Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(5): 1766-1769
Received: 25-07-2017
Accepted: 26-08-2017

Rakesh Reddy
Post-harvest technology of horticultural crops. Bidhan Chandra Krishi Viswavidyalaya (bckv), Nadia, Mohanpur, West Bengal (w.b.), India

Helen Soibam
Post-harvest technology of horticultural crops., BCKV, Nadia, Mohanpur, West Bengale, India

Ayam Victor Singh
Department of botany, Rajiv Gandhi University Rono hills, Doimukh, Itanagar, Arunachal Pradesh, India

Surajit Mitra
Post-harvest technology of horticultural crops., BCKV, Nadia, Mohanpur, West Bengal, India

Correspondence
Ayam Victor Singh
Department of botany, Rajiv Gandhi University Rono hills, Doimukh, Itanagar, Arunachal Pradesh, India

Biochemical evaluation for the selection of suitable processed products in sweet potato cultivars

Rakesh Reddy, Helen Soibam, Ayam Victor Singh, Surajit Mitra

Abstract
Fifteen cultivars of sweet potato (Ipomoea batatas L.) were harvested from the field of (All India Coordinated Research Project on Tuber Crops) AICRPT, Horticulture Research Station, Mandouri and the analysis of biochemical composition was carried out to determine the best nutritive cultivars suitable for making the various process products. It was observed that total soluble solids (TSS) ranged from Sree Bhadra (6.20°Brix) to TSP 12-4(10.30°Brix), dry matter from 90/101(15.5 %) to X-9(33.1 %), moisture content 90/101 (84.50%) to X-9 (66.20%). Total sugars were 5.31 to 9.54 % in cultivar TSP 12-10 and TSP 12-4, respectively. The reducing sugar content ranged from TSP 12-10 (1.04 %)to ST-14 (1.98 %), followed by non-reducing sugars are from TSP 12-7 (3.65 %) to TSP 12-4 (7.95 %). The total carbohydrate content ranged from TSP 12-8 (18.86 %) to TSP 12-1 (28.63 %), protein content from 1.28 % in TSP 12-5 to 3.56 % in ST-14. β-Carotene content differed quite significantly and ranged from 1.29 mg to 13.4 mg/100g in ST-14 and TSP 12-10, respectively. The starch content of the sweet potato cultivars varied significantly from 90/101(9.20 %) to Kishan (22.40 %). 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. Certain high protein cultivars like ST-14, TSP 12-10, BESP-14 etc. were also recommended for cultivation in malnourished areas. Further, a study on the bioactive components and processing can be carried out for the future commercialization.

Keywords: sweet potato, cultivar, composition, human food, β-carotene

Introduction
Sweet potato (*Ipomoea batatas* L.) of family Convolvulaceaeis a dicotyledonous plant (Tortoe, 2010) [26], grown as a starchy food crop throughout the tropical, sub-tropical and frost-free temperate climate zones in the world (ICAR, 2007). It is among the world's most important versatile and underutilized food crop grown generally for its storage roots (Tortoe, 2010) [26]. Sweet potato has high photosynthetic efficiency (Kapinga *et al*., 1997) [14] and yields a high amount of energy per unit area per unit time and is expected to bridge the food shortages and malnutrition (Nedunchezhiyan *et al*., 2012) [17]. Apart from its root, the vine tips and leaves are used as vegetables and an excellent source of green fodder for cattle. The vines are also used for planting material and so do not compete with the root tubers for human food, in addition to the fact that they are easy to handle and transport to the field (Antiaobong and Bassey, 2008) [2]. Among the tuber crops grown in the world, the sweet potato ranks second after cassava (Ray and Ravi, 2005) [21]. China accounts for the highest sweet potato production in the world, followed by Uganda and Nigeria (FAO, 2011). The crop can be considered very important in promoting nutritional security particularly in agriculturally backward areas (Srinivas, 2009) [24] with poor soils. Sweet potato is considered as a 'poor man's rich food' in many parts of India and is largely grown in three states: Orissa, Uttar Pradesh, and West Bengal. In Orissa, sweet potato is grown on an area of 50,700 hectares, with a production of 4,31,300 tonnes (indiastat.com 2010). Sweet potato is nutritious, with the exception of protein and niacin, it provides over 90% of the nutrient per calorie required for most people. It brings more income to farmers than any other root crop as the roots, leaves and tender vines have economic and nutritional values (Antiaobong and Bassey, 2009). In addition to the nutritional values of sweet potatoes, it has been rediscovered as a functional food containing high levels of various phytochemicals which might have various health beneficial effects (Benjamin, 2007) [4]. Most of the studies on phytochemicals in roots or leaves of sweet potato mentioned their health promoting and disease preventing benefits related to the high level of polyphenols particularly, cancer preventive effects. Because of all these beneficial properties, there is a need to study the biochemical traits in sweet potato cultivars grown at Mandouri field.

