Phytochemical and Pharmacological Aspects of *Cucurbita moschata* and *Moringa oleifera*

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### Abstract

Presently research on herbal drug has attracted a lot of attention globally. The herbal drugs are consisting of phytoconstituents that offer therapeutic effects against various diseases. Till date researchers reported significant potential of herbal drugs employed in various traditional, complementary and alternative systems. The pharmacological activity and phytochemical of several medicinal plants has been scientifically documented. *Cucurbita moschata* and *Moringa oleifera* are the medicinal plant and used as nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drug. The present review is useful for up-to-date investigations on the medicinal activity of *Cucurbita moschata* and *Moringa oleifera*.

### 1 Introduction

The plant kingdom is a chief source of synthetic and herbal drugs. In the recent years there has been an increasing awareness about the importance of medicinal plants. Drugs from the plants are easily available, less expensive, safe, efficient and minimum side effects. Plants are the richest resource of drugs of traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drug. Additionally the worldwide medicinal plants as a substitute for conventional drugs in the management of different diseases has been increasing due to the unavailability of modern health facilities, relative availability of medicinal herbs, poverty, and recent revelations that they possess active compounds that may be responsible for different biological and pharmacological actions.

The secondary metabolite namely alkaloids, cardiac glycosides, steroids, saponins, tannins, flavonoids etc are present in different parts of the plant and imparts various types of pharmacological activity. It is estimated that more than 250,000 to 500,000 species of higher plants on globe level were suggested as medicinal plants. The *people living in the developing countries* are depending on traditional and complementary medicines for their basic health care. Hence, the objective of this review is to summarize to date scientific studies on the phytochemical and pharmacological properties of *Cucurbita moschata* and *Moringa oleifera*.

### 2 Cucurbita moschata

Medicinal plants are the gifts of the nature to cure limitless number of diseases among human beings. It played a crucial role in maintaining human health and improving the quality of human life for thousands of years. The use of plants as medicine is increasing in the developed world because they have minor or no side effects. In India, medicinal plants are widely used by all sections of people either directly as folk medicines or in different indigenous systems of medicines or indirectly in the pharmaceutical preparations of modern medicines.

*Cucurbita moschata* is an important horticultural crop that belongs to family Cucurbitaceae, also known as cucurbits. The Cucurbitaceae family consists of 90 genera and approximately 700 species. The Cucurbitaceae are characterised by long flexible stems, a crawling or climbing growth habit and fruit that differ widely in colour and shape, having a thick and impermeable skin protecting a juicy fibrous pulp. Five species
are grown worldwide for their edible fruit, variously known as squash, pumpkin, or gourd depending on species, variety, and local parlance, and for their seeds\(^3\) (Fig. 1).

![Fig 1: fruit and seeds of Cucurbita moschata](image)

*Cucurbita moschata* commonly called 'Kadoo' in Hindi while squash in English. It grows as a large annual vine and has large, showy, yellow-orange flowers and round, lobed leaves, often with fine hairy prickles. *Cucurbita* or *Pumpkin* has received considerable attention in recent years because of the nutritional and health protective value of the seeds as well as the polysaccharides from the fruits. *Pumpkin* fruit is widely grown low-calorie vegetables that are rich in carotenoid content, vital antioxidants, carbohydrates, vitamin A, flavonoid, polyphenolic antioxidants such as lutein, xanthin. *Pumpkin* have a lot of health benefits such as antidiabetic, anticancer, antihypertension, antioxidant, antitumor, immunomodulation, anti-inflammation, antihyperlipidemic, and antimicrobial. Consumption of *pumpkin* helps to prevent skin diseases, eye disorders reducing cell damage in the body, cancer and improve immune function.

The Pumpkin seed is excellent source of protein and also has pharmacological activities such as antidiabetic, antifungal, antibacterial, anti-inflammation activities and antioxidant effects. It has obtained considerable attention in recent years because of the nutritional and health protective values of the seeds. *Pumpkin* seed oil contains mono and polyunsaturated fatty acids as well as saturated ones like palmitic acid, stearic acid, oleic acid and linoleic acid\(^4,5\).

