International Journal of Organic agricultural Research & Development
Volume 20 (3) (2025)

Influence of Thorn Apple (*Datura stramonnium*), Catmint (*Nepeta cataria*) and Turmeric (*Curcunan longa*) Powder blend as an Additive in the Diet of Broiler Chickens

Rafiu, T. A., Abolarinwa, W. O., *Okanlawon, E. O., Sangoniyi, O. and Ameen F, B.,
[1]Department of Animal Production and Health, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

***Corresponding Author: edenokanlawon@gmail.com**:+2348056813070

ABSTRACT

A total of (210) unsexed day-old broiler chick (Abor-acre) was used to determine the effect of thorn apple, catmint and tumeric powder blend on growth performance, carcass, organ, haematology and serum biochemistry at stater phase. Experimental diets were formulated in a ratio 1:1 inclusion of turmeric and datura, catmint and datura blend in which the treatment groups include T1- 0g, T2- 2g/kg of turmeric and datura in ratio 1:1, T3-4g/kg of turmeric and datura in ratio 1:1, T4- 6g/kg of turmeric and datura in a ratio of 1:1 , T5- 2g/kg of catmint and datura in ratio 1:1, T6- 4g/ of catmint and datura in ratio 1:1 and T7- 6g/kg of catmint and datura in ratio 1:1. The birds were randomly allotted into seven (7) dietary treatments of 30 birds per treatment and 3 replicate of 10 birds and were arranged in a completely randomized design. Data were collected on growth performance, carcass characteristics, haematology, serum biochemistry and were analysed using ANOVA. The results revealed significant difference on ($P<0.05$) on some of the parameters measured. Highest ($P<0.05$) final weight gain (2573.53g) was recorded from broiler fed with 2g/kg of turmeric and datura while broiler chicken fed 4g/kg of datura and catmint had the least value (2119.61g). Highest liver value (2.03%) was recorded with broiler bird fed diet 4g/kg of datura and turmeric, while the least proportion (1.60%) with broiler chicken fed diet 4g/kg of datura and catmint. Highest kidney value (0.42%) was record with broiler birds fed diet 4g/kg and 6g/kg of datura and turmeric, while the least value (0.30%) was recorded with diet 2g/kg of datura and catmint supplement. Highest red blood cell value (2.62 x10µl) was recorded from the broiler birds fed diet (2g\kg) of datura and catmint while the least value (2.27 x10µl) was recorded from broiler birds feed diet control (no diet supplement). Highest total protein value (35.50 g/dl) was recorded from broiler with diet 6g/kg datura and catmint while the least value (10.50 g/dl) was recorded from diet 2g/kg datura and catmint supplements. The study concluded that the use of 6g/kg of thorn apple, catmint and turmeric blend had no adverse effect on the performance of broiler chicken. It was therefore recommended that feeding broiler chicken with diet that contain 6g/kg of thorn apple and turmeric blend will help to improve overall performance and economic benefits.

Keywords: Thorn Apple, Catmint, Turmeric, Broiler chicken, Performance, Haematology and serum

INTRODUCTION

The fast rate of development of the poultry production in tropical countries has also engendered a situation of overdependence on the conventional feedstuffs (El-Sayed *et al.,20*19). Sometimes, a situation of competition exists between man and livestock on some grains, especially maize (Suganya *et al.,* 2015), Also, its well known that feed is the most crucial cost of production as it represents the largest part of the cost of production of broiler chickens (Omowumi *et al.,* 2005).The growth rate of commercial broiler chickens is fast and they are able to reach market weight of two kilogram and above at about seven weeks of age or less (Tallentire *et al.,*2016).

The use of antibiotics combined with strict biosecurity and hygiene measures has helped the poultry industry to grow by preventing the negative impacts of many avian diseases. Even as biosecurity may be sufficient, vaccination can also be used as an additional measure as health management. A vaccine provides assistance to the immune system by preparing it against certain pathogens such as viruses or bacteria to which it may be exposed in the future. Despite the important benefit, the presence of antibiotics residues in feed and environment (Gonzalez Ronquillo and Angelis Harnerdez 2017*),*

compromises human and animal health (Diarra *et al.,* 2010) thus initiate the campaign against its uses. Hence, there is a growing need to find effective alternatives to control infectious diseases and limit the spread of resistant bacteria.
Using of synthetic antibiotic has been discouraged by European Union (2006) due to the implicating side effects associated with its retention in animal muscles and it's consumers, therefore introduction of medicinal plants such as *Datura stramonium* may be a potential substitute for synthetic antibiotic
Datura stramonium commonly known as thorn Apple or jimson weed has medicinal uses (Devil *et al.,*2011). It exhibits antibacterial, anti-inflammatory, nematocidal, fungicidal, cytotoxic, antioxidant and acaricidal activities (Singh, 2013). Similarly, Turmeric (*Curcuma longa*) is an extensively used spice, food preservative and colouring material that has biological actions and medicinal application (Apkpbarian *et al.,*2012). The active and main ingredient found in turmeric plants is the curcumin, which has been found to have antioxidant and antibacterial activities. Over the years turmeric has also proved to have protective effect as a feed additive on aflatoxin - induced mutagenicity and hepatocarcingenicity in livestock production. (Keranmi *et al.,* 2011).
Catmint (*Nepeta cataria*) have many reported benefits among which are; diuretic effect, expectorant, antispasmodic (Formisano *et al.,* 2007), sedative, diaphoretic, febrifuge, antioxidant (Tete *et al.,* 2007), insecticidal, antimicrobial, antiviral and fungi (Sharma and Cannoo 2016).
Feed additive are substances added to animal feed to enhance nutritional value, improve health and increase productivity, famers use synthetic feed additives which is more expensive and has residual effects on both the birds and human. Thus, the need to conduct research on herbs that are known to produce certain chemicals that mutually serve as growth promoters with antimicrobial activities. This study therefore will aim at evaluating the effect of *Datura stramonium, Nepeta cataria* and *Curcuma longa* as feed additives on the performance of broiler chickens.

MATERIALS AND METHOD

EXPERIEMENTAL SITE

The experiment was carried out at the Poultry Unit of Teaching and Research Farm, Ladoke Akintola University of Technology Ogbomoso, Oyo State Nigeria. The area is in derived savannah zone of Nigeria. It lies on longitude 4.5^0 east of greenish meridian and latitude 8.5^0 North-East towards Ibadan the capital of Oyo State. (Google Earth Map, 2024).

