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RESEARCH ARTICLE

Haematological profile of West African Dwarf Goats Fed Diets Containing Graded Levels of Eggshell Meal

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ABSTRACT:

A 12-week trial was conducted to investigate the effect of incorporating Eggshell meal(ESM) at graded levels into West African Dwarf(WAD) bucks diet. Haematological parameters were evaluated. Twenty (20) growing WAD bucks weighing 5.7kg on the average were caged individually inside a conventional open-sided house. The bucks were randomly divided into four (4) groups, each group consisting of five (5) animals. The animals in groups 1, 2, 3 and 4 were provided with diets containing 0.0%, 0.5%, 1.0% and 1.5% ESM respectively with group 1 serving as the control. The animals were given known quantity of supplementary feed, forage (Andropogon gayanus) and water between 8 and 9 am every morning. Initial blood samples were collected and analysed after the acclimatization period of 7days. The same procedure was repeated at the 6th and 12th week marking the end of the experiment. Haematological parameters were compared by weeks, significant difference (P<0.001) was observed on Packed Cell Volume and Haemoglobin. Significant difference (P<0.0001) was also observed on Mean Corpuscular Haemoglobin, Mean Cell Volume and Red Blood Cell as well as Monocytes at P<0.05. The animals suffered gastroenteritis between the 9th and 10th week thus the ESM and supplementary feed were cultured. The ESM culture isolated Escherichia coli thus the animals were treated with Streptomycin. It was therefore concluded that ESM may be a rich source of Calcium for growing WAD goats but must be thoroughly sterilized to yield desired result.

Keywords: ***Eggshell, Escherichia coli, Goat, Haematology***.

INTRODUCTION

Contemporary ruminant feeding in a developing country like Nigeria is partly geared towards searching for inexpensive readily available feed resources which can partially or wholly serve as substitute for the scarce expensive feedstuffs and inadequate forages (Okoruwa and Adewumi, 2010). Neumann and Harris (1999) reported that the supply of food of animal origin is not only made up of high quality and readily digestible protein and energy but is also a compact and efficient source of readily available macro nutrient.

Most nutritional experiments deal with the substitution of one ingredient for the other, not much has been made on the local alternative sources for mineral nutrients like Calcium and Phosphorus (Tumova *et al.*, 2004). Calcium and Phosphorus belong to the group of macro minerals which are the most important

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elements required by animals, if inadequate in the diet of young growing animals, it results in abnormal bone development even if the diet contains adequate vitamin B_3. It is stated (Klasing, 1998) that calcium is the most prevalent mineral in the body and is required in the diet in larger quantities than any other mineral. A deficiency of either Calcium or Phosphorus results in lack of normal skeletal calcification resulting in rickets.

The main sources of Calcium are oyster shells, bone ash, limestone and di-calcium phosphate (Iheukweumere and Emenalon, 2004). Dicalcium phosphate has been found to be a major source of calcium for livestock all over the world but is extremely costly following importation. McDonald *et al*. (1992) noted that calcium and phosphorus represent the third most expensive nutrient after energy and protein. According to Aduku and Olukosi (2000), Nigeria produces about 55.9 million eggs annually; this implies that over 250 metric tonnes of the shells are produced as by- product. This can be utilized as mineral supplement since eggshell is highly rich in calcium (90%) with little percentage (less than 5%) of phosphorus; it is possible that optimum dietary level of calcium can be met using eggshell meal at little or no cost at all.

Calcium functions as a constituent of bones and teeth, regulation of nerve and muscle function. In blood coagulation, calcium activates the conversion of prothrombin to thrombin and also takes part in milk clotting. It plays a vital role in enzyme activation. Calcium activates large number of enzymes such as adenosine triphosphatase (ATP), succinic dehydrogenase, lipase etc. Favus *et al.* (2002) stated that calcium is required for membrane permeability, involved in muscle contraction, normal transmission of nerve impulses and in neuromuscular excitability.

Research have established the fact that the long bones play key role in blood formation through a process called haematopoiesis and blood is an outstanding medium that interprets physiological parameters that relates with nutrition, environment, age, sex etc. This study is therefore designed to investigate the effects of eggshell meal as a calcium source on the blood profile of WAD Goats.

MATERIALS AND METHODS

The experiment was carried out in the Sheep and Goat Unit of the Livestock Teaching and Research farm of Kogi State University, Anyigba. The study site is located on latitude 7° 30'N and 6°43`E with an average altitude of 420m above sea level. The area falls within tropical wet and dry climate region of the guinea savannah with average rainfall of 1600mm.The daily temperature range is about 25°C - 35°C (Ifatimehim *et al*., 2011).

The eggshells were collected from eateries *(maishai),* hotels and restaurants. They were washed without removing the shell membranes and treated with boiling water for about one hour, sun dried and milled to obtain the eggshell meal.

