



Consumption patterns, diversity and characteristics of potato crisps in Nairobi, Kenya

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ABSTRACT

Objective: Consumption of crisps as snack is on the increase in Kenya and more so in the urban areas. Some potato crisps are imported and others locally produced. It is, however, not known whether local and imported products are processed to the required specifications. This study aimed to determine the consumption patterns and the characteristics of potato crisps in Nairobi City.

Methodology and results: Potato crisps consumption pattern was determined using a structured questionnaire administered to 215 consumers. A total of 80 shops were surveyed to establish the brands and characteristics of potato crisps sold. The available brands were sampled and evaluated in the laboratory for colour, size, thickness, moisture, salt and oil content. Results showed that 33 % of consumers were males while 67 % were females. A majority, 74 %, consumed potato crisps once a week, on average. Apart from gender, the frequency of purchase was influenced by factors such as festive occasions, seasons and purchasing power. Tropical heat brand was the most preferred (22 %) followed by Krackles (11 %). Pringles, an imported brand was purchased by only 0.6 %, so were the local brands Delice and Highlands. The most preferred flavor was onion-salted. The most commonly purchased package (52 %) ranged between 30-50 g due to affordability and possibly convenience. These were retailing at USD. 0.4-0.5. The least purchased units weighed 150 g and above (2 % consumers). About 28 % of the consumers bought crisps for own consumption, while 72 % purchased for family.

Only 15 % of the outlets surveyed stocked other potato products besides crisps. A total of 24 brands of crisps were available in the market. The most commonly stocked brands were Tropical Heat and Krackles in 46 and 45 % of the outlets surveyed, respectively. All the outlets surveyed stocked local, and 15 % of the outlets also had imported brands. The units of packaging ranged from less than 10 g to 1 kg. The most popular unit packages (40 %) varied from 10 to 100 g, selling between USD. 0.1-0.8. The study showed that potato crisps are highly consumed by children and youths and moderately by adults. The characteristics of the brands evaluated including colour, size, thickness, moisture, salt and oil content varied significantly ($P \leq 0.05$) among the brands. Crisps thickness varied from 1 to 2 mm; the oil content varied from 24 to 40 % while the moisture and salt contents varied from 1 to 6 %, and 1 to 3 %, respectively.

Conclusions and application: Consumption of crisps in Nairobi is dependent on gender, festive occasions, and seasons of the year and availability of disposable income. Except for the thickness, most brands had characteristics that conformed to the local crisps standards. This study provides the most current

information on the crisp market and the results are useful to consumers, processors, policy makers and other stakeholders in the potato processing subsector.

Key words: Potato crisps, brands, consumers, quality characteristics.

INTRODUCTION

Potato is one of the world's major food crops, consumed daily by millions of people of diverse cultural backgrounds in many countries (Pedrschi et al., 2005; Lechman et al., 2009). According to the National Policy on Potato Industry (MoA, 2008), the potato in Kenya is an important food and cash crop that plays a major role in food security and is only second to maize in terms of production and utilization. Most of the potato produced in Kenya is consumed primarily where it is grown (Walingo, 2004). The nutritional significance of the potato in the urban areas is evidenced by the increasing number of fast food restaurants in major towns of Kenya. Depending on the area, potato is widely consumed in Kenya with Nairobi being a major market for all forms of potato products. In 1994, 95 % and 93 % of the households in Nairobi and Kisumu, respectively, utilized potatoes (Omosa, 1994). There has been a worldwide increase in consumption of potato products indicating the need to pay more interest on consumer behavior and innovations in the sector (Buono et al., 2009).

The most important products in the Kenyan potato processing industry are fresh potato chips (French fries), crisps and frozen chips. Potato crisps is one of the most commonly consumed snack worldwide (Kulkarni et al., 1994; Knol et al., 2009). Potato crisp is a fragile but firm slice of potato which has been cooked by deep frying in vegetable oil and to which edible salt (powder or brine) or permitted food grade spices, colour and flavour may have been added (KEBS, 2007; Salvador *et al.*, 2008). Depending on the processor, there are many different types of crisps targeting different consumer preferences. These preferences and other consumer characteristics determine the consumption pattern in any given market.

Potato crisp processing in Kenya has undergone tremendous growth over the last three decades with the number of processors in Nairobi alone increasing from five in the early 1980s (Durr and Lorenzl, 1980) to an estimated 20 processors in 2003 (Walingo et al., 2004). The main outlets for crisp sale are supermarkets and many other small outlets. High consumption is noted during Christmas and Easter festivities and during school holidays. Peak consumption is also noted during peak tourist seasons (Walingo et al., 2004).

The increasing prevalence of obesity in children and adolescents has been partly attributed to increased consumption of snacks with high fat and sugar that make up substantial daily calorie intake. This increasing trend has been reported both in the developed and developing countries all over the world (Vardavas et al., 2007). Through media advertising and education, consumers are becoming more aware of the need to monitor intake of polyunsaturated fats, mono-unsaturated fats and cholesterol. As knowledge increases, so does the concern for various aspects of fats and fat-soluble components in human diet. Salt has been used as a method of food preservation for long. Potato crisps have been popular salty snacks all over the world for over 150 years (Pedreschi et al., 2005). However, the relevance of salt to hypertension and its subsidiary side-effects is becoming increasingly documented. The public health concern arises through the addition of salt to foods rather than from the amounts naturally present in foods (FAO, 2010).

Potato crisps processing and consumption in Kenya has not been well studied. This study was designed to determine the current consumption pattern, diversity and characteristics of potato crisps in the city of Nairobi.

