Review Article

Nutraceutical and Therapeutic Properties of Edible Super Food: Pumpkin Seeds - A Review

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ABSTRACT

Pumpkin seeds, despite their small size, are loaded with enough nutrients necessary to protect the human body against various health issues. Pumpkin seeds, also called as "Pepita" can be incorporated easily into the diet. They are good sources of minerals like magnesium, zinc and amino acid tryptophan, which helps to promote good sleep. They also have high tocopherol content, which makes them a rich source of antioxidants. Phytochemical screening indicated the presence of alkaloids, flavonoids, steroids, diterpenes, saponins, and phenols. High dietary fiber content in these seeds help reduce the risk of heart disease, high blood pressure (hypertension), type 2 diabetes and obesity. Gas chromatographic analysis of the pumpkin seed oil (PSO) showed that the linoleic (39.84%), oleic (38.42%), palmitic (10.68%) and stearic (8.67%) acids were the major fatty acids present in PSO. Studies revealed that PSO can be a valuable source of edible oil due to their high poly unsaturated fatty acids (PUFA) content when compared to other vegetable oils. Besides this, bioactive compounds from the pumpkin seeds are known for their anthelmintic, antidiabetic, antidepressant, antioxidant, anti-atherogenic, hypolipidemic, immunomodulator, antitumor, and cytoprotective properties. United States Pharmacopoeia had included pumpkin seeds as an official medicine for parasite elimination from 1863 to 1936. Literature studies revealed that pumpkin seeds can be used as a traditional and functional food ingredient provided further animal and clinical investigations are carried out to establish the respective molecular mechanisms. The present paper reviews about the nutraceutical and therapeutic applications of this super food.

Keywords: *C.pepo*, anti-atherogenic, hypolipidemic, immunomodulator, cytoprotective, pumpkin seed oil, linoleic acid, PUFA.

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INTRODUCTION

Plant seeds are rich in fiber and nutrient content. Many of the edible seeds contain healthy monounsaturated and polyunsaturated fatty acids, in addition to vitamins, minerals and polyphenolic ingredients. Seeds like flax seeds, chia seeds, pumpkin seeds, hemp seeds, sesame seeds and sunflower seeds are often described as healthy edible super seeds for their nutritive and therapeutic values. In recent years, seeds and nuts have received growing attention due to the high nutraceutical and therapeutic value of their bioactive components. Pumpkins belong to the family Cucurbitaceae. The majority of the species in this family are used as food and are found in five genera: *Citrullus* (water melons and wild colocynths), *Cucumis* (cucumbers, gherkins and melons), *Lagenaria* (gourds), *Sechium* (chayotte) and *Cucurbita*.[1] The genus *Cucurbita,* which is economically the most important one, includes five species: *C.maxima, C.pepo, C.moschata, C.ficifolia* and *C.turbaniformis* in which *C.pepo* exhibits the widest variation, especially with respect to fruit characteristics.[2]

Salted and roasted Pumpkin seeds are consumed as a snack food in many cultures throughout the world.[3] Pumpkin seed oil possesses a strong antioxidant potential and identified as a preventive agent against hypertension and carcinogenic diseases.[4] Pumpkin seed is a nutritious food with high oil (50% w/w) and protein (35%) content, which varies depending on cultivar and phenotypic variation like hulled, semi-hulled, thin layer and naked.[5] The presence of flavonoids and triterpenoids could be the contributing factor of anticancer action since a flavonoid-cucurbitacin is known for its anticancer effect.[6] Epidemiological studies and randomized clinical trials carried out in different parts of the world have been demonstrated or at least suggested numerous health effects related to functional food consumption, such as reduction of cancer risk, improvement of heart health, enhancement of immune functions.[7] Different species of pumpkin are cultivated all over the world for multiple purposes, ranging from commercial to agricultural as well as for decorative uses.[8] *C.pepo* is a native species of North America and has been cultivated there for several thousand years.[9]

Figure 1: Various *Cucurbita pepo* seed phenotypes (A) hulled seeds, (B) semi-hulled seeds, (C) thin-layered seeds, and (D) 'naked' seeds.[5]

Chemical Composition Analysis

Pumpkin seeds are a rich natural source of proteins, triterpenes, lignans, phytosterols, polyunsaturated fatty acids, antioxidative phenolic compounds, carotenoids, tocopherol, and minerals.[10] The recommended methods of the Association of Official Analytical Chemists (AOAC, 2005) were used to determine the chemical composition of the pumpkin seeds, including the contents of moisture, ash, crude protein, crude fat, and crude fibre.

