International Journal of Farm Sciences **4(4)** : 180-187, 2014

Optimisation of development of different dehydrated products from substandard potatoes

UMA N KULKARNI and NAZNEEN KUNDGOL

Department of Food Science and Nutrition
University of Agricultural Sciences, Dharwad 580005 Karnataka
Email for correspondence: unk.uma2007@rediffmail.com

ABSTRACT

Processing of the bulky perishable potatoes into various processed products is viable option which can help to extend the shelflife. Various dehydrated products namely starch, flour, flakes and granules from substandard potatoes collected from 10 different pockets (P) of Kumbapur Farm of University of Horticultural Sciences, Bagalkot, Karnataka were optimized at UAS, Dharwad during 2013-14. Most of the potatoes had brown skin and cream flesh. P_2, P_5, P_6 and P_8 had brownish yellow skin whereas rest showed brown skin. Except for P_3 (yellowish cream skin) most potatoes showed cream and white flesh and all the potatoes were misshaped. Potato tuber mean length breadth and weight varied significantly ($p \leq 0.01$). The highest volume (108.70 ml) and diameter (5.62 cm) were found in P_9 potato whereas the lowest values for volume (62.15 ml) and diameter (4.36 cm) was found in P_7 potato tuber. The highest specific gravity was found in P_4 (1.206) and lowest was found in P_6 (1.134) and P_7 (1.134) respectively. Keeping blanching time constant ie 20 minutes the flour/ flakes/granules were obtained with variation of temperatures in cabinet drier, drying time and added preservative. The flour/flakes/granules obtained by blanching substandard potato slices for 20 min, drying in cabinet drier at 60°C for 6 h with 5 g preservative were acceptable. The products had attractive colour, texture and taste. Similar results were found for hot air oven method. Starch from substandard potatoes was optimised at drying temperature of 60°C, drying time 2 h, preservative @ 5 g using cabinet drier and hot air oven yielded acceptable product which resembled corn starch in appearance, taste, texture and flavour. Rest of the variations like temperature, drying time with no added preservatives yielded unacceptable starch. Yield of dehydrated products from substandard potatoes revealed that peel loss ranged from 240.45 to 329.6 g/kg. The highest edible portion ranged between 761.41 g/kg to 672.25 g/kg.The yield was highest in flour (171.72 g/kg) followed by granules (95.96 g/kg) and starch yield was the lowest (30.18 g/kg).

Keywords: Substandard; potato; processed products; colour; starch

INTRODUCTION

The potato is starchy, tuberous crop from the perennial night-shade *Solanum tuberosum*. The word 'potato' may refer to the plant itself in addition to the edible tuber. Potato is a major food crop grown in more than 100

countries. The native South Americans brought potato under cultivation about 2000 years ago before the Spanish conquest. It was introduced in India by the Portuguese sailors during early 17th century and its cultivation was spread to north India by the British. At present China, Russia, India, Poland and USA contribute a major share of total world potato production. India holds the 3rd position in production and 4th in area under cultivation of potato in the world. It is grown in an area of 1.41 million hectare with an average annual production of 24 MT (Raj et al 2007). About 90 per cent of the total potato production in India is contributed by the Indo-Gangetic plains. It is one of the main commercial crops grown in 23 states of India of which Uttar Pradesh, West Bengal, Bihar, Punjab and Gujarat account for a lion's share. The annual compound growth rate of potato is higher than other major food crops in respect of area, production and productivity (Pandey et al 2009).

MATERIAL and METHODS

Various dehydrated products namely starch, flour, flakes and granules from substandard potatoes collected from 10 different pockets (P) of Kumbapur Farm of University of Horticultural Sciences, Bagalkot, Karnataka were optimized at UAS, Dharwad during 2013-14 which were categorized substandard on the basis of size (>70 g - >120 g), dirt dirt (>2%) physiological damage (>1%) total potato defects (TPODPLOT) (>60%) and disease (nil).

