International Journal of Pharmacy and Biological Sciences
ISSN: 2321-3272 (Print), ISSN: 2230-7605 (Online)
IJPBS™ | Volume 8 | Issue 3 | JUL-SEPT | 2018 | 835-840
Review Article | Biological Sciences | Open Access | MCI Approved| ज्ञान-विज्ञान विमुक्तये
|UGC Approved Journal |

JOURNEY OF CAPSICUM FROM WILD CHILI TO WORLD HOTTEST CHILI (NAGA KING CHILI)

Jyotchna Gogoi*, Indrani Barman and Eyilobeni Murrey

Department of Biochemistry, Assam down town University, Guwahati, Assam – 781026

***Corresponding Author Email: jyotchnagogoi@gmail.com**

ABSTRACT

Chili pepper (Capsicum) is a native plant of South America which has spread to the world during Columbian time. The plant has diversified into domesticated crop cultivar due to human intervention by intercrop cultivation. This unnoticed practice might be considered as serendipity in evolution of Naga King Chili/ Bhut Jolokia (Capsicum assamicum J. Purkay-Lok. Singh) which had spread to North Eastern States of India since time immemorial. Thus, in this review we would try to trace the journey of wild capsicum to domesticated capsicum finally, discovery of new hot species C. assamicum. The article also focuses on cultivation method, highlight its various economical use and emphasize on preservation of traditional cultivation practices for accurate production of the world's hottest chili.

KEY WORDS

Chili pepper, Capsicum, Naga King Chili, Bhut Jolokia, Capsicum assamicum

INTRODUCTION

Different dietary species and their active metabolites provide various beneficial effects on health. They play an important role in treating gastrointestinal system, such as influence gastric emptying, stimulation of gastrointestinal defense and absorption, stimulation of salivary, intestinal, hepatic and pancreatic secretion. *Capsicum annuum* (Solanaceae) is used in various Indian traditional practices. Capsaicin act as double – edged sword so to be used against gastrointestinal complaints such as dyspepsia, loss of appetite, gastroesophageal reflux disease, gastric ulcer and so on. More than 200 constituents are isolated and characterized, out of which few active metabolites have the potential to reduce gastroesophageal reflux disease (GERD) symptoms, inhibits gastrointestinal pathogens, reduce ulceration and cancers. Also, regulates gastrointestinal secretions and absorptions [1].

The Genus - Capsicum is classified under the family Solanaceae, constituted by 25 wild and 5 domesticated species which also includes more than 200 varieties [2, 3]. *C. annuum* is the most commonly cultured among the five domesticated species [4]. Capsaicin is the major constituent of chili peppers whose content varies in pungency levels in all the species [5]. Carotenoids and phenolic compounds are also reported from the chili plants which can be used as natural pigments and antioxidants [6]. All chili peppers may differ in the content of the phytoconstituents and profiles of such constituents as it depends on the genotype and variety, maturity of the fruit and the environmental conditions of the cultures [7].

Among the spices, the capsicum is placed second after black pepper in trade both in volume and value. The quality is critically reviewed by using advanced technologies during production of different pungency forms, processed seasonings and while concentrating oleoresins. Maintenance of the pungency level of chili pepper is a crucial area for research to have its market demand. [8].

In recent years, Naga jolokia (Naga King Chili) is gaining importance in the scientific community because being the hottest chili of the world with Scoville Heat Unit of 1001304 SHU as compared to pure capsaicin 16000000 SHU [9]. The Defence Research Laboratory situated in Tezpur, Assam was the first laboratory to analyze the tremendous hotness in 2000. Anandita Dutta Tamuly, resident of Jorhat, Assam made Limca Book of Records by eating 60 chilies in two minutes and rubbing this chili on her bare eyes in 2006. She tried making this record in the Guinness Book of World Record. This attempt of her made this chili come into limelight of the world.

Fig 1. Photos of Naga King chili/ Bhut Jolokia (*Capsicum assamicum*) from the homestead or kitchen garden of different places of North East India in the month of July. A: (Imphal) Manipur, B: (Kohima) Nagaland, C: (Wokha) Nagaland, D: (Junai) Assam, E: (Dhemaji) Assam and F: (Tezpur) Assam.

