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HAEMATOLOGICAL AND BLOOD CHEMISTRY CHARACTERISTICS OF PULLET CHICKS FED DIET CONTAINING AFRICAN NUTMEG (*Monodora myristica*)

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Abstract
This research was carried out to determine the effect of Monodora myristica on heamatology and blood chemistry characteristics of pullet chicks. The design adopted was completely randomized design (CRD) with five treatments designated as D1, D2, D3, D4 and D5 having 0%, 0.25%, 0.5%, 0.75% and 1.0% of Monodora myristica and each replicated 3 times. A 150-three-week (21 days) old lohmann breed egg-type birds were randomly allocated to 5 dietary treatments and each replicate had ten (10) birds and the experiment lasted seven (7) weeks. Haematological parameters measured were packed cell volume (PCV), white blood cell (WBC) count, red blood cell (RBC) count and haemoglobin (Hb) count. Total serum protein (TP), albumin, globulins, serum glutamic pyruvic transaminases (SGPT) and serum glutamic oxalo-acetic transaminase (SGOT) were blood chemistry parameters measured. Each of the parameters was treated with appropriate recommended method. Data collected were subjected to analysis of variance and means separated using Duncan multiple ranges. Heamoglobin (Hb), Packed Cell Volume (PCV), white blood cell (WBC) and red blood cell (RBC) counts were significantly($P<0.05$) improving above 0.5% inclusion of Monodora myristica. Alkaline phosphatase (AP) serum glutamic oxaloacetate transaminase (SGOT) serum glutamic pyruvic transaminase (SGPT), Total Protein (TP), albulin, globulin and creatinine were significantly ($P<0.05$) improved at 1.0% inclusion of Monodora myristica but were not below 0.75% inclusion. It was concluded that Monodora myristica improves and strengthen the blood parameters thereby having positive effect on health and productivity of pullet chicks. It was recommended that monodora myristica inclusion should be at 1% in feed formulated for pullet chicks.

Keywords: Heamatology, blood chemistry, *Monodora myritica*, pullet chicks

Introduction

Blood system is one of the indices that determine the immunity, energy supply and transportation of nutrients around the body. Strength of the blood to perform its functions of defense, protection, transportation and coordination of the body depends on its constituents. These listed functions of blood are as a result of its compositions (haematological and biochemical components). It is a complex fluid containing a large variety of dissolved suspended inorganic and organic substances (Isaac, *et al.*, 2013). Dellman and Brown (1976) in Ukpong & Ginah (2021) asserted that the blood is special circulating tissues and cells suspended in the interceller fluid substance; it moves in the arteries veins and capillaries of man and animals (Kronfield & Mediway, 1975). The transportation function had been reported to include oxygen from respiratory organs to body cells (Duke, 1983; Ginah & Ukpong, 2021), nutrients and enzymes to target cells and removal of waste products from tissues and cells of the body (Baker & Silverton, 1982; Bentrick, 1974). Isaac, *et al.* (2013) and Etim, et *al.* (2014) reported that the blood maintains homeostasis of the internal environment.

Each blood component should be within normal range for a healthy animal, reduction and exceeding the ranges of components usually result in abnormal body metabolism. A reduction in Packed Cell Volume (PCV) has been reported to reduction of volume of oxygen transported in the body and resulted to decrease in primary and secondary polycythemia (Isaac *et al.,* 2013*)*. PVC reduction in the blood may also suggest the presence of a toxic factor which has adverse effect on blood formation (Oyawoye & Ogunkunle, 1998). A reduction in red blood cell had been reported to influence the quantity of oxygen which reacts with heamoglobin (Chineke, *et al.,* 2006) and increases the level of carbon (IV) oxide returning to the lungs (Ugwuene, 2011; Isaac, *et al.,* 2013). Animals with low white blood cells count are exposed to high risk of disease infection, while those with high count are capable of generating antibodies in the process of phagocytosis and have high degree of resistance to diseases (Soetan, *et al*., 2013). Reduction in total protein and its fractions (albumin &globulin) is an indication for dehydration, infections, immune diseases and inflammatory responses (Soetan, *et al*., 2013; Siva, *et al*., 2007). When serum glutamic pyruvic transaminases (SGPT) and serum glutomic oxaloacetate (SGOT) exceeded the normal range in the blood, it implies that the liver or kidney or both of them in the animal have been damaged. Excess creatinine in the blood causes muscle wasting (Bell *et al.,* 1992; Ukpong & Ginah, 2021). The numerous functions of the blood are subject to individual and collaborative actions of its components, the quantity and action of the components are known to be influenced by genetic, age, sex, management, husbandry system, nutritional, environmental and hormonal factors (Chineke, *et al*., 2006; Peters *et al.,* 2011; Udedibie, 2011; Addass, *et al.,* 2012; Isaac *et al.,* 2013).

