

## The effect of dietary replacement of maize with spent sorghum residue-cassava peel composite meal on growth performance and feed cost analysis in the diet of growing rabbits

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### Abstract

Wastes of spent sorghum residues and cassava peels are noticed in burukutu joints and garri/cassava chips processing areas respectively, whereas, reports have it that they have individually been used comparatively to replace maize. Since cassava is relatively low in crude protein, it becomes necessary to combine it with a feedstuff with relatively high crude protein content in order to bring the final product to a protein level as close as possible to that of maize which it seeks to replace in terms of crude protein and metabolizable energy. Therefore, this study was carried out to evaluate the effect of Spent Sorghum Residue and Sundried Cassava Peels as a Composite Meal on Growth Performance and Feed Cost Analysis in the Diet of Growing Rabbits. A total of thirty crossbred weaned rabbits of mixed sexes, aged 4-6 weeks were used for the feeding trial which lasted for twelve weeks (84 days). The experimental animals were randomly allotted to five treatments and each treatment group was replicated six (6) times with one (1) rabbit per replicate in a completely randomized design (CRD). Five experimental diets were formulated using spent sorghum residue-cassava peel (SSR-CP) composite meal at 0, 25, 50, 75 and 100% to replace maize in diets  $T_1$ -  $T_5$ , respectively. The mixture of SSR-CP was in the ratio of 1:8 to give crude protein of approximately 9% (similar to that of maize). The response criteria at the end of the trial showed that, there were no significant ( $P>0.05$ ) differences in average daily feed intake, average daily weight gain, feed conversion ratio except protein efficiency ratio. The result on feed cost analysis showed that cost per kg diet decreased progressively from  $T_1$  (80.94) to  $T_5$  (53.09) as the levels of SSR-CP composite meals increased in the diets. The result has shown that maize could be replaced by SSR-CP meal up to 100% without any adverse effect on their performance and better economics of production.

**Keywords** –Spent sorghum residue-cassava peel composite meal, performance, feed cost analysis, rabbits

### L'effet du remplacement alimentaire du maïs par une farine composée de résidus de sorgho épuisés et d'écorces de manioc sur les performances de croissance et l'analyse du coût de l'alimentation dans l'alimentation des lapins en croissance



### Résumé

Des déchets de résidus de sorgho usés et d'épluchures de manioc sont observés respectivement dans les zones de transformation des joints de burukutu et des garri/copeaux de manioc, alors que des rapports indiquent qu'ils ont été utilisés individuellement pour remplacer le maïs. Le manioc étant relativement pauvre en protéines brutes, il devient nécessaire de l'associer à un aliment à teneur relativement élevée en protéines brutes afin d'amener le produit final à un taux de protéines aussi proche que possible de celui du maïs qu'il cherche à remplacer en termes de de protéines brutes et d'énergie métabolisable. Par conséquent, cette étude a été réalisée pour évaluer l'effet des résidus de sorgho usé et des

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*pelures de manioc séchées au soleil en tant que repas composite sur la performance de croissance et l'analyse du coût de l'alimentation dans le régime alimentaire des lapins en croissance. Un total de trente lapins croisés sevrés de sexes mixtes, âgés de 4 à 6 semaines ont été utilisés pour l'essai d'alimentation qui a duré douze semaines (84 jours). Les animaux expérimentaux ont été répartis au hasard dans cinq traitements et chaque groupe de traitement a été répété six (6) fois avec un (1) lapin par répétition dans une conception entièrement randomisée (CER). Cinq régimes expérimentaux ont été formulés à l'aide d'un repas composé de résidus de sorgho épuisés et d'écorces de manioc (RSE-EM) à 0, 25, 50, 75 et 100 % pour remplacer le maïs dans les régimes  $T_1$ –  $T_5$ , respectivement. Le mélange de RSE-EM était dans le rapport de 1:8 pour donner une protéine brute d'environ 9 % (similaire à celle du maïs). Les critères de réponse à la fin de l'essai ont montré qu'il n'y avait pas de différences significatives ( $P > 0,05$ ) dans l'apport alimentaire quotidien moyen, le gain de poids quotidien moyen, le taux de conversion alimentaire, à l'exception du taux d'efficacité protéique. Le résultat de l'analyse du coût des aliments a montré que le coût par kg de régime diminuait progressivement de  $T_1$  (80,94) à  $T_5$  (53,09) à mesure que les niveaux de repas composites RSE-EM augmentaient dans les régimes. Le résultat a montré que le maïs pouvait être remplacé par le tourteau RSE-EM jusqu'à 100% sans aucun effet négatif sur leurs performances et une meilleure économie de production.*

