

Health benefits of edible round-fruited types of *Cucurbita pepo*. a short review

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Abstract

Cucurbita pepo, one of the most popular edible plants, is widely used as functional food and medicinal remedies around the world, due to the presence of numerous biologically active components with interesting nutraceutical properties like carotenoids, hypoglycemic polysaccharides, minerals, pectin, polyphenols, saponins, tocopherols, vitamins, cucurbitacins, various anti-fungal proteins, essential fatty acids, essential and nonessential amino acids, and fibre. The edible round-fruited types of *Cucurbita pepo* are called pumpkins. Most parts of the pumpkin (fruit, flowers, and the seeds) have various health benefits including antidiabetic, anticarcinogenic, antiinflammatory, antimicrobial, antioxidant, antiparasitic, hepatoprotective, lipid-lowering, and hypotensive. This short review aims to discuss the antidiabetic, anticarcinogenic, antioxidant, antimicrobial, and antiparasitic benefits of pumpkin.

Keywords: Pumpkin, Functional Food, Antidiabetic, Antioxidant, Antimicrobial

1. Introduction

Cucurbita pepo is a vegetable crop that are grown widely around the world [1-3]. This plant is cultivated from Northern Mexico to Argentina and Chile and has spread to Europe, and Western America [1-3]. *Cucurbita pepo* is one of the economically most important species of the genus *Cucurbita* (*Cucurbitaceae*), including a vast variety of fruits: pumpkins (edible round-fruited types of *Cucurbita pepo*), squashes (edible non-round types of *Cucurbita pepo*), and gourds (non-edible types of *Cucurbita pepo*) [4-6]. Pumpkins are rich in important natural bioactive compounds like carotenoids, hypoglycemic polysaccharides, minerals, pectin, polyphenols, saponins, tocopherols, vitamins, cucurbitacins, various antifungal proteins, essential fatty acids, essential and nonessential amino acids, and fibre [3, 6-12].

Pumpkin, famous for its edible fruit, seeds, leaves and flowers, is excellent sources of nutrition for humans [2-3]. Its fruits, seeds, and flowers have been consumed as vegetable products [3]. Pumpkin pulp is a good source of dietary fibre and high content of mineral elements and polyphenol compounds that have antioxidant activity, while the seeds are rich in bioactive compounds with interesting nutraceutical properties like polysaccharides, peptides, proteins, essential and nonessential amino acids, tocopherols, carotenoids, mineral elements, and fibre [2, 3, 9, 12]. Pumpkin seeds oil belongs to the group of very good quality edible oils, containing a high amount of free fatty acids, such as: linoleic (omega 6 polyunsaturated fatty acid), oleic (omega 9 monounsaturated fatty acid), palmitic, and stearic fatty acids [9].

Due to the presence of the above-mentioned natural compounds and botanicals, most parts of pumpkin have a health protective value. Pumpkin, especially pumpkin seeds oil, reveals health properties including hypertension, diabetes, and cancer [3, 12]. Oil of pumpkin seeds also shows antimicrobial, antioxidant, and antiparasitic properties [1, 3, 7, 12 -17]. Pumpkin can be consumed fresh, cooked, dehydrated as well as being stored frozen or canned. Pumpkin can be processed in to a variety of food products like jam, jelly, marmalade, puree, sauces, flour for bakery products, soups, instant noodles, crackers and natural colouring agents in pasta and flour. Pumpkin seeds can be consumed directly or converted in to toasted and salted snacks, they can also be processed in to flour. The current short review aims to discuss the antidiabetic, anticarcinogenic, antioxidant, antibacterial, antifungal, and antiparasitic benefits of edible round-fruited types of *Cucurbita pepo*.

