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An Experimental Comparative study to evaluate Medhya Karma (Intellectual property) of *Convolvulus pluricaulis* Choisy . & *Evolvulus alsinoides* L. on healthy Albino Wistar Rats - An In Vivo Study

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Abstract: ***Background: Shankhpushpi is described in Ayurveda among the Medhya Rasayana drugs and is traditionally associated with Dhi, Dhriti and Smriti. Convolvulus pluricaulis Choisy. and Evolvulus alsinoides L. are two botanically distinct plants used as Shankhpushpi and Neel Shankhpushpi (Vishnukranta), respectively. This study comparatively evaluated their pharmacognostical and phytochemical characteristics and their Medhya Karma in a scopolamine-induced memory impairment model in Albino Wistar rats. Methods: Authenticated whole-plant samples were subjected to organoleptic, microscopic, powder-microscopic, physicochemical and preliminary phytochemical evaluation, followed by TLC fingerprinting. Twenty-four male Albino Wistar rats were divided into four groups (n=6): normal control, disease control, C. pluricaulis-treated and E. alsinoides-treated. Test drugs were administered orally for 14 days at 270 mg/kg body weight; scopolamine hydrobromide (0.3 mg/kg, i.p.) was administered on days 8–10 in the disease and treatment groups. Learning and memory were assessed by Radial Arm Maze and Cook's Pole Climbing tests. Brain histopathology was performed after the experimental period. Data were expressed as mean ± SEM and analyzed using two-way ANOVA followed by Dunnett's multiple-comparison test. Results: C. pluricaulis showed foreign matter 1.43%, loss on drying 4.30%, pH 7.8, total ash 8.3%, acid-insoluble ash 2.4%, water-soluble ash 1.86%, and water-, methanol-, glacial acetic acid- and chloroform-soluble extractives of 8.6%, 3.1%, 6.3% and 2.9%, respectively. E. alsinoides showed corresponding values of 0.54%, 3.83%, 5.8, 6.2%, 1.22%, 2.8%, and 13.7%, 7.8%, 3.4% and 2.8%. Both samples were positive for carbohydrates, alkaloids, amino acids, saponins, glycosides, tannins and reducing sugars; protein was negative in C. pluricaulis and positive in E. alsinoides. TLC produced five spots for each sample, with Rf values of 0.15, 0.30, 0.48, 0.65 and 0.81 for C. pluricaulis and 0.13, 0.27, 0.44, 0.62 and 0.84 for E. alsinoides. In the Radial Arm Maze, C. pluricaulis reduced mean arm entries from 5.50 ± 0.671 to 2.83 ± 0.601 (P=0.0028), while E. alsinoides reduced them from 5.67 ± 0.558 to 2.67 ± 0.333 (P=0.0008). In the Pole Climbing test, C. pluricaulis reduced latency from 3.73 ± 0.208 to 3.15 ± 0.204 s (P=0.1458), whereas E. alsinoides reduced it from 4.42 ± 0.250 to 3.07 ± 0.475 s (P=0.0002). Histopathology showed marked hippocampal/dentate-gyrus degeneration in the disease-control group and only mild degeneration with preserved architecture in both treatment groups. Conclusion: Both drugs demonstrated Medhya and neuroprotective activity under the experimental conditions, with E. alsinoides showing comparatively greater cognitive benefit, particularly in conditioned learning retention.***
Keywords: Medhya Rasayana; Shankhpushpi; Convolvulus pluricaulis; Evolvulus alsinoides; cognition; memory; Radial Arm Maze; Cook's Pole Climbing; scopolamine; pharmacognosy; phytochemistry; neuroprotection.

I. INTRODUCTION

Ayurveda recognizes *Medha* as a higher mental faculty closely related to *Dhi* (comprehension/intellect), *Dhriti* (retention) and *Smriti* (memory). The classical concept of *Medhya Rasayana* encompasses measures and drugs intended to support intellectual performance, memory, mental stability and healthy ageing. *Shankhpushpi* occupies an important position in this group.

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Convolvulus pluricaulis Choisy. and *Evolvulus alsinoides* L., both belonging to Convolvulaceae, are among the species used under identity of *Shankhpushpi* and *Neel Shankhpushpi* (*Vishnukranta*), respectively. Although their traditional therapeutic reputation overlaps, their macroscopic, microscopic and chemical characteristics are not identical. Correct botanical identification is therefore important for standardization, reproducibility of pharmacological experiments and interpretation of therapeutic claims. This study specifically addressed this issue by combining pharmacognostical authentication, physicochemical evaluation, preliminary phytochemical screening and TLC fingerprinting with an experimental assessment of *Medhya Karma.* A scopolamine-induced memory impairment model was used to challenge cognitive performance, while Radial Arm Maze and Cook's Pole Climbing tests provided complementary behavioural measures. Histopathological examination of the brain was used to relate behavioural changes to tissue-level alterations.

