

MORPHOLOGICAL CHARACTERS AND PHYTOCHEMICAL INVESTIGATION OF *CAPSICUM FRUTESCENS* L.(LEAVES) AND ITS ANTIMICROBIAL ACTIVITY

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Abstract

A medicinal plant *Capsicum frutescens* L. was selected for the present study. Myanmar name Moe- myaw-ngayoke belongs to the family Solanaceae. The specimens were collected from Nampha quarter, Banmaw Township in Kachin State from January to September, 2018. The collected plants were identified by the literature references to confirm its identity. The present research was conducted to study the morphological characters, qualitative analysis and antimicrobial activity of the *Capsicum frutescens* L. In morphological study, inflorescences were axillary and terminal cymes and flowers were pentamerous and hypogynous. In qualitative analysis, alkaloids, glycosides, flavonoids, phenolic compounds, steroids, starch, protein, reducing sugar, α -mino acids and carbohydrates were found to be present in the leaves of *Capsicum frutescens* L. In antimicrobial tests, the various solvent extracts of powdered leaves were tested on six microorganisms by using agar well diffusion methods at the CRDC. In this experiment, ethyl acetate extract of leaves showed the highest activity especially more sensitive against *Bacillus subtilis*, *Staphylococcus aureus*, *Bacillus pumalis* and *Candida albicans*. Therefore, the leaves of *Capsicum frutescens* L. may serve as a source of natural antimicrobial agents to be used in food and medicinal purposes.

Keywords: *Capsicum frutescens*, phytochemicals, and antimicrobial properties

Introduction

The family Solanaceae is one of the most important families of flowering plants economically, floristically, ethnobotanically and scientifically (Perry, 1980).

Solanaceae is a family of about 94 genera and more than 2950 species, also called as nightshades or potato family. It contains many species of economic use, such as food: tomatoes, potatoes, pepper and eggplants (Miller, 1754). A medicinal plant *Capsicum frutescens* L. belongs to the family Solanaceae. The specimens were collected from Nampha quarter, Banmaw Township in Kachin State.

Capsicum frutescens L. is currently native to the majority of central America as well as Northern and Western South America. It spread quickly throughout the tropical and subtropical regions and still grows wild today (Mabberley, 1987). The plant *C. frutesces* is used for various problems with digestion including upset stomach, intestinal gas, stomach pain, diarrhea, and cramps. It is also used for conditions of the heart and blood vessels including poor circulation, excessive blood clotting, high cholesterol, and preventing heart disease (Rose koffi-Nevry, et. al 2012). In Myanmar, it is used for indigestion, anorexia, obesity, cough, fever, edema, ulcers, arthritis, bronchitis and work as antibiotic (Ashin-na-ga-thein, 1976).

In the present study, morphological characters, preliminary phytochemical investigation and antimicrobial studies had been undertaken. As a result, leaves of *C. frutescens* L. revealed the presence of important active constituents and antimicrobial properties. Thus the leaves of *C. frutescens* L. may serve as a source of natural antimicrobial agents to be used in food and medicinal systems.

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Therefore, the aim of this study is to find the medicinal plant scientifically which has effective medicinal values and also to investigate the active constituents of the medicinal plant, to evaluate their specific values and to find out the greatest activity of leaves extracts on six pathogenic microorganisms.

Materials and Methods

Morphological study of *Capsicum frutescens* L.

Capsicum frutescens L. used in this study were collected from Nampah quarter, Banmaw Township. For the identification of their morphological characters, the vegetative and reproductive parts of the plant were selected and collected at their flowering period to fruits and seeds. The specimens were identified and confirmed with the help of literature cited in Hooker (1875-1897), Johnson (1934), Kirtikar and Basu (1935), Cooke (1958), Rendle (1967), Roxburgh (1971), and Kress et. al (2003).

The collected specimens were properly dried, crushed and pounded into powdered form. This powder was stored in the airtight container for another study.

Preliminary phytochemical test

The preliminary photochemical investigation on the powdered leaves of *Capsicum frutescens* L. was carried out to determine the presence or absence of alkaloids, glycosides, phenolic compounds, flavonoids, steroids, terpenoids, α -amino acids, starch, reducing sugar, saponins, tannins, carbohydrates and protein. The methods of Marini Bettalo G.B. et. al (1981), and Trease and Evans (2002) were applied for investigation of phytochemicals. These experiments were carried out at the Department of Botany, Banmaw University.