Materials and Methods

Fifteen cultivars i.e. TSP 12-1, TSP 12-4, TSP 12-5, TSP 12-6, TSP 12-7, TSP 12-8, TSP 12-10, KISHAN, 90/101, BESP-14, ST-14, K/S (Kamalasundari), Shree Bhadra, X-9 and POL 19-9-3of sweet potato harvested from the field of AICRPT, Horticulture Research Station, Mandouri were analysed for its biochemical composition at Post-Harvest technology, laboratory, BCKV, Mohanpur, Faculty of Horticulture, West Bengal, India to determine the best nutritive cultivar. Moisture content was determined using AOAC (2005) method. TSS by using Hand Refractometer. Spectrophotometrically (UV/VIS Spectrophotometer, Model-Optizen POP, Korea) determination (Sadasivam and Manickam, 2011) [22] method for carbohydrate, starch and total soluble sugar using anthrone reagent at wavelength 630nm, protein content using Folinciocalteau reagent at wavelength 660nm and β-carotene content at wavelength 452nm.Reducing sugar by copper reduction method, using Fehling's solution (Ranganna, 1986). Non – reducing sugar content was determined by deducting the reducing sugar content from the total sugar content. CRD (Completely Randomised Block Design) was done on IBM SPSS STATISTICS 19 software to determine the significant difference between the cultivars.

Results and Discussions

All cultivars showed marked variations in the biochemical compositions studied (Table 1).

Dry Matter: Dry matter content was found higher in the cultivars X-9 (33.8%) which was statistically on par with TSP 12-5 (31.7%) followed by Kishan (30.55%), TSP 12-7 (30.55%) whereas the cultivars ST-14 (24.3%), TSP 12-8 (24.05%), POL 19-9-3 (24.05%), TSP 12-10 (23.25%), K/S (20.95%) recorded lower dry matter in comparison with other cultivars. Minimum content of dry matter was found in 90/101(15.5%). These results correlate with the findings of Scott and Matthews (1957) [23], Takahata *et al.* (1993) [25]; Vasudevan *et al.* (1996) [27]; Akkamahadevi *et al.* (1996) [1]. 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 (Bradbury *et al*., 1985; Ingabire and Vasanthakaalam, 2011) [6, 13].

Moisture: It was maximum in 90/101 (84.50%) which was statistically at par with Sree Bhadra (81.45%), Kamalasundari (79.05%), TSP 12-10 (76.75%), TSP 12-8 (75.95%) and ST-14 (75.70%). Minimum moisture content was found in TSP 12-5 (68.30%) which was statistically at par with X-9 (66.20%).

Total Soluble Solids (TSS): Cultivars differed considerably in TSS content of tubers ranging from 6.2 to 10.3^{0}Brix. Maximum TSS value (10.3^{0}Brix) was recorded in cv. TSP 12-4 followed by cultivars Kishan (9.7^{0}Brix), Kamalasundari (9.5^{0}Brix), TSP 12-1 (9.4^{0}Brix), BESP-14 (9.4^{0}Brix). The lowest value was noticed in cv. Sree Bhadra (6.2^{0}Brix).

