

<https://doi.org/10.61308/IEBZ2268>

Phytoadditive effects of breadnut (*Artocarpus camansi*) and breadfruit (*Artocarpus altilis*) leaf meals on performance and nutrient digestibility of Broiler chickens

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Citation: Fatoki, H. O., Ojebiyi, O. O., Fasina, F. B., Adegbenro, E. O., Olawale, S. O. & Tewogbade, A. B. (2025). Phytoadditive effects of breadnut (*Artocarpus camansi*) and breadfruit (*Artocarpus altilis*) leaf meals on performance and nutrient digestibility of Broiler chickens. *Bulgarian Journal of Animal Husbandry*, 62(5), 65-77

Abstract: The rising concern over antibiotic resistance has sparked interest in alternative, natural solutions to promote the performance and health of poultry. Breadnut and breadfruit leaf meals have emerged as potential phyto-additives that replace antibiotics in animal feeds and feeding. Two hundred and fifty-two Arbor Acres a-day-old broiler chickens were used to study the phyto-additive effect of breadnut and breadfruit leaves on their growth performance at 6 weeks. The birds were weighed and distributed into seven treatments of thirty-six birds each, with four Replicates of nine birds each involving two different leaves of *Artocarpus* (breadnut leaves and breadfruit leaves) and three (3) supplementation levels. (Basal diet with 3, 6, 9g breadnut leaf meal and Basal diet with 3, 6, 9g breadfruit leaf meal) in a two-by-three factorial arrangement with a control. The data collected on performance characteristics and nutrient digestibility were analyzed using one-way analysis of variance.

Results shows that Treatment 3 (6g breadnut meal per kilogram of feed) had a higher ($p < 0.05$) final weight (1909.75g), daily weight gain (44.44g), and the lowest FCR (1.52) compared to other treatments. The feed cost per kilogram of weight gain in Treatment 3 (6g breadnut meal per kilogram of feed) was a lower value of ₦ 830.32 ($p < 0.05$). Broilers fed 3g breadnut leaf meal had higher ($P < 0.05$) dry matter digestibility and crude protein digestibility value (81.04% and 92.46%, respectively). In comparison, broiler chickens fed 9g breadnut leaf meal had lower ($P < 0.05$) dry matter and crude protein digestibility values of 65.88% and 85.89%, respectively.

It can be concluded that feeding broiler chickens a diet supplemented with breadnut and breadfruit leaf meal as phyto-genic additives improves weight gain and feed conversion ratio, particularly when 6g of breadnut leaf meal is added per kg of diet. This enhances the overall performance of the broiler chickens without the use of synthetic antibiotics.

Keywords: breadfruit leaf meal; breadnut leaf meal; growth performance; nutrient digestibility; phytoadditive

INTRODUCTION

The poultry industry is a significant source of edible and reliable meat for the population (Ricke et al., 2017; Rimi et al., 2017). Globally, consumers prefer poultry products free from residual antibiotics that may be hazardous to their health (Shittu et al., 2021). Antibiotics are feed additives that optimize gut health, enhance immune

response, increase stress resistance, and promote gut health by improving digestion and nutrient availability. However, feeding antibiotics to livestock produces an ever-increasing number of antibiotic-resistant bacteria, including many that can cause disease in humans (Eckert et al., 2010). The use of antibiotics might result in the deposition of residues in meat (Nisha, 2008), which has led to

the prohibition of their use as growth promoters by the European Union (Eckert et al., 2010). A high level of production and efficient feed conversion are the needs of the modern broiler industry, which can be achieved to a certain extent by the use of specific additives as growth promoters (Shittu et al., 2021). These additives stabilize the microflora and improve the health status and general performance of the animals (Windisch et al., 2008).

Feed additives are materials added to feed to protect animals from diseases (Mobashar, 2024), improve performance by inducing digestive enzyme secretion, leading to enhanced feed digestion and nutrient absorption (Odunowo and Oluhide, 2019), and improve the feed conversion ratio (Huang and Lee, 2018). Phytogetic substances utilized include herbs, spices, essential oils, and non-volatile extracts, such as those from clove, anise, thyme, fennel, or melissa, as well as many other substances (Mathe et al., 2007).

