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Full Length Research Paper

Physical-chemical properties and nutritional evaluation of newly developed tomato genotypes

Aditi Gupta , A. Kawatra and S.Sehgal

Department. of Foods and Nutrition, CCS HAU,Hisar, Haryana

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The present investigation was conducted to study the two genotypes i.e. open pollinated Hisar Arun Selection 7 (SEL-7/HAS-7) and hybrid ARTH-3 at CCSHAU, Hisar (Haryana). Both genotypes were studied for physical characteristics including fruit firmness, juice and pulp content.Total Soluble Solids per cent was found to be higher in ARTH-3, whereas non-significant difference was observed in acidity between the two genotypes. No significant difference in fruit firmness was observed. Higher pulp content and lower juice content were observed in ARTH-3 genotype as compared to SEL-7. Tomato contained 94.45 and 92.24 per cent moisture, 14.73 and 15.62 g protein, 1.61 and 1.56 g fat, 7.34 and 7.21 g ash, 7.58 and 8.69 fibre g per 100 g of fruit in SEL-7 and ARTH-3 genotypes, respectively. Total sugar and non-reducing sugar was found to be significantly ($P<0.05$) higher in ARTH-3 than in SEL-7. The amount of ascorbic acid, lycopene and β-carotene was 31.33 and 27.82, 3.12 and 4.03 and 5.90 and 6.78 mg per 100 g in raw tomatoes, respectively. Ascorbic acid content was significantly higher in SEL-7 than in ARTH-3, whereas lycopene carotene content was significantly higher in ARTH-3 than in SEL-7. No significant difference was observed between the two genotypes in β-carotene content.

Key words- tomato,β-carotene**,** lycopene, ascorbic acid

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) as vegetable and fruit occupy an important place in healthy daily diet. Tomato is grown extensively throughout India for fresh consumption and commercial processing (Maini and Kaur, 2000; Prakash, 2000). Carotenoids and ascorbic acid are antioxidants present in tomatoes (Giovanelli *et al*., 2001). Tomatoes are highly perishable and large quantities of tomato fruits go as a waste due to poor storage facilities (Roy and Pal, 2000) It has been estimated that out of 74.41 lacs tones of annual tomato production in the country, 25-30 per cent of tomato fruits get spoiled in India due to glut in the market and improper handling and storage conditions (Mangal and Siddiqui, 2000). The present investigation was carried out to study the physical characteristics and nutritional composition of newely evolved tomato hybrids.

*Corresponding author E-Mail: aditiguptabkn@gmail.com

MATERIALS AND METHODS

Physical characterstics

Fruit pressure in the randomly selected fresh tomatoes was determined by piercing the probe (hollow pointed end) of the gauze through the lid. Total soluble solids and titrable acidity were measured by using methods developed by Rangana, 1986 and Amerine et al. (1967), respectively.

Nutritional analysis of tomatoes

The tomatoes of both genotypes were blended in electric blender and slurry was dried on plastic sheets in an hot air oven, at 60 ± 5^0C. It was powdered and analyzed for nutritional composition. Moisture, total solids, crude protein, crude fat, crude fibre and ash content in tomatoes were determined using standard methods of A.O.A.C (1995).Total soluble sugars and reducing sugar

were estimated by standard method of analysis given by Yemm and Willis (1954) and Somogyi (1945) respectively. β-carotene in the sample was separated by column chromatography and estimated calorimetrically according to the standard method of (A.O.A.C., 1995) analysis. The content of lycopene was estimated using the procedure outlined by Adsule and AmbaDan (1979) Ascorbic acid in the sample was estimated by titration method of (A.O.A.C., 1995).Calcium and iron were estimated by (Lindsey and Norwell, 1969), whereas Phosphorus was determined colorimetrically by the standard method of analysis given by Chen et al. (1956). After collecting relevant data appropriate statistical tool used for data analysis.

