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Studies on nutritional and morphological quality of different cultivars of sweet potato

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Abstract

Fifteen cultivars of sweet potato (*Ipomoea batatas* L.) were harvested from the field of (All India Coordinated Research Project on Tuber Crops) AICRP, Horticulture Research Station, Mandouri and the analysis of biochemical composition was carried out to determine the best nutritive cultivars. It was carried out in the Post graduate lab, Department of Post Harvest Technology, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia West Bengal, during the period from 2017-2019.

It was found that the tuber weight was varied significantly from 48.11gm to 540.45 gm among the different cultivars. The tuber length was recorded high in TSP-16-2 (12.22cm) and short in cultivar BCSP-10 (6.75cm). Maximum TSS value recorded in KISHAN (10.2°Brix) and the lowest value was recorded cultivar TSP-12-10 (8°Brix). Dry matter content was found higher in the cultivars TSP-12-6 (30.54%). Minimum content of dry matter was found in TSP-12-9 (23.55%). The highest total sugar value was found in the cultivars TSP-16-5 (2.55%). The cultivar with lowest total sugar content was found in TSP-16-8 (1.94%). The result indicated that the cultivars differed considerably in reducing sugars content. In the experiment highest content was found to be in the cultivar BCSP-10 (1.21%). Lowest was found in the cultivars TSP-12-10 (0.83%). The highest Titratable acidity value was found in the cultivars KISHAN (0.416%) and Lowest was found in the cultivars TSP-12-10 (0.128%).

Keywords: Nutritional, morphological quality, cultivars, sweet potato

Introduction

Sweet potato (*Ipomoea batatas*) is non dicotyledonous plant which belongs to the family of Convolvulaceae (Tortoe, 2010) ^[20] grown as a starchy food crop throughout the tropical, sub-tropical and frost-free temperate climate zones in the world (ICAR, 2007) ^[11]. It is among the world's most important versatile and underutilized food crop grown generally for its storage roots (Tortoe, 2010) ^[20]. It is a minor root crop in tropical Africa and despite its industrial potentials as indicated by its growth in terms of production. Among the root and tuber crops, it is the only one that had a positive per capita annual rate of increase in production in Sub-Saharan Africa. It has been a life saver for centuries in many tropical, sub-tropical and warmer temperate areas of the world, warding off famine in times of both climatic disaster and war produces storage roots rich in carbohydrates and β -carotene, a precursor of vitamin A, and its leaves are rich in proteins. The roots also contain vitamins C, B complex, and E as well as potassium, calcium, and iron. Purple-fleshed ones contain antioxidants such as anthocyanins. In world crop statistics, the sweet potato is ranked seventh, just after cassava, with an annual production around 9 Mt and a cultivated area of 110 Mha (FAO, 2009) ^[6]

Sweet potato originated in the Central or South American low lands. Some remains were also found in the Casma valley of Peru as far back as 2000 B.C. Today, it is cultivated in more than a 100 countries in the world. Sweet potato is cultivated extensively for its nutritious and health-promoting values (FAO, 2012 ^[7]; Lee *et al.*, 2012 ^[15]) and also plays an important role in food security. The production reached over 100 million tons in 2014 (FAOSTAT, 2016) ^[8]

Sweet potato is ranked one of the most important food crop after rice, wheat, potato, maize, and cassava (Shekhar *et al.*, 2015) ^[19]. The total production in India is about 1338 thousand tons and area is 110.63 thousands hectare. In West Bengal the area under sweet potato cultivation is 22.85 thousands hectare and production of sweet potato is about 442.28 thousand tons. It grows under many ecological conditions, has a shorter growth period than most crops and shows no marked seasonality.

In most developing countries, it is a smallholder crop tolerant of a wide range of edaphic and climatic conditions and grown with limited inputs. It is also quite tolerant of cold and being cultivated at altitudes as high as 2,500 m, it has become the staple of communities living in the highlands of Uganda, Rwanda, and Burundi in Eastern Africa and in Papua New Guinea where annual per capita fresh roots consumption is over 150 kg. Asia is the largest producing region and China alone accounts for almost 60% of world production. In the southern provinces of Sichuan and Shandong, sweet potato is a major source of raw material for food processing industries (Fuglie and Hermann, 2004)^[9]. Nearly half of the Chinese production is for animal feed (roots and leaves), with the remainder primarily used for human consumption, either as fresh (boiled roots) or processed products (noodles and alcohol). In some temperate countries such as the United States, Japan, and New Zealand, the sweet potato is a high-quality luxury vegetable.

