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Effect of molasses on performance, haematology and serum chemistry of broiler chickens

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Abstract

The effect of dietary inclusion of molasses on performance, haematology and blood chemistry of broiler chicks was investigated using 160 broiler chicks. The experiment was conducted for 9 weeks. The birds were fed diets containing various inclusion rates of molasses (0%, 5%, 10% and 15%) in a completely randomized design. Each treatment was replicated twice with twenty birds per replicate. Performance indices were measured weekly, while the mortality rate was calculated at the end of the study. At the end of the fifth week, 24 blood samples were collected (3 samples per replicate) and analysed for haematological indices: packed cell volume (PCV), haemoglobin concentration (Hb), red blood cells count (RBC) and white blood cells count (WBC). Sixteen blood samples were also collected (2 samples per replicate) and analysed for blood chemistry indices: total protein, albumin, alkaline phosphatase (ALP), urea, cholesterol, aspartate transaminase (AST) and alanine transaminase (ALT). There were no significant differences ($p>0.05$) in daily feed intake, daily weight gain, feed conversion ratio and mortality. There were also non-significant differences ($p>0.05$) in RBC, WBC, albumin, ALP, urea, cholesterol, AST and ALT values among the birds fed all the diets. Significant differences ($p<0.05$) were, however, observed for PCV and Hb among the diets. Apart from the WBC and total protein values, the Hb, RBC, PCV, albumin, ALP, urea, cholesterol, AST and ALT values were within the normal ranges for broiler chicks, except PCV of birds on 15% inclusion of molasses. Molasses can be included up to 10% level in broiler ration without deleterious effect on performance, haematological and serum biochemical parameters of the birds.

Keywords: Blood, Breed, Diet, Physiology, Vaccination

Introduction

In Nigeria, the most common energy source is maize. Aside being used as a conventional energy source, maize is also a very important staple food; as such, humans compete greatly with animals in its utilization thereby resulting in a rise in its cost (Ravindran & Blair, 1993). Molasses is the final effluent obtained in the preparation of sucrose by repeated evaporation, crystallization and centrifugation of juices from sugar cane or sugar beets (Curtin, 1983). Sugarcane molasses has several important roles in livestock feeding, due to the nutritive, appetizing and physical properties of its sugar content (Habibu *et al*., 2014). However, molasses when given in large doses can lead to

adverse reactions. In poultry, molasses is commonly used as a binder in dry poultry diets and as an energy source. Similarly, its administration to chickens through drinking water has been reported (Reddy *et al.*, 1998; Ndelekwute *et al.*, 2010). A readily available and fast means of assessing clinical and nutritional health status of the animal on feeding trial may be the use of blood analysis. Although information on the effect of molasses on weight gain, and feed and water consumption is available (Ndelekwute *et al*., 2010), little work has been done on performance, haematology and blood chemistry of broilers fed molasses-based diets. The aim of this study was therefore to investigate the effect of molasses on performance, haematology and blood chemistry of broiler chicks.

Materials and methods

The experiment was conducted at the Teaching and Research Farm of the College of Animal Science, University of Agriculture, Makurdi, Nigeria. One hundred and sixty day-old unsexed broiler chicks of Marshal MY strain were purchased from Ayodera Farm, Ibadan, Nigeria for the research. They were brooded for 21 days and housed in four separate pens. Each treatment was replicated twice; water and feed were provided *ad libitum*. Newcastle disease vaccine was given during the second and fourth weeks, while Infectious Bursal Disease (Gumboro) vaccine was given on the 8th and 21st days. Other medications (antibiotics, anticoccidials, dewormer and vitamins) were also administered. . Tables 1 and 2 show percentage composition of broiler starter and finisher experimental diets offered the birds from weeks 1-5 and 6-9 respectively. Diets 1, 2, 3 and 4 containing 0, 5, 10 and 15% levels of

Table 1: Ingredient and chemical composition of broiler starter diets

Parameters	Diets			
	1	2	3	4
Molasses	-	5.00	10.00	15.00
Fish meal (72% CP)	4.00	4.00	5.00	7.50
Groundnut cake	40.00	35.00	35.50	29.00
Maize	50.00	47.00	43.00	40.00
Bone meal	3.50	3.50	3.50	3.50
Lysine	0.40	0.40	0.40	0.40
Methionine	0.30	0.30	0.30	0.30
Mineral/Vitamin premix	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Oil (soya)	1.20	1.50	3.70	3.70
Maize offal	-	2.70	-	-
Total	100	100	100	100
Calculated values (% DM)				
Crude protein	23.10	23.16	23.18	23.13
Calcium (%)	1.34	1.36	1.40	1.41
Phosphorus (%)	0.75	0.82	0.81	0.84
Lysine (%)	1.30	1.25	1.27	1.31
Methionine (%)	0.65	0.63	0.63	0.65
ME (Kcal/Kg DM)	3005	2824	2858	2948

