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Yogeshwar Sharma
Associate Professor, Department of Chemistry, Motilal Nehru College, Benito Juarez Marg, University of Delhi South Campus, New Delhi, India

Correspondence
Yogeshwar Sharma
Associate Professor, Department of Chemistry, Motilal Nehru College, Benito Juarez Marg, University of Delhi South Campus, New Delhi, India

A chemical and medicinal potency of *Momordica charantia*

Yogeshwar Sharma

Abstract
Momordica charantia [Family*: Cucurbitaceae*; Genus: *Momordica*] Common Names: Bitter-melon, Bitter-gourd, Bitter-squash, karela and Karavella from Sanskrit. It is a medicinal plant used as a vegetable and folk medicine with hypoglycemic activity of the fruits. It contains an insulin-like compound called charantin which has anti-diabetic properties and helps in reducing the blood sugar levels. It is a good source of dietary fibre, fat and carbohydrates, vitamins and minerals, glycosides, saponins, alkaloids, fixed oils, triterpenes, triterpene glycosides, proteins, and steroids. It also helps in lowering the bad cholesterol levels, thus reducing the risk of heart disease and stroke. It strengthens the immune system, improves respiratory health, boosts skin health and contains anti-ageing properties. The seeds and fruits of bitter gourd have antioxidant, antiviral, anticancer, antiulcer, aphrodisiac, anti-inflammatory, analgesic, antidiabetic and antifertility activities. This article summarizes the general description, medicinal properties, traditional uses, structure of some phytochemicals and market preparations of *Momordica charantia*.

Keywords: *Momordica charantia*, phytochemical constituents, medicinal uses, market preparations

Introduction
Momordica charantia [Family: *Cucurbitaceae;* Genus: *Momordica*] Common Names: Bitter-melon, Bitter-gourd, Bitter-squash, karela and Karavella from Sanskrit. It is a medicinal plant used as a vegetable and folk medicine with hypoglycemic activity of the fruits. Traditionally, fruit juice of bitter gourd is consumed early morning on an empty stomach for controlling glucose levels in hyperglycemic states. Bitter gourd contains an insulin-like compound called charantin which has anti-diabetic properties and helps in reducing the blood sugar levels. It is also an excellent source of dietary fiber which contributes to relieving constipation and indigestion. It is low in calories, fat and carbohydrates which help in weight management. It also stimulates the liver to secrete bile acids that are essential for metabolising fat in the body. Bitter melon is also extensively evaluated for its anti-cancer efficacy against various malignancies. It is a good source of vitamins and minerals, glycosides, saponins, alkaloids, fixed oils, triterpenes, triterpene glycosides, proteins, and steroids [1-7]. It contains potassium, iron, magnesium, and vitamins like A and C. It also helps in lowering the bad cholesterol levels, thus reducing the risk of heart disease and stroke. It strengthens the immune system, improves respiratory health, boosts skin health and contains anti-ageing properties. The seeds and fruits of bitter gourd have antioxidant, antiviral, anticancer, antiulcer, aphrodisiac, anti-inflammatory, analgesic, antidiabetic and antifertility activities [8-12]. Its fruits are also used in rheumatism, colic, worms and disease of the liver.

Indian Bitter-melon

Chinese Bitter-melon

Bitter-melon leaf

It is a tropical and sub-tropical vine, widely grown in Asia, Africa, and the Caribbean for its edible fruit, which is among the most bitter of all fruits.

It grows in tropical areas where it is used as a food as well as a medicine. It is a annual creeper with long stalked leaves producing yellow solitary male and female flowers borne in the leafaxils. The fruit is warty-looking gourd, usually oblong and resembling a small cucumber. The young fruit is bright green turning to orange-yellow when ripe. At ripeness the fruit splits into three irregular valves that curl backwards and release numerous brown or white seeds enclosed in scarlet arils. Its generic name "Momordica" comes from Latin meaning “to bite”. Ripe fruits are relatively bitterer than unripe ones and bitterness is due to the cucurbitacin like alkaloid momordicine and triterpene glycosides. To make bitter gourd less bitter, **s**prinkle salt all over the bitter gourd pieces and leave it for 30 minutes. This will minimise the bitter taste of the gourd making it more palatable or soak it in tamarind juice for a few minutes.

