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Comparative Study on Morphological Characteristics, Ethno Botanical and Ethno Pharmacological Importance of *Capsicum annuum* L. *var. Annuum* and *Capsicum annuum* L. *var.* Frutescens

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ABSTRACT

Background: *Capsicum annuum* L. belongs to the family Solanaceae is primarily used as a spicy vegetable and as a minor ingredient in wide variety of cuisines, dishes, spice blends and sauces. The current study was dealt with the comparison of morphology of vegetative and reproductive parts and ethno botanical and pharmacological importance of *Capsicum annuum L. var. Annuum* and *Capsicum annuum* L. var. Frutescens. Both are shrubby herbs which have an average height ranging between 60-75 cm.

Methods: The study materials (flowers, fruits and seeds) were collected from each ten plants of the two varieties of *Capsicum annuum* L. (*Capsicum annuum* L. *var. Annuum* and *Capsicum annuum* L. var. Frutescens) based on their fruit setting.

Result: The results clearly showed the morphological similarities and differences present in terms of nature and arrangement of leaves, flowers and fruits and a short review of their ethno botanical and pharmacological properties.

Key words: *Capsicum annuum* L. var. Annuum, *Capsicum annuum* L. var. Frutescens, Ethno botany, Floral morphology, Fruit morphology, Pharmacology.

INTRODUCTION

Food is a vital factor for maintaining the health of living organisms. Nutrients supplied by the diet play an inevitable role in maintaining the health of an individual. Plant foods are the magnificent store houses of essential nutrients and energy which feed the whole world. There are innumerable number of vegetables and fruits which are satisfying the hunger needs of human societies. Among them, *Capsicum* is an important source of vegetable used as a spice throughout the world and it belongs to the family Solanaceae which is composed of 95 genera. Since 7500 BC, *Capsicum* has been found to be a part of human diet. *Capsicum* species can be either eaten cooked or uncooked (Aziagba *et al*., 2013). Southern North America and northern South America are considered to be the native for the genus *Capsicum* (Peppers). Now-a-days, chilli is widely grown in tropical and sub-tropical regions of the world (Nasrin *et al*., 2021). Chilli is a good source of water-soluble vitamin C and fat-soluble vitamin A (Mondal and Mondal, 2012).

Among the varieties of domesticated capsicums, the species under study is the most widespread and extensively cultivated variety. This species is available in various forms and sizes, both mild and hot, such as bell peppers, New Mexico chili, cayenne peppers *etc.* Although, the species name "*annumm"* means annual (Latin *annus* - "year"), the plant is not an annual but a short-term perennial. It can live for many seasons and grow into a quite large, shrubby perennial plant when winter frosts are absent. The flowers may be either off-white or with purplish tint. The stem grows to reach a height of about 60 cm and is profusely branched. The berries (fruits) vary in color and may be green, yellow, orange and turn to red upon ripping. It is said to give more yield when the climate is frost-free, warm and dry. *C. annumm* is a self-pollinating species but increased fruit size, lessened time taken for ripening and overall development are achieved by insect visit (Srivastava *et al*., 2017). The insects are attracted by the presence of nectar glands at the base of the corolla. Pollination by bumble bees favor the release of pollen in *C. annum* (Abdel *et al*., 2019).

Ethno botany is a field of botany which deals with the traditional knowledge and medicinal usage of plants for the welfare of the society. This field has achieved a particular importance in improving the health of the people by exploiting the therapeutic properties of medicinal plants. Chilly is one of the important spices which is found to be an inevitable thing in our routine day-to-day life and has a remarkable

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ethno botanical and ethno pharmacological properties. The anti-oxidant property of pepper species is a notable criterion for which it is commonly used in various cuisines and traditional medicines and also is subjected to extensive research (Alam *et al*., 2018). Apart from anti-oxidant potential, it is also reported to record anti-microbial, anti-fungal properties (Aziz, 2010). The peculiar shade of capsicum fruit is attributed to the combined effect of pigments such as capsorubin, capsanthin, cryptoxanthin, zeaxanthin and certain other carotenoids.

Ethno pharmacological studies showed that *Capsicum* has been used for centuries in many communities for its vivid color, flavor and aroma and is said to act as a circulatory stimulant (Kothari *et al*., 2010). Other than nutritional and pharmacological benefits, chilly also possesses commercial importance. From red pepper, an oil named paprika oleoresin which contain carotenoids is derived and is used in coloring of soaps, sauces and cosmetics (Galvez and Mosquera, 2004).

