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Review Article

A Review on *Cucurbita pepo*

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ABSTRACT
Cucurbita pepo is widely used as food and herbal remedies around the world. It contains several phyto-constituents belonging to the categories of alkaloids, flavonoids, and palmitic, oleic and linoleic acids. Many pharmacological studies have demonstrated hepatoprotection, inhibit benign prostatic hyperplasia, hypoglycemic agent, antioxidant, anticancer, antimicrobial, anti-inflammatory, anti-diabetic, and antiulcer activities supporting its traditional uses. This aims a comprehensive study of the chemical constituents, pharmacological and clinical uses.

Keywords: *C. pepo*, Antioxidant, Antidiabetic, Anticancer, Phytochemistry.

INTRODUCTION

Since ages, traditional and/or indigenous drugs have been used. Many ethno-botanical surveys on medicinal plants used by the local population have been performed in different parts of the world, and suggested that several medicinal plants have been used as dietary adjuncts for the treatment of numerous chronic and severe diseases. In India and China, the use of herbal medicines has been commonly practiced for a long time as a less expensive way to treat various health problems. In America, herbal medicines are regulated as dietary supplements and hence can be marketed without prior approval by the Food and Drug Administration (FDA).The herbal drugs are considered frequently less toxic with limited side effects compared with synthetic drugs. The WHO has also recommended the initiation of studies to identify and characterize new herbal preparations from traditionally known plants and the development of new effective therapeutic agents, especially in the areas where we lack safe modern drugs to treat chronic diseases[1–3]. The Cucurbitaceae family also referred as cucurbits forms a very large group and can be cultivated in warmer region of worldwide and make popular food crop plants. Some of these species include squashes, pumpkins, melons and gourds. *Cucurbita pepo* is one of the oldest known cultivated species. This plant is native of Northern Mexico and southwestern and eastern USA. It also exists in wild form in Europe and Asia. This plant has medicinal and nutritional benefits. The immature fruits are consumed as a vegetable. The mature fruit is sweet and used to make confectionery, beverages are roasted, or cooked[4,5].

Botanical Description

C. pepo is an annual creeping or climbing plant with 5-angled stems up to 15 m long. The shallow root system is branched, growing from a well-developed taproot. The stems are rugged and bristle, branching 6-24 cm long, often rooting at the nodes. The plant bears tendrils at 90 degrees to the leaf insertion, which are coiled and 1-6-branched. On bushy plants, tendrils may be poorly developed. The leaves are simple, alternate, broadly ovate to deltoid, basally cordate, apically acute, palmately lobed with 5-7 lobes, marginally toothed, scabrous, palmately veined, 20-30 cm long, and 10-35 cm broad leaves with 5 to 25 cm petioles that are ovate–cordate to suborbicular–cordate, with or without white spots on the surface and have three to five rounded or obtuse, apiculate lobules, the central one bigger than lateral ones. Pumpkin is monoecious (unisexual flowers, with male and female on the same plant) and bears solitary actinomorphic flowers (~ 10 cm across) that produce nectar. Male flowers are long and pedicellate and have a campanulate calyx that is 5 to 10mm long and almost as wide 5–15mm, 1–2mm linear sepals and a tubular campanulate corolla that is rather broader towards the base, 6 to 12 cm long and yellow to pale orange. Flower has three stamens. Female flowers have thick peduncles, 3 to 5 cm long, an ovoid to elliptical, multilocular ovary, sepals that are occasionally foliaceous and a corolla is somewhat larger than that of the male flowers. They have a thickened style and three lobate stigmas[6,7]. Fruits are variable in shape, color, and size. It can be oval, cylindrical, flattened, globular, scalloped, fusiform, and/or tapering to a curved or straight neck on one or both ends. There is more than one color to the soft to hard skin: white, yellow, light to dark green, nearly black, cream, and/or orange. The flesh is also variable in color (white, yellow, orange) and thickness[1].

Traditional Use

Cucurbita pepo is traditionally used in many countries to treat several diseases e.g., as an antiinflammatory, antiviral, analgesic urinary disorders, antiulcer, antidiabetic and antioxidant[4,5]. Traditional medicine,

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Parts used	Traditional uses
Fruit	Cure fatigue and thirst and purify the blood
	Treat cold and alleviate ache
Seed	Treat irritable bladder, prostatic complains
	Anti-parasitic, Taenicide
	Beneficial to the spleen and lungs
	Treat Gastritis, burns, enteritis, Febrile diseases
	Headaches and neuralgia
	Diuretic, a cure for bronchitis and fever.
Leaves	Reduced fever
	A treatment for nausea and a boost to haemoglobin content of the blood.

particularly Ayurvedic systems, and Chinese have used different parts of the plant.

