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Divyabharathi
Department of Plantation, Spices,
Medicinal and Aromatic Crops, Dr.
YSRHU-COH, Anantharajupeta,
Andhra Pradesh, India

KM Yuvaraj
Department of Horticulture,
Principal Scientist and Head,
HRS, Anantharajupeta, Andhra
Pradesh, India

Ramadugu Subash
Department of Vegetable Science,
Dr. YSRHU-COH,
Anantharajupeta, Andhra Pradesh,
India

Corresponding Author:
Divyabharathi
Department of Plantation, Spices,
Medicinal and Aromatic Crops, Dr.
YSRHU-COH, Anantharajupeta,
Andhra Pradesh, India

Ascorbic Acid Contents in Chili Peppers (*Capsicum annum* L.) at Different Ripening Stages

Divyabharathi, KM Yuvaraj and Ramadugu Subash

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Abstract

A study was conducted to evaluate the ascorbic acid content of twelve chilli (*Capsicum annum* L.) genotypes during different ripening stages under summer season conditions. The experiment was carried out using Randomized Block Design with three replications. The genotypes included LCA-808, LCA-807, LCA-806, LCA-805, LCA-804, LCA-657, LCA-625, LCA-485, LCA-484, LCA-481, LCA-479 and LCA-353. Fruits were analyzed at five ripening stages namely green, breaker, fully ripened, partially dried and fully dried stages. Significant variation was observed among genotypes for ascorbic acid content. The ascorbic acid content increased progressively from green stage to fully ripened stage and declined during drying stages. Among all the genotypes, LCA-481 recorded the highest ascorbic acid content at fully ripened stage (281.42 mg/100 g), followed by LCA-479 (183.54 mg/100 g) and LCA-808 (158.34 mg/100 g). The lowest ascorbic acid content was observed in LCA-484 and LCA-807. The results indicated that genotype and ripening stage significantly influenced vitamin C accumulation in chilli fruits. Superior genotypes identified in the present study may be utilized in breeding programmes for improvement of nutritional quality in chilli.

Keywords: Chilli, *Capsicum annum*, Ascorbic acid, Ripening stages, Vitamin C

Introduction

Chilli (*Capsicum annum* L.) is one of the most important spice and vegetable crops cultivated extensively in tropical and subtropical regions of the world (Bosland and Votava, 2012). The crop is valued for its pungency, colour, flavour and nutritional qualities, and is widely utilized in fresh, dried and processed forms in food, pharmaceutical and cosmetic industries. India is one of the leading producers and exporters of chilli, where the crop is cultivated over an area of about 0.87 million hectares with an annual production of nearly 2.3 million tonnes (NHB, 2024-25). Andhra Pradesh occupies a prominent position in chilli cultivation with approximately 0.18 million hectares under cultivation and a production of around 0.82 million tonnes. Apart from its economic importance, chilli fruits are rich sources of vitamins, minerals, carotenoids, phenolic compounds and antioxidants (Srinivasan, 2016) [19]. Among these, ascorbic acid (vitamin C) is considered an important quality parameter contributing to the nutritional and antioxidant properties of chilli fruits.

Chilli is recognized as an excellent source of vitamin C, often containing higher levels than many commonly consumed vegetables and fruits (Howard *et al.*, 1994). Ascorbic acid is a water-soluble antioxidant that plays a vital role in protecting cells from oxidative damage and maintaining normal metabolic activities (Deepa *et al.*, 2007) [3]. The ascorbic acid content in chilli fruits is influenced by genotype, environmental conditions and stage of fruit maturity (Lee *et al.*, 1995; Manju and Sreelathakumari, 2002) [10, 11]. Its concentration generally increases during fruit ripening and declines during storage or drying due to oxidation and degradation processes (Osuna-Garcia *et al.*, 1998) [16]. Significant variation among chilli genotypes for vitamin C accumulation at different ripening stages has been reported by Kumar and Subba Tata (2009), indicating the potential for identifying nutritionally superior lines for crop improvement programmes. Therefore, the present investigation was undertaken to evaluate the ascorbic acid content in selected chilli genotypes at different ripening stages under summer season conditions and to identify promising genotypes with superior vitamin C content for nutritional enhancement

and future breeding programmes.

