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Effect of different levels of feed added coriander (coriandrum sativum) leaves meal on the performance, carcass quality, immune response and blood profile of quails (corturnix cortunix japonica)

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An experiment was conducted to study the effect of different levels of feed added Coriander sativum leaf meal (CLM) on the growth performance viz., weight gain, feed intake and feed conversion ratio, carcass characteristics, immune response and some blood parameters of quails. One hundred and eighty (one week) old Japanese quails were used for this study, the birds were reared in a wooden cage with dimensions of 1 × 1 × 0.4 m (length, width, height). They were divided into four dietary groups and each group was subdivided into three replicates of fifteen quails each. The groups were assigned to four diets containing 0, 2.0, 4.0 and 6.0% CLM. Feed and water were provided ad libitum throughout the experimental period which lasted for 8 weeks. The results showed that there was a no significant (P>0.05) difference in body weight, weight gain and feed conversion ratio between treatment groups. The relative weights of the organs examined were not significantly (P>0.05) different across dietary treatments. All the hematological and serum biochemical parameters evaluated: Pack cell volume (PCV), Hemoglobin (Hb), White blood cell (WBC), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration(MCHC), Albumin, globulin, Aspartate aminotransferase (ALT), Alkaline phosphatase(ALP), Glucose, Urea serum glutamic oxaloacetate transaminase (SGOT) and serum glutamic pyruvate transaminase (SGPT) were not significantly (P>0.05) affected by the inclusion of CLM. Significant influences (P<0.05) were observed for immune response and mortality. The results of this experiment demonstrated that CLM can be included up to 6.0% level in quail rations without any adverse effect on growth performance, carcass characteristics and blood profile of birds.

Keywords: Coriander leaf meal, Japanese quails, growth performance, hematological parameters.

Introduction

For many years, antibiotics have been used in the poultry industry. However, the misuse or continuous use of antibiotics has led to the emergence of the antibiotics residue and drug resistance. Now a day's use of antibiotics as growth promoter in animal nutrition is facing reduced social acceptance and their use has been banned or curtailed in many countries Barug et al (2006) which has led to investigation to alternative feed additives in animal production.The success of modern animal production in supplying large quantity of low cost feed to the human population depends to a large extent on the judicious and creative use of feed additives (FAAN, 2016) [1,2]. A feed additive (medicinal plant) plays a significant role in maintaining an animal's health, improving the characteristics of feed and growth performance. According to Tozyo et al (1994), medicinal plants have some properties being anti-inflammatory, antiseptic, antibacterial activities against microorganism, treatment of gastro intestinal complaints, anthelmintic and antioxidants which are attributed to their active materials[3]. According to Burt (2004) herbs and spices are identified to exert potent antimicrobial properties in vitro against pathogens, and as alternative feeding strategy to replace antibiotic growth promoters. They been shown to offer wide range of activities, including animal performance and increasing nutrient availability when compared or organic chemicals, they present less toxicity and are free of unwanted residues and also act as supplement in animal diets (Falcao-E-Cunha et al., 2007) [4,5].

Generally herbs (medicinal plants) are of leaf origin and their plants produces some chemical compounds as part of their own metabolic activities called phytochemicals. According to Dalle Zotte et al (2016), phytochemicals can be classified by their therapeutic values (antibacterial, antifungal, anti-inflammatory, antiulcer, antioxidant, antiviral, anticancer and immune stimulants) and preparation modes (tincture, decoction, maceration, syrup, inhalation and infusions) [6]. Medicinal plants are potential source of drugs with a promising future because there are about half million plants

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around the world and most of their medical activities have not yet been investigated [7]. According to WHO (1993) around 21,000 plant species have the potential for been used as medicinal plants and are also considered to be very safe as there is no or minimal side effects. Recently, Coriander sativum have been considered very important because of their therapeutic value and several beneficial effects to human and animals especially quails.

Coriander(Coriander sativum) belongs to family Umbelliferae and genus Coriandrum. It was used in time honored Greek medicines by Hippocrates (460-377 BC). Coriander is also regarded as "Spice of happiness" by Egyptians. The leaves contains adequate amounts of micronutrients [8]. It is one of the famous species in Asia, especially in Indonesia. Reports on the plant has shown that its various parts possess different biological activities. Pharmacological studies on the leaves of this plant reveals effective anti-bacterial effect, anti-inflammatory, anti-microbial, anti-cancer, antiviral and antioxidant activity.

