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Crop Performance and Fruit Physicochemical Properties and Nutritional Components of Pumpkin (*Cucurbita moschata*) Cultivated at Different Density

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Abstract

In this study, three pumpkin *(Cucurbita moschata* L.) local cultivars namely: Kafr El-Battikh-1 (KB), Kafr Saad (KS) and El-Edua (ED) were cultivated at different plant density: one, two and three plants per the hill. Data were recorded on some main plant growth and development [average content of reduced sugar (mg/100g) of fresh leaves 25 days after sowing, number of opened female flowers per plant, number of fruits per plant, average fruit weight (kg) and average plant length (cm) 120 days after planting]. Further, the resulting fruits were used to study some nutritional quality including the chemical composition, pectin, beta carotene and some minerals content in both pulp and seed kernel of the fruit. The processing of some food products such as fermented sweet bread from the pulp and chicken burger from the seed kernel were investigated. The obtained results showed that there were significant ($P<0.05$) differences among the cultivars and also among the plant densities used. The fruits harvested from plants grown individually per hill were the best among the others in terms of chemical composition and minerals. The content of pectin and beta carotene contents were also significantly different among the cultivars. The ED cv grown as single plant/hill was the best among the rest of cvs under study in terms of maturit and taste index. Therefore, the treatment ED 1 (1pl/hill) was selected for application in food technological part of current study. The bread and burger were prepared from pumpkin pulp and seed kernel by partially replacing ratios 10, 20, 30 and 40%. The bread and burger were evaluated by some sensory and physical properties. The best results were obtained for bread and burger samples supplemented with 10% and 20% replacement ratio, whether fruit pulp or seed kernel. The products of chemical composition were found in reasonable amounts which confirm the highly nutritional value of these products, as well as, desirable properties that the consumer will accept.

Keywords: *Bread, Burger, Pectin, β- carotene, Seed kernel oil, Sensory evaluation,.*

Introduction

Pumpkins have long been used for traditional medicine in many countries, such as China, Argentina, India, Mexico, Brazil, and Korea, since pumpkin flesh and seeds are rich in proteins, antioxidant vitamins, carotenoids and minerals, as well as, low in calories. Pumpkin seeds, often eaten as a snack, are a good source of zinc, polyunsaturated fatty acids, and phytosterols, which can prevent chronic diseases**.** Pumpkin is commonly refers to cultivars of any one of the species *Cucurbita pepo*, *Cucurbita mixta, Cucurbita maxima, Cucurbita moschata*. The *moschata* species contains varieties that pro-

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duce long and oblong fruits. Mature fruits have tan rather than orange skin. The growth and productivity of several vegetable crops including cucurbits such as muskmelon, watermelon and squash are affected by plant density (Roderiguez *et al.,* 2007; Stevenson *et al*., 2007). The effects of plant density on fruit size and yield result from the competition between plants for the necessary natural resources. So, the size of harvested crop could be adjusted to meet the requirements of the market by manipulating density which affected greatly the yield**.** It is possible to assist spreading pumpkin among consumers through the production of small and medium-sized fruits by increasing the number of plants per area with carefully attention to nitrogen requirements (Cushman *et al*., 2004; Kwon *et al.,* 2007).

Nutritional composition of pumpkin fruit pulp

Pumpkin is a good source of carotene, pectin, minerals, salts and other substances that are beneficial to health. The physical properties such as TSS, TTA, pH pumpkin fruits vary according to the varieties and fruit weight. Overall TSS of pumpkin (*Cucurbita moschata*) ranged from 1-15 □B, while the titratable acidity in pumpkin ranges from 0.01-0.26 per cent. However, the mean pH value ranged from 4.27-7.79, but the average value of 6.77 in pumpkin (*Cucurbita moschata*) fruits (AlJahani *et al*., 2017; Noelia *et al*., 2011).

The pumpkin fruits contains 70-86% edible portion, 85-90% water, 0.7- 1.50% ash, 0.98 -2.10% protein, 0.3-0.6% fat, 1.4-3.5% starch, 1.1-2.7% dietary fibers and energy 179-190 KJ per 100 g fresh weight. The minerals content (mg per 100 g of edible portion) present in pumpkin pulp are found to be in the ranges of: calcium 10-46.35; phosphorous: 30-44.05; iron: 0.44-0.84; magnesium: 38; sodium: 5-6; potassium: 139-355.22; copper: 0.05; manganese: 0.05; zinc: 0.26 and sulphur: 16. The pumpkin (*Cucurbita moschata*) fruits were reported to contain total sugars ranging from 1.36 to 4.90 g/100 g, while the reducing sugars ranged from 1.01 to 2.44 g/100g with an average amount of 1.69%. On the other hand the pectin content in pumpkin (*Cucurbita moschata*) fruit varied from 1.14 to 8.30% (El-Demery, 2011; Noelia *et al*. 2011; Usha *et al*., 2010).

The Carotenoids which are responsible for the color of many fruits and vegetables are present in pumpkins and among the phytochemical components, it was believed to reduce the risk of developing some degenerative diseases. It is responsible of yellow to orange color in the pumpkin flesh. The major carotenoid in pumpkin (>80%) is β-carotene (1.32-4.79 mg/100 g D.W), with lesser amounts of lutein, lycopene and cis α-carotene (Adubofuor *et al.,* 2016; Wang *et al.,* 2012). A pumpkin-rich diet could reduce blood glucose levels and also the active polysaccharides from the pumpkin fruit could increase the levels of serum insulin, improve tolerance of glucose so it could be developed as a new fighting agent against. The pulp is used in the preparation of soups, purees, jams and pies throughout the world and the leaves are also consumed as a vegetable (Abou-Zaid *et al*., 2012; Dari and Mahunu 2010).

Nutritional Composition of pumpkin seed

Pumpkin fruits are variable in size, color, shape and weight. It has moderately hard skin with a thick edible flesh below and a central cavity containing the seeds. Like other members of *Cucurbitaceae* each fruit bears numerous seeds, located at its central hollow cavity, interspersed in between net like mucilaginous network. Pumpkin seed are semi-flat, feature typical ovoid shape with a conical tip while its kernels are olive-green color, sweet, buttery in texture and nutty in flavor so it can be used as a snack and desserts preparations. Generally, in order to obtain good-quality seeds, pumpkin fruit is allowed to mature completely (Devi *et al.,* 2018; Karanja *et al.,* 2013).

The nutritional value of 100 g dried pumpkin seeds is 559 Kcal energy, 10.71 g carbohydrates, 30.23 g proteins, 49.05 g crude oil, 10 mg cholesterol, 16 g dietary fibers, 1.9 µg vitamin C, 35.10 mg vitamin E, 0.153 mg riboflavin, 7 mg sodium, 8.09 mg potassium, 46 mg calcium, 1.343 mg copper, 8.82 mg iron, 9.4 µg selenium, 7.8 mg zinc and 9.00 µg *β*-carotene. Pumpkin seed oils are very rich in essential fatty acids (linoleic acid). The acceptable high linoleic and low linolenic acid levels of these oils suggest that they could be sources of good edible oils (Maheshwari, *et al*., 2015).