II. AIM AND OBJECTIVES

1) To comparatively evaluate the *Medhya Karma* of *Convolvulus pluricaulis* Choisy. and *Evolvulus alsinoides* L. in Albino Wistar rats and to establish their pharmacognostical and phytochemical characteristics.
2) To establish diagnostic macroscopic, microscopic and powder-microscopic characters of both drugs.
3) To determine foreign matter, loss on drying, pH, ash values and extractive values.
4) To compare preliminary phytochemical profiles and TLC fingerprints.
5) To evaluate learning and memory using Radial Arm Maze and Cook's Pole Climbing tests in a scopolamine-induced impairment model.
6) To correlate behavioural findings with histopathological changes in the hippocampus and dentate gyrus.

III. MATERIALS AND METHODS

A. *Study design and source of material*

The study was an experimental comparative investigation combining pharmacognostical, phytochemical and in vivo components. *C. pluricaulis* was collected from the campus of the Post Graduate Institute of Ayurveda, Jodhpur, whereas *E. alsinoides* was collected from the forest area of Bhavnagar, Gujarat. The whole plants were cleaned, authenticated and separately powdered. The test formulation used in the animal experiment was *Churna*.

B. *Pharmacognostical evaluation*

Organoleptic and macroscopic observations were recorded. Microscopic sections were prepared after preservation in FAA and were examined before and after staining with phloroglucinol and concentrated hydrochloric acid. Powder microscopy included unstained and stained preparations together with microchemical tests using iodine, sulphuric acid, hydrochloric acid and acetic acid. Diagnostic structures included epidermis, cortex, endodermis, vascular bundles, xylem, medullary rays, pith, trichomes, fibres, starch grains and calcium oxalate crystals.

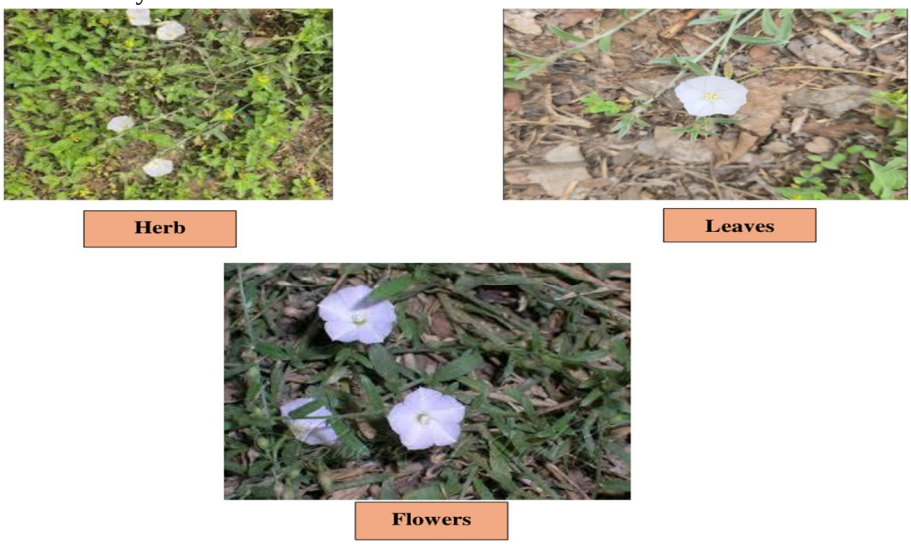

Figure 1. *Convolvulus pluricaulis*: herb, leaves and flowers.

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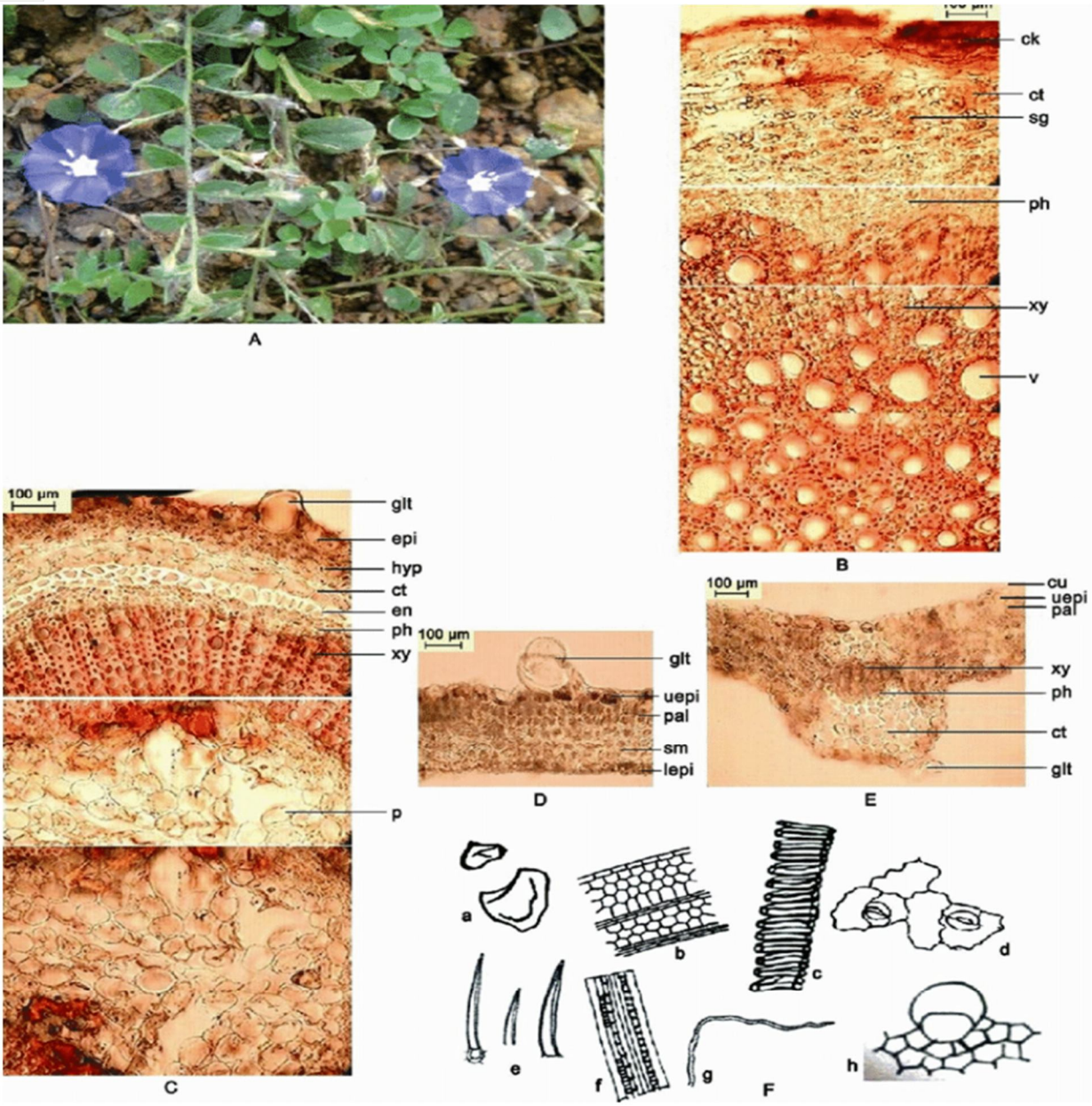

