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DIETS SUPPLEMENTED WITH *ALLIUM SATIVUM* AND *SYZYGINUM AROMATICUM* IMPROVED GROWTH PERFORMANCE AND HAEMATOLOGICAL INDICES IN GROWER BROILER CHICKENS.

***Garba, M.H. [1], Ampitan, T.A.[4], AbdulKadir, A.R.[2], Tawakaltu, A-A [3], Nasiru, S.[1], Ifejesu, A.A[5].**

[1] Faculty of Science, Department of Biochemistry, Federal University Dutse, P.M.B. 7156, Dutse, Jigawa State, Nigeria

[2]Faculty of Science, Department of Biological Sciences**,** Federal University Dutse, P.M.B. 7156, Dutse, Jigawa State, Nigeria

[3] Department of Biochemistry, Federal University of Technology, P.M.B. 65, Minna, Niger State, Nigeria

[4] Federal College of Wildlife Management, Department of Forestry Technology, Forestry Research Institute of Nigeria, New Bussa, Niger State

[5]Department of Animal Production Technology, Federal College of Wildlife Management, Forestry Research Institute of Nigeria, New Bussa, Niger State, Nigeria

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ABSTRACT

Dietary supplements aside aiding in the supply of adequate amount of essential nutrients, also help to improve overall health and management of some health conditions. Day old Anak broiler chicks (125 in number), were raised and randomly grouped into seven treatments (i.e. T1-T7) at the age of five weeks. Therefore, this study sought to assess the potential of *Allium sativum* **and** *Syzyginum aromaticum* blend as supplement in broiler chicken's diet, and how it affects their performances and haematological parameters A hundred and five (105) raised grower broilers of mixed sexes were grouped into seven treatments (T1-T7) consisting of fifteen (15) birds in each treatment. To treatments T1 – T5, *A. sativum* and *S. aromaticum* blend was supplemented at 0.0, 5.0, 10.0, 15.0, and 20.0g kg^{1-} while 5.0gkg^{-1} and 2.0gkg^{-1} of *A. sativum* and *S. aromaticum* alone were supplemented to T6 andT7 respectively. Phyto-components such as: alkaloids, flavonoids, saponins, steroids, phenols, terpenoids, anthraquinones and tannins were revealed to be present after the screening of both spices. Substantial amounts (mg) of alkaloids (6.92 ± 0.05), tannins (5.20 ± 0.03), saponins (4.10 ± 0.03), flavonoids (2.28 ± 0.03) and anthraquinones (1.50 ± 0.00) were also detected during the quantitative phytochemical screening of the *A. sativum* and *S. aromaticum* cocktail. Also high amount (mg) of oligosaccharides (49.1 ± 2.20), fibre (20.3 ± 0.91),

fats (11.9 ± 1.05) and ash (4.8 ± 0.21) were detected in *S. aromaticum*. Feed conversion efficiency (FCE) in the treatments was observed to be higher when compared with the control. The red blood cell (RBC) in the treatments does not differ significantly ($p \leq 0.05$) with the control, while the haemoglobin (Hb) and packed cell volume (PCV) values determined was significantly higher in the groups supplemented with the spices. Compared with treated groups, the mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were significantly higher in the control. No significant difference ($p \leq 0.05$) was observed in the total white blood count (TWBC) and its differentials, between the control and treated groups. Platelet counts PLC was significantly higher ($p \leq 0.05$) in the treated groups in comparison to the control. Conclusively, the potentials to improve the bird's performance and haematological indices by these spices has been confirmed in this study.

