Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; SP1: 2797-2800

B Sakthinathan
Department of Horticulture, AC & RI, TNAU, Madurai, Tamil Nadu, India

V Swaminathan
HC & RI, TNAU, Periyakulam, Tamil Nadu, India

P Balasubramanian
Department of Farm Management, AC & RI, TNAU, Madurai, Tamil Nadu, India

T Sivakumar
Department of Crop Physiology, TNAU, Coimbatore, Tamil Nadu, India

Correspondence
B Sakthinathan
Department of Horticulture, AC & RI, TNAU, Madurai, Tamil Nadu, India

Effect of pre harvest treatments on carotene content of pumpkin juice

B Sakthinathan, V Swaminathan, P Balasubramanian and T Sivakumar

Abstract
Phytochemical factually means "Plant chemicals". Vegetables have immense beneficial properties for human health, because of the presence of phytochemicals. These phytochemicals typically consist of a wide array of phenolic compounds, ascorbic acid, alpha tocopherol and carotenoids, and have been shown to promote health and provide protection against a various list of diseases. Considering the nutraceutical property of cucurbit vegetables, the present study was focused on pumpkin fruit and analyzed the effect of pre harvest application of micronutrient mixture and potassium nitrate at 1% on six different cultivars (CO 1, Arka Chandan, Pumpkin big, Yellow big, Pennadam local and Melur local) with two stage of application (flowering and fruiting stages) along with control. The study revealed that application of micronutrient mixture with potassium nitrate (1%) during fruiting stage of Arka Chandan variety results in reduced reduction of carotene content from initial stage with highest durability of 50 days under packed condition.

Keywords: Vegetables, carotene, micronutrients, potassium, pumpkin

Introduction
Pumpkin (*Cucurbita moschata* L, 2n=2x=40) is one of the most popular warm season vegetables grown commercially all over India for its immature and mature fruits with nutraceutical compounds. Pumpkins are cultivated for their ripe fruit with the seeds in the central cavity and the yellow or orange flesh being consumed because of its nutritional value (Sakthinathan *et al*. 2017) [13]. Pumpkin is popular in traditional medicine for several ailments (antidiabetic, antihypertensive, antitumor, immune modulation, antibacterial, anti-hypercholesterolemia, intestinal antiparasitia, anti-inflammation, antalgic). The presence of many biologically active components including high levels of α- and β-carotene, β-cryptoxanthin, lutein and zeaxanthin, polysaccharides, phytosterols, unsaturated fatty acids, proteins and peptides makes pumpkin extremely attractive for the phytochemical manufacturing industry. Pumpkin is believed to have health benefits due to its carotenoid content (Fu *et al.* 2006) [6]. Due to its high nutritional content and lucrative market price, pumpkin may be considered as a high value crop. Pumpkin occupies a prominent place among the vegetables owing to its productivity, nutritive value, good storability, long period of availability and better transport potentialities. Micronutrients are as essential for plant growth and development as the macronutrients. These are, however, required in very small quantities. Previously, it was considered that most of the soils can supply these minute amounts easily. It is now feared that high yielding crop varieties are mining our soils of all the nutrients especially the micronutrients because their addition as fertilizer element is negligible. Iron and manganese are involved in metabolic processes and these are considered activators of important enzymes (Mengal and Kirkby, 1987) [9]. Iron is also a structural component of haemoglobin and cytochrome. Micronutrients are vital to the growth of plants, acting as catalyst in promoting various organic reactions taking place within the plant. The main role of potassium nitrate is the activation of many enzyme systems involved in the structure of organic substances and in the building up of compounds such as starch or protein and also involved in cell enlargement and in triggering the growth of young meristematic tissues. Also, K promotes photosynthesis and transport of the carbohydrates to the storage organs, thus enhancing the quality and nutritional aspects of pumpkin. Pumpkin fruit juices are important sources of nutrients and contain several important therapeutic properties that may reduce the risk of various diseases. They contain large amounts of antioxidants, vitamins C and E, and possess pleasant taste and aroma (Abbo *et al.* 2006) [1]. In view of scarcity of information pertaining to role of micronutrient mixtures and KNO_3 application in sustaining the carotene content under storage condition, the present study was conducted to evaluate the effect of pre-harvest treatment on flowering and fruiting stage.

