Studies on antioxidant constituents of some domesticated capsicums in the middle hill conditions of western Himalayas

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ABSTRACT: The objective of this study was to determine some cultivars suitable for their antioxidant constituents, which can further be used in breeding programmes to breed superior varieties and F_1 for higher quality attributes. Thirty cultivars of domesticated capsicums were grown and analyzed during 2006–2007; they showed significant variation in their ascorbic acid and capsaicinoids contents. On the basis of ascorbic acid, the rank order of cultivars was PBC-926 > Chilli Long Black > HC-201 > KT OV > Local D-2. On the basis of capsaicinoids content, five top cultivars were selected, namely DARL-210 > Naga Jalokia > Red Sabina > CO-6-1 > Chilli Long Black.

Keywords: antioxidant; cultivar; ascorbic acid; capsaicinoids; HPLC

Vegetables are rich source of the antioxidant nutrients. Nowadays, consumption of vegetables is constantly growing and people are becoming more health-conscious. Horticulturists today are increasingly interested in knowing the health functionality of their production in terms of their antioxidant constitution (Kaur et al. 2007). Owing to adoption of optimum growing technologies and new varieties, the vegetable production has been continuously increasing. At present, there is a need to emphasize the quality of vegetables; quality is the term that adds value to crops and their products.

Capsicums are the most widely cultivated vegetable belonging to family Solanaceae. It is an indispensable commodity in every home and is used as vegetable as well as condiment. Due to its vitamin contents and medicinal properties, the demand for capsicums has been increasing all over the world. Fresh capsicums are good source of ascorbic acid and capsaicinoids. These are the main hydrophilic antioxidant components of capsicum. Genus *Capsicum* includes many cultivated forms such as pungent peppers, paprikas, mild pickle type and bell shaped non-pungent type. The cultivated species of *Capsicum* are *C. annuum, C. frutescens, C. baccatum, C. pubescens* and *C. chinense*. Antioxidants are related with reduced cancer risks; diets rich in vegetables are thus associated with protection from different types of cancers. Interest has been growing steadily in recent years among plant breeders to strengthen the germplasm collection in vegetables, to identify the specific cultivars of vegetables and to develop F_1 and varieties with higher quality attributes. Therefore, a study was conducted to evaluate the variations in ascorbic acid and capsaicinoids content of some domesticated capsicum cultivars.

The experiment was conducted at the Defence Agricultural Research Laboratory, Pithoragarh during the kharif season of 2006–2007. It is a valley situated in western Himalaya, which extends from 29°29'N to 30°49'N latitude and 85°05'E to 81°31'E longitude. The annual rainfall is approximately 1,250 mm, out of which 70–75% is received during the rainy season. The temperature of the valley ranges from the maximum of 35° in summer to the low of –2°C during winter. The experiment was laid in randomized block design with three replications having thirty cultivars belonging to different cultivated species of *Capsicum*. Germplasm was collected from different national and international centers. The seeds were sown in the nursery and then transplanted in the field with spacing of 50 cm in plants and rows. Intercultural operations were performed. Biochemical characterization for ascorbic acid (mg/100 g), capsaicin (mg/100 g) and dihydrocapsaicin (mg/100 g) was performed. Capsaicinoid content was determined

