THE EFFECT OF MATURITY ON THE PROXIMATE COMPOSITION OF ORANGE FLESHED SWEET POTATO

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Abstract
The aim of this work is to analyse the effect of different maturity periods or stages on the proximate composition of different genotypes of orange fleshed sweet-potato tuber as it is known that the nutritional composition of food crops is affected by the maturity stage, because it allows the nutritional and anti-nutritional contents to increase or decrease. The moisture content of the three genotypes were analysed by the gravimetric method while the carbohydrate content was determined by difference as the Nitrogen Free Extractive (NFE). The ash content was determined by using the furnace incineration gravimetric method, protein compositions of the genotypes were gotten by Kjeidhal method, ether extract was used to determination fat content while Wende method was employed in the calculation of crude fibre content. The periods under study are 3, 4 and 5 months while the genotype used are centennial (CEN), NRSP/05/022 (NRSP), 87/0087 (87). There was a significant increase at p<0.05 in all the parameters analysed as potatoes matured from 3-5 months except for carbohydrate which decreased (p<0.05) in centennial and NRSP at 5 month maturity. Generally, 87/0087 had the highest increase in moisture content 56.76a ± 0.03,62.3a9 ± 0.003%, fat 0.8c7 ± 0.02-5.03c ± 0.00%,carbohydrate 36.55 ± 0.01-39.04 ± 0.03%, and ash content 0.54b ± 0.00-1.26b ± 0.03% NRSP had the highest increase in fibre content 1.20a ± 0.01 – 1.55a ± 0.03%, while CEN had the highest increase in protein 5.24 ± 0.01 – 6.4a ± 0.003%.

Keywords: proximate, maturity, sweet potatoes, centennial, and NRSP/05/022.

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1. INTRODUCTION

Sweet potato (*Ipomoea batatas*) is a dicotyledonous perennial vine plant bearing alternate shaped lobed leaves and medium sized sympatalous flowers (Scotta, and Rodriquez-Amaya, 2000). It is a thick root that stores starch which is the major economic importance of sweet potato as food. Sweet potato belongs to the family "*convovulaceae*" and genus "*Ipomoea*" that is, the family referred to as the morning glory family of flowering plants (Chang et al., 2010). The edible tuberous root is long and tapered with a smooth skin whose colour ranges between yellow, orange and purple. The white or pale yellow fleshly varieties are less sweet and moist than those red, pink and orange fleshed ones (Collins and Walter, 1982).

Sweet potato is cultivated throughout the tropic and warm temperate regions of the world and because of its drought tolerance, it is called a "hot weather crops". Its short maturity period makes it a good food security crop that can help to alleviate poverty among rural dwellers through improved processing techniques and food diversification (Woolfe, 1992; FAO/WHO, 2001).Apart from being a major staple food in most of the developing countries of the world, sweet potato can be utilized in many other ways which makes it a valuable and economic cash crop which can also be used as animal feed.

Sweet potato is increasingly recognized as health food as it competes nutritionally with all the staple food and it is being ranked highly in terms of complex carbohydrate, protein, vitamin A and C, Iron and Calcium (Abidin et al., 2004). Carbohydrates are the highest nutrient in sweet potato roots. It accounts for about 60-70% of the dry matter (Cereda et al., 1982). Bradbury and Holloway, (1988) opined that the dry matter content varies depending on

the cultivars and climate. Besides simple starch, sweet potatoes are rich in dietary fibre, beta-carotene (a vitamin A equivalent nutrient), and vitamin B6.

The non-starchy polysaccharide comprising cellulose, hemicellulose and pectin contributes towards the dietary fibre fraction of sweet potato roots which accounts about 70% dry weight basis in raw sweet potato (Shen and Sterling, 1981). According to Boggess et al., (1970), the total lipid content in sweet potato root is in the range of 0.29-2.7% dry weight basis. The type of lipid present is important as they decide the storage quality and off-flavour development during storage of processed product like flakes and chips (Faboya, 1981).

According to Hwang et al., (2010), when passing through the digestive system, sweet potato cyanide and penonidins and other colour related phytonutrients may be able to lower the potential health risk posed by heavy metals and oxygen radicals like mercury, cadmium or arsenic in the diets. Unlike other starchy root vegetables, sweet potato has the ability to improve blood sugar regulation even in persons with type two diabetes as it helps to lower the insulin resistance (Kusano and Abe, 2000). The nutrient categories responsible for the health benefits of this underappreciated tuber are anti-oxidants, anti-inflammatory nutrients and blood sugar regulating nutrients (Zhang et al., 2008; Ozaki et al., 2010).

It is known that the nutritional composition of food crops is affected by the maturity stage, that is, the more the crop is allowed to mature, the more the nutritional and anti-nutritional contents increase or decrease likewise the cooking methods or the processing techniques employed which can lead to loss of nutrients (Woolfe, 1992). Thus, this work seeks to evaluate the effect of maturity on the proximate composition of three genotypes of orange fleshed sweet potato.

