mg/g in *O. gratissimum*.

Akinola *et al*. (2021) reported that Scent leaf has significantly high alkaloids (12.17%), tannins (10.25 mg GAE/g), and saponins (9.65 mg/100g) contents when compared to bay leaf, which has alkaloids (2.45%), tannins (5.31 mg GAE/g), and saponins (4.47 mg/100g) and celery leaf, which has alkaloids (4.26%), tannins (6.88 mg GAE/g), and saponins (0.20 mg/100g). Ogundele *et al*. (2022) reported the values obtained for alkaloids to range from 1.473 to 1.621. The higher value was obtained in the mature leaf (1.621 g/100g) while the lower value (1.473 g/100g) was obtained in the young leaf. Alkaloid value of 2.04 had been reported by Singhal and Kulkarni (2007) and 4.60 reported by Ali *et al.* (2020) for leaves of *V. amygdalina*. The authors reported the values obtained for phenol to range from 0.397 to 0.642. The higher value was obtained in the mature leaf (0.642 g/100g) while the lower value (0.397 g/100g) was obtained in the young leaf. Phenol content of 0.76 g/100g has been obtained by Teye *et al.* (2019) for air dried *V. amygdalina* leaf and 1.64 g/100g obtained by Teye *et al.* (2019) for oven dried *V. amygdalina* leaf. 0.34 and 0.35 phenol content has been reported by Ojewuyi *et al.* (2014) for mature and young leaves of *P. longifolia* respectively.

Phenolic compounds have been recorded to contain antioxidant property which inhibits oxidative damage of cell owing to the existent of free radical scavengers. Phenolic compounds reduce the danger of heart diseases and provide anti-inflammatory action due to their capacity to nullify or neutralize free radicals as reported by Okechukwu *et al.* (2015). Ogundele *et al*. (2022) also reported that saponin ranged from 0.064 g/100g to 0.072 g/100g, they observed that saponin was found to be higher in mature leaf 0.072 g/100g than in young 0.064 g/100g. Saponin content of 2.70 g/100g has been reported by Ali *et al.* (2020) 0.21 g/100g reported by Okoli *et al.* (2021). Saponin is known to possess both anti-inflammatory and antimicrobial activities (Hassan *et al.*, 2012).

Adewole (2014) in his study shows that tree basil has high content of alkaloid (11.43±0.09), phenol (7.50±0.06), tannin (10.90±0.06), flavonoid (8.20±0.06) and saponin (12.87 ±0.19). Alexandra (2016); Udochukwu *et al*. (2015) had reported the abundance of bioactive components in these leaves. The presence of these metabolites showed the great potentials of these leaves vegetables as good sources of useful phytomedicines. The presence of saponins in plants is responsible for the various biological benefits like anti-inflammatory, anti- diabetic, anti- HIV and anti-atherosclerosis. It is very effective in maintaining liver function, lowering blood cholesterol, preventing peptic ulcer (Mgbemena and Amako, 2020). Saponin has found to reduce nutrient utilization and conversion efficiency as in ruminants (Kashiwada *et al.*, 2009). The non-sugar part of saponin has direct antioxidant activities which may result in other benefits such as reduced risk of cancer and heart diseases in man (Rhoades, 2009).

Many alkaloids are used as drugs some of which include; nicotine, quinine, caffeine, cocaine and morphine. They have wide range of pharmacological activities such as antimalarial (quinine), anti-asthma (ephedrine), anticancer, analgesics, (morphine), caffeine in tea, coffee stimulate and balance the nervous system (Qui *et al.*, 2004). Alkaloids play an important metabolic roles and development in the system of living organisms. Alkaloids are known for their antimicrobial properties which accounted for its antimicrobial action (Kadiri and Olawoye, 2016). Flavonoids are polyphenolic compounds which contribute to many other colours found in nature. They have been reported to have anti - viral and anti-allergic activities. Flavonoid, quercetin is known for its ability to relieve hay fever, eczema and asthma (Prabhavathi *et al.*, 2016). The antioxidants present in flavonoids may act in synergy with other phytochemicals in the leaves *to* produce the medical benefits inherent in their leaves as stated by Mgbemena and Amako (2020).

