PHYTOCHEMICAL AND PHARMACOLOGICAL OVERVIEW OF CUCURBITA MAXIMA AND FUTURE PERSPECTIVE AS POTENTIAL PHYTOTHERAPEUTIC AGENT

G. Neelamma1, B. Durai Swamy2 and P. Dhamodaran3

1Research Scholar, Department of Pharmacognosy and Phytopharmacy, JSS College of Pharmacy, Ooty-643001, Tamil Nadu, India.
2Head of Department, Department of Pharmacognosy and Phytopharmacy, JSS College of Pharmacy, Ooty-643001, Tamil Nadu, India.
3Professor, Department of Pharmacognosy and Phytopharmacy, JSS College of Pharmacy, Ooty-643001, Tamil Nadu, India.

Corresponding Author: G. Neelamma
Research Scholar, Department of Pharmacognosy and Phytopharmacy, JSS College of Pharmacy, Ooty-643001, Tamil Nadu, India.

ABSTRACT
Cucurbita maxima, winter squash, pumpkin, calabaza, or marrow, is a species in the gourd family (Cucurbitaceae). Elated cultivated species also known as squash or pumpkins are C. pepo (summer squash, also called marrow), and C. mixtata and C. moschata (both of which are also known as pumpkin or winter squash). It can be difficult to ascertain which varieties are derived from which species, because the names “winter squash” and “pumpkin” are used to refer to several different species, and those species may also have other common names. C. maxima plants are frost-intolerant annual herbaceous plants. The stems, more or less prickly, are generally trailing or climbing vines, with tendrils that allow that allow them to clasp supports. Leaves are simple, alternate, and shallowly to deeply lobed. Fruits (technically referred to as pepos) are relatively large and usually require a long growing season for development. Winter squashes are eaten as a vegetable, mashed or in purees, soups, or pies. The blossoms are also edible, and may be cooked into fritters. Seeds are high in protein and minerals, and are eaten raw, toasted, or pressed to make oil. Squash contain mostly carbohydrates, little protein and almost no fat. As its yellow color indicates, squash is filled with the mineral provitamin A, beta-carotene, as well as calcium and potassium. Squash is filled with soluble vegetable fiber, which provides lasting satiation. The soluble fiber in squash provides a mild laxative effect, making it important for digestive health. Summer squash provides a huge supply of antioxidants, with the skin of squash being especially rich in antioxidants. Steaming and freezing, rather than boiling or microwaving, retains the nutrients within squash. Cooking squash with less water preserves the amount of phenolic compounds, which are associated with color vibrancy and flavor in vegetables. The carotenoids lutein and zeaxanthin protect the eyes. In order to receive the full spectrum of nutrients that squash has to offer, eat skin, seeds and flesh. Squash consumption is recommended to regulate blood sugar and for those with type-2 diabetes.

KEYWORDS: Herbaceous, tendrils, beta-carotene, antioxidant and type-2 diabetes etc.

INTRODUCTION
Cucurbita (Latin for gourd)(1) is a genus of herbaceous vines in the gourd family, Cucurbitaceae, also known as cucurbits, native to the Andes and Mesoamerica. 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. First cultivated in the Americas before being brought to Europe by returning explorers after their discovery of the New World, plants in the genus Cucurbita are important sources of human food and oil. Other kinds of gourd, also called bottle-gourds, are native to Africa and belong to the genus Lagenaria, which is in the same family and subfamily as Cucurbita but in a different tribe. These other gourds are used as utensils or vessels, and their young fruits are eaten much like those of Cucurbita species. Most Cucurbita species are herbaceous vines that grow several meters in length and have tendrils, but non-vining “bush” cultivars of C. pepo and C. maxima have also been developed. The yellow or orange flowers on a Cucurbita plant are of two types: female and male. The female flowers produce the fruit and the male flowers produce pollen. Many North and Central American species are visited by specialist bee pollinators, but other insects with more general feeding habits, such as honey bees, also visit. The fruits of the genus Cucurbita are good sources of nutrients, such as vitamin A and vitamin C, among other nutrients according to species. The plants contain the toxins, such as cucurbitin, cucurmosin, and cucurbitacin. There is
debate about the taxonomy of the genus, as the number of accepted species varies from 13 to 30. The five
domesticated species are Cucurbita argyrosperma, C. ficifolia, C. maxima, C. moschata, and C. pepo. All of
these can be treated as winter squash because the full-grown fruits can be stored for months; however, C. pepo
includes some cultivars that are better used only as summer squash. Cucurbita fruits have played a role in
human culture for at least 2,000 years. They are often represented in Moche ceramics from Peru. After
Christopher Columbus's arrival in the New World, paintings of squashes started to appear in Europe early in
the sixteenth century. The fruits have many culinary uses including pumpkin pie, biscuits, bread, desserts,
puddings, beverages, and soups. Pumpkins and other Cucurbita fruits are celebrated in festivals and in flower
and vegetable shows in many countries.

