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Quality Assesment of Selected Commercial Brand of Chilli Powder in Andhrapradesh Region

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ABSTRACT: Analysed quality parameters of different commercial brand red chilli powders (*Capsicum annuum L)* collected from Guntur Mirchi yard, Guntur, Andhra Pradesh. The quality parameters of moisture content, pH, total ash content, acid soluble ash content, ascorbic acid content, minerals (sodium, potassium, calcium), capsaicin content and ASTA colour value were assessed which are directly related to quality, processing technique, storage condition, packaging of chilli powder. In different varieties of chilli powders moisture content, ash content and ASTA colour values differ significantly between 1.6 to 8.6%, 3.6 to 7.3% and to 76.45 ASTA.

Capsaicin content was estimated by colorimetric method and R^2 shows 0.9978, which shows developed method was linear. In addition, a minimum of 1 mcg/mL capsaicinoids can be detected and developed method can efficiently analyze a great quantity of samples in a short time.

Based on the capsaicin content and colour value of different red chilli powders provides useful information for buyers of chilli exporters and industrial applications.

KEYWORDS: *Capsicum annuum L.*, Capsaicin, Ash value, ASTA colour value.

I. INTRODUCTION

Chilli (*Capsicum annuum* L.) is an important vegetable cum spice crop grown in almost all parts of tropical and subtropical regions of the world. It belongs to the family Solanaceae and originated from South and Central America where it was domesticated around 7000 BC. The genus *Capsicum* includes 30 species, five of which are cultivated *Capsicum annuum* L., *C. Frutescens* L., *C. Chinense* Jacq, *C. pubescens*

R. & P. and *C. Baccatum* L. (Bosland and Votava, 2000; Wang and Bosland, 2006 and Ince *et al.*, 2010) [1-6].

Capsicum annuum is cultivated either for pungent fruited genotypes called chilli (synonyms: hot pepper, American pepper, chile, azi, cayenne, paprika *etc.*) or non-pungent fruited genotypes called sweet pepper (synonyms: Capsicum, paprika, bell pepper, Shimla mirch). Chilli has many culinary advantages. It comprises numerous chemicals including steam-volatile oils, fatty oils, capsaicinoids, carotenoids, vitamins, proteins, fibres and mineral elements (Bosland and Votava, 2000). *Capsicum* fruits may serve as a source of natural bactericidal agents to be used in food and medicinal systems [7-10].

Perez-Galvez *et al*., 2004; Manjula *et al*., 2011 and Sharanakumar *et al*., 201

In India chilli occupies an area of 7.50 lakh hectares with an annual production of 11.67 lakh tones (2009). Andhra Pradesh, Maharashtra, Karnataka and Tamil Nadu are major chilli growing states in India which together contributes about 75 per cent of the total cultivated area (Rajesh Kumar *et al*., 2011). Karnataka stands second in area (1.234 lakh hectares) and production (1.419 lakh tones), while in productivity it ranks eighth in position with an average yield of 1150 kgs of dry chilli per hectare. The important chilli growing districts in Karnataka are Haveri, Dharwad, Gadag, Koppal, Belgaum, Bellary and Raichur of which Haveri and Dharwad districts themselves make up 72 and 60 per cent of total area and production, respectively (http://horticulture.kar.nic.in). In recent years, there has been a great demand for increasing the diversity in chilli for within both culinary and ornamental purposes [14-17].

Though India is the leading producer, the average yield of chilli is very low (1.11 t/ha dry chilli) as compared to developed countries like USA, China, South Korea, Taiwan etc, where the average yield ranges from 3 - 4 t/ha. Low productivity in chilli is mainly attributed to lack, of high yielding, pest and disease resistant varieties or hybrids. Only about 2.60 percent chilli area is under hybrids in India, while in the countries like Korea and Taiwan more than 90 percent area is covered by hybrids [18-20].

Capsicum has been cultivated over centuries, producing both pungent and sweet fruits. *Capsicum annuum* L. is characterized by a wide variety of fruit size, shape and with different capscaicnoid content. Despite the importance of this plant as spice and its medicinal uses, research on its genetic variability and potential for breeding program is still incipient. There is also an urgent need to investigate the genetic control of some traits with the objective of introgressing these traits into cultivated varieties [21-26]. Diversity study helps to select desirable parents for production of hybrids and would provide a guideline for breeders to devise breeding experiments in such a way that they raise adequate populations in the segregating generations to isolate the desired recombinants. Yields can be boosted by eliminating the undesirable characters and by bringing together the desirable genes. Genetic manipulation is one of the methods through which this can be achieved and is possible only when the genetic architecture of the plant is thoroughly understood. Assessment of variability at molecular level is more meaningful, accurate and reliable than variability at phenotypic level as the former is less dependent and influenced by environmental factors. Random Amplified Polymorphic DNA (RAPD) is considered as an essential tool in cultivar identification (DNA typing), in assessment of genetic variability and relationship management of genetic resources and biodiversity, in studies of phylogenetic relationship and in genome mapping (Welsh and McClelland 1990, Williams *et al.*, 1990 and Sandigwad and Patil 2011a, 2011b). Estimation of inter cultivar molecular diversity and their association, if any, with the trait of economic importance would help in identifying molecular markers associated with the trait of interest. RAPD markers could be used to determine the sex of plants at seedling stage (Baratakke and Patil, 2009). This may pave the way for mass cultivation of dioecious tree species where the economic importance is tagged with specific sex [27-30].

The genus capsicum is often a cross pollinated crop and natural cross pollination may go up to 50 per cent depending upon the extent of style exertion, time of anthesis, wind direction and insect population (Murthy and Murthy, 1962 and Hosmani, 1993). This accounts for considerable variation in fruit and yield parameters. Because of chance hybridization with many non-quality chilli varietieslhybrids grown adjacent to these varieties, both desirable and undesirable genes might have been introgressed into these varieties over several decades in addition to accumulation of minor genetic mutations resulting in a lot of variations in these varieties grown in farmer's field. There is a vast reservoir of variability in respect of both yield and quality. Hence, there is a need to assess the variability, identify the best lines, purify and restore or improve the original quality of chilli and pepper cultivars[31-37].

The knowledge of the inheritance of various characters of qualitative nature is of paramount importance to achieve success in plant breeding, whose studies appear to have helped and contributed in a significant way to the plant breeding in general and chilli breeding in particular, in evolving early, high yielding and disease resistant varieties. The knowledge of interrelationships especially in terms of linkage, of distinct characters like pigmentation with economically important characters like number of fruits per plant, flowering, trichome density sterility will help in selecting the superior genotypes [38-40].

Genetic studies leading to linkage information are important from theoretical and applied point of view. Cross over values indicate the distance with economically important characters like number of fruits per plant, flowering, male sterility, branching *etc.,* which would be of invariable help to the breeder at least indirectly in selecting superior genotypes for high yields. Moreover, the marker traits like pigmentation in particular plant part may assume greater importance for identification of the varieties or true hybrids when these marker traits are added to male parents. Further, assigning of all the genes governing different qualitative characters to their respective linkage groups has its fundamental importance. Drosophila, Maize and rice are the examples where this task has been carried out to a greater extent.