Phytochemistry

Pumpkin has been considered as beneficial to health because it contains various biologically active components such as polysaccharides, para-aminobenzoic acid, fixed oils, sterols, proteins and peptides[3,8].

Fruits

These are depicted by a low content of fat (2.3% pumpkin pulp is not a rich source of oil), carbohydrates (66%), proteins (3%),[9] and by high carotenoids content with values of 171.9 to μg/g[10].

Food value per 100 g is: Calories 80 kcal, crude fibre 11.46%, ash 16%. The mineral analysis indicated that pumpkin pulp contained high levels of Mn (0.5 mg/kg), Fe (1.37 mg/kg), Cu (mg/kg), Pb (0.29 g/kg), P (11.38 mg/kg), Ni (0.5 mg/kg), Ca (179 mg/kg), Mg (190 mg/kg), Na (159 mg/kg) and K (160 mg/kg) ([11]). The level of Pb (0.210.25 mg/kg), and Cu (25 mg/kg) are within acceptable range[5].

Seeds

Seed and seed oil are an ample natural source of phytosterols[12], proteins, polyunsaturated fatty acids[13], antioxidant vitamins, carotenoids and tocopherols[14] and various elements[11]. Due to these, components are attributed providing many health benefits.

It contains main fatty acid components being palmitic (10.68%), palmitoleic (0.58%), stearic (8.67%) oleic (38.42%) linoleic (39.84%), linolenic (0.68%), gadoleic (1.14%), total saturated fatty acids (19.35%), and total unsaturated fatty acids (80.65%)[4]. Also, various components such as *p*-aminobenzoic acid, γ-aminobutic acid, polysaccharides, peptides, proteins, carotenoids as lutein, lutein epoxide, 15-cis-lutein (central-cis)-lutein, 9(9')-cis-lutein, 13(13')-cislutein, α-carotene, β-carotene violaxanthin, auroxanthin epimers, flavoxanthin, luteoxanthin, chrysanthemaxanthin, α-cryptoxanthin, β-cryptoxanthin[15].

Δ stigmastatrienol has been abundantly isolated from the seeds sterols with values of 18.8 to 35.1 g/100 g of the total sterol content, followed by the Δ sterol spinasterol with values of 18.223.3 g/100 g of the total sterol content. B-sitosterol and spinasterol represented 41.153.6 g/100 g of total sterol content. The third most abundant is the Δ stigmasterol and Δ stigmastadienol[5].

In seeds, the greatest concentrations of squalene were found ranged 583.2 to 747 mg/100 g. Squalene is a triterpene produced by humans, animals and plants. It is a precursor of steroid hormones, cholesterol, and vitamins D in their biosynthesis in the human body. Squalene also has positive effects in the treatment of certain kinds of cancer[5].

In addition, the seeds contain cucurbitosides which are acylated phenolic glycosides as well as Cucurbitosides F-M[16].

Examination of the seeds of *C. pepo* used HPLC leads to isolation of the following five multiflorane-type triterpenoids[17].

3α--Nitrobenzoylmultiflora-7:9(11)-diene-29-benzoate 3α -Acetoxymultiflora-7:9(11)-diene-29-benzoate.

Leaves

Study suggests that leaves contain secondary metabolites i.e. alkaloids, flavonoids, carbohydrate, phytosterol, tannin, saponin, steroid, gums and mucilage, fixed oils and fats, proteins and amino acids[18].

