



Review Article

A REVIEW ON *Capsicum annuum* (A HERBAL BOON)

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ABSTRACT

Capsicum annuum is a species of the plant genus *Capsicum* native to southern North America and northern South America, belonging to family, Solanaceae, is commonly consumed all over the world as spices. It is commonly known as red pepper in English and mirchi in Hindi. Historically, it has been known to possess medicinal properties like anti-inflammatory, analgesic, antipyretic, hypoglycaemic, anti-microbial activity and stomachic. *C. annuum* have highest proportion of capsaicin in placental tissue as one of the important chemical constituents. This review aims towards discussing various types of phytochemical constituents and pharmacological actions of plant *Capsicum annuum* which is known as herbal boon for all of us.

Keywords: *Capsicum annuum*, red pepper, mirchi, Solanaceae, capsaicin

INTRODUCTION

Capsicum (*Capsicum* spp.) also called as pepper, is a main vegetable and spice crop originated in the American tropics and today cultivated all over the world for fresh, dried, and processing products. Around the genus *Capsicum* there is an increasing interest and fascination due to the considerable variation for several traits, which makes this crop extremely versatile and suitable for innumerable uses as food and non-food products. The genus *Capsicum* includes over 30 species, five of which (*C. annuum*, *C. frutescens*, *C. chinense*, *C. baccatum*, and *C. pubescens*) are domesticated and mainly grown for consumption ¹.

Different varieties are scaled by pungency test for their pungency measured in terms of SHU (Scoville Heat Units). The widely accepted method for evaluating pungency of *Capsicum* was devised by Scoville in 1912 according to which *Capsicum* has been divided in to five groups viz. Non pungent Paprika (0-700SHU), mildly pungent (700-3000SHU), moderately pungent (3000- 25,000SHU), highly pungent (25,000-70,000SHU) and very highly pungent of above 80,000SHU ².

The pungency of the pepper is due to the presence of capsaicinoids, the vanillyl amide units, mainly capsaicin present in highest concentration in placental tissue followed by fruits and seeds. The fruits with seeds are used commonly in spices and food due to their pungent flavor and has been known to possess several medicinal properties like anti-inflammatory, analgesic, carminative, rubefacient and recently its antioxidant ³, hypoglycaemic ⁴, antifungal ⁵ and antimicrobial activities ⁶ have been established. These medicinal properties of *C. annuum* make it popular in both Ayurveda and Homoeopathy. It is an

herbaceous annual plant with glabrous pubescent, lanceolate leaves, white flowers and fruits ⁷.

Plant profile (*Capsicum annuum*)

Synonyms - *Capsicum abyssinicum*, *Capsicum angulosum* Mill., *Capsicum axi* Vell., *Capsicum bauhini* Dunal, *Capsicum caerulescens* Besser, *Capsicum cerasiforme* Mill., *Capsicum ceratocarpum* Fingerh., *Capsicum cereolum* Bertol., *Capsicum comarim* Vell., *Capsicum conicum* Lam., *Capsicum conoide* Mill ⁸.

Biological Source - *Capsicum* consists of the dried, ripe fruits of *Capsicum minimum* and *Capsicum annum* Linn., belonging to family- Solanaceae ⁹.

Taxonomic status

Kingdom	Plantae
Clade	Tracheophytes
Clade	Angiosperms
Clade	Eudicots
Clade	Asterides
Order	Solanaceae
Genus	<i>Capsicum</i>
Species	<i>annuum</i>

Geographical distribution - *Capsicum annuum* is a species of the plant genus *Capsicum* native to southern North America and northern South America. In India it is distributed in Maharashtra: Nasik, Pune, Karnataka, Hassan, Mysore, Kerala, Tamil Nadu ⁸.

Macroscopic description

Tree- It is shrubby perennial herb. Their habits are annual sub woody plants which attain up to 65cm or more in height⁹.

Leaves- The leaves are simple, glabrous, lanceolate to ovate with apex being acutely acuminate and the base being cuneate or abruptly acute and petiolate¹⁰.

Flower-The single flowers are an off-white (some time purplish) color. Flowers are axile in placentation borne at nodes¹⁰.

Stem- Stem is densely branched and up to 60 cm (24 in) tall¹⁰.

Fruits- The fruit are berries that may be green, yellow, orange or red when ripe. The berry fruits are many seeded, globose shaped¹⁰.

Microscopic description

Epidermal studies- *Capsicum annuum*, Foliar epidermal study revealed the presence of anomocytic stomata and uniseriate trichomes at both the adaxial and abaxial foliar surfaces¹¹.

