Chapter

Evolvulus alsinoides (Linn.) Linn.: A Revitalizer

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Abstract

Herbal medicines are utilized as traditional and alternative therapy to precisely restore declining metabolic functions. Herbal bioactive claims its rewards for their effectiveness, safety, and acceptability. *Evolvulus alsinoides* (Linn.) Linn. is a Virya herb from Convolvulaceae with Tridoshhara, Majjadhatu Rasayan, Vajikarak, Chedan, and Nidrajanan properties. In Ayurvedic medicine, the whole plant is used in the treatment of neurodegenerative diseases as brain tonic, amnesia and asthma, epilepsy and as a hepatoprotective. The phytochemical analysis has reported the existence of biomolecules such as β-sitosterol, scopolin, scopoletin, umbelliferon, triacontane, shankpushpine and betaine. A thorough review of classical as well as contemporary literature study has been done on *Evolvulus alsinoides* (Linn.) Linn. to validate the pharmacological actions and cytotoxicity effects on various cell lines.

Keywords: *Evolvulus alsinoides* (Linn.) Linn., virya herb, phytochemical analysis, pharmacological actions, cytotoxicity effects

1. Introduction

The medical herbs are advantageous for humans for the reason of providing remedies that ease the human suffering. The indigenous system has innumerable plants that have been disclosed to have action opposing CNS disorders thus elevating human hardships [1]. The potential of Ayurveda herbs benefit medicinally and it seems likely exploring that medicinal potential is increasing latterly. At the current times, plant dependant drugs procure profuse attention due to the fact that there are onsets of newer approaches on chemical characterization and pharmacological inquisitions [1]. For a long period of time medicinal plants have been valued for their healing and diminishing pain. Medicinal plants are also have been relied abundantly for their curative properties. Various types of herbs have been employed in prominent folk medicine and they have a long history for being benefited in the traditional remedies [2]. In vitro screening methods also contribute to the demand on vital primary inquisition which is crucial to retrieve desired plant extract with promising and effective attributes for upcoming chemical and pharmacological research.

2. *Evolvulus alsinoides* (Linn.) Linn.

The traditional methodology utilized variety of medicinal herbs and one of the notable herbs is *Shankhpushpi* also known as *Evolvulus alsinoides* (Linn.) Linn., has been employed in clinical use for centuries. *Shankhpushpi* is contemplated as *Medha Rasayana* attributes to a drug that revivifies, retains and potentiates intellect and cognizance [3]. *Evolvulus alsinoides* (Linn.) Linn. is included in the Convolvulaceae family and it is a weed primarily available in tropical and sub-tropical miry zones of the world, particularly in East Asia. They are commonly seen in the regions including India and West Cameroon. They are expansively scattered in tropical zones of Africa and world.

Evolvulus alsinoides (Linn.) Linn. is a supine perennial herb consisting small branched rootstock of wood. They are enclosed with plentiful branches that are annual and beyond 30 cm long. The branches include long hairs and frequently prostrate. *Evolvulus alsinoides* (Linn.) Linn. incorporates small leaves which are elliptic in shape. They are acute, susceptive and are densely hairy [4].

Each part of this plant is put to use in Ayurveda medicine to treat cough, cold and fever. They are also employed to cure neurodegenerative diseases like adenitis and dementia. Treatment of venereal disease also includes the use of this plant [5]. Azoospermia, nootroppic and anti-inflammatory activity has also been noted. This plant not only possesses these effects it also consists anti-haemorrhagic and anti-oxidant effects. Ancient medicine claimed this plant as brain tonic and in current years it has been justifies through pre-clinical research [6]. This plant is preferred in the treatment of asthma and amnesia, most common neurodegenerative diseases. Most notable property of *E.alsinoides* (L.) L. is to boost the memory and elevate the intellectuality [7].

