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Full Length Research

Sustainable empowerment of rural women in Nigeria: Transforming waste into wealth by nourishing goats with corn cobs and cassava peels at different tiers

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ABSTRACT: The study aimed at exploring Waste-to-Wealth Feeding by investigating the viability of using corn cobs and cassava peels as goat feed. The growth performance and sensory evaluation of chevon fed different levels of corn cobs and cassava peels as goat feed were investigated. A total of sixteen (16) growing bucks were purchased from different sources and were quarantined accordingly before rearing them together for acclimatisation. They were weighed individually and allotted into the rearing sixteen (16) units, four (4) treatments and four (4) replicates of one (1) animal per and were reared for 24 weeks. The organoleptic evaluation of the fried goat meat revealed that the colour of the goat placed on treatment T1 was significantly different from the others that were placed on treatments T2-T4. The tenderness of goats placed on treatments T1 and T2 was significantly ($p<0.05$) different from those placed on treatments T3 and T4. Juiciness of goats placed on treatments T1, T2 and T4 was significantly ($p>0.05$) different from those placed on treatments T1, T2 and T3. The overall acceptability was not significantly ($p>0.05$) different from each other. The proximate analysis of the fried goat meat showed that there were no variations in the proximate parameters across all the treatments (T1-T4). The results of the weight gain of the goats fed corn cobs and cassava peels showed that T1 and T2 were significantly ($p<0.05$) different from T3 and T4, with T1 having the highest weight gain value of 7.40 kg and T3 having the least value of 5.15 kg. The feed consumed by the animals was significantly ($P<0.05$) different across the treatments, with T1 having 32.00 kg as the highest value observed and T3 with the lowest consumption value of 30.50kg. The feed conversion ratio (FCR) was also significantly different from one another, although T1 and T2 were not significantly different from T3 and T4. Feeding goats with corn cobs and cassava peels at varying levels is therefore recommended for ruminant farmers, especially at 25% and 75% respectively.

Keywords: Cassava peels, corn cobs, goats, organoleptic properties, proximate analysis.

INTRODUCTION

The number one goal of the Millennium Development Goals is eradicating extreme poverty and hunger. According to the African Development Bank (2023), poverty reduction is lagging behind economic growth. Africa is the world's second fastest-growing region. Poverty has declined faster since 2005 than over 1990–2005, but not fast enough to reach the target by 2015. Most workers are employed in vulnerable jobs with low wages and low productivity. Malnutrition is the underlying cause of death in an estimated 45% of all deaths among children under 5 years of age, according to the World Health Organisation (2023). Poverty is a significant issue in rural areas of Nigeria, where a high percentage of the popular-tion depends on agriculture for their livelihoods (Babatunde

et al., 2016). In Oyo State, Nigeria, cassava farmers are particularly vulnerable to poverty (Babatunde *et al.,* 2016). However, waste-to-wealth initiatives can provide opportunities for poverty alleviation among rural women in Nigeria. Utilising corn cob and cassava peel to feed goats at different levels is one such initiative that has the potential to improve the livelihoods of rural women in Nigeria.

Livestock, including goats, play an important role in food security, poverty reduction, and wealth creation in West Africa (Molina-Flores *et al.,* 2020). Utilising corn cob and cassava peel to feed goats at different levels is a waste-to-wealth initiative that has the potential to improve the livelihoods of rural communities in Nigeria. Cassava peel and corn cob are waste products that are readily available in rural communities, making them a cost-effective feed source for goat rearing (Olowoyeye *et al*., 2019). The potential of cassava peel for feeding goats in Nigeria has been recognised, and it has been found to have great potential for goat feeding (Olowoyeye *et al*., 2019). Cassava peel and corn cob are rich in nutrients, including carbohydrates, fibre, and minerals (Fasae and Yusuf, 2022).