Keywords: Blood parameters, *Garlic bulb, Clove,* Phyto-components, Feed Supplement

1.0 Introduction

Before the ascendancy of oil in Nigeria, agriculture was the country's major earner of foreign currency. It accounts for 35% of the country's GDP. However, in recent times, there is a great clamour for diversification of the Nigerian economy now that oil is on the decline. The government of Nigeria is now redirecting its attention to agriculture by paying unprecedented attention to agricultural development, both as a potential leading source of foreign currency and as an instrument for reducing the nation's import bill. [1, 2]

With the production of about 180 million birds annually between 2020-2021, Nigeria is ranked as the second-largest chicken producer in Africa. Twenty-one (21) billion eggs and 454,000 tonnes of meat from chicken birds are produced in Nigeria annually. Nigerian poultry farming sector is an agro-industry that is worth about 4.2 billion USD. Poultry products worth almost 2 billion US dollars were consumed in 2019 alone. When compared with the developed world's average consumptions of 9.4 kg and 15.2 kg of eggs and meat, the average consumption rate by an individual per annum for these products in Nigeria is about 3.5 kg and 2.5 kg respectively and this is grossly inadequate. Demands for poultry eggs and meat is projected to reach 1.3 million tonnes by the year 2025. Despite the prevailing poverty, there has been an astronomical rise in the consumption of animal's products in the country. Quantitatively, the amount of egg consumed has risen to 598,000 tonnes in 2015, compared to the 366,000 tonnes in 2000. It is however, projected that, by 2030, it will reach 947,000 tonnes. Concurrently, the poultry meat subsector has made a significant leap to 317,000 tonnes in 2015 compared to 158,000 tonnes recorded in the year 2000, further increase to about 544,000 tonnes is projected by the year 2030. Given its share size and experience, the is pivotally positioned to Stimulation of an Africa wide industry development and growth will be pivotally steered by the. Nigerian poultry sector [3]

The Nigerian Central Bank Governor (CBN) in 2019, clarified on the massive potentials that abound in poultry industry in Nigeria. He stated that, the poultry farming is a promising industry in Nigeria with a net worth of about #1.59 trillion, making it a sub-sector of Nigeria's agriculture that is most commercialized . This according to him is attributed to the country's population growth. [3]

Chicken meat and egg have an average of up to 20% and 26% protein value. Proteins help the body to maintain and build muscle mass and strength; they are also major

source/precursors of immunoglobulins. Poultry meat is a very rich source heme iron that is most often and preferably utilised by the body as against non-heme iron found in vegetables, beans, fruits, etc. As reported by [4, 5], poultry products are excellent sources of Zinc (Zn), providing up to 19% of the daily recommended intake. Additionally, consumption of poultry products helps to increase the level of collagen, keratin, and protein in the body. [6]

Erythocytes (RBCs) counts, leucocytes (WBC or LEU) counts , mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) are haematological parameters employed in the monitoring of the safety and wellbeing of food and feeds as well as, in the monitoring of the health status in farm animals.[7]

Aside its use as a flavouring agent, spices are also used in traditional medicine centuries ago.[8] Their preservative,[9] antioxidative, [10] and antimicrobial [11] efficacies are other major biological roles played by spices in addition to boosting flavour of foods and drinks. Therapeutic and prophylactic utilisation of spice/herbs to improve the health, well-being as well as growth and feed utilisation of animals have been reported.[12]

Utilisation of garlic for both culinary and medicinal purposes is documented centuries ago. [13]. More so, products sourced from garlic have been shown to possess: anti-atherosclerotic, hypolipidemic, antimicrobial, antidiabetic, antihypertensive, antithrombotic effects, . [14] Among the several components in garlic, allicin is reported to be the main active component. [15] As reported by [16], there is improved growth, decreased mortality rate and improved feed conversion ratio (FCR) exhibited by broilers fed diet supplemented with garlic. Including levels of 1.5, 3 and 4.5% of garlic has been sshown to effectively reduce the cholesterol content in the poultry serum, liver and skin. [13]

Syzyginum aromaticum locally known as Cloves, act as: an aphrodisiac, anti-coughs and colds agents, a booster of blood circulation, inhibitor of blood clotting (to maintain cardiovascular health), a stress reliever, a sedative, an anti- insomnia, and an agent in the management of depression and anxiety . [17]

Therefore, this study sought to assess the potential of *Allium sativum* and *Syzyginum aromaticum* blend as supplement in broiler chicken's diet, and how it affects their performances and haematological parameters.

