

## A overview on *Capsicum annum L.*

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### ABSTRACT

*Capsicum annum L.* belonging to family, Solanaceae, is commonly consumed all over the world as spices. It is commonly known as Red pepper in English and Mirchi in Hindi. Historically, it has been known to possess medicinal properties like anti-inflammatory, analgesic, stomachic. The plant is native to America and cultivated in different parts of tropical and subtropical parts of world. *C. annum L.* owes its medicinal properties to capsaicinoids primarily capsaicin present in highest proportion in placental tissue connecting seeds to fruits, in the fruit itself but not avoidable in seeds. The aim of the present study is to correlate this Ethnopharmacological usage and to scientifically investigate the potentiality of *Capsicum annum L.*

**Key words:** *Capsicum annum*, Red pepper, Mirchi, Solanaceae, capsaicinoids.

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### INTRODUCTION

*Capsicum annum L.* has been known since the beginning of civilization in northern hemisphere and has been a part of human diet since 7500 BC<sup>1</sup>. The genus *Capsicum* consists of about 22 wild species only five being domesticated<sup>2</sup> viz. *C. annum*, *C. chinese*, *C. frutescense*, *C. pubescense* and *C. baccatum*. Different varieties are scaled by pungency test for their pungency measured in terms of SHU (Scoville Heat Units). The widely accepted method for evaluating pungency of *Capsicum* was devised by Scoville in 1912 according to which *Capsicum* has been divided in to five groups viz. non-pungent Paprika (0-700SHU), mildly pungent (700-3000SHU), moderately pungent (3000-25,000SHU), highly pungent (25,000-70,000SHU) and very highly pungent of above 80,000SHU<sup>3</sup>. At this pungency scale Bell pepper is given '0' value. The pungency of the pepper is due to the presence of capsaicinoids, the vanillyl amide units, mainly capsaicin present in highest concentration in placental tissue followed by fruits and seeds. The fruits with seeds are used commonly in spices and food due to their pungent flavor and has been known to possess several medicinal properties like anti-inflammatory, analgesic, carminative, rubefacient<sup>3</sup> and recently its antioxidant<sup>4</sup>, hypoglycemic<sup>5</sup>, antifungal<sup>6</sup> and antimicrobial<sup>7</sup> activities have been established. These medicinal properties of *C. annum* make it popular in both Ayurveda and Homoeopathy. It is an herbaceous annual plant with glabrous pubescent, lanceolate leaves, white flowers and fruits<sup>8</sup>.

### PHYTOCONSTITUENT

*Capsicum* contains about 0.5% to 0.9% colourless, crystalline and pungent principle, known as capsaicin which is volatile above 65 degree centigrade<sup>9</sup>. Chillies also contain ascorbic acid (0.1-0.5%), thiamine, red carotenoids such as capsanthin and capsorubin and fixed oil (4-16%). The pungent phenolic fraction of capsicum also contain a proportion of 6, 7 dihydrocapsaicin. The capsaicin content of fruits varies appreciably in a range up to 1.5% and is much influenced by environmental conditions and age of fruit. In a study of water soluble constituent of three varieties of *C. annum*, Izumitani et al (Chem.Pharm.Bull,1990,38,1299) isolated twelve novel acyclic glycosides (geranylinalool derivatives) named capsainoside A-F (dimeric esters of acyclic diterpene glycoside). The red paprika (*Capsicum annum* var. Longum nigrum) contain a carotenoid, cycloviolaxanthin[(3S,5R,6R,3'S,5'R,6'R)-3,6,3,6'-diepoxy-5,6,5',6'-tetrahydro-beta, beta carotene-5,5'-diol] besides 5,6-epoxycapsanthin, (8S)-capsochrome, karpoxanthin and violaxanthin, cucurbitaxanthin A and B, 3,6-epoxycapsanthin<sup>10</sup>.

## USES

*Capsicum annum L* are used as carminative, an appetizer and a stomachic. Externally, it is used as a counter irritant in the treatment of rheumatism, lumbago and neuralgia<sup>9</sup>. Chilli papper are used as ornamental strings and wreaths and have even been used for germicidal properties. Red chilli peppers emerged as a natural and safe alternative colouring agent, and a growing proportion of the crop is being processed for colouring agents. The colourant is used in many products, especially salad dressings, meat products and cosmetics. Compounds produced from red peppers are also being used as a replacement preservatives for nitrites in meats. The average concentration of capsaicin is around 7000 ppm. In high concentrations, capsaicin is so powerful that it is used in tear gas sprays. Capsaicin enhances allergic contact dermatitis in the guineapig. Chilli is reported to be used in the treatment for mental disorders<sup>10</sup>.