Quails belongs to the order Galliformes, family Phasinidae, genus Cortunix and species japonica. It attains maturity and come into first lay between 5-6 weeks of age and produce between 200-300 eggs in their first year of lay [9]. Japanese quails also known as common quails is mainly raised for meat and egg production and also are valued research animals [10]. It attains a market weight of 140-180g between 5-8 weeks.The Japanese quail is fairly resistant to diseases, but clinical chemistry data can be useful aids for diagnosis and monitoring responses in birds, which often show no clinical signs [11]. The range of avian species for which reference values are published is mostly limited to racing pigeons, to the most common psittacine species, and to peregrine falcons [12]. For those species used as poultry, blood chemistry was established to some extent for quail [13], chicken [14], duck (Farhat and Chavez, 2000), turkey [15], and ostrich [16].

According to Togun and Oseni (2005) Hematological analysis involves the determination of have been found useful for disease prognosis and for therapeutic and feed stress monitoring. Blood analysis provides the opportunity to clinically investigate the presence of several metabolites and other constituents in the body [17]. Nutrition and dietary contents affects the blood profile of healthy animals [17, 18, 19]. Aro et al (2013) posited that haematological parameters like haematocrit value, hemoglobin concentration, white blood cell count, red blood cell count among others are used for routine screening for the health and physiological status of livestock and humans.Blood parameters are excellent medium for measurement of potential biomarkers, because its collection is relatively non-invasive and it encompasses an enormous range of physiological process in the body at any given time [20, 21]. Changes in blood profile can be due to disease (Yadav et al, 2002), stress due to nutritional factor [22], age and sex [21] and breed [23].

The significant effects of herbs and spices have been tested in humans and laboratory animals, for instance Alagbe, J. O (2017) reported the effects of dietary inclusion of Polyalthia longifolia leaf meal as phyobiotic on the performance of broilers[24]. Durrani et al (2006) evaluated the effects of different levels of feed added turmeric on the performance of broiler chicks [25]. Olufemi et al (2004) evaluated the effects of Amaranthus spinosis leaf meal on blood profile of pigs. Although extensive studies have been done on the effect of herb/medicinal plants on animals, yet there is a dearth of information on the dietary inclusion of Coriander leaf meal on the performance of quails. A timely evaluation on the effects of the herb to animals will provide useful information relating to immune system, carcass characteristics and blood profile of quails. Therefore, this study was carried out to evaluate the effects of Coriander leaf meal on the performance, carcass characteristics, immune response and blood profile of quails.

Material and Method

Location of experiment

The experiment was carried out at Dan-malafia Farms, Abuja, Nigeria. The area is located within the derived savannah zone of Nigeria. The research was conducted between January to March, 2018.

Animals and their management

A total of One hundred and eighty (one week) old Japanese quails were used for this study. The birds were divided into four dietary groups and each group was subdivided into three replicates of fifteen quails each. They were housed in a wooden cage with dimensions of 1 × 1 × 0.4 m (length, width, height). Wood shavings were used as litter material in the cages, artificial lighting was used to provide the birds with 24 hours light during the whole experimental period. The initial brooding temperature was 35oC in the first week and it was gradually reduced by 2oC per week to 22oC for the rest of the experiment. Vaccines were administered according to the prevailing vaccination schedule in the environment. Feed and water were provided throughout the experimental period which lasted for 8 weeks.

Preparation of experimental diets

Healthy fresh leaves of Coriander were collected within the farm premises and washed with distilled water, it was later air dried for 6 days. The dried leaves were then hammer milled to produce coriander leaf meal (CLM). CLM was mixed together with other materials to form four experimental diets at levels of 0, 2, 4 and 6% as presented on Table 1. All the diets were formulated to meet the nutrient requirement standards for quails [26, 27,28].