Assays

The moisture content was determined by drying in an oven at 100 –105°C to constant weight. Crude protein was calculated from the nitrogen content measured by Kjeldahl method with Gerhardt model Vat 20 instrument using a factor 6.25 and the crude protein content was obtained by multiplying the quantity of nitrogen by the coefficient 6.25. Total lipids were determined by continuous extraction in a Soxhlet apparatus for 8 h using hexane as solvent, ash by incinerating in a furnace at 550°C, crude fibres by sequential hot digestion of the defatted sample with dilute acid and alkaline solutions. Total carbohydrate was obtained by subtracting (crude protein + crude fat + ash + crude fibre) from 100. The chemical composition of dried pumpkin seeds from Tabriz, Iran is shown in Table 1. Low moisture content allows pumpkin seeds to be stored for longer periods of time without spoiling due to microorganism attack.[11] Oil content reported in this study was found to be higher than that of that of common edible oils such as cottonseed (22-24%), safflower (30-35%), soybean (18- 22%) and olive (12- 50%)[12] and can be considered as a potential source of vegetable oil in food industries. The protein content of pumpkin seed was found to be (25.40%) and was higher than that of certain oil seeds like cashew nuts (22.8%), cottonseed (21.9%), and sesame (18.7%), and that of animal proteins (16.0-18.0%) such as lamb, fish, and beef.[11] The carbohydrate content was found to be almost the same as that in cashew nuts (26.2%) and sesame (26.0%). The moisture content was expressed in g/100 g sample and the other values were reported on a dry basis. All the analyses were performed in triplicate.[13] Chemical composition of the dried seed and kernel of pumpkin seeds (*Cucurbita maxima*) obtained from Saudi Arabia are given in Table 2.[14]

Table 1: Proximate analysis of the whole pumpkin seed (*Cucurbita pepo* subsp. *Pepo* var. Styriaca)[6], Mean ± standard deviation of three determinations.

Parameter	Content (%)
Moisture	5.20 ± 0.28
Oil	41.59 ± 2.71
Protein	25.40 ± 0.61
Ash	5.34 ± 0.04
Fiber	2.49 ± 0.11
Carbohydrate	25.19 ± 3.3

Table 2: Proximate composition (%DM) of the whole seeds and kernels of pumpkin (cucurbita maxima). Mean ± standard deviation, %DM – percentage of dry matter.

Components	Seed	Kernel
Crude protein	39.25±0.66	39.22±2.46
Crude oil	27.83±0.91	43.69±3.92
Total ash	4.59±0.16	5.14±1.23
Crude fiber	16.84±0.81	2.13±0.57
Carbohydrate	11.48±2.53	9.82±2.70
Moisture content	5.97±0.32	6.27±1.36

Fatty acids

Research studies revealed that pumpkin seed kernels comprise unsaturated fatty acids, such as oleic acid (18.14 ± 0.60 %), linoleic acid (52.69 ± 0.92 %), and linolenic acid (1.27 ± 0.22 %) and saturated fatty acids like palmitic acid (16.41 ± 0.95 %) and stearic acid (11.14 ± 1.03 %) Table 3. Because of the presence of higher proportion of linoleic acid, pumpkin seed oil is considered highly nutritive.[14] The Fatty acid composition of pumpkin seed oil is quite close to that of melon seed oil.[15]

Table 3: Fatty acid concentrations (% fat) in pumpkin seeds (*Cucurbitaceae*) by species [16]

