



## **PHARMACOGNOSTIC AND THERAPEUTIC REVIEW ON CONVULVULUS PLURICAULIS**

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### **ARTICLE INFO**

#### **Article History:**

Received 4<sup>th</sup> July, 2020

Received in revised form 25<sup>th</sup>

August, 2020

Accepted 18<sup>th</sup> August, 2020

Published online 28<sup>th</sup> October 2020

#### **Key words:**

*Convolvulus pluricaulis*, Phytochemistry,  
Pharmacology, Shankhpushpi.

### **ABSTRACT**

*Convolvulus pluricaulis* commonly known as shankhpushpi is a multi-target action drug and hence it is a significant herb in Ayurveda. It exhibits a comprehensive range of therapeutic potential and is mainly prescribed for use in chronic cough, mental stimulation, epilepsy, hallucinations, anxiety, insomnia, depression etc. The phytochemistry and pharmacological aspects of the plant have been scrutinized in this article. Some of the biologically active compounds have manifested in the plant. They are carbohydrate-D-glucose, rhamnose, maltose, sucrose, starch, alkaloids like convolvine, convolamine, scopoletin,  $\beta$ -sitosterol, kaempferol, glacial acetic acid, phyllabine, coumarins etc. Additionally, the drug exhibits pharmacological activities like an antidepressant, antidiabetic, anticonvulsant, anthelmintic, antithyroid, antiulcer, cardiovascular, antioxidant, antimicrobial, insecticidal, antifungal, antibacterial, antiviral, anxiolytic etc. In spite of its wide range of remedial actions, no systematic review on *C. pluricaulis* exists as of date. There is a necessity of evidence-based herbal research. For this reason, the curative potential of the plant in the form of the drug needs to be explored.

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### **INTRODUCTION**

*Convolvulus pluricaulis*(CP) commonly known as Shankhpushpi is a native Ayurvedic herb. It belongs to the family Convolvulaceae and has light blue flowers that have an appearance similar to that of a ‘Shankh’ (a marine shell),(Jalwal P, Singh B, Dahiya J, Khokhara S *et al.*, 2016) (Bhalerao SA, Verma DR, Teli NC, Trikannad AA *et al.*, 2016). The plant is well known in the form of the herb as natural medicine. It aids in enhancing and strengthening memory and also prevents illness progression. In addition, it provides strength and immunity to the body. (Jalwal P, Singh B, Dahiya J, Khokhara S *et al.*, 2016). The herb is believed to promote longevity, improve complexion and restore nervous functions, and is found to be pungent, alternative tonic, and bitter. It is known effectively in the

treatment of bronchitis, biliousness, epilepsy, and teething problems of infants. (Jalwal P, Singh B, Dahiya J, Khokhara S *et al.*, 2016) (Bhalerao SA, Verma DR, Teli NC, Trikannad AA *et al.*, 2016) (Amin H, Vyas HA, Harisha CR, Shukla VJ *et al.*, 2011). Moreover, it is also a natural stimulant for the mental stature of children. Consequently, Shankhpushpi is reported as a nerve tonic and is effective in the management of anxiety and neurosis. There are different varieties of Shankhpushpi available and different chemical constituents have been found in plants that have proved the therapeutic effect of the plants. Different extracts of the plant have shown their potential in treating various disorders which are attributed to the presence of various phytoconstituents present in the plant extracts. Furthermore, the literature shows the presence of scopoletin (coumarin derivative) in the methanolic extract of *convolvulus*

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*pluricaulis*, scopoletin regulates stress hormone serotonin and this was found to be responsible for showing antidepressant-like effects in rats. (Gupta GL, Fernandes J *et al.*, 2019) (Amin H, Sharma R, Vyas M, Prajapati PK, Dhiman K *et al.*, 2014). Other constituents like alkaloids – convolvine, convoline, convolamine, phyllabine, phytosterol like  $\beta$ -sitosterol, stigmasterol, phenolic compounds like mangiferin, coumarin-scopoletin, a flavonoid–kaempferol, rutin, terpenoid -  $\beta$ -carotene and triterpenoids like ursolic acid and lupeol have shown their presence in different species of the plant which is reported to possess activities related to antioxidant activity, memory dysfunction and CNS stimulation. (Amin H, Sharma R, Vyas M, Prajapati PK, Dhiman K *et al.*, 2014) (W.C. Evans, D, Evans, GE Trease *et al.*, 2009) (Sethiya NK, Nahata A, Singh PK, Mishra SH *et al.*, 2019). Phytochemical investigations of this plant provide a means for use of this plant in treating various disorders and diseases. To sum up, this review compiles all the phytochemical and pharmacological information of *convolvulus pluricaulis*.

