

DIVERSITY AND CHARACTERISTICS OF POTATO FLAKES IN NAIROBI AND NAKURU, KENYA

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ABSTRACT

Potato flakes are some of the most important form of dehydrated potato products that can be used in different ways including substitution for fresh mashed potatoes. Unlike French fries and crisps whose consumption patterns and diversity is well established, little or no information can be obtained on flakes in Kenya. This study was, therefore designed to assess the diversity and characteristics of potato flakes in Nairobi and Nakuru, Kenya. Potato flakes diversity and characteristics were determined through a structured questionnaire administered to attendants in 148 retail outlets (supermarkets and shops) followed by sampling and laboratory analysis of the available brands. Of all supermarkets surveyed, only 3.4% stocked potato flakes. There were only 2 brands of flakes, one imported and another, local brand. The sales were reportedly low due to the high cost (55%) of the products, lack of public awareness of the product (35%) and inadequate supply (15%). The oil and moisture contents of potato flakes from supermarkets in Nairobi and Nakuru significantly ($P < 0.05$) differed between the brands being generally lower in the imported brand compared to local brand, ranging from 0.13% to 0.32%. There were no significant ($P > 0.05$) differences in levels of sodium chloride with the maximum recorded being 2.11% in imported flakes. The moisture content ranged from 8.52% to 10.51% in local and

imported flakes brands, respectively. The sale of potato flakes can, however, be increased if the processors produced smaller unit weight packages that are more affordable and create awareness to the general public consumer.

Key words: Flakes, lightness, mash potatoes, dehydration

INTRODUCTION

All over the world, potatoes are highly consumed and utilized and hence ranked as third most important food crop with over a billion people depending on it thereby providing food security (CIP, 2012). Kenya is a very significant producer of potato which is important both as food and cash crop and plays a major role in food security millions of people who depend on the crop as a staple food (Ministry of Agriculture 2007).

Potato tubers are used in different ways depending on communities and choice. Tubers are boiled, steamed, baked and roasted. As an industrial crop, chips, starch, flakes, flour and crisps and many recipes have been developed. In Kenya for instance, chips and crisps processed from potatoes have tremendously gained popularity especially in major towns (Abong' et al., 2010a). The potato in Kenya, just like the other roots and tubers in the Sub-Saharan Africa (SSA) is a major source of sustenance and hence a source of energy and the abundant vitamin C (Abong' et al., 2011a). It accounts for more than 20 % of calories consumed world over. The potato has high nutritive value and can supply considerable amounts of energy, minerals and vitamins (Woolfe, 1987; Abong' et al., 2009b).

Potato flakes are dehydrated potato products mostly processed by cooking, mashing and dehydration to produce a conveniently packaged and easy to reconstitute by adding hot water or milk making them desirable to many consumers (Lamberti et al., 2004). Together with potato

granules, powder, shredded and sliced potato, potato flakes are some of the most important form of dehydrated potato products consumed world over (GAS, 2011). They can be used as substitute for fresh mashed potatoes. Flakes can, however, be stored for longer duration on the shelf (Kumar and Tiwari, 2006; Mardiah et al., 2010) compared to most fresh potato products and raw potatoes that can only store for up to 12 weeks in cooler highland areas (Abong' et al., 2009a). Depending on the manufacturers; flakes have different flavors such as onion, chilly, garlic, and butter and can be used as a thickener enhancing creamy frozen desserts, gravies and chocolate milk.

Unlike industrially processed chips and crisps whose consumption patterns and diversity is well established, little or no information can be obtained on potato flakes especially in Kenyan context. This study was designed to assess the diversity and characteristics of potato flakes in Nairobi metropolitan and Nakuru, Kenya.

MATERIALS AND METHODS

Survey of diversity and characteristics of potato flakes

This study was carried out between July 2011 and February 2012. Nairobi and Nakuru were purposively selected due to the large number of factories and supermarkets with diversity of processed potato products. Due to inadequate information on potato flakes sample size determination was not feasible and hence all supermarkets in Nairobi metropolitan and Nakuru town were targeted in the survey. A total of 148 supermarkets were surveyed and data collected using a structured questionnaire which had previously been pre-tested in 10 randomly selected outlets in Nairobi. Data was collected on frequency of purchase or sale, the preferred brand, package size and type, flavor, and trends in consumption or prices.

Sampling of marketed potato flakes

Duplicate samples of available brands of potato flakes were purchased from supermarkets selling the products. Samples were taken to Food Chemistry Laboratory, University of Nairobi for analysis of salt content, moisture content, color and oil content.

Laboratory analysis

Moisture content

Moisture content was determined on triplicate samples by standard analytical methods (KEBS, 2007).

