Journal of Natural Sciences Research
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.3, No.4, 2013

Capsaicinoids Content of Some Indigenous Capsicum Varieties of Assam, India

Khomendra Kumar Sarwa[1], Bhaskar Mazumder[1*] Mithun Rudrapal[1], Manabendra Debnath[2], Atul Kumar[1], Vinod Kumar Verma[1], Manmohan Singh Jangdey[3]

1. Department of Pharmaceutical Sciences, Dibrugarh University, Dibrugarh 786004, Assam, India
2. Department of Human Physiology, DDM College, Khowai 799201, Tripura, India
3. Institute of Pharmacy, Pt. Ravishankar Shukla University, Raipur 491001, Chhattisgarh, India

* E-mail of the corresponding author: bhmaz@yahoo.co.in

Abstract

Seven indigenous varieties of capsicum belonging to five different species available locally in Assam were collected and evaluated for capsaicinoids content with a view to assess their relative potency and/or hotness in order to ensure the functional as well as the nutritional quality of capsicum. These include *Capsicum annum* (*Jati Jolokia*), *Capsicum baccatum* (*Ohm Jolokia*), *Capsicum chinense* (*Bhut Jolokia*), *Capsicum frutescens* (*Dhan Jolokia, Maam Jolokia, Totta Bias*) and *Capsicum pubescens* (*Bhikue Jolokia*). The word *Jolokia* usually refers to the vernacular (Assamese) name of capsicum or *chilli* that is often used just after the particular local name of the capsicum variety as mentioned above by the local people of Assam. Results indicate that *Bhut Jolokia* (*Capsicum chinense*) and *Dhan Jolokia* (*Capsicum frutescens*) possess comparatively higher amount of capsaicinoids (>2%) than other varieties of capsicum. The capsaicinoids content of *Bhut Jolokia* (2.45%) was still higher than that of *Dhan Jolokia* (2.14%). Different varieties of capsicum with decreasing order of their capsaicinoids content are as follows: *Bhut Jolokia* (2.45%) > *Dhan Jolokia* (2.14%) > *Maam Jolokia* (1.38%) > *Bhikue Jolokia* (0.92) > *Ohm Jolokia* (0.67%) > *Jati Jolokia* (0.51%) > *Totta bias* (0.25%). It is very interesting that in addition to *Bhut Jolokia*, the hottest capsicum of the world, another potential and hot capsicum variety i.e., *Dhan Jolokia* has been evolved. However, our present study was an attempt to identify such potential and hot capsicum varieties available locally in Assam for the production of capsaicinoids at large in order to meet the increasing demand of capsicum or capsaicinoids in the global market. Furthermore, large scale cultivation and proper utilization of these indigenous capsicum varieties will help improve the agricultural economy of the state and the country as a whole.
Keywords: indigenous, *Bhut Jolokia*, *Dhan Jolokia*, capsaicioids, climatic condition, capsaicin

1. Introduction

Capsicum is an important agro-medicinal crop cultivated widely in almost all parts of the world including Asian subcontinents like India, Bangladesh, and Pakistan. India is the largest producer as well as consumer of capsicum in the world. It has been estimated that approximately 36% of the global production of capsicum is contributed by India followed by China contributing about 11% of the total capsicum production. Though, a total of 30 species of capsicum are distributed in the plant kingdom, a five well known cultivated species are only found in different parts, especially Andhra Pradesh, Arunachal Pradesh, Assam, Karnataka, Maharastra, Manipur, Odissa and Tamil Nadu of India. These five species include *Capsicum annum*, *Capsicum baccatum*, *Capsicum chinense*, *Capsicum frutescens* and *Capsicum pubescens* (IBPGR 1983). Among these, *Capsicum chinense* and *Capsicum frutescens* are the most common cultivated species found in different regions, especially Assam of North Eastern India. Assam having an area of 78, 438 km^2 is the central part of North East India and provides much larger area with compared to other states of North Eastern region for the cultivation of capsicum. Moreover, due to its geographical location and favorable climatic conditions, Assam is endowed with a quality alluvial soil, which remains as indispensable for the cultivation of agricultural crops like capsicum with high yields.