Biological activity

Antioxidant Activity

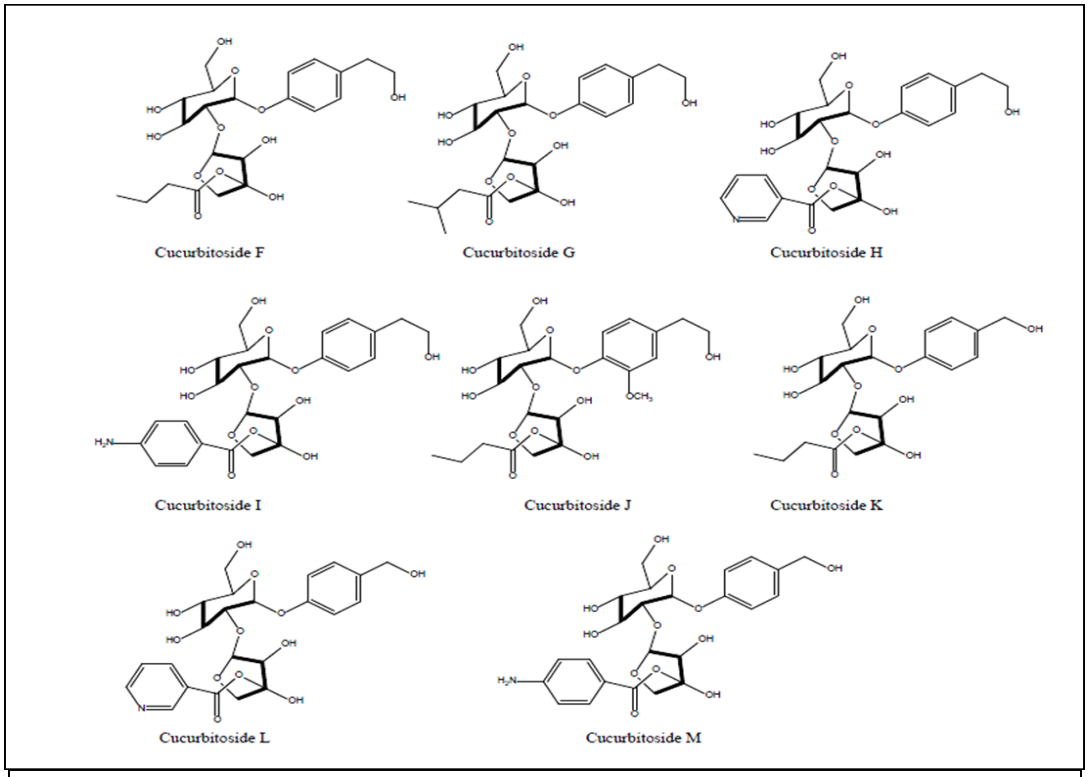
Oxidative stress has been considered as a sure sign of various chronic diseases and their complications such as diabetes, obesity, CVD and cancer[1].Several experimental studies showed the antioxidant activity[3]. Tocopherols (non-glycoside) are compounds of vegetable oil and are natural antioxidants. Seeds oil of the pumpkin containing a mixture of isomers β and δ-tocopherol in range 29.92 to 53.60 mg/100 g making 79% and 84% respectively of the total tocopherol content. Methanolic extract of pumpkin seeds contain higher amount of phenolic compounds[5]. Radical scavenging effect depends on their total phenolic content. It is reported that pumpkin extract administration significantly increased the serious and hepatic activities of superoxide dismutase and glutathione peroxidase in mice, and reduced the concentration of malonaldehyde[1]. 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 mice serum.