India, being the largest chilli producer, has vast potentiality to increase production and promote export besides meeting its domestic requirements.

However, despite continuous efforts at various levels, the chilli productivity did not gain accepted momentum. This could be attributed to various biotic and abiotic constraints. Among biotic constraints, thrips and mites complex causes on an average yield loss to the tune of 34 per cent.

In India, nearly 70 percent of chemical insecticides produced are being used in pest control alone. The large scale use of chemical insecticides is a hazard to the environment and undoubtedly the use of insecticide has created the problem of killing natural enemies of the pests, thereby leading the development of secondary pests. Overdependence on insecticides may also lead to the resurgence of primary insect pests (Dempster, 1968). Hence, there is an urgent need to adopt biological control index for the protection of environment.

However, there are some limitations in biological control also as with the insecticidal control of pests (Johnson *et al.,* 1986). Thus, exploitation of the built-in mechanisms of the plant itself alone or in combination of other methods, is one of the best alternatives for minimizing reduction in yield due to insect-pest damage in terms of reducing the cost of cultivation and protection of the environment. Presence of trichomes, thick cuticle on the epidermal surface of the leaf renders some resistance to many insects. In addition, secondary metabolites are known to confer resistance to a variety of insect pests in chilli [40-45].

The low productivity could be improved through hybridization since marked heterosis (3.8 to 71%) has been reported for yield and its yield components. The occurrence of male sterility in nature is very rare. Male sterility in chilli has not been observed in nature but has been induced artificially by chemicals

(Goetz *et al.,* 2001). Male sterility was considered as disadvantageous but now it has place of pride in the breeding of both cross and self-pollinated crops.

The deliberate exclusion of pollen in this kind of situation has solved many problems like elimination of tedious emasculation, providing correct combinations of parents, providing more flexibility to breeding programme, facilitating quick incorporation of diverse genes for disease resistance in hybrids *etc.* This has of special advantage in the struggle against continuously changing pathogen, reducing cost of F_1hybrid seed production and saving of time upto 70 per cent.

To improve the productivity of chilli, use of hybrid seed is an important tool and for production of hybrid seeds the sterility could play a vital role. The male sterile lines permit hybrid seed production and commercial exploitation of heterosis in crops where emasculation on a large scale is a tedious job. The occurrence of commercially utilizable genetic male sterility or cytoplasmic male sterility is not reported in chilli. Accordingly, induction of male sterility using mutagens has been tried and a few male sterile lines have been obtained but such mutations are rare, recessive and associated with negative and agronomically inferior features. However, when male sterile trait exists in a genotype, its transfer into an agronomically useful variety is possible through back crossing.

In view of its immense practical value, there arises a necessity to understand more about the mechanism of male sterility and the possible cellular changes associated with it. So, one cannot over look the need for enhancing the knowledge of the structural features of the phenomenon of male sterility which include the histological events of microsporogenesis.

The present investigation therefore, was undertaken, with the following objectives

- Assessment of genetic diversity among *Capsicum annuum* L. genotypes revealed by RAPD markers
- Genetic variability studies among *Capsicum annuum* L. genotypes for morphological and yield related traits
- To understand the nature of inheritance of pigmentation and other morphological characters in chilli genotypes.
- Comparative study of anatomical and histological basis of resistance of chilli genotypes to thrips and mites

Capsicum annuum L. is an important agricultural crop of India due its economic importance and for the nutritional value of its fruits that are an excellent source of natural colours and antioxidant compounds (Nevarro et al 2006). Kuchi et al (2014) stated that it is a quintessential spice in every Indian cuisine and is grown throughout length and breadth of country. It belongs to family Solanaceace. Its diploid chromosome number is 24. The fruit is technically a berry varies in colour and size in accordance with the variety; it may be cube-shaped, conical or spherical. Originated in South America, the crop was taken to old world by early explorers. Portuguese carried hot chilli from Brazil to India before 1595. Chilli is the most widely used universal spice and named as "Wonder Spice". Different fruit characteristics like pungency, colour, shape, flavor, size, and their uses are used to classify the peppers (Smith et al 1987, Bosland 1992).
The major producers of chillies in the world are India, China, Pakistan, Morocco, Mexico, Turkey and Bangladesh. Chillies are grown in all regions of India.

The major producers are Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Orissa and Rajasthan contributing two-third of India's production. Andhra Pradesh alone contributes 46% for production making it the largest producer in India.

About 65% of the total chillies produced in India are traded from six major markets, Guntur, Warangal, and Khammam in Andhra Pradesh, Raichur and Bellary in Karnataka, and Jalgoan in Maharastra and even exported to Srilanka, Bangladesh, Malaysia, USA, Nepal, Indonesia, UAE, and Italy from these markets. (Prabhavati et al 2013).
India's yield of chillies in 2013-14 was 1.73 tonnesiha and that of Punjab was tonnesiha (Anon 2014). Chand (2005) found that the three districts of Punjab i.e.

Patiala, Sangrur and Amritsar account for more than 60 % of the total production in the state. With the development of some hybrid varieties the productivity of chilli has increased to a level of 100 quintals per acre of red ripe fruit.

Chilli is a seasonal and annually grown cash crop. Its sowing starts after monsoon showers commencement i.e., from first week of August and extends till October. Growth period is around 4-5 months depending upon varieties cultivated and its harvesting commences from the month of December. Arrivals start hitting the market from February and continue till April. For fresh green chillies fruits are harvested 40-50 days after transplanting. For drying, chillies can be harvested 70-80 days after transplanting. The picking of green fruits continues for 2-3 months at 1-2 weeks interval. There are 5 to 6 pickings for green chilli and 3-4 for red ripe chillies. Pods left to ripen and to partially wither on plant are superior in colour, flavour and pungency qualities than those picked when fully coloured but succulent (Kuchi et al 2014). In Indian subcontinent, chillies are produced throughout the year. Two crops are produced in kharif and rabi seasons in the country.

Chilli grows best at 20-30°C. Growth and yields suffer when temperatures exceed 30°C or drops below 15°C for extended periods. The crop can be grown over a wide range of altitudes from sea level upto nearly 2100 meter (Anon 2009).

In Asian cuisines dried chilli is one of the most widely used spice product as condiments for flavoring and colouring (Jitbunjerdkul and Kijroongrojana 2007, Toontom et al 2010). A number of different parameters such as colour, hotness, ascorbic acid content and volatile flavor compounds are used to assess the quality of dried chilli (Henderson 1992, Ruth et al 2003, Jiang and Kubota 2004, Kim et al 2006, Wang et al 2009, Yaldiz et al 2010).

According to Leung et al (1972) the composition of ripe chilli per 100 gm is moisture content 65.4%, protein 6.3%, fat 1.4%, mineral 2.1%, fiber 15.0%, energy 116 kcal and vitamin C 96 mg and in dry chilli per 100gm contained moisture 15.30%, protein 11.7%, fat 12.4%, mineral 16.9%, fiber 13.4%, and energy 288 kcal and vitamin C 184 mg.