## PHARMACOLOGICAL VIEW

### Insecticidal activities:

The experiment was conducted to investigate the insecticidal activities of black pepper (*Piper nigrum L.*) seed powder and red pepper (*Capsicum annum L.*) fruit powder, against *Rhyzopertha dominica (F.)* and *Sitophilus granarius (L.)*. These powders were mixed with 20 g wheat grains as direct admixtures at different rates viz, 0, 0.15, 0.2, 0.27, 0.37 and 0.5% (w/w) for black pepper and 0, 0.5, 0.85, 1.5, 3 and 5% (w/w) for red pepper to assess for mortality and reduction of F1 progeny. The results revealed that black pepper at 0.5% concentration caused 100% mortality of *S. granarius* in the first five days, also *R. dominica* showed complete mortality at 5% level after 14 days, but red pepper did not cause complete mortality on two insects after 14 days. Both plant materials caused complete reduction in F1 progeny of *S. granarius* and *R. dominica* at highest tested dosages.<sup>11</sup>

### Antioxidant activity:

The antioxidant activity of capsanthin and the fatty acid esters was examined by measuring the free radical-oxidation of methyl linoleate. To assess radical scavenging effect, The production of methyl linoleate hydroperoxides and the decomposition of capsanthins in reaction solution were measured by HPLC. Capsanthin suppressed hydroperoxide formation as well as beta carotene, lutein, and zeaxanthin. Intereststringly, capsanthin decomposed more slowly than the other carotenoids and the radical scavenging effect of capsanthin was found to last longer. Also, the capsanthin esterified partially and/or totally with fatty acids (mono-and/or diesterified capsanthin), isolated from paprika color, suppressed oxidation of methyl linoleate in a similar manner as nonesterified capsanthin. This finding suggests that the radical scavenging ability of capsanthin was not influenced by esterification, that is, the ability would contribute to the polyene chain, especially conjugated keto group. It was first found that esterified (monoesterified and diesterified) capsanthins also were good radical scavengers.<sup>12</sup>

### Antimicrobial activities:

Ethanol extracts of the fruits of three kinds of *Capsicum* showed similar potencies in their antimicrobial activities against Gram(+) and Gram(-) bacterias, and fungi, although they contained different level of capsaicin. Bioautographic tests demonstrated that capsaicin was the main antimicrobial component. At least two other non-polar components of ethanol extract also contributed in the antimicrobial activity and very likely that these compounds were responsible for the activity toward *pseudomonas aeruginosa*..<sup>13</sup>

### Anthelmintic efficacy:

A 90 days study was conducted in Gewane Agricultural Technical and Vocational Education Training College, Ethiopia, to compare the anthelmintic effect of chili or Mitmita (*Capsicum annum longum*) and a conventional treatment such as Triclabendazole on *Fasciola* infections to nutritional levels. A total of 72 Afar and Blackhead local breeds of sheep naturally infected by fascioliasis were randomly allotted into 3 groups, two nutrition levels (supplemented with wheat middling, cotton

seedcake, corn, lime and common salt and not supplemented group) and three section treatments. One treatment group received 10 mg/kg of Triclabendazole drenching orally on the 1, 21, and 42 days during the study period. The second group received 100 gm of crushed or chopped chili solution drenching orally on the 1, 21, and 42 days during the experimental period and the control group received no treatment. The control group divided into two groups of supplemented and not supplemented or grazing only. The treatment efficacy was assessed using the percentage of the egg or fluke reduction, body weight gain, blood parameters results post treatment on 30, 60 and 90 days. At the end of the experiment, animals were slaughtered and postmortem were performed for adult *Fasciola* recovery in the liver. Triclabendazole and chilli treated groups of animals had an efficacy of 100% and 84%, respectively. Animals treated by Triclabendazole and chilli in addition supplementation had high reduction of fecal egg count (FEC) compared to the treatment groups with no supplementation ( $p < 0.05$ ). No significant difference within treatments between two breeds was observed. The result indicated that chili could be an alternative treatment for subclinical ovine fascioliasis to alleviate the production loss in sheep herds.<sup>15</sup>