Fatty acids	Species		
	C. pepo	*C. moschata*	*C. maxima*
Myristic acid (14:00)	0.23 ± 0.06	ND	0.16 ± 0.01
Palmitic acid (16:00)	12.97 ± 0.72^{b}	12.78 ± 0.11^{b}	10.84 ± 0.12^{a}
Heptadecanoic acid (17:00)	ND	ND	0.18 ± 0.01
Stearic acid (18:00)	4.67 ± 0.15^{a}	7.33 ± 0.20^{c}	5.84 ± 0.03^{b}
Oleic acid (18:1)	32.40 ± 0.56^{c}	31.34 ± 0.12^{b}	14.83 ± 0.05^{a}
Linoleic acid (18:2)	36.40 ± 0.82^{a}	35.72 ± 0.25^{a}	56.60 ± 0.29^{b}
Arachidic acid (20:00)	0.39 ± 0.06	ND	0.36 ± 0.02
Eicosenoic acid (20:1n-9)	ND	ND	0.07 ± 0.00
α-Linolenic acid (18:3n-3)	ND	ND	0.24 ± 0.01
Behenic acid (22:00)	0.37 ± 0.06	ND	0.09 ± 0.01
SFA	18.62 ± 0.64^{b}	20.11 ± 0.11^{c}	17.47 ± 0.13^{a}
MUFA	32.40 ± 1.66^{c}	31.34 ± 0.12^{b}	14.90 ± 0.04^{a}
PUFA	36.40 ± 0.82^{a}	35.72 ± 0.25^{a}	56.84 ± 0.29^{b}

Results are expressed as a % of the total fatty acid fraction. Values are mean ± SD. Different superscript letters within a row indicate significant differences by Duncan's multiple range test ($P < 0.05$). ND, not detected; SFA, saturated fatty acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid.

Minerals

Pumpkin seeds are a rich source of minerals [17] and thus could be used as a supplement in food. By digestion of sample using concentrated nitric acid : percholic acid, 2:1 mixture, mineral contents were determined using Inductive couple plasma-optical emission spectrometry, ICP-OES (Model Optima 7000 DV. Table 4 presented the mineral content of pumpkin seed kernels.[18]

Table 4: Mineral composition of pumpkin seed kernels.

Sl. No.	Minerals	Mean value (mg/100g)
1	Iron (Fe)	16.1
2	Manganese (Mn)	487
3	Zinc (Zn)	907
4	Copper (Cu)	124
5	Phosphorus (P)	848.6
6	Potassium (K)	404.9
7	Calcium (Ca)	25.7
8	Magnesium (Mg)	335.6
9	Sodium (Na)	2.2
10	Cobalt (Co)	0.6

Results are expressed as a mean value in mg/100g

Amino acids

Amino acid content is more in *C.pepo* when compared to *C.moschata* and *C.maxima*. All nine essential amino acids were reported in pumpkin seeds. Amino acid contents were found to be higher in the seeds than flesh or peel for all three different species. Arginine content (63.99 ± 0.88 mg/kg raw weight, 18.81%) was significantly higher in the seeds than in peel (1.12 ± 0.05 mg/kg raw weight) and flesh (0.54 ± 0.11 mg/kg raw weight). *C.pepo* seeds were found to contain much higher proportion of Arginine than *C.moschata* (7.03 ± 0.58 mg/kg raw weight) or *C.maxima* (8.69 ± 0.97 mg/kg raw weight).[16]

Tocopherol

Vitamin E (also known as tocopherol or α-tocopherol) is a nutrient that is important for many body processes. Oils produced from husked (Cucurbita pepo L.) pumpkin seeds had more γ-tocopherols than oils produced from naked (var. styriaca) pumpkin seeds. Research studies revealed that Pumpkin seed oils produced by three different processes were found to contain mainly γ-tocopherol ranging from 609.8 mg/kg to 734.7 mg/kg (for husked seed) and from 352.7 mg/kg to 433.4 mg/kg (for Naked seed).[19] γ-tocopherol levels in pumpkin seeds were reported to be in the range 41–620 mg/kg.[20] It was found that the γ- and δ-forms possess a much higher antioxidant activity than the α- and β- forms of tocopherol.[21]

