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Post harvest behavior of different sweet potato (*Ipomoea batatas* (L.) Lam) germplasm under ambient conditions

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Abstract
An experiment was undertaken to study the postharvest behavior of different sweet potato germplasm under ambient conditions. The study indicated that minimum physiological loss in weight was observed in BSP-23 and highest was observed in BSP-27. The higher and lower PLW of tubers was due to increased or decreased transpiration changes with progress of storage period along with the genetic makeup of the plant as well as prevailing environmental conditions. Maximum shelf life was recorded in BSP-23 whereas, BSP-7 recorded minimum. BSP-23 recorded maximum reducing sugars, non-reducing sugars and total sugars. Whereas, minimum was recorded in BSP-30 and BSP-27. Significant variation in quality parameters among different genotypes of sweet potato may be due to the inherent genetic makeup of the genotype and influence of environmental conditions.

Keywords: Postharvest behavior, ambient, reducing sugar, non-reducing sugar, shelf life and genetic makeup

Introduction
Sweet potato (*Ipomoea batatas* L.) is a major economical and healthy food crop in developing countries, which is mainly consumed as boiled roots. Sweet potato is positioned as the seventh most major food crop in the world, fourth in tropical countries and fifth most essential food crop on a fresh weight basis in developing countries after rice, wheat, maize and potato [1] with annual production of 141.54 million tonnes [2]. Sweet potato could be a better competitor as food, feed and industrial raw material [3]. Although sweet potato is cheaper than other crops, this abundant resource is still poorly utilized. Sweet potato roots can be processed into products with improved characteristics and longer shelf life. The carbohydrate content of the sweet potato tubers varies from 25 to 30 per cent, while the rest is composed of water (58 to 72 %). Sweet potatoes being good sources of vitamin C, vitamin E, dietary fiber, calcium, potassium and iron, and are low in fat and cholesterol. However, they also contain moderate quantities of thiamine (B_1), riboflavin (B_2), niacin, pantothenic acid (B_5), pyridoxine (B_6) and folic acid. Moderate quantities of sodium, magnesium, manganese and zinc are also present. The tubers are used as subsidiary food after boiling, baking and frying, moreover tubers also form an industrial raw material for the production of starch, alcohol, pectin, *etc*. Being rich in β-carotene, the orange-fleshed sweet potato is gaining importance as the cheapest source of antioxidant having several physiological attributes like anti-oxidation, anti-cancer and protection against liver injury and is most suiting as a bio fortified crop to combat malnutrition in small and marginal farming community. Sweet potato is, no doubt, an important food for the future and requires greater attention from both consumers and researchers in this part of the world.

During storage, the roots are very perishable because they contain high moisture content (60-75%) hence low mechanical strength as well as high susceptible to microbial decay. They have high respiratory rate and the resultant heat production softens the textures which make them susceptible to damage. Postharvest quality deterioration emanates from respiration, weight loss, microbial attack, weevil damage and sprouting. Respiration and sprouting result in loss of nutritive value of tubers. Sprouting in particular leads to weight loss, reduction of nutritional, processing and marketable quality of roots. The shelf-life therefore varies from few days or months according to the cultivar and storage conditions.

The present study was conducted to study the postharvest behaviour of different sweet potato germplasm under ambient conditions.

Material and methods

The present investigation was carried out at the Department of Vegetable Science, College of Horticulture, Mudigere, University of Agricultural and Horticultural Sciences. Shivamogga during the *Rabi* 2017- 18. Thirty genotypes of sweet potatoes were procured from AICRP on Tuber crops, Dharwad, UHS, Bagalkot have been taken for investigation (Table 1). The experiment was laid out in a randomized complete block design (RCBD) with two replications. The treatments in each replication were allotted randomly by using random number table. Sweet potato cuttings which have 2-3 buds were planted in each replication with 3m × 2m plot size at 60cm × 3 cm spacing. The crop was raised by following the recommended package of practices of University of Horticultural Sciences, Bagalkot.

Observations were recorded on five randomly selected plants in each replication for twelve quantitative traits *viz*., Physiological loss of weight, shelf life and quality parameters includes reducing, non-reducing and total sugars.

