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# Processing potential of three *Solanum* potato varieties in Kenya

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**Trials were conducted with Kerr's Pink, Desiree and Kenya Baraka *Solanum* potato varieties for production of crisps and flakes. Finished crisps were assessed for quality by a trained sensory panel with the aid of a standard colour chart. All three varieties made highly acceptable crisps. Flakes prepared using a single-drum drier were evaluated for quality by trained panels and physico-chemical methods. Flakes from all three varieties had acceptable colour, texture and flavour.**

Keywords: Crisping quality; Flaking quality; Potato varieties

The *Solanum* potato is an important food crop among populations of the highland tropics. In Kenya, it plays a major dietary role comparable to that of the cereals, the crop being grown twice a year in the cool high-altitude areas (1500–3000 m above sea level) where it has a higher yielding potential than other food crops. Maize, Kenya's major staple food, can be grown only once a year at the higher elevations; as a result, potatoes are the preferred subsistence crop in such areas.

Postharvest problems with the potato in Kenya relate to storage, transportation and marketing, and together with strong seasonal price fluctuations, restrict production and utilization of this nutritious tuber crop as a low-cost food in the country. Processing could complement storage of tubers and provide a means of preserving surpluses, thereby reducing wastage and ensuring potato product availability at reasonable prices throughout the year. In addition, processing has considerable potential for diversifying the utilization of potatoes in a variety of forms such as fried or dehydrated products. Locally made potato crisps and imported dehydrated mashed potatoes are the processed potato products most widely marketed and consumed in Kenya, particularly within the large urban centres.

A knowledge of the processing characteristics of potato varieties grown in Kenya is necessary if potato utilization is to be popularized through processing. Some data on the cooking quality of established potato varieties are documented (Anon., 1981), but practically no information is available regarding their suitability for processing. This study was conducted to determine the potential of three popular Kenyan potato varieties for production of crisps and flakes.

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## Materials and methods

Potato varieties used for these studies were Kerr's Pink, the most popular variety grown in Kenya, and two others, Desiree and Kenya Baraka, recently introduced and commercially popularized. The varieties were produced under normal commercial conditions at the National Potato Research Station, Tigoni, in two consecutive growing seasons (long rains and short rains). Prior to processing, the potato tubers were analysed for specific gravity (Kabira, 1983) and reducing sugar content (Ben-Gera *et al.*, 1974).

## Crisp colour determination

Three samples of 10 tubers each were selected from freshly harvested potatoes. For each sample, the tubers were peeled abrasively and cut longitudinally into halves, ten of which were retained for crisp analysis. Two slices (1.3 mm thick) were removed from each tuber half and washed in running tap water for two minutes to remove adhering starch before being dried between cloth towels. A total of 20 slices from each tuber sample were fried for 100 sec in maize oil with an initial temperature of 185°C, using a single-basket thermostatic fryer. After draining and cooling to ambient temperature, the crisps were assessed subjectively for colour using a standard colour chart with a 1–5 rating scale (1–2, preferred; 5, unacceptable; Anon., 1978).

## Sensory evaluation of crisps

A trained panel of six judges evaluated crisps for appearance and flavour. Crisps were served in coded white dishes in a room that was odour-free and well illuminated. Triplicate samples of 4–5 unsalted crisps were presented at random to the judges who worked individually and checked a score card on a 1 (unacceptable) to 10 (excellent) rating scale.

## Preparation of flakes

Flakes were made using the pilot plant facility of the Department of Food Science and Technology, Faculty of Agriculture, University of Nairobi. Duplicate samples of 3 kg each were abrasively peeled and used for flake preparation, using a laboratory single-drum drier. The processing conditions were: pre-cooking at 70°C for 20 min; cooling for 20 min in a water bath (21–23°C); pressure cooking for 10 min; mashing with additives (per kg of mash) as follows: 0.2 g sodium metabisulphite, 0.5 g skim milk powder, 0.15 g lecithin and 0.2 g glycerol monostearate; drum speed of 3 rpm and steam pressure of 3 kg cm<sup>-2</sup> (2.9 bars).

## Assessment of flakes

Flake moisture content was determined by weight loss of four replicate samples of 4 g each dried at 105°C for four hours. Bulk density (g cm<sup>-3</sup>) of the flakes was assessed by placing 20 g of flakes in a glass measuring cylinder and reading the volume after tapping the cylinder ten times on soft pads from a distance of about 20 cm.

Free starch of the flakes was determined according to the modified Blue Value Index (BVI) method of Escher *et al.*, (1979). Water absorption capacity was determined by the standard method described in the European Association for Potato Research handbook (Anon., 1977).