Fig. 4.2 : Microscopy of the whole plant of *Evolvulous alsinoides*. **A**: Whole plant, **B**: T.S. Root, **C**: T.S. Stem, **D; E**: T.S. Leaf and **F**: Powder-a: prismatic crystals, b: parenchymatous cells, c: xylem vessel, d: epidermal cells with stomata, e: trichome, f: bundle of xylem fibres and vessels, g: fibre, h: glandular trichome. **Abbreviations**: ck-cork; ct-cortex; glt-glandular trichome; hyp-hypodermis; lepi-lower epidermis; p-pith; pal-palisade layer; ph-phloem; sg-starch grains; sm-spongy mesophyll; uepi-upper epidermis; v-vessels; xy-xylem.

Figure 2. *Evolvulus alsinoides*: whole plant with transverse sections of root, stem and leaf and powder features.

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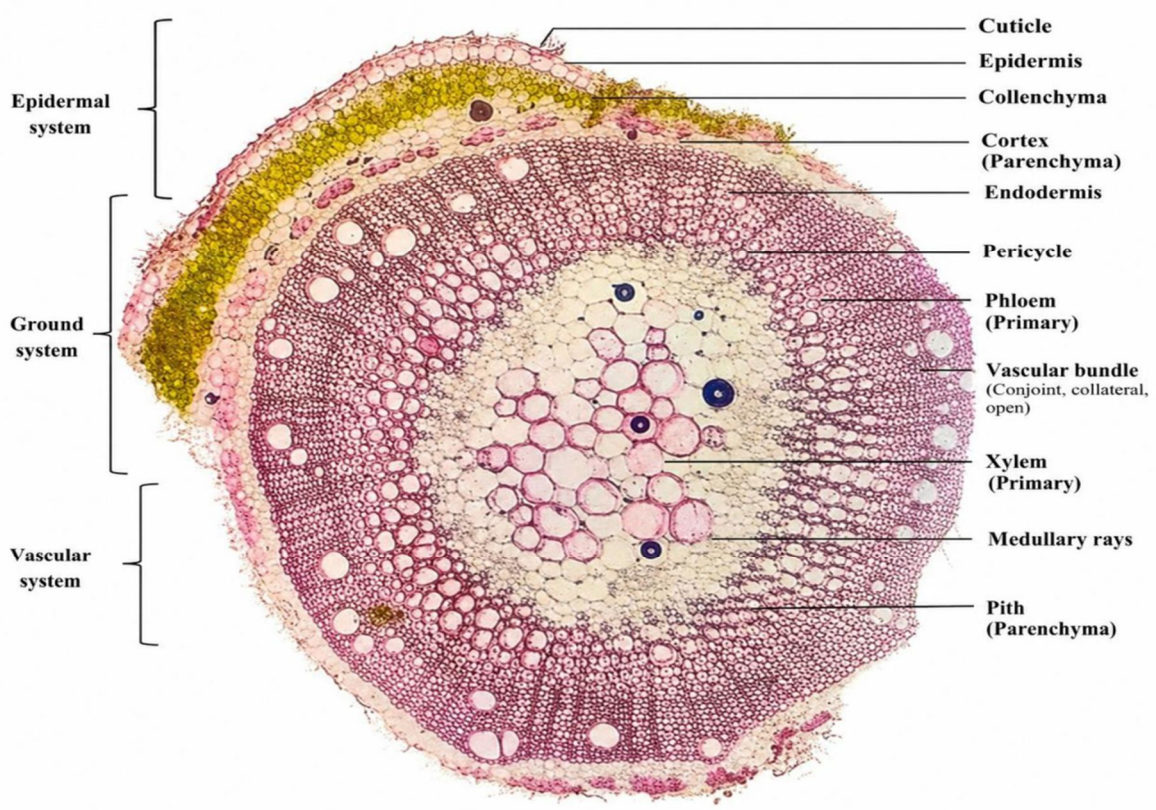

Figure 3. Transverse section of *Convolvulus pluricaulis* stem showing labelled anatomical regions.

