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Studies on Chemical Composition of Some Egyptian and Chinese pumpkin (*Cucurbita maxima*) Seed Varieties

Research article

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Abstract

The chemical composition of seeds of three pumpkin varieties (Cucurbita maxima)kafr el-batikh, kafrsaadof Egyptian origin and a ChineseHongli variety were studied for the contents of moisture,crude fiber, proteins, oils, carbohydrates and ashon dry weight basis.Studies were also carried out on amino acid profile, fatty acids and minerals contents. The results of chemical composition indicate that moisture percentage in these varieties ranged between 3.38 to 5.53%, and contains crude fiber (4.124.69%),total lipids(35.2-41.95%), crude protein (34.19- 39.75%), total carbohydrate (4.8-10.96%) and ash (4.22-5.3%). Amino acid analysis revealed that seeds of these varieties have higher level of Glutamic Acid ranging from 33.03 to 34.76g/100g protein. The fatty acid composition of the oils indicated the predominance of oleic fatty acid (50.0%) in kafr el-batikh oil. Both the Egyptian varieties were prominent in linoleic (24.82 and 29.5%), palmitic (16.56 and 15.60%) and stearic acid (6.93and 7.50%) contents while Hongli variety was predominant inarachidonicfatty acid(42.94%). The seeds of these varieties contained variable amounts of minerals elements (mg/100g dry weight basis) such as potassium (260,208.3 and267), magnesium (96.85,60.95 and 88), manganese (0.852, 0.594 and 0.803), zinc (2.20,1.72 and 2.18), iron (17.0,18.5 and 10.5), copper (0.49, 0.39 and 0.397) respectively indicating the mineral richness in kafr el-batikh.

Keywords: *Cucurbita maxima;* Pumpkin; Chemical composition; Fatty acid; Amino acid; Minerals

Introduction

Pumpkins belong to genus *Cucurbit*a (family *Cucurbitaceae*) are grown throughout the tropical and sub-tropical countries [1]. Worldwide three common types of pumpkin are grown namely *C. pepo*, *C. maxima* and *C moschata* [2]. Five major pumpkin producing countries in the world are China, India, Ukraine, Egypt and the United States [3]. The yellow-orange characteristic color of pumpkin is due to the presence of carotenoids. Pumpkins are a valuable source of carotenoids and ascorbic acid, both of which play a major role in nutrition as provitamin A and as an antioxidant respectively [1]. In addition, pumpkins are a source of minerals, vitamins, pectin, and dietary fiber. *C. moschata* has a high amount of pectin, carotene, vitamins, minerals and other elements beneficial to human health [4]. Squash is cultivated throughout the world for use as a vegetable as well as traditionally as medicine in many countries such as China, Yugoslavia, Argentina, India, Mexico, Brazil and, America. Consumption of foods containing carotene helps prevent skin diseases, eye disorders and cancer [5]. Pumpkin seeds are popular in treating worms and parasites as well as in diabetic treatment [6].

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Materials and Methods

Three types of pumpkin seed varieties (5 kg for each variety) were studied, two of which were planted in Egypt (kafr saad and kafr el-batikh), and the third Chinese variety namly Hongli was planted in China. Chinese variety was obtained from the local market in Cairo whereas kafr saad and kafr el-batikh were obtained from their regions. The seeds were cleaned from foreign materials, hand dehulled and the obtained kernels were ground by using electrical grinder and used for analysis. All reagents were purchased from Sigma-Aldrich.

Analytical Method

Gross chemical composition: Moisture content, crude protein (% N x 6.25), crude fat, crude fiber and ash were determined in pumpkin seed samples as well as pumpkin seed flour according to [7] standard method. Carbohydrate content was determined by the difference.

Determination of minerals

Determination of minerals was carried out by a Flame Photometer 410, spekol 11 spectrophotometer and Atomic Absorption Spectrophotometer at Agriculture Research Center, Giza, Cairo, as described in [7].

Amino acid composition

Amino acids were determined according to the method described by [8] with modifications, summarized as follows: 200 mg of dried, defatted sample was hydrolyzed with 5 ml of 6 N HCl, in sealed tube at 110 °C for 24 hour and the hydrolysate was filtered. The residue was washed with distilled water and the filtrate was evaporated on water bath at 50 °C. The residue was dissolved in 5 ml/loading buffer (0. 2N sodium citrate buffer of pH 2.2). Amino acids were determined chromatographically using Beckmen Amino Acid Analyzer Model 119 CL, at Central Lab., at National Research Center, Giza, Cairo.