DESCRIPTION
Cucurbita species fall into two main groups. The first
group are annual or short-lived perennial vines and are
mesophytic, i.e. they require a more or less continuous
water supply. The second group are perennials growing
in arid zones and so are xerophytic, tolerating dry
conditions. Cultivated Cucurbita species were derived
from the first group. Growing 5 to 15 meters (16 to 49 ft)
in height or length, the plant stem produces tendrils to
help it climb adjacent plants and structures or extend
along the ground. Most species do not readily root from
the nodes; a notable exception is C. ficifolia, and the four
other cultivated mesophytes do this to a lesser extent.
The vine of the perennial Cucurbita can become semiwoody if left to grow. There is wide variation in
size, shape, and color among Cucurbita fruits, and even
within a single species. C. ficifolia is an exception, being
highly uniform in appearance. The morphological
variation in the species C. Pepo and C. Maxima is so
vast that its various subspecies and cultivars have been
misidentified as totally separate species.

The typical cultivated Cucurbita species have five-lobed
or palmately divided leaves with long petioles, with
the leaves alternately arranged on the stem. The stems in
some species are angular. All of the above-ground parts
may be hairy with various types of trichomes, which are
often hardened and sharp. Spring-like tendrils grow from
each node and are branching in some species. C.
argyrosperma has ovate-cordate (egg-shaped to heart-
shaped) leaves. The shape of C. pepo leaves varies
widely. C. moschata plants can have light or dense
pubescence. C. ficifolia leaves are slightly angular and
have light pubescence. The leaves of all four of these
species may or may not have white spots. There are
male (staminate) and female (pistillate) flowers
(unisexual flowers) on a single plant (monoecious), and
these grow singly, appearing from the leaf axils. Flowers
have five fused yellow to orange petals (the corolla) and
a green bell-shaped calyx. Male flowers in Cucurbitaceae
generally have five stamens, but in Cucurbita there are
only three, and their anthers are joined together so that
there appears to be one. Female flowers have thick
pedicels, and an inferior ovary with 3–5 stigmas that
each have two lobes. The female flowers of C.
argyrosperma and C. ficifolia have larger corollas than
the male flowers. Female flowers of C. pepo have a
small calyx, but the calyx of C. moschata male flowers is
comparatively short.

Cucurbita fruits are large and fleshy. Botanists classify
the Cucurbita fruit as a pepo, which is a special type of
berry derived from an inferior ovary, with a thick outer
calyp. Male flowers in Cucurbitaceae generally have
five stamens, but in Cucurbita there are only three, and
their anthers are joined together so that there appears to be one. Female flowers have thick
pedicels, and an inferior ovary with 3–5 stigmas that
each have two lobes. The female flowers of C.
argyrosperma and C. ficifolia have larger corollas than
the male flowers. Female flowers of C. pepo have a
small calyx, but the calyx of C. moschata male flowers is
comparatively short.

Cucurbita fruits are large and fleshy. Botanists classify
the Cucurbita fruit as a pepo, which is a special type of
berry derived from an inferior ovary, with a thick outer
calyp. Male flowers in Cucurbitaceae generally have
five stamens, but in Cucurbita there are only three, and
their anthers are joined together so that there appears to be one. Female flowers have thick
pedicels, and an inferior ovary with 3–5 stigmas that
each have two lobes. The female flowers of C.
argyrosperma and C. ficifolia have larger corollas than
the male flowers. Female flowers of C. pepo have a
small calyx, but the calyx of C. moschata male flowers is
comparatively short.
Taxonomy

