

Development, Characterization and Pharmacological Evaluation of NeuroZen Polyherbal Powder Formulation for Neuropsychiatric Disorders

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ABSTRACT

Background Neuropsychiatric disorders represent a broad group of conditions associated with alterations in cognition, mood, anxiety, behavior, stress response, and neurological function. The limitations and adverse effects associated with some conventional therapies have encouraged investigation of complementary and polyherbal approaches. Medicinal plants such as *Bacopa monnieri*, *Withania somnifera*, *Curcuma longa*, *Nardostachys jatamansi*, and *Mucuna pruriens* possess phytoconstituents associated with neuroprotective, antioxidant, adaptogenic, anxiolytic, antidepressant, and cognitive-supporting activities. Materials and Methods NeuroZen was formulated using ethanolic extracts of Brahmi (*Bacopa monnieri*) whole plant, Ashwagandha (*Withania somnifera*) root, Turmeric (*Curcuma longa*) rhizome, Jatamansi (*Nardostachys jatamansi*) rhizome, and Mucuna (*Mucuna pruriens*) seeds. A representative 100-g formulation contained 25 g Brahmi extract, 25 g Ashwagandha extract, 20 g Turmeric extract, 15 g Jatamansi extract, and 15 g Mucuna extract. The formulation was evaluated for organoleptic, physicochemical, flow, particle-size, pH, phytochemical, and marker-characterization parameters. Pharmacological evaluation in Swiss albino mice was designed using control, standard, and NeuroZen treatment groups at 200 and 400 mg/kg. Nootropic, anxiolytic, antidepressant-like, locomotor, hyperexcitability, and social-interaction parameters were assessed according to the experimental protocols described in the study.

Keywords: NeuroZen; Polyherbal formulation; *Bacopa monnieri*; *Withania somnifera*; *Curcuma longa*; *Nardostachys jatamansi*; *Mucuna pruriens*; Neuropsychiatric disorders; Nootropic activity; Anxiolytic activity; Neuroprotection.

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1 INTRODUCTION

Neuropsychiatric disorders comprise a diverse group of conditions affecting emotional state, cognition, behavior, and neurological functioning. Anxiety, depressive symptoms, cognitive impairment, stress-related disturbances, and other CNS-associated conditions can substantially affect quality of life. Their multifactorial nature involves interactions among neurotransmitter systems, oxidative stress, neuroinflammation, neuroendocrine responses, and neuronal plasticity.

Although several synthetic drugs are available for the management of individual neuropsychiatric conditions, long-term pharmacotherapy may be associated with adverse effects, tolerability problems, drug interactions, and incomplete therapeutic

response. These limitations have stimulated interest in medicinal plants and standardized polyherbal preparations as potential complementary approaches.

Polyherbal formulations are based on the concept that several botanicals may provide complementary pharmacological activities. A properly standardized combination may theoretically influence multiple biological pathways simultaneously. However, such formulations require systematic evaluation of identity, quality, physicochemical characteristics, phytochemical composition, pharmacological activity, and safety.

The present investigation focused on five medicinal plants with reported CNS-related activities.

Brahmi (*Bacopa monnieri*) contains bacosides and has been investigated for memory and learning

enhancement, neuroprotection, anxiolytic and antioxidant effects.

Ashwagandha (*Withania somnifera*) contains withanolides and is traditionally recognized for adaptogenic and stress-modulating properties. The supplied study material identifies adaptogenic, anxiolytic, immunomodulatory, anti-inflammatory, and neuroprotective activities.

Turmeric (*Curcuma longa*) contains curcumin, a major polyphenolic constituent associated with antioxidant and anti-inflammatory activity and reported neuroprotective potential.

Jatamansi (*Nardostachys jatamansi*) contains constituents including jatamansone and has traditionally been investigated for CNS-related effects including sedative, anxiolytic, antidepressant-like, anticonvulsant, and neuroprotective activities.

Mucuna (*Mucuna pruriens*) seeds contain L-DOPA, a precursor of dopamine, and have particular relevance to dopaminergic function.

The supplied formulation data identify these five botanicals as the active components of the polyherbal powder and describe their major pharmacological themes, including CNS activity, adaptogenic effects, neuroprotection, and antioxidant/anti-inflammatory activity.

Therefore, the present study was designed to develop and characterize **NeuroZen polyherbal powder formulation** and investigate its potential pharmacological effects using experimental behavioral models.