Vitamin C is the most important vitamin in fruits and vegetables. Ninety percent of the ascorbic acid in human diet is supplied by them. They are extremely popular for the abundance content of vitamin C larger than other vegetables and fruits commonly recognized as a source of this substance (Durust et al 1997; Osuna-Garcia et al 1998). Ascorbic acid content increases with fruit ripening while it decreases during post harvest handlings (Martinez et al 2005).

Jarret et al (2007) stated that pungency is an important fruit quality attribute and is a key characteristic that is associated with members of the genus Capsicum. The pungency is caused by capsaicinoids, and among the most abundant of these components are capsaicin (trans-8 methyl-N-vanillyl-6-nonenamide) and dihydrocapsaicin (8 methyl- Nvanillylnonanamide), which are responsible for about 90% of total pungency (Ravishankar et al 2003, De Masi et al 2007).

In addition to capsaicin and dihydrocapsaicin, many less abundant capsaicinoids have been detected in Capsicum extracts, including nordihydrocapsaicin, norcapsaicin, homocapsaicin, homodihydrocapsaicin, etc (Constant et al 1995).

Kaale et al (2002) found that an accurate determination of the levels of various capsaicinoids has become important because of the increasing demand by consumers for spicy foods, and the increasing use in pharmaceuticals. Capsaicin is currently used for the treatment of diabetic neuropathy, osteoarthritis, post-herpetic neuralgia, and psoriasis (Jin et al 2009).

According to Singh et al (2009) capsaicinoids in foods have been analyzed by spectrophotometric methods such as ultraviolet and colorimetry. The organoleptic method used for determination of the pepper pungency was invented by a pharmacist, Wilbur L. Scoville in 1912. The hot pepper alcoholic extract was mixed with water and sugar and was given to the human subjects to taste (Scoville 1912). This method of measuring the pungent property of chilli (Scoville test) is now used widely across the world, but is done by High Performance Liquid Chromatography (HPLC).

Color of chilli spice powder is due to the presence of red pigmented carotenoids. The main pigments are capsanthin, capsorubin, zeaxanthin and cryptoxanthin. Carotenoids are very stable in intact plant tissue. However, when chillies are processed by drying and then grinding into spice powder, the carotenoids auto-oxidize easily, due to the effects of heat, light and oxygen. This leads to a more orange and less intense coloration that devalues the spice powder. In addition, carotenoids have provitamin-A activity (Take et al 2012).

Paprika oleoresin, a viscous, dark red liquid, is prepared industrially by solvent extraction (most commonly employed is hexane) of the dried fruit and the subsequent removal of the solvent (Jaren-Galan et al 1999, Parthasarathy et al 2008). Mini et al (1998) found that ethyl acetate produced maximum efficiency for capsaicin extraction, however, extraction with acetone gave the similar results.

Traditionally, sun drying was used to obtain the dried chilli (Oztekin et al 1999, Condori et al 2001). To reduce the moisture content of chilli to 10-15% approximately 7-20 days are needed depending on the weather conditions (Hossain 2003, Oberoi et al 2005). According to Bircan (2005) the process of sun drying creates favorable conditions for mycotoxins contamination since dried chilli is largely susceptible to fungal proliferation So, different drying methods have been employed in the processing of dried chilli to prevent fungal proliferation.

Currently for drying chilli, hot air drying is popular method due to a relatively short drying time, uniform heating and more hygienic characteristics. The temperature for this method ranges from 45 to 700C (approximately 10% of moisture content), and takes about 20 hours (Minguez-Mosquera et al 1994, Diaz-Maroto et al 2003, Ibrahim et al 1997, Berke and Shieh 2001).

Sun drying technique is not a time effective technique, is extremely weather dependent and has the problem of contamination with dust, soil and insects. While the mechanical drying technique is not a cost effective technique and leads to serious injuries such as the worsening of the taste, colour and nutritional content of the product, decline in the density and water absorbance capacity and shifting of the solutes from the internal part of the drying material to the surface, due to high drying temperature.

Keeping the above problems in mind, present work was focused on finding out the most common technique used by the small scale processors, mostly farmers as well as commercial processors. It also involved modifying the sun drying technique in order to minimize the problems associated with the sun drying technique and then comparing it with the other drying techniques in terms of different parameters.
For this, the work was planned with the following objectives:

1. To conduct the survey related to drying of chilli.
2. To study the drying kinetics of red chillies.
3. To assess the various quality characteristics of dried product

II. AIM & OBJECTIVE

The study and evaluate the phyto-chemical composition of six varieties of dried chilli powders like Tomato chillies, Hindupur-S7, Guntur sanam-S4 type, Wonder Hot, Teja chillies-S17, Indo-5 chillies available in Andhrapradesh region.

PLAN OF RESEARCH WORK

- Literature survey
- Sample collection
- Procurement of chemicals and instruments
- Method development
- Evaluation of physical, chemical and microbial parameters as per AOAC (Association of Official Analytical Chemists), FSSAI (Food Safety and Standards Authority of India) and ASTA(American Spice Trade Association) guidelines
- Thesis preparation
- Journal communication

PLANT MORPHOLOGY

Capsicum annuum is a species of the plant genus *Capsicum* (peppers) native to southern North America and northern South America.[1][4]This species is the most common and extensively cultivated of the five domesticated capsicums. The species encompasses a wide variety of shapes and sizes of peppers, both mild and hot, such as bell peppers, jalapeños, and cayenne peppers. Cultivars are descended from the wild American bird pepper still found in warmer regions of the Americas.[5] In the past some woody forms of this species have been called *C. frutescens*, but the features that were used to distinguish those forms appear in many populations of *C. annuum* and it is not a consistently recognizable feature in *C. frutescens* species.[6] Moreover, crosses between *C. annuum* and *C. frutescens* aren't likely because seeds obtained from pollination between those two species (if the embryo survives) will not germinate.[7]

Fig.1.0. Plant of *Capsicum annuum L*

Kingdom:	Plantae
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Solanales
Family:	Solanaceae
Genus:	Capsicum
Species:	C. annuum
Binomial name Capsicum annuum.L.	

Characteristics:

Although the species name *annuum* means "annual" (from the Latin *annus* "year"), the plant is not an annual but is frost tender.[8] In the absence of winter frosts it can survive several seasons and grow into a large, shrubby perennial herb.[9] The single flowers are an off-white (sometimes purplish) color while the stem is densely branched and up to 60 cm (24 in) tall. The fruit are berries that may be green, yellow, orange or red when ripe.[10] While the species can tolerate most frost-fee climates, *C. annuum* is especially productive in warm and dry climates.

