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REVIEW ARTICLE

Delving into the dietary delights of cucurbits: A nutritional and therapeutic exploration

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Abstract

For a well-balanced diet, vegetables are essential, especially as a source of minerals, dietary fiber, vitamins (A, B1, B2, B6, B9, C, D and E) and phytonutrients which are vital to human nutrition. They constitute a sizable percentage of the diet and nutrition. The Cucurbitaceae family of plants include a wide variety of vegetables that have been valued for their nutritional and culinary versatility. They are been grown for commercial purposes round the year. Cucurbits are preferred by many people and can be eaten raw or cooked because of its high water content and low fat content, they facilitate for weight management and hydration. They are utilized in a balanced diet since they have good nutrient profile and little calories. Cucurbits have been shown to be high in dietary fiber, vitamins and minerals, making them suitable for intake by persons of all ages. They have strong antioxidant activity as well as a number of therapeutic benefits, including anti-inflammatory, anti-tumour, anti-diabetic and anti-ulcer qualities. Understanding the nutritional characteristics of cucurbits is imperative to make aware about the most of their health benefits and including them into diet plans that aim to improve overall health and well-being. Cucurbit nutrition, emphasizing key nutrients, health-promoting qualities and possible effects on human health are the topic taken for discussion in this review.

Keywords

cucurbits; gourds; minerals; nutrition; vegetables; vitamins

Introduction

Vegetable being a good source of vitamins and minerals, are considered as protective food. Worldwide a broad variety of vegetables are grown because they are abundant in nutrients, offer lot of health advantages and being staple diet. Because of diverse range of nutritional values and pharmacological activity, cucurbits are farmed widely and consumed worldwide (1). Cucurbitaceae family consists of 110 genera and 650–850 species with a global distribution primarily in tropical and subtropical areas. *Momordica* 45 (bitter gourd), *Cucumis* 25 (cucumber, muskmelon), *Cucurbita* 15 (pumpkin, gourd, squash), *Lagenaria* 6 (bottle gourd) and *Luffa* 6 (sponge gourd) are some of their most abundant genera (2). Generally cucurbits possess high water content which helps to maintain body hydration level and promote healthy skin. Most of the cucurbitacious fruits contains various vitamins, minerals and antioxidants and they act as immunity booster, energy provider and chronic diseases reducer. (Fig. 1)

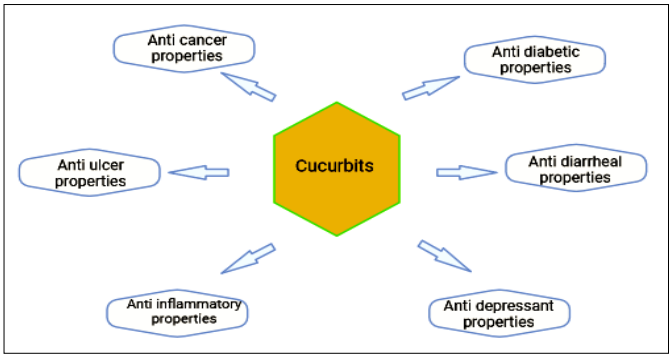

Fig. 1. Health benefits of cucurbits.

Bioactives of major cucurbits

Pumpkin (*Cucurbita moschata* Duch.)

Pumpkin plants are annual vines with branching tendrils and broad lobed smooth leaves having round or oblong shape, ribbed fruit skin that are green, yellow, orange color, contains a good source of vitamins, minerals, carotenes, dietary fibre and carbohydrates (3). 100 g of fresh fruit contains 99.6% moisture, 4.6 g carbohydrates, 1.4 g protein, 0.1 g fat, 0.7 g fiber, 0.6 g minerals, 0.7 mg iron, 10 mg calcium, 30 mg phosphorus, 50 mg of carotene, 0.06 mg thiamine, 0.04 mg riboflavin, 0.5 mg niacin and 2 mg of vitamin C (4). Provitamin A, calcium, iron and zinc are the micronutrients found in tender leaves and shoots which are used as green leafy vegetable. Fruits of pumpkin possess various health benefits like antimicrobial, anti-inflammatory, antidiabetic, anti carcinogenic, antihyperlipidemic, antiviral, antihyperglycemic, antimicrobial activities and the presence of high antioxidant cures chronic diseases, obesity and inhibit kidney stone formation (5).

Seeds of pumpkin are abundant in protein, fiber, PUFA (Polyunsaturated fatty acids), phytosterol, vitamins and minerals such as calcium, magnesium, iron, zinc, manganese, copper and sodium. Pumpkin seeds cures various illnesses and own a positive health effects on blood sugar, cholesterol, immunity, liver function, gallbladder, prostate gland, depression, inflammation, cancer prevention and parasite inhibition. Tryptophan, found in high concentrations in pumpkin seeds (576 mg/100 g), converted into a neurotransmitter called serotonin, helps to overcome depression (6).