Antimicrobial activity of different solvent extracts from leaves of *Capsicum frutescens* L.

Extraction and examination of antimicrobial activity

The dried powder sample of leaves was extracted with pet-ether, chloroform, ethyl acetate, acetone, ethanol, methanol and water. The various solvents extracts of leaves were tested on six pathogenic microorganisms such as *Bacillus pumalis*, *Bacillus subtilis*, *Candida albicans*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. These experiments were carried out at the Central Research and Development Centre.

The study of antimicrobial activities was performed by using agar-well diffusion method according to Cruickshank (1975). Nutrient agar was prepared and boiled, and then 20-25 ml of the medium was poured into a test-tube and plugged with cotton wool and autoclaved at 121°C for 15 minutes. Then the tubes were cooled down at (30-35°C) and the medium was poured into sterilized petridishes and 0.1-0.2 ml of test organisms were also added into the dishes. The agar was allowed to set for 2-3 hours. After this, 10 mm agar well was punched with the help of sterilized cork borer. After that, about 0.2 ml of sample was introduced into the agar well and incubated at 37°C for 24 hours. The inhibitory zone appeared around the agar well, indicating possesses of antimicrobial activity. Then, the diameter of inhibitory zone including 10 mm agar well were measured with the help of a transparent ruler.

Similarly, the controlled experiments using solvent only were prepared for the comparison with plant extracts.

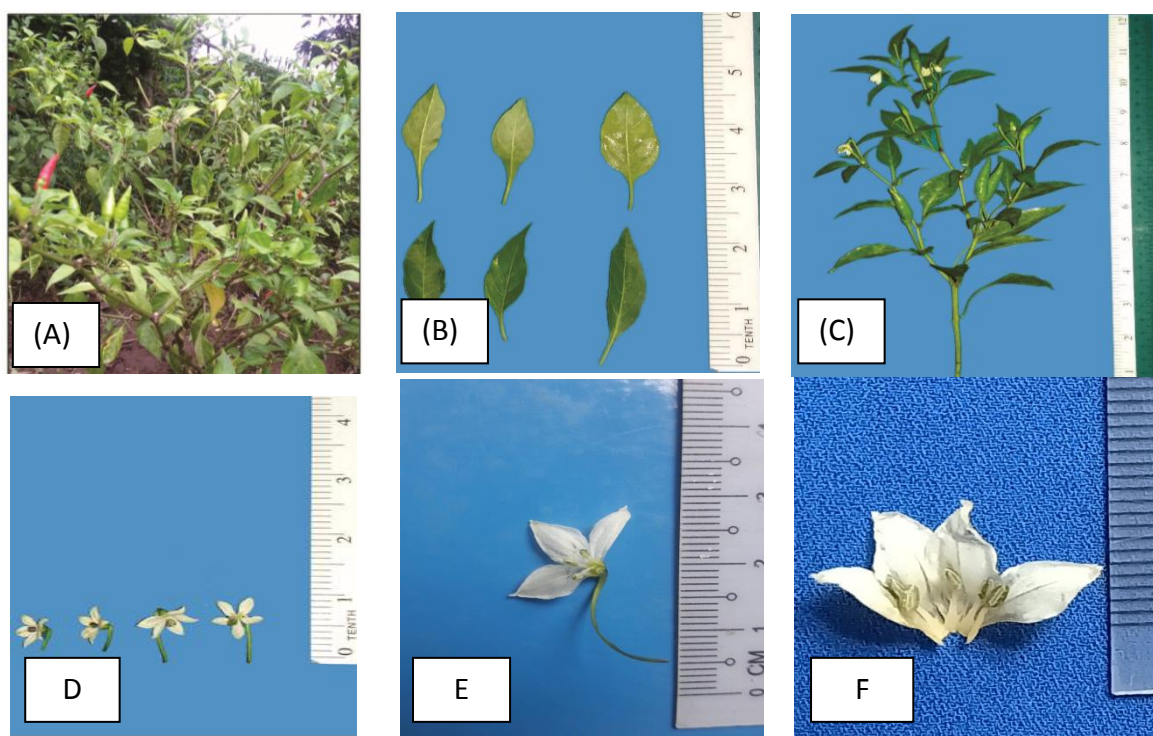
Results

Morphological studies

Scientific name	-	<i>Capsicum frutescens</i> L.
Myanmar name	-	Moe-myaw-ngayoke
English name	-	Red pepper
Family	-	Solanaceae
Useful parts	-	Fruits, leaves, roots

Distinctive characters of *Capsicum frutescens* L.

