

Development of Health Benefited Products by Using Sweet Potato

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Received: 26.12.2019 | Revised: 29.01.2020 | Accepted: 5.02.2020

ABSTRACT

*Overeating or improper diet and shortage of food is a major concern as a health hazard. However, from a global perspective, there is a shortage of food production and supply, because of the higher population in developing countries and decrease in cultivated land due to desertization. From these points of view, revaluation of the crops, which are tolerant to environmental changes such as drought, storms and floods, and which can be cultivated in waste land and tropical areas, is necessary. One such crop is sweet potato (*Ipomea batatas* L.) which originated from Central America. Sweet potato (*Ipomoea batatas* L.) has played an indispensable role as a source of food in Asia and Pacific islands. More than 90 per cent of the world's sweet potato is produced in these regions. China is the leading country of sweet potato production, and the global yield was 134, 244 metric tons in 1996 (Nirvana, 2011), which was about 1/2 of that of potatoes (*Solanum tuberosum* L.) and 1/4 of that of wheat, that means sweet potatoes are one of the major food crops.*

Keywords: Sweet potato, Health hazard, Crop, Tropical areas

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is a perennial tuber but treated as an annual crop of agriculture and farming. Creeping stems are thin and can reach up to 4 meter long. It is a dicotyledonous plant that belongs to the family *Convolvulaceae*, which also contains the morning glory. Sweet potatoes grow well in tropical, subtropical, and temperate climate. Sweet potatoes originated in the New World and were introduced into Spain, India, and the Philippines by Spanish explorers in the 15th and 16th centuries. Their distribution is now worldwide. In parts of Africa, Asia, and

Pacific, sweet potatoes are an important staple crop (Burri, 2011).

Sweet potato is not only a source of energy; it also supplies important nutrients mainly, vitamin A (beta carotene), Vitamin B₆, Vitamin C and Vitamin E as well as dietary fiber and they are low in fat and cholesterol. It serves as an important protein source for many world populations and is an important source of starch and other carbohydrates. The carbohydrate content stored in roots varies from 25 per cent to 30 per cent, while the rest is composed of water (58 % -72 %).

Cite this article: Senthilkumar, R., Muragod, P.P., & Muruli, N. V. (2020). Development of Health Benefited Products by Using Sweet Potato, *Ind. J. Pure App. Biosci.* 8(1), 150-157. doi: <http://dx.doi.org/10.18782/2582-2845.7934>

Sweet potato also contains some essential minerals and trace elements such as iron, potassium, calcium, zinc, sodium, magnesium and manganese (Srivastava et al., 2012).

In addition to the nutritional values of sweet potatoes, it has been rediscovered as a functional food, containing high levels of various phytochemical which might have various health benefits (Hue et al., 2015).

The nutritional value of sweet potato with high levels of vitamin A (709 µg) offers an added benefit to processed products. Sweet potato plays an important role in food security, for example, the dried chips can be stored for consumption during the hungry period when some vital crops are in short supply or not available. The bulkiness and perishability of sweet potato storage is a major barrier to the wider utilization of the crop.

MATERIALS AND METHODS

The present research study on “Diversified value added products from sweet potato

(*Ipomea batatas* (L.)” was carried out in the department of Food Science and Nutrition, University of Agricultural Sciences, Bengaluru, during the year 2015-2016. Details of the experimental material used and methods adopted for the above research study are presented.

Formulation of the sweet potato products

The procured ingredients were standardized, incorporated and products were prepared namely, sweet potato chips, sweet potato biscuits and value added sweet potato flakes by standard procedure and are presented in Table-A,B, and C. Preliminary study was conducted by formulating different variations and selected the acceptable variations for further study.

Development of the sweet potato products

Sweet potato products were developed by using standard procedure (Srivastava et al., 2012; Emenhiser et al., 1999; Akpapunam & Abiante 19991). Figure 1, 2, and 3 were the procedure for the sweet potato products.

