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Evaluation Of the Nutritive Value of Air-Dried and Sun-Dried Sweet Potato (*Ipomoea Batatas*) Peels

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Abstract*:* This study was conducted to evaluate the nutritive value of sweet potato peels. The proximate composition, mineral composition, amino acid profile and anti-nutritional factors were determined in air-dried and sun-dried sweet potato peels. The sweet potato peels used for this research was collected from Gwagwalada and its environs. The results of the analysis show that crude protein (7.89%, 5.63%), crude fibre (3.41%, 3.68%), ether extract (1.71%, 2.15%), ash (6.95%, 5.82%), moisture (10.00%, 11.50%) and nitrogen free extract (70.04%, 71.22%) for air-dried and sun-dried sweet potato peels respectively. The air-dried and sun-dried peels had the following macro mineral contents respectively: calcium (61.70mg/100g, 45.73mg/100g), magnesium (9.33mg/100g, 5.11mg/100g), potassium (10.3mg/100g, 10.74mg/100g), sodium (4.12mg/100g, 1.52mg/100g), phosphorus (21.81mg/100g, 20.45mg/100g). The micro mineral content of zinc (1.00mg/100g) and iron (3.14mg/100g) in air-dried sweet potato peels had a higher value than that of sun-dried sweet potato peels. Sun-dried sweet potato peels had a higher value in copper (1.33mg/100g) and cobalt (0.18mg/100g) compared to the air-dried sweet potato peels. The air-dried and sun-dried sweet potato peels have the same manganese (1.22mg/100g) deposit in the mineral contents. A total of 16 amino acids (lysine, arginine, aspartic acid, threonine, histidine, serine, glycine, alanine, cystine, valine, leucine, phenylalanine, Tryosine, isoleucine, proline and methionine) were identified in the air-dried and sun-dried sweet potato peels, 9 of which were essential amino acid (lysine, arginine, threonine, histidine, valine, leucine, phenylalanine, isoleucine and methionine). The air-dried peels has the highest value of amino acids while sun-dried peels has the least except in Aspartic acid with 2.47% as compared to 2.13% air-dried peels, histidine with 6.18 % as compared to 4.71 % air-dried peels, alanine with 3.77% as compared to 3.13 % air-dried peels, valine with 1.10 % as compared with 0.88% air-dried peels and leucine with 2.79% as compared with 2.04 % air-dried peels. Histidine is the highest among the amino-acids with 6.18% in sun-dried sweet potato peels. The anti-nutritional factors detected includes: flavonoids, phenols, alkaloids, saponins, trypsin, phytate, cyanogenic glycosides, condensed tannins, hydrolysable tannins and anthocyanins. There is a reduction in the level of the nutritional factors after air-drying and sun-drying. Flavonoids in the air-dried peels was found to be above to be above the safe recommended level that should be consumed by animals. The data derived from the nutrient characterization of sweet potato peels in this study are clear indications that the sweet potato peels are rich in nutrients and can be used in feed formulation.

Keywords: Nutrients, Grains, Energy, Sweet potato peels, Phytochemicals

Introduction

The scarcity and high cost of cereal grains especially maize has necessitated the research into alternative energy sources for feeding poultry. Poultry production is one of the livestock industries that offers the highest turnover and quicker returns on investment either in small, medium or large scale production (Afolayan *et al.*, 2014). The potentials of the industry is affected by the high cost of feed especially energy and protein sources. The prices of energy sources have been on the increase in Nigeria (Midau *et al.*, 2011). The major source of energy is maize. However, maize as an important source of energy is required both by humans and processing industries, thereby causing a stiff competition between humans and animals. The prices of maize has soared so high in recent times coupled with its scarcity in the market thereby making it no more economical to be used in poultry feed formulation (Prot *et al.*, 2013). Continual increase in prices of conventional feedstuffs has necessitated the search for alternatives to the expensive energy and protein sources (Ekeyem *et al.*, 2006).

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The starchy root and tuber peels produced in many tropical areas constitute an important energy source for human and animal feeding. Sweet potato (*Ipomoea batatas*) is one of the world's most important food crops. Its main nutritional important has been its starchy content. However, sweet potato can also be a source of other nutritional important dietary factors such as vitamin A, ascorbic acid, thiamin, riboflavin and niacin (Dominguez, 1990). Sweet potato peels (*Ipomoea batatas*) is high in energy, moderate in protein and low in fibre thus making it a good alternative for maize in poultry feeding. Abdel-Hafeez *et al.* (2018) found the value of crude protein and crude fibre to be 36-46g/kg and 38-70g/kg, respectively, and a metabolisable energy of 11.25MJ/kg.

