RESPONSE OF WEANER RABBITS TO DIFFERENTLY PROCESSED CASSAVA ROOT MEAL-FULL FAT SOYBEAN BASED DIETS

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Abstract: - Feeding is the most important component of rabbit production, representing 70% of the costs. Research on alternative feed ingredients for rabbit diets like cassava by-products are important for reducing the cost of production. This study investigated the response of weaner rabbits to differently processed cassava root meal-full fat soybean diets. Cassava roots after peeling and washing, were subjected to five different processing methods: unseived, sieved, pulverized, wet-grated and chips before mixing with extruded full-fat soybean at a ratio of 50:50 to obtain five CASSOY blends. The CASSOY were each used at 30% inclusion levels to obtain 5 dietary treatments. Thirty-six weaner rabbits were divided into six treatments with six replicate, a rabbit per replicate. Feed intake, growth, nutrient digestibility, haematology; serum indices, carcass characteristics, sensory evaluation and cost implication were determined for 10 weeks. Data were subjected to one-way analysis of variance in a completely randomized design. Results showed highest ($p<0.05$) packed cell volume (44.00%), haemoglobin (15.10g/dL), red blood cell count (3.63 $X10^{12}$/L) values were recorded for rabbits fed diets with pulverized cassava root while white blood cell count (6.50 $X10^{3}$/L) was lowest for rabbit fed the control diet. Total protein and globulin were highest ($p<0.05$) in rabbits fed the control diet, glucose and urea were lowest ($p>0.05$) in rabbits fed diet with unsieved cassava root. Highest dressing percentage (60.28%) was recorded for rabbit fed diet with sieved cassava root. Sensory evaluation was significant ($p<0.05$) for all the parameters with the highest overall acceptability for rabbits fed diet with sieved cassava root. The lowest ($p>0.05$) feed cost (₦177.04) and feed cost/weight gain were recorded for diet with wet-grated cassava root. The study concluded that experimental diets with CASSOY did not improve the growth performance of rabbits but improved the blood parameters and cost benefit analysis.

Key-Words: - Rabbit, Cassava root-meal, Soybean meal, CASSOY

1 Introduction

Shortage of cereals recently becomes a serious issue in several regions of the world; in many of these countries, the use of cereal products as animal feeds is increasingly unjustified in economic terms. Non-ruminant like poultry and rabbits are markedly affected by such a trend. Therefore, there is a need to exploit cheaper energy sources to replace expensive cereals for rabbit production, to relieve the food-feed competition in the future. Cassava is one of the non-conventional sources of energy mostly in the tropics. It outstrips maize in terms of starch content per unit mass [51]. As the most important root crop in terms of world production, cassava is ideal for lowland tropical cultivation. Economically, cassava gives high return from limited labour and other inputs associated with smallholder farmers [23]. Cassava, therefore, has potential to serve as rabbit feed. This could possibly reduce the competition of rabbit and man for maize.

Soybean is a legume with high crude protein and lipid levels. The nutrients are readily digestible, and the protein has a high biological value placing it on top of vegetable concentrate feeds [30], [17]. Raw soybeans cannot be used in rabbit feeding due to some active biological compounds with anti-nutritional activities, for this reason soybean is subjected to heat treatment (extrusion) to reduce the anti-nutritional factors to a barest minimal level for rabbit utilization. Soybean is a rich source of plant protein which needs to be processed before consumption [21]. The aim of this study was to evaluate the response of rabbits offered diet containing cassava and extruded full-fat soybean as a partial replacement of maize and soybean meal.

2 Materials and Methods

2.1 Preparation of Test Ingredients (cassava root meal-full fat soybean [cassoy])

The test ingredients for the experiment are cassava (*Manihot esculenta*) of variety MS6 (Idileru) and Soybean (*Glycine max*) of variety TGX923E. The cassava root tubers were purchased from a commercial farm while the full-fat extruded soybean was purchased from a commercial factory. The various test ingredients include:

2.1.1 Cassava- soybean (cassoy) 1

The cassava root tubers were washed (removal of sand and stones), peeled, washed and grated using grating machine. After grating, the cassava was packed into hessian sacks and pressed for about 36 hours using screw press machine and then spread under the sun for about 4-5 days to dry until a moisture content of < 10% was attained after sun-drying. The full-fat extruded soybean was thoroughly mixed with the sun-dried cassava root meal (50:50) and milled using hammer milling machine to give cassoy one.

2.1.2 Cassava- soybean (cassoy) 2

The cassava root tubers were washed (removal of sand and stones), peeled, washed and grated using grating machine. After grating, the cassava was packed into hessian sacks and pressed for about 36 hours using screw press machine, subjected to sieving then sun-drying for about 4-5 days to dry and attain a moisture content of < 10 % after sun-drying. The full-fat extruded soybean was thoroughly mixed with the sieved, sun-dried cassava root meal (50:50) and milled using hammer milling machine to give cassoy two.

2.1.3 Cassava- soybean (cassoy) 3

The cassava root tubers were washed (removal of sand and stones), peeled, washed and soaked for three days. After soaking, the cassava was pulverized using hands, then packed into hessian sacks and pressed for about 36 hours using screw press machine and spread under the sun for about 4-5 days to dry and attain a mois-ture content of < 10% after sun-drying. The full-fat extruded soybean was thoroughly mixed with the sun-dried cassava root meal (50:50) and milled using hammer milling machine to give cassoy three.

2.1.4 Cassava- soybean (cassoy) 4

The cassava root tubers were washed (removal of sand and stones), peeled, washed and soaked for three days. After soaking, the cassava was wet grated using grating machine, the grated cassava was packed into hessian sacks and pressed for about 36 hours using screw press machine and spread under the sun for about 4-5 days to dry and attain a moisture content of < 10% after sun-drying. The full-fat extruded soybean was thoroughly mixed with the sun-dried cassava root meal (50:50) and milled using hammer milling machine to give cassoy four.

2.1.5 Cassava- soybean (cassoy) 5

The cassava root tubers were washed (removal of sand and stones), peeled and washed. The washed cassava was chopped into chips and sun-dried for about 4-5 days to dry and attain a moisture content of < 10% after. The full-fat extruded soybean was thoroughly mixed with the sun-dried cassava chips (50:50) and milled using hammer milling machine to give cassoy five.

The above listed cassava-soybean (cassoy) meals preparation are demonstrated in figures 1, 2, 3, 4 and 5 respectively.

2.2 Experimental rabbits and management

Thirty-six weaner rabbits were purchased from a reputable farm in Ibadan and placed on a period of seven days to acclimatize while been fed pelleted rabbit ration. The recommended routine medication (i.e drugs) programmes were observed. The rabbits were managed under standard management condition for rabbits in the tropics and were fed experimental diets for 10 weeks. The rabbits were divided on weight equalization into six (6) treatment diets consisting of six treatments, six replicates with a rabbit each, in a completely randomized design (CRD) consisting of an inclusion level of cassava and full-fat soybean (CASSOY). Feed and water were provided *ad libitum*, wilted forages were given in the evening. The initial weight was taken on the first day of the experiment and weekly thereafter in the morning before feeding the rabbits.

2.3 Experimental diets

Six experimental diets were formulated to give six treatments, six replicates consisting a rabbit each. Treatment 1 contained maize-soybean meal-based diet without cassoy blend, while treatments 2 to 6 contained cassoy 1 to 5 respectively, replacing equal proportion of maize and soybean meal. The percentage composition of the experimental diet is shown in Table 1. Anti- mould of 0.1% was added to each of the diets.

2.4 Data collection

2.4.1 Proximate composition

Each of the five samples of cassava-soya blends obtained was analyzed for proximate composition according to [11].

