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RESEARCH ARTICLE

COMPARSION OF EGGPLANT GENOTYPES FOR PHENOLIC COMPOUNDS AND OTHER BIOCHEMICAL PARAMETERS

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Abstract

Fifty genotypes of brinjal having fruits of different colours were evaluated for dry matter, total soluble sugars, total phenols, ortho-dihydroxy phenols (ODHs) and flavonols in two years i.e 2012 and 2013. It was found that brinjal has low sugar content and it is a rich source of phenolic compounds. Highest total phenol content was found in genotype G-415 (Green) in 2012 and 2013. G-418 (Green) and P-71 (Purple) showed ODH content in the maximum range (80-100 mg/100g). The maximum flavonol content was found in BLEND-11-WR-2 which having white coloured fruits.

Introduction

Brinjal (Solanum melongena L.) is an useful and popular vegetable which is also known as melanzana and garden egg. It is also known as eggplant due to its shape similar to goose or hen's egg. It is grown in tropical and sub-tropical parts of the world. Phenolic compounds constitute one of the main classes of secondary metabolites of plants. the important Phenolic compounds have important role in defence, attracting pollinators in plants and also contribute to colour and taste as well as nutritional properties of fruits and vegetables. They also contribute to the antioxidant properties and anti-cancer activities of brinjal (Gonthier et al., 2003). Quercetin is reported to exhibit antidiabietic activity. Brinjal is ranked among top ten vegetables to scavenge oxygen radical species because of presence of phenolic compounds (Cao et al., 1996). Brinjal is a good reservoir of phenolic compounds such as chlorogenic acid (Winter and Hermann, 1986).. Stomell and Whitaker (2003) examined phenolic content of the fruit flesh of eggplant cultivars. Luthria and Mukhopadhyay (2006) optimized the extraction of phenolic compounds from eggplant by using different solvent mixtures. Previous studies have shown that environmental conditions have an influence on the concentrations on phenolic compounds (Hanson et al., 2006). Therefore, the study was aimed at determining the differences among different coloured varieties where fruits were taken from plants grown under uniform conditions.

MATERIALS AND METHODS

Plant Materials

Fifty genotypes of brinjal were cultivated under natural conditions at Vegetable Research Farm, Department of Vegetable Science, Punjab Agricultural University, Ludhiana. Brinjal fruits were analyzed for phenolic compounds and other biochemical parameters in year 2012 and 2013.

Dry Matter

50g of sliced fruit of each sample was dried in pre-weighed petri-plates at $65 \pm 2^{\circ}$C till constant weight was obtained. The Dry matter percentage was then calculated by the following formula:

$$\text{Dry Matter Content (\%)} = \frac{\text{Final dry weight of the sample}}{} \times 100$$

Initial fresh weight of the sample

Total Soluble Sugars
Extraction

500 mg dried samples were refluxed with 80% ethanol in a conical flask fitted with water condenser and centrifuged at 5000 rpm for 15 min. Supernatant was collected, the residue left over was given twice washings with 80% aqueous ethanol and the process was repeated. Supernatants were collected and pooled. Ethanol from pooled extract was removed at 50˚C in a flash evaporator under vaccum. Then 1.0 ml of saturated lead acetate was added and volume of the extract made to 100 ml with distilled water. This was kept overnight till all proteins in the extract got precipitated. To this a pinch of sodium oxalate was added to remove lead ions from extract. It was again kept overnight. Thereafter, the extract was filtered through Whatmann no. 1 filter paper. The supernatant were collected, centrifuged and further used for estimation of total soluble sugars.

Estimation

The amount of total soluble sugars was estimated by Phenol sulphuric acid reagent method (Dubois et al., 1956). To 0.1 ml of supernatant obtained from extraction were added 0.9 ml of distilled water and 1 ml of 5 % phenol, followed by the addition of 5.0 ml of conc. H_2SO_4. Then tubes were cooled to room temperature under running water and absorbance was read at 490 nm against reagent blank. Standard curve was prepared using Standard glucose in the range 10-80 µg/ml.

Extraction and estimation of Phenolic Compounds

Extraction

Dried fruit samples (0.5 g) were refluxed with 80% methanol for 2 h. The refluxed material was filtered and volume was made to 25 ml by washing with 80% methanol. The extract thus prepared was used for estimation of phenolic compounds viz. total phenols, ortho-dihydroxyphenols and flavonols.