Materials and Methods

The study was conducted at Department of Horticulture, Agricultural college and research institute, Tamil Nadu Agricultural University, Madurai in 2015-2016. Pumpkin is a warm season crop, which is widely cultivated in tropical and sub-tropical areas. The crop was grown by adopting the standard package of practices prescribed by the Tamil Nadu Agricultural University (TNAU) Crop production guide, 2013. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with two replications. The six different varietal sources *viz*, CO 1, Arka Chandan, Pumpkin big, Yellow big, Melur local and Pennadam local were sown with plant to plant spacing of 2x2 m by simple hand dibbling method with the application of micronutrient mixture and potassium nitrate at 1% on flowering and fruiting stage along with control. Pumpkin juice from six different cultivars was extracted and analysed for carotene content under spectroscopic method according to the method of association of official analysis chemists (AOAC, 2005) [2] and expressed in mg/100 ml of juice. The carotene content was calculated at subsequent intervals of unmitigated period of ten days interval up to fifty days *viz.* (10th, 20th, 30th, 40th, 50th days) and the values are recorded. The results have been presented and discussed at a probability level of 0.05 or 5 % ($P\leq0.05$) probability (Gomez and Gomez, 1984) [7].

Results and Discussion

The effect of pre-harvest treatments on sustaining the carotene content of pumpkin juice from six different cultivars was recorded and illustrated in Table 1. The pre-harvest application of micronutrient mixture and potassium nitrate (KNO_3) at 1% concentration during fruiting stage results better with reduced rate of carotene reduction in Arka Chandan cultivar and exemplified in Fig 2. The decline value was least in T_6 with initial value of (8.07) and reduced subsequently with ten days of interval up to fifty days (7.87, 7.63, 6.93, 5.85 and 5.45) followed by T_5 (7.45) as initial and (7.19, 6.81, 6.50, 5.42 and 5.02) as final value. The treatment T_{12} performs well with reduced decline in carotene content from initial to final day during storage (6.50, 6.33, 6.14, 4.85, 3.77 and 3.37). This is because of the highest content of the carotene content in yellow fleshed varieties (Arka Chandan and Yellow Big), as it was bestowed with natural phytochemical source.

The restrained decrease of carotene content was observed in T_9 (5.59, 5.43, 5.31, 4.07, 2.99 and 2.59) followed by T_{18} (4.60, 4.42, 4.17, 2.96, 1.88 and 1.48) from initial to final day during storage. The highest decline in carotene content with least carotene value during storage was recorded in T_{13} (1.19, 1.00, 0.84, 0.75, -0.33 and -0.11) which results that the particular variety chosen was flabby to endorse the carotene source during cramped storage period of fifty days as commercially unviable and epitomized in Fig 1.

Table 1. Effect of pre-harvest treatment on carotene content under stored condition (mg/100ml)

Treatments	Initial	10 DOI	20 DOI	30 DOI	40 DOI	50 DOI	MEAN
T_1-(CO 1+ Control)	2.11	1.81	1.61	1.49	0.58	0.18	1.30
T_2-(CO 1+ MN + KNO_3 (1%) at Flowering Stage)	2.79	2.62	2.77	2.09	1.01	0.61	1.98
T_3-(CO 1+ MN + KNO_3 (1%) at Fruiting Stage)	3.27	3.12	3.20	2.25	1.17	0.77	2.30
T_4-(Arka Chandan + Control)	5.32	5.40	4.98	4.21	3.13	2.73	4.30
T_5-(Arka Chandan + MN + KNO_3 (1%) at Flowering Stage)	7.45	7.19	6.81	6.50	5.42	5.02	6.40
T_6-(Arka Chandan + MN + KNO_3 (1%) at Fruiting Stage)	8.07	7.87	7.63	6.93	5.85	5.45	6.97
T_7-(Pumpkin Big + Control)	4.13	4.01	3.65	2.48	1.4	1.03	2.78
T_8-(Pumpkin Big + MN + KNO_3 (1%) at Flowering Stage)	4.82	4.65	4.59	3.76	2.68	2.28	3.80
T_9-(Pumpkin Big + MN + KNO_3 (1%) at Fruiting Stage)	5.59	5.43	5.31	4.07	2.99	2.59	4.33
T_{10}-(Yellow Big + Control)	5.08	5.04	4.75	3.74	2.66	2.26	3.92
T_{11}-(Yellow Big + MN + KNO_3 (1%) at Flowering Stage)	6.27	5.53	5.39	4.64	3.56	3.16	4.76
T_{12}-(Yellow Big + MN + KNO_3 (1%) at Fruiting Stage)	6.50	6.33	6.14	4.85	3.77	3.37	5.16
T_{13}-(Melur Local + Control)	1.19	1.00	0.84	0.75	-0.33	-0.11	0.45
T_{14}-(Melur Local + MN + KNO_3 (1%) at Flowering Stage)	1.80	1.20	1.17	1.10	0.02	-0.38	0.82
T_{15}-(Melur Local + MN + KNO_3 (1%) at Fruiting Stage)	2.41	2.18	2.11	1.51	0.43	0.03	1.45
T_{16}-(Pennadam Local + Control)	2.91	2.68	2.32	1.54	0.46	0.06	1.66
T_{17}-(Pennadam Local + MN + KNO_3 (1%) at Flowering Stage)	3.82	3.74	3.52	2.32	1.24	0.84	2.58
T_{18}-(Pennadam Local + MN + KNO_3 (1%) at Fruiting Stage)	4.60	4.42	4.17	2.96	1.88	1.48	3.25
Level of Significance ($P\leq0.05$)	**	**	**	*	*	NS	

