Research Journal of Recent Sciences _____ ISSN 2277-2502
Vol. **1(7),** 10-18, July **(2012)** *Res.J.Recent Sci.*

Effect of Polyherbal Aqueous Extracts (*Moringa oleifera*, Gum arabic and wild *Ganoderma lucidum*) in Comparison with Antibiotic on Growth Performance and Haematological Parameters of Broiler Chickens

Ogbe A.O. and John P. Affiku
Department of Animal Science, Faculty of Agriculture, Nasarawa State University, Keffi, NIGERIA

Available online at: www.isca.in
Received 6th March 2012, revised 10th March 2012, accepted 18th April 2012

Abstract

The search for safe and natural alternative to reduce over-dependence on the use of antibiotic (growth promoters) has led to the evaluation of the effects of polyherbal aqueous extracts from Moringa oleifera, Gum Arabic and wild Ganoderma lucidum on growth performance and haematological parameters of broiler chickens. Eighty (80) day-old Arbor acre broilers were procured from a commercial hatchery and brooded together at the first one week of age on deep litter to acclimatize. At 2 weeks, the chicks were randomly distributed into five groups (8 chicks, each) in duplicate, labeled A-E. All the chicks in all the groups were fed with broiler starter diet containing 22% CP and 2800 Kcal/kg ME from 1 to 4 weeks of age, and broiler finisher containing 20% CP and 2649 Kcal/kg ME was given from 5-8 weeks. Moringa oleifera leaves, Gum Arabic and wild Ganoderma lucidum were collected in Nasarawa and Plateau state for proximate study, mineral and phytochemical analysis. Hot water aqueous extraction (5%, 10% and 20% w/v, each) was carried out and polyherbal mixtures were prepared at equal volume (1:1%w/v) for oral administration at 2, 4 and 6 weeks, respectively: group A (Moringa + Gum Arabic + wild Ganoderma), B (Moringa + wild Ganoderma), C (Gum Arabic + wild Ganoderma), D (Moringa + Gum Arabic) and E (antibiotic, tetracine). Blood was also taken from each group for haematological analysis. The results of proximate study revealed the presence of appreciable amount of crude protein (17.01%) in Moringa leaves, Gum Arabic (15.38%) and wild Ganodema lucidum (16.79%). They also contained appreciable amounts of carbohydrates, crude fibre and fatty acids. The ash content revealed the presence of minerals: K, Na, Fe, Mn, Zn, P, Mg and Cu. The results of phytochemical analysis and anti-nutrients showed the presence of tannins, phytates, oxalate, saponins, trypsin inhibitors and hydrogen cyanide, with Moringa oleifera leaves having higher levels of the anti-nutrients (tannins). Broilers in group E (7.18kg), D (7.18kg) and B (7.03kg) had higher feed intake. Feed intake and mean weight were significantly different ($P<0.05$) at 10 and 20% w/v concentration of extract. The cost of feed consumed did not differ significantly ($P>0.05$). Group E (1.85kg), D (1.75kg) and B (1.73kg) had higher mean weights (gained 1.75kg, 1.65kg and 1.63kg, respectively). Group A had higher feed to gain ratio (4.6), thus low feed conversion efficiency. Carcass and organ weights in all the groups were not significantly affected ($P>0.05$). Haematological parameters (PCV, Hb, RBC and WBC) were all within the normal range values in all the groups. It was concluded that polyherbal aqueous extracts from Moringa oleifera, Gum Arabic and wild Ganoderma lucidum had no adverse effect on the carcass and organs of broilers.

Keywords: *Moringa oleifera*, gum arabic, mushroom, phytonutrients, anti-nutrients, chickens.

Introduction

Antibiotics are utilized as growth promoters and for disease prevention and treatment. The beneficial effects of antibiotics in combating bacteria problems and as growth promoters are well known. Medication of water using antibiotics helps birds to recover from diseases (of bacterial origin). However, there may be problems associated with antibiotics such as drugs toxicity, residual effects and development of bacteria resistance. The negative impact on consumers of meat or poultry products due to residual effects has led to the ban on the use of antibiotics as growth promoters since 2006 by the European Union. Animal scientists and veterinarians are now turning attention to safe and natural alternatives such as plants (phytobiotic) to replace antibiotics. Plants contain phytonutrients and phytochemicals (such as saponins, tannins, oxalates, phytates, trypsin inhibitors and cyanogenic glycosides), which are referred to as secondary metabolites. Secondary metabolites are applied in nutrition and as pharmacologically active agents[1]. Plants are also known to have high amounts of essential nutrients, vitamins, minerals, fatty acids and fibre[2]. There are reports on the presence of certain bioactive chemicals in plants or herbs and mushroom which have nutritional and medicinal benefits[3,4,5,6]. Proximate and phytochemical analysis showed they contained essential nutrients and bioactive compounds (or phytochemicals) that play a role in nutrition (as feed supplement) and as medicines for the treatment of certain diseases[6,7].

Plants like *Moringa oleifera* are in high demand for their nutritional and medicinal value. Moringa leaves and seeds are used by humans as a good source of vitamins (B and C) and

amino acids[8,9]. *Moringa oleifera* was also claimed to boost immune systems[9,10]. It has relatively high crude protein, low anti-nutritional factors and antimicrobial activity[11,12]. Gum Arabic is a secondary metabolite or natural secretion from trees (such as *Acacia nilotica* and *Acacia Senegal*), which is widely used as an additive in food materials. It is an edible coating used to increase stability and shelf-life and to enhance microbial safety of food[13]. Plant substances that are foods are of little or no side effects. Most of the prescribed medicines today (about 25%) are substances derived from plants[14].

In developing countries (like Nigeria), modern medicines (or use of antibiotics) are increasingly unaffordable. There are concerns being raised on the adverse effects of antibiotics and drugs residues in meat and poultry products. Information on the utilization of plant products alone and in combination in form of phytobiotic or phytomedicine as alternative to reduce over-dependence on antibiotics (as growth promoters or for treatment) in poultry production is scanty in Nigeria.

