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Effect of *Carica papaya* (Pawpaw) and *Vernonia amygdalina* (Bitter leaf) on Growth Performance and Oocyst Count of Broiler Chickens

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Abstract

The study was carried out to evaluate the effect of Carica papaya and Vernonia amygdalina leaf meals on performance of broiler chickens. A total of 315 Ross day-old broiler chicks were allocated to seven dietary treatments in triplicates of 15 birds per pen using the completely randomized design (CRD). The dietary treatments comprised of the control diet (T1), 400g of Carica papaya (T2), 400g of Vernonia amygdalina (T3), and their ratios at 300:100 (T4), 200:200 (T5) and 100:300 (T6) while cocci guard (COG) was used as positive control (T7). Data were collected on growth performance and oocyst counts and were analyzed using analysis of variance while significant differences among treatment means were compared using Tukey procedure. In the starter phase, the result showed that feed intake was significantly (P<0.05) better in birds fed the control diet and the diet containing 400g paw paw leaf while final weight, weight gain and FCR were significantly (P<0.05) better in birds fed T3, T4 and T5 at the finisher phase. Oocyst count was significantly (P<0.05) reduced in birds fed diets containing COG and 400g of Vernonia amygdalina. In conclusion the study observed a synergistic effect on the growth performance of birds fed diets containing a combination of pawpaw and bitter leaf and a reduction in the proliferation of Eimeria oocysts in birds fed 400g/100kg of bitter leaf. In conclusion this study showed that the dietary treatment at 200:200g/kg can be included for improvement in growth performance of broiler chickens and 400g/100kg of bitter leaf for control of coccidiosis.

Keywords: ;Additives, phytogenics, synergistic effect, broiler chickens, performance

Description of Problem

The poultry industry is under tremendous pressure due to parasitic disorders named "hidden enemies" as they gradually result in chronic losses without external symptoms. Data from Brazil, Egypt, Guatemala, India, New Zealand, Nigeria and the United States shows that the poultry industry spends about £7.7 to £13.0 billion (at 2016 prices) annually on prophylaxis, treatment, and production losses due to avian coccidiosis [1]. The principal causative agents of coccidiosis in poultry are attributed to members of the

Eimeria genus, which are obligatory intracellular protozoan parasites of the apicomplexan class, classified within the family *Eimeriidae* [2]. There are seven different species of *Eimeria* in chickens that mature within the intestinal epithelial cells of the definitive host [3], among which Eimeria *tenella*, *Eimeria acervulina* and *Eimeria maxima* impose substantial economic losses in poultry industry [4]

Poultry production is anticipated to be more than double by the year [5], therefore the control of coccidiosis is essential if poultry and other livestock meat are to fulfil the protein requirements by the growing world population [6].Studies show that over the years coccidiostats have been used to control coccidiosis and the long-term use of these drugs have led to drug resistance [7].

Recently, there has been an international interest in using herbal products as safe alternatives to control various diseases with a lower risk of resistance development and coccidiosis has not been left out [8, 9, 10] Over 1200 plants had been reported to have antiprotozoal activity [11]. Some of these herbal remedies double as growth-promoters and have natural immuno-stimulating effects.

There are over 300,000 species of flowering plants and less than 1% of them have been explored for use against protozoan diseases [12]. Most of these natural compounds do not always aim directly at the parasites but have immunomodulatory effects, antioxidative or anti-inflammatory properties and act on the intestinal tract, thus helping the host organism to fight against the coccidia infection [13]. Moreover, the plant extracts can have a direct effect on the parasites, by altering the process of oocyst wall formation and inhibiting sporulation [14], or by destroying the sporozoites[15]. Furthermore, there is a lower risk of developing resistance to these natural substances compared to anticoccidial drugs [16].*Carica papaya* is a large perennial herb with a rapid growth rate that possesses self-supporting stems and can produce fruits for up to 20 years [17]. It is a vital plant that is predominant in tropical Africa, more so Nigeria has been identified as the 3rd largest producer in the world [18] while *Vernonia amygdalina* is a wooded shrub of about 2 to 10 m height that regenerates rapidly after planting with petiolate leaves that has bitter taste. It is the most cultivated species of the genus *Vernonia* and is one of the most famous plants found in Africa and Asia [19, 20]. They both have many phenolic groups which may scavenge free radicals, functioning as antioxidant and antibacterial [21]. The two most common important biological compounds in *Carica papaya* are papain and chymopapain [22]. Papain possesses a very powerful digestive action superior to pepsin and pancreatin [23]. Proteolytic destruction of *Eimeria* by papain and/or inflammatory suppression by vitamin A were proposed as possible mechanisms by which *Carica papaya* and its active compounds acted to suppress coccidiosis [24].

