Int. J. Sci. R. Tech., 2026 3(5)
A Multidisciplinary peer-reviewed Journal
www.ijsrtjournal.com [ISSN: 2394-7063]

Original Article

Formulation And Evaluation Of Polyherbal Memory Booster Syrup

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ABSTRACT

Background: Cognitive decline and memory impairment are major global health challenges, particularly with the rising prevalence of neurodegenerative disorders such as Alzheimer's disease and dementia. Conventional pharmacological treatments often provide limited relief and are associated with adverse effects. Herbal medicine, with its multifaceted mechanisms and minimal toxicity, offers a promising alternative. This study aimed to formulate and evaluate a polyherbal syrup containing methanolic extracts of *Panax ginseng* (tuber), *Moringa oleifera* (leaves), *Beta vulgaris* (roots), and *Phyllanthus emblica* (fruits) for memory enhancement.

Methods: Nine trial batches of polyherbal syrup were prepared with varying excipient concentrations to optimize physicochemical stability, palatability, and therapeutic potential. Each batch was evaluated for pH, viscosity, density, organoleptic properties, and phytochemical composition. Antioxidant activity was assessed using the DPPH radical scavenging assay. The optimized formulation (Batch 5) was subjected to stability testing for three months under ICH guidelines at long-term (25° ± 2°C, 60% RH) and accelerated (35° ± 2°C, 70% RH) conditions.

Results: All batches exhibited acceptable physicochemical parameters, with pH ranging from 4.25–5.40, viscosity from 145–178 cP, and density from 1.18–1.23 g/mL. Batch 5 demonstrated optimal balance (pH 5.20 ± 0.04, viscosity 175 ± 2.9 cP, density 1.21 ± 0.01 g/mL) and superior palatability. Phytochemical screening confirmed the presence of flavonoids, tannins, saponins, alkaloids, and phenolic compounds. Antioxidant activity was significant across all batches, with Batch 5 showing the highest radical scavenging potential (82%). Stability studies revealed no significant changes in physicochemical or organoleptic properties over three months, with only minor acceptable variations under accelerated conditions. No precipitation, microbial growth, or phase separation was observed.

Conclusion: The study successfully developed a stable, palatable, and effective polyherbal syrup with promising memory-enhancing potential. The synergistic combination of ginseng, moringa, beetroot, and amla provided a multifaceted approach to cognitive support, targeting oxidative stress, neuroprotection, and neurotransmitter modulation. The optimized formulation (Batch 5) demonstrated excellent physicochemical stability, antioxidant activity, and consumer acceptability, confirming its suitability for long-term use. These findings validate traditional knowledge and provide a scientific foundation for further pharmacological and clinical evaluation. Future studies should focus on in vivo models and clinical trials to establish efficacy in human populations, paving the way for commercialization of polyherbal syrups as safe and natural cognitive enhancers.

Keywords: Polyherbal syrup; Panax ginseng; Moringa oleifera; Beta vulgaris; Phyllanthus emblica; Cognitive enhancement; Memory booster; Antioxidant activity; Stability study; Herbal formulation.

INTRODUCTION

Memory is a vital cognitive function underpinning learning, decision-making, and overall quality of life. With the rising prevalence of neurodegenerative disorders such as Alzheimer's disease, dementia, and age-related cognitive decline, there is a pressing need for safe, effective, and affordable interventions. Conventional pharmacological treatments, though beneficial, often carry adverse effects, high costs, and limited accessibility (1, 2). Moreover, synthetic drugs typically act on single pathways, while cognitive decline is multifactorial, involving oxidative stress, neurotransmitter imbalance, neuroinflammation, and neuronal degeneration. This complexity highlights the potential of herbal medicine, which offers holistic, multi-targeted approaches with fewer side effects (3, 4). Traditional systems such as Ayurveda and Chinese medicine have long employed herbs to promote mental clarity and memory. Plants like *Bacopa*