Pumpkin seed protein is known as cucurbitin, made up of prolamins, glutelins, albumins and salt-soluble globulin. Seeds have heart-healthy polyunsaturated fatty acids, squalene, phytosterols, phenolic compounds, tocopherols, carotenoids, triterpenoids and flavonoids, they promote healthy bone growth, nerve impulse transmission and hormone control (7). They serve as a treatment for depression and hypocholesterolemic (6). The alcohol insoluble polysaccharides (AIP) present in pumpkin peels have the ability to reduce bile acid and promote the development of gut bacteria (8). Peels of pumpkin are high in nutrients *viz*., proteins, lipids, minerals, phytonutrients (9) and the bioactive substance pectin (10).

Bitter gourd (*Momordica charantia* L.)

Among the cucurbitaceous vegetables, bitter gourd is one of the most widely consumed due to its typical anti-diabetic property. 100 g of fruit contains 92.4 g water, 1.6 g Proteins, 0.2 g fat, 4.2 g carbohydrates, 0.8 g fiber, 20 mg calcium, 70 mg phosphorus and 88 mg vitamin C (4). The bitter gourd is rich in valuable minerals and relatively little calories. It possess a high dietary fiber, beta-carotene, zinc, phosphorus, manganese, magnesium, vitamins A, B1, B2, B3, B9 and vitamin C (11). Fruits are rich in iron 0.76 -6.14 mg/100 g of flesh. The leaves and fruits have long been used as a medicine to cure colic and diabetes (12). The bitter compounds found are charantin, vicine, glycosides and arabinosides. Strong hypoglycemic compound known as "charantin," made up of a combination of steroids used to treat diabetes for lowering blood sugar levels (13).

There are numerous bioactive substances present in the fruits including vitamins, minerals, polypeptides and alkaloids present in fruits. Oleanane and Cucurbitane-type triterpenoids are two groups of saponins create diversity of bioactive chemicals exhibit anti-diabetic, antiviral, anti-cancer, anti-tumour, anti-oxidant, anti-inflammatory, analgesic, hypolipidemic and hypocholesterolemic properties. Beta-carotene helps to improve eye vision (14, 15). Bitter gourd fruit juice increases physical stamina and helps to reduce chronic weariness. Seeds of bitter gourd has 35–40% of oil which contains 59.96% of polyunsaturated fatty acids, 36.71% of saturated fatty acids and 3.33% of monounsaturated fatty acids (16).

Watermelon (*Citrullus lanatus* [Thumb])

Watermelon is a popular crop cultivated worldwide, contains high level of (4.5mg/100g) powerful antioxidant lycopene (17). Fruits are rich in natural organic sugars like glucose, sucrose, fructose and contains β-carotene, minerals, vitamins, potassium, magnesium, calcium and iron (18). 100 g of watermelon flesh contains 91.5 g of water, 7.2 g of carbohydrates, 0.6 g of protein, 0.5 g of fiber, 0.2 g of fat, 8.0 mg of calcium, 0.2 mg of iron, 11.0 mg of magnesium, 9.0 mg of phosphorus, 116.0 mg of potassium, 2.0 mg of sodium, 9.6 mg of vitamin C, 0.14 mg of vitamin B6, 366 IU of vitamin A, 0.2 mg of niacin and very low cholesterol and sodium (4).

High concentrations of amino acids found in the fruit are citrulline, L-arginine, cucurbitacin E and triterpene which are anti-inflammatory phytonutrient. It contains phytochemicals that can lower the risk of cardiovascular disease, stroke and cancer according to several epidemiological studies (19). A study report by (20) shows that the fruits are rich in phytochemical compounds called cucurbitacins and their glycoside derivatives have strong biological activities like hepatoprotective, anti-inflammatory, anti-tumor, antimicrobial and anthelmintic effects.

Seed oil of watermelon are being used for cooking and incorporated in cosmetic and pharmaceutical industries. The oil possess anti-inflammatory, anti-ulcer, anti-microbial, antifungal, anti-oxidant and hepatoprotective properties (21). Seeds are excellent source of vitamins, minerals particularly calcium, potassium, magnesium, phosphorus, phytochemicals, fat and protein (22). The high iron content in the seed (7.28 mg/100 g) helps for synthesis of blood haemoglobin (23).

Cucumber (*Cucumis sativus* L.)

Cucumbers produces cylindrical elongated fruits with smooth green skin and are low in fat, calories, cholesterol and salt, rich in potassium, sodium, calcium, vitamin C, niacin, phosphorus, iron, calcium and thiamine. The concentrations of steroids, terpenoids, glycosides and resins are higher in cucumbers but the levels of saponins, alkaloids and flavonoids are intermediate (24). The edible part of 100 g contains 96.3 g water, 0.4 g protein, 0.4 g fiber, 5.7 g carbohydrates, 0.04 mg riboflavin, 0.4 mg niacin and 4.0 mg vitamin C (4). Fruits nourishes and give glow to the skin, helps to remove the accumulated pockets of chemical pollutants and waste products from the body, acting as a cleansing agent (25).