2. Antidiabetic benefits

The diabetes is a devastating endocrinological and/or metabolic disease with an increasing worldwide prevalence and incidence [15]. The diabetes symptomatology, if managed in time, is not serious, but other severe pathological and functional changes may occur if the complications of diabetes are not addressed [14]. Numerous herbal medicines found to be effective in the long-term management diabetes, due to their ability to restore the function of pancreatic tissues by causing an increase in insulin output or inhibit the intestinal absorption of glucose or to facilitation of metabolites in insulin dependent processes [1, 3]. Most of plants contain alkaloids, carotenoids, glycosides, flavonoids, terpenoids, etc., that are frequently implicated as having antidiabetic effect [13]. *Cucurbita pepo*, one of them, reveals active hypoglycemic properties like a standard drug, and this effect might be due to either increased pancreatic insulin secretion from the existing β -cells or insulin release from the bound form [3, 14, 18]. Various components from pumpkin pulp and seed have antidiabetic potential [1, 3, 14, 18]. Among them, D-chiro-inositolphosphoglycan has been considered as an insulin action mediator, deficiency of this may contribute to insulin resistance in individuals with diabetes [18, 19]. The phenolic phytochemicals of pumpkin have antidiabetic effects in terms of β -glucosidase and α -amylase inhibition [18].

Tocopherol isomers (α , β , γ , and δ) from raw pumpkin seeds has been reported to be effective in the alleviation of diabetes through its antioxidant activities [1, 3]. Pumpkin seeds are also good alternative source of food with high nutritional content for instance proteins, lipids, fibres, carbohydrates and minerals (Mg, Ca, Zn, P and Fe) [3, 12, 20]. The protein-bound polysaccharides from pumpkin manifest the antidiabetic activity, these can improve the tolerance of glucose, reduce the blood glucose levels and increase the levels of serum tolerance of glucose [1, 3, 14]. Sugar-removed pumpkin powder and the common pumpkin powder showed a significant increase in plasma insulin and reduction in blood glucose, furthermore the pumpkin fruit powder significantly reduces the C-reactive protein, cholesterol, glucose, triglycerides [1, 14]. Additionally, pumpkin is rich in pectin, which when consumed is purported to control glycaemic levels and reduces the need for insulin when fibre-rich foods are consumed by patients with diabetes [14]. The *Cucurbita pepo*-rich diet has the potential to act as supplement to the existing oral antidiabetic drugs and it minimizes the transformation of pre-diabetics into diabetics [14, 18, 21].

3. Anticarcinogenic benefits

The natural products derived from plants are a promising supply of more efficient anticancer drugs [3]. Alkaloids, carotenoids, flavonoids, terpenoids, polysaccharides, cucurbitacins, and others compounds from plants have been documented as natural bioactive compounds with potential anticancer activity [12, 22, 23]. Generally, cucurbitacins (nitrogen-containing compounds) are not used as medical agents due to their toxicity, but in some cases, cucurbitacins have demonstrated the potential for treating different pathologies including cancer, autoimmune diseases or inflammation [12]. More than 40 cucurbitacin-derived compounds and cucurbitacins isolated from the *Cucurbitaceae* have apoptotic effects [3, 10]. The apoptotic effects are due of cucurbitacins ability to switch the genes, transcriptional activities via nuclear factors and mitochondrial trans-membrane potential and their capability to activate or inhibit pro- or antiapoptotic proteins [3]. Many studies with crude pumpkins extract and its numerous purified fraction including proteins and polysaccharide have shown anticancer activity against melanoma, ascites, and leukemia [3].

The phytoestrogen compounds in pumpkin seeds also exerted an anticancer effect, mainly breast cancer, the phytoestrogen compounds are related to estrogen hormones [10]. The pumpkin seeds exert a biphasic effect, estrogenic and antiestrogenic activities like genistein and daidzein hormones. The oil from pumpkin seeds inhibited testosterone-induced hyperplasia that would be useful in the management of benign prostatic hyperplasia [10, 16, 24]. The hydroalcoholic pumpkin seeds extract inhibited not only cancer cells proliferation but also hyperplastic cells, with a weaker effect on non-hyperplastic cells [10].