The objectives of this research work were: i. To determine the nutritional composition and the phytochemical constituents of *Moringa oleifera,* wild *Ganoderma lucidum* and Gum Arabic. ii. To evaluate the effects of polyherbal aqueous extracts from *Moringa oleifera,* wild *Ganoderma lucidum* and Gum Arabic in comparison with antibiotic on feed intake, growth performance and haematological parameters of broiler chickens.

Material and Methods

Study Area: The research was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Faculty of Agriculture, Nasarawa State University, Keffi, Nigeria. It is located in the Guinea savanna zone of North Central Nigeria and found on latitude 08^0 35 N and longitude 08^0 33 E.

Collection and processing of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum:* *Moringa oleifera* leaves, Gum Arabic and wild *Ganoderma lucidum* were collected at different locations in the morning hours of the day. *Moringa* leaves were collected during flowering stage in Lafia, Nasarawa State. Stems were cut from Moringa trees and spread out under the shade to dry in the sun at 35^0C for 3-5 days. The leaves were removed manually by hand and milled into powder form using a locally made miller machine (unbranded). Wild *Ganoderma lucidum* with red open caps were collected from decaying logs of woods and tree stumps during rainy season (June - September) in Vom, Plateau State. The wild mushroom was washed with water from the borehole and spread out in the sun to dry before milled into powder using a locally made mortar and pestle (unbranded). The milled mushroom powder was again dried in the sun for about 3 hours and then stored in plastic polythene bags at room temperature (28^0C). Dried solid Gum Arabic granules were procured from the open market in Kaduna, Kaduna State, and milled into powder form using a locally made miller machine (unbranded).

Proximate study of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum:* The proximate study (crude protein, crude fibre, nitrogen, fat and moisture) was determined according to the methods recommended by the Association of Official Analytical Chemists[15]. All the determinations were done in duplicates. The proximate values were reported in percentage.

Determination of carbonhydrate and fatty acid: Total soluble carbohydrate was determined by the difference of the sum of all the proximate composition from 100%. The calorific (energy) value was obtained according to the methods of Akinyeye *et al*.[16,17]. This was done by multiplying the value of carbohydrate, protein and crude fat by the Atwater factors of 17, 17 and 37 respectively. Crude fat was converted into fatty acid by multiplying with conversion factor of 0.80, as described by Akinyeye *et al*.[17].

Mineral analysis of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum*: Mineral elements (calcium, magnesium, potassium, sodium, iron, zinc, manganese and copper) in *Moringa oleifera* leaves, Gum Arabic and wild *Ganoderma lucidum* were determined using Atomic Absorption Spectrophotometer (AAS-Buck 205 model). Phosphorus was determined colorimetrically. Flame photometer was used for the determination of sodium and potassium. All determinations were done in duplicates. The values of calcium, magnesium and potassium were reported in percentage (%), while sodium, iron, zinc, phosphorus, manganese and copper were reported in parts per million (ppm).

Phytochemical analysis and anti-nutrients of *Moringa* leaves, Gum Arabic and wild *Ganoderma lucidum:* The quantitative phytochemical and anti-nutrients analysis of *Moringa oleifera* leaves; Gum Arabic and wild *Ganoderma lucidum* were carried out according to the methods of Sofowora[18]. All the determinations were done in duplicates.

Experimental birds and housing: Eighty day (80) old Arbor-acre commercial broiler chicks were procured from a hatchery at Ibadan, Nigeria. All the chicks were first brooded together on deep litter system of housing for one week in order to acclimatize. At two weeks of age, they were randomly distributed into five groups of treatments: Group A (*Moringa oleifera* + Gum Arabic + *Ganoderma lucidum*), B (*Moringa oleifera* + Ganoderma *lucidum*), C (Gum Arabic + *Ganoderma lucidum*), D (*Moringa oleifera* + Gum Arabic), E (Antibiotic only, as control for comparison). Each group was replicated (in duplicates) made of 8 chicks kept in separate wire-mesh compartments supported with wooden frame-work and the dimension measured about 200 cm x 100 cm. The chicks in all the groups (A-E) were fed on broiler starter mash containing 22% CP and 2800kcal ME from 1-4 weeks of age, followed by broiler finisher mash containing 20% CP and 2649kcal ME from 5-8 weeks of age, *ad libitum*. All the chicks in all the groups were given routine vaccinations against infectious bursal disease (first and second dose) at 2 and 5 weeks of age, and

Newcastle LaSota vaccination at 3 weeks of age. Vitamins were administered to all the chicks in their drinking water for 3 days only after each vaccination.

Preparation of polyherbal aqueous extracts and administration to broilers: The Procedure involved; i. Different levels of aqueous extract were prepared (5, 10 and 20% w/v) using milled (powder) samples of Moringa leaves, Gum Arabic and wild Ganoderma in boiling water at 100^0C for 12 h. Each solution was sieved and filtrate collected. ii. The filtrate from each extract was mixed at equal volume to form a polyherbal extract (1:1): Moringa leaves + Gum Arabic + wild Ganoderma (group A), Moringa leaves + wild Ganoderma (B), Gum Arabic + wild Ganoderma (C), Moringa leaves + Gum Arabic (D). Each polyherbal extract was labeled A – D, according to the groups of the broilers. iii. 5% w/v polyherbal aqueous extract was administered orally to the broilers at 2 weeks of age, 10% w/v at 4 weeks, and 20% w/v was administered at 6 weeks of age in each group.