## LITERATURE REVIEW

### Chemical constituents

The literature review proclaims many important phytoconstituents in the plant that are responsible for its pharmacological effect. (Amin H, Vyas HA, Harisha CR, Shukla VJ *et al.*, 2011). Different classes of phytochemicals like carbohydrates (D-glucose, rhamnose, maltose, sucrose, starch), alkaloids (convolvine, convolamine, convoline, phyllabine, convolidine, convoline, convosine, subhirsine, convolidine), flavonoids (rutin, kaempferol), phenolic compounds (mangiferin, scopoletin), phytosterols ( $\beta$ -sitosterol, stigmasterol), terpenoids -  $\beta$ -carotene, triterpenoids (ursolic acid, lupeol) have shown their existence in the plant. Additionally, other constituents like hextriacontane, tetratriacontanoic acid, 20oxodotriacontanol, 29-oxodotriacontanol, linoleic acid, fatty acid, palmitic acid and wax constituents, hydrocarbons, hydroxycinnamic acid, octacosanol, tetracosane are also reported to be present in the plant. (Bhalerao SA, Verma DR, Teli NC, Trikannad AA *et al.*, 2016).

### Phytochemical investigations of methanolic extract (ME) of CP

The extracts were subjected to preliminary phytochemical studies qualitatively with reference to standard procedures. Consequently, the results confirmed the presence of various phytochemicals like alkaloids, flavonoids, carbohydrates, proteins, amino acids, and saponins. Analytical study of HPTLC revealed the presence of scopoletin in the ME of CP depicting well-resolved peaks. The spots were visualized under 300nm and the  $R_f$  value at 0.67 confirms spots resolved were of scopoletin. As per the findings, 0.106% w/w of scopoletin was present in ME of CP. (Gupta GL, Fernandes L *et al.*, 2019) (Amin H, Sharma R, Vyas M, Prajapati PK, Dhiman K *et al.*, 2014) (W.C. Evans, D, Evans, GE Trease *et al.*, 2009).

### Phytochemical investigations of ME of different varieties of shankhpushpi

There are different varieties of shankhpushpi as disclosed in the literature. (Sethiya NK, Nahata A, Singh PK, Mishra SH *et al.*, 2019).

Species 1: *Convolvulus pluricaulis*

Species 2: *Evolvulus alsinoides*

Species 3: *Clitoria ternatea*

Species 4: *Canscora decussate*

The findings of HPTLC analysis showed the presence of various phytochemicals in ME of different species of shankhpushpi. The constituents stigmasterol and scopoletin are reported to be present in all the species of shankhpushpi. Ursolic acid and  $\beta$ -carotene are present in *canscora decussate* and *clitoria ternatea*. Furthermore, mangiferin a polyphenol is present in *canscora decussata*, a triterpenoid lupeol, and flavonoid rutin is present in *clitoria ternatea*. Betulinic acid, chlorogenic acid, and  $\beta$ -carotene are detected in *evolvulus alsinoides*. (Sethiya NK, Nahata A, Singh PK, Mishra SH *et al.*, 2019) (Sethiya NK, Mishra SH *et al.*, 2015) (Sethiya NK, Raja MKMM, Mishra SH *et al.*, 2013) (Sethiya NK, Trivedi A, Mishra SH *et al.*, 2015) (Sethiya NK, Nahata A, Dixit VK *et al.*, 2009).