Collection and Preparation of Test Ingredients

The test ingredients Thorn Apple seed and Catmint leaves were harvested within Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, while Turmeric rhizome was purchased from a local market in Ogbomoso, they were cleaned and later slice into flakes to increase the surface of the area to aid drying. Thereafter each of the test ingredient were spread out evenly to air dry until the weight remains constant. The test ingredients were reduced into lentil-size part with the aid of mortar and pestle, then milled into fine powdering form with the uses of electric blender following the method described by Okanlawon *et al*,. (2024). Thereafter it was sieved and stored in air-tight container until use.

Experimental birds and Management

Two hundred and ten (210) unsexed day-old Abor acre chicks were purchased from a reputable hatchery and used for experiment. The birds were randomly allotted to seven (7) dietary treatments of 3 replicates each (30 birds per treatment and 10 birds per replicate) in a completely randomized design.
Seven experimental diets were formulated in a ratio 1:1 inclusion of turmeric and datura, catmint and datura blend in which the treatment groups include T1- 0g, T2- 2g/kg of turmeric and datura in ratio 1:1, T3-4g/kg of turmeric and datura in ratio 1:1, T4- 6g/kg of turmeric and datura in a ratio of 1:1 , T5- 2g/kg of catmint and datura in ratio 1:1, T6- 4g/ of catmint and datura in ratio 1:1 and T7- 6g/kg of catmint and datura in ratio 1:1. All routine management practice were strictly adhered to; however, 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 gain (g) – Initial weight (g)

Feed intake (g)= (feed given – Leftover)

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

Carcass characteristics and relative organ weights

At the end of 4^{th} week of experimental period, four birds were randomly selected and starved of feed for 12 hours with the presence of abundant

water and slaughtered by severing the jugular veins. The birds were bled; defeathered after which the visceral organs such as liver, intestine, pancreas, spleen, kidney, proventriculus, and hearts were removed. The bled, defeathered and eviscerated weights were evaluated accordingly. The head and shanks were removed to determine the carcass weight.

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

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

Blood Analysis

Four birds were randomly selected from each treatment. About 2.5 ml of blood were collected in tubes containing EDTA anticoagulant to determine the values of haemoglobin concentration, packed cell volume, red blood cells count, total white blood cells count, differential white blood cell count, platelets count, and red cell indices as describe by (Iranloye *et al.,* 2002 and Venkatesan *et al.,* 2006). The blood was slowly expressed into EDTA tubes to reduce the risk of haemolysis after removing the needles from syringes (Haen, 1995).

Serum parameters include, total protein was obtained by biuret method in the assay as described by Kohn and Allen (1995). The globulin concentration was obtained by subtracting albumin from the total protein. 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 and Hoder (1983). Alanine transferase (ALT) activities were determined using spectrophotometric methods as described by Rej and Hoder (1983). Serum urea was determined using a kit (Quinica clinical spam) having a linear measurement of about 566.6 ml per litre of urea concentration. The serum urea will determine calorimetrically. The serum cholesterol was determined using enzymatic endpoint method as described by Roeschlau *et al*. (1974).

Statistical Analysis

Data were analysed using one way analysis of variance (ANOVA) (2002) and Duncan Multiple Range Test of the same statistical package was used to separate means with significant difference at 5%..

RESULTS

Table 1 show the main effect of thorn apple, catmint and turmeric blend on growth performance of broiler chicken. All the parameters measured were significantly ($P<0.05$) affected. Highest ($P<0.05$) final weight gain (2573.53g) was recorded from broiler fed with 2g/kg of turmeric and datura while broiler chicken fed 4g/kg of datura and catmint had the least value (2119.61g). Highest ($P<0.05$) total feed intake value (4029.90g) was recorded with broiler chicken feed with 2g/kg of datura and turmeric while the least value (1800.17g) was recorded from the broiler fed with 4g/kg of dutura and catmint blend. Highest ($P<0.05$) on feed conversion ratio value (2.11) was recorded with broiler chicken fed with 6g/kg of datura and turmeric while the least value (1.80) was recorded with broiler fed with 4g/kg of datura and catmint blend.

Table 1: **Effect of Thorn apple, catmint and Turmeric blend on growth performance on broiler chicken.**

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM
Weight Gain (g)	2528.33^{a}	2573.53^{a}	2406.86^{ab}	2274.50^{bc}	2125.55^{c}	2119.61^{c}	2132.52^{c}	33.89
TFI (g)	2073.49^{b}	4029.90^{a}	3796.15^{a}	3885.35^{a}	1900.46^{c}	1800.17^{c}	2001.31^{c}	279.86
FCR	1.82^{bc}	1.97^{abc}	1.98^{abc}	2.11^{a}	2.04^{ab}	1.80^{c}	2.09^{a}	0.03

^{abc} Means along the row with uncommon superscript are significant difference ($p<0.5$)

TFI = Total feed intake, FCR= Feed conversation ration, T_1 = control, T_2 = 2g turmeric and datura, T_3 = 4g turmeric and datura, T_4 = 6g turmeric and datura, T_5 = 2g catmint and datura, T_6 = 4g catmint and datura, T_7 = 6g catmint and datura

Table 2 :show the carcass characteristics of broiler chicken fed with diet containing thorn Apple, turmeric and catmint. There was significant ($p<0.05$) difference on live weight gain, Slaughtered weight, Defeathered weight, Whole carcass, Carcass %, Breast, Back, Drumstick, Thigh, Wings and neck. Highest ($p<0.05$) live weight gain value (2845.50g) was recorded from broiler birds fed with diet containing 6g/kg of datura and turmeric while the least value (2187.50g) was recorded from broiler birds fed from 2g/kg of datura and catmint. Highest slaughtered weight value (2776.50g) was recorded with the broiler birds fed 6g/kg of datura and turmeric while the least value (2122.50g) was recorded from the broiler bird fed diet 2g/kg of datura and catmint. Highest defeathered weight was recorded from the value (2645.00g) from the broiler birds fed with diet

6g/kg of datura and turmeric, while the least value (2020.00g) was recorded from animal fed diet 2g/kg of datura and catmint. Highest whole carcass value (2434.50g) was recorded from broiler birds fed diet 2g/kg of datura and turmeric, while the least value (1727.00g) was recorded from animal fed diet 6g/kg of datura and catmint. Highest value (2254.00g) of carcass weight was recorded from broiler birds fed diet 2g/kg of datura and turmeric while the least value (1583.50g) was recorded from broiler birds fed diet 6g/kg of datura and catmint. Highest carcass percentage value (79.73%) was recorded from broiler bird fed diet 2g/kg of datura and turmeric, while the least value (70.68%) was recorded from broiler bird fed diet 4g/kg of datura and turmeric. Highest breast value (41.81%) was recorded from broiler birds fed diet 4g/kg of datura and turmeric while the least value (35.99%) was recorded from the animal fed diet 2g/kg of datura ad catmint. Highest drumstick value (14.37%) was recorded from the animal fed with the diet 4g/kg of datura and catmint blend. Highest thigh value (15.07%) was recorded from the broiler chicken fed with the diet 2g/kg of datura and catmint, while the least value (13.34%) was recorded from the animal fed diet 6g/kg of datura and catmint. Highest wing value (11.78%) was recorded from broiler birds fed with 6g/kg of datura and catmint while the least value (10.10) was recorded from broiler birds fed with diet 6g/kg of datura and turmeric. Highest neck value (5.11%) was recorded with broiler bird fed diet 4g/kg of datura and turmeric while the least value (4.24%) was recorded with the broiler chicken fed diet 4g/kg of datura and turmeric.

