

EVALUATION OF SOME PRODUCTS PREPARED FROM SWEET POTATO VARIETIES

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ABSTRACT

The aim of this study was to introduce new untraditional products prepared from sweet potato roots namely, Puroguard and A193 varieties of which physical properties, chemical constituents and minerals contents were evaluated. The obtained results revealed that A193 variety had the highest content of minerals such as potassium, calcium, phosphorus and iron compared to the Puroguard one. Three products of these sweet potatoes such as powder, candied and puree were prepared. The chemical analysis of products such as moisture, protein, total carbohydrates, fats and ash contents was performed. From the sensory evaluation such as color, flavor, texture and appearance it could be noticed that A193 variety was more preferable to consumer attaining the highest scores compared to the Puroguard variety. The candied product had the highest scores than the other products. In this study, Puroguard and A193 varieties were processed to produce jam within four treatments for every variety. It was found that the best jam was that containing potatoes: carrots: oranges (1:1:1) for the two varieties. Also, the powder used to prepare the baby food by adding 10, 20, 30 and 40%. The organoleptic test showed that sample containing 30% sweet potato powder attained the higher grade for all the evaluated characteristics.

Keywords: Sweet potatoes; Powder; Candied; Puree; Untraditional Sweet potato products; Chemical composition.

INTRODUCTION

Sweet potato (*Ipomea batatas L.*) is an important crop all over the world. As a starchy root, it is not only an efficient producer of calories but also rich in many nutrients especially vitamins and minerals. Because it is rich in dietary fiber, sweet potato is becoming a popular food in the modern diet. Recently, in Egypt new sweet potato varieties with good eating and processing properties were developed. The total area annually cultivated with sweet potatoes was about 22307 feddans producing about 258983 tons (Anon, 2008). To implement the starchy properties a project was conceived to develop the technology and processing sweet potato roots into untraditional food products fortified with fruit-based products, thus increasing the economic value of the crop.

Sweet potato flour can serve as a source of energy and nutrients as carbohydrates, beta carotene, minerals (Ca, P, Fe and K) (El-Bastawesy *et al.*, 2008). Natural sweetness, colors and flavors could be added to sweet potato to obtain new untraditional products. Woolfe (1992) and Gurkin Ulm (1988) reported that canning of potato should be carried out as soon after harvesting as possible. However, for the fresh product, the roots are often cured then stored as long as 6 months. Flakes are made from both sources.

Some attempts have focused on processing sweet potato products such as fries, chips, patties, canned and candied products. Subsequently, Walter and Hoover (1986) reported that the processed sweet potato products of limited variety are available to most consumers. Sweet potatoes candied with sweeteners represent an attractive commodity to different consumers.

However, this investigation was carried out to evaluate two new sweet potato varieties for their chemical and organoleptic properties. In addition, the study involved the determination of some important constituents, and then was processed into candied products. The study was extended to make comparative evaluations of the properties and qualities of raw and processed sweet potato root tubers.

MATERIALS AND METHODS

Materials

Two varieties of sweet potatoes namely, A193 (creamy fleshed) and Puroguard (yellow fleshed), were obtained from the Vegetable Research Dept. Hort. Res. Institute Agricultural, Res. Center, Giza, Egypt.

Yellow carrots and orange fruits were obtained from a private farm in Giza Governorate, Egypt.

Methods

Technological methods

1- Sweet potato powder production

Fresh sweet potato roots were washed , blanched , peeled , sliced , dehydrated by the oven at 55 °C for 10 – 12 hrs , ground ,sifted then packaged in polyethylene pags then stored at room temperature until being used for preparing baby foods. The production was accomplished as described by Abdel Magied *et al.* (1991).

Table 1: Five recipes for preparing baby foods.