ME = Metabolizable energy

Table 2: Percentage composition of broiler finisher diets

Ingredients %	Diets			
	T1	T2	T3	T4
Molasses	-	5.0	10.0	15.0
Fish meal (72% CP)	4.0	4.0	4.0	4.0
Groundnut cake	30.0	30.0	30.0	30.0
Maize	50.0	46.0	45.0	45.0
Maize offal	6.2	5.0	2.0	-
Soya oil	3.0	3.5	3.5	5.2
Bone meal	3.5	3.5	3.5	3.5
Lysine	0.4	0.4	0.4	0.4
Methionine	0.3	0.3	0.3	0.3
Premix	0.3	0.3	0.3	0.3
Salt	0.3	0.3	0.3	0.3
Sand	2.0	1.7	0.7	0.35
Total	100.0	100.0	100.0	100.0
Calculated values (% DM)				
Crude Protein	21.51	21.17	20.68	20.85
Calcium	0.38	0.45	0.48	0.51
Phosphorus	0.41	0.40	0.40	0.37
Lysine	0.83	0.82	0.82	0.83
Methionine	0.23	0.23	0.22	0.23
ME (Kcal/kg DM)	2846	2837	2901	2985

molasses respectively, were given to the birds. Proximate composition of the experimental diets was determined according to AOAC (2012). Average daily feed intake was determined by subtracting the quantity of feed remaining from the quantity offered the birds on a daily basis. Daily body weight gain was determined by dividing the total weight gain per bird by the total number of days of the experiment, while the feed conversion ratio was evaluated as a ratio of the feed consumed to weight gain. The mortality rate was determined at the end of the research as the percentage of birds that died during the research period. After the 5th week, 24 blood samples (6 from each group) were collected for haematological analysis, and 16 samples (4 from each group) were collected for blood chemistry analysis. Blood samples were taken from the wing vein of the birds. Samples for haematological indices were analysed for packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell count (RBC) and white blood cell count (WBC), following standard procedures (Schalm *et al*., 1975). Blood samples for blood chemistry indices were analysed for total protein, albumin, ALP, urea, cholesterol, AST and ALT following standard procedures (Schalm *et al*., 1975; Jain, 1986). All collected data on performance, haematology and serum biochemistry were subjected to Analysis of Variance (ANOVA), and significant means at 5% probability level were separated using Duncan multiple range test according to Steel & Torrie (1980).

Results

Results of average daily feed intake, average weight gain, feed conversion ratio and percentage mortality are shown in Table 3. Diets did not significantly ($p>0.05$) affect the above parameters. Results of influence of molasses on haematology and blood chemistry of broilers are presented in Table 4. The PCV values were highest ($P<0.05$) for the birds fed diets 2 and 3, intermediate for diet 1 and lowest for diet 4. The Hb concentrations of broiler chickens fed the diets containing varying levels of molasses varied significantly ($P<0.05$). However, the observed variation in haemoglobin concentration did not follow any defined pattern. There was no significant difference ($p>0.05$) in red blood cell values, although it increased numerically with increased level of molasses in diets of birds. There was no significant difference ($P>0.05$) in WBC values of broiler chickens fed diets containing molasses.

Discussion

The average daily weight gains of birds on diets containing molasses were numerically higher than that of birds on the control diet. This finding agrees with the study of Hildalgo *et al*. (2009) in vinase (a molasses fermentation by-product). Administration of molasses has been reported to decrease feed intake, but increases live weight gain in chickens (Rahim *et al*., 1999; Ndelekwute *et al*., 2010). Futhermore, molasses supplement in feed has been reported to increase the production of short chain fatty acid (SCFA) such as acetic and propionic acids in the caecum of chickens (Gultemirian *et al*., 2014) which contributes to increase in weight gain (Hwangbo *et al*., 2013). Little mortality recorded in all the treatments could be as a result of salmonellosis which was rampant in the farm as at the time of the study. Harland (1995) showed that molasses could be fed at a level of 10% for growing pullets and 20% for laying hens without detrimental effect on the birds.

Haematological and serum biochemical parameters are valuable in monitoring the use of non-conventional feeds, especially their effect on blood and health status of animals.

Mitruika & Rawnsley (1977) reported normal haematological values for chicken as 2.0 - 4.0 x 103 mm for RBC, 3.0 – 6.0 x 103 mm for WBC, 25-45% for PCV and 7.0-13.0g/dl for Hb. The PCV values obtained in this study were within normal limits for chickens except the PCV for chickens on diet containing 15% inclusion level of molasses. The level of PCV varies due to some factors like age, sex, physiological state, sexual maturity, drinking water etc (Oke *et al*., 2007). Highest levels of PCV recorded at the 5 and 10% levels of inclusion could be attributed to improved nutrient availability. This possibly resulted in enhanced erythropoiesis in these groups.