Table A: Sweet potato Chips

Ingredients	Formulation-A in (g)	Formulation-B in (g)	Formulation-C in (g)
Sweet potato	60	60	60
Oil	30	30	30
Chilli powder	6	-	3
Pepper powder	-	6	3
Salt	4	4	4
Total	100	100	100

Table B: Value added sweet potato flakes

Ingredients	Formulation-A in(g)	Formulation-B in(g)	Formulation-C in(g)
sweet potato	15	20	25
Rice flakes	40	35	30
Roasted Bengal gram	10	10	10
Ground nut	10	10	10
Cumin seeds	2	2	2
Mustard seeds	2	2	2
Turmeric powder	1	1	1
Curry leaves	2	2	2
Chilli powder	2	2	2
Garlic	5	5	5
Salt	1	1	1
Oil	10	10	10
Total	100	100	100

Table C: Sweet potato biscuits

Ingredients	Formulation-A in(g)	Formulation-B in(g)	Formulation-C in (g)
Sweet potato flour	10	20	30
Wheat flour	50	40	30
Salt	1	1	1
Sugar	28	28	28
Baking powder	1	1	1
Ghee	10	10	10
Total	100	100	100

RESULTS AND DISCUSSION

Chemical composition of sweet potato products. The chemical composition of the sweet potato and developed sweet potato products viz: sweet potato chips, value added sweet potato flakes and sweet potato biscuits were presented in the Table 1, Table 2, Table 3 and Table 4 respectively

Chemical composition of sweet potato chips

Chemical composition of Sweet potato chips was presented in Table-2. SC2 had higher moisture content (18 %), followed by SC1 (16 %) and SC2 (15 %). Protein was higher in SC3 (2.03 g) and lowest in SC2 (1.01 g). SC1 had the higher fat content (12.20 g) and fat content of SC2 and SC3 are (12.28 g) and (12.42 g) respectively. Energy content was higher in SC3 (265 K.cal) and lowest in SC1 (251 K.cal). SC3 had higher carbohydrate (36.93 g) and SC1 the lowest carbohydrate (30.11 g). The crude fibre was higher in SC1 (3.17 g) and lowest in SC2 (2.25 g) Vitamin-C content

was higher in SC1 (13.20 g) and lowest in SC2 (9.20 g). The SC3 had higher β -carotene (86.09 μ g), SC1 and SC2 were 77.90 μ g and 82.09 μ g respectively. Ash content of SC1, SC2 and SC3 were 15.80g, 15.09g and 16.01 respectively.

Chemical composition of value added sweet potato flakes

Table-3 depicts the chemical composition of value added sweet potato flakes. It has been found that, moisture content was high in SPF1 (16.03 %), followed by SPF2 (18.88 %) and SPF3 (20.08 %). SPF1 had higher protein content (7.17 g) and Protein content of SPF2 and SPF3 were (7.01 g) and (6.09 g) respectively. Fat content was higher in SPF1 (7.92 g) and lowest in SPF3 (5.61g). Energy content of the SPF1, SPF2 and SPF3 were found that, (298 K.cal), (276K.cal) and (252K.cal) respectively. SPF1 had higher carbohydrate (44.43 g), followed by SPF2 and SPF3 were (39.83 g) and (35.06g)

Table 2: Chemical composition of sweet potato Chips per 100g

Nutrients	SC 1	SC 2	SC 3
Moisture (%)	15.00	16.00	18.00
Protein (g)	1.23	1.01	2.03
Fat (g)	12.20	12.28	12.42
Crude fibre (g)	3.17	2.25	2.70
Carbohydrate (g)	30.97	34.11	36.93
Energy (K cal)	251	258	265
Vitamin – C (mg)	13.50	9.20	13.01
β -carotene (μ g)	77.90	82.03	86.09
Ash (g)	15.80	15.09	16.01

SC1- Sweet potato chips 1, SC2-Sweet potato chips 2, SC3-Sweet potato chips3

Moisture content in SC3 was the higher (18 %) as compare to SC1 (15 %) and SC2 (16 %). Protein content was higher in SC3 (2.03 g) and followed by SC1 and SC2 were 1.23 g and 1.01 g respectively. SC3 contain high value of protein content due to addition of both chilli

and pepper powder. Fat content in SC1, SC2 and SC3 were 12.20 g, 12.28 g and 12.42 g respectively. The content of the Vitamin-C found higher in SC3 (13.30 mg) and lowest in SC2 (9.20 mg) similar results were found in Renugmanupaetoon, (2000).