### Phytochemical investigations of ethanolic extracts (EE) of Convolvulus pluricaulis

The presence of phytochemicals like glycosides, alkaloids, flavonoids, coumarins and phenols, hydroxycinnamic acid, octacosanol tetracosane with glucose, sucrose were isolated from the whole plant drug. (Sethiya NK, Trivedi A, Patel MB, Mishra SH *et al.*, 2010) (Chandel U, Kharoliwal S *et al.*, 2017) (Bhowmik D, Kumar KP, Paswan S, Srivastava S, Yadav AP, Dutta A *et al.*, 2012). The dried leaves of *Convolvulus pluricaulis* were subjected to the Soxhlet extraction method by using ethanol as a solvent and the EE of CP was further explored for preliminary phytochemical screening by using a different solvent system for developing TLC. (Chandel U, Kharoliwal S *et al.*, 2017) (Biradar SR, Rachetti BD *et al.*, 2013). The EE of CP was reported to have different components -flavonoids & phenol, that were isolated and identified using TLC. Further, the presence of phenols and flavonoids depicts that this drug can be used for various pharmacological studies. (Chandel U, Kharoliwal S *et al.*, 2017). The phytochemicals present in the EE of CP were determined and quantified by standard procedures. (Chandel U, Kharoliwal S *et al.*, 2017) (Tambe VD, Bhambar SR *et al.*, 2014) (Khoddami A, Wilkes MA, Roberts TH *et al.*, 2013). The presence of bioactive compounds such as flavonoids and phenols was depicted in the study which leads to further research in isolation and identification of the active compound.

### Phytochemical investigations of Aqueous extracts (AE) of Convolvulus pluricaulis

The AE of CP were prepared and subjected to qualitative chemical tests for alkaloids, flavonoids, triterpenoids, tannins, amino acids, carbohydrates, glycosides, saponins, phytosterols, phenols, phlobatannins, quinones, oxalate. The extracts shown the presence of flavonoids, tannins, amino acids, alkaloids, carbohydrates, saponins, phytosterols and phenols. (Giradkar PN *et al.*, 2015) (Kokate CK *et al.*, 1994).

### Phytochemical investigations of Convolvulus pluricaulis by using different solvents

CP was extracted using solvents like petroleum ether, chloroform, ethyl acetate, acetone and methanol were prepared

by the Soxhlet extraction method and aqueous extract of CP was prepared by reflux method. The above mentioned extracts of CP were subjected to Qualitative chemical examination for presence (+) and absence(-) of different phytoconstituents and results obtained are given in Table 1. (Prasad SB, Sharma A *et al.*, 2016).

A detailed phytochemical feature of different species of shankhpushpi is given in tables 2, 3, 4 and 5. (Amin H, Sharma R, Vyas M, Prajapati PK, Dhiman K *et al.*, 2014) (Agarwal P, Sharma B, Fatima A, Jain SK *et al.*, 2014) (Sethiya NK, Nahata A, Mishra SH, Dixit VK *et al.*, 2009).

#### **Preliminary phytochemical screening on EE of Convolvulus pluricaulis**

The EE extract of CP (leaves) was explored for preliminary phytochemical screening which further confirmed the presence of phytochemicals - alkaloids, flavonoids, carbohydrates, glycosides, proteins, sterols, gums and mucilage. These phytoconstituents may be the major contributors to the therapeutic effects of *Convolvulus pluricaulis*. (Agarwal P, Sharma B, Fatima A, Jain SK *et al.*, 2014).

#### **Pharmacological review**

*Convolvulus pluricaulis* is used as a brain tonic and to treat epilepsy, insomnia and nervous weakness. The literature also states that it can be used to treat mental as well as physical fatigue and it can also improve memory and rejuvenate nervous functions. (Jalwal P, Singh B, Dahiya J, Khokhara S *et al.*, 2016) (Bhalerao SA, Verma DR, Teli NC, Trikannad AA *et al.*, 2016) (Cai L, Li R, Tang WJ, Meng G, Hu XY, Wu TN *et al.*, 2015). Traditionally, the leaves of CP are acclimated in the treatment of chronic bronchitis and asthma. Additionally, its roots are well known to cure fever in children and its oil is used to stimulate hair growth. (Bhalerao SA, Verma DR, Teli NC, Trikannad AA *et al.*, 2016). The drug has multiple pharmacological activities. The literature has proved its antidepressant, antidiabetic, anthelmintic, antimicrobial, insecticidal, antifungal and antibacterial activity. Other pharmacological activities like cardiovascular, antioxidant, anxiolytic, neuroprotective, hypolipidemic, anticonvulsant, antiulcer, and anticatatonic activity are also present in the plant. (Jalwal P, Singh B, Dahiya J, Khokhara S *et al.*, 2016).

