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Physicochemical and Nutritional Characteristics of Chilli Cultivars

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Abstract

Chillies, the dried red fruit of genus capsicum represent the essential fraction of agricultural produce. Chilli, imparts colour and characteristic pungent flavour apart from being used as a seasoning factor. Analyzing the physicochemical characteristics of chilli is important to understand their quality. Considering this moisture, ash, water insoluble ash, acid insoluble ash, capsaicin content, colour value, total carbohydrate, protein, fat, fiber, total phenols were analyzed using the standard procedures for the chilli samples viz., *Sattur S4, Sangli Sannam, Tomato Chilli and Byadagi*. Colour value test (Hunter Lab Colour Meter) confirms that all the samples had bright red with relative yellow colour recommended by BIS (IS 2322:1998). Basic knowledge about existing varieties and its quality factor is ultimately necessary to exploit their hidden positive bioactive markers at appropriate places.

Keywords: Capsaicin, Chilli Varieties, Colour, Minerals, Moisture Content, Phenols

1. Introduction

Spices are esoteric food adjuncts that are used throughout the world to flavour foods and beverages. Adverse climate of our country is well suited for almost all kind of spices grown here. The major constituents such as carbohydrates, volatile oil, fixed oil, protein, tannin, resins, pigments and minerals are present in the dry weight of spices [1]. Chilli, one of the most widely used condiment as flavouring and colouring in virtually indispensable in Asian cuisines [2], [3]. Classification of chilli varieties is done based on their colour, size, pungency and the end use to which they are put [4]. The quality of chilli is much important when used in food preparation; grading of fruits is done based on their pungency, colour and aroma. India is the only country, rich in many varieties with different quality factors [5]. The quality of dried chilli is assessed by a number of different parameters such as colour, hotness, ascorbic acid content and volatile flavour compounds [6]–[8]. Chillies with deep red colour tend to retain their colour in storage longer than those which are of lighter shade. The colour intensity of the final product declines as the proportion of seeds included with the pericarp increases. Moisture content, ash content and storage temperature are significant factors to be considered in assessing the quality of the end product. Hence, the study was framed with the objectives to determine the moisture content, ash content, water insoluble ash, acid insoluble ash, capsaicin and colour value. The study also evaluates the nutrient content and phytochemical composition of four varieties of chilli varieties viz., *Sattur S4, Sangali Sannam, Tomato Chilli and Byadagi (Kaddi)* following standard procedures.

2. Motivation

2.1 Sample Preparation

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The selected chilli varieties were purchased from M/s. Andhra Trade Development Corporation (P) Ltd, Guntur, Andra Pradesh and M/s. SA Rawther Spices (P) Ltd, Bengaluru, Karnataka. The selected chilli samples were ground to fine powder so as to pass through 1mm mesh. Quick and uniform grinding was ensured without causing undue heating to avoid possible contact with outside air. The obtained powder samples were stored in a clean, dry airtight glass container [9].

2.2 Physico-chemical Properties of Chillies

Moisture content of the selected samples was analyzed by following Indian Standard Methods. Total ash, acid insoluble ash and water insoluble ash content of the chillies were determined by standard procedure IS: 1797-1985. Capsaicin content of the samples was assessed by following standard procedure [10].

2.3 Colour Value

Colour value of whole chilli samples was measured using the colour flux meter. Colour was measured by using CIELAB scale at 10° observer at D_{65} illuminant and it is supported with universal software v4.10. The equipment is first calibrated by fixing the standard black and white discs. The sample colour was measured by filling the pulp in the transparent cup without any empty space at the bottom .The equipment was closed and the colour value outputs were read in the computer and the values were recorded. Colour value is observed in terms of 'L', 'a' and 'b' where; the vertical axis (luminance, L) indicates whiteness to darkness. The values: a (+) redness, a (-) greenness, b (+) yellowness, and b (-) blueness defines the chromatic portion of the solid.

2.4 Proximate Composition of Chillies

Amount of carbohydrate present in chillies was analysed by following Hedge and Hofreiter [11]. Nitrogen, fat content and insoluble dietary fibre component of the selected chillies was determined by Kjeldahl's method [12], using KELTECH, SOCS PLUS and FIBRA PLUS respectively.

