

Bhut Jholokia Demystified: Insights into the World's Hottest Chili

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ABSTRACT

Bhut Jholokia, or "Bhut Jolokia" or "ghost pepper" (*Capsicum chinense* Jacq.), is one of the world's hottest chili varieties and an important part of the ethnobotany of northeast India. Its high capsaicinoid content has created a lot of interest in its phytochemical chemistry and wide range of biological activities, such as analgesic and anti-inflammatory activities, antimicrobial and anticancer activities, metabolic modulation, and possible cardiovascular benefits. This review offers a concise synthesis of its botanical characterization, traditional therapy, phytochemical profile, pharmacology, toxicology, and agronomic and quality concerns. It also highlights current knowledge gaps and suggests research priorities for upcoming translational and clinical investigations.

Key Words:

Bhut Jholokia, *Capsicum chinense*, Ghost Pepper, Capsaicinoids, Phytochemistry, Pharmacology, Toxicology, Traditional Use.

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1. Introduction

Nature consistently serves as a prime example of remarkable phenomenon of interdependence. Natural substances derived from animals, minerals and plants have been used to treat ailments in humans. One of the world's most extensive plant-based medical traditions is found in India. India has lately documented around 20,000 medicinal plant species, while over 500 traditional groups utilize around 800 plant species for the treatment of various ailments¹.

Bhut Jolokia, or "ghost pepper," is a cultivated variety of *Capsicum chinense* Jacq., which is conventionally grown in the Indian northeastern states of Assam, Nagaland, Manipur, and

Mizoram. Famous throughout the world because of its extreme pungency, it was in the early 2000s that the Guinness Book of World Records declared it to be one of the world's hottest naturally occurring peppers. Its rich capsaicinoid composition has generated very high interest in agricultural, nutritional, and pharmacological studies, in addition to its conventional use in medicine^{1,2}.



Figure -1² *Capsicum chinense Jacq*

1.1 Taxonomic Classification

Table no-1

Scientific Name	<i>Capsicum chinense</i> Jacquin
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Solanales
Family	Solanaceae

1.2 Synonyms

Capsicum sinense Murray

Capsicum toxicarium Poepp. Ex Fingerh

1.3 Vernacular Names

Bhut Jolokia; Ghost Pepper; Umorok; Naga King Chilli; Nag Jolokia; Bih Jolokia; Dorset Naga; Raja Mirchi; Borbih Jolokia; Nagahari; Naga Viper chilli; Saga Jolokia; Tezpur chilli; Poison chilli; etc.

2. Botanical Description

Capsicum chinense Jacq. is commonly known as the habanero pepper and is native to South and Central America. This plant is being able to pollinate itself but can occasionally cross-pollinates with other plants when a large number of insects are present. This plant can reach heights of 50-100 cm in the North-eastern Indian states, and under some circumstances, even higher. The plant's stem is green, with black pigments at the nodes. The leaves are oval in shape and appear crinkled. The flowers are pendent, creamy white with a hint of pale green, and appear in clusters of 2-3 flowers per node. When the plant grows, it typically produces only two fruits per node. The plant's anthers and filaments are blue and purple, respectively. The fruits are elongated, measuring 5-7 cm in length and 2.5-3.0 cm in diameter, with a wavy surface. The fruits might be light green, bright red, or orange. Each fruit contains 4-5 hollow locules, and a single plant can produce approximately 15-20 full-sized fruits and 10-14 smaller fruits in a single season³.

3. Geographical Distribution

These plants are indigenous and easily found in Bangladesh, India, Sri Lanka, Mexico, Australia, and the United States. Wild varieties of *C. chinense* can be found in the eastern lowlands of South America. The Bhut jolokia, or ghost pepper, is mainly cultivated in the Indian states of Nagaland, Assam, and Manipur, although it is also grown in smaller quantities in Mizoram, Arunachal Pradesh, and Meghalaya. It is also grown in the northeastern part of Bangladesh³.

4. Traditional and ethnobotanical uses

Locally, Bhut Jolokia fruits and their products are used as spices, preservatives, and for external use to relieve rheumatism. They are also used in traditional medicine for respiratory conditions and pain relief. Traditionally, non-culinary uses have involved their employment as irritants in deterrent products, e.g., "chilli grenades" to disperse crowds⁴.

