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Capsaicin Content and Pungency of Different *Capsicum spp.* Cultivars

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Abstract

Six chilli cultivars belonging to three species of *Capsicum: Capsicum annuum* L. (cvs 'Meiteimorok' and 'Haomorok'), *Capsicum frutescens* L. (cvs 'Uchithi' and 'Mashingkha') and *Capsicum chinense* Jacq. (cvs 'Umorok' and 'Chiengpi') are economically important food crops. The capsaicin content and pungency in scoville heat unit (SHU) of these six chilli cultivars were determined by high-performance liquid chromatography (HPLC). The capsaicin content and pungency of the chillies varied depending upon the genotype. Among the six chilli cultivars studied, the cultivar 'Umorok' had the highest capsaicin content (2.06%), and was also the most pungent of with 329.100 SHU while the cultivar 'Haomorok' had the least capsaicin content (0.17%) with a corresponding pungency of 26.000 SHU.

Keywords: *Capsicum annuum, Capsicum frutescens, Capsicum chinense,* capsaicin, chilli, high-performance, liquid chromatography, Scoville Heat Unit

Introduction

Chillies are the berries of the genus Capsicum (family: *Solanaceae*) and they are used variously as a pungent flavor in food, natural plant colour, pharmaceutical ingredient and as sprays for riot control and self-defense. The pungent flavor of chillies is due to a group of closely related alkaloid called capsaicinoids found only in the genus Capsicum (Hoffman et al., 1983). Among the capsaicinoids, capsaicin and dihydrocapsaicin together account for about 90% of pungency (Kawada et al., 1970). Capsaicin is also the active principle which accounts for the pharmaceutical properties of chillies. It has been used as a topical analgesic against arthritis pain and inflammation (Deal et al., 1991). Capsaicin binds to the same group of nociceptors which also leads to the sensation of pain from heat and acid (Caterina and Julius, 2001; Julius and Basbaum, 2001; Szallasi and Blumberg, 1999) and reduces pain and imflammation by depleting the neurotransmitters signaling pain. Capsaicin also shows antimutagenecity effect (de Mejia et al., 1998; Macho et al., 2003; Morre and Morre, 2003; Ramirez-Victoria et al., 2001) and a high antioxidant activity (Lee et al., 1995).

Chilli pungency is measured in Scoville Heat Units (SHU) and Scoville organoleptic test was used initially for measuring SHU (Scoville, 1912). However, high-performance liquid chromatography (HPLC) method has replaced the organoleptic method since the HPLC method is considered the most reliable and accurate method for determining both the amount of capsaicin and pungency in a chilli sample (Collins et al., 1995; Perucka and Oleszek, 2000; Woodbury, 1980).

In Manipur, six different indigenous chilli cultivars (Figure 1) belonging to three species of *Capsicum*: *Capsicum annuum* L. (cvs 'Meiteimorok' and 'Haomorok'), *Capsicum frutescens* L. (cvs 'Uchithi' and 'Mashingkha') and *Capsicum chinense* Jacq. (cvs 'Umorok' and 'Chiengpi') form important food crops of the region.

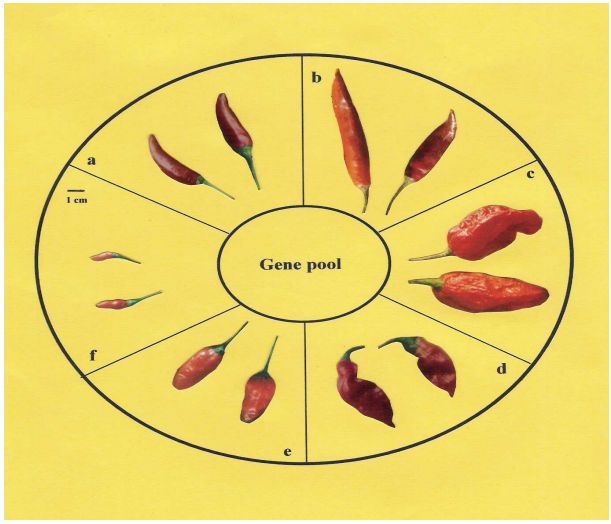

Figure 1 Gene pool of chilli cultivars: *Capsicum annuum* cvs. (a) 'Meiteimorok', (b) 'Haomorok'; *Capsicum chinense* Jacq. cvs. (c) 'Umorok',(d) 'Chiengpi'; *Capsicum frutescens* cvs. (e) 'Mashingkha' and (f) 'Uchithi'

These chilli cultivars with varying degrees of pungency are used variously in different culinary preparations while *Capsicum chinense* Jacq. cv 'Umorok' is a highly pungent chilli with a unique flavour and aroma and is used in hot

Table 1 Capsaicin content and pungency of six chilli cultivars cultivars belonging to three species of *Capsicum: Capsicum annuum* L. (cvs 'Meiteimorok' and 'Haomorok'), *Capsicum frutescens* L. (cvs 'Uchithi' and 'Mashingkha') and *Capsicum chinens*e Jacq. (cvs 'Umorok' and 'Chiengpi')

Sl. No.	Chilli cultivar	Capsaicin (% w/w) (mean values)	Pungency (SHU) (mean values)
1.	'Meiteimorok'	0.24	39.100
2.	'Haomorok'	0.17	26.600
3.	'Uchithi'	0.88	141.200
4.	'Mashingkha'	0.65	104.300
5.	'Umorok'	2.06	329.100
6.	'Chiengpi'	0.79	126.200

sauces. This cultivar 'Umorok' (elsewhere mentioned as 'Naga jolokia' or 'Bhut jolokia'), we believe, is the hottest chilli in the world and there is a need for establishing its geographical indication, as IPR and TRIPS regimes have become the national priorities. Therefore, the present study was undertaken to determine the capsaicin content and pungency of the six economically important chilli cultivars.