MATERIALS AND METHODS

Survey of consumption patterns and characteristics of potato crisps: This study was carried out between October 2009 and January 2010. Nairobi was purposively selected due to the large number of supermarkets and factories that process crisps. The study was a cross-sectional survey and applied quantitative data collection method. The consumer sample size was determined according to Nassiuma (2004). A total of 215 crisps consumers were interviewed from 55 randomly selected supermarkets. Data was collected using a structured questionnaire which had previously been pre-tested. Data was collected on gender of consumer, frequency of purchase, the preferred brand, package size and flavor, and reasons for indicated pattern of purchase. The characteristics of the potato crisps were determined by interviewing supervisors of supermarkets and owners of shops and kiosks. A total of 55 supermarkets and 25 shops and kiosks were selected for the purpose.

Sampling of marketed potato crisps: Duplicate crisp samples of all brands available were purchased from randomly selected supermarkets and shops (kiosks). Since some of the products from the kiosks did not have brand names or labeling, the 5 samples collected from these outlets were coded as Kiosk 1, Kiosk 2, Kiosk 3, Kiosk 4 and Kiosk 5. All the samples were taken to Food Chemistry Laboratory, University of Nairobi for analysis of salt, moisture content, colour, size and oil content.

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 in Soxhlet apparatus for 8 hours using analytical grade

petroleum ether (boiling point 40-60 °C) according to method of KEBS (2007). The oil content was calculated as percent.

Total salt content: Salt content was determined using the modified FAO/WHO method No. 16.209 (AOAC, 1980). Approximately 5 g accurately weighed finely ground samples were dispersed in 100 ml of distilled water and allowed to stand for 5-10 min, while swirling occasionally. 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 colour 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.

Size and thickness of crisps: Ten pieces of potato crisps were picked randomly for each brand and used for measurement of diameter and thickness. The measurements were performed using a hand-held vernier caliper according to Kabira and Lemaga (2006). All measurements were performed in duplicate samples and recorded in mm.

Potato crisp colour: Crisps colour was determined according to PC/SFA (1987) colour chart ranging from a score of 1 to a score of 5. A score of 2.5 was the maximum acceptability score.

Data analysis: Data from consumption pattern and 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).

RESULTS AND DISCUSSIONS

Survey of consumption patterns of potato crisps: The survey found that approximately 33 % of the 215 respondents interviewed were males while 67 % were females. This shows that a majority of the buyers of potato crisps were females or that they are the main group of people who are involved in the actual shopping for household goods in Kenya. A majority of

the respondents (74 %) bought the product 2-5 times in a month compared to 4 % who bought daily, 8 % who bought once and 15 % who bought the product 6-8 times in a month (Figure 1). This is closely comparable to an average consumption rate of two times a week that was reported by Omosa (1994) in Nairobi and Kisumu.

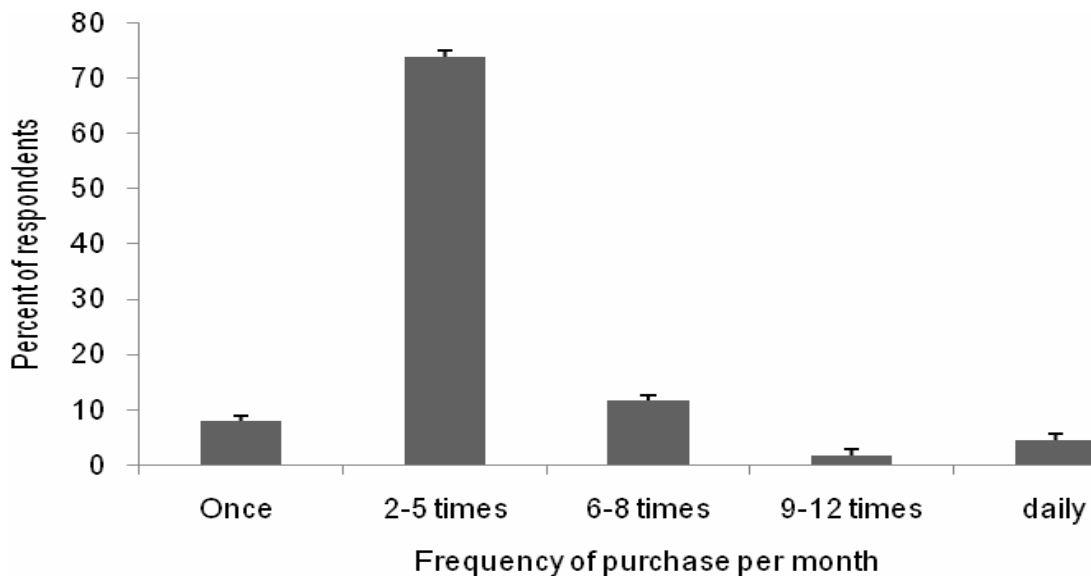


Figure 1: Frequency of purchase of potato crisps by consumers in Nairobi, Kenya. All values are given as mean \pm standard errors.

A part from gender, the frequency of purchasing crisps was influenced by factors such as festive occasions, seasons and availability of money. Occasions that called for celebrations, travelling and outings were cited as being favorable for buying crisps indicating that many people are increasingly using crisps in festivities. Furthermore, most purchases took place at the end of the month when most salaried workers had money to spend compared to mid-month with none or little purchase done.

Frequency of consumption of the various brands of potato crisps varied widely as shown in Figure 2. Many consumers (22 %) preferred Tropical Heat brand, a good number (11 %) preferred Krackles while a low of 0.6 % preferred Pringles, Delice and Highlands. Reasons advanced for preferring a

particular brand were sweetness (22 %), nice flavor (15 %), affordability (6 %), nice packaging (6 %), availability (1 %), and crispiness (3 %). Approximately 2 % had no choice of selecting brands especially in small supermarkets that stocked as few as one or two brands. The results indicate that the Tropical Heat brand is superior in sweetness, flavors and crispiness compared to the other brands. Besides being from an established and one of the oldest potato crisps processing companies, Tropical Heat brand was nicely packaged into a range of units that were affordable to consumers of all levels of income. Despite being of very good quality, Pringles was consumed by a few people, mainly foreigners who could afford to pay the high prices.

