integrity Research Journals

Journal of Animal Science and Veterinary Medicine
Volume 8(6), pages 275-280, December 2023
Article Number: DC1C31FA5
ISSN: 2536-7099
https://doi.org/10.31248/JASVM2023.418
https://integrityresjournals.org/journal/JASVM

Full Length Research

Haematological and serum biochemical indices of growing female pigs fed dietary *Spondias mombin* leaf meal

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Received 13th November 2023; Accepted 13th December 2023

ABSTRACT: Blood serves as physiological indicator of assessing quality of feed offered to an animal, their health status and body functionality. An experiment was carried out to evaluate the haematological and serum biochemical profiles of growing female pigs fed diets with varying levels of *Spondias mombin* leaf meal (SMLM). Sixteen growing female pigs weighing 10.5 to 14.0 kg were randomly allotted to four treatments supplemented maize feed ingredient with 0.0, 2.5, 5.0 and 7.5% in two phases of feeding with *Spondias mombin* leaf meal w/w in a Completely Randomized Design with four animals per treatment and replicated twice. Haematological and serum biochemical parameters were assessed. The results show that Packed Cell Volume (PCV), Red Blood Cell (RBC), Platelets and White Blood Cell (WBC) differentials were similar ($p>0.05$) in mean values, except for Hb which in T_4 was significantly ($p<0.05$) different from other treatments in Hb ($p<0.05$). There were similarities in mean values of serum biochemical indices across treatments, except albumin and Alkaline Phosphatase (ALP) values in T_3 indicating SMLM inclusion improves serum protein synthesis giving rise to more tissue formation. From this study, supplementation of SMLM up to 5.0% maize in growing female pigs' diet have no deleterious effect on physiological health status and has potential to improve tissue development of animals.

Keywords: Blood profile, feedstuff, leaf meal, physiological status, supplementation.

INTRODUCTION

Consumption of high-quality animal protein plays an important role in improving human and animal nutrition, growth, physiological development, and health (Wu, 2022). The Utilization of feedstuff from unconventional sources to feed livestock has effectively moderated the cost of monogastric animal production. Some of these feedstuffs are either leaves of some legumes, browse plants or agro by-products (Ekenyem and Madubuike, 2007). Pig farmers feed their animals with various feedstuffs to reduce the cost of production. Feed quality is particularly a major factor that ensures the success or otherwise of pig production (Okunnade *et al.,*2010). However, blood serves as an indicator of the quality of feed offered to animals, their health status and body functionality (Egbe-Nwiyi *et al.,* 2000). Haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Esonu *et al*., 2001). Madubuike and Ekenyem (2006) stated that haematology and serum biochemical assay of farm animals suggests the physiological disposition of the animals to their nutrition. Heamatological and serum biochemical indices are parameters that are related to the blood and blood forming organs and general systemic functionality in the body. Blood analysis is a readily available and fast means of assessing the nutritional status of animals on feeding trials, because dietary components have measurable effects on blood composition and may be considered as appropriate measure of long-term nutritional status (Etim *et al*., 2014a; Lim *et al*., 2021). Changes in these indices

Table 1. Gross composition of diets fed to growing pigs supplemented with *Spondias mombin* leaf meal (SMLM).

Feed ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4
Maize	45.00	42.50	40.00	37.50
SMLM*	-	2.50	5.00	7.50
Soybean meal	20.00	20.00	20.00	20.00
Corn bran	3.00	3.00	3.00	3.00
Palm kernel cake	25.00	25.00	25.00	25.00
Fish meal	2.00	2.00	2.00	2.00
Dicalcium phosphate	2.50	2.50	2.50	2.50
Oyster shell	1.50	1.50	1.50	1.50
Broiler starter premix	0.25	0.25	0.25	0.25
Lysine	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20
Calculated nutrient levels				
Crude protein (CP)%	17.00	17.46	18.00	18.51
Metabolizable energy (ME) Kcal	2603.84	2591.7	2580.4	2569.1
Crude fibre (CF)%	6.00	7.00	7.40	7.70
Calorie: protein	153:1	148:1	143:1	138:1

SMLM*: ME 2698.62, EE 9.07, CF 16.79, CP 26.34, ASH 7.05, MOISTURE 12.5, and NFE 28.25.