Occurrence

A monecious climber found throughout India often under cultivation, up to an altitude of 1500 m. The plant is cultivated throughout India as a vegetable crop. Two types are grown in North India, the hot season or ‘Jethuya’ and the rainy season or ‘Bara Masiya’; the latter bears fruits nearly throughout the year. They differ in habit of growth, in size and shape of fruit and period of maturation. In South India, nine different types of the species have been selected for cultivation; they yield fruits which differ in size, color and surface characters. Crossing among them has resulted in a few hybrids, some yielding large fruits with thick flash and showing hybrid vigour. The plant is commonly cultivated during the warm season of the year. In the hills, a summer crop is sown during April to July, while two crops are generally taken in the plains. The hot season or early crop is sown between March and April and is often grown without support; the rainy season crop is sown in June-July and need supports. The seeds are sown in lines 2 feet apart in a well prepared and manure beds or in small pits 2 or 3 seeds are planted in each pit but only one plant is retained after germination. The plants are watered once or twice a week during the dry weather. They begin to flower 30-35 days after sowing and fruit become ready for gathering 15-20 days later.

Vernacular names

In India

Bengali	Karala, Baramasiya
Gujrati, Hindi, Punjabi	Karela
Kannada	Haagala, karali
Malayalam	Kaippakka, Paavakka
Tamil	Pavakkachedi, Pakal, Pavakka
Telugu	Kakarakaya

Outside India

Arabic:	Hanzal
Chinese:	ku gua, foo gwa (Bitter gourd), jin li zhi (Bright beautiful lychee)
Danish:	Karela
English:	Bitter gourd, karela, balsam pear, alligator pear, African cucumber
French:	Assorossie, margase
German:	Balsamapfel, Wunder-Balsampfel
Italian:	Balsamini lunghi, porno balsamo,
Japanese:	Tsuru reishi, niga-uri
Portuguese:	Balsamini longa
Spanish:	Balsamina
Thai:	Mara, phakha, maha

Cultivation

Soak seeds in water for some days and prepare containers of good potting soil, well watered & drained. Plant seeds about 1 inch (Approximately 2.5 cm) deep & 2 inches (5 cm) apart. Cover the containers with cellophane & set in a warm, dark place. When seeds sprout, remove cellophane & set near a sunny window; keep soil moist. When seedlings have produced 2 sets of true leaves, they should be transplanted to the ground, or if this is not possible, transplant to a large container of good soil. Transplant outdoors after season has become warm. Prepare a location with partial sun & good soil, well-watered & well-drained. Provide support for vines, with no other type of vine sharing this support (otherwise harvest will be difficult). After about 35 to 40 days, the plant will begin to produce male & female yellow flowers about 2-3 cm in diameter. Male flowers, more numerous, have a yellow center & conical base, while female flowers have a green center & small bump at the base. When a female flower appears, cross pollinate by gently touching several male flower centers with a soft implement (e.g., feather, bit of soft paper, small pointed paintbrush, or fingertip if one has a light touch) & transferring pollen grains to center of female flower. If female’s flowers are numerous & bees are present, this procedure is not needed. If pests appear, control by sprinkling over the plant with a mixture of cayenne pepper, garlic powder & water or with a light solution of soapy water. Throughout the growing season, leaves may be taken from the plant to preserve by drying for use when fresh plant is not available. Take older leaves in mid- morning after dew has dried & no rain has fallen for several days.