RESULTS AND DISCUSSIONS

Physical characterstics

Two genotypes, i.e. open pollinated Hisar Arun Selection 7 (SEL-7) and hybrid ARTH-3 were analyzed for their physical characteristics including fruit firmness, juice and pulp content. The results obtained are presented in Table 4.1

Fruit firmness

Fruit firmness was found to be 0.62 and 0.67 kg/cm^2 in SEL-7 and ARTH-3 respectively . In earlier study, Gowda et al. (1994) observed that the average firmness in eight different varieties of tomatoes ranged from 4.0 to 8.4 lbs/sq. inch, minimum fruit firmness was reported in Pusa Ruby and maximum was in Lerica.

Juice and pulp content

Juice content of tomato genotypes SEL-7 and ARTH-3 was 30.86 and 22.11 ml/100g, whereas their pulp content was 68.47 and 76.41 g per 100g, respectively. Data indicates that pulp content was significantly ($p<0.05$) higher whereas juice content was significantly lower in ARTH-3 than SEL-7.The observed difference may be attributed to the variations in both the genotypes studied. Similarly, wide range of juice content i.e. of 53.6 and 83.3 per cent and 45.0 to 83.3 per cent in tomatoes was reported earlier by Aggarwal et al. (1995) and Kumar and Singh (1996), respectively.

A slightly lower values for pulp content than those observed in our study, i.e. 24.7 to 48.0 and 23 to 50 per cent have been reported by Gowda (1994) and Madaiah et al. (1986).The observed difference may be due to genetic difference in tomato cultivar studied.

Total soluble solids and titrable acidity

Data on total soluble solids and titrable acidity is depicted in Table 4.2

The total soluble solids (TSS) were recorded as 5.1 and 5.5 ^{0}Brix in the analyzed two tomato genotypes .The ARTH-3 had significantly ($p<0.05$) higher amount of TSS than SEL-7. The difference with respect to TSS of fruit might be due to varietal difference (Thakur et al. 1995). The amount of total soluble solids in present study are equivalent to that obtained by Radhakrishnaih et al. (1987), Nainwal et al. (1992) and Ereifej et al. (1997), who reported 4.2 to 6.00; 4.38 to 5.95 and 5-6 ^{0}Brix of TSS in different varieties of tomatoes. The acidity expressed as per cent anhydrous citric acid in fruit was 0.54 and 0.50 in SEL-7 and ARTH-3, respectively. Ereifej et al. (1997) also reported 0.1 to 0.5 per cent titrable acidity in tomatoes.

Nutritional evaluation of tomatoes

Tomatoe genotypes SEL-7 and ARTH-3 were analyzed for their proximate composition, total soluble solids, sugar contents, ascorbic acid, pigments and mineral profile. The results obtained are presented as under:

Proximate composition

Data on proximate composition is presented in Table 4.3

Moisture

Moisture content of SEL-7 and ARTH-3 was 94.45 and 92.27 per cent, respectively. Significantly ($p<0.05$) higher amount of moisture content was found in SEL-7 than in ARTH-3.The moisture content of these tomato genotypes was close to the values reported by Gowda et al. (1994) and Loiudice et al. (1995). Similarly, Thakur and Kaushal (1995) also observed 94.00 to 95.05 per cent moisture in tomatoes.

Crude protein

The protein content was 14.73 g per 100g in SEL-7 and 15.62 g per 100g in ARTH-3, on dry matter basis. The protein content did not differ significantly between the genotypes. Shibli et al. (1995) reported 1.0-2.0 per cent protein in tomatoes on 90 per cent moisture basis. Willis (1984) also reported 0.8 per cent protein in different varieties of tomato on fresh matter basis. They also observed non-significant differences in protein content in

Table 4.1. Physical characteristics of tomatoes

Physical characters	Genotypes		't' value
	SEL-7	ARTH-3	
Fruit firmness (kg/cm^2)	0.62±0.03	0.67±0.05	NS
Juice content (ml/100 g)	30.86±1.52	22.11±1.48	7.14**
Pulp content (gm/100g)	68.47±1.53	76.41±3.02	3.99*

