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Dracaena mannii leaf meal supplementation in broiler chicks: effects on growth performance, haematology and serum biochemical indices

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Medicinal plants have been associated with many activities including antimicrobial, antioxidant, osmoregulatory, immune-modulating, hepato-protective and anti-fungal properties due to the presence of phytochemicals which are eco-friendly and effective. This experiment was carried out to examine the dietary supplementation of Dracaena mannii leaf meal on the growth performance and some haematological and biochemical indices of broiler chicks. 200 one-day old Hubbard broiler chicks (mixed sex) were used in a 28 days' experiment. Chicks were distributed over four groups of 50 birds with 5 replicates containing 10 birds each. Experimental diet was adequate in all nutrients (NRC, 1994). Birds in group 1: corn-soya meal basal diet without Dracaena mannii leaf (DMF), group 2, 3 and 4 were given basal diet with DMF at 200 g, 400 g and 600 g respectively. Phytochemical evaluation of DMF revealed the presence of flavonoids (1005.1 mg/g), phenols (842.9 mg/g), tannins (341.2 mg/g), alkaloids (211.7 mg/g), steroids (133.1 mg/g) and saponins (21.70 mg/g) in order of abundance. The findings also revealed that average daily were similar (P>0.05) in diet 3 and 4 but significantly higher (P<0.05) than other groups. Conversely, average daily feed intake of birds fed diet 1 were similar (P>0.05) to those given diet 2 but significantly (P<0.05) greater than the other groups. No mortality was recorded in all the groups (P>0.05). Pack cell volume, red blood cell, haemoglobin, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, white blood cell, leucocytes and monocytes counts were significantly (P<0.05) influenced by the diets. However, values were within the optimum range for healthy birds. Similarly, total protein, albumin, globulin and albumin/globulin ratio were significantly different (P<0.05) among the groups excepts for creatinine, urea, alkaline phosphatase, aspartate transaminase and alanine transaminase values (P>0.05). The researcher came to the conclusion that dietary supplementation of DMF up to 600 g can optimize the performance of broilers without causing any negative effect on their health status.

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1. Introduction

As antibiotic growth promoters have been banned in the European Union since January 2006, experience has been gained in the use of alternative substances such as phytogenic feed additives (plants) (Ulrich and Arne, 2020; Lubricant and Taraswor, 2001). Medicinal plants have an almost infinite ability to synthesize chemical compounds (phytochemicals) that are safe, eco-friendly and are predicted to have a promising future in animal nutrition due to their broad range of efficacies and their effects on sustainability and safety (Jan, 2021; Alagbe et al., 2023). The use of phytogenics such as Dracaena mannii show a wide range of activities in animal nutrition than synthetic substances due to their pharmacological properties; antimicrobial, anti-helminthic, hepato-protective, immune-stimulators, antioxidant, antifungal, antiviral activities amongst others (Luis, 2021; Enright et al., 2002).

Dracaena mannii is an evergreen, hardy, multipurpose and medium sized tree belonging to the family Agavaceae with about 80 species with high medicinal value due to the presence of phytochemicals such as: phenols, alkaloids, terpenoids, oxalates, saponins, flavonoids, tannins, amongst others (Chinyere et al., 2015; Dutta, 2003). The trees are drought resistance and predominantly found in tropical Africa and some parts of Asia including India (Chineye et al., 2015; Judd et al., 1999). The leaves of D. mannii are oblong-elliptic with a flaring base clinging to the stem for half its circumference, up to 400 × 20 mm (Anigboro et al., 2022; Sharma, 1993). The leaves, stems and roots extracts have been believed to possess pharmacological or therapeutic properties and has been used in the treatment of dermatitis, bacterial infections, liver disorders such as hepatitis, jaundice, cirrhosis, the eradication of intestinal parasites (Mathu et al., 2006; Palombo, 2011). Lagnika et al. (2011); Venter and Venter (1995) demonstrated the antimicrobial activity of D. mannii leaf extract against Staphylococcus aureus. Anigboro et al. (2022); Yasunaka et al. (2005) demonstrated the antifungal properties of D. mannii against Candida albicans.