Collection of data: Feed intake by the broilers in each group was monitored on daily basis. Growth performance in terms of body weight (gain) was determined on weekly basis and feed conversion efficiency was calculated by dividing the total feed intake by the weight gain of the broilers in each group. Blood samples were collected (4 birds/group) on weekly interval through jugular veni-puncture (2 ml/bird) using sterile syroinges and needles and the blood was immediately transferred into test-tubes containing disodium salt of ethylene diamine tetra-acetic acid (EDTA). Blood samples were labeled according to the groups for haematology. Microhaematocrit method was used to determine packed cell volume (PCV) and cyanmethaemoglobin method was used to determine haemoglobin (Hb). Red blood cell (RBC) and white blood cell (WBC) counts were determined using Neubauer haemocytometer[19]. At 9 weeks of age, carcass weights were determined from six randomly selected birds per group after slaughter (by severing the carotid arteries and jugular veins using a sharp knife) and carcass dressed (evisceration). The birds were first fasted for 12 hours (no access to feed except water) before slaughter. The organs and carcass in each group were separated into different parts and weighed: head, neck, shank, wing, thigh, breast, backbone and rib-cage. The organs: Liver, heart, gizzard and spleen were also weighed and expressed as percentage of the live weight.

Statistical analysis: Statistical analysis of data (nutrients, minerals phytochemicals, feed intake, weight gain, carcass and organ weights and haematological values) were all subjected to analysis of variance[20]. Duncan's multiple range tests was used for the mean separation[21]. All the determinations were carried out in duplicates and results presented in mean ± standard deviations.

Result and Discussion

Proximate composition of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum:* The results of proximate study of *Moringa oleifera* leaves, Gum Arabic and wild *Ganoderma lucidum* are presented in Table 1. *Moringa* leaves contained appreciable amount of nutrients: crude protein (17.01% CP), carbohydrate (63.11% CHO) and energy (1440.11kcal/kg). Gum Arabic also contained appreciable amount of crude protein (15.38% CP), carbohydrate (62.26% CHO) and energy (1387.591kcal/kg). Wild *Ganoderma lucidum* also contained valuable amount of crude protein (16.79% CP), carbohydrate (63.27% CHO) and energy (1417.26kcal/kg). A higher crude protein value, crude fibre, fat and ash content in *Moringa oleifera* leaves was reported by Mutayoba *et al.*[22]. The crude protein observed in wild *Ganoderma lucidum* was higher (16.79 ±0.13%) than the crude protein value (13.3%) reported earlier by us. The crude protein, fat and fatty acids values obtained in this study were significantly different ($P<0.05$). These differences may not be unconnected to variations in the geographical location and stage of maturity of the plants and the wild mushroom. The presence of these important nutrients (carbohydrate, low fat and fatty acids) implies that *Moringa oleifera* leaves, gum arabic and wild *Ganodema lucidum* could be a nutritionally valuable and healthy ingredient for poultry. Low fat foods are known to reduce cholesterol level[23].

Mineral composition of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum:* Table 2 showed that *Moringa oleifera* leaves contained minerals, Ca (1.91% ±0.08), Mg (0.38% ±0.01), K (0.97% ±0.01), Na (192 ±4.48), Fe (107.48 ±8.81), Zn (60.06 ±0.30), P (30.15 ±0.47), Mn (81.65 ±2.31) and Cu (6.10 ±0.20) in parts per million (ppm). Gum Arabic also contained minerals, Ca (2.10% ±0.13), Mg (0.42% ±0.10), K (1.30% ±0.04), Na (259.85 ±1.78), Fe (98.42 ±1.55), Zn (47.77 ±1.06), P (30.11 ±0.20), Mn (58.83 ±0.54) and Cu (5.94 ±0.30). Wild *Ganoderma lucidum* also contained minerals, Ca (1.99% ±0.04), Mg (0.34% ±0.01), K (1.11% ±0.04), Na (229.85 ±0.34), Fe (121.37 ±1.82), Zn (51.49 ±2.16), P (30.17 ±1.29), Mn (71.06 ±1.56) and Cu (7.43 ±0.13). These minerals, Mn (81.65, 58.83 and 71.06), Zn (60.06, 47.77 and 51.49) and Cu (6.10, 5.94 and 7.43), observed in Moringa leaves, gum arabic and wild *Ganoderma lucidum*, respectively were higher than those reported by Mutayoba *et al* [22]. Higher values of Fe (318.81), K (1.63%) and Mg (1.03%) were reported by Mutayoba *et al* [22]. Lower values of Ca (0.40%) and P (0.30) in wild *Ganoderma lucidum* were reported by Ogbe *et al* [5]. The values of Mg, K, Na, Fe, Zn, P, Mn and Cu obtained from *Moringa* leaves, gum arabic and wild *Ganoderma lucidum* were significantly different ($P<0.05$). The differences in the composition of minerals may be due to variations in the locality of growth and stage of maturity. The presence of these essential nutrients and minerals in Moringa leaves, gum arabic and wild Ganoderma mushroom would promote normal growth and health status of broiler chickens.

Phytochemical composition of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum:* Table 3 showed that *Moringa oleifera* leaves contained phytates (2.59%), oxalate (0.45%), saponins (1.60%), tannins (21.19%), trypsin (3.00%) and

hydrogen cyanide (0.10%). Gum Arabic also contained phytates (2.05%), oxalate (0.41%), saponins (1.47%), tannins (15.15%), trypsin (2.01%) and hydrogen cyanide (0.06%). Wild *Ganoderma lucidum* also contained phytates (2.43%), oxalate (0.57%), saponins (1.26%), tannins (18.27%), trypsin (2.39%) and hydrogen cyanide (0.08%). The levels of phytochemicals and anti-nutrients were low (less than 5%). The cyanide content of Moringa leaves, gum arabic and the wild mushroom was very low. Tannins appeared high in Moringa leaves (21.19%), followed by the wild Ganoderma mushroom (18.27%) and gum arabic (15.15%). The level of oxalates, saponins, tannins and trypsin in Moringa leaves, gum arabic and wild Ganoderma are significantly different (P<0.05). Some phytochemicals (such as tannins) were reported as phytoconstituents of plants[24]. Phytoconstituents (which include saponins and other bioactive compounds) are antibiotic principles of plants[24].

