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Comparative Study on the β-Carotene, α-Tocopherol and Pectin Values from Three Cultivars of Pumpkin (*Cucurbita maxima*)

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Abstract: Pumpkins are very versatile in their uses for cooking. Most parts of the pumpkin are edible, including pulp and the fleshy shell (peel). Three pumpkin cultivars (*Cucurbita maxima* D.) namely: Kafr El-Battikh-2 (KB), El-Zarka (EZ) and Faraskour (FK), cultivated in Assiut, Egypt were studied for their pectin, beta carotene and α- tocopherol contents. The pectin content was determined spectrophotometrically, β-carotene and α-tocopherol were determined by HPLC. Pectin content ranged from 7.17 to 27.33 mg galacturonic acid/100 g D.W for both pulp and peels of the fruit. The beta carotene was found in substantial amounts which ranged between 1374.57-3313.46 µg/100g for pulp and 145.39-493.15 µg/100g for peel on dry weight basis. The α-tocopherol content of the samples under study was ranged from 167.30 to 1547.35 µg/100g D.W. Significant differences ($P<0.05$) were observed among the cultivars for pectin, β-carotene and α-tocopherol contents. In this study, the pumpkin jam was prepared from pumpkin pulp with 100% and 50% sugar, while hard sweet biscuit was prepared by partially replacing the wheat flour (72% extraction) with 10% and 20% of pumpkin peel. Sensory evaluation was conducted to evaluating the jam and biscuits. The results showed that there were a significant differences ($P<0.05$) in all sensory attributes among jam samples, also between the biscuits supplemented with 10% and 20% of dried pumpkin peel. The results showed that consumption of whole pumpkin fruits without peeling can enhance the amounts of pectin, vitamins A and E consumed. Also, the significance of the study is to produce pumpkin jam or biscuits that will give desirable characteristics that will be accepted by consumer.

Key words: Pumpkin · Pectin · β-carotene · α- tocopherol · Sensory evaluation · Jam · Biscuits

INTRODUCTION

Cucurbitaceae (Cucurbits) family includes around 825 species, derived from tropical and subtropical regions, including 26 species that are cultivated as vegetables. In tropical regions the consumption of cucurbits is very high and it has an important role in human consumption. The main crops are pumpkin, watermelon, cucumbers and melons. Pumpkin is an excellent and low cost resource of carotenoids, precursors of vitamin A. Moreover, it is also a great source of natural and low-cost pectin and has been regarded as a functional food [1]. The common pumpkin types worldwide are *Cucurbita maxima*, *Cucurbita pepo* and *Cucurbita moschata*. Pumpkin shapes range from round to oblong among varieties and size from less than 0.45 kg to more than 4.50 kg, though most weigh 4-8 kg. Pumpkin have a long shelf life of over 6 months without addition of any chemical if stored in a cool dry place of temperatures between 13-15°C [2]. In other words, pumpkins are a good food security crop. Pumpkins are fruits of different species of *Cucurbita* genus, grown around the world for its pulp, seeds and even the flowers serve for human consumption [3]. The Food and Agriculture Organization of the United Nations (FAO) reported an estimated world pumpkins production, in 2007, over 20 million tonnes, especially in China, India, Russia, United States and Egypt [4]. Pectin is the methylated ester of polygalacturonic acid which contains 1, 4-linked α-D-galacturonic acid residues. It is generally found in the cell walls and middle lamellae of higher

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plants. These polysaccharides consist of 300-1,000 chains of galacturonic acid units. Pectin is widely used in the food industry as a thickener, emulsifier, texturizer and stabilizer. Pectin is usually used in jams and jellies as a gelling agent and also used for fruit preparations, fruit drink concentrates, fruit juice, desserts and fermented dairy products. In terms of nutrition, pectin has been shown to lower blood cholesterol levels specially low-density lipoprotein cholesterol fractions and thus reduces the risk for coronary heart diseases [5].Vegetables as functional foods are known to provide important nutraceuticals such as vitamins, minerals and phenolic compounds. These compounds have antioxidant properties and that their regular consumption is beneficial to the human health [6]. carotenoids are the natural plant pigments responsible for the orange colour of pumpkin. Beta-carotene is fat-soluble pigments of plant origin, which is essential in human nutrition. Of the 600+carotenoids with pro-vitamin A activity, the most common are α-and β-carotene. Beta-carotene is an antioxidant precursor to vitamin A in the human body is important in human eye light reception, or the beta-carotene can act directly in cancer prevention [7]. According to the study made by Kandlakunta *et al.* [8] high contents of total carotenoids (2120µg/100 g) and β-carotene (1180 µg/100 g) have been found in *C. maxima.* Murkovic *et al*. [9] reported that three species of pumpkin (*Cucurbita pepo*, *C. maxima* and *C. moschata*) consisted of beta carotene (0.06-7.4 mg/100g), alpha-carotene (0-7.5 mg/100g) and lutein (0-17 mg/100g). Pandey *et al*. [10] reported that the total carotenoids in an Indian collection of pumpkin ranged from 2.34 mg to 14.85 mg/100g of fresh weight. Tocopherols are the fat soluble vitamins having greater antioxidant activity in retarding oxidation and quenching the free radical formation in the vegetable oils during processing and storage periods. It protects vitamin A and essential fatty acids from oxidation in the body cells and prevents breakdown of body tissues.