2.4.2 Energy determination

The metabolizable energy values of processed cassoy blends was determined by the [41] equation as follows.

$$ME = 35 \times \% CP + 18.8 \times \% EE + 35.5 \times \% NFE$$

Where ME = Metabolizable Energy, CP = Crude Protein, EE = Ether Extract, NFE = Nitrogen Free Extract

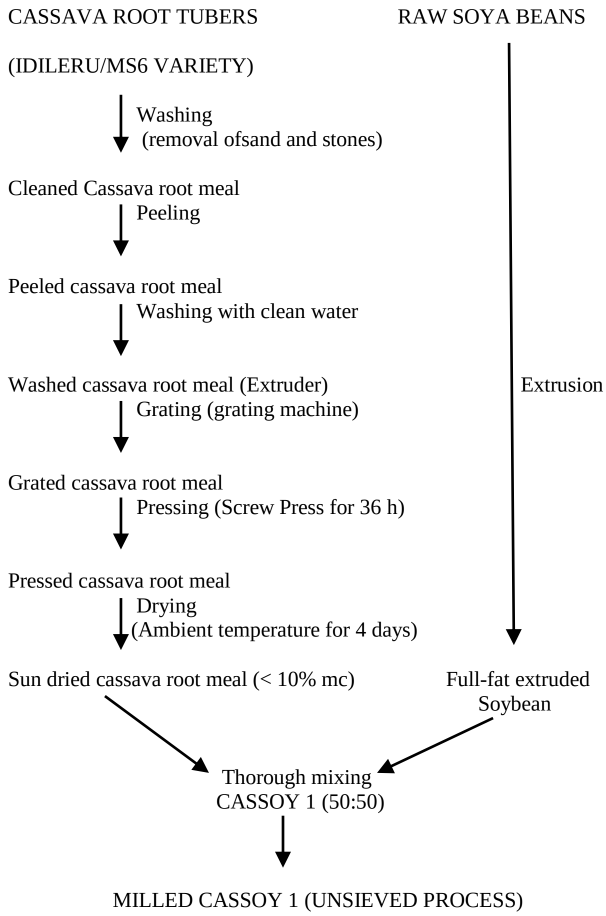

Fig.1: Flow chart showing the processing method of cassava-soybean (cassoy) 1

Table 1: Percentage Composition of Experimental Diet for Rabbit (1 – 10 weeks)

Ingredients	T1 (control)	T2 (Unsieved)	T3 (Sieved)	T4 (Pulverized)	T5 (Wet-grated)	T6 (Chips)
Maize	40.00	30.00	30.00	30.00	30.00	30.00
Soybean meal	18.00	8.00	8.00	8.00	8.00	8.00
Cassoy (50:50)	0.00	20.00	20.00	20.00	20.00	20.00
Fish-meal (72% CP)	0.50	0.50	0.50	0.50	0.50	0.50
Wheat Offal	37.00	37.00	37.00	37.00	37.00	37.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50
*Premix (starter)	0.25	0.25	0.25	0.25	0.25	0.25
Salt (NaCl)	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated analysis						
ME (MJ/Kg)	10.91	10.95	10.78	10.78	10.95	10.95
Crude Protein (%)	18.21	17.81	18.20	18.40	17.75	18.00
Crude Fibre (%)	8.50	10.80	8.80	8.85	10.40	10.45
Ether extract (%)	3.80	4.20	4.20	4.20	4.20	4.20

*Premix composition: Vitamin A (8,000,000IU), Vitamin D (1,600,000IU), Vitamin E (5,000IU), Vitamin K (2,000mg), Thiamine B1(1,500mg), Riboflavin B3(4,000mg), Pyridoxine B6 (1,500mg), Niacin (15,000mg), Vitamin B12 (10mg), Pantothenic acid (1,000mg), Folic acid (500mg), Biotin (20mg), Antioxidant (125,000mg), Manganese (60,000mg), Iron (20,000mg), Zinc (50,000mg), Copper (5,000mg), Iodine (1,200mg), Selenium (200mg), Cobalt (200mg)
ME- Metabolisable Energy

2.4.3 Hydrogen cyanide determination

Alkaline titration adopted [8] method. Ten grams of each of the grounds twelve samples were soaked in the mixture of 200 ml of distilled water and 10 cm^3 of orthophosphoric acid. The mixture was kept for 12 hours to release all the bounded cyanide. The mixture was distilled until 150 ml of the distillate was collected. 200 ml of the distillate was poured into a conical flask containing 40 ml of distilled water. 8 ml of ammonia solution (6 mol/dm^3) and 2 ml of potassium iodide (5%) solution, the mixture was titrated with silver nitrate (0.02 mol/dm^3) to faint but permanent turbidity (1 ml 0.02 mol/dm^3 $AgNO_3$) is equivalent to (1.08 mg HCN).

The percentage hydro cyanide was calculated with the formula:

$$\% \text{ Hydrocyanide} = \frac{\text{Titre} \times 10 \times 0.27 \times 100}{1000 \times \text{weight of sample}} \quad (1)$$

2.4.4 Trypsin inhibitor determination

0.2 g each of the 5 samples was weighed into a screw cap centrifuge tube. 10 ml of 0.1M phosphate buffer and the contents will be shaken at room temperature for 1 hour on a UDY shaker. The suspension obtained was centrifuged at 5000 rpm for 5mins and filtered through whatman no. 42 filter paper. The volume of each was adjusted to 2 ml with phosphate buffer. The test tubes were placed in a water bath, maintained at 37 °C. 6 ml of 5 % TCA solutions was added to one of the tube to serve as a blank. 2mls of casein solution was added to all of the tubes previously kept at 37°C. They were incubated for 20 mins. The reaction was stopped after 20 mins by adding 6 ml of TCA solution to the experimental tubes and shaken. The reaction was allowed to proceed for 1 hour at room temperature. The mixture was filtered through whatman No. 42 filter paper. Absorbance of filtrate from sample and trypsin standard solutions was read at 280 nm. The trypsin inhibitor in mg/g sample was calculated using the formula:

$$\text{T.I (mg/g)} = \frac{\text{A standard} - \text{A sample}}{0.19 \times \text{sample Wt (g)}} \times \frac{\text{Dilution factor}}{1000 \times \text{sample size}} \quad (2)$$

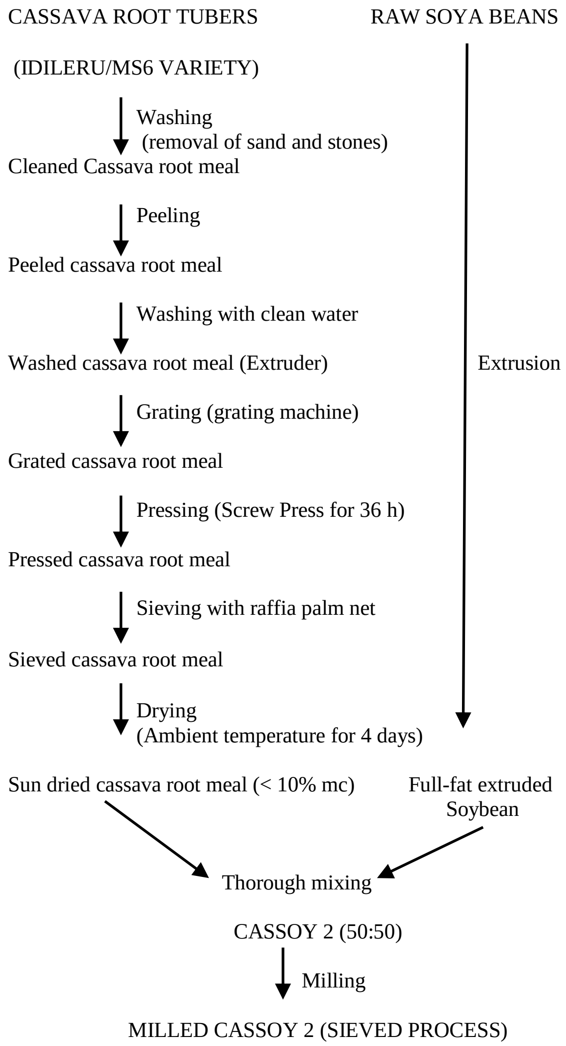

Fig.2: Flow chart showing the processing method of cassava-soybean (cassoy) 2.