Based on the importance laid on chilly, the present research is aimed at comparing the morphological characteristics and ethno botanical and pharmacological importance of two verities namely *Capsicum annuum* L. *var. Annuum* and *Capsicum annuum* L. var. Frutescens.

MATERIALS AND METHODS

The present study was conducted during 2019-2020 in Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore. The study materials, such as flowers, fruits and seeds were randomly collected from each 10 plants of the two varieties of *Capsicum annuum* L. (*C. annuum* L. *var.* Annuum and *C. annuum* L. var. Frutescens) based on their fruit setting.

Vegetative and floral characteristics were studied with the help of dissection and compound microscopes. Morphology of the vegetative and floral parts of both the varieties were studied. The vegetative characteristics analyzed were habit, phyllotaxy and the nature of leaves, leaf shape, leaf apex, texture and venation of leaf. Detailed study of floral parts such as calyx, corolla androecium and gynoecium were carried out. In the case of calyx and corolla, their number, color, shape and aestivation were taken into consideration.

RESULTS AND DISCUSSION

Morphological characteristics of vegetative parts

Solanaceae family has a great attention in the field of botany since it consists of lots of food crops and plants with diverse medicinal uses. The family is occupying various habits such as annuals to perennials, herbs to vines and lianas, shrubs to trees and also epiphytes. The chilly plant is a short-term perennial herb that will reach a height up to 1 m. Leaves are oblong-ovate, ovate, or ovate- lanceolate, with entire margin. The plant bears small flowers which are either white in color or in tinged purple. Insects like ants, spiders, house flies, bees and caterpillars are the pollinators of this plant and they usually visit the plants in the morning around 7 a.m. and will make their exit in the afternoon around 2 pm. The fruits may vary in color and it may be usually red and sometimes may be green or orange or yellow (Bantu and Kokkanti, 2019). The fruits may vary in color and it may be usually red and sometimes may be green or orange or yellow. The length of the fruit may reach up to 15 cm. The shape of the seeds may either discoid or reniform and measure about 3 to 5 mm and are pale yellow in color.

The two varieties (*C. annuum* L. var. Annuum and *C. annuum* L. var. Frutescens) had an overall similarity but the differences were greater (Table 1). This result was supported by Colney *et al*. (2018) who registered notable similarities and differences between the two varieties. Both are shrubby herbs which have an average height ranging between 60-75 cm. *C. annuum* L. var. Annuum is a perennial herb whereas *C. annuum* L. var. Frutescens is an annual herb. The phenotypical differences of both varieties were based on their nature of leaves. The arrangement of leaves is alternate in *C. annuum* L. var. Annuum and is opposite in *C. annuum* L. var. Frutescens. Leaves are green, smooth and simple in both varieties but a marked difference in the size of the leaves was noticed. *C. annuum* L. var. Annuum has smaller leaves than that of *C. annuum* L. var. Frutescens (Table 1). The other characters of leaves such as leaf margin, marginal hairs and epidermal hairs are similar in both varieties and are mentioned in Table 1. This result was supported by Nwachukwu *et al*. (2007) who showed similar characteristics in both taxa.

Table 1: Comparative account of vegetative characteristics of *Capsicum annuum* L. var. Annuum and *Capsicum annuum* L. var. Frutescens.

Characteristics	*Capsicum annuum* L. var. Annuum	*Capsicum annuum* L. var. Frutescens
Habit	Shrubby perennial herb, 60 cm tall	Shrubby, annual herb, 70-75 cm tall
Stem	Green, erect, branched	Green, erect, branched
Root	Tap root	Tap root
Leaves	Green, smooth, simple, alternate, small with reticulate venation	Green, smooth, simple, opposite, larger than *C. annuum* with reticulate venation.
Shape of leaf	Ovate	Ovate
Leaf apex	Mucronate	Mucronate
Leaf margin	Entire	Entire
Leaf marginal hairs	Absent	Absent
Leaf base	Round	Round
Epidermal hairs	Absent	Absent

