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UTILIZATION OF NEW CULTIVAR OF SWEET POTATO FOR PREPARING WEANING FOODS

Abd-Elhady, Y. A. *; Afaf.A.Salim and Mervat M. Anwar *****
*** Faculty of Specific Education Home Economic Dept. Minufiya Univ.**
**** Horticulture Research Institute**
*****Atomic Energy Authority, Nuclear Research Center, Cairo, Egypt.**

ABSTRACT

The aims of this study were to evaluate the nutritional value of new hybrids sweet potato in order to raise public awareness of its potential use in nutrition and to formulate high protein quality weaning foods. The nutritional composition was determined for two new cultivar and local cultivar grown up in Horticulture Institute in El-Qanater El-Khyariya Egypt.

The cultivars namely Minufiya 2/96 and Minufiya 9/96 were compared with local cultivar (Mabrouka). The results show that protein contents of new cultivar were greater than that of local cultivar. Protein levels were 9.78, 11.27 and 5.17% for Minufiya 2/96, Minufiya 9/96 and Mabrouka respectively. The new cultivar also were higher than the local cultivar on total carbohydrates, total sugar, reducing sugar, non-reducing sugar and sucrose content .The results revealed that sweet potato might be mentioned as a source of antioxidant (Vitamin C and β-carotene). The concentration of β-carotene mg/100g F.W was 12.64, 10.20 and 6.76 for Minufiya 2/96, Minufiya 9/96 and Mabrouka respectively, and the content of Vit. C was 15.05, 20.47 and 17.59 mg/100g F.W. for Minufiya 2/96, Minufiya 9/96 and Mabrouka respectively.

Four weaning food mixture were formulated from sweet potato70%, ficus carica 10% and or peanut and chickpea or mung bean or soybean in the ratio (20%) respectively in the form of powder. Data indicate that these mixtures had higher protein quality and quantity .Formula 1 of weaning food mixture showed high acceptability for appearance, texture, odor, color and taste. Also it is cheap weaning foods, the average cost of 100 gram from .080 to 1.50L.E.

Keywords: Sweet potato- weaning – legumes – amino acids – chemical composition

INTRODUCTION

Sweet potatoes are highly nutritious vegetables; however, sweet potato consumption is progressively declining especially in industrialized nations. Part of this decline may be attributed to the lack of sweet potato based products for consumers beyond the baked roots. Conversely, the white potato has seen a great increase in production and a large portion of this increase is due to processed products such as chips, fries, and frozen products. Thus, one way to expand sweet potato consumption is to develop appealing processed products or alternative uses for sweet potato roots (Kays, 1985; Collins & Walter, 1992). It has been commercially dried into dehydrated flakes for many years. However, the resulting product has poor solubility, unattractive brown color, and limited applications. In general, fruit and vegetable powders have been described as value added ingredients in various food systems. Both freeze dried and drum dried fruit and vegetable powders deliver numerous functional and nutritional benefits.

The characteristic flavors, colors, and nutrients as well as water

binding properties of these powders make them an ideal addition to soups, sauces, marinades, baby foods, dips, extruded cereal products, fruit purees for confections, and fillings for frozen toaster snacks (Francis & Phelps, 2003; Pszczola, 2003).

The weaning period usually start at the age of 4 to 6 months old and extended to the age of 2 to 3 years. Special foods are rarely available for these children; consequently, they have to depend on the same types of foods as those eaten by adults. (Mosha and Svanberg, 1983). In Egypt as many areas of the world, the production of milk is not sufficient to supply the needs of the population. For this reason, many efforts had been carried out to produce protein-rich food mixtures for infants and preschool age children from vegetable protein sources alone and or mixed with skim milk powder (Emam, 1996) Protein content of the diet among the low income groups in developing countries is derived mostly from foods of vegetable origin. It is important; therefore to examine the content and quality of the protein in vegetable foods such as sweet potato to determine their actual and potential role in dietary protein adequacy (Woolf, 1992) ideally, complementary foods should contain animal source foods with high biological value to foster growth and development. However, these foods may not be available to most low-income households in developing countries (Neumann et al., 2002). Development of complementary foods is guided by the following principles: 1) high nutritional value to supplement breastfeeding, 2) acceptability, 3) low price, and 4) use of local food items (Lutter et al, 2003).

