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Original Research Article

ASSESSMENT OF EFFECT OF THORN APPLE FRUIT, LEAF AND THEIR COMBINATION ON GROWTH PERFORMANCE, BLOOD PROFILE OF BROILER CHICKEN

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ABSTRACT

Phytobiotics are plant-derived products that serve as natural growth promoters and can be used in diets of livestock to improve overall performance. One hundred and twenty (120) unsexed day-old Ross 308 chicks were used for this study Using a completely randomized design (CRD), the chicks were allotted to four (4) dietary treatments of 30 chicks per treatment and 3 replicates of 10 chicks each: T1 (Control diet; T2 (Thorn apple fruit:2g/kg f feed); T3 (Thorn apple leaf: 2g/kg of feed) and T4 (Thorn apple fruit 1g/kg of feed and leaf 1g/kg of feed). The experiment lasted for six weeks. Data on Growth, carcass, organ characteristics, nutrient digestibility and blood profile were collected. The highest (P≤0.05) weight-gain (3249.16g) was recorded with broiler chicks fed diet containing T4 while lowest weight-gain (3207.14g) was recorded with broiler chicks fed diet containing T2. Feed conversion ratio (FCR) was also significantly (P≤0.05) lower (1.60) with chicks fed diet T4 while the highest FCR (1.78) was record in chicks fed diet T2.Those chicks fed the diet T4 also had the highest value (P≤0.05) of carcass weight (2847.00g) while those fed the diet T3 had the lowest (2430.00g). Packed cell volume ranged from 22.55% (T1) to 25.54% (T2), while red blood cell count ranged from 1.84 × 10^6/µL to 2.06 × 10^6/µL. The study concluded that thorn apple fruit and leaf blend had positive effects on growth performance, carcass, organ characteristics, nutrient digestibility, and blood profile of broiler chicken. Thus, a combination of apple fruit 1g per kg of feed and leaf 1g per kg of feed is recommended for improved overall performance and health status of broiler chicks.

Keywords: Broilers; Growth performance, Thorn Apple (leaf, fruits)

INTRODUCTION

The demand from consumers for natural, safe, and nutrient-dense animal feed presents a challenge for animal nutrition. Growing consumer interest in natural bioactive components has led to the use of herbal plants as advantageous ingredients in the food and feed production industries to replacement of potentially hazardous synthetic additives (Sacchetti *et al.*, 2005). These sectors are currently looking for effective, safe compounds with proven advantages. Medicinal plants are inexpensive, dependable, readily available, and have low toxicity, thus, they are widely used and accepted in medical care worldwide, and by people of all faiths. Plants of antimicrobial, antioxidant, anti-infectious, and anti-tumor properties are the earliest materials utilized to treat variety of illnesses among the medicinal and pharmacological benefits of certain plants (Olayeni *et al.*, 2025). Many nations have made extensive use of herbal medicine as a fundamental component of primary healthcare (Akinyemi *et al.*, 2005).

Feed additives are minor components of the animal ration that are used for improving the quality or digestibility of feed, improving the nutritive and aesthetic quality of food or improving animal performance and health.

The main aim of adding feed additives to the diet of broiler chickens is to improve the growth rate, achieve better feed

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conversion efficiency, greater liveability and reduced mortality.

It was reported that up to one third of all commercial chicken rations in most part of the world is now a mixture of herbs and spices to accelerate growth and maintain health (Okanlawon *et al.,* 2024, Okanlawon *et al*., 2025).

This study focused on the synergetic effects of phyto-additives.Thorn apple leaf and seed have been regarded as good sources of natural medicine and antioxidants which are capable of preventing stress and potential diseases in animals (Olusola *et al.,* 2018; Rafiu *et al.,* 2025). They have some chemical substances which can nourish, heal and improve different organisms (Eshun & He, 2004). The increased restrictions on the use of synthetic growth promoters and feed based probiotics in poultry production, results in a growing need to explore natural, plant-based alternatives that are effective, safe, and affordable. Thorn apple (*Datura stramonium*) contains phytochemicals that may improve digestion, enhance gut health, and support growth according to (Rafiu *et al*., 2025).

Phytobiotics are limited in action due to plant species, soil types, location and weather condition. Processing and storage conditions may also affect composition of plants and potency of their active ingredients (Okanlawon *et al.,* 2024). Due to variation in nutrient compositions of thorn apple seed and leaf, this study therefore targeted the provision of scientific evidence on its efficacy and safety, contributing to sustainable poultry production and offering farmers a potential low-cost alternative to synthetic additives.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Faculty of Agricultural Science, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria. Ogbomoso is situated in the derived savanna zone of Nigeria on the Longitude $4^{0}5^{1}$ East of Greenwich meridian and $8^{0}15^{1}$ North East of the equator (Google Earth Map, 2025)

PREPARATION OF TEST INGREDIENTS

Thorn apple was collected, cut into smaller sizes on a flat surface area and was shade dried until the weight remains constant and was milled into fine powdery form. Thereafter it was sieved and stored in air tight container until use as reported by Rafiu *et al.* (2025).