Cucumbers are rich in polyphenolics and cucurbitacins, which have a range of biological actions, including anti-inflammatory, anti-hyperglycemic, antioxidant, anti-carcinogenic, anti-hyaluronidase, anti-elastase, diuretic, amylolytic, antibacterial and analgesic properties (26). When applied topically to inflamed skin, cucumbers enhance their cooling, calming, healing, emollient and anti-itching characteristics. The whole fruit when applied externally as a poultice cures burns, sores, scolds, wounds. As a cosmetic, fruits are used for skin softening and whitening. The decoction of the green fruit is recommended for cough exclusion and to treat bronchitis, asthma, dyspepsia, piles, hepatitis, diarrhea. Raw fruits are acts as a laxative, anthelmintics and antipyretic. These also cures menstrual disorders, blemished skin rash, while half-ripe fruits acts as purgative (27).

Bottle gourd (*Lagenaria siceraria* [Mol.] Standl.)

Bottle gourd produces large elongated fruits in various sizes and shapes. The fruits have a smooth, light green to dark green skin with pale spongy flesh inside, contains moderate levels of protein, vitamins B and C. Fresh bottle gourd flesh of100 g contains 96 g water, 2.5 g carbohydrates, 0.2 g protein, 0.1 g fat, 0.6 g fiber, 0.6 g minerals, 0.46 mg iron, 20 mg calcium, 10 mg phosphorus, 0.3 mg thiamine and 0.2 mg niacin (4). Choline (1.6%) present in the fruit is a precursor of acetylcholine, a substance that transmits nerve impulses and helps to subside neurological effects (28). Bottle gourd is a good source of dietary fiber and minerals which are beneficial to brain function (29).

Bottle gourd juice helps to manage blood pressure and hypertension, due of its high potassium content. Due to its high dietary fiber content, low fat and cholesterol level, it aids in rapid weight loss. The fruit is regarded as a significant vegetable because of its capacity to preserve and improve human memory (30). Fruits are laxative, cardioprotective, diuretic, hepatoprotective, hypolipidemic, stimulant of the central nervous system, anthelmintic, antihypertensive, immunosuppressive, analgesic, adaptogenic and free radical scavenger (31). Seeds of bottle gourd provide protein, fat, micro and macronutrients, various essential amino acids which address malnutrition when used appropriately (32).

Snake gourd (*Trichosanthes cucumerina* L.)

Snake gourd is a common vegetable that yields short to lengthier fruits. The fruits skin is smooth and features white patterns or stripes running along the length. Fruits contain high concentrations of minerals, vitamins A, B, C, E, proteins, lipids, fiber and carbohydrates. Fresh fruit weighing 100 g has 155µg carotene, 0.05 mg thiamine, 0.06 mg riboflavin, 0.5 mg niacin, 2.0 g protein, 0.3 g fat, 0.5 g minerals, 30 mg calcium, 40 mg phosphorus, 1.7 mg iron and 29 mg vitamin C (4). The most common minerals present in the fruits are potassium, phosphorus, sodium, magnesium and zinc (33).The plant has vital minerals, soluble and insoluble dietary fibers, flavonoids, carotenoids and phenolic acids makes it pharmacologically and therapeutically useful (34).

Snake gourd contains a variety of phytochemicals, including tannins, alkaloids, flavonoids, glycosides and steroids, hence used by pharmacological industries. Plants are recognized for their antioxidative qualities, aid for defending the body against damage caused by free radicals to cell structures, nucleic acids, lipids, proteins and other bodily components. It lowers the risk and slow down the development of numerous acute and chronic illnesses, including cancer, diabetes, cardiovascular disease and other metabolic syndromes (35). The leaves are better source of fat, protein, carbohydrates and minerals. Snake gourd seed oil contains high quantities of ash and crude protein (36). Snake gourd possess many health benefits which include burn healing, lowering blood sugar in type 2 diabetics, reducing inflammation, lowering cancer risk and boosting immunity (37).

Musk melon (*Cucumis melo* L.)

Musk melon has an oval or spherical form with a rough, netted outer skin. Ripe fruit has soft, juicy, delicious flesh of orange or pale green in color. The fruits are excellent source of minerals, especially calcium, phosphorus, iron, vitamins A and C, low in cholesterol, fat and calories. 100 g of muskmelon flesh contains nutrients *viz.*, 0.6 g protein, 0.2 g fat, 3.5 g carbohydrates, 32 mg calcium, 14 mg phosphorus, 1.4 mg iron, 16 mg beta-carotene, 1.2mg vitamin and 26 mg vitamin C. Muskmelon's sweetness is attributed due to its sugars viz., glucose, fructose, sucrose and mannose. Fruits are good for heart diseases because of the anticoagulant 'Adenosine' presence, anti carcinogenic property is due to its high β-carotene content and due to high potassium content hypertension is reduced (4)

Musk melon fruits have number of biological actions such as antihyperlipidemia, antiglycation, antioxidative, anti-inflammatory, analgesic and antidiabetic qualities (38). Fruits have higher concentration of polyphenol antioxidants, which support the cardiovascular and immune systems (39). Seeds are an excellent source of energy, fat, carbohydrates, proteins and secondary metabolites like flavonoids, phenolic, saponins, alkaloids, antioxidants, vitamin E and vital fatty acids (40).