Physical characteristics namely weight, volume, specific gravity, diameter, size, shape, colour, acceptability, visual observation of skin and flesh colour of substandard potatoes collected from 10 different pockets were recorded.

Weight (g) of 10 potato samples measured to two nearest decimals were taken and mean weight for the potatoes was obtained. Volume of selected 10 potato samples was measured by water displacement method as under (Tabatabaeefar 2002):

Volume (cc)= Volume of water with potato (cc) - Volume of water without potato (cc)

Specific gravity was calculated using the following formula (Tabatabaeefar 2002):

$$\text{Specific gravity} = \frac{\text{Weight in air } (g_1)}{\text{Weight of water displaced } (g_2)}$$

Circumference of potato was measured using thread of one mm width across length and breadth of the tubers. Diameter was calculated using the formula:

$$\text{Diameter (cm)} = \frac{\text{Circumference (cm)}}{\eth\ (3.14)}$$

Length (cm) and breadth (cm) were measured by the use of vernier calliper and mean tuber size was obtained. Shape observation and colour categorization were done using the method given by Abong et al (2010).

RESULTS and DISCUSSION

Physical Parameters: Table 1 depicts the physical parameters of substandard potato tubers. Potato tuber mean length varied significantly ($p \leq 0.01$) between the pockets ranging from 6.09 cm in P_{10} to 7.84 cm in P_9. Breadth of the tubers was statistically significant. The values ranged between 4.02 cm in P_7 to 5.69 cm in P_1. Significant variation among the cultivars was observed ranging from 43 mm in Tigoni Long to 56 mm in Kenya Sifa and clone 392617.54 (Abong et al 2010). Highest weight was observed in P_9 (115.77 g) followed by P_4 (114.82 g) and least was observed in P_7 (65.60 g). The variations could be due to genotype and environmental conditions during growth period (Lisinska and Leszczynski 1989, Tabatabaeefar 2002). The highest volume (108.70 ml) and diameter (5.62 cm) were found in P_9 whereas the lowest values for volume (62.15 ml) and diameter (4.36 cm) were found in P_7. The highest specific gravity was found in P_4 (1.206) and lowest in P_6 and P_7 (1.134). Abong et al (2010) also presented similar results with significant difference in specific gravity among the cultivars. Raj and Lal (2008) exhibited specific gravity of 1.10 in Kufri Chipsona-2 which was slightly lesser than the value recorded in Kufri Chipsona-2 in this study. Tabatabaeefar (2002) showed significant difference in volume among the cultivars and also depicted strong positive relation between diameter and volume of the tubers. The difference in volume and specific gravity among the varieties could be due to difference in range of diameter and mass (Kabira and Lemega 2006, Abong et al 2009).

Most of the potatoes had brown skin and cream. P_2, P_5, P_6 and P_8 had brownish yellow skin whereas rest showed brown skin. Except for P_3 (yellowish cream skin) most potatoes showed cream and white flesh and all the potatoes were misshaped.

Scars and green tints were present on all the potatoes. Most of the samples had rough skin. The number of eyes ranged