The bioactive compounds in *Vernonia amygdalina* are Berberine N-3 fatty acids, flavonoids, and vernoside which can inhibit the *Eimeria tenella* sporozoites invasion into intestinal epithelial cells in poultry.

Previous studies shows that both leaves have anticoccidial potentials [25, 26]. [27]

reported that incoporation of *Carica papaya* leaves into broiler finisher diets had nutritional benefits without any deleterious effects on the performance while [25] also reported that *Vernonia amgydalina* can be included in feed as growth promoters.This study was therefore undertaken, to evaluate the synergistic effect of *Carica papaya* and *Vernonia amygdalina* meals on performance of broiler chickens.

Materials and Methods

Experimental site

The experiment was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Zaria, Kaduna State. The farm is located at 5J6Q+5PM, Samaru 81016, Kaduna, Nigeria. It is also in the Northern Guinea Savannah zone, located on longitude 11° 9'37.82124'' N and 7°38'20.9562''E 671m above sea level. The climate is characterized by well-defined dry and wet seasons. The area has three distinct seasons: hot dry season from March to May, the warm rainy season from June to September, and a cool dry season from November to February. The climate is relatively dry with a mean annual rainfall of 700-1400mm [28]

Source and processing of experimental materials

Three hundred and fifteen day-old Ross broiler chicks were purchased from Agrited Nigeria Limited, opposite ROM oil, Idi Ayunre Oluyole, Ibadan, Oyo state, Nigeria. Fresh pawpaw leaves were collected from a Pawpaw plantation at Hayin Gada, along Shika Road, Sabon Gari Local Government area of Kaduna State, Zaria, bitter leaves were purchased from Samaru market in Sabon-Gari Local Government Area of Kaduna State and Cocciguard from Rebson agricultural enterprises limited zaria kaduna state. The leaves were removed from the stem and dried under shade for five (5) days, crushed by grinding using a 1.2mm sieve hammer mill and included as part of the experimental diet.

Experimental design and Management of birds

Three hundred and fifteen day-old Ross broiler chicks were allocated to seven dietary treatments with 3 replicates of 15 birds each in a completely randomized design (CRD). The birds were housed in deep litter pens which was properly cleaned and disinfected. Prior to the arrival of the chicks, wood shaving was spread on the floor and the temperature of the poultry house was regulated using a heat source. Feed and water were provided *ad libitum* throughout the experimental period with necessary vaccinations and medication administered as and when due.

Experimental diets

Seven dietary treatments were formulated as shown in Tables 1 and 2 for the starter and finisher phases respectively. pawpaw and bitter leaf meals were added to the diets as follows:

Diet 1: Standard diet without pawpaw or bitter leaf feed additive (Control)

Diet 2: Standard diet with pawpaw leaf feed additive 400g/100kgDiet 3: Standard diet with bitter leaf feed additive 400g/100kg

Diet 4: Standard diet with pawpaw and bitter leaf feed additives 300:100g/100kg

Diet 5: Standard diet with pawpaw and bitter leaf feed additives 200:200g/100kg
Diet 6: Standard diet with pawpaw and bitter leaf feed additives 100:300g/100kg
Diet 7: Standard diet with Cocci guard 100g/100kg

Data Collection

Growth Parameters

Initial and final weights of birds were taken at the beginning and at the end of both starter and finisher phases. Weight gain and feed intake were calculated weekly while feed/gain ratio, FCR and cost per Kg gain were computed for both phases while mortality was recorded as they occurred.

Faecal oocysts count

Litter samples approximately 100g were collected from each pen while walking in a zigzag pattern, this were pooled and homogenized. The composite samples from each replicate were placed in a hermetically sealed plastic bag and transported to the laboratory. Oocysts per g of litter (OPG) were calculated by microscopic enumeration using a McMaster chamber [29].

