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A review on health benefits and nutritional composition of pumpkin seeds

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Abstract
Pumpkin belongs to the genus *Cucurbita* and family *Cucurbitaceae* is grown all around the world for a variety of reasons. It is used as a food material, animal feed, and for decoration purposes. Though the flesh of different vegetables have found their way into the Indian diet for time immemorial, the seeds have almost always been discarded as waste in spite of having a great nutritive value. After harvesting, the seeds are often used as animal feed, ground up for fertilizer or even discarded in spite of having very nutritious and best quality oil and rich source of protein. 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. 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. This study deals with the review of research work reported on the health and nutritional benefits of pumpkin seeds, whose application 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

Keywords: Pumpkin, *Cucurbita, Cucurbitaceace,* pumpkin seed, by-products

Introduction
Pumpkin belongs to the genus *Cucurbita* and family *Cucurbitaceae*. Pumpkin fruit is one of the widely grown vegetables incredibly rich in vital antioxidants, and valuable source of carotenoids which have major role in the form of pro-vitamin A. Carotenoids are the primary source of vitamin A for most of people living in developing countries. Like other members of *Cucurbitaceae*, pumpkin seeds are located at its central hollow cavity; interspersed in between net like mucilaginous network. Generally, the pumpkin fruit is allowed to mature completely in order to obtain good-quality seeds. The seed content of pumpkin fruit varies from 3.52 % to 4.27 %. Though the flesh of different vegetables have found their way into the Indian diet for time immemorial, the seeds have almost always been discarded as waste in spite of having a great nutritive value. After harvesting, the seeds are often used as animal feed, ground up for fertilizer or even discarded. In India, seeds go as waste in cattle feed and only little amounts are eaten after being salted and roasted.

In many developing countries, the supply of animal protein is inadequate to meet the protein needs of the rapidly growing population. This has necessitated contemporary research efforts geared towards the study of the food properties and potential utilization of protein from locally available food crops, especially from underutilized or relatively neglected high protein oilseed and legumes. Recently increased attention has been given to the utilization of agriculture waste products to produce food, feed, fertilizer and a raw material in industries, to maximize the available resources and at the same time to minimize waste disposal problem. Such utilization could be done economically only in the locations where such resources are available in large quantity. 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. Currently, pumpkin seeds are gaining momentum in the snack food industry as a healthy alternative to other fried snacks. In India, during the last decade, the demand for new nutritionally sound and economically viable food has increased considerably. Consequently, much attention has been given to the use of vegetable by-products that are not commonly used by the food industry and the population.

Keeping the above facts in view, literature regarding the health benefits and nutritional composition of pumpkin seed have been reviewed extensively and reported hereunder.

Health benefits

Pumpkin seed, which are generally discarded during processing are very nutritious and provides best quality oil and excellent source of protein. In addition, they are also a good sources of minerals, dietary fibre, health-benefiting vitamins and mono-unsaturated fatty acids, which are good for heart health. The unique flavour of pumpkin seeds and pumpkin seed oil is well known and enjoyed all over the world and contribute to the development of aromatic flavour during the roasting process. Due to its high nutritional and health protective values and also for pharmacological activities such as antidiabetic, antifungal, antibacterial and antiinflammation and antioxidant effects pumpkin seed has increasing considerable attention (Nkosi *et al*., 2006) [11]. The high unsaturated fatty acid composition of pumpkin seed oil also makes well-suited for improving nutritional benefits of foods (Revathy *et al*., 2013) [14].

The pumpkin seeds are richly endowed in macro elements (magnesium, phosphorus and calcium) and moderate amounts of micro elements (calcium, manganese, copper and zinc) and thus the seed could be used as a valuable food supplement. Besides, the pumpkin is economical and a nutrient dense source, the pumpkin seed flour fortified complementary food mix is economical, with highly acceptable sensory qualities and a rich nutritive value. Stevenson (2007) [16] also quoted that, pumpkin seeds offer a nutritious, sweet, somewhat soft and chewy snack or food additive. Priyanka *et al*., (2015) [12] reported that pumpkin seed are excellent nutrient source filled with minerals mainly zinc, phosphorous, magnesium, potassium and selenium responsible for fighting diseases and acts as weapon for fighting diseases such as arthritis, inflammation, prostate cancer etc.

