ISSN 2714-4410
J. Anim. Prod. Res. (2020) 32(1):78-83

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MINERAL AND ANTI-NUTRITIONAL FACTORS OF DIETS CONTAINING DIFFERENTLY PROCESSED CASSAVA PEELS

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ABSTRACT

The study was conducted to investigate the efficacy of different processing methods on mineral and anti-nutritional factors of cassava peel. The cassava peels collected were sundried for one (1) week before dividing them into four groups. Treatment 1(T_1) is the control group and the cassava peels were only sun-dried. Cassava peels in Treatment 2 (T_2) were processed by soaking in water. In Treatment 3 (T_3), the cassava peels were boiled while fermentation was used as the processing method in Treatment 4 (T_4). The cassava peels in all the four (4) groups were grinded and incorporated into the diet of goats each at 20% of the diet. Mineral and anti-nutritional factors in the four dietary treatments containing 20% of the cassava peel were analysed. The results of anti-nutritive factors showed that tannin, saponin, and hydro-cyanide all differ ($P<0.05$) among treatment groups but phytate content was found to be statistically similar among the treatment groups. Diets containing cassava peels processed by fermentation (T_4) has the lowest (0.70 mg/kg) HCN content followed by T_3 (boiled cassava peels) with a value of 0.87 mg/kg then T2 having an HCN content of 1.38 mg/kg and lastly T_1 with the highest content of 1.56 mg/kg. The results of the mineral analysis revealed that Ca, Mg, K, P, Mn, Fe, and Zn were found to differ ($P<0.05$) among treatment groups. The diets which contained boiled cassava peels (T_3) had the highest calcium content (136.67 mg/kg) followed by fermented cassava peels group (T_4) with a value of 133 mg/kg, then the control group (105.30 mg/kg), and lastly T_2 (72.30 mg/kg). The magnesium content of the diet ranges from 61 mg/kg in T4 to 200 mg/kg in T_2. T_2 (soaked cassava peels) also recorded the highest composition of both zinc and manganese with values of 31.67 mg/kg and 11.30 mg/kg respectively. The processing methods have been effective in decreasing the content of anti-nutritional factors in cassava peel is the fermentation method having the highest effect on reduction of tannin, hydrogen cyanide, and phytate. However, the boiling of cassava peels seems to have a minimum loss of nutrients like crude protein, ash, calcium, magnesium, and potassium. For micro minerals, soaking appears to conserve the nutrients better having the highest composition of zinc and manganese.

Keywords: Minerals, Anti-nutritive factors, Processing methods, Cassava peels

INTRODUCTION

The major factor affecting ruminant production in Nigeria is the scarcity of feeds and the fluctuation in its quality depending on the season (Ajayi *et al.*, 2005). Forages and crop residues available as feeds to small ruminants especially during the extended dry season but are usually low in quality and fibrous resulting in poor utilization and poor performance of animals. There is a need to intensify efforts towards sourcing for alternative and locally available means of feeding ruminants to increase their productivity.

The cassava processing industry yields tons of cassava peels which are a by-product that is valuable as ruminant feeds when properly processed (Aro *et al.*, 2010). Cassava is classified into sweet and bitter cassava varieties

based on its level of cyanide content (Oboh *et al.,* 2002). Cassava is often viewed as an inferior food crop, poor people's crop, or a dangerous crop (Oboh and Elusiyan, 2007). These myths on cassava are due to some limitations in the crop which include the presence of cyanogenic glucosides and low crude protein. Although, the fermentation of cassava is the most important and widely used means of processing cassava to reduce the cyanide content (Oyewole, 1992). Several other processing methods such as sun-drying, soaking and boiling have been confirmed to be effective in reducing the cyanide content of Cassava (Tewe, 1991; Cooke, 1978; Vasconcelos *et al.*, 1990; Nambisan, 1994).

This study is therefore aimed at evaluating the effects of various processing methods on mineral and anti-nutritional factors in cassava peels.

MATERIALS AND METHODS

The experiment was conducted at the Animal Science Laboratory of the Federal University Dutse, Jigawa State, which lies on latitude $11^{o}46'39"$ N and longitude $9^{o}20'3"$ E (Oyebanji *et al*., 2017). Cassava peels were collected from a processing plant at Kila village in Gwaram local government area of Jigawa State. The cassava peels were sundried for one (1) week before dividing them into four groups. The first portion (control) were sun-dried cassava peels, the second portion was soaked for 24 hours before sun-drying, the third portion was boiled for 35 minutes and then sun-dried, and the fourth portion was fermented for 4 days before sun-drying. Each group of the cassava peels was ground separately and then added to the respective experimental diets.

Treatment 1(T_1) is the control group and the cassava peels were only sun-dried. Cassava peels in Treatment 2 (T_2) were processed by soaking in water. Treatment 3 (T_3) cassava peels were boiled while fermentation was used as the processing method in Treatment 4 (T_4). The cassava peels in all the four (4) groups were milled and incorporated into the diet of goats each at 20% of the diet as shown in Table 1.