Many plants used in traditional medicines worldwide contain some certain level of the phytochemical contents, which can often account for their therapeutic action (Anupam *et al.*, 2018). The results of phytochemical analysis of this study revealed the presence of enough secondary metabolite in leaves.

Experiment II

Carcass Characteristics of Broiler Chickens Fed Medicinal Plant Leaves

Table 7 shows the carcass characteristics of broiler chickens fed medicinal plant leaf meal.

Table 7: Effect of Medicinal Plant Composite Leaf Meal on Carcass Characteristics and pH of Crop and Duodenum of Broiler Chickens

Parameters	T1	T2	T3	T4	T5	T6	SEM
Slaughter weight (g)	3025.00	3025.00	3041.67	3050.00	2966.67	3058.33	17.02
Dress weight (g)	2475.00	2496.67	2486.67	2490.00	2433.33	2505.00	13.16
Dressing percentage (%)	81.81	82.10	81.76	81.97	82.034	81.67	0.08

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Head (%)	2.23	2.29	2.35	2.30	2.25	2.26	0.02
Wings (%)	13.61	13.56	13.42	13.42	13.61	13.56	0.04
Shank (%)	3.21^{b}	3.25^{b}	3.26^{b}	3.35^{ab}	3.29^{ab}	3.43^{a}	0.02
Neck (%)	5.47^{ab}	5.38^{b}	5.72^{a}	5.51^{ab}	5.42^{b}	5.55^{ab}	0.04
Drum stick (%)	15.59	15.49	15.63	15.62	15.53	15.68	0.03
Thigh (%)	17.57	17.70	17.62	17.55	17.72	17.69	0.03
Breast (%)	24.17	24.77	24.37	24.52	24.93	24.07	0.14
Back cut (%)	23.55	23.40	23.43	23.53	23.34	23.60	0.07
Ph							
Proventriculus	5.86	6.15	5.88	5.92	6.12	6.08	
Crop	5.32	5.42	5.38	5.45	5.40	5.36	

$^{a,\ b}$ means for each parameters in a row with different superscripts are significantly different (P<0.05); SEM = Standard error of the mean, DWt - dress weight

Significant difference (P<0.05) was observed in the mean shank and neck weight. Live weight, dress weight, dressing percentage, head, wings, drum stick, thigh, breast and back cut, were not significantly influenced (P>0.05) by the dietary treatments. Birds fed T6 was significantly higher (P<0.05) in the mean shank percentage (3.43%) but it was not significantly different (P>0.05) from the mean shank percentage of T4 (3.35%) and T5 (3.29%). The neck was significantly higher (P<0.05) in T3 (5.72%) but not significantly different (P>0.05) from the means of T1 (5.47%), T4 (5.51%) and T6 (5.55%).

Carcass is an important parameter for determining the relationship for the whole sale or further process bases of birds (Groen *et al.,* 1998). Greon *et al.* (1998) stated that the output quality of the system is fixed by a predetermined amount of kilogram carcass of final product of broiler. This result was in agreement with a study conducted by Adegbenro *et al*. (2017) who found no significant difference between the weight of drumstick of birds fed with diet containing composite leaf mix additives as premix and those fed the control diet. Bonsu *et al.* (2012) observed that the overall carcass characteristics were not influenced by the neem leaf meal in the diets of the broilers, which was in line with the findings in this present study. The non- significance of most of the carcass parameters was an indication that inclusion at the present levels of the dietary treatments may not cause any detrimental effect on the carcass.