Medicinal uses:

Hot peppers are used in medicine as well as food in Africa[15] and other places around the world. English botanist John Lindley described *C. annuum* on page 509 of his 1838 'Flora Medica' thus:
In ayurvedic medicine, *C. annuum* is classified as follows:[16]

- *Gunna* (properties) – *ruksh* (dry), *laghu* (light) and *tikshan* (sharp)
- *Rasa dhatu* (taste) – *katu* (pungent)
- *Virya* (potency) – *ushan* (hot)

Capsaicin (8-methyl-N- Vanillyl-6-nonenamide) is the active component of chilli peppers. It is a volatile phenolic chemical similar in structure to vanillin, present in the placenta that bears the seeds in the chilli pepper. It is an irritant for mammals, including humans, and produces a sensation of burning in any tissue with which it comes into contact. Capsaicin and its analogs are called capsaicinoids and are produced by chilli peppers, probably as deterrents Capsaicin (8-methyl-N- Vanillyl-6-nonenamide) is the active component of chilli peppers. It is a volatile phenolic chemical similar in structure to vanillin, present in the placenta that bears the seeds in the chilli pepper. It is an irritant for mammals, including humans, and produces a sensation of burning in any tissue with which it comes into contact. Capsaicin and its analogs are called capsaicinoids and are produced by chilli peppers, probably as deterrents against herbivores perhaps through an evolutionary process. Capsaicin is a flavorless, odorless chemical concentrated in the veins of chillies. Capsaicin and dihydrocapsaicin constitute 80-90 percent of the total capsaicinoids in a chilli pepper. The secretion of capsaicin is an adaptation to protect the fruit from consumption by mammals while the bright colors attract birds that will spread the seeds. The amount of capsaicin in capsicums is highly variable and dependent on genetics, giving almost all types of capsicum varied amount of perceived heat. The only capsicum without capsaicin is the bell pepper, a cultivar of *Capsicum annuum*, which has a zero rating on the scoville scale. Chilli peppers are of great importance in native American medicine, and capsaicin is used in modern medicine mainly in topical medications as a circulatory stimulant and pain reliever. Most of the capsaicin in a pungent (hot) pepper is concentrated in blisters on the epidermis of the interior ribs (septa) that divide the chambers of the fruit to which the seeds are attached. A study on capsaicin production in fruits of *Capsicum chinense* showed that capsaicinoids are produced only in the epidermal cells of the interlocular septa of pungent fruits, that blister formation only occurs as a result of capsaicinoid accumulation, and that pungency and blister formation are controlled by a single locus.

Introduction to Capsaicin:

Molecular formula - C18H27NO3

Chemical formula: 8-methyl-N- Vanillyl-6-nonenamide

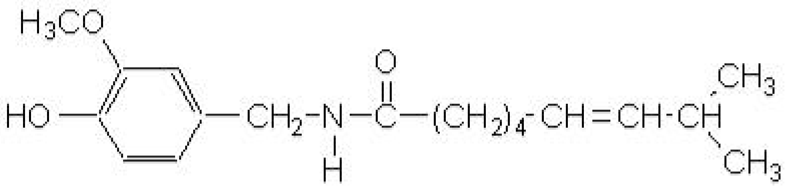

Fig.2.0.Chemical Structure of Capsaicin

The amount of capsaicin in hot peppers varies very significantly between varieties, and is measured in Scoville Heat Units (SHU). Colour is the first notable characterist ic of food and often predetermines or "colours" our expectation. We use colour as a way to identify food and a way to judge the quality of food.

Studies demonstrate that colour predetermines our expectations of flavor and taste. The colour of chillies is no guide to the intensity of their flavour. All chillies begin life green and turn yellow or red as they ripen, although there is no rule that green or red is hotter.

Colour of ground paprika represents its main quality attribute. It is a kind of dark-red colourful oil liquid, a fine food colour with good mobility. It is light-resistant, heat-resistant, acid-resistant, and alkali-resistant and will not be affected by metal ion. It will be soluble in oil and ethanol. With special processing, it can be soluble in water. More than 20 different pigments from paprika fruits have been identified (Deli *et al*., 2001) green chlorophylls, yellowish orange lutein, zeaxanthin, violaxanthin, antheraxanthin, ß-cryptoxanthin and ß- carotene. Red capsanthin, capsorubin and cryptoxanthin are characteristic exclusively for the genus *Capsicum* and are the main pigments that determine the colour of red pepper. ß-, a-, γ- carotene and ßcryptoxanthin have provitamin activity.

A number of investigations revealed that carotenoid rich diet lowers the risk from some degenerative disorders, including different kinds of cancer, cardiovascular and ophthalmologic disorders. Red paprika is a fruit rich in antioxidants. (Daood *et al*., 1996; Deepa *et al*., 2006; Howard *et al*., 2000; Marin *et al*., 2004).

The colour imparted by the oleoresin ranges from red to orange, depending upon the concentration used. Commercial oleoresins are available in strengths ranging from 40,000 to 100,000 ASTA (American Spice Trade Association) colour units. Chillies come in all shapes, sizes and colours ranging from t iny pointed extremely hot, bird"s eye chilli to the large mild fleshy peppers like the anaheim. Indigenous to Central and South America and the West Indies, they have been cultivated there for thousands of years before the Spanish conquest, which eventually introduced them to the rest of the world. Mexican cooking is one of the world"s oldest cuisines, the explorers of the new world brought back the tomatoes and peppers, red hot chillies, avocados, various beans, vanilla and chocolate, these flavours were to change the flavour of Europe. Today there are probably 400 different chillies are grown, and are one of the most widely cultivated crops today, grown from the Far East, China, Japan, Thailand and Indonesia to India to Mexico.

Chilli peppers are the fruits of the genus *Capsicum*. There are several chilli pepper varieties and they have been domesticated for years. Chilli peppers are used to season foods in many cultures and they have become a staple in the diets of Italians, Spaniards, Hungarians, Indians, Chinese, Indonesians, and Africans. When we eat pepper the capsaicin irritates the lining of our mouth causing that familiar burning sensation. Our brain responds to this stimulus by producing endorphins, our body"s own natural pain reliever. The production of endorphins in response to eating chilli peppers may explain why they can be addicting.

Byadagi chilli, which is less spicy and is well-known for their deep red colour, is in great demand now. Since the preparation of oleoresin, its demand from foreign countries has shot up. Byadagi village, which was earlier famous for its sale of chillies, has now seen a sudden spurt in the growth of cold storage units, wherein these chillies are stored so that they don't lose their colour. Also, several industries that produce oleoresin have been started in the district. On a visit to a cold storage unit, one can experience shivering cold even in scorching summer, as the temperature within the unit is from 4 to 6 degree celsius. Storing Byadagi chillies in the cold storage not only preserves their natural colour, but also results in the extraction of more oleoresin from these chillies. Only the required amount of chillies is taken out from the unit and sent to the industry for the preparation of oleoresin. Nearly 30 to 40 per cent more oleoresin can be extracted from the chillies stored in the cold unit. At present, chilli growers and traders can store their chillies at a cost of Rs 60 to 80 per bag.

