To Formulate and Evaluate a Polyherbal Brain Tonic Syrup Containing Clitoria Ternatea, Bacopa Monnieri, And Ocimum Tenuiflorum for Cognitive Enhancement.

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***Abstract*—Herbal medicines have been widely used in traditional systems of medicine for improving cognitive function and maintaining brain health. Polyherbal formulations are gaining popularity due to their synergistic therapeutic effects and reduced side effects. The present study focuses on the formulation and evaluation of a polyherbal brain tonic syrup containing extracts of Clitoria ternatea (Aparajita), Bacopa monnieri (Brahmi), and Ocimum tenuiflorum (Tulsi). These medicinal plants are traditionally known for their neuroprotective, antioxidant, and memory-enhancing properties.**

The plant materials were collected, shade dried, and extracted using hydroalcoholic extraction methods. The extracts were incorporated into a syrup base prepared using sucrose, citric acid, and sodium benzoate. The prepared formulation was evaluated for organoleptic properties, pH, viscosity, specific gravity, and stability. Preliminary phytochemical screening and antioxidant studies were also performed.

The formulated syrup showed acceptable physicochemical properties and potential antioxidant activity. The study indicates that the polyherbal formulation may serve as a natural brain tonic for improving cognitive function and memory.

***Index Terms*—Keywords: Polyherbal formulation, Cognitive enhancement, Clitoria ternatea, Bacopa monnieri, Ocimum tenuiflorum, Antioxidant activity, Neuroprotection, Brain tonic syrup. Keywords: Polyherbal formulation; Cognitive enhancement; Herbal nootropics; Antioxidant activity; Neuroprotection.**

Aim And Objectives

Aim: To formulate and evaluate a polyherbal brain tonic syrup containing Clitoria ternatea, Bacopa monnieri, and Ocimum tenuiflorum for cognitive enhancement.

Objectives:

1. Collection and authentication of medicinal plant materials.
2. Preparation of plant extracts using suitable extraction methods.
3. Formulation of a polyherbal brain tonic syrup.
4. Evaluation of physicochemical properties of the formulation.
5. Study of antioxidant activity and stability of the syrup.

I. INTRODUCTION

The human brain is one of the most complex and vital organs in the body, responsible for regulating cognitive functions such as memory, learning, thinking, decision-making, and emotional control. Cognitive health plays a crucial role in maintaining overall quality of life, and its decline is commonly associated with aging, stress, poor lifestyle, and neurological disorders such as Alzheimer's disease and dementia. In recent years, there has been a significant increase in cognitive impairment cases due to modern lifestyle factors, making it a major global health concern.

One of the primary factors contributing to cognitive decline is oxidative stress, which results from an imbalance between free radicals and antioxidants in the body. The brain is particularly susceptible to oxidative damage due to its high oxygen consumption and lipid-rich composition. Excessive production of reactive oxygen species (ROS) can lead to neuronal damage, impaired synaptic transmission, and reduced cognitive function. Therefore, the use of antioxidant-

rich therapies has gained importance in the prevention and management of neurodegenerative conditions.

Herbal medicines have been widely used in traditional systems of medicine such as Ayurveda for the management of cognitive disorders and enhancement of mental performance. Medicinal plants contain various bioactive compounds including alkaloids, flavonoids, glycosides, tannins, and phenolic compounds, which exhibit significant pharmacological activities such as antioxidant, anti-inflammatory, neuroprotective, and adaptogenic effects. Unlike synthetic drugs, herbal medicines are generally considered safer, cost-effective, and suitable for long-term use with minimal side effects.

In recent years, the concept of polyherbal formulations has gained considerable attention in pharmaceutical research. Polyherbal formulations involve the combination of two or more medicinal plants to achieve enhanced therapeutic efficacy through synergistic interactions. This approach not only improves the overall effectiveness of the formulation but also helps in reducing toxicity and improving patient compliance. The combination of herbs with complementary mechanisms of action provides a holistic approach to treatment.

Clitoria ternatea is widely recognized for its antioxidant and neuroprotective properties. The plant contains anthocyanins and flavonoids that protect neurons against oxidative stress.

Bacopa monnieri is one of the most important Ayurvedic herbs used for memory enhancement. The plant contains bacosides that improve learning ability and cognitive performance.