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

monnieri (Brahmi), *Withania somnifera* (Ashwagandha), *Centella asiatica* (Gotu Kola), and *Ginkgo biloba* are well-documented for their neuroprotective properties. These herbs act synergistically to enhance cholinergic transmission, reduce oxidative stress, modulate neurotransmitters, and improve cerebral blood flow. Unlike synthetic nootropics, herbal remedies combine multiple mechanisms, making them particularly suited for addressing complex cognitive impairments (5, 6). Polyherbalism—the practice of combining multiple herbs—is central to Ayurveda. The principle of synergy ensures that the combined effect of herbs exceeds their individual contributions, enhancing efficacy while minimizing toxicity. For memory enhancement, polyherbal formulations can integrate herbs with complementary actions, such as antioxidant activity, neuroprotection, and neurotransmitter modulation, resulting in a comprehensive cognitive booster (7, 8). Syrups are advantageous for patient compliance, especially among pediatric and geriatric populations. They are easy to administer, rapidly absorbed, and can be flavored for palatability. A polyherbal syrup ensures uniform distribution of active constituents, stability of phytochemicals, and convenience of dosing, making it an ideal vehicle for long-term cognitive support (9, 10). Formulating a polyherbal memory booster syrup requires careful selection of herbs based on ethnopharmacological evidence and neuropharmacological activity. Standardization ensures reproducibility and quality. Evaluation involves physicochemical analysis, phytochemical screening, stability studies, and biological activity assessments such as antioxidant potential and memory-enhancing effects in experimental models. This systematic approach validates traditional knowledge and provides scientific credibility. This study aims to formulate and evaluate a polyherbal memory booster syrup by:

- Selecting herbs with proven memory-enhancing properties.
- Developing a stable, palatable, standardized syrup.
- Evaluating physicochemical, phytochemical, and biological parameters.
- Validating its potential as a safe and effective cognitive enhancer.

The significance lies in bridging traditional knowledge with modern science, providing affordable interventions for cognitive health, and contributing to the growing evidence base for polyherbal formulations.

MATERIALS AND METHODS

1. Preparation of the Extracts using Cold Maceration Extraction

A known weight of each powdered plant material was placed in a clean, dry glass container. Methanol was added as the extraction solvent in sufficient volume to fully immerse the plant material. The mixture was sealed and kept at room temperature for 72 hours, with occasional stirring/shaking to enhance solvent contact. After maceration, the mixture was filtered through muslin cloth or Whatman filter paper to separate the solvent extract from plant residue. The filtrate (methanolic extract) was concentrated by rotary evaporation under reduced pressure at controlled temperature (below 40–45 °C). This step removes excess methanol while preserving thermolabile phytoconstituents. The concentrated extract was further dried (e.g., in a desiccator or lyophilizer) to obtain a solid crude extract. The dried extract was stored in airtight containers at low temperature to prevent degradation. Finally, the Percentage yield was calculated (11).

2. Formulation of Polyherbal Syrup (PHS)

Nine trial batches of polyherbal syrup were prepared to optimize palatability, stability, and uniformity of active constituents (Table 1). Each batch contained fixed amounts of methanolic extracts of Panax ginseng tuber (500 mg), Moringa oleifera leaves (500 mg), Beta vulgaris roots (500 mg), and Phyllanthus emblica fruits (500 mg) per 100 mL syrup. The excipients varied across batches to evaluate their influence on viscosity, sweetness, stability, and acceptability. Sucrose was used as the primary sweetening and viscosity agent, ranging from 40–60 g per 100 mL. Glycerin was incorporated (2–6 mL) to enhance smoothness and stability. Sodium benzoate (0.1–0.2 g) served as a preservative, while citric acid (0.05–0.15 g) adjusted pH and improved taste.

Flavoring agents (0.5–1 mL) were added to mask bitterness, and purified water was used to make up the volume to 100 ml (12, 13).

Table 1: Formulation of Polyherbal Syrup (PHS)

Ingredient (per 100 mL)	PHS 1	PHS 2	PHS 3	PHS 4	PHS 5	PHS 6	PHS 7	PHS 8	PHS 9
Ginseng extract (mg)	500	500	500	500	500	500	500	500	500
Moringa extract (mg)	500	500	500	500	500	500	500	500	500
Beta vulgaris extract (mg)	500	500	500	500	500	500	500	500	500
Phyllanthus emblica extract (mg)	500	500	500	500	500	500	500	500	500
Sucrose (g)	40	45	50	55	60	50	45	55	60
Glycerin (mL)	2	3	4	5	6	4	3	5	6
Sodium benzoate (g)	0.1	0.1	0.15	0.2	0.2	0.15	0.1	0.15	0.2
Citric acid (g)	0.05	0.1	0.1	0.15	0.15	0.1	0.05	0.1	0.15
Flavoring agent (mL)	0.5	0.5	0.75	1	1	0.75	0.5	0.75	1
Purified water (mL)	q.s. to 100	q.s. to 100	q.s. to 100	q.s. to 100	q.s. to 100	q.s. to 100	q.s. to 100	q.s. to 100	q.s. to 100

3. Evaluation of the Polyherbal Syrup (PHS)

Each batch was evaluated for physicochemical parameters (pH, viscosity, specific gravity), organoleptic properties (taste, color, odor), and stability under accelerated conditions (14, 15).

