THE YIELD AND QUALITY PARAMETERS OF NEW CLONES OF SWEET POTATO (*Ipomoea batatas* L.)

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Abstract

This study was conducted at Malway Agricultural Research Station and Chemistry Department, Faculty of Agric. Minia Univ., during 2006 and 2007 seasons to evaluate three new clones of sweet potato; suitable for food, feed and industrial uses or export and local cultivar Mabrouka. The new clones of sweet potato are Assuit 201 (SPA01), Assuit 202 (SPA02) and Assuit 204 (SPA04)]. The results indicated that the three clones performed well and yielded higher than the local cultivar. The highest marketable yield and dry matter content among the evaluated clones were those of SPA01. The clone SPA04 which did not perform well in yield and its components, had good levels of chemical characters (crude protein, total flavonoids, total phenolic compounds, vitamin C and starch) and of vegetative growth (stem length, numbers of primary branches/plant and vine weight).

Nitrate concentrations (NO_3^{1-} mg ion/kg fw) estimates ranged from 159 to 210. The highest level (210 mg ion/kg fw) of nitrates was recorded in roots of Mabrouka cultivar and the lowest one was found in clone SPA02. The nitrite concentrations ranged from 6 to 8 mg ion/kg fw and SPA02 clone contained the highest level. The recorded levels appeared to be within the safe limits (10 mg ion/kg fw) that don't cause toxic effects. The highest values for total soluble sugars (TSS), total reducing sugars (TRS) and total non reducing sugars (TNRS) were given by roots of Mabrouka cv. The levels of vitamin C of the sweet potato samples ranged from 14 mg/ 100g fw for SPA01 to 30 mg/ 100g fw for SPA04.

Total carotenoids (TCs) content, expressed as mg/100g fw was higher in Mabrouka than those determined in the creamy fleshed sweet potato samples (SPA04, SPA02 and SPA01).

The total flavonoids (TFs) concentration in SPA04 were double that of Mabrouka (0.75 mg/100g fw). TFs concentration took an opposite trend to that of TCs. The concentrations of total phenolic compounds (TPCs) in whole tuber root (WTR) and sweet potato peels (SPP) were determined and expressed as tannic acid and chlorogenic acid and the results showed that TPCs levels ranged from 14 to 52 mg/100g fw and were higher in SPP than WTR. The clone SPA04 surpassed the other two studied clones as well as Mabrouka cultivar and contained the highest TPCs concentration.

INTRODUCTION

Sweet potato (SP) (*Ipomoea batatas* (L.) is an American native plant belonging to the family Convolvulaceae, order Polemoniales (Burden, 2005 and Oggema *et al.*, 2007). It is ranked the third most important tuber, after potato (*Solanum tuberosum*) and cassava (*Manihot esculentum*) (FAO, 2003). It is grown around the world in diverse environments and ranks the world's seventh most important food crop; after wheat, rice, maize, Irish potato, barley and cassava (CIP, 2000 and FAO, 2002). Also, sweet potato is one of the important root crops in Egypt and many other countries in the world especially Eastern and Southern parts of the African continent (Tumwegamire *et al.*, 2004). Fresh sweet potato provides about 50% more calories than Irish potato (Woolfe, 1992). Sweet potato is a source of food, feed and processed products (CIP, 2000). It has a unique ability to adapt to a wide range of environmental conditions and grows on marginal areas with poor soils of limited fertility and inadequate moisture (Bioethics Nuffield Councel, 2004).

Sweet potato can be used in various ways, as direct food, processed food, industrial starch and feed (Katayama *et al.*, 2006). The high flavonoid content of sweet potatoes (especially the purple flesh genotypes) gives them strong antioxidant properties (Lu *et al.*, 2001). The phenolic content of sweet potatoes is three times higher than that of blueberry (Cevallos and Zevallos, 2002). The total phenolic content can serve as a useful indicator for the antioxidant activities of sweet potatoes (Teow *et al.*, 2007).

Sweet potato has the highest solar energy fixing efficiency among the principle food crops because of its tremendous capacity to produce dry matter over a long period of time (Hahn, 1977). The total cultivated area in the year of 2000 reached about 14000 feddan with a total production of about 160000 tons and a mean of 11-43 tons/fed (Department of Agricultural Economic statistics, Ministry of Agric., Egypt. Anonymous, 2001).

In the last years, production of the local commercial cultivars in Egypt has been declined due to either the deterioration of these cultivars; using old traditional cultural practices or susceptibility of these cultivars to some diseases and insects. Therefore, improvement could be achieved throughout different approaches such as introducing high yielding genotypes and/or production of F_1 hybrids among promising genotypes for high yielding potential characterization (Shalaby *et al.*, 2001).

Exposure to nitrate and nitrite has been postulated to have several deleterious health effects. Although, Hartman (1982) has tentatively suggested some direct health effects of nitrate itself, at normal levels of exposure, it has no proven toxicological action. The major effects of nitrate appear to be mediated indirectly through its endogenous metabolites, nitrate and N-nitrous compounds, most of which are known to have profound toxicological effects.

Most staples and vegetables, including sweet potatoes, contain vitamin C in both the reduced (L-ascorbic acid) and oxidized (dehydroascorbic acid) forms. Vitamin C is a powerful reducing agent found in millimolar concentrations in plants and is thought to play an important role in scavenging free radicals (natural antioxidant) in plants and animals (Conklin *et al.*, 1996 and Abd El-Naem, 2004). Fortunately, it is an important nutritive compound in sweet potato roots. Moreover, the role of L-ascorbic acid in prevention of curvy and many disease infections has been known for a long time (Secretin, 1974).

