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Seral, Haemotological and Economies of Production of Weaner Pigs Fed Graded Levels of Biodegraded Cassava (Manihot esculenta) Peels

K.A. Arowora[1], A.A. Onilude[2] and O.O. Tewe[3]

[1]*Nigerian stored products research institute P.M.B. 5044, Ibadan.*
[2]*Department of Botary and Microbiology, University of Ibadan.*
[3]*Department of Animal Science, University of Ibadan.*

Target Audience: The farmers, agriculturists, nutritional biochemists and feedmillers.

Abstract

20 weaners pigs weighing 9.2±0.43 were assigned in a completey randomized design to 5 treatments, using graded levels of biodegraded cassava peels to replace cassava flour. Each treatment had 4 replicates of one weaner pig per replicate. Seral and haematological parameters were determined at the end of the 4th and 8th weeks of feeding. At the end of the 8th week, several biochemical parameters carried out revealed no significant differences among treatments in the levels of serum alkaline phosphatase (SALP), aspartate amino transferase (AST) and alanine amino transferase (ALT), urea, albumin, and glucose, while haematological indices estimated were found to be significantly varied with the excepton of mean corpuscular haemoglobin concentration (MCHC) and white blood cells (WBC), Economic analysis of the inclusion of biodegraded cassava peels in the diets of weaner pigs was determined.

Key words: Serum haematology, production cost, weaner pigs, biodegraded cassava peels.

Description of Problems

(1,2,3,4) have demonstrated that the ingestion of numerous dietary components has measurable effects on blood constituents. Blood contains a lot of metabolites and other constituents, which provide a valuable medium for clinical investigation and nutritional status of the individaul. Protein-energy malnutrition depresses serum protein like albumin, transferin and prealbumin etc. It may also be affected by nutritionally unrelated factors such as infection state. (7) reported that changes in the calorie: protein ratio of the diet had marked effects on the body and blood composition of broiler chicks. (8) reported that albumin synthesis is not related to the amount of calorie but to increases in protein intake. It has been reported that extreme protein depletion was necessary for a slight elevation in serum cholesterol (9). (10) discovered that the serum cholesterol was more sensitive to relatively small change in dietary protein in your pigs at the 1st nine-month period following weaning than it was in older pigs. It has been demostrated that allowing pigs to have different access to the same feed did not significantly influence the serum cholesterol level (11), but lower values could be observed in growing pigs by increasing the protein content of the ration from 13 to 19 percent (2). Therefore, this study was carried out to evaluate the dietary effects of biodegraded cassava peels on blood constituents and its utilization in pig production.

Materials and Methods

Analysis of Experimental Diets

Experimental diets were analysed for proximate composition by the methods of (13), while non-starch polysaccharide fraction of the experimental diets was determined by the method of (14). The gross energy of experimental diets was determined using Gallenkamp oxygen ballistic bomb calorimeter using benzoic acid as the standard.

Pig Feeding Trial

Twenty weaner pigs weighing 9.2±0.43 kg were assigned randomly in a completely randomized design to 5 dietary treatment groups consisting of four replicates of one weaner pig per replicate. The pigs were injected with ivomec prior to the commencement of the 56-day feeding trial against endo and ectoparasites (1ml/50kg live weight). Five diets with formulations as presented in Table 1 was prepared with diet 1 (control), being cassava-based, while diets 2-5 consisted graded levels of biograded cassava peels.