Ingredients (%)	Control Formula	Formula No. I	Formula No. II	Formula No. III	Formula No.V
Wheat flour	27	22	17	12	2
Defatted dry milk	30	25	20	15	5
Sugars (sucrose)	10	10	10	10	10
Sweet potato powder	---	10	20	30	40
Carrot	10	10	10	10	10
Tomatoes	10	10	10	10	10
Squash	10	10	10	10	10
Vanillin	2	2	2	2	2
Potassium phosphate mg	400	400	400	400	400
Calcium carbonate mg	500	500	500	500	500
Iron fumarate mg	100	100	100	100	100

I. Sweet potato puree production

Fresh sweet potato roots were washed , blanched , peeled , sliced , shredded , pureed then packaged in polyethylene pags then stored at – 5 ° C until used for preparing of Jam .

Preparing of Jam

Puree divided into for equal parts for the two varieties.

1- The first part 500 g of puree + 350 g sucrose and the total mixture was homogenized and boiled until concentration of 68% (as a control).

2- The second part 500 g of puree + 500 gm carrot + 500 ml orange juice + 1000g sucrose and the total mixture was homogenized and boiled until concentration of 68%.

3- The third part 1000g puree + 500g carrot + 1000g sucrose and the total mixture was homogenized and boiled until concentration of 68%.

4- The fourth part 1000g puree + 500 ml orange juice + 1000g sucrose and the total mixture was homogenized and boiled until concentration of 68%.

Preparation of Jam was carried out according to the method described by Abd El Ghani *et al.* (1997).

II. Candied sweet potatoes

Sweet potato root tubers were processed with sucrose syrup at the ratio of (1:4 w/w). The production was accomplished as described by Chotki (1989). Fresh sweet potato roots were weighed, trimmed, washed, peeled, sliced, shredded, dipped in sucrose syrup (25%) and packaged in jars then stored at -5°C until being used.

2-Analytical methods

All samples were analyzed before and after processing for their chemical composition. Moisture, alcohol insoluble solids, starch, total sugars, protein, ascorbic acid, carotenoids, ash and crude fibers contents were determined according to the methods of A.O.A.C (1998).

3-Sensory evaluation

The prepared samples were subjected to sensory evaluation according to the method of Walter and Hoover (1986). Ten panelists were asked to evaluate color, flavor, texture and appearance. The following scale was applied to all samples under test, however 9-10 = excellent, 6-8 = good; 3-5 = poor and 0-2 = refused.

4- Statistical analysis

The collected data of sensory evaluation were statistically analyzed by the least significant differences (L.S.D) at the 5% level of probability according to Sendecor and Cochran (1980).

RESULTS AND DISCUSSION

Physical properties

Results in Table (2) indicate that the average pulp weight represented about 87% and 86.65% of the total weight of fresh Puroguard and A193 respectively. This pulp after drying decreased to 560(g) in Puroguard variety compared to that of A193 which was 480gm. On the other hand, the peel weight was higher in A 193 variety compared to that of Puroguard as it was 292 gm and 252gm in the two varieties respectively. As for the pulp/peel ratio, Puroguard was 6.9:1 while A193 was 5.9:1. As for the peel color Puroguard was yellow, while that of A193 was cream and pulp color in Puroguard and A193 varieties were yellow and cream in the two varieties respectively. The dehydration, percentage was higher in Puroguard variety compared to that of A 193 being 64% in the first and 56% in the latter. This would be due to the high solid contents in the Puroguard variety.

Table 2: Physical properties of sweet potatoes.

Physical properties	Variety	
	Puroguard	A193
Whole weight of the fruit (g)	2000	2000
Pulp weight (g)	1740	1733
Pulp%	87	86.65
Dry pulp weight (g)	560	480
Peel weight (g)	252	292
Peel%	12.6	14.6
Pulp/peel ratio	6.9:1	5.9:1
Peel color	Yellow	cream
Pulp color	dark yellow	cream
Dehydration percentage*	56	48
Dehydration percentage**	64	56

