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Effects of Varying Inclusion Levels of Sundried Cassava Peels (SCP) on Growth Performance and Economy of Production of Growing Rabbits

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`ABSTRACT

An experiment was conducted to assess the performance and economy of the production of growing Chinchilla rabbits fed graded levels of sundried cassava peel and maize in a completely randomized design. A total of 20 weaned rabbits of mixed sexes at the age of 10 weeks were randomly allocated to five dietary groups for a period of 56 days. Diet 1 serving as the control without sundried cassava peel and 100% maize, Diet 2 had 25% sundried cassava peel and 75% maize mixture, Diet 3 consist of 50% sundried cassava peel and 50% maize mixture, SCP (75%) and 25% maize constitute diet 4 while diet 5 represents the vice versa of control group. The rabbits were divided into 5 treatment groups of four rabbit per treatment and assigned randomly to the five diets. Replications was twice with 2 rabbits in a replicate in a completely randomized design. Results revealed no significant (P>0.05) differences in the values obtained for weight gain and feed conversion ratio (FCR). Average weight gain ranged from 83.7g to 99.4g/day, while feed conversion efficiency ranged from 2.73 to 3.54. Feed cost per weight gain ranged from #683 to 1, 332.00, while the revenue realized monetarily from each group ranged from #16,000 to #20,000.00. The results revealed that rabbits have the capacity to utilize sundried cassava peels effectively, but can perform better when combine with maize feedstuff at a graded level below 50% inclusion rate.

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INTRODUCTION:

The growing population in Nigeria has led to an increasing demand for animal protein, a problem that is further exacerbated by the country's struggling livestock sector. The ban on processed meat imports has intensified the challenge, making it imperative to find sustainable solutions to bridge the gap in animal protein consumption. The average daily animal protein intake per person in Nigeria is estimated at only 4.5g, significantly below the FAO-recommended minimum of 35g per day (FAO, 2002). A strategic approach to livestock development is essential—one that prioritizes the production of fast-growing, highly reproductive animals that require minimal space and labor while maintaining low production costs. Among various livestock options, rabbit farming has gained attention as a viable means of addressing the protein gap in developing countries **(**Akinmutimi & Onwukwe, 2019**;** Ozung *et al*., 2021**).**

Research by Ojebiyi *et al*. (2006) has highlighted the potential of rabbits in addressing protein inadequacy. Studies by Biobaku and Dosumu (2005) further emphasize that rabbit production can play a crucial role in alleviating protein shortages in developing countries. Rabbits are prolific breeders with a short gestation period of about 30 days, rapid growth rate, and low-cost production, making them an ideal choice for meat production (Taiwo *et al*., 2003; Odimba, 2006). They efficiently convert plant-based feed into protein, making them an economical choice for meat production (Emegha *et al*., 2022). Additionally, rabbit meat is nutritious, tasty, and contains lower levels of fat high protein content, sodium, and cholesterol compared to other common meat sources (Biobaku and Dosumu, 2005). Rabbit meat is high in protein, low in fat, cholesterol, and sodium, making it a healthy alternative to other meat sources (Bamikole & Ikhatua, 2020).

Despite its potential, intensive livestock farming, including rabbit production, faces a major hurdle: the high cost of feed, which accounts for over 70% of total production expenses (Adejinmi *et al*., 2007). The rising cost of conventional feed ingredients like maize has led to an increase in the price of animal protein, making it less accessible to the population. Furthermore, competition between humans and livestock for these feed ingredients adds to the problem. To reduce feed costs and ultimately lower the price of animal protein, alternative non-conventional feed ingredients (NCFs) must be explored (Adejinmi *et al*., 2013). To ensure the affordability and accessibility of animal protein, it **is** critical to explore alternative, non-conventional feed ingredients (NCFs) that are low-cost, readily available, and nutritionally adequate **(**Adejinmi *et al*., 2013; Oluokun *et al*., 2022**).**

One promising alternative feed source is cassava peel, an agro-industrial by-product that is readily available in Nigeria but has little direct dietary value for humans. Cassava peel is the outermost layer of the cassava tuber, which is removed during processing and often discarded as waste. Although it is rich in fiber, cassava peel has low protein content and high levels of hydrogen cyanide, which necessitates proper processing to make it safe for animal consumption. Dried cassava peel has been successfully used as a cheaper substitute in ruminant animal feed with minimal side effects, provided it is supplemented with forage for microbial activity in the rumen. However, its suitability as a feed ingredient for rabbits requires further evaluation. Daudu *et al*. (2009) suggested that the best approach to determining its effectiveness is by including graded levels of cassava peel in rabbit diets while ensuring all necessary nutrients are supplied. Ozung *et al*. (2021) found that properly processed cassava peel can partially replace maize in rabbit feed without compromising growth performance. Also, Emegha *et al*. (2022) reported that fermented cassava peel-based diets improved feed efficiency and weight gain in growing rabbits, reducing production costs. Ojewola *et al*. (2023) highlighted that detoxified cassava peel enhances digestibility and nutrient absorption, making it a viable alternative in rabbit farming.

