Capsaicin content of various varieties of Indonesian chilies

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Chilies are widely used in Asian and Meso-American culinary tradition. Their content of capsaicin and dihydrocapsaicin affects the pungency or organoleptic properties. In Indonesia, there are many varieties of chili and 16 have been studied for their capsaicin content and Scoville organoleptic "heat" score. Small (*Capsicum frustescens L*) and large (*Capsicum annuum L*) chilies were assessed. The small Rawit Kalimantan chili had the highest capsaicin concentration at 1.6g/100g and 480,000 heat units. By contrast, the large Tit-Super I chili had 0.08 g/100g capsaicin and 12,500 heat units.

Key words: Chili, capsaicin, Indonesia, Capsicum annum L, Capsicum frustescens L, Rawit Kalimantan, pungency, organoleptic properties, Scoville heat units

Introduction

Capsaicin, the major active compound in chilies, is an alkaloid which causes the "hot", "sharp", or pungent sensation when in contact with mucous membranes. At least twenty edible chilies are known in Indonesia. Each of them has a different degree of pungency. The degree of pungency is believed due to the capsaicin content of chilies[1].

This study was carried out to quantify chemically the capsaicin content of the sixteen local varieties of Indonesian chilies.

Methods

Chili selection

The chilies were divided in two groups:

1. The large size chili (*Capsicum annuum L*)

In this group there are two types of chilies, the red large chilies which are *Tit Super I Tit Super II Jatilaba* and *Paris*; and the curly chilies which are *Keriting Ungu Keriting Lembang, Keriting Pengalengan, Keriting Bengkulu, Keriting Lampung, Keriting Padang, Keriting Medan I* and *Keriting Medan II* (Table 1).

Table 1. Characteristics of 16 varieties of Indonesian chilies.

Name of chili	Length (cm)	Diameter (cm)	Surface	Colour
Tit Super I	10	1.4	wavy	red
Tit Super II	12	1.3	wavy	red
Jatilaba	11	1.5	smooth	dark red
Paris	13	1.3	smooth	red
Keriting Ungu	6	0.5	curly	violet
Keriting Lembang	10	0.6	curly	cherry red
Keriting Pengalengan	11	0.6	curly	cherry red
Keriting Bengkulu	7	0.55	curly	red
Keriting Lampung	11.5	0.6	curly	red
Keriting Padang	10.5	0.5	curly	dark red
Keriting Medan I	9.5	0.7	curly	cherry red
Keriting Medan II	9	0.8	curly	red
Rawit Hijau	3	0.7	smooth	green
Rawit Putih	4	0.9	smooth	greenish white
Rawit Lampung	2.5	0.65	smooth	green
Rawit Kalimantan	1.5	0.4	smooth	red

2. The small size chilies or rawit (*Capsicum frustescens L*)

In this group there are 2 types of chilies: the green rawit which are *Rawit Hijau* and *Rawit Lampung*; and the white rawit (Table 1).

These chilies are known by the name of the location or town where the chili was originally grown. For example, curly type chilies include: *Keriting Bengkulu, Keriting Medan, Keriting Lampung*.

The same variety of chili from different places has variable pungency. The pungency of chili is genetically determined for capsaicin content, but also influenced by the condition and the quality of the soil where the crop is grown[4,5].

Due to these differences in pungency, production areas compete with each other to proclaim that theirs is the most pungent chili. Previous investigation of pungency was carried out organoleptically and led to rather subjective conclusions[6]. Therefore we decided to determine the capsaicin content of the chili chemically. An organoleptic test was also carried out to establish whether there was any positive correlation between the capsaicin content in chili and the degree of its pungency.

Chemical analysis for capsaicin

The capsaicin standard consisted of 60% capsaicin and 30% dihydrocapsaicin (Sigma Chemical Company USA).

Capsaicin was extracted from the dried chili powder using chloroform as the organic solvent.

Two grams of chili powder was extracted with chloroform at 60-62°C for 20 minutes. The residue was washed with chloroform several times until the filtrate was colourless. Dependent on the type of chili, the final volume was made up to 2 or 9 ml. The large red chili was assumed to contain 0.05 - 0.5% capsaicin and diluted up to. 2.0 ml. The curly chili which was more pungent than the large red chili was diluted up to 4.0 ml. The rawit chili was assumed to contain capsaicin 0.5 - 0.9% and diluted up to 7.0 ml.