III. MATERIALS AND METHODS

CHEMICALS:

- Capsaicinoid : Sigma Aldrich (99.67%) (Gift sample from M/s. Andhra Trade Development Corporation (P) Ltd)
- Water: HPLC grade; Merck, Mumbai
- Methanol: HPLC grade; Merck, Mumbai
- Acetonitrile: HPLC grade; Merck, Mumbai
- Potassium. di.hydr.phos: AR grade; Merck, Mumbai
- Acetone: In-house
- Diethyl ether: AR grade; Merck, Mumbai
- Ammonia Solution: AR grade; Merck, Mumbai
- Hydro chloric acid: AR grade; Merck, Mumbai

INSTRUMENTS:

- UV-VIS SPECTROMETER: Lab India
- FLAME PHOTOMETER: Elico
- K.F.Titrimeter (LABINDIA)
- Elec.Balance: Shimadzu (AX200)
- pH-meter: lab India
- Glass ware: Borosilicate (Class-B)
- Micro pipettes: Merck
- Muffle furnace (Remi)
- Centrifuge: Remi (RH 121)
- Sonicator: Pal life sciences
- Vac.filteration unit: Borosilicate glass
- Filter: Nylon (o.45µ) membrane filter

Sample collection and preparation

The study evaluates the nutrient content and phyto-chemical composition of four varieties of chilli varieties like Tomato chillies, Hindupur-S7, Guntur sanam-S4 type, Wonder Hot, Teja chillies-S17, Indo-5 chillies.

The selected chilli varieties were purchased from M/s. Andhra Trade Development Corporation (P) Ltd, Guntur mirchi yard, Guntur, Andra Pradesh. The selected chilli samples (1kg) 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.

Physico-chemical Properties of Chillies
The study was framed with the objectives to determine the physico-chemical characteristics as per FSSAI guide lines.

- ✓ Moisture content
- ✓ Content of ascorbic acid
- ✓ pH measurement
- ✓ Ash content
- ✓ Water insoluble ash
- ✓ Acid insoluble ash
- ✓ Capsaicin content
- ✓ Minerals
- ✓ Colour value

Determination of ascorbic acid content
Weigh accurately about 0.1 g and dissolve in a mixture of 100 ml of boiled water and cooled water and add 25 ml of 1M sulphuric acid. Immediately titrate with 0.05 M iodine, using starch solution as indicator until a persistent blue-violet colour is obtained.
1 ml of *0.05 M iodine* is equivalent to 0.008806 g of C6H806.

Measurement of pH:
The powder (5 g) was dissolved in 50 ml distilled water and pH was measured with glass electrode.
Determination of moisture content:

Add about 20 mI of *dehydrated methanol* to the titration vessel and titrate to the electrometric end point with the *KFreagent.* Transfer quickly the prescribed amount of the substance under examination, accurately weighed, to the titration vessel. Stir for 1 minute and titrate again to the electrometric end point using the *KF reagent.*

Determination of ash content
Weigh accurately about 5 gms of sample in a tared silica / platinum dish Char the material carefully on a burner and transfer the dish to a muffle furnace and ash at a temperature of 550 ±10 0 C until the ash is free of Carbon. Heat the dish again at 550 ± 100 C for 30 minutes Cool in a desiccator and weigh. Repeat this process of heating for 30 minutes, cooling in a dessicator and weighing until the difference between two successive weighing's is less than 1 mg. Record the lowest weight. The percentage ash content (wet weight basis) as follows:

$$\%\ \textbf{ash content} = \frac{\text{(wt. crucible and ash - wt. crucible)}}{\text{(wt. crucible and sample - wt. crucible)}} \times 100$$

Measurement of acid insoluble ash
Boil the ash with 25 ml of 2 M hydrochloric acid for 5 minutes, collect the insoluble matter in a Gooch crucible or on an as What man fi1ter paper, wash with hot water, ignite, cool in a desiccator and weigh. Calculate the percentage of acid-insoluble ash on the dried drug basis.

$$\%\ \text{Acid insoluble ash} = \frac{\text{(wt. crucible and ash - wt. crucible)}}{\text{(wt. crucible and sample - wt. crucible)}} \times 100$$

Determination of capsaicin content
0.5 gram powder of dried chillies was taken and extracted with 25 ml of ethyl acetate. The mixture was shaken and allowed to stand overnight. 10 ml of this solution was taken in a beaker and was kept for 24 hours so that the complete evaporation takes place. Then 0.5 ml of folin's reagent and 6.5 ml of distilled water was

added in the beaker. It was allowed to stand for 3 minutes. Then 1 ml of saturated sodium carbonate was added and the volume was made to 10 ml by adding distilled water.
The optical density of this solution was read in the spectrophotometer at 760 nm wavelength. Capsaicin content was calculated from the calibration curve which was prepared by using the pure capsaicin.

Determination of colouring matter
25 mg powder of the dried chillies was taken in a volumetric flask. The volume was made 100 ml by taking acetone. The sample was kept in dark for about 4 hours. The optical density of this sample was read from the spectrophotometer at 460 nm wavelength. Colouring matter was evaluated using the following formula:
Extractable colour as per ASTA units=

$$\frac{Absorption\ of\ extract\ at\ 450nm * 200}{Cell\ length\ (cm) \times A}$$

Determination of 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 flame photometer

IV. RESULTS AND DISCUSSIONS

- Percentage moisture content of six different commercial brand of chilli powder was ranged from 1.6% to 8.6 %, being lowest for sample 5 (Teja chillies) and highest for sample 6 (Indo chillies) (Table 1). According to Indian Standard, maximum moisture content of chilli powder is 10.0%.
- Ascorbic acid content of six different commercial brand of chilli powder was ranged from 23.89 mcg/ml to 90.43 mcg/ml, being lowest for sample 3 (Guntur sanam-S4) and highest for sample 5 (Teja chillies) (Table 1). According to Indian Standards, ascorbic acid content was range from 15 to 220 mcg/ml.
- pH of six different commercial brand of chilli powder was ranged from 6.9 to 8.8, being lowest for sample 4 (Wonder hot) and highest for sample 5 (Teja chillies) (Table 1). According to Indian Standard, maximum pH of chilli powder is ranged from 5.5 to 9.5.
- Total Ash content ranged from 3.6% to 7.3%, being lowest in sample 3 (Guntur sanam- S4) and highest in sample 4 (Wonder hot). Acid insoluble Ash content ranged from 1.6% to 3.7% being lowest in sample 5 (Teja chillies) and highest in sample 2 (Hindupur-S7) (Table 1). According to Indian Standards, total ash content range from 3 to 10% and acid insoluble ash content ranged from 0.1% to 2.0%.
- The capsaicin content ranged from 57.3 mcg/g to 591.4 mcg/g, being lowest in sample 1 (Tomato chillies) and highest in sample 3 (Guntur sanam-S4). According to Indian Standards, capsaicin content . According to Indian Standards, acceptance limits for capsaicin content for Tomato chillies (25 to 115 mcg/g) , Hindupur-S7 (30 to 110 mcg/g), Guntur sanam-S4 type (90 to 800 mcg/g), Wonder Hot (80 to 600 mcg/g), Teja chillies-S17 (150 to 850 mcg/g), Indo-5 chillies (60 to 250 mcg/g).