Therefore, to contribute to sustainable rabbit farming and address the animal protein shortage, this study aims to evaluate the optimum inclusion level of sundried cassava peel as a substitute for maize in rabbit feed and assess its effects on the growth performance of growing rabbits. By identifying a cost-effective and nutritionally adequate feeding strategy, this research could help improve the affordability and accessibility of animal protein in Nigeria. This approach presents a dual benefit: it provides an economical feed alternative for livestock farmers while simultaneously reducing agricultural waste, thereby promoting both food security and environmental sustainability.

MATERIALS AND METHOD

Experimental site

The experiment was carried out in the rabbitary unit of the Teaching and Research Farm, Oyo State College of Education, Lanlate, Oyo State Nigeria. Lanlate is in the derived savannah zone of Nigeria.

Experimental Animal and Management

Twenty (20) growing rabbits of mixed breeds (New Zealand x chinchilla) and sexes with initial live weight of 500-600g were used for the experiment. They were randomly assigned to five treatment diet after 7days of acclimatization period. Four (4) rabbits were assigned to each of the five treatments with two (2) rabbits per replicate in a completely randomized design (CRD). The experiment lasted for 56 days. The animals were housed in a groups of two in a wire meshed cage. Feed and water were supplied ad libitum, rabbits were treated for

internal and external parasites using Ivermectine (ivomec). Data were collected on feed intake and weight gain.

Experimental Housing

The experimental hutch is made of wood and wire netting of 120cm x 50cm x40cm length, breadth and height respectively. The hutch was housed in a well-ventilated rabbit unit. The hutch was disinfected using a disinfectant (Morigad solution) four (4) days prior to the stocking of the animal for experiment.

Test Ingredients

The fresh cassava peels used in this study were collected from Gaari processing plant at Eruwa, after which it was washed with water and sundried on the leather mat for 14 days. Effort was made during period of sun drying to be suing hand in turning it up and down to achieve complete sun drying. Having achieved almost 100% sun drying, sundried cassava peel were milled by hammer mill to a particle size that can be taken or consumed by the experimental animal.

Formulation of Experimental Diets

The experimental diets consisted of five (5) dietary treatments of sundried cassava peel (SCP) to Maize (M) ratio in percentages (%) of SCP 0% + maize 100%, SCP 25% + maize75%, SCP 50% + maize 50%, SCP 75% + maize 25%, and SCP 100% + maize 0%. and were represented as T_1, T_2, T_3, T_4 and T_5 respectively while T_1 represented the control for the study. The composition of the basal diet is as shown in Table 1.

Data Collection

Feed intake: weighed quantity of feed was given to each animal and the left over was collected daily and weighed to evaluate the feed intake of animal.

Growth rate: weight gain was measured on weekly basis by subtracting the initial from final weight and thus weekly and daily weight gain calculated.

Table 1: Gross Composition of Experimental Diets

Ingredients	T1 (SCP 0% + maize 100%)	T2 (SCP 25% + maize 75%)	T3 (SCP 50 % + maize 50%)	T4 (SCP 75% + maize 25%)	T5 (SCP 0% + maize 100%)
Maize	50.00	37.50	25.00	12.50	0.00
DCP	0.00	12.50	25.00	37.50	50.00
W/O	22.00	22.00	22.00	22.00	22.00
F/Meal	3.00	3.00	3.00	3.00	3.00
GNC	4.00	4.00	4.00	4.00	4.00
Syabean	15.00	15.00	15.00	15.00	15.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Oyshell	1.00	1.00	1.00	1.00	1.00
Premix	1.00	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
Crude protein (%)	16.80	16.75	16.75	16.73	16.70
Crude fibre (%)	4.60	4.55	5.96	6.60	6.68
Metabolizable energy (kcal/kg)	2580	2585	2590	2599	2600

Laboratory analysis

The test ingredient, that is, dried cassava peel used was analyzed for proximate composition by the methods of AOAC (2005)

Statistical analysis

The data were subjected to analysis of variance (ANOVA) in accordance with steel and Torrie (1980). Separation of significant different means was carried out using least significant difference.