Proximate analysis of diets and CLM were determined according to AOAC (2000) [29]. The phytochemical screening was determined according to procedures outlined by Harbone (1973) and Trease and Evans (1983) [30, 31, 32]. The mineral analysis were carried out using Atomic Absorption

Spectrophotometer (AAS) [33].

Parameters measured

Growth performance parameters

Daily feed intake (g) was calculated by difference between feed offered and the left over, feed conversion ratio was determined as feed intake divided by body weight gain, water consumption and mortality were recorded daily throughout the experimental period.

Blood analysis

At the 8th week of the experiment, blood samples were collected from the brachial vein of three randomly selected birds per group. The blood samples were analyzed for some hematological and serum biochemical parameters; blood samples for hematology were collected into bottles containing Ethylene Diamine Tetra Acetate (EDTA). The hematological parameters such as Pack cell volume (PCV), Red blood cell (RBC), White blood cell (WBC), Haemoglobin concentration (Hb) and absolute counts of neutrophils, lymphocytes, monocytes and eosinophils were computed according to the method of Jain (1986) [35].

Blood samples that were meant for serum biochemistry were collected into other bottles free from any anticoagulant. The serum total protein, Albumin and Globulin were computed according to (Doumas and Briggs, 1972) [34], Glutamic oxaloacetate transaminase (SGOT), Glutamic phosphatase transaminase (SGPT) was determined according to Scott (1965) [36].

Carcass Evaluation

At the end of the eighth week, four birds were randomly selected per group; they were fasted overnight and given only water, weighed and slaughtered. After evisceration, the organs were removed and weighed. The carcass weight, dress weight, weight of the visceral organs and other parts of the birds were also recorded.

Immune Parameters

Birds were orally vaccinated against Gumboro virus (on the 11th and 20th days) and Newcastle disease (on the 9th and 16th days). Four (4) birds were randomly selected per replicate to access the antibody response to Newcastle and gumboro virus on the 28th and 42nd day of the experiment. Blood samples were collected from the branchial vein of the vaccinated birds and sent to the laboratory for further analysis. Antibody titers against Newcastle and Gumboro viruses were measured using Hemaaglutination Inhibition Test.

Statistical Analysis

All data generated were subjected to a one way analysis of variance (ANOVA) and treatment means were compared using Duncan's multiple range test as outlined by Steel and Torrie (1990) using SAS (1997) package.

Table 1 Percentage Composition of the Experimental Diets

Ingredients	Diets			
	1	2	3	4
Maize	46.0	46.0	46.0	46.0
Wheat offal	21.25	21.25	21.25	21.25
Soya Meal	20.0	16.0	14.0	12.0
Groundnut Cake	10.0	10.0	10.0	10.0
Bone meal	1.5	1.5	1.5	1.5
Oyster shell	0.5	0.5	0.5	0.5
S/Premix	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50
CLM	0	0.2	4.0	6.0
	100	100	100	100

Table 2: Determined Analysis				
Crude Protein (%)	21.06	21.05	21.04	21.03
Crude Fibre (%)	4.10	4.10	4.10	4.10
Ether extract (%)	3.74	3.74	3.74	3.74
Ash (%)	2.6	2.6	2.6	2.6
Metabolizable energy (Kcal/kg)	2702.0	2706.0	2705	2705.1
Calcium (%)	3.00	3.00	3.00	3.00
Methionine (%)	0.45	0.45	0.45	0.45

*Vitamin –mineral premix contained: Vit A 8,000 IU; Vit D3, 2000 IU; Vit E, 11 IU; Vit B2, 10mg; Vit B3, 30mg; Vit B6, 20mg; Choline chloride, 400mg; Manganese, 120mg; Iron, 70mg; Copper, 10mg; Iodine,2.2mg; Selenium, 0.2mg; Zinc, 45mg; Cobalt,0.02mg

Table 3: Proximate Composition of CLM

Nutrients	% DM
Crude Protein	12.53 ± 0.10
Crude Fibre	6.34± 0.14
Ether extracts	0.97 ± 0.06
Ash	15.51 ± 1.22
Minerals (Mg/kg)	
Calcium	947± 0.05
Phosphorus	12.3± 1.15
Magnesium	0.94± 0.91
Iron	21.03± 0.44
Copper	1.06± 0.70

