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Short communication

Variation in chlorophyll and carotenoids content in bitter gourd genotypes at edible maturity stage

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ABSTRACT

The present investigation was carried out using 22 exotic and indigenous bitter gourd lines and 23 hybrids. A field experiment was designed in a randomized block design with three replications. The samples of each genotype were analysed for chlorophylls, total carotenoids and lycopene content. Total chlorophyll content was recorded highest in genotype S-54 (488.1 µg g^{-1} fresh weight) and among hybrids in hybrid BIGH - 6 (81.5 µg g^{-1} fresh weight). The total carotenoids content was maximum in genotype DBG 7 (32.3 µg g^{-1} fresh weight) and among hybrids in hybrid DBGy-201 × DBG-34 (27.5 µg g^{-1} fresh weight) and lycopene content was highest in S 37 (21.9 µg g^{-1} fresh weight and in hybrid DBGy-201 × DBG-34 (15.1µg g^{-1} fresh weight). The genotypes with better fruit quality traits can be utilized in future breeding programme.

Key words: Chlorophyll, carotenoids, bitter gourd.

Bitter gourd (*Momordica charantia* L.) is popular and grown in all tropical and sub-tropical regions (Behera, 3). Bitter gourd (balsam pear) was first domesticated in Asia, possibly in eastern India and its introduction to the New World apparently took place during the slave trade (Behera *et al*., 4). Colour of fruits and vegetables probably contributes more to the assessment of quality than any other single factor in this crop. Consumers have developed distinct correlations between color and the overall quality of specific products. Plant pigments can be separated into four primary classes based on their chemistry: chlorophylls, carotenoids, flavonoids, and betalains. Very little information is available on the genetic variation in functional quality traits of fruits at edible maturity stage. The objective of present study was to determine genetic variation among bitter gourd genotypes with respect to different functional qualities specially chlorophyll and carotenoid contents of fruits at edible stage.

Twenty two exotic and indigenous bitter gourd lines (Table 1) and 23 hybrids maintained at the Division of Vegetable Science, IARI, New Delhi were grown in a randomized block design with three replications during 2010-11. The immature bitter gourd fruits were selected when pericarp (fleshy portion) was green and seeds were not fully developed, *i.e*. 12-15 days after anthesis depending on the genotype (Pal *et al*., 7). Fruits were first washed with tap water to remove the adhered dust and soil particles, and then they were decontaminated using 0.2 percent Teepol solution, 0.1 N HCl solution and doubled-distilled water in a series. Pericarp (including flesh) of mature but unripe bitter gourd were separated from aril and seeds manually after drying, and cut into pieces 1–2 mm thickness using sharp knife. For whole fruit analysis, the fruits along with aril and seeds were used for this study. The bitter gourd rings were placed on a stainless steel tray and oven-dried at 50 ± 2^{0}C for 24 h in a dehydrator. Fresh weight of samples was determined prior to drying. The dried products were ground using a sample grinder and passed through a 60-mesh sieve to get uniform particle size. The dried products were stored at 4^{0}C prior to analysis. Duplicate samples were analyzed and the average values have been reported. The samples were analysed for chlorophylls, total carotenoids and lycopene content. The data were analysed using SPAR 2 software developed by Indian Agriculture Statistical Research Institute, New Delhi.

The mean sum of square was highly significant for all traits indicating the presence of wide range of variability in the genotypes. The data showed that there were significant differences among the genotypes (22 lines and 23 hybrids) for all the 5 traits studied. The mean performance, range, standard error (SE_D) of difference and critical difference values are presented in Table 1. The mean content of total carotenoids (µg g^{-1} fresh weight), lycopene (µg g^{-1} fresh weight), chlorophyll a (µg g^{-1} fresh weight), chlorophyll b (µg g^{-1} fresh weight) and total chlorophyll (µg g^{-1} fresh weight) are comparatively more in bitter gourd lines than the hybrids. The appearance of fresh fruits and vegetables is a primary criterion in making purchasing decisions. Product appearance is characterized by size, shape, form, color, condition and absence

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Table 1. Proximate quantity of pigments in edible fruits of bitter gourd.

