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SHORT COMMUNICATION

PROCESSING QUALITY OF POTATO VARIETIES STORED AT AMBIENT TEMPERATURE

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Potato tubers of four cultivars *viz.,* Kufri Chipsona-1, Kufri Chipsona-2, Kufri Jyoti and Kufri Bahar were stored at room temperature (22-38 ^{0}C, RH 37-80%) after harvest. Freshly harvested and stored tubers were processed into chips, laccha and french fries and evaluated for losses due to rottage, sprouting and weight loss. Dry matter content was found to be highest in Kufri Chipsona-2 in freshly harvested and 90 days stored potatoes followed by Kufri Chipsona-1, Kufri Jyoti and Kufri Bahar. Similarly, the chips colour and general acceptability were significant and highly acceptable in Kufri Chipsona-1 and Kufri Chipsona-2. In freshly harvested potatoes, quality of the products (chips, french fries and *laccha*) was highly acceptable ranging between 8 and 7 in both processing varieties. Reducing sugars, total phenols, sucrose and browning were within acceptable range in both Kufri Chipsona-1 and Kufri Chipsona-2. The findings of the study suggests that 90 days storage of potatoes at normal temperature with proper ventilation could be explored for storing processing potatoes.

Key words: **Processing quality, potato, temperature**

Harvested potato tubers are subjected to tremendous weight loss, rottage and sprouting under ambient temperatures (25-42^{0}C). Therefore, they are stored in cold stores at 2-4^{0}C, which results in accumulation of reducing sugars in tubers and makes them unsuitable for processing (Ezekiel *et al*. 2005, Khurana 2006, Ezekiel *et al*. 2007). Various alternatives like on-farm storage, ECPS and room temperature storage have been attempted and found successful upto some extent (Das *et al*. 2004, Ezekiel *et al*. 2005, Khurana 2006, Pandey 2007). In Western Uttar Pradesh (West-Central Indian Plains), the ambient temperature during harvest of potato is very high and results in higher weight loss and rottage of potatoes during storage. Hence, processing and value addition of potato for effective utilization/consumption is very important. Processed products like chips, *laccha*, french fries and other dehydrated potato products are very common in the market. Cold stored potatoes (2-4^{0}C temperature) are not desirable for processing because of non-enzymatic browning due to increase in reducing sugar (Ezekiel *et al*. 1999). Potato storage at 10-12^{0}C in commercial cold stores with CIPC treatment which also deteriorates processing quality in some cultivars (Ezekiel *et al*. 2005). Lack of improved on-farm storage structures, high post-harvest losses, low domestic utilization and processing are the major problems of potato utilization in our country (Pandey 2007). Therefore, it is needful to store potatoes under ambient conditions and subject them to processing and evaluate their quality. Therefore, this study was undertaken to evaluate the processing quality of freshly harvested and 90 days stored (at ambient temperature) potato.

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The study was carried out at R. G. College, Meerut and at CPRI Campus, Modipuram using four varieties of potato *viz*. Kufri Chipsona-1, Kufri Chipsona-2, Kufri Jyoti and Kufri Bahar for two consecutive years. Kufri Chipsona-1 and Kufri Chipsona-2 are two processing varieties while Kufri Jyoti and Kufri Bahar are two promising varieties of Western UP, Delhi, Haryana and Punjab. Tubers of these varieties were harvested in the third week of February, well-cured and stored in four replicates (25 kg each) at room temperature (22-38 ^{0}C, RH 37-80%) (Fig. 1) in hessian cloth bags (onion bags with pores of 4 mm^2 size) in a well-ventilated room for 90 days from 20th March to 20th June in both the years of experimentation.