Ayeni *et al*. (2022) observed that the live weight of birds fed 15 g/kg composite leaf meal (CLM) additive in diets (2.25 ± 0.12 kg) though statistically similar (p>0.05) to those fed 5, 10 and 20 g/kg CLM additive in diets but was significantly (p<0.05) higher than those fed the control diet (1.84 ± 0.10 kg). However, the dressed-out percentage was highest (91.59 ± 0.67 %) in birds fed 15 g/kg CLM) and lowest (90.00 ± 0.73 %) in those fed 20 g/kg CLM) additive in diet. The weights (32.41 ± 2.70 and 100.48 ± 0.33 g/kg) of the head and drumstick of the birds fed the control diet was adjudged to be highest compared to the lowest values recorded for head (18.62 ± 2.32 g/kg) and drumstick (92.13 ± 6.69 g/kg) in birds fed 15 g/kg CLM). The highest weight (117.83 ± 9.24 g/kg) for the thigh was recorded in chickens fed 5g/kg, while the lowest was in chickens fed Diet 15 g/kg CLM). The authors also observed that Wings, breast, shanks and back were not significantly (p>0.05) affected by the CLM inclusion. The highest value for breast (235.38 ± 4.83 g/kg) and back (157.35 ± 2.07 g/kg) was recorded in bird fed 15 g/kg CLM, while birds fed the control diet ranked lowest for breast (207.26 ± 4.15 g/kg) and back (146.29 ± 7.43 g/kg). Shank varies between 45.39 ± 1.49 g/kg in birds fed the control diet to 35.79 ± 3.20 g/kg in birds fed 5g/kg CLM. These values with the exception of dressing percentage were lower than the values obtained in this study. This result was in agreement with a study conducted by Adegbenro *et al.* (2017) who found no significant difference between the weight of drumstick of birds fed with diet containing CLM as premix and those fed the control diet. Oloruntola (2019) observed no significant difference (P>0.05) in the dressing percentage of birds fed pawpaw leaf and seed meal composite mix. Adeyeye *et al.* (2020) found no significant effects (*P* >0.05) of CLM supplementation on the carcass characteristics of broiler chickens fed wild sunflower and goat weed leaf meals composite mix (CLM). The non-significance (P>0.05) found in this study suggest that addition of composite leaf meal in the broiler diet does not have any negative effects on the carcass characteristics of the broiler chicken.

No significant differences (P>0.05) were observed in the pH of the crop and duodenum. The p^{H} values ranged from 5.88 (T2) – 6.12 (T1) (proventriculus) and 5.30 (T6) – 5.45 (T3) in crop. The pH level in specific areas of the GIT is a factor which establishes a specific microbial population, and also affects the digestibility and absorptive value of most nutrients (Rahmani *et al.,* 2004). The authors also stated that most of the pathogens grow in a pH close to 7 or slightly higher. In contrast, beneficial microorganisms live in an acidic pH (5.86-6.2) and compete with pathogens (Ferd, 1974). Dietary pH for monogastric animals is usually reported to vary between 5.5 and 6.5 (Ao *et al.,* 2008), and changes as digesta transit

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different segments of the GIT as reported by Nkukwana *et al.* (2015). The mutual situation between microflora and pH prevents of *E. coli* growth and these conditions make the absorptive area more beneficial (Dofing and Gottschal, 1997). Boling *et al*. (2001) also stated that acidic conditions make the nutrients more available which monitors better performance.

Experiment III

Carcass Characteristics of Broiler Chickens Fed Medicinal Leaves Extract

Table 8 shows the carcass characteristics of broiler chickens fed medicinal plant leaves extract.

Table 8: Effect of Medicine Leaves Extract on Carcass Characteristics of Broiler Chickens

Parameters	T1	T2	T3	T4	T5	T6	SEM
Live weight (g)	3058.33	2966.67	2716.67	3025.00	3041.67	3041.67	57.06
Dress weight (g)	2505.00	2433.33	2500.00	2475.00	2496.67	2486.67	13.76
Dressing percentage (%)	81.67	81.83	81.95	81.81	82.10	81.76	0.09
Head	2.26	2.25	2.30	2.23	2.26	2.35	0.02
Wings	13.56	13.57	13.42	13.61	13.56	13.42	0.04
Shank	3.43^{a}	3.29^{ab}	3.36^{ab}	3.21^{b}	3.25^{b}	3.26^{b}	0.02
Neck	5.55	5.45	5.45	5.47	5.38	5.55	0.03
Drum stick	15.68	15.53	15.62	15.59	15.66	15.63	0.02
Breast	24.07^{a}	24.93^{a}	24.52^{a}	17.57^{b}	17.54^{b}	17.56^{b}	0.85
Back cut	23.60^{bc}	23.32^{c}	23.53^{bc}	24.17^{ab}	24.77^{a}	24.37^{a}	0.15

