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Research Paper

Formulation and Evaluation of Polyherbal Gastroprotective Suspension using Bael Fruit Extract

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ABSTRACT

The present research work was carried out to formulate and evaluate a polyherbal gastroprotective suspension using natural herbal ingredients such as ginger, turmeric, bael fruit extract, and isabgol mucilage. Herbal medicines are widely used due to their safety, effectiveness, and minimal side effects compared to synthetic drugs. The prepared suspension was evaluated for various physicochemical parameters including colour, odour, pH, viscosity, sedimentation volume, redispersibility, particle size analysis, and stability study. Phytochemical screening confirmed the presence of flavonoids, tannins, alkaloids, and phenolic compounds responsible for gastroprotective activity. The formulation showed satisfactory stability, good redispersibility, acceptable pH, and suitable organoleptic properties. The synergistic action of herbal ingredients provided promising gastroprotective potential and improved gastric protection. The study concluded that the prepared polyherbal suspension can be considered as a safe and effective herbal formulation for management of gastric disorders and gastrointestinal irritation

INTRODUCTION

Gastrointestinal disorders such as gastric irritation, acidity, indigestion, gastric ulcer, and gastritis are among the most common health problems affecting people worldwide. These disorders may occur due to unhealthy food habits, stress, alcohol consumption, smoking, Helicobacter pylori infection, or prolonged use of non-steroidal anti-inflammatory drugs (NSAIDs). Conventional synthetic drugs used for the treatment of gastric disorders may produce side effects on long-term use. Therefore,

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Fig No 1.1 Human Digestive System

there is an increasing interest in herformulations due to their safety, effectiveness, affordability, and fewer adverse effects (1).

Herbal medicines have been used traditionally for the treatment of digestive disorders since ancient times. Medicinal plants contain various phytochemicals such as flavonoids, tannins, alkaloids, saponins, and phenolic compounds which exhibit antioxidant, anti- inflammatory, antimicrobial, and gastroprotective properties. Polyherbal formulations are gaining importance because the combined action of multiple herbs may provide better therapeutic activity than a single herb (2).

The present study focuses on the formulation and evaluation of a polyherbal gastroprotective suspension using Aegle marmelos (Bael fruit extract) and Plantago ovata (Isabgol mucilage) along with Zingiber officinale extract. These herbs are traditionally known for their beneficial effects on the gastrointestinal tract(3).

Aegle marmelos is an important medicinal plant belonging to the family Rutaceae. Bael fruit has been widely used in Ayurveda for the management of digestive disorders such as diarrhea, dysentery, gastric irritation, and ulcer conditions(4). The fruit contains

phytoconstituents such as tannins, flavonoids, marmelosin, and phenolic compounds which exhibit antioxidant and gastroprotective activities. These compounds help in reducing oxidative stress and protecting the gastric mucosa from damage.Plantago ovata, commonly known as Isabgol, is rich in mucilage and dietary fibers. The mucilage forms a soothing protective layer over the gastric mucosa and helps reduce irritation and inflammation in the stomach. It also improves bowel movement and supports digestive health. Due to its soothing and protective nature, isabgol is widely used in various gastrointestinal preparations (5).Zingiber officinale is another well-known medicinal herb used for digestive disorders. Ginger contains active constituents such as gingerols and shogaols which possess anti-inflammatory, antioxidant, and digestive stimulant properties. Ginger helps improve digestion, reduce nausea, and relieve gastric discomfort.Suspensions are biphasic liquid dosage forms in which insoluble solid particles are dispersed uniformly in a liquid medium. Herbal suspensions are preferred for gastroprotective preparations because they provide easy administration, improved patient compliance, better dispersion of herbal extracts, and soothing action on the gastrointestinal tract. Suspensions are especially useful for patients who experience difficulty swallowing.(6) A stable suspension should possess good sedimentation characteristics,

easy redispersibility, acceptable viscosity, uniform particle distribution, and physical stability. In the present formulation, suitable excipients such as suspending agents, wetting agents, sweeteners, preservatives, and vehicles are used to improve the stability and acceptability of the formulation (7).

