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Phytochemical and Biological Studies of *Cucurbitaceae*: A Mini- Review

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Abstract

Cucubitaceae is the largest family of fruits and vegetables consisting of more than 800 species; with characteristic edible and medicinal value. This family serves as a reservoir for numerous phytochemicals, including tannins, cardiac glycosides, terpenoides, carbohydrates, resins, saponins, carotenoids, and phytosterols. These phytochemicals impart distinguished anti-microbial, anti-oxidant, anti-viral, anti-ulcerative, hepatoprotective, cardio-porotective, anti-cancer and anti-diabetic properties. These traits attribute to its distinctive biological impetus; as discussed in this min-review.

KEYWORDS

Cucurbitaceae, Phytochemical, antioxidants, glycosides

1.0 INTRODUCTION

With about 960 species and 125 genera, the *Cucurbitaceae* family is the largest family of fruit and vegetable crops.*Cucurbitaceae* vegetables have long been used in traditional medicine and cuisine.It is mentioned for its therapeutic value in Indian folk medicine and Ayurveda, and it could be a source for safe and effective therapeutic development. Cucurbitoideae and Zanonioideae are the two main subfamilies into which the plants in this family are further divided according to their morphological, cytological, and floral traits.With 15 tribes and related genera, the subfamily Cucurbitoideae is where the majority of edible varieties have their origins. In the Indian subcontinent, edible food plants are primarily produced by four tribes: Benincaseae, *Cucurbitaceae*, Momordiceae, and Sicyoeae. The Cucurbiteae tribe produces a variety of commercially valuable fruits, such as melons (Cucumis melo), squashes (Cucurbita spp.), gourds (Cucurbita spp.), and luffas (Luffa spp.). There are more than 800 species of the *Cucurbitaceae* family of crops known to science. This family of vegetables has long been valued for its medicinal properties in addition to its use for food. Cucumber and pumpkin are the most recognisable cucurbits; they are grown and eaten throughout the world. Cucurbit seeds are a common snack and have a number of

health advantages. Carotenoids, terpenoids, saponins, and phytochemicals abound in cucurbit plants. Cucurbit vegetables, belonging to the *Cucurbitaceae* family, are beneficial to human health. Numerous studies have demonstrated their antioxidant, antidiabetic, anti-inflammatory, and purgative qualities [1-3]. The naturally occurring non-nutritive chemical components of plants are known as phytochemicals, or phytochemicals are chemicals that are derived from plants [4]. Numerous phytochemicals, including tannins, cardiac glycosides, terpenoides, carbohydrates, resins, saponins, carotenoids, and phytosterols, have been confirmed to be present in the plants belonging to the *Cucurbitaceae* family through phytochemical analysis. In living things, glycosides have a variety of significant functions. Amygdalin was the first glycoside to be discovered in 1830. The class of medications known as cardiac glycosides is primarily utilised in the management of cardiac conditions. By strengthening the contraction, they serve to raise the cardiac output. The cardiac glycosides contribute to an increase in calcium-induced calcium release and, consequently, contraction by raising intracellular calcium. Cardiac glycosides are used in the cardiac treatment of congestive heart failure. They also have anti-inflammatory properties and provide protection against deadly endotoxemia [5]. Heart glycoside is present in the leaves, seeds, and bark of the Momordicabalsamina plant, which belongs to the *Cucurbitaceae* family. Terpenoides are also referred to as isoprenoids occasionally. These include a wide variety of naturally occurring organic compounds that resemble terpenes [4]. Terpenoides inhibit bacteria and fungi by disrupting their membranes. It exhibits antitumor activity as well. This is a common occurrence in Citrullus colocynthis [5]. By stopping cancer cells from proliferating, saponins have antitumor, anti-mutagenic, cytotoxic, hemolytic, and expectorant properties. They can also reduce the risk of human cancers. Because saponins precipitate and coagulate red blood, they can be used to treat wounds and stop bleeding.This family of Chinese medicinal plants includes hensleyagracilaria, which has saponins1. Tannins, also known as tannoid, are a class of biomolecule found in plants that are identified by a phytochemical process [4]. Extracts of Cucumis sativa (cucumber) and Praecitrullus fistulosus (tinda) have been shown to contain tannins. Due to their astringent qualities, tannins speed up the healing process for irritated mucous membranes and wounds. Tannins have the ability to precipitate protons, chelate metal ions, and function as a biological antioxidant. Ellagitannins have the ability to scavenge free radicals. A unique class of substance known as a phytosterol is present in extracts of Momordicacharantia (Karela), Cucumis sativa (cucumber), and Lagenariasiceraria (Loki). The hypocholesterolemic effect of phytosterols is noteworthy. There are more than 600 different types of carotenoids in nature, which are divided into two classes: xanthophylls, which have oxygen, and carotenes, which only have hydrocarbons and no oxygen. The watermelon (Citrulluslanatus) contains carotenoids. Except for Momordica balsamina 1and Cucumis sativa (cucumber), all seed extracts contained resins [4, 5]. References should be cited numerically in order of appearance, denoted within square brackets, such as [1], [2,3], or [4–6]. The introduction serves to provide essential context for the study and underscore its significance. It outlines the study's purpose, emphasizing its importance within the broader research landscape. It also involves a thorough review of the current state of the field, with references to key publications, and when applicable, it addresses contentious or differing hypotheses. Conclusively, the introduction briefly outlines the study's primary objectives and highlights its principal conclusions. It's important to ensure that the introduction remains accessible to scientists from diverse research backgrounds. References should be cited numerically in order of appearance, denoted within square brackets, such as [1], [2,3], or [4–6].