Breadnut (*Artocarpus camansi*) and breadfruit (*Artocarpus altilis*) constitute essential parts of the diet in Nigeria. The nut has 4.87% protein, 3.48% fat, 1.2% fibre, 3.43% ash, 60.96% water, and 26.11% carbohydrate. The fat is also rich in unsaturated fatty acids (Adeleke and Abiodun, 2010). Ethno-pharmacologically, breadnut and breadfruit are known to treat liver diseases, while the leaves can be used to heal cirrhosis, diabetes, and hypertension (Jagtap and Bapat, 2010). The proximate composition of breadnut leaf comprises 21.93% crude protein, 35.84% carbohydrate, 17.17% crude fibre, 4.61% crude fat, 9.70% ash, 0.63% calcium, and 0.41% phosphorus. In comparison, breadfruit leaf meal comprises 18.74% crude protein, 42.59% carbohydrate, 15.59% crude fibre, 3.78% crude fat, 7.60% ash, 0.50% calcium, and 0.36% phosphorus (Fatoki et al., 2024).

Breadnut and breadfruit are currently underutilized because they are often grown in rural or agricultural areas, which are rapidly being converted into urban areas, resulting in a reduction in their availability. Although the plants have been recognized for their importance in food security (Jones et al., 2013), their cultivation is being im-

pacted by this conversion. There is a dearth of information on the use of breadnut and breadfruit leaf as Phytogetic Feed Additives (PFA). This was substantiated by Vianney et al. (2018), who reported that very few reports can be found that deal with the antioxidant potential of these plants. Therefore, this study was designed to examine the phytoadditive effect of breadnut and breadfruit leaf meals on the performance and nutrient digestibility of the Arbor Acres strain of broiler chickens.

MATERIALS AND METHODS

Experimental location

The experiment was carried out at the Poultry and Research Unit, Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, situated in the derived savanna zone of southwest Nigeria, and lies on Latitude 8° 8' 31.7940" North of the equator and Longitude 4° 14' 42.6696" East of the Greenwich Meridian. The altitude ranges from 300m to 600m above sea level, while the mean temperature and annual rainfall are 27 °C and 1247mm, respectively (Google Earth Map, 2023).

Phytoadditives supplementation

The test ingredients used were breadnut (*Artocarpus camansi*) and breadfruit (*Artocarpus altilis*) leaves, which were harvested from the Abede Area of Ogbomoso, where they are found in relatively abundant quantities. The leaves were air-dried at 30 ± 2 °C by spreading them on a clean, cemented surface for ten to twelve (10 to 12) days, until they became crispy to the touch (constant weight). They were then ground into powder and added to the diets, as presented in Table 1.

Experimental Animals and Management

Two hundred and fifty-two one-day-old *Arbor Acres* Strain of broiler chicks were used for the experiment. The birds were weighed at the commencement of the experiment and randomly distributed into seven treatments, each with four replicates, after weighing and balancing.

Table 1. Experimental design

Diets	Treatments
1	Control diet (with antibiotics)
2	3g of breadnut leaf meal/kg of feed (without antibiotics)
3	6g of breadnut leaf meal/kg of feed (without antibiotics)
4	9g of breadnut leaf meal/kg of feed (without antibiotics)
5	3g of breadfruit leaf meal/kg of feed (without antibiotics)
6	6g of breadfruit leaf meal/kg of feed (without antibiotics)
7	9g of breadfruit leaf meal/kg of feed (without antibiotics)

Each replicate consisted of nine birds, totaling thirty-six birds per treatment. Each replicate was housed in a pen measuring 122cm x 90cm x 90cm. The birds were offered adequate feed and clean water *ad libitum* daily throughout the six-week experiment. The birds were weighed every week to determine their weight gain, and the feed offered, along with leftovers, was adequately monitored.

Experimental Diets

Seven experimental diets were formulated, and the gross composition of the experimental diets is presented in Table 2.

Table 2. Composition of Experimental diets for broiler starters (g/100kg)

Ingredients (kg)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7
Maize	54.00	54.00	54.00	54.00	54.00	54.00	54.00
Fish meal (72%)	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Soybean meal	32.00	32.00	32.00	32.00	32.00	32.00	32.00
Soybean Oil	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Wheat Offals	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Lime stone	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DCP	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Salt	0.25	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	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	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
Breadfruit leaf meal	-	0.003	0.006	0.009	-	-	-
Breadnut leaf meal	-	-	-	-	0.003	0.006	0.009
Nutrient Analysis							
Crude Protein (%)	22.13	22.69	23.25	23.82	22.79	23.45	24.07
Ether Extract (%)	3.67	3.72	3.79	3.85	3.78	3.81	3.85
Crude Fibre (%)	3.61	3.69	3.19	3.20	3.64	3.69	3.72
ME (Kcal/kg)	3065.18	3065.18	3065.18	3065.18	3065.18	3065.18	3065.18
Phosphorus (%)	1.20	1.24	1.26	1.29	1.26	1.27	1.29
Calcium (%)	1.09	1.1	1.12	1.14	1.13	1.14	1.16
Lysine (%)	1.34	1.34	1.34	1.34	1.34	1.34	1.34
Methionine (%)	0.54	0.54	0.54	0.54	0.54	0.54	0.54