2.4.5 Growth Performance Characteristics

The body weight, feed consumption and mortality rate were monitored and recorded for each replicate at weekly intervals to determine average feed intake, average body weight gain and feed conversion ratio.

2.4.6 Feed Intake

A known weight of feed for each replicate was given and recorded daily. The left over after each day was kept separately, measured and recorded for each replicate on a daily basis. Feed consumption for each day was obtained from differences between the feed given per day and left over.

Total feed intake (g) = Total feed given (g) – Total feed left over (g)

Average feed intake: This is the difference between feed administered and left over.

$$\text{Daily feed intake} = \frac{\text{Total feed intake (g)}}{\text{Total number of days of the experiment}} \quad (3)$$

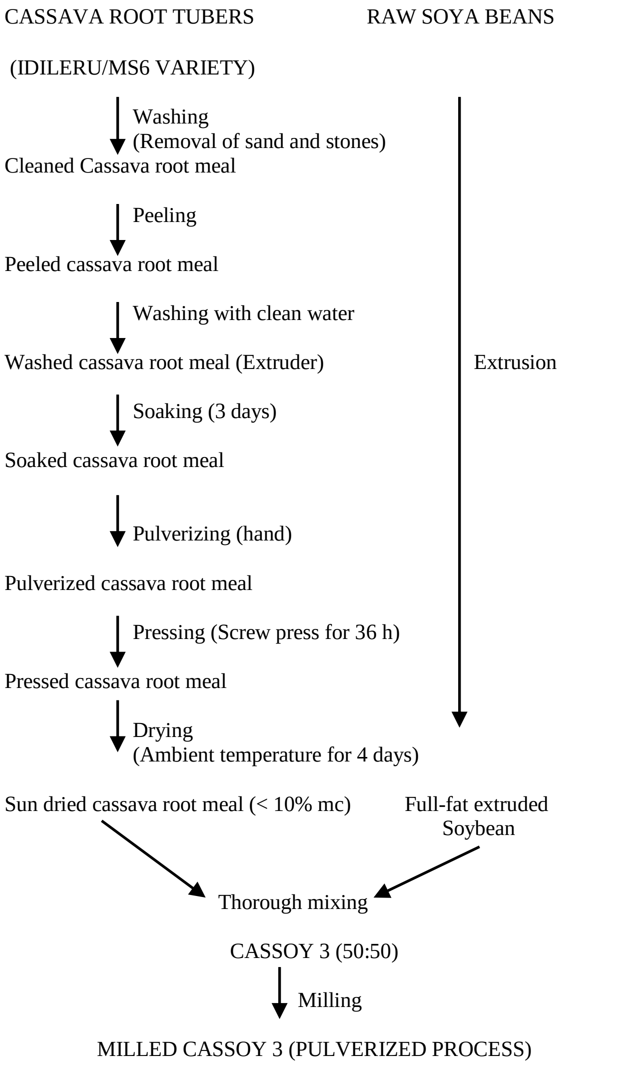

Fig.3: Flow chart showing the processing method of cassava-soybean (cassoy) 3.

2.4.7 Body weight gain

Rabbits in each replicate were weighed on arrival, weighed at the start of the experiment and then weighed at the end of subsequent week for 10 weeks of the experiment. Body weight gain was calculated from the difference between the body weight for the given week and that of the previous week. Final weight was taken and recorded at the end of the experiment.

$$\text{Weight gain (g)} = \frac{\text{Final body weight (g)} - \text{Initial weight gain (g)}}{\text{Total number of weeks of the experiment}} \quad (4)$$

$$\text{Feed Conversion Ratio (FRC)} = \frac{\text{Quantity of feeed consumed (g)}}{\text{weight gain (g)}} \quad (5)$$

$$\text{Protein Efficiency Ratio (PER)} = \frac{\text{weight gain (g)}}{\text{(feed intake (g)} \times \text{\% crude protein of diet)}} \quad (6)$$

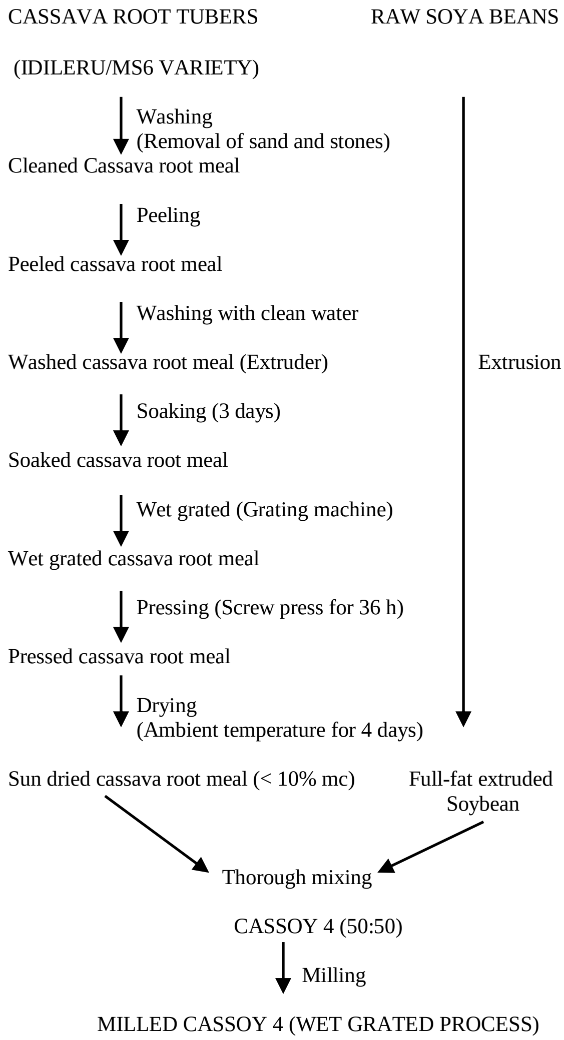

Fig.4: Flow chart showing the processing method of cassava-soybean (cassoy) 4.

$$\text{Mortality (\%)} = \frac{\text{Number of dead rabbits} \times 100}{\text{Initial number of rabbits}} \quad (7)$$

2.4.8 Digestibility Trial

At the end of ten weeks, three rabbits per treatment were selected and transferred into metabolic cages already cleaned and disinfected that were equipped with facilities for collection of faeces for the digestibility trials. These rabbits were allowed to acclimatise for three days before the commencement of the experiment while faecal collection was taken on daily basis for 3 days, weighed and oven dried at 60 °C for 24 hrs and bulked until they were analysed. The following parameters were determined.

$$\text{Nutrient Digestibility} = \frac{\text{Nutrient in feed intake} - \text{Nutrient in feacal output} \times 100}{\text{Nutrient in feeed intake}} \quad (8)$$

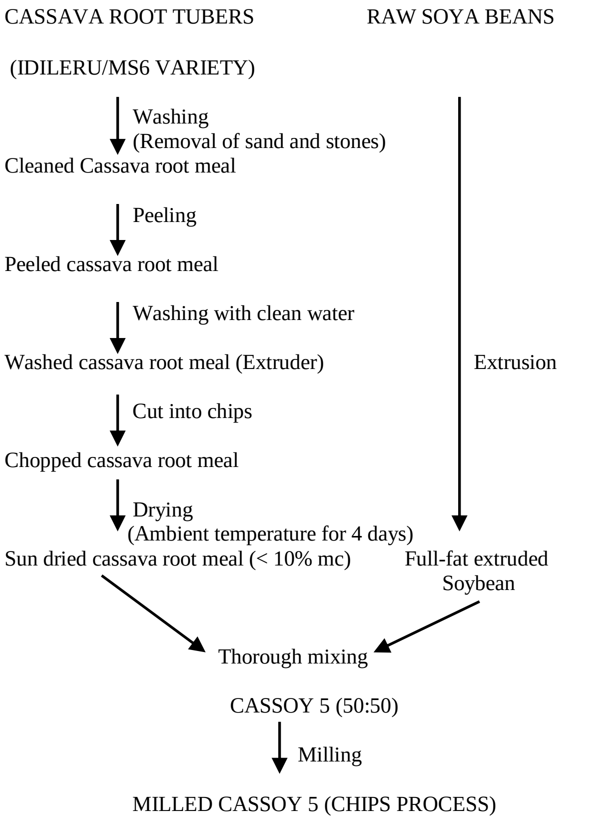

Fig.5: Flow chart showing the processing method of cassava-soybean (cassoy) 5.