10 µl extracted volume containing test chili or 80 µg of capsaicin standard was applied to the silica gel F 254 plate. The chromatogram was developed with diethyl ether[2]. After the development the plate was dried in the air and the capsaicin spot was located by spraying with freshly prepared 0.01% solution of Gibb's reagent in acetone[3].

A blue spot appeared at Rf 0.47 within a few minutes. The spot was scrapped into a centrifuge tube. In each of these tubes was placed 3 ml of borate buffer solution pH 9.4. The tubes were

shaken on an electric shaker for 5 minutes. The supernatant was transferred into a graduated tube and to each of these tubes was added 0.5 ml saturated solution of Gibb's reagent in water (freshly prepared). The residue was washed three times with borate buffer solution and the final volume was made up to 10 ml. The tubes were kept in the dark chamber for 3 0 minutes for colour development.

The intensity of the blue colour was measured at 600 nm with a UV - Visible Shimadzu spectrophotometer, as an indexed total capsaicin and dihydrocapsaicin. The calibration curve for the capsaicin standard, with the same treatment as above, had a linear function (Table 2) as below:

$Y = -4.4079 * 10^{-3} + 2.079 * 10^{-3} * X$

$r = 0.9995$

Table 2. Calibration curve.

Capsaicin Standard (μg)	Absorbency
2.5	0.003
5	0.007
10	0.014
20	0.035
40	0.080
80	0.162

Organoleptic evaluation

Organoleptic evaluation used the Scoville method[7].

Sample preparation: 200 mg of dried chili powder was added to a 50 ml volumetric flask. Absolute ethanol was added and shaken well for 10 minutes. The test solution was prepared by adding 0.15 ml of the supernatant to 140 ml of the 10 % w/v sucrose solution. The test solution contains the equivalent of 240,000 Scoville heat units.

Procedure: Five persons without a liking for "hot" food were selected as panellists. Their involvement met ethical guidelines. A pungent or stinging sensation in the throat, after slowly swallowing 5 ml of solution was considered as more than 240,000 Scoville heat units and was diluted according to Table 3 until the pungent sensation completely disappeared, and then the Scoville grade assigned.

Table 3. Dilution amounts for Scoville grades.

Scoville heat units	Test solution (ml)	Sucrose solution (ml)
240,000	**20**	**0**
360,000	20	10
480,000	20	20
600,000	20	30
720,000	20	40

If the test solution was claimed to have less than 240,000 Scoville heat units, the following more concentrated solutions were prepared according to Table 4. These were assessed in the same way as the standard solution.

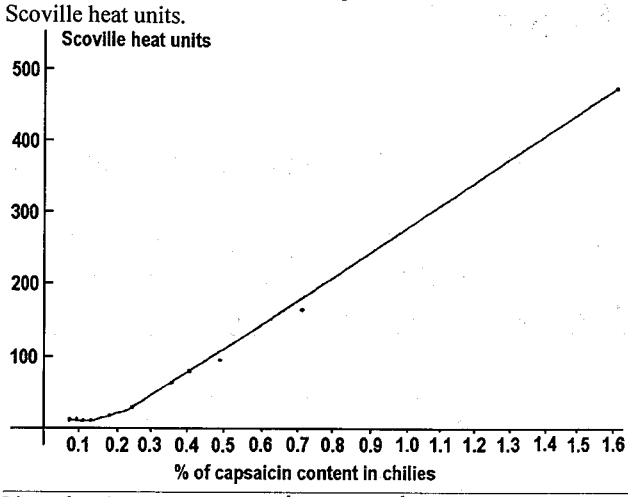
Table 4. Dilution amounts for Scoville grades.

Scoville heat units	Chili supernatant from sample preparation (ml)	Sucrose solution (ml)
100,000	0.15	60
117,500	0.15	70
170,000	0.15	100
202,000	0.15	120
240,000	**0.15**	**140**

Results

The rawit Kalimantan variety had the highest capsaicin content (1.60% of dry weight), and was also the most pungent chili among the 16 local varieties of Indonesia chilies investigated (Table 5). A positive correlation wads found between the capsaicin content of the chilies and the organoleptic heat unit test using the Scoville method (r = 0.99) (Figure 2).

Figure 2. Correlation between capsaicin content in chilies and Scoville heat units.