Elinge *et al.,* (2012) analyzed the nutritional composition of pumpkin seeds and the results obtained were; moisture (5%), ash (5.5%), crude fat (38%), crude fiber (1%), crude protein (27.48%), available carbohydrate (28.03%) and calorific value (564 kcal/100 g). Elemental analysis shows that potassium was the most abundant (273 mg/100g) and manganese was least (0.06 mg/100g). They can be consumed regularly without causing any side effects on human health**.** Pumpkin (*Cucurbita maxima*) whole seeds and kernels contained 39.25, 27.83, 4.59, 16.84% and 39.22, 43.69, 5.14, 2.13% crude protein, crude oil, ash, crude fiber, respectively. Pumpkin seeds contained 41.59% oil, 25.4% protein, 5.20% moisture, 5.34% crude fiber, 2.49% ash and 25.19% total carbohydrate. Linoleic (39.84%), oleic (38.42%), palmitic (10.68%) and stearic (8.67%) acids were the major fatty acids (Alfawaz, 2004; Ardabili *et al*., 2011). Pumpkin seed oil has received considerable attention in recent years due to its nutritional and health-protective value. Recently Montesano *et al.,* (2018) reported that pumpkin seed oils are interesting vegetable oils with important nutritional value, related to the presence of MUFA, PUFA, phytosterols, and carotenoids and can be used as a preservative and as a functional ingredient in different areas such as cosmetics, nutraceuticals and also can be incorporated into food formulations to benefit human health. Pumpkin seeds, generally considered agro-industrial waste, are an extraordinarily rich source of bioactive compounds with interesting nutraceutical properties**.** In recent years, several studies have highlighted the health properties of pumpkin seed oil against many diseases, including hypertension, diabetes, and cancer. It also shows antibacterial, antioxidant, and anti-inflammatory properties (Bardaa *et al*., 2016; Medjakovic *et al*., 2016; Wang *et al*., 2017).

With increased public awareness in sustainable agriculture, clean and efficient energy and waste management technologies, pumpkin seeds have the opportunity to capture a new and emerging market share in the snack food industry. These reports from several studies suggested that pumpkin seeds have the potential to be developed as novel value added product, which is rich in nutrients and to combat wastages of pumpkin seed. The application of these seeds can be considered as a good alternative for the nutritional enrichment of food products and could be consumed as food, having a rich source of oil and nutrients. The use of these by-products adds value to the production, besides contributing to the formulation of new food products and minimizing losses. So, it gives new opportunity to explore the possibilities for the production technologies for the different value added products from pumpkins seeds (Devi *et al*., 2018; Montesano *et al*., 2018).

The aim of this investigation was to study the effect of plant density and cultivar on growth, fruit characteristics and yield in addition to nutritional quality applicability for processing of sweet fermented bread and chicken burger from the best treatment in maturity, taste index (ED 1 plant), as well as, determination of chemical composition, sensory evaluation and physical properties of the resulted products.

Materials and Methods

Materials:

The study was carried out in the Experimental Farm of Vegetable crops Department and the Laboratory of Food science and Technology Department, Faculty of Agriculture, Assiut University. Seeds of the local pumpkin local cvs (landraces) KafrSaad and Kafr El-Battikh were obtained from farmers in Damietta province, while seeds of El-Edua were obtained from farmers in ElMinia province. Seeds used in the whole course of this study were from the same seed lots. Seeds were planted at 90 cm inrow spacing (Abdel-Rahman *et al.,* 2012) on March, 2017 and 2018. Planting was done on the northern side of ridges 3 m wide and 4 m long. Thinning to one or two or three plants per hill was practiced at the two true-leaf stage. Land preparation and all cultural practices were done as recommended for production of pumpkins (Hassan, 2004).

Pumpkin pulp and seeds samples preparation

Ripe pumpkin were cut, peeled, remove the seeds and sliced then dried under vacuum at 50°C for 24 h in an electrical oven. They were then grounded to obtain meal or flour and stored in a freezer at 4°C until analysis and use in preparing of fermented sweet bread. The collected whole seeds were air dried in laboratory at 25°C for 72 h then hand dehulled. The obtained kernels were grounded by an electrical grinder to obtain meal (which will be used in preparing chicken burger) for analysis or stored as mentioned above. The chemical composition of materials used in preparing sweet fermented bread and chicken burger are shown in Table (1).

Table 1. Proximate analysis results on dry weight basis for wheat flour, chicken breast used in preparing fermented sweet bread and chicken Burger.

Materials	Moisture	Ash*	Oil*	Protein*	Crude fiber*	Total carbohy-drates*	Energy* (Kcal/100 g)
Wheat flour (72% extraction)	12.12	0.63	1.57	12.85	0.82	84.13	402.05
Chicken breast meat	72.87	6.94	10.57	65.38	1.38	15.73	419.57

*Results calculated on dry weight basis.

Methods

Plant growth and development

Data were recorded for average content of reduced sugar (mg/100g) of fresh leaves 25 days after planting (A.O.A.C 2000), female flowers per plant, number of fruits per hill, average fruit weight (kg) and average plant length (cm) 120 days after planting.

Fruit physical properties

The pH value, total soluble solids (T.S.S) and total titratable acidity (T.T.A) content were determined according to the methods described in A.O.A.C (2000). In brief, they were as follows: for the pH, 10 g of pumpkin samples were blended with (100 ml) distilled water and pH of the slurry was then measured using pH meter; T.S.S, was measured using an Abbe refractometer (Carl Zeiss, Jena Germany) calibrated against sucrose; total acidity was measured by titrating 10 ml of pH slurry with NaOH 0.1 N solution using (phph) as indicator and the results of T.T.A were expressed as percent of citric acid.

Taste index and the Maturity

A taste index and the maturity were calculated using the equation proposed by Navez, *et al.,* (1999) and Nielsen (2003) as follow:

$$\textbf{Taste index} = \frac{\textbf{Brix degree}}{\textbf{20 x Acidity}} + \textbf{Acidity.}$$

$$\textbf{The maturity} = \frac{\textbf{Brix degree}}{\textbf{Acidity}}$$

Proximate composition

Moisture, crude protein, crude oil, crude fiber, ash, reducing sugars and starch were determined as described in the AOAC methods 2000. The means were reported as a result of triplicate determinations for each sample. The total carbohydrates content was determined by difference according to Pellet and Sossy (1970) as follows: Carbohydrate % = 100 – (protein % + ash % + lipid % + crude fiber %). The caloric value was calculated using value of 4 kcal/g for protein and carbohydrates and 9 kcal/g for fat according to Livesy (1995). The contents of K, Na, Mg, Ca and Fe in the studied samples were determined by iCAP6200 (ICP-OES) Inductively Coupled Plasma Emission Spectrometry (Isaac and Johnson 1985). Total phosphorus content was determined by spectrophotometer (Jackson 1967) after wet ashing following method described in AOAC (2000).

Fatty acid composition of pumpkin seed oil

Preparation of fatty acid methyl esters:

The methyl esters of fatty acids were prepared from oil (which extracted by n-hexane) samples using 5ml 3% H_2So_4 in absolute methanol and 2ml benzene according to Rossel (1983).

Identification of fatty acid methyl esters by gas liquid chromatography:

The fatty acids methyl esters were analyses using Perkin-Elemar gas chromatograph (model F 22) with a flame ionizing detector (FID) in the presence of nitrogen as a carrier gas. The separation was carried out at 190-230ºC (temperature rate 4ºC/min) on a (3m x 3mm) glass column, packed with diethylene glycol succinate (DEGS) on chromosorb w, 80-100 mesh. The injector and detector temperatures were 220ºC. The nitrogen, hydrogen and air flow rate were 30, 30 and 300 ml /min.; respectively. The chart speed was 1cm/min. The peaks were identified by comparison with standard methyl esters by means of their relative retention times under identical conditions. The quantitative determination was performed by measuring the peak areas with an integrator.