* Weight of dehydrated pulp/weight of whole sweet potato x100

** Weight of dehydrated pulp/weight of pulp (without peel)x100

Chemical composition

Table (3) show that the moisture, starch, total sugars and protein contents in Puroguard and A193 varieties varied between 74.18, 78.38%, 53.64, 43.39%, 15.90, 26.17% and 9.75, 9.22%, respectively. Meanwhile A193 variety contained lower amounts of starch and protein compared to the Puroguard. From the same table, it could be shown that total soluble solids, total solids and alcohol insoluble solids contents ranged between 8.60, 7.50%, 25.82, 21.62% and 75.95, 66.93% in Puroguard and A193 varieties , respectively. Puroguard variety contained higher amount of ascorbic acid than A193 while A193 contained higher amount of carotenoids. These differences could be due to the difference in variety. These results are in accordance with those of Li and Oba (1985); Abd El-Magied *et al.* (1991), Abd El-Ghani *et al.* (1997&2001) and El-Bastawesy *et al.* (2008).

Table 3: Chemical composition of fresh sweet potato varieties

*Chemical composition %	Variety	
	Puroguard	A193
Moisture content	74.18	78.38
Total solids	25.82	21.62
Total soluble solids	8.60	7.50
Alco. In soluble solids	75.95	66.93
Starch	53.64	43.39
Total sugars	15.90	26.17
Reducing sugars	3.00	9.73
Non-reducing sugars	12.90	16.44
Protein	9.75	9.22
Carotenoids mg/100g	0.76	38.19
Ascorbic acid mg/100g	47.20	18.57
Crude fiber	2.90	3.72
Ash	3.86	4.38

*on dry weight basis

Results in Table (4) show the mineral content of sweet potato varieties. Contained high amounts of potassium, calcium, phosphorous and iron. While A193 variety contained higher amount of minerals than Puroguard. These results are in good agreement with those of Abd El-Ghani *et al.* (1997).

Table 4: Minerals contents of fresh sweet potatoes

*Minerals (mg/100g)	Variety	
	Puroguard	A193
Potassium	1275.47	1592.27
Calcium	28.90	45.80
Phosphorus	50.92	55.67
Iron	3.20	4.90

*on dry weight basis

Table (5) shows that the moisture, protein, total carbohydrates, fat and ash contents in both Puroguard and A193 varieties varied between 14.15, 14.91%, 4.60,3.71%, 78.32, 78.43%, 0.39, 0.57% and 2.54, 2.38% in the flour respectively. Meanwhile Puroguard variety contained lower amount of moisture and fat compared to A193 in candied product. From the above table , it could be indicated that moisture, protein, total carbohydrates, fats and ash contents ranged between 75.77, 80.58%, 1.41, 1.14%, 22.13 17.56%, 0.13, 0.19% and 0.56, 0.53% in Puroguard and A193 varieties in the puree, respectively. These differences could be due to the difference in products . These results are in agreement with those of Sarhan *et al.* (1975); Truong *et al.* (1986); Bradburg *et al.* (1988) and Rofael and Youssef (1996).

Table 5: Proximate composition of processed sweet potatoes

*Sweet potato processed products	Composition				
	Moisture Content %	Protein %	Total Carbohydrates %	Fat %	Ash %
Puroguard powder **	14.15	4.60	78.32	0.39	2.54
Candied	64.14	1.82	30.71	2.20	1.13
Puree	75.77	1.41	22.13	0.13	0.56
A193 powder **	14.91	3.71	78.43	0.57	2.38
Candied	67.77	1.47	26.53	3.17	1.06
Puree	80.58	1.14	17.56	0.19	0.53

*on fresh weight basis, ** on dry weight basis

Organoleptic evaluation of processed sweet potatoes

The obtained data were statistically analyzed and results are shown in Table (6). The results shown in Table (6) indicate that the best color, flavor, texture and appearance properties were found in the three treatments in the two varieties. It showed not significant differences between the two varieties. The results indicate also that A193 variety had the best color, flavor, texture and appearance in the three methods of processing and were better than the Puroguard variety. However, all the processed varieties either as powder, candied or puree showed excellent grade (8.3-9.5) for all the evaluated

characteristics. The results also indicate that all processed A193 that processed as powder, candied and puree showed the highest scores for color, flavor, texture and appearance compared to those processed from Puroguard variety. On the other hand, most of the A193 variety showed higher scores for color than those of the Puroguard. The obtained data were statistically analyzed and the obtained results are shown in Table (6). These results reveal that the candied of sweet potatoes were found to be the best treatment having the highest scores for color, flavor, texture and appearance.