Carotenoids are a large group up to 800 carotenoids of fat soluble pigments widely distributed in plants and animals (Frank *et al.*, 2004). Dietary carotenoids are thought to provide health benefits by decreasing the risk of disease, particularly certain cancers, stroke heart disease and eye diseases. Carotenoids that have been most studied in this regard is β-carotene which have nutritional benefits due to its ability to convert into vitamin A. The beneficial effects of carotenoids are thought to be due to their role as antioxidants. Many diverse carotenoids besides β-carotene play vital roles in maintaining good health especially in protecting against free radical damage (Tumwegamire *et al.*, 2004). SP is considered a good source of carotenoids (Takahata *et al.* 1993).

Several polyphenolics are present in whole roots of sweet potato and concentrated in peels. The oxidation of these compounds by free oxygen is catalyzed by polyphenol oxidases (PPO), (Woolfe, 1992). The polyphenols are effective hydrogen donors, particularly flavonals such as quercetin (Rice-Evans *et al.*, 1995); flavanols such as catechin gallate esters in green and black teas (Salah *et al.*, 1995), anthocyanins in wines (Frankel *et al.*, 1993) and phenylpropanoids (Castellucio *et al.*, 1995), including chlorogenic acid in apple juice (Miller *et al.*, 1995). Their antioxidant potential is dependent on the number and arrangement of the hydroxyl groups and the extent of structural configuration, as well as the presence of electron-donating and electron-withdrawing substituents in the ring structure (Rice-Evans *et al.*, 1995).

The aims of the present work were, to evaluate some high-yielding clones; suitable for food, feed and industrial uses or export and to compare them with the common local cultivar Mabrouka by determining their chemical contents including TSS, TRS, TNRS, starch, nitrate, nitrite, vitamin C, total carotenoids, total flavonoids and total phenolic compounds.

MATERIALS AND METHODS

The research work took place during 2006 and 2007 seasons on the Experimental Farm at Mallway. The soil tested of the farm was clay, the soil pH was 7.9 and the average chemical properties of the soil are shown in Table (1).

Table 1. Some physical and chemical properties of the soil

Texture grade	Sand	Silt	Clay	pH	E.C	CECe mole/ kg	$CaCo_3$	O.M	Available nutrient (ppm)	
									P	K
Clay	26 %	34 %	40 %	7.9 %	2.0 ds/m	39	3.5 %	0.89 %	9.0	35.0

The plant material use in the study includes three clones (F_1 hybrids Assuit 201, 202 and 204 and the commercial cultivar Mabrouka of sweet potato to be evaluated for high-yielding capacity and good root quality. The three F_1 hybrids were obtained by hand crossing technique under open field conditions by Badawy (2001). Each clone and the commercial cultivar Mabrouka were vegetatively propagated to produce large numbers of high-quality sweet potato transplants. Cuttings (20cm length), with at least three nodes, were taken from the nursery and transplanted on April 10, 2006 and April 15, 2007 seasons. The experimental design was a randomized complete blocks design with three replicates. The transplants were placed at 40 cm spacings in rows, 1m apart. Plot size was 10.5 m^2. Cultural practices were followed as recommended in the commercial field. At harvest time (180 days from transplanting), 5 plants from each plot were randomly taken on which the following data were recorded and averaged: 1) Vegetative characters: Number of branches/plant, main stem length (cm), weight of vines/plant, 2) yield and its components: number and weight of marketable roots /plant, total yield /plant and total yield as ton /fed., and 3) the chemical characters TSS, TRS, TNRS, starch, nitrate, nitrite, vitamin C, total carotenoids, total flavonoids and total phenolic compounds

Proximate Analysis:

Determination of moisture, ash, crude fibers, crude lipids and crude protein (N x 6.25) were performed as described by AOAC (1984).

Extraction and determination of soluble sugars:

Soluble sugars were extracted according to Macrae and Zand-Moghdlam (1978) method. Total soluble sugars were determined by the phenol-sulfuric acid method as described by Dubois *et al.* (1956). Total reducing sugars were determined by modified Neocuproine method described by Dygert *et al.* (1965). Total non-reducing sugars (TNRS) were calculated by subtracting the total reducing sugars (TRS) from the total soluble sugars (TSS).

Determination of starch:

Starch was extracted in 72%(v/v) perchloric acid at room temperature. Quantitative determination of starch was carried out according to the colorimetric method of Clegg (1956).

Extraction and determination of nitrite (NO_2) and nitrate (NO_3): -

The nitrite and nitrate were extracted from sweet potato roots by 1% K_2SO_4 solution and determined as described by Saad (1991).

Determination of vitamin C: -

Vitamin C was extracted using 1.25 % oxalic acid solution. The indophenol method (2,6-dichlorophenol indophenol as described by Mondy and Ponnampalam (1986) was used for determination of vitamin C concentration in sweet potato. All determinations were performed in triplicates and the mean values were recorded.

Determination of carotenoids: -

The carotenoids contents of sweet potato samples were extracted by chloroform and measured according to the official methods of AOAC (1984).