Estimation of total phenols

Total phenols were estimated in plant material by using Folin-Ciocalteu method developed by Swain and Hillis (1959). In this procedure, 5 ml of methanolic extract was evaporated to dryness and the residue was dissolved in 6.5 ml of distilled water. To this 0.5 ml of Folin-Ciocalteu reagent was added and shaken thoroughly followed by addition of 1 ml of saturated solution of Na_2CO_3 after interval of 3 minutes and volume was made to 25 ml with distilled water. The blue colour was developed in the reaction mixture whose absorbance was read after 1 h at 760 nm against reagent blank. A standard curve was prepared by using catechol and results were expressed as mg catechol per 100 g dry weight (dw).

Estimation of Ortho-dihydroxyphenols

The content of ortho-dihydroxyphenols in different genotypes of brinjal was estimated by method given by Nair and Vaidyanathan (1964). 5.0 ml of methanolic extract was evaporated to dryness and residue left behind was dissolved in 1.0 ml of distilled water. To this 0.5 ml of 10% TCA, 1.0 ml of sodium tungstate, 0.5 ml of 0.5 N HCl, and 1.0 ml of freshly prepared 0.5% sodium nitrite were added. A yellow colour was developed. After 5 min 2.0 ml of 0.5 N sodium hydroxide was added. The light cherry colour developed, whose absorbance was read after 15 min at 540 nm against the blank. The blank consisted of water and reagents only. The concentration of ortho-dihyroxyphenols was determined from standard curve prepared by using catechol in the range of 10-100 µg/ml.

Estimation of Flavonols

Total Flavonol content was determined using a colorimetric assay developed by Balabaa et al., (1974). Five ml of methanolic extract was evaporated to dryness and the residue left was dissolved in 10 ml of 0.1 M methanolic solution of aluminium chloride, as a result of which yellow colour developed in reaction mixture. The optical density was read at 420 nm against 0.1 M methanolic solution of $AlCl_3$ as blank.

Statistical analysis

Each analysis consisted of triplicates measurements of each sample and data were presented as average of the three measurements. Data were treated for two way-analysis of variance (ANOVA) at 5% significance level. ANOVA was performed using the statistical software CPCS version 1.0.

RESULTS AND DISCUSSION

The amount of total sugars, total phenols, ortho-dihydroxy phenols and flavonols significantly differed among brinjal genotypes in two years.

Total soluble sugars

Brinjal is known to have low sugar content and thereby it has low calorie value. The total soluble sugars content was found in the range of 0.53-24.77 % in 2012 and in the range of 0.71-20.36 % in 2013 (Table 1). Hanson et al., (2006) analyzed 35 brinjal genotypes and reported sugar content in the range of 20-30 % on dry weight basis. According to Choudhury (1976), white brinjal is considered good for diabetic patients. The present study confirms this, as in this study genotypes having white fruits such as W-230-42-45-1, BLEND-11-WR-2 and BLW-231 showed low total soluble sugars content and could be fit for diabetic patients.

Total Phenols

High diversity within the species for phenolics concentration already has been shown by Stomell and Whitaker, (2003); Hanson et al., (2006) and Prohens et al., (2005). In the present study, total phenols content varied in the range of 70.21 to 296.37 mg/100g DW with average value of 125.58 mg/100g in 2012 and in the range of 75.16 to 298.63 mg/100g DW with average value of 120.78 mg/100g in 2013 (Table 2). These values are in agreement with Hanson et al., (2006) who proposed that the environmental differences among years have influence on the concentrations of phenolics. Kaur et al., (2014) showed a wide variation in total phenols in brinjal genotypes, ranging from 22.62 to 234.46 mg /100g FW (244.28 to 2990.64 mg /100g DW) having nearly 15 fold variations.In present study maximum amount of total phenols was found in genotype G-415 (about 300 mg/100g) in two years. Similar findings were observed by Patel et al., (2013). This showed that genotypes having green fruits have high content of total phenols which have high free radical scavenging activity (Lutharia and Mukhopadhayay, 2006).

Ortho-dihydroxy Phenols (ODHs)

The ODHs varied from 3.41 to 93.00 mg/100g having highest content in genotype P-71 (93.00±4.6 mg/100g) in 2012 whereas in 2013, the ODHs varied in the range of 3.69-98.72 (mg/100g) having highest content in P-71 (98.72±0.1 mg/100g) (Table 2).