Oil content

The oil content was determined by extraction of 5 g of finely ground samples of flakes in Soxhlet apparatus for 8 hours using analytical grade petroleum ether (boiling point 40-60 °C) according to method of KEBS, 2007 and the oil content calculated as a percent.

Total salt content

Salt content was determined using the modified FAO/WHO method No. 16.209 (AOAC, 1980). About 5 g accurately weighed finely ground samples were dispersed in 100 ml of distilled water and allowed to stand for 5-10 min with occasional swirling. Approximately one milliliter of 5% potassium dichromate solution was added and titration performed with 0.1 N silver nitrate solution to the first appearance of an orange-brown color that persisted for 30 sec. The sodium chloride was calculated as percent as follows:

$\% \text{ NaCl} = 5.85N (V_1 - V_0)/W$; where N= normality of silver nitrate; V_1 = ml silver nitrate for titrating the sample; V_0 = ml silver nitrate for titrating the blank, and W= weight of sample in g.

Potato flakes color

flakes color was measured using a color spectrophotometer (NF 333, Nippon Denshoku, Japan) in the CIE Lab L^* , a^* and b^* color scale where ' L^* ' value is the lightness parameter indicating degree of sample lightness varying from 0=black to 100=white. On the other hand ' a^* ' which is

the chromatic redness parameter whose value means red color when positive (+) and green color when negative (-) while 'b*' is yellowness chromatic parameter corresponding to yellow color when positive (+) and blue color when negative (-).

Data analysis

Data from supermarket interviews were analyzed for frequencies and means using SPSS version 11.5 while data from laboratory evaluation were subjected to analysis of variance (ANOVA) and means separated by least significant difference test using Statistical Analysis System (SAS version 9). Significant differences were considered 5% level of significance.

RESULTS AND DISCUSSION

Diversity of potato flakes sold in retail outlets in Nairobi and Nakuru, Kenya

Out of the 148 supermarkets surveyed, only 5 (3.4%) sold potato flakes which were mainly stocked once a month in quantities of 5-10kg. However, all the outlets stocked other processed potato products including chevda (flavored pieces of potato), potato sticks and potato crisps. There were only 2 brands of flakes, one imported and one local brand. The sales were reportedly low due to low consumption rate which was attributed to the high cost (55%) of the products and lack of awareness of the product (35%) and inadequate supply (15%). Unlike potato crisps which is well established industrially and is also popular with many consumers (Abong' et al., 2010b), potato flakes or dehydrated mashed potatoes are not well known in Kenyan market. Inadequate information on flakes is an indication of low processing output, lack of research and general public awareness on the product. In the contrary, potato flakes are used in many occasions in the developed world especially where long shelf life is a key product requirement (Neilson et al., 2006).

The units of packaging were in the range of 201-300g and were selling at US\$ 2-3. The imported brand from United States of America was however, more expensive than the local brand. The fact that very few units of packaging for flakes existed in the available supermarkets means that customers have no choice in terms of quantity and prices. This may serve to partly explain the low consumption of the product. The major packaging material was polyethylene bag for local brand, and combination of polyethylene and carton box for the imported brand which were recommended to be stored in cool dry places. The type of packaging determines product shelf life (Abong' et al., 2011b). Packaging does not only protect flakes from adverse atmospheric conditions such as air and light, but also retards deterioration and ensures product quality and safety (Marsh and Bugusu, 2007). Flakes can be stocked for at least 1 year without any reported loss or deterioration. The double packaging on the imported flakes brand would therefore ensure longer shelf life.

The main consumers of potato flakes are the grownups who normally purchase the products during end months when there exists disposable income. About 70% of the shops reported product scarcity and lack of variety of processors/suppliers and consumers. Few suppliers (2) are probable cause of high retail costs due to manufacturers dictating the product prices which were reported to have been increasing for the last 2 years. On the other hand, high product costs can be attributed to cost of production. This was generally attributed to changes in exchange market. Consumption has, however, remained constant due to lack of awareness and low supplies.

Characteristics of potato flakes sold in retail outlets in Nairobi and Nakuru, Kenya

The oil and moisture contents of potato flakes from supermarkets in Nairobi and Nakuru significantly ($P < 0.05$) differed between the brands that were sold (Table 1). The oil content was generally lower in the imported brand compared to local which is local brand and it ranged from

0.13% to 0.32%. There were no significant ($P>0.05$) differences in levels of sodium chloride with the maximum recorded being 2.11% in imported flakes which is within the standard limits (EAS, 2010). The moisture content ranged from 8.52% to 10.51% in local and imported brands, respectively.