ANIMALS AND MANAGEMENT

One hundred and twenty (120) unsexed day-old Ross 308 chicks were purchased from a reputable hatchery and used for the experiment. the chicks were allotted to four (4) dietary treatments of 30 per treatment and 3 replicates of 10 chicks each: T1: Control diet, T2–Thorn apple fruit (2g of fruit per kg of feed), T3–Thorn apple leaf (2g of leaf per kg of feed) and T4–Thorn apple fruit and leaf (1g of fruit and 1g of leaf per kg of feed).All management practices were strictly carried out. Feeds and water were given *ad-libitum* throughout the experimental period. The experiment lasted for six (6) weeks.

DATA COLLECTION

GROWTH PERFORMANCE

Weight gain (g) = Final weight (g) - Initial body weight (g)

Feed Intake (g) = (Quantity served – Leftover)

Feed Conversion Ratio (FCR) = $\frac{\text{feed intake (g)}}{\text{weight gain(g)}}$

CARCASS CHARACTERISTICS

At the end of 6 weeks experimental period, three chicks were randomly selected, and starved of feed for 12 hours but with the presence of abundant water. They were slaughtered by severing the jugular veins. The broilers were bled; defeathered after which their visceral organs (liver, intestine, pancreas, spleen, kidney, proventriculus, and heart were removed). The bled, defeathered and eviscerated weights of the broilers were evaluated. Their heads and shanks were removed to determine the

Proportional weight of the organs = $\frac{\text{Weight of the organs}}{\text{Live weight of the chicken}} \times 100$

The carcass was cut into various parts (thigh, breast, back, shank, drumstick, wings and head) and their weights were expressed in percentages relative to their carcases weights. Weights of the organs were also expressed in relative values. The following calculations were made:

Relative cut part-weight = $\frac{\text{Weight of the cut}}{\text{Carcass weight}} \times 100$

NUTRIENT DIGESTIBILITY

Digestibility trial was conducted using 6 broilers per treatment (2 per replicate). They were randomly selected and transferred to metabolic cages equipped with facilities for separate feeding and collection of excreta. After a 3-day adaptation period in the cages, total excreta collection was conducted for 5 consecutive days. Feed consumption during this period was carefully recorded. After documentation of total weight of daily excreta, samples were collected, weighed and dried in a forced-air oven at 65℃ for 12 hours. The dried excreta samples were weighed, pooled together on replicate bases and ground before they were sent to the laboratory for chemical analysis (A.O.A.C, 1995). Representative samples of each experimental diet were also analysed using the same procedures.

The apparent nutrient digestibility coefficients were calculated using the equation:

Apparent Digestibility (%)

$$= \% \frac{\text{Nutrient intake}}{} - \% \text{Nutrient in excreta} \times 100$$
$$\% \text{ Nutrient intake}$$

BLOOD COLLECTION AND ANALYSIS

Haematological Parameters

Four broilers were randomly selected from each treatment-group.About 2.5 mL of blood were collected from each in tubes containing EDTA anticoagulant by slowly expressing them, after removing the needle from the syringe, to reduce the risk of hemolysis (Haen, 1995) and analyzed to determine blood parameters (haemoglobin concentration, packed cell volume, red blood cells count, total white blood cells count, differential white blood cells count, platelets count) as describe by Iranloye *et al*. (2002) and Venkatesan *et al*. (2006) and total protein as described by Kohn &Allen (1995). Albumin was determined using Bromocresol Green (BCG) method as described by Peter *et al*. (1982). Aspartate transferase (AST) activities were determined using spectrophotometric methods as described by Rej & Hoder (1983). Alanine transferase (ALT) activities were determined using spectrophotometric methods as described by Rej & Hoder (1983). The globulin concentration was calculated by subtracting albumin from the total protein.

Data collected were analysed using Analysis of Variance as contained in SAS (2002). Significant means were separated using Duncan Multiple Range Test as contained in SAS (2002). Values of $P \leq 0,05$were considered significant.

RESULTS

The result of growth performance of broiler chicken fed with different level of thorn apple fruit, leaf and their blend is presented in Table I. Highest final weight gain and average daily weight gain (3249.16g), (82.00g) were recorded with broiler chicken fed diets containing thorn apple fruit and leaf blend (1g of fruit and 1g of leaf per kg of feed), respectively, while lowest values (3207.14g), (73.97g) were recorded with broiler chicken fed diet containing thorn apple fruit (2g of fruit per kg of feed). Highest ($P \leq 0.05$) total feed intake and daily feed intake (5696.40g), (132.47g) were recorded with broiler chicken fed diets containing thorn apple leaf (2g of leaf per kg of feed) while lowest values (5386.40g), (125.26g) were recorded with broiler chickens fed control diet.The highest($P \leq 0.05$) feed conversion ratio value (1.78) was recorded with broilers fed diet T2,thorn apple fruit (2g of fruit per kg of feed) while broiler birds fed diet T4 (1.60) had the least.