2 MATERIALS AND METHODS

2.1 Plant Materials

The formulation consisted of:

Plant	Botanical name	Part used	Extract	Major marker/active constituent
Brahmi	<i>Bacopa monnieri</i>	Whole plant	Ethanolic	Bacosides
Ashwagandha	<i>Withania somnifera</i>	Root	Ethanolic	Withanolides
Turmeric	<i>Curcuma longa</i>	Rhizome	Ethanolic	Curcumin
Jatamansi	<i>Nardostachys jatamansi</i>	Rhizome	Ethanolic	Jatamansone
Mucuna	<i>Mucuna pruriens</i>	Seeds	Ethanolic	L-DOPA

These plant parts, extraction solvents, and marker constituents correspond to the supplied formulation material.

2.2 Formulation Composition

NeuroZen was prepared as a 100-g polyherbal powder formulation.

Ingredient	Quantity
Brahmi extract	25 g
Ashwagandha extract	25 g
Turmeric extract	20 g
Jatamansi extract	15 g
Mucuna extract	15 g
Total	100 g

The supplied formulation describes this as an example 100-g batch, with the ratio potentially

2.3 Preparation of NeuroZen Powder

The dried extracts were processed individually to obtain a fine and uniform powder. Where necessary, drying was carried out at approximately 40–45°C. The powdered materials were passed through sieve No. 60 to obtain uniform particle size.

The accurately weighed extracts were subsequently blended by geometric dilution to obtain a homogeneous mixture. The final powder was transferred into an airtight, moisture-resistant container and appropriately labelled.

The preparation sequence was:

Parameter	Observation
Colour	Brownish green
Odour	Characteristic aromatic
Taste	Slightly bitter
Texture	Fine powder
Appearance	Homogeneous and free flowing

These observations are reported in the supplied characterization data.

3.2 Physicochemical Evaluation

Loss on Drying

Loss on drying was determined at 105°C.

modified according to therapeutic requirements.

**Drying → Pulverization → Sieving → Weighing
→ Geometric mixing → NeuroZen powder**

→ Packaging and storage.

This preparation procedure follows the supplied formulation protocol.

3 Evaluation of NeuroZen Powder

3.1 Organoleptic Evaluation

The formulation was evaluated for colour, odour, taste, texture, and appearance.

Observed value: 4.6% w/w.

Ash Values

Parameter	Result (% w/w)
Total ash	7.5
Acid-insoluble ash	1.8
Water-soluble ash	3.9

Extractive Values:

Extractive parameter	Result (% w/w)
Alcohol-soluble extractive	11.8
Water-soluble extractive	13.2

The above physicochemical values are taken directly from the supplied formulation characterization data.

4 Flow Properties

4.1 Bulk and Tapped Density

Parameter	Result
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Bulk density	0.46 g/mL
Tapped density	0.56 g/mL

4.2 Carr's Compressibility Index

Carr's index was calculated using:

$$\text{Carr's Index} = \frac{(\text{Tapped density} - \text{Bulk density})}{\text{Tapped density}} \times 100$$

Using the supplied values:

$$\text{Carr's Index} = \frac{(0.56 - 0.46)}{0.56} \times 100 = 17.8\%$$

The supplied interpretation describes this as fair-to-good flow.

4.3 Hausner's Ratio

$$\text{Hausner's Ratio} = \frac{\text{Tapped density}}{\text{Bulk density}} = \frac{0.56}{0.46} = 1.21$$

The supplied data describe this as an acceptable flow property.

4.4 Angle of Repose

The reported angle of repose was 32° , indicating good flow characteristics according to the supplied interpretation.

The density, Carr's index, Hausner's ratio, and angle-of-repose data are reported in the source material.

5 Particle Size and pH

The powder was passed through sieve No. 60, providing a fine and relatively uniform powder. The pH of a 1% w/v aqueous solution/dispersion was reported as:

$$\text{pH} = 6.1$$

The supplied material describes the pH as suitable for oral administration.

6 Preliminary Phytochemical Screening

The formulation was screened for selected phytochemical classes.

Phytoconstituent	Test	Result
Alkaloids	Dragendorff's test	Positive
Saponins	Froth test	Positive
Flavonoids	Shinoda test	Positive
Glycosides	Keller–Killiani test	Positive
Phenolics	Ferric chloride test	Positive

The supplied data report positive results for all five listed phytochemical groups.

7 Chromatographic Marker Characterization

Marker analysis was performed for selected characteristic constituents.

Marker compound	Reported Rf value
Curcumin	0.62
Withanolides	0.48
Bacosides	0.35

These chromatographic values are those reported in the supplied material.

8 Pharmacological Evaluation

The supplied experimental protocol describes the use of Swiss albino mice.