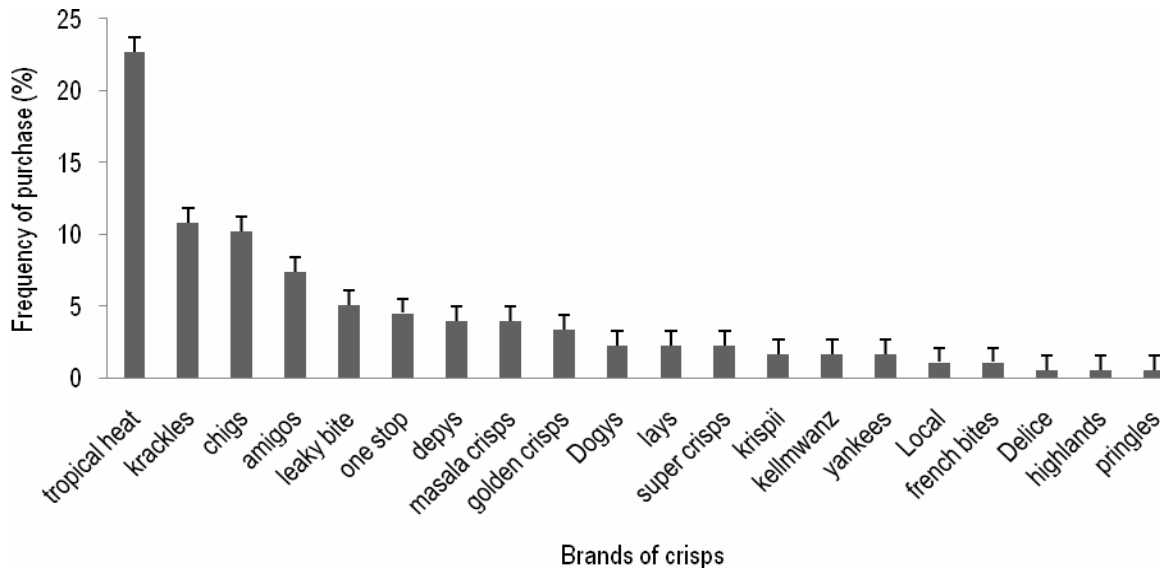


Figure 2: Brands of potato crisps consumers often buy and their frequency of purchase in Nairobi, Kenya. All values are given as mean ± standard errors.

Processors of potato crisps use a variety of flavors on their processed products (Figure 3). The most preferred flavor by consumers was, however, noted to be onion (24 %), salted crisps (12 %) and chillies (7 %). A small group (0.5 %) of processors used chilly-lemon and onion-chilli. Other flavors used included

cheese, tomato, vinegar, masala, garlic and mixtures of any two or more of these. Preference for onion, salt and chilli flavors may be due to the fact that they are commonly used in almost all foods consumed in Kenyan households in food preparations.

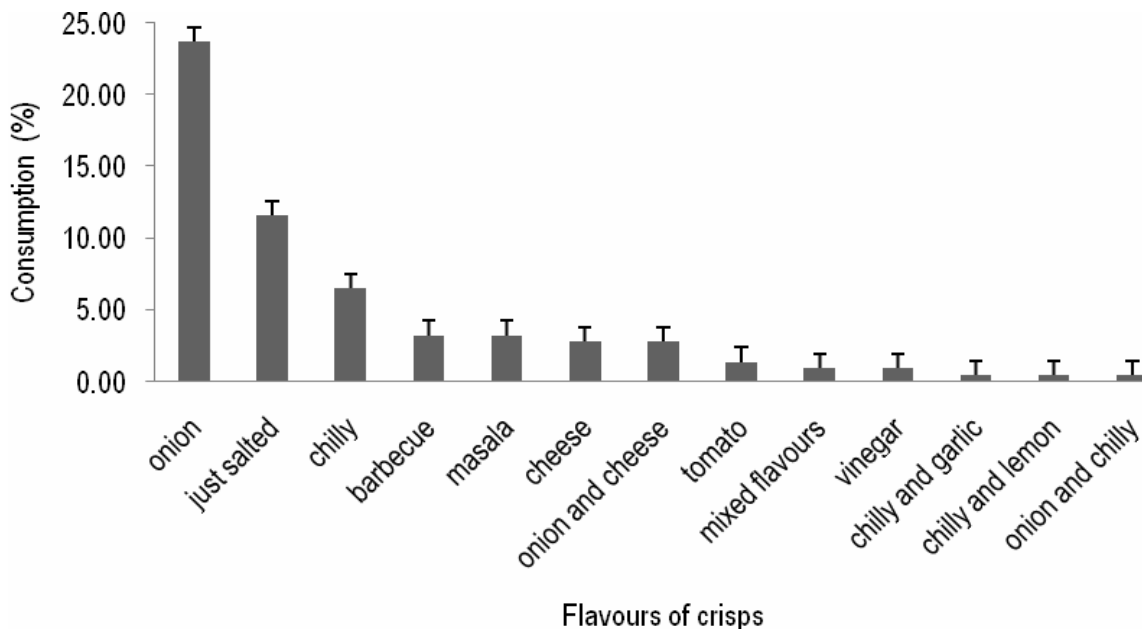


Figure 3: Flavors of potato crisps consumed in Nairobi city. All values are given as mean ± standard errors.

