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Growth Performance, Carcass Characteristics, Digestive Enzymes and Caecal Microflora of Guinea Fowl Fed Diet Supplemented with Pedalium Murex Leaf Powder

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Abstract
The aim of this research was to examine the growth performance, carcass characteristics, digestive enzymes and caecal microflora of guinea fowl fed diet supplemented with Pedalium murex leaf powder. A total of 300 -1 day old mixed sex guinea fowl (Pearl variety) with an average initial body weight of 38.65 ± 0.26 g were randomly distributed into five treatment groups with six replicates (10 birds/ replicate). The experiment lasted for 42 days and a completely randomized design model was adopted. Basic diet formulated to meet the nutritional requirements of birds as specified by Nutritional Research Council in 1994. Birds in group A (control), was fed basic diet only, group B received basal diet supplemented with Neomycin® at 20 g/kg diet while those in group C, D and E were fed basic diet supplemented with Pedalium murex leaf powder at 20 g, 40 g and 60 g/kg diet respectively. Evaluation of phyto-constituents in Pedalium murex leaf powder showed that it contained; phenolic compound at 102.2 mg/g, flavonoid (63.84 mg/g), steroid (56.69 mg/g), tannin (41.67 mg/g), alkaloids (39.06 mg/g) and saponins (27.45 mg/g). Total weight gain and total feed intake were higher in E (2534.9; 5333.6 g/b), treatment D (2515.2; 5323.7 g/b), treatment C (2545.7; 5300.7 g/b) than in treatment B (2284.3; 5069.1 g/b) and treatment A (2100.3; 4750.4 g/b) in that order. Dressing percentage (72.39 - 84.23 %) and weights of head, neck, back, thigh, breast, drumstick were influenced by the treatments ($p<0.05$) except for spleen, liver, gizzard, kidney and heart ($p>0.05$). Protease (0.81 - 1.21 ng/mL), amylase (79.92 - 112.6 U/L) and lipase (10.21 - 19.74 U/L) and Escherichia coli, Lactobacillus sp, Salmonella sp and Staphylococcus sp count were significantly affected ($p<0.05$). It was concluded that dietary supplementation of Pedalium murex leaf powder up to 60 g/kg had no detrimental effect on the performance of birds.

Keywords: Caecal, Growth, Microbes, Performance, Phyto-constituents.

1. Introduction
Because antibiotics are no longer allowed in poultry feed for growth promotion and prophylaxis, utilizing diets enriched or fortified with phytogenics to boost animal performance has become increasingly significant due to the presence of phyto-constituents or phytochemicals in them (John, 2024d). These compounds have a track record of efficacy, safety and environmental friendliness (John, 2024e). Globally, there are several medicinal plants with therapeutic properties that can be used to replace antibiotics and curb the increasing rate of antimicrobial resistance (Omokore and Alagbe, 2019). Among the potential herbal plant is *Pedalium murex*.

Pedalium murex Linn, is a potent succulent medicinal plant belonging to the family Pedaliaceae which includes more than 60 species and 14 genera. It is found in most part of India, Africa and parts of Europe (Imran et al., 2015). The plant can grow up to 40 cm in height with leaves which are alternate, fruits are round with more than one seed in each of their 5 to 12 compartment (Elumalai et al., 2011). The leaves are abundant in resins, saponins, tannins, flavonoids, saponins, alkaloids, glycosides, steroids, phenolic compounds amongst others which possess antimicrobial (Balasubramanian et al., 2008; Banji et al., 2010) , antioxidant, anti-cancer, anti-diarrhea, antiheminthic, immune-stimulatory (Thakkar et al., 2011; Prabhakaran et al., 2016), cytotoxic, anti-diabetic (Balakrishnan et al., 2010), antifungal, antiviral antimalarial (Balakrishnan et al., 2009), anti-progestative, and gastro-protective properties (Ojha et al., 2014; Thamizhmozhil et al., 2011). Traditionally, the aqueous root and leaf extract used in the treatment of gastrointestinal disorder, dysentery, fever, gonorrhea, toothache, wounds and skin disease (Patel et al., 2013; Jyoti and Dipak, 2014). In India, boiled roots are served as a quick relief for sore throat and dental infections (Mohammad and Mohd, 2022; Muruganatham, 2011).