Origin of Naga Jolokia (Naga King Chili)

Naga Jolokia is the traditional crop of Nagaland in Northeast India. Besides Nagaland, the crop is also traditionally cultivated in Assam, Manipur and other Northeastern states of the country. In Assam, this chili is known as Bhoot jolokia or Bih jolokia. The word "Bhoot" refers to typical large pod size of the chili and "Bih" means "poison". It is termed as Bih jolokia because of its very high pungency level [10]. The chili got the name "Naga Jolokia" because it was said that earlier, Naga people used it for trading in Upper Assam in exchange of other crops or utilities. They used to hawk with tag line "Bhoot Jolokia lobi, Kukur dibi" in their popular trade dialect "Nagameez"; it means "take Bhoot jolokia in return, give Dog".

In 1976, Heiser [11] reported that *Capsicum spp*. has evolved from an unknown ancestral farm in Peru – Bolivia region of the New World. In between 5200 and 3400 BC chilies were grown by the native Americans of the region. Since then, chili was the oldest cultivated crop of America. Columbus during his famous voyages carried these plants and introduced into Europe, Asia and Africa. But, there are also controversies related to origin of individual *Capsicum spp*. like *annuum*, *chinense*

and *frutescens* [12, 13, 14]. So, now it is accepted in the scientific world that *Capsicum spp*. has originated in the New World.

The nomenclature of C. chinense is described as a misnomer because it was named by the Dutch botanist Nikolaus Joseph von Jacquin (1727 – 1817) as he collected the seeds from China thus gave the concept that it has originated in China [15]. On discovery in 2000, Naga King Chili was classified as *C. frutescens* but its tremendous pungency level and morphological appearance made it to be classified under *C. chinense*. But, molecular characterization by RAPD showed that this chili is an interspecific hybrid of *C. frutescens* and *C. chinense* [16]. In 2012, Purkayastha *et al*., [17] gave an explanation that Naga Jolokia is a new species of Capsicum which occurred due to introgression of *C. frutescens* and *C. chinense*. This introgression lead to morphological change in Naga Jolokia and in comparative molecular studies, all the three species showed a production of ~750 bp fragment on amplification. But, all of the accession of Naga Jolokia had a deletion of 13 bp in 5.8 rDNA region. Thus, by using ITS sequencing and phylogenetic analysis of the different accessions of Naga Jolokia, it clearly indicates that early delineation of it has been in the evolution of new Capsicum species. Also, divergent evolution was indicated after speciation of Naga Jolokia from homogeneity analysis in ITS sequence study which concluded to be a distinct species from two related species, *C. frutescens* and *C. chinense*. Only, Naga jolokia showed deletion variation. Thus, the specific study gave a new scientific name to Naga jolokia *Capsicum assamicum* J. Purkay – Lok. Singh

Distribution and Cultivation of *Capsicum*

Bolivia, a part of tropical South American region is the primary hotspots where wild species of Genus *Capsicum* was domesticated and cultivated [18, 19]. The other *Capsicum* hotspot is the Atlantic forests in Brazil, but here the wild species are not consumed by humans [20, 21]. Diversity of cultivated capsicum of the world has been mostly reported from Peru [22, 23]. History of cultivation of pepper species in Peru is 4000 years old [24]. It is considered that in pre-Columbian time different species of *Capsicum* were transported to Peru from different regions of South America: *C. annuum* from Mexico, *C. chinense* from Amazon basin and Bolivia was the source for *C. baccatum* and *C. pubescens* [21, 25, 26]. Amazon basin or Central America may had domesticated *C. frutescens* and then transported to Peru [21].

These Capsicum are cultivated either as single strand or intercropped with staple crops or vegetables. Sometimes, it has also been seen that they are cultivated with other Solanaceae family in few squared meters or less than 1 ha [27]. But, *C. assamicum* is cultivated in a different manner in Nagaland. Jhum cultivation is done in paddy fields during summer. In a small scale, it is also grown in homestead gardens. Before planting it in the Jhum fields, the seeds are sown in month of February – March, one to two months old seedlings are then transplanted to main field which has been prepared by burning the bamboo culms after slashing. Direct sowing in Jhum paddy fields is also done. The fruits are harvested in the month of August – September and sold in local markets [10]. In this cultivation, the plant is not maintained, but plants grown in homestead gardens are kept only for 2 to 3 yrs because the pungency of the fruit and size get reduced. Traditional farmers also take one more care to grow the plant in shade in home gardens because pungency gets reduced if grown in bright places. The height attained by 3yrs old plant is 12 -13 feet [10].