Twenty (20) bucks were randomly allocated to four (4) treatment groups of five (5) replicates. There were thus five (5) animals per group in a Completely Randomized Design experiment. The goats were reared individually in partitioned cages which were washed and fumigated 2

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weeks before the commencement of the experiment.

The experimental animals West African Dwarf (WAD) Goats were fed with concentrate, forages and water during the experiment between the hours of 8am and 9am every day. The supplementary diet was served to the animals according to the treatments while the forage (*Andropogon gayanus*) and water were served about 30 minutes later. The supplement was normally given to them at 200g/goat/day, forage 600g/goat/day and water 1000mls/goat/day.

Blood samples (5mls) were collected through the jugular vein puncture of experimental goats from three replicates per treatment into Ethylene Diamine Tetraacetic Acid (EDTA) bottles for haematological analysis before the commencement of the feeding trial. The same procedure was repeated after six (6) weeks and at the 12th week which marked the end of the experiment.

Data collected were subjected to Analysis of Variance (ANOVA) using the Analyze - it Microsoft Excel software package version 2.21 of 2007. The differences between means were separated using the Least Significant Difference (LSD).

RESULTS AND DISCUSSION

All haematological parameters taken before the feeding trial as shown in Table 2 recorded non-significant difference ($P>0.05$) across treatments. The values of Packed Cell Volume (PCV) observed were similar with values recorded by Okonkwo *et al*. (2010), who compared blood profiles of WAD, Red Sokoto and Sahel goats and also within the percentage range of 22-38 % reported by Tambuwal *et al*. (2002) who studied the blood profile of Red Sokoto goats. The concentrations of Haemoglobin (HB) obtained in Table 2 are comparable with the ranges reported by Tambuwal *et al*. (2002) and Okonkwo *et al*. (2010). The RBC count for the Bucks fell within the border line of the range of 4.0-9.0 g/dl obtained by Daramola *et al*. (2005). The WBC count obtained in this study are higher than 13.5±0.8 g/dl reported by Tambuwal *et al.* (2002). MCHC values are within the range of 30 – 36 g/l (The Merck Veterinary Manual, 1991). Among the five major functional units of leucocytes, the lymphocytes had higher values which may suggest that the immune system of the animals may have been challenged probably because the animals were obtained from rural farmers who had little or no care for the animals at all.

The platelet counts obtained in this study (Tables 2,3,4 and 5) are comparable to the literature values of Daramola *et al*. (2005) as they fell within the normal range of 130-400 g/dl values recorded on the WAD goats they worked on.

Some of the haematological parameters shown in Table 5 where results are compared between weeks showed various levels of significant variability which disagrees with the results obtained by Alu (2013) who replaced bone ash with eggshell meal in broiler diet such that eggshell meal replaced bone ash at 0, 25, 50, 75 and 100% for T_1, T_2, T_3, T_4 and T_5 respectively. His result showed that Packed Cell Volume (PCV), White Blood Cell (WBC), Red Blood Cell (RBC), Mean Corpuscular Volume (MCV), Haemoglobin(HB), Mean Corpuscular Haemoglobin(MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), Neutrophils(N), and

Lymphocytes(L), were not affected (P>0.05) by the re- placement of bone ash with eggshell meal in broiler diets.

Nevertheless, most of the haematological parameters values shown in Table 5 decreased as the number of weeks increased. For instance, the PCV values decreased from the initial week (33.0±1.41%) to 29.9±1.97% at week 6 and further decreased to 21.5±2.09 at week 12. This values are slightly lower than the percentage range of 22-38 % reported by Tambuwal *et al*. (2002) for different breeds of goat. The drastic drop in the HB, MCH, MCV and RBC values particularly at 12th week shows clearly that the animals were anaemic. This could be attributed to the gastro intestinal enteritis suffered by the animals between the 9th and 10th week for which they were treated with long acting antibiotic (Streptomycin) for three (3) days. The treatment was recommended after the feeds, faecal samples and ESM were cultured and pathogenic *Escherichia coli* was isolated on the ESM within 78hrs of culturing.

CONCLUSION AND RECOMMENDATION

The Eggshell meal is a rich source of Calcium which is the most prevalent mineral in the body. Most of the haematological parameters investigated dropped or at least dwindled as the number of weeks increased. The gastroenteritis suffered by the animals necessitated the culture and isolation of pathogenic *E. coli* which led to the treatment with streptomycin. This may be the remote cause of the low haematological values recorded at the end of the experiment. It is therefore recommended that more thorough sterilization procedure like soaking of ESM in boiling brine solution for longer periods before drying be adopted to ensure that the ESM is free of any pathogenic agent that can affect the health of the animals.