Sweet potato peels *(Ipomoea batatas)* has a very consistent and nutritional value. The nutritional value of sweet potato *(Ipomoea batatas)* for poultry is a function of the content of starch, protein and anti-nutrients (primarily pytate, gylcosides, condensed and hydrolysable tannins) (Cowieson, 2005). It is also a valuable plant having anti-cancer, antidiabetic and anti-inflammatory activities. Remya and Subha. (2014*)* considered sweet potato to be a valuable source of unique natural product that can be used in the development of medicines against various diseases and in making industrial product.

The objective of this study is to evaluate the nutritive value of air-dried and sun-dried sweet potato peels.

Materials And Methods

Site of the experiment

This experiment was carried out at University of Abuja Research Laboratory which is located along airport road, Gwagwalada FCT-Abuja. Gwagwalada falls within latitude 08°51 and 09°37N, longitude of 007°20 and 007°51E, and the land mass cover 6,550 km (6,500 hectares) and with annual rainfall approximately between 1100 mm to 1650mm (NPC, 2001).

Collection and processing of test ingredients

Sweet potato peels (*Ipomoea batatas)* were gathered from Gwagwalada market, FCT Abuja. Samples were taken to the Department of Crop Science for identification and authentication. The peels were washed with running tap water to remove dirt's, chopped into smaller pieces and shared into 2 parts. The first batch (5kg) was air dried at under a shade for 15 days while the second batch (5kg) which was the sun dried for 7 days until a constant weight was obtained. Both samples were grinded separately using a laboratory blender (Model XC-03, Amani, China) and stored in a well labeled air tight container for further analysis.

Chemical analysis

Crude fibre, crude protein, moisture, ether extract and moisture content were determined according to procedures outlined by AOAC (2000).

Phytochemical evaluation of anthraquinones tannins, alkaloids, saponins, flavonoids, phenols, oxalate, glycosides, steroids and terpenoids were estimated using methods described by Harbone (1973), Odebiyi and Sofowora (1978), Boham and Kocipai (1974).

Mineral analyses of calcium, phosphorus, potassium, sodium, magnesium, manganese, zinc, iron, cobalt, copper, chromium selenium, cadmium and lead were determined using Atomic Absorption Spectrophotometer (AAS – Model 156Y).

Amino acid analysis was carried out using automatic amino acid analyzer (ER-0PA, Hamburg, Germany)

Result and discussion

Proximate composition of air-dried and sun-dried sweet potato peels

The result on the proximate composition of air-dried and sun-dried sweet potato peels is presented in Table 1. The result shows that crude protein (7.89%), ether extract (1.71%), crude fibre (3.41%), ash (6.95 %) and moisture (10.00 %) for air-dried sweet potato peels while sun-dried sweet potato peels contains crude protein (5.63%), ether extract (2.15%), crude fibre (3.68%), ash (5.82%) and moisture (11.50%). The result showed that air-dried sweet potato peels had a high metabolisable energy, moderate protein and crude fibre compared to sundried peels.

The crude protein value obtained in this study for air-dried peels (7.89%) is higher than the 7.70 % crude protein of sweet potato peels reported by Edache *et al.* (2016). The crude protein of the sun-dried sweet potato peels (5.63%) obtained in this study is lower than the crude protein (5.64%) of sweet potato peels reported by Solomon *et al.* (2015). The crude protein (7.89 %) and ash (6.95%) content of the air-dried

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sweet potato peels is higher than the crude protein (5.63%) and ash (5.82%) content of the sun-dried sweet potato peels. This may be due to the different processing methods as well as variations in varieties (Hassan *et al*., 2007; Oluwafemi *et al*., 2020). The author further stressed that the removal of water by heat could affect the nutrient content of food samples.

Table 1: Proximate analysis of air-dried and sun-dried sweet potato peels

Nutrient	Air-dried peels	Sun-dried peels
Moisture (%)	10.00	11.50
Crude protein (%)	7.89	5.63
Crude fibre (%)	3.41	3.68
Ether extract (%)	1.71	2.15
Ash (%)	6.95	5.82
Nitrogen free extract (%)	70.04	71.22
Metabolisable Energy (kcal/kg)	2997.8	3100.5

Mineral composition of air-dried and sun-dried sweet potato peels

Table 2 shows the mineral composition of air-dried and sun-dried sweet potato peels. Results showed that air-dried sweet potato peels have a higher deposit of macro-elements (calcium, magnesium, sodium and phosphorus) than sun-dried sweet potato peel except potassium content which is higher in the sun-dried sweet potato peels. Air-dried sweet potato peels have a higher value in zinc (1.00mg/100g) and iron (3.14mg/100g) compared to sun-dried sweet potato peels. However, sun-dried sweet potato peels have a higher value in copper (1.33mg/100g) and cobalt (0.18mg/100g).