Table 1: List of sweet potato genotypes used for the study

No	Name of the genotype	No	Name of the genotype	No	Name of the genotype
1	BSP-1	11	BSP-13	21	BSP-23
2	BSP-2	12	BSP-14	22	BSP-24
3	BSP-3	13	BSP-15	23	BSP-25
4	BSP-6	14	BSP-16	24	BSP-26
5	BSP-7	15	BSP-17	25	BSP-27
6	BSP-8	16	BSP-18	26	BSP-28
7	BSP-9	17	BSP-19	27	BSP-29
8	BSP-10	18	BSP-20	28	BSP-30
9	BSP-11	19	BSP-21	29	Vikram
10	BSP-12	20	BSP-22	30	Sree Bhadra

Physiological loss of weight

The initial weight of the tubers was recorded on electric top pan balance in each treatment. Thereafter the weights of tubers under each treatment were recorded at four days interval after storage. The cumulative losses in weight were calculated and expressed as per cent physiological loss in weight. Data presented in table 2.

Following is the formula used in calculating PLW

$$PLW = \frac{P_0 - P_1}{P_0}$$

Where,

P_o- Initial weight

P_1- Final weight

Table 2: Mean performance of sweet potato genotypes for physiological loss in weight (PLW) under ambient storage condition

Sl. No	Genotypes	10th Day	15th Day	20th Day	25th Day	30th Day
1	BSP-1	5.93	6.30	6.49	7.49	8.29
2	BSP-2	7.64	10.50	13.44	15.67	17.88
3	BSP-3	9.17	12.25	17.77	19.10	22.12
4	BSP-6	9.10	14.01	14.37	16.98	19.57
5	BSP-7	8.01	10.97	14.39	17.28	20.16
6	BSP-8	4.28	5.09	8.47	9.67	11.94
7	BSP-9	4.87	7.58	8.77	15.60	12.64
8	BSP-10	4.96	6.39	7.68	8.55	9.24
9	BSP-11	5.45	8.71	11.44	14.63	15.59
10	BSP-12	7.25	8.64	10.61	13.49	13.26
11	BSP-13	6.77	10.78	10.83	11.02	15.06
12	BSP-14	8.20	15.33	20.87	39.42	39.60
13	BSP-15	5.40	5.60	6.47	7.56	8.73
14	BSP-16	8.68	11.11	14.32	18.40	19.05
15	BSP-17	9.20	13.26	14.80	17.39	19.16
16	BSP-18	7.70	7.53	9.39	10.96	12.45
17	BSP-19	8.21	9.64	12.01	13.67	15.88
18	BSP-20	7.09	9.76	12.38	18.80	16.45
19	BSP-21	5.22	7.20	8.73	9.97	11.27
20	BSP-22	7.30	9.02	16.91	19.30	19.47
21	BSP-23	4.31	5.04	7.69	8.10	9.76
22	BSP-24	4.52	6.24	6.61	8.97	10.66
23	BSP-25	7.28	7.80	8.84	14.36	15.64
24	BSP-26	5.00	6.25	13.75	19.26	20.85
25	BSP-27	13.70	17.68	24.13	29.33	34.49
26	BSP-28	9.31	10.26	12.73	16.88	16.96
27	BSP-29	4.73	6.85	8.48	10.00	11.50
28	BSP-30	4.89	8.47	10.41	11.83	13.05
29	Vikram	5.00	6.35	8.08	10.60	10.90
30	Sree Bhadra	5.96	6.58	7.45	9.43	10.80

Mean	6.86	9.01	12.45	14.78	15.44
S.Em±	0.71	1.06	1.31	1.95	1.81
C.D @ 1%	2.78	4.14	5.13	7.65	7.07

Shelf life

The shelf life of tubers was decided based on the appearance and marketability of the tubers. When the tubers attained beyond the edible stage and shriveled, then those tubers were considered to have reached the end of their shelf life [4]. Data presented in the figure 1.

Quality parameters

a) educing sugar

Reducing sugars present in the sweet potato tuber samples were estimated by DNSA reagent method and is expressed in percentage [5] (Table 3).