Table 3: Chemical composition of value added sweet potato flakes per 100 g

Nutrients	SPF 1	SPF 2	SPF 3
Moisture (%)	16.03	18.88	20.08
Protein (g)	7.17	7.01	6.09
Fat (g)	7.92	6.08	5.61
Crude fibre (g)	3.86	3.60	3.86
Carbohydrate (g)	44.43	39.83	35.06
Energy(K cal)	298	276	252
Vitamin – C (mg)	7.00	8.50	10.50
β-carotene (µg)	159.98	163.07	171.58
Ash (g)	3.01	2.90	2.70

SPF1-Value added sweet potato flakes 1, SPF2-Value added sweet potato flakes 2, SPF3-Value added sweet potato flakes3 respectively. The amount of crude fibre in SPF1, SPF2 and SPF3 was found that, 3.80g, 3.60g and 3.50g respectively. Vitamin-C content was higher in SPF3 (10.50mg) and lowest in SPF1 (7.00 mg). The amount of β-carotene in SPF1, SPF2 and SPF3 were 159.98 µg, 163.07 µg and 171.58 µg respectively. It has been found that, ash content of SPF1, SPF2 and SPF3 were 3.01 g, 2.90 g and 2.70 g respectively.

Chemical composition of sweet potato biscuits

Chemical composition of sweet potato biscuits was presented in the Table 4. Moisture content of SB1, SB2 and SB3 were 9.89 per cent, 11.47 per cent and 17.88 per cent respectively. SB1 had the higher protein content (4.91 g) and lowest in SB3 (2.68 g). Fat content was higher in SB1 (8.48 g) and lowest in SB3 (7.36 g).The amount of carbohydrate in SB1, SB2 and SB3 was 51.02 g, 50.13 g and 47.27 g respectively and energy was 300 K.cal, 287 K.cal and 266 K.cal respectively. The content of the crude fibre was higher in SB3 (0.28 g),

then followed by SB2 (0.23 g) and SB1 (0.19 g). The amount of Vitamin-C content was higher in SB3 (7.50 mg) and lowest in SB1 (2.90 mg). The content of β- carotene in SB1, SB2 and SB3 were 13.10 µg, 11.20 µg and 9.30 µg respectively. The amount of ash was found that, in SB1, SB2 and SB3were 3.20 g, 3.90 g and 4.04 g respectively.

Mineral composition of the sweet potato and its products

The mineral composition of the sweet potato and developed sweet potato products viz: sweet potato chips, value added sweet potato flakes and sweet potato biscuits were presented in the Table 5, Table 6, Table 7 and Table 8 respectively.

Mineral composition of the sweet potatochips

Table-6 depicts the mineral composition of the sweet potato chips. SC3had higher content of potassium (310.80 mg) and magnesium (42.01 mg). Potassium content in SC1 and SC2 were 230.02 mg and 309.40 mg respectively. The content of the magnesium were found in SC1 and SC2 were 41.90 mg and 14.90 mg respectively. Zinc content was higher in SC2 (0.56 mg), followed by SC3 (0.49 mg) and

SC1 (0.37 mg). The iron content present in SC1, SC2 and SC3 were 1.79 mg, 2.18 mg and 2.07 mg respectively. The content of copper was found in SC1, SC2 and SC3 were 0.21 mg, 0.19 mg and 0.18 mg respectively. The

amount of manganese in SC1, SC2 and SC3 were 0.36 mg, 0.32 mg and 0.32 mg respectively. The content of sodium in SC1, SC2 and SC3 were 5.53 mg, 5.40 mg and 5.58 mg respectively.

Table 4: Chemical composition of sweet potato biscuits per 100g

Nutrients	SB 1	SB 2	SB 3
Moisture (%)	9.89	11.47	17.88
Protein (g)	4.91	3.66	2.68
Fat (g)	8.48	8.01	7.36
Crude fibre (g)	0.19	0.23	0.28
Carbohydrate (g)	51.02	50.13	47.27
Energy(K cal)	300	287	266
Vitamin – C(mg)	2.90	4.20	7.50
β- carotene(μg)	13.10	11.20	9.30
Ash(g)	3.20	3.90	4.04

SB1- Sweet potato biscuits 1, SB2- Sweet potato biscuits 2, SB3-Sweet potato biscuits 3

Moisture content in SB1, SB2 and SB3 were 9.89 per cent, 11.47 per cent and 17.88 per cent respectively. Protein content was higher in SB1 (4.91 g) and lowest in SB3 (2.68 g). However, in the product wheat flour was added so protein level was increased. Fat content in SB1, SB2 and SB3 ranged from 7.36 g to 8.48 g. However the addition of sweet potato flour increased the content of the fat was decreased. Srivastava et al. (2012) reported that, the moisture content of sweet potato was attributed to high water binding capacity of sweet potato which retained higher moisture content in the products. This study was on par with the above results.