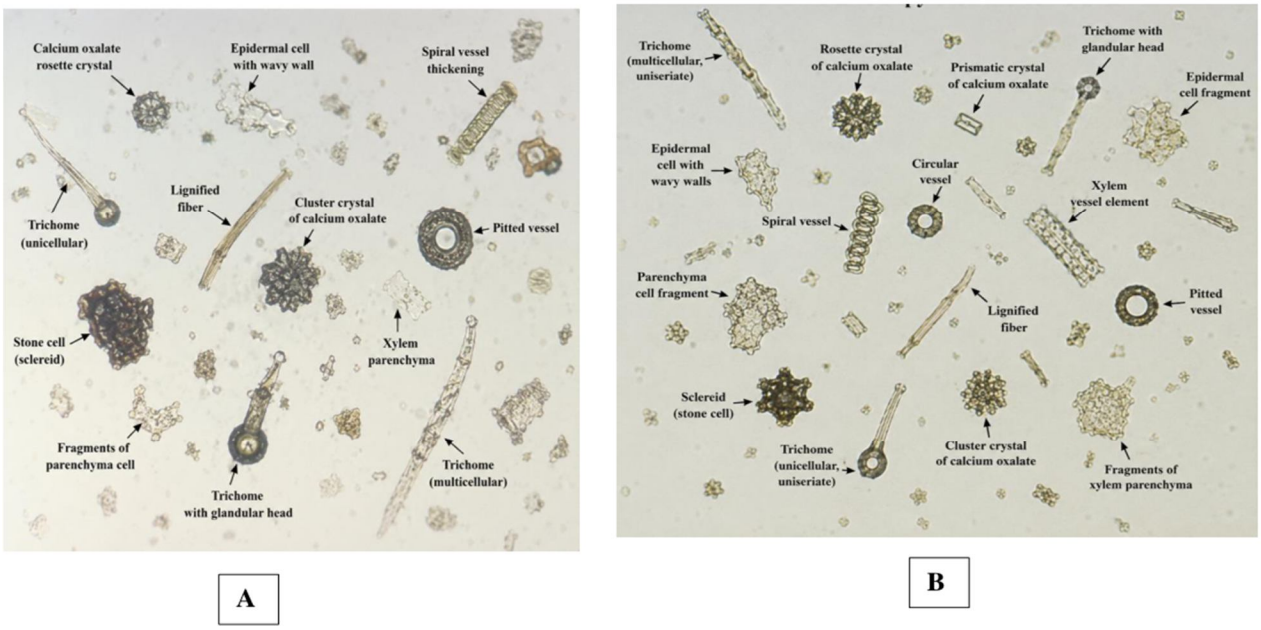

Figure 4. Comparative powder microscopy: A—*C. pluricaulis*; B—*E. alsinoides.*

C. Physicochemical and phytochemical analysis

Foreign matter was determined from a 5-g sample. Loss on drying was measured after oven drying at 105°C to constant weight. A 10% aqueous solution was used for pH determination. Total ash was determined after ignition of 6 g powdered drug at approximately 450°C. Acid-insoluble and water-soluble ash were subsequently determined. Extractive values were determined by maceration using distilled water, methanol, glacial acetic acid and chloroform. Preliminary phytochemical tests were performed for carbohydrates, alkaloids, amino acids, proteins, saponins, glycosides, tannins and reducing sugars. Calcium, iron, phosphorus and potassium were qualitatively tested in the ash. TLC was performed on silica gel 60 F254 plates and visualized under UV light at 366 nm.

D. In vivo experimental design

Twenty-four healthy Albino Wistar rats (approximately 120–150 g at selection) were divided into four groups of six. Group I received 0.5% CMC (5 mL/kg) and served as normal control. Group II received 0.5% CMC and scopolamine hydrobromide (0.3 mg/kg, i.p.) as disease control. Group III received *C. pluricaulis Churna* 270 mg/kg orally once daily for 14 days plus scopolamine on days 8–10. Group IV received *E. alsinoides Churna* 270 mg/kg orally once daily for 14 days plus scopolamine on days 8–10. Scopolamine was administered one hour after oral treatment.

Ethical approvals included approvals from Ethics Committee (DSRRAU/PGIA/IEC/23-24/795) and Institutional Animal Ethics Committee (BMRL/DIC/CCSEA/IAEC/2025/10/06). The experimental section reports two behavioural models: Radial Arm Maze for spatial learning/working memory and Cook's Pole Climbing for conditioned learning and memory retention.