Table 1: Gross Composition of Experimental Diets (kg)

Ingredients	Diet1	Diet2	Diet3	Diet4	Diet5
Cassava flour	40.00	30.00	20.00	10.00	-
Degraded Cassava peel	-	10.00	20.00	30.00	40.00
Palm Kernel cake	20.00	20.00	20.00	20.00	20.00
Brewer's dried grain	27.00	24.85	23.84	23.20	22.74
Soya bean meal	4.00	6.15	7.16	7.80	8.26
Blood meal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Oyster shell 1.00	1.00	1.00	1.00	1.00	1.00
Premix	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100
Calculated crude protein(%)	20.00	20.00	20.00	20.00	20.00
Metabolisable energy (kcal/g)	2.528	2.406	2.347	2.251	2.118

Composition of Vitamin-mineral premix: Vitamin A(10,000,000i.u.), Vitamin D3(2,000,000i.u.), Vitamin E(8,000 i.u.), Vitamin K (2,000 mg), Vitamin B1 (2,000 mg), Vitamin B2 (5,500 mg), Vitamin B6 (1,200 mg), Vitamin B12 (12 mg), Biotin (30 mg), Folic acid (600 mg), Niacin (10,000 mg), Pantothenic acid (7,000 mg), Choline chloride (500,000 mg) Vitamin C(10,00 mg), Iron (60,000 mg), Manganese (80,000 mg) Copper (8,000 mg), Zinc (50,000 mg), Iodine (2,000 mg), Cobalt (450 mg), Magnesium (100,000 mg), Anti-oxidant (6,000 mg).

Blood Analysis

Two male and female pigs per treatment were bled at the end of 4 and 8 weeks of the study. The bleeding was carried out in the morning before feeding and 10ml of blood was obtained from the external jugular vein into a sample bottle using a sterilized needle and syringe. The samples were allowed to clot before centrifugation to obtain the serum. The separated sera were decanted into bijoh bottles and stored at -10°C until analysed. 5ml of blood for haemaological studies were collected into sample bottle containing EDTA as anticoagulant. The serum metabolites, total protein, albumin, globulin, creatinine, urea, cholesterol and glucose were determined as described by (15). The triglyceride determination was carried out by the method of (16), a modification of (17). The serum alkaline phosphatase (SALP) was determined by the method of (18), while apartate amino transerase (AST) and alanine amino transerase (ALT) were

carried out as described by (19). Haematological parameters were determined as follows: Packed cell volume (PCV), red blood cell counts(RBC), white blood cells (WBC) and haemoglobin were determined using Wintrobes microhaemaatocrit and improved Neubauer haemocytometer and Cynomethaemoglobin methods respectively, erythrocytic indices, namely, mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH) were derived as outlined by (20)

Statistical analysis

All data collected were subjected to analysis of variance using (21). Where significant differences were observed; treatment means were compared using the least significant differences (22).

Results and Discussion

Table 2: Proximate Composition and Gross Energy Values of the Experimental Diets

Proximate Composition	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Crude protein	20.01	20.41	20.41	20.80	20.64
Crude fibre	10.00	10.46	11.21	11.90	12.36
Ether extract	8.40	9.62	4.73	6.91	7.75
Ash	13.18	11.70	12.06	12.55	13.80
NFE	48.41	47.81	51.59	47.84	45.45
Gross energy (Kcal/g)	3.96	3.90	4.04	3.97	3.90

The experimental diets were isonitrogenous containing graded levels of bodegraded cassava peels. Diet 1 (control) contained no biodegraded cassava peel. The crude protein values were slightly higher than the calculated value (20.00%).

Table 3: Detergent Fibre Compostion of Diets and Gross Energy Values of Faecal Samples

Proximate Composition	Diet 1	Diet 2	Diet3	Diet4	Diet5
NDF	34.75	36.38	34.75	36.48	44.08
ADF	14.54	18.89	19.72	25.16	24.33
ADL	8.79	12.19	11.04	10.70	12.95
Hemicellulose	19.86	17.49	15.93	11.32	19.75
Cellulose	5.75	6.70	8.68	14.46	11.38
Gross Energy(Kcal/g)	1.680	1.691	1.764	1.735	1.638

Table 3 shows the dietary fibre composition of the experimental diets. The NDF value being an index of the constituents of cellulose, hemicellulose and lignin. No definite patterns were observed among treatments in the detergent fibre components estimated.