Recent studies revealed that methanolic and ethanolic extract from *Pedalium murex* leaves possess antimicrobial properties and have been found to inhibit the activities of pathogenic organisms such as, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Proteus mirabilis*, *Acinetobacter baumannii*, *Enterobacter sp*., *Aspergillus sp*, *Enterococcus faecalis and Streptococcus pyogenes* amongst others (Balamurugan et al., 2010; Sharma et al., 2012).

Previous studies have shown that dietary supplementation of phytogenic feed additives in birds' could influence feed quality by improving palatability (), scavenge the activities of free radicals by removing harmful toxins from the body thereby reducing accumulated cholesterol level (Musa et al., 2020), immune booster (Adewale et al., 2021), growth performance and inhibit the activities of intestinal pathogens (Shittu et al., 2024). However, there is little or no information on the dietary supplementation of *Pedalium murex* leaf powder on the performance of guinea fowl. This research will help to bridge the information gap on animal performance, welfare and food safety.

1.1. Experimental Location

The experiment was conducted at the Poultry section of Sumitra Research Institute, Gujarat and all experimental procedures and management were approved by the ethics committee of the department of Animal Nutrition, Sumitra Research Institute, Gujarat India (ASD/20021G/08).

1.2. Collection And Preparation of Pedalium Murex Leaf Powder

Pedalium murex leaves were harvested from the premises of Sumitra Research Institute in Gujarat. Plant identification was carried out at the Department of taxonomy in the same institute and assigned a unique number (GH/ON/2024A). Selected leaves were rinsed in water, air dried for 16 days and milled into powder using an electric laboratory blender (Lusher, Model (NV-172, China). *Pedalium murex* leaf powder were stored in an air tight labeled container at a room temperature.

1.3. Analysis of Phyto-Constituents in Pedalium Murex Leaf Powder

Concentrations of phyto-constituents in *Pedalium murex* leaf powder was assayed as previously published by Alagbe (2024), Briefly, 200 g was injected into the sample collector of Labron® gas chromatography/mass spectrometry (Model: TH-0087D, Netherlands), the kit is set at different optical density and resolution time to obtain the concentrations of different phyto-constituents.

1.4. Animal Management, Duration and Experimental Design

A total of 300 -1 day old mixed sex guinea fowl (Pearl variety) with an average initial body weight of 38.65 ± 0.26 g was sourced from a reputable breeding farm in Gujarat. Birds were weighed with a digital sensitive scale on arrival to obtain their average initial weight before they were randomly distributed into five treatment groups with six replicates (10 birds per replicate). They were kept in a well disinfected galvanized battery cage equipped with nipple drinker to give unrestricted accessibility to fresh water. Birds were placed on a mixture of glucose and vitamins in ratio 2:1 in 10 liters of water for 7 days, which was the adjustment period and also fed basic diet formulated to meet the nutritional requirements of birds as specified by [14]. A completely randomized design model was used and the trial lasted for 42 days. Animals were given unlimited access to basic diet and brooding temperatures was properly monitored (36°C) and reduced weekly by 2°C until a constant temperature of 27°C was attained.

1.5. Trial Set-Up

Group 1: basic diet supplemented without any additive (negative control)
Group 2: basal diet supplemented with antibiotics (neomycin) at 20.0 g/kg
Group 3, 4 and 5: basic diet supplemented with *Pedalium murex* leaf powder at 20 g, 40 g and 60 g respectively.

1.6. Data Collected

Body weight gain was estimated by subtracting the initial body weight from the final body weight of birds (expressed in grams) at different phases.

Feed intake (g) was calculated was the difference between the feed served and left over at different phases.

Feed conversion ratio was computed as feed intake divided by the body weight gain of birds at different phases.

Protein intake (g/bird) was calculated as feed intake multiplied by crude protein in feed divided by 100.