Table 6: Organoleptic evaluation of processed sweet potatoes.

Parameters	Treatments					
	Puroguard			A193		
	Powder	Candied	Puree	Powder	Candied	Puree
Color	9.3	9.2	9.1	9.4	9.5	9.4
	0.4830459	0.4216370	0.3162278	0.5163978	0.5270463	0.5163978
	0.15275250	0.1333333	0.1000000	0.1632993	0.1666667	0.1632993
Flavor	8.1	9.0	8.8	8.9	9.1	9.0
	0.3162278	0	0.4216370	0.3162278	0.3162278	0
	0.1000000	0	0.1333333	0.1000000	0.1000000	0
Texture	9.4	8.9	8.4	9.2	9.0	9.0
	0.5163978	0.3162278	0.5163978	0.4216370	0	0
	0.1632993	0.1000000	0.1632993	0.1333333	0	0
Appearance	8.5	8.6	8.4	8.3	9.3	9.2
	0.5270463	0.5163978	0.5163978	0.4830459	0.4830455	0.4216370
	0.1666667	0.1632993	0.1632993	0.1527525	0.1527525	0.1333333

*Each value within the same column followed by the same letter is not significantly different at the 0.05% level

**Each value followed after the ranking letter, by its standard deviation and standard error, respectively.

Sensory evaluation for color, taste, flavor, texture and overall palatability.

The obtained data were statistically analyzed and the results are shown in Table (7). These results indicate best color, taste, flavor, texture and overall palatability for all treatments, of the two varieties, as not significant differences existed between the two varieties. The results indicate also that Puroguard variety showed the best color, taste, flavor, texture and overall palatability in the four treatments of jams which were better than the same of A193 variety. However, all the evaluated characteristics of the two varieties in jams containing carrot and orange had very good grade (7.30-8.90) for all the evaluated characteristics. The results also indicate that all processed puroguard jam showed the highest scores for color, taste, flavor, texture and overall acceptability compared to the same jam of A193 variety. On the other hand, most of the Puroguard variety showed higher scores for color than those of A193 variety. These results could be related to the high content of carotenoids therein besides the taste, flavor, texture and overall acceptability of jam mixed with either carrot and orange juice which gave the highest scores (Table, 6). This may be due to the volatile and flavoring substances characterizing carrots and oranges. These results are similar to the same obtained by Abd El-Ghani *et al.* (1997).

Table 7: Sensory evaluation of the sweet potato jams

Sweet potato jams	Color	Taste	Flavor	Texture	Overall palatability
Puroguard Jam without any additives (control)	6.10	5.30	5.70	5.30	5.89
	1.79	1.49	2.16	2.06	1.45
	0.567	0.473	0.684	0.651	0.484
A193 Jam without any additives (control)	5.50	4.90	5.00	5.10	5.22
	1.51	1.37	1.56	1.52	1.20
	0.477	0.433	0.494	0.482	0.401
Puroguard + Carrot + Orange (1:1:1)	8.90	8.60	7.50	8.10	8.72
	0.88	1.07	1.84	1.12	0.75
	0.277	0.340	0.582	0.379	0.252
A193 + Carrot + Orange (1:1:1)	8.00	7.50	7.30	7.60	8.00
	0.67	0.85	1.42	0.97	1.00
	0.211	0.269	0.448	0.306	0.333
Puroguard + Carrot (2:1)	7.50	5.90	6.20	6.60	7.67
	2.07	1.66	1.69	2.12	1.12
	0.654	0.526	0.533	0.670	0.373
A193+ Carrot (2:1)	6.40	5.60	5.70	5.50	6.78
	1.90	1.26	1.49	1.35	1.09
	0.600	0.400	0.473	0.428	0.364
Puroguard + Orange (2 :1)	5.50	6.50	6.40	6.30	6.17
	2.64	2.01	1.90	2.00	2.15
	0.833	0.637	0.600	0.633	0.717
A193 + Orange (2:1)	5.90	5.90	5.60	5.50	5.39
	1.73	1.53	1.84	1.51	1.76
	0.547	0.482	0.581	0.477	0.588