Materials and methods

The matured red fruits of the six chilli samples ('Meiteimorok', 'Haomorok', 'Uchithi', 'Mashingkha', 'Umorok' and 'Chiengpi') were collected from local market outlets or cultivation fields and dried at 60°C for 30 hours. The matured red fruits of the six chilli samples were collected from local market outlets or cultivation fields and dried at 60°C for 30 hours.

A Varian Star HPLC equipped with C_{18} reversed phase column was used and twenty microlitres of the filtered sample was injected onto the column. ASTA method 21.3 (2004) was used for the determination of capsaicin content and pungency in SHU corresponding to the concentration of capsaicinoids were calculated. All experiments were repeated twice and data on the percentage of capsaicin content and the corresponding SHU are presented as the mean of two replicates.

Results and discussion

The first aim of the research was to assess the capsaicin contents and the pungency levels of six economically important chilli cultivars of Manipur. The capsaicin contents and the corresponding SHUs of the six chilli cultivars are shown in table 1. The HPLC chromatogram of capsaicin standard and 'Umorok' sample are shown in figure 2-3.

The data obtained showed a diversified content of capsaicin among the genotypes. The Capsicum annuum cultivars had the minimum capsaicin contents and were also the least pungent ones compared to Capsicum frutescens L. and Capsicum chinense Jacq. Similar genotypic difference in capsaicin content of different chilli cultivars has also been reported earlier (Dyah Juliana et al., 1997; Contreras-Padilla and Yahia, 1998; Mathur et al., 2000; Gnayfeed et al., 2001; Antonious and Jarret, 2006).

Among the six chilli cultivars studied, the cultivar 'Umorok' had the highest capsaicin content (2.06%), and was also the most pungent of with 329.100 SHU followed by 'Uchithi' with 0.8% capsaicin and 141.200 SHU while

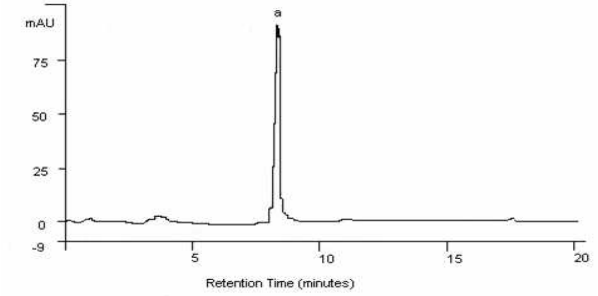

Figure 2 HPLC chromatogram of standard capsaicin showing capsaicin peak (a)

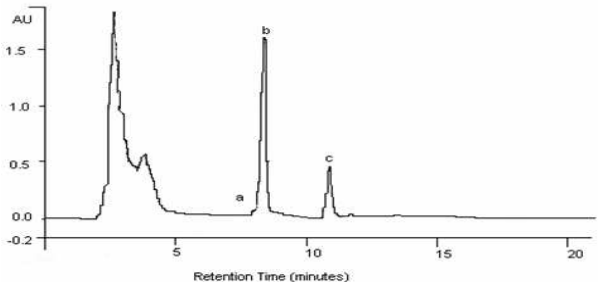

Figure 3 HPLC chromatogram of 'Umorok' sample showing norhydrocapsaicin (a), capsaicin (b) and dihydrocapsaicin (c)

the cultivar 'Haomorok' had the least capsaicin content (0.17%) with a corresponding pungency of 26.000 SHU. The average pungency level of the cultivar 'Umorok' was found to be even greater than the highly pungent 'Habanero' chillies having pungency in the range of 200.000-300.000 SHU (Thomas et al., 1998).

The capsaicin content and the corresponding pungency level of this cultivar can be expected at a much higher level if only the placental tissues have been used for analysis as capsaicin is produced in glands on the placenta, and the

pericarp and seeds forming the larger bulk of whole fruits contain minimum amount of capsaicin. Moreover, since all the cultivars contain more than 0.1% capsaicin and their heat levels are greater than 3000-4500 SHU, they may serve as a potential source of capsaicin.

The HPLC chromatogram of 'Umorok' cultivar showed the presence of capsaicin, dihydrocapsaicin and norhydrocapsaicin showing their maximum contribution in pungency of the cultivar (Figure 3). Capsaicin, dihydrocapsaicin and nordihydrocapsaicin were also reported to be the major capsaicinoids in Capsicum by Gnayfeed et al., 2001.

Conclusions

Thus, the present study reports the capsaicin contents and pungencies in SHUs for six economically important chilli cultivars of Manipur and further shows the influence of genotype on the capsaicin content and pungency in chilli.

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