Reconstitution of flakes was carried out as follows: to 100 ml boiling water containing 1 g salt was added 40 ml of cold milk and 30 g of flakes (Sahasrabudhe *et al.*, 1976). The mixture was stirred with a fork and kept at 71°C on a water bath until served to the panel.

Sensory evaluations were made on the reconstituted flakes, using trained panels in two tests. In the first test, duplicate samples were placed in coded white dishes and presented at random to a panel of 18 judges who were asked to rank the samples in order of preference for colour, flavour, mealiness and suitability for use in 'irio', a traditional Kenyan dish prepared from a mixture of cooked maize, beans, potatoes and green leafy vegetables. The judges worked individually in an odour-free, well-illuminated room and were all familiar with 'irio'.

In the second test, a panel of eight judges scored duplicate samples, coded and presented at random, for colour, flavour, mealiness and overall acceptability. The sensory parameters were rated on a 1 (unacceptable) to 5 (excellent) scale.

## Statistical analyses

Data from objective measurements were examined

by analysis of variance and the least significant difference method (Steel and Torrie, 1960). Sensory scores were examined by analysis of variance and Tukey's test (Larmond, 1977), ranks being transformed into scores according to Fisher and Yates (1963).

## Results and discussion

Specific gravity and reducing sugar content of potatoes used for processing are shown in Table 1. Potatoes harvested after the long rains season were used to evaluate crisping quality; assessment of flaking quality was carried out on potatoes harvested after the short rains.

Although Kerr's Pink and Desiree harvested after the short rains appeared suitable for flake production because of higher specific gravities (dry matter content) and lower reducing sugars, these criteria are not entirely sufficient to predict flake quality since potato tubers may also differ in their cooking characteristics (Burr and Reeve, 1973).

### Crisp quality

No significant differences were found among crisp colour scores of the three varieties (mean score, 1.8). Similarly, no significant varietal differences were detected with respect to appearance (mean score, 7.8) and flavour (mean score, 7.7). All three varieties made crisps of highly acceptable quality.

### Flake quality

Some physico-chemical properties of the flakes are presented in Table 2. The range of moisture was 4.0–4.7% (wet weight basis). This was considered satisfactory for the stability of the flakes (Sapers *et al.*, 1974). For flake bulk density, no significant varietal differences were found. Commercial flakes generally have a bulk density of approximately 0.35 g cm<sup>-3</sup> (Burr and Reeve, 1973).

Flakes made from Kenya Baraka had significantly ( $P = 0.05$ ) higher water absorption capacity than the other two varieties. The water absorption capacity depends upon dry matter content (expressed as specific gravity) of the raw material, lower dry matter content relating to higher water absorption capacities (Hesen and van der Schild, 1979).

There were no significant differences in Blue Value Index (BVI) of flakes made from the three varieties. The BVI range obtained in these tests was within the range (92–182) considered desirable for good textural quality after reconstitution (Hadziyev and Steele, 1979).

The sensory tests showed a definite preference for the Desiree variety in terms of colour and use in

**Table 1** Specific gravity and reducing sugar content of Kenyan *Solanum* potato varieties used for processing (each value is a mean of three determinations)

Potato variety	Long rains season <sup>a</sup> (crisps)		Short rains season <sup>b</sup> (flakes)	
	Specific gravity	Reducing sugar content (%)	Specific gravity	Reducing sugar content (%)
Kerr's Pink	1.073	0.19	1.083	0.08
Desiree	1.073	0.22	1.087	0.11
Kenya Baraka	1.088	0.18	1.073	0.37

<sup>a</sup> Potatoes harvested in September 1981 and assessed immediately for crisping quality

<sup>b</sup> Potatoes harvested in April 1982 and assessed after storage at 12°C (95% r.h.) in June for flaking quality

**Table 2** Physico-chemical evaluations of potato flakes (means of four determinations and S.E.)

Variety	Moisture content (%)	Bulk density (g cm <sup>-3</sup> )	Water absorption capacity (ml 10 g <sup>-1</sup> )	Blue Value Index (Klett units)
Kerr's Pink	4.12 ± 0.21	0.32 ± 0.02a	38.6 ± 0.5a	166.3 ± 12.0 a
Desiree	4.69 ± 0.23	0.30 ± 0.01a	38.2 ± 2.0a	171.7 ± 12.02a
Kenya Baraka	4.01 ± 0.14	0.28 ± 0.02a	41.8 ± 1.4b	179.8 ± 8.13a

Means within columns followed by the same letter are not significantly different at  $P = 0.05$

**Table 3** Mean scores for colour, flavour, mealiness and preference for use of reconstituted potato flakes in 'irio' (ranks transformed into scores)