8.1 Experimental Animals

Parameter	Details
Species	Swiss albino mice
Sex	Either sex

Body weight	20–30 g
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Parameter	Details
Animals	6 per group
Housing	Standard laboratory conditions
Ethical framework	CPCSEA guidelines

The supplied protocol specifies standard laboratory conditions and CPCSEA-based ethical considerations.

200 mg/kg

400 mg/kg

8.2 Test Formulation

NeuroZen polyherbal powder was administered orally. The supplied protocol specifies distilled water/1% CMC as vehicle and doses of:

The treatment was administered by oral gavage in the experimental protocol.

8.3 Experimental Groups

Group	Treatment
Group I	Vehicle control
Group II	Standard drug
Group III	NeuroZen 200 mg/kg
Group IV	NeuroZen 400 mg/kg

The supplied protocol identifies standard drugs according to the behavioral model, including diazepam for anxiolytic assessment and piracetam for memory-related assessment.

9 Nootropic Activity

Elevated Plus Maze – Transfer Latency Method

Transfer latency was used as an indicator of learning and memory. According to the supplied protocol, a reduction in transfer latency indicates improvement in learning and memory.

Measurements were taken on Day 1 and Day 7. The supplied observations describe:

- ☐ Control: high transfer latency.
- ☐ Standard: significantly reduced transfer latency.
- ☐ NeuroZen 200 mg/kg: reduced transfer latency.
- ☐ NeuroZen 400 mg/kg: markedly reduced transfer latency.

The source interprets these findings as evidence of memory-enhancing activity.

10 Anxiolytic Activity Elevated Plus Maze

Open-arm entries and time spent in the open arms were used as behavioral indicators of anxiolytic activity.

The supplied observations indicate that NeuroZen produced an increase in open-arm activity, with the 400 mg/kg dose showing a greater response than the 200 mg/kg dose.

The supplied interpretation describes NeuroZen as exhibiting anxiolytic activity comparable to the standard in the reported observations.

11 Antidepressant-Like Activity Forced Swim Test

The forced swim test was used to evaluate antidepressant-like behavioral activity. Reduction in immobility time was considered indicative of antidepressant-like activity.

The supplied observations report:

- ☐ High immobility in the control group.
- ☐ Significant reduction with the standard.
- ☐ Reduction with NeuroZen 200 mg/kg.

- Marked reduction with NeuroZen 400 mg/kg.

The supplied interpretation indicates antidepressant-like activity of NeuroZen.

Scientific caution: Forced swim test findings should be described as **antidepressant-like behavioral activity**, rather than proof that the formulation treats clinical depression.

12 Locomotor Activity Actophotometer Test

Locomotor activity was assessed to identify possible motor impairment or excessive sedation.

Group	General observation
Control	High hyperexcitability
Standard	Low activity
NeuroZen 200 mg/kg	Moderate activity
NeuroZen 400 mg/kg	Low activity

The supplied interpretation describes a dose-dependent calming effect.

14 Social Interaction Test

Social interaction behavior was evaluated by measuring interaction between unfamiliar mice. The supplied observations indicate:

- Control: low social interaction.
- Standard: high social interaction.
- NeuroZen 200 mg/kg: moderate increase.
- NeuroZen 400 mg/kg: high increase.

The source interprets the increased social interaction as evidence of anxiolytic activity.

15 RESULTS

The developed NeuroZen polyherbal powder exhibited satisfactory organoleptic properties and acceptable physicochemical characteristics. The formulation had a loss on drying of 4.6% w/w, total ash of 7.5% w/w, acid-insoluble ash of 1.8% w/w, and water-soluble ash of 3.9% w/w. Alcohol-soluble and water-soluble extractive values were 11.8% and 13.2% w/w, respectively.

The powder showed a bulk density of 0.46 g/mL and tapped density of 0.56 g/mL. Carr's index and Hausner's ratio were 17.8% and 1.21, respectively, while the angle of repose was 32°, indicating acceptable flow characteristics according to the supplied evaluation.

The supplied observations indicate that the 200 mg/kg formulation produced near-normal locomotor activity, while the 400 mg/kg dose showed only slight reduction. The source therefore interprets the formulation as not producing marked motor impairment.

13 Hyperexcitability Test

The supplied protocol assessed CNS hyperexcitability by observing behaviors such as jumping, rearing, and vocalization.

The reported observations indicate:

The formulation showed positive phytochemical reactions for alkaloids, saponins, flavonoids, glycosides, and phenolic compounds. Chromatographic marker characterization reported R_f values of 0.62, 0.48, and 0.35 for curcumin, withanolides, and bacosides, respectively.

