<u>Original Research Article</u>

Nutrient composition and total antioxidant activity in eggplant (*Solanum melongena*) germplasm.

ABSTRACT

Brinjal, also referred to as eggplant, is one of the most consumed vegetables worldwide. In this investigation, the nutritional makeup and antioxidant capacities of ripe fruits from six different eggplant germplasms were assessed using accepted methodologies. Germplasms differed significantly in terms of variables such as moisture (88.140–91.327%), total soluble sugar (4.559–6.827%), ash (6.576–9.5%), reducing sugar (0.575–3.383%), crude fat (0.940-1.813%), crude protein (0.783–2.736%), and crude fibre (1.410–3.420%). Ascorbic acid, chlorogenic acid, total phenol, anthocyanins, flavonoids, and DPPH radical scavenging activity all exhibited antioxidant properties, with respective concentrations of 12.486-31.78 mg/100g, 150.820-342.650 mg/100g, 604.920-1007.006 mg GAE/100g, 5.156-14.5174 mg/100g, 10.729-22.192 mg/100g, and 88.860-205.070 µg/ml IC_{50}. The nutritional value of JC-1 and the antioxidant characteristics of SM-6-7 were shown to be superior to other germplasms. The superior germplasms can be recommended for consumption as well as for use in breeding.

Keywords: *Anthocyanin, Brinjal, Fibre, Flavonoids, Soluble sugar*

1. INTRODUCTION

In all of India, eggplant, also known as brinjal, or Solanum melongena L., is a widely produced and consumed vegetable. In practically all Indian cuisines, it has a notable presence. In addition to its culinary qualities, eggplants provide a number of health advantages. One vegetable with a lot of antioxidant activity is eggplant. In India, eggplant is frequently referred to as baingan and goes by a variety of names in various Indian languages, including badne kai in Kannada, begun in Bengali, vankaya in Telugu, bengena in Assamese, and vangi in Marathi. These names were derived from the Sanskrit word "Vatingam" which describes the vegetable's capacity to absorb gas. It is thought that eggplant originated in the Indo-Burman region and then expanded to temperate and tropical regions of the world. Due to its diversity, China is viewed as the secondary centre of origin for eggplant, whereas India is thought to be its primary source [1]. In India, Bangladesh, Pakistan, China, the Middle East, the Philippines, the Far East, Egypt, Italy, France, and the United States, eggplant is widely grown [2]. India and China are the top two producers of eggplant.

As a result of its excellent nutritional value and low caloric value, eggplant is an often consumed food. In addition to having a variety of bioactive substances like phenolics, carotenoids, and alkaloids, eggplant is a rich source of minerals like potassium, magnesium, calcium, sodium, and iron [3]. It also contains saccharides like glucose and fructose. Hydroxycinnamic acids (HCA) and its derivatives are the class of phenolic acid that is most frequently found [4]. Ascorbic acid and phenol, which give eggplant its antioxidant properties, are abundant in eggplant. The phenolic content, skin colour, and fruit size of eggplant all have a positive correlation with its antioxidant capacity. Purple eggplant peel has a stronger antioxidant potential because it contains the potent anthocyanin nasunin, also known as delphinidin-3-p-coumaroylrutinoside-5-glucoside, which inhibits lipid peroxidation and has the ability to chelate iron and reduce ROS production [5]. Assam cultivates a variety of native eggplant genotypes in addition to improved cultivars, although information on their biochemical properties appears to be scarce. In light of the aforementioned findings, a study was done to determine the nutritional makeup and antioxidant activity of Assam eggplant germplasm.

2. MATERIALS AND METHODS

Six eggplant germplasm varieties' mature fruits, JC-1, MLC-1, MLC-3, Longai-R-1, Longai-R-2, and SM-6-7 were collected and examined for a variety of criteria from the Horticultural Experimental Farm of the Assam Agricultural University in Jorhat, Assam.

2.1 Nutritional Components

By oven drying the sample for 48 hours at 80°C (±2) until a consistent weight was attained, moisture was ascertained [6]. By utilising the anthrone method given by Clegg [7] and the method using dinitrosalicylic acid as a reagent described by Miller [8], respectively, the total soluble sugar and the reducing sugar were calculated. The crude protein content of the sample was calculated using the nitrogen value multiplied by the factor 6.25 using the Kjeldahl technique [9]. The amount of crude fat and crude fibre was measured using the Soxhlet extraction device and a defatted sample, respectively, according to the AOAC's [6] guidelines. The AOAC's [9] technique was used to determine the ash (total mineral) concentration.