3. Phytochemicals

In current years, Phytochemistry or plant chemistry has been established into evident discipline which lies between organic chemistry of natural creations and biochemistry dealing with plants. It is closely related to both of the subjects [8]. Phytochemistry is related to the innumerable distinct amount of organic materials that are concerned with and aggregated by plants and it deals with plant's properties. The chemical arrangements, biosynthesis, metabolisms and turn over, biological function and their natural distribution.

Evolvulus alsinoides (Linn.) Linn. was interpreted to find the phytochemicals like alkaloids, carbohydrates, steroidal glucosides, saponin, tannins, pseudo tannins, chlorogenic acids, flavones, flavonoids, coumarin, anthocyanin, phenol, terpenoides, resins, volatile oil, anthraquinones, phytosterol and triterpenoids. The analysis portrayed the potentiality of components that are known to illustrate medicinal constituents as well as physiological activities [8].

Phytochemical analysis of *Evolvulus alsinoides* (Linn.) Linn.

S. No	Phytochemical compounds	Methanol extract	Ethanolic extract	Aqueous extract
1	Alkaloid	+	+	–
2	Carbohydrate	+	+	–
3	Steroids	–	–	–
4	Saponin	–	+	–
5	Tannin	+	+	+

S. No	Phytochemical compounds	Methanol extract	Ethanolic extract	Aqueous extract
6	Pseudo Tannins	+	–	–
7	Chlorogenic acid	+	–	–
8	Flavones	–	+	–
9	Flavonoid	+	+	–
10	Coumarin	–	–	–
11	Anthocyanin	–	–	–
12	Phenol	+	+	+
13	Terpenoids	+	+	+
14	Triterpenoids	+	+	+
15	Resins	–	–	–
16	Volatile oil	+	+	+
17	Glycosides	–	+	–

+ = present;
- = absent.

4. Analysis of heavy metals

Test for the presence of heavy metals is done for this plant's leaf extract. Sodium (Na), Potassium (K), Phosphorus (P), Manganese (Mn), Iron (Fe), Calcium (Ca), Zinc (Zn), Copper (Cu), Nickel (Ni) and Magnesium (Mg) were the heavy metals present in the leaf extract. The recent studies have proved that Potassium (approximately 133 ppm) is higher when compared to other heavy metals present [8]. Sodium, Phosphorus, Manganese, Iron, Calcium, Zinc, Copper, Nickel and Magnesium are present in the leaf extract. Metals like Lead and Mercury were not detected in the extract.

5. Antimicrobial activity

Antimicrobial activity attributes the extracts potential to act against the microorganisms by inhibiting the growth and the activities of them. *Evolvulus alsinoides* (Linn.) Linn. displayed commendable potential of antimicrobial activity. The zone of inhibition of the expansion of the isolates refers to the relative antimicrobial potential that *E.alsinoides* (L.) L. possesses. The results of the antimicrobial activity of *Evolvulus alsinoides* (Linn.) Linn. methanol, ethanol and aqueous extract are explained as follows: [8].

5.1 Antimicrobial activity of *Evolvulus alsinoides* (Linn.) Linn. aqueous extract

The organisms used for the antimicrobial activity of *E.alsinoides* (L.) L. aqueous extract are *Salmonella typhi, Acinetobactor baumannii, Staphyloccus aureus, Klebsiella pneumonia, Escherichia coli* and *Pseudomonas aeruginosa.* The inhibition values for three different concentrations for each microbe were obtained for the aqueous extract of *E.alsinoides* (L.) L. The three different conecentrations are 50 μg/ml, 100 μg/ml and 150 μg/ml. The respective inhibition values (mm) are 8, 11, 14 (for *Salmonella typhi*), 10, 13, 16 (for *Acinetobactor baumannii*), 10, 11, 12 (for *Staphyloccus aureus*), 7,8,9 (for *Klebsiella pneumonia*), 8, 10, 12 (for *Escherichia coli*), and 6,8,9 (for *Pseudomonas aeruginosa*).