## GENERAL VIEW

### Reduction of salicylate bioavailability:

The bioavailabilities of aspirin (acetylsalicylic acid) and of salicylic acid were studied in male Wistar rats after acute and chronic administration of a *Capsicum annum* extract, containing 100 mg of capsaicin per gram. With a single administration of 100mg/kg of the extract, aspirin blood levels remained unchanged, but salicylic acid bioavailability was reduced in 44% compared with control animals. With a single administration of 300mg/kg of the extract, aspirin blood level were undetectable while salicylic acid bioavailabilities was reduced in 59%. Chronic administration once daily for 4 weeks of 100 and 300 mg/kg of the extract resulted in undetectable aspirin blood levels, while salicylic acid bioavailabilities was reduced in 63 and 76%, respectively, compared with controls. Result shows that Capsicum ingestion reduces oral drug bioavailability, likely as a result of the gastrointestinal effects of capsaicin.<sup>14</sup>

### Morphometric patterns and preferential uses of *Capsicum* peppers in the State of Roraima, Brazilian Amazonia:

Our objective was to study distinctions in the morphology of the pepper fruits (*Capsicum* spp., Solanaceae) used by indigenous (living in traditional villages) and non-indigenous groups (originated from migration and colonization, with or without miscegenation, living on non-indigenous lands) in the State of Roraima, Northern Brazilian Amazonia. In this sense, we used a database with 182 subsamples of *Capsicum* spp. Accessions were collected at 39 sites (14 indigenous and 25 non-indigenous), which were characterized additionally in relation to the predominant phytophysiology (savanna or forest) and home zone (rural or urban). We found morphological differences in pepper fruits related to both phytophysiology and home zone of the collecting site, but not to ethnical origin. We believe those differences are more related to the inherent crop practices, which suffer strong environmental influence, than to user preference. Both indigenous and non-indigenous groups preferred morphotypes from *C. chinense* and *C. frutescens*, which have small and highly pungent fruits. Nevertheless, fruit color was not important. These morphotypes are used by both indigenous and non-indigenous users for preparing sauce and *jiquitaia* (pepper powder). We suggested 'cultural adherence' as the reason for the common preferred use of peppers by both ethnical groups analyzed in Roraima.<sup>16</sup>

### Growth, Yield and Fruit Quality of Sweet Pepper Plants (*Capsicum annum* L.) as Affected by Potassium Fertilization:

Two field experiments were conducted during the two successive summer seasons of 2009 and 2010 at the Experimental Farm of the National Research Centre in El-Nobaria region, Behira

Governorate, to investigate the response of sweet pepper plants cv. California wonder to different rates of potassium fertilization (50, 100 and 200 kg/fed.) as potassium sulfate in addition to foliar application by potassium oxide (2 and 4 cm/L) and potassium humate (4 gm/L) as a stimulative dose. Potassium foliar applications were made 3 times in a 15 days interval with the same doses during the growing period (30, 45 and 60 days after transplanting). The highest potassium fertilization rate (200 kg/fed.) gave the tallest sweet pepper plants, the highest number of leaves and branches per plants and the highest fresh and dry weights of leaves as well as the highest total yield. Also, the obtained results reported that the fruit measurements expressed as fruit length, average fruit weight and vitamin C content, as well as leaves chemical composition (N, P, K and total chlorophyll) were increased with increasing potassium fertilization rate. On the other hand, spraying sweet pepper plants with potassium humate at rate of 4 gm/L markedly increased vegetative growth, yield, fruit quality and chemical composition. The favorable effects of the potassium on the growth, total yield and fruit parameters were obtained when sweet pepper plants fertilized with 200 kg/fed. potassium sulfate plus foliar application of potassium humate 4 gm/L followed statistically by 200 Kg/fed. potassium sulfate with foliar application of either 2 or 4 gm/L potassium oxide with no significant difference between them but both of them were significantly higher than control.<sup>17</sup>

### **Determination of Capsaicin and Dihydrocapsaicin in Capsicum Fruits by Liquid Chromatography-Electrospray/Time-of-Flight Mass Spectrometry:**

