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PROXIMATE AND PHYTO-CHEMICAL ANALYSIS OF DEHYDRATED FOUR DIFFERENT VARIETIES OF CAPSICUM (*Capsicum annuam L.*)

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ABSTRACT

Bell pepper, also known as sweet pepper or a pepper and capsicum, is a cultivar group of the species Capsicum annuum. Cultivars of the plant produce fruits in different colors, including red, yellow, orange, green, chocolate/brown, vanilla/white, and purple. Bell peppers are sometimes grouped with less pungent pepper varieties as "sweet peppers". Bell peppers are sensitive to an abundance of moisture and excessive temperatures. Bell peppers can be dehydrated and stored in order to increase their availability. The main aim of this research is to determine the proximate principles and phytochemical properties of dried bell pepper samples, in samples of bell pepper with four different colours. Green capsicum was found to be rich with total phenol; Red capsicum was rich with ascorbic acid and β-Carotene. Yellow capsicum was rich with fat and phosphorous and also showed higher amounts of moisture. Purple capsicum was rich with flavonoid, calcium and protein content. Thus, capsicum, though not given any special importance in the diet, is a nutritive fruit and one should consume it in order to gain essential nutrients.

Key words:- Proximate, Phytochemical analysis, β-Carotene, Capsicum annuum L.

INTRODUCTION

Bell peppers (*Capsicum annuum L.*) are part of the Solanaceae family and have been cultivated for thousands of years, beginning in South and Central America before being brought back to Europe from North America by Christopher Columbus. They are grown throughout the world, but mainly in China, Mexico, and in the United States. While green, red, and yellow bell peppers are the most common ones. Other varieties such as orange, purple, brown, and black are also grown.

In the *Capsicum annuum L.* species there are many different varieties from the wild chili to the sweet consumer types. Among all the cultivars the spice paprika and the sweet fresh consumer varieties gained distinguished importance. Cultivars of the fresh consumer pepper produce are cultivated in different colors, size and shape. The produce of the pepper plant is a puffed berry which is hollow inside. The shape of the fruit can be round, flattened round, puffed prism, peaked, and crumpled inside or long thin. The color of the pepper fruit also can vary greatly: green, yellow, red, orange, purple, white and the pale or transition of the previously mentioned colors. The size of the produce varies from 1 cm to 25 cm. Bell peppers have a delightful, slightly watery crunch. Green and purple peppers have a slightly bitter flavour, while the red, orange and yellow are sweeter and almost fruity.

Capsicum was introduced in to India by the Portuguese during the 16th century. India has emerged today as the foremost producer and exporter of capsicum contributing to almost one fourth of the world production. Different species are cultivated in several countries of the world [1]. India is the largest producer of capsicum in the world contributing 25 % of the total world production. Beside India other producers and exporters of capsicums are China, Pakistan, Morocco, Mexico and Turkey. Indian chillies are exported mainly to Sri Lanka, USA, Canada, UK, Saudi Arabia, Singapore, Malaysia, Nepal, Mexico and Germany.

Export and local market both demand high quality sorted fruits and vegetables, which long preserves its fresh condition in the market. Additionally, there is an increased demand for fruits and vegetables that are beneficial for a healthy

life style as well as rich in ingredients that positively influence the prevention of any health malfunction.

Capsicum is an important aspect of the diet and is widely consumed in almost every part of Nigeria. They are also frequently used both chopped and raw in salads, or cooked in stir-fries or other mixed dishes. They can be sliced into strips and fried, roasted whole or in pieces, or chopped and incorporated into salsas or other sauces [2].

Dried foods are more concentrated than fresh foods with low moisture contents and can be stored at ambient temperatures for longer periods. Due to a considerable decrease in the water activity of the material, dried foods have reduced microbiological activity with minimized physical and chemical changes [3,4]. Peppers, similar to other vegetables, are perishable resulting in high losses due to storage problems and marketing. An alternative to the consumption of fresh vegetables is their dried form, which allows their use during the off-season. However, food products are sensitive to drying temperatures and methods that can induce degradation (e.g., oxidation, loss of color, shrinkage or loss of texture) and change the nutritional and functional properties of the products [5].

Capsicum can be preserved by drying, pickling or freezing. Dried peppers may be reconstituted whole, or processed into flakes, or powders. Pickled or marinated peppers are frequently added to sandwich or salads. Frozen peppers are used in stews, soups and salads. Extracts can be made and incorporated into hot sauces. It is widely enjoyed and is essential for African and Ivorian dishes [6] .

Capsicum has many primary and secondary uses, it protects against arthritis, appetite, asthma, bleeding, blood pressure (high/low), chills circulatory disorders, colds, depression, diabetes, heart problems, kidney problems, lung disorder, nausea, ulcers, wound bleeding, blood impurities, jaundice, skin disorder, burns , fever etc. All the four colored peppers exhibit significant abilities in preventing the oxidation of cholesterol or docosahexaenoic acid (DHA).