2.4.9 Blood analysis

Blood samples were collected at the 10th week of the experiment from three selected rabbits in each treatment. Blood was withdrawn from the ear vein of each animal by means of 2 ml sterile needle and syringe into labeled sample bottles containing Ethylene Diamine Tetra Acetate (EDTA) to prevent blood coagulation and were taken to the laboratory to obtain the plasma for (haemoglobin, red blood cells count, white blood cells count and packed cell volume) while another 2 ml blood sample was collected into bottles without anti-coagulant (allowed to clot) before refrigerating for 6 hours and later spun in a centrifuge at 900 rpm for minutes. The separate sera was labeled for each rabbits and stored in the freezer at -2 °C prior to analysis. The sera was allowed to thaw under room temperatures before subsequent analyses.

2.4.10 Carcass analysis

Two rabbits were selected from each treatment. Feed was withdrawn for 12 hours from the rabbits to empty their Gastrointestinal tracts (GIT) and to reduce the variability in the body weight due to intestinal content. The rabbits were weighed, slaughtered, bled and scalded using naked fire and then eviscerated. The carcass weight, empty body weight and dressing percentage were determined and recorded.

$$\text{Dressing percentage} = \frac{\text{Empty carcass weight} \times 100}{\text{Live weight}} \quad (9)$$

The carcass was cut into retail parts (shoulder, rack, loin, head and tail) and then weighed with a sensitive electronic scale. The weight of the internal organs (liver, kidney, heart and lungs) were determined as well, individual weight for each rabbits and then expressed as percentage of live weight.

2.4.11 Sensory evaluation

In evaluating the sensory qualities, samples of meats were collected after de-boning from the rack part and cut into chops and tagged for identification. The samples were put into polythene bags and cooked in water for 30 mins at 70°C in a cooking bath. Sensory evaluation of samples of cooked meat was assessed by the ten trained panelists, where some meat qualities were estimated including colour, juiciness, meaty flavour, tenderness, taste and overall acceptability. Bite size portions were served at room temperature to ten panelists (staff and students) who were asked to comment freely on each sample served. For each parameters, the ten panelists awarded scores using a nine (9) point Hedonic scale (9 = like extremely; 8 = like very much; 7 = like moderately; 6 = like slightly, 5 = neither like or dislike; 4 = dislike slightly 3 = dislike moderately; 2 = dislike very much; 1 = dislike extremely) [9]. A sample of the hedonic scale is shown in appendix 1.

2.4.12 Cost benefit analysis

Feed cost analysis was carried out to access the effect of the diets in relation to performance of the rabbits. Cost of the feed was calculated based on prevailing cost of ingredients per kg as at the time this experiment was carried out.

This was done to determine the following: feed cost (₦/kg), cost of the total feed consumed (₦/kg), feed cost/ weight gain (₦/kg).

Feed cost (₦/kg) = summation of proportion of each ingredient in the diet × cost per kg of ingredient/100

Cost of the total feed consumed (₦/kg) = Cost per kg of feed × Total feed consumed

$$\text{Cost of weight gain (₦/kg)} = \frac{\text{Cost of feed consumption}}{\text{Weight gain}} \quad (10)$$

Feed cost/weight gain (₦/kg) = FCR × Feed cost (₦/kg)

$$\text{Feed cost savings} = \frac{\text{Feed cost saved (trt)} \times 100}{\text{Feed cost of control diet}} \quad (11)$$

It should be noted that cost of purchasing, transportation, processing (peeling, grating and drying) were considered in the overall cost of test analysis of the experimental diets.

2.5 Statistical analysis

The data collected were subjected to one-way analysis of variance (ANOVA) in a completely randomized design (CRD) arrangement. The significance means were separated and compared using Duncan Multiple Range Test [20] of [48] at 5% level of probability.
The statistical model is shown below:

$Y_{ijk} = \mu + T_i + \Sigma_{ijk}$

Y_{ijk} = Trait of interest (output)

μ = Overall mean

Σ_{ijk} = Random residual error.

3 Results

3.1 Chemical Composition of Extruded Full fat soybean-cassava root meal blends

The chemical composition of the various cassoy blends in Table 1 showed the values of crude protein, crude fibre, ether extract, ash, nitrogen free extract, hydrogen cyanide and trypsin inhibitor unit of the experimental diets ranging from 21.69 – 28.92, 8.15 –10.44, 5.80 – 12.69, 3.35 – 8.48, 35.47– 43.74, 1.65 – 2.00mg/kg and 3.15–3.45 mg/g, respectively.

3.2 Chemical Composition of Experimental diets

The chemical composition of the experimental diet is shown in Table 2. The chemical value (crude protein, crude fibre, ether extract, ash and nitrogen free extract) of the experimental diets ranged from 15.07 –17.61%, 6.17 – 9.05%, 6.41 – 10.48%, 3.95 – 7.03%, 56.94 – 67.64%, respectively.

3.3 Effects of differently processed cassava methods on growth performance of rabbits

The effects of differently processed cassava methods on the growth performance of rabbits (Table 4) revealed that some of the parameters were significantly ($P < 0.05$) affected while the initial weight, total feed intake, daily feed intake, feed conversion ratio and protein efficiency ratio were not significantly affected ($P > 0.05$) affected. The final live weight was significantly ($P< 0.05$) influenced by the cassava processing method in the diet. It was revealed that rabbits fed T4 (pulverized) diet had the least average live weight 636.3g. The control, T2 diet, T3diet, T5 and T6 diet were statistically similar across the treatments; 1216.3g, 1060.0g, 1038.8g, 1016.3g and 1048.8g respectively.

Rabbits fed T4 diet were statistically ($P > 0.05$) least on average daily weight gain. The control, T2 diet, T3, T5 and T6 diet were statistically similar across the treatments; 18.93g, 15.14g, 14.84g, 16.86g and 14.98g respectively. The mortality was shown to be highest ($P < 0.05$) in rabbits fed the T4 diet with a value of 33.33% followed by rabbits fed control diets with a value of 16.67%.

3.4 Effects of differently processed cassava methods on apparent nutrient digestibility of rabbits

The effect of differently processed cassava diet on the apparent nutrient digestibility of grower rabbits is shown in Table 5. The result revealed the CP digestibility and ash digestibility were ($P < 0.05$) affected by the cassava processing methods while the DM, CF and fat digestibility were not ($P > 0.05$) affected. The crude protein digestibility value for rabbits fed control diet was observed to be the highest ($P < 0.05$) 80.54% while the values for the experimental diet were statistically similar across the treatments.

Highest value of ash digestibility was recorded significantly ($P < 0.05$) with experimental rabbits fed control diet 64.47%, followed closely by values; 58.87%, 55.83%, 59.35% and 59.73% obtained from rabbits fed T2, T4, T5 and T6 diets respectively. The least value 53.27% was obtained from rabbits fed T3 (sieved cassava) diet.

