PROXIMATE AND PHYTOCHEMICAL COMPOSITIONS OF DIFFERENTLY PROCESSED SWEET POTATO *(Ipomoea batatas)* PEEL MEAL

*Yisa, A. G. and Daniel, C.

Department of Animal Production, School of Animal Health and Production Technology, Federal College of Animal Health and Production Technology, NVRI, Vom, Plateau State

*Corresponding author e-mail: amosgyisa@gmail.com

ABSTRACT

This study investigated the effects of different processing methods (raw, boiled, fermented and dried) on nutritional composition and antinutritional factors of sweet potato (Ipomoea batata) peel. The differently processed sweet potato peels were analysed for proximate and phytochemical compositions in triplicates. The raw and processed sweet potato peels showed significant differences (P<0.05) in the contents of the moisture, crude protein, crude fibre, ash, calcium and phosphorus. The crude protein, ether extract and calcium contents of the raw samples were significantly higher than those of the processed samples. Crude fibre in sun-dried samples was significantly higher (P<0.05) than that of the other processing methods. Nitrogen Free Extract was significantly higher (P<0.05) in the processed compared to the raw samples. The ash content was highest in raw sample (4.12 %) and lowest in the fermented sample (2.67 %). All the processing methods showed significant effects (P<0.05) on the calcium and phosphorus contents of sweet potato peel. The antinutritional constituents present in sweet potato peel showed that the highest value for oxalic acid was in fermented peel. Flavonoids, tannins, hydrogen cyanide and phytic acid levels were higher (P<0.05) in the raw sample compared to the processed sweet potato peel. Based on the results of this study, fermentation and drying of sweet potato peel were most effective in reduction of antinutritional factors without severe effects on nutritional composition and are therefore recommended.

Key words: Proximate, Phytochemical composition, processing, sweet potato peel

INTRODUCTION

Feeding is said to constitute over 55 % of the cost of production of livestock species such as ruminants while for non-ruminants such as poultry, feeding has been estimated to cost between 70 to 80 % of production costs (Oluyemi and Roberts, 2007). The ingredients that supply carbohydrates and protein are the highest contributors amongst ingredients that are used for making animal feed (Aduku 2004) with that of carbohydrates being the highest even in poultry diets (Dei, 2017). The most common carbohydrate sources in animal feeds are cereal grains such as maize, guinea corn, millet and wheat and to a lesser extent root and tuber crops such as cassava and cocoyam. These ingredients, especially the cereal grains are used by man for food and for other industrial purposes which has caused high demand and consequently a lot of pressure being placed on them and therefore, resulting in escalating prices that has affected the cost of feed production. In order to address the issue of rising cost of feed and animal production, the search for available alternatives that can either partly or totally replace the conventional ingredients has been one of the main focuses of animal nutritionists and livestock farmers in general. The sweet potato (*Ipomoea batatas*) which is a root tuber crop is a staple food in many parts of Nigeria. The crop has many varieties but generally takes about 3 months from planting to maturity after which it is harvested, the outer cover of the tuber is peeled off and the inner fleshy part processed by roasting or boiling and then eaten. Normally the outer cover that is peeled off is discarded or given to animals like pigs and ruminants in the backyard. These peels have nutritional potential and can be processed and included in feeds. Like most alternative feed ingredients, they contain substances that can interfere with their digestion (Samtiya *et al*., 2020) and may need to be processed to facilitate or enhance their digestibility. This study was designed to investigate the proximate and phytochemical composition of sweet potato peel meal processed using different methods

MATERIALS AND METHODS

Study Area

This study was carried out at Federal College of Animal Health and Production Technology, Vom, Jos South Local Government Area of Plateau State. Vom is located between latitude 9° 43’44’’N and longitude 8° 47’ 28’’ E with a mean annual rainfall of 131.75cm. The annual rainfall ranges from 146 – 148 mm and the temperature ranges from 4 – 30 ^{o}C (degrees centigrade) depending on season, while the altitude is about 1280m above sea level (Mindat, 2021).

Collection and Preparation of sweet potato peels

Sweet potato peel was collected from households, restaurants, and markets within K-Vom in Jos South Local Government Area of plateau State. The peel was washed cleaned of dirt and in four different ways; 1; The raw peel was air dried under shade for 3 days until it was dry enough to be crushed. 2; Boiling was achieved by putting the peels in a pot on fire and allowed to boil for 20 minutes after which it was sundried for about 5 days to dry matter content of about 90 % according to the method described by Edache *et al* (2018). 3; Fermentation was obtained by soaking the peel inside water for one day (24 hours) after which it was placed in clean black polythene for three days until a sweet-smelling aroma was obtained. 4; Sun-dried peel was kept under the sun for 4 – 5 days until very dry and then ground to powder form using pestle and mortar. The differently processed forms of the peel (labelled Raw, Boiled, Fermented and Dried respectively) were packaged in transparent polythene bags and taken to the laboratory for proximate and phytochemical analyses

Proximate and phytochemical analyses

The percentage compositions of Moisture, Crude Protein (CP), Crude Fibre, (CF), Ether Extract (EE) and Ash were conducted in triplicates (replicates) according to method described by AOAC (2006). The Nitrogen Free Extract content was obtained by subtracting the sum of all the other nutrients from 100. Calcium and phosphorus contents were also analysed using the AOAC (2006) method. Determination of the quantitative contents of phytic acid, tannic acid, flavonoids, Cyanogenic glycosides and oxalic acid were done using the procedure outlined by Krishnaiah *et al* (2009). All analyses were done in triplicates

Data analysis

All triplicate values obtained from the analyses conducted both for proximate and phytochemical compositions, were subjected to Analysis of Variance (ANOVA) using SPSS version 23 (2015). Where applicable, differences between means were separated using the Least Significant Difference (LSD) option in the same package.

