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A review on the ethnobotany, phytochemistry, pharmacology and nutritional composition of *Cucurbita pepo* L.

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ABSTRACT

Cucurbita pepo L. is widely used as a vegetable all around the globe. This review aimed at forming a relation between the traditional uses, phytochemistry, pharmacology and nutritional composition of *C. pepo*. Traditionally this plant is used in Africa and Asia for the treatment of different diseases including fever, whopping cough, urinary problems, anti-scorbutic, hyperplasia, rheumatism, hemorrhoid, miscarriage, prostate cancer, constipation and blindness. Therapeutically, *C. pepo* is effective in antibacterial, antioxidant, antitumor, hypoglycemic (anti diabetic) and hypolipidemic activities. These activities of *C. pepo* might be due to the existence of certain classes of compounds including flavonoids, terpenoids, cardiac glycosides and cucurbitacins glycoside. *C. pepo* is also rich in nutritional components like carbohydrates, proteins, lipids and minerals. Hence, there is need to isolate and characterize active compounds in each class and developing new allopathic drugs with less or no side effects. Moreover, toxicity of this plant with dose dependent manner may also be tested along with measurements to conserve this species.

Keywords: Ethnomedicines, Pharmacological report, Phytochemistry, Hypoglycemic, Hypolipidemic.

INTRODUCTION

Cucurbita pepo L. is among the 15 species of genus Cucurbita in Cucurbitaceae. *C. pepo*'s local name is 'Kadoo' in Urdu, Saraiki and Hindi while squash in English. It grows as a large annual vine and has large, showy, yellow-orange, insect-pollinated flowers and round, lobed leaves, often with fine hairy prickles. The name pumpkin and squash are interchangeably used because their fruit are same, although the species are different from one another. Importance of *Cucurbita* is discussed in the Holy Quran verse of 'Asaffat surah' in relation to Prophet Yunes. God says: we planted a *Cucurbita* bush on his body to rest under its wet and wide leaves (Surah As-saffat ayat 146). Almighty God grow a tree of pumpkin in the area where Younas was thrown out from the abdomen of the whales. It is an excellent plant for Prophet Younas, who spend long time with fear, hunger and thirst inside the huge sea mammal [1].

C. pepo vines and fruit are used as fodder for livestock, gourds used for a vast array of ornamental and traditional purposes [2]. The fruit of the plant is used as cooling agent and also utilized for loose stools, good for teeth, throat infection and eyes infections. The leaves are digestible, used as analgesic, remove biliousness and also used for an external burns. The seeds are diuretic, stimulant, cure painful chests, bronchitis, fever, reduce thirst, good for the brain and used for kidney problmes [3]. Pharmacologically it is used for different activities like anti-hypercholesterolemia, anti-hypertensive, anti-inflammatory, anti-parasitic, anti-tumor, ant-oxidant, anti-diabetic, anti-carcinogenic, anti-bacterial, intestinal and anti-inflammation [4,5]. Different categories of phyto-constituents contain in *C. pepo* such as linoleic acids, oleic acid, alkaloids, flavonoids and palmitic which may be responsible for its medicinal properties. *C. pepo* is a good supplement of protein, carbohydrate, minerals and fat. This coupled with high mineral content which is advantageous for human and animals [6].

Species like *C. pepo* are the highly investigated and widely utilized species in spite of other species in the genus, which are more or less unexplored. Many researchers have carried out several experiments on the different character of *C. pepo* like phytochemistry, ethnobotany, nutrition content and cultivation. The purpose of this study is to create a correlation between scientific studies and habitual uses, ethnobotany, phytochemistry, pharmacology and nutritional composition of *C. pepo* the herb is much important with Islamic and Quranic point of view and its well traditional uses in folk medicines.

METHODOLOGY

Data was gathered from indexed and non-indexed journals by using online bibliographic data bases: PubMed, Scopus, Google, Google Scholar, Web of Science, ISI Web of Knowledge and Science Direct Navigator, as well as some library sources. Inside the data- bases, we used words like Ethnobotany, Phytochemistry, phytopharmacology, nutritional composition, physiological studies of *C. pepo* and other relevant terms. Approximately 200 published articles were found in which potential studies were selected for related to the geographical distribution, taxonomy, morphology, ethnobotany, cultivation, phytochemistry, nutrition status and pharmacology of plant *Cucurbita pepo*. We analyzed the reference lists of about 52 of the selected text having more comprehensive, complete and correct information. All the data was summarized into 3 tables and 3 figures and arranged and tabulated by using Microsoft office. Ethnobotanical table consists of part used, medicinal uses, recipes and study area. Data on phytochemistry and pharmacological activity of reported *Cucurbita pepo* chemical constituents extracted, part used and types of pharmacological activity performed so far.