Morphological characteristics of floral parts

Slight differences in the morphological feature of flowers in both the varieties were examined and are presented in Table 2. In both the varieties, flowers are axillary cyme, actinomorphic, greenish white, elliptic with valvate aestivation. Flower arrangement is opposite in *C. annuum* L. var. Annuum and alternate in *C. annuum* L. var. Frutescens. It was found that both the species have pentamerous flowers but *C. annuum* L. var. Annuum has hexamerous flowers too. Number and arrangement of stamens also differing in both the varieties. Stamens are five in number and free in *C. annuum* L. var. Annuum, whereas in *C. annuum* L. var. Frutescens, they are five in number but found inserted towards the base of the corolla tube. Table 2 represents the detailed floral morphology of both the varieties. This result is in accordance with Nwachukwu *et al*. (2007) who have reported the similarities and differences between the two varieties under study.

Morphological characteristics of fruit

The fruits comprised of many seeded berries which were borne singly at nodes. *Capsicum* fruits are green in color and become yellow, orange, or red when ripe. Differences were noted in the size of fruits in both the varieties (*C. annuum* L. var. Annuum and *C. annuum L.* var. Frutescens) and are presented in Table 3. Fruits of *C. annuum* L. var. Annuum are comparatively very much longer than that of *C. annuum* L. var. Frutescens. Length and diameter of the fruit ranges between 8-15 cm and 1-1.5 cm for the former and for the latter between 1-2 cm and 3-7 mm respectively. Fruit of *C. annuum* L. var. Annuum is long, drooping, cylindrical and with pointed apex whereas in *C. annuum* L. var. Frutescens it is erect, ellipsoid-conical to lanceoloid and with blunted apex. In *C. annuum* L. var. Annuum, fruit count per branch was 2-3 and for *C. annuum* L. var. Frutescens it was 3-4. Seeds were bright yellow, discoid or reniform and 4-5 mm long, 60-80 seeds per fruit in *C. annuum* L. var. Annuum whereas the seeds of *C. annuum* L. var. Frutescens were pale yellow, flattened-lenticular, 3-4 mm long and contain 20-30 seeds per fruit. Morphological characteristics of pepper fruit described in the present study is in accordance with Zhigila *et al*. (2014) who reported that the fruits of *Capsicum* species are berries and are green in color when raw and when ripe the colour changes to either yellow, orange or red.

Ethno botanical importance

***Capsicum annuum* L. var. Annuum**

Avinash and Pushpangadan (1995) reported that the leaves and fruits of the plant were used by few tribal communities in India for abortion and to treat menstrual disorders. According to Rajan (2002), Irulas, the tribal community of Nilgiris, India, use the fruit powder mixed with coconut oil and warmed up, to cure ear problems. Tiwari and Pande (2006) reported that the fruit powder when mixed with honey can be applied to the site of dog bite in cattle to check hydrophobia. Muhammad *et al*., (2006) opined that, certain stomach disorders in cattle can be treated with a mixer of *C. annuum* L. var. Annuum green fruit, table salt and crude sugar. Jose *et al*. (2014) reported that in some communities' people believe that chilly moved over head of the victim cattle of evil eye and burning them will get rid of bad eye effects.

Pepper fruit acts as a stimulant and is externally used as a rubefacient to relieve acute or chronic pain. It is also useful in treating scarlet fever, severely inflamed sore throat,

Table 2: Comparative account of floral characteristics of *Capsicum annuum* L. var. Annuum and *Capsicum annuum* L. var. Frutescens.

Characteristics	*Capsicum annuum* L. var. Annuum	*Capsicum annuum* L. var. Frutescens
Inflorescence and flower	Axillary cyme, actinomorphic, opposite, larger with valvate aestivation	Axillary cyme, actinomorphic, alternate, smaller with valvate aestivation.
Calyx	Greenish white, elliptic	Greenish white, elliptic.
Corolla	White, fused, pentamerous or hexamerous	White, free, pentamerous.
Androecium	Five stamens, free, epipetalous, anthers bluish	Stamens 5, inserted towards the base of corolla tube, anthers bluish, oblong, opening by slits, 1.5-2 mm long.
Gynoecium	Bicarpellary, syncarpous, bilocular with superior ovary, axile placentation	Bicarpellary, syncarpous, bilocular with superior ovary, axile placentation.

