International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Formulation of Suspension Containing Asafoetida For Treatment Antispasmodic Activity

Mr. Rushikesh Gajanan Navale[1], Dr. Harshal Anwane[2], Dr. Shivshankar Mhaske[3], Miss.Janhavi Narendra Jawade[4], Mr. Shankar Bali[5].

Satyajeet College Of Pharmacy

Abstract

This study uses Ferula asafoetida (asafoetida), a popular herbal treatment with smooth muscle relaxant effects, to formulate and evaluate a plant-based antispasmodic solution. Irritable bowel syndrome (IBS), gastritis, and intestinal colic are among the disorders that are frequently associated with spasms, particularly in the gastrointestinal tract. Despite their effectiveness, conventional synthetic antispasmodics are sometimes linked to adverse effects such constipation, dry mouth, and disorientation. Asafoetida provides a natural substitute with little adverse effects because it is abundant in bioactive substances such ferulic acid, sesquiterpene coumarins, and volatile oils that include sulfur. Asafoetida resin was combined with the proper excipients, such as glycerin, Na-CMC, and preservatives, to create a stable, pleasant solution. Evaluation showed favorable physicochemical and organoleptic characteristics, including little sedimentation over 30 days, ease of redispersion, and excellent pH stability (5.6–5.7). Benefits like increased patient compliance, pediatric safety, anti-inflammatory properties, and affordability were also shown by the formulation. According to these results, asafoetida suspension shows promise as a natural antispasmodic. To establish this formulation as a safe and efficient treatment for functional gastrointestinal disorders in the global herbal medicinal market, future directions include preclinical and clinical validation, complex delivery systems, focused therapeutic uses, and regulatory recognition.

INTRODUCTION:

Spasms are **sudden, involuntary contractions of muscles**, which may affect skeletal or smooth muscles. Smooth muscle spasms are frequently involved with disorders affecting the reproductive organs, urinary system, and gastrointestinal (GI) tract, whereas skeletal muscle spasms are frequently linked to cramps or strains. A number of symptoms, such as pain, cramping, bloating, and impaired organ function, can result from these involuntary contractions. Inflammation, illness, emotional stress, or triggers from food can all cause spasms in the gastrointestinal tract. GI smooth muscle spasms are often linked to conditions such as gastritis, intestinal colic, and irritable bowel syndrome (IBS). Similarly, bladder spasms can result in incontinence and urgency, whereas uterine spasms are a prominent cause of period cramps (dysmenorrhea). When muscle fibers are overstimulated by aberrant neurochemical transmission, spasms occur. This is frequently connected to calcium influx into muscle cells and may involve neurotransmitters like acetylcholine, histamine, or serotonin.The discovery of therapeutic treatments, especially antispasmodic medications, that can lessen or prevent these involuntary contractions and enhance patient comfort depends on an understanding of the pathophysiology of spasms.

Antispasmodic activity:

The term "antispasmodic activity" describes a substance's capacity to inhibit or alleviate smooth muscle tissue spasms, especially in the gastrointestinal tract. Involuntary muscular contractions, or spasms, can cause discomfort, bloating, cramping, and stomach pain. These symptoms are frequently linked to illnesses including intestinal colic, dysmenorrhea, and irritable bowel syndrome (IBS).Antispasmodic medications reduce these symptoms by either relaxing smooth muscle or blocking neurotransmitters that cause spasms. Through a variety of ways, including blocking muscarinic receptors, interfering with calcium ion influx, or modifying neurotransmitter release, antispasmodic medicines prevent excessive contractions of smooth muscles. Commonly used conventional synthetic medications like hyoscine and dicyclomine can have adverse effects include impaired vision, dizziness, and dry mouth**.**

Antispasmodic medications:

A class of pharmaceuticals known as antispasmodics is used to treat or prevent spasms, particularly in the smooth muscles of the urinary system, uterus, and gastrointestinal (GI) tract. These drugs are essential for treating disorders such intestinal colic, dysmenorrhea, irritable bowel syndrome (IBS), and overactive bladder, in which pain and functional abnormalities are caused by involuntary muscle spasms.

- **Mechanism of action antispasmodic agents:**
  Antispasmodic drugs function by reducing or preventing smooth muscle spasms, which are involuntary contractions. Usually, ionic changes (like calcium influx) or neurotransmitters (like histamine and acetylcholine) mediate these contractions.