E. Behavioural assessment and histopathology

In the Radial Arm Maze, the total number of arm entries was recorded over days 0, 7 and 14. Lower entries were interpreted in the study as improved acquisition of spatial memory. In the Cook's Pole Climbing test, latency to climb after the conditioned stimulus was recorded; lower latency represented better retention. At the end of the experimental period, brains were isolated, fixed in 10% neutral buffered formalin, processed for paraffin embedding, sectioned at 5 µm and stained with haematoxylin and eosin. Sections were examined for neuronal morphology, hippocampal architecture and dentate-gyrus changes. Statistical analysis was performed using GraphPad Prism; data were expressed as mean ± SEM and analyzed by two-way ANOVA followed by Dunnett's multiple-comparison test, with $P<0.05$ considered significant.

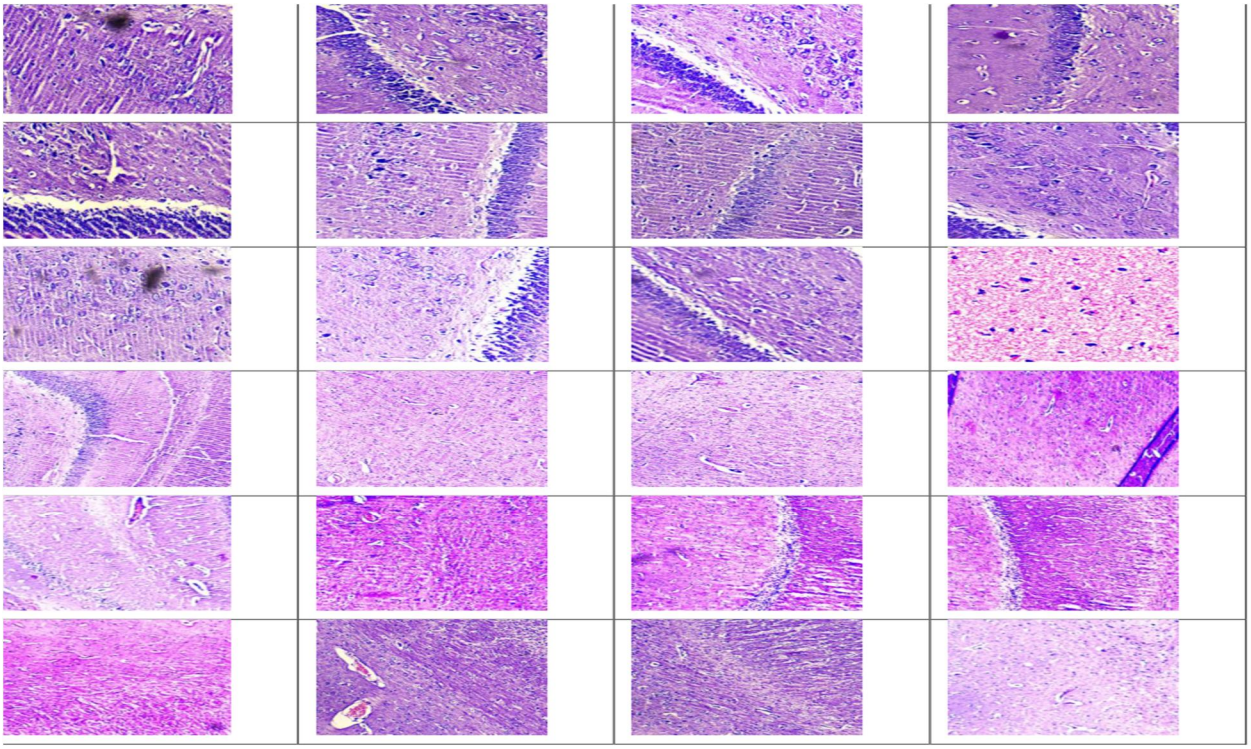

Figure 5. Brain histopathology across experimental groups I–IV.

IV. RESULTS

A. Pharmacognostical Observations

Both samples showed a faint herbaceous odour and slightly bitter, mildly astringent taste. *C. pluricaulis* was described as green to greyish-green with slender, delicate stems and sparse hairs, whereas *E. alsinoides* was greyish-green to green and distinctly silky or pubescent because of fine hairs. Both were prostrate to ascending, much-branched herbs with small leaves and funnel-shaped flowers. Microscopically, both exhibited a single-layered epidermis, cortex, endodermis, collateral open vascular bundles, medullary rays and parenchymatous pith. *C. pluricaulis* showed abundant multicellular uniseriate covering trichomes; *E. alsinoides* showed unicellular to multicellular covering trichomes and a differentiated collenchymatous hypodermis. Powder microscopy revealed parenchyma, epidermal fragments with stomata, lignified xylem vessels, fibres, starch grains, trichomes, medullary rays and occasional calcium oxalate crystals.