Perennial, shrubby herbs, about 130 cm high; stems and branches angular with longitudinal ridges, erect, stout, glabrous, green. Leaves simple, alternate, ovate, 2-5 cm long \times 1-3 cm wide; tip acute, margin entire; base oblique; glabrous, petioles 0.5 – 3 cm long, exstipulate. Inflorescences axillary and terminal cymes with up to 3 flowers; peduncle about 0.1 cm long. Flowers ebracteate, ebracteolate, complete, bisexual, regular, actinomorphic, pentamerous, cyclic, pedicel about 1 cm long; hypogynous. Sepals (5), synsepalous, cup-shaped about 1 cm long, valvate, sepaloid, persistent, pubescent, inferior. Petals (5), synpetalous, campanulate about 1 cm long, valvate, petaloid (greenish white), inferior. Stamens 5, free; filament about 6 mm long; pale-green, epipetalous; anther oblongoid about 4 mm long, ditheous, introrse, basifixed, longitudinal-slit; inferior. Ovary ovoid, oblique about 2 mm long, glabrous; bicarpellary, syncarpous, bilocular, axile placentation, many ovules in each locule; style filiform about 7 mm long; slightly curved at the apex; stigma simple, green; superior. Berries, oblongoid, 3 cm long \times 0.5 cm wide, green, red at the maturity. Seeds numerous, compressed, discoid, yellow, endospermic. Flowering and fruiting almost throughout the year. The results were shown in figure (1).



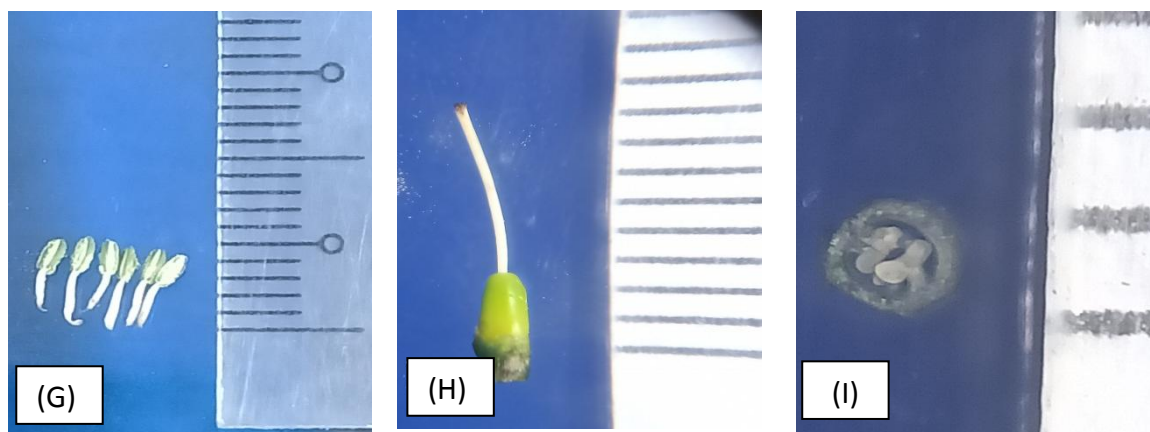


Figure 1 Morphological characters of *Capsicum Frutescens* L.

- (A) Habit (B) Leaves (upper and lower surfaces)
 (C) Inflorescence (D) Flowers
 (E) L.S of flowers (F) Corolla with stamens
 (G) Stamens (H) Gynoecium
 (I) T.S Ovary

Preliminary photochemical investigation of leaves of *Capsicum frutescens* L.

The preliminary phytochemical investigation was carried out on the powdered leaves to determine the present or absent of alkaloids, glycosides, phenolic compounds, flavonoids, steroids, terpenoids, α -amino acids, starch, reducing sugar, tannins, saponins, carbohydrates and protein. The results were shown in figure (2) and table (1).

Table 1 Preliminary phytochemical test of leaves of *Capsicum frutescens* L.