5.2 Antimicrobial activity of *Evolvulus alsinoides* (Linn.) Linn. methanol extract

The organisms used for the antimicrobial activity of *E.alsinoides* (L.) L. methanol extract are *Candida albicans, Aspergillus niger, Staphyloccus aureus, Vibrio cholera, Bacillus megaterium, Klebsiella pneumonia, Salmonella typhi, Yersinia enterocolitica, Bacillus subtilis* and *Listeria monocytogenes*. The inhibition values for three different concentrations for each microbe were obtained for the methanol extract of *E.alsinoides* (L.) L. The three different conecentrations are 50 μg/ml, 100 μg/ml and 150 μg/ml. The respective inhibition values (mm) are 12, 15, 21(for *Candida albicans*), 12, 14, 17 (for *Aspergillus niger*), 12, 15, 18 (for *Staphyloccus aureus*), 13, 16, 22 (for *Vibrio cholera*), 10, 13, 16 (for *Bacillus megaterium*), 11, 15, 17 (for *Klebsiella pneumonia*), 14, 17, 18 (for *Salmonella typhi*), 13, 15, 17 (for *Yersinia enterocolitica*), 11, 12, 13 (for *Bacillus subtilis*) and 10, 12, 15 (for *Listeria monocytogenes*).

5.3 Antimicrobial activity of *Evolvulus alsinoides* (Linn.) Linn. ethanol extract

The organisms used for the antimicrobial activity of *E.alsinoides* (L.) L. aqueous extract are *Escherichia coli, Pseudomonas aeruginosa, Candida albicans* and *Staphyloccus aureos.* The inhibition values (mm) for the concentration 10 mg/ml, for *E.coli* was 14 and for *Pseudomonas aeruginosa* is 11. There was no inhibition found in *Candida albicans* and *Staphyloccus aureos.*

6. Antioxidant activity

Antioxidant activity is primarily described as the activity of preventing the propagation level in oxidative chain reactions that acts as a constraint of the oxidation of lipids, proteins, DNA and so on. Free radicals are directly scavenged by primary antioxidants. Unlike primary antioxidants, secondary antioxidants preclude the forming of free radicals indirectly through Fenton's reaction [9].

Fluorescence Recovery After Photobleaching (FRAP) assay can be easily reproduced and it is directly associated with molar concentration of antioxidant present. This can be implicated as the extract of *Evolvulus alsinoides* (Linn.) Linn. that may act as a free radical scavenger. The FRAP (Fluorescence Recovery After Photobleaching) assay portrays the scavenging efficiency of the extract (Ethanol) of *E.alsinoides* (L.) L. at five distinct concentrations. They are 200 $\mu g \cdot mL^{-1}$, 400 $\mu g \cdot mL^{-1}$, 600 $\mu g \cdot mL^{-1}$, 800 $\mu g \cdot mL^{-1}$ and 1000 $\mu g \cdot mL^{-1}$ and the respective optical densities are 0.907, 1.309, 1.397, 1.561 and 1.825 at 595 nm.

7. GC–MS analysis

The prevailing compounds were, Hexadecanoic acid, methyl ester, Benzoic acid, n-Hexadecanoic acid, D-Allose and Cytidine. The presence of various bioactive compounds justifies for usage of plant extract for various ailments by Ayurveda practitioners [10].

The investigation concluded that the stronger extraction capacity of methanol could have been produced number of active constituents responsible for many biological activities. So that those might be utilized for the development of traditional medicines and further investigation needs to elute novel active compounds

from the medicinal plants which may be created a new way to treat many incurable diseases [10].

Biocompounds of *Evolvulus alsinoides* (Linn.) Linn. leaf extract found by GC MS analysis.