2.2 Antioxidant properties

By slightly modifying the Folin-Ciocalteau assay described by Slinkard and Singleton [10] and using gallic acid as the reference ingredient, the total phenolic content (TPC) of eggplant extract was measured. The results were represented in mg gallic acid equivalents per 100 g of dried sample. The Folin-Ciocalteau reagent was used to determine the chlorogenic acid using the method Swain and Hill [11] outlined. Quercetin was employed as the reference compound, and the values were reported in mg of quercetin equivalents per 100 g of dry weight sample, using the method outlined by Woisky and Salantino [12]. By utilising acidified ethanol (ethanol and HCl 1.0 N, 85:15 v/v), the Abdel-Aal and Hucl technique [13] was used to assess the anthocyanin content. The results were expressed as mg cyanidin-3-O-glucoside equivalents per 100 g of fresh sample. By employing the 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) technique developed by Vani *et al*. [15] and Blois [14], the antioxidant activity was evaluated. Using ascorbic acid as a reference substance, the interpolation from the linear regression curve was used to determine the percent inhibition and the concentration of the sample required to reduce the DPPH concentration by 50% (IC_{50} value). A one-way analysis of variance was performed using the SPPS 25.0 programme for Windows on the data collected in triplicates.

3. RESULTS AND DISCUSSION

Tables 1 and 2 show, respectively, the nutritional makeup and antioxidant properties of the ripe fruits of six different eggplant germplasms. While dried samples were utilised for other parameters, fresh samples were used to measure ascorbic acid, anthocyanin, moisture content, and total antioxidant activity by DPPH. The germplasm Longai-R-1 (91.32 percent) and SM-6-7 (88.14 percent) had the highest and lowest moisture contents, respectively, supported by the works of Hanson *et al*. [16] and Kandoliya *et al*. [17]. Similar values by Khan *et al*. [18] supported that the total soluble sugar concentration was highest in

MLC-1 (6.82 g/100g) and lowest in Longai-R-2 (4.55 g/100g). The reducing sugar concentration was discovered to be highest in JC-1 (3.38 mg/100g) and lowest in MLC-1 (0.57 mg/100g).

The present findings are supported by reports on lowering sugar by Singh *et al*. [19] and Bajaj *et al*. [20]. It was discovered that the crude protein content varied from 0.78 (SM-6-7) to 2.73 (JC-1) g/100g, which is higher than the values reported by Raigon *et al*. [3]. This difference in the crude protein content could be explained by variations in genotype, the nutritional status of the soil, or other biotic interactions. Similar to the results published by San José *et al*. [21], the crude fibre content was determined to be lowest in MLC-3 (1.41 percent) and greatest in Longai-R-2 (3.42 percent). The crude fat content was found to be lowest in Longai-R-2 (0.94%) and greatest in MLC-3 (1.81%), which is really corroborated by the studies of Joel *et al*. [22]. According to Khan *et al*.'s [18] comparable findings, the ash concentration was found to be lowest in SM-6-7 (6.57 g/100g) and highest in Longai-R-2 (9.50 g/100g).

According to the findings of Medina *et al*. [23], the amounts of ascorbic acid were found to be highest in JC-1 (31.780 mg/100g) and lowest in Longai-R-1 (12.486 mg/100g). Similar to the values reported by Hanson *et al*. [16], the total phenol content was found to be lowest in Longai-R-1 (604.92 mg GAE/100g) and greatest in SM-6-7 (1007.00 mg GAE/100g). Due to the various processing techniques used, Sembring and Chin [24] and Kadhim *et al*. [25] reported reduced TPC content, which may differ from the results of the current investigation. The most prevalent hydroxycinnamic acid (HCA) derivative discovered in eggplant is chlorogenic acid [26, 4]. The eggplant utilised in this investigation had between 150.82 (Longai-R-1) and 342.65 (MLC-1) mg/100g of chlorogenic acid, which is supported by the work of Gajewski *et al*. [27]. The anthocyanin concentration ranged from 5.15 mg Cya-3-gluE/100g (SM-6-7) to 14.51 mg Cya-3-gluE/100g (Longai-R-1). Despite having the highest antioxidant activity, cultivar SM-6-7 had the lowest anthocyanin level. This may be because less peel was included in the sample during the research because the fruit is oval-shaped. The range of 10.72 (MLC-3)-22.19 (JC-1) mg QE/100g obtained for the flavonoid content was in good accord with the values reported by Kaur *et al*. [28] 5.00–26.00 mgQE/100g, 3.00–10.00 mgQE/100g, 9.00–11.00 mgQE/100g, and 6.00–12.00 mgQE/100g in wild genotypes, purple genotypes, white genotypes, and green genotypes on a fresh weight basis were found to be in good accord with the current study. Eggplant germplasm had significant antioxidant activity, with an IC_{50} value between 89.13 and 205.52 g/ml. The high phenolic content of the germplasm may be responsible for the high antioxidant activity. MLC-1 had the lowest antioxidant activity, while SM-6-7 had the highest. The results of this study were discovered to be consistent with the values published by Nisha *et al*. [29].