**Mots-clés** – Farine composée de résidus de sorgho usés et d'écorces de manioc, performance, analyse du coût de l'alimentation, lapins

### **Introduction**

The shortage of protein particularly of animal origin in human diets in all parts of Africa and most developing countries of the world has been well documented (FAO, 1986; Bawa *et al.*, 2009). The nutritional status (Nigeria inclusive) is marked by inadequate protein intake both in quality and quantity (Taiwo *et al.*, 2005). According to Njoku (1985) and Cribb (2010), the low protein intake both in quality and quantity is due to the fact that livestock production is not keeping pace with the rise in human population. Aduku (1993) and Adegbola (2004) reported that feed alone accounts for about 70-80 % of the total cost of production in intensive livestock production. The cost of conventional feed ingredient such as maize has been on the increase from year to year leading to increase in the price of animal protein sources (Adejinmi *et al.*, 2007). Most of the conventional feedstuffs are highly competed for by man, hence the need to source for cheaper but readily available feedstuff so as to mitigate the above

challenges. One of such feedstuffs consumed by rabbits is cassava peel meal (Omole and Ajayi, 1986; Ekpo *et al.*, 2015) and Spent Sorghum Residue (SSR). Cassava peel meal is a non-conventional feedstuff for rabbits (Aduku and Olukosi, 1990). It could serve as a cheap source of energy for farm animals but should be fortified with additional protein source because of its low protein level (Obioha and Anikwe, 1982). Sundried cassava peels contain 6.30 % crude protein, 2.32 % crude fat, 20.22 % crude fibre, 6.77 % ash, 64.39 % nitrogen free extract, hydro cyanide 24.80 and 3346.90 kcal/kg of metabolizable energy (Oluremi and Nwosu, 2002). Brewers Dried Grain (BDG) is a by-product of beer and while *spent sorghum residue is a by-product of burukutu* production (local brewing) from sorghum grains. BDG is readily available in many parts of Nigeria and has been subject of studies which seek to evaluate its potential as substitute to conventional sources of energy and protein (Adama *et al.*, 2007). Sundried spent sorghum residue contain 31.60 % crude

protein, 13.73 % crude fat, 7.80 % crude fibre, 16.00 % ash, 30.87 % nitrogen free extract and 3067.00 kcal/kg of metabolizable energy (Adama *et al.*, 2007). This study was therefore aimed at determining the effect of dietary replacement of maize with spent sorghum residue and sundried cassava peels as a composite meal on growth performance and feed cost analysis of growing rabbits

### **Materials and methods**

The experiment was carried out at the Rabbitry unit of the Livestock Teaching and Research Farm, University of Agriculture, Makurdi, Benue State. A total of thirty crossbred weaned rabbits of mixed sexes, aged 4-6 weeks were used for the feeding trial which lasted for twelve weeks (84 days). The acquired animals were allowed to acclimatize for one week on commercial feed (grower mash) before the commencement of the feeding trial. Before the commencement of the experiment, the experimental animals were treated against internal and external parasites by subcutaneous injection of *Ivomec* (0.2 ml/rabbit). A broad spectrum antibiotic, anti-stress/multi-vitamins and *coccidiostat*, all in soluble powdered form was administered through drinking water in the course of the study. The experimental animals were randomly allotted to five treatments and each treatment group was replicated six (6) times with one (1) rabbit per replicate in a complete randomized design (CRD). The rabbits were housed individually in cages with each cage supplied with feeder and drinker and fixed firmly. The cages were thoroughly washed and disinfected with saponated cresol (Izal) and allowed to dry for 7 days before the animals were introduced therein. Spent sorghum residue was collected from

