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Assessment of Nutrient Composition and Capsaicinoid Content of Some Red Chilies

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Abstract. Nutrient composition and capsaicinoid content was studied in six red chili varieties consumed in India. Protein content in the chili varieties ranged from 0.91–1.59 g%, fat 0.82–1.99 g%, dietary fibre 4.65–6.15 g% and ash 0.67–0.82 g%. Capsaicinoids content was highest in Naga king chili (0.55 g%) and lowest in Hathei chili (0.05 g%). Variation in nutrients and bioactive contents was observed among chili varieties. Naga king chili is unique due to its high capsaicinoids as a potential source for food and health point of view.

Keywords: red chili; Naga king chili; capsaicinoids; proximate; fatty acids; antioxidant capacity

1. Introduction

Red chili *(Capsicum* sp.*)* is one of the most widely cultivated spices globally valued for their sensory attributes of colour, aroma and pungency. Red chilies also contain many other important nutrients and bioactive substances. The pungent flavor of red chili is due presence of closely related to the alkaloids called capsaicinoids which is found only in the genus *Capsicum* [1], [2]. Capsaicin and dihydrocapsaicin are the two major capsaicinoids accounting for 77-98% pungency in chilies [3]. Daily percapita consumption of capsaicinoids from chilies in Europe and the United States is estimated at ~1.5 mg and that in India, Mexico and Thailand at ~25-200 mg [4].

Varieties of chilies with different degree of pungency are cultivated in India, among which, bird's eye chili (*C. frutescens* L.) and fire ball chili (*C. annuum* L.) are well-known for their pungency. Hathei chili (*C. annuum* L.) and Guntur chili (*C. annuum* L.) are valued more for colour and flavor rather than pungency. Naga king chili (*C. chinense* Jacq.) also locally called 'Naga mircha'/'Unmarok'/'Bhut Jolokia' is another highly pungent chili from Northeast India which entered the 'Guinness book of world records' in the year of 2000 as the world's hottest chili. To the best of our knowledge, there appear to be no compositional data of these red chili varieties. Therefore this study was taken up to determine the nutrient composition and capsaicinoids content of red chili varieties consumed in India.

2. Materials and Methods

2.1. Sample Collection and Preparation

Samples of fresh red chilies were collected from local markets of different places such as Naga king chili from Kohima in Nagaland; Hathei chili from Sirarakhong in Manipur; big bird's eye chili and small bird's eye chili from Shillong in Meghalaya; fire ball chili from Gangtok in Sikkim, and Guntur chilies from Guntur in Andhra Pradesh. The stalks were removed from the whole fruits and each variety was minced separately into fine paste using a food processor (Waring commercial-blender, USA) from which aliquots were taken for analysis. HPLC grade acetonitrile, methanol, and analytical grade formic acid were procured

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from Merck (Merck, India). Capsaicin, dihydrocapsaicin and nordihydrocapsaicin were purchased from Sigma (St. Louis, MO). All other chemicals were of analytical grade purity.

2.2. Nutrient Analysis

2.2.1. Proximate composition

The Association of Official Analytical Chemists (AOAC) [5] methods were used for analysis of proximate composition and elemental analysis. Ca, Mg, Fe, Zn, Cu and Mn were determined in a flame atomic absorption spectrometer (Varian, Spectra AA220). Phosphorus was estimated by the Fiske and Subbarow method as described in AOAC method (931.01).

2.2.2. Extraction and estimation of capsaicinoid

The capsaicinoid extraction was carried out as described by Kozukue et al. [6] with slight modifications. Briefly, 2.0±0.05 g fresh chili sample was extracted with methanol at 70 °C using water bath for 5 hours. Final volume was adjusted to 25 mL with methanol and centrifuged at 4000 rpm for 10 min at 1 °C. The supernatant was filtered (0.22 µm syringe nylon filter) and used for analysis of capsaicinoids. Individual capsaicinoids were analyzed using Agilent-1100 HPLC equipped with auto-sampler and UV-VIS detector. Waters Symmetry C18 column (250 x 4.6 mm; 5 µm) was used and compounds were detected by UV detector at 280 nm. Scoville Heat Unit (SHU) was calculated based on the standard values (per 100 g) of pure capsaicin as 16,000,000, whereas dihydrocapsaicin, nor-dihydrocapsaicin were 15,000,000 and 9,100,000 respectively.