### 2.1 Botanical classification

| Kingdom        | Plantae          |
|----------------|------------------|
| Division       | Tracheophyta     |
| Class          | Magnoliopsida    |
| Order          | Cucurbitales     |
| Family         | Cucurbitaceae    |
| Genus          | Cucurbita        |
| Species        | Cucurbita moschata |

### 2.2 Vernacular names

| Common name - | Pumpkin, Squash |
|---------------|-----------------|
| Hindi         - | Kaddu, Kashiphal, Petha |
| Tamil         - | Pucani          |
| Kannada       - | Kumbala kaayi   |
| Malayalam     - | Kumpalam        |
| Marathi       - | kashiphal, kaia bhopala |
| Assamese      - | Kumra           |
| Telugu        - | Gummadi         |
| Bengali       - | Kumara          |
| Urdu          - | Kaddu           |

### 2.3 Geographical distribution

*Cucurbita moschata* is a species originating in either Central America or northern South America. It is also found in North America, Australia and different countries of Africa (Zambia, Nigeria), Asia (China, India and Iran) and Europe(Spain and Turkey).

### 2.4 Botanical description

*Cucurbita moschata* is an annual herb with climbing, creeping 5-angled stems up to 15 m long. The leaves are simple, alternate, broadly ovate to deltoid, basally cordate, apically acute, palmately lobed with 5-7 lobes, marginally toothed, Velvety-hairy, scabrous, palmately veined, 20-30 cm long, and 10-35 cm broad.

Stems are scabrous and setose, branching, often rooting at the nodes. Petioles are setose, grooved, 6-24 cm long, and estipulate. The plant bears tendrils borne at 90 degrees to the leaf insertion, which are coiled, and 1-6-branched.

The shallow root system is branched, growing from a well-developed taproot.
Flowers are solitary, unisexual, regular, 5-merous, large, 10–20 cm in diameter, lemon yellow to deep orange; sepals free, subulate to linear, 1–3 cm long; corolla campanulate, with widely spreading lobes. Single axillary flowers (male typically long-stalked with three stamens and female typically short-stalked with 3 two-lobed stigmas) are creamy white to orang-yellow and bloom in late spring. Stalks to thicken at the points were the fruits appear. Fruits generally have distinctive orange flesh. Plants produces a variety of fruits which vary considerably in size and shape. Fruit a large, globose to ovoid or cylindrical berry, weighing up to 10 kg, with a wide range of colours, often covered with green spots and grey stripes, with small, raised, wartlike spots; flesh yellow to orange, many-seeded; fruit stalk enlarged at apex. Seeds obovoid, flattened, 1-2 cm × 0.5-1 cm, usually white or tawny, sometimes dark-coloured, surface smooth to somewhat rough, margin prominent.5,7

2.5 Chemical constituents

The chemical composition of the pumpkin pulp varied between 75.8 and 91.33% moisture, 0.2 and 2.7% crude protein, 0.47 and 2.1% crude ash and 3.1 and 13% carbohydrate content. Pumpkin fruits contain polysaccharides, vitamins (including β-carotene, vitamin A, vitamin B2, α-tocopherol, vitamin C, vitamin E), proteins, essential amino acids (alanine, arginine, aspartic acid, glutamic acid, histidine, leucine, isoleucine, glycine, lysine, methionine, phenylalanine, serine, threonine, valine and tyrosine), valuable antioxidants, phenolics, flavonoids, carotenoids, carotenoids and minerals (especially potassium). Pumpkin is high in β-carotene, which gives it yellow or orange color. Beta-carotene in plants that have a pleasant yellow-orange color is a major source of vitamin A. It is also high in carbohydrates and minerals.3,9

Seeds of pumpkin are rich in oil and the variability in the oil. Pumpkin seeds have a high nutritional value, provides good quality oil, and excellent source of protein. Due to the presence of highly unsaturated fatty acids (palmitic acid, stearic acid, oleic acid and linoleic acid). Pumpkin seed oil is rich in many antioxidants and essential nutritional components like essential fatty acids (FAs), vitamins, squalene, carotenoids, tocopherols, phytoestrogens, phytosterols, polyphenols, hydrocarbon, triterpenoids and selenium. Pumpkins are rich source of calcium, iron, vitamin A, oil (25 -55%), rich in unsaturated oleic and linoleic acids, protein (25 -35%) with high amounts of arginine, aspartate and glutamic acid, but deficient in lysine and sulphur containing amino acids.10

2.6 Traditional uses

Pumpkin helps to prevent skin diseases, measles, jaundice, insomnia, colic, eye disorders reducing cell damage in the body, cancer and improve immune function.