The petiole of *Capsicum annuum* - is made of a layer of cells in the epidermis, 2 to 4 layers of collenchyma in the hypodermis, the general cortex is predominated by parenchymatous cells. The primary growth phase reveals 2 vascular traces from 1 gap having bicollateral arrangement with 2 rib bundle wings¹¹.

Root anatomy of *Capsicum annuum*- showed the piliferous layer is single-cell thick. The vascular bundles are radially symmetrical with exarch xylary cells. Centralized parenchymatous cells occupy the pith region of the root¹¹.

Ovary anatomy of *Capsicum annuum*- revealed the placentation as axile type, ovaries are bilocular and 2-celled¹¹.

Reported Phytoconstituents

Capsaicin is colourless, crystalline and pungent principle found in *Capsicum* which is in amount of 0.5% to 0.9%. The pungent phenolic fraction of capsicum also contain a proportion of 6, 7 dihydrocapsaicin. In a study of water soluble constituent of three varieties of *C. annuum*, isolated twelve novel acyclic glycosides (geranylinalool derivatives) named capsainoside A-F (dimeric esters of acyclic diterpene glycoside)¹¹.

The red paprika (*Capsicum annuum* var. Longum nigrum) contain a carotenoid, cycloviolaxanthin[(3S,5R,6R,3'S,5'R,6'R)-3,6,3,6'-diepoxy-5,6,5',6;-tetrahydro-beta, beta carotene-5,5'-diol] besides 5,6-epoxycapsanthin, (8S)- capsochrome, karpoxanthin and violaxanthin, cucurbitaxanthin A and B, 3,6-epoxycapsanthin.

Chillies also contain ascorbic acid (0.1-0.5%), thiamine, red carotenoids such as capsanthin and capsorubin and fixed oil (4-16%)¹².

Reported Pharmacological activity

Antioxidant activity

The antioxidant activity of capsanthin and the fatty acid esters was examined by measuring the free radical-oxidation of methyl linoleate. Capsanthin suppressed hydroperoxide formation as well as beta carotene, lutein, and zeaxanthin. Capsanthin decomposed more slowly than the other carotenoids. and the

radical scavenging effect of capsanthin was found to last longer. To assess radical scavenging effect, The production of methyl linoleate hydroperoxides and the decomposition of capsanthins in reaction solution were measured by HPLC¹³.

Insecticidal activities

The experiment was conducted to investigate the insecticidal activities of black pepper (*Piper nigrum* L.) seed powder and red pepper (*Capsicum annuum* L.) fruit powder, against *Rhizopertha dominica* (F.) and *Sitophilus granarius* (L.) Th results revealed that black pepper at 0.5% concentration caused 100% mortality of *S. granarius* in the first five days, also *R. dominica* showed complete mortality at 5% level after 14 days¹⁴.

Antimicrobial activities

Ethanol extracts of the fruits of three kinds of *Capsicum* showed similar potencies in their antimicrobial activities against Gram (+) and Gram (-) bacteria's, and fungi, although they contained different level of capsaicin. Bioautographic tests demonstrated that capsaicin was the main antimicrobial component. At least two other non-polar components of ethanol extract also contributed to the antimicrobial activity and very likely that these compounds were responsible for the activity toward *pseudomonas aeruginosa*^{15,23}.

Anthelmintic efficacy

A 90-day study was conducted in Gewane Agricultural Technical and Vocational Education Training College, Ethiopia, to compare the anthelmintic effect of chili or Mitmita (*Capsicum annuum longum*) and a conventional treatment such as Triclabendazole on *Fasciola* infections to nutritional levels. The treatment efficacy was assessed using the percentage of the egg or fluke reduction, body weight gain, blood parameters results post treatment on 30, 60 and 90 days¹⁶.

Antitumoral Properties

Recently, capsaicins became interesting to analyse as they showed protective properties against carcinogenic and mutant agents¹⁷.

Analgesic Properties

Chili pepper is used in painful situations, like rheumatic diseases, migraine, painful diabetic neuropathy, trigeminal neuralgia and arthritis¹⁸.

Antithrombotic and Vasodilatory Properties

As well known, high levels of cholesterol in blood are the main cause of atheroma and thrombus (hematic flux interruption in a blood vessel). Decreasing levels of cholesterol is a way to prevent the mentioned diseases¹⁹.

Bactericidal and Bacteriostatic Properties

Molecules with antimicrobial activity are an important component of the natural defenses of most living organisms against the invasion of pathogens. Some plants, since ancient times, are used as a defense mechanism against a wide range of microorganisms, including bacteria, protozoa, yeasts, fungi and viruses. A survey of the Mayan Pharmacopoeia revealed that the fruits of the *Capsicum* species are cited as natural remedies against infections by microbes²⁰.