2.3. Statistical Analysis

Descriptive statistics namely, mean and standard deviations were calculated. Pearson's correlation test was done to find out the correlation between the two variables using SPSS software.

3. Results and Discussion

3.1. Proximate Composition

Proximate composition of fresh red chili varieties are presented in Table 1. Protein content was lowest in Guntur chili (0.91 ± 0.02%) and highest in Naga king chili (1.59 ± 0.10%). Among the six chili varieties analysed here, the lowest fat content was observed in Naga king chili (0.82 ± 0.03 g/100g) which was significantly ($p<0.01$) lower than small bird's eye chili (1.99 ± 0.14 %). The significantly higher amount of fat content in small bird's eye chili is due to the high ratio of seed than other fruit components. Ash content ranged from 0.67 ± 0.02% in Naga king chili to 0.82 ± 0.05% in Guntur chili which is comparable to the ash content reported in other chili by Uma Pradeep et al. [7]. In the present study, Guntur chili had the highest total dietary fibre (6.25 ± 0.31 %) which was significantly ($p<0.05$) higher than the lowest content observed in Hathei chili (4.15 ± 0.09 g/100g). On the other hand, much higher ash content (1.21-3.03 %) and lower crude fibre (2.37-4.71%) was reported by Ogunlade et al [8] in four other *Capsicum* species. Spices are normally a good source of important minerals and the chili varieties analysed here appears to be rich in Ca, P and Mg. Naga king chili was found to be rich in iron (1.98 ± 0.13 mg/100g) which is significantly ($p<0.05$) higher than other chilies analysed in the study. However Ogunlade et al [8] reported up to 12.93% of iron content in *Capsicum frutescens* (Bird pepper).

3.2. Capsaicinoid Content

Capsaicinoid content of six fresh red chilies is given in Table 2. Capsaicin is the most abundant followed by dihydrocapsaicin and nordihydrocapsaicin in all chilies which is in consonance with findings by other investigators [9], [10]. Naga king chili recorded the highest capsaicinoid content (0.55 ± 0.15%) followed by small bird's eye chili (0.24 ± 0.05%), fire ball chili (0.23 ± 0.02%) and big bird's eye chili (0.14 ± 0.01%). Guntur chili and Hathei chili had the lowest capsaicinoid content of 0.05%. In the present study the total capsaicinoid content of Naga king chili (3.43 g) was shown lower than that reported (5.68 g DW) by Mathur et al. [11]. However, habenero chili grown under green house condition has been shown to synthesize much higher capsaicinoids than those grown under field conditions [12]. Capsaicinoid levels have been reported to depend on the genotype, fruit development and environmental conditions [13] which explain the varying

amount of capsaicinoids reported in different chili varieties. The mean SHU of dried Naga king chili was estimated to be 567318 which is lesser than that of 1001304 SHU recorded in the world hottest chili where the sample harvested from controlled conditions. However, Mathur et al. [11] reported 855000 SHU in Naga king chili grown in Tezpur, Assam and recently, Sanatombi and Sharma [14] have reported just 329100 SHU in Naga king chilies grown in Imphal, Manipur. Habenero, Dearbol and Piquin are most popular pungent chilies measuring with SHU of 200000, 150000 and 60000 respectively [15] but they are much lower than the SHU (567318) reported for Naga king chili in the present study.

