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Carotenoid contents in sweet gourd (*Momordica cochinchinensis* Spreng.) accessions of India

L.K. Bharathi*, T.K. Behera, Rajender Singh and Anita Singh*****
Division of Vegetable Science, Indian Agricultural Research Institute, New Delhi 110012

ABSTRACT

Sweet gourd (*Momordica cochinchinensis* Spreng.) is indigenous to East and South East Asia that contains high levels of β-carotene and lycopene pigments. Though India holds a sizeable population of sweet gourd in the wild, there is no report on its total carotenoids and β-carotene contents. Therefore, the total carotenoids and β-carotene contents of sweet gourd accessions collected from India were estimated by photometric and high performance liquid chromatography (HPLC) methods. On an average, total carotenoids varied from 716 to 832 µg/g and β-carotene concentrations ranged from 133.28 to 141.17 µg/g. Published values for carotenoids vary widely and the values presented here agree closely with most of the earlier reports. In the light of its nutritive value and local availability, efforts need to be taken to educate the local population about the health benefits of this wonder fruit. It would serve as a natural medium of combating vitamin A deficiency in rural areas and also serve as a raw material for commercial extraction of neutraceuticals.

Key words: Total carotenoids, β-carotene, sweet gourd, HPLC, *Momordica cochinchinensis* Spreng.

INTRODUCTION

Sweet gourd (*Momordica cochinchinensis*) is a wild vegetable native to East and South East Asia (de Wilde and Duyfjes, 5). A dioecious stout perennial climber growing up to 30 m high with tuberous roots. The ripe fruits are ovoid or oblongoid or round in shape with bright red arils (Fig. 1) rich in β-carotene and lycopene. It occurs as a natural component of coastal scrub jungles and partially opened forests especially stream banks in South, Middle and North Andaman Islands (Joseph, 8; Bharathi *et al.*, 3). It is a crop in the domestication interface, still more of a wild gathered vegetable of tribal communities (Joseph and Bharathi, 9) in India and is reported to be grown as a vegetable in China and Japan (Jeffrey, 7). In Traditional Chinese Medicine (TCM), the seeds are thought to have resolvent and cooling properties, and are used for liver and spleen disorders, wounds, hemorrhoids, bruises, swelling, and pus (De Shan *et al.*, 4), while in India the seeds are used for treating anemic and arthritis (Nayak, 10). It contains extraordinarily high levels of β-carotene (641 µg/ g) and lycopene (408.4 µg/ g) and often considered as fruit from the Heaven (Bauernfield, 2; Voung, 11; Aoki *et al.*, 1). In Vietnam, bright red seed pulp (aril) is used in the preparation of '*xoi gac*', where the freshly harvested aril and seeds are cooked with glutinous rice to produce nutritious food with orange colour and nutty flavour (Voung *et al.*, 13). Nutritional supplementation trials in Vietnam have shown that the children fed with '*xoi gac*' increased serum vitamin A levels significantly compared to those who received synthetic β-carotene powder or none. Increases in plasma retinol, alpha-carotene, zeaxanthin, and lycopene levels were also significantly higher in children given '*xoi gac*' (Vuong *et al*., 12). The fatty acid in sweet gourd arils improves the bioavailability of β-carotene than that of the synthetic form (Vuong *et al.*, 12).

Though sweet gourd is indigenous to India (De Wilde and Duyfjes, 5) and used by the inhabitants of Andaman and Nicobar Islands, it is still under-utilised vegetable due to lack of awareness about its health benefits and dedicated research efforts on its cultivation and post harvest processing. Though it is a lesser known crop in India, it has wide scope in alleviating vitamin A deficiency that is prevalent in many parts of India. The purpose of this paper was to estimate the total carotenoids and β-carotene contents of ripe sweet gourd fruit arils to understand its nutritional qualities to combat vitamin A deficiency.

MATERIALS AND METHODS

Two ripe fruits from three accessions (IC 553689, IC 553690, and IC 553691) of sweet gourd available at the Central Horticultural Experiment Station, Bhubaneswar, Odisha were selected randomly for the study. All the three accessions were grown under

*Corresponding author's present address: Central Horticultural Experiment Station, Aiginia, Bhubaneswar 751019, Odisha; E-mail: alkb@rediffmail.com
**National Phytotron Facility, Indian Agricultural Research Institute, New Delhi
***Division of Genetics, Indian Agricultural Research Institute, New Delhi

Fig. 1. Sweet gourd plant and ripe fruits.

uniform growth conditions and the total carotenoids and β-carotene were determined using similar procedures. The total carotenoids were estimated after extraction following a modified protocol suggested by Aoki *et al.* (1). Initially 0.5 g of the seed membrane of the fruit was homogenized and then extracted with five-fold volume acetone until complete exhaustion of the colour. The extract was filtered with Whatman paper No. 1 and half the volume, petroleum ether and diethyl ether (2:1 v/v) was added and mixed properly by inverting several times. Three fourth volume of NaCl (1%) was added and subjected to centrifugation at 10,000 rpm for 5 min. The upper organic phase was transferred to fresh tube and then equally divided into two fresh tubes and dried under reduced pressure at 25°C.