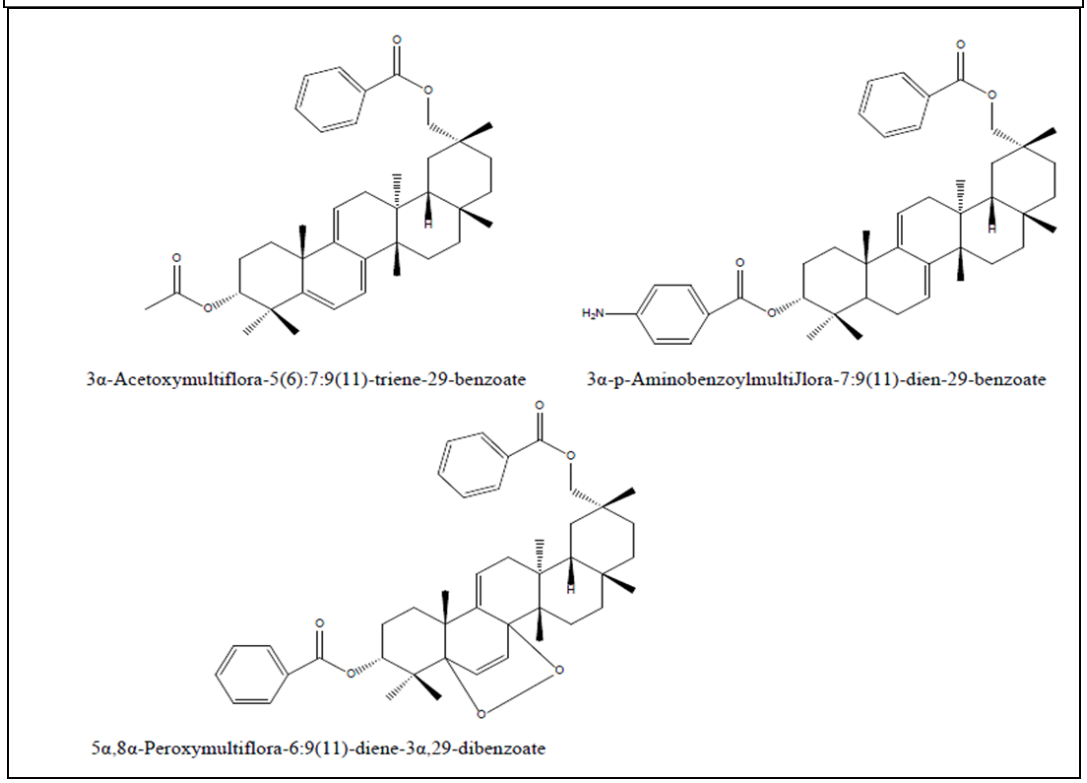
Antidiabetic Activity

Diabetes, a metabolic disease, is a serious problem of modern society due to the severe health complications linked with it[5]. Many several other studies have been recently carried out to recognize the anti-diabetic potential of herbal formulations; pumpkin is one of them, its fruits are used for human consumption in diabetic conditions[19].

In various other reports, the pumpkin exhibited acute hypoglycemic activity (blood sugar lowering) like a standard drug (tolbutamide) in temporarily hyperglycemic animals, in alloxan-induced diabetic animals but not in severe diabetic animals[20,21].

Protein-bound polysaccharide (PBPP) is isolated from aqueous extract of pumpkin fruits which consist of 10.13% protein and 41.21% polysaccharides. Administration of these protein-bound polysaccharides to alloxan-induced diabetic rat model reduced significantly glucose levels.





Tocopherol isomers (α, β, γ, and δ) from raw pumpkin seeds has been reported to be fruitful in the alleviation of diabetes through its antioxidant activities. Tocopherol fraction of pumpkin seed oil was studied in hyperglycemic Wistar rats induced with nonionic copolymer PX-407 with impaired response and loss of β-cell sensitivity to glucose, which is considered as an appropriate model to study the activity of hypoglycemic drug. Results indicated a decrease of insulinemic, lipid profiles and glycemic levels[5].

C. pepo might so be useful for the hindrance of complications associated with diabetes, conjointly since its ancient use in diabetes is well established.

Antimicrobial Activity

Antimicrobial chemotherapy has revolutionized trendy drugs and has considerably reduced death and ailments from infectious diseases[5]. Increasing drug resistance in

infectious microorganisms has warranted the development of new drugs against pathogenic micro-organisms. Natural sources have been considered as the best option to isolate new and novel anti-microbial components.

Extracts of leaves from *C. pepo* showed the largest spectra of activity against *Providencia stuartii, Pseudomonas aeruginosa, Klebsiella pneumoniae, Escherichia coli, Enterobacter aerogenesa* and *Enterobacter cloacae.* The extract from *C. pepo* leaves showed the best MBC spectrum with the values below to 1024 µg/ml recorded on 58.62% (17/29) of the studied microorganisms[22].

Pumpkin oil hampers *Actinetobacter baumanii, Aeromonas veronii biogroup sobria, Candida albicans, Enterococcus faecalis, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Salmonella enterica* subsp. *enterica serotype typhimurium, Serratia marcescens* and *Staphylococcus aureus* at the concentration of 2·0% (v/v)[23]. A peptide (MW 8 kDa) from pumpkin seeds was proved to inhibit *Botrytis cinerea, Fusarium oxysporum and Mycosphaerella arachidicola* at a dose of 375 mg and to exert an inhibitory effect on cell-free translation with an IC50 (50% inhibitory concentration) of 1·2 µM. The extract showed moderate to high activity against all the investigated microbial strains[24].

Anticancer/Antitumor Activity

Cancer is a rapidly growing health problem; it presents the biggest challenge to researchers and medical professionals and has been selected for various prevention and therapeutic strategies. Treatments include chemotherapy, surgery and radio-therapy. However, chemotherapy suffers limitations of drug resistance, toxicity, side-effects and lacking specificity toward tumor cells[25]. Therefore, there's a robust interest in the use of plants as a promising supply of more efficient anticancer drugs.