Out of 25 kg of stored tubers, 5 kg from each replicate were taken for determining weight loss and spoilage after 90 days of storage. Rotted tubers were sorted out at 90 days after storage (DAS) and remaining tubers were used for biochemical analysis. Dry matter content was determined immediately after harvest and 90 days of storage after drying 50 g of diced tubers per replication, in a hot air oven at 70^{0}C for 48 h and then at 60^{0}C till constant weight was obtained. Losses through weight loss, sprouting and rottage were determined. Potatoes from these varieties were processed into chips, *laccha* and french fries after harvest and after 90 days of storage.

For preparing chips, the tubers were cut into 1.75 mm thick slices using an automatic slicer. Chips were then fried in blend of palm olein oil (POO) and sunflower oil (SFO) in 40-60 ratio at 180^{0}C in a deep fat fryer till the bubbling stopped. This blend of oil was found best for chip flavour and storage stability (Dhaka *et al*. 2007). The fried chips were drained to remove excess oil and the chip colour was scored following the method of Mbata *et al* (2002). For the preparation of potato *laccha*, peeled potatoes were passed through square die of 3x3 mm to form sticks of 2-4 cm in length. The fried *laccha* were salted at the rate of 1.5-2% for better keeping quality and taste. French fry is prepared by cutting potatoes into potato strips of 1x1 cm in cross-section having straight cut and 6-10 cm in length. To obtain finished french fry, desired finish- fry colour and texture, two blanchers were used with a lower temperature of 75^{0}C in the first and 90^{0}C in the second blancher.

Parameters like dry matter content (%), reducing sugar and sucrose were determined following standard methods (Nelson 1944, Swain and Hillis 1959, van Handel 1968, Mehta and Singh 2004, Ezekiel et al. 2007). Browning percentage was estimated by frying half kg slices from each replication and counting the number of brown chips following the method of Ezekiel *et al.* (2005). Sensory evaluation like colour, texture, flavour, taste and general acceptability was also determined following method of Mbata *et al.* (2002) and different scales were used for judging (8-like extremely, 7-like very much, 6-like moderately, 5-like slightly, 4-dislike slightly, 3-dislike moderately, 2-dislike very much, 1-dislike extremely for A- Colour, B- Texture, C- Flavour, D- Taste and E- General Acceptability). Four replicates of five tubers each for every estimation and varieties were taken and the data were statistically analyzed using MSTAT 4.0 C package for computers (Michigan State University, USA) software following the method of Gomez and Gomez (1976). Data from sensory evaluations were subjected to an incomplete block design with split plot treatment.

After 90 days of storage, sprouting ranged between 76-100 % and the mean sprouting was 83.7 (Table 1). Sprouting was found to be significant when Kufri Chipsona genotypes were compared with Kufri Bahar, whereas, it was marginally (Kufri Chipsona-1) significant with Kufri Jyoti. Rottage ranged between 2.3-4.9 % and weight loss between 13.3-18.6 %. Peeling loss (%) was minimal in Kufri Chipsona-1 and Kufri Chipsona-2 (7.7-8.6 and 7.5-8.4), respectively in fresh and stored samples (90 DAS) (Table 1). Total losses were minimal or low in both Kufri Chipsona-1 and Kufri Chipsona-2 and were suitable for processing followed by Kufri Jyoti and are in agreement with findings explained by Ezekiel *et al*. (2003) and Marwaha *et al*. (2003). Shriveling occurred due to high temperature prevailing during storage and imbalance occurred between the optimal water and solid content irrespective of cultivars. Ninety days storage did not affect the chipping quality but caused shriveling due to weight loss. Shriveling affected peeling and resulted into one or two grade below standard colour and texture

Table 1. Weight loss, sprouting and tuber rottage after storage (90 days) in different genotypes of potato and peeling loss in freshly harvested potatoes and stored potatoes (90 days)

Genotypes	Weight loss (%)	Sprouting (%)	Tuber rottage (%)	Peeling loss (%)*	
				At harvest	90 DAS
Kufri Chipsona-1	13.3	76	4.0	7.7	8.6
Kufri Chipsona-2	15.0	81	2.3	7.5	8.4
Kufri Jyoti	16.5	78	4.5	11.7	15.4
Kufri Bahar	18.6	100	4.9	13.5	16.7
Mean	15.8	83.7	3.9	10.1	12.3
CD ($P \leq 0.05$)	V= 2.2	V= 4.3	V= 2.1	T= 1.52,	V= 3.27, TxV= 1.98

*During chips preparation, DAS = days after storage

(Tables 2, 3 and 4). Rottage was less because well cured and sorted potatoes (potatoes without any cut and brusing) were stored when the ambient temperature was below 20 ºC.