Botanical nomenclature by Linnaeus in his Genera Plantarum,[12] the fifth edition of 1754 in conjunction with the 1753 first edition of Species Plantarum.[16] Cucurbita pepo is the type species of the genus.[13,14] Linnaeus initially included the species C. pepo, C. verrucosa and C. melopepo (both now included in C. pepo), as well as C. citrullus (watermelon, now Citrullus lanatus) and C. lagenaria (now Lagenaria siceraria) (both are not Cucurbita but are in the family Cucurbitaceae.[15] The Cucurbita digitata, C. foetidissima, C. galeotti, and C. pedatifolia species groups are xerophytes, arid zone perennials with storage roots; the remainder, including the five domesticated species, are all mesophytic annuals or short-life perennials with no storage roots.[16] The five domesticated species are mostly isolated from each other by sterility barriers and have different physiological characteristics.[16] Some cross pollinations can occur: C. pepo with C. argyrosperma and C. moschata; and C. maxima with C. moschata. Cross pollination does occur readily within the family Cucurbitaceae.[17,18] The buffalo gourd (C. foetidissima), which does not taste good, has been used as an intermediary as it can be crossed with all the common Cucurbita.

Reproductive biology: All species of Cucurbita have 20 pairs of chromosomes.[20] Many North and Central American species are visited by specialist pollinators in the apid tribe Eucerini, especially the genera Peponapis and Xenoglossa, and these squash bees can be crucial to the flowers producing fruit after pollination.[21,22] Male flower, part of the perianth and one filament removed. When there is more pollen applied to the stigma, more seeds are produced in the fruits and the fruits are larger with greater likelihood of maturation[23] an effect called xenia. Competitively grown specimens are therefore often hand-pollinated to maximize the number of seeds in the fruit, which increases the fruit size; this pollination requires skilled technique.[24,25] Seedlessness is known to occur in certain cultivars of C. pepo.[26,27] The most critical factors in flowering and fruit set are physiological, having to do with the age of the plant and whether it already has developing fruit.[26] The plant hormones ethylene and auxin are key in fruit set and development.[25] Ethylene promotes the production of female flowers. When a plant already has a fruit developing, subsequent female flowers on the plant are less likely to mature, a phenomenon called “first-fruit dominance”[28] and male flowers are more frequent, an effect that appears due to reduced natural ethylene production within the plant stem.[29] Ethephon, a plant growth regulator product that is converted to ethylene after metabolism by the plant, can be used to increase fruit and seed production.[24,31] The plant hormone gibberellin, produced in the stamens, is essential for the development of all parts of the male flowers. The development of female flowers is not yet understood.[32] Gibberellin is also involved in other developmental processes of plants such as seed and stem growth.[33]
Fig 4: Kabocha seedling seven days after being sown

**Nutrients**
As an example of Curcubita, raw summer squash is 94% water, 3% carbohydrates, and 1% protein, with negligible fat content (table). In 100 grams, raw squash supplies 16 calories and is rich in vitamin C (20% of the Daily Value, DV), moderate in vitamin B6 and riboflavin (12-17% DV), but otherwise devoid of appreciable nutrient content (table), although the nutrient content of different Curcubita species may vary somewhat. Pumpkin seeds contain vitamin E, crude protein, B vitamins and several dietary minerals (see nutrition table at pepita). Also present in pumpkin seeds are unsaturated and saturated oils, palmitic, oleic and linoleic fatty acids as well as carotenoids.

**Toxins**
Cucurbitin is an amino acid and a carboxypyrrolidine that is found in raw Curcubita seeds. It retards the development of parasitic flukes when administered to infected host mice, although the effect is only seen if administration begins immediately after infection. Cucurmosin is a ribosome inactivating protein found in the flesh and seed of Curcubita, notably Cucurbita moschata. Cucurmosin is more toxic to cancer cells than healthy cells. Cucurbitacin is a plant steroid present in wild Curcubita and in each member of the family Cucurbitaceae. Poisonous to mammals it is found in quantities sufficient to discourage herbivores. It makes wild Curcubita and most ornamental gourds, with the exception of an occasional C. fraterna and C. sororia, bitter to taste. This bitterness is especially prevalent in wild Curcubita; in parts of Mexico the flesh of the fruits is rubbed on a woman's breast to wean children. While the process of domestication has largely removed the bitterness from cultivated varieties, there are occasional reports of cucurbitacin causing illness in humans. Cucurbitacin is also used as a lure in insect traps.