Therapeutic Properties

Antioxidant activity

The total phenolic content in the extracts of nuts and plants is considered as a major contributing factor towards the antioxidant activity.[22] Extracts of different types of pumpkin seeds (roasted & salted / unsalted) from different regions, Bulgaria, China, Turkey was subjected to DPPH assay for antioxidant activity. The high concentration of phenolics in the water extract of pumpkin seeds can be due

to the presence of proteins and other water-soluble constituents. Among the other three fractions, methanol extracts contain the higher amounts of phenolics 5–11 mol gallic acid, 7–15% of total extractable phenolics, while the phenolic content of the acetone and ethyl acetate fractions is negligible. Results indicated highest activity for water and methanol fractions and lowest activity for ethyl acetate fractions in all four types. Polar lipid (PL) fractions were found to be more effective scavengers than the neutral lipid (NL) fraction. Acetone fractions are more effective inhibitors of lipid peroxidation catalyzed by lipoxygenase. On the other hand, PL fractions were found to be more effective inhibitors of lipoxygenase than NL and Total Lipid (TL) fractions.[23] Research studies suggested that 21% of the antioxidant capacity of Algerian pumpkin seed oils may be due to the presence of α-tocopherol (7.7 to 31.9 mg/kg of oil), γ-tocopherol (39.3 to 155.1 mg/kg), δ-tocopherol (39.0 to 103.0 mg/kg) content and other secondary metabolites. Antioxidant power determined by 1,1-diphenyl-2-picrylhydrazyl (DPPH) and phosphomolybdenum (PPM) complex methods showed comparable results with that of synthetic antioxidants, ascorbic acid, Trolox, BHA, BHT.[24] The content of bioactive compounds and the *in-vitro* antioxidant activity of the pumpkin oil was significantly affected by species (Cucurbita argyrosperma Huber, CA; and Cucurbita moschata Duchesne, CM) and method of extraction (mechanical pressing and organic solvent). The highest values of the antioxidant activity of the oil extracts (DPPH 38.42, ABTS 86.37 and reducing power 177.31) were reported for the mechanical pressing extraction method in comparison with the organic solvent extraction (DPPH 16.26, ABTS 55.10 and reducing power 117.97)method and this result may be attributed to the high total phenolic content (TPC). Also, the antioxidant activity of the oil extract was higher for CM when compared to the values obtained for CA.[25]

Anthelmintic activity

Anthelmintics are drugs that either kill or expel infesting helminths, parasitic worms that feed on a living host to gain nourishment and protection, while causing poor nutrient absorption, weakness and disease in the host. Fenbendazole was effective on *Ascaridia galli* in vitro at the concentration of 5 mg/ml with a mortality rate of 89.2 ± 3.19 at 36 h post-treatment. Pumpkin seed ethanolic extract was more lethal (mortality rate of 85 ± 1.93) than Pomegranate Peel aqueous extract (73.3 ± 2.72) in vitro at the concentration of 75 mg/ml at 36 h post treatment. Pumpkin seed ethanolic extract at a concentration of 50 mg/ml had a mortality rate of 81.7 ± 4.30 at 36 h post-treatment while the aqueous extract of pomegranate peel had a mortality rate of 63.3 ± 2.72. The pumpkin seed ethanolic extract was found to be a superior anthelmintic agent against *A.galli* adult worms than pomegranate peel aqueous extract. The lethal effect of pomegranate peel and pumpkin seed extract on *A. galli* improved with increasing the dose and treatment time in vitro and with increasing treatment time in vivo. The extracts were more active in vitro than in vivo, which may be due to the influence of pH and other factors in the gastrointestinal tract that may change the worm's response to treatment. Pumpkin seed extract exhibited higher lethal effect and pomegranate peel extract exhibited a lower lethal effect than fenbendazole.[26]

Anti-atherogenic, hypolipidemic and immunomodulator effects

Studies have proved the efficiency of using either flax/pumpkin or purslane/pumpkin seed mixture (components of ω-3 and ω-6) on hyperlipidemia, kidney function and as immunomodulators. Rats fed with 2% cholesterol diet showed a significant increase in total cholesterol, total lipids, and triacylglycerol in both serum and liver. Serum phospholipids, LDL-C, and atherogenic index AI also significantly increased compared with control group. (Table 5)

Table 5: Effect of supplementing seed mixtures on lipid parameters and atherogenic index in hypercholesterolemic rats Group