Determination of pectin

The pectin content was determined by Dische (1947). 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 boiling for 22min, 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 525 nm 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 (1991). A 5g 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 hydrolysate was then extracted using n-hexane and passed through anhydrous sodium sulphate for drying purposes. The extraction was repeated three times. Extracted samples were then filtered through 0.45µm nylon membrane filter (Whatman, Maidstone, England) and analysed 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) was used to identify and quantify the isolated β-carotene.

Preparation and evaluation of fermented sweet pan bread supplemented with pumpkin pulp flour

Fermented sweet bread was manufactured by Bathie (2000) method. The bread was supplemented with 10%, 20%, 30% and 40% pumpkin pulp flour of the cv El-Edua grown as 1 plant/hill (ED 1) sample which was chosen based on taste index and maturity results. The basic ingredients were: wheat flour, water, sugar, vegetable oil, fresh whole egg, baking powder, salt and dried yeast. The percentages of ingredients are shown in Table (2). The fermented sweet bread was manufactured as follows: Mix the flour, water together and then mix with the other ingredients to form dough, put in pans, fermented for 135 minutes at 30ºC ± 2 with relative humidity 80-85% then baked for 25 minutes at 180ºC in an electrical oven. The surface should be dark brown when baking is finished. Remove from the oven and cool before evaluated. The sensory evaluation of sweet bread samples was carried out on subjective characteristics scores including color of crust (10), color of crumb (10), graining of crumb (10), texture (10), taste (10), odor (10) giving total score (60). The products were scored by the judges from the staff of Food science and Technology department, Faculty of Agriculture, Assiut University, according to the method described by Mostafa and Othman (1986).

Physical characteristics of bread

The weight (g) for bread was determined individually within two hours after baking the average was recorded, while the volume (cm^3) was determined by displacement method with clover seeds. Specific volume (cm^3/g) was calculated using the following Equation: Specific loaf volume (cm^3/g) = Volume (cm3)/Weight (g) (Mostafa and Othman 1986).

Table 2. Formulation of fermented sweet bread containing pumpkin pulp flour.

Ingredients	Control	10%	20%	30%	40%
Wheat flour 72% (g)	113.75	102.375	91.00	65.875	54.50
Pumpkin pulp flour (g)	---	11.375	22.75	34.125	45.50
Water (ml)	27.50	27.50	27.50	27.50	27.50
Baking powder (g)	3.38	3.38	3.38	3.38	3.38
Sugar (g)	28.38	28.38	28.38	28.38	28.38
Salt (g)	1.14	1.14	1.14	1.14	1.14
Vegetable oil (ml)	21.12	21.12	21.12	21.12	21.12
Fresh whole egg (g)	22.50	22.50	22.50	22.50	22.50
Dried yeast	3.38	3.38	3.38	3.38	3.38

Preparation of Chicken Burger supplemented with whole pumpkin seeds kernel meal

Control chicken burger was prepared according to Mikhail *et al.*, (2014) with the formula presented in Table (3). The supplemented burgers were prepared using the same formula except for replacing the chicken meat with 10%, 20%, 30% and 40% whole pumpkin seeds kernel meal of the ED 1 pumpkin sample which was chosen based on taste index and maturity results. The ingredients of each formulated burger were homogenized in Braun Cutter Machine, then from the homogenized meat mixture, processed into burger of about 100 g weight, 9 cm diameter and 1.3 cm in thickness.

Table 3. Formulation of chicken burger containing pumpkin seeds kernel meal.

Ingredients (g)	Control	10%	20%	30%	40%
Minced chicken breast meat	875	787.5	700	612.5	525
Whole pumpkin seeds kernel meal	---	87.5	175	262.5	350
Fresh onion	100	100	100	100	100
Salt	15	15	15	15	15
Black pepper	5	5	5	5	5
Allspice	5	5	5	5	5

Cooking of chicken burger samples

Samples of chicken burger were cooked, then cooking loss, cooking yield, shrinkage were determined and calculated according to the following equations as described by El-Magoli *et al.,* (1996); Ou and Mittal (2006) and Jama *et al.* (2008):

Cooking loss = [(weight of raw sample – weight of cooked sample) ÷ weight of raw sample] × 100.

$$\text{Cooking yield (\%)} = \frac{\text{Cooked weight}}{\text{Raw weight}} \times 100.$$

$$\text{Shrinkage (\%)} = \frac{(\text{Raw thickness} - \text{Cooked thickness}) + (\text{Raw diameter} - \text{Cooked diameter}) \times 100}{\text{Raw thickness} + \text{Raw diameter}}$$

Sensory evaluation of burger samples

Burger samples in pouches coded with different numbers were presented to the judges from the staff of Food science and Technology Department, Faculty of Agriculture, Assiut University, who were asked to rate each sensory attribute by assigning a score for color (10), odor (10), tenderness (10), taste (10), texture (10) appearance (10) and overall acceptability (10) of cooked samples according to the method described by AMSA (1995).

Statistical Analysis

The experimental data were subjected to an analysis of variance (ANOVA) for a randomized complete-block design using a statistical analysis system (SAS, 2000).

Results and Discussion

Plant growth and development

The pumpkins cultivars KB, KS and ED grown as three plants per hill showed significantly decreased reduced sugar contents in the leaves of 25-day-old pumpkin as compared to those grown single or two plants / hill (Table 4A). The leaves of plants grown as two plants/hill had the highest contents. There were significant differences also among cultivars. Clearly, cvs KB and KS had greater amounts of reduced sugar contents than ED except when grown as 3 plants/ hill. Likewise, the pumpkin cultivars KB, KS and ED grown as three plants per hill showed significantly decreased number of female flowers compared to those grown as single or two plants / hill (Table 4B). The pumpkins grown as one plants/hill gave the highest number of opened female flowers per plant. Significant differences were detected among cultivars. Obviously, cvs KB and ED had greater number of opened female flowers/plant than cv KS. Apparently, the reducing sugar contents in the leaves of 25-day-old pumpkin plants exhibited rather similar propensity. As indicated by Mohamed *et al.* (2012.), reduced sugar content has been shown to elevate during the transition of pumpkins from vegetative to flowering state. It can typify the ready to flower pumpkins from those recalcitrant ones. It is suggested; therefore, that availability of simple photosynthetic assimilates is crucial during flower anthesis and fruit set (Abdel-Rahman *et al.,* 2012). In line with their finding, the present study showed a magnificent lowered reduced sugar contents in pumpkins leaves as the plants suffered competition due to higher planting density. Level of reduced sugar contents was shown to affect the female flower production that increase with availability of carbohydrates. Thus reduced sugar contents can provide meaningful insight on pumpkin development and fruiting.

There were significant differences in the number of fruits/ plant among the three plant density treatments (Table 4C). The number of fruits per plant was progressively declined as the plant density increased from 1 to 3 plants/ hill. The largest number of fruits was produced by the cv KB followed by KS. The average fruit weight response to planting density was alike the average number of fruits per plant (Table 4D). The lowest fruit weight was produced by the plants grown as 3 plants/ hill and the greatest weight was obtained from pumpkins planted as 3 plants/ hill. The smallest fruits were found for cv ED. Our results were in agreement with Noelia *et al.* (2011) who reported an overall fruit weight of *Cucurbita moschata* varying from 1.52-7.75 kg according to different cultivars. Plant density also significantly affected the vine length (Table 4 E). The longest plants were those grown as 2 plants/ hill while the shortest vine was observed for pumpkins grown as 3 plants/ hill. The longest plants were found for cv KB and those having the shortest vine were from the cv ED. The above depicted results clearly demonstrate that planting intensity greatly influence pumpkin growth, development and fruiting characteristics, possibly through imposing an elevated competition among plants for nutrients (Abdel-Rahman *et al.,* 2012). The elevated intensity produced shorter plants bearing reduced fruits number of smaller weight. It is noticeable that the total fruit yield per hill ranged from 12.8 to 19.7 kg, from 15.7 to 22.3 kg and from 10.5 to 11.8 for planting as one, two and three plants/ hill, respectively.