Table 4: Serum Metabolities and Haematological Indices of Weaner Pigs Fed Graded Levels of Biodegraded Cassava Peel Diets at the End of 4th Week

Parameters	DIETS					
	1	2	3	4	5	SEM
Urea(mg/dl)	26.50	25.25	38.25	30.00	26.00	4.39
Creatinine (mg/dl)	1.10^{ab}	1.03^{a}	1.40^{a}	1.33^{ab}	1.23^{ab}	0.10
Serum alkaline Phosphatase(SALP)(i.u/1)	151.00	177.25	145.50	173.00	149.00	15.65
Aspartate amino transferase(AST)(I.U/1)	31.75	33.75	30.50	30.75	30.25	4.60
Alanine amino transferase(ALT) (i.u/1)	18.50	21.25	21.50	16.50	19.25	3.54
Total Protin(g/dl)	5.95	6.00	6.08	6.13	6.18	0.10
Albumin(g/dl)	2.85	2.88	2.93	2.90	2.98	0.05
Globulin(g/dl)	31.0	3.13	3.15	3.23	3.20	0.05
Cholesterol mg/dl)	98.50^{b}	101.00^{a}	113.00^{ab}	132.50	120.75	7.87
Triglyceride(mg/dl)	74.25^{b}	84.75	93.75	104.00	96.75	6.54
Glucose(mg/dl)	57.50	54.25	46.50	49.75^{a}	48.00	4.20
PCV(%)	29.75^{ab}	33.00^{a}	31.00^{ab}	25.24^{a}	30.25^{ab}	2.18
HB(g/dl)	9.90	10.98^{a}	10.30^{ab}	8.38^{a}	10.05	0.72
RBC(x10^{6}/ul)	5.08	5.63^{a}	4.75^{ab}	3.70b	4.58^{ab}	0.43
MCV(fl)	61.37^{ab}	57.67^{b}	64.45^{ab}	67.56^{a}	60.47^{a}	2.67
MCHC(%)(g/100ml)	33.28	33.26	33.23	33.17	33.26	0.05
MCH(pg)	20.43^{ab}	19.19^{b}	21.41^{ab}	22.41^{a}	22.08^{a}	0.88
WBC(x10^{3}/*ul*)	19.500^{ab}	16,500^{ab}	14,525^{a}	21,700^{a}	17,775^{ab}	1788.8

a,b= means with different superscripts on the same row differ significantly (P<0.05)

It was observed that urea, total protein albumin, globulin, glucose, serum alkaline phosphatase (SALP), aspartic amino transferase (AST) and alanine amino transferase (ALT) were not significantly (P<0.005) affected at the end of the 4th week.

No significant difference (P>0.005) were observed at the end of 8th week in the serum urea concentration, albumin, glucose, SALP, AST and ALT. However, the numerical variation observed for the parameters could be due to varying levels of biodegraded cassava peels, brewer's dried grain and soybean meal and on the varying metabolisable energy composition of the dietary treatments.

The serum total protein showed no significant difference (P>.0.05) among treatments at the end of 4th week, while the results at the end of 8th week showed significant differences (P>0.005) among treatments. Pigs on diet 3 showed the highest level of serum protein at the end of 8th week, while the lowest levels observed in diets 1 and 5 at the end of 4th and 8th week respectively. Values observed in this study were found to be within the normal range of 4.80-10.00g/dl.

Table 5: Serum Metabolities and Haematological indices of Weaner Pigs Fed Graded Levels of Biodegraded Cassava Peel Diets at the End of 8th Week.