Fatty acid composition

Fatty acid content of oil samples was determined according to the method described by [9] and the fatty acid methyl esters (FAME) were analyzed by gas chromatography (Varian 3600 GC, Mississauga, ON). The system was equipped with an auto sampler (Model 8200, Varian) and a flame ionization detector. Helium was used as the carrier gas. The data were processed by a computer using Class-VP data processor (Shimadzu Corporation, Columbia, MD). The FAMEs were separated on a fused silica capillary column (50 m x 0.32 mm, BPx-70, SGE Column, Pty. Ltd, Victoria, Australia) with the film thickness of 0.25 mm. The detector temperature was set at 230°C. Initial injector temperature was held 70 °C for 3 min, increased to 150°C/min and further to 230 °C and held for 17 min. Initial column temperature was 50°C for 0.1 min and increased to 170 °C at the rate of 25 °C/min, held at 170 °C for 1 min, then increased to 180 °C atthe rate of 2 °C/min, and further increased to 230 °C at the rate of 10 °C/min and held for 3 min.

Statistical analyses

Gross chemical analyses was performed in three replicates and the results were statistically analysed. Significant statistical differences of observed chemical parameters means of pumpkin seeds were determined by the Fisher´s least significant differences (LSD) test, after the analysis of variance (ANOVA) for trials set up according to the RCB design.

Result and Discussion

The proximate composition of the pumpkin seeds is presented in Table 1. Moisture content ranged from 3.38 to 5.53% normally found in the seeds of other varieties of pumpkin seeds [10-12] and [13] However, the variety kafr saad recorded the high value of moisture whereas the Hongli recorded the lowest. The protein content of studied pumpkin varieties ranged from 34.19 to 39.75% as reported by [11],[12] and [14]. The crude oil content of Hongli was the highest (41.95%) whereas Kafr El-batikh was the lowest (35.2%). A similar range of variation was reported by [13],[15] and [16]. The data revealed highest level of crude fiber (9.69%) in the Honglifollowed by KafrSaad (9.16%) and Kafr El-batikh (4.12%). Similar values were earlier reported by [14], [17] and [18]. The total carbohydrate and ash contents were found maximum in Kafr El-batikhvariety (10.96%), whereas Kafr Saad variety revealed minimum ash content (4.8%).

Minerals composition

Mineral analyses are essential to guarantee the quality of any food product. Potassium plays an important role in human physiology

Table 1: Gross chemical composition of seeds of three pumpkin varieties.

Characteristics (g/100g on dry we+ight)*	Kafr El-batikh	Kafr Saad	Hongli
Moisture	4.67^{b}	5.53^{c}	^{a}3.38
Protein	36.15^{b}	39.05^{c}	34.19^{a}
Crude oil	35.2^{a}	36.25^{b}	41.2^{c}
Fiber	7.72^{a}	9.16^{b}	9.69^{b}
Ash	5.3^{b}	5.21^{b}	4.22^{a}
Carbohydrates**s	10.96^{c}	4.8^{a}	7.33^{b}

Values with different subscripts on the same row are significant (p<0.05)
Calculated by differences On dry weight basis %
** Calculated by differences.

Table 2: Minerals composition of seeds of three pumpkin varieties

Minerals (mg/100g) on dry weight	Pumpkin varieties		
	Kafr El-batikh	Kafrsaad	Hongli
Fe	17	10.5	18.50
Mn	0.852	0.803	0.594
Cu	0.940	0.397	0.390
Zn	2.20	2.18	1.72
K	260.0	267.0	208.3
Mg	96.85	88.00	60.95

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and sufficient amounts of it reduce the risk of heart stroke while calcium plays a vital role in building stronger, denser bones early in life and keeping bones strong and healthy later in life. Concentrations of major elements such as potassium, magnesium and iron (Table 2) indicated potassium content relatively higher in seeds of Kafr El-batikh (260 mg/100g) and Kafr saad pumpkin seed (267 mg/100g) compared to Hongli seed (208.3 mg/100g) whereas Manganese Copper and Zinc were lowest in content.