Calcium, magnesium, potassium, sodium and phosphorus are regarded as macro nutrients while zinc, manganese, iron, copper and cobalt are micro nutrients. Lack of these minerals in right quantity and quality in the diet of animals could result in deficiency. calcium plays a vital role in providing rigidity and support to animals (Ibrahim *et al*., 2001). Magnesium, zinc, iron and manganese are important co-factors found in the structure of certain enzymes and are indispensible in numerous biochemical pathways (Soetan *et al*., 2010). Interrelationship also occurs between various minerals in the body, for instance, zinc, copper and magnesium deficiency could result in low birth rate, infertility and other reproductive abnormalities (Pathak and Kapil, 2004). Copper deficiency results in an increase in iron in the liver, sodium is an important cellular cation involved in the regulation of acid base balance and muscle contraction (Akpanyung, 2005).

Table 2 Mineral composition of air-dried and sun-dried sweet potato peels

Minerals (mg/100g)	Air-dried peels	Sun-dried peels
Macro element		
Calcium	61.70	45.73
Magnesium	9.33	5.11
Potassium	10.30	10.74
Sodium	4.12	1.52
Phosphorus	21.81	20.45
Micro element		
Manganese	1.22	1.22
Zinc	1.00	0.70
Iron	3.14	1.00
Copper	0.23	1.33
Cobalt	0.009	0.18

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Vitamin composition of air-dried and sun-dried sweet potato peels

Table 3 shows the vitamin composition of air-dried and sun-dried sweet potato peels used in this study. Ascorbic acid contains (101.9 mg/100g air-dried potato peels and 54.40 mg/100g for sun-dried peels), thiamine (94.34 mg/100g for air-dried potato peels and 18.19% sun-dried peels), riboflavin (2.00 mg/100g for air- dried and 1.20 mg/100g sun-dried), β-carotene (1.45 mg/100g for air-dried while sundried potato peels contains 1.86 mg/100g) and α-tocopherol (3.10 mg/100g for air-dried and 2.71 mg/100g sun-dried).

It was observed that air dried sweet potato peels have higher values vitamins compared to sun-dried peels except β-carotene where sun-dried peels has a value of 1.86 mg as opposed 1.45mg/100g in air-dried peels. Kulisic *et al.* (2004); Alagbe *et al*. (2020) reported that vitamin C has antioxidant properties and also have a correlation with α-tocopherol and β-carotene (Wright 2002 and Yeum *et al*., 2009). Vitamin A has also been reported to play a major role in good sight and regulates gene expression (Bakare *et al*., 2010).

Table 3: Vitamin composition of air-dried and sun-dried sweet potato peels

Vitamin analysis (mg/100g)	Air-dried peels	Sun-dried peels
Ascorbic	101.92	54.40
Thiamine	94.34	18.19
Riboflavin	2.04	1.20
β–carotene	1.45	1.86
α-tocopherol	3.10	2.71

Amino acid profile of air-dried and sun-dried sweet potato peels

The amino acid profile of air-dried and sun-dried sweet potato peels is presented in Table 4. The amino acids identified are lysine (2.11% air-dried and 1.38 % sun-dried), arginine (1.77 % air-dried and 1.55 % sun-dried), aspartic acid (2.13 % air-dried and 2.47 % sun-dried), threomine (1.85 % air-dried and 1.00 % sun-dried), histidine (4.71% air-dried and 6.18 % sun-dried), serine (2.03 % air-dried and 2.00 % sun-dried), glycine (1.05 % air-dried and 1.02 % sun-dried), alanine (3.31% air-dried and 3.77 % sun-dried), cystine (5.06 % air-dried and 2.82 % sun-dried), valine (0.88 % air-dried and 1.10 % sun-dried), leucine (2.04 % air-dried and 2.79 %), phenylalanine (4.72 % air- dried and 3.00 % sun-dried), tyrosine (3.51% air-dried and 1.88 % sun-dried), isoleucine (2.84 % air-dried and 2.33 % sun-dried), proline (1.05 % air-dried and 1.04 % sun-dried) and methionine (0.85% air-dried and 0.02% sun-dried).