Table 3: Mean performance of sweet potato genotypes for quality parameters

Sl. No	Genotypes	Reducing sugars	Non-reducing sugars	Total sugars
1	BSP-1	0.55	0.95	1.50
2	BSP-2	0.72	1.04	1.75
3	BSP-3	0.85	0.71	1.55
4	BSP-6	0.57	0.81	1.38
5	BSP-7	0.56	0.77	1.33
6	BSP-8	1.04	1.34	2.37
7	BSP-9	0.50	0.76	1.25
8	BSP-10	0.62	0.92	1.53
9	BSP-11	0.59	0.79	1.37
10	BSP-12	0.50	0.75	1.24
11	BSP-13	0.58	0.84	1.42
12	BSP-14	0.39	0.53	0.92
13	BSP-15	0.67	0.99	1.66
14	BSP-16	0.61	0.90	1.51
15	BSP-17	0.51	0.74	1.24
16	BSP-18	0.97	1.22	2.18
17	BSP-19	0.44	0.60	1.03
18	BSP-20	0.37	0.67	1.03
19	BSP-21	1.20	1.56	2.76
20	BSP-22	0.70	0.92	1.62
21	BSP-23	1.34	1.83	3.17
22	BSP-24	0.60	0.90	1.50
23	BSP-25	0.50	0.67	1.16
24	BSP-26	0.39	0.71	1.10
25	BSP-27	0.31	0.56	0.86
26	BSP-28	0.35	0.51	0.85
27	BSP-29	0.84	1.12	1.96
28	BSP-30	0.31	0.45	0.75
29	Vikram	0.63	0.84	1.47
30	Sree Bhadra	0.63	0.92	1.54
Mean		0.63	0.88	1.50
S.Em±		0.02	0.03	0.02
C.D @ 1%		0.006	0.08	0.08

The clean and dried test tubes were taken to which 0.2, 0.4, 0.6, 0.8 and 1 ml of prepared standard glucose was added. This was made up of 1ml using distilled water and 1ml of DNS reagent was added. The test tubes were closed with aluminum foil and were kept in boiling water both for 10 minutes. The test tubes were cooled, and 4 ml of distilled water was added. The test tubes were vortexed and O.D measured at 540 nm. Clean and dried test tubes were taken to which 2.5 ml of prepared sample was taken and O.D was measured at 540 nm. The amount of reducing sugar present in the sample was calculated using standard graph.

$$\text{Reducing sugars (\%)} = \frac{\text{glucose (mg) in sample from standard curve}}{\text{Aliquot taken for test (ml)}} \times \frac{\text{vol. made (ml) after alcohol evaporation}}{\text{Vol. taken for alcohol evaporation (ml)}} \times \frac{\text{vol. made (ml) after sample extraction}}{\text{Sample taken for extraction (mg)}} \times 100$$

b) Non-reducing sugar

The percentage of non-reducing sugars was obtained by subtracting the percentage of reducing sugars from the total sugars and expressed in percentage (Table 3).

Non-reducing sugar (%) = Total sugar- Reducing sugar

c) Total Sugars

Total sugars present in the sweet potato tuber samples were estimated by Anthrone reagent method and is expressed in percentage [5] (Table 3).

1 ml of sample aliquot was pipette out and different concentrations (0, 0.2, 0.4, 0.6, 0.8 and 1.0 ml) of standard glucose solution in different test tubes and made up the volume of 2.5 ml each with distilled and all the tubes are kept in an ice bath, and 5 ml of anthrone reagent was added slowly. The contents were stirred gently with a glass rod. Then the contents were heated on boiling water bath exactly for 7.5 minutes and cooled immediately in ice bath. After cooling, the absorbance of the solutions were measured at 630 nm against the blank. Then the sugar content was calculated through standard glucose curve.

$$\text{Total sugars (\%)} = \frac{\text{Glucose (mg) in a sample from standard curve}}{\text{aliquot taken (ml) for test}} \times \frac{\text{vol. made after hydrolysis (ml)}}{\text{Vol. taken for alcohol hydrolysis (ml)}} \times \frac{\text{vol. made after alcohol evaporation (ml)}}{\text{Vol. taken for evaporation (ml)}} \times \frac{\text{vol. made after sample extraction (ml)}}{\text{sample taken for extraction (mg)}} \times 100$$

Result and discussion

Physiological Loss of Weight (PLW)

The significant difference between the treatments was noticed with respect to Physiological loss of weight (Table 10). The minimum PLW at 10th, 15th,20th, 25th and 30th day (4.31 %, 5.04 %, 7.69 %, 8.10 % and 9.76 %, respectively) was recorded in genotype BSP-23 followed by BSP-21 (5.22 %, 7.20 %, 8.73 %, 9.97 % and 11.27 %, respectively) whereas, BSP-27 recorded highest physiological loss of weight (13.7 %, 17.68 %, 24.13 %, 29.33 % and 34.49 %, respectively) (Table 2). The results pertaining to physiological loss of weight (PLW) differed significantly among the genotypes. The higher and lower PLW of tubers was due to increased or decreased transpiration changes with progress of storage period along with the genetic makeup of the plant as well as prevailing environmental conditions. These results are in conformity with the findings of [6].