CUCURBITA MAXIMA

**Scientific classification**

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>(unranked): Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>(unranked):</td>
<td>Angiosperms</td>
</tr>
<tr>
<td>Order:</td>
<td>Cucurbitales</td>
</tr>
<tr>
<td>Family:</td>
<td>Cucurbitaceae</td>
</tr>
<tr>
<td>Genus:</td>
<td>Curcubita</td>
</tr>
<tr>
<td>Species:</td>
<td>C. Maxima</td>
</tr>
</tbody>
</table>

**Binomial name**
Curcubita maxima.

**Subspecies**

**Synonyms**
Cucumis rapallito Carrière, Cucumis zapallito Carrière, Curcubita fariniae Moz. ex Naudin, Curcubita maxima var. triloba Millán, Curcubita maxima var. turgida L.H.Bailey, Curcubita maxima var. zapallito (Carrière) Millán, Curcubita maxima var. zipinka Millán, Curcubita pileiformis M.Roem., Curcubita rapallito Carrière, Curcubita sulcata Blanco, Curcubita turbanformis M.Roem, Curcubita zapallito Carrière, Pepo maximus Peterm, Pileocalyx elegans Gasp. Curcubita maxima, one of at least five species of cultivated squash, is one of the most diverse domesticated species. This species originated in South America from the wild Curcubita andreana over 4000 years ago. The two species hybridize quite readily but have noticeably different calcium levels.

**Cultivation**
Different squash types of this species were introduced into North America as early as the 16th century. By the American Revolution, the species was in cultivation by Native American tribes throughout the present-day United States. By the early 19th century, at least three varieties are known to have been commercially introduced in North America from seeds obtained from Native Americans. Secondary centers of diversity include India, Bangladesh, Myanmar, and possibly the southern Appalachians. The large red-orange squashes often seen at Halloween in the United States are C. maxima, but not to be confused with the orange type used for jack-o-lanterns, which are C. Pepo.

**Types**
Many different cultivars of Curcubita maxima have been developed. As in C. pepo, plants exist with a "bush" habit that is particularly evident in young plants, although older plants grow in the wild-type vining manner. Arikara squash is an heirloom variety of C. maxima. Fruits weigh from four to eleven pounds. The shape of the fruit can be tear-drop or round, and they are colored in a mottled orange and green pattern. It is desired both for its eating qualities and as a seasonal decoration. This variety traces its ancestry to the Arikara tribe of the Dakotas, among whom its cultivation predates white settlement. Banana squash has an elongated shape, with light blue, pink or orange skin and...
bright orange flesh. Boston marrow sweet tasting, narrow at one end and bulbous at the other.\textsuperscript{[59]} Buttercup squash is one of the most common varieties of this winter squash, with a turban shape (a flattish top and dark green skin), weighing three to five pounds, and normally heavy with dense, yellow-orange flesh.\textsuperscript{[60]} The Candy Roaster landrace was originally developed by the Cherokee people in the southern Appalachians. Another heirloom variety, it is quite variable in size (10-250+ lbs), shape (round, cylindrical, teardrop, blocky, etc.), and color (pink, tan, green, blue, gray, or orange), yet most have fine-textured orange flesh. This variety enjoys continued popularity, particularly in the southern Appalachians. Hubbard squash is another cultivar of this species that usually has a tear-drop shape. They are often used as a replacement for pumpkins in cooking. According to one source,\textsuperscript{[61]} the name comes from Bela Hubbard, settler of Randolph Township, Ohio in the Connecticut Western Reserve. Many other sources list an alternate history.\textsuperscript{[62,63]} These sources state the hubbard squash (at the time nameless) came to Marblehead, Massachusetts through Captain Knott Martin. A woman named Elizabeth Hubbard brought the fruit to the attention of her neighbor, a seed trader named James J. H. Gregory. Mr. Gregory subsequently introduced it to the market using Mrs. Hubbard's name as the eponym. Gregory later bred and released the blue hubbard, which has a bluish-gray skin. The other major variety, the golden hubbard squash, has a bright orange skin. Gregory advertisements for the squash date from at least 1859.\textsuperscript{[64]} The hubbard squash, including questions regarding the name, is even the subject of a children's ditty, "Raising Hubbard Squash in Vermont".\textsuperscript{[65]} Jarrahdale pumpkin is a pumpkin with gray skin. It is nearly identical to 'Queensland Blue' and 'Sweet Meat' varieties. Kabocha is a Japanese variety. Lakota squash is an American variety. The Nanticoke squash is a rare heirloom variety that was traditionally grown by the Nanticoke people of Delaware and Eastern Maryland. It is a turban-type squash and one of only a few surviving Native American winter squashes from the Eastern woodlands. Turk's turban, also known as "French turban", an heirloom predating 1820, and closely related to the butternut squash.