Data Analysis

All data obtained from the study were statistically analysed using the General Linear Model Procedure of Statistical Analysis Systems software package [30] while significant differences between treatment means were separated using Tukey Procedure

Results and Discussions

Growth Performance of Broiler Chicks (0-4 weeks) Fed Diets Containing Pawpaw leaf and Bitter leaf meals

The growth performance of broiler chicks fed diets containing Pawpaw and Bitter leaf meals is presented in Table 3. The result showed significant ($P<0.05$) differences in feed intake and mortality rate while final weight, weight gain, feed conversion ratio (FCR), feed cost per kg gain were not significantly ($P>0.05$)) different across the dietary treatments. Feed intake was significantly ($P<0.05$) higher in broiler chicks fed diets containing the control diet and 400g *C. papaya* but were at par with those fed the combination of Pawpaw leaf and Bitter leaf at 300:100g, 200:200g and COG and significantly different from ($P<0.05$) groups fed diets containing 400g bitter leaf and their combination at 100:300g. However, the result showed that there was less ingestion of feed in birds fed diets containing 400g bitter leaf and its combination with pawpaw leaf at 100:300 where there was a higher concentration of bitter leaf. This could be attributed to the higher level of saponin in the diet which may have imparted a bitter and undesirable taste in the diets thereby decreasing their palatability.

This finding corresponds with that of [26], who reported significant differences in feed intake and mortality rate and non-significant difference in weight gain and FCR in broiler chickens fed varying levels of pawpaw leaf meals (200-600g). The findings of [31] who reported the effect of graded levels of bitter leaf meal on performance of broiler chickens also agrees with this study as an increasing level of bitter leaf in the feed also led to decrease in feed intake. However, the findings of [32] contradicts the current

Table 1:Composition of Broiler Starter Diets Containing Pawpaw leaf and Bitter leaf meals

Ingredients	0g	PL 400g	BL 400g	PL: BL 300:100g	PL: BL 200:200g	PL: BL 100:300g	COG(100g)
Maize	56.00	56.00	56.00	56.00	56.00	56.00	56.00
Soyabean cake	27.70	27.70	27.70	27.70	27.70	27.70	27.70
Groundnut cake	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Common Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Premix	0.25	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**	**100.00**
Calculated Analysis							
ME Kcal/kg	2.903	2.903	2.903	2.903	2.903	2.903	2.903
Crude Protein (%)	23.19	23.19	23.19	23.19	23.19	23.19	23.19
Crude Fibre (%)	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Ether Extract (%)	3.28	3.28	3.28	3.28	3.28	3.28	3.28
Calcium (%)	1.32	1.32	1.32	1.32	1.32	1.32	1.32
Av. Phosphorus (%)	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Lysine (%)	1.38	1.38	1.38	1.38	1.38	1.38	1.38
Methionine (%)	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Cost (₹/kg)	285.00	287.00	287.50	287.45	287.80	288.15	292.00

Vitamin- mineral premix provide per kg of diet: vit. A, 13,340 i.u; vit. D_3, 2680 i.u;vit. E, 10 i.u; vit. K, 2.68 mg; calcium pantothenate, 10.68mg; vit. B_{12}, 0.022mg; folic acid, 0.668mg; choline chonde, 400mg; manganese, 13mg; iron, 66.68mg; zinc, 53.34mg; copper, 3.2mg; iodine, 1.86mg; cobalt, 0.268mg; selenium, 0.108mg., PL-pawpaw leaf, BL- bitter leaf, COG: coccigaurd.

Table 2: Composition of Broiler Finisher Diets Containing Pawpaw leaf and Bitter leaf meals

Ingredients	0g	PL 400g	BL 400g	PL: BL 300:100g	PL: BL 200:200g	PL: BL 100:300g	COG(100g)
Maize	58.00	58.00	58.00	58.00	58.00	58.00	58.00
Soyabean cake	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Groundnut cake	10.50	10.50	10.50	10.50	10.50	10.50	10.50
Maize offal	7.20	7.20	7.20	7.20	7.20	7.20	7.20
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Common Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Premix	0.25	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**	**100.00**
Calculated Analysis							
ME Kcal/kg	2,932	2,932	2,932	2,932	2,932	2,932	2,932
Crude Protein (%)	20.10	20.10	20.10	20.10	20.10	20.10	20.10
Crude Fibre (%)	4.09	4.09	4.09	4.09	4.09	4.09	4.09
Ether Extract (%)	3.17	3.17	3.17	3.17	3.17	3.17	3.17
Calcium (%)	1.32	1.32	1.32	1.32	1.32	1.32	1.32
Available Phosphorus (%)	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Lysine (%)	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Methionine (%)	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Cost (₦/kg)	271.00	273.00	273.50	273.45	273.80	274.15	278.00