Carbohydrate content was found in SB1 (51.02 g), SB2 (50.13 g) and SB3 (47.27 g). Oluwalana et al. (2012) were found, similar results. Ash content was found highest in SB3 (4.04 g), followed by SB2 (3.90 g) and SB1 (3.20 g). Srivastava et al. (2012) reported that,

the ash content of biscuits increased due to higher ash content of sweet potato and due to externally added fat during biscuit preparation.

Energy content was found in SB1, SB2 and SB3 were 300 K.cal, 287 K.cal and 266 K.cal respectively. Okoye et al., 2008, studied the energy content of all the biscuits samples ranged from 366.28 K.cal to 435.48 K.cal.

Crude fibre content was found that, 0.19 g in SB1, 0.23 g in SB2 and 0.28 g in SB3. Srivastava et al. (2012), reported that, the crude fibre content of biscuits increased significantly, due to higher fibre content in sweet potato flour.

Vitamin-C content sweet potato was analyzed and found that, SB1, SB2 and SB3 were 2.90 mg, 4.20 mg and 7.50 mg respectively. The β-carotene content of SB1 (13.10 μg), SB2 (11.20 μg) and SB3 (9.30 μg). There are no reviews found for this study.

Table 6: Mineral composition of sweet potato chips per 100g

Minerals (mg/100g)	SC1	SC2	SC3
Potassium	230.02	309.40	310.80
Magnesium	41.90	14.90	42.01
Zinc	0.37	0.56	0.49
Iron	1.79	2.18	2.07
Copper	0.21	0.19	0.18
Manganese	0.36	0.32	0.32
Sodium	5.53	5.40	5.58

SC1-Sweet potato chips 1, SC2-Sweet potato chips 2, SC3-Sweet potato chips 3

Mineral composition of the sweet potato chips were found that, SC3 had highest content of potassium (310.80 mg) and magnesium (42.01 mg). Potassium content in SC1 and SC2 were 230.02 mg and 309.40 mg respectively. The content of the magnesium were found in SC1 and SC2 were 41.90 mg and 14.90 mg respectively. Zinc content was highest in SC2 (0.56 mg), then followed by SC3 (0.49 mg) and SC1 (0.37 mg). The iron content present in SC1, SC2 and SC3 were 1.79 mg, 2.18 mg and 2.07 mg respectively. The content of copper was found that, in SC1, SC2 and SC3 were 0.21mg, 0.19mg and 0.18mg respectively. The amount of manganese in SC1, SC2 and SC3 were 0.36mg, 0.32mg and 0.32mg respectively. The content of sodium in SC1, SC2 and SC3 were 5.53 mg, 5.40 mg and 5.58 mg respectively.

Mineral composition of the value added sweet potato flakes

Mineral composition of the value added sweet potato flakes presented in table-7. It has been found that, potassium content was high in SPF3 176 mg, followed by SPF2 (152.10 mg) and (148.90 mg). Magnesium was higher in SPF1 (59.01 mg) and lowest in SPF3 (49.08 mg). SPF3 had higher zinc content (1.09 mg) and zinc content of SPF1 and SPF2 were (1.07 mg) and (1.08 mg)

respectively. The amount of iron found that, in SPF1, SPF2 and SPF3 were 9.39 mg, 8.62 mg and 7.04 mg respectively. Copper content of SPF1, SPF2 and SPF3 were 0.35 mg, 0.40 mg and 0.33 mg respectively. The content of the manganese in SPF1, SPF2 and SPF3 were 0.29 mg, 0.32 mg and 0.33mg respectively. Sodium found that, in SPF1, SPF2 and SPF3 were 11.86mg, 11.67mg and 11.48 mg respectively.

Mineral composition of the sweet potato biscuits

Table-8 depicts the mineral composition of sweet potato biscuits. The potassium content was high in SB3 (156.90 mg), followed by SB2 (130.60 mg) and SB1 (104.30 mg). Magnesium content in SB1, SB2 and SB3 were 29.70 mg, 27.00 mg and 24.30 mg respectively. Zinc content of the SB1, SB2 and SB3 were 1.11 mg, 2.22 mg and 3.33 mg respectively. Iron content was found higher in SB3 (7.45 mg) and lowest in SB1 (2.49 mg). The amount of copper in SB1, SB2 and SB3 were 0.25 mg, 0.51 mg and 0.77 mg respectively. It has been found that, manganese content in SB1, SB2 and SB3 were 1.16 mg, 2.33 mg and 3.50 mg respectively. The amount of sodium in SB1, SB2 and SB3 were 10.90 mg, 9.80 mg and 8.70 mg respectively.