2. MATERIALS AND METHODS

The raw materials (orange fleshed potatoes), chemicals and apparatus used for the analysis where obtained from the sweet potato farm of National Root Crops Research Institute, Umudike, Abia State ,Nigeria. The sweet potatoes were harvested separately based on their maturity stage and stored under ambient temperature until needed for analysis.

2.1. Proximate analysis

The moisture content of the three genotypes of the sweet potato was analysed by the gravimetric method (James, 1995) while the carbohydrate content was determined by difference as the Nitrogen Free Extractive (NFE), a method separately described by Pearson (1976). The ash content was determined by using the furnace incineration gravimetric method (AOAC, 1995), protein compositions of the genotypes were gotten by Kjeidhal method described by James (1995), the continuous solvent extraction method using soxhlet apparatus as described by Pearson (1976) and James (1995) was used for fat content (ether extract) determination while Wende method (James, 1995) was employed in the calculation of crude fibre content.

3. RESULT AND DISCUSSION

Table 1: Nutritional composition of sweet potato

Name	**Percentage (%)**
Essential amino acid	**(%)**
Arginine	0.085
Histidine	0.040
Isoleucine	0.042
Phynyllanin	0.100
Leucin	0.091
Valine	0.15
Methionine	0.15
Carbohydrate	**(%) Starch**
Amylose	34
Amylopectin	60 - 70
Cellulose	
Hemicellulose	
Sugar	0.38 – 5.64
Lipid fraction	**(%)**
Linoleic	44.7
Palmitic acid	29.3
Crude protein	2.7%
Fibre	3.3%
Ash	1.7%
Moisture	78.14%

Source: **USDA (1999)**

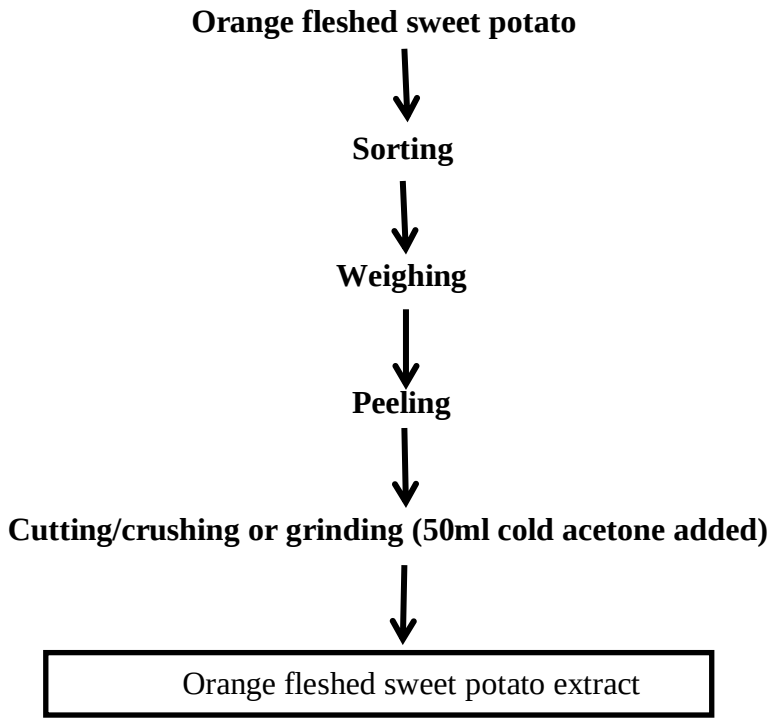

Fig. 1: flow chart for the production of potato extract from orange fleshed sweet potato

Table 2: Effect of maturity on the proximate composition of orange fleshed sweet potato genotypes at 3, 4 and 5 months duration