*Premix- Vitamin A (IU) 1250000, Vitamin D3 (IU) 2500000, Vitamin E (Mg) 40000, Vitamin K3 (Mg) 2000, Vitamin B1 (Mg) 3000, Vitamin B2 (Mg) 5500, Niacin (Mg) 55000, Calcium Pantothenate (Mg) 11500, Vitamin B6 (Mg) 5000, Vitamin B12 (Mg) 25, Choline chloride (Mg) 5000000, Folic acid (Mg) 1000, Biotin (Mg) 80, Manganese (Mg) 120000, Iron (Mg) 100000, Zinc (Mg) 80,000, Copper (Mg) 8500, Iodine (Mg) 1500, Cobalt (Mg) 300, Selenium (Mg) 120, Antioxidant (Mg) 120.000

DCP: Di-calciumphosphate

ME: Metabolizable Energy

Table 3. Composition of Experimental diets for broiler finishers (g/100kg)

Ingredients	T1	Breadnut T2	Leaf T3	T4	Breadfruit T5	Leaf T6	T7
Maize	57.00	57.00	57.00	57.00	57.00	57.00	57.00
Fish meal (72%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Soybean meal	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Soybean Oil	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Wheat Offal	4.60	4.60	4.60	4.60	4.60	4.60	4.60
Lime stone	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Dicalcium Phosphate	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.25	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	0.25
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Breadnut leaf meal	-	0.003	0.006	0.009	-	-	-
Breadfruit leaf meal	-	-	-	-	0.003	0.006	0.009
Nutrient analysis							
Crude Protein (%)	18.05	18.05	18.05	18.05	18.05	18.05	18.05
Ether Extract (%)	3.42	3.42	3.42	3.42	3.42	3.42	3.42
Crude Fibre (%)	3.42	3.42	3.42	3.42	3.42	3.42	3.42
M.E (Kcal/kg)	3070.10	3070.10	3070.10	3070.10	3070.10	3070.10	3070.10
Phosphorus (%)	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Calcium (%)	2.47	2.47	2.47	2.47	2.47	2.47	2.47
Lysine (%)	2.29	2.29	2.29	2.29	2.29	2.29	2.29
Methionine (%)	0.56	0.56	0.56	0.56	0.56	0.56	0.56

*Premix- Vitamin A (IU) 1250000, Vitamin D3 (IU) 2500000, Vitamin E (Mg) 40000, Vitamin K3 (Mg) 2000, Vitamin B1(Mg) 3000, Vitamin B2 (Mg) 5500., Niacin (Mg) 55000, Calcium Pantothenate (Mg) 11500, Vitamin B6 (Mg) 5000, Vitamin B12 (Mg) 25, Choline chloride(Mg) 5000000, Folic acid(Mg) 1000, Biotin (Mg) 80, Manganese (Mg) 120000, Iron (Mg) 100000, Zinc (Mg) 80,000, Copper (Mg) 8500, Iodine (Mg) 1500, Cobalt (Mg) 300, Selenium (Mg) 120, Antioxidant (Mg) 120.

M.E: Metabolizable Energy

Growth performance characteristics data were collected according to the procedure of Ojebiyi et al. (2022) on:

Daily Feed Intake in grams (Feed offered – Left over),

Daily Weight Gain:
Daily weight gain (g) = $\frac{\text{Total weight gain weekly}}{\text{Number of days in a week}}$

Feed Conversion Ratio (FCR):
FCR = $\frac{\text{Total feed intake}}{\text{Total weight gained}}$

Survivability (%) = $\frac{\text{Number of live birds} \times 100}{\text{Total number of birds}}$

Nutrient Digestibility Trial

At week six, four (4) birds per treatment (one bird per replicate) with weights similar to the average weight of the group were selected and allocated to a specially designed metabolic cage measuring 38 x 21 x 38cm equipped with facilities for feeding, drinking, and fecal collection. The first three days were used for acclimatization. On the fourth day, records were taken for feed offered, leftover feed, feed intake, and the wet

weight of fecal samples for each bird. The fecal samples were collected separately from each replicate during the four-day collection period. The feces were weighed and oven-dried at 60°C until a constant weight was obtained. At the end of the collection period, feces from each replicate of the same treatment were bulked, milled, and a representative sample was taken for proximate analysis. Feeding was done on a 12-hour basis (7 am-7 pm) for the four days, according to the procedure outlined by Oladunjoye and Ojebiyi (2010).