#### **Memory enhancing property**

The EE extract of CP was tested for memory enhancing properties along with its ethyl acetate and aqueous fractions. Experiments were conducted on rats at two different doses 100 and 200 mg/kg by using simple memory test models. Models such as pole-climbing apparatus, passive paradigm and active avoidance paradigm were used. The consciousness and learning in rats were improved and the drug showed significant activity in proving its potential. (Jalwal P, Singh B, Dahiya J, Khokhara S *et al.*, 2016). The drug modulates the neuro chemistry of the brain to produce its action.

#### **Anti-depressant activity**

The ME of CP was evaluated for anti-depressant activity in rats. Rats (male wistar rats) were subjected to nine

different types of environmental or psychosocial stresses for 27 days as :**A)** Warm swimming test (40°C, 5mins) **B)** Water and Food deprivation (24 hours) **C)** Cage tilting (30° for 24 hours) **D)** Tail pinching test (1min) **E)** Overnight illumination **F)** Overhang (10mins) **G)** Cold swimming (8°C, 5 mins) **H)** Physical restraint (2 Hours).(Gupta GL, Fernandes J *et al.*, 2019) (Cai L, Li R, Tang WJ, Meng G, Hu XY, Wu TN *et al.*, 2015) (Ge JF, Gao WM, Cheng WM, Lu WL, Tang J, Peng L, Li N, Chen FH *et al.*, 2014). The methanolic extracts of CP were administered at three dose levels 25 mg/kg.p.o; 50 mg/kg.p.o and 100 mg/kg.p.o. Fluoxetine(standard drug) was administered at 10mg/kg.p.o. (Gupta GL, Fernandes J *et al.*, 2019) (Malik J, Choudhary S, Kumar P *et al.*, 2015) (Dhingra D, Valecha R *et al.*, 2007) (MacHado DG, Cunha MP, Nels VB, Balen GO, Colla A, Grando, Brocardo PS, Bettio LEB, Capra JC, Rodrigues ALS *et al.*, 2012) (Wang GL, Wang YP, Zheng JY, Zhang LX *et al.*, 2018) (Zu X, Zhang M, Li W, Xie H, Lin Z, Yang N, Liu X, Zhang W *et al.*, 2017). The extracts showed the significant anti-inflammatory and neuroprotective activity as comparable to the standard drug fluoxetine at mentioned doses. The stress exposure instigated depression like behavior in rats. Administration of *Convolvulus pluricaulis* extracts attenuated the depressive like behavior because of stress exposure and this may be associated with the alteration of inflammatory cytokines, liver enzymes, serotonin and noradrenaline levels. Thus the study demonstrated that CP can be used as a potent drug for the treatment of depression and neuroinflammation. (Gupta GL, Fernandes J *et al.*, 2019).

#### **Neuropharmacological effect by using four herbs**

All the four varieties of shankhpushpi - *Canscora decussata*, *Clitoria ternatea*, *Convolvulus pluricaulis* and *evolvulus alsinoides* were collected, the herbs were coarsely powdered and subjected to Soxhlet extraction methods using methanol as a solvent. The ME of all the four plants was tested and evaluated for *in-vitro* and *in-vivo* neuropharmacological studies. For *in vitro* evaluation, experiments such as protection against  $\beta$ -amyloid induced neurotoxicity on brain cell, antioxidant potential, AchE (acetylcholinesterase enzyme) inhibition and 5-LOX (lipoxygenase) were conducted. (Sethiya NK, Nahata A, Singh PK, Mishra SH *et al.*, 2019) (LePage KT, Dickey RW, Gerwick WH, Jester EL, Murray TF *et al.*, 2005) (Mosmann T *et al.*, 1983) (Sethiya NK, Trivedi A, Mishra SH *et al.*, 2014) (Sethiya NK, Mishra SH *et al.*, 2014). For *in-vivo* evaluation, scopolamine (0.3mg/kg i.p) induced memory retrieval using pole climbing apparatus and the Morris water maze was performed in rat models (male Sprague-Dawley rats). (Sethiya NK, Mishra SH *et al.*, 2014) (Ali EHA, Arafa NMS *et al.*, 2011). As compared to *clitoria ternatea* and *Convolvulus pluricaulis*, the effects of *evolvulus alsinoides* and *canscora decussata* showed significant higher activity against *in-vitro*  $\beta$ -amyloid induced neurotoxicity in neuro 2A cells. For antioxidant potential, AchE inhibition and 5-LOX inhibitory activities, ME of *evolvulus alsinoides* proved to be more significant than other varieties of shankhpushpi. In case of *in-vivo* evaluation, the ME of *evolvulus alsinoides* proved higher significantly activity as compared