Extraction and Determination of total flavonoids (TFs):

Defatted meal sample of root tubers (30.0g) were extracted in a Soxhlet extractor with 100 ml ethanol for 1 hour and the extract filtered according to the method described by Zhuang *et al.* (1992). A known volume of extract was placed in 10 ml volumetric flasks. Distilled water was added to make 5 ml and 0.3 ml $NaNO_2$ (1:20) were added. 3 ml $AlCl_3$ (1:10) were added, 5 min later. After 6 min, 2 ml 1 mol $litre^{-1}$ NaOH was added and the total was made up to 10 ml with distilled water. The solution was mixed well again and the absorbance was measured against a blank at 510 nm (Zhuang *et al.*, 1992).

Extraction and Determination of (TPCs):

TPC contents of whole sweet potato tubers and sweet potato peel samples were extracted by 1% Methanolic-HCl and assayed according to the methods of Taga *et al.* (1984).

Statistical analysis:

Data were subjected to the analysis of variance method and the means were compared, using the Duncan's multiple range test, through the SAS (1985) procedures.

RESULTS AND DISCUSSION

Vegetative characters:

Average number of branches/plant, stem length (cm) and vine weight (kg)/plant were affected by the studied clones, compared with the commercial cultivar Mabrouka (Table 2).

Table 2. Average number of branches /plant, mean of stem length (cm) and vine weight (kg)/plant of the tested sweet potato clones and the commercial cultivar Mabrouka, in the first and second seasons of 2006 and 2007.

Clones/cv	No. branches /plant		Stem length (cm)		Vine weight(kg)/plant	
	2006	2007	2006	2007	2006	2007
Assuit 201	10.0 ab	10.67 a	158.1 c	159.5 c	5.18 c	5.56 c
Assuit 202	9.33 b	10.0 ab	180.7 b	186.0 b	8.71 a	7.18 b
Assuit 204	10.67 ab	11.33 a	231.6 a	232.7 a	7.73 b	8.30 a
Mabrouka c.v	11.33 a	11.67 a	144.7 d	143.0 d	2.47 d	2.29 d

In a column, values followed by the same letter are not significantly different, using Duncan's multiple range test at 0.05 level

Mabrouka cv. recorded the highest values for the number of branches/plant compared to the three clones in the two seasons, with insignificant differences among them. Assuit 204 clone was higher than those of the other two clones and Mabrouka cv., regarding stem length in the two seasons and vine weight in the second season. This clone could be used as a leafy vegetable or for animal feed. Due to its rapid growth and tendency to cover the land in a short time, it might be used as a cover crop to reduce erosion effects (Jayasinghe *et al.,* 2003). On the other hand, estimates for stem length and vine weight/plant showed that Mabrouka cv. gave significantly lower values than those of the tested clones.

Yield and its components:

a) Root size (length and diameter (cm)):

The root length and diameter showed significant differences among the three evaluated clones and the commercial cultivar (Table 3).

Table 3. Root size (length and diameter (cm) of the tested sweet potato clones and the commercial cultivar Mabrouka in the first and second seasons of 2006 and 2007.

Clones/cv	Root size (cm)			
	Length		Diameter	
	2006	2007	2006	2007
Assuit 201	17.32 a	17.13 ab	5.80 a	5.33 a
Assuit 202	13.43 c	13.28 d	2.30 e	2.13 d
Assuit 204	16.30 b	17.33 a	3.16 d	3.00 c
c.v Mabrouka	16.56 b	15.16 c	5.52 b	5.17 a

In a column, values followed by the same letter are not significantly different, using Duncan's multiple range test at 0.05 level.

Assuit 201 was significantly superior over the other two clones and the commercial cultivar Mabrouka in root length and diameter in both seasons. However, Mabrouka cv. gave significantly higher values for root diameter, but only in the second season and with an insignificant difference with that gave by Assuit 201 clone.

b) Weight of marketable root (kg)/plant, root number/plant and total yield (ton/fed.).

Weight of marketable yield (kg)/plant, root number/plant and total yield (ton/fed.) for the three studied clones compared to the local commercial cultivar are illustrated in Table (4). There were significant differences among the tested clones and Mabrouka cv. in the three mentioned characters in the two seasons. Assuit 201 was higher in all yield characters than the other. High yield was associated with marketable roots, and high values of both then number, and size. Mabrouka cv. recorded the lowest values in both years for the studied yield characters. The reduction in yield values of Mabrouka cv. May be due to the poor quality of the used propagating cuttings (Shalaby et al., 2001).These crops are generally clonally reproduced from cuttings, roots, or tubers, it is relatively easy for diseases to be transmitted through from generation to generation (Shalaby *et al.*, 2001).

Table 4. Weight of marketable roots (kg)/plant, root number/plant and total yield (ton/fed.) of the tested sweet potato clones and the commercial cultivar Mabrouka cv. in the first and the second seasons of 2006 and 2007.

Clones/cv	Number of roots /plant		Root weight (kg) /plant		Total yield (ton/fed.)	
	2006	2007	2006	2007	2006	2007
Assuit 201	9.0 a	10.0 a	5.26 a	5.40 a	32.33 a	30.25 a
Assuit 202	6.0 bc	6.33 b	2.19 b	2.30 b	17.02 c	15.28 c
Assuit 204	7.0 ab	7.33 b	2.21 b	2.56 b	18.22 b	17.02 b
Mabrouka c.v	4.33 c	4.0 c	1.18 c	1.24 c	9.83 d	9.51 d

In a column, values followed by the same letter are not significantly different, using Duncan's multiple range test at 0.05 level

The chemical contents: -

Six chemical constituents (dry matter, crude protein, starch, total ash, crude fiber and crude lipids) of sweet potato samples were determined and the results are shown in Fig. (1).