Table 3: Comparative account of fruit characteristics of *Capsicum annuum* L. var. Annuum and *Capsicum annuum* L. var. Frutescens.

Characteristics	*Capsicum annuum* L. var. Annuum	*Capsicum annuum* L. var. Frutescens
Fruit	Berry	Berry
Fruit color	Green when raw and when ripe color changes to yellow, orange or red	Green when raw and when ripe color changes to yellow, or ange or red
Fruit size	Up to 15 cm long, 1-1.5 cm in diameter	1-2 cm long, 3-7 mm in diameter
Fruit shape	Long, drooping, cylindrical, apex pointed	Erect, ellipsoid-conical to lanceoloid, apex blunted.
Fruit count	2-3 fruits per branch	4-5 fruits per branch
Seeds	Bright yellow, discoid or reniform and 4-5 mm, 60-80 seeds per fruit	Pale yellow, flattened-lenticular, 3-4 mm long, 20-30 seeds per fruit

Table 4: Comparative account of ethno pharmacological importance of *C. annuum* var. Annuum and *C. annuum* var. Fruitescens.

Variety	Pharmacological Importance	Reference
C. annuum var. Annuum	Stimulant, carminative, anti-oxidant, anti-microbial, anti-infiammatory, cardio-protective, anti-carcinogenic, anti-viral, anti-obesity, analgesic and used to treat scarlet fever, dyspepsia and snake bite	Dewitt *et al.*, 1998 Bourne *et al.*, 1999 Muhammad *et al.*, 2006 Nazzaro *et al.*, 2009 Cruz *et al.*, 2010 Petrocellis *et al.*, 2011 Luo *et al.*, 2011 Mueller *et al.*, 2011 Park *et al.*, 2012
C. annuum var. Frutescens	Anti- fungal, anti-coagulant, anti-oxidant, anti-haemorrhoidal, anti-rheumatic, anti-septic, analgesic, carminative, diaphoretic, anti- diabetic and improves metabolic rate, activities of cardiovascular system, gastro intestinal tract and is also used to cure pain	Chaiyata, 2003 Fraenkel *et al.*, 2004 Kwon *et al.* 2007 Petrocellis *et al.*, 2011 Saidu and Garba, 2011 Sheikh *et al.*, 2011 Soumya and Bindu, 2012

dysphonia, dyspepsia, jaundice, piles and snakebite (Sujatha and Sirisha, 2018). According to Nadeem *et al*. (2011), the fruit has the property of anti-coagulance which prevents clotting of blood and hence avoids heart attack.

Capsicum annuum L. var. Frutescens

Dewitt *et al*. (1998) reported the traditional usage of fruits as a topical application to relieve muscular spasms. It was also used in the treatment of arthritis, neuralgia, lumbago and chilblains. Szolcsanyi (2004) reported that the fruit is active against neurogenic inflammation which has the symptoms of burning and stinging of hands, mouth and eyes. Capsaicin derived from chili peppers, can be used as topical application to relieve pain in post-herpetic neuralgia, arthritis, psoriasis and diabetic neuropathy (Saljoughian, 2009). Sheikh *et al.* (2011) opined that sore throat can be treated with a weak infusion of pepper fruit as a gargle. As it dilates blood vessels, it plays a role in relieving chronic congestion of people addicted to drink. A combination of *C. annuum* L. var. Frutescens and honey is used for clot lysis. It has also been powdered and placed inside socks as a traditional remedy for those prone to cold feet. According to Oltean *et al*. (2014). *C. annumm* is used as a herbal medicine against Low-back pain (LBP).

Ethno pharmacological importance

Ethno pharmacological importance of two varieties under study are presented in Table 4.

CONCLUSION

Angiosperm morphology is the study of external characteristics of plants. It is significant in the identification, classification and description of plants. Study of ten plants from each of two varieties of *Capsicum annuum* L. (*C. annuum* L. var. Annuum and *C. annuum* L. var. Frutescens) reveals that the few differences that were noted in the morphological characteristics helped to identify the varieties as *C. annuum* L. var. Annuum and *C. annuum* L. var. Frutescens. As promising medicinal plants with wide pharmacological activities, *C. annuum* L. var. Annuum and *C. annuum* L. var. Frutescens can be utilized in several medical applications.

Conflict of interest

The authors have no conflict of interest.

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