Vitamin- mineral premix provide per kg of diet: vit. A, 13,340 i.u; vit. D_3, 2680 i.u;vit. E, 10 i.u; vit. K, 2.68 mg; calcium pantothenate, 10.68mg; vit. B_{12}, 0.022mg; folic acid, 0.668mg; choline chonde, 400mg; manganese, 13mg; iron, 66.68mg; zinc, 53.34mg; copper, 3.2mg; iodine, 1.86mg; cobalt, 0.268mg; selenium, 0.108mg, PL- pawpaw leaf, BL- bitter leaf COG: coccigaurd.

findings because their findings revealed that diet supplementation with inclusion level of pawpaw seed meal from 0.10 to 0.25% significantly increased feed intake of broilers compared with birds that had non-supplemented diet. Reports of [33] also disagrees with this finding as they reported non-significant difference in feed

intake with the inclusion of pawpaw leaf meal in the diet of broiler chickens.

Mortality rate was significantly lower in broiler chicks fed diets containing Pawpaw leaf and Bitter leaf singly and, in their combination, and COG and higher in groups fed diets containing 400g of pawpaw leaf and the control group. The lower mortality recorded in groups fed diets containing Pawpaw leaf and Bitter leaf may be attributed to their medicinal value in combating varying strains of microbial agents [34, 35].

Table 3: Growth Performance of Broiler Chicks (0-4 weeks) Fed Diets Containing Pawpaw leaf and Bitter leaf meals

	Level of Experimental Materials (g/100kg Diet)							
		PL	BL	PL: BL				
Parameters	0g	400g	400g	300:100g	200:200g	100:300g	COG(100g)	SEM
Initial weight (g/bird)	45.56	44.89	45.33	44.67	45.33	44.89	44.00	0.98
Final weight (g/bird)	903.47	929.37	899.97	922.13	915.57	908.67	912.53	28.45
Weight gain (g/bird)	857.91	884.48	854.64	877.46	870.23	863.78	868.53	28.53
Feed intake (g/bird)	1519.97^{a}	1504.57^{a}	1434.95^{b}	1464.10^{ab}	1493.13^{ab}	1438.60^{b}	1502.20^{a}	32.55
FCR	1.78	1.70	1.68	1.67	1.72	1.67	1.73	0.06
Feed cost (? /kg)	285.00	287.00	287.50	287.45	287.80	288.15	292.00	NA
FC/kg gain (? /kg)	506.13	489.00	484.36	479.78	495.53	480.07	506.12	18.04
Mortality (%)	4.44^{b}	4.44^{b}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}	0.00^{a}	1.45

^{a,b}Means with different superscripts on the same row are significantly different (P<0.05), FCR: feed conversion ratio, FC/kg gain; feed cost per kg gain, PL-pawpaw leaf, BL- bitter leaf COG: cocciguard, SEM; Standard Error of Means, NA: Not analyzed.

Growth Performance of Broiler Chickens (5-7 weeks) Fed Diets Containing Pawpaw leaf and bitter leaf meals

The growth performance of broiler chickens fed diets containing Pawpaw leaf and Bitter leaf is shown in Table 4. The result showed that there were significant (P<0.05) differences in final weight, weight gain, feed intake, feed conversion ratio, feed cost per kg gain while mortality rate were not significantly (P>0.05) different across the dietary treatments.

Final weight was significantly (P<0.05) higher in birds fed diets containing combinations of Pawpaw leaf and Bitter leaf at 300:100, 200:200 and 100:300 which were at par with those feed diets containing pawpaw leaf at 400g, bitter leaf at 400g and COG but were statistically higher than the control group. Similarly, weight gain was significantly (P<0.05) higher in birds fed diets containing combinations of Pawpaw leaf and Bitter leaf at 300:100, 200:200 and 100:300 which were at par with those feed diets containing pawpaw at 400g bitter leaf at 400g and COG but were statistically higher than those in the control. Feed intake was significantly (P<0.05) higher in the group fed the experimental diet singly but were at par with those fed the combinations and the control group with the birds fed diets containing COG having the least significance.