Table 2: **The effects of the mixture of thorn apple, turmeric and catmint performance and Carcass characteristics on broiler chicken**

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM
Live weight (g)	2747.50^{a}	2825.50^{a}	2607.50^{bc}	2845.50^{a}	2187.50^{c}	2416.50^{bc}	2192.50^{c}	46.21
Slaughtered weight (g)	2665.50^{a}	2750.50^{a}	2549.00^{bc}	2776.50^{a}	2122.50^{c}	2336.00^{bc}	2138.50^{c}	44.80
Defeathered weight (g)	2546.00^{a}	2625.00^{a}	2419.00^{ab}	2645.00^{a}	2020.00^{c}	2233.00^{bc}	2021.00^{c}	43.33
Whole carcass (g)	2216.50^{ab}	2434.50^{a}	2160.50^{b}	2383.00^{ab}	1786.00^{c}	1885.50^{c}	1727.00^{c}	45.42
Carcass (g)	2068.50^{ab}	2254.00^{a}	1993.50^{b}	2212.50^{ab}	1616.00^{c}	1715.50^{c}	1583.50^{c}	44.40
Carcass %	75.19^{cd}	79.73^{a}	76.44^{bc}	77.67^{ab}	73.89^{de}	70.68^{f}	72.20^{ef}	0.49
Cut Part %								
Breast	40.53^{ab}	38.68^{b}	41.81^{a}	38.96^{b}	35.99^{c}	38.60^{b}	38.46^{b}	0.35
Back	15.53^{c}	15.19^{cd}	14.65^{d}	17.02^{a}	16.17^{b}	16.41^{ab}	16.35^{b}	0.13
Drumstick	13.16^{b}	13.75^{b}	12.20^{c}	12.09^{c}	13.63^{b}	14.37^{a}	13.54^{b}	0.13
Thigh	14.03^{bc}	14.78^{ab}	14.00^{bc}	13.83^{bc}	15.07^{a}	14.10^{bc}	13.34^{c}	0.13
Wings	10.28^{cd}	10.31^{cd}	10.58^{cd}	10.10^{d}	11.25^{ab}	10.78^{bc}	11.78^{a}	0.11
Neck	4.79^{abc}	4.24^{d}	5.11^{a}	5.03^{ab}	4.94^{abc}	4.50^{cd}	4.61^{bcd}	0.06

^{abc} Means along the row with uncommon superscript are significant difference ($p<0.5$)

T_1 = control, T_2 = 2g turmeric and datura, T_3 = 4g turmeric and datura, T_4 = 6g turmeric and datura, T_5 = 2g catmint and datura, T_6 = 4g catmint and datura, T_7 = 6g catmint and datura

Table 3 showed the main effect of thorn apple, turmeric and catmint on organ characteristic of broiler chicken. Significant differences ($p<0.05\%$) were recorded from liver, kidney, lung, whole gizzard, empty gizzard, proventiculus, crop, spleen, heart, small intestine, large intestine, budsar, pancreas, abdominal fat. Highest liver value (2.03%) was recorded with broiler bird fed diet 4g/kg of datura and turmeric, while the least proportion (1.60%) with broiler chicken fed diet 4g/kg of datura and catmint. Highest kidney value (0.42%) was record with broiler birds fed diet 4g/kg and 6g/kg of datura and turmeric, while the least value (0.30%) was recorded with diet 2g/kg of datura and catmint supplement. Highest value (0.63%) of lung was recorded with broiler birds fed diet 6g/kg of datura and turmeric, while the least value (0.44%) was recorded with broiler with no diet supplement. Highest whole gizzard value (2.36%) was recorded with broiler birds fed diet 2g/kg of datura and catmint, While the least value (1.12%) was recorded with broiler birds fed diet 2g/kg of datura and turmeric supplement, highest empty gizzard value (1.35%) was recorded from broiler birds fed diet 6g/kg of datura and catmint, while the least value (0.87%) was recorded with diet 2g/kg of datura and turmeric. Highest proventiculus value (0.71%) was recorded with 4g/kg of datura and catmint, while the least value (0.39%) was recorded with 2g/kg of datura and turmeric. Highest crop value (1.04%) was recorded with broiler chicken fed diet 4g/kg of datura and catmint blend, while the least value (0.30%) was recorded with broiler bird fed diet 6g/kg of turmeric and datura. Highest spleen value (0,14%) was recorded with broiler birds fed diet 4g/kg of datura and turmeric, while the least value (0.10) was record with broiler chicken fed 4g/kg, 6g/kg of datura and catmint. Highest heart value (0.50%) was recorded with broiler fed diet 4g/kg of datura and catmint, while the least value (0.33%) was recorded from broiler birds fed diet 6g/kg of datura and turmeric, Highest small intestine value (4.13%) was recorded with diet 4g/kg of datura and catmint, while the least value (2.68%) was recorded with diet 4g/kg of datura and turmeric. Highest large intestine value (6.68%) was recorded with diet 6g\kg of datura and catmint, while the least value (4.37%) was recorded with diet 2g/kg of datura and turmeric. Highest budsar value (0.12%) was recorded from no diet supplement, while the least value (0.04%) with diet 4g/kg of datura and catmint, highest pancreas value (0.18%) was recorded with diet no supplements, while the least value (0.09%) was recorded with diet 6g/kg of datura and turmeric. Highest abdominal fat

value (0.74%) was recorded with diet 6g/kg of turmeric and datura while the least value (0.09%) was recorded with diet 4g/kg of datura and catmint.