Antiulcer Properties

Red pepper has been used for centuries as digestive. Traditionally conventional ulcer medicines avoid pepper, whereas herbalists recommended it. A study indicated that capsaicin inhibits *in vitro* developing of *Helicobacter pylori* at 10 g/ml, negatively affecting the genesis of peptic and duodenal ulcers²¹.

Species and Cultivar

The *Capsicum* genus belongs: Kingdom Plantae Category Magnoliophyta clade Magnoliopsid Order Solanales Family Solanaceae. The *Capsicum* genus includes almost 30 species; among them, *Capsicum annuum* L., *Capsicum baccatum* L., *Capsicum chinense* Jacq., *Capsicum frutescens* L., and *Capsicum pubescens* are the five most cultivated species²².

Capsicum annuum

The *Capsicum annuum* Fiesta has a bushy habit; fruits are lengthened and thin, erected and grouped, green and gradually yellow, orange and brilliant red. This variety growth very well in medium texture soils, also fertile, deep, and rich in organic matter. Long rotations avoid fatigue phenomena. For field cultivation, soil tillage is typical of renewal crops. Abundant fertilization with manure is suggested. The sowing is carried out in a greenhouse using 3–4 g of seed per m². It is spread by sowing in peat small jars or Phyto cells. Shoots are transplanted to field only when they are sufficiently developed and when the weather became warm (usually April in central and northern regions). Row distance is 70/80 cm, on the same row plants distance is 30/45 cm. After the transplantation, soil between rows is worked (weeding, hoeing) and irrigated. Fertilization is conducted according to national guide lines, which for normal production of 40/60 t/ha is considered to be: 160 kg/ha of nitrogen; 75 kg/ha (normal soil) of phosphorus; 250 kg/ha of potassium²³⁻²⁴.

Capsicum frutescens

Capsicum frutescens means “shrub shape.” It is a perennial plant, very common in India, which needs high temperatures, Its woody trunk can pass 50 cm of height; leaves are elliptical with five tips; fruits are little pepper; flowers are white and orange, or yellow in the centre and grow on summer; fruits, coriaceous and edible, are green when unripe, yellow, bright red, violet, purple or brown when ripe. The *C. frutescens* pepper is less spicy only to the *C. chinense* species (the spiciest)²⁵.

Capsicum chinense

This species includes the spiciest peppers, like Habanero, Naga Dorset and Scotch Bonnet. *C. chinense* pepper smells like an apricot and has a fruity taste. The plant grows slowly, and it can become a small tree of 2 m tall. Flowers, white or greenish, have violet stamens and they can be campanulas, another distinctive trait of these species. Leaves are large, fleshy and rugose; they can have light hair on bottom side. It is very sensitive to sunlight²⁶.

Capsicum pubescens

Known also as Manzana, it is the most common species in Peru and Bolivia. It grows also in the Caribbean and Mexico; it is the most resistant specie to cold. It grows at high elevation. Because of its important vertical growth, this plant can reach some meters of height. It is known also as “tree chile” (tree of pepper) and grows rapidly as a rampant. The principal characteristic of *C. pubescens* are black or dark brown seed in fruits, independently from shape and spicy grade. This specie is easily recognizable for its flowers, violet with white anthers. Elliptical leaves can have fur on the bottom. The wild varieties, of this specie, is not known yet²⁷.

Capsicum baccatum

This specie comes from Bolivia and Peru; it has a medium spicy grade and a yellow or red colour. Its fruit in Peru is used for the national typical meal, ceviche. *Baccatum* specie includes a lot of varieties, both decorative and edible. Among decorative varieties, there is “Bishop’s crown.” The plant is erected, like a small tree and its height varies from 0.5 to 2 m in its habitat. This specie has spear shaped green leaves. Flowers have white yellow-green

brown pointed corolla, yellow stamens, yellow or brown anther with 5–7 petals.

They grow on the leaves axils, one per knot. The fruits, more than forty per plant, are green berries that, as they ripen, change through yellow, orange and red shade, becoming white or violet when ripe. The shape is also variable, so this kind of pepper is usually bought as an ornamental plant. A variety, called pucachu is like a climber²⁸.

CONCLUSION

Capsicum annuum belongs to family- Solanaceae. It have various types of chemical constituents, showing number of pharmacological actions beneficial for protecting our life. The chemical composition of *Capsicum annuum* consists of essential oil, alkaloids, glycoside, flavonoid, tannins and terpenoid. Modern drug can be developed after extensive investigation of its bioactivity, mechanism of action, pharmacotherapeutics, toxicity and after proper standardization and clinical trials.

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