Sweet potato plays a major role as a famine reserve for many rural and urban households because of its tolerance to drought, short growth and high yield with limited inputs on relatively marginal soils. Sweet potato cultivars are rich in dietary fiber, minerals, vitamins and antioxidants, including anthocyanins, phenolic acids, beta-carotene and tocopherol (Bengtsson *et al.*, 2008^[4]; Kim *et al.*, 2007^[13]; Van Jaarsveld *et al.*, 2006^[23]; Tokusoglu *et al.* 2005, 2003^[21] ^[22]). Roots, stems and leaves of sweet potatoes are edible parts with varying composition of nutrients, bioactive, non-nutrients and anti nutrients. It is a low input crop and it is used as a vegetable, dessert, source of starch and it is eaten as a substitute for yam due to its lower cost of production. Sweet potato is comparatively a nutritional heavy weight; rich in complex carbohydrates, vitamins C and E, and also contains good quantities of vitamins A and B, calcium and iron. India has a long history of cultivation of sweet potato (*Ipomoea batatas*) which is one such crop rich in β -carotene, a precursor of vitamin A. Sweet potato has been reported to contain both organic and mineral nutrients including vitamins A and C, zinc, potassium, sodium, manganese, calcium and magnesium.

Materials and Methods

Fifteen cultivars of sweet potato (*Ipomoea batatas* L.) were harvested from the field of (All India Coordinated Research Project on Tuber Crops) AICRP, Horticulture Research Station, Mandouri after 120 days and brought in the lab for analysis of biochemical composition in order to determine the best nutritive cultivars.

Treatment details: The varieties of sweet potato which were evaluated for nutritional aspect assessment are actually the individual treatments.

T₁ = KISHAN, T₂ = SRIBHADRA, T₃ = ST-14, T₄ = BCSP -10, T₅ = TSP -12-4, T₆ = TSP-12-6, T₇ = TSP-12-7, T₈ = TSP-12-9, T₉ = TSP-12-10, T₁₀ = TSP-12-12, T₁₁ = TSP-12-14, T₁₂ = TSP-16-2, T₁₃ = TSP-16-3, T₁₄ = TSP-16-5, T₁₅ = TSP-16-8.

Observations recorded

A. Physical parameters evaluated

1. Tuber weight (gm)
2. Tuber length (cm)
3. Tuber diameter (cm)
4. Tuber shape.
5. Flesh colour.
6. Skin colour.

Bio-chemical and other quality parameters

1. Moisture content (%)
2. Dry matter content (%)
3. TSS(°B)
4. Total sugar content (%)
5. Reducing sugar content (%)
6. Non reducing sugar content (%)
7. Titratable acidity (%)

Preliminary preparation for experiment

Washing: Sweet potato tubers were washed in tap water after that in distilled water containing 50 ppm of chlorine to get rid of any foreign material that may be adhering to the tuber surface and also to reduce the microbial count.

Drying: There after the sweet potato tubers were dried under electric fan.

Moisture content (%): The sample was dried in drier at 66 °C and initial and final weight was recorded by weighing balance.

$$(\%) \text{ moisture} = \frac{\text{Final value} - \text{initial value} \times 100}{\text{Initial value}}$$

Dry matter content (%): Dry matter of harvested tubers of different cultivars was recorded in gram after drying the samples in drier at 66 °C for few hours.

Total soluble solid (°B): A total soluble solid was determined by using a Hand Refractometer.

Total sugar (%): Sugar level was determined by copper reduction Lane and eynon method (Ranganna, 2000)^[17].

Reducing sugar (%): Sugar level was determined by copper reduction Lane and eynon method (Ranganna, 2000)^[17].

Non reducing sugar (%): Non reducing sugar content was determined by deducting the reducing sugar from the total sugar content.