RESULTS AND DISCUSSION

Table 1: Effects of different processing methods on nutritional composition of sweet potato peel

Nutrients (%)	Processing Methods: Raw	Boiled	Fermented	Sun-dried	S E M
Moisture	5.29^{c}	5.17^{ab}	5.74^{a}	4.98^{ab}	0.10*
Crude Protein	8.77^{a}	5.17^{c}	6.08^{b}	6.30^{b}	0.40*
Crude Fibre	3.84^{b}	3.06^{c}	2.83^{d}	4.28^{a}	0.18*
Ether Extract	3.01^{a}	1.80^{c}	2.67^{b}	1.38^{d}	0.20*
Ash	4.12^{a}	3.79^{a}	2.69^{c}	3.30^{b}	0.17*
Nitrogen Free Extract	74.98^{b}	80.62^{a}	79.99^{a}	79.75^{a}	0.69*
Calcium	1.31^{a}	1.09^{c}	0.66^{d}	1.14^{b}	0.07*
Phosphorus	0.26^{b}	0.21^{d}	0.31^{a}	0.25^{c}	0.01*

^{a,b,c} Means in the same row with different superscripts are significantly different (P<0.05)
S E M = Standard Error of Mean * = Significant (P<0.05).

Table 2: Effects of different processing methods on Antinutritional factors of sweet potato peel

Antinutritional factor	Processing Methods: Raw	Boiled	Fermented	Sun-dried	S E M
Oxalic acid (mg/100g)	102.22^{b}	29.93^{d}	112.67^{a}	59.75^{c}	10.02*
Flavonoids (%)	9.10^{a}	2.02^{c}	0.72^{d}	3.23^{b}	0.97*
Tannins (mg/100g)	2.51^{a}	1.42^{b}	0.72^{c}	1.52^{b}	0.19*
Hydrogen cyanide (mg/100g)	10.15^{a}	3.09^{c}	1.98^{d}	4.35^{b}	0.95*
Phytic acid (mg/100g)	34.21	29.44	30.17	32.05	0.91^{NS}

^{a,b,c} Means in the same row with different superscripts are significantly different (P<0.05)
S E M = Standard Error of Mean * = Significant (P<0.05) NS = Not significant (P>0.05)

Table 3. Levels of reduction of sweet potato peels phytochemicals by processing (%)

Antinutritional factor	Raw Sweet potato peel	Reduction by processing (%): Boiled	Fermented	Sun-dried
Oxalic acid (mg/100g)	102.22	70.72	-9.27	70.90
Flavonoids (%)	9.10	77.80	92.09	64.51
Tannins (mg/100g)	2.51	43.43	71.31	39.44
Hydrogen cyanide (mg/100g)	10.15	69.56	80.49	57.14
Phytic acid (mg/100g)	34.21	13.94	11.81	32.05

The proximate compositions of the raw and processed sweet potato peel samples are given in Table 1. Moisture, crude protein, fat, and calcium contents of the raw samples were higher (P<0.05) than those of the processed samples. This is not in agreement with the results obtained by Adegunloye and Okparinde (2017) whose processed sweet potato peel samples contained higher levels of moisture and fat compared to the raw peels while fibre, carbohydrate, crude protein and ash contents were not (P>0.05) affected by processing. Except for the higher crude protein content (8.77 %), the composition of the raw sweet potato peel sample in this study has very similar nutritional content compared to what was obtained by Omoregie *et al* (2009); their values for crude protein, ash, ether extract, crude fibre and Nitrogen Free Extract were 4.64, 4.56, 4.06, 3.80 and 74.70 % respectively. Also, Solomon *et al* (2015) got levels of 5.91, 6.02, 4.71, and 71.16 % for the same nutrients respectively. In the study conducted by Adegunloye and Okparinde (2017), fermentation of sweet potato peels significantly (P<0.05) increased moisture and fat contents, while fibre, carbohydrate, crude protein and ash contents were not (P>0.05) affected. Fermentation significantly reduced crude fibre levels possibly as a result of microbial enzymes degrading the complex polysaccharides during the fermentation process. However, Nitrogen Free Extract Levels were higher (P<0.05) in the processed peels compared to the raw.

