

A Review: Some composition properties of pumpkin seed and oil and its effect on human health

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Abstract

Pumpkin (*Cucurbita* spp.) is an annual plant belonging to the *Cucurbitaceae* family, which is mostly produced in Asia. The cultivation of pumpkin has been increasing in our country in recent years and it is thought that it can be produced as a source of cooking oil as well as being used as a snack to evaluate the by-products of the pumpkin and to consume the valuable ingredients in its seeds. In this compilation study, information was given about the components of the oils obtained from pumpkin plants, seeds and pumpkin seeds and their effect on human health.

Keywords: pumpkin, use, nutrition, oil, fatty acids, healing effect

1. Introduction

The Cucurbitaceae family includes a wide variety of edible plants such as watermelon and squash, and their seeds are often thrown away as waste [1]. In the world, 15,057,448 tons of squash are produced in an area of 1,174,254 hectares [2]. The oil of pumpkin seeds used in confectionery and bakery products is used both in foods (mostly as salad oil)

and in the pharmaceutical industry. In addition to these, seeds of pumpkin are consumed as edible pumpkin and are used as source of vegetable oil. While pumpkin is produced 22.905,868 tonnes in the world [3], pumpkin is produced 430,402 tonnes with 2% ration in Turkey [3]. Pumpkin seed production plot between the years 1994-2018 in Turkey are shown in Figure 1.

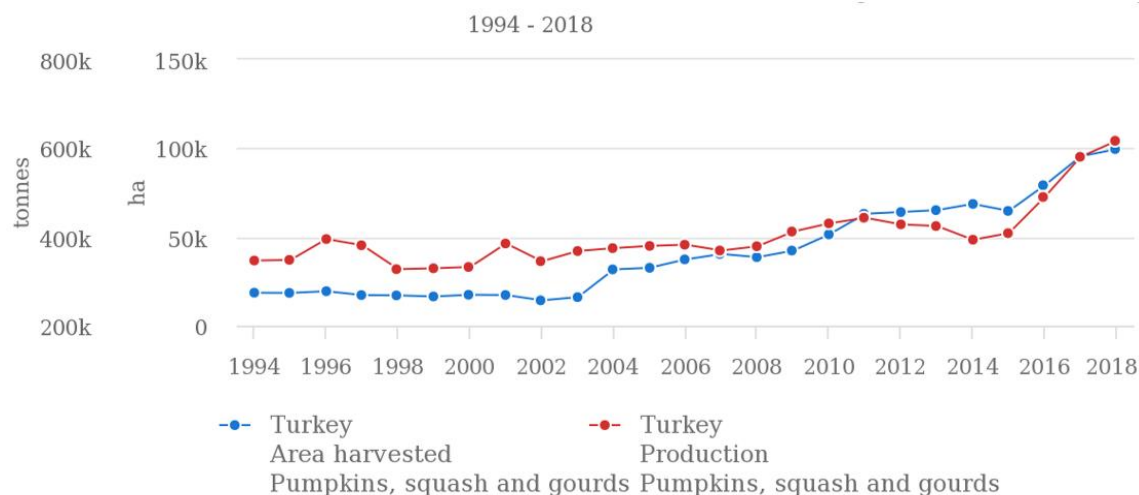


Figure 1. Between the years 1994-2018 pumpkin planting and production data in Turkey [4]

Being a member of the *Cucurbitaceae* family, pumpkin is a widely cultivated plant in most parts of the world, and the plants in this family are often referred to as squash. In terms of climate demand, it grows easily in every region with mild climatic conditions and it has been reported to be beneficial because it is rich in both functional components and other nutrients [1,5-8]. *Cucurbitaceae* have played an important role in human nutrition due to the high nutrient content it contains, especially in equatorial countries where consumption has increased significantly due to the increase in cultivation area [8]. The aim of current study was to review some nutrition properties and healing effect of pumpkin seed and oils.

2. Chemical composition and nutrients of pumpkin seed and oil

Pumpkin seeds are rich in protein, polyunsaturated fatty acids (PUFA), minerals (magnesium, phosphorus, copper and potassium, iron, zinc, manganese), carotenoids, β -carotene and γ -tocopherol. Vitamin E or γ -tocopherol content is particularly high [9]. The total tocopherol content in pumpkin seeds has been determined as 15.9 mg / 100 g [10]. It has been reported that pumpkin seeds contain approximately 27.83% crude fat, 39.25% crude protein and 16.84% crude fiber [11]. *Soha et al.* [12] state that, pumpkin seed sources of trace nutrients such as natural tocopherols, and zinc. It has been reported that pumpkin seeds contain higher levels of potent phytochemicals such as lipochrome (carotenoids), tocopherols, and sterols, and show