Titratable acidity (%)

It was estimated as per Sadasivam and Manickam (1996)^[18] which provide a measure of organic acids in the fruits (expressed as % anhydrous citric acid).

Statistical Analysis

The analysis of data obtained in experiment was analyzed by Completely Randomized Design method by adopting the statistical procedures of Gomez and Gomez, (1984)^[10].

Result and Discussion

Table 1: Sweet potato characters (root skin and flesh colour, weight, length and girth) of Sweet potato cultivars

Sl. no.	Cultivars	Morphological characteristics of sweet potato
1.	KISHAN	Sweet potato tuber shape is long elliptical. Predominant skin colour is purple. Predominant flesh colour is white. Average weight of tuber is 133.33gm. Average length is 13.73cm Average diameter of tuber is 6.49cm.
2.	SRIBHADRA	Tuber shape is long elliptical. Predominant skin colour is white pinkish. Predominant flesh colour is off yellowish. Average weight of tuber is 540.45gm. Average length is 10.45cm Average diameter of tuber is 9.15cm.
3.	ST 14	Tubers are curved. Predominant skin colour is orange. Predominant flesh colour is deep orange. Average weight of tuber is 120.74gm. Average length is 9.92cm. Average diameter of tuber is 10.24cm.
4.	BCSP 10	Sweet potato tuber shape is long elliptical. Predominant skin colour is purple. Predominant flesh colour is white. Average weight of tuber is 70.16 gm. Average length is 6.75cm Average diameter of tuber is 3.46cm.
5.	TSP-12-4	Sweet potato tuber shape is long elliptical. Predominant skin colour is purple. Predominant flesh colour is white. Average weight of tuber is 198.22 gm. Average length is 10.63cm Average diameter of tuber is 5.35cm.
6.	TSP-12-6	Sweet potato tuber shape is long elliptical. Predominant skin colour is purple. Predominant flesh colour is white. Average weight of tuber is 71.45. Average length is 7.36 Average diameter of tuber is 4.62cm.
7.	TSP-12-7	Sweet potato tuber shape is long elliptical. Predominant skin colour is purple. Predominant flesh colour is white. Average weight of tuber is 48.11 gm. Average length is 8.27cm Average diameter of tuber is 4.2cm.
8.	TSP-12-9	Sweet potato tuber shape is long elliptical. Predominant skin colour is light pinkish. Predominant flesh colour is off white. Average weight of tuber is 170.66 gm. Average length is 10.29cm Average diameter of tuber is 6.79cm.
9.	TSP-12-10	Sweet potato tuber shape is long elliptical. Predominant skin colour is purple. Predominant flesh colour is white. Average weight of tuber is 145.5 gm. Average length is 7.49cm Average diameter of tuber is 4.21cm.
10.	TSP-12-12	Sweet potato tuber shape is round elliptical. Predominant skin colour is purple. Predominant flesh colour is white. Average weight of tuber is 185.75 gm. Average length is 8.52cm Average diameter of tuber is 5.46cm.
11.	TSP-12-14	Sweet potato tuber shape is roundish. Predominant skin colour is light purple. Predominant flesh colour is white. Average weight of tuber is 162.42 gm. Average length is 7.16cm Average diameter of tuber is 5.47cm.
12..	TSP-16-2	Sweet potato tuber shape is long elliptical. Predominant skin colour is white pinkish. Predominant flesh colour little yellowish. Average weight of tuber is 470.45 gm. Average length is 12.22cm Average diameter of tuber is 7.76cm.
13.	TSP-16-3	Sweet potato tuber shape is long elliptical. Predominant skin colour is white pinkish. Predominant flesh colour is deep orange Average weight of tuber is 220.59 gm. Average length is 9.56cm Average diameter of tuber is 5.95cm.
14.	TSP-16-5	Sweet potato tuber shape is round elliptical. Predominant skin colour is purple. Predominant flesh colour is deep orange. Average weight of tuber is 425.73 gm. Average length is 8.16cm Average diameter of tuber is 6.4cm.
15.	TSP-16-8	Sweet potato tuber shape is curved. Predominant skin colour is white pinkish. Predominant flesh colour is white. Average weight of tuber is 337.43gm. Average Tuber length is 7.66cm Average diameter of tuber is 5.12cm.