Energy intake (M/kcal/kg) was estimated as feed intake multiplied by metabolizable energy in feed divided by 1000

1.7. Determination of Carcass and Organ Weight

At the end of the trial, 3 birds were randomly selected per replicate, weighed and feed starved for 12 hours to empty their crops. Birds were slaughtered by cutting the jugular veins in their neck region, allowed to bleed, scalded in warm water before it was manually de-feathered. Cut parts (head, neck, back, thigh, breast, drumstick, shank) and organs (spleen, liver, gizzard, kidney, heart) were taken using a sensitive scale. Dressing percentage was expressed as eviscerated weight divided by live weight multiplied by 100.

1.8. Ceacal Microflora and Digestive Enzyme Evaluation

At the end of the experiment (42 d), 3 birds were randomly selected per replicate (from those used for carcass determination) for caecal and digestive enzyme analysis. 10 g of caecal content was collected into sterile sample bottles followed by the addition of 3 drops of peptone reagent before it was taken to the microbiology section of Sumitra Research Institute, Gujarat for analysis. Caecal enumeration was carried out using Bioburden analyzer® (7000 RMS, Netherlands) with technical specifications; flow rate (30 mL/min to 100 mL/min), minimum detection (≥ 0.3µm) and operating range (10 to 90°C). Digestive enzymes were analyzed with EZ7100 Enzyme ATP analyzer (Model, ED/006C, India).

1.9. Proximate Analysis of Experimental Diet

Amarzorb 210® automated feed analyzer (Model RR08T, China) was used for the proximate analysis of experimental diet. Calcium and phosphorus in diet were analyzed using Mectra® atomic absorption spectrometer (model 7200AD, China).

1.10. Data Analysis

Data obtained were subjected to one -way analysis of variance using Statistical Package for Social Science (SPSS) (version 22). Significant differences among the groups were subjected to comparisons using the Duncan multiple range test of the same software. All differences were considered to be statistically significant when $p < 0.05$.

1.11. Experimental Result

Figure 1 shows the phyto-constituents in *Pedalium murex* leaf powder. The compound contained phenolic compound at 102.2 mg/g, flavonoid (63.84 mg/g), steroid (56.69 mg/g), tannin (41.67 mg/g), alkaloids (39.06 mg/g) and saponins (27.45 mg/g).

Nutrient composition of experimental diet at the starter and grower phase is presented in Table 1 and 2. The diet contained crude protein (23.07 % ; 21.10 %), crude fibre (3.18 % ; 3.87 %), crude fat (4.00 % ; 4.18 %), calcium (1.10 % ; 1.15 %), phosphorus (0.61 % ; 0.69 %), lysine (1.37 % ; 1.38 %), methionine (0.65 % ; 0.66 %) and metabolizable energy [(2998.7 ; 3009.6 Kcal/kg)] in that order.

Growth performance of guinea fowl fed diet supplemented with *Pedalium murex* leaf powder (Table 3). Weight gain and feed intake at the starter phase were higher in treatment E (740.25 g , 1718.9 g/bird), treatment D (736.72 g , 1712.6 g/bird), treatment C (732.78 g, 1700.4 g/bird) than in treatment B (684.02 g , 1665.7 g/bird) and treatment A (653.19 g , 1449.8 g/bird) ($p<0.05$). Feed conversion ratio value which varied from (2.22 to 2.44) improved among birds which received treatment C, D and E, intermediate in treatment B and lower in treatment A ($p<0.05$). Protein and energy intake values which varied from 333.45 - 395.35 g/bird and 4362.60 - 5172.34 (M/kcal/kg/bird) were influenced ($p<0.05$) by the treatment. At the growers' phase, weight gain (1447.2 to 1794.6 g/bird) and feed intake (3300.6 to 3614.7 g/bird) were affected ($p<0.05$). There was an improvement in feed conversion ratio, protein and energy intake among birds fed diet supplemented with *Pedalium murex* leaf powder relative to the other groups ($p<0.05$). At the overall production cycle, total weight gain and total feed intake were lowest in treatment A (2100.39 g, 4750.4 g/bird) than in treatment B (2284.3 g, 5069.1 g/bird), treatment C (2545.7 g, 5300.7 g/bird), treatment D (2515.2 g, 5323.7 g/bird) and treatment E (2534.9 g, 5333.6 g/bird) ($p<0.05$). Feed conversion ratio (2.17 to 2.26), protein intake (1026.6 - 1154.4 g/bird) and energy intake [(14596.8 to 16380.4 M/kcal/kg/bird)] were significantly affected ($p<0.05$).