3.5 Effects of differently processed cassava methods on haematological and serum biochemistry of rabbits

Result of the effect of differently processed cassava diet on haematological indices and serum biochemistry at the end of the experiment are indicated in Table 6. At the end of the experiment the results showed that there were no significant (P > 0.05) differences among treatments for MCV and Neutrophil. Packed Cell Volume significantly recorded the highest value of 44% for rabbits fed T4 (pulverized cassava) diet followed by 42% in rabbits fed T5 (wet grated cassava) diet, 35% in T3 diet fed rabbits, 33% in T6 (Chips) diet fed rabbits and 30% in rabbits fed T2 (unsieved cassava) diet. The least PCV value of 23% was recorded in rabbit fed control diet. The exclusion of processed cassava in the control diet reduced the haemoglobin concentration (g/dl) while it increased significantly (P < 0.05) T4 diet (15.10) with the inclusion of pulverized cassava followed closely by14.00 in wet grated cassava diet, 12.00 for chip cassava diet, 11.70 for seived diet and 10.10 for un-sieved cassava diet.

Least Red blood cells ($x10^{12}/l$) 1.85 was obtained in the control diet source followed by a value of 2.41 in the T2 (unsieved cassava) diet and the highest (P < 0.05) value 3.63 was recorded in T4 (pulverized cassava) diet followed closely by 3.40 from T5 (wet grated cassava) diet. However, significant (P < 0.05) differences were observed in the Mean Corouscular Heamoglobin value ranging from 41.18 to 41.89 pg. Values obtained from the Mean Corpuscular Heamoglobin Concentrate (MCHC) was significantly higher 33.83 in T6 (chips cassava) diet and 33.67 in T2 diets and significantly similar across the control diet and dietary treatments with values ranging from 33.33g/dl – 33.48 g/dl. Lymphocyte significantly (P < 0.05) ranged from 58.00% - 63.00%. Eosinophil ranged from 3 -5% and monocyte revealed values range from 0.33% - 1.6%.

The serum biochemistry results shows that there were significant (P < 0.05) differences in all parameters listed. The total protein value recorded was highest (5.80 g/dl) in rabbits fed control diet and least (5.10 g/dl) in rabbits fed T6 diet. Globulin values ranged from 1.70 – 2.33 g/dl while albumin values ranged from 3.10 – 3.80 g/dl. Glucose was significantly (P < 0.05) highest (170.40 mg/dl) in rabbits fed T3 diet, followed closely by rabbit fed T2 diet (166.40 mg/dl). Urea was revealed to be highest (42.00 mg/dl) in rabbits fed T5 diet and least (31.00 mg/dl) in rabbits fed T2 diet.

3.6 Effects of differently processed cassava methods on carcass characteristics and organ of rabbits

Table 7 shows the main effect of differently processed cassava diet on the carcass characteristics and organ of grower rabbits. The results revealed that value obtained for slaughtered characteristics was significantly affected (P < 0.05). The values of live weight showed that rabbits on control diet had the highest (P < 0.05) value 0f 2067.50g followed closely by 1952.5g T4 (pulverized) diet rabbits, 1760g for rabbits on T2 diet, 1710g for rabbit on T3 diet, 1687.50g for rabbits on T6 diet and least value 1505g for rabbits on T4 diet.

The retail parts were significantly (P < 0.05) influenced by the processed cassava diet with the exception of the shoulder which was not (P > 0.05) affected. The racks, loin, head and tail had significant (P < 0.05) value ranges of 19.57 – 22.50%, 13.19- 18.01%, 7.09 – 8.54% and 0.09 – 0.15% respectively. The internal organs were observed to be significantly (P < 0.05) influenced. The highest GIT weight 24.89% was obtained in rabbits fed T4 diet while the least value 15.09 from rabbits fed T3 diet. The liver, heart, kidney and lungs has significantly (P < 0.05) value ranges of 1.65 – 2.39%, 0.14 – 0.28%, 0.59 – 0.69% and 0.42 – 0.66% respectively.

3.7 Effects of differently processed cassava methods on sensory evaluation of rabbits

The effect of differently processed cassava diet on the sensory evaluation on the grower rabbits is shown in Table 8. All parameters stated for the sensory evaluation were significantly (P < 0.05) influenced. For colour, the values obtained ranged from 8.25 the highest for rabbits fed T3 diet to 7.10 the least for rabbits fed T2 diet. Juiciness revealed result of 6.25, the least to 7.10 the highest. Flavour, saltiness, tenderness obtained in the result ranges are 7.05 – 7.65, 3.35 – 4.00, 5.55 – 6.95 respectively. Overall acceptability was revealed to have the highest value in rabbits fed T2 diet followed closely by 7.45 in rabbits fed control diet and the least value 6.75 in rabbits fed T4 diet.

3.8 Effects of differently processed cassava methods on cost benefit analysis

Table 2: Chemical composition of differently processed CASSOY

Parameters	CASSOY 1 Unsieved	CASSOY 2 Sieved	CASSOY 3 Pulverized	CASSOY 4 Wet- grated	CASSOY 5 Chips
Dry matter (%)	93.22	90.16	91.22	92.42	88.89
Crude protein (%)	27.96	25.92	28.92	23.45	21.69
Crude fibre (%)	8.41	7.66	10.11	8.51	10.44
Ether extract (%)	12.43	10.02	10.51	12.69	5.80
Ash (%)	8.48	4.30	4.95	6.94	3.35
NFE (%)	39.47	43.21	35.47	43.74	42.48
HCN (mg/kg)	1.77	1.74	1.66	1.65	2.00
TIU (mg/g)	3.40	3.45	3.15	3.30	3.38

NFE – Nitrogen Free Extract, HCN – Hydrogen Cyanide, TIU – Trypsin Inhibitor Unit

Table 3: Chemical composition of Experimental diets.

Parameters	T1 Control	T2 Unsieved	T3 Sieved	T4 Pulverized	T5 Wet- grated	T6 Chips
Dry matter (%)	90.22	91.01	90.68	90.99	91.21	90.73
Crude protein (%)	15.83	17.23	16.25	17.61	15.25	15.07
Crude fibre (%)	6.17	8.39	8.17	8.94	8.42	9.05
Ether extract (%)	6.41	10.21	9.42	9.81	10.48	8.89
Ash (%)	3.95	6.98	5.54	6.70	6.23	7.03
NFE (%)	67.64	58.19	60.62	56.94	59.62	59.96

NFE – Nitrogen Free Extract

Table 4: Growth performance of rabbits fed experimental diets

Parameters	T1 (Control)	T2 (Unsieved)	T3 (sieved)	T4 (Pulverized)	T5 (Wetgrated)	T6 (Chips)	SEM
Initial weight (g/rabbit)	650.0	645.0	644.0	645.0	640.0	650.0	23.45
Final Live weight (g/rabbit)	1216.3[a]	1060.0[a]	1038.8[a]	636.3[b]	1016.3[a]	1048.8[a]	57.37
Daily weight gain (g/rabbit)	18.93[a]	15.14[a]	14.84[a]	9.19[b]	16.86[a]	14.98[a]	0.83
Total feed intake (g/rabbit)	3318.0	3547	3521	2714.8	3087.0	3521.0	122.84
Daily feed intake (g/rabbit)	47.40	50.68	50.30	38.78	44.10	50.30	1.75
Feed Conversion Ratio	2.54	3.45	3.40	7.06	2.70	3.37	0.62
Mortality (%)	16.67[b]	0.00[c]	0.00[c]	33.33[a]	16.67[b]	0.00[c]	4.63
Protein Efficiency Ratio	0.02	0.01	0.01	0.01	0.01	0.01	0.00

[abcd] Means on the same row having different superscript were significantly different (P<0.05).
SEM – Standard Error of Mean