Table 1. Antioxidant constituents of some domesticated capsicums

Cultivars		Ascorbic acid (mg/100 g)	Vitamin C (% RDA)	Capsaicin (mg/100 g)	Dihydro-capsaicin (mg/100 g)	Capsaicinoids (SHU)
C. annuum						
1	Yolo Wonder	63.25	105.41	5.3	1.7	3,175
2	HC-201	118.70	197.83	–	–	–
3	CO-3763	41.73	69.54	3.6	2.4	4,165
4	CO-0839	90.14	150.23	11.0	-	1,602
5	AC-9-3	90.61	150.41	48.0	33.0	11,798
6	Local D-2	107.54	178.51	–	–	–
7	Arka Basant	79.02	131.17	2.4	3.0	4,660
8	CW-51	81.20	134.79	–	–	–
9	Yellow Capsicum	86.87	144.20	–	–	–
10	Red Capsicum	99.45	165.08	–	–	–
11	Pbc-535	100.95	160.72	61.0	39.0	14,564
12	PBC-326	50.86	84.42	136.3	80.0	32,445
C. frutescens						
13	PBC-926	129.85	215.55	548.7	186.7	110,310
14	KT OV	117.13	194.43	188.0	289.7	71,655
15	Chilli Long Black	120.12	199.39	503.0	291.0	119,100
16	PBC-475	77.89	129.29	14.0	10.0	3,600
17	Sartoria	79.14	131.37	221.0	154.0	56,250
18	CO-6-1	76.05	126.24	922.0	–	138,300
19	CO-6-2	87.25	144.83	568.0	194.0	114,300
20	DARL-210	98.45	163.42	995.0	896.0	278,750
C. chinense						
21	PBC-4426	50.21	83.34	314.0	209.0	78,555
22	Tejpur Chilli	83.65	138.85	975.0	775.0	254,896
23	Red Sabina Habanero	87.23	144.80	704.0	704.0	205,082
24	CC-2	63.80	105.90	486.0	168.0	94,216
25	CO-4696	61.20	101.59	408.0	–	61,200
C. pubescens						
26	PBC-1409	60.96	101.19	187.0	131.0	67,455
27	NBPGR-1	80.30	133.29	481.0	261.0	108,076
C. baccatum						
28	Co-4180	90.60	150.39	216.0	104.0	48,000
29	Co-4381	46.33	74.120	73.6	32.3	15,885
30	KT-14	100.57	166.94	318.7	131.0	67,455
	F-value	**		**	**	
	Gm	84.584		335.74	213.80	
	Sem	3.042		0.0390	2.190	
	CD AT 1%	11.459		0.148	8.357	
	AT 5%	8.612		0.111	6.251	

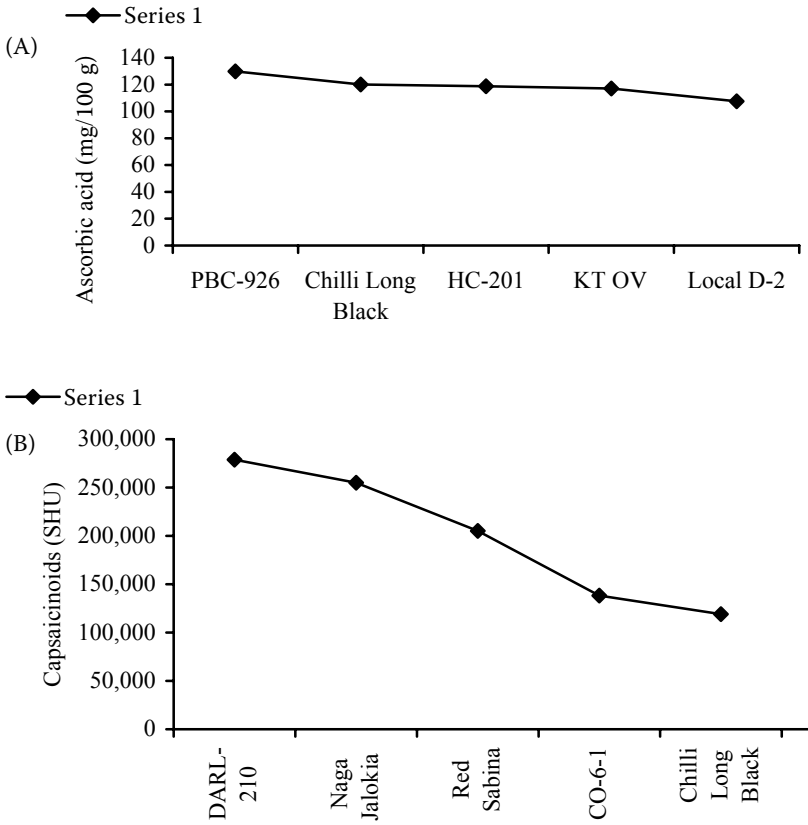

Fig. 1. Ascorbic acid of top 5 cultivars (A), capsaicinoids of top 5 cultivars (B)

by high pressure liquid chromatography (HPLC method) (Estrada et al. 1997). Total capsaicinoid was calculated by the formula given by Rajput and Govindrajan (1981). Ascorbic acid determination in the fruit was done using dinitrophenylhydrazine (DNPH method) (Sadasivam, Balasubraminam 1987). Data were subjected to statistical analyses (Table 1).