Table 4 reveals carcass and organ characteristics of guinea fowl fed diet supplemented with *Pedalium murex* leaf powder. Dressed and eviscerated weight was lower in treatment A (1390.7 g; 1090.1 g) than in treatment B (1439.6 g; 1183.2 g), treatment C (1849.3 g; 1520.5 g), treatment D (1857.9 g; 1533.2 g) and treatment E (1890.1g; 1592.1g) ($p<0.05$). Dressed weight was higher ($p<0.05$) in treatment E (84.23 %), treatment D (82.52 %), treatment C (82.22 %) than in treatment B (78.18 %) and treatment A (72.39 %). The heart, kidney, spleen, liver and gizzard were not affected ($p>0.05$). Relative weights of head, neck, back, thigh, breast and thigh in birds which received treatment B, C, D and E were similar ($p>0.05$) but significantly higher than those in treatment A.

Caecal microflora of Guinea fowl fed diet supplemented with *Pedalium murex* leaf powder is presented in Table 5. *Escherichia coli*, *Salmonella spp* and *Staphylococus spp* counts were similar in treatment C, treatment D and treatment E ($p>0.05$), intermediate in treatment B and significantly lower than those fed treatment A ($p<0.05$). *Lactobacillus spp* count was lower in treatment A than in treatment B, treatment C, D and E ($p<0.05$).

Digestive enzymes of guinea fowl fed diet supplemented with *Pedalium murex* leaf powder is presented in Table 6. Population of protease which varied from 0.80 - 1.21 (ng/mL), amylase (79.92 to 112.6 U/L) and lipase (10.21 - 19.74 U/L) of birds in treatment C, D and E were similar ($p>0.05$) but significantly ($p<0.05$) higher than those in treatment A and treatment B.

2. Discussion

The result on this current study shows that *Pedalium murex* leaf powder contains phyto-compounds with several medicinal and biological activities including, anti-inflammatory, antioxidant, anti-cancer, antivirus, antimicrobial, antifungal, cytotoxic (Alagbe and Ushie, 2021), immune modulator, gastro-protective, anti-diabetic, antidiarrheal (Alagbe et al., 2023), anti-helminthic amongst others (Musa et al., 2020; Adewale et al., 2021; John, 2024a). These compounds (tannins, flavonoids, phenols, saponins, steroids and alkaloids) are non-toxic, safe and has no withdrawal period (John, 2024b; Alagbe et al., 2023). The result obtained aligns with the reports of Gulshan and Nutan (2016); Abirami and Rajendran (2015). Methanolic, aqueous and ethanolic extract from the leaves of *Pedalium murex* have been reported to inhibit the growth of *Klebsiella pneumonia*, *Bacillus cereus*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Salmonella spp*, *Staphylococcus aureus and Escherichia coli* (Adikay *et al.*, 2010; Balamurugan *et al.*, 2010). The high concentration of flavonoid and phenolic compounds in *Pedalium murex* leaf powder suggests that it can effectively function as an antioxidant capable of protecting the body from free radical damage (John, 2024c; Shittu et al., 2024). It also possess anti-inflammatory, analgesic, and antipyretic properties (Daniel et al., 2023; Alagbe et al. (2021); Alagbe, 2021).