2.0 Methodology

2.1 Research Station :

Research work was conducted at the teaching and research farm (9^{o}53'N, 9.883^{o}N and 4^{o}31'E, 4.517^{o}E), of the Federal College of Wildlife Management, Forestry Research Institute of Nigeria, New- Bussa Niger State, [18] between the Months of May to July, 2021.

2.2 Source, Preparation and Formulation Garlic and the Cloves

The spices were cleaned, dried, and separately packaged in polythene bags and stored at room temperature.of 27-32^{o}C. The dried clove sample was pulverised and sieved through a 0.5 mm pore-sized sieve. Garlic (*Allium sativum* L), was roasted at 102^{o}C, pulverised and packaged in an airtight bag. During incorporation into the diet, the separately packaged clove and the garlic were combined as shown in Table 1 [19],

2.4 Performance Characteristics Measurements

At five weeks of age, the initial average weight of birds in each treatment was recorded.

Weekly feed intake (kg) and weight gain (g) in the experimental birds were also recorded

and the feed conversion ratio (FCR) was determined using the formular

$$FCR = \frac{\textbf{Total feed consumption}}{\textbf{Total body weight gain}}.$$

Feed intake (kg), weight gain (g), and feed conversion ratio (FCR) were determined from the above parameters

Table 1: The Composition of broiler Finisher Phase Experimental Diet

Ingredients	T1(%)	T2 (%)	T3(%)	T4 (%)	T5 (%)	T6 (%)	T7 (%)
Maize	48.2	48.2	48.2	48.2	48.2	48.2	48.2
Soya beans	21	21	21	21	21	21	21
Fish meal	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Groundnut Cake)	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Wheat Bran	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Bone meal	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Methionine	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Lysine	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Vitamins premix	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Salt	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Powder coccidiostat	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Growth enhancer	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Garlic/clove blend	0.00	0.5	1.00	1.50	2.00	0.00	0.00
Garlic alone	0.00	0.00	0.00	0.00	0.00	0.50	0.00
Clove alone	0.00	0.00	0.00	0.00	0.00	0.00	0.20

2.5 Measurements of Haematological Indices

A DxH 560 AL Haematology analyser was used for the Haemoanalysis of RBC, Hb, PCV, MCV, MCHC, TWBC, WBD, and Platelet counts

2.6 Determination of Phyto-Components

Qualitative determination of the phytochemicals was done based on the methods of Trease and Evans, (2002) and Sofowora, (1982) [20, 21], while the quantitative methods of analysis of Association of Analytical Chemists (AOAC), (2000) [22] was employed.to determine the amounts (in mg) of some of the proximate components.

2.7 Data analysis

The data collected were subjected to one way analysis of variance in a completely randomized design (CRD) arrangement. The significant means were separated and compared using Duncan multiple range test. The level of confidence was accepted at $p \leq 0.05$ (SAS. 2013).

3.0 RESULTS

Qualitative analyses of *Allium sativum* (garlic) revealed the presence of some phytochemicals as shown in **Table 1**

Table 2: Phytochemical components of pulverised *Allium sativum*

Phytochemical	Detection Status
Saponins	+
Glycosides	+
Flavonoids	+
Reducing sugar	-
Alkaloids	+
Phenols	+
Anthraquinons	+
Tannin	+
Steroids	+
Terpenoids	+

Key: + = detected, - = not detected

Phytochemicals qualitatively determined in *Syzyginum aromaticum* (clove) is depicted in **Table 2**

Table 3: Phytochemical components of pulverised *Syzyginum aromaticum*

Phyto-component	Detection status
Glycosides	+
Steroids	+
Tannins	+
Alkaloids	+
Carbohydrates	+
Proteins	-
Terpenoids	+
Saponins	-
Phenolics	+