Table 1. Physical, morphological and visual parameters of substandard potatoes

Pocket	Size (cm)		Weight (g)	Volume (ml)	Dia (cm)	Specific gravity	Colour		Shape	Scars	Green tint	Type of skin	# eyes	Natural depression
	Length	Breadth					Skin	Flesh						
P_1	7.27	5.69	92.20	86.09	5.34	1.144	Brown	Cream	Misshaped	Present	Present	Rough	5	Present
P_2	6.38	5.24	97.61	92.43	5.47	1.175	Brownish yellow	Cream	Misshaped	Present	Present	Smooth	6	Present
P_3	6.94	4.15	78.99	73.97	4.46	1.185	Brown	Yellowish cream	Misshaped	Present	Present	Rough	8	Present
P_4	7.51	5.35	114.82	101.00	5.46	1.206	Brown	White	Misshaped	Present	Present	Smooth	5	Present
P_5	7.65	5.21	109.95	102.58	5.40	1.144	Brownish yellow	White	Misshaped	Present	Present	Rough	8	Present
P_6	6.49	5.28	92.66	87.81	5.56	1.134	Brownish yellow	White	Misshaped	Present	Present	Smooth	6	Present
P_7	6.25	4.02	65.60	62.15	4.36	1.134	Brown	Cream	Misshaped	Present	Present	Smooth	8	Present
P_8	7.16	4.11	84.88	80.05	5.45	1.185	Brownish yellow	Cream	Misshaped	Present	Present	Smooth	6	Present
P_9	7.84	5.14	115.77	108.70	5.62	1.185	Brown	Cream	Misshaped	Present	Present	Smooth	7	Present
P_{10}	6.09	4.23	69.49	80.05	4.52	1.175	Brown	Cream	Misshaped	Present	Present	Smooth	7	Present

between 5-8. Natural depressions were present in all the potatoes. Deep eye depths lead to heavy losses during peeling, trimming and thus lowers overall yield of crisps (Smith et al 1985, Kabira and Lemega 2006) which was absent in the tubers of present investigation. Thus the tubers investigated in the present study were suitable for processing owing to total potato defects (TPOD).

Standardization of the protocol for commercial production of different dehydrated products from substandard potato

Table 2 shows the preliminary trials for standardization of flour/flakes/granules from substandard potatoes. Variation in drying temperature, drying methods, drying time, percentage of preservatives used and blanching time were made to obtain organoleptically acceptable dehydrated products. Blanching time was kept constant ie 20 min. The flour/flakes/granules obtained using cabinet drier/ hot air oven at 60°C, 65°C and 80°C, drying time of 5 h and preservative @ 5 g were unacceptable whereas flour/flakes/granules obtained by blanching for 20 min at 60°C, drying for 6 h with preservative (10 g) were acceptable. The product had attractive color, texture and taste. Kakade et al (2011) described the optimization of twin-drum drying parameters for production of potato flakes. Study revealed that the optimum values of drum speed, steam pressure and liquid level at the nip of two drums were such that the dried product would be light colored flakes having safe moisture content and high dry solid output rate. Many Kenyan consumers have attributed white or red skin coloured tubers to be of good quality for processing (Kabira 2000). Spray dryer was used to produce potato powder from potato juice. Turning potatoes into powder will increase its substance durability, ease of transportation and the storage (Saydi and Hatamipour 2012).

The data on preliminary trials for standardization of starch from substandard potatoes are presented in Table 3. Variation with drying temperature of 60°C, drying time of 2 h, preservative @ 5 g by using cabinet drier and hot air oven yielded acceptable starch which resembled corn starch in appearance, taste, texture and flavour. Rest of the variations like temperature, drying time without preservatives yielded unacceptable starch.

The developed starch from substandard potatoes had white colour without foreign taste and smell. The developed flour had fine creamy white flour, appearance, natural potato aroma and flour passed through a 80 micron mesh. The developed flakes from substandard potatoes had light yellow colour.

Peel loss, edible portion and yield were significant at $p \leq 0.01$. The values for peel loss ranged from 240.45 to 329.6 g/

Table 2. Preliminary trials for standardization of flour/flakes/granules from substandard potatoes

Blanching time (mn)	Drying (using cabinet drier or hot air oven)		Preservative (KMS) (g)	Acceptability
	Drying temperature (°C)	Drying time (h)		
20	60	5	5	Unacceptable
20	60	5	10	Unacceptable
20	60	6	5	Unacceptable
20	60	6	10	Acceptable
20	65	5	5	Unacceptable
20	65	5	10	Unacceptable
20	65	6	5	Unacceptable
20	65	6	10	Unacceptable
20	80	5	5	Unacceptable
20	80	5	10	Unacceptable
20	80	6	5	Unacceptable
20	80	6	10	Unacceptable