Flavonols

Flavonols in brinjal were found in the range 25.17 to 847.78 mg/100g in 2012 and between 21.38-835.86 mg/100g in 2013 which showed about 34 fold variation (Table 2). BLEND-11-WR-2 and MR-320 genotypes were showed flavonol content in the maximum range (>600 mg) . These values are in aggrement with Helmja et al., (2007) who reported the highest amount of flavonols (660 mg/100g) in brinjal among Solanaceae family.

Table: 1 Colour, Dry matter and total soluble sugars of brinjal genotypes.

Name of the Genotype	Colour of the genotype	Dry Matter (%)		Total soluble sugars (%)	
		2012	2013	2012	2013
BL-2001-1-2	White	7.50	6.56	7.60±0.14	8.14±0.04
BL-201	Purple	8.22	5.94	19.77±0.12	15.62±1.02
BL-202	Purple	8.32	7.08	19.59±0.44	17.33±0.00
BL-204	Purple	8.16	7.40	9.63±0.82	6.50±0.03
BL-207	Purple	7.96	6.60	9.13±0.05	12.56±0.01
BL-214	Purple	7.56	6.66	9.87±0.05	5.76±0.03
BL-215	Purple	8.78	7.42	18.03±0.05	16.88±1.14
BL-219	Purple	8.62	8.30	17.23±0.12	14.44±0.00
BL-220	Purple	8.60	7.58	24.77±0.33	11.74±0.04
BLW-231	White	11.04	10.38	9.87±0.47	6.79±0.01
BLEND-11-WR-1	White	8.06	6.10	ND	4.79±0.01
BLEND-11-WR-2	White, purple	6.0	6.46	6.27±0.29	5.45±0.02

	streaks				
SR-308	Green	11.04	10.70	9.86±0.48	7.13±0.07
BR-104	Purple	9.96	6.46	14.97±0.01	8.10±0.01
BR-118	Purple	9.42	6.60	16.08±0.32	19.51±0.65
BR-133	Purple	8.70	6.18	7.39±0.03	15.80±0.92
BRG-111	Pink	8.54	15.38	7.77±0.12	4.77±0.01
BRG-224	Pink	9.80	5.20	13.13±0.05	10.11±0.81
G-401	Green	8.28	6.30	12.30±0.00	13.30±0.06
G-402	Green	7.12	8.36	14.78±0.26	10.37±0.04
G-403	Green	9.40	8.34	2.87±0.34	4.21±0.57
G-405	Green	8.82	7.40	13.80±0.08	9.44±0.04
G-407	Green	10.10	8.34	3.83±0.09	4.62±0.78
G-408	Green	9.2	9.12	14.80±0.23	12.12±0.08
G-409	Green	8.86	9.08	24.71±0.22	16.13±0.03
G-411	Green	9.14	8.06	5.10±0.50	9.56±0.00
G-412	Green	10.46	9.12	0.70±0.22	0.71±0.01
G-414	Green	7.30	5.60	10.38±0.32	10.57±0.02
G-415	Green	9.78	6.80	4.93±0.54	2.35±0.02
G-418	Green	9.22	8.98	0.53±0.17	0.88±0.01
MR-319	Purple	7.40	5.82	2.75±0.01	4.92±0.51
MR-320	Purple	7.86	6.70	3.72±0.01	8.62±0.05
P-71	Purple	8.60	6.74	5.00±0.14	4.74±1.03
SR-301	Purple	10.08	7.66	5.26±0.05	7.65±0.02
SR-302	Purple	9.30	10.88	7.65±0.05	5.47±0.03
SR-303	Purple	8.70	8.54	5.43±0.34	7.32±0.09
SR-304	Purple	9.40	9.80	3.00±0.14	4.70±0.01
SR-305	Purple	8.44	7.24	5.23±0.09	6.50±0.06
SR-306	Purple	7.12	5.38	14.03±0.39	14.80±0.02
SR-307	Purple	8.42	7.38	13.00±0.00	10.54±0.02