S. No	Name of Compound	Molecular Formula	Molecular weight
1	Tricyclo[2.2.1.0(2,6)]heptane, 1,7,7-trimethyl	$C_{10}H_{16}$	136
2	2,4- Imidazolidinedione, 3-Methyl	$C_4H_6N_2O_2$	114
3	4-Heptanone, 2-Methyl-	$C_8H_{16}O$	128
4	Levoglucosenone	$C_6H_6O_3$	126
5	4H-Pyran-4-one, 2,3-Dihydro-3,5-Dihydroxy-6-	$C_6H_8O_4$	144
6	Benzoic Acid	$C_7H_6O_2$	122
7	Cytidine	$C_9H_{13}N_3O_5$	243
8	4-Methyl-2-Oxopentanenitrile	C_6H_9NO	111
9	2,3-Dihydro-Benzofuran	C_8H_8O	120
10	5-Hydroxymethylfurfural	$C_6H_6O_3$	126
11	2-Methoxy-4-Vinylphenol	$C_9H_{10}O_2$	150
12	Alfa.-copaene	$C_{15}H_{24}$	204
13	Cyclohexene,1-methyl-4- (1methylethenyl)-, (r)	$C_{10}H_{16}$	136
14	Caryophyllene	$C_{15}H_{24}$	204
15	1,1'-Bicycloheptyl	$C_{14}H_{26}$	194
16	1,6-cyclodecadiene, 1-methyl-5-m	$C_{15}H_{24}$	204
17	D-Allose	$C_6H_{12}O_6$	180
18	(−)-5-oxatricyclo[8.2.0.0(4,6)]dodeca	$C_{15}H_{24}O$	220
19	Cyclohexene, 1-Methyl-3-(Formylmethyl)	$C_9H_{14}O$	138
20	1hcyclopropa[A]Naphthalene, 1a	$C_{15}H_{28}O_2$	240
21	Dotriacontane	$C_{32}H_{66}$	450
22	Diethyl phthalate	$C_{12}H_{14}O_4$	222
23	Tetradecanoic acid	$C_{24}H_{48}O_2$	368
24	Tricyclic [2.2.1.0(2.6)]Hept-3-OL	$C_7H_{10}O$	110
25	Benzoic acid,2,6-bis Trimethylsil	$C_{16}H_{30}O_4Si_3$	370
26	2,6,10 trimethyl, 14-ethylene-	$C_{20}H_{38}$	278
27	Cyclohexanol, 4-[(Trimethylsilyl)oxv]-,cis	$C_9H_{20}O_2Si$	188
28	2-cyclohexen-1-Ol,2,4,4- trimethy	$C_{16}H_{24}O_2$	248
29	Pentadecanoic acid	$C_{15}H_{30}O_2$	242

Biological Activity of compounds found in methanolic leaf extrac of *Evolvulus alsinoides* (Linn.) Linn. by GC–MS.

S.No	Compound name	Nature of Compound	Biological activity
1	n-Hexadecanoic acid	Palmitic acid	Antioxidant, Hypocholesterolemic nemaicide, pesticde, Anti-androgenic flavor, hemalytic, 5- Alpha reductase inhibitor
2	Hexadecanoic acid, methyl ester	Fatty acid ester	Antioxidant, Antimicrobial Hypocholesterolemic, Antiandrogenic, Hemolytic, Alpha Reducatase inhibitor.
3	Benzoic acid	Benzen	Arachidonic acid-Inhibitor, Increase Aromatic Amino Acid Decarboxylase Activity and Inhibit Production of Uric Acid
4	D-Allose	Aldohexose sugar	Alcohol-Dehydrogenase-Inhibitor, Anticancer (Duodenum), Antidote (Diazepam), Antidote (Digoxin), Antileukotriene-D4, Circulatory-Depressant, CNS-Depressant and Coronary-Dilator
5	Cytidine	Nucleoside molecule	Glutamatergic antidepressant drug