Parameters	DIETS					
	1	2	3	4	5	SEM
Urea(mg/dl)	23.00	30.00	32.00	32.25	23.75	3.46
Creatinine (mg/dl)	1.05^{b}	1.23^{a}	1.25^{ba}	1.33^{a}	1.10^{ab}	0.09
Serum alkaline Phosphatase(SALP)(i.u/1)	131.75	124.50	132.75	135.75	147.50	11.83
Aspartate amino transferase(AST)(i.u./1)	31.95	29.25	26.75	31.50	34.50	3.93
Alanine amino transferase(ALT) (i.u/1)	23.95	29.25	26.75	31.50	34.50	3.93
Total Protin(g/dl)	6.15^{ab}	21.00	18.75	24.25	23.25	4.71
Albumin(g/dl)	2.75	2.95	2.93	2.93	2.98	0.08
Globulin(g/dl	3.40^{ab}	3.25^{abc}	3.48^{c}	3.10^{bc}	3.08^{c}	0.10
Cholesterol mg/dl)	113.75^{ab}	96.25^{b}	130.50^{a}	110.00^{ab}	103.25^{a}	6.47
Triglyceride(mg/dl)	90.00^{a}	67.00^{a}	91.50^{a}	68.50^{b}	85.75^{ab}	6.47
Glucose(mg/dl	47.50	45.25	55.00	55.00	54.00	5.40
PCV(%)	30.25^{ab}	27.25^{b}	30.75^{ab}	29.75^{ab}	34.50^{a}	2.28
HB(g/dl)	10.38^{ab}	9.05^{b}	10.23^{ab}	9.88^{ab}	11.48^{a}	0.76
RBC(x10^{6}/ul)	5.15^{a}	3.98^{b}	4.73^{ab}	4.55a	5.08^{a}	0.34
MCV(fl)	60.84^{a}	69.30^{a}	65.03^{ab}	65.07^{ab}	67.89^{a}	2.31
MCHC(%)(G/100ml)	33.28	33.19	33.25	33.25	33.18	0.06
MCH(pg)	20.18^{b}	23.01^{a}	21.63^{ab}	21.60^{ab}	22.58^{a}	0.76
WBC(x10^{3}/*ul*)	14,000	13,850	15,800	12,575	12,425	1,616.86

a,b,c= means with different superscripts on the same row differ significantly (P<0.05)

The serum albumin revealed no significant differences (P>0.05) among treatments at both 4th and 8th week. This could probably be due to isonitrogenous nature of the diets. This observation is congruential to the previous reports that abumin levels tend to remain constant throughout life after reaching a maximum at about 3 weeks of age (23). No significant effect (P>0.005) was noticed in the serum globulin content at the end of 4th week, whereas significant effects (P<0.005) were noticed among treatments at the end of 8th week. This might be due to prolonged effects of the experimental diets on serum globulins. This observation concurred with the findings of (24). No significant differences (P>0.05) were noticed in the serum urea values at both 4th and 8th weeks, respectively. This observation could possibly be due to the isonitrogenous nature of the experimental diets. The findings in this work have resemblance with the work of (25) who reported that the nature of dietary protein influenced blood urea levels of normal subjects as the varying levels of urea observed among treatments could be due to the nature of the amino acids in the protein thereby varying the quality of proteins in the experimental diets. Significant variation (P<0.05) of 1.03-1.40 mg/dl and 1.05-1.33mg/dl were observed in the creatinine levels at both 4th and 8th weeks respectively. The observed ranges were within the recommended levels of serum creatinine for swine(26).

The findings in this study showed that there were no significant variations (P>0.05) in the serum glucose levels at both 4th and 8th weeks. The observed non-significant ranges were 46.50-57.50mg/dl, 45.25-55.00mg/dl at both 4th and 8th weeks, respectively. These values were found to be lower than 64.00-122.00mg/dl reported by (27). Contributory factors to this variation could be the varying levels of fibre components in experimental diets. However, there is a general consensus that the water soluble and viscous polysaccharides significantly (P<0.005) affect cholesterol and glucose levels than insoluble

counterparts (28,29). The finding in this study is partly in line with aforementioned.

Significant variation ($P<0.05$) was revealed among treatments in the serum triglycerides (TG) at both 4th and 8th weeks. This could be attributed to the varying levels of lipid composition in the experimental diets coupled with the synthesis of triglycerides. This observation is in agreement with the report of (30) who found that plasma triglycerides are affected by meals containing fat.