Table 4. The growth, development and fruit characteristics of three pumpkin local cultivars grown at different plant density summer season, 2017 and 2018 seasons (1).

Cultivar	Plant density(2)							
	1 plant	2 plant	3 plant	Mean	1 plant	2 plant	3 plant	Mean
	1st season				2nd season			
A- Average content of reduced sugar (mg/100g) of fresh leaves (25 days from sowing)								
'Kafr El-Battikh'	34.3a	37.6a	23.4a	31.8	36.2a	39.6a	24.8a	33.5
'KafrSaad'	33.2b	36.6b	22.5b	30.8	34.4b	37.6b	24.0b	32.0
'El-Edua'	32.2c	34.9c	22.2b	29.7	33.5c	36.2c	23.4b	31.0
Mean	33.2	36.4	22.7	30.8	34.7	37.8	24.1	32.2
$LSD_{0.05}$:(3)	0.4				0.5			
B-Number of opened female flowers per plant								
'Kafr El-Battikh'	11.2a	10.5a	5.6a	9.1	11.4a	10.4a	6.4a	9.4
'KafrSaad'	10.2c	9.4c	5.0c	8.2	10.4c	9.3c	5.9c	8.5
'El-Edua'	10.7b	9.9b	5.4b	8.7	10.8b	9.9b	6.3b	9.0
Mean	10.7	9.9	5.3	8.7	10.9	9.9	6.2	9.0
$LSD_{0.05}$:(3)	0.1				0.2			
C- Number of fruits per plant								
'Kafr El-Battikh'	2.53a	2.38a	2.14a	2.35	3.27ab	2.98ab	2.68ab	2.98
'KafrSaad'	2.19c	2.09c	1.84c	2.04	3.10c	2.28c	1.93c	2.44
'El-Edua'	2.38b	2.24b	1.99b	2.20	3.18b	2.68b	2.38b	2.75
Mean	2.37	2.24	1.99	2.20	3.18	2.65	2.33	2.72
$LSD_{0.05}$(3)	0.02				0.07			
D- Average fruit weight (kg)								
'Kafr El-Battikh'	7.794a	4.685b	1.846ab	4.775	7.110a	4.481a	2.214a	4.601
'KafrSaad'	7.503b	4.909a	1.908a	4.773	6.421b	3.736b	1.871b	4.009
'El-Edua'	5.411c	3.505c	1.782b	3.566	5.594c	2.877c	1.586c	3.352
Mean	6.903	4.366	1.845	4.371	6.375	3.698	1.890	3.988
$LSD_{0.05}$:(3)	**0.16**				**0.19**			
E- Average plant length (cm) at 120 days after planting date								
'Kafr El-Battikh'	444.3a	489.4a	324.9a	419.5	470.7a	519.2a	344.3a	444.7
'KafrSaad'	429.1b	473.7b	318.0b	406.9	456.3b	501.0b	336.3b	431.2
'El-Edua'	418.2c	461.7c	309.9c	396.6	440.0c	486.0c	324.8c	416.9
Mean	430.5	474.9	317.6	407.7	455.7	502.0	335.1	430.9
$LSD_{0.05}$:	2.7				3.5			

(1) Year, season and plant density interaction was significant. (2) Means within column followed by same letter (s) are not significantly different. (3) To compare means of same cultivar grown on different plant density.

Physical properties and chemical composition and of pumpkin fruit pulp

As shown in Table 5 the pH ranged from 4.39 to 6.80 for the studied samples. It is clear that there were a significant ($P<0.05$) differences in the pH among the three studied cultivars. For TSS and TTA, the KS 1 plant and 2 plant treatment recorded the highest values of TSS; 10.30 and 10.02%, while the KB 3 plant treatment has the highest value of TTA: 0.52 comparing with the other treatment. On the other hand the ED 1 plant treatment recorded the highest values of taste index and the maturity 3.81 and 73.49%, respectively, as compared with other plant densities.

Table 5. Physical properties of pumpkin fruit pulp cultivars grown at different plant density (g/100g D.W)*.

Analysis	Cultivar	Plant density (per hill)			Mean
		1 plant	2 plant	3 plant	
TSS (brix%)	Kafr El-Battikh 1	9.60	9.40	8.50	9.17 b
	KafrSaad	10.30	10.02	8.30	9.54 a
	El-Edua	9.70	9.20	7.60	8.83 c
Mean		9.87 a	9.54 b	8.13 c	9.18
pH	Kafr El-Battikh 1	6.80	6.70	6.72	6.74 a
	KafrSaad	4.43	4.51	4.39	4.44 c
	El-Edua	5.91	6.02	5.96	5.96 b
Mean		5.71 b	5.74 a	5.69 c	5.71
T.T.A (g/100g D.W)	Kafr El-Battikh 1	0.41	0.49	0.52	0.47 a
	KafrSaad	0.27	0.24	0.31	0.27 b
	El-Edua	0.13	0.16	0.16	0.15 c
Mean		0.27 a	0.30 b	0.33 a	0.30
Taste index	Kafr El-Battikh 1	1.58	1.45	1.34	1.45 c
	KafrSaad	2.18	2.31	1.65	2.05 b
	El-Edua	3.81	2.99	2.51	3.10 a
Mean		2.52 a	2.25 b	1.83 c	2.2
The maturity	Kafr El-Battikh 1	23.30	19.26	16.32	19.63 c
	KafrSaad	38.29	41.23	26.69	35.40 b
	El-Edua	73.49	56.44	46.91	58.95 a
Mean		45.02 a	38.98 b	29.97 c	37.99

Mean followed by the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

The results in Table 6 showed a significant (P<0.05) difference in the contents of moisture, ash, protein and oil which ranging from 85.70-91.36%, 6.29-8.89%, 9.37-11.65% and 1.12-1.58%, respectively, for all the studied treatment. The ED 1 plant, KB 3 plant treatment significantly (P<0.05) had the highest contents of crude fiber (4.95%) and total carbohydrates (79.91%), respectively. Reducing sugars, starch and the caloric value content ranged from 12.02-21.92%, 46.26-52.18% and 344.64-366.64 kcal/100 g, respectively. From the above mentioned data it is clear that the significant differences were due to different plant density and cultivars. The results for chemical analysis are in consistent with Noelia *et al*., (2011).

Table 6. Chemical composition and physical properties of pumpkin fruit pulp for cultivars grown at different plant density (g/100g D.W)*.