In general, changes in haematological serum biochemical parameters have been used as proxies to predict resistance of birds and other livestock to environmental, nutritional and pathological stresses (Chikumba, *et al.,* 2013).

Blood parameters as diagnostic baselines for routine management practices in farm animals depend on quality and quantity of ingredients that make up the diets. Akinmutimi (2004) reported that both the biochemical and haematological blood components are influenced by the quantity and quality of feed and also the level of anti-nutritional elements present in the feed. Spices used in farm animals' diets reflected in a variety measure in their heamatological and biochemical parameters. Khan *et al.* (2012) observed that black cumin seeds (2.5% or 5%) had higher significant ($p<0.05$) heamatological values than birds fed the control diet. *Curcumin*, capsaicin and garlic were found to be beneficial in protecting the structural integrity and fluidity of erythrocytes under the condition of hyper-cholesterolemia and hyper-triglyceridemia (Kampaiah & Srinivasan, 2002, 2004, 2004a). Black cumin oil was reported by Ebaid, *et al.* (2011) to improve erythrocyte count and increase haemoglobin concentration and number of cells in bone marrow of rat. Soltan *et al.* (2008) reported a contrary view that tilapia fed spices tended to decrease hemacrite (Ht) and hemoglobin (Hb). Nisarani (2009) contended that the difference is due to anti-nutrients inhibiting detachment of haem and possibility of anemia.

Radwan (2003) in Ukpong & Ginah (2021) reported that spices (thyme leaves) showed improvement in antibody titer value, this may be due to the high level of iron in thyme which may affect the transport of oxygen needed for hemoglobin synthesis in the blood. Also, immune responses of the birds were improved. Thyme and cinnamon had higher red blood corpuscles (RBC), packed cell volume (PCV), heamoglobin (Hb) and white blood corpuscles (Al-Kassie, 2009). Al-Sultan (2003) reported that spices increased both erythrocyte and total leukocytic count in broilers. These results

may be due to immune-stimulate activity of active compounds (Antony, *et al*., 1999). Spices have great potential in inhibiting platelet aggregation and allow free flow of blood thereby eliminating myocardial infection and thromboembolic diseases (Banerjee & Maulik, 2002; Ukpong & Ginah, 2021). Platelets in blood have an active role in hemeostasis during damage to blood vessels and thrombosis by forming compact and adhesive aggregates (Srinivasan, 2005). Soltan, *et al.* (2008) reported decreased level of serum glutomic pyruvic transaminase (SGPT) and serum glutomic oxaloacetate (SGOT) of tilapia fed garlic enriched diet. Garlic extracts slightly reduced systolic and diastolic pressure, reduction in blood glucose due to its S-allyl cysteine sulphur oxide and increase insulin level (Oheni, 2001; Akhani, *et al*., 2004; Saeid, *et al*., 2010). Spices also caused reduction in quantity of plasma cholesterol, low density lipoprotein (LDL) cholesterol, very low density lipoprotein (VLDL) cholesterol and increased high density lipoprotein (HDL) cholesterol (Fuhman, *et al*., 2000; Bhandari, *et al*., 2005). Al-Kassie (2009) observed that 200ppm of essential oil from thyme and cinnamon reduced ($p< 0.05$) serum cholesterol but increased the total protein of broilers fed the diet.