Currently, more than 40 cucurbitacin-derived compounds and cucurbitacins have been isolated from the Cucurbitaceae family and from other species of the plant. The apoptotic effects of cucurbitacins is due of their ability to switch the genes, transcriptional activities via nuclear factors and mitochondrial trans-membrane potential and their capability to activate or inhibit pro- or anti-apoptotic proteins[5].

Many preliminary studies (in vitro as well as in vivo) with crude pumpkin extract and its numerous purified fraction– including proteins and polysaccharide–have shown anticancer activity against melanoma, ehrlich ascites and leukemia[3].

Alcoholic extract of pumpkin showed IC50 values on cancer cell lines HepG2 and CT26 of 132.6 and 167.2 µg/ml respectively. The ethanolic extract of fruits of *C. pepo* was determined to exhibit a major dose-dependent inhibitory impact against HeLa cell growth[26].

Other medicinal effects

A few preliminary studies have shown various other pharmacological properties of the plant[5]. Pumpkin-supplemented foods are considered as good source of anti inflammatory, anti prostatic substances[3]. It was reported that the oil preparation could remarkably reduce the bladder pressure, increase the bladder compliance and reduce the urethral pressure[27].

Fahim et al.[28] reported that pumpkin seed oil significantly inhibited adjuvant induced arthritis in rats, similar to a well-known anti-inflammatory substance called indomethacin. Pumpkin seed oil has potential hypotensive activity, as suggested by Zuhair et al.[29]. They additionally prompt that pumpkin seed oil includes an excellent drug interaction with hypotensive drugs like felodipine (Ca antagonist) and captopril (an angiotensin converting enzyme inhibitor), with regard to increase hypotensive potential in hypertensive animal models. Pumpkin may ease depression too, because the seeds contain L-tryptophan, which raises levels of 'happy' serotonin in the brain. Pumpkin (Cucurbita maxima) seeds raw as well as processed could reduce the depression[30]. An anti-helminthes effect was reported at the minimum inhibitory concentration of 23 g pumpkin seed in 100 ml distilled water in preclinical studies[1]. The administration of pumpkin seed proteins after CCl4 intoxication resulted in significantly reduced activity levels of lactate dehydrogenase, alanine transaminase, aspartate transaminase and alkaline phosphatase and hence this protein administration was effective in alleviating the detrimental effects associated with protein malnutrition[31]. Analgesia and antiinflammation activities were observed with head of pumpkin stem[3]. Protein isolate from pumpkin seeds could inhibit trypsin and activated Hageman factor, a serine protease involved in blood coagulation[32,33]. Pumpkin has been used for numerous cosmetic applications such as skin scrubber, body mask, body butter, massage oil, massage lotion and dry facial mask.

Conclusion and future perspectives

Pumpkin is an edible food which can be included in our daily diet that can give various health benefits to improve our overall health. Pumpkin has various effects beneficial to health such as anti-diabetic, anti-carcinogenic, antioxidant and anti-microbial potential. There are other various health beneficial effects of pumpkin also reported such as inhibition of kidney stone formation, and hypotensive, anti-inflammatory and blood-coagulatory effects. In various studies pumpkin products show synergistic and no-change effects to treat diseased conditions. Since most of the studies have been done either in vitro or in animal models, controlled clinical trials are strongly needed to confirm these health-beneficial effects in human subjects. There are various food products such as snacks, pies, etc available containing pumpkin alone and in combination with other edible supplements such as ginger and various fruits for human consumption. Most importantly it is cheap and easily available in developing countries. However, standardization of pumpkin and its antidiabetic component followed by a controlled clinical trial is needed. It would be a good idea to follow up the conventional consumption effects in human populations of those products in regard to numerous chronic diseases like diabetes, cancer and heart diseases. It is very important to analyse various bioactive components from plant and food components; however, very few components have been isolated and characterised from pumpkin. Therefore it

might be a good area to explore in this field to isolate, characterize and evaluate various components of pumpkin from different parts, for medicinal functionality. Over the years scientists have researched many pharmacological actions and potential uses of pumpkin and its extracts. Clearly, there is still a lot to learn about the health effects of this plant. Further studies are required to gain a better understanding of the role of pumpkin extracts in protecting against disease.

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