2.0 METHODOLOGY

In order to write the manuscript, a thorough literature review was conducted using data gathered from books, research articles, journals, and databases like ScienceDirect, Wiley Online Library, SciFinder, Scopus, Springer, Google Scholar, Web of Science, ACS Publications, and PubMed as well as the Indian Ayurvedic Pharmacopoeia protocols should receive in-depth explanations, while well-established methods can

be succinctly described and referenced appropriately.

3.0 RESULTS AND DISCUSSION

Food plants belonging to the *Cucurbitaceae* family, such as Benincasa hispida (Wax gourd), Benincasa fistulosa (Apple gourd), Coccinia grandis (Ivy Gourd), Lagenaria siceraria (Bottle gourd), Cucumis melo (Musk melon), Cucumis sativus (Cucumber), Cucurbita maxima (Pumpkin), Cucurbita pepo (Field pumpkin), Citrullus lanatus (Watermelon), Luffa acutangula (Ridge gourd), Luffa cylindrica (Sponge gourd), Trichosanthes dioica (Pointed gourd It is noted that various *Cucurbitaceae* plant parts are used for veterinary, medical, and nutritional purposes [4, 7].

3.1 Phytochemicals present in Cuurbits And their Biological Impetus

This family of plants is utilised for purposes other than human consumption; they are a vital part of aqua and poultry feed. It is noted that various *Cucurbitaceae* plant parts are used for veterinary, medical, and nutritional purposes. This family of plants is utilised for purposes other than human consumption; they are a vital part of aqua and poultry feed. Furthermore, a few fruits from the *Cucurbitaceae* family may find use in the cosmetics industry [4, 7]. **Table 1** gives an account of genera and species belonging to the *Cucurbitaceae* family along with the list of phytochemicals and their biological potencies. (**See table 1 after reference**).

4.0 CONCLUSION

Thus, the Cucurbetaceae family serves as a hub for characteristic antioxidant, hepatoprotective, cardioprotective, analgesic, anti-diabetic, diuretic, anti-malarial, and anthelminthic properties. This is a distinctive family of fruits and vegetables that contain important phytochemicals that impart significant biological properties.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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Table 1: Phytochemicals and Biological Impetus of *Cucurbitaceae* family