Table – 1
Proximate composition of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum*

Components	Nutrients composition (%)			
	***Moringa* leaves**	**Gum Arabic**	**Ganoderma**	**LOS**
Crude Protein (CP)	17.01 ±0.10^{a}	15.38 ±0.30^{b}	16.79 ±0.13^{ab}	*
Crude Fibre (CF)	7.09 ±0.11	7.41 ±0.12	7.77 ±0.34	NS
Crude Fat (lipid)	2.11 ±0.11^{a}	1.83 ±0.06^{ab}	1.52 ±0.09^{b}	*
Ash Content	7.93 ±0.12^{c}	9.05 ±0.11^{a}	8.42 ±0.13^{b}	*
Moisture	3.21 ±0.10^{a}	3.00 ±0.04^{b}	2.78 ±0.05^{c}	*
Nitrogen (N)	2.83 ±0.16	2.55 ±0.20	2.83 ±0.22	NS
Carbohydrate (CHO)	63.11 ±0.09	62.26 ±0.50	63.27 ±0.20	NS
Fatty acid	1.69 ±0.09^{a}	1.46 ±0.05^{b}	1.22 ±0.07^{c}	*
Dry Matter (DM)	96.79 ±0.10	97.00 ±0.04	97.23 ±0.05	NS
Energy value Kcal/100kg)	1440.11 ±0.30^{a}	1387.59 ±0.90^{c}	1417.26 ±0.42^{b}	*

Data are mean ± standard deviation (SD) of duplicate results; NS = No significant difference (P>0.05); Means bearing different superscript (a, b, c) on the same row differ significantly (P<0.05); asterisk means significantly different (P<0.05); LOS = Level of Significance.

Table – 2
Mineral composition of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum*

Elements	Mineral composition (%)			
	***Moringa* leaves**	**Gum Arabic**	**Ganoderma**	**LOS**
Calcium (%)	1.91 ±0.08	2.10 ±0.13	1.99 ±0.04	NS
Magnesium (%)	0.38 ±0.01^{b}	0.42 ±0.10^{a}	0.34 ±0.01^{b}	*
Potassium (%)	0.97 ±0.01^{c}	1.30 ±0.04^{a}	1.11 ±0.04^{b}	*
Sodium (ppm)	192.95 ±4.48^{c}	259.85 ±1.78^{a}	229.88 ±0.34^{b}	*
Iron (ppm)	107.48 ±8.81^{a}	98.42 ±1.55^{b}	121.37 ±1.82^{a}	*
Zinc (ppm)	60.06 ±0.30^{a}	47.77 ±1.06^{c}	51.49 ±2.16^{b}	*
Phosphorus (ppm)	30.15 ±0.47	30.11 ±0.20	30.17 ±1.29	NS
Manganese (ppm)	81.65 ±2.31^{a}	58.83 ±0.54^{c}	71.06 ±1.56^{b}	*
Copper (ppm)	6.10 ±0.20^{b}	5.94 ±0.30^{b}	7.43 ±0.13^{a}	*

Data are mean ± standard deviation (SD) of duplicate results; ppm = parts per million (1mg/kg = 1ppm); Means bearing different superscript (a, b, c) on the same row differ significantly (P<0.05); asterisk means significantly different (P<0.05); LOS = Level of Significance.

Table – 3
Phytochemical composition of Moringa leaves, Gum Arabic and wild *Ganoderma lucidum*

Components	Quantitative phytochemical contents (%)			
	***Moringa* leaves**	**Gum Arabic**	**Ganoderma**	**LOS**
Phytates	2.59 ± 0.13^{a}	2.05 ± 0.12^{c}	2.43^{b} ± 0.09	*
Oxalates	0.45 ± 0.01^{c}	0.71 ± 0.16^{a}	0.57 ± 0.06^{b}	*
Saponins	1.60 ± 0.05^{a}	1.47 ± 0.23^{b}	1.26 ± 0.06^{c}	*
Tannins	21.19 ± 0.25^{a}	15.15 ± 0.24^{c}	18.27 ± 0.27^{b}	*
Trypsin inhibitors	3.00 ± 0.04^{a}	2.01 ± 0.10^{c}	2.39 ± 0.11^{b}	*
Hydrogen cyanide (HCN)	0.10 ± 0.01	0.06 ± 0.01	0.08 ± 0.01	NS

Data are mean ± standard deviation (SD) of duplicate results; Means bearing different superscript (a, b, c) on the same row differ significantly (P<0.05); asterisk means significantly different (P<0.05); LOS = Level of Significance.

Effect of polyherbal aqueous extracts (*Moringa oleifera,* Gum Arabic and wild *Ganoderma lucidum*) on feed intake and weight gain (kg/bird) of broilers: Table 4 showed the effect of polyherbal extracts from *Moringa oleifera* leaves, Gum Arabic and wild *Ganoderma lucidum* on feed intake of broilers. Group A (Moringa leaves + Gum Arabic + wild Ganoderma) recorded an increase in feed intake from 0.37 to 1.67kg/bird, and from 1-8 weeks of age the total feed intake was 6.89kg, which cost ₦822.34. Group B (Moringa leaves + wild Ganoderma) also recorded an increase in mean feed intake from 0.38 to 1.69kg, and the total feed intake from 1-8 weeks was 7.03kg, which cost ₦839.07. Group C (Gum Arabic + wild Ganoderma) also recorded an increase in feed intake from 0.37 to 1.65kg/bird. However, at higher concentration of polyherbal extract (20%w/v), there was slight decline in feed intake from 7 to 8 weeks of age (table 4). The total mean feed intake recorded in this group was 6.95kg and the total cost of feed consumed was ₦830.11. Group D (Moringa leaves + Gum Arabic) also recorded an increase in feed intake from 1 to 7 weeks of age (0.36kg/bird to 1.69kg/bird), which reduced to 1.65kg/bird at 8 weeks, and the total feed intake in this group was 7.18kg and the cost of feed consumed was ₦857.58. Group E (control) also recorded an increase from 0.40kg/bird to 1.67kg/bird, and the total feed intake was 7.18kg and the cost of feed consumed was ₦857.580. In general, when the broiler chickens were administered with aqueous extracts from Moringa leaves, gum arabic and wild Ganoderma (at 5% w/v), there was no significant difference (P>0.05) in all the groups when compared with that of antibiotic. However, at higher concentration (10 to 20% w/v), there was slight reduction in feed intake by the broiler chickens in group A. This difference in feed intake was significantly different (P<0.05) at 7 weeks of age (table 4). At 8 weeks of age, the broiler chickens in group C and E also showed a significant decrease in feed intake (P<0.05), but this was attributed to infection of the birds with intestinal coccidiosis (as revealed by the clinical signs of bloody diarrhea and postmortem). In general, group D and E had the highest feed intake (7.18 ±0.2, each), followed by B (7.03 ±0.13) and C (6.95 ±0.2). Group A had the lowest feed intake (6.89 ±0.2).