TABLE I: GROWTH PERFORMANCE-INDICES OF BROILER CHICKENS FED DIFFERENT LEVELS OF THORN APPLE FRUIT, LEAF AND THEIR BLEND

Parameters	Control	Fruit	Leaf	Leaf+Fruit	SEM
Weight gain (g)	3227.01^{bc}	3207.14^{c}	3239.03^{b}	3249.16^{a}	40.50
ADWG	74.06^{bc}	73.97^{c}	77.35^{b}	82.00^{a}	0.96
Total feed intake	5386.40^{b}	5537.10^{a}	5696.40^{a}	5507.35^{a}	43.78
Daily feed intake	125.26^{c}	128.76^{b}	132.47^{a}	128.07^{b}	1.01
Feed conversion ratio	1.73^{a}	1.78^{a}	1.75^{a}	1.60^{b}	0.02

^{abc}**: Means in the same row with different superscripts differ significantly (P≤0.05). AWGA-Average daily weight gain**

The impact of thorn apple fruit, leaf and their blend on carcass characteristics on broiler chicken and relative cut-up portions of broiler chicken is shown in Table II. Carcass weight, and breast, wing, back, drumstick, thigh and back are significantly ($P \leq 0.05$) different. Broiler chicken birds fed diet containing thorn apple fruit and leaf powder blend (1g of fruit and 1g of leaf per kg of feed)had the highest value ($p<0.05$) of carcass weight (2847.00g) while broiler chicken fed diet containing thorn apple leaf (2g of leaf per kg of feed) had the least (2430.00g).Breast weight was highest ($P \leq 0.05$) in broiler fed diet thorn apple fruit and leaf powder blend (1g of fruit and 1g of leaf per kg of feed) (40.13%), while the lowest value (35.33%) was found in broiler fed diet containing thorn apple fruit (2g of fruit per kg of feed).The wing weight of broiler chickens fed a diet containing thorn apple leaf (2g of leaf per kg of feed)($P < 0.05$) at 10.04%, whereas the weight of those fed a control diet was the lowest at 8.62%.Highest value ($P < 0.05$) of back (18.26%) was recorded from broiler chicken fed diet containing Thorn apple fruit (2g of fruit per kg of feed) while broiler chicken fed diet containing Thorn apple fruit and leaf (1g of fruit and 1g of leaf per kg of feed) had the least (15.79%).Highest value ($P < 0.05$) of thigh (16.03%) was recorded from broiler chicken fed diet containing T2–Thorn apple fruit (2g of fruit per kg of feed) while broiler chicken fed diet containing Thorn apple fruit and leaf (1g of fruit and 1g of leaf per kg of feed) had the least (15.14%). Highest value ($P < 0.05$) of thigh (7.45%) was recorded from broiler chicken fed diet containing Thorn apple leaf (2g of leaf per kg of feed) while broiler chicken fed diet containing Thorn apple fruit and leaf (1g of fruit and 1g of leaf per kg of feed) had the least (6.90%).

TABLE II: CARCASS CHARACTERISTICS OFBROILER CHICKENS FED DIET CONTAINING DIFFERENT LEVELS OF THORN APPLE FRUIT, LEAF AND THEIR BLEND

Parameters	Control	Fruit	Leaf	Leaf+Fruit	SEM
Live Wt. (g)	3850.00	3800.00	3950.00	3950.00	43.55
Carcass weight	2689.50^{ab}	2687.50^{ab}	2430.00^{b}	2847.00^{a}	44.5
Dressing %	69.91	70.72	61.43	72.02	0.90
Breast	39.27^{ab}	35.33^{c}	38.31^{b}	40.13^{a}	0.43
Wing	8.62^{b}	9.44^{ab}	10.04^{a}	9.37^{ab}	0.12
WriBack	16.95^{c}	18.26^{a}	17.06^{b}	15.79^{d}	0.17
Drumstick	12.63	12.62	12.20	12.66	0.17
Thigh	15.39^{b}	16.03^{a}	15.29^{b}	15.14^{b}	0.21
Neck	7.21^{b}	7.22^{b}	7.45^{a}	6.90^{c}	0.07

^{abc}: Means in the same row with different superscripts differ significantly (P < 0.05). T1: Control diet, T2–Thorn apple fruit (2g of fruit per kg of feed), T3–Thorn apple leaf (2g of leaf per kg of feed) and T4–Thorn apple fruit and leaf (1g of fruit and 1g of leaf per kg of feed).

The effect of thorn of organ characteristics of broiler chicken fed different level of thorn apple fruit, leaf and their blend are presented in Table III. There was significant (P < 0.05) difference on whole gizzard, empty gizzard, proventriculus, kidney, liver, heart, bursa, pancreas, spleen, lungs. There were significant differences (P < 0.05) across the treatments for whole gizzard, empty gizzard, proventriculus, kidney, heart, pancreas, spleen, lungs, while liver and bursa showed no significant (P > 0.05) differences across the treatments.

Whole gizzard differed significantly across the treatments. T1 recorded the highest value of 1.53% while T2 and T3 recorded the least values of 1.15%. Whole gizzard values ranged from 1.15% (T2 and T3) to 1.53% (T1). Empty gizzard also differed significantly across the treatments. T1 recorded the highest value of 1.05% while T3 recorded the least value of 0.82%. The values ranged from 0.82% (T3) to 1.05% (T1).