8. Effect on marker enzymes in Streotozotoc induced Diabetic rats

Diabetes mellitus, generally known as diabetes, is a heterogeneous metabolic disorder indicated by a basic feature of chronic hyperglycaemia with a bother of fat, carbohydrate and protein metabolism. One of the prominent causes of anguish and mortality worldwide is Diabetes mellitus. Pancreatic cells are damaged by creating profuse reactive oxygen species (ROS) that concluded in diabetes mellitus. An imbalance in oxidant and antioxidant activities, Oxidative stress is also included in pathogenesis and complications of diabetes mellitus. The activities including detoxification, storage, metabolism, excretion of the metabolites and xenobiotics performed by liver is vital, thus liver is a crucial organ of the body [11].

The studies show that effect of extract of whole plant of *E.alsinoides* (L.) L. can be availed for the normality of marker enzymes that implies the normality of liver and kidney. The markers AST (aminotransferace), ALT (alanine aminotransferace), ACP (acid phosphatase), LDH (lactate dehydrogenase) and ALP (alkaline phosphatase) were utilized for the study and increase in them in the circulation of blood illustrates damage in liver of diabetic rats, induced by streptozotocin [11]. The diabetes results in increase in the concentration of AST, ALT, ACP, ALP and LDH than in normal conditions. The extract administered was noticed to preserve the values of the enzymes to normal values. Thus showing no crucial difference in between the control (glibenclamide) and the plant extract alone group rats in the normal levels.

The following tables concludes that ethanolic extract of *Evolvulus alsinoides* (Linn.) Linn. importantly decreases the concentration of marker enzymes that exist in serum and tissues, which are commonly found to be higher in levels of streptozotocin induced diabetic rats. Its constructive impact of biomarker enzymes could portray a defensive mechanism contrary to the toxic effect of free radicals consisting in diabetes mellitus [11].

9. Effect of ethanolic extract of *Evolvulus alsinoides* (Linn.) Linn. on marker enzymes as in serum of control and experimental group rats

The results show that the effect of *Evolvulus alsinoides* (Linn.) Linn. is similar and in some cases better than glibenclamide, a drug used for diabetic control. The extract alone also shows notable effects against diabetic rats. The diabetes results in increase in the concentration of AST, ALT, ACP, ALP and LDH than in normal conditions. The extract administered was noticed to preserve the values of the enzymes to normal values. The concentrations of markers AST, ALP, ACP, ALT and LDH (μmoles/L) are 40, 43, 10, 32 and 44 respectively in control. The concentrations of markers AST, ALP, ACP, ALT and LDH (μmoles/L) are 60, 120, 23, 74 and 85 respectively in diabetic control. The concentrations of markers AST, ALP, ACP, ALT and LDH (μmoles/L) are 43, 45, 12, 45 and 45 respectively in Diabetic and *Evolvulus alsinoides* (Linn.) Linn. The concentrations of markers AST, ALP, ACP, ALT and LDH (μmoles/L) are 41, 43, 11, 38 and 44 respectively in Diabetic and glibenclamide. The concentrations of markers AST, ALP, ACP, ALT and LDH (μmoles/L) are 40, 43, 10, 34 and 44 respectively in control.

10. Impact of ethanolic extract of *Evolvulus alsinoides* (Linn.) Linn. on marker enzymes in liver of control and experimental group rats

The research studies conducted portrayed that *Evolvulus alsinoides* (Linn.) Linn. ethanol extract has inhibitory effect not only on alpha glucosidase but also alpha amylase. The inhibitory activity exhibited concentration reliant reduction thus the higher the concentration higher the inhibitory activity. The topmost concentration 100 μg/ml is the concentration that showed the highest inhibition of closely to 63% and the standard acarbose demonstrated the inhibitory activity of 74%.