Ascorbic acid (mg/100 g) is an essential nutrient which is required for human growth, formation of bones and teeth, and resistance to diseases. For an adult person, recommended daily diet should comprise 60 mg. Content of ascorbic acid however varied significantly among the cultivars. It ranged from 41.73 to 129.85 mg/100 g depicting three folds variations. Cultivar PBC-926 exhibited the maximum amount (129.85 mg/100 g) followed by Chilli Long Black (120.12 mg/100 g). The rank order of cultivars was PBC-926 > Chilli Long Black > HC-201 > KT OV > Local D-2 (Fig. 1A,B). All the cultivars except CO-3763, PBC-326 and CO-4381 were found to be excellent source of ascorbic acid and fulfilled more than 100% RDA values for vitamin C.

Capsaicinoid, an active compound which is responsible for pungency, is a mixture of two major related components: capsaicin and dihydrocapsaicin, and four minor related components: norhydrocapsaicin, nordihydrocapsaicin, homocapsaicin and homodihydrocapsaicin. The chilli pungency level has genetic and environmental components. The capsaicinoids content is affected by the genetic make up of cultivar, weather conditions, growing conditions and fruit age (Lindsay, Bosland 1995). Capsaicin ranged from 5.3–995.0 mg/100 g and dihydrocapsaicin from 3.0–896.0 mg/100 g. Difference between the cultivars was statistically significant. Peppers were classified on the basis of the estimated SHU (Scoville Heat Units) pungency scale (1,000); no pungency detectable (0.0–10); mildly pungent (11–30); moderately pungent (31–80) and highly pungent (> 80).

Cultivar DARL-210 exhibited the maximum capsaicin and dihydrocapsaicin, containing 278,750 SHU capsaicinoids followed by Naga Jalokia (254,896 SHU). On the basis of high capsaicinoids (more than 80,000 SHU), five top cultivars, i.e. DARL-210 > Naga Jalokia > Red Sabina > CO-6-1 > Chilli Long Black, were selected (Fig. 2). The peaks of capsaicin and dihydrocapsaicin of top three cultivars were also depicted by the HPLC chromatogram.

To conclude, the above variations observed among the *Capsicum* genotypes suggested the selection of superior genotypes based on quality for exploitation through breeding approaches. Exotic