Table 7: Mineral composition of value added sweet potato flakes per 100g

Minerals (mg/100g)	SPF1	SPF2	SPF3
Potassium	148.9	152.1	176
Magnesium	59.01	53.90	49.08
Zinc	1.07	1.08	1.09
Iron	9.39	8.62	7.04
Copper	0.35	0.40	0.33
Manganese	0.29	0.31	0.33
Sodium	11.86	11.67	11.48

SPF1-Value added sweet potato flakes 1, SPF2-Value added sweet potato flakes 2, SPF3-Value added sweet potato flakes3.

Potassium content high in SPF3 176 mg, followed by SPF2 (152.10 mg) and (148.90 mg). Magnesium had higher in SPF1 (59.01 mg) and lowest in SPF3 (49.08 mg). SPF3 had the higher zinc content (1.09 mg) and zinc content of SPF1 and SPF2 were (1.07 mg) and (1.08 mg) respectively. The amount of iron found present, in SPF1, SPF2 and SPF3 were 9.39 mg, 8.62 mg and

7.04 mg respectively. Copper content of SPF1, SPF2 and SPF3 were 0.35 mg, 0.40 mg and 0.33 mg respectively. The content of the manganese in SPF1, SPF2 and SPF3 were 0.29 mg, 0.32 mg and 0.33 mg respectively. Sodium content, in SPF1 SPF2 and SPF3 were 11.86 mg, 11.67 mg and 11.48 mg respectively.

Table 8: Mineral composition of sweet potato biscuits per 100g

Minerals (mg/100g)	SB1	SB2	SB3
Potassium	104.30	130.60	156.90
Magnesium	29.70	27.00	24.30
Zinc	1.11	2.22	3.33
Iron	2.49	4.98	7.45
Copper	0.25	0.51	0.77
Manganese	1.16	2.33	3.50
Sodium	10.90	9.80	8.70

SB1-Sweet potato biscuit 1, SB2-Sweet potato biscuit 2, SB3-Sweet potato biscuit 3

SB3 had the higher amount of potassium (156.90 mg), followed by SB2 and SB1 were 130.60 mg and 104.30 mg respectively. Magnesium content, in SB1, SB2 and SB3 were 29.70 mg, 27.00 mg and 24.30 mg respectively, Oluwalana et al. (2012) found that, similar results. The amount of zinc in SB1, SB2 and SB3 were 1.11mg, 2.22mg and 3.33 mg respectively. Iron content in SB1, SB2 and SB3 were 2.49 mg, 4.98 mg and 7.45 mg respectively. The amount of copper in SB1, SB2 and SB3 were 0.25 mg, 0.51 mg and 0.77 mg respectively. Manganese content in SB1, SB2 and SB3 were 1.16 mg, 2.33 mg and

3.50mg respectively. The amount of sodium in SB1, SB2 and SB3 were 10.90mg, 9.80 mg and 8.70 mg respectively.

CONCLUSION

The procured ingredients were standardized, for preparation of value added products that is chips, flakes and biscuits. Sweet potato products were developed by using standard procedure. After the standardization of the ingredients, three variations were made for three products namely; Sweet potato chips were SC1, SC2 and SC3. Value added sweet potato flakes were SPF1. SPF2 and SPF3.

Sweet potato biscuits were SB1, SB2 and SB3. Sweet potato and products were analyzed for physico-chemical components. The results of the sweet potato were revealed that, 62.20 percent of moisture, 0.89 g of protein, 0.20 g of fat, 0.70 g of crude fibre, 4.99 µg of β-carotene, 17.29 mg of Vitamin-C, 35.71 g of carbohydrate, 148 K.cal of energy and 1.20 g of ash content. The result of the Value added Sweet Potato Flakes 1 contain potassium (148.9 mg), magnesium (59.01 mg), Zinc (1.07 mg), Iron (9.39 mg), copper (0.35 mg), manganese (0.29 mg) and sodium (11.86 mg). Mineral content was found in SPF2 potassium (152.1 mg), magnesium (53.90 mg), Zinc (1.08 mg), Iron (8.62 mg), copper (0.40 mg), manganese (0.31 mg) and sodium (11.67 mg)

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