Table 2: Physical parameters (weight, length and Tuber diameter) of sweet potato Cultivar

Cultivars	Tuber weigh	Tuber length	Tuber diameter
KISHAN	133.33	9.73	6.49
SRIBHADRA	540.45	10.45	9.15
ST 14	220.74	9.92	10.24
BCSP 10	70.16	6.75	3.46
TSP-12-4	198.22	10.63	5.35
TSP-12-6	71.45	7.36	4.62
TSP-12-7	48.11	8.27	4.2
TSP-12-9	170.66	10.29	6.79
TSP-12-10	145.5	7.49	4.21
TSP-12-12	185.75	8.52	5.46
TSP-12-14	162.42	7.16	5.47
TSP-16-2	470.45	12.22	7.76
TSP-16-3	220.59	9.56	5.95
TSP-16-5	425.73	8.16	6.4
TSP-16-8	337.43	7.66	5.12

Tuber weight (gm)

Tuber weight was varied significantly from 48.11gm to 540.45 gm among the different cultivars. The tuber weight was recorded very high in SRIBHADRA (540.45gm), followed by TSP-16-2 (470.45gm) and the lowest tuber weight was recorded in TSP-12-7 (48.11g), BCSP-10(70.16gm), TSP-12-6(71.45gm). Bhattacharya, N. (2001) [2].

Tuber length (cm)

Tuber length varied significantly from 6.75cm to 12.22cm among the different sweet potato cultivars. The tuber length was recorded high in TSP-16-2 (12.22cm) followed by TSP-

12-4 (10.63cm) and short in cultivar BCSP-10 (6.75cm). Bhattacharya, N. (2001) [2].

Tuber diameter (cm)

Tuber diameter was varied from 3.46cm to 10.24cm among the different sweet potato cultivars. The tuber diameter was recorded maximum in ST-14(10.24cm) followed by SRIBHADRA (9.15cm), TSP-16-2 (7.76cm) and the minimum tuber girth were recorded in cultivar BCSP-10 (3.46cm). Bhattacharya, N. (2001) [2].

Table 3: Biochemical attributes of different sweet potato cultivars.

Cultivars	TSS (^o Brix)	Dry Matter (%)	Moisture (%)
KISHAN	10.2	29.55	70.45
SRIBHADRA	8.4	24.51	75.49
ST 14	9.6	26.52	73.48
BCSP 10	9.8	29.93	70.07
TSP-12-4	9.2	28.75	71.25
TSP-12-6	8.6	30.54	69.46
TSP-12-7	8.8	27.50	72.50
TSP-12-9	8.2	23.55	76.45
TSP-12-10	8	25.39	74.61
TSP-12-12	9.2	29.86	70.14
TSP-12-14	9.8	29.47	70.53
TSP-16-2	9	26.40	73.60
TSP-16-3	9.2	27.46	72.54
TSP-16-5	9.4	25.56	74.44
TSP-16-8	9.2	25.59	74.41
MEAN	9.10	27.37	72.63
S.Em(±)	0.058	0.175	0.175
CD 5%	0.168	0.508	0.508

Studies on bio-chemical properties of sweet potato tubers

During observation of sweet potato cultivars TSS, dry matter content, moisture percentage varies from cultivars to cultivars.

Total Soluble Solids (TSS) Content

The data presented in table indicated that TSS varies cultivars to cultivars, its varies from 8.0 to 10.2°Brix. Maximum TSS value recorded in KISHAN (10.2°Brix) followed by cultivars BCSP 10 (9.8°Brix), TSP-12-14 (9.8°Brix), ST-14 (9.7°Brix). The lowest value was recorded cultivar TSP-12-10 (8°Brix).

Dry Matter (%)

Dry matter content was found higher in the cultivars TSP-12-6 (30.54%) followed by BCSP -10 (29.93%) TSP-12-12(29.86%), KISHAN (29.55%). Minimum content of dry matter was found in TSP-12-9(23.55%).

