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Short communication

Assessment of phytochemical diversity in Indian potato cultivars

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ABSTRACT

The experiment was conducted to analyse ascorbic acid, anthocyanins and total carotenoids content from tubers of 41 Indian potato cultivars. Significant variations were observed among the cultivars for all the analyzed traits. Ascorbic acid ranged from the minimum of 17.65 (Kufri Neela) to the maximum of 47.80 mg/100 g fresh weight (fw) in Kufri Gaurav. The anthocyanin content ranged from a minimum of 0.478 to a maximum of 1.434 μg/g fw in cvs Kufri Khyati and Kufri Kumar, respectively. Total carotenoids content varied from 27.92 to 272.54 μg/100 g fw with the minimum and maximum values exhibited by cultivars Kufri Bahar and Kufri Himsona and Kufri Jeevan respectively. Anthocyanin content was positively correlated (r = 0.020) with the total carotenoids. There was no significant difference in the phytonutrient composition of table and processing cultivars group. The study depicts narrow variability of phytonutrient level in the existing Indian potato.

Key words: *Solanum tuberosum*, phytochemical, variability, Indian potato cultivars.

Potato (*Solanum tuberosum* L.) is one of the most widely grown high carbohydrate crops in the world and a good source of complex carbohydrates. Potatoes contain appreciable amounts of ascorbic acid and vitamin B_1, B_3, B_6, folate, pantothenic acid, riboflavin and minerals such as potassium, phosphorus and magnesium. In general, potatoes are not regarded to be rich in antioxidants. However, depending on the genetic make up, they can contain considerable amounts of polyphenols, anthocyanins or ascorbic acid (Brown *et al*., 2). Polyphenols together with carotenoids and ascorbic acid contribute towards anti-oxidative capacity of a food. Potatoes being a natural source of phytochemicals such as carotenoids, phenolic compounds, flavonoids and anthocyanins help in reducing the risk of chronic diseases, including cancer, age-related neuronal degeneration or cardiovascular diseases. Yellow pigmented potatoes are known to have high carotenoids content such as lutein, zeaxanthin, violaxanthin and antheraxathin. Potato carotenoids are primarily oxygenated carotenoids which are also known as xanthophylls. Purple pigmented potatoes have health benefit against cardiovascular disease, while consumption of yellow pigmented potatoes enhances immune response (Kaspar *et al*., 5).

Colored flesh potatoes, either red or purple pigmented are important due to presence of anthocyanins (belonging to the group of flavonoids). Like anthocyanins from other plants, it has been suggested that analogous potato anthocyanins may also be important functional foods. Cultivated potatoes contain varying amounts of anthocyanins and carotenoids in their tuber skin and flesh. Hence, breeding of novel genotypes possessing high level of these antioxidants is the need of hour. Keeping in view these facts, the study was undertaken to define the range of variability for chemical composition existing in the mature indigenous potato cultivars, with regard to ascorbic acid, anthocyanin and carotenoids content and identify the cultivars rich in these phytonutrients for using them as parent in the breeding programme.

Freshly harvested medium sized tubers of forty one Indian potato cultivars were used for the present study. These cultivars were grown at Central Potato Research Institute Campus, Modipuram, India (29° 4' N, 77° 46' E, 237 masl) during winters in 2012-13 using standard package of practices. Potato tubers were washed, peeled and minced into small size. A representative sample of potato tubers was taken in three replicates and fixed for future analysis using standard procedures as given below.

Ascorbic acid was determined using the methodology described by Sadasivam and Balasubraminan (7). Total anthocyanin content was estimated spectrophotometrically according to Thimmaiah (8) and total carotenoids as per procedure of Thomas and Joshi (9). The mean performance were analysed in Microsoft Excel software 2007 and the dendrogram of biochemical traits was prepared using XLSTAT software.