Shelf life

The genotypes differed significantly for shelf life of tubers. The maximum shelf life was observed in genotype BSP-23, BSP-1 and BSP-19 (44.50 days) followed by BSP-25 (42.50 days) and it was minimum in BSP-7 (28.50 days) (Figure 1). This might be due to inherent genetic makeup of genotypes and influence of prevailing environmental conditions and also due to physico-chemical and biochemical reaction inside the tubers. Similar results were recorded by [7].

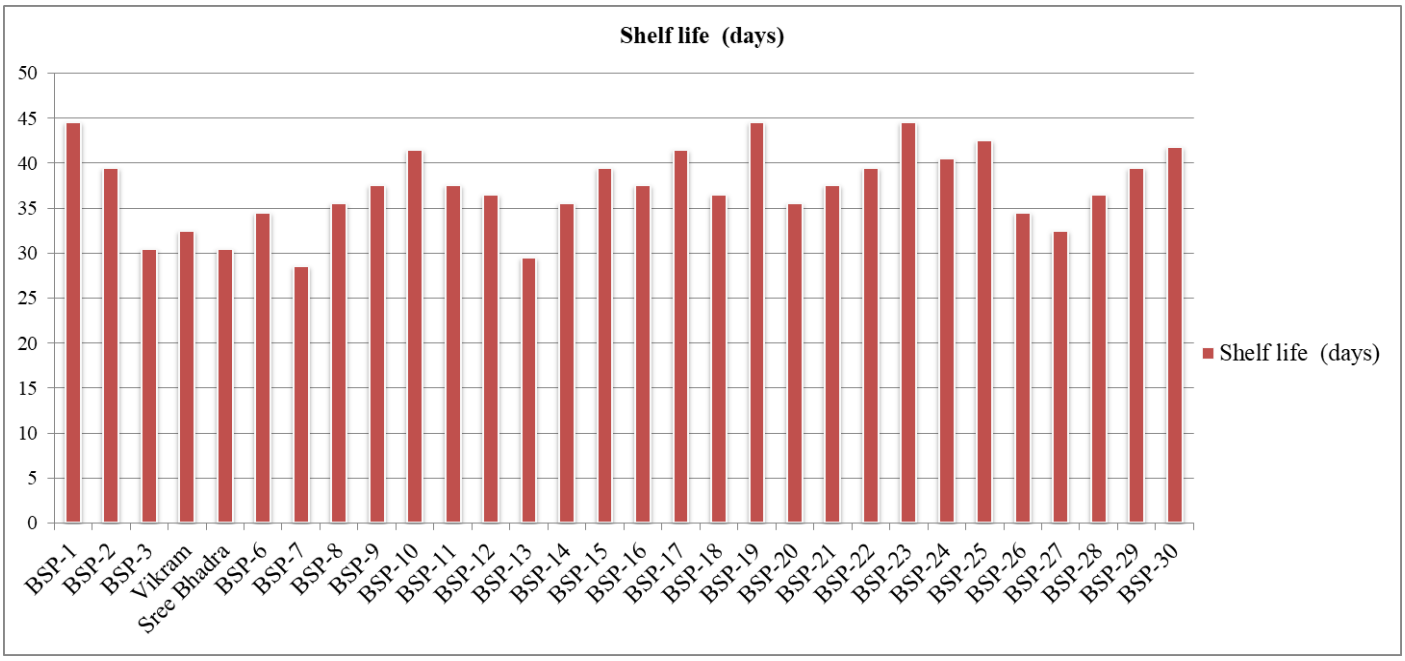

Fig 1: Mean performance of sweet potato genotypes for shelf life

Quality parameters

Genotype BSP-23 recorded maximum reducing sugar (1.34%), non-reducing sugar (1.83%) and total sugar (3.17%) which was followed by BSP-21(1.20%) for reducing sugar, non-reducing sugar (1.56%) and total sugar (2.76%). whereas minimum reducing sugar (0.30%) recorded in genotype BSP-27 and BSP-30. Genotype BSP-30 showed minimum non-reducing (0.45%) and total sugar (0.75%). Significant variations in quality parameters among different genotypes of sweet potato may be due to the inherent genetic makeup of the genotype and influence of environmental conditions (Table 3). The similar study was conducted by earlier scientist [8].

Conclusion

The present investigation revealed that considerable degree of variability exists among the different genotypes of sweet potato for postharvest behavior and quality traits. Thus from the study, considering the better performance in terms of quality of sweet potato genotypes, BSP-23 and BSP-21 found

to be superior over other genotypes with respect to physiological loss in weight, reducing sugar, non-reducing sugar, total sugar whereas, BSP-23 and BSP-1 showed maximum shelf life under ambient conditions. Hence, they were best for cultivation under hill zone of Karnataka.

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