Ethnobotany

C. pepo is used as a vegetable as well as in treatment of various diseases all over the world. Most of the people in Pakistan, Nigeria, Bangladesh, East Africa and Foumban used traditionally pumpkin for the treatment of various human ailments (Table 1). The most preferable plant part is seed used for the treatment of hyperplasia, prostate cancer, urinary diseases, nephritis, bronchitis, hemorrhoid, and anemia in various parts of the world [7]. In Pakistan fruit which is the edible part and used as vegetable. Fruit of the plant is used for curing different diseases through traditional practices ranged from simple (eye, stomach, burning, throat, sore chest, fever, whopping cough, teeth and urinary problems) to complicated ailments (anti-scorbutic, hyperplasia, rheumatism, blindness, hemorrhoid, miscarriage and prostate cancer) [8].

Table 1: Ethnobotany of *Cucurbita pepo*

Part used	Medicinal uses, Recipe, Route of administration, dose	Study Area	Citation
Leaves	Leaves used for strengthening the digestive system and as anti-scorbutic	Nigeria	[6]
	Paste of leaves are used in biliousness and burning sensation	Bangladesh	[7]
	Used as an external application for burns, remove biliousness, digestible and analgesic	Bangladesh	[30]
	Treating bladder disorders, stomach upsets, intestinal worms, bedwetting, rheumatism, benign prostatic hyperplasia, burns and wounds	Pakistan	[31]
Fruit	Fruit are good for teeth, eyes, throat, astringent to the bowels and laxative	Bangladesh	[7]
	Antihelmintic agent, effective in urinary complexities, cardio protective action, anti-inflammatory	Pakistan	[32]
	Used in the curing of fatness, gastric problems, irritable bladder in children	Pakistan	[33]
	Juice obtained from the fresh fruit of the plant and then mix with rose extract (Arq-e-Gulab). This is used as eardrops for removing otitis	Pakistan	[34]
	Fruit is boiled in water and serve with salt and black pepper and its decoction is used to cure intestinal disorders and gastric problems	Pakistan	[35]
	Human blindness.	Bangladesh.	[30]
Fruit stalk	Used for heartburns	East Africa	[35]
Seeds	Seeds are used in urination problems, for curing bladder disorder, an antihelmintic agent	Nigeria	[6]
	Childhood *Eenuresis nocturna* and irritable bladder have been treated successfully with pumpkin seed	Nigeria	[6]
	Used to eradicate tapeworm	Nigeria	[6]
	Treat stomach ulcers, provide vitality (Vitamin E), clean kidneys and used to remove worms.	East Africa	[35]
	Seeds are diuretic, tonic, bronchitis, fever, good for the kidney	Bangladesh	[7]

	Regularly use of seeds can cure prostate cancer.	Foumban, Cameroon	[36]
	Used in treatment of whooping cough in small children, lack of milk for nursing mothers, hemorrhoids, anemia, malnutrition, constipation.	Malaysia	[38]
	Seeds are diuretic, and are used as a treatment of urinary system problems	Pakistan	[37]
	Seeds are stimulant, diuretic, fattening cure sore chests, good for the kidney and the brains, bronchitis, fever, allays thirst	Bangladesh.	[30]
Pulp	Used against tapeworms in children and in pregnant woman.	Pakistan	[30]
Whole plant	Pumpkin is useful for who is suffering from bronchial asthma, cough, edema	Malaysia	[38]
	Beneficial for bloody and purulent phlegm, night blindness and habitual miscarriage	Malaysia	[38]
	Treating the umbilical cord, Extract is used to bath baby 2 times daily, extract is given orally	Nigeria	[39]
	It is useful in headache, cold, heart diseases, lung infection, maleness, piles, arthritis, fever	Malaysia	[38]