African Nutmeg is one of the plants regarded as spice because of its seeds. It is a perennial edible plant of the Annanacea family, a berry fruit and grows wild in the evergreen forests of Africa (Burubai, 2007; Keay, 1968; Keay, *et al*., 1989). In some places, the plant is grown and conserved due to its economics and medicinal properties (Okafor 2003; Ukpong & Ginah, 2021). All parts of the plant are useful particularly in traditional medicine. The root relieves tooth ache (analgesic), the seeds as whole, ground or roasted are used for treatment of headache, skin diseases, worms, mild fever, and serves as stimulant to relieve constipation and control passive uterine hemorrhage in women immediately after child birth (Irvine, 2000; Egharevba & Ikhatua, 2008). The seeds have essential oil, macro-nutrients, minerals without lead and cadmium (Amoo *et al.*, 2006). The seeds are part of human diets particularly in the preparation of local delicacies like pepper soup and African salad. African nutmeg is best known by its local names Ehuru (Igbo), Ariwo (Yoruba), Ikposa (Bini) and Iwoun (Efik) (Keay, *et al.,*1989; Etukudo, 2000; Egharevba & Ikhatua, 2008; Kenyue, 2001; Ukachukwu, *et al*., 2012). The uses of African nutmeg in feed of livestock has created avenue to determine the effect of feed containing the plant on haematology and blood chemistry on pullet chick.

Materials and Methods

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike. Umudike is located at 05^0 29^1 North and 07^0 33^1 East, it has maximum and minimum daily temperatures of 27-36^0C and 20-26^0C respectively and relative humidity of 57-91% (Wiki, 2020). The relative humidity during rainy season is well over 72%, March being the warmest month while July to October represent the coolest months. The dry season months range from November to mid- March while rainy season ranges from the month of April to October though there may be variations in some years. Umudike has an altitude of 153 meters above sea level.

The seeds of African Nutmeg (*Monodora myristica)* were sourced from markets in Umuahia (Abia State) and Nsukka (Enugu State) Nigeria. The seeds were sun-dried, de-husked and crushed with a clean grinding machine before use as test ingredients in the feed. One hundred and fifty (150) day-old Lohmann breed egg-type chicks were procured from a local dealer for the experiment. These birds were raised in a brooding pen using kerosene stoves placed under metal hovers as source of heat to keep the deep litter brooding house warm. Light was provided using lantern and electricity whenever it was necessary. The chicks were fed commercial starter mash during the

brooding stage which lasted twenty-one days and from twenty-two (22) days the birds were transferred to rearing pens. The routine health management practices carried out was provision of a vet / foot dip at the entrance of the poultry house; daily washing of drinkers and feeders; provision of clean water and feeds; changing beddings once every month and cutting surrounding vegetation. They were also given routine vaccines at appropriate time, merek vaccine (Newcastle Disease Vaccine, NDV-B1) at day old through intraocular; anti - biotic and anti- stress from two (2) days to seven (7) days through drinking water, gumboro vaccine (IBDV) at the age of ten (10) days through drinking water ; lasota (NDV) at age of twenty- one (21) days through drinking water; coccidiostat was administered through drinking water at the of six(6) weeks. At rearing pens the birds were randomly assigned five (5) diets depending on the level of *Monodora myristica* inclusion (0, 0.25, 0.5, 0.75 and 1%) respectively. The birds were kept on deep litter throughout the experimental period which lasted 8 weeks. Lighting was supplied using lantern at night and sometimes electricity was also used, when necessary, at night to supplement natural light. Wood shavings were used as litter materials. The experiment was carried out in a completely randomized design (CRD) with the five-treatment designated as D_1, D_2, D_3, D_4 and D_5 which represented different inclusion levels of 0.0, 0.25, 0.5, 0.75 and 1% respectively. The one hundred and fifty (150) birds were randomly assigned to the five (5) treatments and each treatment was replicated three times. There were thirty (30) birds per treatment and ten (10) birds per replicate.

Table 1

Composition of the Experimental Diets Containing Varying Levels of Monodora myristica at Starters' Stage

			Chicks Mesh		
Ingredients	**D1 (0.0%)**	**D2 (0.25%)**	**D3 (0.5%)**	**D4 (0.75%)**	**D5 (1.0%)**
Maize	52.25	52.00	52.25	52.25	52.25
Wheat Offal	11.00	11.00	11.00	11.00	11.00
Lyon Bean	3.00	3.00	3.00	3.00	3.00
Soya Bean	19.00	19.00	19.00	19.00	19.00
Fish Meal	7.00	7.00	7.00	7.00	7.00
PKC	2.5	2.5	2.5	2.50	2.50
Bone Meal	3.00	3.00	2.50	2.50	2.25
Calcium Phosphate	0.75	0.75	0.75	0.75	0.75
Common Salt	0.75	0.75	0.75	0.75	0.75
Vit./min. (Pre-Mix)	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methonine	0.25	0.25	0.25	0.25	0.25
M. myristica	0.00	0.25	0.50	0.75	1.00
Total	100.00	100.00	100.00	100.00	100.00
Calculated Energy (kg/cal)	3125.00	3125.00	3125.00	3125.00	3125.00
Crude Protein (%)	20.65	20.65	20.65	20.65	20.65