Analysis	Cultivar	Plant density (per hill)			Mean
		1 plant	2 plant	3 plant	
Moisture	Kafr El-Battikh 1	85.70	86.90	90.30	87.63 c
	KafrSaad	86.60	87.67	90.76	88.34 b
	El-Edua	88.60	90.21	91.36	90.06 a
Mean		86.97 c	88.26 b	90.81 a	88.68
Ash*	Kafr El-Battikh 1	6.29	6.63	6.35	6.42 c
	KafrSaad	8.86	7.97	7.33	8.05 b
	El-Edua	8.89	8.37	8.02	8.43 a
Mean		8.01 a	7.66 b	7.23 c	7.63
Protein*	Kafr El-Battikh 1	9.39	9.46	9.37	9.41 c
	KafrSaad	9.70	9.81	9.88	9.80 b
	El-Edua	11.65	11.35	11.31	11.44 a
Mean		10.25 a	10.21 b	10.19 c	10.22
Oil*	Kafr El-Battikh 1	1.44	1.15	1.05	1.21 c
	KafrSaad	1.52	1.22	1.12	1.29 b
	El-Edua	1.58	1.53	1.32	1.48 a
Mean		1.51 a	1.30 b	1.16 c	1.32
Crude fiber*	Kafr El-Battikh 1	3.85	3.43	3.32	3.53 c
	KafrSaad	4.07	3.84	3.82	3.91 b
	El-Edua	4.95	4.84	4.59	4.79 a
Mean		4.29 a	4.04 b	3.91 c	4.08
Total carbohy-drates*	Kafr El-Battikh 1	79.03	79.33	79.91	79.42 a
	KafrSaad	75.85	77.16	77.85	76.95 b
	El-Edua	72.93	73.91	74.76	73.87 c
Mean		75.94 c	76.80 b	77.51 a	76.75
Reducing sugars*	Kafr El-Battikh 1	12.02	13.96	14.56	13.51 c
	KafrSaad	19.54	21.49	21.92	20.98 a
	El-Edua	16.22	16.56	17.21	16.66 b
Mean		15.93 c	17.34 b	17.89 a	17.05
Starch*	Kafr El-Battikh 1	51.14	50.64	52.18	51.32 a
	KafrSaad	46.31	46.26	47.39	46.65 c
	El-Edua	48.86	49.28	49.65	49.26 b
Mean		48.77 b	48.73 b	49.74 a	49.08
The caloric value*	Kafr El-Battikh 1	366.64	365.51	366.57	366.24 a
	KafrSaad	355.88	358.86	361.00	358.58 b
	El-Edua	344.64	354.81	356.16	351.87 c
Mean		355.72 b	359.73 a	361.24 a	358.90

Mean followed by the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

Pectin, Beta-carotene and Mineral composition of pumpkin fruit pulp

From data in Table 7 the highest pectin and beta carotene contents were found in ED 1 plant (11.49 mg galactutonic acid/100g D.W) and KB 1 plant (2.89 mg/100g D.W) treatment, respectively. The minerals contents (mg/100g D.W) were found to be significantly ($P<0.05$) different. Potassium was the highest (1924.34 - 2465.53) followed by phosphorus (440.90-450.06) and sodium (51.02-65.01), while magnesium, calcium and iron were found in reasonable quantities, with significant differences as a result of different plant density and among the cultivars. It is noted from Table 7 that most of the mineral elements, pectin, beta carotene with the highest values were found in the 1 plant density, which confirming that 1 plant density was the best among the others. Our results are in the same range as previous studies (Adubofuor *et al.,* 2016; Noelia *et al*. 2011).

Table 7. Pectin (mg galacturonic acid/100 g D.W), beta-carotene and mineral composition (mg/100g D.W) of pumpkin fruit pulp cultivars grown at different plant density.

Analysis	Cultivar	Plant density (per hill)			Mean
		1 plant	2 plant	3 plant	
Pectin	Kafr El-Battikh 1	6.85	6.77	6.38	6.67 c
	KafrSaad	7.61	7.57	6.98	7.39 b
	El-Edua	11.49	11.33	11.09	11.30 a
Mean		8.65 a	8.56 b	8.15 c	8.45
Beta-carotene (mg/100g D.W)	Kafr El-Battikh 1	2.89	2.35	2.31	2.52 a
	KafrSaad	2.16	2.34	2.48	2.33 b
	El-Edua	2.41	2.23	2.07	2.24 b
Mean		2.49 a	2.31 ab	2.29 b	2.36
K	Kafr El-Battikh 1	2374.23	2200.46	1968.24	2183.20 b
	KafrSaad	2214.69	2005.51	1924.34	2048.18 c
	El-Edua	2465.53	2296.65	1956.87	2239.68 a
Mean		2351.48 a	2167.54 b	1952.04 c	2157.02
P	Kafr El-Battikh 1	440.90	440.92	440.90	440.91 c
	KafrSaad	448.56	447.92	448.50	448.33 b
	El-Edua	450.06	450.01	450.06	450.04 a
Mean		446.51 a	446.28 b	446.49 a	446.43
Na	Kafr El-Battikh 1	60.19	60.10	60.18	60.16 b
	KafrSaad	64.26	65.01	64.86	64.71 a
	El-Edua	51.28	51.02	51.22	51.17 c
Mean		58.58 a	58.71 a	58.75 a	58.68
Mg	Kafr El-Battikh 1	18.62	18.68	18.60	18.63 b
	KafrSaad	16.52	16.48	16.54	16.51 c
	El-Edua	21.28	21.27	21.20	21.25 a
Mean		18.81 a	18.81 a	18.78 a	18.80
Ca	Kafr El-Battikh 1	16.68	16.38	16.48	16.51 c
	KafrSaad	17.79	17.86	17.90	17.85 b
	El-Edua	35.25	35.02	35.12	35.13 a
Mean		23.24 a	23.08 b	23.17 ab	23.16
Fe	Kafr El-Battikh 1	2.69	2.70	2.66	2.68 b
	KafrSaad	2.86	2.86	2.87	2.86 a
	El-Edua	1.73	1.69	1.70	1.71 c
Mean		2.43 a	2.42 ab	2.41 b	2.42

Mean followed by the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

1- Pumpkin seeds

Chemical composition of pumpkin seed kernel

The results in Table 8 showed that there were significant (P<0.05) differences in all the chemical composition properties as a result of different cultivars and plant density, where the ED 2 plant; ED 1 plant; KB 2 plant; ED 3 plant; KS 1 plant had the highest values of moisture (7.20%); ash (5.95%); protein (33.15%); oil (41.35%) and crude fiber (3.50%), respectively, as compared with other seeds kernel treatment. The total carbohydrates, caloric value were ranged from 18.18-22.10% and 561.30-574.03 kcal/100g, respectively, in the studied treatment. The contents of the chemical composition of the seeds kernels were within the values reached by the researchers in previous studies (El-inge *et al.*, 2012; Maheshwari, *et al.,* 2015).

Table 8. Chemical composition of pumpkin seed kernel from three cultivars grown at different plant density (g/100g D.W).

Analysis	Cultivar	Plant density (per hill)			Mean
		1 plant	2 plant	3 plant	
Moisture	Kafr El-Battikh 1	4.22	4.67	4.53	4.47 c
	KafrSaad	5.33	5.20	6.43	5.65 b
	El-Edua	6.93	7.20	7.01	7.05 a
Mean		5.49 b	5.69 ab	5.99 a	5.72
Ash*	Kafr El-Battikh 1	4.55	5.30	5.21	5.02 b
	KafrSaad	5.00	5.06	4.89	4.98 b
	El-Edua	5.95	5.83	5.80	5.86 a
Mean		5.17 b	5.40 a	5.30 ab	5.29
Protein*	Kafr El-Battikh 1	33.14	33.15	33.05	33.11 a
	KafrSaad	30.48	30.10	30.27	30.94 b
	El-Edua	31.00	31.10	31.05	30.28 c
Mean		31.54 a	31.34 a	31.46 a	31.44
Oil*	Kafr El-Battikh 1	40.13	40.25	40.10	40.16 b
	KafrSaad	39.06	39.51	39.40	39.32 c
	El-Edua	41.24	41.17	41.35	41.25 a
Mean		40.14 b	40.31 a	40.28 a	40.24
Crude fiber*	Kafr El-Battikh 1	2.95	2.72	2.16	2.61 b
	KafrSaad	3.50	3.23	3.36	3.36 a
	El-Edua	2.34	2.56	2.38	2.43 b
Mean		2.93 a	2.84 a	2.63 b	2.8
Total carbohydrates*	Kafr El-Battikh 1	19.23	18.58	18.18	18.66 c
	KafrSaad	21.96	22.10	22.08	22.05 a
	El-Edua	19.47	19.34	19.42	19.41 b
Mean		20.22 a	20.01 ab	19.89 b	20.04
The caloric value*	Kafr El-Battikh 1	570.65	569.17	565.82	568.55 b
	KafrSaad	561.30	564.39	564.00	563.23 c
	El-Edua	573.04	572.29	574.03	573.12 a
Mean		568.33 a	568.62 a	567.95 a	568.3