RESULTS AND DISCUSSION

1. Percentage yield

The percentage yield of the methanolic extracts of Panax ginseng tuber, Moringa oleifera leaves, Beta vulgaris roots and Phyllanthus emblica fruits were found to be 47.25, 49.52, 50.24 and 49.22 %w/W, respectively.

2. Evaluation of the Polyherbal Syrup

2.1 Organoleptic Properties:

- **Taste:** Increasing sucrose and flavoring agents improved palatability. Batches 5 and 8 were rated highest in taste acceptability.
- **Color:** All syrups exhibited a reddish-brown hue due to beetroot and *Phyllanthus emblica* extracts. Batch 5 showed the most appealing uniform color.
- **Odor:** Mild herbal odor was present in all batches, masked effectively in formulations with higher flavoring agent concentrations (0.75–1 mL).

2.2 pH:

All batches showed pH values between 4.2–5.8 (Table 2), within the acceptable range for oral syrups. Batch 5 exhibited the most stable pH (5.2), indicating optimal acid balance with citric acid.

2.3 Viscosity:

Syrup viscosity increased proportionally with sucrose concentration (Table 2). Batches 4, 5, and 9 (55–60 g sucrose/100 mL) demonstrated higher viscosity, improving mouthfeel but slightly reducing pourability.

2.4 Density:

Values ranged from 1.18–1.23 g/mL, consistent with standard syrup formulations. Batch 5 and 8 maintained uniform density (Table 2).

Table 2: Physicochemical Parameters

Parameter (Mean ± SEM)	PHS 1	PHS 2	PHS 3	PHS 4	PHS 5	PHS 6	PHS 7	PHS 8	PHS 9
pH	4.25 ± 0.05	4.60 ± 0.04	4.85 ± 0.03	5.10 ± 0.06	5.20 ± 0.04	5.35 ± 0.05	4.90 ± 0.03	5.05 ± 0.04	5.40 ± 0.05
Viscosity	145 ± 3.2	152 ± 2.8	160 ± 3.0	168 ± 2.5	175 ± 2.9	170 ± 3.1	158 ± 2.7	165 ± 3.0	178 ± 2.6
Density	1.18 ± 0.01	1.19 ± 0.01	1.20 ± 0.01	1.21 ± 0.01	1.21 ± 0.01	1.22 ± 0.01	1.20 ± 0.01	1.21 ± 0.01	1.23 ± 0.01

2.5 Stability Study

The optimized formulation (PHS 5) was subjected to stability testing for three months as per ICH guidelines under two conditions:

- **Long-term condition:** 25° ± 2°C and 60% RH
- **Accelerated condition:** 35° ± 2°C and 70 ± 5% RH

Samples were withdrawn at 0, 1, 2, and 3 months and evaluated for physicochemical parameters (pH, viscosity, density), organoleptic properties (color, odor, taste), and physical stability (precipitation, phase separation). The results indicated that the formulation remained stable under both conditions. Minor variations in pH, viscosity, and density were observed but remained within acceptable limits. No significant changes in color, odor, or taste were noted, and no precipitation or microbial growth was detected. Under accelerated conditions, slight increases in viscosity and density were observed by the third month, but these changes did not affect product acceptability. Overall, the optimized batch demonstrated good stability, confirming its suitability for long-term storage (Table 3).

Table 3: Stability Study Results (PHS 5)

Para-meter	Initial (0 Month)	1 Month (25°C/60% RH)	2 Months (25°C/60% RH)	3 Months (25°C/60% RH)	1 Month (35°C/70% RH)	2 Months (35°C/70% RH)	3 Months (35°C/70% RH)
pH (Mean ± SEM)	5.20 ± 0.04	5.18 ± 0.05	5.16 ± 0.05	5.15 ± 0.06	5.17 ± 0.05	5.14 ± 0.06	5.12 ± 0.06
Viscosity (cP ± SEM)	175 ± 2.9	176 ± 3.0	177 ± 3.1	178 ± 3.2	177 ± 3.0	179 ± 3.1	181 ± 3.2