Groups	Total Cholesterol (mg/dL)	Total lipids (mg/dL)	Triacylglycerol (mg/dL)	Phospholipids (mg/dL)	Atherogenic Index
G1(control	104.11^{c}±3.86	618.75^{d}±8.68	65.49^{c}±1.87	124.25^{c}±5.06	1.79^{c}±0.15
G2 (HC)	220.35^{a}±5.25	723.25^{a}±15.52	100.93^{a}±2.45	245.71^{a}±17.29	6.79^{a}±0.37
G3 (F/P)	120.48^{b}±3.20	652.5^{b}±15.87	77.99^{b}±1.7	200.1^{b}±8.32	2.06^{b}±0.19
G4 (P/P)	115.44^{b}±7.30	635.5^{c}±9.89	66.32^{c}±3.13	195.45^{b}±5.20	1.95^{bc}±0.26

(1) G1: control rats; fed basal diet [27], Group (2) G2: hypercholesterolemic rats (HC) fed the balanced diet supplemented with cholesterol at a dose level of 2 g/100 g diet; Group (3) G3: hypercholesterolemic diet supplemented with flax/pumpkin seed mixture (F/P); and Group (4) G4: hypercholesterolemic diet supplemented with puslane/pumpkin seed mixture (P/P).

The Cholesterol-enriched diet significantly increased serum urea, creatinine, sodium and potassium levels as well as significantly increased serum IgG and IgM

compared to healthy control. Hypercholesterolemic rats fed with a diet supplemented with flax/pumpkin or purslane/pumpkin seed mixtures showed a significant decrease in the lipid parameters and increase in IgG and IgM levels as compared with hypercholesterolemic rats, indicating the anti-atherogenic, hypolipidemic and immunomodulator effects of the seed mixtures. This may probably be due to the presence of unsaturated fatty acids (including alpha linolenic acid) in the seed mixture.[28]

Antidiabetic and antihyperlipidemic activity

Diabetes is a serious global metabolic disorder characterized by elevated blood glucose levels resulting from the failure of cells to use glucose.[29] Wide variety of natural substances derived from plant kingdom was found to possess antidiabetic action[30] and easy to administer with few or no side effects.[31] The untreated diabetic control rat group showed an increase in blood glucose level, from 288.6±2.376 to 318.6±4.471 after 21 days. Whereas oral administration of Cucurbita maxima seed extracts in Wistar albino rats against streptozotocin (50 mg/kg i.p.) at a dose of 200 mg/kg p.o. for 21 days produces significant antidiabetic effect in controlling the blood glucose level when compared to control group. The decrease in the blood glucose level reported was from 289.7±3.375 to 264.1±1.815 for Petroleum Ether extract, from 287.5±3.402 to 230.8±2.712 for Ethyl acetate extract and from 285.3±3.753 to 189.9±1.896 for alcohol extract after 21 days. Alcoholic extract of Cucurbita maxima has shown maximum effect than petroleum ether and ethyl acetate. In addition to this, it was reported that the oral administration of *Cucurbita maxima* significantly decreased serum Total Cholesterol (TC), Triglycerides (TG's), Low Density Lipids (LDL), and at the same time markedly increased serum insulin and High-Density Lipids (HDL) levels. Flavonoids, phenols or saponins in the extract of Cucurbita maxima seeds may be the reason for its antidiabetic and antihyperlipidemic activities.[32] The study of Makni et al., (2010) revealed a significant increase in the activities of aspartate aminotransferase and alanine aminotransferase in diabetic rats when compared to control group, indicating considerable hepatocellular injury in diabetic rats. The administration of flax and pumpkin seed mixture attenuated the increased levels of the plasma enzymes caused by diabetes and led to a subsequent recovery towards normalization comparable to the control group animals. Research findings suggested that flax and pumpkin seed mixture supplemented to diet may be helpful in preventing diabetic complications in adult rats. assay (ELISA) kit Ref. RIT-461 No. AKRIN-010T (Shibayagi Co., Ltd., Japan). Plasma insulin level (Fig. 2) of DD rats decreased by 42% in comparison to the CD group. Flax and Pumpkin seeds mixture supplemented to the diet of DMS group increased plasma insulin concentration by 63% in comparison to the DD group. Flax and Pumpkin seeds mixture significantly increased the tolerance for glucose (Fig. 3). The maximum glucose tolerance was noticed 120 min after glucose injection.[33]