Table 3: **The effects of the mixture of thorn apple, turmeric and catmint on Organ characteristics of broiler chicken.**

Parameters (%)	T1	T2	T3	T4	T5	T6	T7	SEM
Liver	2.01^{a}	1.91^{a}	2.03^{a}	1.95^{a}	1.94^{a}	1.60^{b}	1.85^{a}	0.03
Kidney	0.34^{cd}	0.42^{a}	0.42^{a}	0.36^{bc}	0.30^{d}	0.31^{d}	0.40^{ab}	0.01
Lung	0.44^{c}	0.45^{c}	0.54^{abc}	0.63^{a}	0.46^{bc}	0.45^{c}	0.56^{ab}	0.02
Whole gizzard	2.10^{abc}	1.12^{d}	1.94^{c}	1.80^{c}	2 .36^{a}	2.26^{ab}	2.02^{bc}	0.06
Empty gizzard	1.34^{a}	0.87^{c}	1.19^{b}	1.23^{ab}	1.25^{ab}	1.21^{ab}	1.35^{a}	0.03
Proventiculus	0.44^{bcd}	0.39^{d}	0.40^{d}	0.48^{b}	0.42^{cd}	0.71^{a}	0.47^{bc}	0.02
Crop	0.39^{b}	0.38^{b}	0.49^{b}	0.30^{b}	0.55^{b}	1.04^{a}	0.38^{b}	0.05
Spleen	0.13^{ab}	0.12^{bc}	0.14^{a}	0.13^{a}	0.10^{c}	0.10^{c}	0.13^{ab}	0.00
Heart	0.38^{cd}	0.42^{bc}	0.36^{b}	0.33^{d}	0.37^{cd}	0.50^{a}	0.45^{ab}	0.01
SI	3.06^{bc}	2.90^{c}	2.68^{c}	2.92^{c}	4.12^{a}	4.13^{a}	3.68^{ab}	0.11
LI	5.18^{b}	4.37^{c}	4.54^{bc}	4.56^{bc}	6.39^{a}	6.13^{a}	6.68^{a}	0.14
Budsar	0.12^{a}	0.07^{b}	0.06^{b}	0.05^{b}	0.06^{b}	0.04^{b}	0.05^{b}	0.01
Pancreas	0.18^{a}	0.12^{bc}	0.16^{ab}	0.17^{ab}	0.17^{ab}	0.15^{ab}	0.09^{c}	0.01
Abd fat	0.31^{c}	0.39^{c}	0.65^{b}	0.74^{a}	0.22^{d}	0.09^{e}	0.33^{c}	0.03

^{abc} Means along the row with uncommon superscript are significant difference ($p<0.5$)
SI = Small intestine, LI = Large intestine, Abd fat = Abdominal fat, T_1 = control, T_2 = 2g turmeric and thorn apple, T_3 = 4g turmeric and thorn apple, T_4 = 6g turmeric and thorn apple, T_5 = 2g catmint and thorn apple, T_6 = 4g catmint and thorn apple, T_7 = 6g catmint and thorn apple

Table 4 shows the main effect datura, turmeric and catmint blend on the haematology parameters on broiler chicken. Significant differences ($p<0.05$) were recorded on red blood cell, mean corpuscular volume, mean corpuscular haemoglobin concentration, neutrophils, lymphocyte, eosinophils, monocytes, platelet. Highest red blood cell value (2.62 x10^{6}µl) was recorded from the broiler birds fed diet (2g\kg) of datura and catmint while the least value (2.27 x10^{6}µl) was recorded from broiler birds feed diet control (no diet supplement). Highest mean corpuscular volume value (115.50fl) was recorded from broiler birds fed from no supplement feed diet, while the least value (109.00fl) was recorded from the broiler birds fed diet 2g\kg of datura and catmint. Highest mean corpuscular haemoglobin concentration value (502.50pg) was recorded with broiler birds fed diet 6g\kg of datura and catmint, while the least value (481.00 pg) from broiler bird fed with no diet supplements. Highest neutrophils value (52.50%) was recorded from broiler birds fed diet 6g\kg of datura and catmint, while the least value (15.00%) was recorded from broiler fed diet 4g\kg of datura and catmint supplements. Highest lymphocyte value (75.00%) was recorded from broiler diet fed 6g\kg of datura and catmint, while the least value (40.50%) was recorded from broiler birds fed from 2g\kg of datura and catmint supplements. Highest eosinophils value (4.00%) was recorded from broiler birds fed with no supplement, while the least value was recorded from broiler birds fed with 2g\kg, and 6g\kg of datura and catmint and (2g\kg and 6g\kg) of datura and turmeric supplements. Highest monocyte value (11.50%) was recorded from broiler birds fed diet 4g/kg of datura and catmint, while the least value (0.00%) was recorded from broiler birds fed diet 6g/kg of datura and catmint supplements, highest platelet value (42.50x10^{3}) was recorded from broiler birds feed diet 6g\kg of datura and catmint, while the least value (25.00x10^{3}) was recorded from broiler birds fed with no supplements and pack cell volume, haemoglobin concentration, haemoglobin, mean corpuscular haemoglobin, white blood cell and basophilis has no significant differences ($p<0.05$) recorded.

Table 4: The effects of the mixture of thorn apple, turmeric and catmint on Haematology of broiler chicken

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM
PVC (%)	26.50	29.00	27.25	27.50	28.50	28.00	26.50	0.50
HC (g/dl)	0.27	0.29	0.27	0.27	0.29	0.26	0.27	0.01
HB (g/dl)	130.50	142.00	134.00	135.00	143.00	136.00	132.00	2.53
RBC (x10^{6}µl)	2.27^{b}	2.59^{ab}	2.44^{ab}	2.40^{ab}	2.62^{a}	2.53^{ab}	2.32^{ab}	0.04
MVC (fl)	115.50^{a}	112.00^{ab}	112.25^{ab}	114.00^{ab}	109.00^{b}	110.50^{ab}	112.50^{ab}	0.70
MCH (pg)	56.50	55.00	55.00	56.25	54.50	54.00	56.50	0.35
MCHC (g/dl)	481.00^{b}	490.50^{ab}	489.75^{ab}	493.75^{ab}	502.00^{a}	490.00^{ab}	502.50^{a}	2.03
WBC (x10^{3}µl)	137. 00	147.25	149.00	148.25	154.50	153.50	155.00	2.23
N (%)	21.50^{bc}	33.50^{b}	18.25^{bc}	21.50^{bc}	52.50^{a}	15.00^{c}	22.00^{bc}	2.69
L (%)	65.50^{a}	60.00^{ab}	68.25^{a}	71.75^{a}	40.50^{b}	70.00^{a}	75.00^{a}	3.04
E (%)	4.00^{a}	0.00^{b}	0.25^{b}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{b}	0.40
M (%)	1.50^{cd}	4.00^{bcd}	7.25^{b}	1.25^{cd}	5.00^{bc}	11.50^{a}	0.00^{d}	0.80
PLT (x 10^{3})	25. 00^{b}	30.00^{ab}	30.75^{ab}	38.75^{a}	28.00^{b}	38.50^{ab}	42.50^{a}	1.82