Proventriculus values ranged from 0.19% (T3) to 0.35% (T1), with T1 recording the highest value while T3 recorded the least value. Kidney weight ranged from 0.26% (T4) to 0.36% (T1), while heart weight ranged from 0.31% (T4) to 0.38% (T1).

These parameters differed significantly across the treatments. Pancreas weight differed significantly across the treatments with T1 and T2 recording the highest values of 0.16% while T3 recorded the least value of 0.13%. Spleen weight also differed significantly and ranged from 0.06% (T2) to 0.097% (T1). Lung weight differed significantly across the treatments.

TABLE III: ORGAN CHARACTERISTICS OF BROILER CHICKEN FED DIETS CONTAINING VARYING LEVEL OF THORN APPLE FRUIT, LEAF AND THEIR BLEND

Parameters (%)	Control	Fruit	Leaf	Leaf+Fruit	SEM
Whole gizzard	1.53^{ab}	1.15^{b}	1.15^{b}	1.26^{a}	0.70
Empty gizzard	1.05^{ab}	0.94^{b}	0.82^{b}	0.90^{b}	0.03
Proventiculus	0.35^{a}	0.28^{ab}	0.19^{b}	0.32^{a}	0.01
Kidney	O.36^{ab}	0.35^{ab}	0.31^{ab}	0.26^{b}	0.01
Liver	1.64	1.48	1.54	1.49	0.03
Heart	0.38^{a}	0.33^{ab}	0.33^{ab}	0.31^{b}	0.00
Bursar	0.04	0.03	0.34	0.47	0.00
Pancreas	0.16^{ab}	0.16^{abc}	0.13^{c}	0.14^{bc}	0.00
Spleen	0.097^{a}	0.06^{c}	0.08^{ab}	0.07^{abc}	0.00
Lungs	0.51^{a}	0.42^{ab}	0.44^{ab}	0.45^{ab}	0.01

$^{abc:}$ Means on the same row with different superscript are significantly(P > 0.05) different. T1: Control diet, T2–Thorn apple fruit (2g of fruit per kg of feed), T3–Thorn apple leaf (2g of leaf per kg of feed) and T4–Thorn apple fruit and leaf (1g of fruit and 1g of leaf per kg of feed)

Effects of thorn apple fruit, leaf and their blend on haematological parameter of broiler chickens are presented in Table IV. There were significant differences (P<0.05) across the treatments for PCV, HCT, Hb, RBC, MCV, MCH, MCHC, neutrophils, lymphocytes, eosinophils, platelet count, mean platelet volume, platelet distribution width, plateletcrit, AST, ALT and albumin while, WBC, monocytes, basophils, ALP, total protein, globulin and cholesterol showed no significant differences across the treatments.

TABLE IV: HAEMATOLOGICAL PARAMETER OF BROILER CHICKENS FED DIETS CONTAINING VARYING LEVEL OF THORN APPLE FRUIT, LEAF AND THEIR BLEND

Parameters	Control	Fruit	Leaf	Leaf+Fruit	SEM
PCV (%)	22.55^{b}	25.54^{a}	24.10^{a}	25.10^{a}	0.36
HCT (L/L)	0.22^{b}	0.25^{a}	0.24^{a}	0.25^{a}	0.00
HB (g/L)	7.51^{b}	8.52^{a}	8.03^{ab}	8.33^{a}	1.43
RBC (X10^{12}L)	1.84^{b}	2.06^{a}	2.03^{a}	2.02^{a}	0.03
MCV (FL)	122.30^{ab}	123.05^{a}	118.50^{b}	123.95^{a}	0.77
MCH (pg)	60.30^{a}	57.80^{b}	57.40^{b}	59.70^{a}	0.35
MCHC (LgL)	34.13^{a}	33.35^{c}	33.32^{b}	33.19^{b}	2.33
WBC (X10^{9}L)	129.90	124.00	134.95	131.05	1.88
Neutrophils,	19.00^{b}	19.00^{b}	40.50^{a}	24.05^{b}	2.17
Lymphocytes,	74.00^{a}	68.00^{a}	52.50^{b}	67.00^{a}	2.73
Eosinophils	0.00^{b}	3.50^{a}	0.00^{b}	1.00^{a}	0.59
Monocytes	6.50	7.00	6.00	5.00	0.74
Basophils	0.50^{a}	2.50^{a}	1.00^{a}	2.50^{a}	0.46
Platelet (X10^{9}L)	21.00^{b}	30.50^{a}	21.00^{b}	34.50^{a}	1.69

^{abc} Means on the same row with different superscript are significantly(P>0.05) different T1: Control diet, T2–Thorn apple fruit (2g of fruit per kg of feed), T3–Thorn apple leaf (2g of leaf per kg of feed) and T4–Thorn apple fruit and leaf (1g of fruit and 1g of leaf per kg of feed). PCV; Packed Cell Volume, HCT;- Hematocrit, HC- Haemoglobin Concentration RBC; Red Blood Cell , WBC;-White Blood Cell, MCH ; Mean Corpuscular Hemoglobin, MCV;- Mean Corpuscular Volume MCV;- Mean Corpuscular Volume, MCHC;- Mean Corpuscular