The sample from one of the tubes was resuspended in acetone and spectrophotometer absorbance was measured at 450 nm. The total carotenoids (µg/g) were calculated based on the spectrophotometer reading using Lambert-Beer's equation. Similarly, the dried sample of the second tube was resuspended in chloroform and 30 µl of chloroform extract of the carotenoids was applied to the high performance liquid chromatography (HPLC) with a Waters' 2998 PDA UV-VIS detector, using YMC30 stainless steel reverse phase column (250 mm × 4.6 mm, 5 µ sorbent), with the following solvent system: solvent A= Methanol and tertiary butyl methyl ether (TBME) (1:1) and solvent B = Methanol: TBME: water (5:1:1) up to at total run time of 30 min. The amount of β-carotene was estimated based on the percentage of the coverage of its peak in comparison to the calibrated curve of authentic standard using Waters Empower™ 2 Chromatography software.

RESULTS AND DISCUSSION

Chromatograms of β-carotene extracted from different accessions of sweet gourd aril are shown in Fig. 3 and the ranges of total carotenoids and β-carotene concentrations of sweet gourd arils in the three accessions are given in Table 1. In the present experiment which was performed under uniform growth conditions and determination procedures, the total carotenoids varied from 716 to 832 (µg/g fresh weight) and β-carotene ranged from 133.28 - 141.17 (µg/g FW) (Table 1). The highest concentrations of total carotenoids and β-carotene were observed in IC 553690 (Fig. 2). The ratio of β-carotene/total carotenoids varied among the three accessions, ranging between 16.7 and 18.5%. In earlier reports, the estimates of carotenoids vary widely from 83 µg (Voung *et al.*, 13) to 718 µg/g (Ishida *et al.*, 6). The discrepancy in these reported carotenoid levels

Table 1. Total and β-carotene content of *Momordica cochinchinensis* ripe fruits.

Accession No.	Total carotenoids (µg/ g FW)	β-carotene (µg/ g)	Proportion of β-carotene to total carotenoids (%)
IC 553689	810 ± 0.12	139.60 ± 0.21	16.7
IC 553690	832 ± 0.14	141.17 ± 0.18	16.9
IC 553691	716 ± 0.19	133.28 ± 0.17	18.5