A simple, highly selective, sensitive, and reproducible liquid chromatography-electrospray ionization/ time-of-flight mass spectrometry method has been developed for the direct and simultaneous determination of capsaicin and dihydrocapsaicin in Capsicum fruit extracts. Capsaicin and dihydrocapsaicin are the two major members of the so-called capsaicinoid family, which includes other minor analogues, and usually account for at least 90% of the pungency trait in Capsicum fruits. Chromatographic separation of capsaicin and dihydrocapsaicin was achieved with a reversed-phase chromatography column, using a gradient of methanol and water. Quantification was done using as an internal standard (4,5-dimethoxybenzyl)-4-methyloctamide, a synthetic capsaicin analogue not found in nature. Analytes were base-peak resolved in less than 16 min, and limits of detection were 20 pmol for capsaicin and 4 pmol for dihydrocapsaicin. The intraday repeatability values were lower than 0.5 and 12% for retention time and peak area, respectively, whereas the interday repeatability values were lower than 0.6 and 14% for retention time and peak area, respectively. Analyte recoveries found were 86 and 93% for capsaicin and dihydrocapsaicin, respectively. The method developed has been applied to the identification and quantification of capsaicin and dihydrocapsaicin in fruit extracts from different Capsicum genotypes, and concentrations found ranged from 2 to 6639 mg kg<sup>-1</sup>.<sup>18</sup>

### **ANTIFUNGAL AND ANTIBACTERIAL POTENTIALITY OF SIX ESSENTIAL OILS EXTRACTED FROM PLANT SOURCE:**

In vitro evaluation of six essential oils viz., *Allium sativum*, *Capsicum annum*, *Cassia fistula*, *Coriandrum sativum*, *Cuminum cyminum* and *Curcuma longa* were tested against ten seed borne fungi of paddy viz., *Pyricularia oryzae*, *Bipolaris oryzae*, *Alternaria alternata*, *Tricoconis padwickii*, *Drechslera tetramera*, *Drechslera halodes*, *Curvularia lunata*, *Fusarium moniliforme*, *F. oxysporum* and *F. solani* and five human pathogenic bacteria viz., *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Vibrio cholera* and *Streptococcus pneumonia* at 500,1000,1500 and 2000 ppm concentration. Among the six essential oils, *A. sativum* recorded a complete inhibition in eight fungi compared to control. *A. sativum* is followed by *C. sativum*, *C. longa* and *C. cyminum*. No significant activity was observed in *C. annum* and *C. fistula* against all the test fungi. In antibacterial assay, *A. sativum* recorded a maximum inhibition of all test bacteria in the range of 10.9 to 36.9 mm, followed by

*C. longa* (5.6 -25.6 mm), *C. cyminum* (10.9-30.2 mm). Least inhibition was observed in *Capsicum annum* and no antibacterial activity was observed in *C. fistula*.<sup>19</sup>

#### **DIFFERENTIATION OF ADVENTITIOUS BUDS FROM *CAPSICUM ANNUM* L. HYPOCOTYLS AFTER CO-CULTURE WITH *AGROBACTERIUM TUMEFACIENS*:**

In vitro organogenesis in hypocotyl explants of the pepper cultivar 'Bryza' was induced on MS medium containing 5 mg/l 6-benzyloaminopurine (BAP) and 1 mg/l indole-3-acetic acid (IAA). The hypocotyl explants were then inoculated with *Agrobacterium tumefaciens* LBA4404(pBI121). After 2 days of culture the first cell divisions were observed in the epidermis and cortex. After 6–7 days, numerous adventitious bud primordia appeared in 58.4% of the explants. In further stages of culture, buds developed into shoots in 8.4% of the explants. Histological analysis revealed hypertrophy and the presence of necrotic cells in the cortex. Necrotic changes were also observed in the vascular bundles. It is likely that culture on a selective medium containing kanamycin and co-culture with *Agrobacterium tumefaciens* strongly affected the organization of the hypocotyl meristematic tissue, and in consequence brought about necrosis and isolation of the adventitious buds from the vascular bundles.<sup>20</sup>

#### **EFFECT OF NAPHTHALENE ACETIC ACID AND MEPIQUAT CHLORIDE ON PHYSIOLOGICAL COMPONENTS OF YIELD IN BELL PEPPER (*CAPSICUM ANNUM* L.):**