*burukutu* (local beer) production sites within Makurdi metropolis, they were sun dried for seven rain free/sunny days. Cassava peels was also collected from garri/cassava chips processing locations in Makurdi, washed and sun dried for seven rain free/sunny days before they were crushed with a hammer mill for use in analysis and in the test diets. The combined spent sorghum residue and cassava peels as a composite meal was used as replacement for maize in the test diet. The experimental diets were formulated using the nutrient composition tables of NRC (1994) and Lebas (2004) as a guide. Five experimental diets were formulated, spent sorghum residue-cassava peel (SSR-CP) composite meal was used at 0, 25, 50, 75 and 100% to replace maize in diets T<sub>1</sub> - T<sub>5</sub> respectively (Table 1). The experimental treatments is represented as thus;

- T1= Control diet with maize as the major energy source at 0% replacement.
- T2= SSR-CP composite meal shall replace 25% of maize in the diet.
- T3= SSR-CP composite meal shall replace 50% of maize in the diet.
- T4= SSR-CP composite meal shall replace 75% of maize in the diet.
- T5= SSR-CP composite meal shall replace 100% of maize in the diet.

The mixture of SSR-CP was in the ratio of 1:8 to give crude protein of approximately 9% (similar to that of maize). Weighed quantity of diet was given to the experimental animals while fresh, clean and cool water was given *ad libitum*. The proximate chemical analysis of dietary ingredients (dried spent sorghum residue and cassava peels) was carried out and analyzed for their proximate composition in accordance with standard procedure (AOAC, 2000).

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**Table 1: ingredients and nutrients composition of experimental diets (%)**

INGREDIENT	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>
Maize	37.46	28.09	18.73	9.37	0.00
SSR-CP	0.00	9.37	18.73	28.09	37.46
Full fat soybean	17.54	17.54	17.54	17.54	17.54
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Rice offal	19.00	19.00	19.00	19.00	19.00
Maize offal	13.00	13.00	13.00	13.00	13.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
<b>Calculated Nutrient Composition</b>					
Crude protein (%)	17.24	17.24	17.24	17.24	17.24
Crude fibre (%)	10.31	11.88	13.46	15.04	16.61
Ether extract	7.06	6.75	6.43	6.13	5.81
Calcium	1.12	1.13	1.13	1.16	1.18
Phosphorus	0.64	0.64	0.64	0.64	0.64
Lysine	0.74	0.73	0.72	0.71	0.70
Methionine	0.24	0.23	0.22	0.21	0.20
ME (Kcal/kg)	3141.25	3099.23	3072.42	3038.31	3003.58

SSR-CP= Spent Sorghum Residue-Cassava Peels. ME= Metabolizable Energy; M.E (Kcal/kg) = [37 x %CP + 81 x %EE + 35.5 x %NFE + 35.5 x (0.22) CF] (Pauzenga, 1985; modified by Carew, 2016). Premix (Agrimix Broiler starter) Manufactured by AGRITED NIG.LTD. Suppling the following per kg of diet: vit.A-10,000 iu, vitD3. 3000 iu, E-30 iu, Vit k -0.0023g, Thiamine (B1)-0.0017g, Riboflavin (B2)-0.005g, Pyridoxin (B6) -0.0031g, Vit B12 -0.016mg, Biotin-0.006mg, Niacin-0.031g, Pantothenic acid -0.008g, Folic acid-0.008g Manganese -0.085g, Zinc-0.05g, Iron-0.025g, Copper-0.006g, Iodine-0.001g, Selenium-0.12mg, Cobal33t-0.22mg, B.H.T.-0.06g, Ethoxyquin-0.065g, Choline Chloride-0.02g.

### Results and discussion

The result of the analysed proximate composition of experimental diets is shown in Table 2, formulated using standards of NRC, (1977), Lebas, (1980) as cited by Aduku (1990). The Crude Protein level in the diets (18.35 to 21.14 %) is higher than 16-18 % reported by Aduku and Olukosi (1990) for growing rabbits but can be compared with 19.21 – 22.75 % by Hadiza (2019) who fed mixtures of brewers dried grains and sorghum brewers dried grains, 19.77 – 20.11 % by Igwebuiké *et al.* (2013a) on performance parameters of rabbits fed two varieties of sorghum and 19.21 – 22.75 % by Hadiza (2019) who fed mixtures of brewers dried grains and sorghum brewers dried grains. This could be attributed to variety of spent sorghum residue and cassava peels used. The Crude Fibre levels (12.40 – 17.07 %) in the diets are within the value of 10-17 % recommended by Cheeke (1983), Johnson-

Delaney (2006). Cheeke (1983) reported that although rabbits digest fibre poorly, dietary fibre is useful in preventing enteritis for chewing and level of 15-18 % dietary fibre is therefore suggested for optimum growth in rabbits. The Ether Extract value (4.75 – 5.11 %) is higher than 2.32 - 2.35 % reported by Oluremi and Nwosu (2002), 3.13 – 3.97 % by Igwebuiké *et al.* (2013a) but is similar to 4.50 – 6.77 % by Makinde *et al.* (2017), 3.77 – 5.48 % by Ekpo *et al.* (2015) and falls within 3 – 6 % reported by Aduku and Olukosi (1990). This could be attributed to the inclusion of SSR-CP.