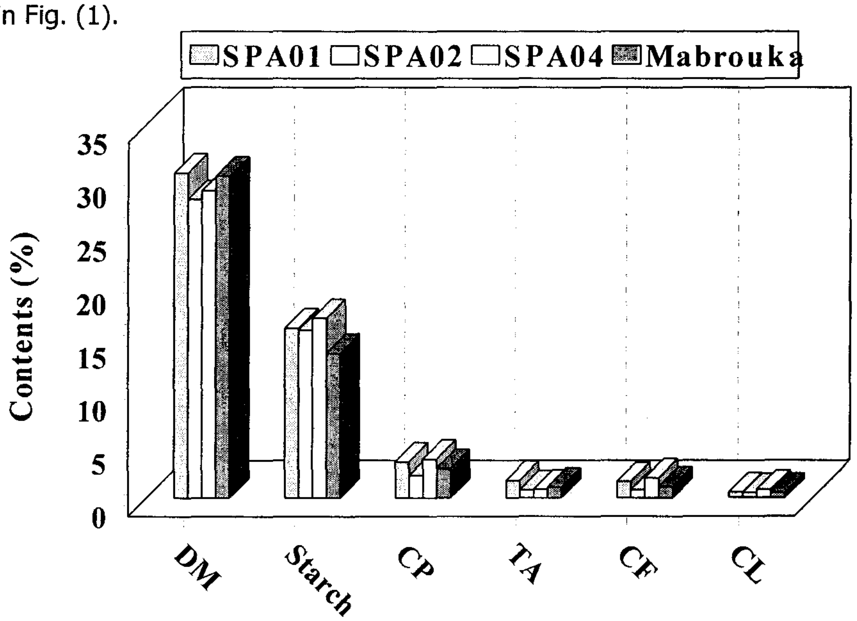

Fig. 1. Chemical analysis of the testes sweet potato tubers.

DM= dry matter, CP= crude protein, TA= total ash, CF= crude fiber, CL= crude lipids

The data indicated that dry matter values were in close extent and ranged from 28 to 30.5%. The dry matter of clone SPA01 was very close to that recorded for Mabrouka; whereas, both SPA02 and SPA04 contained relatively lower levels of dry matter (Fig. 1). Similar results were reported by El-Shimi (1996) and El-Denary (1998). In common with other roots and tubers, the sweet potato has high moisture content, resulting in relatively low dry matter content. The average dry matter content in tuber is approximately 30%, but varies very widely depending on such factors as cultivar, location and climate (Bradbury and Holloway, 1988). The results showed that the starch content in the three tested new clones were higher than that recorded for Mabrouka cultivar and the highest detected level of starch was recorded for SPA04 (Fig. 1).

Crude protein in tuber roots of SPA04 was the highest (3.65%), followed by SPA01 (3.41%). These results, generally, are in a good agreement with those reported by El-Shimi (1996), El-Denary (1998) and Shalaby *et al.* (2001). The studies of Akkamahadevi *et al.* (1996) on composition of selected five sweet potato varieties showed significant differences among these cultivars in protein contents (ranging from 3.74 to 8.63%). Sweet potatoes are not considered a good source for crude lipids and crude fiber, which did not exceed 0.51% and 1.8%, respectively.

It could be concluded from data shown in Fig. (1) that the new sweet potato clone SPA04, significantly, surpassed in most of the determined local commercial cultivar Mabrouka in components; such as starch, crude protein, crude fiber and total lipids and these are in accordance with the observations by Shalaby *et al.* (2001) who mentioned that the clonal selection improved some vegetative characters, storage-root quality traits and chemical composition where it increase dry matter, crude fiber and crude protein (%).The chemical approximate analyses of sweet potato are widely depending on many factors including cultivars, soil composition, climate and cultivation practices (Shalaby *et al.*, 1993; Ravindran *et al.*, 1995; Mansour *et al.*, 2002).

Sugar contents:

The quantitative analyses of total soluble sugars (TSS), total reducing sugars (TRS) were assayed and the results are shown in Fig. (2). The highest values for TSS, TRS and TNRS were recorded in tuber roots of Mabrouka cultivar whereas the lowest ones were found in SPA01. Similar results reported by Chen *et al.* (1994). Shalaby *et al.* (1993) evaluated two commercial Egyptian cultivars for root chemical composition and sugars and foundsignificant differences between them. Variability in total sugars between sweet potato samples was notable and the estimates ranged from 0.38% to 5.64% fresh weight (fw) among many cultivars (Chen *et al.*, 1994 and Woolfe, 1992). It was also reported the considerable variability in total sugars existed even within different roots of the same cultivar.