Table 2: Phytochemical and pharmacological investigation of *Cucurbita pepo*

Compound isolated	Part used	Reported Activity	Citation
p-coumaric, Caffeic acid tri-hexoside, p-hydroxybenzoic acid, Caffeic acid derivative, Vanillic acid, Sinapic acid, Dihydroxybenzoic acid	Seeds	Antioxidant	[15]
Cardiac glycosides, Terpenoids, Resins, Saponins	Seeds	Immuno-suppressive, antibacterial, antiulcer, antioxidant	[10]
quercetin-3,4`-O-β -D-diglucopyranoside, , 3,4-dihydroxy methyl benzoate, Isorhamnetin 4-O-β-D glucopyranoside, 3,4-dihydroxybenzoic acid, isorhamnetin, quercetine, myricetine, , quercetin-4`-O-β-D-glucopyranoside, 5,7dihydroxy,3,6,3`trimethoxyflavone.	Flower	Antibacterial	[11]
2,16-dihydroxy- 22,23,24,25,26,27-hexanorcucurbit-5-en-11,20-dione 2-O-β-D-glucopyranoside, cucurbitacin L 2-O-β-Dglucopyranoside, 16-hydroxy-22,23,24,25,26,27-hexanorcucurbit-5-en-11, 20-dione 3-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside, cucurbitacin K 2-O-β-D-glucopyranoside.	Fruit	Anti tumor	[8]
13(18)-oleanen-3-ol, tetrahydro-thiophene, cholesterol, calotropoleanly ester, linoleic acid.	Fruit	Antibacterial, Antiviral, Antitumor	[12]

PHARMACOLOGICAL REPORTS

Antitumor activities:

Research report have proven that the extracts of rind, flesh and seed oil of *C. pepo* show inhibition for cancer cell breast carcinoma (MCF7) and liver carcinoma (HEPG2). The seed oil show probable cytotoxicity against breast carcinoma (MCF7) with IC_{50} in the range of 0.40–1.01 mg. The isolated protein and rind extract was most effective against HEPG2 and MCF7 (IC 50: 0.40 mg), followed by the isolated protein (IC_{50}: 0.54 mg). Fruit ethanolic extract have significant inhibitory effect against HepG and HeLa cell growth [8].

Antimicrobial activities:

The antibacterial activities of *C. pepo* oil showed higher zone of inhibition (60%) against *Staphylococcus aureus* and *Escherichia coli.* In another study it was recorded that the oil content (linolic acid, oleic acid) showed good antimicrobial activity against *S. aureus* with zone of inhibition of 15mm. In addition to that *Bacillus subtilis*, *Bacillus cereus* were found to be susceptible against fruit extracts. Methanolic and petroleum ether with a concentration of 10, 50, 100, 200, 500, 1000 µg/ml were found to be effective against *Bacillus subtilis*, *Staphylococcus aureus* and *Escherichia coli.* Some fungi are pathogenic causing different diseases. Sood *et al*. studied antifungal

activities of *C. pepo* and noticed that it has high potency against *Fusarium oxysporium, Trichoderma reesei* [10]. In another study it was noticed that methanolic and ethyl acetate extract has significant antifungal activities against *A. flavus* [11]. Badr *et al*. recorded its anti fungal activities against *Saccharomyces cerevisea* [12]. *Cucurbita* also has antigiardial activities against *Giaradia lambelia* [13].

Antioxidant activities:

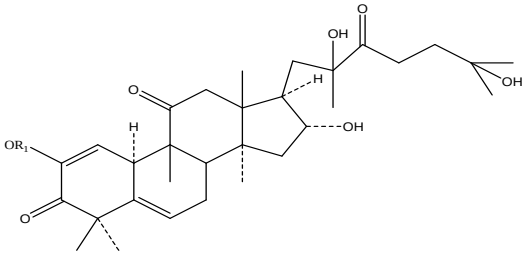
Some antioxidants are natural and present in plant metabolites, e.g. in polyphenols (phenolic acids, flavonoids) and terpenoids (carotenoids), and the utilization of foods which contain polyphenols and terpenoids in large amount play an important role in prophylaxis against many diseases. The regular use of fruit and vegetables reduce frequency of cardio-vascular and cancer diseases [14]. Methanol and ethanol extract of *C. pepo* seeds have antioxidant activity [15]. The tetracyclic triterpenoids (cucurbitacins) isolated from seeds show antioxidant activity [16].

***Hypoglycemic and hypolipidemic*:**

Flavonoids compounds, including quercetin with antioxidant activity possess hypoglycemic effect in diabetic rats [17]. Moreover, the presence of pectin which serves as to low blood glucose is an agent of *C. pepo* [18]. The lipid reducing effects of *C. pepo* is probably due to its fibres. By inhibiting the absorption of bile acids and cholesterol these substances reduce plasma LDL levels and enhancing the activity of LDL receptors. Furthermore, a fiber-rich diet reduces triglyceride levels by suppressing lipogenesis in the liver [19,20]. Cholesterol levels in rats can be reducing by oleic acid and linoleic acid which is unsaturated fatty acids present in *C. pepo* seed reduce [21]. The lipid-reducing properties of this plant are partly attributed to the pectin present in it. Previous data suggest that diets rich in pectin facilitate excretion of bile acids which lead to their synthesis increase from cholesterol in the liver and ultimately reduction of blood cholesterol levels [22]. It may suggest the addition of this plant in antidiabetic regimens to treat human diabetes.