Previous studies have shown that the dietary supplementation of phytogenics in broilers yielded positive outcome on growth performance as well as blood parameters since there is a direct relationship between nutrition and blood of animals (). For instance, Zaminur et al. (2013) reported that supplementation of guava (Psidium guajava) and mango (Mangifera indica) leaf meal at 4.5 % and 7.5 % improved final daily weight, feed intake as well as reduction in mortality rate of broilers. Deka et al. (2020) recorded an improvement in pack cell volume, red blood cell, haemoglobin, white blood cells and some serum biochemical indices of broilers fed diet supplemented with Azadirachta indica leaf meal at 0.3 % without causing any deleterious effect. Recent literature reports have indicated that phytogenic feed additives may also improve gut integrity because of its antioxidants and immune-modulating properties (Alagbe, 2018). These results suggest that medicinal plants medicinal plants can be used to bridge the gap between food safety and poultry production. However, there is little or no report on the dietary supplementation of D. mannii leaf on broiler chicks

There is no reason to presume that because medicinal plants originate from nature, it must be safe. Therefore, this study was carried out to investigate the effect of dietary supplementation of D. mannii leaf on the growth performance and some heamatological and serum biochemical indices of broiler chicks.

2. Research Method

This Experimental location, management of birds and experimental design

200 one-day old Hubbard broiler chicks (mixed sex) were used in a 28 days' experiment carried out at the Poultry unit of Sumitra Research Institute located between 23o 13' N and 72o 41' E, Gujarat India. The average initial weights of birds were taken before they were distributed over four groups of 50 birds with 5 replicates containing 10 birds each. A properly disinfected automated battery cage measuring 400 cm (length) × 200 cm (breath) × 100 cm (height) equipped with a stainless feeder and nipple drinkers as well as a suspended electric bulb (200 watts) for brooding was used. Birds were given glucose /vitamin mixture (2 g/5 g to 1 liter of water) on arrival and fed four experimental diet consisting of corn-soya meal formulated based on hubbard recommendations for broilers. Chicks were fed ad libitum for 4 weeks and also offered fresh clean water. Birds in group 1: corn-soya meal basal diet without Dracaena mannii leaf (DMF), group 2, 3 and 4 were given basal diet with DMF at 200 g, 400 g and 600 g respectively. A completely randomized design technique was adopted and efficient management practices were strictly adhered to.

Collection, identification and processing of Dracaena mannii leaf

Freshly harvested leaves of Dracaena mannii were harvested from the Research farm of Sumitra Research Institute, Gujarat, India and sent to the biological science section for proper identification and issued a voucher number (HH/08/2021). Leaves were washed with a running tap water followed by a distilled water, air-dried in a shade for ten days and grinded to powder using an electric blender. Thereafter it was packed into a transparent labeled polythene bags and transferred into the laboratory for further examination.

Phytochemical examination of Dracaena mannii leaf (DMF)

Quantification of steroids in Dracaena mannii leaf meal (DMF) was carried out according to procedures outlined by Alagbe et al. (2024). Analysis of other component were stated below:

Total flavonoids content

Using catechin as a reference, the total flavonoid content was calculated using the aluminium chloride technique. After adding 0.1 mL of aluminum chloride and 0.2 mL of 5 percent sodium nitrite, 2.0 grams of Dracaena mannii leaf meal (DMF) was added to 3 mL of 1 M sodium hydroxide. The mixture was thoroughly mixed and incubated for 10 minutes at room temperature. Immediately, 10 mL of distilled water were added to the final volume. Using a spectrophotometer, the reaction mixture's absorbance at 550 nm was evaluated in comparison to a blank.

Total phenolic concentration

The Folin-reagent Ciocalteu's was used to determine the total phenolic contents in DMF. 2.0 grams of DMF and 0.4 mL of 1:10 v/w were combined followed by the addition of 4 mL of sodium carbonate solution and kept at room temperature for 15 minutes. A spectrophotometer was used to test the sample's absorbance at 800 nm in comparison to the blank. The phenolic content in the sample was expressed as milligrams of catechol per dry gram of dry weight.