Mean followed by the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

Pectin, Beta-carotene and Mineral composition of pumpkin seed kernel

The results in Table 9 showed that the content of pectin was not significantly (P<0.05) different due to plant density, but there were significant differences as a result of different cultivars and ranged from 1.10 to 1.28 mg galacturonic acid/100g D.W.). For the beta-carotene KB 1 plant gave the highest content (0.86 mg/100 g D.W) among the rest of the seeds kernel samples. The mineral elements contents (mg/100g D.W) were significantly (P<0.05) different between the cultivars. The potassium component was highest with values (490.69 - 586.21) followed by phosphorus (500.62 - 540.04) and magnesium (240.86-302.80). The calcium was found in different values between the cultivars where the highest content was ED 3 plant (72.06 mg) and the smallest KS 2 plant (66.01 mg). There were also reasonable amounts of sodium and iron in the studied samples. As shown from the data in Table 8, the 1 plant density, regardless of the cultivar, gave the highest values, which is the best. Such data were agreement with Ardabili *et al.,* 2011 and Alfawaz, 2004 who reported similar results on chemical analysis like us.

Table 9. Pectin (mg galacturonic acid/100g D.W), beta-carotene and mineral composition (mg/100g D.W) of pumpkin seed kernel from three cultivars grown at different plant density.

Analysis	Cultivar	Plant density (per hill)			Mean
		1 plant	2 plant	3 plant	
Pectin	Kafr El-Battikh 1	1.16	1.15	1.16	1.16 b
	KafrSaad	1.10	1.09	1.10	1.10 c
	El-Edua	1.28	1.28	1.26	1.27 a
Mean		1.18 a	1.17 a	1.17 a	1.17
Beta-carotene (mg/100g D.W)	Kafr El-Battikh 1	0.86	0.85	0.85	0.85 a
	KafrSaad	0.82	0.80	0.80	0.81 b
	El-Edua	0.70	0.70	0.69	0.69 c
Mean		0.79 a	0.78 b	0.78 b	0.78
K	Kafr El-Battikh 1	586.21	585.80	586.00	586 a
	KafrSaad	570.02	572.21	575.09	572.44 b
	El-Edua	492.26	490.69	492.30	491.75 c
Mean		549.50 b	549.57 b	551.13 a	550.06
P	Kafr El-Battikh 1	505.73	505.72	505.70	505.72 b
	KafrSaad	500.64	500.62	500.62	500.63 c
	El-Edua	540.04	540.00	540.03	540.02 a
Mean		515.47 a	515.45 b	515.45 b	515.46
Na	Kafr El-Battikh 1	20.18	20.02	20.10	20.10 b
	KafrSaad	21.30	21.32	21.29	21.30 a
	El-Edua	18.85	18.83	18.80	18.83 c
Mean		20.11 a	20.06 b	20.06 b	20.08
Mg	Kafr El-Battikh 1	302.80	300.69	301.20	301.56 a
	KafrSaad	296.51	296.01	294.41	295.64 b
	El-Edua	240.86	240.90	241.01	240.92 c
Mean		280.05 a	279.20 b	278.87 b	279.37
Ca	Kafr El-Battikh 1	68.52	68.02	68.60	68.38 b
	KafrSaad	66.08	66.01	66.07	66.05 c
	El-Edua	72.03	72.01	72.06	72.03 a
Mean		68.87 a	68.68 b	68.91 a	68.82
Fe	Kafr El-Battikh 1	5.65	5.48	5.62	5.58 c
	KafrSaad	7.25	7.29	7.24	7.26 a
	El-Edua	6.08	6.05	6.01	6.05 b
Mean		6.33 a	6.27 b	6.29 ab	6.30

Mean followed by the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

Fatty acid composition of pumpkin seed kernel oil

The fatty acids compositions of pumpkin seed kernel oil from three cultivars grown at different plant density are reported in Table 10. From these results it could be noticed that the major fatty acids were palmitic, oleic and linoleic make up more than 82.00 % of the total fatty acids in pumpkin seed kernel oil. The linoleic acid represented the highest percentage of total fatty acids in all the studied oils, followed by oleic then palmitic and stearic acid. The contents of fatty acids were similar in every cultivar at different plant density under study. In addition the total unsaturation fatty acids were ranged from 69.27 to 75.04% in these oils. In comparison to previous studies, the differences in fatty acid quantities may be due to the cultivars, the environmental and agricultural factors. All major fatty acids have been identified by many authors (Achu *et al.,* 2006; Stevenson *et al*., 2007; Szterk *et al.*, 2010).

Table 10. Fatty acid composition of pumpkin seed kernel oil from three cultivars grown at different plant density (%).

	Carbon: chain	Kafr El-Battikh 1			KafrSaad			El-Edua		
		1 plant	2 plant	3 plant	1 plant	2 plant	3 plant	1 plant	2 plant	3 plant
Palmitic	16:0	13.40	13.56	13.02	12.20	12.40	12.06	11.50	11.20	11.10
Heptadecanoic	17:0	0.27	0.24	0.26	0.24	0.26	0.25	0.23	0.24	0.22
Stearic	18:0	6.30	6.00	6.30	7.18	7.20	7.01	6.94	6.92	6.86
Arachidic	20:0	1.17	1.01	1.07	0.84	0.87	0.86	1.22	1.16	1.17
Behenic	22:0	0.05	0.05	0.06	0.12	0.12	0.13	0.06	0.06	0.06
Lignoceric	24:0	0.10	0.11	ND	0.09	0.10	ND	0.11	ND	0.11
Total saturated		21.29	20.97	20.71	20.67	20.95	20.28	20.06	19.58	19.52
Plmitoleic	16:1	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.11
Heptadecenoic	17:1	0.19	0.18	0.19	0.18	0.17	0.18	0.17	0.17	0.17
Oleic	18:1	24.18	24.44	24.06	24.50	24.06	24.59	26.09	26.03	26.18
Linoleic	18:2	44.53	44.62	44.72	49.21	49.39	49.27	48.02	48.21	48.29
Linolenic	18:3	0.09	0.09	0.08	0.17	0.16	0.18	0.10	0.12	0.10
Gadoleic	20:1	0.18	0.18	0.17	0.20	0.21	0.21	0.19	0.20	0.19
Total uns.		69.27	69.61	69.32	74.36	74.09	74.53	74.68	74.84	75.04
T.s./ T. uns		0.31	0.30	0.30	0.28	0.28	0.27	0.27	0.26	0.26

Sensory Evaluation, chemical composition of Sweet fermented bread made from pumpkin pulp flour

The physical characteristics of bread samples processed from wheat flour and its mixtures with 10, 20, 30 and 40 percent of ED1 PPF are showed in Table 11 and Fig 1. It was found from Table 11 that the loaf weight was increased in all ED1 PPF bread. The increased of bread weight was correlated to the amount of ED1 PPF present in the flour mixture. On the other hand the loaf volume, specific volume of fortified bread with these ratios was lower when compared with 100% wheat flour fermented bread. Our results are in the same range as Mettler and Seibel 1993 who reported that the dilution of gluten was causing the reduction of loaf volume but the high water retention causing the increase in bread weight.