Feed conversion ratio was significantly (P<0.05) better in birds fed diets containing combinations of the experimental diet and cocci guard but were statistically different from those fed diets

containing the experimental material singly and the control diet. Better FCR values were reported in group fed diet with combinations of the experimental material and COG, this indicates more efficient conversion of feed to body weight gain than other treatment groups. This agrees with [36] who suggested that the improvement in FCR may be associated with the beneficial effect of the bitter leaf which strengthened the gastrointestinal enzymes and thereby improved digestion and assimilation of nutrients. [37] also reported that bitter leaf enhanced gastrointestinal enzymes (chymotrypsin) production, which may improve not only the utilization of feed but could aid in the digestion of sporozoites and other intestinal parasites that could cause decreased utilization of the feed.

The improvement in feed efficiency and growth performance may be due to activation of feed intake and secretion of digestive secretions, immune stimulation, anti-bacterial activities, coccidiostat, anthelmintic, antiviral, or anti-inflammatory activity and antioxidant effect on the birds.

Previous studies reported that phytogenic feed additives generally improved nutrient utilization and absorption or the stimulation of the immune system, hence, influencing growth promotion in livestock by changing the intestinal microbiota and increasing nutrient absorption; enhanced nitrogen absorption, improvement of the immune response morphological and histological modifications of the gastrointestinal tract and antioxidant activity [38, 39].

Feed cost per kg gain was significantly ($P<0.05$) higher in birds fed diets containing combinations of the experimental diet at 200:200g and was at par with those fed the combinations at 100:300g, 300:100g and cocci guard with the control diet being statistically the least. This finding aligns with the reports of [40, 41, 42], who observed that supplementing poultry diets with leaf meals could reduce production costs and increase profit margins.

The findings of this study are in line with a similar study carried out by [26], who reported significant differences in feed intake but contradicts his finding of non-significant difference in FCR. In contrast [43] studied the effect of graded levels of bitter leaf meal on performance of broiler chicken and recorded decrease in final

Table 4: Growth Performance of Broiler Chickens (5-7 weeks) Fed Diets Containing Pawpaw leaf and Bitter leaf meals

	Level of Experimental Materials (g/100kg Diet)							
		PL	BL	PL: BL				
Parameters	0g	400g	400g	300:100g	200:200g	100:300	COG	SEM
Initial weight (g/bird)	903.47	929.37	899.97	922.13	915.57	908.67	912.53	28.45
Final weight (g/bird)	2231.35^{b}	2401.28^{ab}	2349.27^{ab}	2443.22^{a}	2510.79^{a}	2486.69^{a}	2406.81^{ab}	93.90
Weight gain (g/bird)	1327.88^{b}	1471.91^{ab}	1449.30^{ab}	1521.09^{a}	1595.22^{a}	1578.03^{a}	1494.28^{ab}	87.06
Feed intake (g/bird)	2927.83^{ab}	3054.80^{a}	3031.50^{a}	2934.47^{ab}	2887.70^{ab}	2973.67^{ab}	2805.04^{b}	91.09
FCR	2.23^{b}	2.08^{b}	2.10^{b}	1.93^{a}	1.81^{a}	1.91^{a}	1.88^{a}	0.09
Feed cost (? /kg)	271.00	273.00	273.50	273.45	273.80	274.15	278.00	NA
FC/kg gain (? /kg)	605.49^{c}	566.99^{bc}	573.08^{bc}	526.98^{ab}	496.72^{a}	522.60^{ab}	523.24^{ab}	24.33
Mortality (%)	6.67	2.22	2.22	4.44	2.22	2.22	2.22	2.52

^{a,b,c}Means with different superscripts on the same row are significantly different ($P<0.05$), FCR: feed conversion ratio, , PL-pawpaw leaf, BL- bitter leaf, COG: cocciguard, SEM; Standard Error of Means, NA: Not analyzed.

weight, feed intake, weight gain and feed cost/kg weight gain as the inclusion of bitter leaf meal increased. This difference could be attributed to the wide disparity in the inclusion levels of the meal as their 5% inclusion was at par with the control diet but started reducing at higher levels.