In the supplied pharmacological observations, NeuroZen demonstrated dose-related activity across several behavioral models. The 400 mg/kg dose generally produced greater effects than the 200 mg/kg dose. The reported findings included reduced transfer latency, increased open-arm activity, reduced immobility, reduced hyperexcitability, and increased social interaction.

16 DISCUSSION

The development of NeuroZen was based on combining five botanicals with complementary pharmacological profiles. The formulation includes Brahmi, Ashwagandha, Turmeric, Jatamansi, and Mucuna, which collectively provide several phytochemical classes and reported CNS-related activities.

Brahmi contributes bacosides and is associated with cognitive and neuroprotective activity. Ashwagandha contributes withanolides and may support adaptogenic and stress-related effects. Curcumin from Turmeric provides an important antioxidant and anti-inflammatory component. Jatamansi contributes CNS-active constituents, while Mucuna provides L-DOPA, which is relevant to dopaminergic pathways.

The physicochemical characterization demonstrated that the prepared powder possessed suitable powder-handling characteristics. The Carr's index, Hausner's ratio, and angle of repose indicated acceptable flow, which is important for reproducibility during handling and dosing.

The positive phytochemical screening supports the presence of several classes of bioactive constituents. The chromatographic marker results further provide preliminary evidence of characteristic constituents associated with some of the principal botanical ingredients.

The pharmacological observations suggest that NeuroZen may exert multiple CNS-related effects. Improvement in transfer latency suggests a potential nootropic effect, while increased open-arm activity and social interaction suggest anxiolytic-like effects. Reduction in forced-swim immobility indicates antidepressant-like behavioral activity. Reduction in hyperexcitability may indicate CNS-calming effects.

The multi-component nature of NeuroZen is particularly relevant because neuropsychiatric disorders involve multiple interacting biological processes rather than a single pharmacological target. Antioxidant, anti-inflammatory, adaptogenic, neurotransmitter-related, and neuroprotective activities may therefore contribute collectively to the observed behavioral effects.

However, these findings should be interpreted as **preclinical evidence**. Behavioral tests in rodents cannot by themselves establish clinical efficacy in human neuropsychiatric disorders.

Further studies are necessary to establish pharmacokinetics, mechanism of action, toxicity, dose-response relationships, standardization, and clinical relevance.

17 Proposed Mechanistic Rationale

A possible integrated mechanism can be represented as:

NeuroZen Powder

↓

Bacosides + Withanolides + Curcumin + Jatamansi constituents + L-DOPA

↓

Antioxidant activity + modulation of inflammatory pathways + stress-response modulation + neurotransmitter-related effects

↓

Neuroprotection + reduced oxidative stress + improved neuronal function

↓

Potential improvement in learning, memory, anxiety-related behavior and mood-related behavioral parameters

The supplied material similarly presents combined CNS action involving neuroprotection, stress reduction, neurotransmitter balance, cognitive enhancement, and mood stabilization.

18 Statistical Analysis

The supplied experimental protocol specifies:

- One-way analysis of variance (ANOVA)
- Dunnett's post-hoc test
- Statistical significance at $p < 0.05$

For the final journal manuscript, the actual numerical observations should be presented as **mean**

± **SEM**, together with the exact sample size and exact p-values wherever possible.

19 CONCLUSION

The present study describes the development and characterization of **NeuroZen**, a polyherbal powder formulation containing extracts of Brahmi, Ashwagandha, Turmeric, Jatamansi, and Mucuna. The formulation demonstrated satisfactory organoleptic characteristics,

physicochemical properties, powder-flow characteristics, phytochemical profile, and preliminary chromatographic marker characterization.

The pharmacological observations supplied for the experimental model indicate promising nootropic, anxiolytic-like, antidepressant-like, calming, and social-interaction effects, with generally greater responses observed at the 400 mg/kg dose.

The combination of botanicals with complementary phytochemical and pharmacological properties provides a rational basis for further investigation of NeuroZen as a potential polyherbal CNS-modulating formulation. Nevertheless, the current findings should be considered preliminary preclinical evidence, and further standardized pharmacological, toxicological, mechanistic, and clinical studies are

necessary before therapeutic conclusions can be drawn.

20 Declarations Ethics Approval

Animal experiments were conducted in accordance with the applicable institutional and CPCSEA guidelines after obtaining approval from the Institutional Animal Ethics Committee (IAEC), Approval No. IAEC:1877/PO/Re/S/16/CCSEA/2025/001 dated 13th December 2025.

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