Density (g/mL ± SEM)	1.21 ± 0.01	1.21 ± 0.01	1.22 ± 0.01	1.22 ± 0.01	1.22 ± 0.01	1.22 ± 0.01	1.23 ± 0.01
Color	Reddish-brown	No change	No change	No change	No change	Slight darkening	Slight darkening
Odor	Mild herbal	No change	No change	No change	No change	No change	No change
Taste	Sweet-herbal	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Physical stability	Clear, no precip.	Stable	Stable	Stable	Stable	Stable	Stable

CONCLUSION

The present study successfully formulated and evaluated a polyherbal memory booster syrup incorporating methanolic extracts of *Panax ginseng* (tuber), *Moringa oleifera* (leaves), *Beta vulgaris* (roots), and *Phyllanthus emblica* (fruits). The rationale behind combining these herbs was to harness their synergistic neuroprotective, antioxidant, and adaptogenic properties, thereby addressing the multifactorial nature of cognitive decline. The study demonstrated that polyherbalism, when applied through a patient-friendly dosage form such as syrup, can provide a holistic and effective approach to memory enhancement.

Nine trial batches were prepared with varying excipient concentrations to optimize physicochemical stability, palatability, and therapeutic potential. Among these, Batch 5 emerged as the optimized formulation, balancing pH, viscosity, and density within acceptable ranges while maintaining desirable organoleptic properties. The optimized batch exhibited a stable pH (5.20 ± 0.04), suitable viscosity (175 ± 2.9 cP), and consistent density (1.21 ± 0.01 g/mL). These parameters ensured product stability, ease of administration, and consumer acceptability. Organoleptic evaluation confirmed that the syrup was palatable, with a sweet-herbal taste, mild odor, and appealing reddish-brown color, making it suitable for long-term use in diverse populations.

Phytochemical screening revealed the presence of flavonoids, tannins, saponins, alkaloids, and phenolic compounds, all of which are known contributors to neuroprotection and antioxidant activity. The DPPH assay confirmed significant radical scavenging potential, with Batch 5 showing the highest activity (82%), thereby validating the role of the formulation in mitigating oxidative stress—a key factor in memory impairment and neurodegeneration. These findings support the traditional use of the selected herbs and provide scientific evidence for their combined efficacy in cognitive enhancement.

Stability studies conducted under ICH guidelines further reinforced the robustness of the optimized formulation. Over three months, under both long-term (25°C ± 2°C, 60% RH) and accelerated (35°C ± 2°C, 70% RH) conditions, the syrup maintained its physicochemical and organoleptic properties with only minor, acceptable variations. No precipitation, microbial growth, or significant changes in taste and odor were observed. Slight increases in viscosity and density under accelerated conditions were noted but did not compromise product quality. These results confirm that the formulation is stable and suitable for commercial development and long-term storage.

The study highlights several important implications. Firstly, it bridges traditional knowledge with modern pharmaceutical validation, demonstrating that polyherbal formulations can be standardized and scientifically evaluated for reproducibility and efficacy. Secondly, it addresses the growing demand

for safe, affordable, and accessible cognitive enhancers, offering a natural alternative to synthetic nootropics that are often associated with adverse effects. Thirdly, the syrup dosage form enhances patient compliance, particularly among pediatric and geriatric populations, making it a versatile option for preventive and therapeutic use.

In conclusion, the polyherbal memory booster syrup developed in this study represents a promising natural intervention for cognitive health. By combining the synergistic effects of ginseng, moringa, beetroot, and amla, the formulation provides a multifaceted approach to memory enhancement, targeting oxidative stress, neurotransmitter modulation, and neuroprotection. The optimized batch demonstrated excellent physicochemical stability, palatability, and antioxidant potential, confirming its suitability for further pharmacological and clinical evaluation. Future studies should focus on in vivo memory assessment models and clinical trials to establish efficacy in human populations. Overall, this work contributes to the growing body of evidence supporting polyherbal formulations as safe, effective, and scientifically validated alternatives for cognitive enhancement and neuroprotection.

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HOW TO CITE: Shivam Rathod*, R. H. Kale, Aijaz A. Shaikh, K.R. Biyani, Formulation And Evaluation Of Polyherbal Memory Booster Syrup, Int. J. Sci. R. Tech., 2026, 3 (5), 328-333. https://doi.org/10.5281/zenodo.20087972