B. Physicochemical analytical results

Parameter	*C. pluricaulis*	*E. alsinoides*
Foreign matter (%)	1.43	0.54
Loss on drying (%)	4.30	3.83
pH (10% aqueous solution)	7.8	5.8
Total ash (%)	8.30	6.20
Acid-insoluble ash (%)	2.40	1.22
Water-soluble ash (%)	1.86	2.80
Water-soluble extractive (%)	8.60	13.70
Methanol-soluble extractive (%)	3.10	7.80
Glacial acetic acid-soluble extractive (%)	6.30	3.40
Chloroform-soluble extractive (%)	2.90	2.80

E. alsinoides had lower foreign matter and moisture than *C. pluricaulis*. *C. pluricaulis* showed higher total ash and acid-insoluble ash, whereas *E. alsinoides* showed higher water-soluble ash. The most marked difference in extractive values was observed for water and methanol, with *E. alsinoides* yielding 13.7% and 7.8%, respectively, compared with 8.6% and 3.1% for *C. pluricaulis*. *C. pluricaulis* had higher glacial acetic acid extractive value (6.3% vs 3.4%), while chloroform extractives were closely similar (2.9% vs 2.8%).

C. Preliminary phytochemical screening

Phytochemical class	**Test**	***C. pluricaulis***	***E. alsinoides***
Carbohydrates	Molisch; Benedict	Positive; Positive	Positive; Positive
Alkaloids	Wagner	Positive	Positive
Amino acids	Ninhydrin	Positive	Positive
Proteins	Millon	Negative	Positive
Saponins	Foam test	Positive	Positive
Glycosides	Keller–Killiani	Positive	Positive
Tannins	Ferric chloride; Vanillin	Positive; Positive	Positive; Positive
Reducing sugars	Benedict	Positive	Positive

The ash of both samples tested positive for calcium, iron, phosphorus and potassium. The qualitative profile therefore demonstrated broadly overlapping phytochemical classes, with protein detection distinguishing the two samples in the reported screening.

D. TLC fingerprinting

Sample	Mobile phase	Solvent front (cm)	Spot distance (cm)	Rf
C. pluricaulis	Ethyl acetate:toluene:acetic acid 5:4:1	8	1.18	0.15
		8	2.36	0.30
		8	3.84	0.48
		8	5.20	0.65
		8	6.48	0.81
E. alsinoides	Ethyl acetate:acetic acid:formic acid:water 10:1.1:1.1:2.6	8	1.04	0.13
		8	2.16	0.27
		8	3.52	0.44
		8	4.96	0.62
		8	6.72	0.84

E. Radial Arm Maze results

Group	Day 0	Day 7	Day 14
Group I – Normal control	5.67 ± 0.333	4.33 ± 0.333	3.33 ± 0.422
Group II – Disease control	5.00 ± 0.683	7.33 ± 0.494	7.17 ± 0.703
Group III –*C.pluricaulis*	5.50 ± 0.671	3.83 ± 0.601	2.83 ± 0.601
Group IV – *E.alsinoides*	5.67 ± 0.558	3.17 ± 0.792	2.67 ± 0.333

Dunnett's within-group comparisons reported significant Day-0 to Day-14 improvement for the normal control (mean difference 2.333; 95% CI 0.5239–4.143; P=0.0094), disease-control change (mean difference −2.167; 95% CI −3.976 to −0.3573; P=0.0165), *C. pluricaulis* (mean difference 2.667; 95% CI 0.8573–4.476; P=0.0028) and *E. alsinoides* (mean difference 3.000; 95% CI 1.191–4.809; P=0.0008). For the treatment groups, the numerical reduction in arm entries was greater with E. alsinoides.

F. Cook's Pole Climbing results

Group	**Day 0 (s)**	**Day 7 (s)**	**Day 14 (s)**
Group I – Normal control	3.15 ± 0.170	2.72 ± 0.190	2.76 ± 0.201
Group II – Disease control	4.35 ± 0.063	4.03 ± 0.188	3.91 ± 0.205
Group III – *C.pluricaulis*	3.73 ± 0.208	3.43 ± 0.200	3.15 ± 0.204
Group IV – *E.alsinoides*	4.42 ± 0.250	2.81 ± 0.191	3.07 ± 0.475

The normal-control group maintained low latency. The disease-control group showed persistently prolonged latency. *C. pluricaulis* reduced latency from 3.73 ± 0.208 s to 3.15 ± 0.204 s, but the Day-0 versus Day-14 comparison was not statistically significant (mean difference 0.5750; 95% CI −0.1628 to 1.313; P=0.1458). *E. alsinoides* reduced latency from 4.42 ± 0.250 s to 3.07 ± 0.475 s; the Day-0 versus Day-7 and Day-0 versus Day-14 comparisons were highly significant (mean differences 1.608 and 1.345, respectively; P<0.0001 and P=0.0002).

G. Histopathological Findings

Group	Histopathological interpretation
I – Normal control	No inflammatory or other cellular alterations; dentate gyrus and hippocampal architecture normal.
II – Disease control	Marked hippocampal architectural alteration and dentate-gyrus degeneration; neuronal swelling/rounding and eosinophilic neuronal necrosis reported.
III – *C. pluricaulis*	Mild dentate-gyrus deterioration; overall cellular morphology comparatively preserved.
IV – *E. alsinoides*	Mild dentate-gyrus deterioration; cellular architecture comparatively preserved.

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The histological observations were directionally concordant with the behavioural results. The disease-control group showed the greatest structural injury, whereas both treatment groups showed preservation of neuronal architecture with only mild dentate-gyrus changes.