Table 5: Nutrient digestibility of rabbits fed experimental diets

Parameters	T1 (Control)	T2 (Unsieve)	T3 (sieved)	T4 (Pulverized)	T5 (Wetgrated)	T6 (Chips)	SEM
Dry Matter (%)	74.26	74.26	74.15	74.69	74.64	74.26	0.26
Crude Protein (%)	80.54^{a}	76.63^{b}	75.26^{b}	74.57^{b}	76.15^{b}	75.38^{b}	0.63
Crude Fibre (%)	63.41	63.81	65.19	60.40	62.95	65.10	0.67
Fat (%)	72.81	71.59	65.19	67.38	64.43	70.31	1.25
Ash (%)	64.47^{a}	58.87^{ab}	53.27^{b}	55.83^{ab}	59.35^{ab}	59.73^{ab}	1.25

^{abcd} Means on the same row having different superscript were significantly different (P<0.05).
SEM – Standard Error of Mean

Table 6: Haematological indices and serum biochemistry rabbits fed experimental diets

Parameters	T1(Control)	T2(Unsieved)	T3(sieved)	T4(Pulverized)	T5(Wetgrated)	T6(Chips)	SEM
HEAMATOLOGY							
PCV (%)	23.00^{d}	30.00^{c}	35.00^{b}	44.00^{a}	42.00^{a}	33.00^{bc}	1.77
HB (g/dl)	7.70^{d}	10.10^{c}	11.70^{b}	15.10^{a}	14.00^{a}	12.00^{b}	0.61
RBC ($X10^{12}$/L)	1.85^{d}	2.41^{c}	2.83^{b}	3.63^{a}	3.40^{a}	2.65^{bc}	0.15
MCH (pg)	41.62^{ab}	41.89^{a}	41.34^{bc}	41.32^{bc}	41.18^{c}	41.51^{abc}	0.07
MCHC (g/dL)	33.48^{b}	33.67^{a}	33.43^{b}	33.33^{b}	33.33^{b}	33.83^{a}	0.04
MCV (fl)	12.43	12.45	12.37	12.40	12.35	12.45	0.02
WBC ($X10^{3}$/L)	6.50^{c}	6.70^{bc}	7.10^{b}	6.60^{c}	8.60^{a}	6.80^{bc}	0.18
Neutrophil (%)	37.00	34.00	33.00	36.00	33.00	35.00	0.57
Lymphocyte (%)	59.00^{ab}	61.00^{ab}	60.00^{ab}	58.00^{b}	63.00^{a}	62.00^{ab}	0.61
Eosinophil (%)	3.00^{b}	4.00^{ab}	5.00^{a}	4.00^{ab}	3.00^{b}	3.00^{b}	0.27
Monocyte (%)	1.33^{ab}	1.33^{ab}	1.67^{a}	1.67^{a}	1.33^{ab}	0.33^{b}	0.16
SERUM BIOCHEMISTRY							
Total Protein (g/dl)	5.80^{a}	5.30^{cd}	5.40^{bc}	5.60^{ab}	5.50^{bc}	5.10^{d}	0.60
Globulin (g/dl)	2.33^{a}	1.70^{b}	2.00^{ab}	1.80^{ab}	1.80^{ab}	2.00^{ab}	0.05
Albumin (g/dl)	3.57^{ab}	3.60^{ab}	3.40^{b}	3.80^{a}	3.70^{a}	3.10^{c}	0.06
Glucose (Mg/dl)	162.07^{c}	153.10^{d}	170.40^{a}	166.40^{b}	159.07^{c}	162.20^{c}	1.37
Urea (Mg/dl)	36.00^{bc}	31.00^{d}	39.00^{abc}	40.00^{ab}	42.00^{a}	35.00^{cd}	0.99

^{abcd} Means on the same row having different superscript were significantly different (P<0.05).PCV– Packed Cell Volume, HB– Haemoglobin, RBC– Red Blood Cell, WBC – White Blood Cell, MCH – Mean Corpuscular Haemoglobin, MCHC – Mean Corpuscular Haemoglobin Concentration, MCV –Mean Corpuscular Volume, SEM – Standard Error of Mean

Table 7: Carcass Analyses of rabbits fed experimental diets

Parameters	**T1 (Control)**	**T2 (Unsieved)**	**T3 (sieved)**	**T4 (Pulverized)**	**T5 (Wetgrated)**	**T6 (Chips)**	**SEM**
Slaughter characteristics							
Live weight (g)	2067.50^{a}	1760.00^{c}	1710.00^{d}	1505.00^{e}	1952.50^{b}	1687.50^{d}	55.90
HCW (g)	1796.00^{a}	1500.00^{d}	1493.50^{d}	1352.00^{e}	1681.00^{b}	1556.00^{c}	43.11
ECW (g)	1176.50^{a}	995.50^{c}	1031.00^{c}	789.50^{e}	1031.00^{b}	932.50^{d}	33.48
DP (%)	56.91^{bc}	56.56^{bc}	60.28^{a}	52.46^{d}	57.48^{b}	55.26^{c}	0.73
Retail parts (% live weight)							
Shoulder	11.37	18.47	19.21	18.84	21.46	19.62	0.38
Racks	21.57^{c}	21.71^{bc}	22.29^{ab}	20.47^{d}	19.57^{e}	22.50^{a}	0.32
Loin	17.64^{a}	15.86^{b}	18.01^{a}	13.19^{c}	16.22^{b}	13.21^{c}	0.58
Head	7.43^{c}	7.96^{b}	7.26^{cd}	8.54^{a}	7.09^{d}	8.45^{a}	0.17
Tail	0.15^{ab}	0.09^{b}	0.18^{a}	0.10^{ab}	0.13^{ab}	0.15^{ab}	0.01
Internal organs (% live weight)							
GIT	17.72^{c}	15.93^{d}	15.09^{d}	24.89^{a}	15.93^{d}	20.69^{b}	1.04
Liver	1.65^{c}	2.39^{a}	1.84^{b}	1.86^{b}	1.73^{bc}	1.69^{bc}	0.08
Heart	0.27^{a}	0.14^{b}	0.15^{b}	0.20^{ab}	0.28^{a}	0.15^{b}	0.02
Kidney	0.59^{b}	0.69^{a}	0.62^{ab}	0.63^{ab}	0.59^{b}	0.63^{ab}	0.01
Lung	0.49^{b}	0.66^{a}	0.56^{ab}	0.54^{ab}	0.64^{a}	0.42^{b}	0.03

^{abcd} Means on the same row having different superscript were significantly different ($P<0.05$).
HC W – Hot Carcass Weight, EC W – Empty Carcass Weight, DP – Dressing Percentage,
SEM – Standard Error of Mean

Table 8: Sensory evaluation of rabbits fed experimental diets

Parameters	T1 (Control)	T2 (Unsieved)	T3 (sieved)	T4 (Pulverized)	T5 (Wetgrated)	T6 (Chips)	SEM
Colour	7.15^{c}	7.10^{c}	8.25^{a}	7.75^{ab}	7.50^{bc}	7.50^{bc}	0.12
Juciness	6.95^{ab}	6.70^{c}	7.10^{a}	7.00^{a}	6.25^{d}	6.80^{bc}	0.01
Flavour	7.60^{ab}	7.65^{a}	7.10^{bc}	7.45^{abc}	7.05^{c}	7.05^{c}	0.09
Saltiness	3.50^{bc}	3.60^{abc}	3.85^{ab}	3.70^{abc}	4.00^{a}	3.35^{c}	0.08
Tenderness	5.55^{c}	6.75^{ab}	5.65^{c}	5.75^{c}	6.95^{a}	6.50^{b}	0.17
Overall Acceptability	7.45^{a}	7.55^{a}	7.30^{ab}	6.75^{b}	7.40^{a}	7.30^{ab}	0.09

