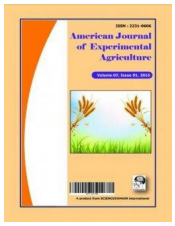

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Haematological and Serum Biochemical Characteristics of West African Dwarf Goats Fed Complete Diets Containing Graded Levels of Sweet Orange Peel Meal

J. Oloche[1*], J. A. Ayoade[1] and O. I. A. Oluremi[2]

[1]Department of Animal Production, University of Agriculture, Makurdi, Nigeria.
[2]Department of Animal Nutrition, University of Agriculture, Makurdi, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author JO designed the study, wrote the protocol and wrote the first draft of the manuscript. Author JAA reviewed the experimental design and all drafts of the manuscript. Authors JO, JAA and OIAO managed the analyses of the study. Author JO identified the plants. Authors JO and OIAO performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Sixteen West African Dwarf (WAD) goats of about 6 - 8 months of age, having an average weight of 6.79 kg were used in a completely randomised design to evaluate the haematology and serum biochemistry of WAD goats fed diets containing graded levels of sweet orange peel meal (SOPM). Four dietary treatments were formulated and compounded to contain 0%, 12.5%, 25%, and 50% of SOPM, and these were designated T_1, T_2, T_3 and T_4 respectively, and the study lasted for 84 days. Results showed that haematological parameters such as; haemoglobin (Hb), red blood cells (RBC), white blood cells (WBC), mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV), and mean corpuscular haemoglobin concentration (MCHC), did not show significant difference ($P>0.05$) among the treatments means. Serum biochemical components such as urea, total protein (TP), albumin, serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic

**Corresponding author: E-mail: juliangi@yahoo.com;*

transaminase (SGPT) and creatinine also did not show any significant variation among the treatments. The study showed that replacement of maize offal with SOPM up to 50% level in the complete diets of WAD goats did not adversely affect their haematology and serum biochemistry.

Keywords: Haematology; serum biochemistry; sweet orange peel meal; WAD goats.

1. INTRODUCTION

Ruminants constitute a very important part in the livestock subsector of the Nigerian agricultural economy. The potential of small ruminant production in alleviating the low animal protein intake by man in developing nations such as in Nigeria needs no emphasis [1]. Notwithstanding, the high cost of formulating livestock feed has been a major constraint militating against the increased production of valuable sources of animal protein [2] in Nigeria. This has necessitated the use of agricultural byproducts, crop residues and agro industrial byproducts. A good number of by products are derived from sweet orange fruits; these include citrus pulp, citrus molasses, citrus peel oil and citrus peels. Sweet orange peels in Nigeria can be easily collected at no cost from sweet orange fruit retailers who peel and sell sweet orange fruits to consumers for direct consumption. [3] reported that sweet orange peels contained 9.30 - 10.96% crude protein, 13.66 - 14.94% crude fibre, 2.33 - 2.90% ether extract, 65.30 - 67.95% nitrogen free extract, and 5.07 - 5.56% ash. The peels are available all through the year and can constitute environmental hazard when poorly disposed, but if properly harnessed it can be a potential feed ingredient for ruminant feeding. [4] reported that nutritional studies should not be limited to performance, carcass quality and protein intake alone, as the effect of feed materials on blood constituents is also very relevant and should be evaluated. Laboratory study and tests on blood profile are important tools that help detect any deviation from normal animal or human body [5]. Blood examination is a good way of assessing the health status of animals as it plays a vital role in the physiological, nutritional and pathological status of animals [6]. Haematology and serum biochemistry facilitates diagnosis of a disease condition, enhances prognosis and assessment of efficacy of therapy and toxicity of drugs and substances [1]. Sweet orange peels contain tannin, saponin, oxalate, flavonoid and limonene, although the amounts present, is in such quantities that may not be deleterious to the health of animals [7]. Processing such as sun-drying and fermentation of the sweet orange peels further reduce even the small quantities of these anti-nutrients that are present [7]. Thus, this study was therefore designed to investigate the effect of diets containing sweet orange peels on the haematology and serum biochemistry of West African Dwarf (WAD) goats.