Table 4.2 : Acidity and total soluble solids of tomatoes

Parameters	Genotypes		't' value
	SEL-7	ARTH-3	
Acidity (%)	0.54±0.02	0.50±0.03	NS
Total soluble solids (ºBrix)	5.1±0.2	5.5±0.3	3.54*

Table 4.3 : Proximate composition of tomatoes (g/ 100 g dry weight)

Proximate composition	Genotypes		't' value
	SEL-7	ARTH-3	
Moisture	94.45±1.63	92.24±1.52	3.54*
Protein	14.73±1.52	15.62±1.61	NS
Fat	1.61±0.69	1.56±0.38	NS
Ash	7.34±0.58	7.21±1.13	NS
Fibre	7.58±1.21	8.69±1.23	NS
Carbohydrates	69.48±0.32	66.27±0.92	5.69**

four tomato varieties studied.

Crude fat

The crude fat content of both the genotypes of tomato was almost similar i.e. 1.61 and 1.56 per cent in SEL-7 and ARTH-3, on dry matter basis, respectively. The data of the present is in accordance to the results of study of Anita (1998), who reported that crude fat content in different tomato genotypes varied from 1.54 to 1.89 per cent in dry matter basis.

Ash content

The ash content in SEL-7 and ARTH-3 was determined as 7.34 and 7.21 per cent, respectively, on dry matter basis. The values corresponded to 0.48 and 0.53 per cent when calculated on fresh matter basis. Non significant difference was observed in ash content of both the genotypesResults obtained are in close conformity to those obtained by Ereifej et al. (1997) who reported 0.5 to 0.7 per cent ash in tomatoes on fresh weight basis.

Crude fibre

The crude fibre content in SEL-7 and ARTH-3 was determined 7.58 and 8.69 per cent, on dry matter basis, respectively, which corresponded to 0.49 and 0.62 per cent, in fresh matter basis. Abdel Rahman (1982) also in the earlier study reported the similar amount of fibre content (0.56%) in tomatoes on fresh matter basis. Shibli et al. (1995) found 0.5 to 0.7% of fibre on four varieties of tomatoes. Carbohydrates content of SEL-7 and ARTH-3 was 69.48 and 66.27 g per 100 g, respectively on dry matter basis. Carbohydrate content of SEL-7 was significantly higher than carbohydrate content of ARTH-3.

Sugar content

Data on total sugar, reducing sugar and non-reducing sugars are presented in Table 4.4 The total sugar content was found to be 25.31 and 27.45 per cent in SEL-7 and ARTH-3 on dry matter basis, respectively. ARTH-3 contained significantly ($p<0.05$) higher amount of total sugar content than SEL-7. Similarly, Loiuidice et al. (1995) and Thakur and Kaushal (1995) also reported very close range of sugar in tomato varieties.

The reducing sugar content was 22.76 and 23.29 per cent in SEL-7 and ARTH-3 on dry weight basis, respectively. The reducing sugar content was found in similar range in two genotypes. These findings are very close to those reported earlier by Pathak and Mahajan (1978), Joshi et al. (1983) and Thakur and Kaushal

Table 4.4 : Sugar content of tomatoes (g/ 100 g dry weight)

Sugar	Genotypes		't' value
	SEL-7	ARTH-3	
Total sugar	25.31±1.23	27.45±1.24	18.24**
Reducing sugar	22.76±1.39	23.29±1.19	NS
Non-reducing sugars	2.60±0.22	3.82±0.53	3.84*

Table 4.5 : Ascorbic acid and pigments of tomatoes (mg /100 g fresh weight)

Vitamins and pigments	Genotypes		't' value
	SEL-7	ARTH-3	
Ascorbic acid	31.33±1.23	27.82±2.17	3.94*
Lycopene	3.23±0.92	4.03±0.87	3.69*
β-carotene	5.40±1.62	6.78±2.13	NS