The ash content (10.07 – 17.39 %) is higher than 5 – 6.5 % reported by Aduku and Olukosi (1990), 5.16 – 5.61 % reported by Oluremi and Nwosu (2002) and 5.00 – 6.81 % by Makinde *et al.* (2017). This could be due to the ash content in the test diet. The Metabolizable energy (ME) values range from 2389.48 - 2712.73 kcal/kg and were

numerically similar and can be compared with 2410 by NRC (1977), Lebas (1980), 2500 – 2800 kcal/kg ME level reported by Aduku and Olukosi (1990) and 2239.15 – 2626.00 kcal/kg by Adejinmi *et al.* (2013) for growing rabbits in tropical environment. The linear decrease in ME across the experimental diets may not be disconnected with rise in crude fibre due to increasing levels of SSR-CP composite meal inclusion. The results of growth performance and feed cost analysis are presented in Tables 2 and 3, respectively. There were no significant ( $p>0.05$ ) differences in all parameters measured except protein efficiency ratio (PER) which differ significantly ( $p<0.05$ ) across treatments.

The PER values range of 0.82 – 1.13 with T5 having the least value (0.82), were lower than the posited The PER values range of 0.82 – 1.13 were lower than 6.29 – 7.20 by Biobaku *et al.* (2003), 1.46 – 1.63 by Jegede *et al.* (2006), 1.43-1.64 reported by Dairo and Egbeyemi (2012) and can be compared with 1.04 – 1.16 reported by Onifade and Tewe (1993). This could be due to difference in dietary protein and with T4 (0.90) and T5 (0.82) comparing favourably. There was no mortality in the cause of the study; this could be due to the high hygienic measures taken during the collection, storage, method of preparation/processing of test diets and storage of the experimental diets, feeding and management of the animals that prevented contamination.

**Table 2: proximate composition of experimental diet**

NUTRIENT (%)	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>
Dry Matter	90.6	90.17	90.25	90.50	90.81
Crude Protein	18.35	19.41	18.90	20.31	21.14
Ether Extract	5.11	4.96	5.98	4.75	4.92
Ash	11.84	10.07	12.34	16.14	17.39
Crude Fibre	12.40	11.95	14.73	14.54	17.70
Nitrogen Free Extract	42.90	47.67	38.30	34.76	30.29
Metabolizable Energy (Kcal/kg)	2712.73	2731.63	2658.35	2483.80	2389.48

**Table 3: effect of SSR-CP composite meal on rabbit performance**

Parameters	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	SEM
Initial Weight (g)	525.00	525.00	533.33	541.66	533.33	14.30
Final Weight (g)	1290	1425.33	1414.17	1275.83	1253.33	48.66
Average Daily Feed Intake (g)	43.39	53.00	49.78	46.88	49.03	1.90
Average Daily Weight Gain (g)	9.11	11.12	10.46	8.71	8.57	0.52
Feed Conversion Ratio	4.86	4.94	4.82	5.72	6.00	0.19
Protein Efficiency Ratio	1.13 <sup>a</sup>	1.08 <sup>ab</sup>	1.11 <sup>ab</sup>	0.90 <sup>bc</sup>	0.82 <sup>c</sup>	0.04*
Mortality	0.00	0.00	0.00	0.00	0.00	0.00

<sup>a, b, c</sup> Means on the same row with different superscripts are significantly ( $P < 0.05$ ) different. \* = Significant difference, <sup>NS</sup> = Not significant, SEM = Standard error of mean.