V. DISCUSSION

The present study provides an integrated comparison of two botanically distinct drugs used as *Shankhpushpi* and *Neel Shankhpushpi* (*Vishnukranta*) and links their identity, physicochemical profile, phytochemical composition and experimental cognitive activity. The pharmacognostical findings are particularly relevant because substitution of closely related or traditionally conflated plant materials can compromise reproducibility. The two samples showed overlapping family-level anatomical features but also useful differentiating characters. The abundant multicellular uniseriate covering trichomes described for *C. pluricaulis* and the combination of unicellular/multicellular trichomes with a differentiated collenchymatous hypodermis in *E. alsinoides* provide practical microscopic markers for authentication.

The physicochemical results further support differentiation. *E. alsinoides* contained less foreign matter (0.54% vs 1.43%) and lower loss on drying (3.83% vs 4.30%), while *C. pluricaulis* showed greater total ash and acid-insoluble ash. The higher water- and methanol-soluble extractives of *E. alsinoides* suggest a greater proportion of constituents soluble in these polar solvents under the conditions used. These values should be interpreted as study-specific quality-control observations rather than universal pharmacopoeial limits, because geographical origin, harvesting stage, drying, storage and extraction procedures can affect crude-drug parameters.

The phytochemical screening demonstrated broad qualitative overlap. Both samples were positive for carbohydrates, alkaloids, amino acids, saponins, glycosides, tannins and reducing sugars, while protein was reported only in *E. alsinoides*. The study also discovered the presence of calcium, iron, phosphorus and potassium in the ash of both samples. The TLC fingerprints produced five spots in each species but with distinct Rf distributions. *C. pluricaulis* showed Rf values of 0.15, 0.30, 0.48, 0.65 and 0.81, whereas *E. alsinoides* showed 0.13, 0.27, 0.44, 0.62 and 0.84. These fingerprints are useful as preliminary comparative identity markers; they do not by themselves establish the identity of individual compounds.

The behavioural experiment demonstrated that scopolamine produced the expected impairment pattern in the disease-control group. In the Radial Arm Maze, the disease-control group increased arm entries from 5.00 ± 0.683 to 7.17 ± 0.703, whereas both treatment groups showed reductions. *C. pluricaulis* decreased entries from 5.50 ± 0.671 to 2.83 ± 0.601 (P=0.0028), and *E. alsinoides* decreased them from 5.67 ± 0.558 to 2.67 ± 0.333 (P=0.0008). Under the study's interpretation, these reductions indicate better acquisition of spatial learning and working memory.

The Cook's Pole Climbing findings are particularly informative for comparative interpretation. *C. pluricaulis* showed a numerical improvement, but its Day-0 versus Day-14 change was not significant (P=0.1458). *E. alsinoides* showed a marked and statistically significant reduction in latency, with P<0.0001 for Day 0 versus Day 7 and P=0.0002 for Day 0 versus Day 14. Thus, although both drugs showed cognitive benefit across the study, *E. alsinoides* produced the more consistent effect in conditioned learning retention. Histopathology strengthened this interpretation. Scopolamine-associated injury in the disease-control group was characterized by hippocampal architectural disruption, dentate-gyrus degeneration and eosinophilic neuronal necrosis. Both treatments were associated with preservation of tissue architecture and only mild dentate-gyrus degeneration. The convergence of behavioural and histological observations supports a neuroprotective component to the reported *Medhya* activity.

From an Ayurvedic perspective, the study explains the observed activity through *Medhya Rasayana* action, *Tikta* and *Madhura Rasa*, *Sara* and *Picchila Guna*, predominantly *Shita Virya*, *Madhura Vipaka* and *Tridosha-shamaka* action, with particular relevance to *Prana Vata* and *Sadhaka Pitta* and nourishment of *Majja Dhatu*. The modern interpretation proposed in the study relates the observed activity to phytoconstituents such as alkaloids, flavonoids, coumarins, glycosides, triterpenoids, steroids, phenolic compounds and saponins and their reported antioxidant, neuroprotective, anti-inflammatory and cholinergic-modulatory potential. These mechanistic explanations remain hypotheses in the context of the present experiment because neurotransmitter concentrations, oxidative-stress biomarkers and molecular targets were not directly measured.

The overall comparative result favoured *E. alsinoides*. Its greater water- and methanol-soluble extractives, distinct TLC profile, significant Pole Climbing improvement and numerically greater Radial Arm Maze reduction provide a coherent experimental signal. Nevertheless, superiority should be interpreted only within the specific dose, model, duration and outcome measures used. The study does not establish clinical superiority in humans.

VI. PROBABLE INTEGRATIVE INTERPRETATION OF MEDHYA KARMA

The findings may be organized into a pharmacognosy-to-pharmacology framework. First, botanical authentication reduces uncertainty regarding the test material. Second, physicochemical and TLC profiles provide reproducible quality-control descriptors. Third, preliminary phytochemistry demonstrates multiple classes of potentially active constituents. Fourth, the behavioural models indicate improvement in spatial and conditioned memory. Finally, preservation of hippocampal and dentate-gyrus morphology provides structural support for the behavioural observations. This integrated chain is consistent with the Ayurvedic concept that the therapeutic identity of a *Dravya* depends not only on its name but also on its authentic physical characteristics, properties and actions.

