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Study of Different Physico-Chemical Properties of Byadagi Chilli Powder

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ABSTRACT: *The present investigation was carried out to determine the effect of milling methods on quality parameter of the Byadagi chilli. The physical properties of size, shape, surface area, volume, specific gravity and bulk density of the whole dried Byadagi chilli was found to be 10.03cm, conical, 22.25 cm^2, 5.09cm^3, 0.313 and 0.102 g/cm^3 and the quality parameters* viz., *colour, ascorbic acid, capsaicin content and pH of dried chilli were found to be 22.86 (L*), 10.88 (a*) and 10.13 (b*), 68.57mg/100g, 0.024% and 5.0, respectively. The quality parameters* viz., *colour, ascorbic acid, capsaicin content and pH of chilli powder obtained from cryogenic grinder is significantly different from spice pulveriser followed by low temperature grinder. The colour values of cryogrinderchilli powder were observed to be 40.15 (L*), 33.66 (a*) and 36.80 (b*) and was found much better than low temperature pulveriser39.34 (L*), 32.03 (a*) and 37.28(b*) and spice pulveriser35.84 (L*), 30.09 (a*) and 31.39(b*), respectively. The ascorbic acid (18.57mg/100g) and capsaicin content (0.017%) was found to be retained more in cryogrinder compare to other methods.*

Key words: *Milling methods, Quality parameter and Byadagi chilli.*

INTRODUCTION

Chilli (*Capsicum annuum*Linn.) is an important spice and vegetable crop used all over the world in one form or the other. The native of chilli is considered to be Mexico with Guatemala as the secondary centre of origin. Introduced to India by the Portuguese in 17th century, chilli is also called as hot pepper, red pepper, cayenne pepper, capsicum, etc., which has two important commercial qualities. It is valued for its pungency which is imparted by an alkaloid capsaicin and red colour ducts red pigment capsanthin, capsorubin and capxanthin. Chillies, besides imparting pungency and red colour to the dishes, are a rich source of vitamin A, C and vitamin E (tocopherol) and assist in digestion and are also a source of proteins, minerals, oleoresin and red pigment. Chillies are widely used as spices, condiments, culinary supplements, medicine, vegetable and ornamental plants too. It forms an important ingredient in day-to-day curries, pickles, *chutneys* and oleoresin (Anon., 2009) [1]. India ranks first in the world in terms of production, consumption and exports. Total production of spices is 4.3 million metric tons and the area covered is 2.56 million ha. The total production of chillies during the year 2010-11 was 10.5 Lakh tons. Out of this Andhra Pradesh contributed 51 per cent, Karnataka 9 per cent, Orissa 4 per cent, Maharashtra 4 per cent, West Bengal 4 per cent, Rajasthan 5 per cent, Madhya Pradesh 11 per cent and others 12 per cent. The average productivity of chillies was 1266 kg ha^{-1}. India has exported 2 Lakh tons of red chillies during 2010-11. Chilli is exported in different forms such as whole chillies, dried, fresh chillies, chilli powder and chilli oleoresin to South Asian countries, USA and Canada. The popularity of chilli is due to its wide range of shape, size and sensory attributes such as colour, pungency and piquancy that make generally insipid bulk nutritive flesh and cereal and vegetable foods more appetizing (Govindarajan *et al*., 1987) [2]. Chilli with higher colour value and less pungency are preferred in Europe and the West. Chinese chilli is known for cleanliness, very low aflatoxinlevels and good cultural practices. Indian chillies contain about 16% (d.b.) moisture content, while 10-11% (d.b.) is the acceptable limit in the export market.

Chillies which contain high moisture content, (300-400% d.b) after harvest are highly perishable and hence processing and storage of chillies are of considerable importance both to the farmers as well as to the processor and consumer. The shelf-life of freshly harvested chillies is estimated to be 2-3 days

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based on 12-15% cumulative loss. It is essential to reduce the moisture content and provide aeration to the chillies after harvesting to prevent the development of micro-flora and subsequent. Loss of quality or total spoilage. The most important quality attributes chillies are the colour and the pungency. The red colour of chillies is mainly due to the carotenoid pigments. The pungency of chillies is due to the compound capsaicin. Therefore, chillies are pungent.

MATERIAL AND METHODS

The physical properties and proximate composition were studied for both, dried and powdered *Byadagi*chilli. The quality parameters of dried chilli *viz*., colour, ascorbic acid, titrable acidity and capsaicin content were used for the study.

Physical properties of *Byadagi*chilli

Size: Size is the measure of physical dimensions of the object. The size of the *Byadagi* chilli was determined by measuring its length at mutually perpendicular and along the major and minor axes using verneir callipers (Oberoi *et al*., 2005) [3].