Variety	Colour	Flavour	Mealiness	Preference for use in 'irio'
Kerr's Pink	-0.43a	-0.05a	-0.14a	-0.38a
Desiree	+0.66b	+0.05a	-0.05a	+0.43b
Kenya Baraka	-0.14a	+0.09a	+0.19a	+0.05a

Means for 18 judges

Means within columns followed by the same letter are not significantly different at  $P = 0.05$

**Table 4** Mean scores for reconstituted potato flakes prepared from three Kenyan potato varieties

Variety	Colour	Flavour	Mealiness	Overall acceptability
Kerr's Pink	3.7a	4.1a	4.2a	4.0a
Desiree	4.6b	4.1a	3.2b	4.1a
Kenya Baraka	3.6a	3.6a	3.1b	3.6a

Scores of 3.0 and above are acceptable. Each score is a mean of 16 observations

Means within columns followed by the same letter are not significantly different at  $P = 0.05$

'irio' (Tables 3 and 4). However, Kerr's Pink was rated significantly higher ( $P = 0.05$ ) in mealiness than Desiree and Kenya Baraka (Table 4) though the ranking panel (Table 3) could not detect any differences.

The colour preference for Desiree is probably related to its uniform, fresh-looking (light-yellow mash) appearance. Preference for the same variety in making 'irio' shows that colour preferences should be known and taken into account when attempting to improve traditional foods. The average result from the mealiness tests is in agreement with the preference of Kenyan consumers for a potato which has a mealy (or floury) texture on cooking.

Results indicate the possibility of commercial utilization of Kenyan potato varieties for production of potato crisps, potato flakes or other fried and dried products. Varieties for processing are preferably those having a high dry matter content with low reducing sugars (Gray and Hughes, 1978). Potato varieties of high dry matter content are important for processing because of their better finished product yield, low oil retention on frying, and higher quality compared with those having low dry matter content. A low reducing sugar content is desirable for the production of attractive finished products without resorting to expensive chemical or other treatments (e.g. use of sulphite, hot water treatment, etc.) for improvement of colour, particularly in chips and crisps.

## References

- Anon. (1977) Methods of assessment for potatoes and potato products, *European Association for Potato Research, Wageningen*
- Anon. (1978) Potato Chip Snack Food Association announces brand new color chart, *Chipper Snacker* 35

- 19-20
- Anon. (1981) *Annual Report 1979*, National Potato Research Station, Ministry of Agriculture, Tigon
- Ben-Gera, I., Weisslowitz, H., Shalom, P. and Basker, D. (1974) *Uniform methods for laboratory examination of potatoes*, Agric. Res. Organisation, the Volcani Centre, Bet Dagan, Israel, Special Publ. No. 33
- Burr, H.K. and Reeve, R.M. (1973) Potatoes, in: (Eds. Van Arsdell, W.B., Copley, M.J. and Morgan, A.I.) *Food dehydration*, Vol. 2, 2nd ed. Westport, Conn., The AVI Publ. Co.
- Escher, F., Rotach, P., Schweingruber, P. and Solms, J. (1979) A modified method for determining the 'Blue Value Index' of instant mashed potato products, *Lebensm. Wiss. Technol.* 12 27-30
- Fisher, R.A. and Yates, F. (1963) *Statistical Tables for Biological, Agricultural and Medical Research*, London, Longman Group Ltd.
- Gray, D. and Hughes, J.C. (1978) Tuber quality, in: (Ed. Harris, P.M.) *The potato crop*, London, Chapman and Hall
- Hadziyev, D. and Steele, L. (1979) Dehydrated mashed potatoes - chemical and biochemical aspects, *Adv. Food Res.* 25 55-136
- Hesen, J.C. and van der Schild, J.H.W. (1979) The potato as a raw material for the food industry in the Netherlands, in: *Agri-Holland 7*, Ministerie van Landbouw en Visserij, Hoofdafdeling Afzetbevordering Buitenland, Den Haag, Holland
- Kabira, J.N. (1983) Variation in specific gravity of Kenyan potatoes, *Kenya J. Sci. Technol.* (B) 4 111-115
- Larmond, E. (1977) *Laboratory methods for sensory evaluation of food*, Research Branch, Canada Dept. Agric., Publ. 1637, Ottawa
- Sahasrabudhe, M.R., Larmond, E. and Nunes, A.C. (1976) Sulfur dioxide in instant mashed potato flakes, *Can. Inst. Food Sci. Technol. J.* 9 207-211
- Sapers, G.M., Panasiuk, O., Talley, F.B. and Shaw, R.L. (1974) Flavor quality and stability of potato flakes. Effects of drying conditions, moisture content and packaging, *J. Food Sci.* 39 555-558
- Steel, G.D. and Torrie, J. (1960) *Principles and Procedures in Statistics*, New York, McGraw-Hill Book Co.