Ocimum tenuiflorum is known for its adaptogenic properties and helps the body cope with stress. It also possesses antioxidant and anti-inflammatory activities that contribute to brain health.

The combination of these three medicinal plants in a polyherbal formulation may provide synergistic benefits for improving cognitive function and memory.

Figure l: Herbal medicines have been widely used in traditional systems of medicine such as Ayurveda for the management of cognitive disorders and enhancement of mental performance

II. REVIEW OF LITERATURE

Kongkeaw et al. (2014) conducted a systematic review on Bacopa monnieri and reported significant improvement in memory performance and cognitive function in human subjects. The study concluded that bacosides present in the plant enhance synaptic activity and neuronal communication, thereby improving learning ability (Journal of Ethnopharmacology) [1].

Pattana yak et al. (2010) reviewed the pharmacological properties of Ocimum tenuiflorum and found that it possesses strong adaptogenic, antioxidant, and anti-inflammatory activities. The study highlighted its role in reducing stress and improving mental performance (Pharmacognosy Reviews) [2].

Tiwari et al. (2014) investigated the neuroprotective effects of Clitoria ternatea and reported significant improvement in memory and learning in experimental models. The presence of flavonoids and anthocyanins was identified as the key factor responsible for its antioxidant activity (Pharmaceutical Biology) [3].

Bhattacharya et al. (2000) studied the antioxidant activity of Bacopa monnieri and demonstrated its ability to reduce oxidative stress in the brain. The study concluded that the herb enhances cognitive performance by protecting neuronal cells (Phytotherapy Research) [4].

Sairam et al. (2002) evaluated the anti-stress activity of Ocimum tenuiflorum and reported that it significantly reduces stress-induced biochemical changes. This adaptogenic effect contributes to

improved cognitive function (Journal of Ethnopharmacology) [5].

Aguiar and Borowski (2013) reviewed the neuropharmacological effects of Bacopa monnieri and concluded that it improves memory acquisition and retention by enhancing cholinergic function (Medical Hypotheses) [6].

Rai et al. (2012) reported that Ocimum tenuiflorum enhances cognitive function by reducing cortisol levels and improving antioxidant defense systems. The study emphasized its role as a natural brain tonic (Journal of Ayurveda and Integrative Medicine) [7].

Meena et al. (2011) reviewed the pharmacological properties of Clitoria ternatea and reported its potential in improving memory and treating neurological disorders. The study highlighted its antioxidant and neuroprotective activities (International Journal of Pharmaceutical Sciences) [8].

Singh and Dhawan (1997) conducted experimental studies on Bacopa monnieri and demonstrated its role in improving learning ability and memory retention in animal models (Indian Journal of Pharmacology) [9].

Goyal et al. (2007) studied the pharmacological properties of Ocimum tenuiflorum and confirmed its antioxidant, anti-inflammatory, and neuroprotective effects, which contribute to improved brain function (Indian Journal of Experimental Biology) [10].

Kumar et al. (2010) reported that herbal drugs with antioxidant properties play a significant role in preventing neurodegenerative disorders. The study emphasized the importance of natural therapies in cognitive enhancement (Journal of Chemical and Pharmaceutical Research) [11].

Patel et al. (2011) highlighted the importance of polyherbal formulations in improving therapeutic efficacy. The study concluded that the synergistic effect of multiple herbs enhances pharmacological activity (Phytomedicine) [12].

Gupta et al. (2013) reported that polyherbal formulations show better antioxidant and neuroprotective activity compared to single-herb extracts due to synergistic interactions (Journal of Pharmaceutical Research) [13].

Sahu et al. (2012) studied herbal brain tonics and concluded that they improve memory, concentration, and learning ability with minimal side effects (Asian Journal of Pharmaceutical and Clinical Research) [14].

Yadav et al. (2014) reviewed the role of herbal nootropics in cognitive enhancement and reported that plant-based formulations provide safer alternatives to synthetic drugs with fewer adverse effects (Journal of Pharmacognosy and Phytochemistry) [15].

III. DRUG PROFILE:

3.1 Clitoria ternatea (Aparajita)

Figure 3.1: Flower of Clitoria ternatea (Aparajita) showing characteristic blue-violet petals. The plant is a rich source of anthocyanins and flavonoids responsible for its antioxidant and neuroprotective properties.

