

Original Research Article

Evaluation of Quality Parameters at Ripening Stage in New Tomato (*Lycopersicon esculentum* Mill.) Germplasms

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ABSTRACT

The present investigation was conducted at M.E.S., Vegetable Science and analysis was carried out in the Laboratory of Department of Agricultural Biochemistry, N.D. University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during Rabi season 2016-17. Ten germplasms of tomato namely NDTH-90, NDTH-101, NDTH-108, Kalyanpur Selection-2, Kalyanpur Selection-3, Kalyanpur Selection-6, IIVR Selection-2, CO-3, Arka vikas and Pusa Early Dwarf were analysed at ripening stage. Tomato germplasms with successive ripening stages were grown in Completely Randomized Design with three replications. In respect of tomato fruit have been collected separately and analysed for physical and biochemical parameters. The physical parameters namely, fruit size, fruit weight, colour and specific gravity were determined whereas, biochemical parameter were explored for the determined of lycopene, β carotene, total chlorophyll, chlorophyll a, chlorophyll b, ascorbic acid, total mineral, total free amino acid, total acidity and activity of enzyme, polyphenol oxidase and peroxidase. The data obtained in the experiment showed the highest fruit size length and diameter (4.83, 7.17 cm), at ripening stage was found in variety Pusa Early Dwarf & Arka vikas. Maximum fruit weight (95.33g.) and specific gravity (1.28 ml/cc) at ripening stage in variety CO-3 & Pusa Early Dwarf. Whereas Maximum ascorbic acid (27.67 mg/100) at ripening stage was found in variety NDTH-101 and total mineral (0.80 mg/100g) at ripening stage was found in variety Arka vikas. Total acidity (0.50 %) at ripening stage was found in variety Pusa Early Dwarf. Maximum lycopene (4.93 mg/100g) at ripening stage was found in germplasms Kalyanpur Selection-6 and β carotene (1.50 mg/100g) at ripening stage was found maximum in germplasms Kalyanpur Selection-3. Whereas, total chlorophyll (1.77 mg/100g) at ripening stage was found maximum in germplasms NDTH-90 chlorophyll a & b (1.27, 0.58 mg/100g) at ripening stage was found maximum in variety/germplasms NDTH-108 & Pusa Early Dwarf. Whereas, polyphenol oxidase (35.87 unit/mg) and peroxidase enzyme (1.80 unit/mg) were found maximum in variety /germplasms Arka vikas & NDTH-108 at ripening stage.

Keywords

Fruit size, weight, specific gravity, colour, lycopene, beta carotene, chlorophyll a b, ascorbic acid, total mineral content, titrable acidity content and Polyphenol oxidase, Peroxidase content

Introduction

The tomato (*Lycopersicon esculentum* Mill.) is one of the most widely consumed and most popular fresh vegetable in the industrialized world. Tomato belongs to the family Solanaceae having diploid chromosome number ($2n=24$). It is the

world's largest vegetable crop after potato and sweet potato but it tops the list of canned vegetables. It is an important condiment in most diets and a very cheap source of vitamins and antioxidants. It also contains a large quantity of water and,

calcium and Niacin which are of great importance in the metabolic activities of man. Tomato is a good source of vitamins A, C and E and minerals that are very good for body and protect the body against diseases (Taylor, 1987).

Tomato is the second most widely grown vegetable crop in the world other than potato (Hanson *et al.*, 2001). Canada is the second larger producer of tomato next to Mexico. Total area of world under tomato cultivation is 4.50 million ha and total production is 240.51 million tonnes with 31.8 tonnes /ha productivity whereas, in India total area is 0.767 million ha and production is 16.385 million tonnes with 21.353 million tonnes /ha productivity. In U.P., total area is 0.010 million ha, production is 0.413 million tonnes with 39.488 million tonnes /ha productivity. (NHB, 2014-15).