Table 4: Phytochemistry of CLM

Parameters	Quantity
Saponin (%)	0.75± 0.04
Tannin (%)	0.89± 0.07
Phenols (%)	1.30± 0.12
Alkaloids (%)	2.06± 0.14
Flavonoids (%)	4.11± 0.92
Phytate (mg/g)	10.22±1.22

are 0.75%, 0.89%, 1.30%, 2.06%, 4.11% and 10.22mg/g for saponin, tannin, phenols, alkaloids, flavonoids and phytate respectively. Table 4 shows the growth performance of quails fed CLM, the values obtained for the final live weight are 189.1, 180.7, 188.1 and 185.1g for diets 1, 2, 3 and 4 respectively. There was no significant difference (P>0.05) among the treatments in terms of the final live weight. The daily feed intake values obtained are 619.0, 600.4, 603.1 and

Table 5: Growth Performance of Japanese quails fed CLM

Diets Parameters 12 3 4 S/L					
Number of quails	45454545				
Initial body weight (g)	19.11± 0.07	19.05 ± 0.11	19.16± 0.22	19.01± 0.15	NS
Final body weight (g)	189.1 ± 0.12	180.7± 0.10	188.1± 0.51	185.1± 1.22	NS
Daily feed intake (g)	610.1 ± 2.11	600.4 ± 1.80	603.1± 1.23	602.7±1.45	NS
Daily weight gain (g)	169.0 ± 0.83	581.3 ± 1.40	583.9 ±1.61	583.7± 1.34	NS
FCR	3.23 ± 0.08	3.32± 0.07	3.21 ± 0.12	3.26± 0.14	NS
Mortality	08	0	0	0	**

NS: No significant difference (P>0.05)
**: Significant difference(P<0.05)
FCR: Feed conversion ratio

Table 6: Effect of feeding different levels of CLM on haematological parameters of Japanese quails

Parameters	Diets			
12	3	4	S/L	
Pack cell volume (%)	51.07±0.13	51.11± 0.16	51.08± 0.11	51.10±0.15 NS
Haemoglobin (g/dl)	11.07±0.13	11.11± 0.16	11.08± 0.11	11.10±0.15 NS
Red blood cell $(10)^6 mm^3$	3.06 ± 0.23	3.11 ± 0.29	3.09 ± 0.31	3.13 ± 0.77 NS
White blood cell $(10)^6 mm^3$	123.7 ± 1.16	127.11± 1.10	124.1± 1.25	127.9 ± 1.31 NS
MCV (f/l)	81.11±3.31	81.99±4.01	81.22±2.14	81.05±3.12 NS
MCH (pg)	26.44±2.17	27.01±1.81	27.13±1.56	27.18±1.09 NS
MCHC (g/dl)	32.16±0.21	33.14±0.33	33.09±1.25	33.45±1.76 NS
Neutrophil (%)	40.10 ± 0.71	40.16± 0.67	43.10± 0.88	43.89 ±1.40 NS
Monocytes (%)	3.44 ± 1.12	3.08 ± 1.61	3.19 ± 1.14	3.27 ± 1.87 NS
Lymphocytes (%)	61.33±0.09	62.51 ± 0.12	61.34± 0.14	62.13± 0.08 NS

NS: No significant difference (P>0.05)
**: Significant difference (P<0.05)
MCV: Mean corpuscular volume
MCH: Mean corpuscular haemaoglobin
MCHC: Mean corpuscular haemoglobin concentration

Results

Table 2 reveals the proximate composition of CLM. The proximate components are 12.53%, 6.34%, 0.97%, 15.51%, 947mg, 12.3mg, 0.94mg, 21.03mg and 1.06mg for crude protein, crude fibre, ether extracts, ash, calcium, phosphorus, magnesium, iron and copper respectively. However all the values agrees with the report of Anju et al (2011) and Omar et al (2017) on the nutritional composition of coriander leaves [37, 38, 39]. Table 3 shows the phytochemical analysis of CLM, the phytochemical components of CLM used in this experiment

602.7 g for diets 1, 2, 3 and 4 while those of Feed conversion ratio (FCR) are 3.23, 3.32, 3.21 and 3.26 for diets 1, 2, 3 and 4. Mortality was detected only treatment 1, throughout the experimental period [40, 41, 42].