Studies have shown that cassava peel and corn cob can be used successfully as an adequate source of much-needed protein (Corn cobs and Cassava peels have 0.84 and 4.75% Crude Protein, respectively) and energy for smallholder goat production (Fasae and Yusuf, 2022). Cassava peel in fresh or dried form also provides complementary energy to cattle, sheep, and goats in traditional systems (Food and Agricultural Organisation, 2023). Utilising cassava peel and corn cob for goat feed can help reduce waste and promote sustainable waste management practices in rural communities (FAO, 2023). Utilising corn cob and cassava peel to feed goats at different levels is a waste-to-wealth initiative that has the potential to improve the livelihoods of rural communities in Nigeria. Cassava peel and corn cob are cost-effective and nutritious feed sources for goats, which can help improve their growth and productivity. By implementing this initiative, we can promote sustainable livestock production practices and contribute to poverty alleviation in rural areas of Nigeria. This study aims to explore Waste-to-Wealth Feeding by investigating the viability of using corn cobs and cassava peels as goat feed in order to determine the meat quality and sensory evaluation of chevon from goats fed different levels of corn cobs and cassava peel.

MATERIALS AND METHODS

Experimental site

The study was carried out at the experimental site of the Department of Animal Health and Production, Oyo State College of Agriculture and Technology, Igboora, Oyo State. It lies in the savannah forest of latitude 7′43°N and 3′28°E at an elevation of 140m above sea level. The average annual minimum temperature is above 21.5°C, and the maximum average temperature is about 32.5°C.

Experimental animals and management

A total of sixteen (16) growing bucks were purchased from different sources and were quarantined accordingly before rearing them together for acclimatisation. They were weighed individually and allotted into the rearing sixteen (16) units pens with four (4) treatments and four (4) replicates of one (1) animal per replicate based on weight and age equalisation. They range from 4 - 5 months and 5 – 6 kg, respectively.

At the end of the 24 weeks of the experiment, 2 animals per treatment were slaughtered by the Halal method with the animal facing the Qibla (East-wards). Prior to slaughtering, the animals were starved of feed for 12 hours in order to have an empty stomach so as to avoid faecal contamination during evisceration.

Organoleptic properties evaluation

A total of 20 semi-trained individuals were used to assess the meat samples. The fried meat samples were evaluated for aroma, flavour, colour, juiciness, tenderness, and overall acceptability. The samples were rated on a nine-point hedonic scale with a maximum score for extremely high condition, while the lowest score was assigned to the poorest condition (Mahendrakar *et al.,* 1988). Equal bite size from all treatments was coded and served. Each sample was evaluated independently of the other. They were asked to chew crackers biscuits and rinsed their mouth with water in order to neutralise their taste buds, and this was repeated after each bite and evaluation of the samples till the end of the exercise.

Statistical analysis

The data collected were subjected to one-way Analysis of Variance. Mean values of variables showing significant ($p<0.05$) difference were separated using Duncan's multiple range test.

RESULTS

Tables 1, 2, and 3 represented the composition (%) of the goat diet, proximate composition (%) of the cassava peels used, and proximate composition (%) of the corn cobs used, respectively. The organoleptic evaluation of the fried chevon in Table 4 revealed that the colour of chevon obtained from goats placed on treatment T1 was significantly different from others that were allotted to treatments

Table 1. Composition (%) of the goat diet.

Ingredients	Treatments			
	T1 (0%)	T2 (33.65% cassava peel 66.35% corn cobs)	T3 (66.35% corn cobs 33.65% cassava peel)	T4 (50% cassava peel 50% corn cobs)
Corn bran	50.00	39.45	39.45	39.45
SBM	5.00	5.00	5.00	5.00
PKC	13.00	13.00	13.00	13.00
WO	28.00	28.00	28.00	28.00
Cassava Peel	-	3.55	7.00	5.28
Corn Cobs	-	7.00	3.55	5.28
Bone meal	3.50	3.50	3.50	3.50
Salt	0.50	0.50	0.50	0.50
CP (%)	14.98	14.06	14.15	14.10
M.E (kcal/kg)	2539.68	2285.84	2337.86	2311.85

SBM = Soya Bean Meal; PKC = Palm Kernel Cake; WO = Wheat Offal.