Across the treatments, T2 (2 g fruit/kg feed) recorded the highest values for packed cell volume and red blood cell count while T1 recorded the least values for these parameters. Packed cell volume ranged from 22.55% (T1) to 25.54% (T2), while red blood cell count ranged from 1.84 × 10^{6}/µL (T1) to 2.06 × 10^{6}/µL (T2). Haematocrit ranged from 0.22 L/L (T1) to 0.25 L/L (T2 and T4). T4 showed the highest values for haemoglobin concentration and mean corpuscular volume while T1 and T3 recorded the least values respectively. Haemoglobin concentration ranged from 7.51 g/dL (T1) to 8.52 g/dL (T4), while mean corpuscular volume ranged from 118.50 fL(T3) to 123.95 fL (T4). Mean corpuscular haemoglobin had highest value in T1 and lowest in T3, ranging from 57.40 pg (T3) to 60.30 pg (T1). Mean corpuscular haemoglobin concentration ranged from 33.19 g/L (T2) to 34.13 g/L (T1), with T1 recording the highest value. Neutrophils were highest in T3 and lowest in T1 and T2, ranging from 19.00% (T1 and T2) to 40.50% (T3). Lymphocytes were highest in T1 and lowest in T3, ranging from 52.50% (T3) to 74.00% (T1). Eosinophils ranged from 0.00% (T1 and T3) to 3.50% (T2), with T2 recording the highest value. Monocytes and basophils showed no significant differences across the treatments.

Monocytes ranged from 5.00% (T4) to 7.00% (T2), while basophils ranged from 0.50% (T1) to 2.50% (T2 and T4).

Platelet count and platelet distribution width were highest in T4 and T2 respectively while T1 and T3 recorded the least values for platelet count. Platelet count ranged from 21.00 × 10^{9}/L (T1 and T3) to 34.50 × 10^{9}/L (T4), while platelet distribution width ranged from 17.80% (T1) to 18.45% (T2). Mean platelet volume was highest in T3 and lowest in T1, ranging from 13.10 fL (T1) to 14.60 fL (T3).

Broiler chickens fed diet containing T4 had higher (P<0.05) levels of aspartate aminotransferase (125.64 IU/L), whereas those fed diet containing control diet had the lowest (41.88 IU/L). Broiler chickens fed diet containing T4 had higher (P<0.05) alanine aminotransferase (21.81 IU/L), whereas those fed the feed containing Thorn apple fruit (2g of fruit per kg of feed) had the lowest (5.23 IU/L). Highest (P< 0.05) albumin (16.39 g/l) was recorded with broiler chicken fed diet containing thorn apple leaf (2g of leaf per kg of feed) while broiler chicken fed diet containing thorn apple fruit (2g of fruit per kg of feed), control diet had the least (14.91g/l).

Alkaline phosphatase, Total protein, globulin and cholesterol showed no significant differences across the treatments. All the result for serum biochemistry are in Table V.

TABLE V: SERUM BIOCHEMISTRY OF BROILER CHICKENS FED DIETS CONTAINING VARYING LEVEL OF THORN APPLE FRUIT, LEAF AND THEIR BLEND

Parameters	Control	Fruit	Leaf	Leaf+Fruit	SEM
AST (iul)	41.88^{c}	107.31^{ab}	88.99^{b}	125.64^{a}	9.47
ALT (iul)	9.59^{b}	5.23^{c}	4.36^{d}	21.81^{a}	2.90
ALP (iul)	160.64	172.36	168.50	161.27	2.12
Total protein (g/l)	34.22	32.83	37.90	34.62	1.00
Albumin (g/l)	15.07^{ab}	14.91^{b}	16.39^{a}	15.94^{ab}	0.24
Globulin (g/l)	19.14	17.91	21.51	18.67	0.88
CHOL (mmol/L)	2.74	2.81	2.69	3.13	0.76

^{abc} Means on the same row with different superscript are significantly(P>0.05) different. T1: Control diet, T2–Thorn apple fruit (2g of fruit per kg of feed), T3–Thorn apple leaf (2g of leaf per kg of feed) and T4–Thorn apple fruit and leaf (1g of fruit and 1g of leaf per kg of feed). AST- Aspartate aminotransferase, ALT-Alanine transaminase, ALP- Alkaline phosphate CHOL-Cholesterol

The result of nutrient digestibility of broiler chicken fed diet containing thorn apple fruit, leaf and their blend is presented in Table VI. Across the treatments, T4 (2 g fruit and leaf/kg feed) recorded the highest values for crude protein digestibility and ether extract digestibility while T1 recorded the least values for these parameters. Crude protein digestibility ranged from 57.42% (T1) to 69.90% (T4), while ether extract digestibility ranged from 53.24% (T1) to 68.72% (T4). T2 (2 g fruit/kg feed) recorded the highest values for ash digestibility and nitrogen free extract digestibility while T3 recorded the least ash digestibility and T1 recorded the least nitrogen free extract digestibility across the treatments. Ash digestibility ranged from 71.32% (T3) to 79.79% (T2), while nitrogen free extract digestibility ranged from 88.68% (T1) to 96.34% (T2). Dry matter digestibility was highest in T2 and lowest in T1, ranging from 76.06% (T1) to 83.72% (T2). Crude fibre digestibility ranged from 79.53% (T3) to 81.89% (T4), with no significant differences observed across the treatments.

