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Synergetic Effect of Cassava Sievate/Soybean Milk Residue Mixtures as Replacement for Maize in Growing Rabbits Diet

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Abstract
The grain replacement value of cassava sievate/soybean milk residue (CS/SBMR) mixtures was investigated in a 56 days feeding trial using thirty two (32) cross bred rabbits of mixed sexes with average weight range of 546.38 ± 30.76 and 560.88 ± 29.020g. Four diets were formulated as follows: Diet 1 without inclusion of CS/SBMR served as the control. Diets 2, 3, and 4 had CS/SBMR mixtures replacing corn of the control diet at 25, 50 and 75 % respectively. The animals were randomly distributed to the four dietary treatments. Each treatment had eight animals with each rabbit serving as a replicate in a completely randomized design experiment. Results showed that there were significant differences (P<0.05) in the final live weight, daily weight gain, feed to gain ratio, daily feed intake, feed cost per kg (₦) . Diets with CS/SBMR mixtures had similar (P<0.05) average daily weight gains of 12.85 ± 1.81, 11.55 ± 0.39 and 11.26 ± 1.18 for T2, T3 and T4 respectively which are higher (P<0.05) than 9.96 ± 1.21 of the control. The digestibility of nutrients shows that the dry matter, crude protein as well as ether extract digestibilities across the treatments were similar (P>0.05) for rabbits in treatments 1, 2 and 3 but higher (P<0.05) than rabbits in treatment 4. Rabbits fed 50 % inclusion level of CS/SBMR had the lowest (P<0.05) cost per kg weight gain (N152.77/kg weight gain). The heamatological parameters measured were not affected by dietary treatments. Relative kidney and liver weights were not affected (p>0.05) but the dressed carcass, dressing percentage, heart, lungs and spleen were affected (p<0.05) by dietary treatments. Inclusion of cassava sievate/soybean milk residue mixtures in the diets of growing rabbits enhanced growth, reduced cost of production and is thus recommended for use by resource poor farmers to partially replace the expensive conventional maize.
Keywords: cassava sievate, soybean milk residue, growing rabbits, performance

Introduction

Foods of animal origin are recognized as having high energy density and as good sources of high-quality protein; readily available iron and zinc; vitamins B6, B12 and B2; and, in liver, vitamin A. They also enhance the absorption of iron and zinc from plant based foods (Gibson, 2011). Increasing access to affordable animal source foods could therefore significantly improve nutritional status and health for many poor people, especially children (FAO 2013). The expansion of the livestock industry is however been threatened by persistent feed ingredient shortages. In the event of global feed crisis therefore, the only pragmatic approach to solving the escalating prices of feed ingredients is the use of alternatives to the conventional ingredients that can partly or wholly replace them without compromise on the health status and performance of the animals. The high cost of both cereal and legume grains have generated interest in the use of grain by-products and other crop residues (Nuhu *et al*., 2008). Maize serves as a staple food for a large proportion of people in Nigeria and it represents between 45 and 55% of most poultry diet. Consequent upon the demand by livestock, direct consumption by man and the high demand for industrial uses, there is continuous rise in its market price thus making it difficult to wholly use it in formulating feeds and still get the expected margin of profit to sustain increase productivity especially in monogastric animal production. According to Bickel and Deboer (1988), the extents to which by-products can be utilized depend on the cost of the feedstuff, their safety for animal health and alternative uses. Ojebiyi (2009), added that in order to be useful alternatives the potential feed ingredient must not be a stable item of food that is directly eaten by man to avoid scarcity; it must be available all year round; it must be easy to procure and process (if need be) and preserved into usable form; it must have a comparative cost advantage over the conventional feeds stuff and must not contain toxic factors at levels lethal to animals. Cassava sieviate (CS) and soybean meal milk residue are agro by-products with potential as ingredient in rabbit diet which can reduce the cost of production. Ogbonna *et al*., (1993) and Bamgbose (1995) had earlier reported that industrial by-products such as wheat offals, palm kernel cake, cassava peel, rice offal and maize offal can replace a sizeable proportion of maize in poultry ration. Earlier work by Ojebiyi *et al*., (2011), reveals that SBMR/CS (3:2) mixtures can be incorporated in the diets of African giant land snail up to 30% without adverse effect on performance. Iyeghe-Erakpotobor (2006), reported that soyabean cheese waste meal is widely used by farmers for fattening sheep and cattle. However the potential of cassava sieviate and soybean milk residue in replacing maize in rabbit diet has not been fully exploited. This forms the basis of this study.