Tomato crop is adapted to a wide variety of climates ranging from the tropics to within a few degrees of the Arctic Circle. However, in spite of its broad adaptation, production is concentrated in few warm and rather dry areas. Though, it is a perennial plant in tropical climates, it is grown as an annual in North America. Tomatoes find numerous uses in both fresh and processed forms that include ketchup, sauces, pastes and juice. Tomato is considered as an important cash generating crop for small holders and medium scale commercial farmers providing employment opportunity in the production and processing industries (Naika *et al.*, 2005).

Tomatoes commonly consumed in daily diets are a major source of antioxidants. Tomato being an important source of potassium, phosphorus, magnesium, iron, so necessary to the normal activity of nerves and muscles. Vitamins as A, B and C tomatoes is the third source of vitamin C in

our diet and the fourth for vitamin A, through its content in beta-carotene or pro vitamin A. Phytosterols, compounds that help to keep cholesterol under control folic acid, which helps eliminate homocysteine, an amino acid whose metabolism is dependent on the metabolism of vitamins from B complex, especially that of folic acid. Compositionally, the tomato has a unique nutritional and phyto-chemical profile.

The major phyto- chemicals in tomato are the carotenoids consisting of 60 to 64% lycopene, 10 to 12% phytoene, 7 to 9% neurosporene, and 10 to 15% carotenes. Tomatoes based foods are the world rich sources of lycopene (Sgheri *et al.*, 2008). Based on a fresh weight basis, tomato (on average) contains about 35 mg/kg of lycopene, with red cultivars containing in average 90 mg/kg of lycopene and yellow ones only 5 mg/kg Processed tomatoes (sauce, paste, juice, and ketchup) contain 2- to 40-fold higher lycopene than fresh tomatoes.

Materials and Methods

The experiment was conducted in the department of vegetable science at MES of vegetable farm Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P) during the Rabi season 2016-2017. The climate of Faizabad comes under the category of semi-arid.

The biochemical parameters were as Fruit size, weight, specific gravity, colour, lycopene, beta carotene, chlorophyll a b, ascorbic acid, total mineral content, titrable acidity content and Polyphenol oxidase, Peroxidase content. by Jayaraman (1981). The statistical analysis of the data obtained was carried out by the method as suggested by Gomez and Gomez (1984).

Results and Discussion

The fruit length varied from 3.90-4.83 cm at ripening stage was respectively. These results are nearly corresponding with Chattopadhyay *et al.*, (2013) as observed for fruit diameter i.e. 3.18-4.90 cm. The fruit size decreases at ripening stage is attributed to the loss of moisture and carbohydrates in accordance with Karki (2005).

The fruit diameter varied from 4.80-7.17 cm at ripening stage was respectively. These results are nearly corresponding with Chattopadhyay *et al.*, (2013) as observed for fruit diameter i.e. 4.18-7.20 cm. The fruit size decreases at ripening stage is attributed to the loss of moisture and carbohydrates in accordance with Karki (2005).

In the present investigation, average fruit weight of tomato varieties / strains at ripening stage was ranged from 46.97-95.33 g. while Chattopadhyay *et al.*, (2013) reported in the range of 42.00-134.40g and Leonardi *et al.*, (2000) found 107-156 g for the cluster and salad tomato. It is well established fact that among different tomato varieties / strains, the physical parameters especially average weight lies wide variation. The results of average fruit weight ranges slightly in accordance with Chattopadhyay *et al.*, (2013). The fruit weight decreases within excepted of weight loss per cent, the mean weight loss at ripening stage was varied weight loss 11.16 per cent are in accordance with Getinet *et al.*, (2008).

Specific gravity of tomato varieties / strains was ranged from 0.96-1.28 ml/cc at ripening stage. The specific gravity increases within excepted of fruit weight and fruit volume data at ripening stage. This is closely coherence with the inference of Nainwal *et al.*, (1992) as resulted 0.94-1.30 ml/cc in

different tomato varieties. These values for physical parameters in present study are very close to the literature available. Little variation may be due to the varieties/ strains and place. Difference in chemical composition of fruit in present findings and in reported literature may be due to the differences in varieties/ strains, location and fruit ripening stage.