Dry matter content (%) was found to be highest in Kufri Chipsona-2 (22.4 and 22.9) in fresh and 90 days stored potatoes, respectively followed by Kufri Chipsona-1, Kufri Jyoti and Kufri Bahar (Table 3). Slight increase in dry matter (DM) at 90 DAS could be due to heat induced water losses. Chipsona varieties had dry matter more than 20% and were suitable for processing and have acceptable colour for chips, french fry and *laccha* (Table 4). Other organoleptic characters were also found acceptable in these two varieties. However, at 90 days storage these parameters showed negative trend due to shriveling of potatoes. In freshly harvested, the chips colour and general acceptability were significantly higher and acceptable in Kufri Chipsona-1 and Kufri Chipsona-2, while Kufri Jyoti was moderately acceptable compared with Kufri Bahar. Similarly, quality of the products (chips, french fry and *laccha*) was of high general acceptability ranging between 8 and 7 in both processing varieties (Table 4).

Reducing sugars were very high in Kufri Jyoti and Kufri Bahar in fresh and stored potatoes, while Kufri Chipsona-1 and Kufri Chipsona-2 showed lower levels of reducing sugars (Table 3). Total phenols, sucrose and browning were within acceptable range in both Kufri Chipsona-1 and Kufri Chipsona-2 (Table 3). Both these varieties were found suitable for chipping as their tubers

Table 2. Yield of french fries prepared from different potato genotypes in freshly harvested potatoes and stored potatoes (90 days)

Genotypes	Peeling loss (%)		Trimming and cutting losses (%)		Processing losses (%)		Yield of fries (%)	
	Fresh	Stored	Fresh	Stored	Fresh	Stored	Fresh	Stored
K. Chipsona-1	8.9	9.3	2.6	2.9	11.5	12.2	57.6	53.1
K. Chipsona-2	8.5	8.9	1.9	2.3	10.4	11.2	55.6	51.1
K. Jyoti	10.6	12.3	3.8	4.3	14.4	16.6	44.4	41.0
K. Bahar	13.7	15.2	2.9	3.8	16.6	19.0	42.3	40.1
CD ($P \leq 0.05$)	T: 1.2,	V: 1.8, TxV:1.5	T: NS,	V: 0.7, TxV: 1.3	T: 1.4,	V: 1.9, TxV: NS	T: 3.1,	V: 4.8, TxV:2.5

NS: non significant

Table 3. Dry matter content, reducing sugar, total phenol content, sucrose and browning in freshly harvested and stored potatoes (90 days).

Genotypes	Dry matter content (%)		Reducing sugar (mg 100 g dry wt^{-1})		Total phenol (mg 100 g)		Sucrose (mg 100 g f w^{-1})		Browning (%) dry wt^{-1})	
	Fersh	Stored	Fresh	Stored	Fresh	Stored	Fresh	Stored	Fresh	Stored
Kufri Chipsona-1	21.3	21.7	228	756	21.2	29.6	912	3678	35.4	31.1
Kufri Chipsona-2	22.4	22.9	389	634	18.8	30.1	922	3294	36.6	75.8
Kufri Jyoti	19.1	19.4	549	1186	26.7	35.8	865	4663	21.7	63.8
Kufri Bahar	18.1	18.3	1380	1068	16.7	24.0	1024	4167	89.7	98.8
Mean	20.2	20.6	636	911	20.8	29.9	931	3950	45.8	67.4
CD ($P \leq 0.05$)	T= NS, V=0.67, TxV= 0.21		T= 173, V= 89, TxV= 123		T= 6.45, V= 2.12, TxV= 2.78		T= 578, V= 109, TxV= 87		T= 11.1, V= 12.4, TxV= 12.3	

T= Storage duration; V= Variety; NS= non-significant

Table 4. Organoleptic characteristic and acceptability of potato products in freshly harvested and stored potatoes (90 days).