^{abc} Means along the row with uncommon superscript are significant difference ($p<0.5$)
PVC = Packcell volume, HC = Haemoglobin conc, HB = Haemoglobin, RBC = Red blood cell, MVC = Mean corpuscular volume, MCH = Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin conc. WBC= White blood cell, N = Neutrophils, L = Lymphocyte, E = Eosinophilis, M = Monocytes, B = Basophils, PLT = Platelet, T_1 = Control, T_2 = 2g turmeric and datura, T_3 = 4g turmeric and datura, T_4 = 6g turmeric and datura, T_5 = 2g catmint and datura, T_6 = 4g catmint and datura, T_7 = 6g catmint and datura.

Table 5 show the effect of thorn apple, turmeric and catmint on serum biochemistry of broiler chicken. There was significant ($p<0.05$) effect on total protein, albumin, globulin, aspartate amino transferases, alanine amino transferases alkaline phosphate, creatine, high density lipoprotein, cholesterol and triglycerides. Highest total protein value (35.50 g/dl) was recorded from broiler with diet 6g/kg datura and catmint while the least value (10.50 g/dl) was recorded from diet 2g/kg datura and catmint supplements. High albumin value (16.50 g/dl) was recorded from the diet 6g/kg of datura and catmint, while the least value (12.00 g/dl) was recorded from the diet 2g/kg of datura and turmeric supplements. Highest globulin value (20.50 g/dl) was recorded from the diet 4g/kg of datura and catmint, while the least value (2.50 g/dl) was recorded from the

diet 2g/kg of datura and catmint. Highest aspartate amino transferases value (137.50 µ/l) was recorded from broiler fed with no supplement while the least value (48.50 µ/l) was recorded with diet 2g/kg of datura and turmeric. Highest alanine amino transferases value (11.00µ/l) was recorded from broiler fed with no supplement while the least value (5.50µ/l) was recorded with diet 6g/kg of catmint and thorn apple. Highest alkaline phosphate value (202.50 µ/l) was recorded from diet 2g/kg of datura and catmint while the least value (82.50) was recorded from diet with 4g/kg of datura and catmint supplement. Highest creatine value (51.50µmmol/dl) was recorded from diet with no supplement while the least value (37.50µmmol/dl) was recorded from diet with 2g/kg of catmint and datura supplement. Highest high density lipoprotein value (2.75 mmol/l) was recorded from the diet 6g/kg of datura and catmint, while the least value (1.45 mmol/l) was recorded from the diet 4g/kg of datura and catmint.

Highest cholesterol value (4.70mmol/l) was recorded with the diet 6g/kg of datura and turmeric while the least value (2.45mmol/l) was recorded from diet 4g/kg of datura and catmint supplements. Highest triglycerides value (0.55 mmol/l) was recorded with diet no supplements while the least value (0.25 mmol/l) was recorded from the diet 2g/kg and 6g/kg datura and catmint and 6g/kg of datura and turmeric supplements.

Table 5 show the effects of mixture of thorn apple, turmeric and catmint on serum biochemistry of broiler chicken.

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM
TP(g/dl)	28.00^{bc}	25.00^{c}	32.00^{ab}	32.50^{ab}	10.50^{d}	33.50^{ab}	35.50^{a}	1.70
ALB(g/dl)	12.50^{cd}	12.00^{d}	13.50^{bc}	14.50^{b}	10.50^{c}	13.00^{cd}	16.50^{a}	0.37
GLB(g/dl)	16.00^{ab}	13.50^{b}	18.50^{ab}	18.00^{ab}	2.50^{c}	20.50^{a}	19.50^{ab}	1.27
AST(µ/l)	137.50^{a}	48.50^{c}	107.50^{b}	108.50^{b}	97.50^{b}	119.50^{ab}	122.50^{ab}	5.88
ALT(µ/l)	11.00^{a}	8.50^{b}	6.00^{dc}	7.50^{bc}	8.50^{b}	7.00^{cd}	5.50^{c}	0.38
ALP(µ/l)	107.50^{c}	149.50^{b}	87.00^{c}	183.00^{a}	202.50^{a}	82.50^{c}	189.00^{a}	9.13
UREA (mmol/l)	0.51	0.35	0.43	0.36	0.35	0.48	0.43	0.2
CREAT(µmmol/dl)	51.50^{a}	42.00^{ab}	43.00^{ab}	49.50^{ab}	37.50^{b}	43.00^{ab}	51.50^{a}	1.52
HDL (mmol/l)	1.80^{bc}	1.80^{bc}	1.90^{b}	2.50^{a}	1.55^{cd}	1.45^{d}	2.75^{a}	0.09
CHOL (mmol/l)	3.60^{c}	3.75^{c}	2.50^{d}	4.70^{a}		2.45^{d}	4.85^{a}	0.16
TRIG (mmol/l)	0.55^{a}	0.30^{b}	0.50^{a}	0.25^{b}	0.25^{b}	0.30^{b}	0.25^{b}	0.03

^{abc} Means along the row with uncommon superscript are signific ant difference ($p<0.5$)

T_1 = control, T_2 = 2g turmeric and datura, T_3 = 4g turmeric and datura, T_4 = 6g turmeric and datura, T_5 = 2g catmint and datura, T_6 = 4g catmint and datura, T_7 = 6g catmint and datura

TP= Total protein, ALB = Albumin, GLB= Globulin, CREAT = Creatine, HDL= high density lipoprotein, CHOL= Cholesterol, TRIG =Triglycerides, ALP= Alkaline phosphate and AST = Aspartate Amino Transferases.