Table 7: Serum biochemical indices of Japanese quails fed different levels of CLM

	Diets				
Parameters	1	2	3	4	S/L
Albumin (g/dl)	13.10±0.23	12.88± 0.73	13.12± 0.91	13.08± 1.20	NS
Globulin (g/dl)	19.11±1.01	18.90± 1.17	18.98± 1.24	19.06 ± 1.31	NS
Total protein (g/dl)	31.11± 1.10	31.78±1.06	32.10±1.29	32.14±1.55	NS
AST (U/l)	31.6± 1.22	30.1±1.09	31.40±1.50	31.90±1.21	NS
ALT (U/l)	403±0.25	399±0.12	391±0.22	401± 0.27	NS
Glucose ((mmol/L)	17.3± 1.30	16.9±0.91	17.11±0.85	18.11±0.77	NS
Bilirubin (µmol/L)	20.4± 0.07	21.2±0.40	20.9±0.35	21.1±0.25	NS
Uric acid (µmol/L)	321±0.06	308±0.61	324±0.58	307± 0.76	NS
SGPT (iu/l)	23.5±1.14	22.7± 1.23	23.8±1.46	23.9±1.56	NS
SGOT (iu/l)	36.5±0.91	35.7± 1.20	34.9±0.35	36.9±0.35	NS

SGPT: Serum glutamic pyruvate transaminase
SGOT: Serum glutamic oxaloacetate transaminase
ALP: Alkaline Phosphase
ALT: Alanine aminotransferase
NS: No significant difference (P>0.05)
**: Significant difference (P<0.05)

Table 8: Carcass characteristics and relative organ weights of quails fed CLM

	Treatments				
Parameters	1	2	3	4	S/L
Slaughter weight	189.1 ± 0.12	180.7± 0.10	188.1± 0.51	185.1± 1.22	NS
Dressing percentage	68.11 ± 0.23	67.56 ± 0.71	68.12.1± 0.65	68.70.1± 1.22	NS
Organs (g)					
Head	2.10± 0.98	2.13± 0.12	2.01± 0.34	2.07± 0.88	NS
Thigh	4.40± 0.30	4.13± 0.22	4.01± 0.54	4.07± 0.66	NS
Heart	3.10± 0.22	3.23± 0.12	3.01± 0.34	3.09± 0.71	NS
Liver	3.76± 0.18	3.88± 0.22	3.78± 0.34	3.77± 0.55	NS
Gizzard	4.06± 0.10	4.03± 0.12	4.11± 0.14	4.17± 0.15	NS
Intestine	8.02± 0.12	8.04± 0.62	8.21± 0.34	8.37± 0.25	NS

NS: No significant difference (P>0.05)
**: Significant difference (P<0.05)

Table 9. Effect of different level of CLM on the immune response of Japanese quails

Parameters	Treatments				
	1	2	3	4	S/L
At day 28					
Newcastle (ND) log2	1.6± 0.45	3.56±0.21	3.3±0.33	3.7± 0.18	**
Gumboro (IBD) log 2	3.11±0.91	5.07±0.88	5.11±1.10	5.12±1.30	**
At day 45					
Newcastle (ND) log 2	4.1±0.19	8.09±0.77	8.3± 0.12	8.21±0.11	**
Gumboro (IBD) log2	3.1± 1.23	5.01±1.40	5.4± 1.31	5.12±1.20	**

NS: No significant difference (P>0.05)
**: Significant difference (P<0.05)

Table 5 reveals the heamatological parameters of quails fed different levels of CLM. The pack cell volume (PCV) values obtained are 51.07%, 51.11%, 51.08% and 51.10% for diets 1, 2, 3 and 4 respectively while those of Haemoglobin (g/dl) are 11.07, 11.11, 11.08 and 11.10 respectively. The red blood cell values obtained are 3.06, 3.11, 3.09, and 3.13 (106mm3) for diets 1, 2, 3 and 4 respectively while those of white blood cell are 123.7, 127.1, 124.1 and 127.9 (106mm3) for diets 1, 2, 3 and 4 respectively while those of Neutrophils (%) are 40.10, 40.16, 42.1 and 43.89 for diets 1, 2, 3 and 4 respectively. Pack

cell volume, red blood cell (RBC), white blood cell (WBC), MCV, MCH and MCHC were not significantly (P>0.05) affected by the different inclusion levels of CLM.