When the broilers were administered with polyherbal extract at higher concentration (10 to 20%w/v), group A (1.51kg) had the least weight gain (table 5). The feed cost per weight gain of the broilers in this group (A) was higher (₦79.37), followed by C (₦75.86), B (₦74.09), D (₦72.63) and E (₦68.46) had the least cost. The feed cost per kg live weight was also higher in group A (₦74.42), followed by C (₦71.33), B (₦69.73), D (₦68.46) and E (₦64.74) had the least cost. The feed to gain ratio was also high in group A (4.6). The reduction in feed intake and body weight in group A and C was significant (P<0.05). The combined effects of tannins in the polyherbal aqueous extracts may be responsible for reduction in feed intake and growth performance (weight gain) of the broilers (figure 1). Tannins are plant polyphenols, which (in excess) have ability to form complex with metal ions and this can reduce feed efficiency and weight gain[25,26]. High level of saponnins and phytates can also affect feed intake due to reduction of protein digestibility and bioavailability of minerals[27,28].

Table – 4
Group weekly mean feed intake and weight gain (kg/bird) of broilers administered polyherbal aqueous extracts (*Moringa oleifera*, Gum Arabic and wild *Ganoderma lucidum*)

Parameters	Age (week)	Group mean (±SD) feed intake (kg/bird)					
		A	B	C	D	E	LOS
Initial feed intake	1	0.37±0.04	0.38±0.01	0.37±0.01	0.36±0.03	0.40±0.01	NS
Initial weight	1	0.10±0.00	0.10±0.00	0.10±0.00	0.10±0.00	0.10±0.00	NS
Weight at 5%	2	0.26±0.01	0.23±0.01	0.21±0.01	0.25±0.01	0.24±0.01	NS
Weight at 10%	4	0.56±0.03^{a}	0.57±0.06^{a}	0.54±0.02^{b}	0.55±0.01^{b}	0.58±0.02^{a}	*
Weight at 20%	6	1.09±0.05^{b}	1.08±0.06^{b}	1.10±0.03^{ba}	1.09±0.06^{b}	1.26±0.06^{a}	*
Mean final weight	8	1.61±0.01	1.73±0.21	1.68±0.04	1.75±0.04	1.85±0.01	NS
Mean weight gain		1.51±0.01	1.63±0.21	1.58±0.04	1.65±0.04	1.75±0.01	NS
Total cost of feed consumed (N)		822.34	839.07	830.11	857.58	857.58	NS
Feed to gain ratio		4.6	4.3	4.4	4.4	4.1	NS

Data are mean (±SD) of duplicate results; A = represent broilers administered with extracts from Moringa leaves + Gum arabic + wild Ganoderma, B = Moringa leaves + wild Ganoderma, C = Gum arabic + wild Ganoderma, D = Moringa leaves + Gum arabic, E = antibiotic only as control for comparison. NS – means no significant difference (P>0.05). Means on the same row bearing different superscript of a, b, c – differ significantly (P<0.05), asterisk means - significantly different (P<0.05), LOS – Level of Significance.

Effect of polyherbal aqueous extracts (*Moringa oleifera,* Gum Arabic and wild *Ganoderma lucidum*) on carcass and organs weight (%) and haematological parameters of broilers: The carcass analysis showed that pre-slaughter mean weight and dressed (carcass) weight of broilers in group E, D and B was 2.23, 2.17 and 2.16kg, respectively at the end of the experiment (9 weeks of age). Group A and C (2.07kg and 2.09) had the least mean weight (table 5). The carcass weight in Group E, D and B were heavier (1.65, 1.58 and 1.56kg), respectively. Group A and C had the least (1.49 and 1.54kg) mean weight. Although, the pre-slaughter and dressed (carcass) weights did not show any significant difference (P>0.05), but the increase in weights in these groups (E, D and B) may be attributed to the beneficial effect of the polyherbal extracts and antibiotic. High value of live body weight was said to attract high value of dressed (carcass) weight[29]. The result also showed that dressing percentage was higher in group E and C (73.90% and 73.41%) than the others (table 5). In terms of carcass weight, the breast cut was heavier in weight in group A (28.53%). Group E had the least breast weight (25.51%). The thigh was also heavier in weight in group A (31.22%). The high values or weights of the cut carcass parts (thigh, breast and wings) in all the groups imply better growth performance.