2.5 Total Phenols

Methanol extraction method by Nuutila [13] was followed for sample extraction. The total phenols content was estimated spectrophotometrically [14]. To 0.5ml of 50% Folin-Ciocalteu reagent, 2.5ml of 20% (w/v) sodium carbonate and gallic acid or 1.0ml of sample extracts was added. This was placed in dark for 40 minutes and the absorbance was recorded at 750nm against a blank using spectrometer (Perkin-Elmer: λ-25 UV/VIS).

2.6 Minerals

Chilli varieties chosen for the present study were taken and assimilated with triacid mixture (nitric acid, sulphuric acid and perchloric acid). The digested solution was made up to 100 ml in a standard flask and used for the estimation of minerals using Atomic Absorption Spectrometer (Shimadzu Model No AA6300S).

2.7 Phytochemical Composition of Chillies

The selected chilli varieties namely *Sattur S4, Sangali Sannam, Tomato Chilli and Byadagi* were ground to coarse powder. The coarse powder was extracted with methanol using soxhlet apparatus. The extracts were condensed to dryness using rotary evaporator. Extracts prepared fresh were subjected to qualitative analysis of phytochemicals for the identification of alkaloids, tannins, saponins, flavonoids, carotenoids, steroids and phenols.

3. Results

Shelf life of agricultural commodity, including spices is significantly influenced by its moisture content and is frequently an index of quality [15]. Moisture content of the chilli powders were well within the standard value (Figure 1). Ash content of chilli powder ranged between 3.6 and 7.4 %. Acid insoluble ash content ranged between 0.519 and 1.079%, which is much less than the standard value 1.3 ensuring the good quality of chilli. The water insoluble ash content ranged between 1.5 and 3.7 %. Total ash is a widely accepted index of refinement of foods and acid insoluble ash is a useful index of mineral matter (dirt or sand in spices).Capsaicin content of capsicum fruits ranges between 0.1 and 1.0 %. The genetic make-up of the cultivar affects the capsaicinoid content followed by climate, soil and age of the fruit. Breeders can selectively

grow cultivars with varying degrees of pungency. Level of pungency could be tailored by the amount of stress subjected to the plants as pungency increases along with stress. The capsaicin content of chilli varieties ranged between 0.241 and 0.294 %.

Table 1. Colour value of Chilli

Chilli Varieties	Colour Value		
	'L'	'a'	'b'
Sangali Sannam	37.63±0.28[b]	33.30±0.93[c]	34.21±0.26[c]
Sattur S4	40.49±1.29[a]	35.53±0.36[ab]	40.28±0.24[a]
Tomatto Chilli	40.94±0.39[a]	36.04±0.17[a]	39.81±1.22[a]
Byadagi	40.94±1.09[a]	34.77±0.05[b]	38.76±0.08[b]

Values are mean ± SD of four samples in each group. [a-d] Means followed by different superscript are significant at 5% level ($p<0.05$)

Depending on the variety Chilli powder may vary in colour from dark blackish red to orange yellow. The red colour of chillies is owing to the presence of cartenoid pigments like capsanthin (major pigment 35%), capsorubin, zeaxanthin, violaxanthin, cryptoxanthin, betacarotene, etc., As shown in Table 1 colour value was graded as L-White to black (100-0), a-red (+a) to green (-a), b-yellow (+b) to blue (-b). The given samples had values of L as 37.63 to 40.94, indicating the darker colour. Similarly when analyzing the colour range, they recorded +a (red) as +36.04 to +30.47, indicating the richness of red colour. Likewise for yellow to blue, the range showed values closer to yellow (+40.28 to +34.21). This colour value test confirms that all the samples had bright red with relative yellow colour recommended by BIS (IS 2322:1998).