Total Sugar: The highest value was found in the cultivar TSP 12-4 (9.54%) which was statistically on par with Kamalasundari (8.96%) followed by BESP-14 (8.71%). The cultivar with lowest sugar content was TSP 12-10 (5.31%). These results correlate with the findings of Zhang *et al.* (2002) [28] and Akkamaha devi *et al.* (1996) [1].

Reducing Sugar: The highest content was recorded in the cultivar ST-14 (1.98%) followed by TSP 12-7(1.72%) which was statistically on par with TSP 12-4 (1.59%), 90/101 (1.53%) and TSP 12-5 (1.42%). The lowest content was recorded in the cultivar TSP 12-10 (1.04%). These results correlate with the findings of Akkamaha devi *et al.* (1996) [1].

Non-reducing sugar: TSP 12-4 (7.95%) recorded the highest value followed by Kamalasundari (7.72%), BESP-14 (7.65%), Kishan (7.17%) while TSP 12-8 (4.22%), TSP 12-5 (4.17%), showed significantly lower non-reducing sugars content. The lowest value was found in the cultivar TSP 12-7 (3.65%).

Carbohydrate: There was significant variation among the cultivars with respect to the total carbohydrates content of tubers i.e. 12.11% to 28.63%. The cultivar TSP 12-1 had a significantly higher amount of total carbohydrates (28.63%) followed by Kishan (28.48%), TSP 12-7 (27.86%) whereas minimum in the cv. 90/101(12.11%). These results correlate with the findings of Omodamiro *et al.* (2013).

Protein: Maximum protein content of (3.56 %) was found in cv. ST-14 which was statistically on par with cv. TSP 12-10 (3.55 %), BESP-14(2.84 %) and Sree Bhadra (2.75%). The lowest content was noticed in cv. TSP 12-5(1.28%). Variability in protein content is due to production practices (Constantine *et al*., 1974), environmental conditions and genetic factors (Collins *et al.*, 1982 and Li, L. 1974) [8].

β-carotene: There was great variation among the cultivars with respect to β-carotene content. The orange-fleshed sweet potato had the highest β-carotene content among the cultivars of sweet potato. Highest carotene content was found in cv. ST-14 with 13.4 mg/100g (fresh weight basis) followed by Kamalasundari (6.27 mg/100g) which are orange fleshed and was lower in cultivars X-9 (1.66 mg/100g), TSP 12-8 (1.6 mg/100g) and TSP 12-5 (1.49 mg/100gm). Minimum was found in TSP 12-10 (1.29 mg/100g). Cultivars X-9 is purple fleshed and cv. TSP 12-10 is white fleshed. These results correlate the findings of Onwueme (1978), Lila Babu *et al.* (1990) [16].

Starch: Starch was found in the range of 9.20-22.40 % among the 15 sweet potato cultivars which agree with the findings of Chatopadhyay *et al.* (2002), Bhattarcharya (2001). Starch content was found to be highest in cv. Kishan (22.40%) which was statistically on par with TSP 12-7 (22 %), TSP 12-1(21.44 %) and BESP-14 (19.60%). The lowest starch content was found in 90/101 (9.20%).