SR-309	Purple	8.78	8.80	19.84±0.47	15.21±0.01
SR-310	Purple	7.52	7.16	15.00±0.51	10.83±0.53
SR-311	Purple	8.60	14.80	9.40±0.00	7.97±0.04
SR-312	Purple	9.10	5.80	14.99±0.38	11.46±0.02
SR-313	Purple	8.96	7.70	22.91±0.23	20.36±0.03
SR-318	Purple	8.62	8.34	6.43±0.19	8.84±0.05
SRV-360-1	White	10.42	7.24	1.13±0.05	2.61±0.01
W-230-42-45-1	White	6.58	7.06	5.74±1.00	7.00±0.00
WL-502	White	8.20	7.26	ND	3.15±0.05
WO-406	White	20.52	15.80	1.01±0.13	0.81±0.01
MEAN		**8.03**	**7.97**	**10.02**	**8.98**

Data values are represented as mean±S.D, ND = Not Detected

Table: 2 Total phenols, Ortho-dihydroxy phenols (ODHs) and flavonols in brinjal genotypes.

Genotypes	Total Phenols (mg/100g)		ODHs (mg/100g)		Flavonols (mg/100g)	
	2012	**2013**	**2012**	**2013**	**2012**	**2013**
BL-2001-1-2	125.95±0.5	111.15±0.3	10.93±1.5	13.96±2.3	257.79±3.5	249.48±0.5
BL-201	129.57±1.0	119.89±0.1	35.59±2.1	25.76±0.1	363.43±2.1	353.27±1.3
BL-202	115.42±0.1	116.95±0.1	39.31±0.3	41.41±0.1	185.34±1.0	197.41±0.5
BL-204	113.42±2.7	109.84±0.1	30.10±3.3	44.41±0.1	133.16±2.7	130.86±1.4
BL-207	149.76±0.9	122.52±0.2	15.31±4.3	30.38±0.1	134.02±6.2	129.48±0.3
BL-214	102.44±0.9	106.73±0.2	59.03±1.9	42.35±0.1	351.03±24.6	334.65±0.3
BL-215	72.21±2.6	96.15±1.2	39.62±2.4	39.74±0.2	77.07±1.0	46.21±0.3
BL-219	100.37±0.3	125.63±0.1	29.79±0.3	19.00±0.2	276.20±0.5	250.86±0.8
BL-220	129.15±0.3	143.84±0.1	39.66±0.8	32.66±0.3	206.14±4.5	209.14±0.6
BLW-231	111.79±4.0	123.15±0.0	39.61±0.7	38.59±0.4	133.27±2.7	125.69±1.4
BLEND-11-WR-1	98.65±2.7	87.42±0.2	24.47±2.6	23.35±0.1	359.82±10.5	355.69±0.5
BLEND-11-WR-2	118.57±0.4	140.41±0.1	31.59±2.0	32.35±0.3	848.99±7.22	835.86±16.9
SR-308	106.22±1.2	91.31±0.2	39.90±3.3	30.86±0.2	99.94±4.2	90.86±0.3
BR-104	70.21±0.5	94.04±0.5	4.03±3.4	3.69±0.1	118.10±0.3	126.21±0.5