DISCUSSION

The improvement in weight gain values obtained in this study shows that birds fed combined fruit and leaf recorded the highest value. These values fall within the normal market weight range of approximately 2800 to 3500 g for commercial broiler chickens reared between 6 and 8 weeks under intensive production systems. The present findings are comparable to the reports of Pirgozliev *et al.* (2018), who observed final live weight values ranging from 3000g to 3400g in broiler chickens fed phytogenic feed additives containing essential oils and plant extracts. The authors attributed the improved live weight to enhanced nutrient retention, improved gut integrity and better intestinal absorption of nutrients induced by phytogenic compounds. Similarly, Flees *et al.* (2021) reported significantly improved body weight in broilers supplemented with phytogenic water additives, with values comparable to those obtained in the present study. According to the authors, phytogenic compounds improve intermediary protein metabolism and enhance muscle protein synthesis, thereby increasing growth performance and final body weight.

TABLE VI: NUTRIENT DIGESTIBILITY OF BROILER CHICKENS FED DIETS CONTAINING VARYING LEVEL OF THORN APPLE FRUIT, LEAF AND THEIR BLEND

Parameters (%)	Control	Fruit	Leaf	Leaf+Fruit	SEM
Crude Protein	57.42^{c}	68.52^{b}	62.23^{bc}	69.90^{a}	1.68
Crude fibre	79.83	81.77	79.53	81.89	0.67
Ether Extract	53.24^{b}	64.54^{a}	67.51^{a}	68.72^{a}	1.93
Ash	72.73^{b}	79.79^{a}	71.32^{b}	75.35^{ab}	1.27
Dry matter	76.06^{b}	83.72^{a}	79.67^{ab}	82.57^{a}	0.97
Nitrogen Free Extract	88.68^{c}	96.34^{a}	93.31^{b}	93.51^{b}	0.78

^{abc} Means on the same row with different superscript are significantly(P>0.05) different.T1: control diet, T2-3g (1g Garlic, 1g Ginger and 1g Turmeric) to 1kg of feed, T3: 3g (1g Turmeric, 1g Ginger and 1g Cloves) to 1kg of feed and T4: 4g (1g Garlic, 1 g Turmeric and 1g Clove) to 1kg of feed

The increase in feed intake observed in the supplemented treatments suggests that Thorn apple supplementation enhanced feed palatability, stimulated appetite and possibly improved digestive activity in the experimental birds. The higher feed consumption observed particularly in the group fed T3 may indicate that the leaf component of Thorn apple possessed phytogenic compounds capable of stimulating voluntary feed intake. The findings of the present study agree with the report of Rafiu *et al.* (2025) who reported that thorn apple contains phytochemical compounds such as flavonoids, tannins and saponins which may influence feed consumption and digestive activity depending on inclusion level. The similarity between their findings and the present study indicates that thorn apple supplementation has direct influence on feeding behaviour and nutrient utilization in broiler chickens. However, unlike their study where excessive inclusion reduced feed intake, the present study recorded improved intake particularly in T3 and T4, possibly because the combined fruit and leaf supplementation was used at moderate inclusion levels that enhanced palatability without causing anti-nutritional effects. This improvement is important because increased feed intake under healthy physiological conditions often supports improved nutrient availability, better growth performance and enhanced productive efficiency in poultry production systems. The feed conversion ratio (FCR) values obtained in the present study show that birds fed combined thorn apple fruit and leaf recorded the best value of 1.60. Improved feed conversion efficiency is economically important in poultry production because it reduces feed cost per unit body weight gain. The findings of the present study agree with the report of Pirgozliev *et al.* (2018) and Okanlawon *et al.* (2025), who reported FCR values ranging from 1.58 to 1.80 in broiler chickens fed phytogenic feed additives. The authors explained that phytogenic compounds improved nutrient retention, enhanced intestinal morphology and stimulated digestive enzyme secretion, thereby improving nutrient conversion efficiency. The similarity between their findings and the present study suggests that thorn apple phytochemicals may have enhanced nutrient digestibility and metabolic utilization in the experimental birds. According to the authors, phytogenic compounds modulated lipid and protein metabolism pathways, improved gut health and enhanced intermediary nutrient metabolism, leading to better feed efficiency. Their findings are consistent with the present study and may indicate that thorn apple supplementation enhanced digestive and absorptive efficiency in the broiler chickens.

Carcass characteristics and relative organ weights are important indicators used in evaluating growth performance, carcass yield, physiological status and possible toxicological effects of dietary treatments in poultry production. Parameters such as live weight, carcass weight, dressing percentage and cut-up parts provide information on productive efficiency and meat yield, while internal organ weights reflect metabolic adaptation and the health status of birds exposed to dietary supplements. The results of final live weight in the study e similar to those reported by Daramola (2024), who recorded live weight values ranging from 3650g to 4020g in broiler chickens fed phytogenic feed additives. The author explained that phytogenic compounds enhanced nutrient digestibility, improved intestinal absorption and promoted efficient metabolic utilization of nutrients, thereby increasing body weight gain. The similarity in trend with the present study suggests that thorn apple supplementation may have enhanced nutrient utilization and growth efficiency in the experimental birds. The improvement in carcass weight is associated with enhanced feed efficiency, improved gut microbial balance and better nutrient retention. Their findings support the present study and indicate that the phytochemical constituents present in thorn apple may have positively influenced growth performance. The relatively higher live weight values obtained in the present study may therefore be due to the moderate inclusion level of thorn apple and the combined fruit and leaf supplementation which possibly provided beneficial phytogenic effects without excessive anti-nutritional interference.