Ripe fruit of Bitter Gourd

When fruits develop, they will be soft, light green gourds with a bumpy or irregular surface. Allow to develop until they become orange and to split open to reveal a number of seeds. These seeds are covered in a sticky, bright red aril. Arils attract ants and birds so pick up mature fruit when it begins to split. Scoop out seeds, wash thoroughly to remove arils, & set seeds out to dry. When dry, seeds may be wrapped loosely in clean brown paper & stored to plant next season. At the same time preserve the mature fruits. As an alternate way to remove arils, spread the seeds on a large, clean piece of cloth and allow drying for a few days. Then, the arils may be easily rubbed from the seeds. In temperate climates, the plant begins to lose vigor after about six to nine months. It will produce a large number of female flowers, & at the same time begin to weaken noticeably. At this time it should be harvested. Fruits which are nearly mature should be allowed to ripen, but may be picked so that seeds can be obtained. The immature fruits are removed & preserved by drying, canning, or other ways. Near the end of the season, the vines may be removed from their support & spread out to dry. To preserve immature fruits, slice thinly & dry by spreading on a screen and protect

it from moisture & insects. To preserve mature fruits, wash & cut into small pieces, & placed in a container of spirits. This may be strained for a tincture, or used as it is. Immature fruits may also be cooked & eaten fresh, canned, or preserved in other standard ways. The seeds may be planted & the cycle begin again when weather is warm, or at any time for indoor cultivation.

Parts used

The fruits of bitter gourd though bitter is wholesome and esteemed as vegetable when young and medicinally used as an acrid, anti-diabetic, anti-inflammatory, digestive, purgative, stimulant, stomachic, appetizer; it may be sliced and preserved after drying for use in the off season. The root of bitter gourd is used as an acrid, astringent, and bitter whereas the leaf is used as a antipyretic, bitter, emetic and purgative. The fruit is also pickled. It is often used as a flavoring for food preparations. The seed mass of the ripe fruit is used as condiment. The bitterness is reduced by steeping the fruit in salt water and cooking after removing the skin.

Macroscopy

Habit: Annual, stem long much branched, angled and grooved more or less pubescent or hairy; young parts hairy or villous.

Tendrils: Simple, slender, elongate, pubescent.

Calyx: 8-10 mm long, pubescent; lobes 5-6 mm long, elliptic, subacute.

Corolla: Somewhat irregular, lemon yellow; segments obtuse or emarginate, 1.6 -2 cm long, veined.

Flowers: Monoecious.

Male flowers: Solitary; peduncles 5-10 cm long, glabrous or pubescent, furnished with large reniform or orbicular bract at or below the middle.

Female flowers: Peduncles 5-10 cm long, slender bracteate usually at or near the base. Staminodes 3, glandulyform. Ovary fusiform, muricate, stigmas 3, bifid.

Fruit: Bright orange colored, 5-15 cm long, pendulous, fusiform, usually pointed or beaked, ribbed, bearing numerous triangular tubercles giving it the appearance of crocodile's back, 3 valves at the apex when mature.

Seeds

8-13 mm long, compressed, corrugate on the margin, sculptured on both faces

Leaves

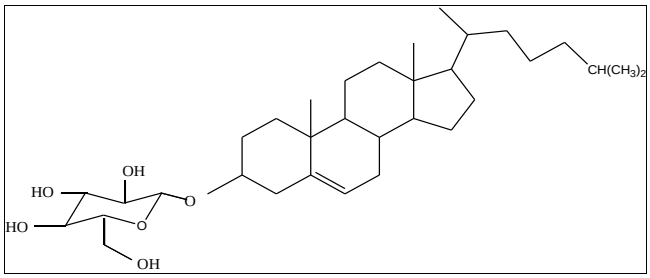
Almost orbicular in outline 5-12.5 cm. Diameter, pubescent or sub glabrous on both sides cordate at the base deeply divided into 5-7 lobes, the acute or sub-acute, apiculate, coarsely spinous dentate, constricted at the base, the sinus between them narrow, rounded; petioles 2.5-5 cm long, channeled.