The most active form of vitamin E is α-tocopherol which is easily converted by the body to vitamin E and it is believed to protect the body against degenerative mal-function, particularly cancer and cardiovascular disease [11]. Vitamin E content of the vegetables ranges from 1.84 to 4.58 mg/100ml extract. In the pumpkin pulp it was found with value 1.06 mg/100 g fresh weight (FW). The fluted pumpkin extract had 5.07mg/100ml of vitamin E whereas the content of α-tocopherol in oil extracted from a mixture of *Cucurbita pepo* and *Cucurbita maxima* pumpkins was 12.6 mg/100g [12].Vitamin E functions as a chain breaking antioxidant that prevents the propagation of free radicals. Vitamin E benefits the body by acting as an antioxidant, protecting vitamins A, C, red blood cells and essential fatty acids from destruction [13]. Jam production is an excellent way of preserving fruits and berries as the season draws to an end. Jams are fruit preserves traditionally made with fruits or berries, sugar and water. They are characterized by their special viscous structure that is the product of interactions between sugars, acid and pectic substances [14]. Pumpkin jam is obtained using thermal treatment, one of the most important methods of preservation of vegetables. Thermal processing has the ability to improve the bio-availability of beta-carotene, in view of the fact the breaks down then cellulose structure of plant cells. However, during thermal processing some degradation of pigments and color of food products inevitably occurs [15]. Biscuits are a popular foodstuff consumed by a wide range of population due to their varied taste, long shelf life and relatively low cost. Biscuits belong to the flour confectionery. It is flat crisp and may be sweetened or unsweetened according to preference. In recent years, biscuits are fortified with various nutrients to enrich them to become a complete food with all necessary nutrients. The base material used for the preparation of biscuit i.e. wheat flour contains a limited amount of β-carotene which is considered as precursor of vitamin A which is available in variety of fruits and vegetables [16]. A well-balanced diet that will strengthen the immune system is now of great significance. There is an increasing tendency among consumers to consume food products of a high nutritional value, even if they are not very popular. These days, the vegetable market offers a wide spectrum of products, among which pumpkin preserves have become increasingly popular. Customers seem to have realized that pumpkin has ornamental, as well as nutritive value, so they are beginning to appreciate the significance of pumpkin as a healthy and valuable component of various meals. Pumpkins are regarded as valuable vegetables primarily because of the high carotenoid content and the low energetic value. In the Middle East, pumpkin is used for sweet dishes, a well-known sweet delicacy is called halawa yaqtin. It has numerous culinary uses either eaten fresh vegetables or as ingredients in pies, soups, stews, jam, sweet, marmalade, beverage, baby food, ice-cream, instant pumpkin kofta and breads [17]. Pumpkin is high in β-carotene, which gives its yellow or orange color. Consumption of foods containing carotene helps in prevention of eye disorders, cancer and skin diseases. Incorporation of β-carotene rich foods in diets is the best measure to improve vitamin A nutrition of individuals to overcome the problems and diseases caused by Vitamin A Deficiency (VAD) [18].

The objective of this work was to determine the contents of pectin, β-carotene, α-tocopherol in pulp and peel from three cultivars of pumpkin (*Cucurbita maxima)* grown under Assiut Governorate conditions. In addition to evaluating the products (jam and biscuits) made from pumpkin samples under study.

MATERIALS AND METHODS

Materials: Three pumpkin *(Cucurbita maxima* L.) cultivars: Kafr El-Battikh-2 (KB), El-Zarka (EZ) and Faraskour (FK) were grown under Assiut governorate conditions at the Experimental Farm of Faculty of Agriculture, Assiut University, Assiut, Egypt, during winter 2014.

Sample Preparation: Ripe pumpkin were cut, peeled, cleaned of seeds and sliced, the pumpkin pulp was stored in a freezer at -4°C until the time for analysis. The collected peels were dried in an electrical oven at 50°C for 24 hours and grounded to obtain meal then stored as above until analysis.

Methods

Determination of Moisture: Moisture was determined as described in the AOAC methods [19].

Determination of Pectin: The pectin content was determined by the carbazole method [20]. Add 0.3 mg of the sample, 0.1 ml water, 40 ml 4 M sulfamic acid (pH 1.6), 2.4 ml sulfuric acid and 100 ml 0.1% w/v carbazole to a glass tube. After 22 min of boiling, the solution was mixed thoroughly and the absorbance of both blank and sample or standard (galacturonic acid with concentration 20, 40, 60, 80 and 100 mg/l) was read at 525nm using UV–Visible spectrophotometer Model UV 1601 version 2.40 (Shimadzu). The pectin content was expressed as mg of galacturonic acid /100 g sample D.W.