VII. LIMITATIONS AND FUTURE RESEARCH

The study was performed in a small animal sample (n=6 per group) and over a relatively short period. The phytochemical work was primarily qualitative, and TLC spots were not assigned to individual compounds. No quantitative marker assay, neurotransmitter estimation, oxidative-stress profiling or molecular target analysis was reported. Therefore, mechanistic explanations should be regarded as probable rather than definitive. Human clinical studies are required before therapeutic recommendations can be generalized.

VIII. CONCLUSION

Both *Convolvulus pluricaulis* Choisy. and *Evolvulus alsinoides* L. demonstrated significant *Medhya* activity under the experimental conditions of the study. Their distinct pharmacognostical characters, physicochemical profiles and TLC fingerprints support botanical differentiation and quality control. Both drugs improved performance in the Radial Arm Maze, while *E. alsinoides* produced the more consistent improvement in Cook's Pole Climbing. Histopathology showed preservation of hippocampal and dentate-gyrus architecture in both treatment groups compared with marked degeneration in the scopolamine disease-control group. Overall, *E. alsinoides* exhibited comparatively superior cognition-enhancing activity, but both drugs warrant further standardized phytochemical, mechanistic and clinical investigation.

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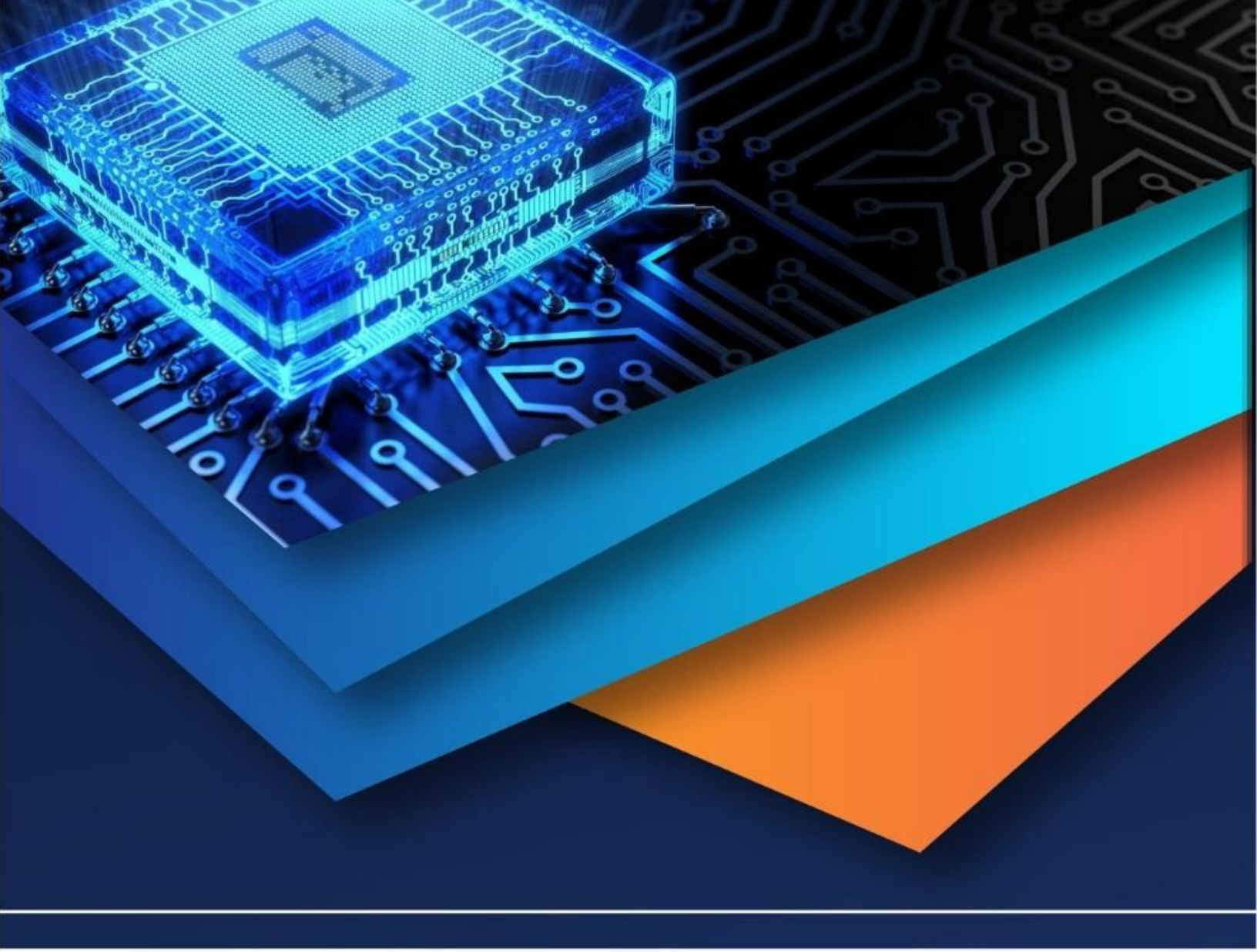

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