Apparent nutrient digestibility (%) =

$$\frac{\text{Nutrient intake (g)} - \text{Nutrient excreted (g)} \times 100}{\text{Nutrient intake (g)}}$$

Dry matter digestibility (%) =

$$\frac{\text{Dry matter feed intake (g)} - \text{Dry matter excreta output (g)}}{\text{Dry matter in feed intake (g)}}$$

Nutrient intake = % Nutrient in diet x
Feed intake (gDM)

Nutrient Voided = % Nutrient in excreta x
Amount of excreta voided (gDM)

RESULTS AND DISCUSSION

The growth of broilers fed a diet containing varying levels of breadnut and breadfruit leaf meal is presented in Table 4.

The final weight, total weight gain, daily weight gain, total feed intake, daily feed in-

take, and feed conversion ratio were significantly ($P < 0.05$) affected by the level of breadnut and breadfruit leaf meal. However, survivability was not significantly affected by the level of phyto-additive supplementation ($p > 0.05$). Broiler chickens fed a control diet and 6g (T3) breadnut leaf meal per kg of feed had similar higher final weights (1938.42g vs 1909.75g, respectively), while the birds fed 6g (T6) breadfruit leaf meal per kg of feed had a lower final weight (1795.08g). A similar trend was observed for the daily weight gain. Broilers fed 9g breadnut leaf meal (77.89g) had similar ($P < 0.05$) higher daily feed intake, whereas the lowest ($P < 0.05$) daily feed intake value (70.46g) was obtained in birds fed 6g breadfruit leaf meal. This result corroborates the findings of Çelikbilek et al. (2014), who reported a significant impact of phytogenic feed additives on the physical performance of broiler chickens. Similarly, Hashemipour et al. (2013) reported that broiler chickens fed diets containing oregano essential oil improved daily weight gain and daily feed intake at the finisher phase. Alp et al. (2012) also observed that feed supplementation with oregano essential oil regulated feed consumption and improved feed conversion in broiler chickens. Amad et al. (2011) reported a notable increase in body weight gain and average daily feed intake in broiler chickens fed oregano essential oil compared to those fed antibiotics. Additionally, Banerjee et al. (2013) reported that phytogenic feed additives, such as digestarom, play a significant role in enhancing the perfor-

Table 4. Performance characteristics of broiler chickens fed breadnut leaf and breadfruit leaf meal

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM	P-value
Initial weight (g)	42.92	42.69	43.08	43.53	43.25	42.97	43.00	0.56	0.96
Final weight (g)	1938.42 ^a	1840.58 ^{ab}	1909.75 ^a	1875.44 ^{ab}	1884.81 ^{ab}	1795.08 ^c	1827.92 ^{ab}	44.38	0.04
Total weight gain (g)	1895.50 ^a	1797.97 ^b	1866.67 ^a	1831.92 ^{ab}	1841.56 ^a	1752.11 ^b	1784.92 ^b	44.27	0.03
Daily weight gain (g)	45.13 ^a	42.81 ^{bc}	44.44 ^a	43.62 ^b	43.85 ^{ab}	41.72 ^c	42.50 ^{bc}	1.05	0.03
Daily feed intake (g)	73.50 ^b	75.24 ^{ab}	72.23 ^b	77.89 ^a	75.50 ^{ab}	70.46 ^c	71.48 ^{bc}	2.17	0.01
Feed conversion ratio	1.66 ^b	1.74 ^{ab}	1.52 ^c	1.83 ^a	1.75 ^{ab}	1.62 ^b	1.63 ^b	0.08	0.02
Survivability (%)	100.00	97.00	94.44	100.00	100.00	94.44	94.44	0.02	0.24

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

mance of broiler chickens by improving feed efficiency and body weight, which is in line with the results of this study. On the contrary, Duwa et al. (2019) reported that broiler chickens fed a diet containing garlic meal as a phytogenic feed additive have no significant effect on feed intake.

Broiler chickens fed 6g breadnut leaf meal had the lowest value (1.52) for feed conversion ratio (FCR), while the highest value (1.83) was observed in broiler chickens fed 9g breadnut leaf meal. This result supported the findings of Windisch et al. (2008) and Alhajj et al. (2015), revealing that Phytogenic Feed Additives (PFAs) caused reduced feed intake at essentially unchanged final body weight, thereby improving FCR. This is also in accordance with earlier reports of Alcicek et al. (2003) and Guo et al. (2004), who reported improvement in the final body weight and FCR as a result of the PFA supplementation.

The main effects of ingredient type and level of inclusion on the growth performance of broiler chickens are presented in Table 5.