Genus	Species	Phytochemicals	Biological Properties	References
CUCURBITA	Cucurbita pepo (gourd): Known locally as kaddu, konda, and kumra, and also as pumpkin, gourd, acorn squash, marrow, and summer squash.	• About half of the oil extracted from pumpkin seeds is linoleic and oleic acid, with the remaining 50% being sterols (mainly sitosterol and stigmasterol) and Δ7 sterols (avenasterol, spinasterol). • Moreover, it includes carotenoids, α-tocopherol as the main tocopherol, squalene, triterpenoids, and sesquiterpenoids. • Minerals (Particularly phosphorus, potassium, magnesium, calcium, iron, zinc and trace elements). • Proteins and amino acids. • Carbohydrates (6-10%). • Vitamins (thiamine, riboflavin, niacin, pyridoxine, and pantothenic acid), Phenolic glycosides, and lignans.	• Di-uretic and anthelmintic. • Addresses issues related to an enlarged prostate gland and irritable bladder-related micturition issues. • Antioxidant activity (free radical scavenging and inhibitory activity against lipid peroxidation).Anti-androgenic activity. • Immunological activity. • Anti-viral and Anti-fungal activity. • Cardiovascular activity. • Anti-inflammatory activity. • Hepatoprotective activity. • Anti-bacterial properties. • Anti-ulcer and antioxidant activities are exhibited by tetracyclictriterpenoids (cucurbitacins) extracted from seeds. • The fruit is cooling and astringent to the bowels, increases appetite, cures leprosy and purifies the blood. • Seeds cure sore chests, haemoptysis, bronchitis and fever.	6-8
CUCURBITA	Cucurbita maxima (pumpkin)	• There are also phytochemicals like proteins, carbohydrates, saponins, polyphenolics, and flavonoids. • •Iron, calcium, phosphorus, and vitamin A are also abundantly present. • The plant also yields α-tocopherol, gibberellin, and cucurbitaxanthin. • Pumpkins have antioxidant β-carotene, which help to improve the immune function and can reduce the risk of diseases like heart disease and cancer.	• Its anti-inflammatory, anti-tumor, anti-hypertensive, anti-diabetic, and immunomodulatory properties have been traditionally attributed to its proteins and polysaccharides; that have demonstrated anti-cancer activity against melanoma. • Pumpkin seed proteins have been shown to suppress the growth of melanoma. • *Cucurbita maxima* Duchesne aerial parts methanol extract exhibits anti-EAC (Ehrlich Ascites Carcinoma) properties. • Liver and digestive disorders were treated	9-15

			with the seeds. • Spinasterol from the flowers of *C. maxima* showed potential anti-carcinogenic, anti-genotoxic, and anti-mutagenic activity. • It showed anti-microbial activity against the fungi *Aspergillus niger* and *Candida albicans* as well as the bacteria *Bacillus subtilis* and *Pseudonomas aeruginosa.* • The oil from the seeds exhibited anthelmintic property in a dose and time dependent manner. It had no effect on *Trichophyton mentagrophytes, Staphylococus aureus,* or *Escherichia coli*. • The extract has a diuretic effect by inhibiting the kidneys' ability to reabsorb water, electrolytes, and low-molecular-weight organic compounds into the bloodstream. This process encourages the production of urine. The extract may have dose-dependent activity. • *C. maxima* may be investigated for therapeutic benefit as a substitute treatment for medical conditions linked to sedation and vertigo due to its possible CNS stimulant effect. By enhancing the insulin effect of plasma and either increasing the pancreatic secretion of insulin from β-cells of islets of Langerhans or its release from bound insulin or increasing peripheral glucose utilisation, the alcoholic extract of *C. maxima* significantly decreased the elevated fasting blood glucose. Moreover, it has a strong anti-hyper-lipidemic effect that simultaneously raises HDL cholesterol and decreases triglycerides and total cholesterol.	
CUCURBITA	*Cucurbita andreana* (Wild Giant Squash)	• Cyclooxygenase-2 (COX-2) inhibitory and strong anti-cancer properties were demonstrated by *Cucurbita andreana*. Cucurbitacins B, D, E, and I were obtained through fruit extract purification guided by bioassay.	• The anti-inflammatory and growth-inhibiting properties of these cucurbitacins on human colon, breast, lung, and central nervous system cancer cell lines were assessed. • Additionally, the effect on lipid peroxidation and the enzymes cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2) was assessed. • Cucurbitacins B, D, E, and I, in that order, had inhibitory effects on the colon, breast, lung, and central nervous system.	16
CUCURBITA	*Cucurbita ficifolia* (leaf gourd)	• The plant treats diabetes type 2 and heals wounds, haemorrhoids, fever, and other ailments.	• Type 2 diabetic patients showed acute hypoglycemic activity in temporally hyper-	6, 7