Linear function: $Y = -6.364 * 10^{-4} + 3.36 * 10^{-4} * X$; r = 0.99

Table 5. Capsaicin content and organoleptic test of 16 varieties of Indonesian chilies.

Name of chili	% of dry weight	Scoville heat units
Tit Super I	0.08	12500
Tit Super II	0.09	12500
Jatilaba	0.13	12500
Paris	0.08	12500
Keriting Ungu	0.24	30000
Keriting Lembang	0.47	82500
Keriting Pengalengan	0.40	82500
Keriting Medan I	0.35	65000
Keriting Medan II	0.24	30000
Keriting Bengkulu	0.41	47500
Keriting Padang	0.45	82500
Keriting Lampung	0.73	170000
Rawit Hijau	0.49	100000
Rawit Putih	0.44	82500
Rawit Lampung	0.89	170000
Rawit Kalimantan	1.60	480000

Discussion

Understanding food choice on the basic of food chemistry is increasingly important for at least four reasons. The first is that new culinary styles and food products are developing or being developed, and a knowledge of their nutrient and non nutrient profile is required by health workers, food technologists and regulatory bodies, who wish to evaluate food component intakes.

Chilies are used in the major Asian and meso-American food traditions which are serving as a basis for many of these new food developments.

The second reason is the need to understand the biological effects of capsaicin and related compounds, which are at least at the level of taste, but also on neural tissue elsewhere[8] and on the thermic response to food[9,10].

The third reason is the question of capsaicin toxicology for which the upper range of intake will be of interest. There is some evidence that capsaicin may increase the risk of oesophageal cancer[11].

The last reason is that of medical application, such as the prevention or therapy of thrombotic disorders[12], through the fibrinolytic activity of capsaicin. This is currently under investigation in Dept of Pharmacology in the Faculty of Medicine at University of Indonesia, using the Green Rawit chili. Capsaicin is also used topically in the treatment of painful neuropathisis.

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印度尼西亞產辣椒的辣素(Capsaicin)含量

摘要

辣椒在亞洲及中美洲的烹飪中廣泛被應用. 辣椒中辣素和雙氫辣素(Dihydrocapsaicin) 的含量影響其辣味. 該文選用了16種印度尼西亞產的辣椒, 研究了它們辣素含量和Scoville 辣熱分數. 對小辣椒(Capsaicum frustescens L) 和大辣椒(Capsicum annuum L) 進行了評估. 結果發現, 小Rawit Kalimantan 辣椒每百克含辣素1.6 克, 而大Tit-super I 辣椒僅含辣素0.68 克和12,500個熱單位.

Penetapan kadar capsaicin beberapa jenis cabe (*Capsicum Sp*) di Indonesia

Cabe (*Capsicum Sp*) merupakan salah satu komponen pelengkap masakan yang populer di Indonesia. Selain sebagai pelengkap masakan, cabe memiliki beberapa khasiat farmakologi yang potensial bagi dunia pengobatan. Diantaranya adalah khasiatnya sebagai 'fibrinolytic agent', yang pada masa mendatang dapat menjadi suatu terobosan baru dalam pengobatan penyakit pembuluh darah dan jantung koroner.

Capsaicin merupakan zat berkhasiat utama dalam cabe. Capsaicin inilah yang memberikan rasa dan aroma pedas pada cabe. Sekurang-kurangya ada dua puluh jenis cabe lokal yang biasa dikonsumsi oleh masyarakat. Tiap jenis cabe ini memiliki derajat kepedasan yang berbeda, dan diduga berkaitan dengan kadar capsaicinnya.

Penetapan kadar capsaicin cabe pada penelitian ini dilakukan secara spektrofotometri dengan pewarnaan reagen Gibb's. Sebelumnya dilakukan isolasi capsaicin dari ekstrak cabe, secara kromatografi lapis tipis dengan eluen dietil eter dan adsorben sisika gel F 254.

Untuk membuktikan relevansi antara kadar capsaicin dengan derajat kepedasan cabe, dilakukan uji kepedasan cabe secara organoleptis dengan metode Scoville. dari hasil penetapan kadar capsaicin pada enam belas jenis cabe lokal, diperoleh kadar capsaicin yang berkisar antara 0,007-1,60% dengan kadar tertinggi pada cabe Rawit Kalimantan, yang juga merupakan cabe yang terpedas menurut uji organoleptis.

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