Ridge gourd (*Luffa acutangula* [L.] Roxb.)

The long ridged skin of the fruit gives a unique look. The

colour of the fruits ranged from light to dark green. Fruits are considered as a "Nutrition powerhouse" because of its high and diversity of nutrient content such as iron, magnesium, manganese, zinc, riboflavin, dietary fiber, low saturated fat and cholesterol. Fresh 100 g fruit provides 95.2 g of water, 0.5 g of protein, 0.1 g of fat, 0.5 g of minerals, 18 mg of calcium, 26 mg of phosphorus, 0.5 mg of iron, 0.5 g of fiber, 3.4 g of carbohydrates, 0.01 mg of riboflavin, 0.2 mg of niacin and 5 mg of vitamin C (4). The fruits possess sugars, lipids, protein, phytin, amino acids, arginine, cystine, glutamic acid, glycine, hydroxyproline, leucine, serine, tryptophan and pipecolic acid.

Ridge gourd is a hypoglycemic agent, tonic, expectorant, laxative, purgative and diuretic. The primary chemical components of the fruit are amino acids, pipecolic acid, carotenoids, fat, protein, phytin, saponins and trace amount of fluorine and iodine (41). The peptide and charantin found in the fruit have the ability to regulate insulin, which lowers sugar levels in blood and urine. It has significant cooling effect on the body, acts as a natural detoxifier, purifies the blood and strengthens the immune system, helps to improve the skin glow. (42) reported that there is a strong anthelmintic activity present in the fruits aids in blood purification, weight loss and jaundice. The entire plant is applied topically to heal wounds and ulcers. The seeds contain stable oil composed of glycerides of myristic, stearic and palmitic acids (43).

Ash gourd (*Benincasa hispida* [Thumb.])

Ash gourd is grown for its large, mild-tasting fruit with a pale green waxy coated skin. 100 g of fresh fruit contains 96.5 g moisture, 0.4 g protein, 0.1 g fat, 1.0 g carbohydrates, 0.3 g minerals, 30 mg calcium, 30 mg phosphorus, 0.8 mg iron, 0.8 g fiber, 0.06 mg thiamine and 0.4 mg niacin. Fruit contains β-sitosterin, uronic acid, flavonoids, glycosides, sacchrides and carotenes. The ash gourd is prized for its therapeutic qualities, particularly in Ayurveda to treat peptic ulcers. Terpenes in the fruits found to carry anti-cancer properties (4). Fruit possess rich level of macro and micronutrients, with no fat, low calorie and a comparatively high level of K and Na (44). Fruits act as strong antioxidant, antipyretic, gastroprotective, bronchodilator, anti -ulcer agent.

Due to its nutritional and therapeutic qualities, the fruits facilitate to lessen the risk of chronic illnesses, enhance digestion, boost immunity, shield the heart and improve vision. It generates essential phytochemicals such as steroids and triterpenes (45). Fruits are rich in potassium and low in salt contents. Traditionally the fruits are used to treat blood disorders, dyspepsia, fever, jaundice, menstrual amenorrhea, dysmenorrheal, menorrhagia, urinary calculi, laxative, diuretic, tonic, epilepsy and other psychologic disorders. Seed contains β-sitosterol, n-triacontanol and lupeol which are antiangionic, bronchodilator and anti-ulcer. The seeds contain anosmotin-like protein,acetoin, nonanol, octoanol and acetoin which act as an essential component for glycosidic conjugate (46).

Sponge gourd (*Luffa cylindrica* [L.] Roxb.)

Sponge gourd produces elongated fruits with smooth green skin as they mature the skin becomes soft like sponge and develops fibre inside when maturity approached. Fruits possess good source of carbohydrates, minerals, fibers, composed of 60 % cellulose, 30 % hemicelluloses and 10 % lignin (47). 100 g fresh fruit contains 93.2 g water, 1.2 g protein, 0.2 g fat, 0.5 g minerals, 20 mg calcium, 30 mg phosphorus, 0.36 mg iron, 2.0 g fiber, 2.9 g carbohydrates, 0.02 mg of thiamine, 0.06 mg of riboflavin and 0.4 mg of niacin (4). Fruits are good source of vitamin A and C. Numerous minerals, including tannin, oxalate, phosphorus, phytic acid, Mg, Na, Cu, Zn and Mn, shows that it is a potential vegetable protein source in human diet (48).