Key: + = detected, - = not detected

Quantitative determination of the phytochemicals and proximate components in the *Syzyginum aromaticum* and *Allium sativum* cocktail/blend revealed the presence of substantial amounts (in mg) of these phyto-components as depicted in **Table 4**

Table 4: Amounts of phytochemicals and proximate components determined in *Syzyginum aromaticum* and *Allium sativum* cocktail

Phytochemical	Amount determined (mg)
Alkaloids	6.92 ± 0.05
Tannins	5.20 ± 0.03
Saponins	4.10 ± 0.03
Flavonoids	2.28 ± 0.03
Anthraquinones	1.50 ± 0.00
Oligosaccharides	49.10 ± 2.20
Fibre	20.30 ± 0.91
Fats	11.90 ± 1.05
Ash contents	4.80 ± 0.21

Values are mean ±SEM of 3 determinations.

There seems to be reduced feed intake in T6 and T7 which results in what could be termed "pseudo performance" as the FCR apparently appears to be lower than the values in T2-T5 but in reality those groups had higher weight gain Table 5

Table 5: Performance of experimental birds sustained on *Syzyginum aromaticum* and *Allium sativum*-fortified diets.

Prmt (g)	T1 (g)	T2 (g)	T3 (g)	T4 (g)	T5 (g)	T6 (g)	T7 (g)
AIBW	347.93± 9.23^{ab}	377.33± 7.56^{b}	384.73± 10.01^{b}	359.20± 10.35^{ab}	421.60± 11.10^{c}	266.16± 6.34^{ab}	336.37± 8.84^{a}
MFBW	1493.33± 21.04^{a}	1580.00± 20.38^{ab}	1466.6± 19.00^{ab}	1346.6± 17.24^{a}	1666.6± 23.58^{b}	1433.33 ±20.89^{ab}	1413.33± 16.57^{a}
MBWG	1145.40± 12.50^{c}	1202.67± 13.03^{d}	1081.87± 10.37^{b}	987.40± 11.76^{a}	1245.0± 14.00^{e}	1167.17 ±11.84^{c}	1147.17± 11.94^{c}
MFC	722.25± 7.22^{de}	712.43± 6.97^{cd}	697.43± 5.26^{c}	631.29± 6.44^{a}	736.80± 8.31^{e}	663.78± 7.24^{b}	645.71± 6.76^{ab}
(FCE)	0.64	0.62	0.61	0.63	0.58	0.59	0.57

Values on the same row, with different superscripts are significantly different (P≤ 0.05)

Parameter = **Prmt,** Average initial body weight = **AIBW**, Mean final body weight = **MFBW**, Mean body weight gain = **MBWG**, Mean feed consumed = **MFC**

Haematological parameters of birds fed diets containing Garlic-Clove cocktail supplements remarkably improved compared with control group (Table 5)

Table 6: Haematological indices of grower broiler chickens sustained on diet fortified with *Syzyginum aromaticum* and *Allium sativum*