Cardiovascular activity

Elevated triglyceride, oxidised LDL cholesterol and low HDL levels are associated with Cardiovascular disease (CVD), one of the most important health issues causing death in many parts of the world.[34] Lowering LDL-cholesterol reduces the risk of CVD and also reduces morbidity and mortality.[35] Research studies showed that a pumpkin seed has a beneficial effect on atherogenic rats as there was a decrease in their serum concentrations of total cholesterol from 4.89 mmol/L to 2.55 mmol/L (48%) and Low Density Lipids cholesterol from 3.33 mmol/L to 0.70 mmol/L (79%), and increased the serum levels of HDL-C from 0.43 mmol/L to 0.89 mmol/L.[36] Pumpkin seed oil (PSO) is high in unsaturated fatty acids and plant sterols, which have numerous cardiovascular benefits. Research studies showed a substantial decrease in low density lipoprotein (LDL) levels seen among the subjects whose LDL scores were out of range at the baseline. The reduction in LDL levels stood at 59.22 mg/dL while maximum increase recorded in HDL levels amounted to 15.12 mg/dL. Thus, experiment results revealed PSO possessed hypolipidemic and anti-hypertensive activity as it lowered DBP and LDL and increased HDL levels.[37] Studies also indicated that daily incorporation of PSO for 6 weeks into the diet of postmenopausal women with elevated blood pressure significantly reduced the central systolic blood pressure (SBP) by roughly 7 mm Hg and wave reflection without any significant changes in heart rate (HR), heart rate variability (HRV). Their study revealed that consumption of PSO over the long term improved arterial hemodynamics in postmenopausal women and therefore might be effective in the prevention and treatment of hypertension in this population thus could reduce the CV risk.[38]

Anti-obesity activity

Imbalance between energy intake and expenditure results in Obesity, a chronic metabolic disorder.[39] Diet-induced obesity (DIO) in animals reflects in body weight composition, insulin resistance, dyslipidemia and impaired glucose tolerance.[40] A high-fat diet (HFD) was found to increase body weight, insulin resistance, and fat content in rats. However, administration of Cucurbita maxima seed oil (CSO) reduced the pathological alterations induced by HFD rats, obesity and hyperlipidaemia.[41] Obesity-induced rats fed with HFD diet showed dyslipidaemic changes such as an increase in triglycerides, total cholesterol, LDL, and a decrease in plasma HDL levels, which were reversed by the oral administration of CSO. (Table 6).[42]

Table 6: Effect of Cucurbita seed oil on plasma lipid profile in control and experimental rats Results are expressed as mean ± SD

	Control	HFD	HFD + CSO	HFD + Orlistat
LDL (mg/dL)	17.36±1.09	35.89±1.99	25.64±1.56	22.89±1.09
As mean HDL (mg/dL)	32.01± 1.89	9.97±1.25	23.26±1.90	27.90±1.87
Triglycerides (mg/dL)	15.49±1.43	32.15±1.90	26.78±1.67	22.12±1.25
Total cholesterol (mg/dL)	87.90±1.76	167.89±2.67	100.21±1.67	95.24±1.32

Urinary System Disorders

Urinary system disorders include bladder infection and urinary incontinence. Nocturia, or nocturnal polyuria, is the medical term for excessive urination at night resulting in a disturbed sleep. Common causes of nocturia are a urinary tract infection (UTI) or bladder infection in which the urinary bladder becomes infected by bacteria (typically *Escherichia coli*), rarely by fungi. Urinary incontinence is another chronic problem of uncontrolled leakage of urine, very common especially at older ages. These infections cause frequent burning sensations and urgent urination throughout the day and night. Sometimes these disorder leads to other health problem, such as diabetes or obesity. Mie Nishimura et al.,[43] reported the effect of pumpkin seeds oil from Cucurbita maxima on urinary dysfunction in human Overactive Bladder (OAB). Oral administration of 10 g of oil/day from C. maxima for about 12 weeks reduced the degree of Overactive Bladder System Score (OABSS) (Table 7), which was developed and validated by Homma et al.,[44] as a useful assessment tool specifically for evaluating OAB symptoms.