Materials and methods

Site of the Experiment: The experiment was conducted at the Rabbitary Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo state. Ogbomoso is located within the derived Savannah zone of Nigeria.

Collection and Preparation of Test Ingredients:
The Cassava sievate used for this study was collected from local garri processing plants and Teaching and Research Farm garri processing unit while the Soybean milk residue was collected from local soybean milk producers. The processing of the cassava sievate and soybean milk residue was done by the procedures of Ojebiyi *et al.*, (2011).

***Formulation of experimental diets*:** The cassava sievate and soybean milk residue were combined in ratio 3:2 and mixed with other feed ingredients to formulate four experimental diets as follows, Diet 1: 0% CS/SBMR mixtures, Diet 2: 25% CS/SBMR mixtures, Diet 3: 50% CS/SBMR mixtures, Diet 4:75% CS/SBMR mixtures (Table 1)

Table 1: Gross composition of experimental diets

	Diets			
Ingredients (%)	**1**	**2**	**3**	**4**
Maize	24	18	12	6
CS/SBMR	0	6	12	18
Fixed ingredients[1]	76.00	76.00	76.00	76.00
Total	**100.00**	**100.00**	**100.00**	**100.00**

[1]Fixed ingredients: corn bran 13,Groundnut cake 13, rice bran 14,brewer dry grain 16 ,palm kernel 15.25, fish meal 1, bonemeal 2.5, premix 0.25 salt 0.5,lysine0.25, methionine 0.25

Experimental Animals and Management: Thirty two (32) cross-bred rabbits with initial weight range of 546.38 ± 30.76 and 560.88 ± 29.02g were used for the experiment. The rabbits were weight-balanced at the commencement of the experiment and randomly distributed into four treatment groups of eight rabbits each. Each rabbit served as a replicate in a completely randomized design experiment. Treatment groups 1, 2, 3 and 4 were assigned to diets 1, 2, 3 and 4 respectively. The rabbits were housed individually on wood-wire cages measuring 44 x 34 x 44 cm. The drinking and feeding trough made of earthen pot and reinforced with cement to prevent tipping-off were removable types for easy cleaning.

A total of 100g of feed divided into two portions of 50g in the morning (8.00 hr) and 50g in the evening (16.00 hr) were supplied to each rabbit per day while orts were collected and weighed in order to determine feed intake. There was a constant supply of fresh water. Temperature was not artificially controlled and varied between 25 and 27^0C. Humidity was not measured. There was no artificial light but minimum of 12 hour light / 24 hour. The rabbits were weighed on weekly basis and weight gain for each animal per week was calculated as the difference between the present weight and the weight for the previous week. The daily weight gain was obtained by dividing the total weight gain by the number of days. Feed to gain ratio was calculated as total feed intake divided by the weight gain for each animal.

Feed cost / kg weight gain was calculated by multiplying cost / kg of feed by the feed to gain ratio. The experiment lasted for 8 weeks.

***Digestibility Trial*:** Feacal samples were collected for five days at the seventh week from four rabbits per treatment for digestibility trials. The fresh feacal sample was weighed before and after sun drying and stored in a plastic bag. The samples collected for five days for each animal was bulked together and sub sample taken for analysis of proximate composition.

Haematological parameters: blood collected into EDTA bottles was analysed for red and white blood cells counts using haemocytometer method (Ghai, 1993). Packed cell volume (PCV) and Haemoglobin (Hb) were analysed by the methods of wintrobe micro haematocrit and Cyanomethaemoglobin (Ghai, 1993) respectively.

Carcass and Organ Evaluation: At the end of the experiment (8 weeks), the rabbits were tagged, starved overnight and weighed before being slaughtered. They were scalded and eviscerated to remove the internal organs for measurement. The dressed carcass as well as the internal organs were weighed and expressed as a percentage of the body weight.