No	Constituents	Extract	Test Reagents	Observation	Remark
1.	Alkaloids	3% HCL	1. Mayer's reagent 2. Hager's reagent 3. Wagner's reagent	White ppt Yellow ppt Reddish Brown ppt	+
2.	Glycosides	Ethanol EtOH	1 ml of water and sodium hydroxide	Yellow Colour	+
3.	Phenolic compounds	H ₂ O	3% Ferric chloride solution	Green Colour	+
4.	Flavonoids	Ethanol EtOH	Small pieces of Mg, few drops of HCl	Pink Colour	+
5.	Steroids	Ethanol EtOH	CHCl ₃ and Conc: H ₂ SO ₄	Green	+
6.	α -amino acids	H ₂ O	Dry and sprayed with Ninhydrin reagent and kept in over at 110°C	Pink Spot	+

No	Constituents	Extract	Test Reagents	Observation	Remark
7.	Terpenoids	Ethanol EtOH	CHCl ₃ and Conc: H ₂ SO ₄	Pink	+
8.	Starch	H ₂ O	Iodine Solution	Bluish black ppt	+
9.	Reducing sugar	H ₂ O	Benedict Solution	Brick red ppt	+
10.	Saponins	H ₂ O	Distilled Water	Frothing	+
11.	Tannins	H ₂ O	5% Ferric Chloride solution and sulphuric acid	No Yellowish brown ppt	-
12.	Carbohydrates	H ₂ O	1 ml of a mixture of equal parts of felling's solution A and B	Brick red ppt	+
13.	Protein	H ₂ O	NaOH Sol: and 3% CuSO ₄ Sol:	Red or violet colour	+

(+) Presence

(-) Absence

The tests indicated that, alkaloids, glycosides, phenolic compounds, flavonoids, steroids, terpenoids, α -amino acids, starch, reducing sugar, saponins, carbohydrates and protein were found to be present and tannin was absent in the leaves of *Capsicum frutescens* L.

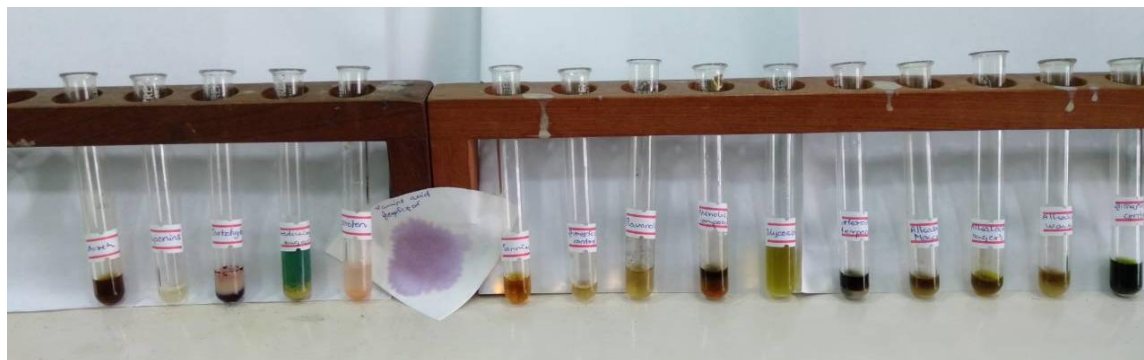


Figure 2 Preliminary phytochemical investigation of leaves of *Capsicum frutescens* L.

Antimicrobial activity of various solvent extracts of *Capsicum frutescens* L.

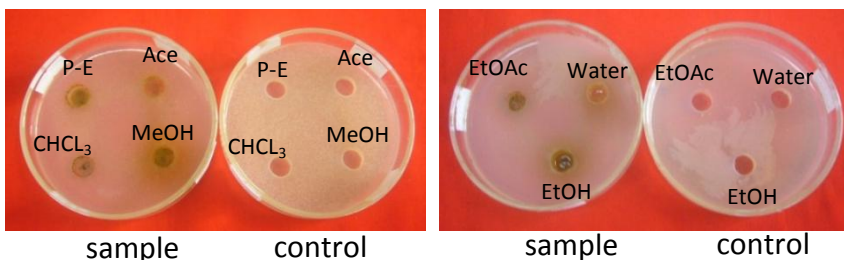
Antimicrobial activity of various solvent extracts such as pet-ether, chloroform, ethyl acetate, acetone, ethanol, methanol and aqueous extract were tested on six microorganisms. The results were shown in Table (2) and Figure (3).

Table 2Antimicrobial activity of various solvent extracts of leaves of *Capsicum frutescens* L.