In recent days, capsicum and its different products has attained high commercial demand in the global market for having applications in various commercial food products, cooked foods and also in medicines. Capsicum fruits represent a group of five characteristic pungent compounds, which are collectively termed as capsaicinoids. These are namely capsaicin, dihydrocapsaicin, nordihydrocapsicin, homocapsaicin and homohydrocapsaicin. Chemically,

these are acid amides of vanillylamine with C9-C12 branched chain fatty acid. Capsaicin and dihydrocapsaicin together constitute more than 80% (Kirschbaum-Titze *et al.* 2002) of total capsaicinoids content of capsicum. The capsaicinoids (mainly capsaicin) content generally indicates the hotness or pungency of capsicum (*chilli*), which in turn ensures the functional as well as nutritional quality of capsicum. The hotness or pungency is commonly expressed in terms of Scoville Heat Units (SHU) with respect to the total capsaicinoids content of capsicum. For example, *Capsicum chinense,* an indigenous capsicum variety of Assam (locally known as *Bhut Jolokia*) has been recognized as the hottest *chilli* (1001304, SHU) of the world as per Guinness Book of World Records, 2006, because of its very high capsaicin content (2-3%) as compared to other varieties of Indian *chilli* (less than 1%) (Bosland 2007). Capsaicinoids have many applications as medicines in treating gastritis, arthritis, musculoskeletal and neuropathic pain, chronic indigestion etc. (Webster *et al*. 2012). Furthermore, capsaicinoids have been reported to possess a variety of biological activities (Lee *et al*. 2011) such as antioxidant (Materska *et al*. 2005), anticarcinogenic (Macho *et al.* 2003) promotion of energy metabolism and suppression of fat accumulation etc (Lee *et al.* 2011; Whiting *et al.* 2012).

In the present study, seven different indigenous varieties of capsicum available locally in Assam, India were investigated for the capsaicinoids content with a view to assess their potency or hotness and also to identify the hottest variety among them for the production of capsaicinoids at large in order to meet the increasing demand of capsicum or capsaicinoids in the global market.

2. Materials and Methods

Fruits belonging to different indigenous species of capsicum were collected from a local market of the Dibrugarh district of Assam, India and sundried for at least 7 days, and stored separately in tightly closed polythene bags under dark condition until further study. Plant specimens were authenticated by Botanical survey of India, Shillong (Voucher No. BSI/ERC/2012/Plant identification/208 and BSI/ERC/2012/Plant identification/209). Pure capsaicin (capsaicin 95% USP) was obtained as gift sample from Chillies Export House, Virudhanagar, India. It contains capsaicin (59.87%), dihydrocapsaicin (34.75%) and nohydrocapsaicin (3.21%). Sodium hydroxide and Phosphomolybdic acid were procured form Himedia, India, and acetone from Merck, India.

Dried capsicum fruits were coarsely powdered in a mechanical grinder. 10 g of powdered capsicum were subjected to maceration with acetone for 24 hours and the liquid extract was collected by filtration. The capsaicinoids content of the extract was estimated by spectrophotometric method (Sadasivam & Manikam 1992). 1 ml of acetone extract was pipetted out into a dried test tube and allowed to evaporate to dryness in a hot water bath. The residue was dissolved in a 5 ml of 0.4% aqueous solution of sodium hydroxide, and then 3 ml of 3% phosphomolybdic acid was added into it. The test tube was shaken for about 1 hour and centrifuged (Remi India) at 5000 rpm for 10 minutes in order to remove any floating debris. The clear blue colored supernatant was transferred into a quartz cuvette and the absorbance was taken at 650 nm in a UV-visible spectrophotometer (Hitachi U-2001). The content of capsaicinoids in the extract was obtained from the calibration graph of the pure sample of capsaicin.