Shape: The shape of the fruit was determined by tracing the longitudinal and lateral cross sections of the fruit and then comparing it with the standard charts and the most suitable shape was considered (Mohsenin, 1965) [4].

Volume and specific gravity

The volume of *Byadagi* chilli was determined by the platform scale method (Sahay and Singh, 2002) [5]. The weight of the chilli was determined by weighing on the balance in air. Thereafter, the chilli was forced into the water with the help of a sinker rod. The latterreading of the scale while the chilli was submerged minus the weight of container and water was the actual weight of the displaced water. The volume of the chilli was estimated by using the following formula.

$$\text{Volume } (mm^3) = \frac{\text{Weight of displaced water (g)}}{\text{Weight density of water (g } mm^{-3})}$$

The specific gravity of chilli was determined by the following method given by Sahay and Singh, (2002) [5]. The specific gravity and weight density of water are taken as 1.0 and 998.4 kg m^{-3}, respectively. Knowing the weight of the *Byadagi* chilli in air, the volume and the weight density of the chilli was obtained by the ratio of weight to volume. The specific gravity of chilli was calculated using the following expression.

$$\text{Specific gravity} = \frac{\text{Weight of Byadagi chilli in air (g)} \times \text{Specific gravity of water}}{\text{Weight of displaced water (g)}}$$

Surface area

The surface area of *Byadagi* chilli was determined by using digital planimeter. The *Byadagi*chilli was carefully cut using a knife. The cut skin layers were then placed on a graph sheet and the outlines were traced by using a sharp lead pencil. Initial point was marked on the outline of the graph and the planimeter was run along the outline in clockwise direction till it reached the initial point. The surface area of the chilli was displayed by the planimeter (Mohsenin, 1965) [4].

Bulk density: The bulk density of *Byadagi* chilli was determined by measuring the volume of a known weight of chilli samples. Accurately 100 g of chilli was weighed into a volumetric box and the weight of the sample was recorded. The bulk density was determined by using the weight and volume of the sample (AOAC, 1975) [6].

Proximate composition of dried chilli and chilli powder

Moisture content: The moisture content of the fresh and dried chilli was determined by hot air oven method (AOAC, 1995) [7]. About 5 g of the chilli was weighed into a weighed moisture box and dried in an oven at 100 ± 1°C for 16 hours and cooled in a dessicator. The weight of the dried sample was recorded. The moisture content of the sample was calculated by using the formula

$$\text{Moisture content } (\%) = \frac{W_1 - W_2}{W_3} \times 100$$

Where,

W_1 = Initial weight of the sample (*g*)
W_2 = Final weight of the sample (*g*)
W_3 = Weight of the dried sample (*g*)

Crude Protein

The crude protein in chilli was determined using micro Kjeldahl method (AOAC, 1995) [7]. A finely grounded 2 g of *Byadagi* chilli powder was transferred to a digestion tube, to this 0.5 g of digestion mixture and 10 ml of concentrated H_2SO_4 were added. The sample was digested in a digestion unit till it became colourless. Then the tubes were cooled and transferred

to the distillation unit. Forty ml of 40% NaOH solution was allowed into the tube. Liberated ammonium was absorbed in 2% boric acid solution containing mixed indicator. The pink colour of the boric acid solution was turned to green and this was titrated against 0.01N HCl until the pink colour was obtained. The protein in per cent was obtained by using the following formula.

$$= \frac{TV \times 0.014 \times 100\,(ml) \times 0.01 \times 100 \times 6.25}{\text{Weight of the sample (g)}} \times \text{Aliquot used for distillation (ml)}$$

Where, TV = Titre value

Crude fat

The crude fat content of the dried chilli and chilli powder grinded in selected milling methods were determined by SOCS – PLUS apparatus (AOAC, 2005). Dried chilli powder (2 g) was weighed accurately and transferred to thimble. The empty beaker weight was taken and all the beakers were loaded into the system. The petroleum ether was poured into the beaker from the top and boiled for about 80-90 min at 80°C. After the completion of process time, the temperature was doubled to 160 °C for 15 – 20 min to collect the petroleum ether. All the beakers were removed and placed in a dessicator for about 5 min. The final weight of the beaker was noted down.

$$\text{Fat content (\%)} = \frac{W_2 - W_1}{W} \times 100$$

Where

W_1 = Initial weight of the beaker (g)
W_2 = Final weight of the beaker (g)
W = Weight of the sample taken (g)