Ascorbic acid content in potato cultivars ranged from 17.65 to 47.80 mg/100 g fw depicting three fold variation in the cultivars (Fig. 1a). Cultivar Kufri Gaurav and Kufri Chipsona-1 recorded the highest ascorbic acid content of 47.80 and 41.86 mg/100 g fw,

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respectively, with an average content of 28.22 mg/100 g fw. The cultivars having lowest ascorbic acid were Kufri Neela (17.65 mg/100 g fw), Kufri Jyoti (18.90 mg/100 g fw) and Kufri Sadabahar (19.44 mg/100 g fw). Globally the highest and the lowest ascorbic acid content has been recorded in *tuberosum* accessions in a range of 2.8 mg/100 g fw (Dalamu *et al.*, 3) to 42 mg/100 g fw (Han *et al.*, 4) with an average of 17.1 mg/100 g fw. Indian potato cultivars have a mean ascorbic acid content of 28.22 mg/100 g fw, which is quite appreciable. Different cultural practices, geographical location, stage of ripeness, soil and weather conditions affect the chemical composition particularly nutrient content, but varietal variations or genetic factor are known to have larger influence. The anthocyanin content ranged from 0.478 to 1.434 µg/g fw in Indian potato cultivars (Fig. 1b), being maximum in Kufri Kumar (1.434 µg/g fw) followed by Kufri Naveen (1.311 µg/g fw) and Kufri Gaurav (1.234 µg/g fw). Kufri Khyati and Kufri Chipsona-3