Total saponin concentration

Using a vanillin and concentrated sulfuric acid colorimetric technique, saponin was quantified. 0.4 milliliters of 77 percent sulfuric acid, 0.5 milliliters of freshly made vanillin solution, and 0.2 milliliters of DMF were combined. The mixture was allowed to cool to room temperature before being heated in a water bath for 30 minutes at 60 degrees centigrade. A spectrophotometer was used to detect the absorbance at 560 nm.

Total alkaloid content

Alkaloids were precipitated by mixing 20 mL of acetic acid solution in ethanol (10 percent w/v) with 2.0 grams of DMF and placing the mixture on a water bath for 10 minutes followed by the addition of ammonium hydroxide. After the precipitate reached a constant weight, it was transferred to desiccators and reweighed to estimate the total alkaloid content.

Total tannins estimation

The Folin-Ciocalteau technique was employed to determine the total tannin concentration. 2.0 mL of sodium bicarbonate and 1.0 mL Folin-Ciocalteau was added to 2.0 grams of DMF to dilute it (100 mL). The combination was thoroughly mixed and then let to cool for 15 minutes at room temperature. Then, using a spectrophotometer, the absorbance of the standard curve and DMF were compared to a blank at 800 nm.

Measurements:

Growth performance traits

The average initial weights of the birds were taken before the commencement of the experiment thereafter it was measured on a weekly basis and expressed in grams. Weight gain was estimated by subtracting the final body weight from the initial body weight (grams). Average daily weight gain was calculated by dividing the weight gain by the number of experimental days (28 days). Average daily feed intake (grams) = total feed intake divided by the number of experimental days (28 days).

Collection of blood and analysis

On the 28th day of the experiment, blood samples were collected from ten randomly selected birds per treatment and sent to Sumitra research laboratory for heamatological and serum biochemical examination. 4 ml of blood was collected from the wing vein of each birds out of which 2 ml was transferred into a sterile bottle with anti-coagulant for haematological studies, the remaining 2 ml was collected into bottles free from anticoagulant for serum biochemical examination. All samples were kept in an ice pack to prevent deterioration. Analysis of red blood cell, pack cell volume, haemoglobin, white blood cell, leucocytes and monocytes were carried out using XN-1500 advanced diagnostic auto-analyzer (HD-066DC, Netherlands) equipped with closed and open tube volume at 100 µL each, work station (intel pentium dual core 2.00 GHz 200 W desktop/tower), (3Gb/s 7200 RPM 16 MB Cache hard drive; 2 GB memory module CD-RW) and (11-inch torch screen with LCD monitor).

Serum biochemical evaluation was carried out with 200T/H automatic chemistry analyzer composed of a sample and reagent volume 70 µL and 350 µL with post spectral spectrophotometry equipped with LAN port access, thirteen operational wave lengths (305, 340, 450, 480, 505, 546, 570, 600, 630, 686, 712, 705, 722 nm) and humidity of 40 to 85 % and can display results within 120 seconds.

Statistical analysis

Data obtained were subjected to analysis of variance in a completely randomized design using statistical package for social sciences (SPSS version 25.0). Duncan multiple range test of the same software was used to test the difference among the means at $P \leq 0.05$ level of significance.

Using the model: $Yxy = \mu + \alpha x + \beta xy$, was used in this investigation, where Yxy = general response to variables; x = the overall mean; αx = effect of the xth treatment (1=4); and βxy = random error term for each estimate.