DISCUSSION

Result for growth performance of broiler chicken fed diet with thorn, turmeric and catmint, was in line with that of (Botsoglou *et al.*, 2003) who reported that the inclusion of the phytobiotic blend in the diets will help to improve growth performance of broiler chicken. When Investigated the antioxidant activities of dietary organ essential and alpha tocopheryl acetate supplementation in long term froze turkey meat, the weight gain and total feed intake had the highest in T5 with the inclusion level of 2g/kg of datura and turmeric while on feed conversion ration had the highest from diet with the inclusion level of T4 6g/kg of datura and catmint. This might be because of the level of inclusion or the potency of phytochemical used in this study might have been reduced through the processing, storage, harvesting and drying as reported by (Vispute *et al.*, 2012). The result for growth performance was in line with (Rafiu *et al.,* 2023) who reported that the inclusion level of phytobiotic help to improve growth performance. The result of the experiment shows that there was significant increase with highest weight gain from broiler chicken fed diet containing 2g/kg of turmeric and datura blends and this result was in line with the report of Ademola *et al.,* (2009) who reported that phytobiotics used in the studies containing tannin, helps to improve growth performance of livestock. It was also reported that Phytobiotics are natural growth promoters and this has been proven in these studies and also agrees with the report of kafi *et al.,* (2017) who observed highest Live weight on birds supplemented with inclusion of turmeric powder in feed than other groups. Inclusions of phytobiotics are natural growth studies also help to improve feed intake since it has reported by (Bagno *et al.,* 2018. That phytobiotics in the diet of livestock helps to increase the feed intake because it contains flavonoid which helps to increase a palatability of the diet. The effect of datura, turmeric and catmint on carcass characteristics on broiler chicken. The result of the treatment had significant ($p<0.05$) effect on all the carcass characteristics across the treatments (T1, T2, T3, T4, T5, and T6).

Feed conversion ratio: this also confirm the result of Emadi and Kermanshahi (2018) also reported the inclusion of phytobiotics in the diet of broilers helps to convert the diet taken into meat. Similar findings were reported by Modal *et al.,* (2019) and Arslan *et al.,* (2020) who also observe that addition of turmeric powder in the feed enhanced the overall performance of broiler chickens .it was reported by Singh *et al.,* (2004) that datura contain some bioactive compounds such as alkaloids, tannin and phenol which are known to influence microbial population in the gut potentially which improve the nutrient absorption, to promote the performance of the intestinal flora thereby it improve digestion and enhance the utilizations of energy, leading to

improve growth. Similarly, observations were made by Mohamed *et al.,* (2021)

The improvement in the weight gain in different level of inclusion could be attributed to the fact that herbal plant may provide some compound that enhance digestion and absorption of some nutrient in the diet which leading to improve the growth of birds in this study. Higher dressing percentage and carcass yield might be due to the positive influence of thorn apple, turmeric and catmint powder that leads more gain in the body weight of the broilers. This may be linked to the activities of the phytochemicals in the diet which may exert a positive effect of thorn apple and turmeric and thorn apple and catmint supplementation on the carcass traits being recorded in this study agrees with the report of Kaghdad *et al.,* (2012) that stated that supplementation of turmeric powder in broiler chicken significantly increase the dressing percentage as level of inclusion increases. The result of cut off part and organ obtained did not follow a definite pattern that can be attributed to thorn apple and turmeric powder inclusion and it support the report of Muhammed *et al.,* (2021) who stated that the addition of turmeric did not affect the development of certain body organ improvement to carcass weight and edible carcass weight in these experiment is attributed to the antioxidant activity of turmeric as it contain beneficial photochemicals (phenols, quinines, flavones, tannin, terpenoids and alkaloids) found in thorn apple, turmeric and catmint. Using this study would act as natural growth boosters, enhancing both growth and carcass yield as reported by Arutselvi *et al.,* 2012. shows the effect of datura, turmeric and catmint on organ characteristics of broiler chicken. This present study agrees with (Koochaksaraie *et al*., 2011) who revealed that supplementation of cinnamon powder at the dose rate 250 to 200mg/kg in broiler diets did not have any influence on the heart. The weight of spleen, gizzard, liver and pancreas were affected ($p < 0.05$) by the treatment, this present study is not in agreement with the finding of (Hernandez *et al*., 2004) who found no difference in gizzard, liver and pancreas weight of broiler chicken fed wheat soybean meal-based diet supplemented with an antibiotics and two plant extract (an essential oil extract oregano, cinnamon and pepper and a labiate extract from sage, thyme and rosemary). Small intestine had the highest value in T3 compared to other treatments. This shows that the present study is not in line with the finding of (Sarica *et al*., 2005) who used an antibiotics growth promoter and two herbal natural additives with and without exogenous enzymes in wheat-based broiler diets. Proventriculus, liver and pancreas were recorded to be significantly in their experiment because of different inclusion level. This variation on organ parameters may be because of the difference in the method of thorn apple, turmeric and catmint processing and environmental factors. The stability of the relative weights of the heart, kidney, lungs and pancreas in thorn apple, turmeric and catmint in the diet which did not affect or alter the normal anatomical and physiological function of these organs and this has shown that turmeric, thorn apple and catmint helps to prevent inflammation of the internal organ since they have been reported by batool *et al., (*2020) that they serve as anti-inflammation.

The result for haematology indicates an increase in the count of red blood cells, mean corpuscular volume, means corpuscular haemoglobin, concentration, neutrophils, lymphocyte, eosinophil, monocyte and platelet which is suggestive of polycythemia and positive erythropoiesis as reported by Okpuzor *et al.,* (2009). This is an indication of sufficient iron in the blood. This suggest that the inclusion of the blend will improve oxygen carrying capacity of the cells and it agrees with the reports of Uchechukwu *et al.,* (2024). Values obtained for haemoglobin decreases as turmeric, thorn apple decrease while it increases with low level of inclusion of datura and catmint. The bioactive compound in turmeric most especially curcumin is known to have anti-oxidant, anti-inflammatory and erythropoietic properties, which contribute to improved blood health and oxygen transport in broilers. However, the observed white blood cell value among bird place on 6g\kg of catmint and datura diet and feed additive in this study fall within the normal range as reported by Israel *et al*,. (2022). This result shows an increase in count of white blood cells indicating expression of leucocytes and their production from bone marrow which suggest that there was no infection or regenerative anaemia, it improve function through mechanism, such as enhancing the activity of macrophages and natural killer cells. The present study showed some numerical increase with inclusion of the blend which in line with the report of (Emadi and kermanshahi 2007) that supplementation of turmeric in the diet of broiler chicken showed a consequential increase in lymphocyte, eosinophil, monocyte, and basophil since the thorn apple, turmeric and catmint as in this study contains alkaloid and phenol as reported by Arutselvi *et al.,* (2004) consistent with existing literature on the effects of phytoganic feed supplements by (Emadi and kermanshahi 2007) has all demonstrated that turmeric supplementation particularly at moderate level can improve haematological indices. All these parameters fall within the normal rage as reported by Israel *et al.,* (2022) for

healthy broiler.