Table 3. Preliminary trials for standardization of starch from substandard potatoes

Drying (using cabinet drier/ hot air oven)		Preservative (KMS) (g)	Acceptability
Drying temperature (°C)	Drying time (h)		
60	1	-	Unacceptable
60	1	5	Unacceptable
60	2	-	Unacceptable
60	2	5	Acceptable
65	1	-	Unacceptable
65	1	5	Unacceptable
65	2	-	Unacceptable
65	2	5	Unacceptable

Table 4. Recovery of dehydrated products from substandard potatoes

Dehydrated product	Peel loss (g/kg)	Edible portion (g/kg)	Yield (g/kg)
Flour	250.47	754.58	171.72
Starch	320.60	681.26	30.18
Flakes	329.61	672.25	60.35
Granules	240.45	761.41	95.56
Mean	285.28	717.38	89.45
'F' test	*	*	*
SEm±	1.89	2.96	2.68
$CD_{0.01}$	8.16	12.79	11.58
CV	1.48	0.92	6.70

*Significant at 1% level

kg in granules and flakes. The highest edible portion was observed in granules (761.41 g/kg) followed by flour (754.58 g/kg) and lowest was observed in flakes (672.25 g/kg). The yield was highest in flour (171.72 g/kg) followed by granules (95.96 g/kg) and starch possessed the lowest values (30.18 g/kg) (Table 4).

REFERENCES

Abong GO, Okoth MW, Imungi JK and Kabira JN 2010. Evaluation of selected Kenya potato cultivars for processing into potato crisps. Agriculture and Biology Journal of North America **1(5):** 886-893.

Abong GO, Okoth MW, Karuri EG, Kabira JN and Mathooko FM 2009. Influence of potato cultivar and stage of maturity on oil content of French fries (chips) made from eight Kenyan potato cultivars. African Journal of Food, Agriculture, Nutrition and Development **8(9):** 1667-1682.

Kabira JN 2000. French fries and crisps processing characteristics of selected potato varieties in Kenya. Publication of African Potato Association, Uganda, pp 507-511.

Kabira JN and Lamega B 2006. Potato processing: quality evaluation processing for research and food industries application in east and central Africa. Kenya Agricultural Research Institute, Nairobi, Kenya, pp 9-15.

Kakade RH, Das H and Ali S 2011. Performance evaluation of a double drum dryer for potato flake production. Journal of Food Science and Technology **48(4):** 432–439.

Lisinska G and Leszczynski W 1989. Potato science and technology. Elsevier Science Publishers Ltd, America, New York, pp 11-202.

Pandey SK, Singh SV, Marwaha RS and Pattanayak D 2009. Indian potato processing varieties: their impact and future priorities. Potato Journal **36(3-4):** 95-114.

Raj D and Lal BB 2008. Effect of cultivars, cold storage and frying media on yield and processing qualities of potatoes. Journal of Food Science and Technology **45(1):** 20-27.

Raj D, Lal BB, Sharma PC and Ahlawat OP 2007. Utilization of unmarketable potatoes for preparation of ready-to-serve instant Halwa powder: a better way of processing. Journal of Food Science and Technology **44(1):** 40-43.

Saydi D and Hatamipour MS 2012. Analysis of the effective parameters on potato powder quality

produced by a spray dryer. Iranian Journal of Chemical Engineering **9(3):** 55-62.

Smith LM, Clifford AJ, Creveling AK and Hamblin CL 1985. Lipid content and fatty acid profiles of various deep-fat-fried foods. Journal of the American Oil Chemical Society **62(6):** 996-998.

Tabatabaeefar A 2002. Size and shape of potato tubers. International Agrophysics **10:** 301-305.

Received: 3.12.2014 ***Accepted: 27.12.2014***