Blood	**Treatments**						
Indices	1	2	3	4	5	6	7
RBC	10.42±1.37^{a}	11.24±0.95^{a}	10.10±1.33^{a}	11.17±2.01^{a}	8.34±1.80^{b}	7.36±1.22^{a}	9.63±2,00^{a}
Hgb	6.150±0.46^{a}	8.750±0.78^{ab}	8.850±1.22^{ab}	9.550±0.85^{bc}	7.500±1.35^{ab}	12.45±1.62^{c}	10.05±0.39^{bc}
PCV	18.00±1.74^{a}	26.00±3.01^{ab}	26.00±3.02^{ab}	28.00±2.06^{bc}	22.50±1.85^{ab}	36.50±1.66^{c}	30.00±2.57^{bc}
MCV	82.00±7.21^{b}	53.00±4.62^{a}	72.33±8.24^{ab}	76.50±7.92^{c}	77.00±8.95^{c}	82.50±6.92^{c}	85.50±8.31^{c}
MCH	30.00±4.11^{b}	24.00±1.63^{a}	24.50±3.38^{a}	24.00±5.20^{a}	25.00±4.33^{a}	25.50±5.09^{a}	30.00±5.22^{b}
MCHC	43.50±2.66^{b}	30.50±1.97^{a}	33.00±1.73^{ab}	32.00±1.66^{a}	26.50±1.16^{a}	35.50±1.02^{ab}	29.00±1.25^{a}
PLC	430±32.00^{a}	542.00±37.03^{ab}	441.00±41.11^{a}	660.50±52.10^{bc}	451.50±28.62^{a}	803.50±64.01^{bc}	848.00±65.53^{c}
TWBC	21.67±1.74^{c}	24.17±2.01^{d}	17.10±1.30^{b}	14.50±0.98^{a}	27.40±$^{e2.23}$	21.10±1.86^{c}	24.00±2.30^{d}
Neu	15.00±1.03^{b}	13.50±1.20^{a}	16.00±2.00^{b}	20.00±2.54^{d}	14.50±1.75^{c}	20.50±2.89^{d}	14.50±1.76^{c}
Lymp	74.00±1.44^{a}	78.00±1.80^{a}	128.50±2.47^{b}	72.00±2.02^{a}	79.00±1.78^{a}	63.00±0.89^{a}	78.50±$^{a1.98}$
Mon	6.00±0.40	8.50±0.54	5.50±0.60	8.00±0.92	6.50±0.50	6.50±0.50	7.00±1.73
Eos.	6.00±0.40	8.50±0.54	5.50±0.60	8.00±0.92	6.50±0.50	6.50±0.50	7.00±1.73
Bas.	6.00±0.40	8.50±0.54	5.50±0.60	8.00±0.92	6.50±0.50	6.50±0.50	7.00±1.73

Values with different superscripts on the same row are significantly different (P≤ 0.05)**. KEY: RBC** = Red blood cell count**, Hgb** = Haemoglobin, **PCV** = Packed cell volume, **MCV** = Mean cell volume, **MHC** = Mean haemoglobin concentration, **MCHC** = Mean cell haemoglobin concentration, **PLC**= Platelet count, **TWBC** = Total white blood count, **Neu** = Neutrophils, **Lymp** = Lymphocytes, **Mon** = Monocytes, **Eos** = Eosinophils, **Bas** = Basophils

4.0 Discussion

In addition to the supply of additional macro and trace nutrients, essential for rapid and healthy growth and overall performance of birds, improved organoleptic scores of food and feed, has also been reported when poultry feed is supplemented with some natural products. [23] (Table 4), Growth performance among the groups fed diet supplemented with Garlic-Clove cocktail when compared with the control group, has been observed to remarkably increase ($p \leq 0.05$) (Table 5). However, underperformance observed in T3 and T4 when compared to control group (T1), might not be unconnected with poor feed consumption or the genetic make-up of the some of the birds in these two groups.

According to the World health organisation (WHO) [24], supplement is any extract from plants , animal or microorganisms that contains natural substances with therapeutic potentials or, that can serve as basic ingredients for pharmaceutical semi synthesis..

Presence of phytochemicals in *A. sativum and S. aromaticum* extracts, as revealed in Tables 2 and 3, has been corroborated by findings of Nwadiaro *et al.[25]*. Phytochemicals with remarkable number of bioactivities against different microoganisms are known to be produced by plants. [26]. More so, Aliero and Gumi [27] and Usman *et al. [28], have reported higher concentration of* alkaloids in the bulb and the clove bud than in the leaves. Therefore, results observed in Tables 1 and 2 confirms their findings. Worthy of note is, pharmacologically active phytochemicals as revealed to be present in these spices, are reported to exert severe effects against different strains of infective microorganisms, which is suggestive of their popular utilisation locally for the treatment of various illnesses [29]. Because of the unique roles of Flavonoids to modify the body's reaction to

allergies, viruses and carcinogens. Among the numerous phytochemical, due to their ability they are referred to as natural response and biological modifiers, [25]