Table 7: Changes in obstructive bladder scoring system (OABSS) in all subjects given the extract of pumpkin seed oil (*Cucurbita maxima*)Values are expressed as mean ±SD.

	Day 0 (0 week)	6 weeks	12 weeks
Total score	4.4±2.2	3.5±2.1*	2.7±2.2**
Q1 (daytime frequency)	0.7±0.5	0.6±0.5	0.4±0.5**
Q2 (nighttime frequency)	1.6±0.8	1.4±0.9	1.1±1.0**
Q3 (urgency)	1.5±1.2	1.1±1.1*	0.1±1.3**
Q4 (urgency incontinence)	0.7±0.9	0.4±0.7	0.3±0.6*

*P<0.05, **P<0.01 versus the level of OABSS (obstructive bladder scoring system) on day 0

Benign Prostatic Hyperplasia (BPH), also called prostate gland enlargement is a common condition found in elderly population especially in men. An enlarged prostate gland can cause uncomfortable urinary symptoms, such as blocking the flow of urine out of the bladder. Research findings indicated that synergistic effect of pumpkin seed oil and saw palmetto oil induced a higher symptomatic improvement on BPH and also suggested that administrations of pumpkin seed oil and saw palmetto oil are clinically safe.[45]

Antibacterial and anti-inflammatory effect

Antimicrobial activity is a collective term for all active principles that inhibit the growth of bacteria, prevent the formation of microbial colonies and may destroy microorganisms. Anti-inflammatory is the property of a substance or treatment that reduces inflammation or swelling. Ziaul Amin et al.,[46] explored the anti-inflammatory activity using BSA denaturation assay and Antibacterial activity using disc diffusion method from two different varieties (indigenous and hybrid) of pumpkin seed oil. Their studies revealed that the indigenous variety exhibited highest anti-inflammatory activity ranging from 79.52 ± 0.29% to 89.68 ± 0.78% at various concentrations of 15 to 45 µg/mL pumpkin seed oil, when compared to the hybrid variety whose anti-inflammatory activity ranging from 72.93 ± 1.28% to 84.26 ± 0.51% at the same concentrations. IC50 of indigenous pumpkin seed oil (IPSO) and hybrid pumpkin seed oil (HPSO) were found to be 1.21 ± 0.08 µg/mL and 1.66 ± 0.30 µg/mL respectively. Their research studies clearly indicated that both the varieties of PSO have antibacterial activity. The indigenous pumpkin seed oil showed the highest area of inhibition (18 ± 1 mm) against E. coli B-24 JPN and the hybrid pumpkin seed oil exhibited the highest zone of inhibition (16.67 ± 2.89 mm) against E. coli BL21. Hence the pumpkin seed oil offers a copious potential for the development of novel agents effectual against infections that are presently difficult to treat.

CONCLUSION

According to research findings, pumpkin seeds are high in oil and protein and Linoleic acid is the most abundant fatty acid in most varieties, followed by oleic acid. Thus, pumpkin seed oil lies in the linoleic-oleic group such as cottonseed, corn, sesame, sunflower, and soybean oils. *C.moschata* seeds are rich in minerals and can be used in everyday food to combat some mineral deficiencies. Seeds of some species of Cucurbitaceae can be used as an alternate to traditional vegetable oil sources to meet the

increasing demands.[47] A Significant percentage of γ-tocopherol present (609.8 mg / kg to 734.7 mg / kg) in various species of pumpkin seeds make them a rich source of antioxidants. Seeds of *C.maxima*, had the highest β-carotene content. *C. pepo* seeds had significantly more β-sitosterol [48] than the others. A Significant amount of phenolics, tocopherols, and sterols could provide high protection against oxidative stress. Good shelf life and other physicochemical properties make them an ingredient of choice in food products (snacks, squash, soups). Pumpkin seeds find vast application in pharmaceutics due to their antioxidant activity, high percentage of unsaturated fatty acids and plant sterols. The antidiabetic and antihyperlipidemic effect of pumpkin seed oils may be due to their flavonoids and saponin contents.

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