Materials and Methods

Twelve genotypes of *Capsicum annum* L. namely LCA-808, LCA-807, LCA-806, LCA-805, LCA-804, LCA-657, LCA-625, LCA-485, LCA-484, LCA-481, LCA-479 and LCA-353 were grown in a Randomized Block Design with three replications at the College of Horticulture, Dr. YSR Horticultural University, Anantharajupeta during summer 2024. Healthy fruits were harvested at five ripening stages viz., green stage, breaker stage, fully ripened stage, partially dried stage and fully dried stage. The fruits were washed thoroughly with tap water, cut into small pieces and homogenized using mortar and pestle with 4 per cent oxalic acid. The homogenate was centrifuged at 5000 rpm for 10 minutes and filtered through Whatman No. 541 filter paper. The volume was made up to 100 ml with 4 per cent oxalic acid. The ascorbic acid content was estimated by volumetric method using 2,6-dichlorophenol indophenol dye as described by Sadasivam and Balasubramanian (1987) [18], and expressed as mg per 100 g fresh weight. Five samples from each treatment were analyzed for estimation of ascorbic acid content.

Results and Discussion

The analysis of variance revealed significant differences among chilli genotypes for ascorbic acid content at different ripening stages indicating the presence of substantial genetic variability. Similar variability among chilli genotypes was reported earlier by Mishra *et al.* (2004) [14] and Antonious *et al.* (2006) [1]. The

ascorbic acid content increased progressively from green stage to fully ripened stage and thereafter declined during partially dried and fully dried stages. Similar trends were observed by Osuna-Garcia *et al.* (1998) [16], Lalitha Kumari *et al.* (1999) and Kumar and Subba Tata (2009).

As shown in Table 1. Among the evaluated genotypes, LCA-481 recorded the highest ascorbic acid content at fully ripened stage (281.42 mg/100 g), followed by LCA-479 (183.54 mg/100 g) and LCA-808 (158.34 mg/100 g). The lowest ascorbic acid content was observed in LCA-484 (32.86 mg/100 g) and LCA-807 (35.74 mg/100 g). The observed differences among genotypes may be attributed to genetic factors controlling synthesis and accumulation of ascorbic acid in fruits (Khadi *et al.*, 1987; Manju and Sreelathakumari, 2002) [6, 11]. The increase in ascorbic acid content during ripening may be due to enhanced metabolic activities and biosynthesis of sugars and organic acids during fruit maturation. Similar observations were reported by Lee *et al.* (1995) [10], Gnayfeed *et al.* (2001) [4] and Deepa *et al.* (2007) [3]. A reduction in ascorbic acid content during partially dried and fully dried stages was observed in all genotypes. This decrease may be due to oxidation and degradation of vitamin C during moisture loss and drying processes. Similar findings were reported by Robi and Sreelathakumari (2004) [17] and Martinez *et al.* (2005) [12]. The observed variability among genotypes may be useful for selection of nutritionally superior parents in chilli breeding programmes aimed at improving fruit quality and antioxidant properties (Tripodi and Kumar, 2019) [20]

Table 1: Mean ascorbic acid content (mg/100 g) of chilli genotypes at five ripening stages

Genotypes	Green Stage	Breaker Stage	Fully Riped Stage	Partially Dried Stage	Fully Dried Stage
LCA-808	106.82	132.45	158.34	141.26	101.48
LCA-807	23.18	29.56	35.74	31.28	20.15
LCA-806	48.95	61.72	73.28	64.41	44.36
LCA-805	26.44	32.68	38.42	34.16	23.05
LCA-804	57.36	70.45	84.26	75.12	52.08
LCA-657	46.15	57.84	69.95	62.14	42.56
LCA-625	66.28	82.45	101.34	89.76	61.25
LCA-485	24.05	29.68	35.46	31.18	20.84
LCA-484	22.08	27.14	32.86	28.95	19.64
LCA-481	192.74	236.18	281.42	253.86	188.54
LCA-479	122.45	151.76	183.54	164.28	116.47
LCA-353	58.16	69.84	84.72	74.86	51.34
Mean	66.72	82.81	98.78	88.44	61.81
SE(m)±	1.92	2.24	2.94	2.52	2.04
CD at 5%	5.58	6.49	8.54	7.22	5.94
CV (%)	4.26	4.48	4.68	4.39	4.18

Conclusion

The present study revealed significant variation among chilli genotypes for ascorbic acid content at different ripening stages. The ascorbic acid content increased from green stage to fully ripened stage and decreased during drying stages. Among all the evaluated genotypes, LCA-481 recorded the highest ascorbic acid content followed by LCA-479 and LCA-808. These genotypes may be recommended for utilization in breeding programmes aimed at improving nutritional quality in chilli. The study also confirmed that ripening stage plays an important role in determining vitamin C accumulation in chilli fruits.

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