Table 9: Cost benefit analysis rabbits fed experimental diets

Parameters	T1 (Control)	T2 (Unsieved)	T3 (sieved)	T4 (Pulverized)	T5 (Wetgrated)	T6 (Chips)	SEM
Feed Consumed (kg)	3.32	3.55	3.52	2.71	3.09	3.52	0.40
Feed Cost (₦/kg)	75.65	56.68	57.55	57.21	57.35	56.87	2.05
Total Feed Cost (₦/kg)	250.86^{a}	203.42^{b}	202.63^{b}	155.33^{d}	177.04^{c}	200.24^{b}	7.27
Feed Cost/ WG(₦/kg)	206.52^{b}	192.12^{c}	195.09^{c}	264.88^{a}	174.34^{d}	193.33^{c}	7.02
Feed Cost Savings (%)	0.00	24.19	23.93	24.38	24.19	24.82	2.73

The effect of differently processed cassava diet on the cost benefit analysis is shown in table 9. The result obtained in this experiment showed that the feed consumed, feed cost and feed cost savings were not significantly ($P > 0.05$) affected. While the total feed cost and feed cost/weight gain were significantly ($P < 0.05$) affected.
The value of the total feed cost was recorded highest ($P < 0.05$) in the control diet 250.86 and the least value 155.33 was recorded in the T4 diet. The feed cost/ weight gain values recorded highest 264.88 in T4 diet, followed by 206.52 in control diet and statistical similar values of 195.09, 193.33 and 192.12 for T3 diet, T6 diet and T2 diet respectively, while the least value 174.34 was recorded for T5 diet

4 Discussion

The result of chemical composition of the processed CASSOY showed that crude protein content (21.69 % – 28.92 %). The level of crude protein (CP content) is of particular nutritional significance as it may meet animal protein energy requirement and help to boost the immune system against diseases and gastrointestinal parasite infestation. [25] [16]. The crude protein content of the CASSOY used in this study was high. This confirmed the potential of the extruded full fat soybean as a good alternate source of protein to the soybean meal. The crude protein values were in line with the crude protein recorded by 27.5 % for cassava root meal [31], 27% for cassava root meal [36] and 20 % for cassava leaf meal [35]. Proteins are essential for continous replenishment of the endogenous protein that is lost due to infections with gastrointestinal helminthes. The crude protein obtained is adequate to meet nutrient requirement of different classes of rabbits [19] [1].

The dry matter content of the CASSOY in the present study compared favourably with the findings of [35] and [38], who reported (87.16 – 94.99) % and (89.78 – 92.56) % respectively.

The ether extract recorded in this study was quite higher than the range of (4 – 10) % recommended by [44]. This could be as a result of the cassava processing and inclusion of the extruded full fat soybean which goes to show the variation of values across the different CASSOY especially the chip method which recorded the lowest value.

Ash content reflects the mineral composition of the diet and it is an indication of intrinsic ability of the diet to supply minerals to the rabbits. The values of ash content recorded in this study was lower to that reported 9.85 % by [38] for cassava peel / soybean residue and close to that reported 5.32 % for [36] for cassava sievate with soybean milk residue. The HCN and TIU values recorded showed that the processing method of the cassoy reduced the anti-nutritional factors to bearest minimum.

The Trypsin Inhibitor Unit (TIV) values of the blended CASSOY samples were low and within the ranges recommended by [13], this is due to the extension process of the full fat soybean. The hydrogen cyanide corresponds with the general optimum tolerance level recommended for livestock [52].The crude protein contents of the experimental diet presented in this study showed that the crude protein (15.25 – 17.61) % met the minimum nutrient requirement of weaner rabbits ranging from (15 – 18) % reported by [5] [18] [27] but below the optimal crude protein level of (18 – 20) % as recommended by [49]. Differences were observed between calculated and analyzed crude protein of the experimental diets. The differences may be due to variation between tabulated nutrient content values used in the calculation and actual nutrient content of the ingredient used in formulating the diets. The crude fibre values corroborated with the findings of [35] but was in comparism to the findings of [38] and [12] who reported a value ranges of (9.89 – 10.21) % and (9.1 – 12.3) % respectively.

Although, it is below the value recommended by FAO who stated that the crude fibre of the treatment diets were higher than that of the control diet but the values of all the diets fell within the range of (6 – 16) % as recommended by [49]. To get enough bulk (fibre) for growing rabbits, (13 – 14) % crude fibre content seems satisfactory. Some researches indicate that rabbits need a certain minimum of fibre or regular digestion; (9-10) % of indigestible crude fibre, (FAO). From this study, it was observed that the crude fibre of the treatment diet recorded higher crude fibre than that of the control diet, this was as a result of the inclusion of the processed cassava in the diets. The ether extract recorded was high due to the presence of the extruded full fat soybean which is known to have a high proportion of fat.

The average final live weight values obtained in this study ranged between (636.3 – 1216.3) g/rabbit and lower than the values reported by [39], [31] and [37] but close to the range reported by [36]. The daily weight gain (9.19-18.93) g/rabbit was quite low compared to [31] who reported range of (44.1 – 45.1) g fed varying levels of cassava root meal in the diet to rabbits. Similar results have been reported by (9.96 – 12.85) g [36] and (8.6 – 15.0) g [12] and [40]. Feed conversion ratio was not significantly affected by the experiment. The mortality rate recorded in this study could be attributed to the health and environment factors. The apparent digestibility showed that the rabbits in control diets T1 (control) and T2 (un-sieved) had better nutrient digestibility than T3 (sieved), T4 (pulverized), T5 (wet grated) and T6 (chips). The crude protein digestibility range (74.57-80.54) % tallies within the findings (72.65 – 82.88) % of [39], closely ranged with results (63.3 – 76.44) % obtained by [36] and higher than the values (54.2 – 65.7) % reported by [40]. According to [19] and [18], the high values indicated efficient utilization on concentrate feed protein and forage protein by rabbits. The ash digestibility of ranges (53.27 – 64.47) % falls within the results (34.7 – 63.44) % reported by [36]. Generally the ash digestibility obtained in this study across the treatment groups is lower compared with other nutrients.

The mean PCV values of (23 – 44) % obtained in this study with the exception of that of the control diet were within the normal range as reported by [29], [37] and [28] for growing rabbits. This was in contrast with [12] findings who carried out a research to assess the blood composition of rabbits fed dietary levels of cassava and yam wastes and not in line with [41] who reported a value of (41.09 – 49.74) % for rabbit fed control diet.

However, the values obtained from this study was not in line with [39] who reported a value of 40% for rabbits fed control diet. The Packed Cell Volume values were in line with results of [34] who also reported the haematological parameters of weaning rabbits fed sesame seed meal in a semi-arid region and not in line with [6] who reported value range of (19.6 – 28.5) % for weaner rabbits fed raw or processed pigeon pea seed meal based diets. [3] reported that haematological traits especially Packed Cell Volume and Haemoglobin were correlated with the nutritional status of the animal.

Futhermore, [30] reported a PCV range of (30 – 50) % which is in line with the values of this study. The Hb value (7.10 – 15.1) g/dl falls within the recommended values (10-15) g/dl of [28] , (10 – 15) g/dl of [46], (8 – 17) g/dl of [9] and (13.2 – 13.4) g/dl of [53] and higher than recommended values (7.02 – 10.48) g/dl of [37]. The values obtained in this study agrees with [12] who recorded a value range of (8.2 – 12.5) g/dl for rabbits fed dietary levels of cassava and yam wastes. Low haemoglobin concentration of 10.30 g/dl reported by [14], could be due to the harmful effects of high dietary contents. The Hb values (10.3 – 12.0) g/dl of [33] is in line with the values obtained from this study. PCV and Hb have been shown to indicate nutritional status. [6] values of Hb (6.5 – 8.4) g/dl were not in line with the observations of this study.