Clitoria ternate is a perennial climbing herb belonging to the family Fabaceae. The plant is widely used in Ayurvedic medicine for its nootropic and neuroprotective properties. The flowers contain anthocyanins, flavonoids, and triterpenoids which exhibit antioxidant activity.

Studies have reported that extracts of Clitoria ternatea improve memory retention and learning ability in experimental models. The antioxidant activity of the plant helps protect brain cells from oxidative stress and enhances cognitive performance [1]

3.2 Bacopa monnieri (Brahmi):

Figure 3.2: Leaves of Bacopa monnieri (Brahmi), a well-known medicinal plant used for memory

enhancement. The plant contains bacosides which improve synaptic transmission and cognitive function.

Bacopa monnieri is one of the most widely studied medicinal plants used for cognitive enhancement. The plant contains active compounds known as bacosides which play an important role in improving memory and learning.

Research studies have shown that Bacopa monnieri improves synaptic communication and increases neuronal signalling in the brain. It is also known to possess anti-anxiety and adaptogenic properties that help reduce mental stress and improve concentration [2].

3.3 Ocimum tenuiflorum (Tulsi)

Figure 3.3: Leaves of Ocimum tenuiflorum (Tulsi), an adaptogenic herb known for its antioxidant and anti-inflammatory properties that support brain health and stress management.

Ocimum tenuiflorum is an aromatic medicinal plant commonly used in traditional Indian medicine. It contains bioactive compounds such as eugenol, Rosmarinus acid, and ursolic acid which exhibit antioxidant and anti-inflammatory properties.

Tulsi is known as an adaptogenic herb that helps the body cope with physical and psychological stress. Its neuroprotective properties support brain function and may improve cognitive performance [3].

IV. MATERIALS AND METHODS:

4.1 Plant Materials:

Plant	Part Used
Aparajita	Flower
Brahmi	Leaves
Tulsi	Leaves

6.2Chemicals and Reagents:

Chemical	Function
Honey	Syrup base
Citric acid	Flavoring agent
Sodium benzoate	Preservative
Ethanol	Extraction solvent
Distilled water	Vehicle

V. EXTRACTION PROCEDURE

5.1. Drying and Powdering

The collected plant materials were washed with distilled water and shade dried for approximately 5–7 days. The dried materials were then pulverized into coarse powder using a mechanical grinder and stored in airtight containers.

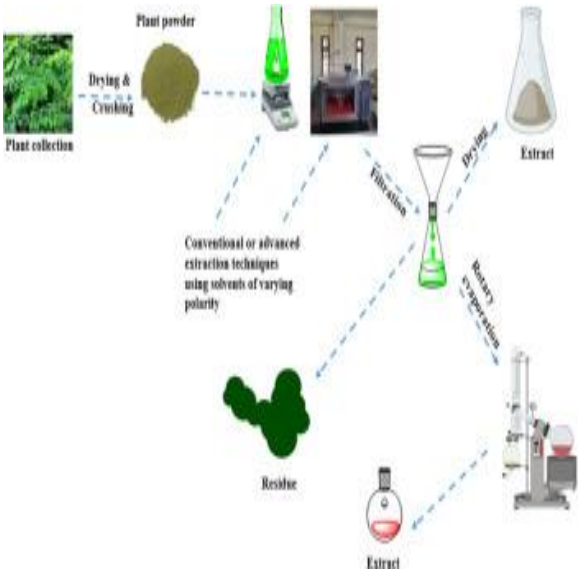

Figure number 5.1: diagrammatic representation of drying, extraction and collection of active ingredients from plants

5.2 Extraction:

Hydroalcoholic extraction was performed using Soxhlet apparatus.

Procedure:

1. Weigh 100 g of powdered plant material.
2. Place the powder in Soxhlet extraction apparatus.
3. Add ethanol-water mixture (70:30) as solvent.
4. Carry out extraction for 6–8 hours.
5. Filter the extract using filter paper.
6. Concentrate the extract using rotary evaporator.
7. Store the extract at refrigerated temperature.