Determination of β-Carotene by HPLC: β-carotene was determined according to the method of Tee and Lim [21]. Five grams of the sample was hydrolyzed with 20 ml of 95% (v/v) ethanol (HPLC grade) and 5 ml of 100% KOH and refluxed for 30 min. The hydrolyzate was then extracted using n-hexane and passed through anhydrous sodium sulphate for drying . The extraction was repeated three times. Extracted samples were then filtered through 0.45µm nylon membrane filter (Whatman, Maidstone, England) and analyzed using a reversed phase HPLC using µ Banda Pak C18 (3.9 x 300 mm) column and acetonitrile-methanol-ethyl acetate (88:10:2) as the mobile phase. The β-carotene eluted was detected and quantified using a UV-Visible detector attached to the 600 controller model HPLC (Waters, Milford, MA, USA). The retention time (Rt) and peak areas of appropriate standard (β-carotene) were used to identify and quantify the isolated β-carotene.

Determination of α-Tocopherol by HPLC: Two grams of sample was weighed into centrifuge tubes. Successively, 1 ml of distilled water, 1 ml of ethanol, 1 ml of methyl *tert*-butyl ether (MtBE) and 1 ml of petroleum ether were added. After each addition, the tubes were shaken for 30 seconds. Then, the samples were centrifuged (5000 rpm, 5 min) and the upper layer was transferred into a flask. The extraction with 1 ml of MtBE and 1 ml of petroleum ether was repeated twice. The combined extracts were concentrated under vacuum at 30ºC in a rotary evaporator. The residue was dissolved in 2 ml of mobile phase (*n*-hexane: MtBE, 96: 4, v/v) and then centrifuged (14000 rpm, 5 min). The resulting solution was analyzed for vitamin E by HPLC at 50ºC. Tocopherols are separated on a column packed with 5µml iChrosorb RP18 (Merck) (120 x 4.6 mm), with methanol/water (98/2) as the mobile phase, flow rate: 1.5 ml/min [22].

Preparation of Jam from Fresh Pumpkin Pulp with 100% and 50% Sugar: Jam was prepared according to the traditional method using pumpkin as a raw material. The formula A (100% sugar) consisted of pumpkin fruit pulp (1 kg), sugar (1 kg), citric acid (3 g) and formula B (50% sugar) consisted of pumpkin fruit pulp (1 kg), sugar (0.5 kg) and citric acid (1.5 g). The fruits were washed, peeled and cut into small pieces of similar size. Then, the prepared fruit pulp and a little of sugar was placed in a cooker and mixed well. The mixture was cooked under continuous stirring for 12-15 minutes during which the remaining sugar and citric acid was added. Then the mixture was cooked until the total soluble solids reached 67°Brix. After that, the heat was turned off and the Jam was cooled to 87°C, filled in sterilized dry jars.

Sensory Evaluation of Jam: Jam products were sensory evaluated by a panel of the judges from the staff of Food and Technology department, Faculty of Agriculture, Home Economic Department, Nutrition and Food Science, Faculty of Specific Education, Assiut University.

International protocols (23) were used to perform the descriptive analyses. The parameters evaluated using ten points hedonic scales were: consistency (10), homogeneity in colour (10), intensity of odour (10), intensity of taste (10), free of sugar granules (10) and overall acceptability (50).

Processing of Hard Sweet Biscuit with 10% and 20% of Pumpkin Peel: Hard sweet biscuit was prepared by partially replacing the wheat flour (72% extraction) with 10% and 20% of pumpkin peel. The recipe of the biscuit was as follow: wheat flour or its blends, 350 g, sucrose, 115 g, shortening (palm oil), 50 g, skimmed milk powder, 5 g, high fructose (42 E.D.), 10 g, ammonium bicarbonate, 5.5 g, sodium bicarbonate, 2 g, sodium metabisulfate, 0.10 g and vanillin extract, 0.04 g. Preparation was as follows: Fat and sucrose firstly creamed by using a mechanical mixer for 10 min. Sodium and ammonium bi-carbonate dissolved in 100 ml water were added to the prepared creamed mixture following by adding high fructose to the mixture. As creaming process was continued, wheat flour or its blends, skimmed milk powder and vanillin extract were added and mixed well. The biscuit dough was sheeted to a thickness of 3.5 mm, cut using a circular mould (51 mm dia.) and baked at 205°C for 9-10 min. After baking, biscuits cooled to room temperature, packed in polypropylene pouches and sealed.

Sensory Evaluation of Supplemented Biscuits: Biscuit samples in pouches coded with different numbers were presented to the judges from the staff of Food Technology Department, Faculty of Agriculture, Home Economic Department, Nutrition and Food Science, Faculty of Specific Education, Assiut University, who were asked to rate each sensory attribute by assigning a score for surface colour (10), surface characteristics (10), crumb colour (10), taste (20), texture (20) and mouth feel (10) as described by Sudha *et al*. [24].

Statistical Analysis: The data collected were analyzed with analysis of variance (ANOVA) Procedures using the Duncan test. Differences between means were compared by LSD at 5% level of significant [25].