The mineral content of sodium was ranged from 22.4 to 97.5 mcg/g, being lowest sample 4 (Wonder hot) and highest in sample 5 (Teja chillies), potassium was ranged from 48.4 to 134.6 mcg/g, being lowest in sample 5 (Teja chillies) and highest in sample 3 (Guntur sanam-S4), calcium was ranged from 28.6 to 93.2 mcg/g, being lowest in sample 1 (Tomato chillies) and highest in sample 5 (Teja chillies). According to Indian Standards, maximum sodium content is 120 mcg/g, potassium 60 mcg/g and calcium is 55 mcg/g of chilli powder.

- The colour value was ranged from 13.03 to 76.45 ASTA, being lowest in sample 2 (Hindupur-S7) and highest in sample 4 (Wonder hot). According to Indian Standards, colour value acceptance limits for Guntur sanam S4-Type 32 to 44 ASTA, Wonder hot 70 to 100 ASTA and Teja chillies 50 to 70 ASTA colour values.

Table.1.0. Capsaicin Linearity

Conc (mcg/mL)	Absorbance
0	0
50	0.107
100	0.178
200	0.249
400	0.537

600	0.789
800	0.997

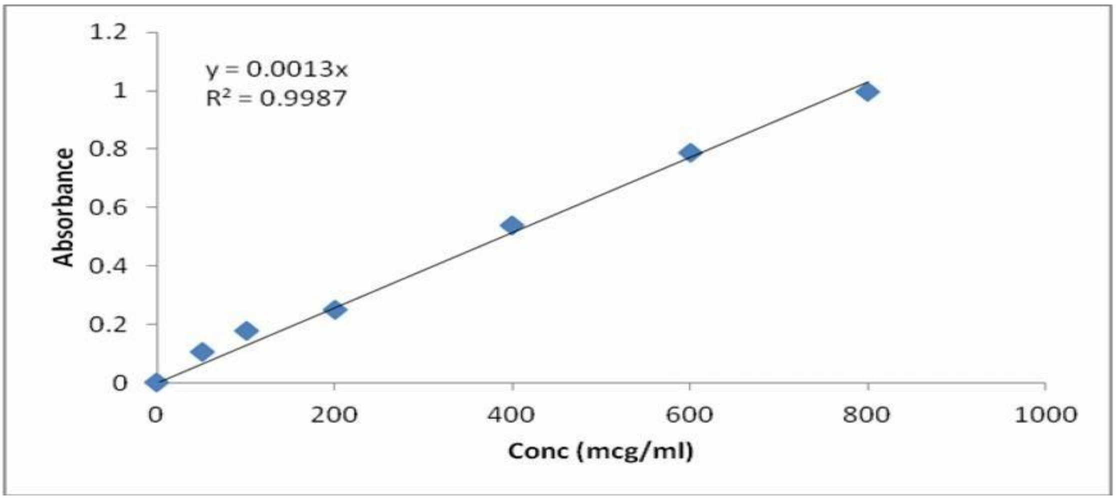

Fig.3.0. Capsaicin calibration curve

S.No.	Chilli variety	Moisture content (%)	Content of ascorbic acid (mcg/g)	pH	Total ash (%)	Acid insoluble ash (%)	Capsaicin content (mcg/g)	Minerals (mcg/g)			Colour value (ASTA colour value)
								Na	K	Ca	
1	Tomato chillies	6.3	60.57	6.9	5.4	1.4	57.3	50.4	101.5	28.6	36.18
2	Hindupur-S7	5.4	30.96	8.3	6.7	3.7	56.2	40.5	90.4	80.2	13.03
3	Guntur sanam- S4 type	3.5	23.89	7.3	7.3	2.9	591.4	58.3	134.6	93.2	32.69
4	Wonder Hot	4.4	90.43	6.3	3.6	2.4	348.6	22.4	97.8	89.4	96.45
5	Teja chillies-S17	1.6	67.95	8.8	7.3	1.6	730.2	97.5	48.4	78.6	64.38
6	Indo-5 chillies	8.6	56.31	7.4	6.5	2.5	69.4	80.4	94.3	78.4	25.22