All these prevented diarrhoea and dysentery which are usually the main causes of death in rabbits (Maertens and Salifou; 1997; Fomunyam *et al.*, 2000; Etchu *et al.*, 2012). This is supported by Oluremi and Nwosu (2002) who reported 0 % mortality in rabbits fed cassava peel meal. Igwebuike *et al.* (2013b) also reported a similar trend in rabbits fed sorghum offals as replacement

for wheat offals. This is an indication that, SSR-CP composite meal can replace maize in the diets of growing rabbits without adverse effect on growth performance. The result on feed cost analysis shows that the cost per kg diet decreased progressively from T<sub>1</sub> (80.94) to T<sub>5</sub> (53.09) as the levels of SSR-CP composite meals increased in the diets. This is because SSR-CP composite

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meal is cheaper than maize as of the time the experiment was conducted. There is reduction from T<sub>1</sub> (control) to T<sub>5</sub> (total replacement). This was because, the price of maize was twice as expensive as SSR-CP. The cost of feeding and total cost of production decrease across treatment groups (except T<sub>2</sub>). This could be attributed to high mean total feed intake in T<sub>2</sub> (N4452.33). The Cost per kg weight gain decreased with increasing levels of SSR-CP from T<sub>1</sub> (N393.24) to T<sub>5</sub> (N318.31), which also showed the best cost per kg weight gain and improved savings up to N74.93 in rabbits fed total replacement of maize with SSR-CP composite meals (T<sub>5</sub>). This could be attributed to decrease in cost per kg diet as SSR-CP inclusion increased. Olagunju (2001), reported that maize replaced with sun-dried cassava peel meal in growing rabbit diet reduced cost per kilogramme weight gain. The economic implication of replacing maize with SSR-CP composite meal in rabbit diets was favourable to cost

analysis which could be interpreted to mean a positive response of rabbits to the inclusion of SSR-CP composite meal as replacing for maize. The poor returns from rabbits in T1 (N426.31) may be attributable to poor growth rate (Shaahu *et al.*, 2017) and cost benefit ratio is high in T1 (1.22) and low in T3 (0.82) making T3 the best since it is numerically favoured in FCR as well. However, judging from the cost benefit ratio, diets T3 and T5 are similar; this therefore is an indication of a favourable cost analysis which could be interpreted to mean a positive response of rabbits to the inclusion of SSR-CP composite meal in replacing maize. This finding agrees with Adama *et al.* (2007), Adeniji and Ehinmidu (2007), Amaefule *et al.* (2006) and Akpodiete and Inoni (2000), that, a viable way of reducing feed cost is through the use of alternative feed resources which would ultimately reduce the cost of livestock production in developing land.

**Table 4: effect of SSR-CP composite meal on feed cost analysis of rabbits**

Parameters	T <sub>1</sub> (0% SSR-CP)	T <sub>2</sub> (25% SSR-CP)	T <sub>3</sub> (50% SSR-CP)	T <sub>4</sub> (75% SSR-CP)	T <sub>5</sub> (100% SSR-CP)	SEM
Total Feed Intake (g)	3644.83	4452.33	4181.33	3937.50	4118.17	159.43
Total Weight Gain (g)	765.00	933.67	879.00	731.50	719.50	43.85
– <sup>1</sup> Diet (N)	80.94	73.97	67.01	60.06	53.09	1.83
Cost Of Feeding (N)	295.01	329.34	280.19	236.49	218.63	12.80
CostKg <sup>-1</sup> Weight Gain (N)	393.24	365.49	322.72	343.28	318.31	11.54
Total Cost of Production (N)	491.69	548.90	466.99	394.14	364.39	21.33
Gross Revenue (N)	918.00	1120.40	1054.80	877.80	863.40	52.63
Gross Margin (N)	426.31	571.50	587.81	483.66	499.01	37.68
Cost Benefit Ratio	1.22	1.12	0.82	1.00	0.83	0.07

**Conclusion**

This study showed that there is a great potential for improvement in feed intake, weight gain, feed conversion and growth rate of rabbits fed spent sorghum residue-cassava peel composite meal as replacement for maize.

It has also shown that maize could be replaced by spent sorghum residue-cassava peel composite meal up to 100% without any adverse effect on their performance and

better economics of production.

**Recommendation**

From the findings of the present study, considering feed intake, weight gain, feed conversion ratio, cost/kg diet, and cost/kg weight gain, cost of feeding and no mortality, farmers who want to maximize economic potentials in rabbit production can rear rabbit incorporating spent sorghum residue-cassava peel composite meal up to

100% to replace maize.

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