Therefore, the objectives of this study were to evaluate the nutritional value of new hybrid sweet potatoes and to formulate a high-protein weaning food based on the new variety of sweet potatoes, easy to prepare, with high protein, high energy supplementary and low price to be available for infants in different socioeconomic classes.

MATERIALS AND METHODS

1. Plant materials:

Two field experiments were performed during the successive seasons of 2005 and 2006 on the experimental farm in Horticultural Research Station of El-Qanater El-Khirya Kalubia Government, Egypt, the coastal lines used in this study (min2/96 and) were true seeds of complex crosses between two parental cultivars. The seeds were brought from coastal Research and Education Center, Charleston , Clemson University USA. The new hybrid of use study names Minufiya 6/96 and Mabrouka (local cultivar).

Then work RAPD to the new cultivars of study used Random Primer. The results were OPA 0.02, OPA 0.04, and OPA0.19. OPA 0.07, OPB0.03 OPB0.04, OPB0.020, OPC0.1, OPD0.19, OPE0.018 and OPO 20. At agriculture Genetic Engineering Research Institute on date 22/2/2005. The transplantation on May 7 in.

All treatments were subjected to uniform application of nitrogen fertilization (30kg/fed.) as ammonium sulphate (20.6%N), calcium super phosphate 45 kg/fed (1505%P2O5) during soil preparation and (96 kg/fed)

potassium sulphate (48% K2O) at tow equal portions i.e. , at 30 and 60 days after transplanting .

2. Methods

A- Vegetative growth, yield and its components.

A sample consisted of 3 plants taken at random from each plot at 110 days after transplanting, in each season of study. Average length of main branch (cm), number of both branches and average number of leaves on main branch. After 150 days from transplanting in both seasons of study the tuber roots of every plot were harvested. The following data were recorded:

- Average weight of tuber root (gm), number of tuber roots per plants, total weight of tuber roots (ton/fed), average length of tuber roots (cm) and average diameter of tuber root (cm).

- Ten tubers roots were randomly chosen from each treatment to determine average length and diameter of tuber roots.

B – Chemical analysis

Five uniform sized tuber roots of each treatment were cleaned, dried at 70 ^{o}C, grounded and analyzed to determine chemical compositions of total carbohydrates (A.O.A.C., 2000), total sugars described by Dubis et al (1956). Ascorbic acid (V.C) content and total carotene were determined (as fresh weight basis) by Both (1958) and titration with 2,6 dichlorophenel-indophenol. Protein and crude fibers were determined according to the methods of A.O.A.C (2000), whereas, fat and ash content were determined according to the methods of A.O.A.C (2000), total carbohydrates were calculated on dry weight basis by differences (100 – {protein + fat + ash}. Minerals were determined using atomic absorption according to A.O.A.C (2000), Vit. C and β carotene were determined according to the methods of A.O.A.C (2000)

Preparation of weaning food mixture:

Protein quality assessment:

Protein quality was assessed by amino acid score using amino acid contents of the weaning mixture and human amino acid requirements according to FAO (1985) and by protein Efficiency Ratio (PER) as described by Al-Smyer et al (1974) using three equations:

PER1= -0.486 + 0.454 leucine - 0.047 proline.

PER2 = 0.468 + 0.454 leucine – 0.105 tyrosine

PER3 = - 1.816 + 0.435 methionine + 0.78 leucine + 0.211 histidine – 0.944 tyrosine

Organoleptic evaluation:

Sensory evaluation was done by test panel according to Notter et al (1959) for appearance, texture, color, odor and taste.

Statistical analysis

The obtained results were statistically analyzed and least significant difference (L.S.D. at 0.05 level) as reported by Gommez (1984) was used to compare treatment means.