A large number (88 %) of potato crisps bought by the respondents were packaged in polythene bags which tended to be cheaper; 10 % were packaged in polythene bags lined with aluminium foil which were a little higher in price while 2 % were packaged in plastic containers or cans lined with aluminium foils which were quite expensive, and were mainly for imported brands. Packaging is an essential marketing parameter of any food stuff displayed on the shelves of shops. The principal roles of food packaging are to protect food products from contamination and damage, to contain the food, and to provide consumers with ingredient and nutritional information. Traceability, convenience, and tamper indication are secondary functions of increasing importance. The goal of food packaging is to contain food in a cost-effective way that satisfies industry requirements and consumer desires, maintains food safety, and minimizes environmental impact (Marsh and Bugusu, 2007). It is therefore apparent that packaging in aluminium foil would lead to prolonged shelf-life of the product. The cost of packaging in such materials is, however, high leading to higher prices of potato crisps.

Units of packaging varied from as low as 20 g up to 1 kg. However, the most purchased packaging units, 52

%, ranged from 30-50 g due to affordability; retailing at USD. 0.4-0.5 compared to units of 150 g and above that were least purchased (2 %) due to their high costs, retailing at USD. 1.3 and above.

It was noted that 28 % bought potato crisps for their own consumption while 72 % bought crisps for their family members. This result was different from the findings of Omosa (1994) who observed a larger number (59 %) of consumers who bought crisps for self consumption. It therefore indicates that crisps are increasingly consumed by many people in the family. A good portion of crisps meant for the family, 53 %, was specifically taken to the children only. This information explains why a large percent of consumers (56 %) bought more potato crisps during the holidays when schools were closed, 17 % during back to school periods compared to 8.5 % during school days. It is apparent that most of the potato crisps are consumed by children, another reason why quality should be assured to prevent any health hazards that could be related to potato crisps such as may be caused high salt and fat consumption. There were varied reasons why correspondents bought crisps (Figure 4).

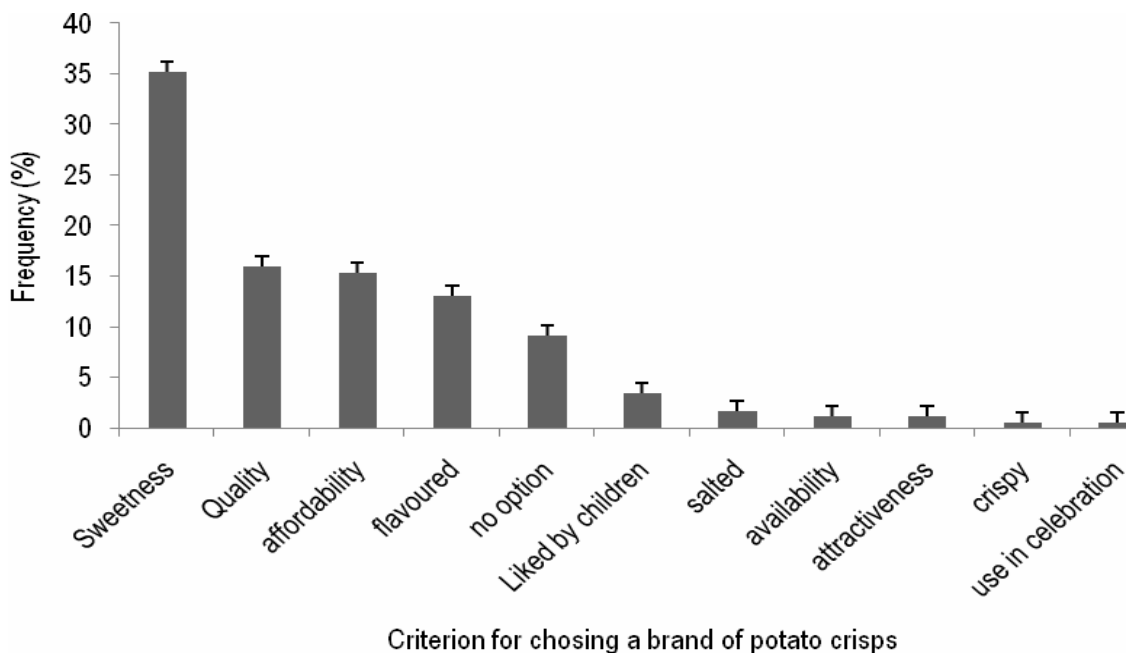


Fig. 4: Criterion for choosing potato crisps brands by consumers in Nairobi, Kenya. All values are given as mean \pm standard errors.

The major criterion for choosing type of crisps was sweetness (35.2 %), followed by quality (15.9 %) and affordability (15.3 %) while the least criterion was crispiness (0.6 %). Sweetness is a function of the fresh potatoes used, preparation and flavours used. The processors therefore need to satisfy the consumers' perceived level of sweetness.

Characteristics of potato crisps sold in Nairobi city: All the outlets surveyed sold potato crisps. Besides potato crisps, 15 % of the outlets (all being supermarkets) sold other potato products such as chevda and potato sticks. This is an indication of how potato crisps have become important snack food for a large consumer base in Kenya making it a necessary and important stock on the supermarket shelves.

The frequency of purchasing (procuring) potato crisps from processors in a month varied from once a month (4 %) to four times a month (38 %) as indicated in Figure 5. This means that a majority of the shops would procure crisps at least once a week. A good number of outlets (15 %) would also purchase crisps depending on volumes of sales and how fast the brands of crisps move. However, the quantities purchased per month could not be ascertained by most of the interviewees (86 %) who were mostly supervisors in charge of crisps section of the supermarkets while 6 % reported a purchase of between 1 kg to 15 kg and 2 % purchased 20 kg and above on each occasion.