Figure number 7.2: extraction of aparjata flower

VI. FORMULATION OF POLYHERBAL SYRUP

6.1 Formulation Table (100 ml):

Ingredient	Quantity	Role
Aparajita extract	5 ml	Cognitive enhancer
Brahmi extract	5 ml	Memory booster
Tulsi extract	5 ml	Adaptogen
Sucrose	65 g	Syrup base
Citric acid	0.5 g	Flavoring agent
Sodium benzoate	0.2 g	Preservative
Distilled water	q.s	Vehicle


Figure number 6.1: formulation of polyherbal syrup

6.2 Preparation Procedural

1. Sucrose was dissolved in distilled water with gentle heating to prepare simple syrup.
2. The herbal extracts were added slowly with continuous stirring.
3. Citric acid was added to adjust the pH of the formulation.
4. Sodium benzoate was added as preservative.
5. The mixture was filtered using muslin cloth.
6. The prepared syrup was transferred into sterilized amber-colored bottles and stored at room temperature.

VII. EVALUATION OF SYRUP

7.1 Organoleptic Evaluation

Parameter	Observation
Color	Bluish purple
Taste	Sweet herbal
Odor	Characteristic
Appearance	Clear

7.2 Physicochemical Evaluation:

1. pH:

The pH of the syrup was measured using a digital pH meter.

2. Viscosity:

Viscosity was determined using a Brookfield viscometer.

3. Specific Gravity:

Specific gravity was determined using a pycnometer.

7.3 Phytochemical Screening

Phytochemical	Result
Alkaloids	Present
Flavonoids	Present
Tannins	Present
Glycosides	Present

7.4 Antioxidant Activity:

The antioxidant activity of the formulation was evaluated using the DPPH radical scavenging assay. The decrease in absorbance at 517 nm indicated the free radical scavenging activity of the herbal extracts.

7.5. Stability Study:

The stability of the syrup was studied under different storage conditions.

Storage Condition	Duration
Room temperature	30 days
Refrigerated temperature	30 days

Parameters observed included colour, pH, and viscosity.

VIII. RESULTS AND DISCUSSION

The formulated polyherbal syrup exhibited acceptable organoleptic characteristics and physicochemical properties. The pH and viscosity values were found to

be within suitable ranges for oral syrups. Preliminary phytochemical screening confirmed the presence of bioactive compounds such as flavonoids and tannins. The antioxidant activity observed in the formulation may contribute to its neuroprotective properties. The combination of Aparajita, Brahmi, and Tulsi may produce synergistic effects for cognitive enhancement.

8.1 Organoleptic Evaluation

Parameter	Observation
Color	Bluish purple
Odor	Characteristic herbal
Taste	Sweet herbal
Appearance	Clear and smooth

8.2 Physicochemical Parameters

Parameter	Result
pH	4.8
Viscosity	120 cps
Specific gravity	1.20
Density	1.18 g/ml

8.3 Phytochemical Screening Results

Phytochemical	Result
Alkaloids	Present
Flavonoids	Present
Tannins	Present
Saponins	Present
Glycosides	Present

8.4 Antioxidant Activity Results (DPPH Assay)

Concentration (µg/ml)	% Radical Scavenging
20	25%
40	41%
60	56%
80	69%
100	82%

Higher concentration of extract showed increased antioxidant activity.

8.5 Stability Study Results

Day	Color	pH	Observation
0	Purple	4.8	Stable
15	Purple	4.7	No change
30	Purple	4.7	Stable

IX. NOVELTY OF THE FORMULATION

The present study focuses on the development of a polyherbal brain tonic syrup combining three medicinal plants with complementary pharmacological activities.

The novelty of the formulation lies in:

- Combination of three well-known nootropic herbs in a single syrup dosage form.
- Use of natural plant extracts for cognitive enhancement.
- Development of a palatable herbal syrup suitable for oral administration.
- Potential synergistic neuroprotective and antioxidant effects.

Unlike many synthetic cognitive enhancers, the proposed herbal formulation may offer improved safety and reduced adverse effects.

X. FUTURE SCOPE

The present study successfully demonstrated the formulation and preliminary evaluation of a polyherbal brain tonic syrup containing Clitoria ternate, Bacopa monnieri, and Ocimum tenuiflorum. Although the formulation exhibited promising physicochemical properties and antioxidant activity, further research is required to establish its full therapeutic potential and commercial applicability.

Future studies may focus on in vivo pharmacological evaluation using suitable animal models to assess memory-enhancing and neuroprotective effects in detail. These studies can provide insight into the mechanism of action and efficacy of the formulation in improving cognitive functions such as learning, memory retention, and behavioral performance.