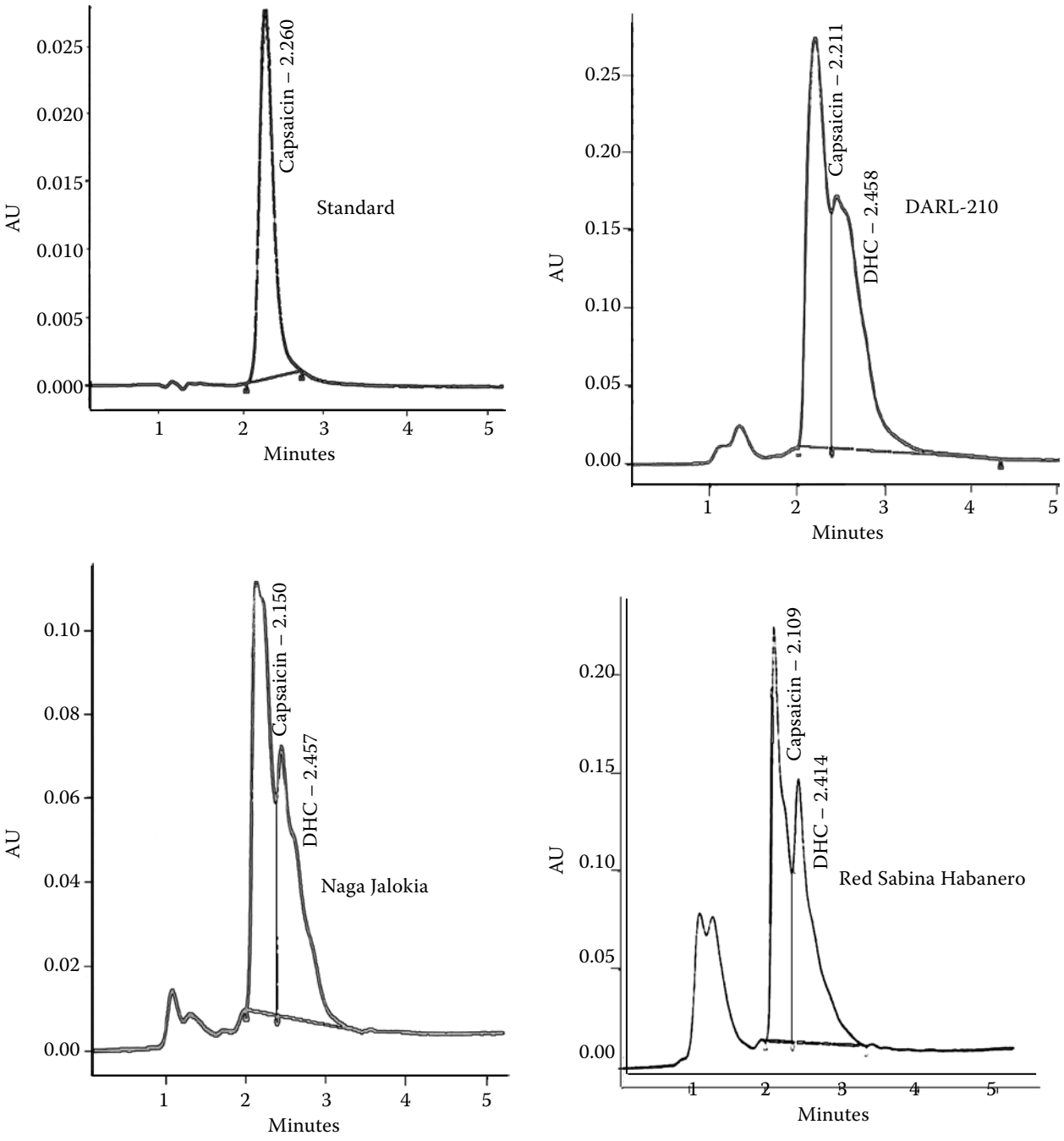

Fig. 2. HPLC chromatograms of top three cultivars including standard

germplasm will be an important asset for breeding improved commercial capsicums in order to increase the nutritional quality. Plant breeders can identify the specific cultivars to be used in breeding programmes for developing antioxidant-rich varieties.

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Studium antioxidantů některých zdomácnělých paprik v horských podmínkách západní Himálaje

ABSTRAKT: Cílem práce bylo určit vhodnost kultivarů z hlediska složení antioxidantů, což může být následně využito ve šlechtitelských programech pro šlechtění nových odrůd a F_1 s kvalitnějšími vlastnostmi. Třicet kultivarů zdomácnělé papriky, které byly pěstovány a analyzovány během let 2006–2007, vykázalo významné rozdíly v obsahu kyseliny askorbové a kapsaicinoidů. Na základě hodnot kyseliny askorbové bylo pořadí nejvhodnějších kultivarů následující: PBC-926 > Chilli Long Black > HC-201 > KT OV > Local D-2. V případě obsahu kapsaicinoidů bylo vybráno pět nejlepších kultivarů v tomto pořadí: DARL-210 > Naga Jalokia > Red Sabina > CO-6-1 > Chilli Long Black.

Klíčová slova: antioxidanty; kultivar; kyselina askorbová; kapsaicinoidy; metoda HPLC

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