RESULTS AND DISCUSSION

Table (1): Evaluation of two new cultivar and local cultivar in some vegetative growth, yield and its components characters in 2005-2006

Characters		No of branch yield	Length of main branch (cm)	Number of leaves of main branch	Number of roots/ plant	Average of tuber root fresh weight (gm)	Total tuber roots yield(ten-fed)
New	Min. 296	28.97	131.60	18.17	7.80	520.00	21.50
	Min. 296	27.09	175.20	13.76	5.92	618.30	24.37
Local	Mabrouka	23.73	212.40	21.37	4.32	460.00	12.43
	Min. 296	28.93	129.30	16.56	8.56	490.00	20.64
	Min. 296	27.20	170.10	12.45	6.03	643.30	23.50
	Mabrouka	23.77	201.30	20.61	4.33	450.00	11.40
L .S.D5%		1.82	9.353	1.635	1.31	22.98	1.953

- **Nutritional value**

Table (2)|: Evaluation of two new cultivar and local cultivar in some, yield and its chemical characteristics at harvested in sweet potato.

Characters		Total carotene mg/100g F.w of tuber roots	Ascorbic acid(V.C) mg/100g F.w of tuber roots	Total carbohydrates%	Total sugers D.W basis%	Reducing sugars content of tuber roots	Non reducing sugars content of tuber roots	Sucrose sugars content of tuber roots	Protein content of tuber roots
New	Min. 296	12.64	15.05	83.80	6.49	0.76	6.22	6.62	9.78
	Min. 296	10.20	20.47	83.20	7.34	0.76	7.24	5.84	11.27
Local	Mabrouka	6.76	17.59	75.95	4.50	0.75	4.57	5.80	5.11
L .S.D5%		0.993	0.854	4.87	2.587	0.072	0.393	0.772	0.65

Potato vegetative characters.

Data in Table (1) show the number of branches per plant which was found to be significantly differed between three cultivars, Min 2/96 was the highest in the number of branches per plant compared with Min 6/96 and local cultivars (Mabrouka) while in the characters length of main branches (cm) and number of leaves per plant local cultivar increasing than Min 2/96 and Min 6/96 in this trait. Data in same table show that the effect of different cultivars of seed potato yield /fed and its components (number of roots/plant, average weight of tuber root). It is clear that yield and its components increased in Min 2/96 to number of roots per plant followed by Min 6/96 then Mabrouka cultivar, while in the total yield (ton/fed) and average of tuber root fresh weight the Min 6/96 was the greater than the Min 2/96 and local cultivar.

Data presented in Table (2) reveal that the sucrose content was higher in the Min2/96 than Min6/96 and local cultivar. No significant differences were observed between Min 6/96 and Mabrouka cultivars, while in the starch content show no significant differences were observed between Min 2/96 and Min 6/96. Whatever Mabrouka cultivar (local) was higher value in this trait, concerning protein trait the new cultivar gave higher value 11.27followed the Min 2/96 .

Table (3): Chemical composition of mixture ingredients Formula I(g/100g mixture).

	Component				
	Protein	**Fat**	**Total carbohydrates**	**Ash**	**Energy (K Cal%)**
Sweet potato	11.27	0.26	88.23	3.91	390
Mung bean	26.47	1.43	62.7	4.04	334
Ficus carica	6	1.2	89	3.8	390

Chemical composition of mixtures:

The results of chemical composition of mixture ingredients (g/100g dwt) are presented in Table (3). The protein contents in formula (1) were 11.27, 26.47 and 6% for sweet potato, mung bean and ficus carica respectively. Values for fat, total carbohydrates, ash and energy were (0.26, 1.43 and 1.2%0, (88.23, 62.7 and 89%), (3.91, 4.04 and 3.8%) and (390, 334 and 390 K.cal) sweet potato, mung bean and ficus carica respectively.