3. Results and Discussion

Seven indigenous varieties of capsicum (figure 1) belonging to five different species were collected and analyzed. These include *Capsicum annum* (*Jati Jolokia*), *Capsicum baccatum* (*Ohm Jolokia*), *Capsicum chinense* (*Bhut Jolokia*), *Capsicum frutescens* (*Dhan Jolokia, Maam Jolokia, Totta Bias*) and *Capsicum pubescens* (*Bhikue Jolokia*). The word *Jolokia* usually refers to the vernacular (Assamese) name of capsicum or *chilli* that is often used just after the particular local name of the capsicum variety as mentioned above by the local people of Assam.

Results reveal that *Bhut Jolokia* (*Capsicum chinense*) and *Dhan Jolokia* (*Capsicum frutescens*) possess comparatively higher amount of capsaicinoids (>2%) than other varieties of capsicum. The capsaicinoids content of *Bhut Jolokia* (2.45%) was still higher than that of *Dhan Jolokia* (2.14%). However, results of our present studies are in accordance with results already reported by Mathur *et al.* (2000). Different varieties of capsicum with decreasing order of their capsaicinoids content are as follows: *Bhut Jolokia* (2.45%) > *Dhan Jolokia* (2.14%) > *Maam Jolokia* (1.38%) > *Bhikue Jolokia* (0.92) > *Ohm Jolokia* (0.67%) > *Jati Jolokia* (0.51%) > *Totta bias* (0.25%) as depicted in table 1.

It has been suggested that geographical and climatic factors could affect the capsaicinoids content of capsicum grown in a particular geographical location (Antonious *et al*. 2010). It is further believed that the functional quality of a

particular capsicum variety depends primarily on its capsaicinoids content. So, favorable climatic conditions and quality alluvial soil of North Eastern region, particularly Assam are the key factors for the growth of different capsicum plants with considerably high capsaicinoids content than other parts of India. Tiwari *et al*. (2005) studied that capsaicinoids content of capsicum drops up to 50% if grown in central India rather than North Eastern region of India. We could assume that the temperature ranging from 15-30 ℃ and altitude of about 2000 m from seal level are the important climatic factors for favorable growth of hot capsicum with higher capsaicinoids accumulation in Assam. Furthermore, the hotness of *Bhut Jolokia* and *Dhan Jolokia* were found to be much significant as compared to other varieties of capsicum. So, these could be considered as superior capsicum varieties over other varieties of capsicum available in Assam. Due to this fact, these two varieties, in particular are currently gaining huge commercial importance in Indian as well as global market.

4. Conclusion

Though, seven different indigenous varieties of capsicum are found in Assam, *Bhut Jolokia* (*Capsicum chinense*) and *Dhan Jolokia* (*Capsicum frutescens*) are the two potential capsicum varieties, which can suitably be adopted for cultivation in large scale for the production of capsicum and/or capsaicinoids in order to meet the high commercial demand of the capsicum and/or capsaicinoids in global market. It is very interesting that in addition to *Bhut Jolokia*, the hottest capsicum of the world, another potential and hot capsicum variety i.e., *Dhan Jolokia* has been evolved, but no much genetic resources is available for this variety till date. So, further scientific investigation is required on this valuable capsicum variety. However, the large scale cultivation and proper utilization of these indigenous capsicum varieties will help improve the agricultural economy of the state and the country as a whole.

Acknowledgement

Authors greatly acknowledge with thanks Late Prof. (Dr.) A. K. Dolui for his novel ideas, righteous contribution and invaluable guidance towards the work presented in this paper. Mr. Khomendra Kumar Sarwa is highly grateful to Indian Council of Medical Research (ICMR), New Delhi for providing SRF to carry out the research work. We extend our sincere thanks to Chillies Export House, Virudhanagar, India for providing us the gift sample of capsaicin.

References

Antonious, G.F., Terry, B. & Jarret, R.L. (2009), "Pungency in *Capsicum chinense*: Variation among countries of origin", *Journal of Environmental Science and Health* **44,** 179-184.