The result of lycopene was exhibited ripening stage varied from 2.77-4.93 mg /100gm. It was in accordance with Watada *et al.*, (1976) reported that lycopene contents of 0.2-46.71 μg / g fresh weight at ten maturities to ripening stages. According to Helyes *et al.*, (2002) the lycopene content of sixteen different tomato varieties harvested in hungary ranged between 39.3 and 171.0 mg kg⁻¹. Farkas (1994) observed that lycopene production was inhibited by the environmental temperature above 32 °C. During the ripening period, lycopene content of tomatoes increases sharply from the pink stage onwards.

Results pertaining to β carotene in different selected varieties / strains ripening stage was varied in range of 1.23-1.50 mg /100g which was in accordance with the finding of Watada *et al.*, (1976) are reported that β carotene content of 0.7-2.90 μg / g fresh weight at ten maturities to ripening stage and Matthews (1974) are reported that β carotene content increased significantly with each increase in maturity stage. Mean values for β carotene in mg /100g fresh fruit for each harvested ripening stage 0.32 mg/ 10g.

The results of total chlorophyll was found in ranged from 1.37-1.77 mg /100g at ripening stage whereas, Chlorophyll a was found in range of 0.97-1.27mg /100g at ripening stage while Chlorophyll b was also found in range of 0.43-0.58 mg / 100g at ripening stage.

Table.1 Fruit size, fruit weight, Specific gravity and Fruit colour of different varieties/germplasms of tomato at ripening stage

S.N.	Varieties/germplasms	Fruit size		Fruit weight (g)	Specific gravity	Fruit colour
		Length (cm)	Diameter (cm)			
1	NDTH-90	4.67	5.03	61.13	0.96	Light Red
2	NDTH-101	4.63	5.10	59.37	0.97	Light Red
3	NDTH-108	4.33	4.80	61.00	1.05	Light Red
4	Kalyanpur Selection -2	4.60	5.33	61.63	1.04	Light Red
5	Kalyanpur Selection -3	3.90	5.67	57.93	1.14	Light Red
6	Kalyanpur Selection -6	4.65	5.70	62.07	1.19	Light Red
7	IIVR Selection -2	4.77	5.40	79.77	0.99	Light Red
8	CO-3	4.70	5.77	95.33	0.95	Light Red
9	Arka Vikas	4.53	7.17	57.13	0.98	Light Red
10	Pusa Early Dwarf	4.83	4.93	46.97	1.28	Light Red
	CD at 5 %	0.67	0.42	1.99	0.20	Light Red

Table.2 Lycopene, β Carotene content and Chlorophyll content (mg/100g) of different varieties/germplasms of tomato ripening stage

S. No.	Varieties / germplasms	Lycopene content (mg/100g)	β Carotene content (mg/100g)	Chlorophyll content (mg/100g)		
				a	b	Total
1	NDTH-90	4.63	1.27	1.10	0.49	1.77
2	NDTH-101	4.53	1.33	1.12	0.53	1.67
3	NDTH-108	4.67	1.25	1.27	0.56	1.47
4	Kalyanpur Selection -2	4.40	1.45	1.20	0.48	1.53
5	Kalyanpur Selection -3	4.73	1.50	0.97	0.46	1.63
6	Kalyanpur Selection -6	4.93	1.40	1.16	0.43	1.57
7	IIVR Selection -2	3.30	1.43	1.17	0.57	1.43
8	CO-3	3.97	1.48	1.05	0.49	1.60
9	Arka Vikas	2.77	1.30	1.15	0.52	1.73
10	Pusa Early Dwarf	4.37	1.28	1.23	0.58	1.37
	CD at 5 %	0.66	0.10	0.18	0.09	0.32

Table.3 Ascorbic acid, Total mineral content, Polyphenol oxidase (unit/mg) and Peroxidase (unit/mg) of different varieties/germplasms of tomato at ripening stage