Pathology of Capsicum plants

Capsicum plants are more robust crop compared to tomatoes. Its production is rated 2nd among all the crops of India. However, they are susceptible to a number of pathogens which brings considerable economic losses.

They are susceptible to pathogens such as bacteria, fungi and viruses. Bacterial wilt is most economically important bacterial disease caused by *Ralstonia solanacearum* Smith. Bacterial leaf spot [*Xanthomonas campestris*, var vesicatoria (Doidge)] and bacterial soft rot [*Erwinia carotovora* (Smith)] are the other bacterial diseases which cause heavy loss to the crop production [28].

Sclerotium rolfsii Sacc. and *Colletotrichum capsici* Syd. are the fungal pathogens which cause Southern blight and anthracnose, respectively [28]. Fruit rot and slow wilting are the fungal diseases reported in *C. assamicum* by the traditional farmers of Nagaland [10]. Pepper Veinal Mottle Virus (PVMV) and Tomato Yellow Leaf Curl Virus (TYLCV) are the most important viruses which are the most important viruses causing viral infection in the

plants. Also, about 33 more viruses are known to infect the chili crop [28].

Uses of *Capsicum*

Capsicum is one crop, which is consumed and cultivated across the globe in the kitchen garden. The desirable attribute to be used in food is its pungency. Besides its use as food, other attributes which have been discovered are repellent, medicine and color agent. It is used as barnacle repellent, to protect underground electrical cables from gnawing by mice, to limit the eating of bird seeds by squirrels. It is also used as anti-mugger aerosols in place of mace and tear gas by the Police department of the United States [15].

Clinical studies have revealed that capsaicin at low concentration (0.13-160 µM) in rats; protect the gastric mucosa against ulceration by ethanol [29]. Also, another major pharmacological effect of capsaicin is that it can reduce adipose tissue in rodents by enhancing energy and lipid metabolism. The possible mechanism might be by increasing catecholamine secretion from the adrenal medulla by activating the sympathetic nervous system. This finding might play role in obesity treatment [30, 31]. Topical application of capsaicin has shown relief of neuropathic pain with slight skin irritation. This property has been used in topical creams and patches to treat chronic pain syndromes such as post-herpetic neuralgia, rheumatoid arthritis and musculoskeletal pain [32, 33]. Also, *C. assamicum* leaves have been reported to be used traditionally in aliments such as boils, headache and night blindness [34].

As a coloring agent, chili is used in a wide assortment of foods, drugs and cosmetics. It is also used to improve the feather color of flamingoes in zoos. It has carotenoids which control the pod color. Thus, carotenoid compounds vary from yellow to red pigments of aliphatic or alicyclic structures, composed of isoprene units [35]. The different colors like, red color of capsaicin is due to carotenoids capsanthin and capsorubin. Yellow-orange color is due to beta-carotene and violaxanthin which are used as a source of coloring agent [36, 37]. The pod color of *C. assamicum* varies from blood red to yellow color. Thus, the cultivation of this hot chili might serve as a source of coloring agent with its unique appetizing aroma.

Conclusion and Future Perspective of *Capsicum*

Capsicum is a native plant of South America, but in the present scenario it has become a global crop and important vegetable in every individual kitchen. In addition to it, *C. assamicum* is the hottest chili to be reported which has a unique aroma. This aroma acts as a metaphor to this plant which makes it spicier. Cultivation practice of Hottest chili should be as per traditional farming knowledge so that it can used in large scale of spice industries. This chili has been traditionally reported with healing property against gastrointestinal abnormalities, asthma, toning of body muscles after body exercise and removing pus from boils. With these properties, it can also act as medicinally important plant. Thus, scientific measurement should be taken for protecting *C. assamicum* hotness and uniqueness.

ACKNOWLEDGEMENT

Authors are thankful to Ms. Lembi Wairokpam, Ms. Khrielaneinuo Suokhrie and Mr. Bulbul Das for providing some folk information about the Naga King Chili.