The major pigments namely capsanthin, capsorubin, zeaxanthin and cryptoxanthin contribute colour to the chilli powder. Cultivar, maturity at harvest, drying conditions, and moisture content decides the colour of dried chilli. Moisture level less than 10 percent give dull colour whereas, above 10 percent enzymatic browning is likely to takes place leading to darkening of chilli. Prevention or control in browning is the major problem faced by the food processors as color significantly influences consumer decision in selection of food items [16]. Auto-catalyzed degradation of carotenoids occurs in ground chilli powder due to which its colour is not stable during storage in ground form. Colour retention is influenced by storage temperature and moisture content [17]. Chillies contain 27 to 28 g per cent of carbohydrate, 19.68 to 20.78 g per cent of fibre (Table 2). Santamaria *et al* [18] reported that chilli *Guajillo Puya* (*Capsicum Annum L*) had relatively higher amount of carbohydrate, protein and fat and lower level of fiber as 31g, 16.50g, 8.1g and 29.3g respectively. The result obtained for the proximate content of spices matches with the statement of Otunola *et al* [19] who mentioned that spices contribute nutrients to the diet. Total phenol content of the given chilli samples were from 2.35 to 2.75 g/100g. Hasler [20] predicted that capsicum variety have reasonable to high levels of phenols, which are important antioxidant components capable of reducing the risk of degenerative diseases. In a study conducted by Parrilla *et al* [21] the phenolic content fresh and processed peppers ranged from 568 mg to 1032 mg GAE/100 g DW. An obvious difference in the phenolic content could be due to differences in cultivar, soil and weather conditions, as well as post harvest manipulation and maturity. Similar variability has been observed for Jalapeno peppers grown in different parts of the state of Chihuahua [22], [23].

According to Kadhi *et al* [24] mineral substance in differ appreciably in different cultivar of chilli (*Capsicum annum L.*). The mineral analysis of the chilli varieties indicated that the samples selected for the study was rich in sodium, potassium, iron, magnesium and phosphorus (Figure 2). Of the chilli varieties selected for the study, *Sattur S4 and Sangali Sanna*m had maximum sodium content as 0.05g/100g followed by *Byadagi* and *Tomato Chilli*. The sodium content of dry chillies provided by Spice India reported the value as 0.02 g/100g. Potassium content of chilli varieties ranged from 0.5 to 3.60 g/100g. Bernardo *et al* [25] varieties of Spanish peppers, at various ripening stages reported that potassium was the