Table 3: The influence of molasses on performance of broilers

Parameters	Diets			
	T1	T2	T3	T4
Daily feed intake (g)	87.79±0.08	84.93±0.36	85.29 ±0.86	88.86±1.86
Daily weight gain (g)	24.23±0.22	28.37±1.49	31.64 ±1.50	27.36±2.79
Feed conversion ratio	3.91±0.40	2.97±0.06	3.28 ±0.22	3.46±0.30
Percent mortality (%)	3.75±0.47	2.50±0.39	2.50 ±0.39	1.90±0.34

Table 4: Influence of molasses on haematology and blood chemistry of broilers

Parameters	Diets			
	1	2	3	4
Packed cell volume (%)	25.5±0.5[b]	27.0±44[a]	27.33±0.95[a]	24.66±0.20[c]
Haemoglobin (g/dl)	8.49±0.16[b]	8.9±0.13[a]	9.11±0.31[a]	8.11±0.10[b]
Red blood cell ($x10^6$/l)	2.26±0.22	2.3±0.25	2.49±0.24	2.39±0.28
White blood cell ($x10^6$/l)	10.34±0.57	10.42±0.30	10.49±0.22	9.27±0.81
Total protein (g/l)	14.70±10.40	47.45±0.95	15.30±3.10	41.90±10.10
Serum albumin (g/dl)	2.40±2.00	4.85±0.5	2.35±0.05	4.00±1.80
ALP (iμ/l)	2.11±13.18	1.99±9.91	2.80±8.91	1.51±2.62
Serum urea (mol/l)	1.60±0.20	1.60±0.10	2.00±0.10	1.90±0.30
Serum cholesterol (mg/dl)	91.00±32.00	125.50±4.50	118.00±29.50	118.00±29.00
ALT (iμ/l)	141.00±41.00	240.00±0.50	122.00±0.50	157.00±47.00
AST (iμ/l)	16.00±0.00	14.00±0.00	16.00±1.50	15.50±1.50

Means with different superscripts along the same row vary significantly ($P<0.05$)
ALP = Alkaline phosphatase; AST = Alkaline serum aminotransferase; ALT = Alkaline serum transaminase;

Although PCV was depressed and lowest in birds on 15% molasses, normal values indicate that 15% molasses may not induce anaemia and affect the birds' health. Normal values of PCV, Hb and RBC neither demonstrated anaemia nor impeded erythropoiesis and high amount of iron, copper and zinc showed more efficient erythropoiesis. It is possible that levels higher than 10% inclusion of this ingredient in broiler rations may be deleterious to their health. Haemoglobin (Hb) is a measure of the oxygen carrying capacity of the blood. Aganga *et al*. (1988) reported that the number of erythrocytes and Hb for Yankasa sheep vary with season; being significantly higher during the wet season. The levels of RBC and Hb obtained in this study were within normal limits for poultry indicating that inclusion of molasses in the diet did not interfere with the oxygen carrying capacity of the red blood cells. High levels of leucocytes could be as a result of interplay among factors such as nutrition, space, place of confinement, salmonellosis infection and type of water given to birds. Fayemi *et al*. (2007) reported increases for all other haematological parameters besides PCV and RBC in control chickens (cockerel) fed molasses. The difference in results may be because the latter study was conducted in cockerels and the molasses was not administered continuously to the cockerels. The iron, copper and zinc components in molasses are important nutrients required for the erythropoiesis. These minerals could have possibly numerically elevated the RBC of the molasses diets. There were no significant differences ($p>0.05$) in total protein, albumin, urea, cholesterol, AST and ALP values across the diets, although they were within the normal range except serum protein, which was higher than normal values (2.5 – 5.5 gm/dl in broiler chickens) reported by Donald (2005). Values of serum AST and ALT under normal circumstances, are low in the blood, but might become high when the plane of nutrition is low or there is hepatocellular damage (Ekpeyong & Biobaku, 1986). The concentrations of serum total protein, albumin and bilirubin reflect hepatic injury and usually provide a good index of the health status of the animal (Okwori *et al*., 2016). The blood transports or conveys nutrients and materials to different parts of the entire system. Therefore, whatever affects the blood, for example drugs, pathogenic organisms or nutrition, will certainly affect the entire body in terms of health, growth, maintenance and reproduction. Serum proteins are important in osmotic regulation, immunity and transport of several substances in the animal body (Jain, 1986). Donald (2005) stressed that the level of normal substances in the blood can provide clues to the animal functions.

It is concluded from this study that molasses can be included up to a level of 10% in broiler ration without deleterious effect on performance, haematological and serum biochemical parameters of broilers. It is therefore, recommended to commercial broiler farmers for its palatability, safety, growth enhancement and efficiency. However, further studies on the economics of molasses inclusion in the diets of broilers is suggested so as to justify its use.

Conflicts of Interest

The authors declare no conflicts of interest.

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