Total ash

The total ash content of the fresh and dried samples was determined by muffle furnace method (AOAC, 1980). Accurately 5 g of the sample was weighed into a crucible (which was previously heated to about 600°C and then cooled). The crucible was placed on a clay pipe triangle and heated first over a low flame till all the material was completely charred, followed by heating in a muffle furnace for about 3-5 h at 600°C. It was then cooled in a desiccator and weighed. The percentage of ash was calculated by using the following expression.

$$\text{Total ash (\%)} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample (g)}} \times 100$$

Crude fibre

The crude fibre content in dried chilli and chilli powder was determined by sequential acid and alkali hydrolysis method using Fibra-Plus apparatus. Accurately 2 g of fat free dried chilli sample was taken in a crucible. The sample was boiled in 1.25% sulphuric acid, subsequently boiled in 1.25% sodium hydroxide solution. The sample was dried in hot air oven at 100 °C till all the moisture was evaporated. The weight of the crucible before ashing was note down. The obtained dried sample was ashed in a muffle furnace at 550 °C for 4 h. After ashing, the crucibles were cooled in a desiccator and reweighed. The residue obtained after subtraction of the ash was regarded as fibre. The crude fibre was obtained by using the following equation.

$$\text{Crude fibre (\%)} = \frac{W_1 - W_2}{W} \times 100$$

Where,

W_1 = Weight of the sample before ashing (g)
W_2 = Weight of the sample after ashing (g)
W = Weight of the sample taken (g)

Carbohydrates

Total carbohydrate content was determined by phenol sulphuric acid method

(Dubois, 1956). One gram of the sample was weighed exactly and extracted with 80% ethanol. The sample was centrifuged at 5000 rpm for 10 min subsequently followed by three extractions and the final volume was made upto 25 ml. The test sample of 0.1 ml and 0.2 ml was pipette out into a test tube followed by the addition of 1 ml of 5 % phenol and 5 ml of 96 % sulphuric acid and the tubes were shaken well for 10 min. The tubes were placed in water bath at 25-30 °C for 20 min and absorbance was read at 490 nm. The total amount of carbohydrate present in the sample was calculated using standard graph.

$$\text{Total carbohydrates (\%)} = \frac{X}{0.1} \times 100\text{mg of glucose}$$

Qualityparameters of *Byadagi*chilli and chilli powder

The quality parameters of *Byadagi*chilli (i.e., colour, ascorbic acid, capsaicin, titrable acidity and aflatoxin) were determined using standard methods, which are explained under the following headings.

Colour

Colour is one of the most important qualities of acceptance for products, which reflects sensation to

the human eye. Colour is important to consumer as a means of identification, as a method of judging quality and for its basic aesthetic value. Dried products are usually darker in colour, but darker colour does not mean better quality. Too dark may imply that the product is over dried. The advantage is that this parameter can be visually determined for assessing dryness quality. The spectrophotometer was used to determine the colour of chilli in the present investigation and is shown in (Plate 5). The colour of the dried chilli was measured using a colour scan spectrophotometer CIELAB scale at 10° observer and at D_{65}illuminant. The instrument was initially calibrated with a black as well as with standard ceramic plates. The 3-dimensional scale L^*, a^* and b^* was used. The L^* is the lightness coefficient, ranging from 0 (black) to 100 (white), a^* represents greenness and redness (+100 for red and -80 for green) while b^* represents yellowness and blueness (+70 for yellow and -80 for blue), C represents croma value and H represents hue angle. Though all the values L^*, $a^*$and b^* were measured, the +a^* values, which was a measure of redness of chilli, were considered for comparison of chilli (Kaleemullah and Kailappan, 2006) [8].

Ascorbic Acid

Ascorbic acid was estimated by titration method. Exactly 5 ml of the working standard solution was pipetted into a 100 ml conical flask, to this 10 ml of 4 per cent oxalic acid was added and was it was titrated against dye solution until it turned to pink colour end point (V_1 ml). The amount of the dye consumed was equivalent to the amount of ascorbic acid. One gram chilli sample was weighed and crushed using 4% oxalic acid. The extract was filtered through Whatman No. 41 filter paper and the volume was made upto 100 ml. Five ml of the filtrate was pipetted out into conical flask, 10 ml of 4% oxalic acid was added and titrated against the dye solution (V_2 ml). The amount of ascorbic acid present in the sample was calculated using the following equation.

$$\text{Ascorbic acid (mg 100 g}^{-1}) = \frac{0.5\,(\text{mg}) \times V_2\,(\text{ml}) \times 100\,(\text{ml})}{V_1\,(\text{ml}) \times 5\,(\text{ml}) \times \text{Weight of sample}} \times 100$$