Microscopy

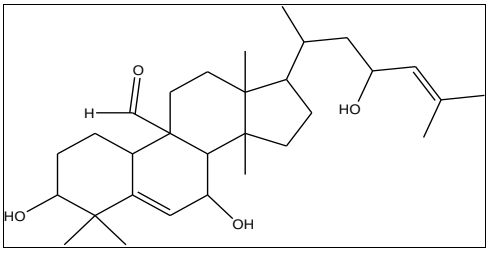
The stem is pubescent; the transverse section shows an outer epidermal layer; parenchymatous layer forms the cortex; a sclerenchymatous lignified tissue encircles the vascular tissue with a central pith with parenchymatous cells some of which have rosette calcium oxalate crystals. Both surfaces of the leaf show numerous trichomes on the veins and veinlets, both multicellular uniseriate clothing trichomes and glandular types; epidermal cell walls wavy; stomata anomocytic with 4-5 subsidiary cells. The transverse section of the leaf shows dorsiventral structure; giant clothing trichomes with collapsed cells occur on the upper surface while a few of the same occur on the veins on the lower surface; the palisade cells abut on the collenchyma cells in the midrib region, the spongy mesophyll comprises large parenchymatous cells and contain rosette-type calcium oxalate crystals; vascular xylem elements are lignified.

Phytochemical constituents in bitter gourd

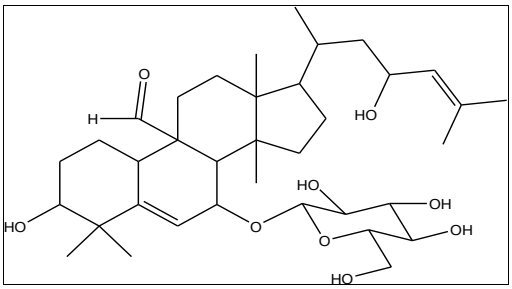
The main constituents of bitter gourd are triterpene, steroid, alkaloid, protein, lipid and phenolic compounds [9]. The leaves and fruits of bitter gourd contain bitter phytochemicals like charantin, glycosides and karavilosides along with a plant insulin polypeptide-p, which are hypoglycemic in action. Charantin is a steroidal saponin and it has blood sugar lowering activity. Charantin is responsible for the hypoglycemic properties of bitter melon. It is a 1:1 mixture of two steroidal saponins, β-sitosteryl glucoside and 5, 25-stigmasteryl glucoside. It is insoluble in water and a very strong basic compound [13-18]. Some of the phytochemical constituents present in bitter gourd are: Charantin, Momordicin, Momordicoside-F-l, Momordicoside-F-2, Momordicoside-G, Momordicoside-I, Karaviloside I, Karaviloside II, Mutachrome, Flavochrome, 5-Hydroxytryptamine, Ascorbigen, β-sitosterol-β-d-glucoside, Citrulline, Galacturonic acid, Lanosterol, Lutein, Lycopene, etc. The chemical structure of some of the phytochemical constituents in bitter gourd are:



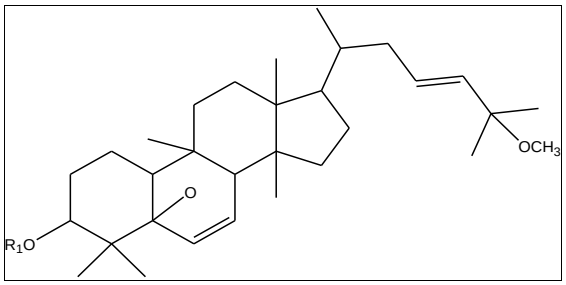
Structure of charantin



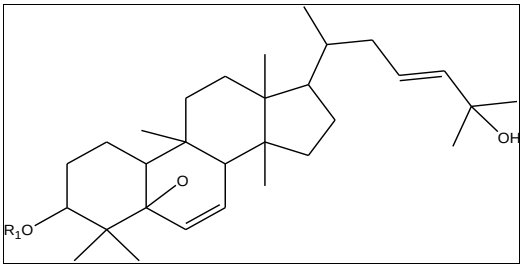
Momordicine I



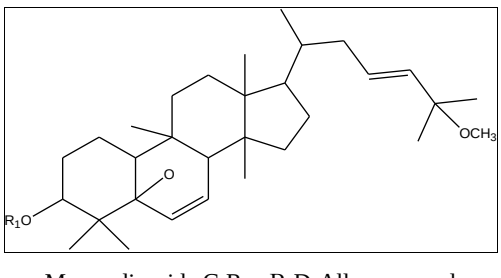
Momordicine II



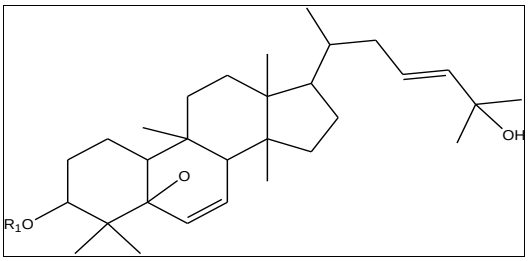
Momordicoside F1 R_1= B-D-Glucopyranosyl



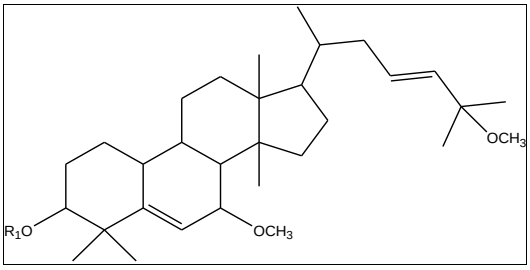
Momordicoside F2 R_1= B-D-Allopyranosyl



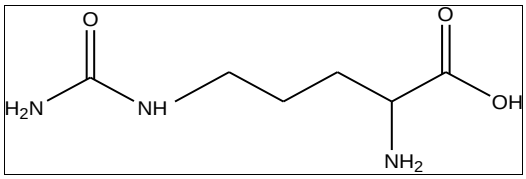
Momordicoside G R_1= B-D-Allopyranosyl



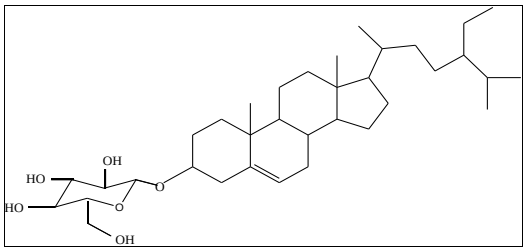
Momordicoside I R_1= B-D-Glucopyranosyl



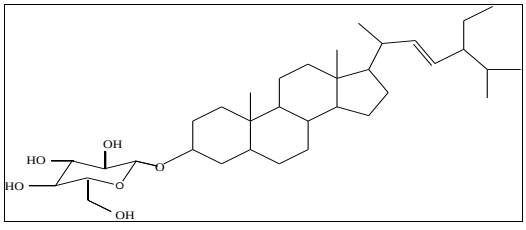
Karaviloside I; R_1 = B-D-Glucopyranosyl
Karaviloside Ii; R_1 = B-D-Allopyranosyl