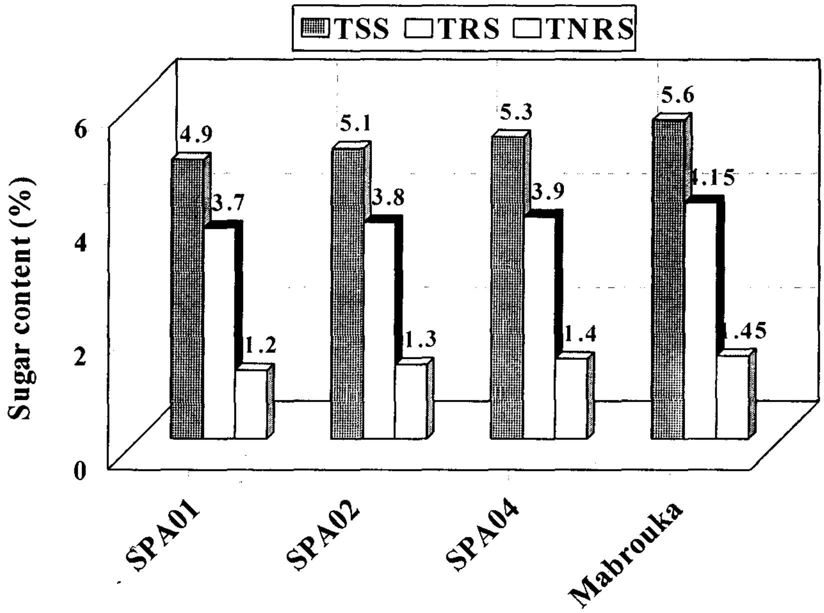

Fig. 2. Sugar contents of sweet potato clones. TSS=Total soluble sugars, *TRS= Total reducing sugars, TNRS= Total non-reducing sugars*

Data shown in Fig. 2 illustrated the presence clear differences among the tested sweet potato clones in all determined chemical constituents; such as soluble sugar, starch and protein content. The *Ipomoea batatas* has soluble sugar content around 5.6% (Chen *et al.*, 1994). El-Shimi (1996) found that total sugar and starch percentages in tuber roots of the sweet potato strains and cultivar 925, 1135 and Mabrouka were 3.27, 2.22 and 2.99% (sugar) and 15.76, 14.27 and 18.98% (starch), respectively. Akkamahadevi *et al.* (1996) evaluated five new selected sweet potato cultivars and found that starch content (71.66-84.6% dw) and total sugar content (5.35-16.99%) differed among the cultivars on a dry weight basis.

Nitrates and nitrites contents: -

Estimated values of nitrate concentration (NO_3^{-1} mg/ion kg fw) ranged from 159 to 210 (Fig. 3). The highest level (210 mg/ion kg fw) of nitrates was recorded in roots of Mabrouka cultivar and the lowest one was found in SPA02. MAFF (1987) reported that nitrate concentration in vegetables vary enormously, ranging from 1 to 10000 mg/kg of fw. Our results are in good agreement with those reported in the applied classification of MAFF (1987) which stated that sweet potato belongs to division I; i.e. vegetables or crops containing low nitrate concentration (less than 250 mg/ion kg fwb)

Data shown in Fig. (4) showed that nitrite concentration ranged from 6 to 8 mg/ion kg fw and SPA02 clone contained the highest level. These recorded levels are very safe (10 mg/ion kg fw) and don't cause any toxical effects.

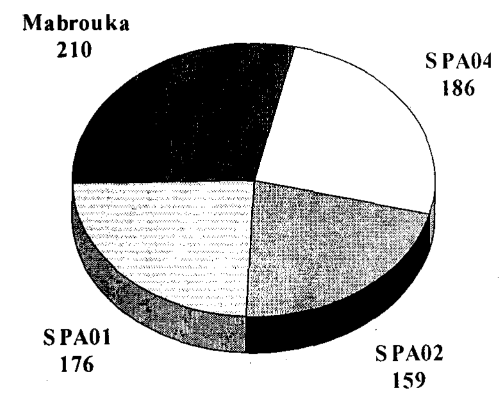

Fig. 3. Nitrates (NO_3^- mg/ion kg fwb) in different SP samples (fresh weight basis fwb)

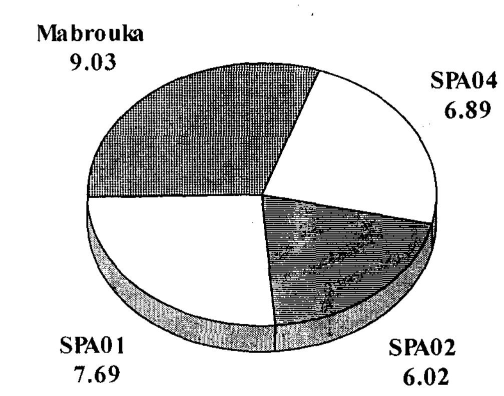

Fig. 4. Nitrates (NO_2^- mg/ion kg fwb) in different SP samples (fresh weight basis fwb)

The acute toxic effects of large doses of nitrite are well documented. The significance of relatively small concentrations of nitrite to adults is judged mainly in the light of the possible role of nitrite as a precursor of the carcinogenic N-nitroso compounds. For this reason, it is important to identify those factors thought likely to increase nitrite ingestion in order to reduce the intake of this ion, since there is an evidence that high intra-gastric nitrite concentration correlates with increased risk from stomach cancer (Hartman, 1982) and the reduction of nitrate to nitrite in the gastric lumen is an important source of nitrite for formation of N-nitroso compounds.