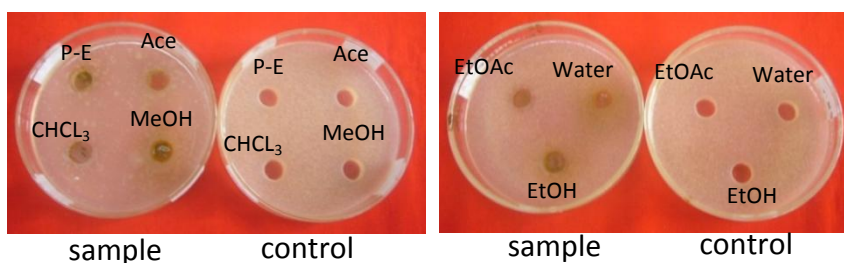
Sample	Solvents	<i>B.subtilis</i>	<i>S.aureus</i>	<i>P.aeruginosa</i>	<i>B.pumilis</i>	<i>C.albicans</i>	<i>E.coli</i>
Leaves	Pet-ether	-	-	-	-	-	-
	CHCl ₃	-	-	-	11mm	-	11mm
	MeOH	-	-	-	12mm	19mm	12mm
	Acetone	-	-	-	12mm	19mm	-
	EtOAc	19mm	19mm	12mm	19mm	19mm	-
	EtOH	19mm	13mm	13mm	19mm	13mm	-
	Water	-	-	19mm	-	-	-

Agar well - 10 mm

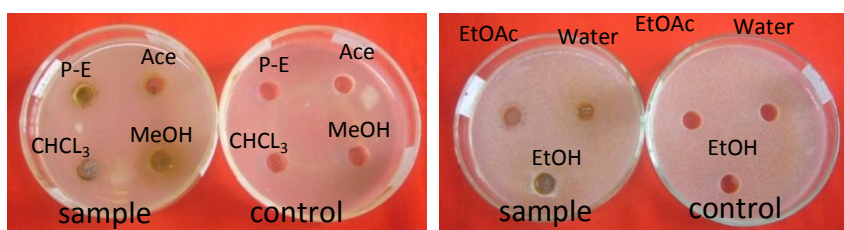
In this experiment, methanol and acetone extracts of leaves showed the highest activity especially more sensitive against *Candida albicans*. Ethyl acetate extract of leaves showed the highest activity especially more sensitive against *Bacillus subtilis*, *Staphylococcus aureus*, *Bacillus pumilis* and *Candida albicans*. Ethanol extract of leaves showed the highest activity on *Bacillus subtilis* and *Bacillus pumilis*. Moreover aqueous extract of leaves showed the greatest activity on *Pseudomonas aeruginosa*.