Oocysts count of Broiler Chickens Fed Diets Containing Pawpaw leaf and Bitter leaf meals

The oocysts per gram count of broiler chickens fed a diet pawpaw leaf and bitter leaf meal is shown in Figure 1. The result showed that there were significant ($P<0.05$) differences in oocysts per gram counts were statistically similar in groups fed diets containing COG (1800.00 counts), 400g of bitter leaf (2940.00 counts) and significantly different from those fed pawpaw leaf at 400g (8130.00 *V.* counts) and combinations of pawpaw leaf and bitter leaf at 300:100 (12480.00 counts), 200:200 (12740.00 counts) and 100:300 (6820.00 counts) while the highest counts were in birds fed diets containing 0g (30620.00 counts). Reduction in oocysts per gram count in group fed diet containing COG may be attributed to the efficacy of the anticoccidial drugs which was reported to be effective in treating coccidial infection in chickens [3]. Bitter leaf at 400g were shown to reduce the incidence of *Eimeria spp* by reducing their oocysts and oocysts per gram count. This may be attributed to high levels of tannins and saponins in bitter leaf which were reported to prevent coccidia infection [44]. In a related study, pawpaw leaf and bitter leaf have been reported to reduce the oocyst per gram count as compared with control group [25, 26] Tannins was reported to form chelates with metal ions, particularly iron leading to the disruption of the walls of oocysts contributing to its anticoccidial activity [45]. Similarly, tannins have been reported to have anticoccidial effect by showing

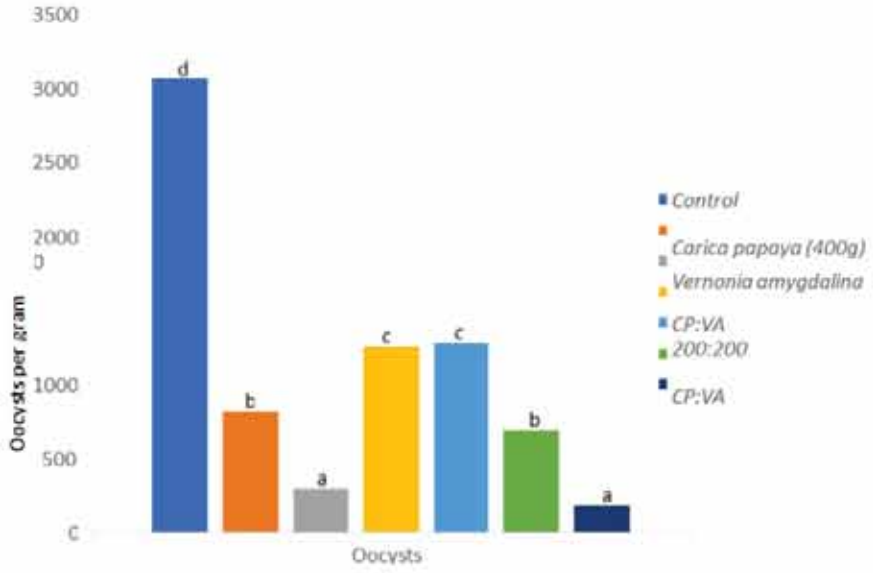

Figure 1 :Oocysts count of broiler chickens fed diets containing pawpaw leaf and bitter leaf meals

reduction in sporulation of *E. tenella, E. maxima* and *E. acervulina* under laboratory conditions using pine extracts [46]. In another study, [47] suggested that the presence of tannins and saponins accounts for the efficacy of the methanolic plant extracts of *A. indica, S. dasyphyllum* and *N. diderichii* against strains of *Eimeria spp*. This is because saponins have been reported to interact with the cholesterol on the parasite cell membrane, thus resulting in death of parasite [48]. Many plants and herbal products and their extracts including their essential oils have been found to have chemotherapeutic effect against coccidiosis in poultry birds [13, 49]. They were reported to inhibit the sporulation of coccidian oocysts [50]. This result is in line with the findings of [41, 51] who stated that bitter leaf possesses anticoccidial properties. Phytogenic feed additives have also been reported to act against some chicken parasites, especially coccidian [44, 52] *Galla rhois* and *Nectaroscordum tripedale* extracts have shown promising result against coccidia infection [53, 54].

Conclusion

From the findings of this study, it can be concluded that

1. The addition of the ratio of pawpaw leaf and bitter leaf meals in broiler chicken diets significantly impacted a synergistic effect on growth performance at the finisher phase.
2. The addition of 400g of bitter leaf was significantly best for the reduction of oocyst count.

Application

1. Farmers and feed millers can use the ratio of Pawpaw leaf and Bitter leaf at 200:200/100kg for improved growth performance
2. Bitter leaf can be included at 400g/100kg as a means of controlling proliferation of *Eimeria* oocysts.

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