The sensory characteristics of the studied fermented bread as influence by the incorporation of 10%, 20%, 30% and 40% fortified ED1 PPF are outlined in Table (10). The data revealed that both fortified bread improved all studied sensory characteristics. However, the best scores of all studied sensory characteristics were recorded for 10% and 20% fortified bread with ED1 PPF. The crust color, crumb properties, texture, taste, odor, over all acceptability scores of control bread and 10%, 20%, 30%, 40% ED1 PPF breads were different. Incorporation of ED1 PPF recorded lower scores for all quality attributes of fortification 10%, 20%, 30% and 40% than the control. The color of the fermented sweet bread was affected by the addition of ED1 PPF as shown in Fig. 1.

Table 11. Sensory properties and physical evaluation of fermented sweet bread processed from wheat flour and its blends with ED 1plant pumpkin pulp flour (PPF).

Bread sample	Crust color	Crumb		Texture	Taste	Odor	Total score	physical evaluation		
		Color	Graining							
	(10)	(10)	(10)	(10)	(10)	(10)	(60)	Volume (ml)	Weight (g)	Specific volume (ml/g)
WF100% (Control)	9.23	9.13	8.63	8.95	8.99	8.61	53.54	613.00	184.67	3.32
90% WF + 10%PPF	8.85	8.36	8.30	8.64	8.19	8.55	50.89	604.00	187.37	3.22
80% WF + 20%PPF	8.77	8.10	8.16	8.10	8.32	8.45	49.90	589.00	192.31	3.06
70% WF + 30%PPF	7.98	7.98	7.95	7.98	8.43	7.95	48.27	576.00	194.62	2.96
60% WF + 40%PPF	7.34	7.35	7.39	7.35	8.26	7.95	45.64	547.00	197.09	2.78
F Value	0.63	0.62	0.28	0.43	0.14	0.11	9.40	2012.10	38.60	0.06
LSD 0.05	3.02	2.58	2.75	2.98	2.67	3.12	3.03	1.82	2.60	2.74

WF: Wheat flour. PPF: Pumpkin pulp flour (ED 1plant).

The gross chemical composition of fermented sweet bread samples is presented in Table (12). The moisture content of bread samples was ranged from 24.84 to 26.47%. The ash, oil, protein, crude fiber contents was significantly ($P<0.05$) increased in the fortified bread with ED1 PPF as compared with control, these results may be due to higher content of ash, oil, protein and crude fiber in ED1 PPF compared to wheat flour so the addition of ED1 PPF to sweet fermented bread caused that increase. The data revealed that all fortified bread with ED1 PPF had lower total carbohydrates and energy comparing with the control.

Table 12. Chemical composition of fermented sweet bread processed from wheat flour and its blends with pumpkin pulp flour (PPF). *On dry weight basis.

Bread samples	Moisture	Ash*	Oil*	Protein*	Crude fiber*	Total carbo-hydrates*	Energy* (Kcal/100 g)
WF100% (Control)	26.46	1.11	8.45	10.19	0.60	79.65	435.41
90% WF + 10%PPF	25.99	1.78	8.49	10.24	0.92	78.57	431.65
80% WF + 20%PPF	26.47	2.39	8.61	10.38	1.24	77.38	428.53
70% WF + 30%PPF	25.44	3.20	8.56	10.54	1.86	75.84	422.56
60% WF + 40%PPF	24.84	4.18	8.72	10.61	2.03	74.46	418.76
F Value	268.54	272.07	136.42	50.05	152.57	2581.43	55494.5
LSD 0.05	0.1378	0.2068	0.0917	0.1452	0.146	0.1104	0.0764

WF: Wheat flour. PPF: Pumpkin pulp flour (ED 1plant).

Fig. 1. The fermented sweet bread processed from wheat flour and its blends with ED 1 pumpkin pulp flour (PPF) at 10, 20, 30, 40% replacement ratios.

Sensory Evaluation, physical properties and chemical composition of Chicken burger supplemented with whole pumpkin seed kernel meal.

Sensory evaluation of cooked tested burger represented in Table (13) and Fig. (2). There are no significant ($P<0.05$) differences between the control chicken burger and the samples supplemented by 10%, 20% - 30% of WPSKM in terms of odor, tenderness, taste and texture as well as over acceptability. On the other hand the control, 10% and 20% burger samples possessed the best color between the studied samples. The total score which expresses consumer acceptability was highest for burgers containing 10%, 20% supplemented burgers, with values 58.89 and 56.62, respectively, as compared with 61.21 for control (100% chicken breast meat). Frying the burger in oil caused a decrease in the weight of the burger and consequently decreasing in cooking loss which ranging from 11.15 – 19.52% for supplemented burger, comparing with 21.54% for control. The shrinkage value of burger (as a result of changes in diameter, thickness after cooking) was decreased in supplemented burger ranged from 7.77-15.65% comparing with 15.96 for control. Consequently, the cooking yield was increased as a result of decreasing in shrinkage, cooking loss values was found in quantities from 79.46 to 85.42% for supplemented burgers samples, compared to 78.43% for control. This is agreement with the findings of Abbas, (2009). From the above mention data there were significant differences between the control burger and 40% supplemented sample in all parameters which confirms that this ratio is undesirable and gave poor results.

Table 13. Sensory Evaluation and physical properties of supplemented chicken Burgers.

Burger sample	Sensory evaluation								Physical properties		
	Color (10)	Odor (10)	Tenderness (10)	Taste (10)	Texture (10)	Appearance (10)	Overall acceptability (10)	Total score (70)	Cooking loss (%)	Shrinkage (%)	Cooking yield (%)
Control (100% CBM)	8.90	8.84	8.65	8.65	8.90	8.52	8.75	61.21	21.54	15.96	78.43
90% CBM + 10%WPSKM	8.63	8.26	8.58	8.52	8.30	8.30	8.30	58.89	19.52	15.65	79.46
80% CBM + 20% WPSKM	8.20	7.82	8.10	8.30	8.10	8.10	8.00	56.62	18.05	13.59	80.87
70% CBM + 30% WPSKM	7.16	7.37	7.29	7.25	7.29	7.16	7.50	51.02	15.74	10.68	84.72
60% CBM + 40% WPSKM	6.65	6.35	6.30	6.30	6.00	6.50	6.50	44.60	14.45	7.77	85.42
F Value	2.80	3.46	2.89	3.03	2.05	1.24	1.09	46.91	11.15	12.09	26.56
LSD 0.05	1.82	1.69	1.87	1.82	2.46	2.41	2.60	3.08	2.69	3.16	1.90

CBM: chicken breast meat WPSKM: whole pumpkin ED 1plant seed kernel meal.