The vitamin/mineral pre- mix (Animal care services (Nig.Ltd, Lagos) provided the following vitamin and mineral per kg of diet:Vit.A, 8000 I.U.Vit.D_3 ,18000I.U;Vit.E,20I.U; Vit.K,2.0mg; Vit.B_1,1.55mg; Vit.B_2,4.4mg;Vit.B_6,2.35mg;Vit.B_{12},0.013mg;Biotin,0.042mg;Niacin,23.5mg ;Pantothenic acid,6.5mg Folic acid,0.65mg, Mn,75mg ;Zn,45mg ; Cholie,150mg, Fe,20mg Cu,5mg;Mg,1.10mg; Se,0.01mg; Co,0.02mg;B.H.T,90mg; Ethoxyquin, 33mg.

The jugular veins of selected birds were punctured using syringe; 7ml of blood sample was collected per animal per sampling day. The 4 ml of the blood sample was stored in bottles containing ethyldiamine tetra acetic acid (EDTA) for haematological studies according to the method of Cole (1986). Haematological parameters measured included packed cell volume (PCV), white blood cell (WBC) count, red blood cell (RBC) count and haemoglobin (Hb) count. The analyses of blood samples were done at National Veterinary Research Institute (NVRI), Umudike. The biochemical components were analyzed according to the method of Cole (1986).

The total protein was determined using Biuret method described by Cole (1986). A biuret reagent was used as the diluent and the serum diluted. The diluted solution was allowed to stand for 10 minutes at room temperature and later read in a spectrophotometer at 550mm wavelength. The globulin values were determined by subtraction of albumin values from total protein values (Bush, 1991). The SGPT was measured using the principle of Reitman and Frankel (1957). The Calorimetric method was used in the determination of the SGOT. Alkaline phosphatase (AP or ALP) determination was performed using the modified method of Wright, *et al. (*1972). The creatinine was determined using an ammonia-selective electrode (Thompson, *et al*., 1974). The data collected were subjected to analysis of variance (ANOVA) appropriate for a completely randomized design (CRD) and means were further subjected to Duncan Multiple Range Test as package by SPSS (2006) for window version 20.

Results and Discussion

Table 2

Haematological Parameters of Egg-Type Chicks Fed Monodora myristica Containing Diet

Parameters	D_1 (0.0%)	D_2 (0.25%)	D_3 (0.5%)	D_4 (0.75%)	D_5 (1.0%)	SEM
Heamoglobin (g/dl)	5.64^{c}	6.00^{b}	6.07^{b}	6.09^{ab}	6.10^{a}	0.12
PCV (%)	16.92^{b}	18.00^{b}	18.18^{a}	18.28^{a}	18.30^{a}	0.62
WBC (x 10^3mm)	2.57^{b}	2.64^{b}	2.80^{a}	2.80^{a}	2.81^{a}	0.41
RBC (x 10^6mm)	1.23^{c}	1.27^{c}	1.60^{b}	1.67^{b}	1.72^{a}	0.06

Means in a row with different superscripts are significantly different from one another ($P \geq 0.05$). PVC, WBC and RBC respectively represent packed cell volume, white blood and red blood corpuscles; 0.0%, 0.25%, 0.5%, 0.75% & 1.0% - levels of *Monodora myristica* inclusion in the diets, SEM: Standard error of the means.