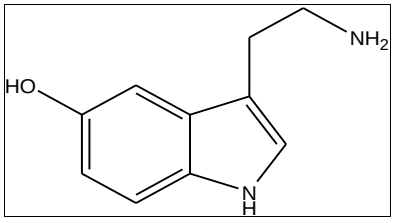
Citrulline



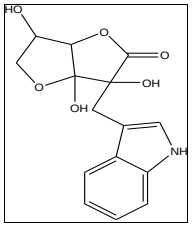
β-Sitosterol B-D-Glucoside



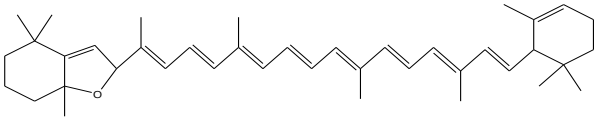
5, 25-Stigmasteryl Glucoside



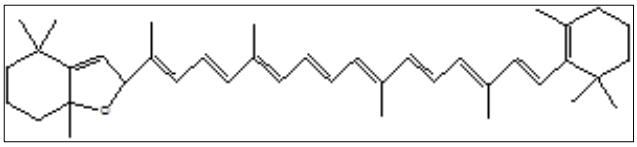
5-Hydroxytryptamine



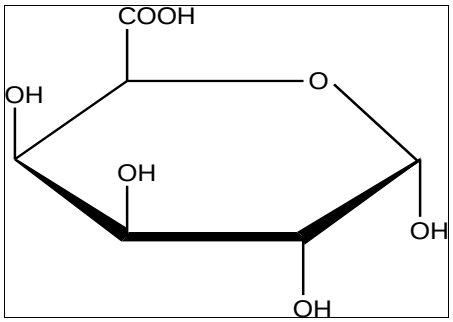
Ascorbigen



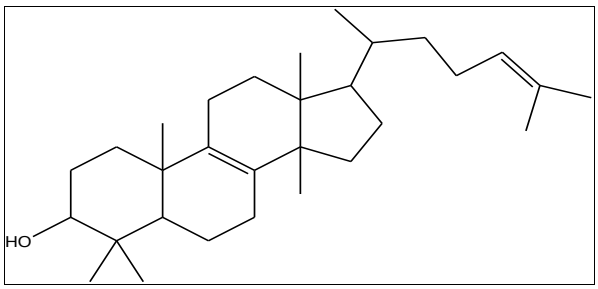
Flavochrome



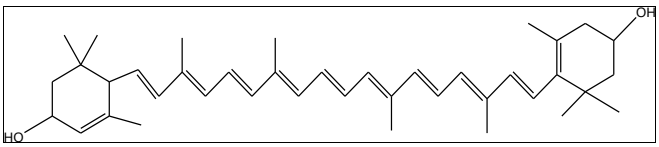
Mutachrome



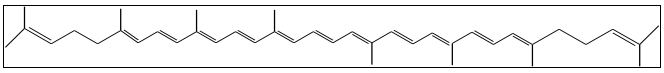
Galacturonic Acid



Lanosterol



Lutein



Lycopene

Other constituents in bitter gourd are carbohydrates, mineral matter, ascorbic acid, alkaloids, glucoside, saponins and mucilage. Bitter gourd fruit is also a rich source of folic acid, β-carotene, magnesium, phosphorus, potassium, iron and vitamins A and C.

Medicinal uses and market preparations

It is a medicinal plant used as a folk medicine with hypoglycemic activity of the fruits. Fruit part of bitter gourd is made up of many different proteins, triterpenes, alkaloids, flavonoids, phenolic compounds, saponins, acids and steroids that are chemically active. It contains an insulin-like compound called charantin which has anti-diabetic properties and helps in reducing the blood sugar levels. The fruits are stomachic and also used in gout, rheumatism and of spleen and liver diseases. Fruit juice with chalk/sugar is used in stomatitis, and as an emmanagogue in dismenorrhoea. The roots are used as astringent and in hemorrhoids. The juice of the leaves is used as an emetic, purgative in bilious affections and also in relieving burning of the soles of feet. For night blindness, leaf juice with black pepper is applied locally. Fruit, leaves and roots are used as a folk remedy for diabetes mellitus. The fruit is bitter cooling, digestible, laxative, antipyretic, antihelmintic, appetiser, cures biliousness, Kapha, blood diseases, anemia, urinary discharges, asthma, ulcers, bronchitis and juice is useful in cholera [18-20]. Some of the market preparations containing bitter gourd are momordica charantia capsule, karela juice, karela tablet, jamun karela juice, karela churna, bitter melon, etc.

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