Capsaicin

The capsaicin content of the dried chilli and chilli powder was determined by colorimetric method. Accurately 0.5 g of sample was weighed in volumetric flask. To this 10 ml dry acetone was added and centrifuged at 10000 rpm for 10 min. 1 ml of the supernatant was transferred to test tube and evaporated to dryness in a hot water bath. The residue was dissolved in 5 ml of 0.4% NaOH solution. Add 3ml of 3% of phosphomolybdic acid shake the content and let it be for 1hr. Filter the solution into centrifuge tube to remove any floating debris. Centrifuge about 5000 rpm for 10-15 min. Transfer the clear blue colour solution to the cuvette and read the absorbance at 650 nm. The capsaicin content of the samples was calculated using standard graphs.

pH

pH of dried chilli and chilli powder was measured by using digital pH meter (Systronics). One gram of sample was dissolved in 100 ml of distilled water in a beaker then the electrode of the pH meter was dipped in the sample under test .

Water activity

The water activity of dried chilli and chilli powder was measured by RotronicHygrolab 3 water activity analyser. Before measuring the water activity, the instrument was calibrated for its accuracy by measuring the wateractivity of distilled water. The sample under test was kept in sample cup of 50 ml size provided with water activity meter. The sensor was placed on the sample cup by firmly closing in such a way that the air should not enter into the sample cup. The reading was displayed on the water activity display screen and the water activity of the sample was recorded (Suresh, 2008).

RESULTS AND DISCUSSION

Physical properties of dried *Byadagi*chilli

The physical properties of dried *Byadagi* chilli (without stalk) are presented in Table 2**.** The size, shape, surface area, volume, specific gravity and bulk density were found to be 10.03cm, conical, 22.25 cm^2, 5.09cm^3, 0.313 and 0.102 g/cm^3, respectively.

Table 2
Physical parameters of dried *Byadagi chilli*

Physical properties	*Dried chilli*
Size (cm)	10.03
Shape	Conical
Surface Area (cm^2)	22.25
Volume (cm^3)	5.09
Sp. Gravity	0.313
Bulk density (g/cm^3)	0.102

Proximate composition of dried whole Byadagichilli and Chilli powder

The effect of different milling methods on proximate composition of *Byadagi*chilli and Chilli powder is presented in Table 3. The initial proximate composition *viz*., moisture, protein, fat, total minerals, crude fibre and carbohydrates content of dried chilli were observed to be 8.90% ,16%, 8.44%, 13.57%, 27% and 26% respectively. The proximate composition of chilli powder milled using selected milling methods ranged between 8.91 to 10.08% (moisture), 15.35 to 16.85% (Protein), 8.15 to 12.21% (Fat), 8.25 to 12.08% (Total minerals), 25.76 to 26.54% (Crude fibre)and 25.70 to 28.65% (Carbohydrates) respectively. It is observed that, there was no much difference in the moisture content of chilli powder obtained from three milling methods. Among the milling methods, cryogenic grinder and low temperature pulverizer machine yielded chilli powder rich in carbohydrates, protein, fat and total minerals found to be retained in chilli powder samples obtained from the cryogenic grinder. The powder recorded highest carbohydrate due to retention of volatiles and minerals in the samples. The chilli powder grounded in cryogenic grinder was found to be superior to the chilli powder obtained by low temperature pulverizer and chilli pulverizer. The loss in the nutrient of chilli powder obtained from chilli pulverizer might be due to the heat generated during milling process. The majority of the nutrients found to be retained in chilli powder samples obtained from the cryogenic grinder and low temperature pulverizer which might be due to the exposure of the samples to the atmosphere and low temperature maintained during milling process when compared to chilli pulveriser which generated high temperature during milling.

Quality parameters of dried chilli and chilli powder

The quality parameters of dried chilli and chilli powder milled by selected milling methods are depicted in Table 4. The quality parameters *viz*., colour, ascorbic acid, capsaicin content, pH and water activity of dried chilli were found to be 22.86 (L*), 10.88 (a*) and 10.13 (b*), 68.57mg/100g, 0.024% and 5.0, respectively. The quality parameters *viz*., colour, ascorbic acid, capsaicin content, pH and water activity of chilli powder varied significantly and ranged between of 35.84 to 40.15 (L*), 30.09 to 33.66 (a*) and 31.39 to 37.28 (b*), 18.57 to 21.42 mg/100g, 0.012 to 0.027, 4.99 to 5.06 and 0.562 to 0.620 respectively. The chilli powder obtained from the selected milling equipment is shown in Plate 10. The ascorbic acid was unstable especially on exposure to oxygen and heat generated during milling. No rise in the temperature was observed in chilli pulverizer it may be due to the exposure of the product to ambient condition. Whereas, in case of pulverization the loss of capsaicin might be due to the heat generated during milling. When compared to the other milling method the capsaicin content retained more in low temperature pulverization which might be due to the low temperature maintained by circulating the tap water around the grinder. The water activity of the sample is directly in relationship with the moisture content of the sample. The water activity was found to be highest