Result on overall growth performance reveals that total weight gain and feed intake of birds fed diet supplemented with *Pedalium murex* leaf powder at 20 g (treatment C), 40 g (treatment D) and 60 g/kg diet (treatment E) were highest followed by the antibiotics group (treatment B: Neomycin at 20 g /kg diet) while the control group (treatment A). This result suggests that *Pedalium murex* leaf powder are involved in the secretion of digestive juices or enzymes (protease, amylase and lipase) thereby facilitating the transport of absorbed nutrient to the blood stream, resulting in improved feed conversion ratio among birds (John, 2024d; John, 2024e). The presence of *Pedalium murex* leaf powder in the feed also ensures a balanced intestinal morphology thus improving the body weight of birds (Alagbe, 2024; Shittu et al., 2023). The total weight gain range (2100.39 - 2534.9 g) recorded in this study aligns with the report of Shittu et al. (2021) who recorded a weight gain of 2200.1 - 2600.8 g in broilers fed diet supplemented with *Sida acuta* but lower than 1900.5 - 2100.7 g reported by Daniel et al. (2023) when Pawpaw seed essential oil was supplemented in the diet of broilers. Feed conversion ratio values (2.19 - 2.46) recorded in this experiment is in agreement with the reports of Muritala et al. (2022) who recorded a range of 2.00 - 2.40 in birds fed different levels of *Polyalthia longifolia* leaf extract. Higher protein and energy intake observed among birds fed with *Pedalium murex* leaf powder could be as a result of modulation in the retention time of feed in the gut of birds compared to the other groups. Protein and energy intake range [(1026.6 to 1154.4 g/bird)] and [(14596.8 - 16380.4 (M/kcal/kg/bird)] is within 1055.7 - 1200.8 g/bird and 13890 - 17330.9 (M/kcal/kg/bird) reported by Daniel (2024) when Doum palm pulp extract was fed birds at different levels.

In this trial, dressed percentage in birds fed treatment C (20 g *Pedalium murex* leaf powder/kg diet), treatment D (40 g *Pedalium murex* leaf powder/kg diet) and treatment E (60 g *Pedalium murex* leaf powder/kg diet) being higher than those fed Neomycin (treatment B) and control (treatment A) indicates that *Pedalium murex* leaf powder supplementation in diet of birds had positive influence on the total weight gain which translates to an improved meat yield in birds. This is made possible due to the presence of phyto-constituents in *Pedalium murex* leaf powder (Figure 1). The values of dressing percentage in this study (72.39 - 84.23 %) was higher than the values (71.05−76.55 %) reported by Oluwafemi *et al.* (2021) when turmeric essential oil was fed to broiler chickens. The dietary treatments did not influence the cut-up parts of the spleen, liver, gizzard, gizzard and heart suggesting that the dietary supplementation of *Pedalium murex* leaf powder up to 60 g/kg was not toxic to the birds. However, weights of cut parts (head, neck, back, thigh, breast and drum stick) were higher among birds that received both antibiotics (treatment B), treatment C, D and E compared to treatment A. This parts could possibly be influenced by the overall total weight gain of birds. The outcome obtained is in agreement with the reports of Oluwafemi et al. (2021) when ginger and garlic oil mixture was supplemented in the diet of broilers.

Results on caecal microflora showed that the dietary supplementation of *Pedalium murex* leaf powder among birds in group C, D and E decreased the proliferation *Escherichia coli*, *Salmonella spp* and *Staphylococcus spp* in the intestine compared to those in treatment B and A. Though neomycin supplementation in the diet reduced the population of pathogenic organisms in the gut however, its efficacy cannot be compared to the action of *Pedalium murex* leaf powder. It is important to note that increase in the dietary supplementation of *Pedalium murex* leaf powder enhanced the rapid multiplication of beneficial bacteria (*Lactobacillus spp*). This suggests that *Pedalium murex* leaf powder has the potential of competing with harmful pathogens for nutrients via its antimicrobial properties, thus creating a normal and balanced gastrointestinal flora or environment (Omokore and Alagbe, 2019). Outcome obtained is in agreement with the reports of Shiitu et al. (2021) when phytogenics was supplemented in the diet of birds.

3. Conclusion

In conclusion, *Pedalium murex* leaf powder contains several phyto-constituents with medicinal properties and can be used to replace antibiotics in poultry production since its constituents are non-toxic and has no withdrawal period. Supplementation of *Pedalium murex* leaf powder up to 60 g/kg diet can promote the growth performance of birds and can promote a balanced gut in birds.