Amino acid composition: Glutamic Acid (33.03 to 34.76g/100g protein) is predominant amino acid in these varieties followed by arginine (9.78 to 10.70 g/100g protein). Arginine is associated with the cardiovascular system as a precursor to nitric oxide synthesis, which is an important blood pressure regulator [19]. Cysteine has not been reported in this study. Among other essential amino acid, phenylalanine and leucine contents were high in the seeds of kafr el- batikh and Hongli varieties, while isoleucine and lysine contents were high content in Kafrsaad variety. Methionine was low in kafr el- batikhand Hongli varieties and proline was low in Kafr saad seeds. However, the pattern of amino acids contents in seeds of this variety was similar to other varieties and oil seeds reported earlier [20] (Table 3).

Fatty acid composition

The quality and nutritional properties of fatty acids of pumpkin oil are high due to its inherent chemical characteristic. The commercial uses of oil are fatty acid-dependent which are influenced by genotype of the variety and environmental conditions [21].

Among the eight fatty acids estimated for all the varieties (Table 4), oleic acid was the dominant fatty acid in kafr el-batikh and kafr saad pumpkin oils (50.0 and 45.7%), followed by linoleic acid (24.82 and 29.5%) and palmitic acid (16.56,15.60%) respectively. Arachidonic acid (42.94%) was the predominant fatty acid in Hongli, followed by linoleic acid (14.04%), palmitic acid (9.6%) and oleic acid (8.8%). Linolenic acid was 0.6% and 0.7% in Kafr El- batikh and Kafr saad respectively while it was not detected in hongli variety.

Table 3: Amino acids composition of pumpkin seed varieties.

pumpkin seed varieties			Amino acids (g/100 g protein)
Kafr saad	Chinese	Kafr El-batikh	
1.83	2.03	1.90	Therionine
3.70	3.71	3.40	Valine
1.20	0.26	0.07	Methionine
4.77	1.27	1.16	Isoleucine
2.59	4.57	4.36	Leucine
3.51	5.90	5.45	Phenylalanine
3.96	3.21	3.04	Lysine
4.14	4.13	3.68	Aspartic
1.75	1.78	1.73	Glycine
5.31	5.02	4.93	Alanine
34.76	33.37	33.03	glutamic acid
3.15	3.05	3.05	Serine
6.25	2.40	2.28	Tyrosine
3.16	3.22	3.21	Histidine
3.96	3.21	3.04	Lysine
10.70	9.92	9.78	Arginine
1.18	1.11	1.32	Proline

Table 4: Fatty acids composition of total lipids of pumpkin seed varieties (% of total fatty acids).

Fatty acids (% of total fatty acids)	Carbon chain	Pumpkin varieties		
		Kafr el-batikh	Kafrsaad	Hongli
Capric acid	C10	ND	ND	3.06
Lauric acid	C12	ND	ND	2.80
Myristic acid	C14	ND	ND	1.9
Palmitic	C16:0	16.56	15.60	9.6
Palmitoleic	C16:1	ND	ND	0.8
Margaric Acid	C17	ND	ND	1.3
Heptadecenoic acid	C17:1	ND	ND	1.3
Stearic	C18:0	6.93	7.5	3.8
Oleic	C18:1	50.0	45.7	8.18
Linoleic	C18:2	24.82	29.5	14.04
Linolenic	C18:3	0.6	0.7	ND
Arachidonic	C20;4	0.3	0.4	42.94
Hexacosanoic acid	C26:0	0.8	0.6	ND

Pumpkin is a nutritious major vegetable crop with its prolific use in preparing sweet without any milk product or fat. However, seed quality adds additional value for confectionary use and export utility. Usually, low oil content in a high oleic background of seed is preferred for confectionary/ table use.

In conclusion seeds of Egyptian variety kafr el-batikh is found to be rich in protein (39%), low in oil content, low in fiber while Chinese variety is relatively high in oil content, high in fiber, high in Fe-mineral and low in protein content. The negative relationship in oil content in seed either with protein or carbohydrate is expected to compensate overall metabolic process. Even another Egyptian variety is low in oil content. However, kafr el-batikh is found to be the rich source of all the minerals especially Fe, Cu, and Mg. In spite of low oil content, both Egyptian varieties are higher in palmitic fatty acid which is saturated and not desirable for health. One of the highly desirable features of variety kafr el-batikh is richness of its oil in oleic fatty acid which has a high confectionary use, nutritive value as well as medicinal use. It's higher content of linoleic fatty acid ensures its utility for industrial use. In spite of these facts, pumpkin will continue as a major source of nutritious vegetable with value-added seed for confectionary use. Thus, its high fruit yields and traits for market preference will be the primary requirement for farmers to ensure his economic return.

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