are often used to determine the various statuses of the body and to determine stresses due to environmental, nutritional and pathological factors (Isaac *et al.,* 2013). Different animal species and breeds have their different ranges of haematological and serum biochemical characteristics (Okah and Ehuriah, 2015). However, haematological and serum biochemistry characteristics of animals are generally influenced among other factors by the quality of the feeds consumed by such animals. The effects of any feed ingredient on the haematological indices of swine are of immense assistance in deciding whether or not such a feed ingredient should be used as pig feed stuff. This study was carried out to evaluate the haematological and serum biochemistry of weaned female pigs fed dietary *Spondias mombin* leaf meal. *Spondias mombin* Linn (Iyeye) belongs to the family *Anacardiacae*. It grows in the rain forest and in the coastal area. It can reach a height of 15 - 22m. The trunk has deep incisions in the bark, which often produces a brown resinous substance. The leaves and the flowers are at the end of the branches. Before the tree starts to flower, it strips itself from most of the leaves. The fruit, and 1½-inch long oval yellow plum, has a leathery skin and a thin layer of fruit pulp with a very exotic taste. It hangs in numerous clusters of more than a dozen on the tree. Very rich in vitamins B_1 and C, the fruit mostly exists as an oval seed (Ayoka *et al*., 2008). The fruits are widely valued as feed for cattle and pigs (Ayoka *et al.*, 2008). The mode of propagation of the plant is by seeds and cuttings. *Spondias mombin* leaves have been considered very important because of their therapeutic value and several beneficial effects to human and animals especially broilers and are used as phytogenic feed additives (Alagbe *et al.,* 2018). The objective of this study is to evaluate the effects of *Spondias mombin* supplemented diet on heamatological and serum biochemical parameters of weaned female pigs.

MATERIALS AND METHODS

Experimental location

The study was carried out at the piggery unit of the Teaching and Research Farm of the University of Ibadan, Nigeria (7° 20'N and 3° 50'E, 200 m). A total of sixteen (16) female growing pigs with an average weight range of 10.5 to 14.3 kg were allotted to four treatments in a completely randomized design with two replicates per treatment and the experiment lasted for four weeks. The experimental pens were thoroughly cleaned, washed and disinfected prior to the arrival of the animals. The breed of the animals used is landrace. They were sourced from piggery unit of the Teaching and Research Farm of the University of Ibadan. The animals were randomly assigned into their four (4) experimental units with diets containing 0.0%, 2.5%, 5.0% and 7.5% *S. mombin* replacement of maize in each treatment. Nutrient composition of *S. mombin* was determined (AOAC, 2010) and nutrient level of diets as shown in Table 1. Clean drinking water sourced from farm borehole was provided *ad libitum* for experimental animals throughout the period of experiment.

Table 2. Heamatology of growing female pig fed different inclusion level of *Spondia mombin* leaf meal (phase one).

Parameters	Treatments				SEM
	1	2	3	4	
PCV (%)	26.66	28.33	24.66	35.00	1.56
Heamoglobin (g/dl)	8.88^{ab}	9.44^{ab}	8.22^{a}	12.13^{b}	0.54
Red Blood Cell (x10^{6}ul)	5.44	5.71	6.29	5.66	0.14
White Blood Cells (x10^{3}ul)	5.97	6.91	6.82	6.47	0.33
PLATELET (x10^{6})	1.66	1.89	1.28	1.43	0.10
Lymphocytes (%)	54.00	62.66	44.33	56.33	2.78
Neutrophils (%)	39.66	33.33	51.66	39.33	3.48
Monocytes (%)	3.33^{b}	1.66^{ab}	2.00^{ab}	1.33^{a}	0.28
Eosinophils (%)	3.00	2.33	2.00	4.66	0.44

^{abc}: Means with different superscripts along rows are significantly different ($p<0.05$) SEM: Standard errors of means.

Experimental design

The experimental design used was completely randomized design. The pigs were separated into four dietary treatments with two replicates each and two pigs per replicate.

Treatment 1: 0.0% Spondias mombin leaf meal.
Treatment 2: 2.5% Spondias mombin leaf meal.
Treatment 3: 5.0% Spondias mombin leaf meal.
Treatment 4: 7.5% Spondias mombin leaf meal.

Blood collection and analysis

Blood was collected in two phases during the experiment from 3 animals in each treatment which was done early in the morning. Blood samples were collected from the anterior vena cava, jugular vein of the pigs and transferred into two sets of sample bottles: one set containing Ethylene Diamine Tetra-acetic Acid (EDTA), an anticoagulant to prevent the blood from clotting for heamatology and the other set was without an anticoagulant for serum biochemical analysis.