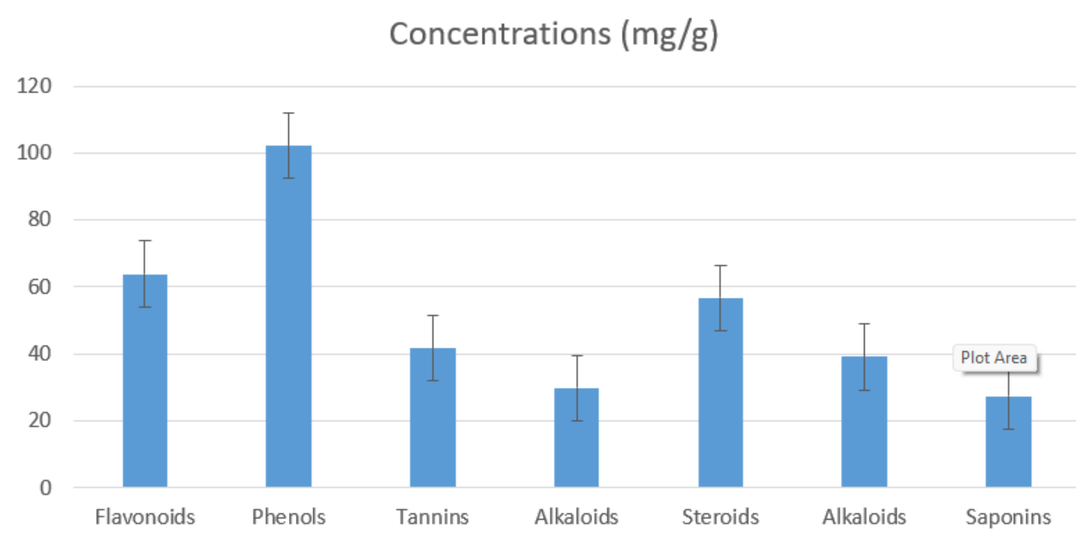

Figure 1. Concentrations of Phyto-constituents in *Pedalium murex* leaf powder.

Table 1. Nutrient composition of experimental diet fed to Guinea fowl at 0-21 days.

Ingredients	Content (%)
Maize	52.5
Corn bran	2.04
Soybean meal	32.0
Fish meal (Imported brand)	3.00
Calcium carbonate	3.00
Bone meal	6.00
Lysine	0.25
Methionine	0.25
*Starter premix	0.25
Sodium chloride	0.35
Total	100.0
Nutrient levels (%)	
Crude protein	23.07
Crude fibre	3.18
Crude fat	4.00
Calcium	1.10
Phosphorus	0.61
Lysine	1.37
Methionine	0.65
Energy (Kcal/kg)	2998.7

Each 2.5 kg starter premix contains; vitamin A, 4,000,000 IU; vitamin K3, 800mg; vitamin E 4,000 mg; vitamin B1 800 mg; vitamin B2, 2000 mg; vitamin B5, 10,600 mg; vitamin B5, 4000 mg; vitamin B6, 1200 mg; vitamin B8, 40 mg; vitamin B9, 320 mg; vitamin B12; Iron, 20,000 mg; Copper, 4130 mg; Zinc, 250 mg; Manganese, 30,000 mg.

Table 2. Nutrient composition of experimental diet fed to Guinea fowl at 22-42 days.

Ingredients	Content (%)
Maize	53.5
Corn bran	3.00
Soybean meal	30.4
Fish meal (Imported brand)	2.00
Calcium carbonate	3.50
Bone meal	6.50
Lysine	0.25
Methionine	0.25
*Grower premix	0.25
Sodium chloride	0.35
Total	100.0
Nutrient levels (%)	
Crude protein	21.10
Crude fibre	3.87
Crude fat	4.18
Calcium	1.15
Phosphorus	0.69
Lysine	1.38
Methionine	0.66
Energy (Kcal/kg)	3009.6

Each 2.5 kg grower premix contains; vitamin A, 2,000,000 IU; vitamin K3, 900mg; vitamin E 4,200 mg; vitamin B1 820 mg; vitamin B2, 3000 mg; vitamin B5, 10,000 mg; vitamin B5, 5000 mg; vitamin B6, 1500 mg; vitamin B8, 50 mg; vitamin B9, 350 mg; vitamin B12; Iron, 22,000 mg; Copper, 4000 mg; Zinc, 300 mg; Manganese, 35,000 mg.