Table 2. Proximate composition (%) of the cassava peel used.

Parameters	Values (%)
Moisture content	8.72
Crude protein	4.75
Crude fibre	8.69
Ether extract	2.22
Ash	8.79
Nitrogen free extract	66.77
Total	99.94

Table 3. Proximate composition (%) of the corn cobs used.

Parameters	Values (%)
Cellulose	40.22
Hemicellulose	36.01
Lignin	10.27
Ash	1.79
Ether extract	0.72
Crude protein	0.84
Carbon	10.35
Total	100.20

Table 4. Sensory properties of fried goat meat fed corn cobs and cassava peels.

Parameters	Treatments			
	T1	T2	T3	T4
Colour	7.30^{b}±0.35	8.46^{a}±0.29	8.38^{a}±0.26	8.55^{a}±0.32
Tenderness	6.10^{a}±0.34	8.70^{a}±0.24	7.80^{ab}±0.31	7.41^{b}±0.42
Juiciness	6.20^{a}±0.44	8.69^{a}±0.26	7.53^{b}±0.34	8.70^{a}±0.34
Flavour	7.20^{b}±0.28	7.20^{b}±0.34	7.07^{b}±0.32	8.17^{a}±0.23
Overall acceptability	3.19±0.32	2.64±0.25	3.18±0.30	2.70±0.35

(T2-T4). The tenderness of chevon obtained from goats allotted to treatments T1 and T2 were significantly ($p<0.05$) different from those in treatments T3 and T4. The Juiciness of chevon from the goats of treatments T1, T2 and T4 were

Table 5. Proximate evaluation of fried goat meat fed grain levels corn cobs and cassava peels.

Parameters	Treatments				SEM	P.value
	T1	T2	T3	T4		
Moisture Content	73.10	72.80	72.10	73.03	0.48	0.91
Ether extract	3.02	3.16	3.08	3.08	0.06	0.93
Crude protein	22.70	23.01	22.89	22.94	0.14	0.92
Crude fibre	0.56[a]	0.40[b]	0.51[a]	0.49[ab]	0.22	0.04
Ash	1.09	1.10	1.05	0.99	0.26	0.49

[ab]means in the same row with different superscripts are significantly different (p<0.05).

Table 6. Growth performance of goat fed graded levels of corn cobs and cassava peels.

Parameters	Treatments				SEM	P-value
	T1	T2	T3	T4		
Initial weight (kg)	5.75	5.85	5.60	6.15	0.29	0.93
Final weight (kg)	13.15[a]	13.10[ab]	10.75[b]	12.10[ab]	0.43	0.12
Weight gain (kg)	7.40[a]	7.25[a]	5.15[b]	5.95[b]	0.37	0.01
Feed consumed (kg)	32.00[a]	31.45[ab]	30.50[c]	30.94[bc]	0.22	0.03
Feed conversion ratio	4.33[b]	4.34 [b]	5.95[a]	5.21[ab]	0.27	0.29

[abc] Means in the same row with different superscripts differ significantly (p<0.05).

significantly (p<0.05) different from that of treatment T3. The overall acceptability was not significantly (p>0.05) different from each other.

The proximate analysis of the fried chevon in Table 5 showed that there were no variations in the proximate parameters across all the treatments (T1-T4). They were not significantly (p>0.05) different from one another except for the crude fibre, that were significantly (p<0.05) different.

The results (Table 6) of the weight gain of the goats fed corn cobs and cassava peels showed that goats in treatments T1 and T2 were significantly (p<0.05) different from T3 and T4, performed better with T1 having the highest weight gain value of 7.40 Kg and T3 had the least value of 5.15 Kg. The feed consumed by the animals was significantly (p<0.05) different across the treatments, with animals in treatment T1 having 32.00 kg as the highest value observed and those in treatment T3 with the lowest consumption value of 30.50 kg. The feed conversion ratio (FCR) was also significantly different from one another, although treatments T1 and T2 were not significantly (p<0.05) different from T3 and T4.