CONTRIBUTION OF AUTHORS

OCO and DNI were responsible for the supervision of the study, write up, managed the literature searches and collected the data during the study. APA was responsible for the research design. He also processed and analyzed the data. OCO and APA compiled and wrote the first and final write up for this article. All authors read and approved the final manuscript.

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Table 1: Composition of Supplementary Diet

Ingredients (%)	T_1 ($ESM_{0.00}$)	T_2 ($ESM_{0.5}$)	T_3 ($ESM_{1.0}$)	T_4 ($ESM_{1.5}$)
Brewers Dry Grain	49.25	49.00	49.25	49.00
Bambaranut Waste	29.00	29.00	29.00	29.00
Maize Offal	4.25	4.00	4.25	4.00
Rice Mill waste	2.00	2.00	1.00	1.00
Palm oil	4.50	4.50	4.50	4.50
Maize	9.00	9.00	9.00	9.00
Bone Meal	1.00	1.00	1.00	1.00
Eggshell Meal	**0.00**	**0.50**	**1.00**	**1.50**
Table Salt	1.00	1.00	1.00	1.00
Total	**100**	**100**	**100**	**100**
Calculated values				
Crude Protein (%)	17.17	17.13	17.10	17.02
Crude fibre (%)	16.63	16.45	16.26	16.19
Energy Kcal/kg	2745.44	2738.94	2732.44	2720.34

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Table 2: Haematological Parameters of WAD Bucks Analysed before Feeding Trial.

	TREATMENTS				
Parameter	**T_1 ($ESM_{0.00}$)**	**T_2 ($ESM_{0.5}$)**	**T_3 ($ESM_{1.0}$)**	**T_4 ($ESM_{1.5}$)**	**LS**
PCV (%)	31.9 ± 2.37	28.7±2.91	26.8±1.78	28.4±3.34	NS
HB (g/dl)	11.02 ± 0.66	9.99±0.84	8.99±0.58	9.84±1.01	NS
WBC (g/dl)	24.94 ± 2.15	33.51±5.18	24.83±5.07	28.83±3.36	NS
MCH (g/dl)	17.01 ± 0.91	15.66±1.02	14.06±1.16	14.21±1.39	NS
MCHC (g/dl)	34.86 ± 0.64	35.17±0.95	33.60±0.23	33.35±0.75	NS
MCV (g/dl)	47.19 ± 2.22	41.89±3.62	40.26±2.84	43.10±4.06	NS
RBC (g/dl)	6.911 ± 0.35	7.27±0.67	7.38±0.34	7.43±0.44	NS
N (%)	18.3 ± 2.08	24.9±3.73	27.8±6.77	26.4±3.27	NS
L (%)	81.1 ± 2.30	68.3±9.27	71.3±7.02	72.1±3.37	NS
M (%)	0.1 ± 0.13	0.1±0.14	0.5±0.19	0.5±0.19	NS
E (%)	0.1 ± 0.13	0.4±0.30	0.5±0.27	0.5±0.19	NS
B (%)	0.0 ± 0.00	0.0±0.00	0.0±0.00	0.0±0.00	NS
PLT (g/dl)	301.6 ± 19.60	321.7±19.87	311.1±17.56	335.3±9.44	NS

NS = Not Significant(P>0.05), PCV= Packed cell volume, HB = Haemoglobin, WB = White Blood cells, MCH = Mean Corpuscular Haemoglobin, MCHC =Mean Corpuscular Haemoglobin Concentration, MCV=Mean cell volume, RBC = Red blood cell, N = Neutrophils, L = Leucocytes, M = Monocytes, E = Eosinophils, B = Basophils, PLT = Platelets.

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Table 3: Haematological Parameters of WAD Bucks at Week 6

	TREATMENTS				
Parameter	**T_1 ($ESM_{0.00}$)**	**T_2 ($ESM_{0.5}$)**	**T_3 ($ESM_{1.0}$)**	**T_4 ($ESM_{1.5}$)**	**LS**
PCV (%)	33.3±4.06	28.50±8.50	25.30±1.45	32.00±3.06	NS
HB (g/dl)	11.27±1.18	9.75±2.55	8.47±0.46	10.47±1.53	NS
WBC (g/dl)	24.83±3.92	39.75±7.25	37.20±10.20	29.07±9.44	NS
MCH (g/dl)	17.83±0.56	16.00±3.60	12.73±0.87	15.60±1.06	*
MCHC (g/dl)	33.97±0.72	34.60±1.4	33.40±0.12	32.37±2.02	NS
MCV (g/dl)	52.60±1.80	46.65±12.20	37.80±2.96	48.30±1.37	NS
RBC (g/dl)	6.31±0.62	6.04±0.25	6.73±0.29	6.66±0.76	NS
N (%)	20.70±2.4	27.50±6.50	46.30±10.84	26.70±3.84	*
L (%)	77.70±3.18	72.50±6.50	51.70±10.87	70.30±2.40	NS
M (%)	0.30±0.33	0.00±0.00	1.00±0.00	1.00±0.00	*
E (%)	0.30±0.33	0.00±0.00	0.5±0.27	0.5±0.19	NS
B (%)	0.0±0.00	0.0±0.00	0.00±0.00	0.00±0.00	NS
PLT (g/dl)	288.00±36.17	309.5±10.50	324.70±13.38	322.7±18.10	NS