These results correlate with the findings of Vasudevan *et al.* (1996)^[24]; Akkamahadevi *et al.* (1996)^[11]. The low dry matter content may be due to presence of high moisture in the tuber. The average dry matter content is 26.27%, but varies according to cultivar, climate, soil conditions and agronomic practices (Ingabire and Vasanthakaalam, 2011)^[12].

Moisture (%)

Moisture percentage of sweet potato tubers was also varied significantly among the different cultivars. The maximum value was recorded in TSP-12-9 (76.45%) followed by SRIBHADRA (75.49 %), TSP-12-1 (74.61%). Minimum moisture content was found in TSP-12-6 (69.46%).

Table 4: Bio chemicals attributes of different sweet potato cultivars

Cultivars	Total Sugar (%)	Reducing Sugar (%)	Non-Reducing Sugar (%)	Acidity (%)
KISHAN	2.20	1.14	1.06	0.416
SRIBHADRA	2.02	1.12	0.90	0.256
ST 14	2.45	1.17	1.28	0.224
BCSP 10	2.06	1.21	0.85	0.32
TSP-12-4	1.95	1.05	0.90	0.352
TSP-12-6	2.15	1.15	1.0	0.224
TSP-12-7	2.35	1.19	1.16	0.16
TSP-12-9	2.10	1.13	0.97	0.256
TSP-12-10	2.00	1.17	0.83	0.128
TSP-12-12	2.40	1.14	1.26	0.224
TSP-12-14	2.15	1.16	0.99	0.352
TSP-16-2	2.05	1.13	0.92	0.32
TSP-16-3	1.98	1.07	0.91	0.352
TSP-16-5	2.55	1.19	1.36	0.288
TSP-16-8	1.94	1.06	0.88	0.288
MEAN	2.16	1.14	1.01	0.277
S.Em (±)	0.036	0.020	0.017	0.018
CD 5%	0.106	0.058	0.050	0.054

Total Sugar

Considerable cultivar specific differences in total sugar content of tubers were also recorded. Total sugar content varies from 2.55% to 1.94 the highest value was found in the cultivars TSP-16-5 (2.55%), followed by ST-14(2.45%). Lowest total sugar content was found in TSP-16-8 (1.94%), followed by TSP-12-4(1.95%).

Total sugars in stored, raw staple sweet potato types range from 1.9% to 3.2% on a fresh weight (FW) basis (Picha, 1986)^[16]. These results correlate with the findings of (Chattopadhyay *et al.*, 2002)^[5]. Akkamahadevi *et al.* (1996)^[11]

Reducing Sugar

The result indicated that the cultivars differed considerably in reducing sugars content. In the experiment highest content was found to be in the cultivar BCSP-10(1.21%) followed by TSP-16-5 (1.19%), TSP-12-7 (1.19%). Lowest was found in the cultivars TSP-12-4 (1.05%).

These results correlate with the findings of (Chattopadhyay *et al.*, 2002)^[5]. Akkamahadevi *et al.* (1996)^[11].

Non-Reducing Sugar

Non reducing sugar content of tubers was varies considerable among the cultivars. In the experiment highest content was found to be in the cultivar TSP-16-5 (1.36%), followed by ST-14 (1.28%), TSP-12-12 (1.26%). Lowest was found in the cultivars TSP-12-10 (0.83%).

These results correlate with the findings of (Chattopadhyay *et al.*, 2002)^[5].

Titrateable Acidity: The result indicated that in sweet potato cultivars acidity present in very low scale. The highest value was found in the cultivars KISHAN (0.416%) followed by TSP-12-4, (0.352%), TSP-12-14 (0.352%) TSP-16-3 (0.352%). Lowest was found in the cultivars TSP-12-10 (0.128%).

Summary and Conclusion

15 varieties of sweet potato were evaluated for its physico-chemical and other important traits. Based on the assessment, it was found that the tuber weight was varied significantly from 48.11gm to 540.45 gm among the different cultivars. This study help in selecting the best nutritive cultivars suitable for making various processed products such as chips and crisps, production of alcohol, flour, snacks, noodles, jam, candies, snacks or biscuits and maltose as a sweetener. Best variety among this cultivars found in KISHAN,ST-14,TSP-12-14.

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