			glycemic rabbits and alloxan-diabetic rabbits.	
MOMORDICA	*Momordica charantia* (Bitter gourd). Commonly known as bitter melon or bitter gourd.	• Proteins mimicing insulin and steroidal glycosides that did not cross-react in an immunoassay for bovine insulin; produce hypoglycemic effects caused by insulin-like polypeptides • Upon perenteral administration, P-or V-insulin can result in hypoglycemia in both humans and lab animals. • Alkaloid, such as Kuguacins F-S (cucurbitane-triterpenoids) have also been isolated from the plants. • Vicine (pyrimidine nucleoside) has been isolated from the seeds, and it has been observed that when administered intraperitoneally. Vicine produced a hypo-glycemic response in normal fasting albino rats.	• It exhibits anti-tumor activity towards human nasopharyngeal carcinoma cells. • The seed extract normalises the impaired anti-oxidant status in streptozotocin induced diabetes by scavenging free radicals, thereby reducing the risk of diabetic complications. • Protein fractions from *M. charantia* fruit and seed have anti-cancer qualities. They can stop cell division, guanyl-atecyclase activity, and ribosomal activity. Results showed increased blood haemoglobin and white blood cell count decreased as a result of regular extract consumption in leukaemia patient. • It also has the ability to treat liver diseases and has analgesic, anti-microbial, anti-oxidant, anti-opacity, anti-fertility, anti-inflammatory, and hypotensive properties. • The mature fruits are used externally for fast wound healing and internally for the treatment of peptic ulcers. • The fruits are used as anthelmintic, anti-emetic, carminative, purgative, and for the treatment of anaemia, jaundice, malaria, and cholera. • Found effective against *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, and *Pseudomonas aeruginosa*. • Possess anti-HIV activity as well.	6, 7, 17, 18
Momordica	*Momordica dioica* It is also known as small bittergourd, spine gourd.	• Available phytoconstituents are ascorbic acid, vitamin A, thiamine, riboflavins, niacin, protein carbohydrates, lectins, carotenes, bitter principles, oleanoic acid, stearic acid, gypsogenin, alpha-spiranosterol hederagenin, momordica ursenol, and tri-terpenes of urisolic acid, dark brown semidrying oil and saturated fatty acids. • Alkaloids, β-sitosterols, saponin glycosides, and cucurbitacins and cucurbitaneglycosides • *M. dioica* dry roots yield two steroidal compounds and three tri-terpenes. • Alpha-spinasterol-3-O-beta-D-glucopyranoside (II), alpha-spinasterol-3-O-beta-D-glucopyranoside (III), 3-O-beta-D-glucuronopyranosyl gypsogenin (IV), and 3-O-beta-D-glucopyranosyl hederagenin (V) are the compounds present.	• Aqueous and ethanolic root extracts are reported to have anti-fertility activity. • Alcoholic extracts demonstrated anti-malarial activity against the NK 65 strain of *Plasmodium berghei* and anti-allergic activity. • Root extracts are used as astringent, febrifuge, antiseptic, anthelmintic, and spermicidal. • They are also used in bleeding piles, urinary infections, and as a sedative. • The extracts significantly increased uterine weight and exhibited moderate estrogenic activity. • Fruit pulp has analgesic and anti-inflammatory properties, as well as anti-	19

		• A novel compound is Constituent III. • The fruit of *M. dioica* contains two new aliphatic constituents, 6-methyl tritriacont-5-on-28-ol and 8 methyl hentriacont -3-ene, in addition to the well-known sterol pleuchiol.	diabetic, anti-oxidant, and hepatoprotective properties against hepatic damage induced by carbon tetrachloride. • The hepatoprotective properties of *M. dioica* may be attributed to the presence of its phytoconstituents, such as steroids and triterpenoids. • The ethanolic extract exhibits 100% abortificient activity.	
CUCUMIS	*Cucumis sativus* (Cucumber) It is a widely cultivated plant of gourd family which is eaten in the unripe, green form. Its local name is Khira or Sasha.	• It has been reported that the phytochemicals found in cucumber plants include chemical constituents in the form of alkaloids, terpenoids, flavonoids, phenols, carotenoids, steroids, tannins, saponins, and glycosides. • In addition, cucumbers are a good source of protein, carbohydrates, minerals, and vitamins.	• Fruit extract has been demonstrated to have carminative and antacid properties in mice as well as analgesic and free radical scavenging effects. • Fruits ease indigestion and relieve constipation. • Seeds have anthelmintic, di-uretic, cooling, and tonic properties. • Mature, raw cucumbers improve skin health and offer relief from celiac disease. • You can cook and eat immature cucumbers to treat diarrhoea. Burns and open sores can be treated with a cucumber poultice. • The seeds can be used to expel parasitic worms. • The juice from the leaves induce vomiting and aid digestion.	6, 7, 20-23
Cucumis	*Cucumis melo* (Musk melon) It is locally known as Kharbuja. Commonly known as Melon, muskmelon.	• Fatty acids and amino acids are present in seeds with a number of phenolic glycosides.	• The entire fruit can be used medicinally to treat minor burns and scrapes, as well as to help with chronic eczema and skin hydration. • Aqueous *C. melo* fruit extract demonstrated dose-dependent cytotoxic effects on the human prostate carcinoma PC-3 cell line. The quantity of viable cells dropped as the extract dose rose. This demonstrates the *C. melo* fruit's cytotoxic and anti-cancer properties. • The fruit has laxative, di-uretic, galactagogue, and tonic properties. • The flowers cause vomiting because they are expectorant. • The seeds are used as a fever reducer, cough suppressant, and digestive aid. • As a vermifuge, a mixture of seed powder and water is utilised. • The fruit extract exhibits a high level of SOD, or superoxide dismutase activity. • The antioxidant and anti-inflammatory qualities of the extract in vitro and in vivo are	24-27

