Potato J (2015) 42 (1): 76-79

ASCORBIC ACID LOSSES DURING STORAGE OF POTATO TUBERS

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Key words: Ascorbic acid, CIPC, processing, storage

Potato (*Solanum tuberosum* L.) is one of the most important tuber crops being widely consumed in the world. Apart from supply of energy and high quality protein, potato has also been documented as an important source of vitamins and minerals and also as a valuable source of scurvy preventive vitamin C, more commonly known as ascorbic acid. Ascorbic acid being anti-oxidant also enhances the absorption and internal transport of dietary iron and zinc from other plant sources as it is a strong reducing agent in the plant metabolism (Cook and Reddy, 2001). Potato tubers have been reported to contain up to 46 mg of ascorbic acid per 100 g tubers (on fresh weight basis) and its availability depends on the variety, maturity status and the environmental conditions under which crop is grown (Nourian *et al*., 2003; Han *et al*., 2004). In the year 2000, the recommended daily allowance (RDA) of vitamin C, has been replaced by dietary reference intake (DRI). Dietary reference intakes for vitamin C have been established as 90 mg for men and 75 mg for women (NAS, 2000). Many authors (Agustin *et al*., 1978; Shekhar *et al*., 1978) have reported that the ascorbic acid content is affected by the storage conditions as well as length of storage. Presently besides being part of a regular diet, potatoes are also processed in chips, French fries and flakes etc. and it is pertinent to know the status of ascorbic acid in potato cultivars being used in processing. Therefore, a study was conducted to investigate the changes in ascorbic acid content of potato tubers of indigenous and exotic popular processing varieties during storage up to six months under the elevated temperatures of 10-12°C, which is the commercially adopted practice by the industry.

Five indigenous processing varieties *viz.* Kufri Chipsona-1, Kufri Chipsona-2, Kufri Chipsona-3, Kufri Himsona, Kufri Surya along with two exotic varieties *viz*. Atlantic and Lady Rosetta were grown at Central Potato Research Institute Campus, Modipuram, Meerut (29.1° N latitude, 77.92° E longitude, and altitude of 300 meters above mean sea level) following all the recommended cultural practices. Mature and well cured tubers of these varieties were stored at 10-12°C during the last week of March and treated (through fogging) with CIPC (Isopropyl N-(3-Chlorophenyl) Carbamate) @ 35 ml/tonne (50% a.i.) twice during the first fortnight of April and June. The tuber samples were analysed periodically for ascorbic acid content at monthly intervals up to 180 days after storage (Sadasivam and Manickam,1997). Five processing size tubers (>45 mm) were washed,

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peeled and chopped. The chopped tuber tissues (5 g) were then frozen with liquid nitrogen. Ascorbic acid was extracted with 4% (w/v) oxalic acid and then it was oxidized to dehydro-ascorbic acid by the addition of bromine water. 2, 4-Dinitrophenylhydrazine was added to the oxidized products and the red colour of resultant osazone was photometrically measured at 540 nm. The statistical analyses of experimental data were done using 'IRRISTAT' software developed by the International Rice Research Institute (http://www.biometrics@IRRI.cgiar.org)

Results revealed that tubers exhibited maximum ascorbic acid content (mg/100 g fresh weight) at zero day of storage and less consistency was observed with increase in storage duration up to 180 days **(Fig. 1)**. At the time of storage, the ascorbic acid content ranged between 13.71 mg/100 g fresh weight (cv. Atlantic) and 19.56 mg/100 g fresh weight (cv. Lady Rosetta)

After 30 days of storage, the content decreased in all the varieties except for a marginal increase in Kufri Chipsona-3. Rapid decrease of ascorbic acid concentration at the beginning of the storage can be attributed to the immediate reaction of ascorbic acid with the dissolved oxygen (Polydera *et al.*, 2003) in the tuber tissues. Ascorbic acid oxidizes to dehydroascorbic acid in the presence of oxygen molecules and enzyme ascorbic oxidase. Lady Rosetta (17.74 mg/100 g) retained maximum ascorbic acid content amongst all the processing varieties followed by indigenous variety Kufri Chipsona-2 (15.93 mg/100 g). Significantly lowest content was observed in exotic variety Atlantic (9.98 mg/100 g) and the per cent decrease in ascorbic acid content was 27.21 compared to zero day. The results are in accordance with Hagg *et al.* (1998) who also reported reduction of ascorbic acid during storage (ambient temperature) in four potato cultivars.

At 60 and 90 days after storage, the maximum decrease in ascorbic acid content was noticed in Lady Rosetta by 36.09 and 36.61%, respectively and the least in Kufri Chipsona-1 i.e. 0 and 14.01%. In all the varieties, ascorbic acid declined gradually with the increase in storage duration except in Kufri Chipsona-3. Maximum reduction (%) at 120, 150 and 180 days of storage at 10-12°C was observed in variety Kufri Chipsona-2