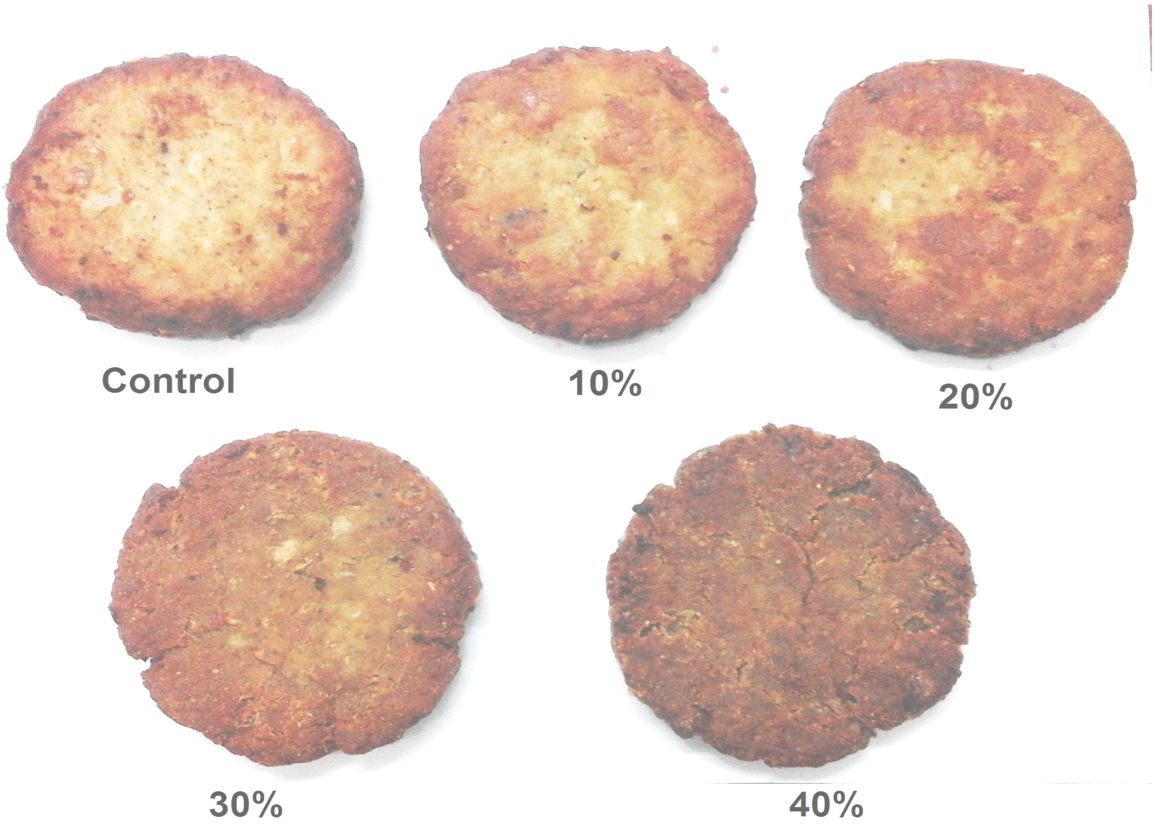

Fig. 2. The chicken burger made from chicken breast meat and its mixtures with ED 1 whole pumpkin seed kernel meal (WPSKM) at 10, 20, 30, 40% replacement ratios.

Table 14. Chemical composition of supplemented chicken Burgers.*on dry weight basis.

Burger samples	Moisture	Ash*	Oil*	Protein*	Crude fiber*	Total carbo-hydrates*	Energy* (Kcal/100 g)
Control (100% CBM)	56.87	5.10	13.64	58.44	4.74	18.08	428.84
90% CBM + 10%WPSKM	53.32	4.70	16.12	56.36	4.35	18.47	444.40
80% CBM + 20% WPSKM	52.94	4.77	18.70	53.74	4.04	18.75	458.26
70% CBM + 30% WPSKM	51.41	4.81	21.00	52.04	3.50	18.65	471.76
60% CBM + 40% WPSKM	49.22	4.86	22.28	50.26	3.24	19.36	479.00
F Value	1462.29	39.82	3558.36	2849.36	199.55	162.82	72403.2
LSD 0.05	0.1909	0.1768	0.159	0.1648	0.123	0.1198	0.2017

CBM: chicken breast meat. **WPSKM: whole pumpkin ED 1plant seed kernel meal.**

The chemical composition (on a dry weight basis) of cooked chicken burgers with and without WPSKM is shown in Table 14. The results revealed that all the samples contained significantly ($P<0.05$) high protein (50.26–58.44%), oil (13.64–22.28%), total carbohydrates (18.08-19.36%) contents, and consequently higher energy content (Kcal/100g) in treated burgers (444.40-479.00) comparing with the control (428.84). It was observed that the increase in the amount of WPSKF in the burger blends have been a significant decrease in ash and crude fiber. This is consistent with previous studies (Mikhail *et al*., 2014).

In conclusion, overall data tend to suggest cultivation of the pumpkin fruits as one or two plant/hill in order to collectively maintain horticultural cropping and both nutritional and acceptability of processed food products. The cultivar ED grown as one plant/hill was the most acceptable among the tested cultivars concerning utilization in manufacturing sweet bread containing pumpkin fruit pulp and chicken burger with seed kernel added.

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الاداء المحصولي والخصائص الفيزيوكيميائية والمكونات الغذائية لثمار القرع العسلى المزروع بكثافات نباتيه مختلفة

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الملخص

فى هذه الدراسة تم زراعة ثلاثة أصناف من القرع العسلى (*Cucurbita moschata* L.) وهي: كفر البطيخ – ١ (KB) ، كفر سعد (KS) ، والعدوة (ED) بكثافة نباتية مختلفة: نبات واحد ، اثنان وثلاثة نباتات في الجورة. خضعت الثمار الناتجة لدراسة بعض الخواص النباتية متمثلة فى كمية السكر المختزل فى الاوراق الطازجة بعد ٢٥ يوم من العقد ومتوسط طول النبات بالسم بعد ١٢٠ يوما من تاريخ الزراعة ومتوسط عدد الثمار فى النبات ومتوسط وزن الثمرة بالكجم وعدد الأزهار المؤنثة والمذكرة المتفتحة لكل نبات والنسبة الجنسية وكذلك دراسة الجودة الغذائية التي يتم تمثيلها في التركيب الكيميائي ، البكتين ، البيتا كاروتين ، بعض المعادن في كل من لب ثمار ونواة بذور القرع العسلى. بالإضافة إلى تصنيع بعض المنتجات الغذائية مثل الخبز الحلو المخمر من لب الثمار وبرجر الدجاج من نواة البذور. أظهرت النتائج المتحصل عليها وجود فروق معنوية ($P < 0.05$) بين الأصناف وكذلك بين الكثافة النباتية المستخدمة في الدراسة. كانت الثمار ذات الكثافة النباتية الواحدة هي الأفضل بين الكثافات الأخرى من حيث التركيب الكيميائي والمعادن. ولوحظت فروق معنوية ($P < 0.05$) بين الأصناف في محتوى البكتين والبيتا كاروتين للكثافة النباتىة الواحدة عند مقارنتها بالكثافات الأخرى. وكانت عينة صنف العدوة بكثافة نباتية واحدة هي الأفضل بين بقية العينات تحت الدراسة من حيث النضج ودليل التذوق. ولهذا تم أختيار هذه العينة للتطبيق في الجزء التكنولوجي على النحو التالي: معالجة تصنيع الخبز المتخمّر الحلو من اللب وتصنيع برجر الدجاج من نواة بذوره. تم إعداد عينات الخبز والبرجر من لب ثمار القرع العسلى ونواة البذور عن طريق الاستبدال الجزئي بنسب ١٠ و ٢٠ و ٣٠ و ٤٠٪. تم إجراء التقييم الحسي والخصائص الفيزيائية لتقييم الخبز والبرجر. تم الحصول على أفضل النتائج بالنسبة لعينات الخبز والبرغر المدعمة بنسبة إحلال ١٠٪ و ٢٠٪ سواء كانت للب الثمار أو نواة للبذور. ووجدت قيم التركيب الكيميائى للمنتجات بكميات معقولة ، مما يؤكد القيمة الغذائية العالية لهذه المنتجات ، بالإضافة إلى الخصائص المرغوبة التي يقبلها المستهلك.