2. MATERIALS AND METHODS

Sweet orange peels were collected from retailers of sweet orange fruits around Makurdi metropolis in Benue State of Nigeria. Makurdi is located on latitude 7º43'N and longitude 8º3'E [8]. They were sun-dried on concrete floors for 48 hours, when it became crispy; it was packed, milled and stored in synthetic bags for use. The SOPM was used to replace maize offal in the diets of WAD goats at 0%, 12.5%, 25% and 50% constituting four dietary treatment groups (T_1, T_2, T_3 and T_4 respectively). Sixteen grower WAD goats, aged between 5-8 months and having an average weight of 6.79 kg were used. The animals were obtained from medium scale goat producers within Makurdi metropolis and its environs, and were vaccinated against pestes des petits ruminants (PPR), using PPR vaccine at source and dewormed using ivermectin. Two weeks to the arrival of the animals to the experimental site, the pens were thoroughly washed using a strong disinfectant (moriguard) and allowed to dry. On arrival, the animals were weighed and randomly distributed into four treatment groups of four animals each, in a completely randomised design. Each animal was kept in a separate pen which was bedded with wood shavings to serve as both litter materials and beddings. Animals were fed between 08:00 hr and 09:00 hr daily and also served with clean water *ad libitum* and the study lasted for 84 days. On the last day of the experiment, blood was collected from each animal via the jugular vein before morning feeding to analyse for haematological and serum biochemical components. Blood samples for haematology was collected into sterile sample tubes containing ethylene diamine tetra acetic acid (EDTA), while sample tubes for serum biochemistry were without EDTA in order to allow the blood to clot for the serum to be decanted for analysis. PCV, Hb, RBC and WBC were determined as reported by [9]. MCV, MCH, and MCHC were calculated from the PCV, Hb, and RBC as established by [10]. Serum total protein was obtained by the biuret method as described

by [11], while the albumin was by the bromocresol green method [12]. The SGPT and SGOT were determined calorimetrically. Determination of serum urea and creatinine were by the modified method of [13] while cholesterol was determined by the method of [14].

3. RESULTS AND DISCUSSION

Table 1 presents the dietary composition of experimental diets fed to the WAD goats. The effect of SOPM on the haematological indices is presented in Table 2. There were no significant differences (P>0.05) among the treatments in PCV, Hb and RBC, this implies that the animals were not anaemic [1]. The PCV values of 25.50 - 27.75% were similar to 25.50 - 28.00% reported by [6] when he evaluated the effect of dietary monensin inclusion on selected haematological parameters of WAD goats. The Hb values of 8.50 - 9.25 g/dl were similar to 8.10 - 9.40 g/dl and 8.65 - 9.30 g/dl as reported by [1,6] respectively. Since the Hb values were similar to the control, it means that all the treatments were capable of supporting high oxygen carrying capacity in the experimental animals. The WBC values for treatments containing the test ingredient were similar to the control indicating that the animals were not militating against any disease condition. MCV, MCH, and MCHC were also not significantly different (P<0.05) among the treatments, implying that the experimental animals were not suffering from any type of anaemia. Result of the effect of SOPM on serum biochemistry is presented in Table 3. Urea, total protein, albumin, globulin, SGOT, SGPT, cholesterol and creatinine did not show any significant variation among the treatments. Similarity of the values of urea in treatments having the test ingredient with the control implies that, replacing maize offal with SOPM did not cause any undue elevation in the urea level of the animals as a result of amino acid imbalance. Blood urea level is also commonly considered in ruminants to reflect the protein quality of the diet, thus, it also implies that the protein quality of all the diets were adequate. Albumin which is a very strong predicator of health was observed to be normal in this study. The albumin range of 28.47 - 33.00 g/l was similar to 29.30 - 32.70 g/l reported as by [15] when he evaluated the haematological and biochemical components of WAD goats fed *Tephrosia bracteolate*-based forage. SGOT and SGPT values were 189.20 - 198.33 iμ/l and 37.45 - 48.60 mg/dl respectively. SGOT and SGPT are liver enzymes, and similarity among all the treatments implies that, treatments containing SOPM were safe and did not alter the levels of these enzymes as to tamper with their normal functioning to cause deleterious effects on the liver. Cholesterol levels were normal, meaning that the meat from the experimental animals was safe, and would not lead to cholesterol elevation in consumers. Creatinine values were between 6.93 - 7.81 mg/dl and this was normal, suggesting that, increasing the levels of SOPM from 0 - 50% in the diets of the experimental goats did not have deleterious effects on the lean tissue mass of the animals as to cause emaciation.