Generally, the carcass and organ weight analysis in all the groups did not show appreciable variations. There was no significant difference (P>0.05) in the organ weights in all the groups. However, the weight of the gizzard in group C was high (10.64 %,) possibly due to the response of the broilers in this group to the combined effect of the high fibre content of the Gum Arabic and the mushroom (table 1). Also, when the broilers were administered with either polyherbal extracts or antibiotic, all the haematological parameters appeared within the normal range values (table 6): PCV = 29-44%; HB = 9.1-13.9g/dl; RBC = 2.01 x 10^{12}/L – 3.41 x 10^{12} L; WBC = 2.35 x 10^{9}/L – 2.82 x 10^{9}/L. Wide ranges of normal haematological values were reported by Ogbe *et al.*[19,30]. Fluctuations in haematological values of avian blood are normal phenomenon and may be associated with the physiological status of the birds[19,30]. Earlier studies have found *Moringa* (and other plants products) to be non-toxic and recommended for use in developing countries[31]. Aweng *et al*[32] reported that clean drinking water has become scarce nowadays due to poor land use management and pollution by sewage or waste dumping site. This polluted water will have to go through treatment process before it can be circulated for drinking. Possibly, *Moringa oleifera* and other plants products may also be useful for poultry drinking water treatment.

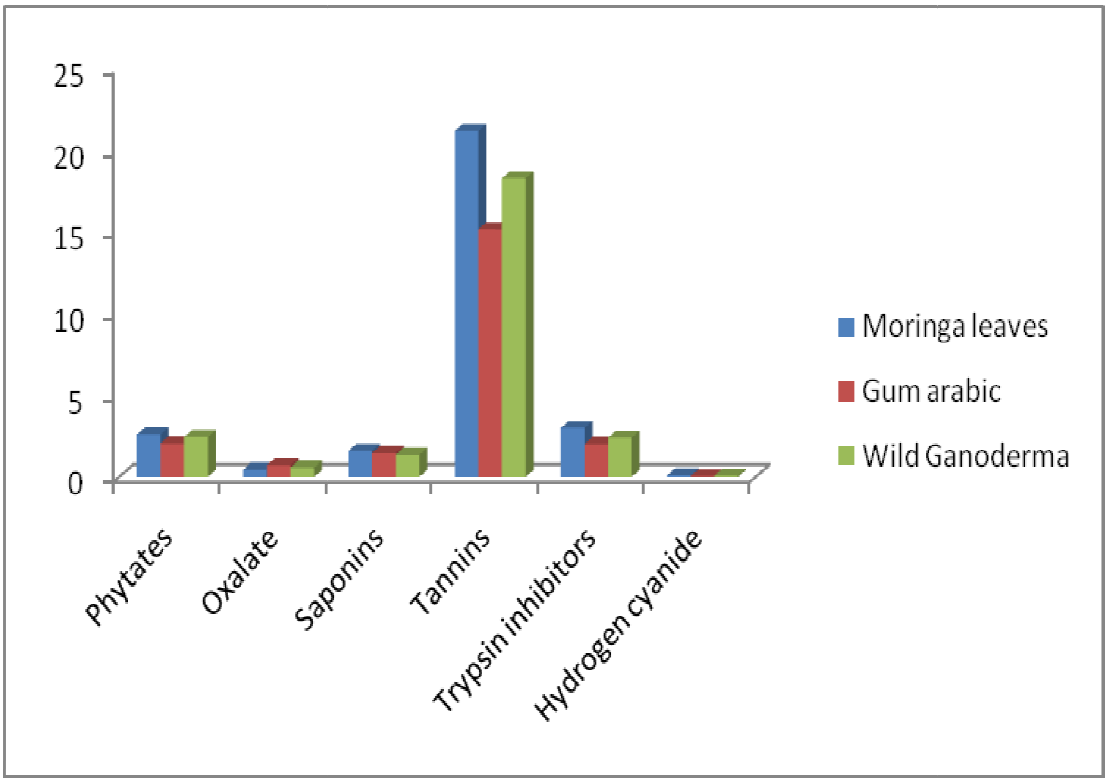

Figure – 1
Phytochemicals and anti-nutrients in *Moringa* leaves, Gum Arabic and wild *Ganoderma lucidum*

Table – 5
Carcass and organ body weights (%) of broilers administered polyherbal aqueous extracts from *Moringa oleifera*, Gum Arabic and wild *Ganoderma lucidum*

	Parameters	**Group mean weights and organ: body weight ratio (%)**					
		A	**B**	**C**	**D**	**E**	**LOS**
1a.	Pre-slaughter weight at 9 weeks (kg/bird)	2.07±0.01	2.16±0.11	2.09±0.20	2.17±0.01	2.23±0.10	NS
b.	Dressed (carcass) mean weight (kg/bird)	1.49±0.01	1.56±0.13	1.54±0.20	1.58±0.01	1.65±0.11	NS
c.	Dressing percent	71.98±0.68	72.17±2.11	73.41±0.83	72.58±0.33	73.90±2.18	NS
2.	**Carcass weight (%)**						
i.	Breast (chest)	28.53±0.21	25.96±0.15	26.76±0.99	27.94±1.02	25.51±0.07	NS
ii.	Thigh (legs)	31.22±0.77	31.18±2.09	29.34±0.35	30.80±0.59	30.06±1.07	NS
iii.	Back bone	15.10±0.33	15.94±2.33	16.28±0.11	15.24±0.83	16.68±1.07	NS
iv.	Rib cage	9.74±1.51	9.31±0.30	9.12±0.04	10.48±0.40	9.48±1.04	NS
v.	Wings	10.41±0.57	11.20±0.45	10.08±0.31	11.11±0.40	10.38±1.53	NS
vi.	Neck	6.72±0.06	6.74±0.09	7.61±2.18	6.67±0.42	6.68±0.43	NS
v.	Shank	14.09±0.82	14.38±1.09	13.10±1.39	15.24±0.96	13.64±1.27	NS
3.	**Organ weight (%)**						
i.	Gizzard	9.39±0.86	9.65±0.78	10.64±2.10	8.89 ±0.86	9.14±0.59	NS
Ii	Liver	6.72±0.06	7.95±1.62	6.55±0.69	6.35±0.03	6.68±0.43	NS
iii.	Heart	3.36±0.04	3.22±0.26	3.28±0.35	3.17±0.01	3.05±0.19	NS
iv.	Spleen	2.02±0.02	1.93±0.16	1.91±0.21	1.91±0.01	1.83±0.12	NS
v.	GIT content	26.18±0.70	20.81±0.57	22.93±2.43	22.24±4.59	17.70±2.00	NS

*Data are mean (±SD) of duplicate results; A = represent broilers administered with extracts from Moringa leaves + Gum arabic + wild Ganoderma, B = Moringa leaves + wild Ganoderma, C = Gum arabic + wild Ganoderma, D = Moringa leaves + Gum arabic, E = antibiotic only as control for comparison. NS = No significant difference (P>0.05), LOS – Level of significance.