The heamatology parameters measured include Red Blood Cells (RBC), White blood Cell (WBC), Platelets, Haemoglobin, Packed Cell Volume (PCV), Monocytes, Lymphocytes, Neutrophils, Eosinophils, and Haemoglobin (Hb) and were analyzed according to Baker *et al*. (1998). Also, serum biochemical parameters assessed include blood glucose, cholesterol, triglyceride, Alanine transferase, Alanine phosphatase, total protein, albumin and globulin were determined using the method described by Toro and Ackerman (1975).

Statistical analyses

All data obtained were analyzed using one way analysis of variance (ANOVA) procedure of IBM SPSS version 25 (2017) program. Means were compared using Tukey HSD procedure of the same software.

RESULTS AND DISCUSSION

The results for the growing female pigs animals' heamatological and serum biochemical parameters response to *Spondias mombin* supplemented diets is shown in Tables 2, 3, 4, and 5. From Table 3, PCV, RBC, Platelets and WBC differentials were similar ($p>0.05$) in mean values, except for T_4 which differs significantly in Hb value from other treatments ($p<0.05$). In the second phase of heamatological assessment, mean values of PCV, Hb, RBC, lymphocytes, neutrophils, and monocytes were similar. Values of eosinophils in T_4 differ ($p<0.05$) from other treatments which seemingly reflects the difference observed in WBC differential values. Table 5 shows serum biochemical indices across treatments, indicating that there is a similarity in mean values of glucose, cholesterol, triglyceride, serum total protein, albumin, globulin and concentration of alanine phosphatase in the blood sample. Values of alanine transferase from T_1 to T_3 are similar but significantly differ ($p<0.05$) from T_4. Table 5 shows blood biochemical indices for the second phase of feeding with *Spondias mombin* supplemented diets. Alanine phosphatase values for T_1 and T_2 differ significantly from those of T_3 and T_4. Serum albumen for T_3 has the highest value which differs significantly ($p<0.05$) from other treatments.

Packed cell volume

From Tables 3 and 4, there was no significant difference between the mean values of PCV in all the diets and they were all within the normal range (32 - 50) as reported in Research Animal Resource (2009). Slight depression in range was observed in phase 1 of feeding among animals

Table 3. Heamatology of growing female pig fed different inclusion level of *Spondia mombin* leaf meal (phase two).

Parameters	Treatments				SEM
	1	2	3	4	
PCV (%)	33.33	36.00	33.00	31.33	1.50
Heamoglobin (g/dl)	11.13	11.97	11.10	10.50	0.50
Red Blood Cell (x10^6ul)	5.59	5.98	6.23	6.09	0.11
White Blood Cells (x10^3ul)	6.01^a	5.83^a	7.29^b	6.54^{ab}	0.28
PLATELET (x10^6)	1.82^a	6.90^b	1.41^a	1.52^b	0.13
Lymphocytes (%)	60.33	64.67	48.67	59.33	2.45
Neutrophils (%)	35.33	29.33	45.33	32.67	2.51
Monocytes (%)	4.00	3.33	3.33	4.00	0.26
Eosinophils (%)	2.33^a	2.66^a	2.67^a	4.00^b	0.38

^{abc}: Means with different superscripts along rows are significantly different ($p<0.05$) SEM: Standard errors of means.

Table 4. Serum biochemistry of growing female pig fed different inclusion level of *Spondia mombin* leaf meal (phase one).

Parameters	Treatments				SEM
	1	2	3	4	
Glucose(mg/dL)	58.97	53.97	55.00	64.73	4.08
Alanine Phosphate enzyme I.U/L	36.70	37.23	38.25	42.29	0.42
Alanine Transferase Enzyme I.U/L	4.88^{ba}	7.52^{ab}	8.80^{ab}	12.67^b	1.00
Cholesterol amount(mg/L)	44.16	125.28	143.88	160.2	75.35
Triglyceride amount(mg/L)	93.26	70.21	90.21	92.46	6.49
Serum albumen(g/L)	3.53	3.49	3.70	3.74	0.08
Total protein (g/L)	6.21	5.95	6.4	5.96	0.57
Serum globulin	2.67	2.45	2.75	2.70	0.18

^{abc}: Means with different superscripts along rows are significantly different ($p<0.05$) SEM: Standard errors of means.