Table 1. Proximate composition and mineral content of red chili varieties

Name of the chili	Naga King chili	Fire ball chili	Big bird's eye chili	Small bird's eye chili	Guntur chili	Hathei chili
Proximate composition (g/100g)						
Moisture	89.67 ±1.03	89.18 ±1.86	87.84 ±2.06	87.66 ±1.54	88.23 ±1.40	90.00 ±1.42
Protein	1.59 ±0.10	1.48 ±0.02	1.52 ±0.02	1.28 ±0.08	0.91 ±0.02	1.57 ±0.06
Fat	0.82 ±0.03	1.10 ±0.03	1.71 ±0.04	1.99 ±0.14	1.18 ±0.06	0.87 ±0.07
Ash	0.73 ±0.02	0.67 ±0.02	0.82 ±0.05	0.69 ±0.07	0.75 ±0.06	0.78 ±0.04
Soluble Dietary Fiber	0.63 ±0.01	0.68 ±0.05	0.68 ±0.09	0.66 ±0.07	0.73 ±0.07	0.62 ±0.05
Insoluble Dietary Fiber	4.20 ±0.29	4.50 ±0. 28	5.47 ±0.46	5.48 ±0.52	5.52 ±0.50	4.02 ±0.95
Total Dietary Fiber	4.83 ±0.19	5.18 ±0.16	6.15 ±0.21	6.14 ±0.17	6.25 ±0.38	4.65 ±0.09
Carbohydrate	2.36 ±0.07	2.39 ±0.08	1.96 ±0.09	2.24 ±0.08	2.71 ±0.06	2.13 ±0.08
Energy (KJ)	24.44 ±1.03	26.74 ±0.57	30.67 ±0.74	32.45 ±1.81	26.56 ±0.93	23.87 ±1.75
Minerals (mg/100g)						
Iron	1.98 ±0.13	0.66 ±0.04	0.48 ±0.06	0.34 ±0.06	0.79 ±0.06	1.08 ±0.07
Zinc	0.11 ±0.01	0.18 ±0.02	0.18 ±0.03	0.15 ±0.03	0.18 ±0.02	0.22 ±0.03
Phosphorus	40.08 ±1.73	55.39 ±2.35	46.69 ±1.59	30.02 ±1.59	34.66 ±0.98	40.16 ±0.21
Copper	0.08 ±0.01	0.13 ±0.06	0.09 ±0.02	0.08 ±0.01	0.16 ±0.01	0.10 ±0.01
Manganese	0.19 ±0.04	0.22 ±0.02	0.13 ±0.01	0.15 ±0.02	0.21 ±0.02	0.30 ±0.02
Calcium	8.79 ±0.95	19.08 ±1.08	20.44 ±1.70	17.93 ±2.35	16.04 ±0.78	16.56 ±1.26
Magnesium	17.59 ±0.97	29.67 ±1.65	28.78 ±1.06	25.05 ±1.48	20.03 ±0.86	24.80 ±0.92

Values are mean ±SD (n=4)

Table 2. Capsaicinoids contents (g/100g) in fresh and dehydrated whole fruits of different red chili varieties

Name of the red chili	Capsaicin	Dihydro-capsaicin	Nordihydro-capsaicin	Total capsaicin-oids	Scoville Heat Unit[#]
Naga king chili	0.46 ±0.12	0.09 ±0.02	0.004 ±0.001	0.55 ±0.15	87959
Fire ball chili	0.14 ±0.01	0.09 ±0.01	0.008 ±0.001	0.23 ±0.02	36941
Small bird's eye chili	0.17 ±0.01	0.07 ±0.02	0.015 ±0.036	0.24 ±0.05	38901
Big bird's eye chili	0.08 ±0.01	0.05 ±0.01	0.014 ±0.008	0.14 ±0.01	21869
Guntur Chili	0.02 ±0.01	0.02 ±0.01	0.002 ±0.001	0.05 ±0.02	7639
Hathei chili	0.03 ±0.01	0.02 ±0.01	0.002 ±0.001	0.05 ±0.01	7542

Values are mean ±SD (n=4); [#]-values are units/100g of samples

4. Conclusion

The study on the nutrient and bioactive substances in chili varieties consumed in India shows the diversity within the *Capsicum* species. The varieties of chilies analysed here can be considered to be a good source of minerals and bioactive compounds. Varietal specific data on nutrient and bioactive substances can enhance the use of more nutritious variety as well as to make use of specific traits in cultivation. Considering the importance of capsaicin in health and disease, and its commercial implications in the pharmaceutical and food industry, Naga king chili offers great potential for future exploitation.

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