Table 1: Chemical composition of basal diet (percentage dry matter)

Feedstuffs/materials	Inclusion
Corn	52.00
Wheat bran	3.00
Soy bean meal	28.00
Fish meal (65 percent)	2.00
Groundnut cake	9.00
Limestone	2.00
Bone meal	3.50
Lysine	0.20
Methionine	0.25
*Mineral/vitamin premix	0.25
Salt	0.30
Total	100.0
Calculated analysis (g/kg)	
Crude protein (CP)	226.1
Crude fibre (CF)	44.8
Ether extract (EE)	48.0
Calcium (Ca)	16.3
Phosphorus (P)	61
Lysine	17.0
Methionine plus cysteine	88
Energy (kcal/kg)	3002.5
Determined analysis	
Crude protein (CP)	231.6
Crude fibre (CF)	42.0
Ether extract (EE)	46.7
Calcium (Ca)	18.6
Phosphorus (P)	85
Lysine	20.1
Methionine plus cysteine	10.2
Energy (kcal/kg)	2998.5

Each Kg of Mineral/vitamin premix contains; vitamin A, 10,000 I.U; vitamin E, 28.0 mg; vitamin D 4,000I.U, vitamin K, 5.00mg; vitamin B2, 5.0mg; Niacin, 80 mg; vitamin B12, 25 mg; choline chloride, 100 mg; Manganese, 10.0 mg; Zinc, 40.1mg; Copper, 8.0g; folic acid, 4.5mg; Iron, 5.1g; pantothenic acid, 30mg; biotin, 31.5g; antioxidant, 70mg

3. Result and Discussion

As revealed in Table 2, the growth performance of broiler starter chicks fed Dracaena mannii leaf meal (DMF). Average daily weight gain of birds fed diet 3 (400 g DMF/100 kg diet) were similar (P>0.05) to those fed diet 4 (600 g DMF /100 kg diet) but significantly (P<0.05) higher than those fed diet 1 (0g DMF) and 2 (200g DMF/ 100 kg diet). Conversely, average daily feed intake of birds fed diet 1 were similar (P>0.05) to those given diet 2 but significantly (P<0.05) greater than the other groups. This study clearly confirmed that adding Dracaena mannii leaf meal at 600 g (diet 3) and 800 g (diet 4) significantly improved (P<0.05) average daily weight gain against the other group. Likewise, average daily feed intake also decreased numerically across the group suggesting that the presence of phytochemicals such as flavonoids and phenols which are found to be abundant in DMF (1000.51 mg/g and 842.9 mg/g) possess antioxidant and antimicrobial properties, thus reducing microbial pressure in the gut as well as boosting the immune system of birds (Singh et al., 2023; Teanpaisan et al., 2017; Tekwu et al., 2012; Rolando, 2020). Increased weight gains in diet 3 and 4 along with reduced feed intake reveals better feed utilization by the birds. Feed conversion ratio was better (P<0.05) for DMF supplemented animals than the control (diet 1). No mortality was recorded in all the groups suggesting a high level of hygiene during the experimental period. The presence of tannins and alkaloids DMF plays active role in traditional herbal remedies and are under investigation for antibacterial, antineoplastic, antifungal, and other pharmaceutical functions (Shaheen et al., 2015; Tenover, 2006). The result recorded in this experiment corroborates with the reports of (Alagbe, 2018) who recorded an enhancement in growth rate of broiler starter chicks fed Delonix regia extracts at 2 mL/liter. The extract was reported to stimulate bile and enzymatic production as well as improving the rate of feed digestion in birds. Velenzuela et al. (2017) reported that dietary supplementation of phytochemicals at 2g/kg significantly (P<0.05) increased growth rate and reduced the mortality in broilers.

As presented in table 3, haematological indices of broiler starter chicks fed Dracaena mannii leaf meal. Pack cell volume of birds fed diet supplemented with DMF at 200 g/100kg diet (diet 2) and 400 g/100kg diet (diet 3) were similar (P>0.05) to those fed diet 4 (800 g/kg diet); but significantly higher (P<0.05) than those in control (diet 1). Red blood cell and monocytes values follow similar trend, they were greater (P<0.05) in diet 3 (400 g/100kg diet) and diet 4 relative to the other groups.