4. CONCLUSION

It is possible to draw the conclusion from the current study that there is intervarietal diversity in the eggplant germplasm, which can be used in the future for various breeding programmes to generate an improved variety or be advised for consumption. While JC-1 was discovered to have high nutritional qualities with the highest amounts of reducing sugar, crude protein, flavonoid content, and ascorbic acid SM-6-7 was discovered to be superior in terms of antioxidant properties having highest antioxidant activity and highest content of total phenol among other germplasms.

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Table 1. Nutrient composition of eggplant germplasm (dry weight basis)

Genotype/Parameters	JC-1	Longai-R-1	Longai-R-2	MLC-1	MLC-3	SM-6-7	$CD_{0.05}$	S.Ed
Moisture (%)	89.72 ± 0.71^{bc}	91.32 ± 0.61^{a}	90.47 ± 0.73^{abc}	89.14 ± 0.24^{cd}	90.85 ± 0.24^{ab}	88.14 ± 0.34^{d}	0.94	0.43
Total soluble sugar (g/100g DW)	6.00 ± 0.004^{b}	5.89 ± 0.012^{c}	4.55 ± 0.01^{f}	6.82 ± 0.01^{a}	5.03 ± 0.02^{d}	4.97 ± 0.01^{e}	0.03	0.01
Reducing sugar (g/100g DW)	3.38 ± 0.31^{a}	1.93 ± 0.05^{c}	1.66 ± 0.08^{c}	0.57 ± 0.02^{d}	0.93 ± 0.04^{d}	2.74 ± 0.14^{b}	0.26	0.12
Crude protein (g/100g DW)	2.73 ± 0.16^{a}	1.76 ± 0.24^{b}	1.46 ± 0.19^{bc}	1.30 ± 0.11^{c}	1.72 ± 0.14^{bc}	0.78 ± 0.10^{d}	0.29	0.13
Crude fibre (% DW)	1.73 ± 0.08^{c}	2.43 ± 0.23^{b}	3.42 ± 0.09^{a}	2.650 ± 0.095^{b}	1.41 ± 0.35^{c}	2.67 ± 0.09^{b}	0.34	0.15
Crude fat (% DW)	1.14 ± 0.05^{d}	0.98 ± 0.02^{e}	0.94 ± 0.04^{e}	1.45 ± 0.008^{b}	1.81 ± 0.02^{a}	1.24 ± 0.01^{c}	0.05	0.02
Ash (g/100g DW)	7.33 ± 0.22^{b}	7.51 ± 0.25^{b}	9.50 ± 0.21^{a}	9.26 ± 0.24^{a}	7.58 ± 0.23^{b}	6.57 ± 0.32^{c}	0.45	0.20

$^{a-f}$ Means in the same row with different letters are significantly different ($P < 0.05$)
Means±standard deviation of three replications

Table 2. Antioxidant properties of eggplant germplasm

Genotype/Parameters	JC-1	Longai-R-1	Longai-R-2	MLC-1	MLC-3	SM-6-7	$CD_{0.05}$	S.Ed
Ascorbic acid (mg/100g FW)	31.78±0.72^{a} (309.14)*	12.48±0.28^{f} (143.85)*	16.93±0.11^{d} (177.68)*	15.29±0.50^{e} (140.82)*	25.43±0.43^{b} (277.99)*	21.58±0.28^{c} (181.98)*	0.78	0.35
Total Phenol (mg GAE/100gm DW)	903.12±1.06^{b}	604.92±1.25^{e}	702.70±0.28^{c}	631.08±0.55^{d}	903.80±0.45^{b}	1007.00±1.20^{a}	1.02	0.46
Chlorogenic acid (mg/100g DW)	300.28±0.47^{b}	150.82±0.57^{f}	164.85 ±0.95^{e}	342.65±1.93^{a}	274.63±0.61^{c}	224.07±1.11^{d}	1.92	0.87
Anthocyanin content (Cya-3-gluE mg/100g FW)	10.92±0.34^{b} (106.26)*	14.51±1.16^{a} (167.25)*	10.59±0.84^{c} (110.58)*	8.60±0.89^{e} (79.22)*	9.34±0.33^{d} (102.07)*	5.15±0.30^{f} (43.47)*	1.31	0.59
Flavonoid content (mg QE/100g DW)	22.19±0.38^{a}	12.28±0.27^{d}	13.05±0.46^{d}	19.72±0.25^{b}	10.72±0.50^{e}	14.78±0.03^{c}	0.63	0.29
IC_{50} (µg/ml FW)	92.79± 0.19^{e} (0.09 mg)*	111.68±0.73^{c} (0.13 mg)*	105.03±0.61^{d} (0. 11mg)*	205.52±0.54^{a} (0.18 mg)*	195.30±1.26^{b} (0.21 mg)*	89.13± 0.23^{f} (0.07 mg)*	1.25	0.56

$^{a-f}$ Means in the same row with different letters are significantly different ($P < 0.05$)
Means±standard deviation of three replications
**Values inside brackets are on dry weight basis.*