Table 4.6 : Mineral content of tomatoes (mg/100 g dry weight)

Minerals	Genotypes		't' value
	SEL-7	ARTH-3	
Calcium	76.41±0.75	77.75±1.82	NS
Phosphorus	374.12±6.61	386.05±2.35	NS
Iron	12.29±1.57	11.61±0.84	NS

Mean ± Standard deviation of three independent observations
** ($p < 0.01$) Highly-significant
* ($p < 0.05$) significant
NS Non -significant

(1995). The non-reducing sugar content in SEL-7 and ARTH-3 was 2.60 and 3.82 per cent, respectively. ARTH-3 had significantly ($p<0.05$) higher amount of non-reducing sugar than SEL-7. On the contrary, Pathak and Mahajan (1978) reported 0.31 to 0.51 per cent of non-reducing sugar in raw tomatoes on fresh matter basis considering 93 to 95 per cent moisture. It may be due to varietal difference.

Ascorbic acid and pigments

Ascorbic acid and pigment content of genotypes i.e. SEL-7 and ARTH-3 are depicted in Table 4.5 The β-carotene content was 5.40 and 6.78 mg per 100 g in SEL-7 and ARTH-3, respectively. The content of β-carotene was observed slightly higher in ARTH-3 than in SEL-7 genotype. Data corresponds to earlier study by Nainwal et. al (1992) and Anita (1998), who reported β-carotene content range from 4.75 to 6.25 and 4.80 to 5.30 mg per 100 g in different tomato genotypes .

The ascorbic acid content was found to be 31.33 and 27.82 mg per 100g in genotypes SEL-7 and ARTH-3, respectively. The data indicates ascorbic acid content was significantly ($P<0.05$) higher in SEL-7 than in ARTH-3. Similar to this study Anita (1998) and Thakur and Kaushal (1995) reported that vitamin C content ranged from 19.88 to 27.68 and 19.50 to 30.06 mg per 100 g in different tomato genotypes.

Lycopene content was determined as 3.23 and 4.03 mg per 100g in tomato puree prepared from SEL-7 and ARTH-3, respectively. Lycopene content was significantly higher in ARTH-3 than in SEL-7. Data corresponds to earlier study by Anita (1998) and Nainwal et. al (1992) who reported lycopene content range from 0.84 to 3.99 and 1.40 to 4.15 mg per 100 g in different genotypes of tomato.

Minerals

The mineral content of two genotypes of tomato is presented in Table 4.6

Calcium

The calcium content was 76.41 and 77.75 mg per 100 g of SEL-7 and ARTH-3 respectively, on dry matter basis. Non-significant difference in the calcium content was

observed. The results of present study are similar to that of Shibli et al. (1995) and Ereifej et al. (1997) who reported calcium content of tomato in the range of 69 to 76 mg per 100g of solids.

Iron

The iron content of two genotypes studied was 12.29 and 11.61 mg per 100g on dry matter basis in SEL-7 and ARTH-3 ,respectively. There was non-significant varietal influence to the iron content. Shibli et al. (1995) reported 1.4 to 1.8 mg of iron on 90 per cent moisture basis in four different varieties of tomatoe.

Phosphorus

The phosphorus content of two tomato genotype was 374.12 and 386.05 mg per 100 g. The phosphorus content was slightly higher in ARTH-3 than SEL-7, however the difference was not significant.The phosphorus content obtained in tomato was close to the value reported earlier by Loiudice et al. (1995) and Shibli et al. (1995) who reported 450 to 598 mg and 465 to 706 mg per 100 g of phosphorus on dry matter basis in different varieties of tomatoes, respectively.

Conclusion: The present investigation was conducted to study nutritional composition of two tomato genotypes (HAS-7 and ARTH-3). The results indicated that both tomato varieties contained good nutritional profile and physical properties and can be used to make further nutritional products.

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