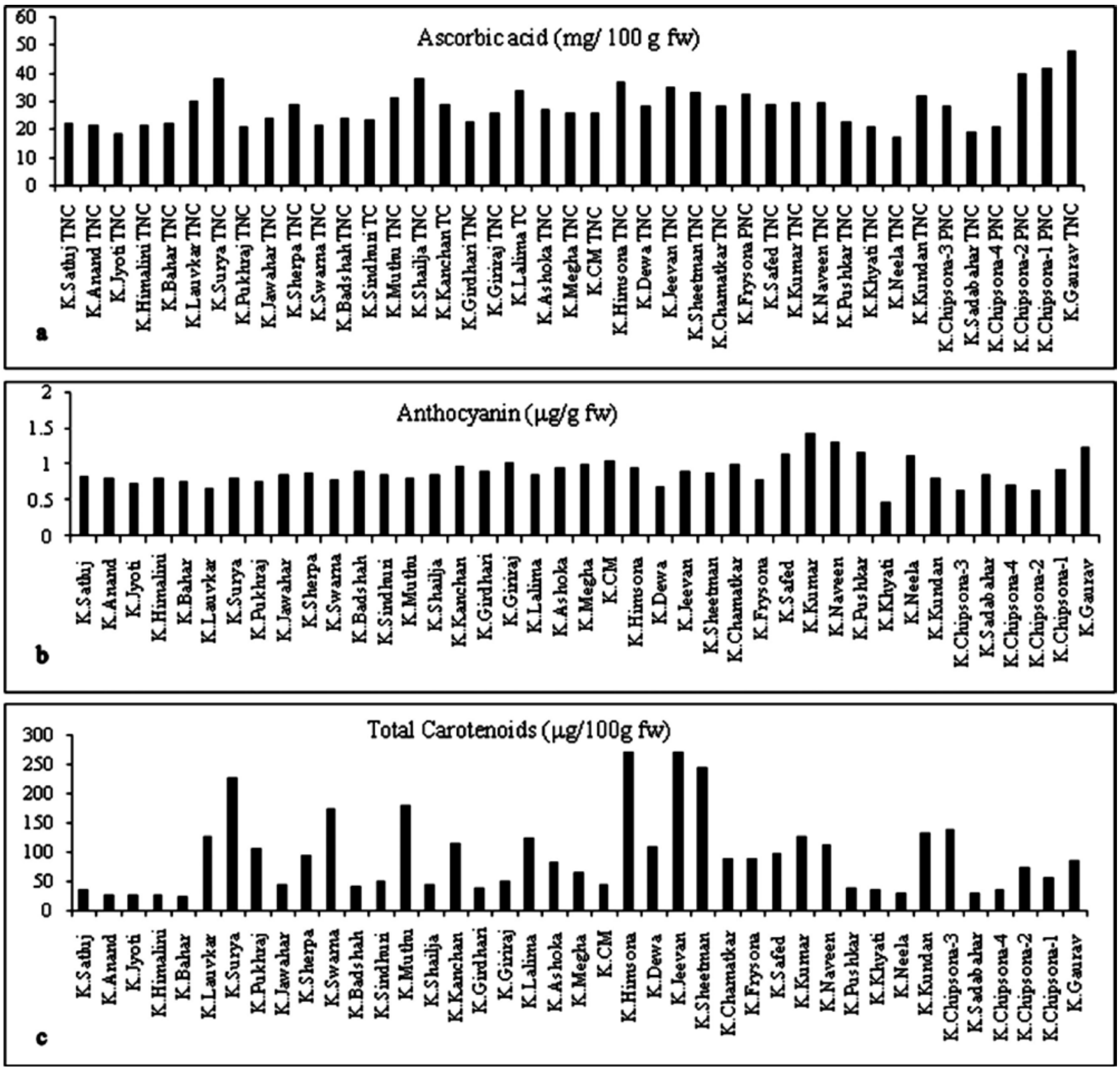

Fig. 1. Mean performance of potato cultivars for ascorbic acid (a), anthocyanin (b) and total carotenoids content (c) values are mean of three replicates. K.CM: Kufri Chandramukhi; TNC: Table potato non coloured; TC: Table potato coloured; PNC: Processing potato non coloured.

were the cultivars with least anthocyanin content of 0.478 and 0.632 µg/g fw, respectively. However, this content is negligible compared to those in purple (368 mg/100 g fw) and red fleshed (22 mg/100 g fw) potatoes, sometimes reaching up to 508 mg/100 g in *tubersoum* background (Lewis *et al*., 6). Anthocyanin content is the function of presence of colour. It imparts either red or purple coloration to flesh or skin or both. Since all the Indian potato cultivars generally have white or cream flesh and most of these do not have red or purple skin, the anthocyanins content are almost negligible. But there exists good amount of variability in potato germplasm (Dalamu *et al*., 3), which may be exploited for introgression of high anthocyanin in new cultivars. The mean carotenoids content in Indian potato cultivars was 95.82 µg/100 g fw (Fig. 1c). Cultivars Kufri Himsona and Kufri Jeevan (272.54 µg/100 g fw) contained the highest carotenoids content, while Kufri Bahar (27.92 µg/100 g fw) followed by Kufri Anand (29.85 µg/100 g fw) have the lowest concentrations. Worldwide findings have revealed the carotenoids content as high as 50-100 µg/100 g fw in white fleshed, up to 100-350 µg/100 g fw in yellow fleshed and up to 1000 µg/100 g fw in intense yellow fleshed genotypes (Brown *et al*., 2). More than 90% of the Indian potato cultivars are either cream or white fleshed, hence the observed mean carotenoids content was low. Breeding for enhanced carotenoid content has to be initiated keeping such accessions in the parentage for obtaining cultivars with high carotenoids. Carotenoid levels of native Andean cultivars of the Andigenum group have been reported to range from 535 to 3,895 µg/100 g fw and concentrations greater than 2,000 µg/100 g fw have been found in diploid *Solanum* germplasm (Andre *et al*., 1). Although tuber carotenoid concentrations are low in comparison with certain raw, carotenoid-rich vegetables, such as carrot (8,285 µg carotene/100 g fw), tomato (2,573 µg lycopene/100 g fw), and spinach (12,198 µg lutein and zeaxanthin/100 g fw) (USDA, 10), still potatoes contribute substantially to human carotenoid consumption because of the large quantities of potatoes consumed world over.

The average ascorbic acid content in table potato cultivars was 27.48 mg/100 g fw and 28.85 mg/100 g fw in non-coloured and coloured group, respectively, while the processing potatoes on an average had a content of 32.74 mg/100 g fw. The average anthocyanin content varied as 0.91 and 0.89 µg/g fw in table cultivars (non-coloured and coloured), while the processing potatoes had an average anthocyanin content of 0.74 µg/g fw with no significant difference ($P<0.05$). Similarly, significant variation in the average total carotenoid content was not observed in table potato cultivars (97.85 µg/100 g fw in non coloured cultivars *vis a vis* 99.26 µg/100 g fw in coloured cultivars). The processing potatoes in comparison contained low carotenoids content (80.35 µg/100 g fw).

Cluster analysis of ascorbic acid, anthocyanins and total carotenoids grouped the cultivars into 4 clusters with 0.06 to 3.38 inter-cluster values (Fig. 2). The mean performance of cultivars in each cluster is depicted the highest ascorbic acid content containing cultivars were grouped in cluster 3 that is constituted by two processing cultivars, *viz*., Kufri Chipsona-1, Kufri Chipsona-2 and two table cultivars Kufri Gaurav and Kufri Shailja, while cluster 4 comprised of cultivars Kufri Neela, Kufri Pushkar, Kufri Naveen and Kufri Kumar had high anthocyanin content. The cultivars, *viz*., Kufri Muthu, Kufri Surya, Kufri Jeevan, Kufri Himsona and Kufri Sheetman of cluster 2 recorded the highest total carotenoids content. Clusters 1 comprising of maximum cultivars, *i.e.* 28 had significantly lower phytonutrients content.