Laboratory analysis: The proximate composition of the test ingredients, experimental diet, and the faecal samples were analyzed using the procedure of AOAC (2005). Hydrogen cyanide content was determined by photo spectrometric method using the procedure described by Bradbury *et al.* (1990) and Egan *et al.* (1988). Gross energy was determined by Gallenkamp Ballistic Bomb Calorimeter.

All data collected were subjected to one way analysis of variance using the General Linear Model (GLM) of SAS (2000). Duncan Multiple Range Test of the same statistical package was used for comparing the means.

Results and Discussion

The chemical composition of CS/SBMR is presented in Table 2. The profile of the test ingredients shows that they have potential as ingredients for use in rabbit diet.

Table 2: Chemical composition of Test ingredients

Parameters	Soybean milk residue	Cassava sievate	CS\SBMR
Crude protein (%)	43.93	2.00	13.22
Crude fat (%)	4.88	0.28	3.86
Crude fibre (%)	4.04	1.22	2.00
Ash (%)	5.72	1.71	5.32
Dry matter (%)	92.02	91.72	91.24
Gross Energy (Kcal/g)	3.151	2.314	2.631
HCN (Mg/kg)	------	1.14	0.97

CS/SBMR = Mixture of cassava sievate with soybean milk residue

The proximate composition of the experimental diets (Table 3) shows that the nutrients are adequate to support good growth of growing rabbits (Lebas *et al.,* 1986, NRC, 1984).

Table 3: Proximate composition of Experimental Diets

Composition	Diet 1	Diet 2	Diet 3	Diet 4
Dry Matter (%)	90.76	90.65	90.83	90.61
Crude Protein (%)	16.58	16.75	16.47	16.82
Crude fibre (%)	10.48	10.50	10.52	10.54
Ash (%)	5.13	4.97	5.29	5.23
Crude Fat (%)	4.06	4.21	4.57	4.39
G E (Kcal/g)	3.186	3.186	3.204	3.167

G E = Gross Energy
Diet 1 = 0% inclusion level of cassava sievate/ soybean milk residue
Diet 2 = 25% inclusion level of cassava sievate/soybean milk residue
Diet 3 = 50% inclusion level of cassava sievate/soybean milk residue
Diet 4 = 75% inclusion level of cassava sievate/soybean milk residue

The performance characteristic is presented in Table 4.

Table 4: Growth Performance of Rabbit fed CS/SBMR (3:2)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4
Initial live weight (g)	548.63 ± 35.67	546.38 ± 30.76	546.75 ± 20.76	560.88 ± 29.02
Final live weight (g)	1106.00 ± 49.26^{b}	1214.13 ± 50.97^{a}	1155.38 ± 84.75^{ab}	1143.50 ± 107.29^{ab}
Weight gain (g/rabbit/day)	9.9 6± 1.21^{b}	12.85 ± 1.81^{a}	11.55 ± 0.39^{a}	11.26 ± 1.18^{a}
Feed intake (g/rabbit/day)	40.75 ± 1.15^{b}	45.16 ± 0.91^{a}	38.85 ± 2.09^{ab}	41.33 ± 1.63^{b}
***Feed cost/kg** (₦)	46.23±1.13^{a}	43.99±1.24^{b}	41.74±1.18^{c}	39.5±1.11^{d}
Feed to gain Ratio	4.59 ± 0.61^{a}	3.93 ± 0.11^{a}	3.66 ± 0.32^{b}	4.65 ± 1.58^{a}
***Feed cost/kg weight gain** (₦)	212.20±5.99^{a}	172.88±4.88^{c}	152.77±4.31^{d}	183.68±5.18^{b}

^{a,b,} Means showing the same superscripts on the same row are not significantly different (P>0.05)

***1 US Dollar = 160 Nigeria Naira**

Diet 1 = 0% inclusion level of cassava sievate/ soybean milk residue
Diet 2 = 25% inclusion level of cassava sievate/soybean milk residue

Diet 3 = 50% inclusion level of cassava sievate/soybean milk residue
Diet 4 = 75% inclusion level of cassava sievate/soybean milk residue