The results show that phytoadditives significantly ($P < 0.05$) influence all the performance parameters measured, except survivability. The final weight (1938.42g) obtained in broiler fed on control diet is ($P < 0.05$) higher than 1835.94g vs 1875.26g in broiler fed on breadfruit leaf meal and breadnut leaf meal, respectively. A higher

daily feed intake value (75.12g) was observed in broiler chickens fed breadnut leaf meal, while a lower feed intake (72.48g) was obtained in broiler chickens fed breadfruit leaf meal diet. This result negates the findings of Abdulsalam et al. (2015), who documented that *Moringa oleifera* leaf meal as an additive in broiler chickens' feed had no significant ($P > 0.05$) effect on feed consumption and feed conversion ratio.

The lowest FCR value (1.66) was obtained in broilers fed breadfruit leaf meal, which is similar to the value obtained in broilers fed the control diet (1.66). Meanwhile, the highest value (1.69) was obtained in broilers fed a diet containing breadnut leaf meal. The appreciable body weight, reduced feed intake, and improved FCR could be a reflection of the palatability and digestive stimulation properties of the gastrointestinal tract (GIT). This result corroborates the findings of Parade et al. (2019) that broiler chickens supplemented with lemongrass leaf powder consume less feed than the control group. Similarly, Fafiolu et al. (2020) observed and reported a quantitative increase in body gain, reduced feed intake, and improved FCR observed in broiler chickens fed phytogenic feed additives at 4-6 weeks of age with lemon and orange peels as phyto-additive. Contrary to the result obtained in this study, Madhupriya et al. (2018) documented that

Table 5. Main Effect of Ingredient (breadnut leaf and breadfruit leaf meal) and supplementation levels on growth performance of broiler chickens

Parameters	CONTROL	Phyto-additives			Supplementation Level			
		BN	BF	SEM	3g	6g	9g	SEM
Initial weight (g)	42.92	43.10	43.07	0.32	42.97	43.03	43.26	0.39
Final weight (g)	1938.42 ^a	1875.26 ^b	1835.94 ^c	37.49	1862.69 ^b	1852.42 ^b	1851.68 ^b	45.91
Total weight gain (g)	1895.50 ^a	1832.16 ^b	1792.87 ^c	37.25	1819.72 ^b	1809.39 ^c	1808.42 ^c	45.35
Daily weight gain (g)	45.13 ^a	43.62 ^b	42.72 ^c	0.88	43.32 ^b	43.08 ^b	43.06 ^b	1.08
Daily feed intake (g)	73.50 ^b	75.12 ^a	72.48 ^c	1.14	75.37 ^a	71.35 ^c	74.68 ^b	1.40
Feed conversion ratio	1.66 ^b	1.69 ^b	1.66 ^b	0.04	1.74 ^a	1.57 ^c	1.73 ^a	0.05
Survivability (%)	100.00	97.22	96.29	0.01	98.61	94.44	97.22	0.02

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

BN = Breadnut leaf meal, BF = Breadfruit leaf meal

the supplementation of broilers' diets with PFAs improves feed intake. Similarly, Witkowska et al. (2019) also reported the highest feed intake in broiler chickens fed thyme essential oil as a phyto-additive supplementation.

The bird fed with the control diet had the highest ($p<0.05$) daily weight gain (45.13g). In comparison, the lowest value (43.06g) was recorded at the 9g supplementation level, which is similar to the values (43.32g and 43.08g) recorded at the 3 g and 6g supplementation levels, respectively. The highest ($p<0.05$) daily feed intake (75.37g) was obtained in broilers fed phyto-genic feed additives at 3g per kg of feed, but the lowest value (71.35g) was obtained in broilers fed phytoadditives at 6g per kg of feed. This result negates the findings of Purnama et al. (2021), who reported that supplementation of 10 g/kg dietary breadfruit leaf powder caused an increase in body weight gain when

compared with other birds fed 2.5g and 5g /kg breadfruit leaf powder. Broilers fed phytoadditives at 6g per kg of feed had the least (1.57) value of feed conversion ratio.

The interaction effect of inclusion levels with breadnut leaf and breadfruit meal on growth performance of broiler chickens is presented in Table 6.

Broilers fed breadnut leaf meal at 9g per kg of feed had heavier final weight gain (2037.31g) compared to the counterparts fed the same phyto-genic feed additives. Daily feed intake observed for broiler chickens fed breadnut leaf meal (77.89g) at 9g per kg of feed was ($P<0.05$) higher than that of broiler chickens fed breadfruit leaf meal at 9g per kg of feed (71.48g). However, broilers fed breadfruit meal at 6g per kg of feed had a significantly higher feed intake (70.46g) than broilers fed breadnut leaf meal at 6g per kg of feed (68.20g). The broiler chickens fed breadnut

Table 6. Interaction Effect of inclusion levels and ingredient type on growth performance of broiler chickens