1.2 Types of Suspension

Suspensions are classified into different types based on particle size, route
administration, degree of flocculation. The main types of suspensions are as follows:

1. Flocculated Suspension:

In flocculated suspensions, particles form loose aggregates known as flocs. These flocs settle rapidly but can be easily redispersed on shaking. Flocculated suspensions prevent the formation of hard cake and improve redispersibility.

2. Deflocculated Suspension:

In deflocculated suspensions, particles remain separate and settle slowly. However, they may form a compact sediment or cake at the bottom, which becomes difficult to redisperse (9).

3. Oral Suspension:

Oral suspensions are liquid preparations intended for oral administration. They are commonly used for pediatric and geriatric patients because they are easy to swallow and provide better patient compliance.

4. Topical Suspension:

Topical suspensions are applied externally on the skin for local action. These suspensions help in delivering drugs directly to the affected area.

5. Parenteral Suspension:

Parenteral suspensions are sterile preparations administered by injection. They are prepared under aseptic conditions and should possess uniform particle size and stability.

6. Dry Suspension:

Dry suspensions are supplied in dry powder form and require reconstitution with water before use. These preparations provide improved stability during storage(10).

Gastrointestinal disorders such as gastric ulcer, acidity, indigestion, gastric irritation, and inflammation are common health problems affecting millions of people worldwide. These disorders mainly occur complications.

Synthetic antiulcer and antacid drugs are commonly used for the treatment of gastric disorders. However, prolonged use of synthetic medicines may produce adverse effects such as headache, constipation, diarrhea, nausea, and hormonal imbalance. Because of these limitations, herbal due to stress, irregular eating habits, spicy food consumption, smoking, alcohol intake, Helicobacter pylori infection, and prolonged use of non-steroidal anti-inflammatory drugs (NSAIDs). Gastric mucosal damage caused by these factors may lead to ulcer formation and digestive complications. Therefore, proper gastroprotective therapy is essential for maintaining gastric health and preventingmedicines are gaining importance due to their natural origin, safety, effectiveness, affordability, and minimal side effects. Herbal medicines have been used since ancient times in traditional systems of medicine such as Ayurveda for the treatment of various gastrointestinal disorders(11).

Medicinal plants contain several phytoconstituents including flavonoids, tannins, alkaloids, saponins, glycosides, and phenolic compounds which possess antioxidant, anti- inflammatory, antiulcer, and gastroprotective activities. These phytochemicals help in reducing gastric irritation and protecting the gastric mucosa from damage.The present study focuses on the formulation and evaluation of a polyherbal gastroprotective suspension using natural herbal ingredients such as bael fruit extract, ginger extract, and isabgol mucilage. Bael fruit possesses antiulcer, antioxidant, antimicrobial, and digestive

properties. Ginger is widely used for its anti-inflammatory, antiemetic, antioxidant, and digestive stimulant activities. Isabgol mucilage acts as a soothing and protective agent for the gastric mucosa and also works as a natural suspending agent.Suspension is a biphasic liquid dosage form in which finely divided insoluble particles are
dispersed uniformly in a liquid medium. Suspensions are commonly used for herbal formulations because they improve patient compliance, enhance stability, and allow easy administration(12). A good suspension should possess slow sedimentation rate, easy redispersibility, acceptable viscosity, and physical stability.Herbal suspensions are becoming increasingly popular due to their therapeutic benefits and natural composition. The use of herbal ingredients in suspension dosage forms provides better patient acceptability and improved medicinal value. Herbal formulations are considered safer alternatives to synthetic medicines and are widely used for long-term treatment(13).