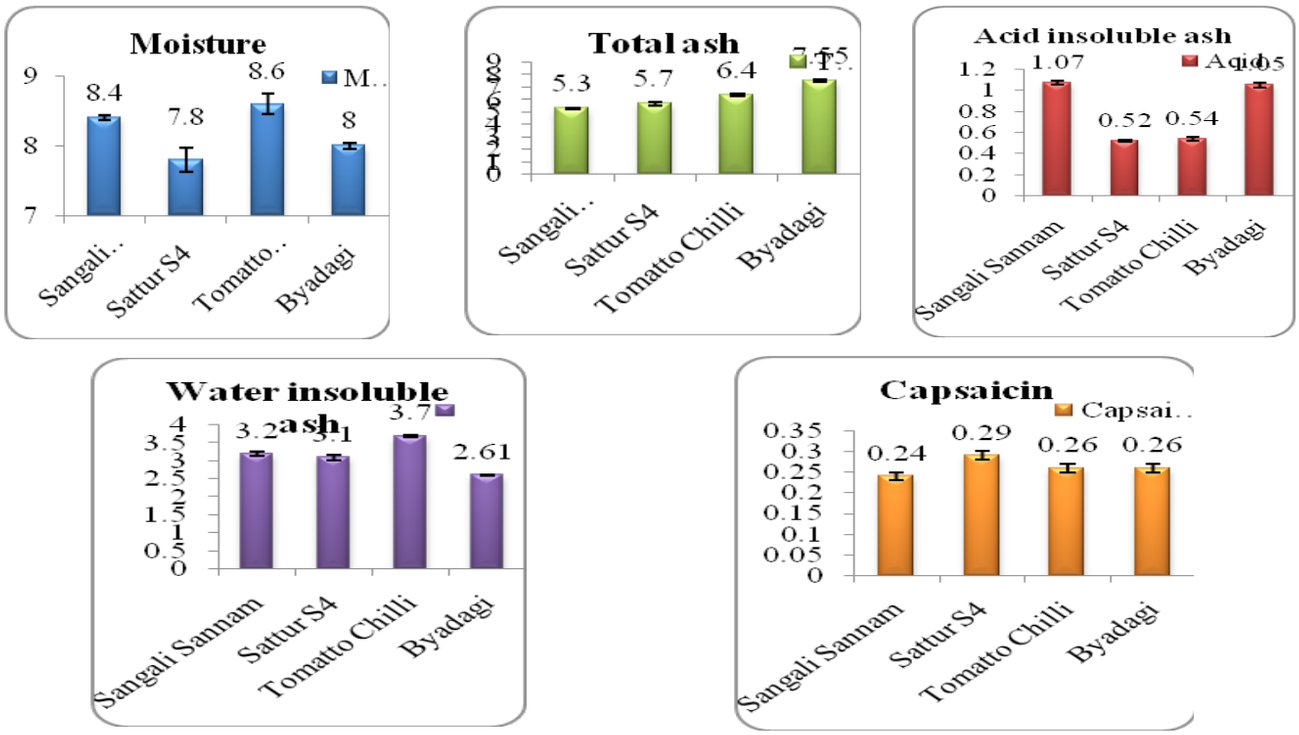

Figure 1. Physico chemical properties of chillies.

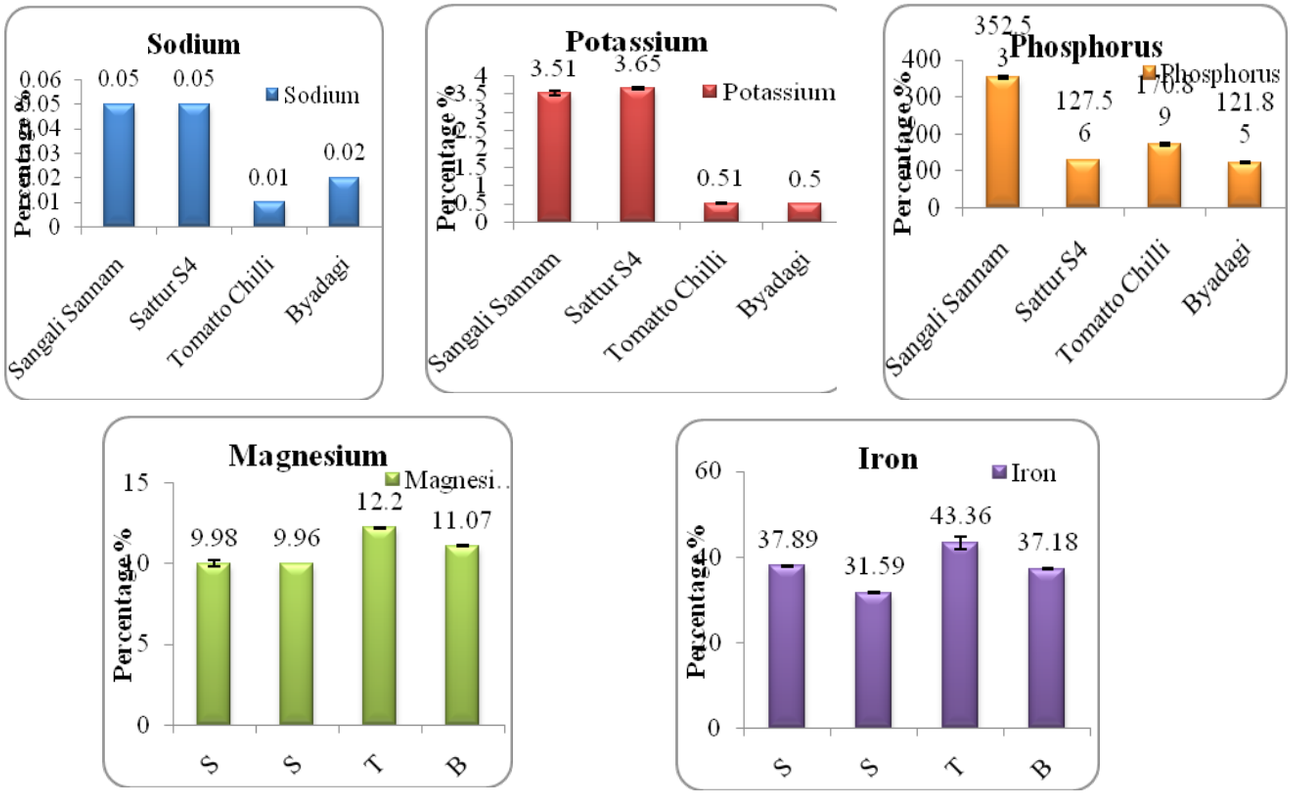

Figure 2. Mineral content of chilli varieties.