4. Antioxidant benefits

Oxidative stress has been considered as a hallmark of various chronic diseases and their complications [7]. Various extracts of pumpkin have potential antioxidant activity [7, 11, 12, 25]. The oil from pumpkin seeds has been proven to contain high amount of natural antioxidants like tocopherol and carotenoid, might be considered as playing a protective role against toxic substances and free radicals [3, 9, 10]. Methanolic extract of pumpkin seeds, that contains a higher amount of phenolic compounds (benzoic acid, quercetin, luteolin, kaempferol, syringic acid, p-coumaric acid, β carotene, and tannin), significantly increases the serious and hepatic activities of superoxide dismutase and glutathione peroxidase, and reduces the concentration of malonaldehyde [3, 26]. It has also been found that pumpkin polysaccharide could increase the superoxide dismutase and glutathione peroxidase activity and reduce the malondialdehyde content in tumour-containing serum [3]. Excellent antioxidant potential of pumpkin is also due to cucurbitacins free radical scavenging ability like singlet oxygen, hydroxyl radical and superoxide anions [27].

5. Antimicrobial benefits

Diseases caused by microorganisms and parasites are major causes of death, disability, and social and economic disruption for millions of humans [7]. Antimicrobial and antiparasitic components from pumpkin have been considered as the good option to prevent and to treat the diseases caused by bacteria, fungi, and parasites [7]. Moreover, it has been noticed that some proteins from pumpkin fruits possess antifungal activities via inhibition of pathogenic fungal proteases without toxicity for human erythrocytes [7].

Fruit extracts were proved to inhibit *Bacillus subtilis*, *Bacillus cereus*, while the pumpkin seeds were proved to inhibit *Aspergillus flavus*, *Botrytis cinerea*, *Fusarium oxysporum*, *Mycosphaerella arachidicola*, *Rhodotorula rubra*, *Saccharomyces cerevisiae*, and *Trichoderma reesei* [3, 7, 28]. Pumpkin seed oil (peptides, proteins, linoleic acid, oleic acid from pumpkin oil) showed a broad spectrum antimicrobial activity against several microorganisms, such as: *Acinetobacter baumannii*, *Aeromonas*, *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Salmonella enterica* subsp. *enterica* serotype *typhimurium*, *Serratia marcescens*, *Staphylococcus aureus*, and *Candida albicans* [3, 7, 28]. Extracts of leaves from *Cucurbita pepo* showed the largest spectra of activity against *Providencia stuartii*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*, *Enterobacter aeruginosa* and *Enterobacter cloacae* [3].

6. Antiparasitic benefits

Most of the antiparasitics are derived from synthetic or semisynthetic sources [29, 30]. The antiparasitic synthetic substances have been reported to cause considerable toxicity to humans, posing serious threat to human health [30]. A solution to this is to develop antiparasitics from reasonably less expensive and available raw materials. Pumpkin can be promoted as an alternative to synthetic antiparasitic, the aqueous extract of this plant showing more potent antiparasitic activity [30, 31]. The extract of pumpkin may contribute for the development of phytotherapeutic products that provide a lower risk to humans, in addition it could be more cost effective, safer and accessible [30]. Antiparasitic effects of pumpkin may be attributed to the abundance of cucurbitacins, cucurbitins, cucurmosins, saponins, and sterols, that might play a crucial role in affecting nematodes [3, 28, 32].

7. Conclusions

Pumpkins, edible round-fruited types of *Cucurbita pepo*, have bioactive compositions that promote health and human life. Pumpkins provide a valuable source of carotenoids, polysaccharides, minerals, pectin, polyphenols, tocopherols, vitamins, essential fatty acids, essential and nonessential amino acids, and fibre that have a major role in the human nutrition.

Being rich source of natural bioactive compounds and botanicals, most parts of pumpkins have a health protective value. Pumpkin, especially pumpkin seeds oil, reveals health properties, including diabetes, cancer, antibacterial, antifungal, antioxidant, and antiparasitic properties. Pumpkin is cheap and easily available vegetable resource, and it would be a good idea to encourage the consume of pumpkin in all regions of the world.

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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