It was found that cholesterol levels varied considerably ($P<0.05$) among treatments at both 4th and 8th weeks. A linear increase was observed among diets 1 to 4 at the end of 4th week, whereas no definite partern was reveled in the serum cholesterol at the end of 8th week. This variation could probably be due to the varying levels of saturated fatty acid components of the diets, which served as the base for the cholesterol synthesis. The observed effects of the experimental diets, on serum cholesterol levels among treatments were in agreement with the normal range of 76-174 mg/dl reported (31). This might probably be due to the fact that 10-15% dietary crude fibre limit in swine diets was not exceeded (32).

The findings in this study showed that there were no significant variations ($P>0.05$) in the values obtained for AST and ALT at both 4th and 8th week of samplings. The value obtained for AST were in consonance with the range of 31.1 ± 1.4i.u/1 reported by (33) for growing pigs.

However, slightly lower non-significant values were obtained in treatments 1 and 4 for the 4th week sampling; treatment 4 was found to be lowest at the end of 8th week. The lower values obtained for AST and ALT were indicative of normal functioning of the livers of the experimental pigs as extensive tissue destruction of these enzymes are liberated into the serum thereby leading to higher levels in diseased states as manifested in the sera of patients with acute hepatic disease (34).

Serum alkaline phosphatase activities of the experimental pigs in this study were not significantly varied at the ends of both 4th and 8th weeks. Higher values were noticed at the end of 4th week with range 145.50-177.25 (i.u./1), while lower values with range 125.50-147.50 i.u./1 were recorded at the end of 8th week. Non-significant variation of the values obtained could be indicative of the fact that biodegraded cassava peels have no significant effects ($P>05$) on the activities of serum alkaline phosphatase.

The values obtained in this study for the ratio of PCV to Hb and MCHC were within the range for the normal pig and these values were 3:1 and 33% respectively. Apart from MCHC, all other haemotaological parameters examined in this study were found to show significant trend ($P<0.05$) at the end of 4th and 8th weeks were found to be lower than the normal average of blood values of 42%, 14g/dl and $7x10^6$/ul, respectively for pigs reported by (20). However, the low values of PCV and the Hb observed at the end of 4th week in this study, especially on treatments 1 and 4 could suggest normocytic iron deficiency anaemia, as evidenced by the reports of (35,24), who observed a direct relationship between dietary iron, Hb, PCV and serum iron. However, improvements were noticed in the values of PCV, Hb and RBC obtained on pigs in teatements 1 and 4 at the end of the 8th week. This could be due to prolonged feeding of the experimental diets coupled with the increased age of the animals. This findings is partly in agreement with the work of (36) who found that gender, age, hormonal changes and disease conditions in the body organs influence nutrient absorption, transport, metabolism and excretion.

The MCV values in this study varied significantly at both 4th and 8th weeks. Contributory factors to the variation could be the levels of inclusion of ingredients used to formulate the experimental diets. The values observed in this study are higher than 49.7 ± 4.0 fl reported for growing pigs by (37). However, the values obtained in this study were very close to the value of 66.0 ± 1.4 fl obtained by (38) for growing pigs.

The variation ranges in the MCHC at both 4th and 8th weeks were found to be smaller and insignificant. The ranges of 33.20-33.26% and 33.17-33.28% were revealed at the end of 4th and 8th weeks, respectively. The values attained for MCHC in this study were very close to the of

previous reports given in the literature (37). Statistical trend revealed for MCH recorded significant variation (P<0.05) which could be attributed to varying nutritional protein quality of experimental diets. The ranges observed for 4th and 8th weeks, respectively as 19.19-22.14pg and 20.18-23-.01pg were found to be higher than what was reported by (37). Significant variation (P<0.05) was observed in the values of white blood cells (WBC) among treatments at the end of the 4th week, while similarities were observed in the values of WBC among treatments at the end of 8th week. It has been found that the number of leucocytes is influenced by age, stress, digestion, gestation, parasites etc(39).