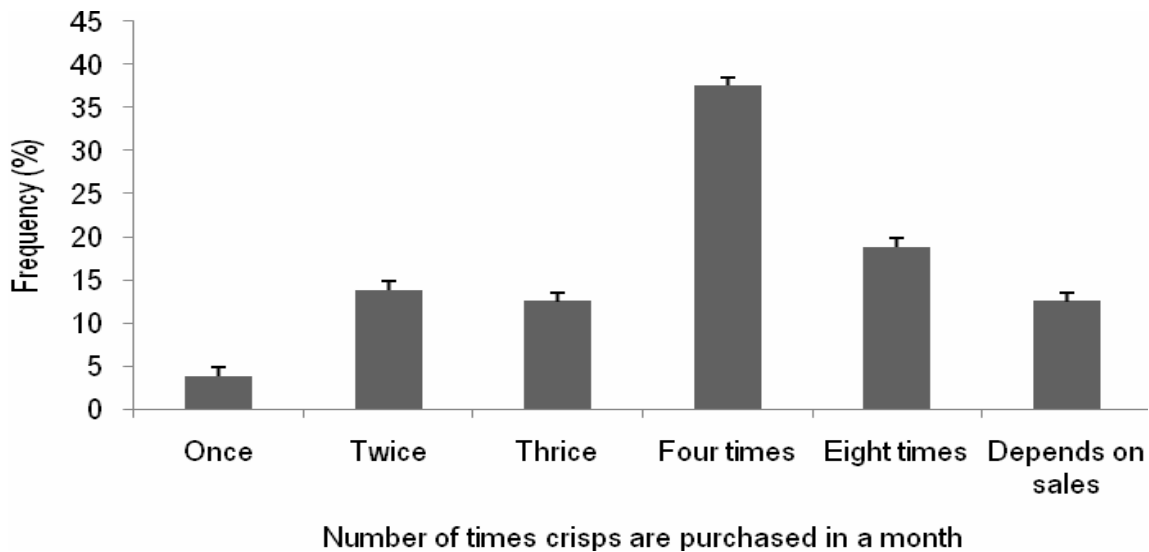


Figure 5: Frequency of stocking potato crisps in supermarkets and shops in Nairobi, Kenya. All values are given as mean \pm standard errors.

A total of 24 brands of crisps were being sold in Nairobi during the period of study. The crisps sold in the supermarkets were from companies, both processing and importing, licensed by the Kenya Bureau of Standards. It is worth noting that only crisps sold in supermarkets were clearly labeled and

could be appropriately identified while those from kiosks were neither labeled nor branded in any way (Figure 6). Samples obtained from kiosk therefore limit traceability and have no tamper indications which are functions of increasing importance (Marsh and Bugusu, 2007).



Figure 6: Unbranded crisps from small shops (kiosks) in Nairobi.

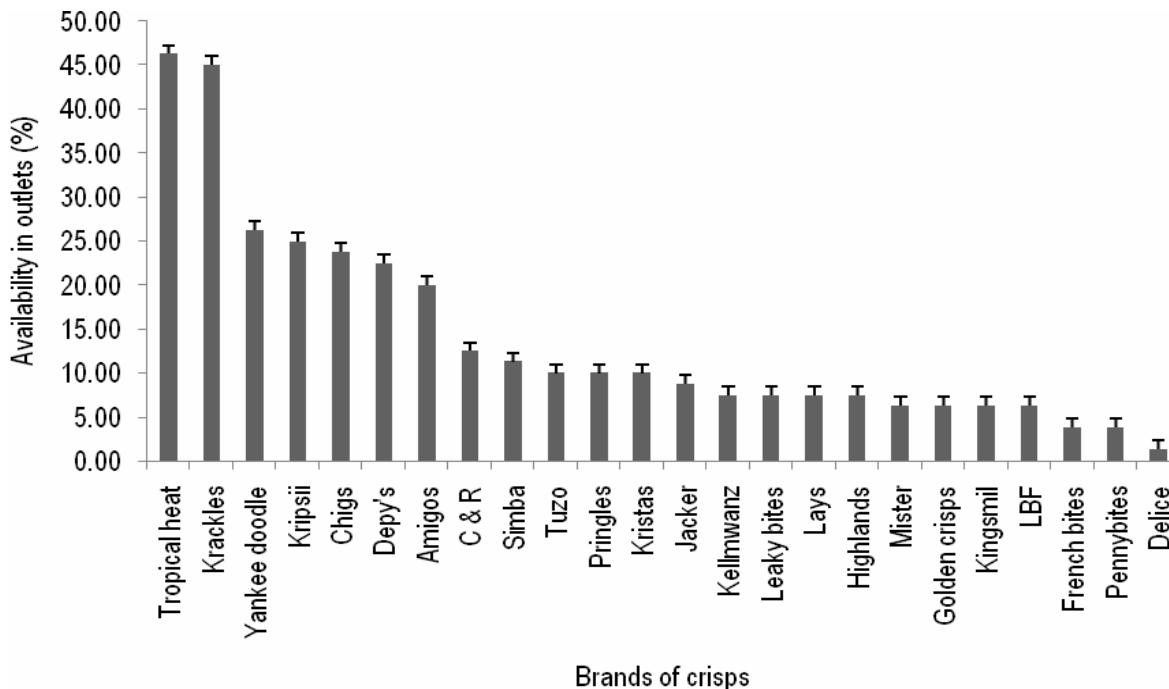


Figure 7: Frequency of purchase by consumers of various brands of potato crisps in Nairobi, Kenya. All values are given as mean ± standard errors.

The most stocked brands in the outlets were Tropical Heat and Krackles, available in 46 and 45 % of the outlets, respectively. Delice was the least stocked being available in 2 % of the outlets (Figure 7). The larger volumes of stocks indicate popularity of the two brands in the market.