Table 1. Dietary composition and calculated nutrients of experimental diets fed to WAD goats (%)

Feed ingredients	Experimental diets			
	T_1	T_2	T_3	T_4
Rice offal	20.00	20.00	20.00	20.00
Maize offal	48.81	42.71	36.61	24.40
SOPM	0	6.10	12.20	24.41
Full-fat soybean meal	28.19	28.19	28.19	28.19
Bone ash	2.00	2.00	2.00	2.00
Salt	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00
Calculated values				
Crude protein	17.00	16.92	16.96	16.92
Crude fibre	15.27	15.30	15.33	15.42
Ether extract	7.95	8.50	9.05	10.15
Nitrogen free extract	59.78	59.22	58.20	57.50
ME (kcal/kg)	3395.14	3419.09	3427.04	3489.81

SOPM = Sweet orange peel meal, ME = Metabolisable energy, T_1 = 0%SOPM, T_2 = 12.5%SOPM T_3 = 25%SOPM, T_4 = 50%SOPM

Table 2. Effect of sweet orange peel meal on haematological indices of the experimental goats

Parameters	Experimental diets				SEM
	T_1	T_2	T_3	T_4	
PCV (%)	23.50	27.75	26.75	26.25	1.69
Hb (g/dl)	8.50	9.25	8.75	8.65	0.55
RBC ($x10^6$/µl)	12.01	13.79	12.38	12.24	1.99
WBC ($x10^3$/µl)	6.80	7.40	5.30	7.20	1.13
MCV (fl)	21.71	20.75	22.52	21.08	2.48
MCH (pg)	7.24	6.91	7.22	7.36	0.79
MCHC (g/dl)	33.20	33.33	32.81	33.14	0.25

SOPM = Sweet orange peel meal, SEM= Standard error of mean, Hb = haemoglobi; RBC = red blood cells, WBC = white blood cells, PCV = packed cell volume; MCV= mean corpuscular volume, MCH = mean corpuscular haemoglobin; MCHC = mean corpuscular haemoglobin concentration; T_1 = 0%SOPM, T_2 = 12.5%SOPM T_3 = 25%SOPM, T_4 = 50%SOPM; fl = fentolitre, pg = picogram

Table 3. Effect of sweet orange peel meal on the serum biochemistry of the experimental goats

Parameters	Experimental diets				SEM
	T_1	T_2	T_3	T_4	
Urea mmol/l	16.28	13.53	14.86	15.83	2.17
Total protein g/l	80.06	79.51	82.41	75.78	3.87
Albumin g/l	30.53	28.47	32.13	33.33	2.85
Globulin g/l	48.75	50.47	50.29	42.45	3.04
SGOT iµ/l	198.33	180.20	195.73	193.10	24.11
SGPT mg/dl	48.60	41.33	44.83	37.45	8.06
Cholesterol mg/dl	61.50	76.25	84.25	92.00	10.62
Creatinine µmol/l	7.23	6.93	7.81	7.11	5.45

SGOT = Serum glutamic oxaloacetic transaminase, SGPT = Serum glutamic pyruvic transaminase, SEM = Standard error of mean, ^{ns} = Not significant; T1 = 0%SOPM, T2 = 12.5%SOPM, T3 = 25%SOPM, T4 = 50%SOPM

4. CONCLUSION

The results from this study showed that replacing maize offal with SOPM up to 50% level did not cause any negative effect on the haematological and serum biochemistry of the WAD goats as to jeopardize their health. Therefore, farmers can incorporate SOPM in the diets of WAD goats up to 50% level, particularly during the dry period for economic goat production without any adverse effect.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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