to *canscora decussata*, *clitoria ternatea* and *Convolvulus pluricaulis*. The study was concluded by finding that *evolvulus alsinoides* has remarkable neuropharmacological effect as compared to other species of shankpushpi and this may be attributed to the existence of steroids such as stigmasterol and betulinic acid, coumarins (scopoletin) and flavonoids like  $\beta$ -carotene and chlorogenic acid in the drug. So it can be used in the treatment of neuronal disorders including Alzheimer's disease. The other three varieties may be used as substitutes. (Sethiya NK, Nahata A, Singh PK, Mishra SH *et al.*, 2019).

**Anthelmintic activity**

The aqueous extract of *Convolvulus pluricaulis* was prepared and from the aqueous extract, enteric coated pellets were formulated. The aqueous extract and formulated enteric coated pellets were evaluated for anthelmintic activity. (Giradkar PN *et al.*, 2015). The standard drug Albendazole was used. Experimental animals used were adult earthworms (*Pheretima posthuma*) and Cattle worms collected from moist soil. The reason for selection of adult earthworms is its anatomical and physiological features which corresponds to intestinal round worm parasites of human beings. (Giradkar PN *et al.*, 2015) (Shivkumar YM, Kumar V *et al.*, 2003). All the test and standard samples were prepared in distilled water. Worms were placed in a petri dish containing the test and standard solutions at mentioned concentrations as per the protocol. (Giradkar PN *et al.*, 2015). Time taken for the paralysis and death of individual worm was observed and recorded. On screening, it was noted that aqueous extract of *Convolvulus pluricaulis* at 10 mg/ml exhibited paralysis of earthworms on 182.35 min.sec and their death at 371.5 min.sec.

The earthworms that were exposed to albendazole solution got paralyzed at 189.33 min.sec and their death occurred at 371.5 min.sec. The enteric coated pellets were also found to have significant activity.

**Immunomodulatory activity**

The *evolvulus alsinoides* showed significant immunomodulatory activity in adjuvant induced arthritic (AIA) rat model by causing immune suppression in AIA rats which demonstrates that the herb may provide an significant approach in the treatment of arthritis. (Sethiya NK, Nahata A, Mishra SH, Dixit VK *et al.*, 2009).

**Table 1** Qualitative tests of *Convolvulus pluricaulis* using solvents - Petroleum ether, Chloroform, Ethyl acetate, Acetone, Methanol and Water. (Prasad SB, Sharma A *et al.*, 2016).

Sr.No.	Compound	Reagent	Pet. Ether	Chloroform	Ethyl acetate	Acetone	Methanol	Water
1	Alkaloids	Hager's	-	+	-	-	+	-
		Dragondorff's	-	-	-	+	+	-
2	Carbohydrates	Benedict's	-	-	-	-	-	+
		Fehling's	-	-	-	-	-	-
		Borntrager's	-	-	-	-	-	-
3	Glycosides	Modified Borntrager's	-	-	-	-	-	-
		Legal test	-	-	-	-	-	-
4	Saponin	Froth test	-	-	-	-	-	+
5	Fixed oils	Stain test	+	-	-	-	-	-
6	Phenols	Fecl <sub>3</sub> test	-	-	+	-	+	+
7	Tannins	Gelatin test	-	-	-	-	-	-
8	Flavonoids	Alkali test	-	-	+	+	-	+
		(Lead acetate)	-	-	-	-	+	+
9	Resin	Acetone+water	-	-	-	-	+	-

+(Present), -(Absent)

The other pharmacological activities of *Convolvulus pluricaulis* are summarized in table 6. (Agarwal P, Sharma B, Fatima A, Jain SK *et al.*, 2014).