Fruits boost up immunity and helps to cure various ailments, such as inflammatory conditions, diarrhea and viral infections treated with sponge gourd fruits and the triterpenoids (sapogenins 1 and 2) detoxify and rejuvenate the skin, promote circulation and varicose veins (49). Dishes made from immature fruit are beneficial for diabetics. Due to its easy digestion, it is recommended for people with suffering from fevers and malaria. The phytochemicals flavonoids, tannins, cardiac glycosides, saponins, exhibit antimicrobial and antibacterial properties (50).

Ivy gourd (*Coccinia grandis* L.)

Ivy gourd is consumed widely to cure diabetes since it lowers blood sugar. 100 g of edible fruit contains 93.5 g moisture, 1.3 g protein, 0.1 g fat, 0.5 g minerals, 40 mg calcium, 30 mg phosphorus, 1.4 mg iron, 1.6 g fiber, 3.1 g carbohydrates, 156 µg carotene, 0.07 mg thiamine, 0.08 mg riboflavin, 0.07 mg niacin and 15 mg vitamin C. The leaves are edible and rich in vitamins particularly vitamin A (8000–18000 IU) in 100 g leaves (4). Ivy gourd fruits are safe, environment friendly treats diabetes without any negative effects (51). The phytochemicals *viz.,* alkaloids, tannins, saponins, phenols, amino acids, carbohydrates, reducing sugar and flavonoids have therapeutic efficacy. The leaves are used as dietary additive (52).

Ivy gourds carries anti-hyperglycemic properties because they contain pectin, which inhibits the small intestine's ability to absorb glucose (53). Pectin in the fruit, leaf, stem and root reduces the amount of glucose absorbed from the gut and triterpenoids enhances insulin secretion (51). All the plant parts possess antipyretic, analgesics, antioxidants, anti-bacterial, anti-mutagenic, hepatoprotective and expectorant properties, reduces diabetes, ulcers, wounds and jaundice (54).

Bioactives of Minor cucurbits

Chayote (*Sechium edule* [Jacq.])

Chayote is a pear-shaped fruit with thin, pale green skin, smooth and firm texture, contains a single, large seed in the center. 100 g of edible portion contains 92.5 g moisture, 0.7 g protein, 0.1 g fat, 0.4 g minerals, 30.63 mg phosphorus, 0.34 mg iron, 0.6 g fiber, 5.7 g carbohydrates, 0.04 mg riboflavin, 0.4 mg niacin and 4.0 mg vitamin C. Chayote is rich in protein, minerals and carbohydrates (4).

Chayote seeds have low lipid (less than 1%) and high protein (1%) content (55). Chayote flour helps to lower blood pressure and diabetes (56). Arteriosclerosis, hypertension and kidney stones are treated with leaf infusion. The chayote flour contains potassium (3.9 mg/100 g), sodium (8.6 mg/100 g) and calcium (6.6 g/100 g). The plant parts like leaves, fruits and seeds have been utilized in traditional medicine to treat the ailments like diabetes, obesity, arteriosclerosis and kidney disorders (57).

Gherkin (*Cucumis anguria*)

Gherkins are small cucumbers, with the fruit length ranges from 1 to 3 inches. The fruits are slightly coarse in texture with high moisture and low calories (25). Majority of fruit (95%) is made up of water, with trace amounts of protein (0.6%), fats (0.1%) and carbohydrates (2.2%). Fruit components include total sugars (1.38 g), total dietary fiber (0.7 g), glucose (0.63 g), fructose (0.75 g), starch (0.08 g) and nutrient content of choline (5.7 mg), betaine (0.1 mg), beta -carotene (31 µg), alpha-carotene (8 µg), beta cryptoxanthin (18 µg), lutein+zeaxanthin (16 µg), vitamin C (3.2 mg), thiamin (0.031 mg), riboflavin (0.025 mg), niacin (0.037 mg), pantothenic acid (0.240 mg), vitamin B6 (0.051 mg), folate (14 µg), γ-tocopherol (0.02 mg) and vitamin K (72 mg). They are abundant in micronutrients, polyphenolics, phytochemicals and bioactive substances (26).

Since ancient times, fruits are utilized for culinary purposes, therapeutic and cosmetic product preparation (58). The components like cucurbitacin B, cucurbitacin D and cucurbitacin G used in cancer treatment. It consists of many useful compounds such as flavonoids, tannins, alkaloids, saponins, steroids and possess high level of antioxidant activity. Anthraquinones and saponins are used as an antibacterial and antifungal agents. Fruits possess a variety of biological properties, including anti-inflammatory, anti-hyperglycemic, anti-inflammatory, anti-carcinogenic, antioxidant and analgesic properties (59).

Pointed gourd (*Trichosanthes dioica* [Roxb.])

The fruit of pointed gourd is long, with tapering tips that give the fruit a pointed look. Usually green when immature, upon ripening turn to orange-red color. The nutrients *viz.*, iron, protein, vitamins A and C are all abundantly available in it. Out of 100 g of edible part, 92 g water, 2.0 g protein, 0.3 g fat, 0.5 g total minerals, 3.0 g fiber, 2.2 g carbohydrates, 153 µg carotene, 0.5 mg niacin and 29 mg vitamin C are present in the fruit and they have the capacity to lower the total cholesterol and blood sugar (4).