Capsicum is known to be a medicinal plant [7]. It is a powerful local stimulant, with no narcotic effect, largely used in hot climate as a condiment and most useful in atony of the intestine and stomach. It is antiseptic and therefore a most valuable agent as a gargle in ordinary sore throat or in diphtheria. The antiseptic properties in capsicum makes it effective in fighting food poisoning, couple with good supply of probiotics, yeasts and fungal infection problems like ring worm, shingle, athletes foot etc can be easily eliminated. It is also used as an antibacterial, antifungal, anti-aging and antioxidant agent.

The present investigation was undertaken to analyze the proximate nutrient and phytochemical content in four varieties of dried powder of sweet pepper (*Capsicum annuum L*) .

MATERIALS AND METHODS

Samples of four different colored (Red, Green, Yellow and Purple) sweet peppers *C.annuum* variety were obtained from the local market of Anand, Gujarat, India. The fruit samples were thoroughly washed,sliced with stainless kitchen knife, dried in moisture extraction oven at 65^0 C for about 48 hrs and milled. The dried pepper powders were packed in airtight glass containers and stored at 25 ± 1^0 C in the dark. Twenty grams (20g) of the flour of each variety was weighed, homogenized with 100 ml distilled water and centrifuged. The supernatant was used for determination of total phenol and flavonoid content.

Biochemical and Phytochemical analysis

Moisture, protein and ash content of the dry pepper flour were determined according to AOAC [8]. Calcium was determined by the method of Clark and Collip [9]. Phosphorus was estimated by the method of Fiske and Subbarao [10]. Vitamin-C was estimated by the method of Sadashivam S et al., [11]. β- Carotene estimation was done by the method of Plummer [12]. Total phenol estimation was carried out by the method of Malik and

Singh [13]. Flavonoid was estimated by the method of Lamalson and Carnet [14].

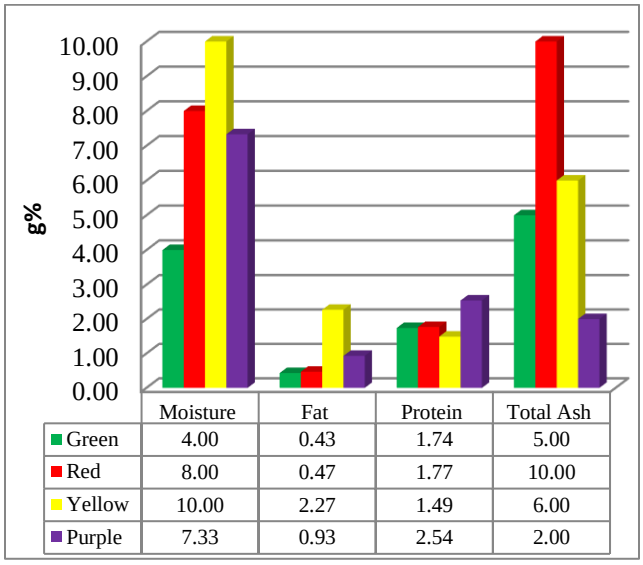
Statistical analysis

All the assays were carried out in triplicate. The results are expressed as mean values and standard error (SE) of the mean. The differences were analyzed using one-way analysis of variance (ANOVA) followed by Duncan tests. For all analyses, p-values <0.05 were considered statistically significant. Data was analyzed using SPSS version 16 program.

RESULTS AND DISCUSSION

Mean value of moisture content was found to be 10.00 gm% in yellow capsicum, which was the highest. Moisture content in green, red and purple capsicum were 4.00 gm%, 8.00 gm% and 7.33 gm%, respectively **(Fig:1)**, which showed no significant differences between the four varities of capsicum in moisture content. Fat content was 2.27 gm% in yellow capsicum which was the highest. Fat content in green, red and purple capsicum were 0.43, 0.47 and 0.93 respectively **(Fig:1)**. Green and red samples showed no significant differences where as yellow and purple showed highly significant differences ($p \leq 0.01$).

Protein content was 2.54 gm% in purple capsicum which was the highest. Protein content in green, red and yellow capsicum was found to be 1.74, 1.77 and 1.49gm% respectively **(Fig:1)**. No significant difference was seen between green and red capsicum, where as yellow and purple capsicum were found to be significantly different ($p \leq 0.01$). Ash content was found to be 10.00 gm% in red capsicum, which was the highest. Yellow and green capsicum showed an ash content of 6.00 gm% and 5.00 gm% respectively which was less than for red capsicum. Purple capsicum gave the least ash content of 2.00 gm % **(Fig:1)**. Red capsicum was highly significant ($p \leq 0.01$) when compared to the other three varieties of capsicum, whereas green, yellow and purple capsicum did not show any significant differences. Ash content of pepper is known to contain significant quantities of P, Ca and K salts that are valuable to humans [15].