Proximate Analysis of Feed

The experimental diets were oven-dried, milled to pass through a 1.0 mm screen using a sample mill and sub-samples were taken for analysis. The milled samples were used for proximate analysis to determine Nitrogen (N) which was used for crude protein calculation (N × 6.25), DM, CF, EE, and following procedures of AOAC (2000).

Mineral Analysis

Atomic Absorption Spectrometer was used to determine the content of the macro minerals of the cassava peel such as calcium (Ca), magnesium (Mg), potassium (K), phosphorus (P), while the micro-minerals such as iron (Fe), zinc (Zn) and manganese (Mn) were analysed according to the procedures described by AOAC (2002).

Analysis of Anti-nutritional factors

Tannin, phytate, saponin, and cyanide were analysed according to AOAC (2000).

Statistical analysis

Data generated from the study were subjected to one-way Analysis of Variance (ANOVA) of the Completely Randomized Design using SPSS 20.0. Significant differences among treatment means were separated using Fisher's Least Significant Difference (LSD) and considered significant at a probability level of 0.05.

Table 1: Feed Composition (%) of Experimental Diets

	Treatments			
Ingredients	**T_1**	**T_2**	**T_3**	**T_4**
Cassava peels	20.00	20.00	20.00	20.00
Sorghum	56.72	56.72	56.72	56.72
GNC	19.28	19.28	19.28	19.28
Bone meal	2.00	2.00	2.00	2.00
Salt	1.00	1.00	1.00	1.00
Premix	1.00	1.00	1.00	1.00
Total (%)	**100**	**100**	**100**	**100**
Calculated CP (%)	**14**	**14**	**14**	**14**

GNC= Groundnut cake, T_1= sun-dried cassava peel meal (control), T_2= soaked cassava peel meal, T_3= boiled cassava peel meal, T_4= fermented cassava peel meal

RESULTS AND DISCUSSION

Proximate composition (%) of Experimental Diets

The results of the proximate composition of the experimental diet are presented in Table 2. The results showed a significant ($p<0.05$) difference among the treatments on all the parameters evaluated. The cassava peels processed by soaking (T_2) have the lowest dry matter (DM) content (90.57 %) while the highest value (92.53 %) was obtained in the group processed through fermentation (T_4). The highest value for crude protein was obtained in T_3(9.48 %) while T_2 recorded the lowest value (4.74 %). The values obtained for crude fibre (CF) are 11.63%, 10.68%, 13.59%, and 12.12% for T_1, T_2, T_3, and T_4 respectively. The content of ether extract (EE) values ranged from 7.34 % in T_4 to 6.03 % in T_1. The Ash content of the diets ranged from the lowest value of 4.81 % in T_2 to the highest value of 6.55 % in T_2. The boiling method has the least effect on crude protein and mineral degradation in cassava peels because it recorded the highest crude protein and ash composition.

Table 2: Proximate Composition (%) of Processed Cassava Peel Meal

	Treatments					
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**LSD**	**S.E.M**
DM	91.65^b	90.57^c	92.53^a	91.72^b	0.45	*
CP	6.92^b	4.74^c	9.48^a	8.02^b	1.19	*
CF	11.63^b	10.68^c	13.59^a	12.12^b	0.55	*
EE	6.03^d	6.60^c	6.97^b	7.34^a	0.34	*
ASH	6.07^b	4.81^d	6.55^a	5.60^c	0.27	*

$^{a, b, c, d}$ means in the same row differ significantly ($p<0.05$), DM-dry matter, CP-crude protein, CP-crude fiber, EE-Ether extract

Mineral composition of experimental diets

The mineral composition of the experimental diets is presented in Table 3. The result showed that there were significant (P<0.05) differences among treatment groups for all the parameters evaluated. The diets which contained boiled cassava peels (T_3) had the highest calcium content (136.67 mg/kg) followed by fermented cassava peels group (T_4) with a value of 133 mg/kg, then the control group (105.30 mg/kg), and lastly T_2 (72.30 mg/kg). Calcium content obtained in this study (136.67 mg/kg) is higher than those observed by Otache *et al.* (2017) who reported values ranging from 13.74 to19.81 (mg/kg). This higher calcium observed in the current study may be attributed to other components of the diet. The magnesium content of the diet ranges from 61mg/kg in T_4 to 200mg/kg in T_2. This also varies with the findings of Otache *et al.* (2017) who reported a range of 10.44 to 16.80 (mg/kg). The phosphorus content of the diet ranges from the lowest value of 15.52 mg/kg in T_3 to 84.67 mg/kg in T_4. The highest value (84.67 mg/kg) of phosphorus obtained in this study was lower than the value (1,300 mg/kg) reported by Waba *et al.* (2018), who evaluated the proximate, mineral and anti-nutritional substance of cassava peel fed to goats. The treatment group containing boiled cassava peels (T_3) recorded the highest potassium content (6400 mg/kg) while T_2 (soaked cassava peels) and T_4 (fermented cassava peels) both recorded the lowest value of 2500 mg/kg. The potassium composition of cassava peels in this study is higher than those reported by Otache *et al.* (2017) who observed the highest value of 113.39 mg/kg. This wide disparity in phosphorus and potassium with literature may be due to differences in diet composition since the cassava peels only form 20% of the diet in the current study.