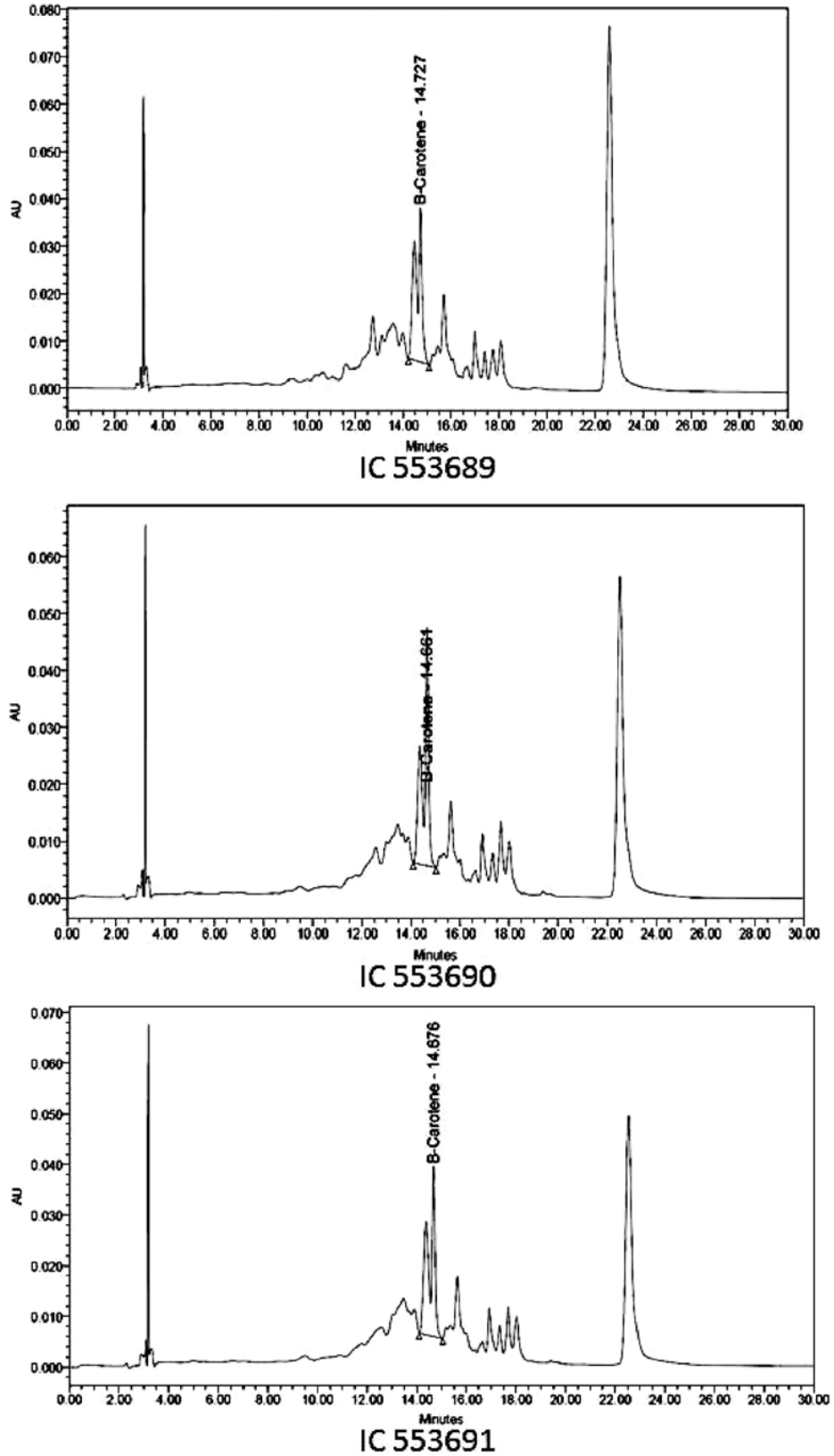

Fig. 2. Chromatograms of carotenoids in three accessions of sweet gourd.

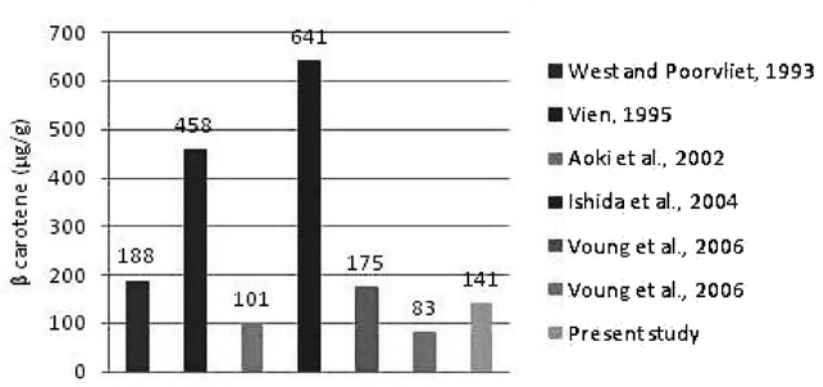

Fig. 3. Comparative β-carotene contents in sweet gourd genotypes by different workers.

might be due to degree of ripeness (Voung *et al.*, 13), degradation of carotenoids during extraction, method of analysis, transport and storage, as most are sensitive to light and heat (Bauernfield, 2).

Total carotenoids concentrations of sweet gourd arils as reported in the present study (716-832 µg/ g) are in agreement with those of Aoki *et al.* (1), West and Poorvliet (14), and Voung *et al.* (13). The values of β-carotene concentrations estimated (133.28-141.17 µg/g) are also in agreement with most of the reports published earlier (Fig. 3), barring Ishida *et al.* (6), who reported substantially higher values of total carotenoids (2926 µg/ g) and β-carotene (636.2-836.3 µg/ g).

Our study has revealed that sweet gourd accessions available in India contain high levels of β-carotene that can be used to eradicate vitamin A deficiency in rural areas through natural means. The bioavailability of β-carotene from sweet gourd fruit is also better than other sources of vitamin A due to fatty acids present in the arils (Voung *et al.*, 13). In contrast to other types of plants in the *Momordica* genus, such as *M. charantia* (bitter melon), ripe *M. cochinchinensis* seed membrane is significantly more nutritious than the mesocarp, particularly for provitamin A, carotenoids, lycopene and alpha-tocopherol (Voung *et al.*, 13).

In light of its high nutritional value, particularly the remarkably high concentration of β-carotene, more systematic efforts are needed to identify and collect the nutrient rich natural variability and select accessions with high carotenoids for commercial cultivation of sweet gourd.

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