Table 1: Oil, sodium chloride and moisture contents of potato flakes from Supermarkets in Nairobi and Nakuru, Kenya

Sample	Source	Oil content (%)	NaCl (%)	Moisture content (%)
Imported brand	Nakuru	0.13 ± 0.01c	2.11 ± 0.11a	10.51 ± 0.09a
Imported brand	Nairobi	0.24 ± 0.01b	1.26 ± 0.00b	10.49 ± 0.08a
Local brand	Nairobi	0.31 ± 0.03a	1.58 ± 0.52ab	8.89 ± 0.02b
Local brand	Nairobi	0.32 ± 0.01a	1.72 ± 0.00ab	8.52 ± 0.07c

The amount of oil in any given potato product has a major influence on the flavor and storability and depends on potato cultivar and processing parameters which may explain the observed differences noted in the two brands (Kita et al., 2007; Ziaifar et al., 2008). The levels of oil in flakes are extremely low since unlike deep-oil-fried crisps and French fries, they are processed without addition of oil. Flakes would therefore form part of menus of many consumers who are health conscious and watch their oil intake (Hagenimana et al., 1997).

The level of sodium chloride consumed is becoming increasingly important since its high consumption is related to several health disorders including high blood pressure (Vardavas et al., 2007). However, the levels observed in the marketed flakes brands are within statutory limits of Kenya. The moisture content determines the shelf-life of any given product and depends on processing and packaging (Marsh and Bugusu, 2007). Potato flakes being dehydrated products

are expected to have <10% moisture content to be able to have longer storage life. Higher levels of moisture content in imported could be due to environmental conditions they are subjected during shipment.

Color parameters of the flakes differed significantly ($P<0.05$) among the brands as indicated in Table 2.

Table 2: Color parameters of potato flakes from supermarkets in Nairobi and Nakuru

Sample	Source			
	e	L*	a*	b*
Local brand	Nairobi	79.43 ± 0.91b	-0.71 ± 0.05b	14.11 ± 0.23a
Local brand	Nairobi	79.50 ± 0.71b	-0.65 ± 0.02b	17.94 ± 3.53a
Imported brand	Nairobi	85.40 ± 0.49a	0.89 ± 0.03a	16.55 ± 0.71a
Imported brand	Nakuru	86.10 ± 1.28a	-0.11 ± 1.07ab	18.76 ± 0.66a

The lightness parameter (L^*) was significantly ($P<0.05$) lower in local brand (79.43) and higher in imported brand (86.10). The same trend was observed in the redness (a^*) parameter that ranged from -0.71 to 0.89 while there was no significant ($P>0.05$) differences noted in the yellowness (b^*) parameter. The lightness parameter indicates how close food product color is close to whiteness; the closer it is to 100, the whiter the product. It therefore shows that the imported brand has better color than the local brand. Flakes of both the brands tended towards green than red as indicated by the negative redness parameter values which is an indication that the processing parameters for the flakes may not yield dark red products resulting from maillard reaction such as those produced from crisps or chips (Hassanpanah et al., 2011). Color is an important sensory attribute that determines the capacity of any food product to be

accepted by the consumer at first site (Surkan et al., 2009). Any manufacturer must, therefore, endeavor to conform to consumer requirement (Krokida et al., 2001). The differences in color parameters between the two brands could be related to potato variety which determines the content of reducing sugars and proteins and dehydrating temperature (Mendoza et al., 2007).

CONCLUSION

There exist only two brands of potato flakes sold in retail outlets in Nairobi and Nakuru, Kenya, which are in short supply due to inadequate production. Though they differed, the brands had characteristics most of which conformed to the statutory standards. The sale of potato flakes can, however, be increased if the processors produced smaller unit weight packages that are more affordable and create awareness to the general public consumer.

ACKNOWLEDGEMENTS

Authors are grateful to Kenya Agricultural Productivity and Agribusiness Project (KAPAP) and the National Potato Research Centre (KARI) for financial support.

REFERENCES

1. Abong, G.O., Okoth, M.W., Karuri, E.G., Kabira, J.N. and Mathooko, F.M. (2009a): Levels of reducing sugars in eight Kenyan potato cultivars as influenced by stage of maturity and storage conditions. *J. Anim. Plant Sci.*, 2 (2): 76-84.
2. Abong, G.O., Okoth, M.W., Karuri, E.G., Kabira, J.N. and Mathooko, F.M. (2009b): Nutrient contents of raw and processed products from Kenyan potato cultivars. *J. Appl. Biosci.*, 16: 877-886.
3. Abong, G.O., Okoth, M.W., Imungi, J.K. and Kabira, J.N. (2010a): Consumption patterns, diversity and characteristics of potato crisps in Nairobi, Kenya. *J. Appl. Biosci.*, 32: 1942-1955.