Table 2 summarized the effect of *Monodora myristica* on heamatological parameters of egg-type chicks at starter stage. There were significant ($P < 0.05$) differences in mean haemoglobin of the treatment groups. The heamoglobin of birds fed diet D_5 (0.75% *Monodora myristica*) was similar ($P > 0.05$) to that of birds fed diet D_4 but higher ($P < 0.05$) than those of birds fed diets $D_1 – D_3$. The haemoglobin of D_2 and D_3 birds were similar ($P > 0.05$) but higher ($P < 0.05$) than that of D_1 (the control). The mean haemoglobin values were 5.64 g/dl, 6.00 g/dl, 6.07 g/dl, 6.09 g/dl and 6.10 g/dl for birds fed diets containing 0.0%, 0.25%, 0.5%, 0.75% and 1.0% *Monodora myristica* additive, respectively. The result was in agreement with report of Ebaid, *et al.* (2011) that black cumin oil increased haemoglobin concentration and number of cells in bone marrow of animals. The haemoglobin (Hb) result observed with *Monodora myristica* diets correlated the report by Al-Kassie (2009) who worked with thyme and cinnamon on broiler diets. The significant ($P<0.05$) differences among treatment means of packed cell volume (PCV) of birds fed diets D3 (0.50% *Monodora myristica*), D_4 (0.75% *Monodora myristica*) and D_5 (1.00% *Monodora myristica*) were similar ($P > 0.05$)

but higher ($P < 0.05$) than those of birds fed diets D_1 (the control) and D_2 (0.25% *Monodora myristica*), which were themselves similar ($P>0.05$). The PVC values were 16.92%, 18.00%, 18.18%, 18.28% and 18.30 % for birds fed diets containing 0.0%, 0.25%, 0.5%, 0.75% and 1.0% *M. myristica* additive, respectively. The observed results of Packed Cell Volume (PCV) were contradicted the report of Kanman, *et al.* (2005) that pre-biotic produced higher ($P < 0.05$) PCV compared with the control group. The observed results were also below the normal range of 22 – 35% (Mitruka & Rawnsky, 1977). The factors that could be attributed to this are genetic and environmental (particular feed quality). The result also showed significant ($P<0.05$) differences among the treatment means of white blood cell (WBC) count. The white blood cell counts of birds fed diets D_3, D_4 and D_5 were similar ($P > 0.05$) but higher ($P < 0.05$) than those of birds fed diets D_1 (the control) and D_2 (0.25% *Monodora myristica*), which were themselves similar ($P>0.05$). WBC counts were 2.57 x 10^3mm, 2.64 x 10^3mm, 2.80 x 10^3mm, 2.80 x 10^3mm and 2.81 x 10^3mm for birds fed diets containing 0.0%, 0.25%, 0.5%, 0.75% and 1.0% *M. myristica* additive, respectively. The observed results on White Blood Cell (WBC) levels were similar to report by Al-Sultan (2003) who observed that spices increased WBC count in broilers. Also, the results were in line with the report by Al-Kassie (2009) on thyme and cinnamon in broiler diets. The results on WBC may be due to the anti-microbial activities of *Monodora myristica*.

There were significant ($P < 0.05$) differences in red blood cell of the treatment groups. The red blood cell counts of birds fed diet D_5 (1.0% *Monodora myristica*) was the highest ($P<0.05$), followed by those of birds fed diets D_3 (0.5% *Monodora myristica*) and D_4 (0.75% *Monodora myristica*), which were themselves similar ($P > 0.05$) while those of birds fed diets D_1 – D_2 lowest ($P<0.05$) but similar ($P>0.05$) among themselves. The red blood cell (RBC) counts were 1.23 x 10^6mm, 1.27 x 10^6mm, 1.60x 10^6mm, 1.67 x 10^6mm and 1.72 x 10^6mm for birds fed diets containing 0.0%, 0.25%, 0.5%, 0.75% and 1.0% *M. myristica* additive, respectively. The observed increase level of RBC as *M. myristica* inclusion level increased could be as a result of constant red blood cell formation in the marrow of the bones influenced by the iron content of *M. myristica* and this encouraged transportation of oxygen hence the formation of oxy-heamoglobin. The result was similar to the report of Al-Kassie (2009) on thyme and mixed spices.