Limitations in the chemical analysis to determine how much phosphorous is available from the non-phytate phosphorous (NPP) and the phytate phosphorous (PP)could not allow for clear indication as to what degree, if any phosphorous is utilised by animals and birds. In other words, chemical analysis does not provide information on phosphorous bioavailability of the ingredients or diet and thus any change in PP and phosphorous bioavailability of an ingredient will not be reflected in in this system. Consequent upon that, since the homeostatic interaction of parathyroid hormone (PTH) (a P regulating hormone) and calcitonin (a calcium regulating hormone) led to the formation of hydroyapetite (which confer rigidity on the bone matrix) through the interaction of the cationic and anionic forms of these minerals, observation on the improved tibia and toe breaking strength; feed conversion ratio and weight gain in Table 5 confirms a positive contribution in phosphate level by NPP from the bone meal added during diet formulation (Table 1). and most probably, PP in *Allium sativum/Syzyginum aromaticum* cocktail. A positive linear relationship was found between tibia and toe bone ash percentage [30]. Phosphorous (in form of Phosphate) is an essential element for all forms of life from single to multicellular animals. In poultry, it plays an important role in normal muscle growth and egg formation. It is also a veritable component of nucleic acids, phospholipids and genetic code, aside its role as a cofactor in many enzymes complexes. More so, maintenance of acid-base and osmotic balance, protein synthesis, amino acid and energy metabolism are other unique functions performed by Phosphorous (in form of Phosphate).

Since the formulated diet in Table 1 is based on the formulation protocol of the national research council (NRC) [19]; the proximate composition of such formulation is available in the compendium. Therefore, the present study did not do proximate composition, and we acknowledge this as a limitation of our study. However, observation on the improved performance and haematological indices prompted the quantitative determination of a limited proximate components such as: oligosaccharides, fibre, fat and ash contents, considering the roles they are known play as prebiotics that promotes the growth and development of probiotics [31], which correlates with the observed improvements Table 4.

As reported by EL-Sheraji *et al. [32], A. sativum and Syzyginum aromaticum consists of substantial amount of carbohydrates both as phytochemicals and proximate components (Tables 2, 3 and 4). These constituents sugar molecules such as:* mannan-oligosaccharides (MOS), arabinoxylooligosaccharides (AOS), isomalto-oligosaccharides (IMOS),), xylo-oligosaccharides (XOS), fructo oligosaccharides (FOS), Inulin, pyrodextrins and soy oligosaccharides (SOS) *are mainly homopolysaccharides and oligosaccharides in nature.* These molecules possess some prebiotic properties that promote the growth and physiologic activities of some beneficial microorganisms in the guts that will systematically lead to the elimination of harmful pathogens colonizing the intestinal track of the birds [33].Drastic reduction in the population of harmful pathogens will guaranty production of varieties of bacteria and other immuno-modulators that can activate macrophages as first line of defense, to easily inactivate and subsequently neutralize the pathogens. [34]. The main function of prebiotics in diminishing the coccidial infection in chickens, and at the same time, ensuring the survival of some reasonable colony of these microbes that might serve as

a source of non-attenuated vaccine for healthy chickens has been reported *[35]*.

Presence of essential oils such as: Eugenol, eugenyl, acetate and β – caryophylline has been confirmed in *Syzyginum aromaticum* (Clove) [36]; these molecules confers some biological benefits such as: antibacterial, antifungal, insecticidal, antioxidant and anticarcinogenic capabilities on this spice [37]. Additionally, when compared with Butylated hydroxytoluene (BHT) and Butylated hydroxyanisole (BHA), clove's essential oil has been reported to be veryeffective as an antioxidant in their scavenging activity against 2,2- diphenyl- 1-picryl hydracyl (DPPH) radical; at much lower concentration . More so, activity in iron chelation has been demonstrated in the same essential oils. [37]

Sulfur compounds that includes ajoene, allyl polysulfides, (diallylsulphides, diallyldisulphides, triallyltrisulphides), vinyldithiins and S-allylcysteine are known to be present in garlic. They are compounds reported to be active against several ailments such as intestinal, respiratory and skin disorders. It is also active in relieving flatulence, worms' infection wounds healing, and as an anti-aging [38].