Table 3. Growth performance of Guinea fowl fed diet supplemented with *Pedalium murex* leaf powder.

Variables	A	B	C	D	E	SEM	P-value
Starter (1 - 21 d)							
Initial body weight (g/bird)	38.91	38.88	38.72	38.68	38.65	0.40	0.10
Final body weight (g/bird)	692.1^{c}	722.9^{b}	771.5^{a}	775.4^{a}	778.9^{a}	28.7	0.03
Weight gain (g/bird)	653.19^{c}	684.02^{b}	732.78^{a}	736.72^{a}	740.25^{a}	26.1	0.02
Feed intake (g/bird)	1449.8^{c}	1665.7^{b}	1700.4^{a}	1712.6^{a}	1718.9^{a}	98.6	0.04
Feed conversion ratio	2.44^{a}	2.32^{b}	2.22^{c}	2.22^{c}	2.22^{c}	0.14	0.01
Protein intake (g/bird)	333.45^{c}	383.11^{b}	391.09^{a}	393.90^{a}	395.35^{a}	13.6	0.04
Energy intake (M/kcal/kg/bird)	4362.60^{c}	5012.26^{b}	5116.67^{a}	5153.39^{a}	5172.34^{a}	172.3	0.01
Grower phase (22 - 42 d)							
Body weight gain (g/bird)	1447.2^{c}	1600.3^{b}	1774.2^{a}	1778.5^{a}	1794.6^{a}	28.94	0.03
Feed intake (g/bird)	3300.6^{c}	3403.4^{b}	3600.3^{a}	3611.1^{a}	3614.7^{a}	166.4	0.04
Feed conversion ratio	2.38^{a}	2.20^{b}	2.13^{c}	2.13^{c}	2.10^{d}	0.10	0.01
Protein intake (g/bird)	693.13^{c}	714.71^{b}	756.06^{a}	758.33^{a}	759.09^{a}	23.8	0.02
Energy intake (M/kcal/kg/bird)	10234.2^{c}	10552.9^{b}	11163.5^{a}	11197.0^{a}	11208.1^{a}	186.2	0.01
Total production (1 - 42)							
Total weight gain (g/bird)	2100.39^{c}	2284.3^{b}	2545.7^{a}	2515.2^{a}	2534.9^{a}	123.2	0.02
Total feed intake (g/bird)	4750.4^{c}	5069.1^{b}	5300.7^{a}	5323.7^{a}	5333.6^{a}	190.1	0.03
Feed conversion ratio	2.46^{a}	2.30^{b}	2.19^{c}	2.19^{c}	2.19^{c}	0.12	0.02
Protein intake (g/bird)	1026.6^{c}	1097.8^{b}	1147.1^{a}	1152.2^{a}	1154.4^{a}	20.7	0.01
Energy intake (M/kcal/kg/bird)	14596.8^{c}	15565.2^{b}	16280.1^{a}	16350.3^{a}	16380.4^{a}	192.2	0.02

Values followed by different letters were significantly different ($p<0.05$); diet A: basic diet only (control); B: basic diet supplemented with Neomycin at 20.0 g/kg diet while C, D and E: basic diet supplemented with *Pedalium murex* leaf powder at 20 g, 40 g, 60g per kg diet respectively; SEM: standard error of mean

Table 4. Carcass and organ characteristics of Guinea fowl fed diet supplemented with *Pedalium murex* leaf powder.