Table 1: Biochemical attributes of different sweet potato cultivars

Cultivars	DM (%)	M (%)	TSS (ºBrix)	TS (%)	RS (%)	NRS (%)	C (%)	P (%)	β-caro (μg/100g)	S (%)
TSP 12-1	30.5	69.5	9.4	8.34	1.22	7.12	28.63	1.28	3.66	21.4
TSP 12-4	28.2	71.8	10.3	9.54	1.59	7.95	25.12	2.5	2.12	18.19
TSP 12-5	31.7	68.3	7.9	5.59	1.42	4.17	26.72	1.28	1.49	19.57
TSP 12-6	30.4	69.6	8	6.86	1.28	5.58	24.01	1.42	3.00	17.7
TSP 12-7	30.55	69.45	7.9	5.37	1.72	3.65	27.86	2.05	2.01	22.0
TSP 12-8	24.05	75.95	7.8	5.39	1.17	4.22	18.86	1.49	1.6	14.8
TSP 12-10	23.25	76.75	7.4	5.31	1.04	4.27	15.63	3.55	1.29	12.4
KISHAN	30.55	69.45	9.7	8.5	1.34	7.17	28.48	1.74	1.74	22.4
90/101	15.5	84.5	8.3	7.55	1.53	6.02	12.11	1.81	5.42	9.2
BESP-14	27.8	72.2	9.4	8.71	1.06	7.65	24.72	2.84	2.64	19.6
ST-14	24.3	75.7	8.9	7.85	1.98	5.87	19.09	3.56	13.4	14.8
K/S	20.95	79.05	9.5	8.96	1.24	7.72	17.11	1.79	6.27	13.2
Shree Bhadra	18.55	81.45	6.2	5.51	1.08	4.43	15.05	2.75	2.54	11.6
X-9	33.8	66.2	8.3	6.25	1.33	4.92	26.38	1.99	1.66	18.32
POL 19-9-3	24.05	75.95	8	6.5	1.31	5.19	20.03	2.13	1.85	16.02
MEAN	26.27	73.72	8.46	7.077	1.35	5.73	21.99	2.144	3.378	16.75
S.Em (±)	0.904	2.203	0.495	0.356	0.26	0.25	0.716	0.317	0.32	1.002
CD (0.05)	2.723	6.983	1.493	1.013	0.9	0.77	2.159	0.957	0.965	3.02

Where, DM=dry matter, M=moisture, TSS=total soluble solids, TS=total sugar, RS=reducing sugar, NRS=non- reducing sugar, C=carbohydrate, P=protein, β-caro=beta-carotene and S=starch

Conclusion

It is, therefore, imperative to select varieties in terms of biochemical characteristics that will enable sweet potato to compete favourably in the market as well as processing industries. Cultivars like X-9, TSP 12-5, TSP 12-7, TSP 12-6, BESP-14, are high in the dry matter with low sugars can be recommended for making the processed products like sweet potato chips and crisps. Cultivars Kishan, TSP 12-7, TSP 12-1, BESP-14with high starch content can be recommended for the production of alcohol, flour, snacks, and noodles. Cultivars such as Kishan, Sree Bhadra, TSP 12-4, BESP-141are found to have a good amount of sugar content and therefore, could be promoted for the production of jam, candies, snacks or biscuits and maltose as a sweetener. Cultivars like ST-14, TSP 12-10, BESP-14and Sree Bhadra with high protein content can be recommended at the malnourished areas for cultivation.