Table 5. Serum biochemistry of growing female pig fed different inclusion level of *Spondia mombin* leaf meal (phase two).

Parameters	Treatments				SEM
	1	2	3	4	
Glucose(mg/dL)	62.23	64.69	60.85	62.62	5.78
Alanine Phosphate enzyme I.U/L	28.9^a	28.93^a	35.68^b	36.30^b	0.28
Alanine Transferase Enzyme I.U/L	4.10	3.30	3.04	2.61	0.46
Cholesterol amount(mg/L)	133.08	110.29	90.58	127.94	8.06
Triglyceride amount(mg/L)	57.52	66.13	37.63	63.44	6.09
Serum albumen(g/L)	2.78^a	2.66^a	4.32^b	2.82^a	0.35
Total protein (g/L)	7.06	6.98	7.34	6.13	0.22
Serum globulin	4.28^b	4.31^b	3.04^a	3.30^a	0.33

^{abc}: Means with different superscripts along rows are significantly different ($p<0.05$) SEM: Standard errors of means.

in treatments 1 to 3 indicating pre-anemic condition. Esonu *et al.* (2001) reported that reduction in the concentration of Packed Cell Volume in the blood usually suggests the presence of a toxic factor or a physiological adjustment with adversarial effect on blood formation. Normalcy in cell volume was restored during phase 2 of the assessment, highest in T_2, which may be attributed to potential of SMLM aiding blood corpuscles production.

Heamoglobin

Mean values of Hb, revealed statistical difference in the values obtained in the present study lower than values reported in Research Animal Resource (2009) in the first

phase of feeding and was restored to range during second phase of assessment. This suggests that there was adequate proteins and iron for haemoglobin synthesis and subsequent oxygen transport to the tissues. Iron is an important component of haemoglobin.

White blood cells

Tables 3 and 4 showed normal production systemic defense cells, though lower than range in phase 1, animals in T_3 phase 2 show ranges reported in literature for pigs. White cells as well as monocytes in phase 1 and eosinophils in phase 2 shows treatment effects ($p<0.05$). The primary function of eosinophils is detoxification of foreign proteins or toxins produced by bacteria and parasites (Banerjee, 2013), this may be attributed to animals adjusting to SMLM, a foreign feedstuff, inclusion in diets. However, values were maintained in reported physiological range.

Blood biochemical indices cooperatively help in assessment of normal physiological functionality of the body system. Cholesterol is the precursors for steroid hormones, bile acids and vitamin D, which is an essential component of cell membranes. Although not significantly different, phase 2 cholesterol values nose-dived in T_2 and T_3. Okonkwo and Esiegw (2018) reported that *Spondias mombin* leaf meal may have a hypocholesterolemia effect on the blood of the broilers.

Plasma proteins serve as a source of nutrition for tissues. A dynamic equilibrium exists between proteins of plasma and those of tissue (Sokunbi, 2010). All values of total protein, albumin and globulin falls within the normal range. However, second phase of assessment shows that albumin value in T_3 differ from other treatments, indicating 5% SMLM inclusion favour serum protein synthesis given rise to more tissue formation and had no deleterious effects on the blood profile of the weaned female pigs (Alaba *et al*., 2021).

Alanine transferase enzyme (ALT)

The principal role of ALT enzymes is to breakdown excess protein into energy found in the liver and are markers of liver health in animals. Means of ALT in both phases of feeding in this study, though highest in T_4, are normal but lower than values documented in literature 22-47 I.U/L (RAR, 2009). Low ALT levels are expected and normal, though uncommon, reference ranges are based on probability. For most reference values, 95% of population is expected to fall into normal range. While 5%, though health and normal may be lower than required. However, lower ALT may have underlaying risk factors. Diehl *et al.* (1984) reported that there exists a relationship between pyridoxine (vitamin B6) and ALT. ALT requires vitamin B6 to function and this might be deficient in the diet.

Conclusion

The haematological and serum biochemistry of grower female pigs fed varying dietary levels of *Spondias mombin* leaf meal did not show any adverse or deleterious effects on the physiological and health status of the animals.

Recommendation

Based on the findings, the use of SMLM for feeding of grower pigs can be recommend. Therefore, there is need for further research higher inclusion level of SMLM higher than of this research.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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