RESULTS AND DISCUSSION

Fruit Weight and Moisture: The weight values of pumpkin (*Cucurbita maxima)* fruits under study were ranged from 3.21 – 4.65 Kg. Noseworthy and Loy [26] reported lower weight values of 'Cehualca' than the weight values found in the present study, for *C. maxima* (0.91-2.04 kg). Karkleliene *et al.* [27] reported that 2 cultivars of *C. maxima* ('Bambino' and 'Gele Reuzen') had higher weight (7.1, 8.4 kg, respectively), than the reported in the present study. The moisture content of the fruit pulps and peels under study are presented in Fig. 1. The results show that the three cultivars of pumpkin both pulp and peel have high moisture contents ranged from 85.84 to 93.67%. Analysis of variance showed that there were significant ($P<0.05$) differences between moisture levels of pulp and peel for cultivars. The peels were found to contain lower moisture 85.84 – 90.53% compared with range of 91.34 – 93.67% pumpkin pulps (Fig. 1). Generally, the moisture content of fruits and vegetables varies from 66–96% [28]. The moisture content is variable even in the same variety depending upon the locality and other environmental factors [29]. Our results of moisture in pumpkin were similar to the reported by Fedha *et al.* [30] for *C. moschata* and *C. maxima*.

Pectin: Pectin is a complex polysaccharide being polymolecule, polydisperse and heterogenic due to the complicated chemical composition and structure. The composition, structure and physiological properties of pectin might be influenced by conditions of extraction as well as sources, location and many other environmental factors [31]. In this study the highest pectin content was found in Faraskour pulp sample (27.33 mg galacturonic acid/100g D.W) and the lowest pectin was in Faraskour peel sample (7.17 mg galacturonic acid/100 g D.W) (Fig. 2). Moderately contents of pectin were significantly ($P<0.05$) found in Kafr El-Battikh-2: pulp, peel, El-zarka: pulp and peel which was 19.37: 10.10, 17.33 and 7.66 mg galacturonic acid/100g D.W, respectively. El Shafie [29] reported that pumpkin fruits from three growing areas in Sudan contain a range of 92.80-93.95% moisture and 0.56% total pectin on fresh weight basis. Abdella [32] studied the isolation and characterization of pectic substances from yellow-orange and white pumpkin peels. His results indicated that yellow-orange pumpkin peels contain relatively higher percentage of pectin compared to white pumpkin peels. Total pectin was found to be 0.25% for yellow-orange and 0.23% F.W for white sample. Jun *et al.* [33] reported that the pectic substances of alcohol insoluble polysaccharide fractions extracted from the pumpkin peel could contain a high amount of galacturonic acid content.

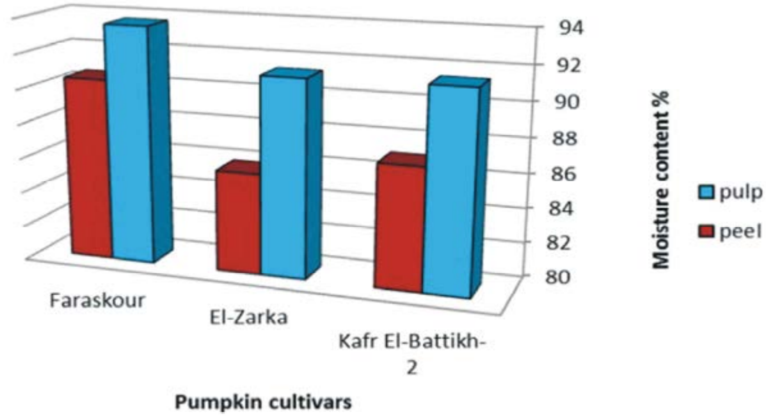

Fig. 1: Moisture content of pumpkin cultivars both pulp and peel

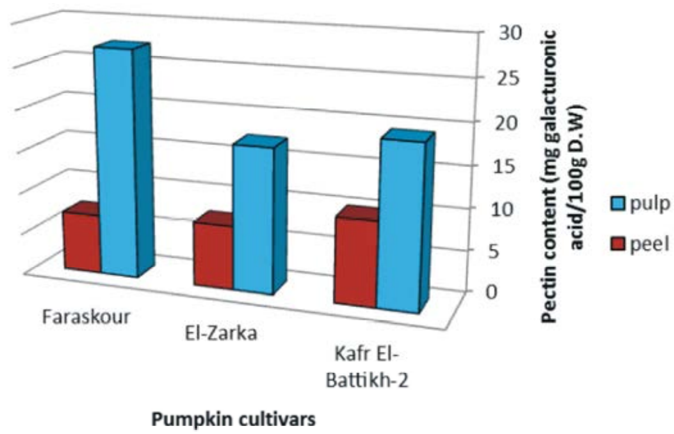

Fig. 2: Pectin content of pumpkin cultivars both pulp and peel

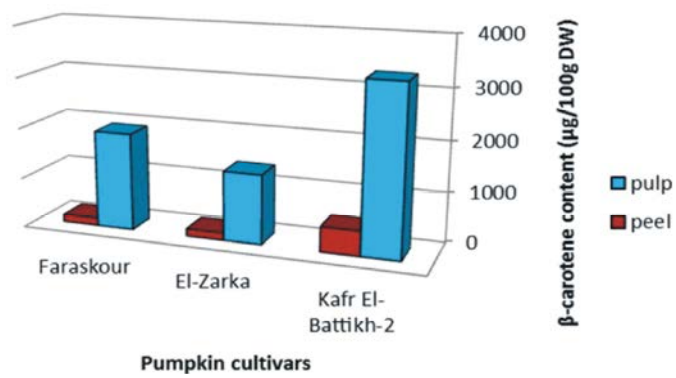

Fig. 3: β-carotene content of pumpkin cultivars (pulp and peel)