The cost-effectiveness of using corn cobs and cassava peels in feeding goat

From my findings**,** the cost effectiveness of using corn cobs and cassava peels to feed goats in Nigeria depends on several factors which includes the following; Corn cobs and cassava peels are often considered waste and can be obtained at a lower cost compared to traditional feed sources, these materials are abundant in Nigeria, reducing transportation costs and utilizing these waste materials can reduce waste disposal issues.

Considering the cost, the cost of traditional feed sources, such as grains and concentrates, can range from ₦400 to ₦1500 per kilogram in Nigeria, and the cost of corn cobs and cassava peels can range from ₦100 to ₦500 per kilogram, depending on the season, source and processing requirements.

Invariably, using corn cobs and cassava peels can reduce feed costs by 30 to 50% compared to traditional feed sources, and at the same time, utilising these waste materials can reduce waste disposal costs. Using corn cobs and cassava peels to feed goats in Nigeria can be a cost-effective option, considering the low cost and local availability of these materials. However, it is essential to consider the nutrient limitations and processing requirements to ensure the quality and safety of the feed. By balancing the diet and implementing proper processing and storage, farmers can potentially save on feed costs and reduce waste disposal issues.

DISCUSSION

The sensory evaluation showed that most of the parameters were significantly (p>0.05) different from each other. The higher colour was recorded in treatment 4. De Palo *et al. (2012*) revealed that colour change is subjective, which means that identifying meat freshness is dependent on the observer's experience. The colour of the meat has been found to be considered as an important parameter that attracts customers to buy meat in the market (King *et al.,* 2023).

Treatment 4 also had the highest juiciness ratings, which was because of the post-mortem meat transformation (Omojola *et al.,* 2003). Juiciness has two effects, which are

the impression of moisture released during chewing and also the salivation produced by the flavour factor (Omojola *et al.,* 2003).

The tenderness of T2 was higher than others. Tenderness is known to be the most important sensory attributes that affect meat acceptability (Dekkers *et al.,* 2018. The highest flavour was recorded in T4. Meat flavour has taste and aroma as components (Khan *et al*., 2015).

Treatments 1 and 3 were highly accepted than treatments 2 and 4, but they were all acceptable based on the parameters taken.

The results obtained from the proximate analysis showed that there were no significant differences across the treatments. These results negated the findings of Tefera e*t al. (*2021), who reported significant differences among all parameters measured for beef arsi. The high crude protein levels could be due to the interaction of protein molecules (actin and myosin) in meat to form actinomyosin complex and increases in myofibrila proteins, which have been covered by denatured sarcoplasmic protein. The results obtained agreed with those of Puolanne and Halinen (2010), who reported an increase in protein content of the meat as a result of an increase in myofibrila protein due to denatured sarcoplasmic protein.

The high moisture content may be due to normal moisture in the goat meat, which is usually around 74-76%. When goat meat is fried, some of this moisture evaporates, but it can also become trapped within the meat, especially if the frying temperature is too low.

The higher weight gain recorded in T1 may be due to the higher protein content of the diet, which is in line with the finding of Adebowale and Taiwo (1996) who postulated that weight gain was dependent on dry matter intake and protein quality of the feed fed to the animal. The results obtained in this study is in line with the findings of Bawala et *al.* (*20*07) who reported that the supplementation of cassava peels with high protein content such as palm kernel cake, rumen epithelia wastes, cassava leaves occasioned by high dietary protein contents and palatability up to 25 to 50% has improved sheep and goat productivity.

Conclusion

Conclusively, feeding goats with graded levels of corn cobs and cassava peels is very profitable as it reduces the cost of feeding and enhances the growth of the animals, as well as the palatability of the meat obtained from them. Feeding goats with corn cobs and cassava peels at varying levels is therefore recommended for ruminant farmers, especially at 25% and 75%, respectively.

CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

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