Parameters	A	B	C	D	E	SEM	*P*-value
Live weight	1896.7^{c}	2005.6^{b}	2430.3^{a}	2457.9a	2500.1^{a}	138.2	0.03
Dressed weight (g)	1390.7^{c}	1439.6^{b}	1849.3^{a}	1857.9^{a}	1890.1^{a}	102.4	0.04
Eviscerated weight (g)	1090.1^{c}	1183.2^{b}	1520.5^{a}	1533.2^{a}	1592.1^{a}	110.9	0.02
Dressing percentage (%)	72.39^{c}	78.18^{b}	82.22^{a}	82.52^{a}	84.23^{a}	8.52	0.05
Cut parts of organs (% live weights)							
Spleen	0.22	0.25	0.21	0.23	0.25	0.53	0.13
Liver	2.18	2.20	2.23	2.25	2.28	0.21	0.08
Gizzard	3.06	3.15	3.18	3.20	3.26	0.34	0.06
Kidney	0.31	0.34	0.35	0.38	0.39	0.09	0.01
Heart	0.59	0.60	0.62	0.61	0.61	0.05	0.01
Cut parts (% of Live weights)							
Head	2.93^{b}	3.15^{a}	3.23^{a}	3.25^{a}	3.28^{a}	0.08	0.01
Neck	3.65^{b}	4.71^{a}	4.78^{a}	4.82^{a}	4.85^{a}	0.12	0.02
Back	10.08^{b}	15.26^{a}	15.34^{a}	15.56^{a}	15.65^{a}	3.82	0.03
Thigh	8.56^{b}	10.82^{a}	10.85^{a}	10.91^{a}	10.93^{a}	2.91	0.02
Breast	14.86^{b}	20.87^{a}	20.88^{a}	20.96^{a}	20.98^{a}	8.07	0.03
Drumstick	6.40^{b}	10.36^{a}	10.44^{a}	10.68^{a}	10.72^{a}	2.55	0.01

Values followed by different letters were significantly different ($p<0.05$); diet A: basic diet only (control); B: basic diet supplemented with Neomycin at 20.0 g/kg diet while C, D and E: basic diet supplemented with *Pedalium murex* leaf powder at 20 g, 40 g, 60 g per kg diet respectively; SEM: standard error of mean

Table 5. Caecal microflora of Guinea fowl fed diet supplemented with *Pedalium murex* leaf powder

Parameters Log 10 (Cfu/g)	A	B	C	D	E	SEM	*P*-value
Escherichia coli	7.33^{a}	5.09^{b}	3.46^{c}	3.40^{c}	3.00^{c}	0.92	0.01
Lactobacillus spp	5.48^{c}	7.39^{b}	9.00^{a}	9.21^{a}	9.93^{a}	1.71	0.02
Salmonella spp	2.88^{a}	1.14^{b}	1.10^{b}	1.02^{b}	1.00^{b}	0.05	0.01
Staphylococcus spp	5.12^{a}	3.94^{b}	3.89^{b}	3.00^{b}	2.85^{c}	0.12	0.01

Values followed by different letters were significantly different ($p<0.05$); diet A: basic diet only (control); B: basic diet supplemented with Neomycin at 20.0 g/kg diet while C, D and E: basic diet supplemented with *Pedalium murex* leaf powder at 20 g, 40 g, 60g per kg diet respectively; SEM: standard error of mean

Table 6. Digestive enzymes of Guinea fowl fed diet supplemented with *Pedalium murex* leaf powder.

Parameters	A	B	C	D	E	SEM	*P*-value
Protease (ng/mL)	0.81^{c}	1.00^{b}	1.13^{a}	1.18^{a}	1.21^{a}	0.07	0.01
Amylase (U/L)	79.92^{c}	98.23^{b}	110.2^{a}	110.7^{a}	112.6^{a}	18.92	0.05

Lipase (U/L)	10.21[c]	14.55[a]	18.70[a]	18.73[a]	19.74[a]	4.06	0.02

Values followed by different letters were significantly different ($p<0.05$); diet A: basic diet only (control); B: basic diet supplemented with Neomycin at 20.0 g/kg diet while C, D and E: basic diet supplemented with *Pedalium murex* leaf powder at 20 g, 40 g, 60g per kg diet respectively; SEM: standard error of mean

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