β-Carotene and α-Tocopherol: The β-carotene content in three cultivars of pumpkin under study is presented in Fig. 3. The results show that fruit pulps contain significantly ($p<0.05$) higher beta-carotene than fruit peels. Data from Fig. 3 show that β-carotene contents for Kafr El-Battikh-2 cultivar were the highest (pulp: 3313.46, peel: 493.15µg/100g) as compared with other cultivars Faraskour (pulp: 1927.92, peel: 151.71 µg/100g) and El-zarka (pulp: 1374.57, peel: 145.39 µg/100g).Pumpkins, especially winter squash cultivars, are considered as a good source of β-carotene. According to Holden *et al*. [34] the content of β-carotene in cultivars of American origin (in a raw fruit) reaches to 4.2 mg/100g. For Polish cultivars 'Amazonka' showed the highest β-carotene content (about 12 mg /100g) [35]. Seroczyñska *et al*. [36] studied the content of beta carotene in flowers and fruit

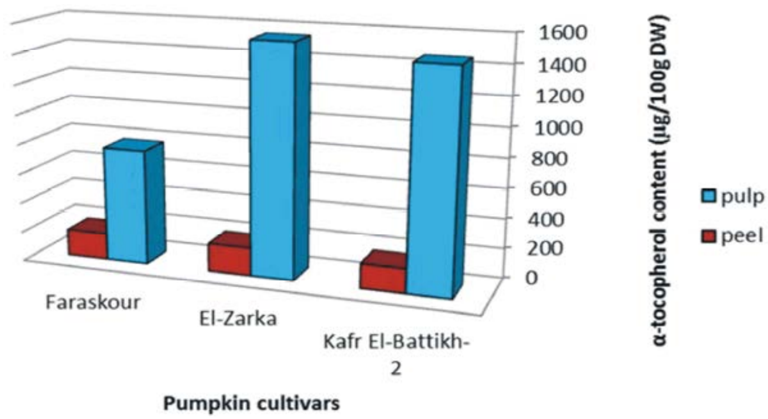

Fig. 4: α-tocopherol content of pumpkin cultivars both pulp and peel

flesh of winter squash (*Cucurbita maxima* Duch.) and they reported that the β-carotene content in fruit flesh ranged from 0.07 to 6.07 mg/100g F.W. The contents of β-carotene in the above mentioned researches are similar with our values for the cultivars under study. The varied differences in the β-carotene amounts in pumpkins may be attributed to the long period during which these fruit vegetables can be harvested and to their extended shelf life. Some of the low levels reported may be due to analyses of immature pumpkins [37].

The α-tocopherol contents of pumpkin (pulp and peel) cultivars are shown in Fig. 4. It noticed that El-Zarka both pulp and peel was significantly ($P<0.05$) had the highest content of α-tocopherol with values 1547.35 and 188.86 µg/100g D.W, respectively. However, the lowest contents of α-tocopherol 774.52, 167.30 µg/100g D.W were found in Faraskour pulp and Kafr El-Battikh-2 peel, respectively. Our results for pumpkin pulp agreements with Echessa *et al.* [2] who evaluating some micronutrients in three species of pumpkin is common within the Lake Victoria Basin (*Cucurbita maxima, Cucurbita pepo* and *Cucurbita moschata*), they found that the content of α-tocopherol in pumpkin pulp of *Cucurbita maxima* was ranged from 0.57 to 3.73 mg /100 g D.W. β-Carotene (Pro-vitamin A) is the vitamin in vegetables (carrots, paprika and pumpkins) that give them their yellow, orange or red colours. It is present in lipoproteins and in cellular membranes and works through scavenging and inactivation of the radicals. It also functions as a physical quencher by suppressing the oxidative action of singlet oxygen. Alpha-tocopherol is the main source of vitamin E in vegetables. Like β-carotene it is present mainly in lipoproteins and in cellular membranes. The vitamin is a scavenger of lipid peroxidation radicals, either through destruction of peroxyl radicals or through blocking the production of hydroperoxides from singlet oxygen [38]. The contents of β-carotene and α-tocopherol in this study were obtained from pumpkin fruits at maturation stage. Since the peels of the pumpkin fruits contain reasonable contents of β-carotene and α-tocopherol, people may be encouraged to eat whole pumpkins without peeling before boiling or baking (as any vegetable, pumpkin fruits are used boiled or baked). The fruit slices could also be dried without peeling to making the maximum utilization of β-carotene and α-tocopherol.

Calculation of Vitamin A and E by IU (International Unit): An IU (International Unit) is a unit of measurement for vitamins and other specific biologically active substances. The precise measure of one IU differs from substance to substance and is established by international agreement for each substance. The equivalents of 1 IU for selected vitamins are: vitamin A: 1 IU is the biological equivalent of 0.6 mcg beta-carotene, vitamin E: 1 IU is the biological equivalent of 0.67 mg natural- α-tocopherol, which natural α-tocopherol, also called d-α tocopherol or RRR-α-tocopherol, is the form of α-tocopherol that occurs naturally in foods. It is expressed in milligrams [39, 40]. The calculated vitamins A, E of pumpkin (pulp, peel) cultivars from β-carotene and α-tocopherol contents under study are presented in Table 1. The data revealed that vitamin A contents was significantly ($P<0.05$) higher and ranged from 2290.95 to 5522.43 IU in the pulp of three pumpkin cultivars as compared with 242.32 to 821.92 IU for the peel of the same cultivars.