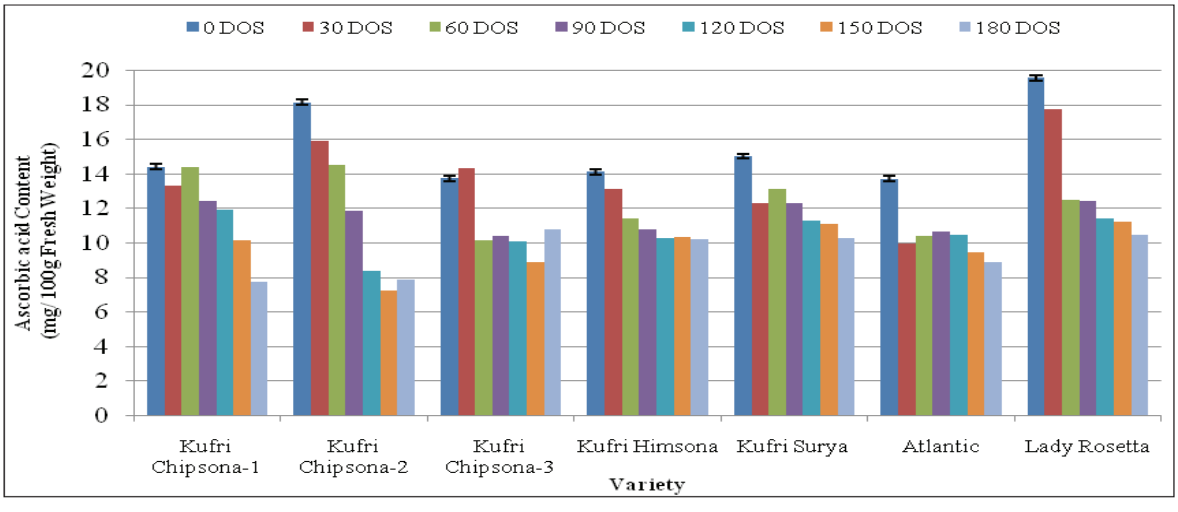

Fig. 1. Changes in ascorbic acid content during storage at 10-12°C (standard bars represents standard error of interaction between variety and storage of duraion)

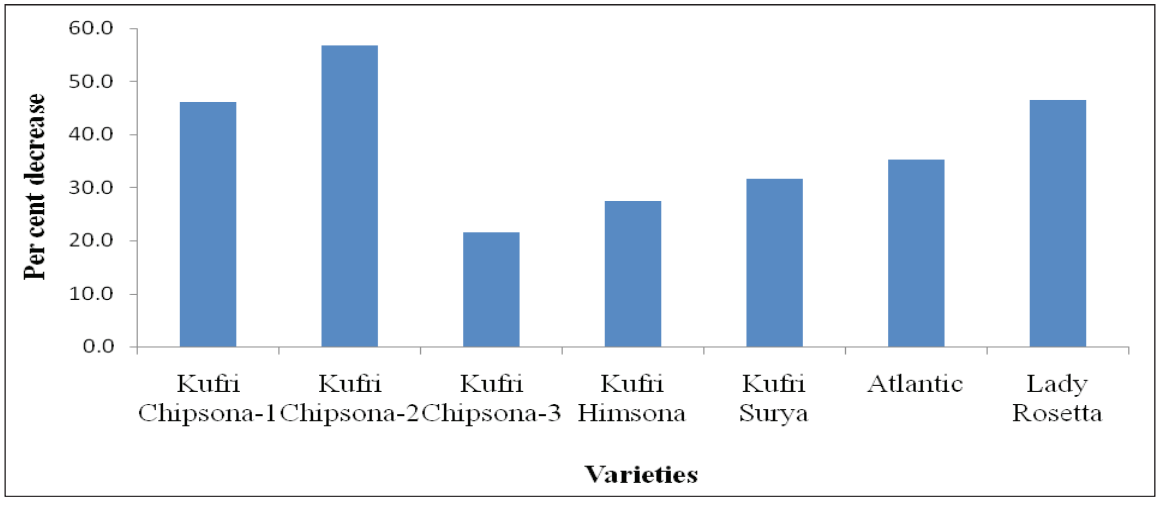

Fig. 2. Per cent decrease in ascorbic acid content of potato varieties after 180 days of storage compared to zero day.

i.e. 53.88, 60.00 and 56.69% respectively. Different varieties behaved differently with respect to retention of ascorbic acid content. High levels of ascorbic acid were retained by variety Kufri Chipsona-1 (82.52%) at 120 days, Kufri Surya (73.77%) at 150 and Kufri Chipsona-3 (78.47%) at 180 days of storage. This study is in agreement with Rivero *et al*., 2003, who reported that the concentration of vitamin C decreases markedly during the storage after 20 weeks. However, an increase was observed in variety Kufri Chipsona-2 and Kufri Chipsona-3 at 180 days of storage, but the final concentration noticed at these sampling dates were significantly lower than the initial levels (zero day of storage). This unusual increase may be attributed partly to the reversal of the oxidation of ascorbic acid (Benkeblia and Selselet-attou, 1999). This finding is in conformity with earlier report by Keijbets and Ebbenhorst-Seller (1990). After 180 days of storage (**Fig. 2**) the maximum decrease was recorded in variety Kufri Chipsona-2 (56.6 %) and the minimum in Kufri Chipsona-3 (21.53%).

The processing cultures like Kufri Chipsona-3 Kufri Himsona and Kufri Surya showed lower losses in ascorbic acid as affected by storage duration hence, these may be considered as better source of ascorbic acid in human diet.

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MS received: 12 June 2014; Accepted: 03 June 2015