Table – 6
Mean (±SD) haematological values of broilers administered polyherbal aqueous extracts from *Moringa oleifera*, Gum Arabic and wild *Ganoderma lucidum*

Group	**Haematological parameters**	**5%**	**10%**	**20%**	**LOS**
A	PCV	31.00±0.71	32.00±0.21	38.00±3.54	NS
	Hb	9.40±0.07	9.50±0.14	13.55±0.21	NS
	RBC	2.02±0.01	2.19±0.26	3.33±0.04	NS
	WBC	2.57±1.61	2.52±3.54	2.80±2.21	NS
B	PCV	31.00±4.95	29.00±0.71	39.00±2.83	NS
	Hb	9.60±1.06	8.80±0.14	13.55±0.07	NS
	RBC	2.30±0.47	2.03±0.04	3.33±0.03	NS
	WBC	2.70±6.87	2.70±6.87	2.50±9.90	NS
C	PCV	33.00±4.95	32.00±4.24	38.00±7.07	NS
	Hb	10.3±1.20	10.1±1.13	13.40±0.71	NS
	RBC	2.29±0.38	2.29±0.37	3.13±0.34	NS
	WBC	2.59±1.80	2.59±1.80	2.35±5.66	NS
D	PCV	29.00±1.41	29.00±2.83	44.00±1.41	NS
	Hb	9.10±0.28	9.10±0.28	13.90±0.00	NS
	RBC	2.01±0.00	2.02±0.03	3.41±0.06	NS
	WBC	2.52±2.83	2.52±2.83	2.50±7.07	NS
E	PCV	32.00±2.12	34.00±2.12	42.00±2.12	NS
	Hb	9.60±0.28	9.90±0.52	13.55±0.21	NS
	RBC	2.25±0.00	2.51±0.19	3.36±0.02	NS
	WBC	2.50±7.07	2.50±7.07	2.82±4.04	NS

*Data are mean (±SD) of duplicate results; A = broilers administered Moringa leaves + Gum arabic + wild Ganoderma, B = Moringa leaves + wild Ganoderma, C = Gum arabic + wild Ganoderma, D = Moringa leaves + Gum arabic, E = antibiotic only. PCV = %, Hb (g/dl), RBC ($x10^{12}$/L), WBC ($x10^{9}$/L). NS = No significant difference (P>0.05), LOS – Level of significance.

Conclusion

In conclusion, the results of this study showed that *Moringa oleifera* leaves, gum arabic and wild *Ganoderma lucidum* contained appreciable amount of crude protein, dietary fibre, fatty acids and minerals, which are nutritional requirements of broiler chickens. These plants (products) and the wild *Ganoderma* mushroom contained valuable phytochemical constituents that improve growth performance and health of broiler chickens. Anti-nutritional factors in *Moringa oleifera* leaves, gum arabic and wild *Ganoderma lucidum* were low. However, the combined effects of anti-nutritional factors (like tannins) as a result of the combination of two or more aqueous extracts from these plants (products) could affect feed intake and weight gain of broilers. It was also concluded that the polyherbal extracts had no adverse effects on heamatological parameters of broilers. The heamatological values observed in this present study were all within the normal range. However, further trials on single doses of aqueous extract from *Moringa oleifera* leaves and seeds, gum arabic and wild *Ganoderma lucidum* and in feed are recommended.

References

1. Soetan K.O. and Oyewole O.E., The need for adequate processing to reduce the anti-nutritional factors in animal feeds- A review, *African Journal of Food Science,* **3(9),** 223-232 **(2009)**

2. Gafar M.K. and Itodo A.U., Proximate and mineral composition of hairy indigo leaves, Electronic *Journal of Environmental, Agricultural and Food Chemistry*, **10(3),** 2007-2018 **(2011)**

3. Guo F.C., Sacelkoul H.F.J., Kwakkel R.P., Williams B.A. and Verstegen M.W.A. Immunoactive, medicinal properties of mushroom and herb polysaccarides and their potential use in chicken diets, In *World's Poultry Science Journal,* **(59),** 427-440 **(2003)**

4. Ogbe A.O., Mgbojikwe L.O., Owoade A.A., Atawodi S.E. and Abdu P.A. The effect of a wild mushroom *(Ganoderma lucidum*) supplementation of feed on the immune response of pullet chickens to infectious bursal disease vaccine, *Electronic J. Environ. Agric. and Food Chem. (EJEAFChe),* **(7),** 2844-2855 **(2008)**

5. Ogbe, A.O., Ditse, U., Echeonwu, I., Ajodoh, K., Atawodi, S.E. and Abdu, P.A. Potential of a wild mushroom, *Ganoderma* sp., as feed supplement in chicken diet: Effect on performance and health of pullets, *Int. J. Poultry Sc,* **8(11),**1052-1057 **(2009a)**

6. Ogbe A.O., Atawodi S.E., Abdu P.A., Sannusi A. and Itodo A.E., Changes in weight, faecal oocyst count and packed cell volume of *Eimeria tenella*-infected broilers treated with a wild mushroom (*Ganoderma lucidum*) aqueous extract, *In Journal of South African Veterinary Association,* **(80),** 97-102 **(2009b)**

7. Ogbe A.O., Efenu P., Nicholas U., Pam A., Abarshi A., Banyigyi S. and Odugbo M., Response to treatment of skin ailments in Animal Patients using aqueous Ganoderma extract, *EJEAFChe,* **10(1),** 1816-1820 **(2011)**