Table (4) show the chemical composition (g/100g dwt) of formula (2). Protein contents were 11.27, 19.6 and 6% for sweet potato, chickpea and ficus carica respectively. On the other hand values of fat, total carbohydrates, ash and energy are (0.26, 5.4 and 1.2), (88.23, 61.4 and 89%), (3.91, 1.1 and 3.8%) and (390. 372.6 and 390 Kcal) for sweet potato, chickpea and ficus carica respectively.

Table (5) illustrates the chemical composition (g/100g dwt) of formula (3). The tabulated data indicated that, the protein contents are 11.27, 25.8 and 6% for sweet potato, peanut and ficus carica respectively. On the other hand values of fat, total carbohydrates, ash and energy are (0.26, 49.24 and 1.2), (88.23, 22.37 and 89%), (3.91, 2.33 and 3.8%) and (390. 365.84 and 390 Kcal) for sweet potato, peanut and ficus carica respectively.

Table (4): Chemical composition of mixture ingredients formula 2 (g/100g mixture).

	Component				
	Protein	**Fat**	**Total carbohydrates**	**Ash**	**Energy (K Cal%)**
Sweet potato	11.27	0.26	88.23	3.91	390
Chickpea	19.6	5.4	61.4	1.1	372.6
Ficus carica	6	1.2	89	3.8	390

Table (5): chemical composition of mixture ingredients formula 3(g/100g mixture).

	Component				
	Protein	**Fat**	**Total carbohydrates**	**Ash**	**Energy (K Cal%)**
Sweet potato	11.27	0.26	88.23	3.91	390
Peanut	25.8	49.24	22.37	2.33	635.84
Ficus carica	6	1.2	89	3.8	390

Table (6) shows the chemical composition (g/100g dwt) of formula (4). The protein contents were 11.27, 36.5 and 6% for sweet potato, soybean and ficus carica respectively. On the other hand values of fat, total carbohydrates, ash and energy are (0.26, 19.9 and 1.2), (88.23, 30.2 and

89%), (3.91, 4.9 and 3.8%) and (390. 445.9 and 390 Kcal) for sweet potato, soybean and ficus carica respectively. Pallet and Young (1988) reported that the quality of sweet potato protein is lowest for the infant, but moderate to high for all other age groups suggested that an improvement in both quality and quantity of protein would be beneficial in those societies relying partly or heavily on sweet potato as a source of protein.

Table (6): chemical composition of mixture ingredients (g/100g mixture).

	Component				
	Protein	**Fat**	**Total carbohydrates**	**Ash**	**Energy (K Cal%)**
Sweet potato	11.27	0.26	88.23	3.91	391
Soy bean	36.5	19.9	30.2	4.9	445.9
Ficus carica	6	1.2	89	3.8	390

Table (7) shows the chemical composition of some weaning foods mixtures prepared from sweet potato (70%), ficus carica (10%) and mung bean (20%) or chickpea (20%) or peanut or soybean (20%). The data indicate that, protein contents are 13.78, 13.49, 12.41 and 15.79 % for formula 1, 2, 3 and 4 respectively. These contents supplies about 98.4, 96.4, 88 and 112.8% of protein daily requirements according to FAOWHO/UNU (1985) the minimum level of protein was set at 14%. The same table show values of total carbohydrates were 81.33. 71.79, 87 and 73.63 for formula 1, 2,3 and 4 respectively. fat contents were 0.59, 9.84, 1.32 and 4.22 % for formula 1,2,3 and 4 respectively, while ash contents of formula 1,2,3 and 4 were 3.93, 3.60, 3.35 and 4.11 respectively. On the other hand, energy for formula 1, 2, 3 and 4 were 385.75, 429.68, 381.0 and 395.66 K cal respectively.