Pumpkin seed oil can retard the progression of hypertension and mitigate hypercholesterolemia, arthritis, reduced bladder and urethral pressure. Pumpkin seed oil has been foundto alleviate diabetes by promoting hypoglycemic activity. Pumpkin seeds have also been associated with lower levels of gastric, breast, lung, colorectal cancer and prostate cancer11,12.

2.8 Pharmacological activities

The pumpkin has pharmacological activities such as anti-diabetic, antihypertension, antitumor, immunomodulation, antifungal, antibacterial and antiinflammation activities, and antioxidant effects (Table -1).

3 Moringa oleifera

Moringa oleifera belongs to the family Moringaceae, commonly known as the ‘drumstick’ or ‘horseradish’ tree. It is an affordable and readily available source of major essential nutrients and nutraceuticals, and it has the potential to eradicate malnutrition. Moringa oleifera is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan. All parts of the Moringa tree are edible and have long been consumed by humans.25

Drumstick is recognized as a vibrant and affordable source of phytochemicals, having potential applications in medicines, functional food preparations, water purification, and biodiesel production. The multiple biological activities including antiproliferation, hepatoprotective, anti-inflammatory, antinoceptive, antiatherosclerotic, oxidative DNA damage protective, antiperoxidative, cardioprotective. Moringa oleifera are attributed to the presence of functional bioactive compounds, such as phenolic acids, flavonoids, alkaloids, phytosterols, natural sugars, vitamins, minerals, and organic acids (Fig 2).

3.1 Botanical classification

Kingdom - Plantae
Division - Magnoliophyta
Class - Magnoliopsida
Order - Capparales
Family - Moringaceae
Genus - Moringa
Species - Moringa oleifera

3.2 Vernacular names

Common name - Drumstick, horseradish tree
Hindi - Senjana
Tamil - Murungai Maram
Kannada - Nuggekayee
Malayalam - Muringa

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3.3 Geographical distribution

The drumstick tree is a small fast growing ornamental tree which is native to India, Ethiopia, the Philippines and the Sudan, and is being grown in West, East and South Africa, tropical Asia, Latin America, the Caribbean, Florida and the Pacific Islands. The trees are said to have been originated from Agra and Oudh in North Western region of India to South of the Himalayan Mountains. They are cultivated in Asian, African, Middle Eastern and South American regions.

3.4 Botanical description

_Moringa oleifera_ is a fast-growing, deciduous tree. It can reach a height of 10–12 m (32–40 ft) and the trunk can reach a diameter of 45 cm (1.5 ft).

The bark has a whitish-grey colour and is surrounded by thick cork. Young shoots have purplish or greenish-white, hairy bark. The tree has an open crown of drooping, fragile branches and the leaves build up feathery foliage of tripinnate leaves.

Table 1: Reported pharmacological activities of _Cucurbita moschata_

| Extract       | Pharmacological activity                                                                 | References            |
|---------------|------------------------------------------------------------------------------------------|-----------------------|
| Fruit         | Phenolic phytochemicals have anti-diabetic effects in terms of b-glucosidase and a-amylose inhibition | Kwon et al.           |
| Fruit         | Purification and characterization of an antifungal PR-5 protein which reduced tumour weight in S-180-bearing mice. | Cheong et al.         |
| Seeds         | Purification and characterization of moschatin which efficiently inhibits the growth of targeted melanoma cells M21. | Xia et al.            |
| Fruit         | Isolated protein-bound polysaccharide have anti-diabetic effects in diabetic rats         | Quanhong et al.       |
| Fruit         | Showed a broad spectrum antimicrobial activity against several bacteria                   | Rajakaruna et al.    |
| Seeds         | Beta-carotene has anti-inflammatory properties and regular consumption of pumpkin seeds can protect against joint inflammation | Wang et al.          |
| Fruit peel    | Antioxidant and burn wound healing activities                                              | Bahramsooltani et al. |
| Fruit and seeds| Antidiabetic effect in STZ-induced diabetic mice                                            | Marbun et al.         |
| Fruit and seeds| Effectiveness of Pumpkin Flesh and Seeds Toward Diabetic Mice                              | Marbun et al.         |
| Flower        | Antimicrobial activity                                                                     | Muruganantham et al.  |
| Leaves        | Antibacterial activity against _Staphylococcus aureus, Klebsiella pneumoniae, and Escherichia coli._ | del Castillo et al.   |
| Fruit extracts| Anti-inflammatory and antiulcer activity                                                   | Govindan et al.       |

Leaves are alternate, compound tripinnate, petiole slender, leaflets opposite, entire, elliptic, all parts stalked, pale beneath, glands linear, hairy. lowers are fragrant and bisexual, surrounded by five unequal, thinly veined, yellowish-white petals.