Genotype	Total carotenoids (μg g^{-1} fr. wt.)	Lycopene (μg g^{-1} fr. wt.)	Chlorophyll a (μg g^{-1} fr. wt.)	Chlorophyll b (μg g^{-1} fr. wt.)	Total chlorophyll (μg g^{-1} fr. wt.)
S-57	15.4	3.8	137.2	72.0	212.7
S-55	23.2	11.1	37.3	46.3	85.0
S-32	4.5	0.4	35.1	74.1	111.9
S-26	4.6	0.7	51.3	11.2	63.8
S-27	15.9	7.0	97.0	114.9	215.7
S-46	5.4	1.7	38.8	108.3	150.7
S-41	2.8	1.3	343.3	46.6	392.8
DBGy-201	15.5	3.8	94.2	285.7	386.5
S-54	26.5	17.7	445.0	38.3	488.1
S-37	22.9	21.9	59.7	125.9	188.6
S-52	19.3	17.3	17.3	18.4	36.3
S-53	1.5	0.5	41.3	64.2	106.8
S-2	4.7	1.5	42.0	159.0	205.8
PDM	5.6	2.1	57.4	226.0	288.3
S-63	4.4	1.0	145.6	28.8	176.0
S-29	13.7	3.7	20.8	12.5	33.2
MC-84	0.5	ND	9.9	8.2	18.3
DBG-41	5.5	3.3	20.5	10.1	31.3
S-56	3.2	0.7	23.7	11.7	35.6
S-51	10.0	1.8	35.4	14.0	49.9
DBG-52	9.1	1.7	18.4	10.7	29.9
DBG-7	32.3	2.0	27.4	10.7	38.2
CD at 5%	0.3	0.3	13.1	9.4	12.5
CV (%)	1.81	3.70	9.73	8.40	4.99

ND = Not detected

of defects. Appearance is utilized throughout the production–storage–marketing–utilization chain as the primary means of judging the quality of individual units of product (Aminah and Anna, 1). The color change in fruit peel was associated with the enzymatic degradation of chlorophyll as fruit ripeness increased. However, fruits lightness increase as ripening day proceeded (Lewallen and Marini, 6). In the present findings, total chlorophyll content was recorded highest in S-54 (488.1) followed by S-41 (392.8 μg g^{-1} fresh weight) and DBGy 201 (386.5 μg g^{-1} fresh weight). Genotype S-54 had highest chlorophyll a content (445.0 μg g^{-1} fresh weight) followed by S-41 (343.3 μg g^{-1} fresh weight). Chlorophyll b content was recorded maximum in DBGy 201(285.7 μg g^{-1} fresh weight) followed by Pusa Do Mausami (226.0 μg g^{-1} fresh weight). Among the hybrids, total chlorophyll content was recorded highest in BIGH - 6 (81.5 μg g^{-1} fresh weight) followed by DBGy-201 × S-41 (74.1 μg g^{-1} fresh weight) and Beejo Sheetal Hybrid (71.4 μg g^{-1} fresh weight). Genotype US-33 had highest chlorophyll a content (49.0 μg g^{-1} fresh weight) followed by DBGy-201 × S-41 (48.9 μg g^{-1} fresh weight). Chlorophyll b content was recorded maximum in BIGH-6 (25.3 μg g^{-1} fresh weight) followed by Pusa DBGy-201 × S-41 (24.6 μg g^{-1} fresh weight). As dark green coloured bitter gourd fruit has high demand for both domestic (except Kerala) and international markets, the content of chlorophyll is the best judge for selecting a variety or hybrid for commercial cultivation. Hence, the breeding lines such as S-54, S-41 and DBGY-201 have great potentiality for future breeding programme.