In addition, clinical trials in human subjects are essential to validate the safety, efficacy, and dosage of the formulation. Controlled clinical studies can help in establishing the therapeutic potential of the polyherbal syrup in managing cognitive disorders and improving mental performance.

Further research can also be directed toward detailed phytochemical and pharmacokinetic studies to identify and quantify the active constituents responsible for the observed biological activity. Understanding the absorption, distribution, metabolism, and excretion (ADME) of the phytoconstituents will help in optimizing the formulation.

Long-term stability and shelf-life studies under various environmental conditions should be conducted to determine the product's storage requirements and expiration period. This is essential for large-scale production and commercialization of the formulation.

Moreover, the formulation can be further developed into advanced and alternative dosage forms such as capsules, tablets, suspensions, or nano formulations to improve bioavailability, patient compliance, and therapeutic efficacy. Novel drug delivery systems may enhance the targeted delivery of active compounds to the brain.

Future work may also explore the synergistic interactions between the selected medicinal plants at a molecular level to better understand their combined pharmacological effects. This could lead to the development of more effective polyherbal combinations.

Additionally, the formulation has potential for commercial development as a nutraceutical or herbal supplement, provided that regulatory approvals and quality standards are met. Standardization of raw materials and quality control parameters will be crucial for ensuring consistency and safety.

In conclusion, the present formulation provides a strong foundation for further research and development. With advanced studies and clinical validation, this polyherbal brain tonic syrup has the potential to emerge as a safe, effective, and natural alternative for cognitive enhancement and brain health management.

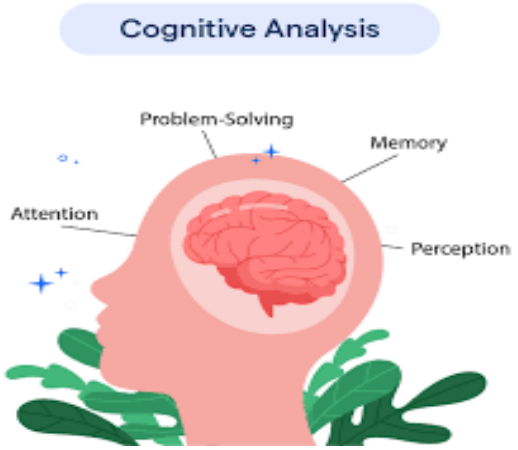

Figure 12: diagrammatic representation of cognitive analysis

XI. CONCLUSION

1. The present study was successfully carried out to formulate and evaluate a polyherbal brain tonic syrup using extracts of Clitoria ternatea, Bacopa monnieri, and Ocimum tenuiflorum. These medicinal plants were selected based on their well-documented neuroprotective, antioxidant, and cognitive-enhancing properties.
2. The prepared formulation exhibited acceptable organoleptic characteristics such as color, taste, odor, and appearance, indicating good patient acceptability. The physicochemical parameters, including pH, viscosity, and specific gravity, were found to be within suitable limits for an oral syrup formulation. Preliminary phytochemical screening confirmed the presence of important bioactive constituents such as flavonoids, alkaloids, tannins, and glycosides, which are known to contribute to therapeutic activity.
3. The antioxidant activity evaluated using the DPPH assay demonstrated significant free radical scavenging potential of the formulation, which may be attributed to the presence of phenolic compounds and flavonoids. The antioxidant property plays a crucial role in protecting neuronal cells from oxidative stress, thereby supporting cognitive function and brain health.
4. The combination of the selected medicinal plants in a single formulation is expected to produce a synergistic effect, enhancing overall therapeutic efficacy compared to individual extracts. The adaptogenic property of Tulsi, memory-enhancing activity of Brahmi, and neuroprotective effect of Aparajita together contribute to improved cognitive performance.
5. Stability studies indicated that the formulation remained stable under different storage conditions, with no significant changes in physicochemical parameters. This suggests that the prepared syrup is suitable for storage and further development.
6. In conclusion, the formulated polyherbal brain tonic syrup shows promising potential as a natural and safe cognitive enhancer. However, further studies including in vivo pharmacological evaluation and clinical trials are recommended to validate its efficacy and establish its therapeutic potential for human use.

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