Bosland, P.W. & Baral, J.B. (2007), "Bhut Jolokia -The world's Hottest Known Chilly Pepper is a Putative Naturally Occurring Interspecific", *Hybrid Horticulture Science* **42**, 222-224.

IBPGR (1983), "Genetic Resources of Capsicum", International Board for Plant Genetic Resources, Rome.

Lee, J., Li, Y., Li, C. & Li, D. (2011), "Natural products and body weight control", *North American Journal of Medical Science* **3**, 13-19.

Luo, X.J., Peng, J. & Li, Y.J. (2011), "Recent advance in the study on capsaicinoids", *European Journal of Pharmacology* **650**, 1-7.

Macho, A., Lucena, C., Sancho, R., Daddario, N., Minassi, A., Munoz, E. & Appendino, G. (2003), "Nonpungent capsaicinoids from sweet pepper synthesis and evaluation of the chemopreventive and anticancer potential", *European Journal of Nutrition* **42**, 2-9.

Materska, M. & Perucka, I. (2005), "Antioxidant activity of the main phenolic compounds isolated from hot pepper fruit (*Capsicum annuum* L.)", *Journal of Agriculture Food and Chemistry* **53**, 1750-1756.

Mathur, R., Dangi, R.S., Das, S.C. & Malhotra, R.C. (2000), "The hottest chilli variety in India", *Current Science*, **79**, 287–288.

Sadasivam, S. & Manikam, A. (1992), "Biochemical methods for agriculture science", Wiley Eastern Ltd., New Delhi, 193-194.

Tiwari, A., Kaushik, M.P., Pandey, K.S. & Dangi, R.S. (2005), "Adaptability and production of hottest chilli variety under Gwalior agro-climatic conditions", *Current Science*, **88**, 1545-1546.

URL: http:// www. guinnessworldrecords.com (Guinness Book of World Records, 2006, Hottest Spice).

Webster, L.R, Peppin, J.F., Murphy, F.T., Tobias, J.K. & Vanhove, G.F. (2012), "Tolerability of NGX-4010, a capsaicin 8% patch, in conjunction with three topical anesthetic formulations for the treatment of neuropathic pain", *Journal of Pain Research*, **5**, 7-13.

Whiting, S., Derbyshire, E. & Tiwari, B.K. (2012), "Capsaicinoids and capsinoids. A potential role for weight management ? A systematic review of the evidence", *Appetite*, **59**, 341-348.

Table 1. Different indigenous capsicum varieties of Assam, India and their capsaicinoids content

Name of the variety	Species	Description	Capsaicinoids Content (%)
Bhikue Jolokia	*Capsicum pubescens*	Bell shaped like tomato with a flat base, 2.0-2.2 cm diameter, 1.5 cm height, smooth surface, dark red, characteristic aroma.	0.92
Bhut Jolokia	*Capsicum chinense*	Elongated, 5.0-7.0 cm long, 2.5-3.0 cm width, undulating rough surface, dark red, characteristic aroma.	2.45
Dhan Jolokia	*Capsicum frutescens*	Tiny in size, elongated, 1.0-1.5 cm long, 0.5 cm width, smooth surface, light red, characteristic aroma.	2.14
Jati Jolokia	*Capsicum annum*	Elongated, 2.5-3.0 cm long, width 0.8-1.0 cm 9, smooth surface, light red, characteristic odour.	0.51
Maam Jolokia	*Capsicum frutescens*	Elongated, 1.5-1.75 cm long, width0.5-0.75 cm, smooth surface, light red, characteristic aroma.	1.38
Ohm Jolokia	*Capsicum baccatum*	Rough shape with flat base, 2.0-3.0 cm diameter, 2.0-2.5 height, and base divided into three lobes, each having 3-4 grooves, dark red.	0.67
Totta Bias	*Capsicum frutescens*	Elongated, 4.0-5.0 cm long, 1.0 cm width, smooth surface, orange to light red in color.	0.25

Figure 1. Capsicum varieties of Assam, India