Culinary and Medicinal Uses
Both squash and blossoms are edible and can be prepared in a variety of ways. Squash blossoms can be added to soups and stews, as well as be sauteed, stuffed, and dipped in batter and fried. Squash can be made into french fries and used raw for salads. Winter squash are more nutritious than summer. Summer squashes cook quickly and are eaten with the skin. Winter squash can be baked whole or sliced in half, placed on a baking sheet, brushed with oil and left to bake at 400 F. For steaming and boiling, remove skin from winter squash. A simple and delicious way to prepare acorn squash is by baking and serving with butter. Butternut squash has a similar taste to sweet potato, and can be used as a substitute in recipes calling for sweet potato. Butternut squash is commonly made into soup. Spaghetti squash is a large, light yellow variety that is unique due to its spaghetti-like flesh.\textsuperscript{[67]} The stringy flesh is delicate and has a consistency similar to angel-hair pasta with a mild flavor. To prepare, slice the squash in half and scoop out the seeds. Place the squash face down on a pan with a bit of water on the bottom, and bake for 30-40 minutes. Once tender, the insides can be scraped out and made into long strands. Serve right away with marinara sauce, butter or olive oil.\textsuperscript{[68]} Zucchini , like pumpkin, is highly versatile and can be made into a variety of sweets such as zucchini bread, brownies, and cakes. Zucchini is an ingredient in the dish Ratatouille, and is also delicious when stuffed with cheese and baked.\textsuperscript{[69]} Pumpkin can be made into beer by fermenting persimmons, hops, maple sugar, and pumpkin.\textsuperscript{[70]} Both summer and winter varieties can be prepared savory or sweet, with pumpkin pie being a classic example of sweet seasoning. The seeds of several squash varieties can be dried out, mixed with oil, salt and pepper, and toasted on a cookie sheet at 350 F until golden and crispy.\textsuperscript{[71]} Different varieties of summer squash have little difference in taste, while winter squash have a broader range of flavors.
Squash contain mostly carbohydrates, little protein and almost no fat. As its yellow color indicates, squash is filled with the mineral provitamin A, beta-carotene, as well as calcium and potassium. Squash is filled with soluble vegetable fiber, which provides lasting satiation. The soluble fiber in squash provides a mild laxative effect, making it important for digestive health. Summer squash provides a huge supply of antioxidants, with the skin of squash being especially rich in antioxidants. Steaming and freezing, rather than boiling or microwaving, retains the nutrients within squash. Cooking squash with less water preserves the amount of phenolic compounds, which are associated with color vibrancy and flavor in vegetables. The carotenoids lutein and zeaxanthin protect the eyes. In order to receive the full spectrum of nutrients that squash has to offer, eat skin, seeds and flesh. Squash consumption is recommended to regulate blood sugar and for those with type-2 diabetes.

Seeds have anti-parasitic properties, and the seeds and oil extracted from seeds have a history of use in botanical and folk medicine. Dried summer squash seeds are used in some cultures around the world to heal intestinal worms and parasites. The antioxidant supply in squash is linked to cancer prevention. Squash also has the three strongest anticarcinogens, those being vegetable fiber, vitamin C, and Beta-carotene, making the consumption of this starchy vegetable important for cancer prevention. The sodium and potassium contained in squash reduces hypertension. Squash without salt is highly recommended for those with hypertension. The pulp in squash neutralizes excess stomach acid, and also soothes the stomach, healing stomach disorders. An early colonist named Elizabeth Skinner found that the seeds of pumpkins can be ground into a meal and applied to skin to "taketh away freckles and all spots." When the plants of the Three Sisters plot are eaten together, they provide a nutritional balance of carbohydrates, protein, healthy fats and vitamins.

**PHARMACOLOGY**

**Antimicrobial / Anti-inflammatory / Neuro Effects:**

Extracts of leaves, fruits and flowers of C. maxima were subjected to pharmacologic and microbiological studies. Results showed complete inhibition of B. subtilis and partial inhibition of E. coli. Fruits and leaves showed neuro effects: decrease motor activity, ataxia, temporary palpbral ptosis among others. Ethyl acetate extracts of flowers showed decreased respiratory rate, analgesia, diarrhea and exophthalmos. The toxicity evaluation of Cucurbita maxima seed extract in mice: Hydroalcoholic extract of CM seeds had a considerable safety margin and devoid of acute toxicity.