The serum biochemical parameters as influenced by the diets are presented on Table 6, the albumin values obtained are 13.10, 12.88, 13.12 and 13.08 g/dl for diets 1, 2, 3 and 4 respectively while those of globulin (g/dl) are 19.11, 18.90, 18.98 and 19.06 for diets 1, 2, 3 and 4 respectively.Aspartate aminotransferase (AST) values obtained are31.6, 30.1, 31.40 and 31.90 (U/l) for diets 1, 2, 3 and 4 respectively while those of alkaline aminotransferase (ALP) are 403, 399, 391 and 401 (U/l) for diets 1, 2, 3 and 4. The glucose values obtained are 17.30, 16.90, 17.11 and 18.11 mmol/l for diets 1, 2, 3 and 4 respectively while those of bilirubin (µmol/l) are 20.4, 21.2, 20.9 and 21.1 for diets 1, 2, 3 and 4. Albumin, globulin, total protein, ALT, ALP, glucose, bilirubin, uric acid, SGPT and SGOT values were not significantly (P>0.05) different among the dietary treatments.

Table 7 shows the carcass characteristics and relative organ weight of quails fed CLM. The final dressing weight ranges between 67.56 and 68.70%. There was no significant difference among the treatments in terms of the final dressing percentage.

The immune response as influenced by the diets are presented in Table 8, on the 28th day the Newcastle antibody titers obtained are 1.6, 3.56, 3.30 and 3.70 while those of gumboro titers are 3.11, 5.07, 5.11 and 5.12 for diets 1, 2, 3 and 4 respectively. The antibody titers obtained on the 45th day are 4.10, 8.09, 8.30 and 8.21 for diet 1, 2, 3 and 4 respectively while those of gumboro antibody titers obtained are 3.11, 5.01, 5.40 and 5.12 for diets 1, 2, 3 and 4 respectively. The antibody titers values were significantly (P<0.05) affected by the dietary inclusion of CLM.

Discussion

The crude protein and energy values obtained in the experimental diets fall within the range recommended by Murakami et al (1993) [40, 43], NRC (1994) and Hyankova et al (1997) [44]. The crude protein content in CLM (12.53%) is low, therefore it cannot serve as a good protein substitute in quails ration and this is contrary to the reports Alagbe, J. O (2017) [45]. The mineral composition showed that calcium is the highest followed by iron, phosphorus, copper and magnesium in descending order. This mineral trend agrees with the findings of Anju et al (2011) but contrary to the reports of Asaolu (2009) [46, 47, 48], this implies proper bone formation, blood coagulation, nerve contraction and cell permeability in the birds. Minerals plays a vital role in biochemical reactions thus allowing efficient metabolic process in the body (Onwuka, 2005) [49].

The results on phytochemical analysis showed that it contains saponin, tannin, phenol, alkaloids, flavonoids and phytate. According to Bako et al (2005) phytochemicals vary in distribution within the plant parts as well as in their occurrence within the plant species and have also been reported to reduce the risk of some diseases due to their protective and therapeutic roles [50, 51].According to Adisa et al (2010), tannins are known to possess antibacterial and anti-viral activity, saponin plays a significant role in maintaining blood cholesterol levels (Cheeke, 2000) and phenol is an erythrocyte membrane modifier [52].

The non-significant (P>0.05) differences obtained in the final live weight and feed conversion ratio of quails agreed with the views of Safa M A El Tazi et al (2014) and Savas Sariözkan et al (2018) when quails were fed Lemon Grass (Cymbopogon Citratus) but contrary to the reports of Alagbe, J. O (2017) [53, 41], this shows that CLM contains essential amino acids and minerals necessary for the normal functioning of the body. Significant differences (P<0.05) was observed in the mortality rate, quails fed diet 1 had the highest mortality (8), no mortality were recorded in diets 2, 3 and 4. This is an indication that CLM contains natural antibiotics and a good level of antioxidants.