great promise for immunomodulation, reproductive health and therapeutic effect in a range of disease conditions [12]. According to some other studies, the intake of whole extract of pumpkin seed is highly associated with reduced symptoms associated with prostatic hyperplasia [13,14]. The sexual arousal properties of pumpkin seeds have also been shown in a number of studies [15]. It is understood from various sources that pumpkin seed oil contains a significant amount of vitamin E (tocopherol). Apart from these, it is also known to provide some other health benefits such as inhibiting the enlargement of the prostate. Despite its determined health benefits, pumpkin seed oil has been reported to exhibit anti-microbial activity. Therefore, it is well suited for improving nutritional benefits in food formulations [14]. In previous study, according to results of mineral content, the seeds from 10 pumpkin genotypes were a significant source of minerals. The most dominant minerals in the genotypes were potassium (K), phosphorus (P), magnesium (Mg), sulfur (S), and calcium (Ca), respectively ($p < 0.05$ %). Other minerals, e.g. Mo, B and Ni were present at lower levels, while Al, Co, Cd, Cr, Pb and Se minerals were not detected in all genotypes. The highest level of K, which is significant for the homeostatic balance of body fluids, was determined in genotype-1 (10,332.631 ppm). Phosphorus (P) and magnesium (Mg) were the most abundant minerals with values varying from 3569.690 to 9108.835 ppm and 1275.145– 3938.163 ppm, respectively [16].

Table 1. Bioactive ingredients and their percentages in pumpkin seeds (food value per 100 g). Courtesy: USDA [1]

Principles	Nutritive value	Percentage of RDA (%)
Energy	559 Kcal	28
Carbohydrates	10.71 g	8
Protein	30,23 g	54
Total fat	49.05 g	164
Cholesterol	0 mg	0
Dietary fiber	6 g	16
Vitamins		
Folate	58 μ g	15
Niacin	4.987 mg	31
Pantothenic acid	0.750 mg	15
Pyridoxine	0.143 mg	11
Riboflavin	0.153 mg	12
Thiamine	0.27 mg	23
Vitamin A	16IU	0,5
Vitamin C	1,9 μ g	3
Vitamin E	35.10 mg	237

Table 1. Bioactive ingredients and their percentages in pumpkin seeds (food value per 100 g). Courtesy: USDA (Continued) [1]

Principles	Nutritive value	Percentage of RDA (%)
Minerals		
Sodium	7 mg	0,5
Potassium	809 mg	17
Calcium	46 mg	4,5
Copper	1.343 mg	159
Iron	8.82 mg	110
Magnesium	592 mg	148
Manganese	4.543 mg	198
Phosphorus	1233 mg	176
Selenium	9,4 µg	17
Zinc	7,81 mg	71
Phytonutrients		
Carotene-β	9 µg	-
Crypto-xanthine-β	1 µg	-
Lutein-zeaxanthin	74 µg	-

Table 2. Physico-chemical characterization of pumpkin seed oil [26,27]

Parameters	
Refractive index (40 ° C)	1.46
Specific gravity (25 ° C)	0.91
Acid value (mg KOH / g oil)	1.6 - 7.54 ± 0.02
Saponification value (mg KOH / g oil)	175 - 185.3 ± 1.30
Iodine value (g I ₂ / 100 g oil)	86.7 - 153.66 ± 0.65
Peroxide value (meq O ₂ / kg oil)	1.5 - 2.33 ± 0.65
Unsaponifiable matter (%)	1.25 ± 0.15

*Values are mean ± SD of three determinations.

Table 3. Pumpkin seed oil fatty acid (%) and phenolic acids (mg / 100 g) composition [27].

Fatty acid	Composition
Palmitic (C16: 0)	15.97 ± 0.39
Palmitoleic (C16: 1)	tr.
Stearic (C18: 0)	4.68 ± 0.56
Oleic (C18: 1)	44.11 ± 0.63
Linoleic (C18: 2)	34.77 ± 0.95
Linolenic (C18: 3)	tr.
Arachidic (C20: 0)	0.41 ± 0.40
SAFA	21.07 ± 1.19
MUFA	44.12 ± 0.57
PUFA	34.78 ± 0,85
Phenolic acids	
Protocatechuic acid	1.81 ± 0.26
Caffeic acid	3.88 ± 0.03
Syringic acid	7.96 ± 0.13
Vanilic acid	2.46 ± 0.37
p-coumaric acid	2.50 ± 0.95
Ferulic acid	4.99 ± 0.29
Unidentified compounds	*

SAFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; tr.: trace amounts (less than 0.2%);*: Compound detected, but concentration in sample not determined; Values are mean ± SD of three determinations

3. Pumpkin oil

Pumpkin seeds have been used in many countries for oil or protein production. It is understood from studies conducted in Yugoslavia, Austria, Hungary and Nigeria that cooking oil is obtained from pumpkin seed extraction system [17]. The production of oil from pumpkin seeds adds value to agricultural by-products while ensuring the use of a renewable resource. The color of pumpkin seed oil varies from dark green to brown, and it has been found that the oil content of different pumpkin seed varieties varies depending on the variety, growing conditions, climatic factors and agricultural factors [14]. Industrial production of pumpkin seed oil is generally produced by hydraulic cold pressing due to its high oil content [18]. On the other hand, oil production from plant seeds by hydraulic cold pressing has a major disadvantage due to the high residual oil level in the seed and changing between 5-15% by weight [19].