Pack cell volume, red blood cell and monocytes values were within the established ranges for healthy birds; (30.00−49.00 %), [(2.50 – 3.90 (×106/L)] and [(0.01 – 1.01 (×109/L)] reported by Jain (1993); Kuttappan et al. (2013) and Abdi-Hachesoo et al. (2011). Haemoglobin, white blood cell, leucocytes, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentrations in diet 3 (400 g/100kg diet) and diet 4 (600 g/kg diet) were similar (P>0.05), but significantly greater than other groups (P<0.05). Values of haemoglobin, white blood cell, leucocytes, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentrations were within the normal values (10.20 – 15.10 g/L), [1.90 – 9.50 (×109/L)], [1.92 – 6.00 (×109/L)], 60.05 - 100.2 (pg), 32.00 – 44.00 (fl) and 30.20 – 36.20 (g/dL) cited by Simaraks et al. (2004); Talebi et al. (2005) and Albokhadaim (2012). Blood analysis is used to detect a range of disorders and conditions in animals (Alagbe, 2019).

For instance, determination of pack cell volume helps to diagnose polycythemia, dehydration, anaemia, lung disease, tumor in the kidney and other health conditions (Alagbe, 2023). Heamoglobin is a protein found in the red blood cell that carries oxygen in the body and gives blood it's red colour (Ramalan et al., 2022; Omokore and Alagbe, 2019). Decrease in haemoglobin, red blood cell, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration values below the optimum ranges is a sign of anaemia (Alagbe et al., 2022). Elevation in mean corpuscular haemoglobin suggests vitamin B12 and folic acid deficiency as well as reticulocyte (Anuore et al., 2023). White blood cells are responsible for the production of antibodies which prevents the birds against infections (Agubosi et al., 2022).

As shared in table 3, serum biochemical indices of starter broiler chicks fed Dracaena mannii leaf meal. Total protein and albumin and globulin values of birds fed diet 3 (400 g/kg) were similar (P>0.05) to those in diet 4 (600 g/kg) but significantly greater (P<0.05) than diet 1 and 2. The total protein, albumin and globulin values were within the normal ranges (30.00−80.00 g/L), (20.0 – 60.0 g/L) and (20.0 – 57.0 g/L) reported by Simaraks et al. (2004). This suggests the absence of immune disorder, severe inflammation on vital organs as well as leaking of blood into tissues (Alagbe, 2022). Albumin/globulin ratio values which varied from 10.1 to 11.6 g/L were higher in diet in diet 3 and 4, intermediate in diet 2 and lower in diet 1.

Albumin play an important role in maintaining the oncotic pressure in the blood as well as transportation of hormones, vitamins and enzymes (Adewale et al., 2021). Albumin/globulin ratio gives insight into the nutritional status and immune status of birds (Alagbe, 2022). They are also vital indices for the diagnosis of other health conditions such as: liver and kidney diseases, chronic infections, pancreatitis, amongst others (Alagbe, 2023). Globulin are saddled with the responsibility of maintaining immune defense and some enzymatic activities (Alagbe et al., 2023). Creatinine, urea, alkaline phosphatase, aspartate transaminase, alanine transaminase values were not influenced (P>0.05) by the diets. Their corresponding values ranged from 0.42 – 0.51 mg/dL, 3.44 – 3.58 mg/dL, 82.10 – 89.06 (IU/L), 56.00 – 59.22 (IU/L) and 102.8 – 120.6 (IU/L). However, values were within the normal range for broilers reported by Albokhadaim (2012). Results on creatinine and urea suggests the absence of any inflammation of the kidney (Agubosi et al., 2022). Rapid increase of alkaline phosphatase and alanine transaminase in the blood are caused by liver and bone disease as well as vitamin D deficiency (Singh et al., 2022).

4. Conclusion

It was concluded that DMF show a wide range of potential benefits all targeting the enhancement of birds. It is loaded with several phytochemical with pharmacological properties, dietary supplementation of DMF especially at 400 g (diet 3) and 600 g (diet 4) had positive effects on final weight gain and feed conversion ratio as well as enhancing some of the blood parameters examined without causing any deleterious effect on the health status of broiler chicks.