The fruit has moderate amount of vitamin B-complex and minerals, including potassium, sulfur, magnesium, sodium and copper. 100 g leaves have 5.4 mg protein content, 4.2 mg fiber, 5.8 mg carbohydrate, 1.1 mg fats, 531 mg calcium and 73 mg phosphorus. Additionally, they contain powerful bioactive compounds such as triterpenes and polyphenols to improve health and immunity (60). The bioactive compounds in fruits *viz.,* peptides like trichosanthin, lectin, triterpenes like cucurbitacin B, euphol, α-amyrin, β-amyrin, lupeol, taraxerol, betulin, karounidiol, sterols, steroidal saponin, tannin and flavonoids exhibit antihyperglycemic, antihyperlipidemic, antitumor, cytotoxic, anti-inflammatory and antidiarrheal properties (61).

Many medicinal qualities are present in the root, stem, leaf, fruits and seed, such as antidiabetic, anti-ulcer, antioxidant, antipyretic, wound healing, laxative and hepato-protective effects (62). It is used to treat jaundice, skin diseases, viral infections, fever, flu, disorders of the ears, nose and throat, gastritis, bloating and anaemia (63).

Winter squash (*Cucurbita maxima* [Duch.])

Winter squash has a sweet, nutty flavor and a dense, creamy texture with a hard, thick skin that protects the flesh inside. Excellent sources of mineral elements like P, Ca, Mg, K, Fe, Cu, Zn, alkaloids, tannins, flavonoids and glycocides are found in *Cucurbita maxima* are essential for body's growth and maintenance. Fruits are rich source of vitamins, carotenes, nutrients like carbohydrates, minerals and dietary fibers. It possess the properties like hypoglycemic, in-vitro antioxidant, suppression of tyrosinase, cholinesterase and hypolipidemia (64). The bioactive elements present in the fruit are used to treat depression and low blood cholesterol (6).

The seeds have hepatoprotective, wound-healing, anti-ulcer, anti-diabetic and antioxidant qualities (65). Due to their high zinc content the seeds are utilized to treat hypertension, coronary heart disease risk and prostate problems in their early stages. Significant concentrations of bioactive chemicals with pharmacological properties, such as antibacterial, antifungal, anti-mutagenic, antioxidant, anti-hyperglycemic, antidepressant and anti-inflammatory properties are present in the fresh leaves and flowers (66). The harmful pathogens *viz., Pseudomonas aeruginosa, Escherichia coli, Bacillus subtilis*and *Staphylococcus aureus* are all significantly inhibited by *C. maxima* leaf extract (67).

Summer squash (*Cucurbita pepo* L.)

Summer squash are harvested during the summer months while they are still immature, with tender skin. Phenolic compounds such as chlorgenic acid, benzoic acid, quercetin, luteolin, kaempferol, syringic acid, p-coumaric acid, sinapic acid, β carotene and tannin are present in the fruit (68). The nutrients *viz.,*1.4 g protein, 3.9 g carbohydrate, 0.2g fat, 22 cal energy, 140 IU vitamin A, 0.07 mg B1, 0.04 mg B2, 18 mg vit C, 0.6 mg niacin, 17 mg Ca, 38 mg P, 0.5 mg Fe, 340 mg K, 94.8 g moisture and 0.6mg iron are present in 100 g of edible part (4).

Squash seeds contains 39.50% protein, 33.46 % fat, 10.93 % carbohydrates and 1.59 % fiber content. Squash seeds are eaten as an appetizer and to treat prostate issues and parasite-related diseases. Antioxidants such as phenolic compounds, carotenoids, lutein, zeaxanthin, beta -carotene and dehydroascorbic acid are present in the fruit. They combat cancer and other chronic illnesses due to their anti-proliferative and pro-apoptotic properties (69) (Table 1).