Table (7): Chemical composition of weaning food mixture (g/100g mixture)

Formula (4)	**Formula (3)**	**Formula (2)**	**Formula (1)**	**Component**
15.79	12.41	13.49	13.78	Protein
4.22	1.32	9.84	0.59	Fat
73.63	79.87	71.79	81.33	Total carbohydrates
4.11	3.35	3.60	3.93	Ash
395.66	381.0	429.68	385.75	Energy (Kcal y)
				Minerals (Mg/100g)
143.74	120.34	101.83	130.2	Ca
265.05	210.25	191.45	360.7	P
42.53	48.93	42.93	77.4	Na
1086.33	898.53	793.93	880.6	K
5.1	3.12	2.36	5.58	Fe
2.15	1.85	1.83	2.02	Zn

Minerals contents of all formulas were presented also in Table (7). Values (g/100g mixture) for Ca, P, Na, K, Fe and Zn were 130.2, 360.7, 77.4, and 880.6, 5.58 and 2.02), 101.83, 191.45, 42.93, 793.93. 2.36 and 1.83), (120.34, 210.25, 48.93, 898.53, 3.12 and 1.85) and (143.74, 265.05, 42.53, 1086.33, 5.1 and 2.15) for formula 1, 2, 3 and 4 respectively. Data in Table

(8) indicate the evaluation of essential amino acids composition of the mixture of formula (1). The results showed that the combination of sweet potato, mung bean and faces carica efficient complementation of the amino acids, which met the FAO (1970) reference pattern.

Table (8): Essential amino acids composition and amino acid scores of the mixture.

Essential amino acids	Sweet potato : soy bean : ficus carica	FAO Ref. Pattern (g/16gN)	Amino acid scores %
Isolucine	6.47	4.00	161.75
Leucine	9.74	7.00	139.14
Lysine	7.54	5.50	137.10
Metionine+cystine	3.46	3.5	99.14
Phenylalanine	7.72	6.00	128.67
Theronine	6.82	4.00	170.5
Valine	8.98	6.09	147.45
Tryptophan	1.71	1.25	136.80
Proline	4.56		
Histidine	2.97	2.5	156.31
Tyrosine	4.56	2.73	149.48
RER1	3.53		
PER2	3.43		
PER3	2.17		

As indicated by A.A.S and P.E.R protein of the mixture was adequate, this reflects the high nutritive value of the mixture as a weaning food. The results of the protein efficiency ratio (PER) are present in the same table.

The protein efficiency ratio (PER) values of formula 1, 2, 3 and 4were ranged from (2.38-3.09), (2.30-3.37), (2.64-3.39) and (2.17-3.53) The obtained data were higher than that obtained by Badee et al (2004) . this reflect the nutritive value and high protein quality of the prepared formulas contained sweet potato, ficus carica, and /or mung bean, chickpea, peanut and soybean.

The same results were found in tables 9, 10 and 11 for formula 2, 3 and 4

Table (9): Essential amino acids composition and amino acid scores of the mixture.

Essential amino acids	Sweet potato : peanut: ficus carica	FAO Ref. Pattern (g/16gN)	Amino acid scores %
Isolucine	5.9	4.00	147.0
Leucine	8.84	7.00	126.29
Lysine	6.57	5.50	119.45
Metionine+cystine	3.23	3.5	92.28
Phenylalanine	7.58	6.00	126.33
Theronine	6.25	4.00	156.25
Valine	8.38	6.09	137.6
Tryptophan	2.30	1.25	
Proline	4.81		
Histidine	2.67	2.5	140.53
Tyrosine	4.86	2.73	180.02
RER1	3.37		
PER2	3.25		
PER3	2.30		

Organoleptic evaluation

Organoleptic evaluation of weaning food mixture showed high acceptability for appearance, texture, odor, color and taste. Also it is cheap weaning foods, the average cost of 100 gram from .080 to 1.50L.E.

Table (10): Essential amino acids composition and amino acid scores of the mixture.

Essential amino acids	Sweet potato : chickpea: ficus carica	FAO Ref. Pattern (g/16gN)	Amino acid scores %
Isolucine	6.39	4.00	159.75
Leucine	9.36	7.00	133.71
Lysine	7.78	5.50	141.45
Metionine+cystine	3.55	3.5	101.14
Phenylalanine	8.27	6.00	137.83
Theronine	6.72	4.00	168.0
Valine	8.7	6.09	142.86
Tryptophan	2.41	1.25	141.8
Proline	5.3		
Histidine	3.11	2.5	163.68
Tyrosine	5.24	2.73	191.94
RER1	3.39		
PER2	3.29		
PER3	2.64		

Table (11): Essential amino acids composition and amino acid scores of the mixture.