Reduction in Aspartate Amino Transferase and alanine, amino-transferase and alamine aminotransferase levels across the treatment group suggest that thorn apple, turmeric and catmint 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.

CONCLUSION AND RECOMMENDATION

It was concluded that the inclusion of thorn apple, turmeric and catmint blend in the diet of broiler chicken had no detrimental adverse effect on growth performance, carcass, organ, Haematological and serum biochemistry. It was therefore recommended that feeding broiler chicken with diet that contain 6g/kg of thorn apple and turmeric blend will help to improve overall performance.

REFERENCES

Ademola, S. G., Farinu, G. O., and Babatunde, G. M. (2009). Tannin-rich extracts from some tropical plants as possible alternatives to antibiotics in broiler diets. *Livestock Research for Rural Development,* 21(8), Article #122.

Arslan, M., Haq AU., Ashraf, M., Iqbal, J. and Mund, M.D. (2020). Effect of turmeric (Curcumalonga) supplementation on growth performance, immune response, carcass characteristics and cholesterol profile in broilers. Veterinaria, 66(1): 16-20. 2316674ja

Arutselvi, R., Balasaravanan, T., Ponmurugan, P. and Muthu, S. (2012). Phytochemical screening and comparative study of anti-microbial activity of leaves and rhizomes of turmeric varieties. *Asian Journal of Plant Science and Research*, 2 (2): 212-219. 2357864ja.

Arutselvi, R., Subramanian, A., & Kothandaraman, P. (2004). Effect of phytogenic feed additives (turmeric, thorn apple, and catmint) on hematological parameters of broiler chickens. *International Journal of Poultry Science*, 3(6), 412–417.

Apkpbarian, F., Johnson, T.D. and Elisha. (2012) G "Biological and Medicinal Properties of Turmeric (Curcuma Longa): A Review." *Journal of Medicinal Plants*, vol. 10, no. 1, 2012, pp. 45–53.

Bagno, O. A., Prokhorov, O. N., and Shevchenko, S. A., (2018). Phytobiotics in the nutrition of farm animals. *Agricultural Biology*, 53(4), 687–697.

Batool, A ., Batool, Z., Qureshi, R., and Iqbal Raja, N. (2020). Phytochemicals, Pharmacological properties and biotechnological aspects of highly medicinal plant: Datura stramonium. *Journal of Plant Sciences*.Vol 8(2): 29-40 doi: 10.11648/j.jps.20200802.12

Botsoglou, N. A., Govaris, A., Botsoglou, E., Grigoropoulou, S., Papageorgiou, G., and Ambrosiadis, I. (2003). Antioxidant effect of dietary oregano essential oil and α-tocopheryl acetate supplementation in turkey meat during refrigerated storage. *Meat Science*, 65(3), 1193–1200.

Devil, R. (2011). Effect of probiotics on growth performance, gut health and immune response in broiler chickens. Journal of Animal Science, 89(10), 2891-2898.

Diarra, M. S., and Malouin, F. (2010). Antibiotic use in the poultry industry and its impact on human health: A review of alternatives. *Journal of Poultry Science*, 89(2), 257-267.

Emadi, M.. and Kermanshahi, H. (2007a). Effect of turmeric rhizome powder on the activity of some blood enzymes in broiler chickens. *International Journal of Poultry Science*, 6(1), 48–51. https://doi.org/10.3923/ijps.2007.48.51

Emadi, M., and Kermanshahi, H. (2018). Influence of phytobiotics on growth performance, nutrient utilization and meat yield in broiler chickens: A review. *Iranian Journal of Applied Animal Science*, 8(1), 9–18

El-Sayed, S. A., Soliman, M. M., and El-Manylawi, M. A. F. (2019). Alternative feed resources in poultry nutrition: A review. *International Journal of Veterinary Science*, 8(4), 196–202.

Erliassa, D., Tjong, D. H., & Santoso, U. (2009). The role of curcumin as a natural antioxidant and hepatoprotective agent: effects on free radical scavenging and liver cell protection. *Journal of Applied Biological Sciences,* 3(2), 45–52.

Formisano, C., Rigano, D., and Sorrentino, R. (2007). Pharmacological properties of Catmint (Nepetacataria) and its therapeutic applications: A review. Phytotherapy Research, 21(2), 135-141.

Gonzalez Ronquillo, M., and Angeles Hernandez, J. C. (2017). Antibiotic and synthetic growth promoters in animal diets: Review of impact and analytical methods. Food Control, 72, 255–267.

Google Earth Map (2024). Geographical location

of LAUTECH, Ogbomoso, Oyo State, Nigeria. Google http://earth.google.com/web/search/lautech+ogbomoso: Date accessed October 25, 2024.

Haen, P. J. (1995). "*Principles o Hematolog ", Brown Communications, Dubuque*, 454 pp

Hernández, F., Madrid, J., García, V., Orengo, J., and Megías, M. D. (2004). Influence of two plant extracts on broilers performance, digestibility, and digestive organ size. Poultry Science, 83(2), 169–174. https://doi.org/10.1093/ps/83.2.169

Hossain , M. E., Adhikary, K., Akter, N., Bhowmik, P., Sultan, M. N., Islam, S., and Das, G. B. (2022). Fish oil, Azadirachtaindica and Curcuma longa improve feed efficiency and meat quality of the broiler chicken.

Israel, J. B., Habila, S. L., Ishaku, L. E. and Sati, S. N. (2022) Haematological and Serum Biochemical Parameters of Broilers Slaughtered at Bukuru Live Bird Market of Jos South Local Government Plateau State Nigeria. Acta Scientific Veterinary Sciences. Vol 4 (6).pp 1-7 DOI: 10.31080/ASVS.2022.04.0399

Iranloye, B.O. (2002). Effect of chronic garlic feeding on some haematological parameters. *Africa Journal Biomedical Research*., 5: 81- 82.

Merck Veterinary Manual. (2012). 11th Edition Susan E. Aiello, Michael A. Moses ISBN: 978-0-911-91061-2 July. Whitehouse Station, NJ :Merck and Co., Inc.

Mohamed, E., AbdEl-Hack, M. T. and El-Saadony. (2021) the active substance of turmeric: its effects on health and ways to improve its bioavailability. *Journal of science of food and Agriculture.* Vol 101(14) 5747-5762 . DOI :10.1002/jsfa.11372.