Table 1. Nutritional and therapeutic component of cucurbits

S. No.	Name of the vegetable	Bio active compounds	Key nutritional component	Therapeutic component	Reference
1.	Pumpkin	Phytosterols	Beta carotene and vitamin A	Blood sugar regulation	(5)
2	Bitter gourd	Terpenoids and Saponin	Vitamin C and potassium	Anti hyper glycemic and anti viral	(15)
3	Watermelon	Citrulline and xanthophyll	Vitamin A and Vitamin C	Regulates autonomic nervous system	(19)
4	Cucumber	Cucumegastigmanes 1, 2 and orientin	Vitamin K and C	Anti inflammatory and antioxidant	(24)
5	Bottle gourd	Omega 3 and flavone c glycosides	Vitamin B1(thiamine) and vitamin B2 (Riboflavin)	Anti cancer and reduce heart stroke problems	(29)
6	Snake gourd	Beta Sitasterol, Triterpenes	Vitamin C and Potassium	Collagen synthesis and regulates fluid balance	(37)
7	Musk melon	Alpha tocopherol and cryptoxanthin	Vitamin A and folate	Supports immune system	(39)
8	Ridge gourd	Linoleic acid and palmitic acid	vitamin B2 (Riboflavin) and vitamin C	Reliefs respiratory issues and lowers blood sugar	(41)
9	Ash gourd	Alonusenol and Multiflorenol	Vitamin C and Vitamin E	Anti obesity and anthelmintic	(45)
10	Sponge gourd	Formononetin and genistein	Lignin, hemicelluloses and cellulose	Anti diabetic and Anti malarial	(50)
11	Ivy gourd	Triterpenes and ellagic acid	Total phenols Beta carotene	Anti hyperglycemic	(51)
12	Chayote	Diosmetin 7- O Rutinoside	Folate, Iron and Calcium	Hypoglycemic and anti ulcerogenic	(57)
13	Gherkin	Alpha-tocopherol	Vitamin A and Vitamin C	Anti carcinogenic and anti hyperglycemic	(26)
14	Pointed gourd	Lupeol	Lutein and Zeaxanthin	Anti-tumour and anti hyperlipidemic	(63)
15	Winter squash	Catechin and kaempferol	Vitamin B6 and potassium	Anti ulcer and anti depressant	(65)
16	Summer squash	Salicylic acid and protocatechuic acid	Folate, Thiamin and Niacin	Anti proliferative and pro apoptotic properties	(69)

Bioactives of lesser known cucurbits

Spine gourd (*Momordica dioica* Roxb.)

Spine gourds are elongated, cylindrical fruits green when immature turns to yellow-orange coated with spines or prickles on ripening. 100 g of spine gourd fruit contains 84.1 % moisture, 7.7 g carbohydrates, 3.1 g protein, 3.1 g fat, 3.0 g fiber, 1.1 g minerals, 9.1 % ash and trace amount of ascorbic acid, carotene, thiamine, riboflavin and niacin (70).

The fruit possess diuretic, laxative, hepato protective, anti-venomous, anti-hypertensive, anti-inflammatory, anti-asthmatic, antipyretic, anti-leprosy, anti-diabetic and anti-depressant properties and leaves acts as anti-helminthic, anti hemorrhoidal, hepato protective, anti bronchitic and analgesic properties (71). Fruits lowers blood pressure, enhances cardiovascular health and strengthens the body's defence mechanism against illness. Bioactive components *viz.,* polyphenols, carotenoids, flavanoids, tannins, alkaloids, steroids, triterpenoids and saponins, found to have anti-inflammatory, anti-pyretic, anti-venomous, hepatoprotective, diuretic, laxative and anti-depressant properties (72).

Sweet gourd (*Momordica cochinchinensis* [Lour.])

Fruits of sweet gourd are sweet in nature both in cooked and salad form. They gained attention as a possible source of carotenoids, particularly β-carotene and lycopene (73). It is often known as gac fruit with very high concentration of polyunsaturated fatty acids and α-tocopherol (vitamin E), as well as exceptionally high quantities of carotenoids. Carotenoids and bioactive components of the fruit possess anticancer properties (74). The fruits are rich in phytochemicals and are regarded as "super" fruits because of their special antioxidants. The peel, pulp, seeds and aril of fruits are also rich in phytonutrients and have long been utilized in traditional medicine and folk healing. These carotenoids support a range of health advantages, such as anti-inflammatory, anti-cancer and cardiovascular protection properties (75).

Balsam apple (*Momordica balsamina*)

Balsam apple is a tropical vine that produces small and oblong shaped fruits. Resins, alkaloids, flavonoids, glycosides, steroids, terpenes, cardiac glycoside and saponins are found in plant parts like fruits, leaves, bark and seeds. It has mineral composition *viz.,* potassium, magnesium, calcium, salt, zinc, manganese, iron and amino acids. A diet high in potassium is beneficial for controlling hypertension and cardiovascular diseases (76). Plant contains a wide variety of phenolic acids, including quinic acid and different types of chlorogenic acids which exhibits anti-inflammatory, antioxidant, anti-diabetic, anti-malarial, anti-diarrhea, antiseptic, anti-bacterial, anti-viral, hypoglycemic, analgesic and hepatoprotective properties. Viruses can't proliferate in the therapeutic agent "Momordin". The fruits are rich in phenolic phytocompounds, which exhibit health-promoting qualities like lowering blood sugar, cholesterol, cancer and certain cardiovascular disorders (77).