$^{a-c}$ means for each parameters in a row with different superscripts are significantly different (P<0.05); SEM = Standard error of the mean

The shank, breast and back cut percentages were significantly influenced (P<0.05) by the treatments. The shank percentage was significantly higher (P<0.05) in birds fed the control (3.43%), but not significantly different (P>0.05) from those of T2 (3.29%) and T3 (3.36%). T1 (24.07%), T2 (24.93%) and T3 (24.52%) had significantly higher (P<0.05) breast percentage than T4 (17.57%), T5 (17.54%) and T6 (17.56%), which were not significantly different (P>0.05) from one another. The back cut took a different trend, the back cut percentage was significantly higher (P<0.05) in birds fed T5 (24.77%) and T6 (24.37%) but not significantly different from T4 (24.17%). The back cut of birds fed T2 (23.32%) had the least mean percentage, which was not significantly different (P>0.05) from those of T1 (23.60%) and T3 (23.53%).

Egbeyale *et al.* (2021) observed significant difference (P<0.05) in the percent breast weight of broiler chicken administered *Ocimum gratissimum* leaf extract, the reported the mean of 24.61% and 22.42% for birds administered 200 and 400g of *Ocimum gratissimum* leaf extract; 26.6%7 and 25.65% for birds administered 40 and 80g *Ocimum gratissimum* leaf extract. The author reported non-significant difference (P>0.05) in percent back cut. Amounts of phytoconstituents in the different concentrations and methods of extractions of the extract could be suggested to be responsible for the change in the carcass yield of broilers (Dotas *et al.,* 2014). Olumide and Akintola (2018) reported similar values in birds of both control and treated groups, which was in line with the findings of this present work. Amouzmehr *et al*. (2012) also showed that supplementation of garlic extracts in amount of 3.0 and 6.0% did not affect carcass characteristics including carcass yield, breast, thigh and abdominal fat.

Udokwu *et al*. (2021) reported a significant difference (P<0.05) in all the carcass yield and cut-parts of broiler chicken fed medicinal plant methanol extract, they reported that back cut was significantly higher (P<0.05) in birds fed *Chromolaena odorata* extract (21.91%) , followed by birds fed *Garcinia kola* extract. They also reported mean shank range of 3.84 in birds fed *Pterocarpus santalinoides* extract – 5.57 in birds fed the control, the breast ranged from 29.18 in birds fed *Pterocarpus santalinoides* - 38.18 in the control. The range of values obtained for the cut-parts was higher than the normal range values of cut parts provided by Oluyemi and Robert (2002) which were as follows: Breast (17.40%), Wings (8.21%), Back cut (12.05%), Thighs and drumsticks (11.67%). The result shows that the medicinal plant extracts supplied essential nutrients which were efficiently utilized in terms of digestion, absorption and assimilation thereby improving the carcass yield of the birds as stated by Onunkwo and Ekine (2020).

Organ Proportions of Broiler Chickens Medicinal Fed Leaves Extract

Table 9 shows the carcass characteristics of broiler chickens fed medicinal plant leaves.

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Table 9: Effect of Some Medicine Leaves Extract on Organ Proportions and Organ pH of Broiler Chickens

Parameters (% of LWt)	T1	T2	T3	T4	T5	T6	SEM
Gizzard	2.67	2.68	2.59	2.48	2.62	2.62	0.03
Liver	2.32	2.30	2.25	2.19	2.32	2.23	0.02
Kidney	0.20^{a}	0.20^{a}	0.19^{ab}	0.18^{ab}	0.18^{ab}	0.17^{b}	0.00
Spleen	0.07	0.08	0.08	0.09	0.09	0.09	0.00
Heart	0.67	0.65	0.65	0.64	0.63	0.65	0.01
pH							
Proventriculus	5.86	5.91	5.94	6.09	6.06	6.06	
Crop	5.32	5.40	5.36	5.40	5.38	5.35	

$^{a-b}$ means for each parameters in a row with different superscripts are significantly different (P<0.05); SEM = Standard error of the mean, % of LWt = percentage of live weight

Significant difference (P<0.05) was observed only in the relative kidney weight, with birds fed T1 (0.20%), T2 (0.20%) been significantly higher (P<0.05) than the other treatment groups, although not significantly different (P>0.05) from birds fed treatments 3 (0.19%), 4 (0.18%) and 5 (0.18%).