The mean phytonutrient content though was generally low in Indian potato cultivars, few of them showed appreciable concentrations of these phytonutrients. Consumption of such potato cultivars can help in addressing health related issues and their usage as parental lines in breeding programme shall help in developing nutritious potato cultivars.

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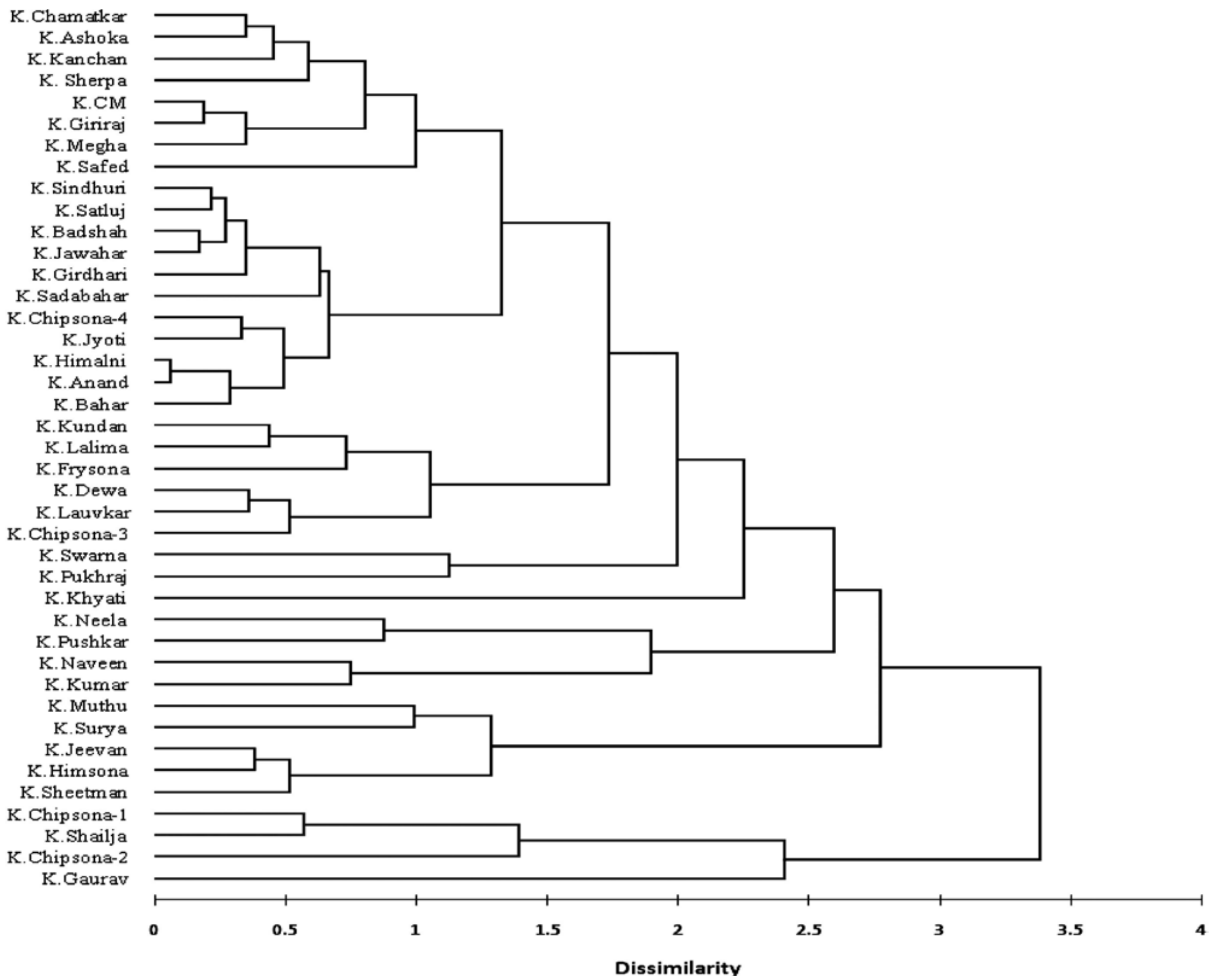

Fig. 2. Clustering of potato cultivars based on biochemical parameters.

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