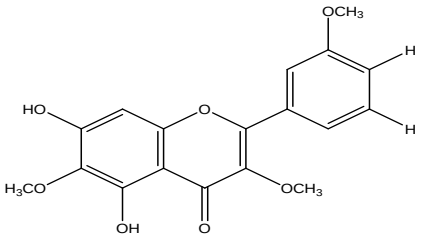
Phytochemistry

The chemical constituents which are glycosides in nature found in *C. pepo* seeds are cucurbitacin L 2-O-β-D glucopyranoside (Fig. 1), cucurbitacin K 2-O-β-D-glucopyranoside, 16-hydroxy-22,23,24,25,26,27-hexanorcucurbit-5-en- 11, 20-dione 3-O- α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside and 2,16-dihydroxy-22,23,24,25,26,27 hexanorcucurbit-5-en- 11,20-dione 2-O-β-D-glucopyranoside [8]. *C. pepo* seeds also contain cardiac glycosides, terpenoids and resins [15]. Flowers are rich in phenolic compounds such as quercetin-3,4`-O-β -D-diglucopyranoside, 3,4-dihydroxy methyl benzoate, Isorhamnetin 4-O-β-D glucopyranoside, isorhamnetin, quercetine, myricetine, quercetin-4`-O-β-D-glucopyranoside, 5,7dihydroxy,3,6,3`trimethoxyflavone (Fig. 2) [11]. The fruit of *C. pepo* also contains mixture of triglyceride fatty acids and isolated compounds were Tetrahydro-thiophene, linoleic acid, calotropoleanly ester, cholesterol, 13(18)-oleanen-3-ol and 13(18)-ursen-3-ol (Fig. 3) [12].

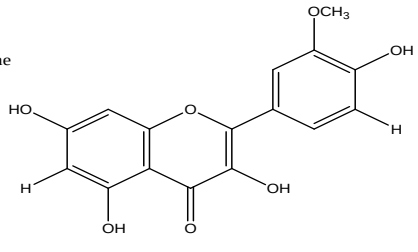


R1= β-glc

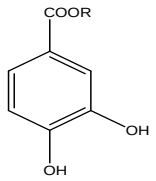
Figure 1. Cucurbitacin L 2-O-β-D glucopyranoside



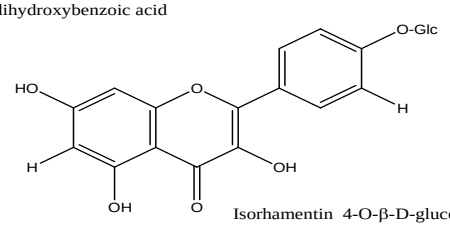
5,7-dihydroxy-3,6,3`-trimethoxy flavone



Isorhamentin



3,4-dihydroxybenzoic acid



Isorhamentin 4-O-β-D-glucopyranoside

Figure 2. Phenolic compounds (Mohamed *et al*., 2009)

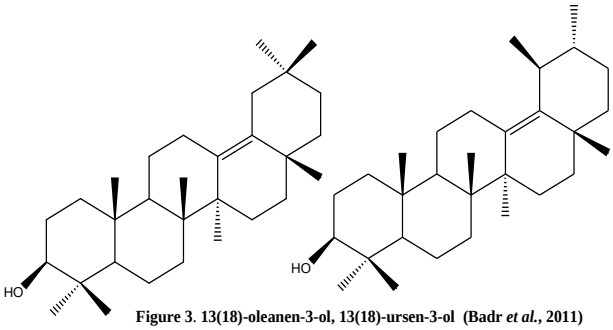


Figure 3. 13(18)-oleanen-3-ol, 13(18)-ursen-3-ol (Badr *et al.*, 2011)

Nutritional Composition

C. pepo is rich in nutrients and amount of crude protein, crude lipid is higher in seeds rather than fruit and rind of *C. pepo* as well as the amount of different metals like Na, Mg, Fe, K, P, Ca is also higher in seeds as compared to fruit and rind. At the other hand the amount of carbohydrates is higher in fruit (Table 3).