Advantages of Herbal Formulations:

- Natural and safe in nature
- Less toxic compared to synthetic drugs Economical and easily available
- Better patient compliance Suitable for long-term therapy
- Possess multiple therapeutic activities

Importance of Herbal Formulations :

Herbal formulations play an important role in modern healthcare because they are prepared from natural sources and possess fewer adverse effects. Herbal medicines have been used since ancient times for the prevention and treatment of various diseases. They are economical, easily available, and generally safer for long-term use. Due to increasing awareness about natural therapy, herbal formulations are gaining popularity worldwide. Herbal preparations also contain multiple phytoconstituents that provide synergistic therapeutic effects (14).

Advantages of Herbal Medicines:

Herbal medicines possess several advantages over synthetic drugs. They are natural, biodegradable, and produce minimal side effects. Herbal drugs are cost-effective and suitable for chronic therapy. They improve overall body health and immunity. Herbal medicines are easily available and culturally accepted in many countries. Most herbal preparations contain antioxidants, flavonoids, alkaloids, and tannins which contribute to therapeutic activity. Their long history of traditional use also supports their safety and effectiveness.Gastroprotective formulations are required to protect the gastric mucosa from damage caused by stress, alcohol, spicy food, infections, and excessive use of NSAIDs. Gastric ulcers and irritation are common health problems affecting many people. Herbal gastroprotective formulations help inreducing acidity, inflammation, and ulcer formation naturally. These formulations also promote healing of the gastric lining and reduce oxidative stress in the stomach. Common symptoms of gastric irritation include burning sensation in the stomach, abdominal discomfort, acidity, bloating, nausea, vomiting, and loss of appetite. Severe ulcers may cause bleeding, weight loss, and sharp stomach pain. Continuous gastric irritation can damage the protective mucosal lining of the stomach. Herbal gastroprotective agents help in reducing these symptoms naturally and improve gastric health(15).

MATERIAL AND METHODS

Requirements:

Active Ingredients : Bael Extract
Ginger Extract Isabgol Mucilage

Chemicals: Xanthan Gum
Honey Glycerin
Sodium Benzoate
Apparatus: Beaker
Test Tube
Measuring Cylinder Wire
Guaze Waterbath

PLANT PROFILE :

1) AEGLE MARMELOS(BAEL FRUIT):

Fig No 02 Bael Fruit

Biological Source: Aegle marmelos Linn.
Family: Rutaceae Kingdom:Plantae Division: **Magnoliophyta Class**: Magnoliopsida Genus: Aegle
Species: Aegle marmelos
Chemical Constituents: Bael fruit contains tannins, flavonoids, marmelosin, coumarins, alkaloids, phenolic compounds, pectin, and essential oils
Uses: Possesses gastroprotective activity
Helps reduce gastric irritation
- Acts as antioxidant and anti-inflammatory agent Improves digestion
- Protects gastric mucosa

2) PLANTAGO OVATA (Isabgol):

Fig No 03 Plantago Ovata (Isabgol)

Biological Source:Plantago ovata Forssk.
Family: Plantaginaceae Kingdom: Plantae **Division:** Magnoliophyta Class: Magnoliopsida **Genus:** Plantago Species: Plantago ovata

Chemical Constituents: Isabgol contains mucilage, hemicellulose, polysaccharides, fiber, proteins, fixed oils, and glycosides.
Uses: Forms protective layer on gastric mucosa Soothes gastric irritation
Improves bowel movement Supports digestive health Acts as demulcent agent

3) ZINGIBER OFFICINALE(Ginger):

Fig No 04 Zingiber Officinale (Ginger)

Biological Source: Zingiber officinale Roscoe
Family: Zingiberaceae Kingdom: Plantae **Division**: Magnoliophyta Class: Liliopsida Genus: Zingiber

Species: Zingiber officinale

Chemical Constituents: Ginger contains gingerols, shogaols, volatile oils, zingiberene, flavonoids, phenolic compounds, and resins.