5. Phytochemical Composition

The intense flavor in chili peppers arises from a related group of compounds called capsaicinoids. These species, which the *Capsicum* produce, are attributed to the hotness and pungency properties of the fruits. Capsaicinoids vary in different structures, consisting of different branched fatty acid moieties attached to the benzene ring of vanillyl amine. Changes in their chemical composition through changes in acyl moiety structure may thus alter the specie level⁵.

There are two major capsaicinoids present in chili peppers, including capsaicin and dihydrocapsaicin, which represents more than 90% of the total content of capsaicinoids. Other minor capsaicinoids are nordihydrocapsaicin, homodihydrocapsaicin, and homocapsaicin. The amounts of capsaicinoids can be calculated in Scoville Heat Units (SHU), a measurement scale developed by Wilbur Scoville for the spiciness⁵.

6. Pharmacological Activities

The significant bioactivities ascribed to Bhut Jholokia, with focus on mechanisms involved and preclinical data, are discussed below.

Table No.-2

S.No	Bioactivity	Experimental Model / Species	Extract / Dose	Mechanistic Insights	Key Findings	References
1.	Anti-inflammatory & Analgesic	Mouse / Rat	Bhut Jholokia extract, topical or oral	TRPV1 activation; inhibition of COX & LOX; modulation of TNF- α , IL-1 β , IL-6	Reduced paw edema, nociception, hyperalgesia	Liu & Nair, 2010; Mathur et al., 2011 ^{6,7}
2.	Antioxidant	In vitro (DPPH, ABTS, FRAP)	Methanolic / ethanolic extracts	Free radical scavenging; inhibition of lipid peroxidation	Strong antioxidant potential, ROS reduction	Liu & Nair, 2010; Singleton et al., 1999 ^{6,8}
3.	Antimicrobial	Bacterial & fungal cultures	Capsaicinoid fraction, 25–100 μ g/ml	Membrane disruption; inhibition of biofilm formation	Inhibited Gram-positive & Gram-negative bacteria; antifungal effect	Meghvansi et al., 2010; Sanatombi & Sharma, 2008 ^{9,10}
4.	Anti-hyperlipidemic / Metabolic	Wistar rats	Methanolic fruit extract, 250 mg/kg	AMPK activation; increased thermogenesis	Reduced cholesterol, triglycerides, LDL; increased HDL	Kumar et al., 2015 ¹¹
5.	Anticancer	Human cancer cell lines (renal, colon, prostate)	Capsaicin 100–400 μ M	Mitochondrial apoptosis; ROS generation; modulation of Bax & caspase-3	Induced apoptosis, cell cycle arrest, cytotoxicity	Surh, 2002; Perla et al., 2018 ^{12,13}

7. Toxicological Considerations

High dosages of Bhut Jolokia lead to severe side effects because of its very high content of capsaicin. Adverse toxicological effects mentioned include severe oral and gastrointestinal irritation, stomach cramps, nausea, vomiting, and, in severe cases, rupture of the esophagus. Capsaicin-mediated sympathetic stimulation can also induce cardiovascular stress reactions including tachycardia, hypertension, and excessive sweating. In addition, topically or ocular contact with concentrated extracts can lead to extreme chemical burns, erythema, and mucosal tissue inflammation. Therefore, proper use and consciousness of the threshold dosage are necessary while using Bhut Jolokia or its derivatives as medicines or food ingredients^{14,15}.

8. Conclusion

Bhut Jolokia (*Capsicum chinense*), which is one of the highest capsaicinoid-containing peppers, displays a wide array of pharmacological activities due to its intricate phytochemical composition. The bioactive nature of compounds like capsaicinoids and phenolic constituents was associated with profound anti-inflammatory, antioxidant, antimicrobial, and hypolipidemic activities. These bioactivities suggest its significance in the prevention and treatment of metabolic and inflammatory diseases. Although showing encouraging initial results, therapeutic safety and effectiveness of Bhut Jolokia are yet to be completely explained. It is thus critical to conduct rigorous in vivo studies and controlled clinical trials in order to validate its pharmacological potency and make it a candidate for new therapeutic drugs.

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CONFLICT OF INTEREST

There is no conflict of interest among the authors.

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