**Toxicity evaluation of Cucurbita maxima seed extract in mice:** Hydroalcoholic extract of CM seeds had a considerable safety margin and devoid of acute toxicity.

**Antigenotoxicity/Spinasterol:** Study on antigenotoxic constituents of squash flowers showed isolate SQFwB2D (spinasterol) from the chloroform extract to possess the most antigenotoxicity, decreasing the mutagenicity of tetracycline by 64.7%. Pumpkin seed Oil / BPH: Pumpkin seed oil has been approved by the Germany's Commission E since 1985 for the treatment of BPH (benign prostatic hyperplasia).

**Antiparasitic:** Study showed that pumpkin seed can produce an antihelminthic effect. There was alteration in helminthic motility and a protheolithic effect. Egg destruction was noted in the gravid proglottids.

**Hypoglycemic:** Study evaluated the hypoglycemic activity of fruit juice and hydro-alcoholic extract of C. maxima in STZ-induced diabetic rats. Both caused significant decrease in hyperglycemia, with the extract showing more hypoglycemic effect than the fruit juice.

**Immunomodulatory / Seeds:** Cm seeds were tested for immunomodulatory effects using a dexamethasone-induced immunosuppression model in rabbits. Results showed Cucurbita maxima possesses potential to act as an immunomodulator.

**Antidiabetic/Aerial Parts:** Study of antidiabetic activity of methanol extract of aerial parts in Wistar albino rats against STZ-induced diabetes showed fasting blood glucose reduction in a treatment-duration dependent manner.

**Anticancer / Aerial Parts:** Study evaluated the antitumor activity of a methanol extract of C. maxima Duschesne aerial parts on Ehrlich Ascites Carcinoma model in mice. Results revealed significant anticancer activity attributed to its cytotoxicity and antioxidant properties.

**Sterols / Antimicrobial Activity:** Study of flowers afforded a 4:1 mixture of spinasterol and 24-ethyl-5a-trien-7, 22, 25-tetraene. Results showed slight activity against fungi A. niger and C. albicans and bacteria B. subtilis and P. aeruginosa.

**Anthelmintic / Schistosomiasis:** Study of a decoction prepared from C. maxima var. alyaga seeds showed a killing effect on S. japonicum somulae in vitro, with a dose-effect relationship in the mean percentage somula death.

**Hepatoprotective:** Study showed the hepatoprotective activity of methanol extracts of C maxima and Legenaria siceraria seeds against paracetamol-induced hepatotoxicity.

**Anthelmintic Activity / Comparative Study:** Study compared the in-vitro anthelmintic activity of Asparagus racemosus and C. maxima against Indian model. Both ethanolic and aqueous extracts of both plants showed...
significant anthelmintic activity, with the EE of A. racemosus showing better activity. [87]

**Human Overactive Urinary Bladder / Pumpkin Seed Oil:** Study evaluated the effect of pumpkin seed oil from C. maxima on urinary dysfunction in human overactive bladder. Pumpkin seed oil significantly reduced the degree of OABSS (overactive bladder symptoms score) [88].

**Anti-Inflammatory / Fruit:** Study evaluated a methanol extract of fruit for anti-inflammatory activity in rats using a carrageenan induced paw edema model. Results showed potent anti-inflammatory activity. Standard reference drug was indomethacin [89].

**Humoral Immune Response / Seeds:** Study evaluated the humoral immune response in rabbits treated with Curcubita maxima seeds. Results showed C. maxima seed powder has the ability to modulate humoral immune response in normal and immunosuppressed rabbits. [90] [91]

**Protease Inhibitory Activity / Seed Coat Extracts:** Curcubita maxima and Citrullus lanatus seed coat extracts showed good protease inhibitor activity. [92]

**Corrosion Inhibition:** Study evaluated the inhibitive action of peel of Curcubita maxima on mild steel corrosion. Results showed the extract functions as a good corrosion inhibitor with IE increasing with extract concentration. [93]

**Anti-Inflammatory / Seed Extract / Foregut Induced Injury:** Results showed CMSE has the ability to maintain foregut mucosal integrity normalizing redox system activity and inflammatory mediators. [94]