References

1. Maji AK and Banerji P. Phytochemistry and gastrointestinal benefits of the medicinal spice, *Capsicum annuum* L. (Chilli): a review; J. Complement Integr. Med. 13; 97 – 122 (2016)
2. Conforti F, Statti GA and Menichini F. Chemical and biological variability of hot pepper fruits (*Capsicum annuumvar. acuminatum L.*) in relation to maturity stage; Food Chem. 102; 1096–1104 (2007)
3. Pino J, Gonz´alez M, Ceballos L, Yah ARC, Aguirre JT, Moreno LL, Sauri-Duch E. Characterization of total capsaicinoids, colour and volatile compounds of Habanero chilli pepper (*Capsicum chinense* Jack.) cultivars grown in Yucatan; Food Chem. 104; 1682– 1686 (2007)
4. Sitthiwong K, Matsui T, Sukprakarn S, Okuda N, Kosugi Y. Classification of pepper (*Capsicum annuum* L.) accessions by RAPD analysis; Biotechnology. 4; 305–309 (2005)
5. Oboh G, Puntel RL and Rocha JBT. Hot pepper (*Capsicum annuum*, Tepin and *Capsicum chinense*, Habanero) prevents Fe2+-induced lipid peroxidation in brain-*in vitro*; Food Chem. 102; 178–185 (2007)
6. Suna K, YoulHa T, Park J. Characteristics of pigment composition and colour value by the difference of harvesting times in Korean red pepper varieties

(*Capsicum annuum*, L.); Inter. J. Food Sci.Technol. 43; 915–920 (2008)
7. Vega-G´alvez A, Di Scala K, Rodr´ıguez K, Mondaca RL, Miranda M, Lopez J, Won MP. Effect of air-drying temperature on physico-chemical properties, antioxidant capacity, colour and total phenolic content of red pepper (*Capsicum annuum*, L. var. Hungarian); Food Chem. 117; 647–653 (2009)
8. Govindarajan VS. Capsicum production, technology, chemistry and quality. Part 1: History, Botany, Cultivation and Primary processing; Crit Rev Food Sci Nutr. 22; 109 – 176, (1985)
9. Kehie M, Kumaria S, Tandon P. Manipulation of culture strategies to enhance capsaicin biosynthesis in suspension and immobilized cell cultures of Capsicum chinense. Jacq. CV. Naga King Chili; Bioprocess Biosyst. Eng. 37; 1055-1063, (2014)
10. Bhagowati RR and Changkija S. Genetic variability and traditional practices in Naga King Chili Landraces of Nagaland; Asian Agri. History, 13; 171 – 180 (2009)
11. Heiser CB. Peppers, Capsicum (Solanaceae). In: The Evolution of Crop Plants (Simmonds NW, ed.) (Longman Press, London, UK) (1976)
12. McLeod MJ, Eshbaugh WH, Guttman SI, A preliminary Biochemical systematic Study of the genus Capsicum – Solanaceae. In: The biology and taxonomy of the Solanaceae (Hawkes JG, Lester RN and Skelding AD, eds.); (Academic Press, London, UK) (1979)
13. McLeod MJ, Guttman SI, Eshbaugh Wh, Rayle RE. An electrophoretic study of the evolution in Capsicum (Solanaceae); Evolution 37; 562 – 574 (1983)
14. Pickersgill B. The genus Capsicum: A multidisciplinary approach to the Taxonomy of cultivated and wild plants; Biologisches Zentralblatt 107; 381 – 389 (1988)
15. Bosland PW. Capsicum: innovative uses of an ancient crop. In: Progress in New Crops (Janick J, ed.) (ASHS Press, Arlington, Virginia, USA) (1996)
16. Bosland PW, Baral JB. 'Bhut Jolokia' – the world's hottest known chile pepper is a putative naturally occurring interspecific hybrid; Hort. Science 42; 222 – 224 (2007).
17. Purkayastha J, Alam SI, Gogoi HK, Singh L. Capsicum assamicum Sp. Nov. (Solanaceae) from Assam, North Eastern India; Ozean J. Applied Sci. 5; 55-60 (2012)
18. Eshbaugh WH. Peppers: History and exploitation of a serendipitous new crop discovery. In: Janick J, Simon JE, editors; (New crops, Wiley New York, USA) (1993)
19. Olmstead RG, Bohs L, Migid HA, Sartiago-Valentin E, Garcia VF, et al. A molecular phylogeny of the solanaceae; Taxon 57; 1159-1181 (2008)