The flowers are about 1.0-1.5 cm (1/2”) long and 2.0 cm (3/4”) broad. They grow on slender, hairy stalks in spreading or drooping later flower clusters which have a length of 10–25 cm. The flowers are fragrant and bisexual, surrounded by five unequal, thinly veined, yellowish-white petals. The flowers are about 1.0-1.5 cm (1/2”) long and 2.0 cm (3/4”) broad. Ovary hairy, style slender, tubular, stigma truncate, perforated. Ovules many, 2-seriate on each placenta. Fruit a one-celled, loculicidally 3-valved capsule, pendulous, greenish, 22.5-50.0 cm in length, triangular, 9-ribbed. Seeds many in the depressions of the valves, trigonous, winged; albumen absent, embryo straight.

3.5 Chemical constituents

_Moringa oleifera_ is found to contain non-nutritive chemicals which they use as self-defense mechanism also known as Phytochemicals. These phytochemicals include catechol tannins, gallic tannins, steroids, interpenoids, flavonoids, saponins, antarquinaones, alkaloids and reducing sugars.
Moringa oleifera is rich in compounds containing the simple sugar, rhamnose called glucosinolates and isothiocyanates. The stem contains: 4-hydroxymellein, vanillin, β-sitosterone, octacosanic acid and β-sitosterol and bark, 4-(α-L-rhamnopyranosyloxy)– benzyl glucosinolate. The purified, whole-gum exudates from the drumstick plant contains: Larabinose, D-galactose, D-glucuronic acid, L-rhamnose, D-mannose and D-xylose. The leaves contain quercetin-3-O-glucoside and quercetin-3-O-(6″-malonylglucose), and lower amounts of kaempferol-3-Oglucoside and kaempferol-3-O-(6″-malonyl-glucoside). They also contained 3-caffeoylquinic and 5-caffeoylquinic acid. The whole pods are reported to contain nitriles, an isothiocyanate and thicarbamates and O-[2′-hydroxy-3′- (2″-heptenyloxy)]; propylundecanoate and O-ethyl-[(α-L-rhamnosyloxy)- benzyl] carbamate, methyl-phydroxybenzoate and β-sitosterol. The mucilage from the pods designated as drumstick polysaccharide, the investigation of which revealed the presence of galactose, dextrose, xylene and sodium, potassium, magnesium, calcium salts of glucuronic acid. Contrary to the definition of mucilages, the presence of dextrose was an exception.

3.6 Nutritional analysis Moringa oleifera leaves

Moringa oleifera leaves is a good source of many nutrients in fact they contain larger amounts of several nutrients than the common foods often associated with these nutrients. These include vitamin C, which fights a host of illness including colds and flu; vitamins A, which acts as a shield against eye disease, skin disease, heart ailments, diarrhea, and many other diseases; Calcium which builds strong bones and teeth and helps prevent osteoporosis (Table 2)\textsuperscript{28-30}.

| Nutrient   | Fresh leaves | Oven dried |
|------------|--------------|------------|
| Moisture (%) | 75.9         | 6          |
| Energy (Kcal) | 92           | 271.54     |
| Protein (g) | 6.7          | 23.78      |
| Carbohydrates (g) | 12.5       | 28.32      |
| Fat (g) | 1.7         | 7.014      |
| Fibre (g) | 0.9         | 11.8       |
| Vitamin C (mg) | 220         | 56         |
| Beta – carotene (µg) | 6780 | 37800      |
| Iron (mg) | 0.85       | 19         |
| Calcium (mg) | 440        | 3467       |
| Phosphorus (mg) | 70          | 215        |
| Beta carotene (µg) | 6780 | 37800      |