The final live weight values obtained in this study ranged between 1106.00 to 1214.13g and falls within the range of values reported by Ayanwale *et al.*, (2006). Although the ADG values of between 9.96 and 12.85 observed in this study is higher than 6.68 to 7.30 reported by Babarinde (2006), the values were lower than 15g to 20g obtainable in the temperate (Ivor, 1994 and Lebas *et al*, 1986). The lower ADG under tropical conditions can be due to factors like breed, nutrition, climate, stress, disease and management (Lebas *et al*, 1986). The cost of feed per kg reduced linearly (p<0.05) from 46.23 ±1.13 in the control diet (Diet 1) to ₦39.50±1.11 in diet 4 implying that CS/SBMR mixtures has cost saving effect. The most economical in terms of cost of feed per kilogramme weight gain is diet 3, which translate to higher revenue and more profit .

All haematological parameters measured in this study (Table 5) were not (P>0.05) affected by dietary treatments and the values obtained falls within the normal range reported for rabbit by Mitruka and Rawnsley (1977). Although, the Packed Cell Volume obtained in this study were not significantly (P>0.05) different among the treatment, they were a little higher than the value reported by Farinu *et al.*, (1999) who fed mango seed meal to rabbit. Also, the value of haemoglobin obtained this study were higher than the value reported by Omole and Ajayi (1976) who fed dried brewer grain to rabbit. The values of Red Blood Cell obtained in this study were higher than the values reported by Adewumi *et al.*, (2004) while the value of White Blood Cell obtained were higher than the values reported by Taiwo *et al.*,(2006) who fed raw and cooked mucuna seed meal to weaned rabbits.

Table 5: Haematological parameters of rabbits fed cassava sievate/ soybean milk residue mixture (3:2)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4
P C V (%)	27.75±1.50	28.13±1.72	27.63±2.66	28.25±1.14
Heamoglobin (g/dl)	8.88±0.53	8.09±0.59	8.53±0.9	9.68±0.33
RBC($x10^6$ mm^3)	9.11±0.29	9.08±0.19	9.32±0.66	8.41±0.86
WBC (x 10^3 mm^3)	7.05±0.78	7.08±0.58	7.80±0.57	7.95±0.14

Diet 1 = 0% inclusion level of cassava sievate/ soybean milk residue
Diet 2 = 25% inclusion level of cassava sievate/soybean milk residue
Diet 3 = 50% inclusion level of cassava sievate/soybean milk residue
Diet 4 = 75% inclusion level of cassava sievate/soybean milk residue

It can be inferred that since all the haematological parameters of rabbit fed with CS/SBMR mixtures are within the normal range and blood constituents can be used as a measure of health status, growing rabbit can have CS/SBMR mixtures included in their diet up to 75% level without any negative effect on health.

The nutrient digestibility by rabbits fed CS/SBMR (Table 6) shows that the dry matter crude protein and ether extract digestibilities of rabbits in diets 1 ,2 and 3 are similar (p>0.05) but higher than (p<0.05) than the values obtained for rabbits in diet 4. The dry matter digestibility of rabbits on the various treatments (56.30-71.30%) are similar to the values (66.67 to 75.69%) reported by Igwebuike *et al.*, (2008) who fed graded levels of albida pods.The crude fibre digestibility decreased ((p<0.05)) linearly as the level of CS/SBMR increases. Generally the crude fibre digestibility obtained in this study across the treatment groups is lower compared with other nutrients.

Table 6: Digestibility of Nutrients by Rabbits fed CS/SBMR

Parameters (%)	Diet 1	Diet 2	Diet 3	Diet 4
Dry Matter digestibility	71.30 ± 1.20^a	68.47 ± 1.18^a	71.02 ± 1.65^a	56.30 ± 2.34^b
Crude Protein digestibility	76.28 ± 1.36^a	74.72 ± 0.98^a	76.44 ± 1.28^a	63.3 ± .02^b
Ether extract digestibility	89.71 ± 0.43	91.25 ± 1.80	89.51 ± 0.06	84.22 ±1.12
Crude Fibre digestibility	56.66 ± 3.08^a	41.18 ± 1.80^b	34.92 ± 4.87^{bc}	27.54 ± 3.71^c
Ash digestibility	63.44 ±2.78^a	59.69 ± 2.29^{ab}	54.39 ± 1.71^b	34.70 ± 3.4^c
Gross Energy Digestibility	89.81 ± 0.42	88.58 ± 0.44	89.04 ± 0.62	84.00 ± 0.85