On the basis of dry weight of pumpkin cultivars (pulp and peel) El-Zarka pulp had the highest content of vitamin E with value 2.31 followed by Kafr El-Battikh-2 pulp 2.18 and Faraskour pulp 1.16 IU. The peels of three

Table 1: Calculated vitamins A, E of pumpkin (pulp, peel) cultivars from β- carotene and α-tocopherol contents

	Vitamin A (IU)[1]		Vitamin E (IU)[2]	
Pumpkin cultivars	Pulp	Peel	Pulp	Peel
Kafr El-Battikh-2	5522.43a	821.92a	2.18b	0.25N.S
El-Zarka	2290.95c	242.32c	2.31a	0.28N.S
Faraskour	3213.20b	252.85b	1.16c	0.27N.S

Results calculated on dry weight basis. Means within column followed by same letter(s) are not significant at 0.05 level of probability by using the Duncan Test. 1- One international Unit (IU) of vitamin A=0.6 mcg of beta carotene. 2- One international Unit (IU) of vitamin E=1.49 mg natural alpha-tocopherol

Table 2: Sensory evaluation of pumpkin jam

Sample		Consistency (10)	Homogeneity in colour (10)	Intensity of odour (10)	Intensity of taste (10)	Free of sugar granules (10)	Over all acceptability (50)
KB	A	9.1a	9.3a	8.7b	8.7a	8.7a	44.5a
	B	8.1d	8.9b	8.7b	8.2c	8.5b	42.4c
EZ	A	9.0a	9.0b	9.0a	8.8a	8.3c	44.1a
	B	8.2d	8.6c	8.6c	8.1c	8.0d	41.5d
FK	A	8.5c	9.3a	8.8b	8.6b	8.5b	43.7b
	B	8.8b	8.7c	8.9a	8.5b	8.0d	42.9c

*Means having different superscripts within the column are significantly different at $p < 0.05$. A = Pumpkin jam made with 100% sugar. B = Pumpkin jam made with 50% sugar, KB= Kafr El-Battikh-2, EZ= El-Zarka, FK= Faraskour.

Table 3: Sensory Evaluation of supplemented Biscuits.

Sample		Colour(10)	Surface character (10)	Crumb colour(10)	Taste (20)	Texture (20)	Mouth feel (10)	Total score (80)
Control	A	8.7b	8.4b	8.1b	18b	16.6g	8.0a	67.8b
K B	B	8.1c	7.8d	7.7c	17.4d	17e	7.7b	65.7c
	C	7.3e	7.1f	7.4d	16.5e	16.8f	6.6d	61.7e
E Z	B	9.1a	8.7a	8.3a	18.6a	19.1a	8a	71.8a
	C	8.2c	8.1c	8.1b	18.1b	18.1b	7.8b	68.4b
F K	B	7.7d	7.2f	7.2e	17.8c	17.5c	7.5c	64.9d
	C	7.4e	7.3e	7.3e	17.5d	17.2d	7.4c	64.1d

*Means having different superscripts within the column are significantly different at $p < 0.05$. A = Control Biscuits, B = Biscuits supplemented with 10% dried pumpkin peel, C = Biscuits supplemented with 20% dried pumpkin peel. KB= Kafr El-Battikh-2, EZ= El-Zarka, FK= Faraskour

pumpkin cultivars under study were not significantly ($P>0.05$) different in calculated vitamin E content which ranged from 0.25 to 0.28 IU. According to the USDA National Nutrient database (which is similar to our results), 100 gram on fresh weight of pumpkin, raw, cooked, boiled, drained, without salt contains vitamin A ranged from 4992.25 to 5166.67IU and vitamin E from 0.66 to 1.22 IU [41].

Sensory Evaluation of Jam and Biscuits: Sensory evaluation is considered to be a valuable tool in solving problems involving food acceptability. It is useful in product improvement, quality maintenance and more important in a new products development [42]. The results of analysis of variance in consistency, homogeneity in colour, intensity of odour, intensity of taste, free of sugar granules and overall acceptability of the jam made from pumpkin pulp are shown in Table 2. The results indicated significant differences in all sensory attributes among jam samples. The differences depended on the amount of sugar used in processing jam. The bumpkin jam made with 100% sugar recorded the highest scores of sensory attributes followed by the jam made with 50% sugar in all pumpkin cultivars under study. Kafr El-Battikh-2 pumpkin jam made with 100% sugar was the better in overall acceptability as compared with other jam samples.

Sensory evaluation of supplemented biscuit samples are shown in Table 3. It was observed that there were significant differences in colour, surface character; crumb colour, taste, texture and mouth feel for all samples as compared with control. Also, there were significant differences between the biscuits supplemented with 10% dried pumpkin peel and the biscuit supplemented with 20% dried pumpkin peel in sensory attributes. The total score (80) for supplemented biscuit samples varied from 61.7 to 71.8. Among the pumpkin cultivars El-Zarka peel recorded the highest score (71.8) in all sensory attributes at 10% supplementation as compared with other samples (Kafr El-Battikh-2, Faraskour) and the control one.