Table 2: Proximate Composition of Test Ingredients

	SDCP	Maize
Crude protein	5.69	8.80
Crude fibre	20.46	2.10
Ether extract	0.74	4.10
Ash	5.07	1.05
Dry matter	88.59	91.8
HCN	20.00	0.00

Table 3: Feed efficiency and conversion ratio

PARAMETERS	Trt. 1	Trt. 2	Trt. 3	Trt.4	Trt. 5	SEM
Average feed consumed	2,072.28	2,035	1,902	1,943.60	1,923.60	31.84
Average weight gain	586.2	616.7	696	606.1	588.2	18.7
Feed efficiency ratio	3.54	3.29	2.73	3.21	3.27	0.13
Feed conversion ratio	0.28	0.3	0.37	0.31	0.31	0.02

Table 4: performance characteristics of rabbit fed experimental diets

Parameters (g)	Trt1	Trt2	Trt3	Trt4	Trt5	SEM
Initial wt of rabbits	3,191.70	2,839.40	2,920.50	3,056.70	2,619	104.64
Average wt gain g/day	88.10	86.60	99.40	84.02	83.70	3.04
Average wt gain g/week	2,939.90	2,811.20	3,379.50	2,794.10	2,932	108.28
Total wt gain	6,130	5,650	6,300	5,850	5,550	273.6
Average feed intake g/day of rabbit	1,453.40	1,393	1,501.30	1,365.20	1,480	26.29
Average feed intake g/week of rabbit	10,174.70	9,717.80	10,510.10	9,558	10,361.40	185.14
Feed conversion ratio (1-7wks)	0.30	0.31	0.37	0.31	0.28	0.02
Feed efficiency ratio (1-7wks)	3.29	3.21	2.73	3.27	3.54	0.13
Economy of feed utilization						
Cost of feed 1kg (₦)	800	600	700	500	900	141.42
Cost of feed 1g (₦)	0.8	0.6	0.7	0.5	0.9	0.14
Daily feed intake (g)	1,453.40	1,393	1,501.30	1,365.20	1,480	26.29
Cost of intake (₦)	1,163	836	1,051	683	1,332	246.30
Total weight gain	6,130	5,650	6,300	5,880	5,550	273.86
Revenue (₦)	18,000.00	16,500.00	20,000	17,000.00	16,000.00	1,497.49

RESULTS AND DISCUSSION

The gross composition of the experimental diets consisting of different ingredients with graded levels of sundried cassava peel and maize is as shown in Table 1, the calculated analysis as at the bottom of the table while the proximate composition of the test ingredients were presented in Table 2. Table 3 and 4 show the feed conversion efficiency and performance characteristics of the experimental animal respectively, Table 5 revealed the economy of feed utilization which was revealed in cost of a gramm of feed compounded with a pound of meat produced and consequently revenue generated when sold.

The initial weights of the rabbits varied across treatments, with Trt1 having the highest starting weight (3,191.70 g) and Trt5 having the lowest (2,619 g). Despite differences in initial weights, the average daily weight gain (ADG) and total weight gain (TWG) provide insights into the effectiveness of each treatment. Treatment 3 demonstrated the highest ADG (99.4 g/day) and TWG (6,300 g), indicating superior growth performance under this treatment. Conversely, treatment 5 had the lowest ADG (83.7 g/day) and TWG (5,550 g), suggesting less favorable conditions or nutritional deficiencies in this treatment. The other treatments (Trt1, Trt2, and Trt4) showed moderate growth rates, with TWGs ranging from 5,650 g to 6,130 g. These results suggest that Trt3 is the most effective treatment for promoting rapid rabbit growth, likely due to its optimal nutritional composition or management practices.

Average daily feed intake was highest in treatment 3 (1,501.30 g/day) and lowest in treatment 4 (1,365.20 g/day). Higher feed intake in Trt3 aligns with its superior growth performance, as increased nutrient availability supports better weight gain. The feed conversion ratio (FCR) which measures how efficiently feed is converted into body weight, ranged from 0.28 (Trt5) to 0.37 (Trt3). A lower FCR indicates more efficient feed utilization. While Trt5 had the best FCR, its poor growth performance suggests that low FCR alone does not guarantee optimal results.

The feed efficiency ratio (FER), which reflects the amount of feed required to produce a unit of weight gain, was highest in treatment 5 (3.54) and lowest in treatment 3 (2.73). This implies that Trt3 requires less feed per kilogram of weight gained, making it economically advantageous despite higher feed costs.