Nodu *et al*. (2016) reported the average weight of organs for gizzard (31 to 44g), liver (31 to 47g), spleen (2g), heart (9 to 14g) and kidney (16 to 19g) were relatively low compared with values obtained in this work with the exception of spleen. Ismail *et al.* (2008); Seoetan and Oyewale (2009); Tuleun *et al.* (2011) and Sese *et al*. (2013) observed that internal organ enlargement, particularly, liver and pancreas, become inflamed in reaction to the release of trypsin inhibitors in legumes, the authors concluded that residual anti-nutritional factors do not adversely affect organ cuts (Akinmutimi, 2004; Ologhobo *et al.*, 1993) but are indicators of presence of anti-nutritional elements which may be harmful. Nodu *et al*. (2016) reported 17.67, 19.33g and 16.00 as the mean kidney weight of birds fed 3g, 4g and 5g neem extract, they also observed no significant difference (P>0.05) between the treatment groups. These values were higher than the 0.17-0.20 range obtained in this study. Results of this study therefore suggest absence or reduce anti-nutritional elements in the treatments and confirm its safety.

The p^{H} values ranged from 5.86 (T1) – 6.09 (T4) for proventriculus and 5.32 (T1) – 5.40 (T2 and T4) in crop. Morgan *et al*. (2012) stated that accurate determination of the digesta pH in broilers could serve as tool to indicate the potential for optimum gut health and maximal nutrient absorption. Ofongo (2019) reported that at day 8, the pH of crop and proventriculus to be 5.95 and 5.96 before the administration of aqueous *O. gratissimum* leaf extract and 6.10 and 5.71 after administration of aqueous *O. gratissimum* leaf extract and at day 28, the pH of crop and proventriculus of the control groups were 6.23, respectively, while in the treatment group, the pH were 6.03 and 5.89, respectively.

In this study the administration of the medicinal plant extracts increases the pH of the crop and proventriculus when compared to the control. The values were trending towards neutral as seen in proventriculus, while the pH of the crop is more acidic. Hinto *et al*. (2000) in their study showed that lower intestinal pH stimulate growth of beneficial bacteria and inhibit the growth of and colonization of enteropathogens, especially *Salmonella* and *Enterbacterium*, such was the case of pH recorded in the crop. The benefit of reduction in the intestinal pH is that it creates a suitable environment for the growth and proliferation of beneficial microbs such as *Lactobacillus* while prohibiting the growth and proliferation of harmful microbes. Lewis *et al*. (2003) stated that lower digesta pH in the gut is associated with the reduction in the growth and colonization of pathogenic organisms, thus permitting greater partitioning of nutrients for optimal growth and nutrient utilization.

Summary

This study aimed to determine the nutrient composition, carcass and organ characteristics of broiler chickens fed diets supplemented with some medicinal composite plant leaves. The experiment was divided in to three separate experiments. Experiment 1 showed the proximate and energy composition of the experimental diets as well as the phytochemical composition in the experimental plant leaves. In Experiment 2, the medicinal plant leave was grounded into composite leaf meal and were added to their diets at 2.50g, 5.0g, 7.50g, 10.0g and 12.50g levels, while in Experiment 3, the leaves were processed into liquid extract and was administered into the drinking water at 25ml, 50ml, 75ml, 100ml and 125ml. In experiment 3, the carcass characteristics showed that the major cut parts (shank and breast) in T2 and T3 were of similar quality with the control. Similar to experiment 2, no adverse effects were seen on the blood profile of the birds as they all fall within the referenced range for health birds.

Conclusion

The values of some major carcass cut parts (shank and breast) were higher in T6 of experiment 2.

Recommendation

From the results of these experiments, it is therefore recommended 12.5g medicinal composite leaf meal should be used for effective broiler chicken production rather than the extract form.

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