CONCLUSION

From this study, it can be concluded that the three cultivars of pumpkins named Kafr El-Battikh-2, El-Zarka, Faraskour both pulp and peel contained high moisture levels, substantial amounts of beta-carotene which ranged between 1374.57- 3313.46 µg/100g for pulp and 145.39-493.15 µg/100g for peel on dry weight basis. The pumpkin pulps, peels contained substantial amounts of pectin and α-tocopherol. Vitamin A and E were more in the pulps than in the peels of fruits. These results show that consumption of whole pumpkin fruits without peeling can enhance the amounts of pectin, vitamins A and E consumed. Also, the significance of the study is to produce pumpkin jam or biscuits that will give desirable characteristics that will be accepted by consumer. At the same time, the nutritious jam and biscuits were produced to consumer which is rich in β-carotene, α-tocopherol that would have added taste and improve flavour. The production of these products gives the variation of jam and biscuits in market.

REFERENCES

1. Ngouémazong, D.E., F.F. Tengweh, I. Fraeye, T. Duvetter, R. Cardinaels, A.V. Loey, P. Moldenaers and M. Hendrickx, 2012. Effect of de-methylesterification on network development and nature of Ca^{2+}-pectin gels: Towards understanding structure function relations of pectin. Food Hydrocolloids, 26: 89-98.
2. Echessa, A.C.P., H.A. Nyambaka, N. Ondigi, S. Omuterema, W. Toili and A. Sande, 2013. Variation of micronutrients in pumpkin fruit varieties grown within the Lake Victoria Basin. Food Science and Quality Management, 17: 33-40.
3. Provesi, J.G., C.O. Dias and E.R. Amante, 2011. Changes in carotenoids during processing and storage of pumpkin puree. Food Chem., 128: 195-202.
4. FAO, 2011. Food and agriculture organization of de united nations. Statistical Database – FAOSTAT, 2008. Accessed in 20.01.2011.
5. Yeoh, S., J. Shi and T. A. G. Langrish, 2008. Comparisons between different techniques for water-based extraction of pectin from orange peels. Desalination, 218: 229-237.
6. Biswas, A., N. Sutivisedsa, H.N. Cheng, J.L. Willett, W.C. Lesch and R.R. Tangsrud, 2012. Extraction and Analysis of Antioxidant Capacity of Eight Edible Beans. J. Food, Agric. Environ., 10(1): 89-96.
7. Dini, I., G.C. Tenore and A. Dini, 2013. Effect of industrial and domestic processing on antioxidant properties of pumpkin pulp. LWT- Food Science and Technology, 53(1): 382-385.
8. Kandlakunta, B., A. Rajendran and L. Thingnganing, 2008. Carotene content of some common (cereals, pulses, vegetables, spices and condiments) and unconventional sources of plant origin. Food Chemistry, 106(1): 85-89.
9. Murkovic, M., U. Mülleder and H. Neunteu, 2002. Carotenoid Content in Different Varieties of Pumpkins. Journal of Food Composition and Analysis, 15(6): 633-638.
10. Pandey, S., J. Singh, A.K. Upadhyay, D. Ram and M. Rai, 2003. Ascorbate and Carotenoid Content in an Indian Collection of Pumpkin (*Cucurbita moschata* Duch. ex Poir.). Cucurbit Genetics Cooperative Report, 26: 51-53.
11. Sakai, K., S. Kino, M. Takeuchi, T. Ochi, G. Da Cruz and I. Tomita, 2010. Analysis of Antioxidant Activities in Vegetable Oils and Fat Soluble Vitamins and Biofactors by the PAO-SO Method. In Advanced Protocols in Oxidative Stress II, pp: 241-250). Humana Press.
12. Madukwe, E.U., A.M. Nwabunze and L. Onyibalu, 2013. Bioavailability of vitamins C, E and pro-vitamin A in extracts of fluted pumpkin (*Telfairia occidentalis*), tomato (*Lycopersicum esculentum*) and eggplant (*Solanum melongena*). International Journal of Basic and Applied Sciences, 2(3): 244-250.
13. Wardlaw, G.M. and M. Kessel, 2002. Perspectives in Nutrition. 5th Ed.). New York: McGraw Hill Higher Education, pp: 328-400.
14. Figuerola, F.E., 2007. Berry Jams and Jellies, in Y. Zhao (editor), Berry Fruit: Value-Added Products for Health Promotion, CRC Press, pp: 367-386.
15. Dutta, D., A. Dutta, U. Raychauduri and R. Chakraborty, 2006. Rheological characteristics and thermal degradation kinetics of betacaraotene in pumpkin puree. J. Food Eng., 76: 538-546.
16. More, V., A. Chougule, R. Khotpal and A. Kulkarni, 2015. Preparation and utilization of emulsifiers in sweet biscuits. Int. J. Curr. Res.Chem. Pharma. Sci., 2(8): 26-31.
17. Ratnayake, R.M.S., L.D. Melton and P.L. Hurst, 2003. Influence of Cultivar, Cooking and Storage on Cell-wall Polysaccharide Composition of Winter Squash (*Cucurbita maxima).* J. Agric. Food Chem, 51: 1904-1913.