3.1. Phytochemicals

Fats and oils provide concentrated energy reserves to maintain optimum body temperature. Humans use about 40 million tons of fats and oils each year, demonstrating the importance of fats in the diet and their common daily use [20].

The oil content in pumpkin seeds makes up about 30-50% of the seed [21] and is rich in various bioactive components such as unsaturated fatty acids, sterols, tocopherols, squalene and carotenoids [22,23].

The dominant fatty acids found in pumpkin seed oil are: palmitic, stearic, oleic and linoleic acids. Previous studies have reported that different varieties of pumpkin seed oil used for oil production contain 10.3-11.7% palmitic, 4.1-5.4% stearic, 30.5-40.8% oleic and linoleic 42.1-51.5% linoleic acid [24]. *Türkmen et al.* [25] and *Seymen et al.* [16] reported that oil contents of pumpkin seeds changed between 22.74% and 46.97%. The major unsaturated fatty acids of the samples were oleic acid (26.14% - 39.97%) and linoleic acid (38.52% - 54.31%); saturated fatty acids were stearic acid (5.01% - 7.87%) and palmitic acid (10.24% - 15.10%) [25].

4. Bioactive properties of pumpkin seeds

Plants are the best known and rich natural sources of antioxidants of tocopherols and phenolics. They are considered as primary chain-breaking antioxidants in free radical chain reactions or they increase the oxidation stability potential of plant oils by converting lipid radicals into more stable products [18,27].

Table 4. Tocopherol composition of pumpkin (*Cucurbita maxima* var. "Béjaoui") seed oil (mg / 100 g) [27].

Tocopherol	Composition
α - Tocopherol	128 \pm 14.42
γ - Tocopherol	113.66 \pm 1.52
δ - Tocopherol	177 \pm 14.17
Total	418.66 \pm 33.36

α -Tocopherol is recommended for human and animal consumption as it has higher biological activity than other tocopherols, but γ -tocopherol shows a higher antioxidant capacity compared to α -tocopherol [28]. *Amin et al.* [29] performed DPPH (2,2-diphenyl-1-picrylhydrazyl) test to determine the free radical scavenging capacity of domestic pumpkin seed oil and hybrid pumpkin seed oil in their study. In the DPPH test, both native and hybrid varieties of pumpkin seed oil at a concentration of 15, 20, 25, 30, 35, 40 and 45 μ g / mL showed the percentage of antioxidant activity. Domestic pumpkin seed oil varied between 74.48 \pm 1.10% and 96.05 \pm 1.04%, while hybrid pumpkin seed oil

showed between 63.21 \pm 2.10% and 79.03 \pm 6.14%. Antioxidant activities and total phenol contents of genotypes were found between 0.193 and 11.753 % to 56.944 mg GAE/100 g and 87.153 mg GAE/100 g, respectively [16].

Yasir et al. [30] wanted to emphasize the importance of antioxidant and gene protective activities of pumpkin seed oil in their study and investigated 3 types of pumpkin seed oil in their research.

The researchers obtained an oil yield varying between 20-41% from pumpkin seeds and determined a total phenol content of 16-40% in the

equivalent of gallic acid. They reported that high phenolic content (149.5-396.4 GAE / g oil) had high DPPH radical suppression power.

5. Human Health Effect

The highly unsaturated fatty acid composition of pumpkin seed oil makes it very suitable for improving the nutritional benefits from foods. Pumpkin seed oil plays a role in providing many health benefits [31]. The most critical health benefit attributed to pumpkin seed oil is to prevent enlargement of the prostate and reduce its size [32,33].

Pumpkin seed oil is a strong dichromatic viscous oil that has been documented for its strong antioxidant activity [14] and has been identified as an exceptional protector against hypertension and carcinogenic diseases [34,35].

Pumpkin seed oil, as well as properties similar to almond oil, especially carried by zinc and selenium derivatives, minerals, effective anti-inflammatory and antioxidant properties, such as many health benefits such as special sterols help of the blood cholesterol level and hypertension lowering properties of the composition was adopted [14].

There is also evidence that pumpkin seed oil can delay the progression of hypertension [34], and alleviate hypercholesterolemia [34] and arthritis [36].

Lipid components in pumpkin seeds have been associated with reduced bladder and urethral pressure and improved bladder compliance in humans [37,38].

Pumpkin seed oil has been found to alleviate diabetes by promoting hypoglycemic activity [31].

Pumpkin seed oil has been found to provide an important source of vitamin E (tocopherol) in Japanese diets [39].

Pumpkin seed oil is a natural product that is often used in folk medicine in the treatment of different cardiovascular conditions such as hypertension and atherosclerosis [40,41].

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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