Vitamin C (L-Ascorbic acid):

The levels of vitamin C of the sweet potato samples was determined titratablely and ranged from 14-30 mg/ 100g fwb (Fig. 5). The highest level (30 mg/100g fwb) was recorded in the tissue of SPA04 clone and the lowest one was in SPA01 (14 mg/100 g fwb). These results appeared lower than those reported by Batistuti *et al.* (1992). Meanwhile, Chen *et al.* (1994) reported that vitamin C content was 15.7 mg/100 g fw in the cv. J 57. Composition and quality of five sweet potato cultivars were evaluated by Akkamahadevi *et al.* (1996) who found that vitamin C (L-ascorbic acid) content ranged between 16.13 and 23.42 mg. El-Denary (1998) found that the ascorbic acid (V.C) content in Mabrouka, Mansoura, Golden Bright and 925 cvs. were 15.67, 15.89, 11.57 and 8.46 mg/100 g w, respectively. Sweet potato is quickly becoming an important supplementary staple and has great potentials to alleviate wide spread malnutrition and poverty in developing countries. It is a good source of vitamin A and starch (CIP, 2000).

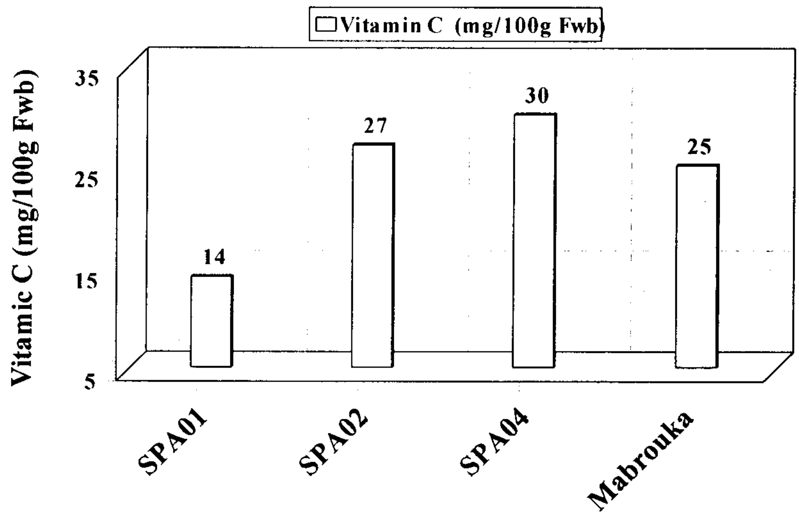

Fig. 5. Vitamin C content (mg/100g fw) in sweet potato samples

Factors which affect ultimate utilization include the dietary level of carotenoid administered, the type and sufficiency of dietary fat, the presence of antioxidants such as ascorbic acid or prooxidants such as nitrites, the presence of adequate bile in the dietary tract, the type and adequacy of dietary protein, and the age of, presence of disease or parasites in, the organism (Woolfe, 1992).

Total carotenoids (TCs) and total flavonoids (TFs): -

Total carotene content expressed as mg/100g fwb in cultivar (Mabrouka) was higher than those determined in creamy fleshed sweet potato samples (SPA04, SPA02 and SPA01), (Fig. 6). The levels of carotenoids ranged from 1.45 to 2.74 mg/100g and the lowest value was found to be that of SPA02 estimated values appeared much lower than those reported recently by Mbwaga *et al.* (2007) who found that orange fleshed sweet potato cultivars contained high β-carotene (27 µg/100g up to 30 µg/100g), which is a precursor to vitamin A. Vitamin A deficiency is the world's most common cause of child blindness (Mukherjee and Hangantileke, 2002). The recorded results are in general agreement with those reported by Takahata *et al.* (1993), El-Shimi (1996), El-Denary (1998) and Jorgensen and Skibsted (1999).

The estimated low carotene contents in our samples could be related the used method, genetic factors within clones and environmental factors. Similar results were reported by Mbwaga *et al.* (2007) who showed that β-carotene contents of stored roots were significantly different ($P<0.05$) across sites and within cultivars, and added also the β-Carotene contents had no clear trends with increasing or decreasing of altitude for the most tested cultivars.

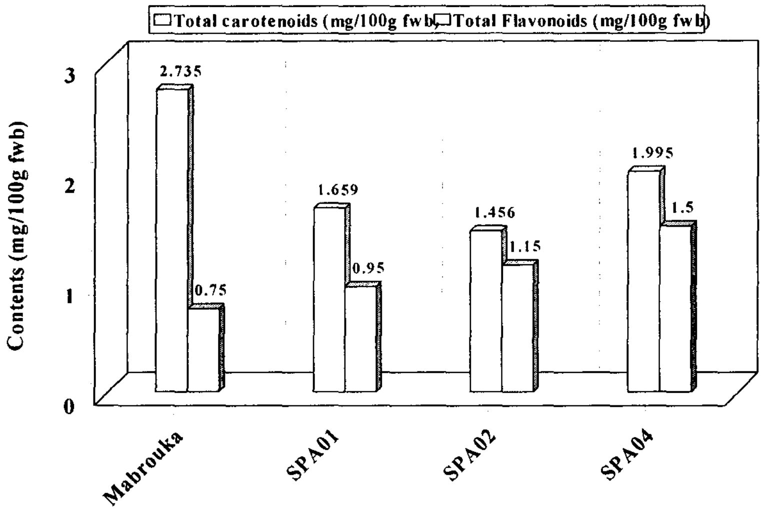

Fig. 6. TCs and TFs (mg/100g fwb) in sweet potato samples

Many investigators have been reported that humans are not able to make carotenoids and hence these compounds must be obtained through diet (Frank *et al.*, 2004). In this study we have determined the carotenoids concentrations because the dietary carotenoid has the ability to prevent many infections and reduce the risk of cancer, cardiovascular and neurodegenerative diseases. Certain carotenoids, acting as antioxidants can potentially reduce the toxic effects of reactive oxygen species (ROS) therefore carotenoids, have been implicated in the etiology of diseases such as cancer and aging (Frank *et al.*, 2004).