Parameters	Phyto-additives	Supplementation Levels			SEM
		3g	6g	9g	
Initial weight (g)	Breadnut leaf	42.69	43.08	43.53	0.31
	Breadfruit leaf	43.25	42.97	43.00	0.31
	SEM	0.38	0.38	0.38	
Final weight (g)	Breadnut leaf	1898.72 ^b	1815.36 ^b	2037.31 ^{aX}	39.85
	Breadfruit leaf	1938.72 ^a	1814.14 ^b	1843.22 ^{bY}	39.85
	SEM	48.81	48.81	48.81	
Daily weight gain (g)	Breadnut leaf	44.22 ^a	42.28 ^b	47.47 ^{aX}	0.93
	Breadfruit leaf	45.13 ^a	42.23 ^b	42.92 ^{bY}	0.93
	SEM	1.14	1.14	1.14	
Daily feed intake (g)	Breadnut leaf	75.23 ^a	68.20 ^{bY}	77.89 ^{aX}	1.38
	Breadfruit leaf	75.50 ^a	70.46 ^{bX}	71.48 ^{bY}	1.38
	SEM	1.69	1.69	1.69	
Feed conversion ratio	Breadnut leaf	1.74 ^a	1.52 ^{bY}	1.83 ^a	0.04
	Breadfruit leaf	1.75 ^a	1.62 ^{bX}	1.63 ^b	0.04
	SEM	0.04	0.04	0.04	
Survivability (%)	Breadnut leaf	97.22	94.44	100.00	0.01
	Breadfruit leaf	100.00	94.44	100.00	0.01
	SEM	0.02	0.02	0.02	

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

SEM Standard Error of Mean

leaf meal at 6g per kg of feed had the lowest feed conversion ratio (1.52) compared to their counterparts fed the same phytogetic feed additives.

This result corroborates the report of Purnama et al. (2021), who reported that supplementation of 10 g/kg dietary breadfruit leaf powder caused an increase in body weight gain of the bird. Notably, the feed conversion ratio displayed a significant increase in birds fed a diet containing 6g of breadfruit leaf meal compared to those on diets containing 6g of breadnut leaf meal per kg of feed.

The main effect of feeding breadnut and breadfruit leaf meal as phytoadditive on the nutrient digestibility of broiler chickens is presented in Table 7.

No significant ($P>0.05$) difference was observed in the value obtained for crude fibre digestibility, but significant ($P<0.05$) differences were observed in the value obtained for dry matter digestibility, crude protein digestibility, crude fat digestibility, nitrogen-free extract digestibility, and ash digestibility.

Broilers fed 3g breadnut leaf meal had higher ($P<0.05$) dry matter digestibility and crude protein digestibility value (81.04 and 92.46%, respectively). In comparison, broiler chickens fed 9g breadnut leaf meal had lower ($P<0.05$) dry matter and crude protein digestibility values of 65.88 and 85.89%, respectively.

Broiler chickens fed 9g breadnut leaf meal had ($P<0.05$) lower nitrogen-free extract and

ash digestibility (56.25 and 68.98 %, respectively). In comparison, higher ($P<0.05$) value (76.15 and 77.44 %) was recorded for nitrogen-free extract and ash digestibility, respectively, in broiler chickens fed 3g breadnut leaf meal. The supplementation of breadnut leaf meal and breadfruit leaf meal in the basal diet resulted in increase in crude protein, crude fat, Nitrogen free extract and Ash digestibility with decreasing value in crude fibre digestibility this contradict the findings of Marivel et al. (2020), who reported decrease in Crude protein, Crude fat, and Ether extra extract digestibilities in broiler chickens fed diets containing ginger and garlic. Similarly, Shittu et al. (2021) observed a decrease in Crude protein, Crude fat, and Ether extract digestibilities except crude fibre digestibility.

The main effect of feeding two different phytoadditives on the nutrient digestibility of broiler chickens is presented in Table 8. Significant ($P<0.05$) differences were observed at varying inclusion levels in all parameters measured except crude fat and Ash digestibility.

Broilers fed phytoadditives at 9g per kg of feed had the lowest value (72.12%) for dry matter digestibility, while broilers fed phytoadditives at 3g per kg of feed had better dry matter (78.99%). Broilers fed phytoadditives at 9g per kg of feed had the lowest value (88.71%) for crude protein digestibility. In comparison, broilers fed phytoadditives at 3g per kg of feed digested crude protein better (91.74%). Broilers fed phytoadditives at 6g

Table 7. Nutrient digestibility of Broiler chickens fed Breadnut and Breadfruit leaf meal at the Finisher phase