The leucoytes or WBC plays a significant role in the defence against foreign bodies. At age 5-6 weeks, the leucocytes count of a pig is the same as recorded for adults, (40) reported a range of 18,000-27,000/ul of healthy pig. Leucocytes count above this indicates proliferation of foreign bodies or the development of an abnormal physiological state in the animal body. Although the values obtained for the WBC of the experimental pigs at the end of 4th week were within the range of values by (40), the values of WBC obtained for the experimental pigs at the end of 8th week were outside the range of previous report (40).

Table 6: Economies of Production of Weaner Pigs Fed Graded levels of Biodegraded Cassava Peels.

Parameters	DIETS				
	1	2	3	4	5
Feed cost/kg diet (₦)	8.88	9.59	9.84	9.95	9.98
Cost of feed consumed/day (₦)	24.95 ± 1.46	28.28 ± 1.53	29.40 ± 1.70	27.81 ± 1.56	27.99 ± 1.46
Cost of feed/kg live weight gain (₦)	25.33 ± 1.32	30.66 ± 1.82	27.94 ± 0.99	30.49 ± 2.83	31.81 ± 2.55
Weekly dry matter intake/kg	19.66 ± 1.12	21.06±1.12	20.94±1.21	19.56±1.05	17.48±1.56
Weekly body weight gain/kg	7.44 ± 0.47	6.69 ± 0.09	7.63 ± 0.16	6.75 ± 0.60	6.38 ± 0.39
Feed conversion ratio	2.88 ± 0.15	3.20 ± 0.07	2.84 ± 0.10	3.07 ± 0.29	3.38 ± 0.13
Projected revenue/pig(₦)	4165.00±264.24^a	3475.00±105.00^a	4270.00±90.37^a	3500.00±80.83^b	3570.00±217.64^a
Cost of total feed consumed/pig (₦)	1396.82±81.60	1615.91±85.55	1648.20±95.53	1556.78±83.55	1561.47±83.80
Projected profit/pig (₦)	2768.18±314.99	2129.09±150.70	2621.80±198.57	1943.15±127.16	2008.53±234.00

a,b - means with different superscripts on the same row differ significantly (P<0.05)

In this experiment, the best feed conversion ratio was observed in diet 3, a diet that had 50% of the cassava flour being replaced by biodegraded cassava peel. The lowest feed cost per kilogram live weight was noticed in treatment 1, while the highest was indicated in treatment 5.

In a situation whereby the pigs are projected to the weight of 60kg, it means that pigs on diet 3 will first attain this weight because in another 24 weeks (6 months) each of the pigs would have added 45.75 kg to their final live weight, while the least growing animals in treatment 5 would have added 38.25 kg each within the same period. It could be observed that comparable gains were obtained between the control diet and the test diets even with the total replacement of cassava flour with biodegraded cassava peels and despite the reduced feed cost per kg noted for diet 1. This observation is in agreement with the report of (41) who showed that the real production value of diets for growing pigs to be globular ones. It however, compared with the report

closely associated with the feed utilization, which is the ability of feed to support growth.

Although no definite pattern was observed in projected profit per pig, the highest was found in treatment 1 to be₦2,768.00 ± 314.99, while the lowest was shown to be₦1943.00 ± 127.16 by treatment 4.

Conclusions and Applications

(1) From the results of blood parameters obtained at the end of this feeding experiment, it was observed that the parameters estimated were found to be within the normal physiological ranges for growing pigs which elicited in the normal physiological state of the experimental pigs. In view of aforementioned, it can be concluded that nutritional adequacy for growth of weaner pigs can be attained with the use of biodegraded cassava peels fortified with ingredients such as soybean meal and blood meal.

(2) Also, there were no significant differences (P>0.05) among treatments in the feed cost per kg live weight. This indicated that test diet consisting biodegraded cassava peels can safely replace cassava-based diets in pig production.

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