Mondal, M. A., Yeasmin, T., Karim, R., Siddiqui, M. N., Raihanun-Nabi, S. M., Sayed, M. A., and Siddiky, M. N. A. (2019). Effect of dietary supplementation of turmeric (Curcuma longa) powder on the growth performance and carcass traits of broiler chicks. SAARC *Journal of Agriculture*, 13, 188–199. https://doi.org/10.3329/sja.v13i1.24191.

Keranmi, A., (2011). Effect of probiotic on growth performance, intestinal morphology and immune response in broiler chickens. *Journal of Animal and Veterinary Advances*, 10(11), 1431-1436.

Kaghdad, A. I., Al-Fartosi, K. G., & Al-Mousawi, H. A. (2012). Effect of turmeric (Curcuma longa) powder on some physiological traits in broiler chickens. *Basrah Journal of Veterinary Research,* 11(1), 70–78.

Kafi, A. H., Rezaeipour, V., and Abdullahpour, R. (2017). Effects of turmeric powder on performance, carcass traits, immune system, and blood parameters in broiler chickens. *International Journal of Basic and Applied Sciences*, 6(2), 109–115.

Kohn, R.A. and Allen, M.S. (1995). Enrichment of proteolitic activity relative to Nitrogen in preparation from the rumen for in vitro studies. *Animal Feed Science Technology, 52(1/2): 1-14.793937.*

Kafi, A. H., Rezaeipour, V., and Abdullahpour, R. (2017). Effects of turmeric powder on performance, carcass traits, immune system, and blood parameters in broiler chickens. International Journal of Basic and Applied Sciences, 6(2), 109–115.

Koochaksaraie, R., M. Irani, and S. Gharavysi, 2011. The effects of cinnamon powder feeding on some blood metabolites in broiler chicks. Brazilian Journal of Poultry Science, 13(3), 197–202.

Okanlawon, E.O., Bello, K.O., Akinola, O.S., Oluwatosin, O.O., Irekhore, O.T. and Ademolue, R.O. 2020b. Carcass yield and intestinal morphology of male rabbits fed diets supplemented with turmeric (Curcuma Longa) powder. Ghana Journal Agricultural of Science. 55(2):97–106. 2278288ja

Okanlawon, E.O. Bello, K.O., Akinola. O.S. and Adeola, A.A. (2024). Effect of dietary phytobiotics blend (turmeric, garlic, ginger and clove) on growth performance, carcass yield, haematology and serum biochemistry of rabbits. *Egyptian Journal of Rabbit Science, 34(1): 35-46.*

Omowumi, O. O., Akinmoladun, A. F., and Adedeji, O. B. "Economic Analysis of Feed Costs in Broiler Chicken Production in Nigeria." Poultry Economics Journal, vol. 12, no. 4, 2005, pp. 56–62.

Okpuzor, J., Okochi, V. I., Ogbunugafor, H. A. Ogbonnia, S. T., Fagbayi and Obidiegwu, C. (2009). Estimation of cholesterol level in different brands of vegetable oils. Pakistan J. Nutrition, 8: 57-62. 128317ja

Peter, T., Biamonte, G.T. and Doumas, B.T. (1982). Protein (Total protein) in serum, urine and cerebrospinal fluids; Albumin in serum. In: Selected method of clinical chemistry. Volume 9 (Paulkner WR, Meites S Eds) A*merican Association for clinical chemistry*, Washington, D.C.

Rafiu, T.A., Sangoniyi, O., Adewale, A. A., and Raheem, N. O. (2023) Growth

performance, organ, carcass characteristics and meat quality of broiler fed bitter leaf (vernonia amygdalina and catmint (Nepeta racemosa) leaf meal supplements. *Nigeria Journal of Animal Production,* volume, page(2020 NSAP Proceeding), 1353-1356. https://doi.org/1051791/njap.vi.5737

Rej, R. and Hoder, M. (1983). Aspartate transaminase. In: Methods of Enzymatic Analysis. 3rd ed. (*H.U.Bergmeyer, J. Bergmeyer and M. Grassl, Eds*). Weinhein Verlag-Chemie, 3: 433.

Roeschlau, P., Beru,T. E. and Gruber, J.W. (1974). Clinical Chemistry, 12: 403.

SAS. (2002**).** SAS/STAT Software: Changes and Enhancements through Release 8.1, SAS Institute Inc., Cary, NC.

Sarica, S., Ciftci, A., Demir, E., Kilinc, K., and Yildirim, Y. (2005). Use of an antibiotic growth promoter and two herbal natural feed additives with and without exogenous enzymes in wheat-based broiler diets. South African Journal of Animal Science, 35(1), 61-72.

Sharma, R. and Cannoo, S. (2016). Antiviral and antifungal properties of Nepetacataria: A review of recent findings. Phytotherapy Research, 30(5), 717-724.

Singh, V., Pandey, R. P., and Singh, R. H. (2004). Pharmacological studies on Datura stramonium Linn. (Solanaceae) with special reference to its antimicrobial activity. Journal of Ethnopharmacology, 91(2–3), 193–196. https://doi.org/10.1016/j.jep.2003.12.013

Singh, P. (2013). Probiotics in poultry: A review. Journal of Animal Science and Technology, 55(1), 1-11.

Suganya, T., Senthilkumar, S., Deepa, K. and Kalaikannan, A. (2015). Nutritional importance of maize – A review. International Journal of Food Science and Nutrition, 4(3), 30-35.

Tete, E. A., Lamine, K., and N'Da, D. (2007). Medicinal properties of Nepetacataria: Sedative, diaphoretic, febrifuge, and antioxidant effects. Journal of Ethnopharmacology, 110(3), 388-394.

Tallentire, D., Morrison, M., and Smith, G. (2016). Growth performance and market weight of commercial broiler chickens: A study of fast-growing strains. *Poultry Science Review, 15(2), 112-119.*

Uchechukwu, E. O., Xinyu, C., Vivian, U., Oleforuh, O., Vivian, U., Patience, N., Onu, H., Zhang, K, Q and Shugeng, Wu. (2024) Phytobiotics in poultry: revolutionizing broiler chicken nutrition with plant-derived gut health enhancers. *Journal of Animal Science and Biotechnology*. Vol 15, (169). https://doi.org/10.1186/s40104-024-01101-9

Visput, M.M., (2019). Improvement in poultry performance through application of phytobiotics. www.side share.net.

Venkatesan, R., Nagarajan, P. Rajaretnam, R.S. and Majumdar, S.S. (2006). "Hematologic and serum biochemical values in aged female onnet macaques Macaca radiata anesthetized with etamine hydrochloride", *Journal of America Association of Laboratory of Animal Science.*, 45 (2): 45-48.