			due to the SOD activity.	
Citrullus	*Citrullus lanatus* (water melon).	• Nearly 95% of a watermelon is made up of water. Small amounts of fat, protein, minerals, and vitamins are also present. • Lycopene, vitamin A, and carbohudrates are the fruits' main nutritional components. • Lycopene, a red pigment with anti-cancer properties, is what gives watermelon its colour.	• Watermelon's high water content makes it a potent diuretic; it's also been used traditionally to treat kidney issues and cardiovascular disease. • Once fully grown, they are utilised to lower fevers. • Water melon extracts from the rind, root, seed, and leaf exhibit analgesic and anti-inflammatory properties. • Cucurbitacin E, which is isolated from *C. lanatus* (wild melon), a member of the *Cucurbitaceae* family, has anti-inflammatory properties as well. It is watermelon's wild ancestor. • This plant is frequently used as a laxative, for gout, swellings, and rheumatism.	28-30
	Citrullus colocynthis (Bitter apple). It is locally known as Makkal.	• The plant contains cucurbitacins A, B, C and D, α-elaterin and various other constituents.	• The fruits cure hyperglycemia, tumours, ulcers, asthma, bronchitis, and constipation. • They are also bitter, cooling, cathartic, carminative, anti-pyretic, and anthelmintic. • Analgesic and anti-inflammatory properties have been reported for the aqueous extracts of the plant's roots, stems, fruits, and seeds. • It was found to significantly increase insulin and decrease plasma glucose levels in diabetic rats induced with alloxan.	31, 32
TRICHOSANTHES	*Trichosanthes cucumerina* (Snake gourd), the fruit of which is mainly consumed as a vegetable. It is commonly called as Snake gourd, Vipergourd, Snake tomato and long tomato.	• It has a high protein and vitamin C content. Water, fat, carbohydrates, fibre, iron, P, vitamin B1, vitamin B2, and niacin are also present. • The plant is richly constituted with a variety of chemical constituents like flavonoids, carotenoids, and phenolic acids. • The main active constituents are triterpenoids, saponins, and cucurbitacins.	• Fruit and root both have cathartic properties; the root tubers have anti-inflammatory properties and the seeds have anti-diabetic properties. It is used to treat skin allergies, fever, headaches, bronchitis, and abdominal tumours. • The seeds possess antimicrobial, anti-spasmodic, insecticidal, and gastroprotective qualities. • The anti-microbial properties of the leaf extract in petroleum ether, chloroform, ethyl acetate, and methanol exhibit activity against a range of pathogenic bacteria, including *Salmonella paratyphi*, *Bacillus cereus*, *Enterobacter faecalis*, *Staphylococcus aureus*, and *Escherichia coli*. • This plant extract's anti-bacterial power	33-35

			stems from the presence of phenolic compounds like flavonoids and carotenoids.	
LAGENARIA	*Lagenaria siceraria* (Bottle gourd); locally known as Loki, belonging to the family *Cucurbitaceae*.	• Rich in choline and vitamin B complex, it also has a fair amount of vitamin C, ascorbic acid, and β-carotene. Cucurbitacins B, D, G, and H, primarily B, have also been reported to be present. • It also contains flavone-C-glycoside, polyphenol, proteins, fibres, and saponins. • Two sterols, sitosterol and campesterol, have been identified and are said to have anti-hepatotoxic properties.	• Seeds yield a novel protein called Lagenin; which has been found to have anti-tumor, immune-protective, and anti-poliferative qualities. • There is a notable hepatoprotective effect of the fruits. • Treats liver disorders. • The fruit exhibits maximum anti-oxidant activity. • The anti-bacterial activity was effectively shown against *Pseudomonas aeruginosa* and *Streptococcus pyogenes*, but not against clinical isolates of *S. aureus* and *Escherichia coli*. • It possesses analgesic, sedative, and CNS depressant activity.	33, 36-42