In the phytochemical analyses of the sweet potato peel oxalic acid level was significantly (P<0.05) reduced by boiling and sun drying but was increased by fermentation. This is contrary to the reports of Oke and Bolarinwa (2012) and Edache *et al* (2018) that fermentation reduced oxalate levels from between 58 to 65 % in cocoyam and unpeeled sweet potato respectively. There is likely to have been an error in the analysis. The levels of flavonoids, tannins and hydrogen cyanide were significantly less than the quantity obtained in the raw peel with fermentation being most effective compared to boiling and sun drying. Except for oxalic and phytic acids, fermentation was more effective (Table 3) in reducing the levels of flavonoids, tannins and hydrogen cyanide compared to other processing methods. Generally the levels of all antinutritional factors were significantly reduced by processing methods which is in consonance with the report of Edache *et al* (2018) which showed that levels antinutritional factors (oxalates, phytates, tannins and trypsin inhibitors) in raw unpeeled sweet potato were reduced by processing. The same effects of processing (roasting and boiling) were shown to reduced levels of antinutritional factors (Tannin, phytate, oxalate, cyanide and trypsin inhibitor) in foods by Nwafor *et al* (2017).

CONCLUSION AND RECOMMENDATION

The chemical composition of sweet potato peel reveals that it is of high energy value that is improved with processing. The raw unprocessed peel also contained phytic acid, oxalic acid, tannin, hydrogen cyanide and flavonoids that are antinutritional factors which levels are significantly reduced by all the processing methods employed. However, fermentation and sun-drying were more effective in reducing the levels compared to boiling and therefore making sweet potato peel a suitable alternative to maize and other conventional energy sources in livestock diets

REFERENCES

Adegunloye, D. V. and Oparinde, T. C. (2017) Effects of Fermentation on the Proximate Composition of Irish (*Solanum tuberosum*) and Sweet Potato (*Ipomoea batatas*) Peels. Advances in Microbiology, 7, 565-574. https://doi.org/10.4236/aim.2017.77044

Aduku, A. O. (2004). Animal Nutrition in the Tropics. Feeds and Feeding, Pasture Management, Monogastric and Ruminant Nutrition. Typeset by Davcon Computers and Business Bureau. 11 Baptist Church Road, Samaru, Zaria, Kaduna State.

A O A C (Association of Official Analytical Chemists), (2006). Official Method of Analysis of the Association of Official Analytical Chemists (W. Horwitz Editor) 18th Edition. Washington D.C.

Dei, H. K. (2017). Assessment of Maize (*Zea mays*) as Feed Resource for Poultry, Poultry Science, Milad Manafi, IntechOpen, DOI: 10.5772/65363. https://www.intechopen.com/chapters/52383

Edache, J. A., Tuleun, C. D., Yisa, A. G., Okpala, E. J., Dabi, D.P. and Muduudtai, R. U. (2018). Performance of growing Japanese quails (*Coturnix coturnix japonica*) fed different levels of peeled, cooked, sun-dried sweet potato (*Ipomoea batatas*) diets. *African Journal of Food, Agriculture, Nutrition and Development* 18 (3):13588 – 13601. ISSN 1684 5374

Krishnaiah, D., Devi, T., Bono, A. and Sarbatly, R. (2009). Studies on phytochemical constituents of six Malaysian medicinal plants. *Journal Medicine. Plants Restricted*. 3(2): 67-72.

Mindat (2021). https:www.mindat.org/feature-2310407.html

Nwafor, F. I., Egonu, S. N., Nweze, N. O. and Ohabuenyi, S. N. (2017). Effects of processing methods on the nutritional values and anti-nutritive factors of Adenanthera *pavonina* L. (Fabaceae) seeds. *African Journal of Biotechnology.* 16 (3): 106 – 112. http://academicjournals.org/AJB

Oke, M. O., and Bolarinwa, I. F. (2012). Effect of Fermentation on Physicochemical Properties and Oxalate Content of Cocoyam (*Colocasia esculenta*) Flour. Volume 2012 |Article ID 978709 | https://doi.org/10.5402/2012/978709

Oluyemi, J. A. and Roberts, F. A. (2007). Poultry Production in Warm Wet Climates. Macmillan Tropical Agriculture, Horticulture and Applied Ecology Series. Macmillan Press Limited, London and Basingstoke

Omoregie, E., Ighoche, L., Ojobe, T. O., Absalom, K. V. and Onusiriuka, B. C. (2009). Effect of varying levels of sweet potato (*Ipomoea batatas*) peels on growth, feed utilization and some biochemical responses of the cichlid (*Oreochromis niloticus*). *African Journal of Food, Agriculture, Nutrition and Development* 9 (2): 770 - 712

Samtiya, M., Aluko, R. E and Dhewa, T. (2020). Plant food anti-nutritional factors and their reduction strategies: an overview. *Food production, Processing and Nutrition* 2 (6) 2020 https://doi.org/10.1186/s43014-020-0020-5

S P S S (2015). Statistical Package for Social Sciences, P C version 23. SPSS Inc. 444 N. Michigan Avenue, Chicago, United States of America

Solomon, S. G., Okomoda, V. T. and Oloche, J. A. (2015). Evaluation of Sweet Potato (*Ipomea batatas*) peel as a replacement for maize meal in the diets of *Clarias gariepinus*. *Journal of Fisheries Sceinces.com* 9 (4): 063 - 068