Snap melon (*Cucumis melo* var. *momordica*)

Snap melon is a fruit with many nutritional benefits; 100 g of edible fruit contains 15.6 g of carbohydrates, 18.6 mg of vitamin C and 74.0 k calories. Fruit has 0.3% protein, 0.1% fat, 95.7% moisture and 265 IU of vitamin A per 100 g flesh (78). They are good sources of vitamin C, vitamin A, sugars, minerals and dietary fibre. This fruit is used to make a refreshing beverage which cools the body. The primary antioxidants in snap melon are ascorbic acid, carotenoids, phenolic compounds. The fruit and seed contain phenolics compounds possess antioxidant and antidiabetic activity helps to reduce oxidative stress (79). The seeds contain 12.5 to 39.1% edible oil. Omega-3 fatty acids and vitamin E are abundant in seeds (80)

African horned cucumber (*Cucumis metuliferus*)

Fruits have spiky, vivid orange-yellow skin covered in protrusions that resemble horns. The fruit are high in fiber, vitamin C and saponin an oily glycoside that is the core cause of postpartum pain alleviation. Fruit has a high concentration of calcium (21.25±25.40 mg/100 g), magnesium (47.87±10.53 mg/100 g), vitamin C (275.07±44.23 mg/100 g) and acidity (6.5±1.45 meq/100 g) (81). The vitamin A of the fruit improves vision, vitamin B content aids in rehydration and other vitamins replenishing the daily requirement by our body (82). The fruit has higher water content which is crucial in the removal of toxins from the body and low in calories making perfect diet and to lose weight. They provide adequate amount of potassium, iron and trace levels of calcium, magnesium, zinc, sodium, copper and phosphorus.

The oleic acid of the seed aid in blood pressure reduction, linoleic acid an omega fatty acid facilitate to improve human health. The seeds also possess the antioxidants *viz.,* γ-tocopherol and α-tocopherol. These two forms of vitamin E offer numerous health advantages to cells and organs, including the skin, muscles, neurons, heart and red blood cells, Flavonoids, alkaloids, steroids, tannins and saponins are the major constituents. Although phytochemical substances have a broad range of actions, in african horned cucumber exhibit antibacterial, antifungal, antiviral and anti-spasmodic properties (83).

Bitter apple (*Citrullus colocynthis* L.)

Bitter apple produce small, round fruits that are unpalatable when raw because of their intense bitterness. The fruit has good amount of crude fiber (7 – 8 %), protein (8 – 9 %), fat (6.5 - 7.5%), carbohydrates (58%) and energy (339.69 kcal/100 g). The glycosides, flavonoids, alkaloids, fatty acids and essential oils along with curcurbitacins A, B, C, D, E, I, J, K, L and colocynthosides A and B, present in the fruit possess diverse biological activities, including antioxidant, cytotoxic, antilipidemic, insecticide and antimicrobial properties (84). The fruits contains a laxative agent in conventional medicine and been utilized in traditional medicine for their possible therapeutic benefits, like anti-inflammatory and antidiabetic effects. Ash, protein, fat and carbohydrates are found in seeds (85). Approximately 70% of seed oil is made up of unsaturated fatty acids, which include linoleic acid (55 - 74 %), oleic acid (9 – 17 %), palmitic acid (8.35 - 11.70 %) and stearic acid (5.36 - 9.84%) (86).

Fig leaf gourd (*Cucurbita ficifolia*)

Fig leaf gourd produces elongated fruits which are edible when ripe. Both fruits and seeds are rich in vitamins, minerals and nutraceuticals that helps to prevent cardiovascular illnesses. In traditional medicine, fruits are being used to treat fever, haemorrhoids and gastrointestinal issues (87). It contains a special vitamin called vitamin B8, also called D-chiro inositol, which helps to reduce the diabetes by acting as an insulin mediator or natural anti-hyperglycemic agent (88). The oil has a high proportion of mono and poly-unsaturated fatty acids, particularly omega-9 (18:1) and omega-6 (18:2). Fruit oil has the ability to fight oxidative damage since it is rich in many antioxidants, particularly flavonoids and carotenoids (89).

Buffalo gourd (*Cucurbita foetidissima*)

The fruit pulp and peel of buffalo gourds contains high concentration of starch and other components like pectins, resins, water-soluble organic acids and vitamins. Buffalo gourds are known for their good source of nutritional and medicinal qualities (90). Fruit oil has 45–65% linoleic acid content and roots have dry weight starch level of more than 55% . The seeds have high oil (28%) and protein (29%) content. Due to its high percentage of linoleic acid and very low percentage of linolenic acid, the oil has a high unsaturated to saturated fatty acid ratio (63%) to be used as a desirable food oil (91).

Conclusion

Cucurbitaceous vegetables have immense value in terms of food, nutrition and therapeutic . These vegetables supply vital nutrients like vitamins and minerals in various compositions and are crucial to overall human health. From the nutritional perspective, regular consumption of cucurbitaceous vegetable offer undeniable positive effects on health. The phyto nutraceuticals, whole dietary antioxidants, pharmacological activities exhibit high level of health promoting roles in humans to prevent and manage degenerative chronic diseases and rectify disorders. They are recommended as a healthy source to be incorporated in food and drinks to serve as nutraceuticals and nutritional supplements. Thus cucurbit consumption with essential nutrients nourishes our bodies and provides good health.. By adding cucurbits in the diet, taste of the food is enhanced, nutritional benefits are exploited, health is improved and altogether more active lifestyle is encouraged.

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Authors' contributions

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