Uses: Improves digestion Reduces gastric discomfort

Possesses anti-inflammatory activity Acts as antioxidant agent

EXCIPIENT PROFILE :

1) XANTHAN GUM:

Category : Suspending agent / Thickening agent

Properties:

White to cream coloured powder Odourless and tasteless

Soluble in water Produces viscous solution

Uses: Used as suspending agent

Used in pharmaceutical and food formulations

2) HONEY:

Category : Sweetening agent

Properties : Yellowish brown viscous liquid Sweet taste

Pleasant odour Water soluble

Uses:

Used in herbal syrups and suspensions Used as flavouring and sweetening agent

3) **SODIUM BENZOATE:**

Category: Preservative

Properties:

White crystalline powder Odourless

Freely soluble in water

Uses: Used as preservative in oral liquid preparations

- **Formulation Of Polyherbal Gastroprotective Suspension:**

SR.NO	INGRIDIENTS	ROLE OF INGRIDIENTS
1	Bael Extract	Gastroprotective Active
2	Isabgol Mucilage	Mucosal Protective Agent
3	Ginger Extract	Digestive Synergistic Herb
4	Xanthan Gum	Suspending Agent
5	Glycerin	Wetting Agent
6	Sodium Benzoate	Preservative
7	Distilled Water	Vehicle

FORMULATION BATCHES OF GASTROPROTECTIVE SUSPENSION

SR.NO	INGRIDIENTS	BATCH 1	BATCH 2	BATCH 3
1	Bael Extract	5ml	5ml	5ml
2	Isabgol Mucilage	3ml	4ml	5ml
3	Ginger Extract	1ml	1ml	1ml
4	Xanthan Gum	0.2 g	0.3 g	0.4 g
5	Glycerin	5ml	7ml	9ml
6	Sodium Benzoate	0.1 g	0.1g	0.1g

EXPERIMENTAL WORK:

PROCEDURE :

Step 1 : Preparation of Bael Fruit Extract

The dried bael fruit powder was taken and extracted by decoction method. The powder was boiled with distilled water for 15–20 minutes. The extract obtained was filtered using filter paper and the filtrate was collected.

Step 2 : Preparation of Ginger Extract

Ginger powder was boiled with distilled water for 10–15 minutes. The mixture was filtered using filter paper and the filtrate was collected as ginger extract.

Step 3 : Preparation of Isabgol Mucilage
Isabgol was soaked in distilled water and kept for swelling. After complete swelling, the mucilage formed was collected and used in formulation.
Step 4 : Preparation of Suspending Agent Dispersion
Xanthan gum was dispersed separately in a small quantity of distilled water with continuous stirring to form a smooth dispersion without lumps.
Step 5 : Preparation Of Suspension
Bael extract, ginger extract, and isabgol mucilage were mixed together in a beaker. Honey and glycerin were added with continuous stirring. Sodium benzoate solution was added as preservative. The xanthan gum dispersion was then added slowly with constant stirring to
obtain a uniform suspension.
Polyherbal Gastroprotective Suspension
Step 6 : Volume Adjustment
Finally, distilled water was added quantity sufficient (q.s.) to make the final volume. The prepared
suspension was transferred into a clean container and stored properl(16)

RESULT AND DISCUSSION

PHYTOCHEMICAL SCREENING OF POLYHERBAL GASTROPROTECTIVE SUSPENSION:

Procedure For Phytochemical Tests:

1) Test For Flavonoids :
Procedure:
Take 2 ml of suspension sample in a test tube and add few drops of dilute sodium hydroxide solution. Formation of intense yellow colour indicates presence of flavonoids.
Observation:
Yellow colour observed.
Result:
Flavonoids present.
2) Test for Tannins Procedure:
Take 2 ml of suspension sample and add few drops of ferric chloride solution. Formation of dark blue or greenish black colour indicates presence of tannins.
Observation:
Greenish black colour observed.
Result:
Tannins present.
3) Test for Phenolic Compounds
Procedure:
Add few drops of ferric chloride solution to 2 ml of sample. Appearance of bluish black colour indicates presence of phenolic compounds.
Observation:
Bluish black colour observed.
Result:
Phenolic compounds present.
4) Test For Saponins:
Procedure:
Take 2 ml of suspension and shake vigorously with distilled water. Formation of stable foam indicates presence of saponins.
Observation:
Stable foam observed.
Result:
Saponins present.
5) Test for Alkaloids Procedure:
Add few drops of Mayer's reagent to 2 ml of suspension sample. Formation of cream col-
oured precipitate indicates presence of alkaloids.
Observation:
Cream coloured precipitate observed.
Result:
Alkaloids present.