Reference

1. Akkamahadevi, Pasare B, Neera, Srinivasan CN, Pushpa B. Composition and cooking quality of five sweet potato varieties. J Root Crops. 1996, 101-104.
2. Antiaobong EE, Bassey EE. Constraints and prospects of Sweet potato Ipomoea batatas (L) Lam production in humid environment of south-eastern Nigeria. Proceedings of the Second African Regional Conference on Sustainable Agriculture, held at the Governor’s office Annex, Uyo, Nigeria. 2008; 2(3):68-72.
3. AOAC. Official Methods of Analysis of the Association of Official Analytical Chemists. 18th ed., Gaithersburg, MD, 2005.
4. Benjamin AC. Sweet potato: A review of its past, present and future role in human nutrition. Adv. Food and nutrition Res. 2007; 52:1-48.
5. Bhattacharya N. Growth development and tuber quality of Sweet potato cultivars grown as rain fed under upland and low land situations. Ph.D. thesis submitted to Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India, 2001.
6. Bradbury JH, Hammer B, Nguyen T, Anders M, Millar JS. Protein quantity and quality and trypsin inhibitor content of sweet potato cultivars from the high lands of Papua New Guinea. J agri. food chem. 1985; 33(2):281-285.
7. Chattopadhyay A, Chakraborty I, Sen H. Physico-Chemical characteristics of Sweet potato as a function of cultivars. The Hort. J. 2002; 15 (2):45-50.
8. Collins WW and Walter WM. Potential for increasing the nutritional value of Sweet potatoes. Proceedings of the First International Symposium, (Eds. Villareal, R. L. and Griggs, T. D.) Asian Vegetable Research and Development Centre, Snanhua, Tainan, Taiwan, 1982; 355.
9. Constantine RJ, Hernandez TP and Jones LG. Effects of irrigation and nitrogen fertilization on quality of Sweet potatoes. J. American Soc. Hort. sci. 1974; 99:308.
10. FAOSTAT. Food and Agricultural Statistical Database, 2011. Available from; http://faostat.fao.org.
11. ICAR (Indian Council of Agricultural Research). Handbook of Agriculture. Directorate of Information and Publication, India Council Agri. Res., New Delhi, 2007; 512-516.
12. Indiastat.com. Sweet potato area, production and productivity in India, 2010.
13. Ingabire M and Vasanthakaalam H. Comparison of the nutrient composition of four Sweet potato varieties cultivated in Rwanda. American J. Food. Nutr. 2011; 1(1): 34-38.
14. Kapinga RE, Ewell PT and Jeremiah SC. Sweet potato in Tanzania farming and food systems: Implication for research, Ministry of Agriculture and Livestock Development, Tanzania/International Potato Centre (CIP), Nairobi, Kenya, 1997; 47.
15. Li L. Variation in protein content and its relation to other characters in Sweet potatoes. J. Agri. Assoc. China. 1974; 88: 17.
16. Lila Babu, Nambisan B and Sundaresan S. Comparative evaluation of biochemical constituents of selected tuber crops. J Root Crops. ISRC National Symposium Special, 1990; 17: 270-273.
17. Nedunchezhiyan M, Byji G and Jata SK. Sweet Potato Agronomy. J Agri. Univ. Puerto Rico. 2012; 60(2):163-171.
18. Omodamiro RM, Afuape SO, Njoku CJ, Nwankwo II, M

Echendu TNC and Edward TC. Acceptability and proximate composition of some Sweet potato genotypes. Inter. J Biotech. Food Sci. 2013; 1(5):97-101.

19. Onwuene IC. In: The Tropical Tuber Crops, John Willey and Son's New York. 1978; 168-171.
20. Ranganna S. In: Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Edn, 1986. Tata McGraw Hill Publication Company Ltd., New Delhi.
21. Ray RC and Ravi V. Post-harvest spoilage of Sweet potato and its control measures. Critical Review of Food Sci. Nutr. 2005; 35:623-644.
22. Sadasivum S. and Manickam A. Biochemical Methods. New age International publishers. 3rd edn, 2011.
23. Scott LE and Matthews WA. Carbohydrate changes in Sweet potatoes during curing and storage. Proceedings Ancient Soc. Hort. Sci. 1957; 70:407-418.
24. Srinivas T. Economics of Sweet potato production and marketing, in: Loebenstein, G and Thottapilly, G (Eds.). The Sweet potato, Spring Science Business Media, BV, 2009; 436-447.
25. Takahata Y, Noda T and Nagata T. HPLC determination of carotene content of some Sweet potato cultivars and its relationship with colour values. Japanese J Bred., 1993; 43:421-427.
26. Tortoe C. Microbial deterioration of white variety Sweet potato (Ipomoea batatas L.) under different storage structures. Inter. J plant Bio. 2010; 1(1):10-15.
27. Vasudevan K, Padmaja G and Jayakumar S. Induced tuber colour mutants and their biochemical characteristics in Sweet potato. J Root Crops. 1996; 22:137-138.
28. Zhang Z, Wheatley CC, Corke H and Zhang ZT. Biochemical changes during storage of Sweet potato roots differing in dry matter content. Post-Harvest Bio. Tech. 2002; 24(3):317-325.