Parameters (%)	T1	T2	T3	T4	T5	T6	T7	SEM	P-value
Dry Matter (%)	73.64 ^b	81.04 ^a	71.54 ^b	65.88 ^c	76.93 ^a	79.40 ^a	78.36 ^a	1.10	0.03
Crude Protein (%)	89.23 ^b	92.46 ^a	88.64 ^b	85.89 ^c	91.02 ^a	92.15 ^a	91.53 ^a	1.26	0.03
Crude Fat (%)	90.46 ^a	93.59 ^a	90.28 ^a	87.45 ^c	92.23 ^a	93.31 ^a	92.67 ^a	1.15	0.02
Crude Fibre (%)	80.21	81.87	75.06	77.80	79.21	80.12	81.20	0.97	0.07
NFE (%)	66.15 ^b	76.15 ^a	63.74 ^b	56.25 ^c	70.64 ^a	74.03 ^a	72.54 ^a	0.94	0.04
Ash (%)	72.01 ^b	77.44 ^a	68.98 ^c	62.97 ^c	74.14 ^b	74.69 ^b	74.73 ^b	0.52	0.02

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

T1= Control, T2= 3g breadnut leaf meal, T3= 6g breadnut leaf meal, T4= 9g breadnut leaf meal, T5= 3g breadfruit leaf meal, T6= 6g breadfruit leaf meal, T7= 9g breadfruit leaf meal per kg of feed, SEM: Standard Error of Mean, NFE: Nitrogen-free extract

per kg of feed had the lowest value (77.60%) for crude fibre digestibility. In comparison, those fed phytoadditives at 3g per kg of feed digested the crude fibre better (80.54%). Birds fed phytoadditives at 9g per kg of feed had the lowest value (64.39%) for nitrogen-free extract digestibility. In comparison, broilers fed phytoadditives at 3g per kg of feed digested the nitrogen-free extract better (73.39%).

Feeding different phytoadditives had a significant ($P<0.05$) influence on all parameters measured except crude fat and Ash digestibilities. Birds fed breadnut leaf meal had ($P<0.05$) low dry matter digestibility (72.82%) when compared with the broilers fed breadfruit leaf (78.23%). Broiler chickens fed breadnut leaf meal had a lower ($P<0.05$) value (88.99%) of crude protein digestibility, while the birds fed breadfruit leaf meal had a higher ($P<0.05$) value (91.56%). Broilers fed breadnut leaf meal have a lower ($P<0.05$) value (78.25%) of crude fibre digestibility when compared with broiler chickens fed breadfruit leaf meal, which had a higher ($P<0.05$) value (80.18%). Broiler chickens fed breadnut leaf meal had a lower ($P < 0.05$) value (55.38%) of nitrogen-free extract digestibility compared to broiler chickens fed breadfruit leaf meal, which had a higher ($P < 0.05$) value (72.41%) recorded for nitrogen-free extract. The improvement in crude protein digestibility and other parameters by supplementing diets with the phytogenic feed additive (PFA) can be attributed to its potential to cause an

increase in intestinal villi length and enhance endogenous secretions. Furthermore, several studies have reported that PFAs can improve the digestibility of feed nutrients, particularly protein digestibility (Giannenas et al., 2014; Steiner and Syed, 2015). This improvement results in better utilization of amino acids, leading to reduced excretion of nitrogenous compounds in feces. The current results are in agreement with the findings of El-Deek et al. (2012) and Zentner et al. (2012), who reported that PFAs have the potential to reduce emissions from animal houses. By maintaining good litter quality in poultry houses, producers can reduce economic losses and improve the welfare of chickens (Taira et al., 2014).

Table 9 below summarizes the interaction effect of different phytoadditives and the level of inclusion on nutrient digestibility of broiler chickens.

There were significant ($P<0.05$) interaction effects observed for dry matter digestibility, Crude protein digestibility, crude fat digestibility, nitrogen-free extract digestibility, and Ash digestibility. Broiler chickens fed breadfruit leaf meal at 6g and 9g per kg of feed had significantly ($P<0.05$) better dry matter (79.40 and 78.36%, respectively). This corroborate the findings of Upah et al, (2021), who documented that crude protein, crude fibre, ether extract, nitrogen free extract and ash were significantly ($P<0.05$) different among dietary treatment groups in his study on *Euphorbia heterophylla* (Spurge weed) leaf meal as phyto-

Table 8. Main Effect of Ingredient (breadnut leaf and breadfruit leaf meal) and varying levels on Nutrient digestibility of broiler chickens