Fig No 08 : Phytochemical Screening

The phytochemical screening of the prepared polyherbal gastroprotective suspension confirmed the presence of flavonoids, tannins,phenolic compounds, saponins, and alkaloids. These phytoconstituents are responsible for antioxidant, anti-inflammatory, and gastroprotective activities of the formulation and support the therapeutic potential of the prepared suspension.

EVALUATION PARAMETERS OF SUSPENSION :

FORMULATION (BATCH 1)

SR.NO	TEST	OBSERVATION
1	Colour	Light Brown
2	Odour	Smooth Suspension
3	Nature	Characteristic Herbal Odour
4	Taste	Sweet & Slightly Pungent
5	pH	6.34
6	Sedimentation Volume	0.70
7	Redispersibility	Easily Redispersed
8	Viscosity	Moderate
9	Particle Size Analysis	Uniform Distribution
10	Stability Study	Stable

FORMULATION (BATCH 2)

SR.NO	TEST	OBSERVATION
1	Colour	Brown
2	Odour	Uniform Suspension
3	Nature	Mild Herbal Odour
4	Taste	Sweet
5	pH	6.20
6	Sedimentation Volume	0.75
7	Redispersibility	Redispersed in 3 Shakes
8	Viscosity	Slightly High
9	Particle Size Analysis	Fine and Uniform
10	Stability Study	Physically Stable

FORMULATION (BATCH 3)

SR.NO	TEST	OBSERVATION
1	Colour	Brownish Yellow
2	Odour	Pleasant Herbal Odour
3	Nature	Smooth and Homogeneous
4	Taste	Slightly Sweet Pungent

5	pH	6.10
6	Sedimentation Volume	0.72
7	Redispersibility	Easily Redispersed in Gentle Shaking
8	Viscosity	Moderate
9	Particle Size Analysis	Uniform Particle Distribution
10	Stability Study	No Significant Change Observed

EVALUATION PARAMETER (TESTING):

1)PH : 10 ml of suspension was diluted with distilled water and pH was measured using pH paper or pH meter.

Purpose:

pH determination helps evaluate stability and compatibility of formulation.

Fig No 09 : PH Test

2)Viscosity Test: Viscosity of suspension was determined using Ostwald viscometer.

Purpose: Viscosity helps prevent rapid settling of particles and improves stability.

3) Sedimentation Test :

50 ml of suspension was transferred into a graduated cylinder and kept undisturbed for 24 hours.

Sediment volume was observed.

Formula:

F = Vu / Vo Where:

F = Sedimentation volume

Vu = Ultimate volume of sediment

Vo = Original volume of suspension

Purpose:

This test evaluates physical stability of suspension.

4) Redispersibility Test :

The sedimented suspension was shaken manually and number of shakes required for uniform dispersion was observed.

Purpose: This test determines ease of redispersion of settled particles.

5) Particle Size Analysis :

A small quantity of suspension was observed under microscope to evaluate particle distribution.

Purpose:

Uniform particle size improves stability and appearance of suspension

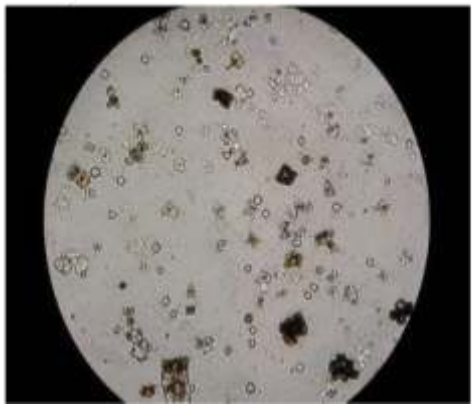

Fig No 13 : Particle Size Analysis

COMPARATIVE RESULTS OF BATCHES :