11. The inhibition (%) of alpha glucosidase by ethanolic extract of *Evolvulus alsinoides* (Linn.) Linn.

In comparison with the inhibition of alpha amylase by *Evolvulus alsinoides* (Linn.) Linn., the inhibitory action of it on alpha glucosidase is limited. The inhibitory activity of alpha glucosidase by the extract of *E.alsinoides* (L.) L. is about 53% at a concentration 100 μg/ml. This study proves that the *Evolvulus alsinoides* (Linn.) Linn. contains therapeutic antibiotic impact in type II diabetes mellitus [12].

12. A cognitive enhancer of spacial memory

D-Galactose caused mental retardation and cognitive dysfunction as measured by open field, avoidance/escape, T-maze, Y-maze and Morris maze in mice. D-gal, a reducing sugar which can be metabolized at normal concentration, induces the production of reactive oxygen species (ROS) and advanced glycation end products (AGEs) at higher doses that causes detoriating effect in the mice.

An extract from *Evolvulus alsinoides* (Linn.) Linn. have illustrated the strongest memory enhancing property by keeping in control of acetylcholinesterase and also increasing the levels of acetylcholine in the brain and so it possess reasonably acceptable antiamnesiac outcome in animal neurotoxicity model. Scopoletin, a furanocoumarin found in *E.alsinoides* (L.) L. promotes the gene and it can be used for monotherapy for learning and memory.

13. HPTLC fingerprinting analysis (high performance thin- layer chromatography)

The TLC chromatogram was run for *E.alsinoides* (L.) L. along with standard for various profiles such as steroids, glycosides and terpenoids.

Glycosides comprise a very wide range of compounds that are of common and ubiquitous occurrence in almost all plants. Many plants store medicinally important chemicals in the form of inactive glycosides. The nonsugar portion contains the biochemically active properties of medical interest. Once the glycoside is split into its two components, the nonsugar component is free to exert its chemical effects on the body. For example, digitalis is a glycoside that causes the heart to contract (pump) more forcefully when ingested [13]. These pharmaceuticallyvaluable glycosides contribute to almost every therapeutic class, cardiac drugs, laxatives, counterirritants, analgesics, renal disinfectants, antirheumatics, anti-inflammatory, antituberculosis, expectorant and antispasmodic action [2].

14. Ethnopharmacological activities

To carry out enzyme inhibition studies, lactate dehydrogenase was cloned from *Plasmodium falciparum* 3D7 strain using expression vector pET28a and expressed in *Escherichia coli* BL21 (DE3).

Methanol extract of *E.alsinoides* was tested at 50 mg/mL concentration for PfLDH inhibitory activity. Methanol extract of *E.alsinoides* (L.) L. reduced PfLDH activity to (25.04 ± 0.51) %. Effects of *E.alsinoides* (L.) L. were statistically significant at 0.001 levels [7]. The chloroform and ethyl acetate extracts were showed graded dose response. The chloroform, ethyl acetate extracts were protected 27.4% and 28.3% at 120 min, it indicates that *Evolvulus alsinoides* (Linn.) Linn. extracts are considerably reduced the inflammation but when compared with standard drug at 12.5 mg/kg body weight was not that much potent drug, but the extracts were reduced the inflammation caused by prostaglandins, histamine and 5- hydroxy tryptamine at initial stage.

15. Conclusion

The traditional methodology utilized variety of medicinal herbs and one of the notable herbs is *Shankhpushpi* also known as *Evolvulus alsinoides* (Linn.) Linn. has been employed in clinical use for centuries. *Shankhapushpi* is contemplated as *Medha Rasayana* attributes to a drug that revivifies, retains and potentiates intellect and cognizance. *Evolvulus alsinoides* (Linn.) Linn. possess activities like antibiotic, antimicrobial, antiinfalamatory and antidiabetic. The heavy metal analysis shows the presence of notable metals in the extract and phytochemical analysis portrays the presence of crucial phytochemicals present in it. Various studies proved that *E.alsinoides* (L.) L. carries nootropic effect and it is indeed a potent plant for the treatment of brain disorders.

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