BR-118	124.31±2.0	106.07±2.0	35.59±2.1	39.83±1.4	373.96±10.5	365.00±0.5
BR-133	137.84±4.2	122.13±0.1	6.55±1.7	15.52±0.0	346.37±19.6	324.65±0.6
BRG-111	155.47±3.4	140.63±0.1	13.68±3.4	15.45±0.1	176.66±2.4	166.72±1.3
BRG-224	83.73±0.9	108.05±0.1	57.55±0.3	59.92±1.4	171.20±7.5	163.20±10.6
G-401	134.79±1.8	112.63±0.2	41.28±3.3	41.45±0.7	71.37±1.8	75.00±0.0
G-402	132.42±2.4	100.10±0.2	21.62±3.3	24.27±0.2	54.31±1.6	61.55±0.5
G-403	149.36±1.3	123.47±0.4	45.86±2.1	21.31±0.3	63.73±1.1	62.59±0.5
G-405	129.89±1.3	111.47±0.2	31.31±0.7	29.41±0.1	155.46±1.7	144.83±0.0
G-407	92.05±1.5	75.16±0.2	62.52±2.9	60.11±0.9	82.93±6.3	69.83±0.0
G-408	129.89±3.1	101.68±0.2	59.28±0.1	41.10±0.3	25.17±3.1	21.38±0.8
G-409	98.82±0.9	75.79±0.3	58.83±0.2	42.90±0.1	32.93±5.2	46.55±0.0
G-411	136.36±0.3	110.42±0.1	58.83±0.3	40.69±0.7	83.61±9.2	94.08±0.3
G-412	222.31±1.8	219.47±0.9	30.07±0.5	24.80±0.1	155.46±1.3	143.10±1.6
G-414	207.10±1.1	220.70±9.7	26.87±1.1	23.28±0.0	84.31±25.4	79.65±1.3
G-415	293.52±0.4	298.63±9.5	70.04±0.7	67.52±0.3	177.07±4.8	182.41±0.3
G-418	114.94±1.4	125.37±0.2	82.11±0.1	84.38±0.3	150.45±4.7	139.65±1.0
MR-319	121.62±0.3	110.31±0.9	33.96±1.5	38.93±0.2	539.65±0.8	514.14±0.3
MR-320	126.79±0.5	125.37±0.2	28.14±0.7	28.66±0.2	742.23±3.9	755.86±0.3
P-71	118.47±2.2	135.15±0.2	93.00±4.6	98.72±0.1	189.31±12.0	202.24±0.9
SR-301	139.73±0.4	122.26±0.1	24.10±0.1	28.55±0.1	256.55±1.0	216.90±0.3
SR-302	87.70±5.2	92.37±0.0	20.62±4.6	33.24±0.2	149.31±3.9	128.97±0.3
SR-303	107.84±2.6	97.89±0.0	40.31±2.4	39.97±0.2	155.34±1.9	141.38±0.8
SR-304	135.63±2.5	116.26±0.2	53.00±4.2	48.62±0.2	402.86±3.9	395.35±0.3
SR-305	119.61±1.6	115.42±0.2	49.52±2.7	40.55±0.3	499.47±5.2	523.45±0.6
SR-306	148.55±2.2	120.63±0.2	58.81±0.5	40.35±0.2	582.06±3.2	563.45±1.3
SR-307	90.47±5.1	120.94±0.2	25.35±3.9	38.95±0.5	198.97±1.4	195.00±1.4
SR-309	78.45±1.2	96.21±1.2	37.97±0.6	39.81±0.8	140.51±0.3	113.79±0.0
SR-310	124.14±1.6	110.84±0.2	35.93±0.7	24.76±0.1	195.69±0.9	189.48±0.6
SR-311	119.21±0.9	120.94±0.2	59.48±0.4	48.52±0.1	189.48±8.0	167.07±1.4

SR-312	125.05±1.0	115.26±0.0	37.69±0.1	38.76±0.1	219.65±4.8	207.41±0.5
SR-313	146.57±1.5	134.38±0.2	39.85±2.9	23.28±0.4	394.76±3.1	419.65±0.8
SR-318	121.15±0.8	139.84±0.1	3.41±0.5	9.04±0.1	554.13±0.8	525.52±0.5
SRV-360-1	133.58±1.1	110.47±0.1	23.40±1.8	23.52±0.3	182.23±4.7	158.27±2.7
W-230-42-45-1	102.79±0.1	75.52±0.2	37.04±4.8	51.14±0.2	97.46±1.7	107.07±0.6
WL-502	120.68±1.1	123.26±0.1	11.33±2.5	13.66±0.1	162.35±3.0	180.34±0.8
WO-406	124.52±0.6	114.47±0.2	32.50±2.2	30.41±0.1	114.23±0.5	128.10±1.3
MEAN	**125.58**	**120.78**	**37.73**	**35.80**	**234.29**	**228.19**

Data values are represented as mean±S.D of three replications, ND = Not Detected

Summary

Brinjal (Solanum melongena L.) is the one of the common vegetable grown throughout the world. It is rich in nutrients as well as secondary metabolites which have many benefits for health. Phenolic compounds, constitutes important class of secondary metabolites, popular in present world as they act as antioxidants. Because of their strong antioxidant potential these are extracted from brinjal genotypes.

The fruit extracts of brinjal showed high amount of phenolic compounds such as total phenols, ortho-dihydroxy phenols and flavonols specially in genotypes having fruits of green and white colour. Brinjal fruits has low sugars mainly in white fruits, account for its healthy profile. This seems that brinjal of green colour can be used as natural antioxidant agent and recommened for diabietic patients.

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