Table-2. Quality parameters of chilli powder

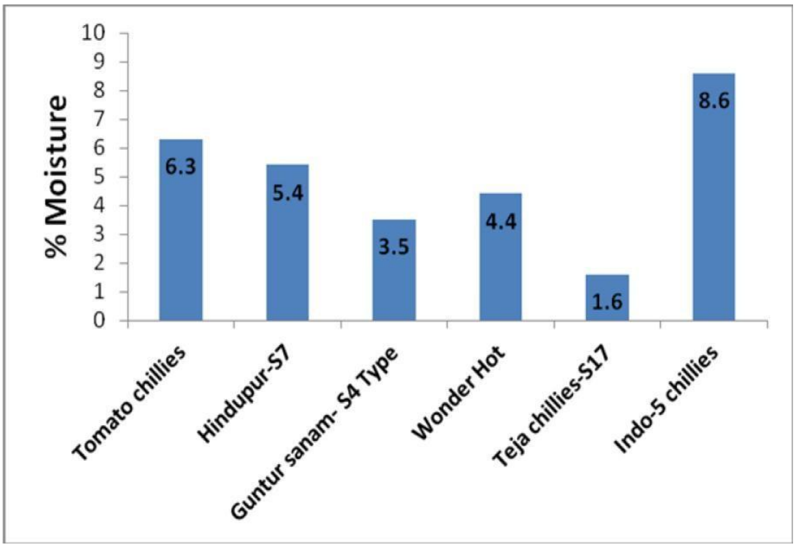

Fig.4.0. %Moisture content in different varieties of chillies

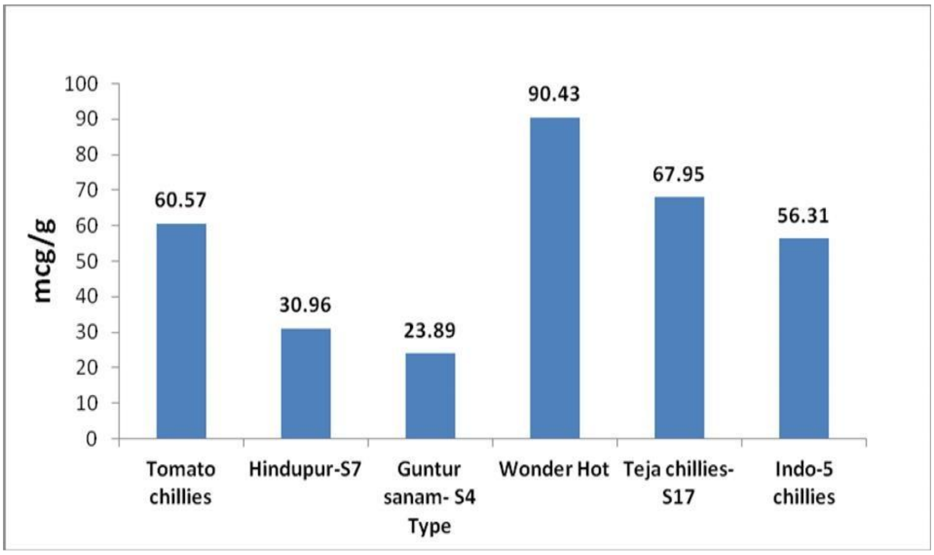

Fig.5.0. Ascorbic acid content in different varieties of chillies

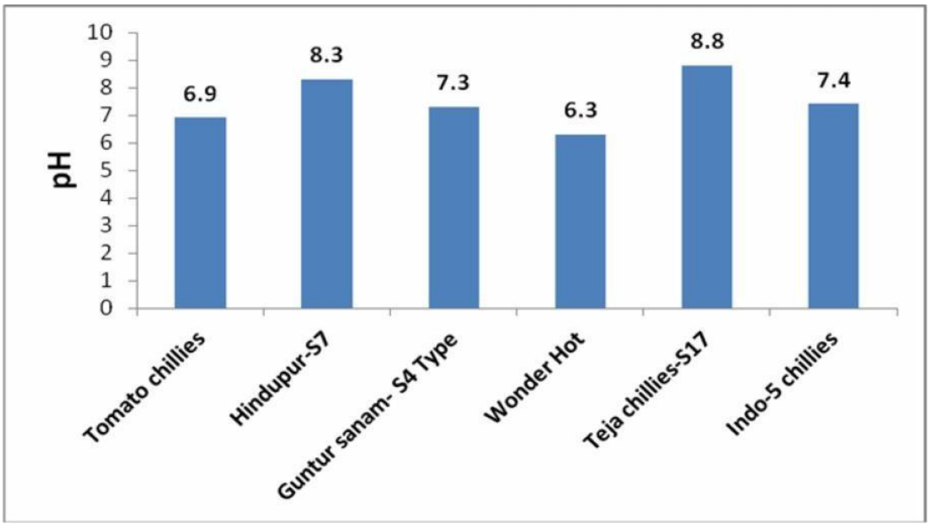

Fig.6.0. pH content in different varieties of chillies

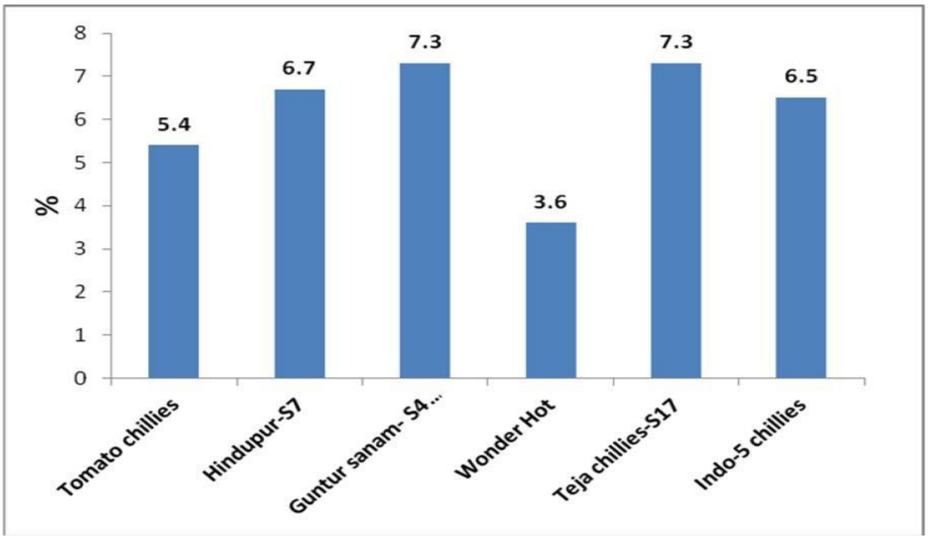

Fig.7.0. Total ash content in different varieties of chillies

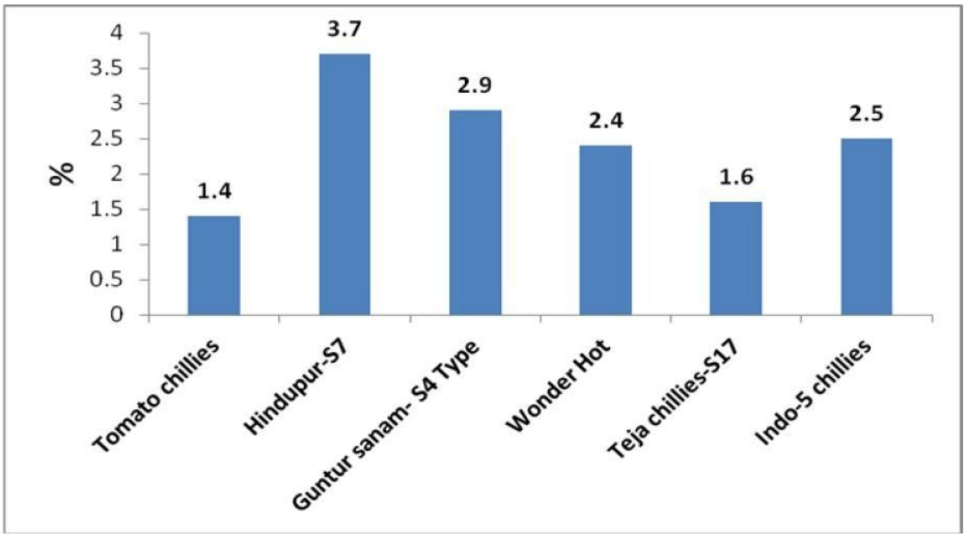

Fig.8.0. Acid insoluble Ash content in different varieties of chillies

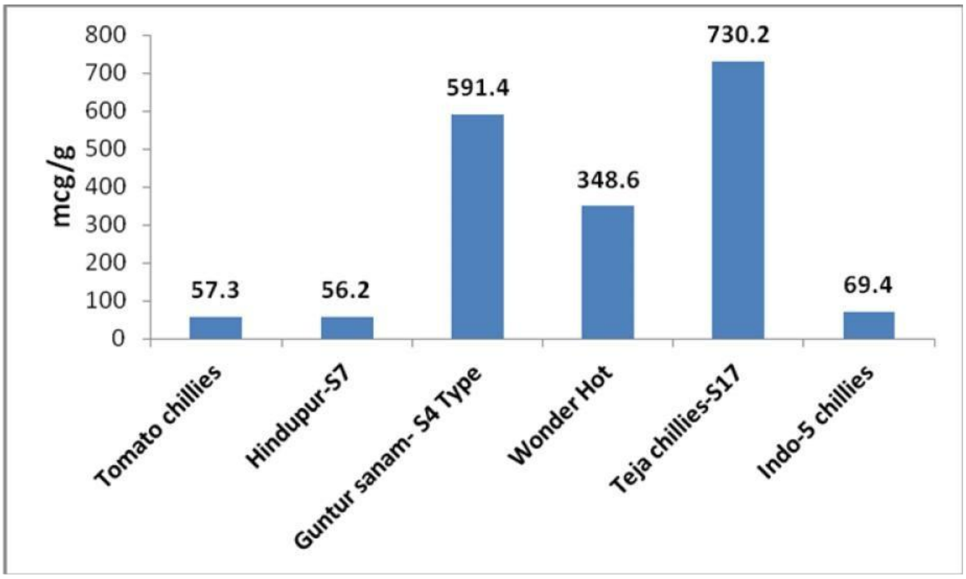

Fig.9.0. Capsaicin content in different varieties of chillies

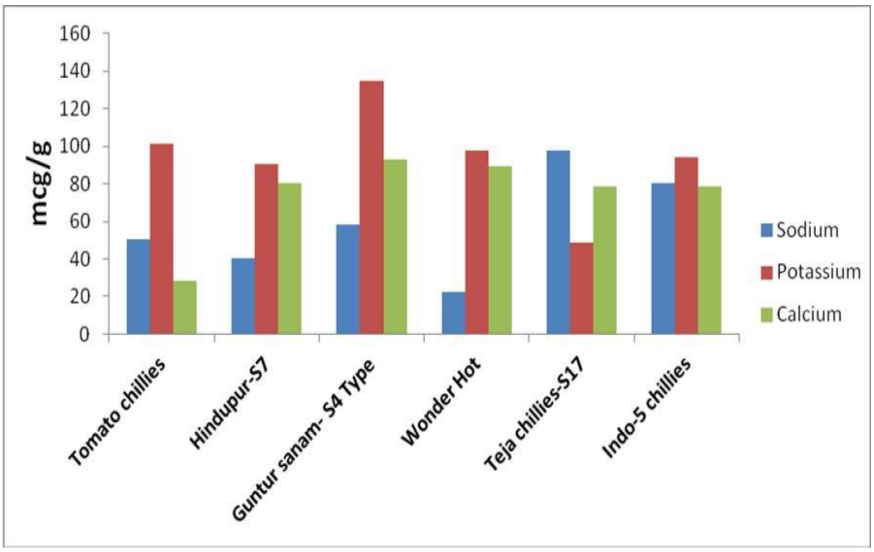

Fig.10.0. Sodium, potassium and calcium content in different varieties of chillies

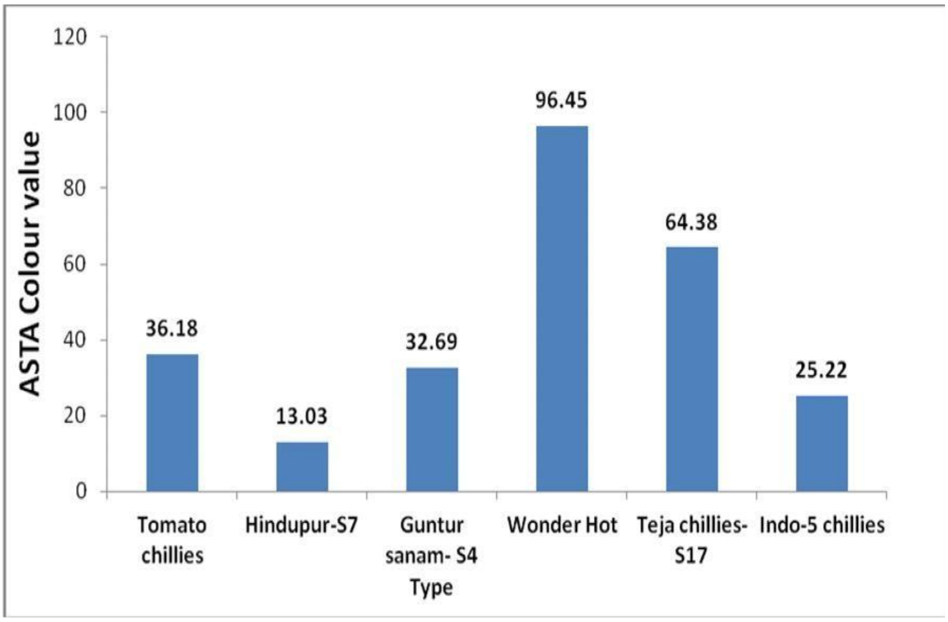

Fig.11.0. Colour value content in different varieties of chillies

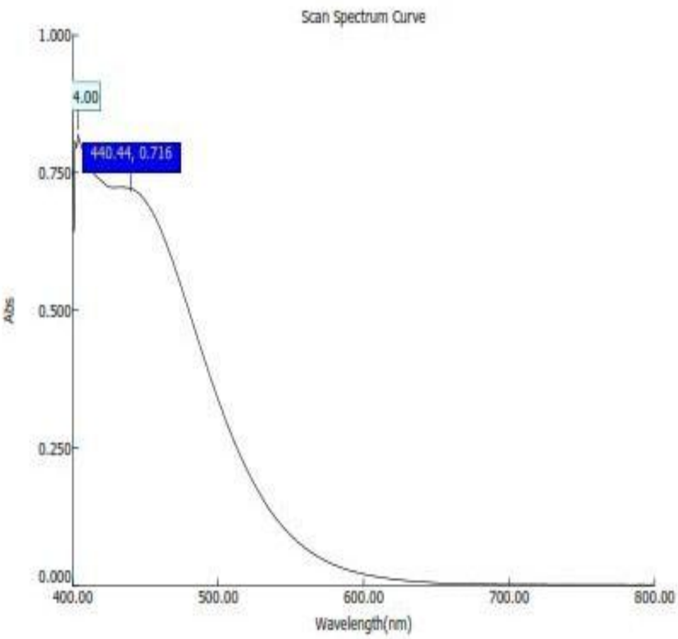

Fig.12.0. Lambda max for colour value estimatio

V. SUMMARY AND CONCLUSION

Now a day's natural colour has great value and the colour value is very useful for buyers of chilli exporters. People are very conscious about health hazards caused by chemical colours, so natural colours would help overcome these. It produces great value in market for its usage in food, textile, and cosmetics.

Capsaicin is also used in food industry and pharmaceutical industry. Capsaicin overcomes the storage of chillies and it can be stored for longer periods. It can be made available in low growing chilli areas. Many experiments are carried out on chillies to get better yield. Better colour and capsaicin yielding varieties of chillies would help extraction industries and in turn farmers to get better market. The variations in fat contents might be due to difference in treatments, preparation and drying methods employed.

From the performed quality control tests for different commercial brands of chilli powders we found that, all samples were satisfied Indian Standards (FSSAI) .

From this study it can be concluded that, wonder hot, Guntur sanam-S4 type and Teja chillies powders are a potential source of capsaicin content with high quality of colour value. In the other hand, these three varieties are excellent source of natural colour and these three varieties can be used for edible and industrial applications.

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