NS = Not Significant(P>0.05), PCV = Packed cell volume, HB = Haemoglobin, WB = White Blood cells, MCH = Mean Corpuscular Haemoglobin, MCHC=Mean Corpuscular Haemoglobin Concentration, MCV = Mean cell volume, RBC = Red blood cell, N = Neutrophils, L = Leucocytes, M = Monocytes, E = Eosinophils, B = Basophils, PLT = Platelets.

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Table 4: Haematological Parameters of WAD Bucks at Week 12

	TREATMENTS				
Parameter	**T_1 ($ESM_{0.00}$)**	**T_2 ($ESM_{0.5}$)**	**T_3 ($ESM_{1.0}$)**	**T_4 ($ESM_{1.5}$)**	**LS**
PCV (%)	26.50±1.50	23.00±5.00	22.50±2.50	14.00±2.00	*
HB (g/dl)	9.65±0.45	8.25±1.05	7.65±0.65	6.00±0.70	*
WBC (g/dl)	31.60±0.60	35.15±17.35	19.20±5.40	33.25±2.45	NS
MCH (g/dl)	14.00±1.00	13.70±1.30	10.85±0.55	8.35±0.05	*
MCHC (g/dl)	36.50±0.50	36.50±3.50	34.00±1.00	33.50±0.50	NS
MCV (g/dl)	38.40±2.30	32.60±1.60	31.80±2.40	25.05±0.45	*
RBC (g/dl)	6.95±0.81	6.00±0.20	7.06±0.25	7.20±0.92	NS
N (%)	18.50±6.50	26.50±10.50	10.0±0.00	23.00±2.00	NS
L (%)	81.50±6.50	50.00±34.00	90.0±0.00	77.00±2.00	NS
M (%)	0.00±0.00	0.50±0.50	0.00±0.00	0.00±0.00	NS
E (%)	0.00±0.00	1.00±1.00	0.00±0.00	0.5±0.19	NS
B (%)	0.0±0.00	0.0±0.00	0.00±0.00	0.00±0.00	NS
PLT (g/dl)	292.00±4.00	313.50±22.50	306.00±0.00	342.00±13.00	NS

NS =Not Significant($P>0.05$), *= $P<0.05$, PCV= Packed cell volume, HB= Haemoglobin, WB= White Blood cells, MCH = Mean Corpuscular Haemoglobin, MCHC=Mean Corpuscular Haemoglobin Concentration, MCV=Mean cell volume, RBC= Red blood cell, N= Neutrophils, L= Leucocytes, M= Monocytes, E= Eosinophils, B= Basophils, PLT= Platelets

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Table 5: Haematological Parameters of WAD Bucks Compared Between Weeks

Parameter	INITIAL	WEEK 6	WEEK 12	LS
PCV (%)	33.0±1.41	29.9±1.97	21.5±2.09	**
HB (g/dl)	11.29±0.43	10.01±0.67	7.89±0.57	**
WBC (g/dl)	22.73±2.07	32.02±3.98	29.80±4.20	NS
MCH (g/dl)	17.30±0.56	15.50±0.85	11.73±0.93	***
MCHC (g/dl)	34.28±0.38	33.49±0.59	35.13±0.88	NS
MCV (g/dl)	47.71±0.92	46.31±2.57	31.96±1.92	***
RBC (g/dl)	8.26±0.30	6.47±0.26	6.80±0.30	***
N (%)	21.8±2.87	30.5±4.28	19.5±3.32	NS
L (%)	77.8±3.00	67.6±4.29	74.6±8.66	NS
M (%)	0.2±0.11	0.6±0.15	0.1±0.13	*
E (%)	0.3±0.14	0.5±0.21	0.3±0.25	NS
B (%)	0.0±0.00	0.0±0.00	0.0±0.00	NS
PLT (g/dl)	325.3±18.57	311.4±11.15	313.4±9.30	NS

*=P<0.05, ** =P<0.001 *** = P<0.0001, NS =Not Significant(P>0.05), PCV= Packed cell volume, HB= Haemoglobin, WB= White Blood cells, MCH = Mean Corpuscular Haemoglobin, MCHC=Mean Corpuscular Haemoglobin Concentration, MCV=Mean cell volume, RBC= Red blood cell, N= Neutrophils, L= Leucocytes, M= Monocytes, E= Eosinophils, B= Basophils, PLT= Platelets.