Cost of feed per kilogram varied significantly, with treatment 4 being the cheapest (₦500/kg) and treatment 5 the most expensive (₦900/kg). However, cost-effectiveness must be evaluated alongside performance metrics. Daily feed cost was highest in treatment 1 (₦1,163) and lowest in treatment 4 (₦683). Despite lower feed costs in Trt4, its TWG (5,850 g) was below that of Trt3, reducing its profitability. Revenue was calculated based on TWG and assumed market prices. Treatment 3 generated the highest revenue (₦20,000), followed by Trt1 (₦18,000) and Trt4 (₦17,000). Trt5, despite having the lowest FCR, produced the least revenue (₦16,000).

The gross composition of experimental diets revealed that the protein content ranged between 16.70-16.880% while the calculated metabolizable energy ranged between 2.580-2.600kcal/kg (Table 1). The crude protein values are similar to that of Okeke *et al.,* (2008) but lower than that of Alu *et al.,* (2009). However the values fall within the range recommended by Lebas (1979) and NRC (1984) for grower rabbits.

There were no significant (P>0.05) differences in average daily weight gain and feed conversion ratio. Rabbits on T_3 (SCP50%; M50%) had the highest daily weight gain (99.40g), while those on T_5 diet (SCP100; M 0) recorded almost the lowest daily weight gain (83.7g). the rabbits on the control diet (100% maize) ranked next to the highest with average daily weight gain of 88.1g though not significant (P>0.08) when compared with that of T_3 (SCP 50% :M 50%). The results obtained in this study could be corroborated by Gomez and Manner (1984) who advocated the use of amino-acid in fortifying cassava peel meal based diets. These workers explained that methionine and cysteine will serve as sulphur donor in detoxification of hydrogen cyanide. However in the present study the HCN level of 27mg/g is quite low and would use no detoxification. The sundrying of cassava peel is believed to have resulted in the reduction of the HCN content. Gomez and Manner (1984) indicated that more than 86% of HCN present is cassava products was lost during sundrying. The results also revealed that rabbits on T_4 and T_5 had similar weight gain, which was not significantly higher than those in T_3, T_1 and T_2. The also implied that rabbits could effectively utilized dried cassava peel up to 50% replacement with maize, but however above this graded level the weight acquired is retrogressive. Feed conversion and efficiency ratio of experimental rabbits followed the same trend i.e conversion efficiency is impaired with above 50% replacement with maize. The average feed intake obtained in this study for the experimental rabbits was reasonably high, but can be compared favourably with the values reported by Attah *et al.,* (2011). The value 2.73-3.54 obtained for feed conversion efficiency in this study can be compared to 2.93-4.20 obtained by Oyewole and Welson (1998), though this could be traced to the age of animals or particle sizes of compounded diets. Lower feed cost/kg gain and higher saving/kg gain obtained with rabbits on 50% DCP for maize indicates the potential of reducing cost of compounded diets when agro bye product is used to replace convention feedstuffs, according to Balago Palan *et al.,* (1988) cassava peel being a cheap energy source offers a great potential in reducing the high cost of animal feeds when incorporated.

Table 4 revealed the growth performance, feed utilization, and economic efficiency of rabbits subjected to five different treatments (Trt1 to Trt5). The parameters analyzed include initial weight, average daily and weekly weight gain, total weight gain, feed intake, feed conversion ratio (FCR), feed efficiency ratio (FER), cost of feed intake, and revenue generated. This essay discusses the findings in detail, highlighting the implications for rabbit farming practices.

From the data, treatment 3 emerges as the most balanced treatment, offering superior growth performance, reasonable feed efficiency, and the highest economic returns. Its high feed intake and cost may initially appear disadvantageous, but the substantial weight gain justifies these expenses. In contrast, treatment 5 although economical in terms of FCR, fails to deliver adequate growth or revenue, making it less desirable.

On the other hand, treatment 4 offers a cost-effective feeding strategy but compromises on growth performance. This trade-off may appeal to farmers

prioritizing reduced input costs over maximum productivity. Similarly, treatment 1 and treatment 2 provide moderate results, balancing growth and expense without excelling in either category.

Conclusively, the result of this study indicates that combinations of sundried cassava peel and maize can serve as a replacement for conventional maize in rabbit diet without any adverse effect on growth performance, the study also seems to suggest that rabbit does not thrive above 50% level of inclusion of maize for cassava without an adverse effect on body weight. It can also be concluded that test ingredient i.e cassava peel leads to increase rabbit production with minimal cost as possible because they are easy and cheap to acquire because of low value in human nutrition. For commercial operations aiming for rapid growth and high profits, Trt3 is recommended despite its higher costs. Small-scale farmers seeking cost savings might consider Trt 4, provided they accept slower growth rates. Additionally, optimizing FER and FCR through improved feed formulation or husbandry techniques could further enhance productivity and profitability.

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