	Moisture	Fat	Protein	Total Ash
Green	4.00	0.43	1.74	5.00
Red	8.00	0.47	1.77	10.00
Yellow	10.00	2.27	1.49	6.00
Purple	7.33	0.93	2.54	2.00

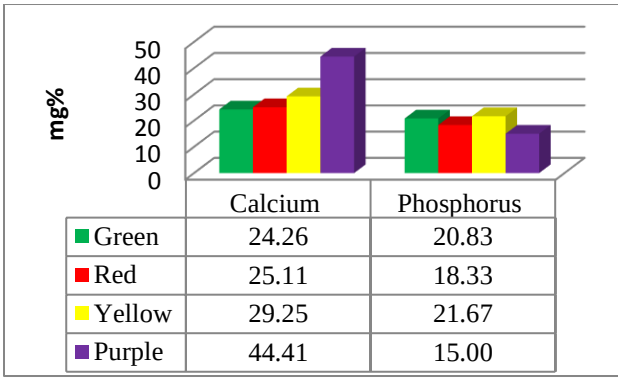
Fig:1 Moisture, fat, protein, and total ash content from different varieties of dehydrated capsicum.

Mean value of calcium content was 44.41 mg% in purple capsicum, which was higher than the other three varieties of capsicum. Red and yellow capsicum showed calcium content of 25.11 mg% and 29.25 mg% respectively, which was less than purple capsicum. Green capsicum gave the least calcium content of 24.26 mg% **(Fig:2)**. Thus, purple capsicum showed a higher significant difference ($p \leq 0.01$) than green, red and yellow capsicum. There was no significant difference observed between green, red and yellow capsicum. Calcium is a major mineral used in the mineralization of bones and shells,. Its main function is in muscle contraction and it can bind to several different calcium modulated proteins. Calcium is known to stabilize cell membrane and thus may prevent physiological disorders attributed to calcium deficiency [16].

Mean value of phosphorus content was 21.67 mg% in yellow capsicum which was higher than the others. Green and red capsicum showed phosphorus content of

20.83 mg% and 18.33 mg% respectively, which was less than yellow capsicum. Purple capsicum had the least phosphorus content of 5.00 mg% **(Fig:2)**. Phosphorus content of purple capsicum showed a higher significant difference ($p \leq 0.01$), where green, red and yellow capsicum showed no significant differences.

Phosphorus is the main ingredient for the structural formation of bones by combining with calcium and forms calcium phosphate. Phospholipids are the main structural components of all cellular membranes. Nearly every cellular process that uses energy obtains it in the forms of ATP. ATP is also important for phosphorylation, a key regulatory event in cells.

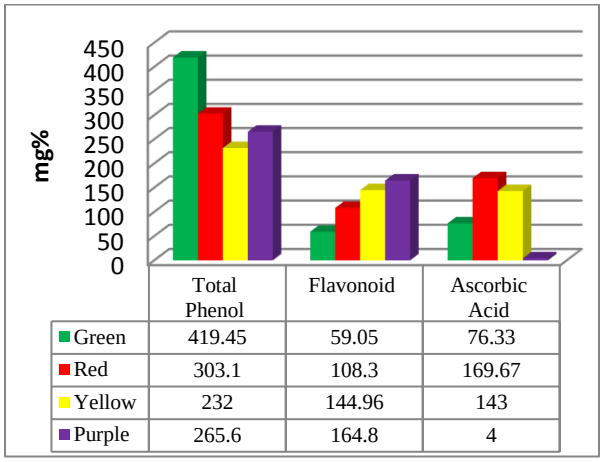


	Calcium	Phosphorus
Green	24.26	20.83
Red	25.11	18.33
Yellow	29.25	21.67
Purple	44.41	15.00

Fig:2 Calcium and phosphorus content from four different varieties of dehydrated capsicum.

Ascorbic acid (vitamin-C) content was 169.67 mg% in red capsicum, which was the highest. Yellow capsicum showed an ascorbic acid content of 143 mg% which was less than red capsicum. Green capsicum revealed 76.33 mg% ascorbic acid content which was less than yellow capsicum. Purple capsicum gave the least ascorbic acid content of 4.00 mg%. **(Fig:3)**, which showed a highly significant difference ($p \leq 0.01$) between all the four varieties of capsicum in ascorbic acid content.