20. Pickersgill B. Cytogenetics and evolution of Capsicum L. In: Chromosome engineering in plants: genetics, breeding, evolution; (part B. Elsevier, Amsterdam) (1991)
21. Moscone EA, Scaldaferro MA, Gabriele M, Cecchini NM, Sánchez García Y, Jarret R, Davina JR, Ducasse DA, Barboza GE, Ehrendorfer F. The evolution of chili peppers (Capsicum-Solanceae): a cytogenetic perspective; Acta Hortic. 747; 137-169 (2007)
22. Meckelmann SW, Riegel DW, van Zonneveld M, Ríos L, Peña K, Ugas R, Quinonez L, Mueller-Seitz E, Petz M. Compositional characterization of native Peruvian chili peppers (Capsicum spp.); J. Agric. Food Chem. 61; 2530-2537 (2013)
23. Ugás R and Mendoza V. Investigaciones en Capsicum natives. Serie El punto de ají No. 1-2; (Programa de Hortalizas, Universidad Nacional Agraria La Molina Lima, Peru) (2013)
24. Perry L, Dickau R, Zarrillo S, Holst I, Pearsall DM, Piperno DR, Berman MJ,Cooke RG, Rademaker K, Ranere AJ, Raymond JS, Sandweiss DH, Scaramelli F, Tarble K, Zeidler JA. Starch fossils and the domestication and dispersal of chili peppers (Capsicum spp. L.) in the Americas; Science 315; 986-988 (2007)
25. Moses M, Umaharan P, Dayanandan S Microsatellite based analysis of the genetic structure and diversity of Capsicum chinense in the Neotropics; Genet. Resour. Crop Evol. 61; 741-755 (2014)
26. Kraft KH, Brown CH, Nabhan GP, Luedeling E, Ruiz JDJL, d' Eeckenbrugge GC, Hijmans RJ, Gepts P. Multiple lines of evidence for the origin of domesticated chili pepper. Capsicum annuum, in Mexico; Proc. Natl. Acad. Sci., 111; 6165-6170 (2014)
27. Dagnoko S, Yaro-Diarisso N, Sanogo PN, Adetula O, Dolo-Nantoume A, Gamby-Toure K, Traore-Tera A, Katile S, Diallo-Ba D. Overview of pepper (Capsicum spp.) breeding in West Africa; African J. Agri. Res., 8; 1108-1114 (2013)
28. Dafalla GA. Situation of tomato and pepper viruses in Africa. In: Proceedings of a Conference on "Plant Virology in SubSaharan Africa". d'A, Hughes J.BO Odu (eds.). International Institute of Tropical Agriculture, June 4-8, Ibadan, Nigeria, pp-18-24 (2001)
29. Holzer P and Lippe IT. Stimulation of afferent nerve endings by intragastric capsaicin protects against ethanol-induced damage of gastric mucosa; Neuroscience 27; 981-987 (1988)
30. Kawada T, Hagihara K, Iwai K. Effects of capsaicin on lipid metabolism in rats fed a high fat diet; J. Nutr. 116; 1272-1278 (1986)
31. Watanabe T, Kawada T, Yamamoto M, Iwai K. Capsaicin, a pungent principle of hot red pepper, evokes catecholamine secretion from the adrenal medulla of anesthetized rats; Biochem. Biophys. Res. Commn. 142; 259-264 (1987)
32. Backonja MM, Malan TP, Vanhove GF, Tobias JK. NGX-4010, a high-concentration capsaicin patch, for the treatment of postherpetic neuralgia: a randomized,

double-blind, controlled study with an open-label extension; Pain Med. 11; 600-608 (2010)
33. Tesfaye S. Advances in the management of diabetic peripheral neuropathy; Curr. Opin. Support Palliat. Care, 3; 136-143 (2009)
34. Deorani SC and Sarma GD. Medicinal plants of Nagaland; (Bishen Singh/Mahendra Pal Singh, Dehradun, India) (2007)
35. Bunnell RH and Bauernfeind JC. Chemistry, uses and properties of carotenoids in foods; Food Technol. 16; 36-43 (1962)
36. Harkay-Vinkler M. Storage experiments with raw material of seasoning paprika with particular reference to the red color pigment components; Acta Alim.. Acad. Sci. Hung. 3; 239-249 (1974)
37. Kanner J, Harel S, Palevitch D and Ben-gera I. Color retention in sweet paprika powder as affected by moisture contents and ripening stage; J. Food Technol. 12; 59-64 (1977)

Received:06.05.18, Accepted: 08.06.18, Published:01.07.2018

***Corresponding Author:**
Jyotchna Gogoi*
Email: jyotchnagogoi@gmail.com