Genotypes	Storage	Chips					French fry					*Laccha*				
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
K. Chipsona-1	Fresh	7	7	7	8	7	8	8	8	7	8	8	7	7	8	8
	Stored	6	7	7	7	7	7	8	7	7	7	7	7	7	7	7
K. Chipsona-2	Fresh	7	7	7	8	7	8	8	7	8	8	8	8	7	8	8
	Stored	6	6	7	7	7	7	7	7	8	7	7	8	7	7	7
K. Jyoti	Fresh	6	6	5	6	6	6	6	7	6	6	6	6	5	6	6
	Stored	5	6	5	6	5	4	5	4	4	5	5	6	5	5	5
K. Bahar	Fresh	6	6	5	6	5	6	6	6	5	6	6	6	5	5	5
	Stored	4	6	5	5	5	4	5	4	4	4	4	5	4	4	4
CD ($P \leq 0.05$)		T= 0.6, V= 0.8, TxV= 1.4					T= 0.4, V= 0.7, TxV= 1.2					T= 0.7, V= 0.7, TxV= 1.3				

possessed required shape and size, contained more than 20% dry matter and low reducing sugars, and produced light coloured chips (Marwaha *et al*. 2003, Singh and Pandey 2003, Ezekiel *et al*. 2007).

Evaluation for french fries showed that Kufri Chipsona-1 and Kufri Chipsona-2 produced fries of acceptable colour and texture (Table 4) with minimum peeling, trimming and cutting losses (Table 3) and also produced maximum yield (Table 2). There was slight reduction in fries yield in stored tubers of all the varieties which was due to shriveling, weight loss and almost 100% sprouting (Table 2). Kufri Chipsona-1 was better suited for fries due to oblong shape of its tubers which meet

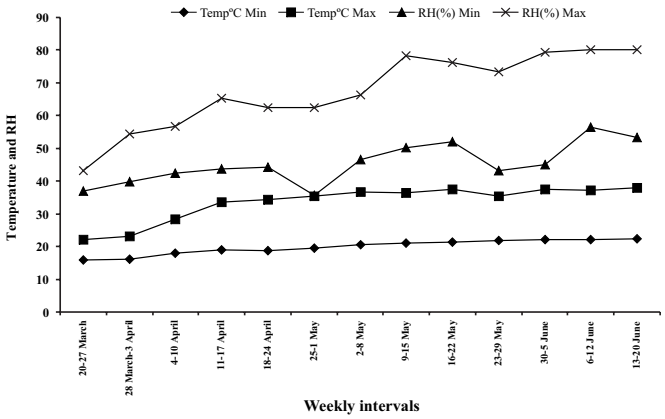

Fig. 1. Weekly average of temperature (ºC) and RH (%) from 20th March to 20th June

the minimum requirements of shape, size, texture, dry matter and reducing sugars for processing (Marwaha *et al*. 2003). However, Kufri Chipsona-2 was not suitable for fries. Organoleptic characteristics of potato products slightly reduced after 90 days at storage in Kufri Chipsona-1 and Kufri Chipsona-2 (from 8 to 7), whereas, in Kufri Jyoti and Kufri Bahar it reduced from 6 to 5 and 6 to 4, respectively (Table 4). The findings conclude that Kufri Chipsona-1 and Kufri Chipsona-2 potato varieties are suitable for processing when stored at room temperature (between 45 to 90 days) for making chips, French fries and *laccha* and would be helpful to farmers in retaining the produce on-farm, release it slowly in the market and avoid glut situations.

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