**DISCUSSION/CONCLUSION**

The various phytochemicals present in the extracts (methanol, ethanol, aqueous, petroleum ether, chloroform, ethyl acetate, acetone) of *convolvulus pluricaulis* are scrutinized which confirms that plant has various biological effects and can be used to protect body against invasion, disease and infection. Different alkaloids, carbohydrates, flavonoids, phenols, terpenoids, triterpenoids, sterols, fatty acids are present in plant. Various pharmacological activities of the plant like anti-depressant activity, memory enhancing property, neuropharmacological effect, anthelmintic activity, immunomodulatory activity, antioxidant, anticonvulsant, antibacterial, anxiolytic activity were studied by using different *in vitro* and *in vivo* models that confirm the significant activities of this drug. Though different species of shankpushpi have proved their curative potential individually in studies related to various pharmacological activities like anti-depression, anthelmintic, antimicrobial, insecticidal, anti-diabetic, immunomodulatory etc. their combination with one another is yet to be explored. Different types of alkaloids, flavonoids, tannins, amino acids, phenols, terpenoids etc. have found their presence in plant as active chemicals which are further responsible for its pharmacological effects.

This reveals that this herb is valuable source for medicinally important molecules, yet a lot of work has not been done on different species of *Convolvulus pluricaulis*. Thus, in approaching these gaps in our knowledge, conducting experiments on different species of the plant and developing better animal models and discovering novel targets and treatment strategies are essential.

**Funding**

NIL

**Conflict of Interest**

We declare no conflict of interest.

**Table 2** Detailed Phytochemical feature of CP (Amin H, Sharma R, Vyas M, Prajapati PK, Dhiman K et al., 2014) (Agarwal P, Sharma B, Fatima A, Jain SK et al., 2014) (Sethiya NK, Nahata A, Mishra SH, Dixit VK et al., 2009)

Class	Chemical constituents
Carbohydrates	D-glucose, maltose, rhamnose, sucrose, starch and other carbohydrates
Proteins and amino acids	Proteins and amino acids
Alkaloids	Convolamine has been identified and other alkaloids like convoline, convolidine, convolvine, confoline, convosine etc. were found in other species of this family.
Fatty acids/volatile oil/Fixed oil	Volatile oils, fatty acids, fatty alcohols, hydrocarbons, myristic acid (30.9%), palmitic acid (66.8%) and linoleic acid (2.3%) and straight chain hydrocarbon, hextriacontane.
Phenolics/Glycosides/Triterpenoid/Steroids	Scopoletin, $\beta$ -sitosterol and ceryl alcohol, 20 oxodotriacontanol, tetratriacontanoic acids, flavonoid-kaempferol, steroids-phytosterols.

**Table 3** Detailed Phytochemical feature of *Evolvulus alsinoides*- a source of Shankpushpi (Amin H, Sharma R, Vyas M, Prajapati PK, Dhiman K et al., 2014) (Sethiya NK, Nahata A, Mishra SH, Dixit VK et al., 2009).

Class	Chemical constituents
Carbohydrates	D-glucose, maltose, rhamnose, sucrose, starch.
Proteins and amino acids	Ergot alkaloids
Alkaloids	Convolamine, convoline, convolidine convolvine, confoline, convosine etc.
Fatty acids/volatile oil/Fixed oil	Volatile oil, stearic, oleic, linoleic acid with magnesium phosphate, palmitic, 8-methyldecanoic and heptadecanoic acids.
Phenolics/Glycosides/Triterpenoid/Steroids	Scopoletin, scopolin, umbelliferone, $\beta$ sitosterol, kaempferol etc.
Plant growth regulator	Phytohormones

**Table 6** Pharmacological investigations of *Convolvulus pluricaulis* (Agarwal P, Sharma B, Fatima A, Jain SK et al., 2014)