Table 3: Mineral composition of diets containing processed cassava peels

Parameters	Treatments				
	T_1	T_2	T_3	T_4	S.E.M
Ca (mg/kg)	105.30^b	72.30^c	136.67^a	133.00^a	14.97
Mg (mg/kg)	69.33^c	200.00^a	160.20^b	61.00^c	14.28
P (mg/kg)	72.00^c	75.67^b	15.52^d	84.67^a	2.94
K (mg/kg)	2700.00^b	2500.00^b	6400.00^a	2500.00^b	470.71
Fe (mg/kg)	1.13^c	21.32^b	2.20^c	51.67^a	3.16
Mn (mg/kg)	15.50^c	31.67^a	11.00^d	18.00^b	2.02
Zn (mg/kg)	1.48^d	11.30^a	2.83^c	7.17^b	0.64

a, b, c, d means along the rows with different superscript are significantly (P>0.05) different.
T_1= Sundried cassava peel (control), T_2= Soaked cassava peel, T_3= Boiled cassava peel, and T_4= Fermented cassava peel.

For micro minerals analysed, T_2 (soaked cassava peels) has the highest composition of zinc and manganese with values of 31.67 mg/kg and 11.30 mg/kg respectively. The iron content obtained for T_1, T_2, T_3, and T_4 are 1.13, 21.32, 2.20, and 51.67 mg/kg respectively. The

control group had the lowest zinc content (1.48 mg/kg) while T_3 recorded the lowest manganese composition (11.00 mg/kg). The values obtained for iron are 1.13 mg/kg, 21.32mg/kg, 2.20mg/kg and 51.67mg/kg for T_1, T_2, T_3 and T_4 respectively. The mineral composition of cassava peels observed in this study agrees with the findings of Otache *et al.* (2017) who reported values ranging from 7.28 to 7.57 (mg/kg).

Anti-nutritive content of experimental diets

The results of anti-nutritive factors (Table 4) revealed that tannin, saponin, and hydro-cyanide all differ significantly ($P<0.05$) among treatment groups. However, phytate composition was found to be statistically similar ($P>0.05$). The tannin content of the various experimental diets are 229.04 mg/kg, 139.70mg/kg, 203.70mg/kg and 135.11mg/kg for T_1, T_2, T_3 and T_4 respectively. The tannin content observed in this study varies with the findings of Waba *et al.* (2018) who recorded a value of 24.09 mg/kg. The highest saponin composition (12.99 mg/kg) was recorded in T_3 while T_2 had the lowest value of 5.72 mg/kg. The values of saponin observed in the current study are higher than those observed by Waba *et al*, (2018) who reported a value of 1.87 mg/kg in cassava peels. The phytate content of the experimental diets ranged from the lowest value of 2.18 mg/kg in T_4 to 3.37 mg/kg in the control group (T_1). The phytate composition of the cassava peels obtained in this study agrees with the findings of Waba *et al*. (2018) who reported a phytate content of cassava peels as 2.14 mg/kg.

Diets containing cassava peels processed by fermentation (T_4) has the lowest (0.70 mg/kg) HCN content followed by T_3 (boiled cassava peels) with a value of 0.87 mg/kg then T_2 (1.38 mg/kg) and lastly the control group (T_1) with the highest HCN composition of 1.56 mg/kg. Hydro-cyanide content in the cassava peels obtained in the current study varies with the findings of Oboh *et al*. (2007) and Waba *et al*. (2018) who reported HCN values of 44.6 to 6.2 (mg/kg) and 31.22 mg/kg respectively. The difference in levels of anti-nutritional factors observed in the current study with reported literature could be attributed to the variety of the cassava and other components of the experimental diet.

Table 4: Anti Nutritive Factors of Diets containing Processed Cassava Peels

Parameters	**Treatments**				
	T_1	**T_2**	**T_3**	**T_4**	**S.E.M**
TAN (mg/kg)	229.04^{a}	139.70^{b}	203.70^{a}	135.11^{b}	54.568
SAP (mg/kg)	14.00^{a}	5.720^{b}	12.988^{a}	6.985^{b}	4.7937
HCN (mg/kg)	1.5550^{a}	1.3820^{ab}	0.8740^{bc}	0.7020^{c}	0.6287
PHY (mg/kg)	3.3660^{a}	2.5080^{a}	2.6400^{a}	2.1780^{a}	1.2243

Means along the rows with different superscript are significantly ($P<0.05$) different.
T_1= Sundried cassava peel (control), T_2= Soaked cassava peel, T_3= Boiled cassava peel, and T_3= Fermented cassava peel. TAN= Tannin, SAP= Saponin, HCN= Hydro-cyanide, PHY= Phytate,

CONCLUSION

The processing methods have been effective in decreasing the content of anti-nutritional factors in cassava peel is the fermentation method having the highest effect on the reduction of tannin, hydrogen cyanide, and phytate. However, the boiling of cassava peels seems to have a minimum loss of nutrients like crude protein, ash, calcium, magnesium, and potassium. For micro minerals, soaking appears to conserve the nutrients better having the highest composition of zinc and manganese.

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