MN-Micronutrient mixture, KNO3-Potassium Nitrate, DOI-Days of Interval,
**Highly Significant (5%),
*Significant (1%), NS-Non Significant

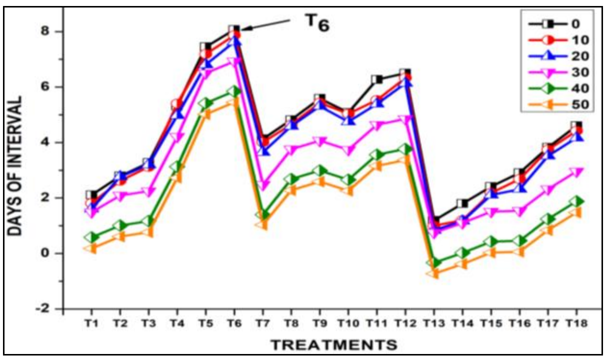

Fig 1: Effect of pre-harvest treatment on carotene content understored condition (mg/100ml)

The pre-harvest application of micronutrient mixture and KNO_3 at fruiting stage results in condensed quantity of decline with utmost carotene content. This is because, the potassium cation (K+) takes a crucial part in many metabolic processes in the cell, serves as an osmoregulator and participates in several processes that take care of the water management of plants (Sangakkara *et al.* 2000) [14] thus, increasing the qualitative attributes like phytochemical compounds of the crop. The micronutrient mixture along with boron, iron, zinc and magnesium has profound effect on enhancing and preserving the beta carotene content, as it has the ability to increase the fruit morphological parameters. These results are in agreement with the findings of (Upadhyay *et al.* 1997) [16]. (Casttrillo and Bermudez) [4] Stated that reducing sugar content was augmented during storage period. The utilization of elements like Zn and Mn together from resource sulfate Zn and Mn increased efficiency and quality of potato crop. (Mousavi, 2007) [10] Found that application of Zn along with Mn to from foliar application caused increase in efficiency and quality of potato crop. In plants, the potassium is related to the synthesis of proteins and carbohydrates, sugars and starch storage and this stimulated the growth and improved utilization of water and the resistance to pests and diseases (Balibrea *et al.* 2006) [3]. An increase of TSS and lycopene content in tomato fruits may depend on a higher sugar import and accumulation with the increase of reducing sugars in the fruits. The plants grown with the higher K levels in the nutrient solution confirm that K played an important role in the configuration of quality profile in tomato fruits (Sofia, 2008) [15].

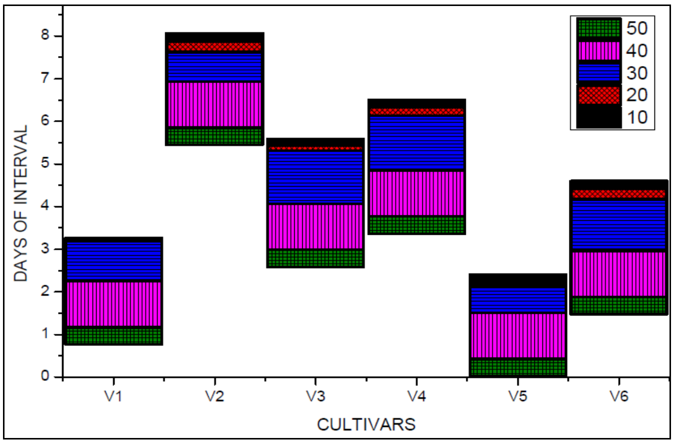

Fig 2: Effect of pre-harvest treatment on carotene content in different pumpkin cultivars.

These findings are in line with the reports of (Nanthakumar and Veeraragavathatham, 2001) [11] that potassium nitrate treatment will improve the fruit yield and qualitative characters of brinjal. (Grundon, 1987) [8] Elucidated that zinc is needed by plants for growth hormone production and is particularly important for internode elongation. Iron plays an important role in plant respiratory and photosynthetic reactions. Primary functions of boron in plants are related to cell wall formation and reproductive tissue (Sakthinathan, 2017) [12]. Our results also coincides with the analogous work done by (Dubois *et al.* 1956) [5] which reveals that, the decrease of carotene content might be due to the contribution of the reducing sugars to non-enzymatic browning phenomenon.