The heamatological values were not significantly (P>0.05) influenced by the dietary inclusion of CLM, The pack cell volume (PCV), heamoglobin (Hb) and RBC values increased from diet 1 to 2 before it eventually decreased though not at a significant level. This values are within the range recommended by Ashraful Kabir (2013) and Wikivet (2013) on blood biochemistry analysis of Japanese quails [54]. According to Ologun and Ikeobi (2006) RBC serves as a carrier of haemoglobin, transport of oxygen and carbon dioxide in the body (Isaac et al, 2013), PCV is involved in the transport of oxygen and absorbed nutrients (Maton et al, 1993) [44]. Hemoglobin plays a vital role in oxygen transportation to tissues of animals (Soetan et al, 2013) [41]. Adeyinka and Bello (2013) reported that WBC and its differentials are fight infections and produce antibodies to protect the body. PCV and Hb were correlated with the nutritional status of an animal (Etim et al, 2014) this is a clear indication that the quails were well fed, the results of the heamatological traits in this research is contrary to the findings of Rafiu et al (2013) and Olufemi et al (2004) when Amaranthus spinosis leaf meal was fed to growing pigs [40]. Togun et al (2007) also reported that physiological and nutritional and physiological status of animals could alter the MCV and PCV values. A PCV less than 35% is a sign of anaemia and a PCV greater than 55% is indicative of dehydration. According to Adenkola et al (2008) an increase in neutrophils; lymphocyte ratio is a good indicator of nutritional stress [35].

The total protein, albumin, globulin, glucose, AST, ALT and bilirubin of the quails used in this experiment were not affected (P>0.05) by the inclusion of CLM. Quails fed diet 2 had the highest value of total protein followed by diet 4, 1 and 3 respectively though not at a significant level. Oyawoye and Ogunkunle (2004) reported that diets have measurable effects on blood components [1, 3, 29]. Albumin content in the blood are easily influenced by protein shortage, the results obtained is an

indication that the experimental diets contained enough protein to support the normal protein reserves across the group. The values for all the parameters fall within the normal range values established for growing quails established by Ashraful Kabir (2013), he also reported that high albumin and globulin values indicates body defense mechanism. Glucose for instance plays a significant role in energy supply for proper body mechanism.ALP and ALT did not inhibit significant changes showing that CLM did not have any deleterious effect on the liver and kidney of the birds [41, 49].

The values obtained for SGPT and SGOT were not significantly (P>0.05) different among the treatment. According to Iyayi (1994) SGPT and SGOT values usually respond to the presence of toxic substances in the diet. The results obtained agrees with the findings of Iheukwuemere et al (2002) but contrary to the report of Olabanji et al (2007) when rabbits were fed Wild sunflower meal blood meal mixture.

Dietary inclusion of CLM did not affect the carcass and organ weight of the birds (P>0.05), this results obtained in this experiment is contrary to the reports of Bolu et al (2009) when dried pawpaw seeds were fed to broiler chickens. According to Madhusadha et al (1986) anti- nutrients are causes of internal organs enlargement in birds, the non-significant differences in the carcass characteristics could also be attributed to the quality of diet in each treatment. This result is in agreement with the findings of Mehala and Moorthy (2008) but contrary to the reports of Alagbe, J.O (2017) when miadiasin was supplemented in the diet of broiler chickens.

The values of the antibody titre production for both N.D and IBD were significantly influenced (P<0.05) by the different dietary inclusion of CLM, this is a sign that CLM is an highly potent immune-modulatory agent thus performing multiple biological activities, including antiviral and antibacterial properties attributed mainly to their antioxidant and antiradical activity. This observation is in agreement with the reports of Alagbe, J.O (2016) and Emadi and Kermanshahi (2007) [44, 41, 39].

Conclusion

The growth performance, carcass characteristics, blood profile measured showed no significant differences. It could therefore be concluded that CLM could be efficiently utilized and tolerated by quails up to 6.0% inclusion level without any negative effect on the performance and health status of the birds.

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