^{a,b,c,d} Means showing the same superscripts on the same row are not significantly different (P> 0.05),
Diet 1 = 0% inclusion level of cassava sievate/ soybean milk residue

Diet 2 = 25% inclusion level of cassava sievate/soybean milk residue
Diet 3 = 50% inclusion level of cassava sievate/soybean milk residue
Diet 4 = 75% inclusion level of cassava sievate/soybean milk residue

The control group had higher digestibility than the CS/SBMR containing diets, this is usually the case when dietary fibre is very high in lignin content (Egbeyale *et al*., 2012). This corroborate the earlier report of Cheeke (1977) and (1987) that fibre is poorly digested in rabbit because it is rapidly propelled through the colon and excreted as hard feaces and that digestibility of fibre by rabbit is lower than for most animals including pig and rat. The report corroborate the earlier claim of Longe and Adetola (1983)and Annison(1990) that pectin and lignin were the limiting factors in the utilization of fibrous plant feed resources. The high ether extract (EE) digestibility attested to the high ability of rabbits to utilize dietary fat (Beyen 1988). The digestibility of EE is in agreement with the observation of Cheeke *et al.*, (1987) and Onifade and Tewe (1983).

Carcass and Organ characteristics of rabbit fed varying inclusion level of CS/SBMR are presented Table 7. The values obtained for kidney and liver were not significantly (P>0.05) affected by the dietary treatments. It is a common practice in feeding trials to use weights of some internal organs like liver and kidney as indicators of toxicity. Bone (1979) reported that if there were any toxic elements in the feed, abnormalities will be observed in the weights of liver and kidney.

Table 7: Carcass and organ characteristics of growing rabbit fed cassava sievate/ soybean milk residue mixture (3:2.)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4
Dressed Carcass (g)	600.89±11.07^{c}	685.01±17.37^{b}	638.35±19.53^{b}	727.27±32.69^{a}
Dressing %	54.33±2.65^{b}	56.42±1.92^{b}	55.25±1.46^{b}	63.60±3.17^{a}
Heart (%of BW)	0.19±0.01^{c}	0.23±0.02^{ab}	0.25±0.01^{ab}	0.29±0.02^{a}
Kidney (% of BW)	0.58±0.01	0.59±0.03	0.64±0.04	0.59±0.04
Liver (% of BW	2.73±0.11	2.76±0.14	2.73±0.03	2.71±0.09
Lungs (% of BW)	0.95±0.09^{a}	0.83±0.02^{ab}	0.72±0.04^{b}	0.80±0.04^{ab}
spleen (% of BW)	0.14±0.02^{a}	0.08±0.00^{b}	0.07±0.00^{b}	0.07±0.00^{b}

[abc] Means along the same row with similar superscripts are not significantly different (P>0.05).
BW-Body Weight
Diet 1 = 0% inclusion level of cassava sievate/ soybean milk residue
Diet 2 = 25% inclusion level of cassava sievate/soybean milk residue
Diet 3 = 50% inclusion level of cassava sievate/soybean milk residue
Diet 4 = 75% inclusion level of cassava sievate/soybean milk residue

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 (Ahamefule *et al.*, 2006). In this study there were no visible abnormality thus confirming the safety of the test ingredients. The value obtained for eviscerated weight, dressing percentage, Heart, Lungs and Spleen were significantly (P<0.05) affected by the dietary treatments. The values obtained in this study for the carcass and organs parameters of rabbit agree with value reported by Rao *et al*., (1978) for growing rabbits. The observed trend in carcass weight may be due to difference in carbohydrate metabolism in maize and CS/SBMR mixtures.

Conclusion

It can be concluded that although 75% of maize in growing rabbit's diet can be replaced with CS/SBMR mixtures, however, 50% is most economical. The use of these non conventional ingredients will reduce production cost and increase expected returns to farmers thus stimulating higher productivity. The negative impact of disposing this waste/residues on the environment will also be minimize when used as ingredients for livestock.

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