There was an observed general trend of increasing values of all the parameters (Hb, PVC, WBC and RBC) as the inclusion level of *M. Myristica increased*. The improvement in the haemoglobin (Hb) of the birds implies that *Monodora myristica* is capable of detoxifying anti-nutrients, immobilizing and promoting the attachment of haem to haemoglobin thereby reducing anemia possibilities. Nisarani (2009) reported that cyanides (bioactive compound in lyon bean) inhibit detachment of haem from haemoglobin. The haemoglobin could be influenced by the age of the birds and initial nature (stage of contamination) of the ingredients for feed formulation. The improved haematological parameters ensured proper functioning of blood as medium for transportation of nutrients and oxygen, immune response and clotting (Chineke, *et al.,*2006; Isaac, *et al.,* 2013).

The general improvement in haematology parameters of the egg-type chicks would be attributed to minerals, vitamins and bioactive compound content of *Monodora myristica*. The results on Hb, PCV, RBC and WBC agreed with the report by Ibrahim et *al.* (2004) that onions and/or garlic improved the haemtology of broilers. The results on haematology parameters were similar to the report by Al-Kassie (2009) that higher Hb, PCV, RBC and WBC were obtained from birds fed thyme and cinnamon extracts. Blood parameters are major indices for physiological, pathological and

nutritional status of the birds and modify the constituent compounds of blood when compared to normal values (Onu, 2012). These could be used to interpret the metabolic stage of a bird as well as the quality of feed. The Hb, PCV, RBC and WBC observed in the study with *Monodora myristica did* not fall within the normal range for healthy chicks at this stage (Mitruka & Rawnsky, 1977; Anon, 1980) but increases as the level of *M. myristica* increased. The Hb, PCV, RBC and WBC of birds fed *M. myristica* inferred that the diets were better utilized and assimilated into the blood stream for use by the birds (Onu & Aniebo, 2011; Onu, 2012). It would be suggested that the immune system of the birds were improving; that the age and sex of the birds and environmental could also be factors to the observations.

Table 3

Blood Chemistry Parameters of Egg-Type Chicks Fed Monodora myristica Containing Diets

Parameters	D_1 (0.0%)	D_2 (0.25%)	D_3 (0.5%)	D_4 (0.75%)	D_5 (1.0%)	SEM
T P (g/dl)	4.03^{d}	4.40^{c}	4.63^{c}	5.60^{b}	6.33^{a}	0.09
Albumin(g/dl)	2.13^{c}	2.27^{c}	2.38^{c}	2.90^{b}	4.10^{a}	0.11
Globulin(g/dl)	1.90^{b}	1.23^{b}	2.27^{ab}	2.70^{a}	2.23^{ab}	0.44
SGPT (u/l)	16.61^{c}	17.40^{c}	18.40^{b}	18.67^{b}	22.10^{a}	0.83
SGOT (*u*/l)	35.00^{a}	31.10^{b}	29.94^{b}	27.00^{c}	27.01^{d}	0.97
A P (g/dl)	40.00^{a}	37.60^{b}	37.40^{b}	35.00^{c}	30.00^{d}	0.09
Creatinine	0.33^{a}	0.44^{b}	0.60bc	0.80^{c}	1.16^{c}	0.09

Means in a row with difference superscripts are significantly different from one another (P< 0.05) SGPT, SGOT, AP and TP respectively represent glutamic pyruvic transaminases, glutamic oxaloacetate transaminase, alkaline phoshatase and total protein; 0.0%, 0.25%, 0.5%, 0.75%, & 1.0% - levels of *Monodora myristica* inclusion in the diets, SEM: Standard error of the mean

Table 3 summarized the effect of *Monodora myristica* on some blood chemistry parameters of egg-type chicks at starter stage. There were significant ($P < 0.05$) differences in total protein, albumin, globulin, serum glutamic pyruvic transaminases (SGPT), serum glutamic oxaloacetate transaminase (SGOT), alkaline phoshatase, and creatinine. The result showed that the blood total protein (TP) of birds fed diet D_5 (1.0% *Monodora myristica*) was the highest ($P < 0.05$), followed by that of D_4 (0.75%*Monodora myristica*) birds, then those of birds fed diets D_3 (0.5% *Monodora myristica*) and D_2 (0.25% *Monodora myristica*) which were themselves similar ($P > 0.05$), while that of birds fed diet D_1 (0.0% *Monodora myristica*) was the lowest. The total Protein values were 4.03 g/dl, 4.40 g/dl, 4.63 g/dl, 5.60 g/dl and 6.33 g/dl for birds fed diets containing 0.0%, 0.25%, 0.5%, 0.75% and 1.0% *Monodora myristica* additive respectively.