18. Bhaskarachary, K., R. Ananthan and T. Longvah, 2008. Carotene content of some common (cereals, pulses, vegetables, spices and condiments) and unconventional sources of plant origin. Food Chemistry, 106: 85-89.
19. AOAC, 2000. Association of Official Analytical Chemists. Official Methods 965.33. Official Methods of Analysis. 17th Ed., Gaithersburg, MD.
20. Dische, Z., 1947. A new specific color reaction for hexuronic acids. Journal of Biological Chemistry, 167: 189-198.
21. Tee, E.S. and C.L. Lim, 1991. Carotenoid Composition and Content of Malaysian Fruits and Vegetables by AOAC and HPLC methods. Food Chemistry, 41: 309-339.
22. Balz, M., E. Schulte and H P. Thier, 1992. Trennung von Tocopherolen und Tocotrienolen durch HPLC. Fat Sci. Technol., 94(6): 209-213.
23. ISO 6658: 2005 (E), (the International Organization for Standardization), Sensory analysis-Methodology-General Guidance. Second Edition, Switzerland.
24. Sudha, M.L., R. Vetrimani and K. Leelavathi, 2007. Influence of Fibre from Different Cereals on the Rheological Char-acteristics of Wheat Flour Dough and on Biscuit Quality. Food Chemistry, 100(4): 1365-1370.
25. Gomez, K.N. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. John Wiley and Sons .Ins. New York, 2nd Ed.
26. Noseworthy, J. and B. Loy, 2008. Improving eating quality and carotenoid content of squash. Cucurbitaceae 2008. Pitrat M (Ed.). Proceedings of the IXth EUCARPIA meeting on genetics and breeding of Cucurbitaceae INRA, Avignon.
27. Karkleliene, R., P. Viškelis and M. Rubinskiene, 2008. Growing, yielding and quality of different ecologically grown pumpkin cultivars. Sodinink Dar, 27: 401-410.
28. Joslyn, M.A., 1970. Methods in Food Analysis. 2nd Ed. Academic Press. New York and London, pp: 565-599.
29. El Shafie, A.S., 1981. Isolation, Fractionation and Characterization of Pumpkin Pectic Substances. M.Sc. Thesis, University of Khartoum, Sudan.
30. Fedha, M.S., M.A. Mwasaru, C.K. Njoroge, N.O. Ojijo and G.O. Ouma, 2010. Effect of drying on selected proximate composition of fresh and processed fruits of two pumpkin species. Agric. Biol. J. N. Am., 1: 1299-1302.
31. Gulfi, M., E. Arrigoni and R. Amado, 2005. Influence of Structure on *in vitro* Ferment Ability of Commercial Pectins and Partially Hydrolyzed Pectin Preparations. J. Carbohydrate Polymers, 59: 247-255.
32. Abdella, A.Y.I., 2008. Isolation and characterization of pectic substances from pumpkin (*Cucurbita* spp) peels. M.Sc. Thesis, Fac. Agric., Univ. Khartoum., Sudan.
33. Jun, H., C. Lee, G. Song and Y. Kim, 2006. Characterization of pectic and polysaccharides from pumpkin peel. Lebensmittel-Wissenchaft und-Technologie, 39: 554-561.
34. Holden, J.M., A.L. Eldridge, G.R. Beecher, M. Buzzard, S. Bhagwat, C.S. Davis, L.W. Douglass, S. Gebhardt, D. Haytowitz and S. Schakel, 1999. Carotenoid content of U.S. foods: an update of the base. J. Food Comp. Anal., 12: 169-196.
35. Sztangret, J., A. Korzeniewska, M. Horbowicz and K. Niemirowicz-Szczytt, 2004. Comparison of fruit yields and carotenoids content in new winter squash hybrids (*Cucurbita maxima* Duch.). Veg. Crops Res. Bull, 61: 51-60.
36. Seroczyñska, A., A. Korzeniewska, J. Sztangret-Wiœniewska, K. Niemirowicz-Szczytt and M. Gajewski, 2006. Relationship between carotenoids content and flower or fruit flesh colour of winter squash (*Cucurbita maxima* Duch.). Folia Horticulturae Ann., 18(1): 51-61.
37. Rodriguez-Amaya, D.B., 1997. Carotenoids and Food Preparation: The Retention of Provitamin A Carotenoids in Prepared, Processed and Stored Foods. Opportunities for Micronutrient Interventions, Washington DC.
38. Elmadfa, I. and K.H. Wagner, 2003. Non-nutritive bioactive food constituents of plants: Tocopherols (Vitamin E). Int. J. Vitam. Nutr. Res., 73(2): 89-94.
39. Biesalski, H.K., G.R. Chichili, J. Frank, J. Von Lintig and D. Nohr, 2007. "Conversion of β-carotene to retinal pigment". Vitamins and hormones, 75: 117-30.
40. Khoo, H.E., K.N. Prasad, K.W. Kong, Y. Jiang and A. Ismail, 2011. Carotenoids and their isomers: color pigments in fruits and vegetables. Molecules, 18, 16(2): 1710-38
41. Anonymous, 2003. Winter squash. USDA Database for Standard Reference, Release 16.
42. Kramer, A. and B.A. Twigg, 1974. Quality Control for the Food Industry. 3rd Edition, AVI. Inc., Westport.