Table 2: Effect of *Dracaena mannii* leaf meal on the growth performance of broiler starter chicks

Index	[1]Diet 1	[2]Diet 2	[3]Diet 3	[4]Diet 4	[5]SEM
Initial body weight (g/b)	52.09	52.01	52.00	51.98	0.01
Final body weight (g/b)	1409.5^{c}	1623.6^{b}	1710.8^{a}	1724.9^{a}	73.90
Average weight gain (g/b)	1357.4^{c}	1571.6^{b}	1658.8^{a}	1672.9^{a}	65.11
Average daily weight gain (g/b)	48.48^{c}	56.13^{b}	60.01^{a}	60.03^{a}	5.53
Total feed intake (g/b)	1922.0^{a}	1900.6^{a}	1837.1^{b}	1836.9^{b}	72.06
Average daily feed intake (g/b)	68.64^{a}	67.85^{a}	61.03^{b}	61.03^{b}	5.02
Feed conversion ratio	1.52^{a}	1.50^{a}	1.41^{b}	1.40^{b}	0.01
Mortality (%)	-	-	-	-	-

[1]Standard diet plus 0g DMF; [2]Standard diet plus 200 g/100kg DMF; [3]Standard diet plus 400 g/100kg DMF; [4]Standard diet plus 600 g/100kg DMF;[5]Standard error of mean; [a,b,c]Means with different superscripts along row are significantly (P<0.05) different.

Figure 1: Phytochemical composition of *Dracaena mannii* leaf meal

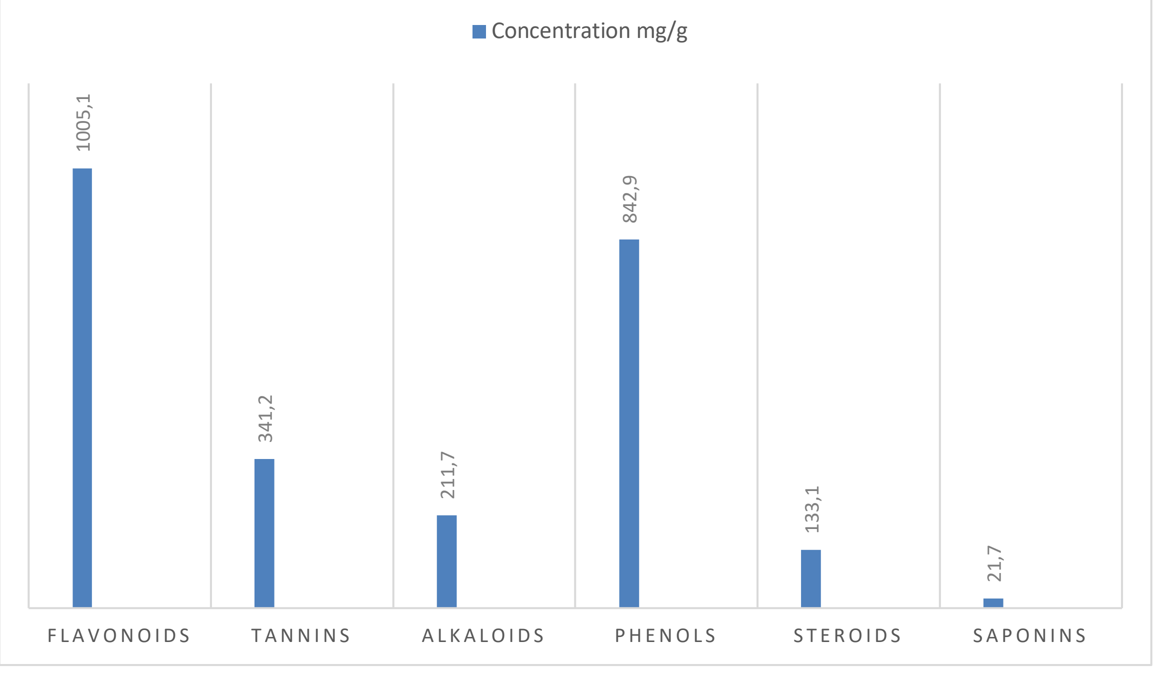

Table 2: Haematological indices of broiler starter chicks fed *Dracaena mannii* leaf meal