Pharmacological Activity	Plant part/extract/Standard drug	Dose/Model	Result
Antioxidant activity	Whole plant / Chloroform / Ascorbic acid	84%, 83%, 48% / DPPH	Significant anticonvulsant activity.
Antioxidant activity	Whole plant / methanolic / Ascorbic acid	41 $\mu$ g/ml / DPPH model	Significant free radical scavenging effect.
Anticonvulsant activity	Whole plant / methanolic / Phenytoin	500 and 1000 mg/kg , MES model	The extract at the mentioned dose reduced the mean recovery time from convulsion. However the extract didn't suppress the hind limb extension.
Antibacterial activity	Whole plant / methanolic / Tetracycline	<i>Escherichia coli</i> ATCC 8739, <i>staphylococcus aureus</i> 6538 / Cup Plate Model	The methanolic extract of <i>Convolvulus pluricaulis</i> was found to be more significant against <i>Escherichia coli</i> in comparison to <i>staphylococcus aureus</i> .
Antidepressant activity	Whole plant / ethanolic / Imipramine or Fluoxetine	50, 100 mg/kg , TST and FST model	Only chloroform fraction in this doses significantly reduced the immobility time in both TST and FST.
Anxiolytic activity	Aerial part / ethanolic / Diazepam	200 mg/kg, EPM model	Ethyl acetate fractions at the mentioned dose showed significant activity and reduced the neuromuscular co-ordination indicative of the muscle relaxant activity.
Anxiolytic activity	Flower part / ethanolic / Diazepam	100, 200, 400 mg/kg, EPM model	The flower extract of the plant showed significant activity at the mentioned doses in mice.
Anti-thyroid activity	Root part / ethanolic / Methimazole	0.4 mg/kg, radioimmunoassay technique	The extract at the mentioned dose prompt the inhibition in thyroid function. This was attributed to mediation through T4 to T3 conversion.
Antiulcer activity	Whole part / ethanolic / Sucralfate	375, 750 mg/kg, gastric ulcer model	The result was found due to augmentation of mucosal defensive factors like mucin secretion rather than acid pepsin.
Antiviral activity	Whole part / aqueous / Rivastigmine	150 mg/kg, scopolamine induced increased tau and amyloid precursor protein	As compared to the scopolamine group the extracts reduced the increased protein and mRNA levels of tau and A $\beta$ PP levels followed by reduction in A $\beta$ levels.

A $\beta$ PP: amyloid precursor protein

**Table 4** Detailed Phytochemical feature of *Clitoria ternatea*- a source of Shankpushpi (Sethiya NK, Nahata A, Mishra SH, Dixit VK et al., 2009)

Class	Chemical constituents
Carbohydrates	Water soluble mucilage, delphinidin 3,3,5-triglucoside. oligosaccharides or flutulene.
Proteins and amino acids	Amino acids and amides, protein finotin, trypsin inhibitors.
Alkaloids	Alkaloids
Fatty acids/volatile oil/Fixed oil	Palmitic, stearic, oleic, linoleic, linolenic acids.
Phenolics/Glycosides/Triterpenoid/Steroids	P-hydroxycinnamic acid, flavonol-3-glucoside, $\beta$ -sitosterol, $\gamma$ -sitosterol, anthoxanthin glucoside, hexacosanol, anthocyanins, kaempferol, quercetin, pentacyclic triterpenoid, taraxerol and taraxerone from the roots etc.
Plant growth regulator	Indole acetic acid, kinetin, gibberellic acid.

**Table 5** Detailed Phytochemical feature of *Canscora decussata*- a source of Shankpushpi (Sethiya NK, Nahata A, Mishra SH, Dixit VK et al., 2009)

Class	Chemical constituents
Carbohydrates	Carbohydrates
Proteins and amino acids	Proteins and amino acids
Alkaloids	Alkaloids
Fatty acids/volatile oil/Fixed oil	Fatty acids/volatile oil/Fixed oil
Phenolics/Glycosides/Triterpenoid/Steroids	Xanthone, Mangiferin, Scopoletin etc.

### Abbreviations Used

CP : *Convolvulus pluricaulis*,  
ME : Methanolic Extract,  
EE : Ethanolic Extract,  
AE : Aqueous Extract,  
TLC : Thin Layer Chromatography,  
HPTLC : High Performance Thin layer Chromatography,  
p.o : per oral,  
i.p : Intraperitoneally,  
AChE : Acetylcholinesterase enzyme,  
LOX : Lipoxygenase,  
AIA : Adjuvant induced arthritic,  
CNS : Central Nervous System,  
DPPH : 1, 1-diphenyl-2-picryl-hydrazyl,  
MES : Maximal Electro Shock,  
TST : Tail Suspension Test,  
FST : Forced Swim Test,  
EPM : Elevated Plus Maze,  
A $\beta$ PP : Amyloid Precursor Protein.

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**How to cite this article:**

Manjushree Kundlik Pawar *et al* (2020) 'Pharmacognostic and Therapeutic Review on *Convolvulus Pluricaulis*', *International Journal of Current Advanced Research*, 09(10), pp. 23151-23157. DOI: <http://dx.doi.org/10.24327/ijcar.2020.23157.4583>

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