Parameters	control	Phyto-additives		SEM	Supplementation level (g)			SEM
		BN	BF		3g	6g	9g	
Dry Matter (%)	73.64 ^b	72.82 ^b	78.23 ^a	1.92	78.99 ^a	75.47 ^b	72.12 ^c	2.35
Crude protein (%)	89.23 ^b	88.99 ^b	91.56 ^a	0.79	91.74 ^a	90.39 ^a	88.71 ^c	0.98
Crude Fat (%)	90.46	90.44	92.74	0.73	92.92	91.79	90.06	0.89
Crude Fibre (%)	80.21 ^a	78.25 ^b	80.18 ^a	1.77	80.54 ^a	77.60 ^b	79.50 ^a	2.17
Ash (%)	72.01	70.01	74.52	2.11	75.79	71.83	68.85	2.59
NFE	66.15 ^b	65.38 ^b	72.41 ^a	2.45	73.39 ^a	68.89 ^b	64.39 ^c	3.00

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

BN = Breadnut leaf meal, BF = Breadfruit leaf meal

Table 9. Interaction Effect of inclusion levels with breadnut leaf and breadfruit leaf meal on Nutrient digestibility of broiler chickens

Parameters	Phyto-additives	Supplementation Levels (g)			SEM
		3g	6g	9g	
Dry Matter (%)	Breadnut leaf	81.04 ^a	71.54 ^{bY}	65.88 ^{cY}	1.91
	Breadfruit leaf	76.93 ^b	79.40 ^{aX}	78.36 ^{bX}	1.91
	SEM	2.34	2.34	2.34	
Crude protein (%)	Breadnut leaf	92.46 ^a	88.64 ^{bY}	85.90 ^{cY}	0.78
	Breadfruit leaf	91.01 ^a	92.15 ^{aX}	91.53 ^{aX}	0.78
	SEM	0.95	0.95	0.95	
Crude Fat (%)	Breadnut leaf	93.60 ^a	90.28 ^{bY}	87.45 ^{cY}	0.71
	Breadfruit leaf	92.23 ^a	93.31 ^{aX}	92.67 ^{aX}	0.71
	SEM	0.86	0.86	0.86	
Crude Fibre (%)	Breadnut leaf	81.87	75.07	77.80	1.87
	Breadfruit leaf	79.21	80.13	81.20	1.87
	SEM	2.29	2.29	2.29	
Ash (%)	Breadnut leaf	77.44 ^a	68.97 ^b	62.96 ^{cY}	2.10
	Breadfruit leaf	74.14 ^a	74.69 ^a	74.73 ^{aX}	2.10
	SEM	2.57	2.57	2.57	
Nitrogen Free Extract (%)	Breadnut leaf	76.15 ^a	63.75 ^{bY}	56.25 ^{cY}	2.44
	Breadfruit leaf	70.64 ^a	74.03 ^{aX}	72.54 ^{aX}	2.44
	SEM	2.98	2.98	2.98	

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

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

SEM = Standard Error of Mean, 3g = Phytoadditives per kg of feed, 6g = Phytoadditives per kg of feed, 9g = Phytoadditives per kg of feed

additives, but negates the findings of Wang et al. (2021), who reported that Phytogenic Feed Additives supplementation did not cause significant differences in the digestibility of dry matter and crude protein among the treatments.

Broiler chickens fed breadfruit leaf meal at 6g and 9g per kg of feed had significantly ($p < 0.05$) higher dry matter digestibility (79.40 and 78.36%, respectively), crude protein digestibility (92.15 and 91.53%, respectively), crude fat digestibility (93.31 and 92.67%, respectively), and nitrogen free extract digestibility (74.03 and 72.54%, respectively) than their counterparts fed breadnut leaf meal at the same inclusion level. Broiler-fed breadfruit leaf meal at 9g per kg of feed had significantly ($p < 0.05$) higher ash digestibility (74.73%) compared to the counterparts fed the same inclusion level of breadnut leaf meal.

The high digestibility of crude protein, ether extract, and nitrogen-free extracts among all dietary treatments by the broiler chicks may be due to improved morphological and physiological development of the intestine, resulting in better intestinal absorption and utilization of nutrients in the diets. This agreed with the findings of Hashemi et al. (2008a) and Biasata et al. (2018), who reported that high concentration of polyunsaturated fatty acids and antimicrobial, anti-oxidative and anti-inflammatory properties of phytochemicals in *Euphorbia heterophylla* which enhanced a balance between the host, intestinal microbiota, intestinal microscopic features and diets results in improved gut health, intestinal morphology, improve digestive process, increased digestibility, absorption and retention of protein in amino acid.

CONCLUSION

It can be concluded that incorporating breadnut and breadfruit leaf meal into the diets of broiler chickens as phytogetic feed additives significantly enhances their weight gain and feed conversion ratio. Specifically, supplementing 6 grams of breadnut leaf meal per kilogram of diet has been shown to improve the overall performance of broiler chickens without the use of synthetic antibiotics.

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Received: May 27, 2025; Approved: July 30, 2025; Published: October, 2025