The observed total protein result was in line with the report by Jamel, *et al.* (2010) that ginger extract had significant effect on total protein. The result was also similar to the report by Obikaonu, *et al.* (2011) that neem essential oil increased total protein content of broiler because of its ability to induce protein digestibility and absorption by mucosa cells. The birds fed *Monodora myristica* as additive showed improvement in total protein. The result implied that protein available in the feed was properly mobilized and utilized by the birds. The result indicated that *Monodora myristica* stimulated digestion and absorption of nutrients in the digestive gut (Srinivasan, 2005). Total protein in the blood increased as *Monodora myristica* inclusion in the diets increased. The increase in total protein is as a result of ability of the test ingredient to fortify feed protein and its utilization (Alka-Shama, *et al.,* 1996).

There were significant ($P < 0.05$) differences in the albumin of the treatment birds. The albumin value of birds fed diet D_5 (1.0% *Monodora myristica*) was the highest ($P<0.05$), followed by that of fed diet D_4

(0.75% *Monodora myristica*) while those of fed diets D_3 (0.5% *Monodora myristica*), D_2 (0.25% *Monodora myristica*) and D_1 (the control) were similar ($P>0.05$) and the lowest ($P < 0.05$). The albumin values were 2.13 g/dl, 2.27 g/dl, 2.38 g/dl, 2.90 g/dl and 4.10 g/dl for the birds fed diets containing *M. myristica* additive *at* 0.0%, 0.25%, 0.5%, 0.75% and 1.0% levels, respectively. *Monodora myristica* increased albumin as the inclusion level increased, just as it was in TP. The albumin in the blood indicates the health conditions of the animal; reduction in normal albumin indicates loss of immune–modulatory properties (Odoemelam, *et al.,* 2013). The result agreed with report by Jamel, *et al.* (2010) that ginger in drinking water induced increase albulin content of the blood.

There were significant ($P < 0.05$) differences in globulin levels of the experimental birds. The globulin value of birds fed diet D_4 was similar ($P>0.05$) to those of birds fed D_3 and D_5 but higher ($P < 0.05$) than those of birds fed diets $D_1 – D_2$ which were themselves similar ($P >0.05$). The globulin values were 1.90 g/dl, 2.13 g/dl, 2.25 g/dl, 2.70 g/dl and 2.23 g/dl for the birds fed diets containing *M. myristica* additive *at* 0.0 %, 0.25 %, 0.5 %, 0.75 % and 1.0% levels, respectively. Globulin and albumin are components of serum protein which indicate the safety status of feed given to the birds and the health conditions the birds. The low levels of albulin and globulin in birds fed control diets showed that the birds were not healthy as compared to *Monodora myristica diets* fed birds. The results were similar to report by Radwan (2003) that thyme leaves improved the antibody values. The results were also similar to the reports of Fuhman, *et al.* (2000), Banerjee, *et al.* (2000) and Soltan (2008).

There were significant ($P < 0.05$) differences in mean values of the serum glutamic pyruvic transaminases (SGPT) of the treatment birds. The SGPT of birds fed diet D_5 was the highest ($P<0.05$), followed by those of birds fed diets D_4 and D_3 which were themselves similar ($P > 0.05$) then followed by that of birds fed diets D_2while the least was that of birds fed diet D_1. The SGPT values were 16.61u/l, 17.40 u/l,18.40u/l, 18.67u/l and 22.10u/l for birds fed diets containing *M. myristica* additive at 0.0 %, 0.25 %, 0.5%, 0.75 % and 1.0 % levels, respectively. The activity of SGPT in diets with *Monodora* additive was reduced ($P < 0.05$) than in the control. Higher activity of SGPT is an indication of disease conditions. The observed SGPT were within the normal range of 10 – 37 (Mitruka & Rawnsky, 1977). *Monodora myristica* reduces the SGPT of the birds. The result on SGPT is similar to the report by Khan, *et al.* (2012) that black cumin seeds have positive effect on SGPT of the blood. The result is also in line with the report by Ukoha (2011) that *Monodora myristica* lowers SGPT in the blood of birds. The observed result may be due to *Monodora myristica* possessing antifungal, antibacterial and anti-oxidative properties (Obolo, 2010, Ukachukwu, *et al*., 2012). Serum glutamic oxaloacetate transaminases (SGOT) showed significant ($P < 0.05$) differences among treatment means. The SGOT of birds fed diet D_2 (0.25% *Monodora myristica*) was similar to D_3 (0.5% *Monodora myristica*) but lower than D_4 and D_5 (0.75% and 1.0% *Monodora myristica* diets). Birds fed diet D_5 (1.0% *Monodora myristica*) showed significant reduction ($P < 0.05$) in SGOT compared to birds fed diet D_1 (the control). The SGOT observed were 35.00u/l, 31.00u/l, 29.00u/l, 27.00u/l and 27.01u/l for 0.0%, 0.25%, 0.5%, 0.75% and 1.0% *Monodora myristica* inclusion levels respectively. The SGOT of birds fed *Monodora* diets were lower than in the control birds. Like the SGPT, the SGOT is another blood enzyme that is associated with the health status of birds and quality of feed given. It indicates the effect of toxic substances present in the feed and body of the birds. Increase in serum glutamic transaminase indicated high chances of hepatoxicity. Reduction in SGOT indicated that the birds were partially or completely free from toxins and microbes capable of