Table 3
Effect of milling methods on proximate composition of chilli powder

Methods of milling	*Moisture(%)*	*Protein(%)*	*Fat(%)*	*Total minerals(%)*	*Crude fiber(%)*	*CHO(%)*
Dried chilli	8.9	16	8.44	13.57	27	26
Chilli pulverizer	8.91	15.35	8.15	11.76	25.76	28.5
Low temperature pulverizer	9.11	16.28	9.21	12.08	26.26	25.7
Cryogenic grinder	10.08	16.85	12.21	8.25	26.54	25.96

Table 4
Effect of milling methods on quality characteristic of chilli powder

	Quality characteristics						
	Colour			*Ascorbic acid*	*Capsaicin*		*Water*
Method of milling	*L**	*a**	*b**	*(mg/100g)*	*(%)*	*pH*	*activity*
Dried chilli	22.86	10.88	10.13	68.57	0.024	5.00	0.554
Chilli pulverizer	35.84	30.09	31.39	11.42	0.007	4.90	0.562
Low temperature pulverizer	39.34	32.03	37.28	18.57	0.012	5.02	0.583
Cryogenic grinder	40.15	33.66	36.80	18.57	0.017	5.06	0.620

L^* = Lightness or Darknessa^* = Redness or Greenessb^*= Yellowness or Blueness.

in cryogenic grinder followed by low temperature pulveriser and lowest in chilli pulveriser. The pH content of the sample depends on the maturity of the plant, soil type, harvesting conditions and freshness of the sample. The pH of the sample was found to be highest in cryogenic grinder followed by low temperature pulveriser and lowest in chilli pulveriser. The results of the present investigation are in confirmation with Shankuntala and Shadaksharaswamy (1995) and Bera*et.al*. (2001) [9] [10].

CONCLUSION

The retention of nutrients was found to be more in cryogenic grinder as compared low temperature pulverization and chilli pulverization. The proximate composition (moisture, protein, crude fat, total minerals, crude fiber and carbohydrate) of chilli powder milled in cryogenic grinder was observed to be 10.08%, 16.85%, 12.21%, 8.25%, 26.54% and 25.96%, respectively.The colour value of chilli powder obtained from cryogenic grinder was found to be much better than low temperature and chilli pulverization. The capsaicin content was found to be retained more in low temperature pulverization compared to other milling methods. The water activity and pH was found to be highest in cryogenic grinder followed by low temperature pulveriser and lowest in chilli pulveriser.

REFERENCES

Annyomous, (2009), Patent Rights of Naga Chilli, *Nagaland post*, 18 March: 4.

Govidajaran V. S., D. Rajalakshmi, and N. Chand, (1987), Capsicum production, technology, chemistry and quality, Part IV, Evaluation of quality, *CRC Crit. Rev. Food Sci. Nutr.*, **25:** 185-283.

Oberoi H. S., Ahmed K. U. M., JaspreetKaur. and Bangali Baboo, (2005), Quality red chilli variety as affected by different drying methods, *Journal of Food Science and Technology.* **42**(5): 384-387.

Mohsenin N. N., (1965), Terms, Definitions and Measurements related to mechanical harvesting of selected fruits and vegetables, Penna Agricultural Experimental Station, Progress report.

Sahay K. M. and Singh K. K., (2002), Unit Operations of Agricultural Processing,*Vikas Publishing House Pvt. Ltd.* pp. 8-9.

AOAC, (1975), Official Methods of Analysis, (14thEdn.), Association of OfficialAnalytical Chemists, Washington, DC.

AOAC, (1995), Official Methods of Analysis, (16th Edn.), Vol. II. Association of Official Analytical Chemists, Arlington, Virginia, USA.

Kaleemullah S. and Kailappan R., (2006), Drying Kinetics of Chillies in Deep-BedDryer, *Journal of Food Science and Technology*, **43**(4): 420-424.

Shakuntala N. M. and Shadaksharswamy, (1995), Food, Facts and Principles, New Age International Publisher. pp. 66-67.

Bera M. B., Singh, C. J., Shrivastava, D. C., Kumar, K. S. and Sharma Y. K., (2001), Storage stability of colour substance in thermally processed dry chilli powder, *Journal of Food Science and Technology*, **38**(1): 8-11.