Nutritional Composition of pumpkin seed

Pumpkin seed are known as nutritional powerhouse, as these seeds are excellent nutrient source filled with minerals mainly zinc, phosphorous, magnesium, potassium and selenium responsible for fighting diseases and acts as weapon for fighting diseases such as arthritis, inflammation, prostate cancer etc. They were generally regarded as a waste but now they can play important role in food by nutritional aspects. They can be consumed regularly without causing any side effects on human health (Maheshwari, *et al*., 2015) [8]. Pumpkin fruits are variable in size, colour, shape and weight, having moderately hard flesh with a thick edible flesh below and a central cavity containing the seeds. Like other members of *Cucurbitaceae*, each fruit bear 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 which can be enjoyed as snack, added in desserts and in savory dishes. Generally, in order to obtain good-quality seeds, pumpkin fruit is allowed to mature completely.

The nutritional characteristics and composition of pumpkin seed is summarised in table 1.

Table 1: Nutritional characteristics and composition of pumpkin seed. (* Nutritional value per 100 g)

Principle	Nutrient Value	Percentage of RDA	Principle	Nutrient Value	Percentage of RDA
Energy	559 Kcal	28%	**Electrolytes**		
Carbohydrates	10.71 g	8%	Sodium	7 mg	0.5%
Protein	30.23 g	54%	Potassium	809 mg	17%
Total Fat	49.05 g	164%	**Minerals**		
Cholesterol	0 mg	0%	Calcium	46 mg	4.5%
Dietary Fiber	6 g	16%	Copper	1.343 mg	149%
Vitamins			Iron	8.82 mg	110%
Folates	58 µg	15%	Magnesium	592 mg	148%
Niacin	4.987 mg	31%	Manganese	4.543 mg	198%
Pantothenic acid	0.750 mg	15%	Phosphorus	1233 mg	176%
Pyridoxine	0.143 mg	11%	Selenium	9.4 µg	17%
Riboflavin	0.153 mg	12%	Zinc	7.81 mg	71%
Thiamin	0.273 mg	23%	**Phyto-nutrients**		
Vitamin A	16 IU	0.5%	Carotene-ß	9 µg	--
Vitamin C	1.9 µg	3%	Crypto-xanthin-ß	1 µg	--
Vitamin E	35.10 mg	237%	Lutein-zeaxanthin	74 µg	--

(Source: USDA National Nutrient data base)

Pumpkin (*Cucurbita maxima*) 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 seed kernels contained moderate concentrations of minerals, especially P, Mg, and K. and methionine and tryptophan were the most limiting amino acids, while arginine, glutamic, and aspartic acids were the most plentiful amino acids. The saturated fatty acid content was 27.73%, comprises 16.41% palmitic acid and 11.14% stearic acid whereas unsaturated fatty acid value was 73.03% and consisting mainly of 18.14% oleic acid and 52.69% linoleic acid. Therefore, pumpkin seed kernels can be a quite promising for commercial exploitation because of its high lipid and protein content in the kernels, and their fatty acid and amino acid compositions (Alfawaz, 2004) [3].

Achu *et al*., (2005) [1] showed that cucurbit seeds from different regions in Cameroon contained protein content of 28-40%, fat 44-53% and carbohydrate 7-10%, showing that they could be exploited as oil and protein sources.

Later in the year, Ardabili *et al*., 2011 [4] reported that pumpkin seed oil can be a valuable source of edible oil as the seeds contained 41.59% oil and 25.4% protein and moisture, crude fiber, total ash, and carbohydrate contents were 5.20%, 5.34%, 2.49%, and 25.19%, respectively. The specific gravity (0.915), dynamic viscosity (93.659 cp), refractive index (1.4662), and acid value (mg KOH/g oil), peroxide value (meq O_2/kg oil), iodine value (g I_2/100 g oil), saponification number (mg KOH/ g oil), and unsaponifiable matter content (%) of the extracted oil from pumpkin seeds were 0.78, 0.39, 10.85, 104.36, 190.69, and 5.73, respectively. Linoleic

(39.84%), oleic (38.42%), palmitic (10.68%) and stearic (8.67%) acids were the major fatty acids.