causing liver diseases. The result was in agreement with the reports by Jamel, *et al.* (2010) that ginger in drinking water reduced SGOT of the blood.

Alkaline Phosphatase (AP) levels of birds fed diets D_2 and D_3 were similar ($P > 0.05$) buthigher ($P<0.05$) than that of birds fed diet D_4 and lower ($P < 0.05$) than that of birds fed diet D_1 (the control). AP level of birds fed diet D_5 was the lowest ($P < 0.05$). The general trend was that of increasing reduction in the AP level of the blood of the birds as the quantity of *Monodora myristica* included increases. The AP levels were 40.00g/dl, 37.60g/dl, 37.40 g/dl, 35.00 g/dl and 30.00 g/l for birds fed diets containing *M. myristica* additive at 0.0 %, 0.25 %, 0.5 %, 0.75 % and 1.0 % levels, respectively. The AP of *M.myristica*-fed birds was lower than in the control birds. The reduction in AP tends to low mortality occurrences. The AP works with other blood enzymes including SGOT and SGPT to determine healthy architecture of the organs. The result corroborated with the reports by Henry (1984), Hassan, *et al.* (2007) and Khan, *et al*. (2012) who worked with rosemary, thyme, garlic and ginger.

Blood creatinine of birds fed diet D_4 and D_5 were similar ($P > 0.05$) to that of birds fed diet D_3 but lower ($P<0.05$) than that of birds fed diets D_2 while that of birds fed diet D_3 was also similar to D_2 but lower than that of birds fed diet D_5, which was the highest ($P<0.05$). The creatinine values were 0.33 g/dl, 0.44 g/dl, 0.60 g/dl, 0.80 g/dl and 1.16 g/dl for birds fed diets containing *M. myristica* additive at 0.0%, 0.25%, 0.5%, 0.75% and 1.0% levels, respectively. Creatinine increased as the levels of *Monodora myristica* increased. Defect in metabolism could be due to changes in creatinine and other blood enzymes from normal level indicate severity of hepatic disease (Henry, 1984). The blood chemistry parameters of the birds were highly improved with 1.0% (0.01 g/kg) *Monodora myristica* inclusion levels. The observed results were in line with reports by Al-Kassie (2009). *Monodora myristica* contains bio-chemicals which can be responsible for neutralizing free radicals, and quenching oxygen by dislocation peroxides. This property of *Monodora myristica* contributed to the delay of many oxidative–stress related diseases. The blood chemistry of the birds fed *Monodora myristica*-containing diets suggests that the immune system of the birds and nutritional status were adequate. The improvement in blood chemistry parameters of the birds implied that *M. myristica* has anti-microbial and immune properties to address the health needs of the birds

Conclusion and Recommendation

From the results obtained, it could be concluded that Monodora myristica added to the diets contributed to improve heamatological and blood chemistry characteristics of the pullet chicks. These improvements would enhance the growth and reproductive performance of the chicks,The recommendations were that Monodora myristica addition in diets may be more than 1% but should not be more 3.5% and that seeds should be thoroughly processed to reduce the strong pungent scent.

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