The β-carotene concentration of whole fruit was about five times higher than that of carrot (Tuan *et al.*, 10). The immature fruits of bitter melon are a good source of carotenoids (Raman and Lau, 8; Zhang *et al*., 11). Carotenoids act as light absorbers in photosynthetic membranes and prevent damaging photooxidative processes (Bartley and Scolnik, 2). In the present findings, among 22 lines of bitter gourd, the maximum total carotenoids content was present in genotype DBG 7 (32.3 µg g^{-1} fresh weight) followed by S 54 (26.5 µg g^{-1} fresh weight) and S 55 (23.2 µg g^{-1} fresh weight). Lycopene content was highest in S 37 (21.9 µg g^{-1} fresh weight followed by S 54 (17.7 µg g^{-1} fresh weight) and S 52 (17.3 µg g^{-1} fresh weight). Similarly, among bitter gourd hybrids (Fig. 1&2), the maximum total carotenoids content was present in hybrid DBGy-201 × DBG-34 (27.5 µg g^{-1} fresh weight) followed by BIGH-3 (19.7 µg g^{-1} fresh weight) and Chayan (19.5 µg g^{-1} fresh weight). The lycopene content was highest in DBGy-201 × DBG-34 (15.1µg g^{-1} fresh weight) followed by US-33 (3.4 µg g^{-1} fresh weight) and BIGH-4 (3.3 µg g^{-1} fresh weight). These hybrids with higher content of bioactive compounds such as carotenoids can be used directly for commercial cultivation. The lycopene, a red carotenoid, was found less at the edible stage as compared to total carotenoids. The absence of lycopene in the early stages of fruit maturation was also reported by Tuan *et al*. (10) and they opined that lycopene is accumulated only in the final stage when the pulp began to turn red which might be attributed to its conversion to downstream biosynthetic products.

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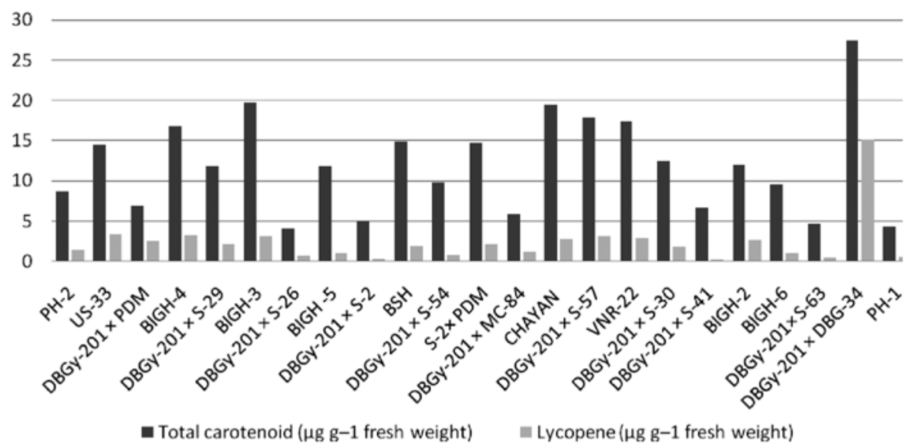

Fig. 1. Variation in total carotenoids and lycopene content among bitter gourd hybrids.

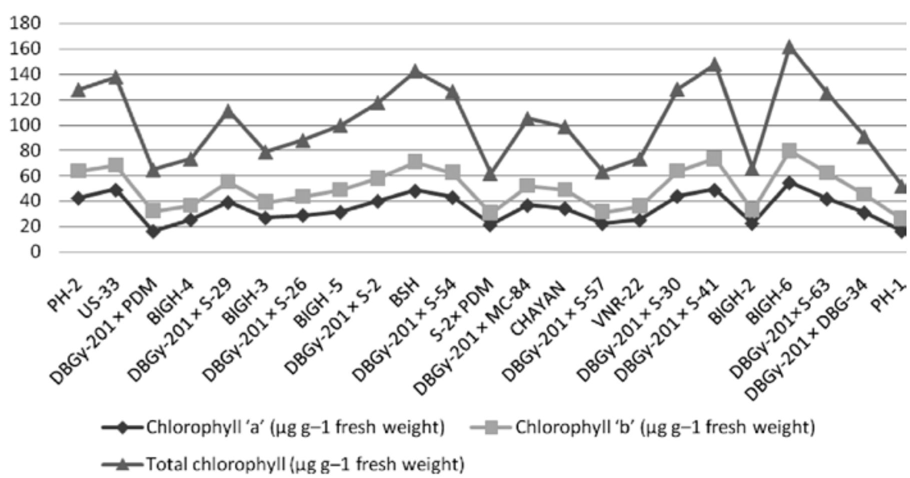

Fig. 2. Variation in chlorophyll content among bitter gourd hybrids.

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