All the shops surveyed stocked brands of crisps made in Kenya while only 15 % of the outlets had imported

brands in addition to local ones. Imports constituted not more than 2 % of the crisps stocked in the shops surveyed. The imported crisps originated from various countries including South Africa, Belgium, North America, Malaysia, and the United Kingdom. This was an indication that most of the crisps marketed in Kenya are processed locally from the local cultivars. It was noted that the imported crisps were quite

expensive, in some cases costing as much as twice the cost of the local ones for the same quantity. The imports were, however, of better quality compared to local ones; they had uniform size and colour with low oil contents. This is in agreement with the findings of Walingo et al. (2004).

Many reasons were advanced by the outlets as to why they stocked particular brands. A large number of the outlets stocked potato crisps brands depending on how fast they were moving on the shelves (61.3 %) compared to those who stocked crisps depending on the availability (31 %), affordability (28 %), good quality (24 %) and being from established companies (18 %). How fast the potato crisps move from the shelves is a function of consumer preference taking into account quality requirements. The marketers will therefore stock moving brands in spite of their qualities since their main aim is to make profits from high volumes of sales.

The major packaging material for potato crisps was polythene (60 %) or polythene lined with aluminium foil (28 %). Other outlets (14 %) sold imported crisps packaged in tins and plastic containers with aluminium foil. The latter packaging materials were used in the imported brands only (Figure 8). The imported crisps were more attractive in terms of packaging compared to local crisps. Type of packaging determines storage life as it influences the intensity of light exposure on the product. Extended exposure of products to light is reported to lead to oxidation of fats leading to rancidity (Lennersten and Lingnet, 1998). The imported crisps are therefore likely to last longer on the shelves compared to local crisps. The imported products require extra protection since most of them have to be shipped from overseas and sometimes take too long to reach the destination.



Figure 8: Packaging of locally produced (left) and imported (right) potato crisps sold in various outlets in Nairobi, Kenya.

The units of packaging ranged from less than 10 g to 1 kg. The most popular unit packages (40 %) varied from 10 g to 100 g as they were cheap and affordable to most customers. The latter sold at between USD. 0.1 and USD. 0.8 depending on the size of packaging. The unit packages in 90 % of kiosks were not indicated but on laboratory analysis, the unit sale weight varied between 5g and 20 g selling at between USD. 0.05 and USD. 0.1. The prices for imported crisps were, however, significantly higher compared to those of locally made ones, in some cases even double for the same quantity. This could be attributed to the investment on attractive packaging, quality

crisps produced and transport cost from countries of origin.

The study found that potato crisps were a popular snack food item for young children and youths in their teenage while parents are moderate buyers of the products. Large variations in sales, depending on seasons, were observed; this variation depended on the type of shop. Most sales for supermarkets were recorded at month ends when many people had money and during school holidays characterized by celebrations and festivities. For kiosks, high sales were recorded mainly during school days since the major consumers were school going children who bought crisps on their way to school.

In all the outlets, potato crisps were stored in cool dry and open shelves for up to 4 weeks before restocking. Approximately 22 % of complaints from customers involved packages having too small quantities; 3 % of the complaints were about the products being broken, oily, salty or too costly. This means that crisps are fast moving goods and given their nature very little deterioration would normally occur on shop shelves. Crisps are known to suffer from the problem of rancidity which reduces shelf-life by up to about three months at which point consumers begin to perceive loss of quality (organoleptic and physicochemical changes) that make the product unacceptable (Surkan et al., 2009). Crisps packaged in polythene bags placed in cartons were mainly transported by vans to supermarkets or bicycles and on foot to kiosks for sale. Most shops (43 %) accepted a supplier of crisps when their products to be supplied were known to be fast moving. Approximately 21 % of shops, mainly supermarkets, insisted on Kenya Bureau of Standards mark of quality and that crisps be of required weights since correct weight was critical to customer satisfaction. Only 26 % of the shops recorded potato crisps losses which were mainly due to breakages (11 %), rodents' damage in stores (4 %) and on expiry (3 %). The losses were, however, less than 5 % in all the recorded cases. This was due to the fact that in most cases the suppliers took liability for broken or expired products and provided replacements.

It was noted that 82 % of the shops at times of the year suffered from a scarcity of crisps supply from the suppliers. The shortage was attributed to lack of raw potatoes for processing occasioned by high competition by domestic ware potato demand especially in the months of April-July. Drought also

contributed to the shortages at times. Another cause of scarcity was transport problems encountered by the suppliers.

In terms of pricing, 64 % of outlets said that the prices had generally remained constant due to high competition by many processors. This means that crisps processing has continued to attract a great number of processors scrambling for the same market. The outlets (19 %) had, however, had price increases occasioned by scarcity especially in cases of small shops where there was only one supplier. About 11 % of outlets on the other hand said the trend in pricing had been characterized by fluctuation. Consumption trend as reported by respondents varied widely with 54 % of outlets recording an increase attributed to the fact that more people have developed a liking for crisps and its use in festivities, while 19 % indicated that consumption was constant, and 15 % said consumption fluctuated depending on prevailing economic situation.

Laboratory analysis of potato crisps marketed in Nairobi: Table 1 summarizes the characteristics of different brands of crisps found in Nairobi City. Colour of crisps significantly ($P \leq 0.05$) differed among the brands ranging from a minimum score of 1 to 2.3. Since the maximum upper limit was a score of 2.5, it therefore means that all the brands sold in the supermarkets and kiosks, conformed to the recommended standards (PC/SFA, 1987). Most potato crisps are known to turn brown on prolonged storage due to physico-chemical changes that occur depending on storage conditions (Kulkarni et al., 1994). Colour is one of the sensory properties that determines acceptability of a food product at first site (Surkan et al., 2009) and hence must conform to consumer requirement (Krokida et al., 2001).