Table 3: Nutritional composition of *Cucurbita pepo*

Components	Seeds	Fruits	Rind	Citation
Moisture (%WW)	5.00	92.93+/-1.01	84.18+/-1.42	[40]
Crude lipid (%DW)	38.00	0.18	6.57	[12,41]
Crude Protein (%DW)	27.48	15.50	23.95	[12,42]
Crude fiber (%DW)	1.00	NA	NA	[43]
Carbohydrates	28.03	48.40	19.45	[12,42]
Energy (K cal per 100g)	564	NA	NA	[44]
B-carotene(µg/100g)	NA	3934.02	751.9	[12]
Ca (mg/100g)	9.78±0.03	0.60	0.57	[45]
Mg (mg/100g)	67.41±0.05	0.45	0.78	[45,46]
Na (mg/100g)	170.35±0.08	0.33	0.33	[45]
K (mg/100g)	237.24±0.09	0.67	0.83	[45]
P (mg/100g)	47.68±0.04	0.62	0.74	[45]
Fe (mg/100g)	3.75±0.02	0.65	0.78	[45,46]
Zn (mg/100g)	14.14±0.02	0.79	0.80	[45]
Mn (mg/100g)	0.06±0.01	0.64	0.67	[45]

Keys: The data are mean value ± standard deviation of triplicate results.
DW=Dry Weight, WW= Wet Weight,

Cultivation

For the better production of *C. pepo* we use different substance. It is suggested that use of bio fertilizer with the combination of organic and inorganic fertilizer will increase production of *C. pepo* and these fertilizer is also friendly to environment because it will not pollute the environment [23]. Organic and inorganic fertilizer also affect the nutrient content of plant like when mineral fertilizers were applied to tomato then fruit were contain higher amount of sugar, whereas when organic fertilizers were applied acid content were higher in the fruit [24]. It is suggested that for better growth and yield of *Cucurbita* farmers should use organic and inorganic manure such as cow dung, poultry droppings as they are less toxic, environment friendly and cheaper [25]. When we treated Broccoli with organic manure then the head of Broccoli contain high amount of nutrient K, N and P. [26]. So manure will also affect the nutrient content of *C. pepo*. Salinity is the major problem in drought areas it significantly decreased the production of *C. pepo* [27]. *Cucurbita pepo* were treated with different conc. of sodium chloride grown under greenhouse conditions and the absorption of both total and soluble magnesium, calcium, potassium and sodium were measured in leaves as well as fruit. When higher level of NaCl applied total sodium concentration increased in leaves, while in the fruit this tendency was the reverse. At the same time as soil salinity increased, total and soluble potassium content decreased in leaves other than it increased in fruit. Response of magnesium and calcium was similar in fruits to that of potassium to the treatments [28]. The increasing doses of gamma rays decreased pollen age, pollen viability continuously as compared to non-irradiated pollens in pumpkin and winter squash. So if it affects pollen it also affects the production of *C. pepo*. Along with the increasing dose of gamma rays, FR (Fruit-set-rate) decreased and seedless fruit increased while non- irradiated pollens gave the fruit-set with seeded in all periods [29].

CONCLUSIONS AND FUTURE RECOMMENDATIONS

It is concluded that due to ethnobotanical, phytochemical, pharmacological and nutritional values of *C. pepo* it attain high importance throughout the world. The available research data on *Cucurbita* indicate its medicinal value used globally for ethnomedicinal treatments, especially for Hyperplasia, Prostate cancer, Urinary diseases, Nephritis, Bronchitis, Hemorrhoid, and Anemia. The medicinal properties of *Cucurbita* are due to the

presence of different chemicals like Caffeic acid, Caffeic acid tri-hexoside, Cardiac glycosides, p-coumaric acid, Resins, Saponins, Sinapic acid, Vanillic acid etc so, increasing medicinal value of *C. pepo* is demanding for the discovery of more potential phytochemical which can lead to the improvement in drug system which are used for the benefits of human beings. Pharmacological studies confirmed the antibacterial, antiviral, antiulcer and antitumor activity that provides scientific basis to the use of *C. pepo* in traditional medicines. No anti obesity activity has been yet reported from the literature and there is no sufficient information available about the toxic effect of *Cucurbita* or its derived medicines that needs a lot of attention. To reduce overexploitation of *Cucurbita* the local people should be trained for technical processes such as collection, drying and processing. Also some good policies are required for the cultivation, conservation and trade of *Cucurbita* to control severe genetic erosion of valuable genotypes from the population.

Conflict of interest

None declared.

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