*Means, within the same column, followed by the same letter is not significantly different at < 0.05% level

**Each value is followed standard deviation and standard error, respectively.

The obtained data were statistically analyzed and results are shown in Table (8). These results indicate that the best color, taste, flavor, texture and overall acceptability in the five treatments. No significant differences in sensory characteristic, i.e. color, taste, flavor, texture and overall acceptability were found in each treatment. The results indicate also that sample No. III showed the best color, taste, flavor, texture and overall palatability in all treatments of baby food samples. However, all the evaluated characteristics showed that sample No. III attained very good grade (7.80 - 8.80) for all the evaluated characteristics. These results could be related to the high content of sweet potato powder (30%) there in and also to the high content of carotenoids and the volatiles, as well as the flavoring substances characterizing carrots and tomatoes. These results are similar to the same obtained by Abd El-Ghani *et al.* (1997).

Table 8: Sensory evaluation of the different baby food samples.

Samples	Color	Taste	Flavor	Texture	Overall palatability
Control without sweet potato powder	6.30	5.70	5.20	5.90	5.40
	0.949	1.160	1.135	0.876	1.075
	0.300	0.367	0.359	0.277	0.340
I 10% of sweet potato powder	7.20	6.60	6.20	6.30	6.30
	1.135	1.075	1.135	1.160	1.059
	0.359	0.340	0.359	0.367	0.335
II 20% of sweet potato powder	7.70	7.60	7.70	7.10	7.20
	0.949	1.713	1.703	1.101	1.135
	0.300	0.542	0.539	0.348	0.359
III 30% of sweet potato powder	8.80	8.60	8.10	7.80	8.10
	1.033	1.506	1.729	1.033	0.994
	0.327	0.476	0.547	0.327	0.314
V 40% of sweet potato powder	8.00	7.00	7.20	7.30	7.10
	1.155	1.05	1.229	0.949	0.73
	0.365	0.333	0.389	0.300	0.233

*Each value, within the same column, followed by the same letter is not significantly Different at P > 0.05% level

**Each value is followed standard deviation and standard error, respectively.

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تقييم بعض المنتجات المحضرة من أصناف البطاطا

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يهدف هذا البحث إلى تقييم منتجات جديدة من البطاطا حيث استخدم صنفى Puroguard ، A193 مع دراسة الصفات الفيزيائية والمكونات الكيميائية والأملاح المعدنية لهذين الصنفين حيث أوضحت النتائج المتحصل عليها أن الصنف A193 يحتوى على نسبة أعلى من الأملاح المعدنية مثل البوتاسيوم والكالسيوم والفسفور والحديد من الصنف Puroguard كما تم تقييم ثلاث منتجات من هذه الأصناف وهى المسحوق و المسكرة والبيورية وتم دراسة التحليل الكيميائى لهذه المنتجات الثلاثة من حيث الرطوبة والبروتين والكربوهيدرات والدهون والرماد كما أجرى التقييم الحسى لهذه المنتجات من حيث اللون والنكهة والقوام والمظهر وأوضحت النتائج ان الصنف A193 حصلت منتجاته على درجات حسية أعلى من الصنف Puroguard في جميع الصفات وان منتج المسكرة حصل على أعلى الدرجات الحسية من باقى المنتجات.

في هذه الدراسة استخدم الصنفين لإنتاج مربى بأربعة معاملات لكل صنف مع إضافة البرتقال والجزر بنسبة ١:١:١ هي التي حصلت على أعلى النتائج فى كلا الصنفين كما تم عمل غذاء للأطفال بإضافة مسحوق البطاطا وتم تقييمه حسيا وأوضحت النتائج أن إضافة مسحوق البطاطا بنسبة ٣٠% هي التي حصلت على أعلى النتائج