**CNS Stimulant Activity / Seed Oil:** Study evaluated the CNS stimulant activity of crude drug extract in Swiss albino mice. Results showed a petroleum ether extract showed good CNS stimulant effect that can be explored for therapeutic use as alternative treatment in medical conditions associated with dizziness and sedation. [95]

**Anti-Giardial Activity:** Study evaluated the antigiardial activity of C. maxima, D. curcubita pepo, and L. siceraria. Curcubita maxima petroleum ether extract of seeds showed the highest activity against Giardia lamblia. The activity could be due to the presence of triterpene (curcubitacins). [96]

**Antithelmintic:** Study evaluated the antiparasitic activity of C. maxima using canine tapeworms on exposed albino rats. Results showed an anthelmintic effect at MIC of 23 gr. of pumpkin seed in 100 cc of water. Superficial non-erosive gastritis was noted in rats after 4 hours of 9 gr/kg [97].

**Antidiabetic / Antihyperlipidemic:** Study evaluated the antidiabetic and antihyperlipidemic effect of various extracts of seeds of C. maxima in STZ-induced diabetic wistar albino rats. Results showed significant reduction (P<0.05) in blood glucose and significant decrease in total cholesterol, LDL, VLDL, triglycerides, and marked increase in serum insulin and HDL-cholesterol [98].

**Cytotoxicity / Seeds:** In brine shrimp lethality assay, the LD50 of a methanol extracts and petroleum ether fraction of Pumpkin seed were 31.70 ppm and 21.95 ppm respectively [99].

**Antibacterial:** Study of ethanol seed extract showed a spectrum of inhibition on Staph aureus, B. subtilis, P. mirabilis, K. pneumonia and E coli. [100]

**Diuretic:** Study of a hydroalcoholic extract showed significant (p<0.01) diuretic activity at the dose of 300 mg/kg when compared to control acetazolamide [101].

**Toxicity Study / Aerial Parts:** Study in mice evaluated the safety of methanol extract of aerial parts. Extract was well tolerated up to 2g/kg in acute toxicity study. In subacute toxicity study, it exhibited no significant alterations in any parameters. [102]

**Analgesic Study / Aerial Parts:** Study evaluated the analgesic effect of hydroalcoholic extract of CMD in a formalin model in rats. Results showed reduction of acute pain and chronic pain in all concentrations. Naloxone inhibited the analgesic effect of the extract [103].

**Lipid Composition / Seeds:** Lipid analysis of pumpkin seed oil yielded an oil content of 12% with oleic acid, stearic acid, palmitic acid, and linolein acid. The high degree of unsaturation makes it suitable as a drying agent, and the lower fatty acid content makes it suitable for edible use. (see constituents above) [104].

**Triterpene Esters / Cytotoxicity and Melanogenesis Inhibition / Seeds:** Study on seeds yielded three new multiflorane-type triterpene esters (compounds 1-3). Compound 1 exhibited melanogenesis inhibitory activity. Compounds 1 and 3 showed weak cytotoxicity against HL-60 and P388 cells. [105]

**CONCLUSION**

The overview of this article gives a new plat form about the diverse pharmacological action of Curcubita maxima and its pharmacognostic features and opening a new area for further research on isolation and characterization bioactive compounds and evaluation of new therapeutic activity in future.

**REFERENCES**

34. Oliver, Lawrence R.; Harrison, Steve A.; McClelland, Marilyn. "Germination of Texas Gourd (Cucurbita texana) and Its Control in Soybeans (Glycine max)". Weed Science, 1983; 31(5): 700–706. JSTOR 4043694.


76. Toxicity evaluation of Cucurbita maxima seed extract in mice / Summary Pharmaceutical Biology/, 2006; 44(4): 301-303


85. Toxicity evaluation of Cucurbita maxima seed extract in mice / Summary Pharmaceutical Biology/, 2006; 44(4): 301-303


Pathak / Intern Journ of Pharmaceutical, Chemical, and Biological Sciences, 2012; 2(2): 151-154


91. Protease Inhibition Studies and Metallic Responses of Cucurbita maxima and Citrullus lanatus Seed Coat Extracts / Mr. Sreenu Barla, Dr. DSVGK Kaladhur, Dr. Govinda Rao Duddukuri / IJSR - INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH, Sept 2013; 2(9).