EVALUATION	BATCH 1	BATCH 2	BATCH 3
Colour	Light Brown	Brown	Brownish Yellow
	Characteristic Herbal	Mild Herbal	Pleasant Herbal
Taste	Sweet and Slightly Pungent	Sweet	Slightly Sweet and Pungent
pH Determination	6.34	6.20	6.10
Sedimentation Volume	0.70	0.75	0.72
Redispersibility	Easily Redispersed	Redispersed in 3 Shakes	Easily Redispersed
Viscosity	Moderate	Slightly High	Moderate
Particle Size Anal- ysis	Uniform Distribu- tion	Fine and Uniform	Uniform Distribu- tion
Stability Test	Stable	Physically Stable	No Significant Change
Appearance	Smooth Suspension	Uniform Suspen- sion	Homogenous Sus- pension

The comparative evaluation study of all formulations showed satisfactory results for the prepared polyherbal gastroprotective suspension. All batches exhibited acceptable organ- oleptic properties, good stability, and suitable pH range. Among all formulations, Batch 2 showed comparatively better sedimentation volume, viscosity, and redispersibility charac- teristics indicating improved physical stability of suspension. No significant phase separa- tion or instability was observed during the study period. Therefore, Batch 2 was considered as the optimized formulation for the prepared gastroprotective suspension.

The polyherbal gastroprotective suspension containing Aegle marmelos extract, Plantago ovata mucilage, and Zingiber officinale extract was prepared successfully using suitable excipients. The prepared formulation showed

satisfactory physical appearance and ac- ceptable stability.

The organoleptic evaluation indicated that the suspension was brown in colour with char- acteristic herbal odour and sweet, slightly pungent taste. The formulation appeared mooth, uniform, and free from large aggregates or phase separation. The pH of the prepared suspension was found within acceptable range suitable for oral administration. The viscosity study showed that the suspension possessed appropriate

flow property which helped maintain uniform dispersion of particles and prevented rapid sedimentation.

Sedimentation study revealed moderate sediment formation after storage, but the sedi- ment was easily redispersed on gentle shaking, indicating good physical stability of the formulation. The redispersibility test confirmed that the suspension could be uniformly dispersed without difficulty.

Particle size analysis showed that the particles were uniformly distributed throughout the formulation without formation of large aggregates. Stability studies carried out at room temperature showed no significant changes in colour, odour, pH, or appearance during the study period.

Phytochemical screening confirmed the presence of flavonoids, tannins, phenolic com- pounds, saponins, and alkaloids in the prepared formulation. These phytoconstituents are known for antioxidant, anti-inflammatory, mucosal protective, and gastroprotective activ- ities. The presence of these constituents supports the potential gastroprotective activity of the prepared suspension.

Overall, the results indicated that the formulated polyherbal gastroprotective suspension possessed satisfactory evaluation parameters, good stability, and potential therapeutic ac- tivity for gastric protection and digestive health

SUMMARY AND CONCLUSION

The present study was carried out to formulate and evaluate a polyherbal gastroprotective suspension using Aegle marmelos fruit extract, Plantago ovata mucilage, and Zingiber officinale extract. Herbal formulations are gaining importance because of their safety, effectiveness, and lesser side effects compared to synthetic medicines.

The prepared suspension was evaluated for various parameters such as organoleptic properties, pH, viscosity, sedimentation volume, redispersibility, and stability. The formulation showed acceptable physical appearance, good stability, easy redispersion, and suitable pH for oral administration.

Phytochemical screening confirmed the presence of flavonoids, tannins, phenolic compounds, and other phytoconstituents responsible for antioxidant and gastroprotective activity. The combined action of herbal ingredients may help protect gastric mucosa and improve digestive health.

From the overall study, it was concluded that the prepared polyherbal gastroprotective

suspension showed satisfactory evaluation parameters and potential gastroprotective activity. Thus, the formulation may be useful as a natural and effective herbal preparation for gastric protection and digestive disorder

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