The levels of vitamin C are very variable and may be affected by maturity, genotype and processing. This vitamin acts as a protector of pigments preserving them from chemical and biochemical oxidation [17]. Vitamin-C is hypothesized to prevent cancer by inhibiting the formation of N-nitroso compounds in the stomach and also by stimulating the immune system [2].



	Total Phenol	Flavonoid	Ascorbic Acid
Green	419.45	59.05	76.33
Red	303.1	108.3	169.67
Yellow	232	144.96	143
Purple	265.6	164.8	4

Fig: 3 Total phenol, flavonoids, ascorbic acid content from four different varieties of dehydrated capsicum

β-carotene content was 4320.10 µg% in red capsicum, which was the highest. Yellow capsicum showed a β-carotene content of 2172.31 µg% which was less than red capsicum. Green capsicum revealed 412.44 µg% β-carotene content which was less than red and yellow capsicum. Purple capsicum gave the least β-carotene content of 412.44 µg% **(Fig:4)**. Thus red capsicum showed a highly significant difference ($p \leq 0.01$) from the other three varieteies of capsicum. Green and purple capsicum showed no significant differences between each other.

The color of mature pepper fruit is determined by the composition of carotenoids. The fruit colour of red pepper is genetically determined by three loci, y, c_1, and c_2. [18]. β-carotene (Vitamin A) is an all important anti-oxidant and part of today's healthy lifestyle. [2].

Phenolic content was highest in green capsicum which was found to be 419.45 mg%. Red capsicum showed a total phenol content of 303.10 mg% which was less than green capsicum. Purple capsicum revealed 265.60 mg% phenol content.

Yellow capsicum gave the least phenol content of 232.00 mg% **(Fig:4)**. There was a highly significant difference ($p \leq 0.01$) between all the four varieties of capsicum. Phenolic compound rich foods contain antioxidant activity which plays a vital role in the human body system. Phytochemicals, including phenolics and flavonoids are suggested to be major bioactive compounds contributing to the health benefits of fruits and vegetables. [19].

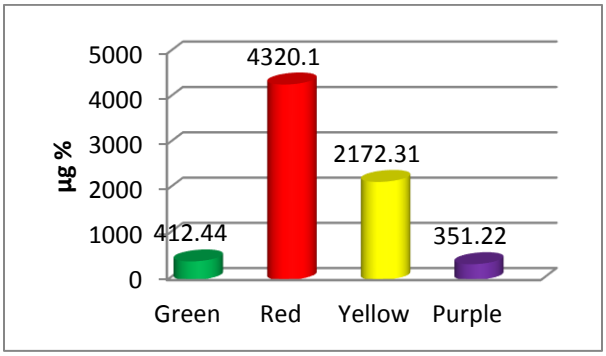


Fig: 4 β-carotene content from four different varieties of dehydrated capsicum.

Flavonoid content was highest in purple capsicum (164.80 mg%). Red and yellow capsicum showed flavonoid contents of 108.30 mg% and 144.96 mg% respectively. Green capsicum gave the least flavonoid content of 59.05 mg% **(Fig:4)**. There was a highly significant difference ($p \leq 0.01$) between all the four capsicum types. Flavonoids refer to a class of secondary metabolites . They are most commonly known for their antioxidant activity. However it is also known that they reduce the risk for the development of chronic diseases, such as cardiovascular disease and cancer [19].

CONCLUSION

According to the above analysis the moisture and fat contents were high in yellow capsicum as compared to the other three varieties of capsicum. Moisture content in purple capsicum was slightly lower than red capsicum and the fat content in green capsicum was slightly lower than red capsicum. Protein content was found to be fairly good in all four varieties of capsicum, but purple capsicum showed the highest amount of protein. Ash content was high in red capsicum as compared to the other three varieties, ash content in the green was slightly lower than in yellow capsicum. Phosphorus content was found to be fairly good in all four varieties of capsicum, but yellow capsicum showed the highest amount of phosphorus. Purple capsicum was found to be high in calcium content as compared to the other three varieties of capsicum. Ascorbic acid and β-carotene content was found to be higher in red capsicum as compared to the other three varieties of capsicum. Purple capsicum was found to be low in ascorbic acid and β-carotene content. Total phenol content in green capsicum was found to be high as compared to the other three varieties of capsicum, while yellow capsicum was found to be slightly lower than purple capsicum in phenol content. Purple capsicum was found to be higher in flavonoid content as compared to the other three varieties of capsicum. Purple capsicum showed higher levels of protein, calcium and flavanoid contents while red capsicum was richer in ash, ascorbic acid and β-carotene. Green capsicum was higher in total phenol content. Thus consumption of all the four varieties can enable many health benefits to control various diseases condition such as asthma, blood pressure, diabetes, heart problems, kidney problems, blood clotting, cancer, high blood cholesterol etc.

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