Essential amino acids	Sweet potato : soy bean: ficus carica	FAO Ref. Pattern (g/16gN)	Amino acid scores %
Isolucine	6.43	4.00	160.75
Leucine	9.96	7.00	138.43
Lysine	7.37	5.50	143
Metionine+cystine		3.5	
Phenylalanine	7.97	6.00	132.83
Theronine	6.65	4.00	166.25
Valine	5.85	6.09	95.06
Tryptophan	2.36	1.25	188.8
Proline	4.31		
Histidine	3.63	2.5	145.2
Tyrosine	4.74	2.73	79.0
RER1	3.09		
PER2	3.03		
PER3	2.38		

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استخدام أصناف جديدة من البطاطا لعمل وجبات للأطفال

يحيي عبد المنعم عبد الهادى*، عفاف سالم* ومرفت محمد أنور ***

*** قسم الاقتصاد المنزلى كلية التربية النوعية- جامعة المنوفية**

**** معهد البحوث الزراعية-الجيزه- مصر**

***** هيئة الطاقة الذرية – مركز البحوث النووية**

أجريت هذه الدراسة بهدف تقدير القيمة الغذائية للبطاطا لامكان استخدامها فى التغذية. وقد تم تقدير القيمة الغذائية لصنفين من الأصناف الجديدة وصنف من الأصناف المحلية تم زراعتها فى معهد بحوث البساتين بالقناطر الخيرية. وقد سميت هذه الأصناف باسم منوفية ٦٩/٢ ، منوفية٦٩/٦ ، المبروكة (الصنف المحلى). وقد أظهرت النتائج ارتفاع محتوى الأصناف الجديدة من البروتين مقارنة بالصنف المحلى حيث كان مستوى البروتين ٩,٧٨ ، ١١,٢٧ ،٥,١٧ لكل من منوفية٩٦/٢، منوفية ٩٦/٦ ، مبروكة بالترتيب. كما أظهرت النتائج أيضا ارتفاع محتوى الأصناف الجديدة عن الصنف المحلى فى الكربوهيدرات الكلية والسكريات الكلية والسكريات المختزلة والسكريات غير المختزلة وسكر السكروز . كما أظهرت النتائج أن البطاطا يمكن أن تكون مصدرا لمصادات الأكسدة (فيتامين ج والبيتاكاروتين) حيث كان تركيز البيتاكاروتين ١٢,٦٤ ، ١٠,٢٠ ، ٦,٧٦ ملليجرام /١٠٠جم من الوزن الجاف لكل من منوفية ٩٦/٢ ، منوفية ٩٦/٦ والمبروكة بالترتيب بينما كان تركيز فيتامين ج ١٢,٠٥ ، ٢٠,٤٧ ،١٧,٥٩ ملليجرام /١٠٠جم من الوزن الرطب لكل من منوفية ٩٦/٢ ، منوفية ٩٦/٦ والمبروكة بالترتيب.

تم عمل أربعة خلطات غذائية للأطفال مكونة من البطاطا (٧٠%) والتين المجفف (١٠%) فول الصويا أو الفول السودانى أو العدس الصيفى أو الحمص (٢٠%) وذلك فى صورة بودرة لتحسين جودة بروتين البطاطا ، وقد أوضحت النتائج ارتفاع هذه الخلطات فى محتواها من البروتين سواء من حيث النوع أو الكمية. وبعمل حسابات التكلفة اتضح ان الخلطة(١٠٠ جم) رقم ١ (٢٠% عدس صيفى) كانت اقل تكلفة يليها الخلطة رقم ٢ (٢٠% حمص) ثم رقم ٣ (٢٠% فول سودانى) ثم رقم ٤(٢٠% فول صويا) وتراوحت تكلفتها من ٠,٨٠ -١,٥٠ جنيه مصري.