Table 2. Proximate composition of chilli varieties

Proximate Nutrients	*Sangali Sannam*	*Sattur S4*	*Tomatto Chilli*	*Byadagi*
Carbohydrate	27.00±0.24[b]	27.00±0.64[b]	28.00±0.48[a]	28.00±0.44[a]
Protein	20.56±0.07[a]	19.68±0.37[c]	20.78±0.20[a]	20.12±0.30[b]
Fat	13.50±0.32	18.00±0.19	14.50±0.17	14.50±0.42
Fiber	21.30±0.48[b]	19.30±0.17[d]	22.60±0.72[a]	20.60±0.01[c]
Total Phenols	2.75±0.06[a]	2.75±0.05[a]	2.35±0.06[b]	2.67±0.04[c]

Values are mean ± SD of four samples in each group. a-d Means followed by different superscript are significant at 5% level ($p<0.05$)

Table 3. Phytochemical composition of chillies

Phytochemicals	*Sattur S4*	*Sangali Sannam*	*Tomato Chilli*	*Byadagi*
Alkaloids	+	+	+	+
Carotenoids	+	+	+	+
Saponin	+	+	+	+
Steroids	–	–	–	–
Tannins	+	+	+	+
Flavonoids	+	+	+	+
Phenols	+	+	+	+

major element found in all the samples. Magnesium content of varieties namely Sattur *S4 and Sangali Sannam* was 10.00 mg/100g whereas Tomato chilli had a higher concentration of 12.20 mg/100g. Rubio et al [26] reported that red pepper fruit contained a higher concentration of magnesium and potassium compared to green pepper as ripening stages influence the mineral content of pepper (*Capsicum annum L.*). Khadi et al [24] stated that amount of magnesium in dry fruits of *Capsicum annuum L.* influence ascorbic acid content. Tomato chilli variety had higher amount of iron as 43.27 mg/100g followed by *Sattur S4, Byadagi and Sangali Sannam*, with 37.60, 37.40 and 31.60 mg/100g respectively. Kochhar [27] provided the data on iron content of both green and dry red chilli as 1.2 and 2.3 mg/100g. Parthasarathy et al [28] recorded that among the 12 cultivars analyzed for its physico-chemical composition and mineral content BC-30 possessed the highest content of protein, fat, carbohydrate, potassium, phosphorus and iron. Chilli variety *Sattur S4* had higher phosphorus content as 352 mg/100g. Phosphorus content of *Byadagi, Sangali Sannam and Tomatto chilli* was found to be 121, 126 and 170 mg/100g respectively. Results of the present study was concomitant with studies of Cravioto et al [29] who estimated the phosphorus content of Mexican dry chillies and it ranged from 216 to 517mg/100g. Gupta and Tambe [30] reported that the phosphorus content of 12 cultivars of chillies ranged between 38.6 and 68.8 mg/100g. Saimbhi et al [31] evaluated mineral content of green and red fruit of chillies and observed that the fresh red fruits had maximum phosphorous content compared to matured green fruits. This difference in mineral content might be due to differences in soil quality and fertilizer used [32].

Secondary metabolites of plants, act as defense mechanism [33]. The chilli varieties namely *Sattur S4, Sangali Sannam, Tomato Chilli and Byadagi* (Kaddi) contain alkaloid, carotenoid, flavanoid, tannins and phenolic compounds which are considered to be medicinally active constituents (Table 3). Otunola et al [19] reported that compared to garlic and ginger, pepper (*Capsicum frutescens L.*) has appreciable amount of carotenoids, flavonoids and saponins.

4. Discussion

This study researched the contents of physico chemical compounds, minerals and the total phenols of four different varieties of chilli viz., *Sattur S4, Sangali Sannam, Tomatto Chilli and Byadagi* (Kaddi). Chillies had optimum level of moisture as 7.8 to 8.6 per cent and provided substantial

amount of nutrients specially minerals, had appreciable range of chemical entity capsaicin with phytochemical principles. Knowledge on general composition of existing varieties would enable the food processors to design and develop technology that suits the material exactly, which in turn minimize post harvest loses, and helps in complete utilization of the nutrients present.

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