	Parameters (%)					
	Moisture	Ash	Fibre	Fat	Protein	Carbohydrate
Genotypes	**(3 MONTHS)**					
CEN	$50.35^{c} \pm 0.01$	$0.27^{c} \pm 0.03$	$0.56^{c} \pm 0.01$	$1.06^{a5} \pm 0.01$	5.24 ± 0.00	$42.52^{a} \pm 0.01$
NRSP	$52.45^{b} \pm 0.03$	$1.06^{a} \pm 0.03$	$1.20^{a} \pm 0.01$	$0.92^{b} \pm 0.01$	3.17 ± 0.00	$41.21^{a} \pm 0.001$
87	$56.76^{a} \pm 0.03$	$0.54^{b} \pm 0.03$	$0.63^{b} \pm 0.03$	$0.67^{c} \pm 0.03$	4.85 ± 0.03	$36.55^{b} \pm 0.03$
LSD	0.10	0.04	0.05	0.05	-	0.25
Genotypes	**(4 MONTHS)**					
CEN	$57.45^{c} \pm 0.01$	$0.39^{c} \pm 0.03$	$0.61^{c} \pm 0.01$	$1.14^{c} \pm 0.01$	$6.07^{a} \pm 0.00$	$34.36^{a} \pm 0.00$
NRSP	$58.53^{b} \pm 0.03$	$1.29^{a} \pm 0.03$	$1.40^{a} \pm 0.03$	$1.02^{c} \pm 0.01$	$3.24^{c} \pm 0.00$	$34.53^{a} \pm 0.03$
87	$60.48^{a} \pm 0.03$	$0.72^{b} \pm 0.00$	$0.70^{c} \pm 0.03$	$0.98^{c} \pm 0.03$	$5.75^{b} \pm 0.03$	$31.80^{b} \pm 0.03$
LSD	0.25	0.25	0.03	0.45	-	0.25
Genotypes	**(5 MONTHS)**					
CEN	$60.47^{b} \pm 0.00$	$0.53^{c} \pm 0.03$	$0.67^{c} \pm 0.01$	$1.30^{c} \pm 0.03$	$6.41^{a} \pm 0.03$	$30.61^{c} \pm 0.00$
NRSP	$60.40^{b} \pm 0.03$	$1.31^{a} \pm 0.00$	$1.55^{a} \pm 0.03$	$1.25^{c} \pm 0.03$	$3.63^{b} \pm 0.03$	$31.87^{c} \pm 0.03$
87	$62.39^{a} \pm 0.03$	$1.26^{b} \pm 0.00$	$0.77^{b} \pm 0.01$	$5.03^{c} \pm 0.00$	$5.98^{a} \pm 0.00$	39.04 ± 0.03
LSD	0.19	0.01	0.09	-	0.07	-

Mean ± standard deviation of triplicate determination (n=3).
Any sample means bearing superscript along the same row are significantly different ($p<0.05$).

Table 2 shows the effect of maturity stages on the proximate composition of orange fleshed sweet potato genotypes at 3, 4 and 5 months respectively. The moisture content of centennial, NRSP and 87 significantly increased from 50.35% - 60.47%, 52.45%-60.40%, and 56.76 – 62.39% from 3–5 months respectively. Values obtained were however lower than 78.14% as reported in table 1for all the genotypes reviewed. However, from the results, 87/0087 had the highest moisture content as the maturity duration increased.

There was a significant ($p<0.05$) increase in ash content of all the samples analysed with 87 having the highest increase of 0.72% which is almost the same with the 0.75% reported by Low et al., (2009) for orange fleshed sweet potato. CEN increased from 0.27% - 0.53%, NRSP increased from 1.06% – 1.31%, 87 increased from 0.54% - 1.26%. Also from table2, the fibre content for all the samples increased with NRSP having increased the highest from 1.20% - 1.55% while CEN had the lowest increase of 0.56% - 0.67%. The fibre content of all genotypes was lower than the reported 3.3% in table 1. This shows that the genotypes are ideal to be in weaning foods for children.

The result showed that orange fleshed sweet potato genotypes are energy dense foods as exampled by the rate at which the fat content increased as the maturity period increased. It is also necessary to ensure proper utilization of vitamin A (beta-carotene) since vitamin A is fat soluble. Oduro et al. (2000) identified some important nutrient in sweet-potatoes which includes carotene, vitamins B_2 and C, polyphenols, thiamines, phosphorus, niacin, iron, calcium and carbohydrate (Islam, 2006). CEN fat content increased from 1.06% - 1.30%, NRSP increased from 0.92% - 1.25% while 87 increased the most, from 0.67% – 5.03%. Significant increase was observed in the protein content of all the genotypes. CEN had the highest increase of 5.24% - 6.41% while NRSP had the lowest increase of 3.17% - 3.63%. Carbohydrate content of the genotypes significant5ly ($p<0.05$) decreased for both CEN and NRSP from 42.52% - 30.61%, 41.21% - 31.87% respectively. Meanwhile 87-genotype increased from 36.55% -31.87% although a decrease was observed after the 4th month. Moorthy and Ramanujan (1992) reported that age, variety, growth season and cultivars type affect their physico-chemical properties.

4. CONCLUSION

The results of this study show that maturity stage has a significant effect on the proximate composition of orange fleshed sweet potato. All the genotypes showed a varying degree of nutritional changes with the different maturity periods. From the result and analysis, it can be inferred that matured orange fleshed sweet potatoes at 5months were nutritious with 87/0087 and NRSP/05/022 having higher values than CEN.

The knowledge of the proximate composition of sweet potatoes in different maturity duration is important in order to find the best stage to achieve better functional and nutritional properties. Thus, further study should be carried out with respect to the utilization and diversification of the genotypes into produce such as weaning foods for children.

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