In a study conducted at College of Agriculture, University of Agricultural Sciences, Dharwad, India. Effect of foliar spray of naphthalene acetic acid [NAA] (50, 100 and 150 ppm) and mepiquat chloride [MC] (500, 1000 and 1500) at 45 and 65 days after transplanting (DAT) on yield, physiological and biochemical parameters of bell pepper (*Capsicum annum*, cv. Tarihal Local) was studied. All treatments significantly increased fruit yield, number of fruits, average fruit weight and number of seeds. Total chlorophyll, ascorbic acid and nitrate reductase activity were also increased. Fruit yield was significantly high (159.89 g/plant) with double spray of MC @ 150 ppm at 45 DAT and at 65 DAT followed by MC @ 1500 ppm at 45 DAT (156.49 g/plant) compared to control. From economic point of view, single spray of MC @ 500 ppm at 45 DAT was more profitable compared to other treatments.<sup>21</sup>

#### **CHANGES IN THE CONTENTS OF ANTIOXIDANT COMPOUNDS IN PEPPER FRUITS AT DIFFERENT RIPENING STAGES, AS AFFECTED BY SALINITY:**

The interest in the consumption of pepper fruits (*Capsicum annum* L.) is, to a large extent, due to its content of bioactive nutrients and their importance as dietary antioxidants. A greenhouse experiment was carried out to determine the effects of salinity and different ripening states of pepper fruits on several compounds with antioxidant properties. Fruits from plants grown under three saline treatments (0, 15, and 30 mM NaCl) were collected at three maturity states (green, turning, and red). Antioxidant activity in the hydrophilic (HAA) and lipophilic (LAA) fractions, lycopene, b-carotene, ascorbic acid, total phenolic compounds and reducing sugars were determined. From the nutritional point of view, the red state was the most appropriate state of maturation, since red peppers had the highest levels of lycopene, b-carotene, and sugars and the highest antioxidant activity for both hydrophilic and lipophilic fractions. The effect of salinity depended on the maturity state of the peppers: it had no effect on HAA, b-carotene or sugars, but decreased ascorbic acid and total phenolic compounds, and increased LAA and lycopene. The use of a moderately-saline water was beneficial when peppers were harvested in the red state, by increasing HAA and LAA in fruits, with no significant effects on other parameters.<sup>22</sup>

## ANATOMICAL FEATURES OF LEAVES OF SWEET PEPPER (*Capsicum annuum* L.) FED WITH CALCIUM USING FOLIAR NUTRITION:

The effect of three foliar-applied Ca-containing preparations on the anatomical features of leaves of sweet pepper (*Capsicum annuum* L.) was studied. The following preparations were used: Ca(NO<sub>3</sub>)<sub>2</sub>, Librel Ca and Wapnowit, applied at the respective concentrations of 0.5%, 1%, 1%, which corresponded to a content of 2000 mg Ca □ dm<sup>-3</sup>. Light and scanning electron microscopy were used in the study. It was demonstrated that in amphistomatic bifacial pepper leaves numerous specialised cells occurred which accumulated calcium oxalate crystals in the form of crystalline sand. Anisocytic stomata were found with a much greater density in the abaxial epidermis. They were characterized by very well-developed outer cuticular ledges. It was found that in the leaves of the plants sprayed with the nutrient supplements with increased Ca content there was a much smaller number of epidermal cells per 1 mm<sup>2</sup> than in the control plants. These cells were distinguished by an increased size. In the case of the application of the nutrient supplements Librel Ca and Wapnowit, the number of stomata also decreased. However, the application of the calcium supplements resulted in an increase in the value of the stomatal index compared to the control, which is attributable to a significant reduction in the number of epidermal cells not belonging to the stomata. The plants additionally supplied with Ca were marked by a larger number of colenchyma layers and an increased volume of leaf parenchyma cells. In the case of pepper leaves, the thin cuticle and the outer cell wall are not a major barrier to the Ca-containing preparations applied for spray treatment. Nevertheless, the decrease in the number of stomata may restrict the possibility of Ca uptake by this way, which compensates the increase in surface area of particular epidermal cells that will be the main way of Ca penetration into the internal leaf tissues.<sup>23</sup>

**DISCUSSION AND CONCLUSION:** In conclusion, this study provides evidences for *Capsicum annuum* L which could partly contribute to its ethnomedical uses. This study provide important information regarding plant (*capsicum annuum* L) in the field different diseases and its important medicinal uses. The study of plant *Capsicum annuum* L create a dynamic objectives in research field of medicine.

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