The TCs in whole roots of Mabrouka were higher than those reported in roots of new tested clones. The estimated TCs level in Mabrouka appeared to be 137%, 164% and 187%, relative to the levels of SPA04, SPA01 and SPA02, respectively. There is a clear relationship between carotenoids level and the color of flesh, and since all tested new genotypes have a cream flesh they showed lower TCs values than the TCs in Mabrouka. Various natural carotenoids, besides β-carotene, were proven to have anticarcinogenic activity and some of them showed more potent activity than β-carotene. Thus, these carotenoids (α-carotene, lutein, lycopene, β-cryptoxanthin, fucoxanthin, and astaxanthin) as well as β-carotene might be considered useful for cancer prevention (Frank *et al.* (2004). Carotenoids may also play an important role in the prevention of age-related macular degeneration cataracts and other blinding disorder.

The TFs concentration in SPA04 gave a double value (1.5 mg/100fw) of that reported for Mabrouka (0.75 mg/100g fw) (Fig. 6). It is clear the TFs concentration took a reversal trend to that of TCs. Many investigators (Vinson *et al.*, 1998 and Zhishen *et al.,* 1999) concluded that pharmacological effects of flavonoids are correlated with their antioxidants activities. Moreover, it was suggested that the overall antioxidant effect of flavonoids on lipid peroxidation might be related to their ^{-}OH and $^{-}O_2$ scavenging properties and their reaction with peroxy radicals (Hussain *et al.,* 1987 and Zhishen *et al.,* 1999). Flavonoids are differing from other phenolic substances in the degree of oxidation of their central pyran ring and, very fundamentally also, in their biological properties. While some classes (the flavonones, for example) are colourless, the members of other classes (the anthocyanes, for example) are always coloured and known as pigments of flowers or other plant parts.

Total phenolic compounds: -

The concentrations of total phenolic compounds (TPCs) in whole tuber root (WTR) and sweet potato peels (SPP) were determined and expressed as tannic acid and chlorogenic acid (Fig. 7) and the results showed that TPCs levels ranged from 14 to 52 mg/100 g fwb and were higher in SPP than WTR. The new clone SPA04 surpassed on the other studied clones as well as Mabrouka whereas it contains the highest TPCs concentration. This is genotype called high containing phenolic substances. Many investigators correlated a relationship between secondary metabolites such as phenolic compounds and the potentiality of plants against pathogens attacks (Rice-Evans *et al.* 1995).

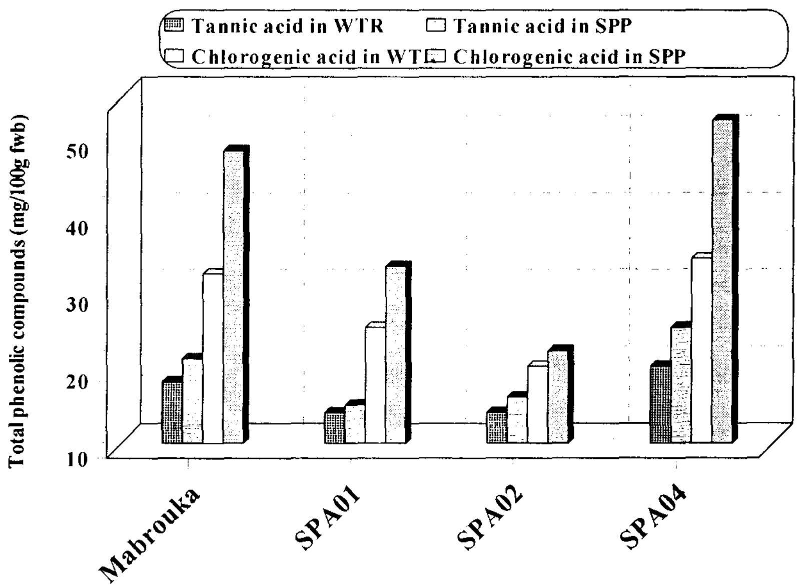

Fig. 7. TPCs (mg/100g fwb) in sweet potato samples

Polyphenolics are formed separately in intact tissues, but if the tissues are disrupted in some way in the presence of oxygen the components mingle and oxidation rapidly occurs. This leads to the production of quinones which either polymerize directly or combine with amino acids and amino groups in proteins to form dark coloured (brown) compounds (Woolfe, 1992). In wounded tissue, many enzymes such as POD and PPO were induced. Polyphenols such as chlorogenic acid and isochlorogenic were produced and respiratory rates of tissue and mitochondria were increased, including CN-insensitive respiration (Uritani, 1998). Polyphenols are the building blocks of lignin and dietary fibre, which is known to determine the texture and nutritional value of vegetable foods. Phenolic substances such as flavonols, cinnamic acids, coumarins and caffeic acids or chlorogenic acids are believed to have antioxidant properties, which are suggested to play an important role in protecting food, cells and any organ from oxidative degeneration (Osawa, 1999 and Nandutu *et al.*, 2007).