The Hb value recorded for rabbits fed control diet 7.70 g/dl was lower compared to 12.30 g/dl from [39] who fed rabbits control diets containing the same ingredients at similar proportion. This could be attributed to the environmental factor according to [50] and [2] who observed that factors such as age, nutrition, health, degree of physical activity, sex and environmental factors affect blood values of animals. The red blood cell counts (1.85 – 3.63) $X10^{12}/L$ recorded in this study were not within the recommended ranges of (5 – 8) $X10^{12}/L$, (6.65 – 6.68) $X10^{12}/L$, (3.8 – 7.9) $X10^{12}/L$, (4 – 8.6) $X10^{12}/L$ reported by [9], [28], [29] and [53]. According to [53], when the haemtological values fall within the normal range reported for rabbits by [29], it is an indication that the diets did not show any adverse effects on haemalogical parameters during the experimental period but when the values fall below the normal range, it is indication of anaemia [29] [45]. The WBC counts in this study (6.5 – 8.6) $X10^3/L$ falls within the recommended ranges (3.0 – 12.5) $X10^3/L$, (8.72 – 9.56) $X10^3/L$, (4.5 – 11) $X10^3/L$ and (5 – 13) $X10^3/L$ reported by [9], [28], [46] and [53] respectively.

The value of White Blood Cell count in this study falls in line with [41] who reported a range of (5.80 – 20.10) $X10^3/L$ as normal values of haematological and some biochemical parameters in serum and urine of New Zealand white rabbits. It goes to show that the rabbits remained healthy because decrease in number of WBC below the normal range is an indication of allergic conditions, anaphylactic shock and certain parasitism or presence of foreign body in circulating system [6].

The Mean Corpuscular Haemoglobin value in this study (41.88 – 41.89) pg is lower than the recommended values (18 – 24) pg [28], (19.85 – 20.06) pg [53]. The result was not in accordance with [12] who obtained a range of (20.8 – 24.5) pg from rabbits fed cassava waste and also not in line with [39] who obtained a value of 33.50 pg for rabbits fed unpeeled cassava root meal. [33] posited that Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) are used in diagnosing anaemic conditions. MCHC values (33.33 – 33.83) g/dl obtained from this study aligned with the recommended ranges (27 – 37) g/dl and (27 – 34) g/dl of [46] and [28] respectively. The results of the MCHC was in accordance with [53] recommended value of (3.30 – 3.33) g/dl for rabbits.

Lymphocyte in this study falls within the values (43 – 80) % of [28]. It also falls within the recommended value (40 – 80) % [46] but contradicts the findings (31.6 – 33.6) % of [53] and (33 – 37) % of [6]. The higher the value of leucocyte count, the better the ability of the animal to fight disease [47]. Monocyte values (0.33 – 1.67) % obtained from this study falls within the recommended range of [28], [46] and [53]. Eosinophil on the other hand was higher than the recommended value for rabbits as stated by [28] and [46].

Total serum protein value obtained in this study falls within the recommended value (5 – 7.5) g/dl of [28]. It was greater than the values (2.9 – 5.3) g/dl obtained by [6] and lower than the values (5.81 – 6.75) g/dl recorded by [39] and (5.2 – 6.3) g/dl by [12]. Globulin value fell within the recommended value (1.5 – 3.3) g/dl of [28]. The result fell within the ideal range (1.94 – 2.26) g/dl obtained by [38], (1.10 – 2.70) g/dl by [6] and (1.30 – 2.0) g/dl by [33].

The Albumin value (3.1 – 3.8) g/dl fell within the recommended values of (2.5 – 4.0) g/dl, reported by [28] and [9] and lower than the values (4.1 – 4.2) g/dl reported by [34]. It also fell within the values (3.07 – 4.50) g/dl and (2.3 – 4.3) g/dl reported by [39] and [41]. Glucose (153.1 – 170.4) mg/dl contradicted the recommended values (50 – 140) Mg/dl of [28]. It was close to the result (125 – 192.4) mg/dl obtained by [39]. Urea values (31 – 42) mg/dl reported in this study was below the normal range of (8.1 – 25.0) mg/l reported by [24] for rabbits reared in the temperate climate. The result was close to that (37.56 – 43.38mg/dl) obtained by [39] and lower than (49.3 – 70.6mg/dl) obtained by [6]. The values obtained in this study for the carcass and organs parameter of rabbits not in agreement with values reported by [31] who fed rabbit unpeeled cassava root meal at various inclusion level. The values obtained from the organs, heart and kidney agrees with the values reported by [36] who fed rabbits, cassava sievate/soybean milk residue mixture replacement for maize in growing rabbit's diet. But there is a contradiction in the ranges of result obtained from lungs and liver. [15] reported that if there were any toxic elements in the feed, abnormalities will be observed in the weight of liver and kidney. The abnormalities would arise as a result of increased metabolic rate of the organ in an attempt to reduce the toxic metabolites or the anti–nutritional factors to non-toxic metabolites [6]. In this study there was no visible abnormality in any of the organ which confirms the safety of the test ingredients consumed by the rabbits.

The dressing percentage values were with the range reported by [36], but higher that the values obtained by [34].

The sensory quality attributes show that the rabbit meat was well accepted irrespective of the processing method of the cassava as none of the palatability criteria were adjudged below average by the taste panels. Tenderness values obtained from this study was in agreement with the range (5 – 5.63) reported by [12]. [55] reported that tenderness is regarded as the most important sensory attribute affecting meat acceptability and the most critical eating quality characteristics which determines whether consumers are repeated buyers.

The study showed that result of the cost benefit analysis of this experiment which recorded lowest total feed cost in the T4 diet and the highest total feed cost in the control diet. This is due to the high cost of maize and soyabean meal at the time of this study compare with low cost of cassava and extended full fat soyabean. According to [7], high cost of feed has been attributed to escalating prices of conventional feed ingredients especially the energy sources such as maize, sorghum etc. The feed cost/ WG in this study recorded the lowest in T6 diet and the highest in T4 diet. This is due to the very poor FCR of the rabbit fed T4 diet which in turn was as a result of high rate of mortality recorded for this treatment. This result indicates that replacing maize with cassava in rabbit diet would minimize cost and maximize profit yield.

5 Conclusions

The experiment showed that CASSOY 3 (50:50) blend via pulverized method recorded the highest crude protein and least TIU value. The superiority of the rabbits on control diets relative to those on treatment diets as evidenced by reduced weight, crude protein and ash digestibility is an indication that inclusion of CASSOY does not improve neither the growth performance nor nutrient digestibility. Dietary inclusion of CASSOY (pulverized) in rabbits tend to improve various haematological parameters such as the PVC, Hb and RBC, while some of the serum biochemical constituents such as Total protein and globulin where improved by the control diet. The carcass analysis recorded highest values of live weight, hot carcass weight and empty carcass weight from rabbit fed control diet which is an indication of the high growth performance and nutrient digestibility. The result of the sensory evaluation recorded the highest overall acceptability for rabbits fed T2 diet (un-sieved). The cost benefit analysis recorded the experiment diet having lower cost value to that of the control diet.

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APPENDIX 1: SAMPLE OF HEDONIC SCALE

Score	Colour	Juiciness	Flavour	Taste	Tenderness	Overall Acceptability
1	Dislike Extremely	Extremely Dry	Extremely Bland	Extremely Tasty	Extremely Tough	Dislike Extremely
2	Dislike Very Much	Very Dry	Very Bland	Very Tasty	Very Tender	Dislike Very Much
3	Dislike Moderately	Moderately Juicy	Moderately Meaty	Moderately Tasteless	Moderately Tender	Dislike Moderately
4	Dislike Slightly	Slightly Dry	Slightly Bland	Slightly Tasty	Slightly Tender	Dislike Slightly
5	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
6	Like Slightly	Slightly Juicy	Slightly Meaty	Slightly Tasteless	Slightly Tender	Like Slightly
7	Like Moderately	Moderately Juicy	Moderately Meaty	Moderately Tasteless	Moderately Tender	Like Moderately
8	Like Very Much	Very Juicy	Very Meaty	Very Tasteless	Very Tender	Like Very Much
9	Like Extremely	Extremely Juicy	Extremely Meaty	Extremely Tasteless	Extremely Tender	Like Extremely