The air-dried peels had a higher value of amino acid compared to sun-dried peels. Amino acids are organic compounds that combine to form proteins; as such, they influence the quantity and quality of protein. Amino acids are classified as essential and non-essential and their requirements vary according to animal species and their production system (Swanepoel *et al*., 2010). Amino acids also affect the function of other nutrients in the animal's body such as presence of lysine, which ensures adequate calcium absorption and aids in the antibody production. Diets rich in amino acids help to boost help the immune system against gastro intestinal infestations (Kyriazakis and Houdijk, 2006)

Table 4: Amino acids profile of air-dried and sun-dried sweet potato peels

Amino acids (%)	Air-dried peels	Sun-dried peels
Lysine*	2.11	1.38
Arginine*	1.77	1.55
Aspartic acid	2.13	2.47
Threonine*	1.85	1.00
Histidine*	4.71	6.18
Serine	2.03	2.00
Glycine	1.05	1.02
Alanine	3.31	3.77

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Cystine	5.06	2.82
Valine*	0.88	1.10
Leucine*	2.04	2.79
Phenylalanine*	4.72	3.00
Tyrosine	3.51	1.88
Isoleucine*	2.84	2.33
Proline	1.05	1.04
Methionine*	0.85	0.02

*general essential amino acids

Phytochemical composition of air-dried and sun-dried sweet potato peels

The phytochemical composition of air-dried and sun-dried sweet potato peels is presented in Table 5. The phytochemical components are flavonoids (6.33 % air-dried and 4.11 % sun-dried), phenols (4.40 % air-dried and 3.04 sun-dried %), alkaloids (1.88 % air-dried and 1.55 % for sun-dried), saponins (2.01 % air-dried and 1.87 % sun-dried), trypsin (0.86 % air-dried and 0.44 % sun-dried), phytate (2.28 % air-dried and 2.41 % sun-dried), cyanogenic glycosides (0.23 % air-dried and 0.07% sun-dried), condensed tannins (0.22 % air-dried and 0.21 % sun-dried), hydrolysable tannins (2.04 % air-dried and 3.72 % sun-dried) and anthrocyanins (1.71 % air-dried and none for sun-dried).

Phytochemicals are secondary metabolites which protect plants against degenerative disease (Omale and Okafor, 2008; Agubosi *et al*., 2021) and exhibits several pharmacological effects in animals (Dreosti, 2000; Shittu and Alagbe, 2021). According to Igwe *et al*. (2010), alkaloids helped in parasites and predators in plants and when ingested, could result in a negative effect on the thyroid stimulating hormone and some enzymes (Okaka *et al*., 1992; Agubosi *et al*., 2021). Anthocyannins have been suggested possess antidiabetic, anticancer and anti-inflammatory activities (Hock *et al*., 2017; Shittu *et al*., 2021).

Saponins is characterized by a bitter taste, foaming properties and posses antimicrobial properties (Alagbe, 2020; Adewale et al., 2021). The anti-nutritional effect of saponins is the retardation in growth rate, due to reduction in feed intake is probably the major concern (Cheeke *et al*., 2006; Singh et al., 2021). Phytates bind minerals like calcium, iron, magnesium and zinc and make them unavailable (Aletor, 1991; Alagbe and Motunrade, 2019). Exposure to cyanide or intentional consumption of cyanogenic glycosides may lead to acute intoxications, characterized by growth retardation and neurological symptoms resulting from tissue damage in the central nervous system (Kumbukani, 2020).

Table 5: Phytochemical composition of air-dried and sun-dried sweet potato peels

Parameters (%)	Air-dried peels	Sun-dried peels
Flavonoids	6.33	4.11
Phenols	4.40	3.04
Alkaloids	1.88	1.55
Saponin	2.01	1.87
Trypsin	0.86	0.44
Phytate	2.28	2.41
Cyanogenic glycosides	0.23	0.07
Condensed tannins	0.22	0.21
Hydrolysable tannins	2.04	3.72
Anthocyannin	1.71	-

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Conclusion

Sweet potato is one of the most consumed tuber crops in the world due to its palatability and wide range of uses and the results from this study indicates that the peels has a lot of nutritional values which includes protein, minerals, vitamins and amino acid. The peels can be used to substitute other ingredients especially maize in animal feed.

The nutritional content in the air-dried peels is the highest hence it is a useful source of animal feed. Air-drying reduces the moisture content in the peels, preserves it from adverse temperatures and even increase the nutritional content of the peels (as observed in this study). Considering the energy value, the amino acid, vitamins and mineral content in this study is relatively high, the air-dried sweet potato peels and sun-dried sweet potato peels can be used as an energy source in animal feedstuff.

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