8. Makkar H.P.S. and Becker K. Nutritional value and an nutritional components of whole and extracted *Moringa oleifera* leaves, *In Animal Feed Science and Technology*, **(63),** 211-228 **(1996)**

9. Olugbemi T.S., Mutayoba S.K. and Lekule F.P. Effect of Moringa (*Moringa oleifera*) Inclusion in Cassava based diets to broiler chickens, *In International Journal of Poultry Science,* **9(4),** 363-367 **(2010)**

10. Jayavardhanan K.K., Suresh K., Panikkar K.R. and Vasudevan D.M. Modular potency of drumstick lectin on host defense system, *In Journal of Experimental Clinical Cancer Research,* **(13),** 205-209 **(1994)**

11. Makkar H.P.S. and Becker K., Nutrients and anti-quality factor in different morphological part of *Moringa oleifera* tree, *Journal of Agric. Sc.,* **(128),** 211-322 **(1997)**

12. Dahort U.M. Anti-microbial activity of small protein of Moringa oleifera leaves, *Journal of Islamic Acad. Science,* **11(1),** 27-32 **(1998)**

13. Roony M.L. Introduction to Active food packaging technology, In: Han J.H., editor, Innovations in food packaging, San Diego, Calif: Elsevier Academic press, 63-79 **(2005)**

14. Ngaski M.M., Phytochemical screening and proximate analysis of *Cassia siamea* leaves, M.Sc Thesis, Usmanu Danfodiyo University, Sokoto, Nigeria, **(2006)**

15. AOAC, Official Methods of Analysis, 15th Edition, *Association of Official Analytical Chemists,* Washington, D.C; USA, 807-928 **(1990)**

16. Akinyeye R.O., Oluwadunsin A. and Omoyeni A., Proximate, mineral, anti-nutrients and phytochemical screening and amino acid composition of the leaves of *Pterocarpus mildbraedi* Harms, *Electronic Journal of Environmental, Agricultural and Food Chemistry,* **9(8),** 1322-1333 **(2010)**

17. Akinyeye R.O., Oluwadunsin A. and Omoyeni A. Proximate, mineral, anti-nutrients and phytochemical screening and amino acid composition of the leaves of *Pterocarpus mildbraedi* Harms, *Electronic Journal of*

Environmental, Agricultural and Food Chemistry, **10(1),** 1848-1857 **(2011)**

18. Sofowora A., Medicinal Plants and Traditional Medicine in Africa; John Wiley and Sons, Ltd, Ife, Nigeria, 55-201 **(1993)**

19. Ogbe A.O., Atawodi S.E., Abdu P.A., Oguntayo B.O. and Noel D., Oral treatment of *Eimeria tenella*-infected broilers using aqueous extract of wild mushroom (*Ganoderma* sp): Effect on haematological parameters and histopathology lesions, *African Journal of Biotechnology,* **9(52),** 8923-8927 **(2010)**

20. Olawuyi J.F., Biostatistics: A foundation course in health sciences. 1st Edition. University College Hospital, Published by Tunji Alabi Printing Co. Total Garden, Ibadan, Nigeria, 1-221 **(1996)**

21. Duncan D.B., Multiple range and multiple F-tests. *Biometry,* **(11),** 1-42 **(1955)**

22. Mutayoba S.K., Dierenfield E., Mercedes V.A., Frances Y. and Knight C.D., Determination of chemical composition and anti-nutritive components for Tanzanian locally available poultry feed ingredients, *International Journal of Poultry Science,* **10(5),** 350-357 **(2011)**

23. Gordon M.N. and Kessel M., Perspective in Nutrition. McGraw Hill Company, Ohio, New York, 5th Edition, 257-281 **(2002)**

24. Ajayi I.A., Ajibade O. and Oderinde R.A., Preliminary Phytochemical Analysis of some Plant Seeds, *Research Journal of Chemical Sciences,* **1(3)**, 58-62 **(2011)**

25. Dei H.K., Rose S.P. and Mackenzie A.M., Shea nut (*Vitellaria paradoxa*) meal as a feed ingredient for poultry, *World's Poultry Science Journal,* **63(4),** 611-624 **(2007)**

26. Armstrong W.D., Rogler J.C. and Featherston W.R. Effects of tannins extraction on the performance of chicks fed bird resistant sorghum grain diets, *Poultry Science,* **(53),** 714-720 **(1974)**

27. Shimoyamada M., Ikedo S., Ootsubu R. and Watanabe K., Effect of Soya beans saponins on chmotryptic hydrolyses of soybeans proteins, *Journal of Agricultural and Food Chemistry,* **(46),** 4793-4797 **(1998**)

28. Thompson L.U., Potential health benefits and problems associated with anti-nutrients in foods, *International Journal of Food Resources,* **(26),** 131-149 **(1993)**

29. Ojewole G.S., Uka S.N. and Onyenucheya F., Comparative carcass characteristics of indigenous poultry feds different agro-industrial by-product, *Tropical Journal of Anim. Sci*., **3(2),** 159 -161 **(2000)**

30. Ogbe A.O., Adeyefa C.A.O. and Joshua R.A., Growth rate and haematological parameters of broiler chickens vaccinated with IBD (Gumboro) vaccines exposed to different handling temperature, *Journal of Science and Technology Research,* **(2),** 36–38 **(2003)**

31. Mangale Sapana M., Chonde Sonal G. and Raut P.D., Use of *Moringa Oleifera* (Drumstick) seed as Natural Absorbent and an Antimicrobial agent for Ground water Treatment, *Research Journal of Recent Sciences,* **1(3),** 31-40 **(2012)**

32. Aweng E.R.1, Anwar I.1, Siti Rafiqah M.I. and Suhaimi O.1. *Cassia alata* as a Potential Coagulant in Water Treatment, *Research Journal of Recent Sciences,* **1(2),** 28-33, **(2012)**