Conclusion

In conclusion, different pumpkin cultivars investigated in this study presented different physicochemical (carotenoid) properties, which are important factors for appraising the nutritional quality and processing characteristic of pumpkin fruits. Among the six cultivars, Arka Chandan showed the highest carotene content and proved to be highly suitable for processing purpose. The disproportionable gratitude between the growth of the world population and food production urges the food experts to find the new ways to utilize food raw materials and to preserve their nutrient content to the fullest possible extent. The energy crisis of past years resulted in higher food prices in the developing countries. These factors lead to revision of existing technologies and development of new low energy processing technologies. These data will help in the selection of pumpkin cultivars to improve the processing efficiency and health benefits of pumpkin products. In addition, further studies are required to obtain a thorough evaluation of pumpkin fruit and novel technological treatments should be applied in order to reduce the nutritional losses during processing of pumpkin. This fact result the present study with the commencement of new vegetable processing technology (Pumpkin juice) as it is naturally bestowed with carotenoid compounds which benefits the humanitarian.

Acknowledgement

The author was very much grateful for the support rendered by faculties of Horticulture department and Orchard workers of Agricultural College and Research Institute (AC & RI), Tamil Nadu Agricultural University (TNAU), Madurai, for accomplishing the research activities in an exultant progression.

References

1. Abbo ES, Olurin T, Odeyemi G. Studies on the storage stability of soursop (*Annona muricata* L.) juice. Afr. J Biotechnol. 2006, 5:108-112.
2. Association of Official Analytical Chemists-AOAC. Official Methods of Analysis of AOAC International (18th Ed.). Gaithersburg, AOAC, 2005.
3. Balibrea MA, Martínez-Andújar C, Cuartero J, Bolarín MC, Pérez-Alfocea F. The high fruit soluble sugar content in wild Lycopersicon species and their hybrids with cultivars depends on sucrose import during ripening rather than on sucrose metabolism. Funct. Plant Biol. 2006; 33:279 288.
4. Castrillo and Bermudez, Postharvest ripening in waxcoated Bacado mango, International Journal of Food Science & Technology. 1992; 27:457-463.
5. Dubois M, Gilles KA, Hamilton JK, Rebers PA, Smith F. Colorimetric method for determination of sugars and related substances. Analytical Chemistry. 1956; 28(3):350-360.
6. Fu C, Shi H, Li Q. A review on pharmacological activities and utilization technologies of pumpkin. Plant Foods Hum. Nutr. 2006; 61:73-80.
7. Gomez ZKH, Gomez AA. Statistical procedures for agricultural research. 2nd Edn. John Wiley and Sons, New York, 1984, 381.
8. Grundon NJ. Hungry crops: A guide to nutrient deficiencies in field crops. Brisbane, Australia: Queensland Government, 1987, 246.
9. Mengel S, Potassium. In: (Eds. A. V. Barker and D. J. Pilbean). Handbook of Plant Nutrition, CRC Taylor and Francis, New York, USA, 2007, 395-402.
10. Mousavi SR, Galavi M, Ahmadvand G. Effect of Zinc and Manganese Foliar Application on Yield, Quality and Enrichment on Potato (*Solanum tuberosum* L.). Asian J Plant Sci. 2007; 6:1256-1260.
11. Nanthakumar S, Veeraragavathatham D. Effect of integrated nutrient management on yield and quality attributes of brinjal CV “Plr 1” South Indian J Hort. 2001; 49:195-198.
12. Sakthinathan B, Udhaya Nandhini D. Phytochemicals-A Nutraceutical Source of Vegetables. Chem Sci Rev Lett. 2017; 6(24):2133-2137.
13. Sakthinathan B, Swaminathan V, Balasubramanian P. Influence of carbonation on microbial spoilage and post-harvest quality of pumpkin juice. Multilogic in science.

2018; 7(1):19-22.
14. Sangakkara UR, Frehner M, Nosberger J. Effect of soil moisture and potassium fertilizer on shoot water potential, photosynthesis and partitioning of carbon in mungbean and cowpea. Crop Sci. 2000; 185:201-207.
15. Sofia C. Influence of Potassium and Genotype on Vitamin E Content and Reducing Sugar of Tomato Fruits. Hortscience. 2008; 43(7):2048-2051.
16. Upadhyay A, Noomhorm, Ilangantileke SG. Effects of gamma irradiation and hot water treatment on the shelf life and quality of Thai mango CV Red, The Australian Centre for International Agricultural Research, 1994, 348-351.