All the Cucurbitaceae oilseeds (*Cucumeropsis mannii*, *Cucurbita maxima*, *Cucurbita moschata*, *Lagenaria siceraria* and *Cucumis sativus*) has rich source of most essential amino acids, giving protein digestibility, corrected amino acid scores of 0.67 for *C. sativus* and 0.48 for *C. mannii* which was for lysine, indicating that in the absence of tryptophan and methionine, lysine was the limiting amino acid in these seeds and low levels of phenolic compounds (0.34 to 0.43%). Defatted *C. mannii* could be a good for preparing infant formula, especially when mixed with soybean, in order to increase its lysine content and defatted cakes has high total protein contents and the trichloroacetic acid soluble fraction of proteins ranging from 25% (*C. maxima* from North West) to 94% of total proteins (*C. sativus* from Adamawa and South West), due to the postharvest treatment of the seeds (Mercy *et al*., 2011) [9].

Further in the year, Elinge *et al.*, 2012 [6] analyzed the nutritional and anti-nutritional composition of pumpkin seeds and the results obtained were; moisture (5%), ash (5.5%), crude fat (38%), crude fibre (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/100 g) and manganese was least (0.06 mg/100 g). The anti-nutritional parameters analyzed were; phytate (35.06 mg/100 g), oxalate (0.02±0.10 mg/100 g), hydrocyanic acid content (0.22±0.04 mg/100 g) and nitrate (2.27±002 mg/100 g). They reported that the pumpkin seeds if properly utilized can serve as good source of minerals. Also Srbinoska *et al*., (2012) [15] studied and compared the chemical composition of seeds of *C. maxima* D. and *C. pepo* L. cultivated in the Republic of Macedonia. They found that higher kernel yield and content of moisture, ash, total nitrogen, proteins and carbohydrates in the *C. pepo* than in *C. maxima* seed. The highest extract yield of 487.4 g/kg dry matter was also obtained from *C. pepo* kernel as compared to *C. maxima* kernel (388.2 g/kg dry matter), when *n*-hexane was used as solvent. In all extracts, the palmitic, stearic, oleic and linoleic acids were predominant but the linoleic/oleic acid ratio was higher in *C. maxima* extracts. D7-Sterols were predominant in all extracts, while D5-sterols content was higher in the whole seed than in the kernel extracts. Higher tocopherol content was determined in the extracts of *C. pepo* whole seed and kernel (153.79 mg/kg and 117.81 mg/kg, respectively), than in those of *C. maxima* (121.24 mg/kg and 117.55 mg/kg, respectively). In all extracts γ-tocopherol content was higher than α-tocopherol.

The Pumpkin seeds were well endowed in crude oil, protein, carbohydrates and crude fibre. This was proved by Karanja *et al.*, (2013) [7] who studied on the nutritional composition of the pumpkin (*cucurbita spp*.) seed cultivated from selected regions in Kenya and found that all groups of *Cucurbita spp.* seeds were rich in oil, fibre and protein. The fatty acid profile, was similar to that from sesame, sunflower and soybean oils which were rich in polyunsaturated fatty acids. The pumpkin seeds were found consists of crude fibre (11.69-24.85%), crude fat (31.9-41.37%), crude protein (14.05-33.29%) and carbohydrates (8.66-27.35%). Fatty acid profile showed a high content of unsaturated fatty acids and the dominant fatty acids were palmitic (1.16-20.81%), stearic (0.16-5.56%), oleic (15.56-30.79%), and linoleic acids (26.18-81.21%). The highest elemental minerals were potassium and sodium (124-335 and 70-148 mg/100 g) respectively. α-tocopherol content ranged between 8.33 and 122.65 µg/g. they concluded that the pumpkin seed could be incorporated in foods to increase the nutritional value especially in diets that are deficient in the said nutrients.

Asiedu *et al*., (2014) [5] determined the nutrient composition and protein quality of four species of the *Curcubitaceae* family and found that the moisture, crude protein, fat and ash content of the seeds were 5.44-6.66, 30-36, 44-58 and 3.18-4.90%, respectively. Crude fibre was less than 2.5%. The *Curcubitaceae* seeds contained high amounts of Zn (5.0-7.1 mg/100 g), Cu (1.4-7.9 mg/100 g) and Fe (5.6-8.5 mg/100 g). All the seeds had good protein quality as judged by the PER (0.75-1.36) and (NPU) (46.10-69.10). They concludes that *Curcubitaceae* seeds is an important food resources and thus their consumption should be promoted.

Raphael *et al*., (2014) [13] determined the Proximate composition of pumpkin (*Cucurbita pepo*) seeds from Zimbabwe and found that *C. pepo* seeds were good alternative source of food with high nutritional content for instance proteins, lipids, fibres, carbohydrates and minerals (Mg, Ca, Zn, P and Fe).