Bacillus subtilis



Staphylococcus aureus



Pseudomonas aeruginosa

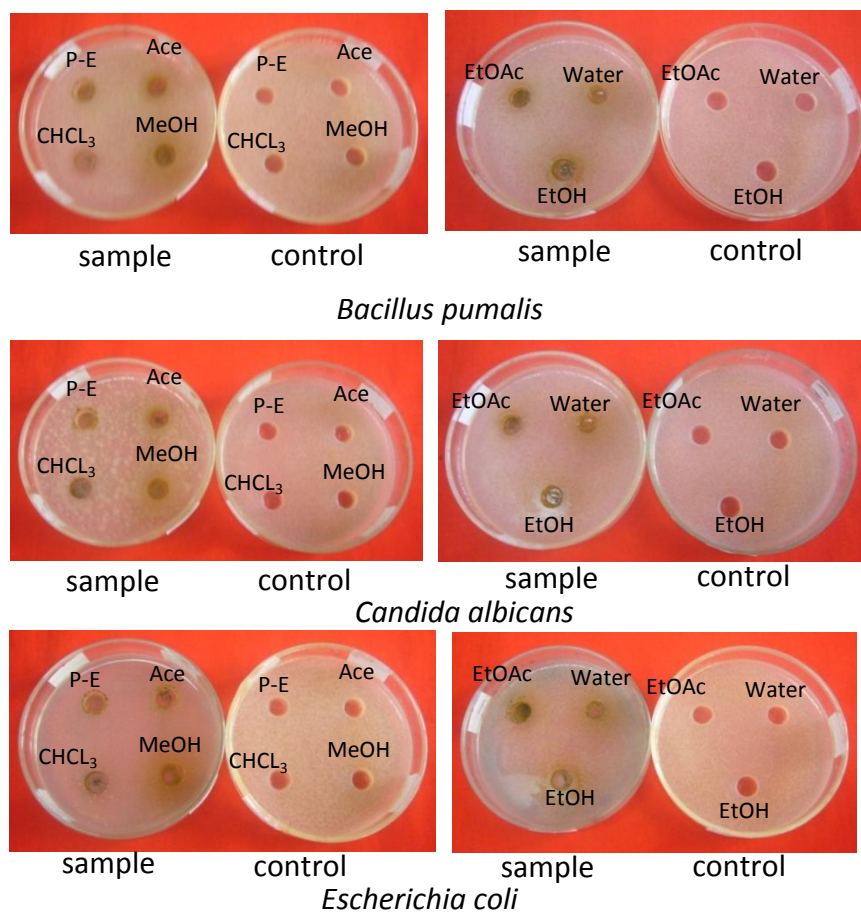


Figure 3 Treatment of various extracts from the leaves of *Capsicum frutescens* L.

Discussion and Conclusion

A medicinal plant *Capsicum frutescens* L. belongs to the family Solanaceae. The specimens were collected from Nampha quarter, Banmaw Township in Kachin State. In the present investigation, the morphological studies on both vegetative and reproductive parts of the plant, preliminary phytochemical analysis and antimicrobial activity of the leaves had been undertaken.

As a results of morphological studies, *C. frutescens* L. was perennial, shrubby herbs; stems and branches angular with longitudinal ridges, erect, glabrous. Leaves were simple, alternate, ovate, tip acute, margin entire; base oblique, petiolate, exstipulate. Inflorescences were axillary and terminal cymes with up to 3 flowers. Flowers were ebracteate, ebracteolate, bisexual, actinomorphic, pentamerous, hypogynous. Sepals were five, synsepalous, valvate, persistent, pubescent, inferior. Petals were five, synpetalous, campanulate, valvate, inferior. Stamens were five, free, epipetalous, anther oblongoid, ditheous, introrse, basifixed, inferior. Ovary was ovoid, oblique, glabrous, bicarpellary, syncarpous, bilocular, axile placentation, style filiform, stigma simple, superior. Fruits were berries, oblongoid. Seeds were numerous, compressed, discoid, endospermic. These characters are in agreement with those mentioned by Hooker (1875-1897), Johnson (1931), Kirtikar and Basu (1935), Cooke (1958), Rendle (1967), Roxburgh (1971), and kress et. al (2003).

The preliminary phytochemical investigation was carried out on the powdered leaves. These tests indicated that the leaves contained alkaloids, glycosides, phenolic compounds, flavonoids, steroids, terpenoids, α -amino acids, starch, reducing sugar, saponins, carbohydrates and protein. Tannin was absent in leaves of *Capsicum frutescens* L. According to Vinayaka (2010), phytochemical analysis revealed saponins, tannin, alkaloids, glycosides and steroids in methanol extract. These compounds are medicines for treating various diseases in human being (Website (1)).

The antimicrobial activity of various solvent extracts such as pet-ether, chloroform, ethyl acetate, acetone, ethanol, methanol and aqueous extract were tested on six microorganisms. In this experiment, methanol and acetone extracts of leaves showed the highest activity especially more sensitive against *Candida albicans*. And then, ethyl acetate extract of leaves showed the greatest activity especially more sensitive against *Bacillus subtilis*, *Staphylococcus aureus*, *Bacillus pumilis* and *Candida albicans*. Ethanol extract of leaves showed the highest activity on *Bacillus subtilis* and *Bacillus pumilis*. Finally, aqueous extract of leaves showed only the highest activity on *Pseudomonas aeruginosa* and pet-ether extract of leaves did not show the activity on all test microorganisms. According to Vinayaka (2010), *S.aureus* was found to be more susceptible to the methanolic extract followed by *P.aeruginosa*. From this finding, nevertheless, it can be inferred that leaves of *C. frutescens* L. can be effective in the formulation of medicine for the treatment of disease caused by *S. aureus*, *B.pumilis*, *P.aeruginosa*, and *C. albicans* such as wound infections, pneumonia, urinary tract infection, respiratory system infection, soft tissue infections, ear infection, eye infection, skin infections, vaginal candidiasis, sores and ring worm.

Therefore, the results of this present study on morphology can give a few information on the systematic study on a member of the family Solanaceae. Moreover, the leaves of *C.frutescens* L. included many chemical constituents. They are employed for medicinal purposes. And then the leaves of *C.frutescens* L. may serve as a source of natural antimicrobial agents to be used in food and medicinal system. Finally the main objective of the present research work was that *C. frutescens* had medicinal values not only in fruit but also in leaves.

Acknowledgements

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