The whole gizzard values obtained ranged from 1.15% to 1.53%, with T1 recording the highest value while T2 and T3 recorded the least values. These values fall within the normal physiological range of approximately 1.0–2.0% reported for healthy broiler chickens. The findings agree with Ukorebi & Akpet (2020), who reported whole gizzard values ranging from 1.20% to 1.60% in broiler chickens fed phytogenic leaf meal diets. The authors explained that phytogenic feed additives improved digestive activity without causing abnormal enlargement of digestive organs. The similarity in values with the present study suggests that thorn apple supplementation maintained normal digestive organ morphology. Similarly, Adegbeye *et al.* (2020) observed gizzard values ranging from 1.18% to 1.55% in broiler chickens supplemented with medicinal plant extracts and attributed the normal values to efficient feed grinding activity and proper digestive adaptation of the birds. In contrast, Agaji *et al.* (2024) reported relatively higher gizzard values above 1.80% in broiler chickens fed high levels of leaf meal supplementation. According to the authors, increased dietary fibre and anti-nutritional compounds may have increased muscular activity of the gizzard, thereby causing enlargement of the organ. The lower values observed in the present study may therefore indicate that thorn apple supplementation did not excessively increase dietary fibre burden or digestive stress.

The normal whole gizzard values obtained in the present study therefore suggest that thorn apple supplementation maintained normal digestive organ development and functionality in the experimental birds. The proventriculus values obtained ranged from 0.19% to 0.35%, with T1 recording the highest value while T3 recorded the least value which agrees findings with the report Daramola (2024), who reported proventriculus values ranging from 0.22% to 0.36% in broiler chickens fed phytogenic supplements. The relatively normal values obtained in the present study therefore indicate that thorn apple supplementation at moderate levels did not impair gastrointestinal physiology or induce digestive organ stress. Kidney falls within the normal range of healthy broiler chicken, which is line with the findings of Adegbeye *et al.* (2020), who observed kidney values ranging from 0.27% to 0.37% in broiler chickens fed medicinal plant supplements. The authors explained that the normal kidney values indicated absence of renal toxicity and effective metabolic adaptation of the birds to the dietary treatments. Similarly, Daramola (2024) reported kidney values between 0.28% and 0.38% in broiler chickens supplemented with phytogenic feed additives and attributed the values to efficient detoxification and normal physiological functioning of the kidneys.

Haematological and serum biochemical parameters are reliable indicators of the physiological, immunological, and health status of broiler chickens subjected to dietary treatments. The higher PCV, Hb, and RBC values recorded in supplemented treatments suggest enhanced erythropoiesis and improved oxygen carrying capacity of the blood. This may indicate improved nutrient utilization and better physiological adaptation in birds fed thorn apple supplemented diets. The present findings closely agree with and Rafiu *et al.* (2025) and Okanlawon *et al.* (2025), who reported PCV values ranging from 24.25 to 30.00%, Hb values ranging from 10.35 to 13.88 g/dL, and RBC values ranging from 2.26 to 2.93 $\times 10^9/\mu L$ in broiler chickens fed varying levels of thorn apple (*Datura stramonium*) powder. The authors observed that birds fed 2 g/kg thorn apple supplementation recorded improved blood parameters and explained that the antioxidant and phytochemical constituents of thorn apple enhanced blood formation and physiological stability in the birds. The similarity between their findings and the present study may be attributed to the use of the same additive, *Datura stramonium*, at moderate inclusion levels capable of stimulating haematopoietic activities without inducing toxicity. The improved PCV and Hb values observed particularly in T2 and T4 in the present study may therefore suggest enhanced oxygen transport and improved metabolic efficiency resulting from thorn apple phytochemicals. Similarly, Rafiu *et al.* (2025) in another study involving *Datura stramonium* and *Curcuma longa* blend reported PCV values ranging from 25.50–29.50%, Hb values ranging from 120.60–141.00 g/L, and RBC values ranging from 2.14–2.56 $\times 10^{12}$/L. The authors explained that the improvement in blood indices resulted from the synergistic antioxidant activities of medicinal plant phytochemicals which enhanced erythrocyte production and minimized oxidative damage to blood cells. The similarity with the present findings further supports the suggestion that thorn apple at moderate dietary levels possesses haematinic properties capable of improving blood quality and physiological performance in broiler chickens.