Table 1: Characteristics of different brands of potato crisps sold in Nairobi.

Brand	Colour	Diameter (mm)	Thickness (mm)	Oil content	Moisture content (%)	Sodium chloride (%)
C and R	1.50 ± 0.00	37.50 ± 0.71	1.00 ± 0.00	40.15 ± 0.24	2.42 ± 0.04	1.67 ± 0.15
Chigs	1.63 ± 0.18	35.00 ± 0.00	1.50 ± 0.00	30.31 ± 0.18	2.33 ± 0.27	1.50 ± 0.02
Delice	1.63 ± 0.18	40.00 ± 0.00	1.00 ± 0.00	37.54 ± 0.47	3.16 ± 0.24	2.03 ± 0.12
Highlands	1.13 ± 0.17	40.00 ± 0.00	1.00 ± 0.00	29.77 ± 0.72	3.68 ± 0.01	1.20 ± 0.10
Jacker	1.50 ± 0.00	44.00 ± 0.00	1.00 ± 0.00	24.40 ± 0.11	1.65 ± 0.04	1.92 ± 0.01
Kellmwanz	1.00 ± 0.00	32.50 ± 0.71	1.00 ± 0.00	31.10 ± 0.59	4.08 ± 0.20	1.25 ± 0.31
Kingsmill	1.12 ± 0.18	35.50 ± 0.70	1.50 ± 0.00	35.50 ± 0.71	4.97 ± 0.30	1.63 ± 0.05

Kiosk 1	2.00 ± 0.00	40.00 ± 0.00	1.00 ± 0.00	35.06 ± 0.98	3.42 ± 0.12	1.20 ± 0.37
Kiosk 2	1.25 ± 0.35	40.00 ± 0.01	1.00 ± 0.00	34.68 ± 0.49	3.55 ± 0.12	1.71 ± 0.03
Kiosk 3	1.50 ± 0.00	40.00 ± 0.02	1.00 ± 0.00	31.28 ± 0.53	3.41 ± 0.16	1.10 ± 0.04
Kiosk 4	1.50 ± 0.01	42.50 ± 0.71	1.00 ± 0.00	28.40 ± 0.62	3.35 ± 0.31	1.41 ± 0.19
Kiosk 5	1.75 ± 0.35	41.00 ± 0.14	1.00 ± 0.00	28.59 ± 1.42	4.06 ± 0.57	1.89 ± 0.00
Krackles Plain	1.56 ± 0.55	38.25 ± 0.50	1.25 ± 0.29	32.97 ± 0.69	2.80 ± 0.51	2.43 ± 0.61
Krackles Ripples	1.13 ± 0.45	42.50 ± 0.49	1.50 ± 0.30	32.39 ± 0.55	3.17 ± 0.32	1.91 ± 0.72
LBF	1.37 ± 0.18	36.50 ± 0.71	1.00 ± 0.00	39.50 ± 0.71	3.95 ± 0.28	1.32 ± 0.02
Pennybites	2.25 ± 0.30	35.00 ± 0.00	1.00 ± 0.00	35.50 ± 0.71	5.45 ± 0.22	1.54 ± 0.05
Simba	1.50 ± 0.00	43.50 ± 0.71	1.00 ± 0.01	35.59 ± 0.53	3.26 ± 0.67	1.49 ± 0.28
Amigos	1.00 ± 0.00	36.50 ± 0.70	1.50 ± 0.00	31.38 ± 0.57	2.92 ± 0.19	1.22 ± 0.06
Depy's	2.37 ± 0.17	35.50 ± 0.71	1.50 ± 0.01	33.58 ± 0.62	3.34 ± 0.12	1.57 ± 0.19
Frenchbites	2.25 ± 0.35	35.00 ± 0.00	1.50 ± 0.00	30.94 ± 0.66	2.30 ± 1.06	2.16 ± 0.04
Golden crisps	1.13 ± 0.10	40.00 ± 0.00	1.00 ± 0.00	36.24 ± 0.14	1.85 ± 0.02	1.27 ± 0.05
Kripsii	1.00 ± 0.00	32.50 ± 0.70	1.00 ± 0.01	38.08 ± 0.19	1.09 ± 0.03	1.44 ± 0.03
Kristas	1.62 ± 0.18	40.00 ± 0.00	1.50 ± 0.00	29.01 ± 1.41	2.79 ± 0.10	1.96 ± 0.03
Lays	1.00 ± 0.00	44.50 ± 0.70	1.00 ± 0.01	24.37 ± 0.37	2.34 ± 0.40	2.96 ± 0.16
Leakybite	1.63 ± 0.00	41.00 ± 1.41	1.50 ± 0.00	32.19 ± 0.40	2.91 ± 0.16	1.96 ± 0.17
Mister	1.00 ± 0.17	32.50 ± 0.71	1.00 ± 0.00	25.37 ± 0.13	2.65 ± 0.24	1.87 ± 0.02
Pringles	1.00 ± 0.00	45.00 ± 0.00	1.00 ± 0.00	33.52 ± 0.80	3.56 ± 0.04	1.59 ± 0.10
Tropical	1.13 ± 0.17	36.00 ± 5.65	1.50 ± 0.00	31.79 ± 0.71	2.44 ± 1.10	1.72 ± 0.11
Tuzo	1.50 ± 0.00	40.00 ± 0.00	1.50 ± 0.00	30.44 ± 2.19	3.09 ± 0.03	1.67 ± 0.21
Yankee Doodle	1.13 ± 0.18	31.00 ± 1.41	2.25 ± 0.35	35.75 ± 0.62	3.29 ± 0.42	1.34 ± 0.10
Yankee Plain	1.38 ± 0.17	35.00 ± 0.00	1.50 ± 0.00	40.22 ± 0.04	3.05 ± 0.21	1.95 ± 0.12