3.7 Traditional uses

Moringa oleifera leaf powder used as effective soap for hand wash. It is used as an antiseptic. Oil from moringa seeds are used in foods and in hair care products and as a machine lubricant. Moringa is used in India and Africa in feeding programs to fight malnutrition. It is used as an aphrodisiac, boosts immune system. It is used to treat rheumatism, asthma, cancer, constipation, treatment of epilepsy, anemia, anxiety, blackheads, blood impurities, bronchitis, catarrh, chest
congestion, cholera, conjunctivitis, cough, diarrhoea, eye and ear infections, fever, abnormal blood pressure, pain in joints, scurvy, semen deficiency, headaches, tuberculosis, intestinal ulcers, bacterial, fungal, viral and parasitic infections. Moringa works as circulatory and cardiac stimulants, contains antilithogenic, antilulcer, anti-inflammatory, diuretic, antispasmodic, antioxidant, cholesterol lowering, antihypertensive, antiepileptic, antipyretic, hepatoprotective, anti-diabetic, anti-fungal and antibacterial activities (Table 3).

### 3.8 Pharmacological activities

| Plant parts            | Pharmacological activity                                                                 | References       |
|------------------------|------------------------------------------------------------------------------------------|------------------|
| Leaves                 | Leaves exhibited analgesic potency similar to that of indomethacin                       | 33 Manaheji et al. |
| Leaves                 | Antimigraine properties                                                                  | 34 Kanchar PU     |
| Leaves                 | Neuropathic pain induced by chronic constriction injury                                  | 35 Jurairat et al.|
| Leaves                 | Anti-inflammatory activity in a carrageenan-induced paw edema model                      | 36 Gurvinder et al.|
| Roots                  | Anti-inflammatory activity                                                               | 37 Ezeamuzie et al.|
| Leaves                 | Antipyretic activity in a Brewer’s yeast-induced pyrexia model                           | 38 Bhattacharya et al.|
| Leaves                 | Protection against Alzheimer’s disease in a colchicine-induced Alzheimer’s model using behavioral testing | 39 Ranira et al. |
| Leaves                 | Anxiolytic activity in staircase test and elevated plus maze test                       | 40 Lakshmi et al. |
| Leaves & flower        | Anti-tumour activity; induces the apoptosis of human hepatocellular carcinoma cells       | 41 Jung et al.    |
| Leaves                 | Antiproliferative effect of *Moringa oleifera*                                           | 42 Tiloke et al.  |
| Leaves & fruits        | Antistress, antioxidant, and scavenging potential                                         | 43 Luqman et al.  |
| Leaves                 | Antibacterial and antioxidant activity                                                   | 44 Kumar et al.   |
| Leaves                 | Hepatoprotective effects against carbon tetrachloride and acetaminophen-induced liver toxicity | 45 Patel et al.   |
| Leaves                 | Reduced ulcer index in ibuprofen-induced gastric ulcer model and in pyloric ligation test,| 46 Dhimmar et al. |
| Leaves & seeds         | Antihypertensive effect on spontaneous hypertensive rats; reduced chronotropic and inotropic effects in isolated frog hearts. | 47 Randriamboavonij et al. |
| Leaves                 | Antiobesity activity against high fat diet-induced obesity in rats                       | 48 Nahar et al.   |
| Seeds                  | Protection against asthma; this effect was a direct bronchodilator effect combined with anti-inflammatory and antimicrobial actions | 49 Anita et al.   |
| Leaves & seeds         | Antihyperglycemic and hypoglycemic activity in alloxan-induced diabetic rats.            | 50 Odedele et al. |
| Leaves                 | Anti-allergenic effect; reduced scratching frequency in an Ovalbumin sensitization model. | 51 Hagiwara et al.|
| Seeds                  | Anthelmintic activity against Haemonchus contortus eggs and third stage larvae           | 52 Cabardo et al. |
| Seeds                  | Wound healing in diabetic animals showed improved tissue regeneration, decreased wound size, down regulated inflammatory mediators, and upregulated vascular endothelial growth factor in wound tissues | 53 Choudhury et al.|

### 4 Conclusion

The review illustrated that *Cucurbita moschata* and *Moringa oleifera* are an important medicinal plant with varied pharmacological spectrum. Almost all parts of *Cucurbita moschata* and *Moringa oleifera* such as leaf, fruit, seed, bark and root are used for treatment of various diseases. The
phytoconstituents present in various part of both plants are accountable for the pharmacological activities. A systemic research and development work should be undertaken for the development of products for their better economic and therapeutic utilization.

5 Conflict of interests
None

6 Author’s contributions
SS and SSS collected the data and drafted the manuscript. Both authors have read and approved the final manuscript.

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