Studies on chemical composition of some Egyptian and Chinese pumpkin (*Cucurbita maxima*) seed varieties indicated that moisture percentage in these varieties ranged between 3.38 to 5.53%, and contained crude fiber (4.12-4.69%), 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 34.76 g/100 g protein (Al-Anoos *et al.*, 2015) [2].

Pumpkin seed oil has received considerable attention in recent years due to its nutritional and health-protective value. Recently Montesano *et al*., 2018 [10] also 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.

Conclusion

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 are 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.

References

1. Achu BM, Fokou E, Martin F. Nutritive value of some Cucurbitaceae oilseeds from different regions in Cameroon. African Journal of Bio-technology. 2005; 4(11):1329-1334.
2. Al-Anoos IM, El-dengawy RAH, Hasanin HA. Studies on chemical composition of some Egyptian and Chinese

pumpkin (*Cucurbita maxima*) seed varieties. Journal of Plant Science & Research. 2015; 2(2):1-4.
3. Alfawaz M. Chemical Composition and Oil Characteristics of Pumpkin (*Cucurbita maxima*) Seed Kernels. Food Sci. & Agric. Res. Center, King Saud Univ, 2004, 5-18.
4. Ardabili AG, Farhoosh R, Khodaparast MHH. Chemical composition and physicochemical properties of pumpkin seeds (*Cucurbita pepo* Sub sp. pepo Var. Styriaka) grown in Iran. J Agr. Sci. Tech. 2011; 13:1053-1063.
5. Asiedu MS, Ameyaw PN, Agbemafle I, Hammond SH, Debrah KT. Nutrient Composition and Protein Quality of Four Species of the *Curcubitaceae* Family. Advance Journal of Food Science and Technology, 2014; 6(7):843-851.
6. Elinge CM, Muhammad A, Atiku FA, Itodo AU, Peni IJ, Sanni OM *et al*. Proximate, mineral and anti-nutrient composition of pumpkin (*Cucurbita pepo L*) seeds extract. International Journal of Plant Research. 2012; 2(5):146-150.
7. Karanja JK, Mugendi BJ, Khamis FM, Muchugi AN. Nutritional composition of the pumpkin (*cucurbita spp*.) Seed cultivated from selected regions in kenya. Journal of Horticulture Letters. 2013; 3(1):17-22.
8. Maheshwari P, Prasad N, Batra E. Papitas -The Underutilized Byproduct and the Future Cash Crop- A Review. American International Journal of Research in Formal, Applied & Natural Sciences. 2015, 31-34.
9. Mercy BA, Elie F, Germain K, Martin F. Chemical evaluation of protein quality and phenolic compound levels of some Cucurbitaceae oilseeds from Cameroon. African Journal of Biotechnology. 2011; 12(7):735-743.
10. Montesano R, Blasi F, Simonetti MS, Santini A, Cossignani L. Chemical and Nutritional Characterization of Seed Oil from *Cucurbita maxima* L. (var. Berrettina) Pumpkin. Foods. 2018; 7(30):1-14.
11. Nkosi CZ, Opaku AR. Antioxidant effects of pumpkin seeds (*Cucurbita pepo*) protein isolate in ccl4 Included liver injury in low protein fed rats. Phototherapy Residues, 2006.
12. Priyanka M, Neha P, Ekta B. Papitas -The Underutilized Byproduct and the Future Cash Crop- A Review. American International Journal of Research in Formal Applied & Natural Sciences, 2015, 15-34.
13. Raphael K, Clive W, Amos M, Misheck M, Clarice N, Perkins M *et al*. Proximate composition of pumpkin gourd (*Cucurbita pepo*) seeds from Zimbabwe. International Journal of Nutrition and Food Sciences. 2014; 3(4): 279-283.
14. Revathy MN, Sabitha N. Development, quality evaluation and popularization of pumpkin seed flour incorporated bakery products. International Journal of Food and Nutritional Sciences. 2013; 2(2):40-45.
15. Srbinoska M, Hrabovski N, Rafajlovska V, Fiser SS. Characterization of the seed and seed extracts of the pumpkins *cucurbita maxima* D. and *cucurbita pepo* L. from Macedonia. Macedonian Journal of Chemistry and Chemical Engineering. 2012; 31(1):65-78.
16. Stevenson DG. Oil and Tocopherol content and composition of pumpkin seed oil in 12 cultivars. J of Agricultural Food Chemistry. 2007; 55:4005-4013.