S. No.	Varieties / germplasms	Ascorbic acid content (mg/100g)	Total mineral content (mg/100g)	Titration acidity content (%)	Polyphenol oxidase(unit/mg)	Peroxidase (unit/mg)
1	NDTH-90	24.27	0.73	0.30	34.77	1.53
2	NDTH-101	27.63	0.77	0.47	35.17	1.57
3	NDTH-108	25.57	0.74	0.36	35.80	1.80
4	Kalyanpur Selection -2	25.63	0.78	0.40	35.07	1.63
5	Kalyanpur Selection -3	25.77	0.79	0.41	35.33	1.25
6	Kalyanpur Selection -6	25.70	0.72	0.32	35.67	1.09
7	IIVR Selection -2	22.24	0.75	0.42	34.83	1.47
8	CO-3	22.73	0.71	0.48	35.53	1.67
9	Arka Vikas	20.50	0.80	0.37	35.87	1.17
10	Pusa Early Dwarf	25.87	0.76	0.50	34.93	1.26
	CD at 5 %	1.59	0.05	0.13	0.84	0.30

It is also evident from the findings of Watada *et al.*, (1976) reported that the average total chlorophyll content decreased from 13.4 µg / g fresh weight in ripening stage. Change in the chlorophyll content after six stage were not significant and a small amount (0.3 µg) of chlorophyll. The ratio of chlorophyll a and b was 2 in the immature fruit and approached 1 as the fruit ripened.

Ascorbic acid in different varieties / strains was varied from 20.50-27.63 mg/100g at ripening stage. It is closely correlated with maximum limit of ascorbic acid (25.50 mg/100g) at ripening stages as reported by Matthews (1974). Little variation may be due to the variety / strains and place.

Maximum total mineral content 0.80 mg/100g was recorded in variety Arka vikas at ripening stages while minimum content being recorded 0.71 mg/100g at ripening stages in variety CO-3. Increase in total mineral at ripening stage enhances the uptake of minerals available in the soil profile and it's metabolism in fruits. The results are supported by Agrawal *et al.*, (2009), Ahmad *et al.*, (2003) and Vaipuri *et al.*, (2004) who reported as increase in N, P, K and S uptake.

Acidity was found in range of 0.30-0.50 per cent at ripening stage was varied in range from 0.20-0.52 per cent which is closely related with lower of acidity are reported by Shusheela *et al.*, (1991). Little variation may be due to the variety / strains and place.

Difference in enzyme activity of fruit in present findings and in reported literature may be due to the difference in varieties / strains at ripening stage. Studies on enzymatic composition of tomato varieties / strains showed a range of variability in different component at ripening stage.

Polyphenoloxidase enzyme in different varieties / strains were varied from 34.77-35.87 mg /100g at ripening stage. It is closely correlated with maximum limit of polyphenol oxidase enzyme (33-48 mg /100g at six harvested stage) the lowest value was observed in the first stage, the highest one was measured in the third and fourth stage, as reported by Helyes *et al.*, (2006) are reported as increase in N,P,K and S uptake.

Peroxidase enzyme content of different varieties / strains ranged from 1.09-1.80 ml /g at ripening stage which is partially in coherence with upper and lower limit of peroxidase enzyme (2.073-0.24 ml /g) as reported by Rai *et al.*, (2011).

The peroxidase activity increased significantly upon applying chitosan during fruit set and fruit growing, finding a smaller effect for the salicylic acid. Benzoic acid did not modify the peroxidase or catalase activity. These values for enzyme activity in present study are very close to the literature available. Little variation may be due to the variety / strains and place.

In the light of present investigation explored physical and biochemical parameter the results of ten varieties/germplasms of tomatoes, CO-3 recognized promising characters in terms of fruit size, colour and weight will certainly attract the consumers in the market and it corresponds for generating more earning to the producers as well. Considering nutritional aspect Kalyanpur Selection-6 recognized highest qualitative composition as resulted having lycopene content which currently placed as anti-cancerous use, whereas NDTH-101 germplasm is found highly qualitative tomato due to highest enzymatic content therefore, it may be recommended for vast use among the consumers.

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