There is increasing evidence that consumption of a variety of phenolic compounds present in natural foods may lower the risk of serious health disorders because of the antioxidants activity of these compounds (Keli *et al.*, 1996 and Hertog *et al.*, 1993).

CONCLUSION

In the present work, testing the three promising genotypes of sweet potato to dissolve the lack food problem and starch industry could be recommended Under the global problem of increasing prices and lack of bread, we can use the sweet potato flour as bread substitute, whereas it contains starch ranged from 16 to 19%, after mixing with wheat or/and corn flours. In spite of sweet potato is poor in protein content and protein components. In this view of point, it is possible for plant breeders to concentrate their efforts on increasing the protein percent and TPCs in sweet potato. Many Asian and African countries use sweet potato as a solution of lack of foods problem also the European countries use this crop in preparation of many balanced food meals after mixing it with some legumes.

In common with other Convolvulaceae plants, sweet potatoes contain a number of naturally occurring compounds that give these plants high nutritive values. The most important classes of these compounds are anthocyanins (purple varieties), phenolic compounds, and total carotenoids (yellow varieties).

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إنتاجية و مقاييس الجودة لبعض التراكيب الوراثية الجديدة للبطاطا

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أجريت هذه الدراسة بمزرعة محطة البحوث الزراعية بملوى وبقسم الكيمياء بكلية الزراعة – جامعة المنيا خلال موسمي الزراعة ٢٠٠٦ و ٢٠٠٧ بهدف تقييم ثلاث تراكيب وراثية جديدة من البطاطا للمحصول العالي والصلاحية كغذاء مقارنة بالصنف المحلي "مبروكة" . التراكيب الوراثية الجديدة هي أسيوط ٢٠١ ، أسيوط ٢٠٢ ، أسيوط ٢٠٤ وقد تم الحصول عليهم في دراسة سابقة. أوضحت النتائج أن التراكيب الوراثية الجديدة كانت الأفضل في الإنتاجية مقارنة بالصنف المحلي. من بين التراكيب الوراثية الثلاثة تفوق التركيب الوراثي أسيوط ٢٠١ حيث كان هو الاعلى في الإنتاجية وفي المحصول المسوق ومحتوي المادة الجافة مقارنة بالصنف التجاري المحلي.

اعطي التركيب الوراثي أسيوط ٢٠٤ محصولاً أقل من السلالة الخضرية أسيوط ٢٠١ أو٢٠٢ فقد كانت قيمته هي الأعلى في القياسات الكيميائية (البروتين الخام – الفلافونيدات الكلية – الفينولات الكلية وفيتامين ج والنشا) وأيضا في القياسات الخضرية (طول الساق الرئيسي – عدد الأفرع/نبات – الوزن الطازج للعرش كجم/نبات) فهذا التركيب الوراثي يمكن استخدامه كغذاء للإنسان وكتغذية للحيوان (العرش الأخضر) وكغطاء نباتي لمنع التصحر.

تراوح تركيز النيترات (ايون مجم/كجم وزن طازج) في جذور البطاطا بين ١٥٩ إلى ٢١٠ مجم/كجم وزن طازج واعلي قيمة (٢١٠ مجم/كجم) سجلت في الصنف مبروكة واقل قيمة (١٥٩مجم/كجم) سجلها التركيب الوراثي أسيوط ٢٠٢ أما مستوي النيتريت فكان بين ٦ إلى ٨ مجم/كجم وزن طازج والتركيب الوراثي أسيوط ٢٠٢ قد احتوي على اعلي مستوي والمستويات المسجلة تعتبر داخل الحدود الآمنة (١٠ مجم ايون/كجم وزن طازج).

سجل الصنف لمحلي "مبروكة "أعلي القيم للمواد الصلبة الذائبة الكلية والسكريات المختزلة وغير المختزلة . وتراوح مستوي فيتامين ج في العينات المأخوذة من البطاطا بين ١٤ مجم/١٠٠ جم وزن طازج بالنسبة للتركيب الوراثي أسيوط ٢٠١ إلى ٣٠ مجم/١٠٠ جم وزن طازج للتركيب الوراثي أسيوط ٢٠٤.

سجل الصنف المحلي "مبروكة" اعلي محتوي من الكاروتينويدات الكلية معبرا عنها بالمليجرام/١٠٠ جم وزن طازج مقارنة بالتراكيب الوراثية الجديدة الاخرى (أسيوط ٢٠١ ، ٢٠٤).

تطرقت الدراسة لتقدير تركيز الفلافونويدات الكلية فسجل التركيب الوراثي أسيوط ٢٠٤ ضعف التركيز المسجل للصنف مبروكة (٠,٧٥ مجم/١٠٠ جم وزن طازج). كان مسلك تركيز الفلافونويدات الكلية مسلك عكسي بالنسبة الكاروتينويدات الكلية. تم تقدير تركيز المركبات الفينولية الكلية فى الدرنات الجذرية الكاملة وفى القشور وتم التعبير عن تركيزها فى صورة حمض التانيك وحمض الكلوروجينيك وقد أوضحت النتائج أن مستوي الفينولات الكلية قد تراوح بين ١٤ الي ٥٢ مجم/١٠٠ جم وزن طازج و المستويات كانت اعلي في القشور عنها في الدرنات الجذرية الكاملة والتركيب الوراثي الجديد أسيوط ٢٠٤ قد تفوق في محتواه من الفينولات الكلية عن التراكيب الوراثية الاخري بالإضافة إلي الصنف "مبروكة".