4. Abong, G.O., Okoth, M.W., Imungi, J.K. and Kabira, J.N. (2010b): Characteristics of the potato crisps processing industry in Kenya. *J. Anim. Plant Sci.*, 8 (1): 936- 943.
5. Abong, G.O., Okoth, M.W., Imungi, J.K. and Kabira, J.N. (2011a): Losses of ascorbic acid during storage of fresh tubers, frying, packaging and storage of potato crisps from four Kenyan potato cultivars. *Am. J. Food Technol.*, 6 (9):772-780.
6. Abong, G.O., Okoth, M.W., Imungi, J.K. and Kabira, J.N. (2011b): Effect of packaging and storage temperature on the shelf life of crisps from four Kenyan potato cultivars. *Am. J. Food Tech.* 6, (10): 870-881.
7. AOAC. (1980): Official methods of analysis, 13th ed., Association Official Analytical Chemistry, Washington, DC, USA.,
8. CIP (2012): Potato. www.cipotato.org/potato. Accessed on 3-8-2012.
9. EAS. (2010): Potato Crisps Specifications. 1st Edn., East African Standards, USA.,
10. GAS. (2011): Potato flakes. <http://www.scribd.com/doc/46426710/Potato-Flakes>
11. Hagenimana, V., Karuri, E.G. and Oyunga, M.A. (1997): Oil content in fried processed sweet potato products. *J. Food Proc. Preserv.*, 22: 123-137.
12. Hassanpanah, D., Hassanabadi, H. and Chakherchaman, S.H.A. (2011): Evaluation of cooking quality characteristics of advanced clones and potato cultivars. *Am. J. Food Technol.*, 6: 72-79.
13. KEBS (Kenya Bureau of Standards). (2007): Potato Crisps Specifications. KEBS, Nairobi.
14. Kita, A., Lisinska, G. and Gołubowska, G. (2007): The effects of oils and frying temperatures on the texture and fat content of potato crisps. *Food Chem.*, 102: 1-5.
15. Krokida, M.K., Maroulis, Z.B. and Saravacos, G.D. (2001): The effect of method of drying on the color of dehydrated products. *Int. J. Food Sci. & Technol.*, 36: 53-59.

16. Kumar, A. and Tiwari, G.N. (2006): Effect of Mass on Convective Heat Transfer Coefficient During Onion Flakes Drying. *Am. J. Food Tech.*, 1 (1): 1-18.
17. Lamberti, M., Geiselmann, A., Conde-Petit, B. and Escher, F. (2004): Starch transformation and structure development in production and reconstitution of potato flakes, *LWT-Food Sci. & Technol.*, 37, p. 417-427.
18. Mardiah, A., Huda, N. and Ahmad, R. (2010): A Study on the Physicochemical Properties, Microstructure and Sensory Characteristics of Fish Flakes. *Am. J. Food Technol.*, 5 (6): 469-482.
19. Marsh, K. and Bugusu, B. (2007): Food packaging-roles, materials, and environmental issues. *J. Food Sci.*, 72 (3): 39-55.
20. Mendoza, F., Dejmek P. and Aguilera, J.M. (2007): Color and image texture analysis in classification of commercial potato chips. *Food Res. Int.*, 40: 1146-1154.
21. Ministry of Agriculture (MoA). (2007): Challenges in potato research. The National Policy on Potato Industry. Proceedings of Potato Stakeholders Workshop, Nairobi, Kenya.
22. Neilson, A.P., Pahulu, H.F., Ogden, L.V. and Pike, O.A. (2006): Sensory and nutritional quality of dehydrated potato flakes in long-term storage. *J. Food Sci.*, 71 (6): s461-S466.
23. Surkan, S., Albani, O. and Ramallo, L. (2009): Influence of storage conditions on sensory shelf-life of yerba mate. *J. Food Qual.*, 32: 58–72.
24. Vardavas, C.I., Yiannopoulos, S., Kiriakakis, M., Poulli, E. and Kafatos, A. (2007): Fatty acid and salt contents of snacks in the Cretan and Cypriot market: A child and adolescent dietary hazard. *Food Chem.*, 101: 924–931.
25. Woolfe, J.A. (1987): The potato in the human diet. Cambridge University Press, Cambridge, UK., pp: 19-54.

26. Ziaifar, A.M., Achir, N., Courtois, F., Trezzani I. and Trystram, G. (2008): Review of mechanisms, conditions, and factors involved in the oil uptake phenomenon during the deep-fat frying process. *Int. J. Food Sci. Technol.*, 43: 1410-1423.