Index	[5]Diet 1	[6]Diet 2	[7]Diet 3	[8]Diet 4	**Range	[4]SEM
Pack cell volume (%)	30.92^{b}	34.02^{a}	36.33^{a}	36.80^{a}	30.00 – 49.00	0.08
Red blood cell (×10^{6}/L)	2.95^{b}	3.00^{b}	3.91^{a}	3.93^{a}	2.50 – 3.90	0.02
Heamoglobin (g/L)	9.92^{c}	11.30^{b}	14.05^{a}	14.88^{a}	10.20 – 15.10	0.20
[1]MCH (fl)	31.74^{c}	39.08^{b}	42.06^{a}	43.65^{a}	32.00 – 44.00	0.58
[2]MCV (pg)	65.12^{c}	78.22^{b}	97.83^{a}	98.00^{a}	60.05 – 100.2	0.72
[3]MCHC (g/dL)	30.02^{c}	32.84^{b}	36.00^{a}	36.07^{a}	30.20 – 36.20	0.55
White blood cell (×10^{9}/L)	5.56^{c}	7.22^{b}	9.38^{a}	9.41^{a}	1.90 – 9.50	0.03
Leucocytes (×10^{9}/L)	2.33^{c}	4.17^{b}	5.06^{a}	5.11^{a}	1.92 – 6.00	0.01
Monocytes (×10^{9}/L)	0.08^{b}	0.09^{b}	1.02^{a}	1.18^{a}	0.01 – 1.02	0.01

[1]Mean corpuscular haemoglobin; [2] Mean corpuscular volume; [3]Mean corpuscular haemoglobin concentration; [4]Standard error of mean;[5]Standard diet plus 0g DMF; [6]Standard diet plus 200 g/100kg DMF; [7]Standard diet plus 400 g/100kg DMF; [8]Standard diet plus 600 g/100kg DMF; [a,b,c]Means with different superscripts along row are significantly (P<0.05) different; **Simaraks et al. (2004).

Table 3: Serum biochemical indices of broiler starter chicks fed *Dracaena mannii* leaf meal

Index	[1]Diet 1	[2]Diet 2	[3]Diet 3	[4]Diet 4	**Range	[5]SEM
Total protein (g/L)	41.80[c]	56.20[b]	63.90[a]	64.50[a]	30.0 – 80.0	0.71
Albumin (g/L)	20.80[b]	30.00[b]	33.00[b]	34.00[a]	20.0 – 60.0	0.34
Globulin (g/L)	20.00[c]	26.20[b]	30.90[a]	30.50[a]	20.0 – 57.00	0.32
Albumin/Globulin ratio (g/L)	10.4[b]	11.5[a]	11.0[a]	11.1[a]	0.02 – 1.80	0.02
Creatinine (mg/dL)	0.42	0.49	0.51	0.50	0.02 – 1.00	0.02
Urea (mg/dL)	3.44	3.52	3.50	3.58	2.00 – 6.00	0.01
Alkaline phosphatase (IU/L)	82.10	89.06	88.91	88.02	60.0 – 116.8	0.86
Aspartate transaminase (IU/L)	58.71	56.00	58.40	59.22	40.0 – 155.6	0.69
Alanine transaminase (IU/L)	102.8	114.2	118.0	120.6	100.0 – 202.0	1.38

[1]Standard diet plus 0g DMF; [2]Standard diet plus 200 g/100kg DMF; [3]Standard diet plus 400 g/100kg DMF; [4]Standard diet plus 600 g/100kg DMF;[5]Standard error of mean; [a,b,c]Means with different superscripts along row are significantly (P<0.05) different; **Albokhadaim (2012).

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