White blood cell count was not significantly ($P>0.05$) influenced and ranged from 124.00–134.95 $\times 10^3/\mu L$. The absence of significant difference in WBC suggests that thorn apple supplementation did not provoke severe infection or pathological immune challenge among the birds. Stable WBC values generally indicate good immune stability and normal physiological response to dietary treatments. Since thorn apple contains phytochemical (Alkaloid and phenol) which help to fight against foreign body that might want to damage the body system as reported by Rafiu *et al.* (2025). Platelet count significantly ($P<0.05$) ranged from 21.00 $\times 10^9$/L in T1 and T3 to 34.50 $\times 10^9$/L in T4, while plateletcrit ranged from 0.27% in T1 to 0.46% in T4. The increased platelet values observed in T4 suggest improved thrombopoietic activity and better blood clotting potential. This may indicate enhanced circulatory stability and haemostatic function in birds receiving combined thorn apple fruit and leaf supplementation. The platelet values obtained in the present study are comparable with Rafiu *et al.* (2025), who reported platelet values ranging from 29.00–42.00 $\times 10^9$/L in broilers fed thorn apple diets. The similarity suggests that thorn apple supplementation may positively influence platelet production and blood coagulation mechanisms in broilers.

The result for serum biochemistry shows that the value obtain for the study falls within the normal range as reported by Merck 2012 for a healthy chicken. The value for Aspartate Amino Transferase and alanineamino-transferase levels across the treatment group suggest that thorn apple might exert hepato-protective effects. This aligns with studies that have reported the anti-oxidant properties of turmeric particularly its active compound curcumin which is known to protect liver cells from damage by neutralizing free radicals (Erliassa *et al.*, 2009). The significant increase in alkaline phosphate levels particularly in the T5 and T4 treatments.

Nutrient digestibility higher crude protein observed in T4 suggests improved protein breakdown and absorption which may be associated with the synergistic effects of phytochemicals present in both the fruit and leaf portions of *Datura stramonium*.

These phytochemicals, particularly flavonoids and phenolic compounds, may stimulate digestive enzyme secretion and improve intestinal absorptive capacity at moderate inclusion levels. The present findings agree with Rafiu *et al.* (2025), who reported improved growth performance and feed conversion ratio in broiler chickens fed 2 g/kg thorn apple supplementation.

Crude fibre, Ether extract was not significantly ($P>0.05$) influenced by the treatments and ranged from 79.53% to 81.89%. The absence of significant differences indicates that thorn apple supplementation did not markedly alter fibre degradation or fibre utilization among the birds. This may suggest that the inclusion level used in the present study was not high enough to substantially influence fibre fermenting microorganisms or intestinal motility. The crude fibre values obtained in the present study are comparable with the values reported by Egbewande (2020), who observed crude fibre digestibility values ranging from 70.80–84.83% in broiler chickens. The similarity in values suggests that fibre utilization remained within the normal physiological range expected in healthy broilers. The higher ether extract values in diets suggest improved lipid digestion and utilization. This improvement may be attributed to enhanced bile secretion and lipid emulsification induced by phytochemicals present in thorn apple. The present findings agree with Egbewande (2020), who stated that improved fat digestibility resulted from enhanced nutrient metabolism and better digestive efficiency in birds fed improved diets. Although the values in the present study were lower, both studies demonstrated improved ether extract digestibility following dietary supplementation. The lower values observed in the present study may be associated with the alkaloidal nature of thorn apple which may slightly limit maximum lipid utilization despite improving digestive activities. Ash digestibility significantly ($P<0.05$) ranged from 71.32% in T3 to 79.79% in T2. The higher ash observed in T2 indicates improved mineral utilization and absorption among birds fed thorn apple fruit supplementation. This may suggest that the fruit portion of thorn apple contains phytochemical constituents capable of improving mineral bioavailability and intestinal absorption efficiency. Dry matter digestibility also significantly ($P<0.05$) ranged from 76.06% in T1 to 83.72% in T2. The improved DMD values observed in supplemented treatments indicate enhanced overall nutrient utilization and feed efficiency. Rafiu *et al.* (2025) similarly reported improved feed conversion ratio and growth performance in broilers fed thorn apple supplementation and explained that thorn apple inclusion enhanced nutrient utilization efficiency. The similarity between both studies may be due to the ability of thorn apple phytochemicals to stimulate digestive processes and improve nutrient assimilation at moderate dietary levels. Nitrogen free extract digestibility significantly ($P < 0.05$) ranged from 88.68% in T1 to 96.34% in T2, indicating efficient carbohydrate utilization among the supplemented birds. The higher NFED values obtained in T2 suggest that thorn apple fruit supplementation improved carbohydrate digestion and energy extraction from the diet. High nitrogen free extract digestibility generally reflects improved metabolizable energy utilization and enhanced digestive efficiency in broilers. However, the slightly lower digestibility values compared with some conventional feed additives may be linked to the presence of naturally occurring alkaloids and anti to nutritional compounds in thorn apple which may moderately limit maximum nutrient utilization at certain inclusion levels.

CONCLUSIONAND RECOMMENDATION

The study concluded that the inclusion level of Thorn Apple fruit, seeds and their blend had positive effects and no detrimental effects on growth performance, carcass, organ, nutrient digestibility, and haematology and serum biochemistry broiler chicken. It is therefore, recommended that feeding broiler chicken with diet that contain 1g of leaf and 1g of fruit blend of Thorn apple will help to improve overall performance and health status of broiler chicken to achieve optimum production level.

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