Results are means of duplicate samples ± sd

The average sizes of crisps (in diameter) significantly ($P \leq 0.05$) varied among the brands. The brand Yankees Doodle recorded the lowest diameter of 31 mm compared to Golden crisps and Tuzo both of which were 40 mm. The size of potato crisps is determined by the raw potato and the sorting criterion used in a particular industry (Kabira and Lemaga, 2006); the larger the potatoes so will the diameter of the resulting product. During processing (slicing), however, a potato tuber produces several pieces which vary in size. The size to be allowed into the subsequent processing operations is at the discretion

of the manufacturers. The Kenya Bureau of Standards (2007) recommends processors to use potatoes of sizes 45-60 mm for the best quality to be achieved. This reduces lots of breakages of crisps made from too large potatoes. From this study, the upper limit for size had been observed by processors, but lower size limit does not seem to have been observed and it therefore means that the industries are not keen on size selection probably due to cost implications. This explains why local potato crisps had large variation of size compared to imported ones, which were more uniform (Figure 9).



Figure 9: Variation in size of potato crisps between local (left) and imported potato crisps (right).

With the exception of Yankeess Doodle with an average thickness of 2.25 mm, all the other brands of potato crisps in the market met the 1-1.5 mm thickness criterion recommended by Kenyan Bureau of Standards (Table 2). The importance of thickness of crisps has been studied at length in the developed countries. The thinner sizes, due to their larger surface area to volume ratio, have been shown to absorb a lot of frying oil compared to those with large size (Kita et al., 2007).

Table 2: Statutory requirement for potato crisps in Kenya.

Characteristic	Maximum limit
Moisture content, %	4.7
Fat content, % dry weight	40.0
Sodium chloride, % dry weight	2.5
Thickness	1.0 mm- 1.5 mm
Colour	Light yellow to golden brown

Source: Kenya Bureau of Standards (2007)

The oil content varied significantly ($P \leq 0.05$) among the brands of crisps ranging from 24.37 % in the brand Lays to 40.22 % in the brand Yankees doodle. Except for brands C and R and Yankee Doodle, all the other brands had the required amount of oil, maximum 40 %. It was, however, noted that most of the imported brands had quite low oil contents below 30 % compared to most locally produced brands that had amounts exceeding 30 %. This could be attributed to differences in processing oils and dry matter characteristics of potatoes used. Oil uptake by crisps is primarily a surface phenomenon involving adhesion and the method of drainage of oil upon retrieval of potato slices from the frying oil bath may contribute to the differences of oil contents (Ufheil and Escher, 1996). Many factors have been reported to

affect the oil content of crisps including oil quality, frying temperature and duration, product size, shape and composition (moisture content, solids, fat, gel-strength, and proteins), pre-frying techniques (blanching, drying and frying) and coating (Ufheil and Eescher, 1996; O'Connor et al., 2001; Cuesta et al., 2001; Kita et al., 2007; Ziaifar et al., 2008; Abong, et al., 2009). In earlier studies of oil uptake by potato crisps, Gravouelle (1996) noted that potato tuber dry matter was a major factor for the potato processing industry, and that it was required to be between 23 and 25 % to minimize the oil uptake and improve the yield. Potatoes with high dry matter (>20 %) have been shown to produce higher yields with lower oil content than those of lower dry matter (Lulai and Orr, 1979).

The moisture content of crisps marketed in Nairobi varied from as low as 1.09 % in Krispii to as high as 5.45 % in Penny Bite. All the brands except Kingsmill and Penny Bite met the required upper limit of 4.7 %. Deep-fat frying of food products such as potato crisps is a drying process in which rapid moisture loss occurs and crisps being small slices are bound to have minimal moisture contents (Esturk et al., 2000). The amount of moisture content depends among many other factors on packaging material, storage conditions and the amount of moisture at the end of processing. Moisture content is an important shelf-life determinant; the higher the levels of moisture the faster the microbial spoilage of food products. Crisps, being food products that can store up to 6 months would require that moisture levels be kept as low as possible.

CONCLUSIONS AND RECOMMENDATIONS

The consumption of potato crisps in Nairobi depends on gender, occasions, seasons of the year, and availability of disposable income. Approximately 24 processors were identified based on brands of potato crisps obtained from the shops. Except in the sizes, most brands with a few exceptions had characteristics that conformed to the crisps standards. The sale of potato crisps in Nairobi can, however, be improved if processors produce uniform products which are attractive in colour. Processors of the branded crisps

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The amount of salt in the crisps differed significantly ($P \leq 0.05$) among the different brands ranging from 1.10 % in Kiosk 3 coded sample to 2.96 % in the brand Lays. The Kenyan standard recommends levels of up to 2.5 %, a criterion that almost all the brands met with exception of the brand Lays. A similar study in Crete found high salt levels of up to 3.4 % (Vardavas, 2007). It also shows that taking most crisps brands in Nairobi does not pose great danger especially to children who are the main crisps consumers with regard to salt levels. However, due to concerns of the negative effects of high salt consumption coupled with the fact that most crisps consumers are children, this limit should be reduced to 2 %. Consumption of high salty snacks can be a dietary hazard for human beings and especially children (Vardavas, 2007).

should also target the kiosks through sale of smaller unit weights that are more affordable to the consumers. Supermarkets sell the bulk of potato crisps in Nairobi as opposed to kiosks which sold few and unbranded crisps. It is, however, noted that maximum oil content set at 40 % by the Kenyan regulatory body is quite high and could be reduced to about 35 % which was achieved by 55 % of the brands evaluated.

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