As pointed out by Odeghe *et al*. [39] examination of the numbers and morphology of erythrocytes, leucocytes, and thrombocytes (Table 5) could reveal a lot about the presence of some metabolites and other toxic constituent molecules in the body of animals; which could ease the evaluation of the physiological, nutritional and pathological status of an organism. Results from this study showed that, supplementation of the experimental diet with *Syzyginum aromaticum* and *Allium sativum* both as a blend and singly, brings about dose related elevations in the hematological parameters investigated. The observation thus made in Table 6 appeared to be valid, since the ranges of hematological parameters can be altered positively or negatively, on oral ingestion of medicinal compounds or drugs. [40] In this study, Except for its suppressive effects on the MCHC, most of the effects recorded for the extract were positive in this study (**Table** 6).

Fighting infections, prevention of infection by foreign bodies (through phagocytocis), production, transportation and distribution of antibodies in immune response are major roles played by lymphocytes. Remarkable increase ($p \leq 0.05$) in the total white blood count (WBC) (except in T3 and T4), lymphocytes and granulocytes (Neutrophils, Eosinophils and Basophils), suggestive of leucopoietic and possible immune-modulatory effects of *S. aromaticum* and *A. sativum* [41].

Blood platelets plays a biological role in blood clotting, in case of animal sutaining internal or external injury. The observed increase in platelet count following the supplementation of the experimental diet with *S. aromaticum* and *A. sativum* as a cocktail and singly is a desirable property, because, high platelet count ensure fast and adequate blood clotting to curtail loss of blood in the case of injury. Presence of some active principle(s) in *S. aromaticum/A. sativum* (either singly or as a cocktail), that are haematopoetin-like (leucopoetin, thrombopoetin) might be responsible for such increase. [42]

Major indices employed in the evaluation of circulating red blood cell (RBCs) includes: Packed cell volume (PCV), haemoglobin (Hb) and mean corpuscular haemoglobin (MCH) and their determined values are crucial in the diagnosis of anaemia and also erythropoietic efficiency of the bone marrow [43]. Table 5 showed that the *S. aromaticum* and *A. sativum* as a blend or singly, does have the potential to stimulate the release of a hormone, erythropoietin from by the kidney. This hormone is a potent regulator of RBC production. [44] This might also imply a significant improvement in the affinity to oxygen that will result in the corresponding

increase in the delivery of oxygen to the tissues. [45] However, fall in the number of MCHC observed in this study is suggestive of RBC swelling which is indicative of *S. aromaticum* and *A. sativum* selective toxicity to red blood cells among other erythrocyte lineages.

Conclusion

Since there has been reservations (fear) expressed by the science/research community on the possible bio-accumulation of synthetic antibiotics, antiparasitic and antiviral drugs often administered to farm animals, adopting safer, cheaper, available and accessible alternatives is an option. The studied supplements (*S. aromaticum* and *A. sativum*) will most certainly provide cheaper and more readily available options but also a less toxic, less carcinogenic and less immuno-suppressive viable strategy to the synthetic chemotherapeutics. Moreover, the very low mortality rate and an outstanding feed conversion ratio (FCR) recorded in this experiment should be a source of encouragement to adopting this cheaper, safer and readily available alternative for poultry rearing.

Authors contributions:

This work was carried out as collaboration between all authors. Authors MHG, ATA and TA-A designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors, NS, AAR and AM managed the literature searches and performed the Statistical analysis..

Competing interests

All the authors declared no competing interests exist

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