Antispasmodics are categorised into following types based on mechanism of action:

1. **Neurotropic Antispasmodics**: Inhibiting parasympathetic (cholinergic) nerve impulses, particularly muscarinic receptors, is the primary way in which these medications affect the neurological system.
   They lessen involuntary muscular spasms by lowering acetylcholine activity.
   Examples: Atropine, Hyoscine butylbromide, Dicyclomine

2. **Myotropic Antispasmodics**: Regardless of neuronal activity, they have an immediate effect on the smooth muscle. They decrease muscle contractility by changing ion channels or enzyme activity.
   Examples: Mebeverine, Papaverine, Drotaverine

3. **Mixed- action Antispasmodics**: These provide a more comprehensive mechanism by having both neurotropic and myotropic effects.
   Examples: Alverine citrate

Despite their widespread use, synthetic antispasmodic medications can have adverse effects include dizziness, dry mouth, constipation, and impaired vision. Because they may provide comparable efficacy with a better safety profile, plant-based antispasmodic medicines are gaining popularity.Herbs with antispasmodic qualities, such fennel, peppermint, and asafoetida, have long been used in traditional medical systems like Ayurveda and Unani. Herbs with antispasmodic qualities, such fennel, peppermint, and asafoetida, have long been used in traditional medical systems like Ayurveda and Unani. Researchers are increasingly using plant-based treatments with antispasmodic properties to get around these restrictions. Numerous therapeutic plants have demonstrated notable smooth muscle relaxant properties, such as Zingiber officinale (ginger), Ferula asafoetida (asafoetida), and Foeniculum vulgare (fennel). In example, asafoetida has been used historically to treat digestive problems and is well-known for its antispasmodic and carminative qualities.It is thought to work by relaxing intestinal smooth muscles and lessening spasms brought on by acetylcholine.

Plant profile

Asafoetida (Ferula asafoetida)

Synonym: Ferulafoetida, Ferula narthex

Common name: Asafoetida, Hing (hindi), Devil's dung, Stinking gum.

Family: Apiaceae (Umbelliferae)

Botanical description:

- **Habit:**
  - A perennial plant having a carrot-shaped rootstock or a big, meaty taproot.
  - Sulfur-containing volatile oils cause a strong, disagreeable smell.
- **Root:**
  - thick, cylindrical taproot that simulates a carrot.
  - contains milky latex, also known as oleo-gum-resin, which is gathered for culinary and medicinal purposes.
- **Leaves:**
  - Large, alternate, pinnately compound, with segments that are finely separated.
  - The base of leaf stalks is covered in sheaths.
  - The tint is bluish-green and has a waxy coating.
- **Flowers:**
  - Comprising enormous compound umbels, they are small, yellow, and characteristic of the Apiaceae family.

- Bisexual and hermaphrodite, with normal symmetry.

➢ **Fruits:**
- At maturity, the schizocarp divides into two mericarps.
- Dorsally compressed, oval or oblong, with noticeable oil canals (vittae).

Geographical Distribution of Asafoetida:

1. Native/Endemic Regions:

Asafoetida is indigenous to the dry mountainous areas of:

- Afghanistan AF
- Uzbekistan UZ
- Turkmenistan TM
- Iran IR
- Tajikistan TJ

Raw asafoetida resin has historically been mostly produced and exported from these nations.

2. Cultivated Regions:

a. India

Despite not being indigenous to India, Ferula asafoetida is imported and utilized extensively, particularly in:

- **Ayurvedic medicine**
- **Culinary (spice) use**
- **Unani and Siddha practices**

Asafoetida cultivation has recently been attempted in India, particularly by the CSIR-Institute of Himalayan Bioresource Technology, or CSIR-IHBT:

- **Jammu & Kashmir** (Leh, Kargil)
- Uttarakhand
- **Himachal Pradesh** (Lahaul-Spiti region)
- **Punjab and Maharashtra** (experimental cultivation)

b. China and Central Asia

- Due to their similar climate, several areas of western China might be home to Ferula species.
- Various Ferula spp. grow naturally across the central Asian steppes and mountains.

3. Preferred Habitat:

- cool, arid to semi-arid regions.
- arid temperate regions at high elevations (1200–2500 meters above sea level).
- must have sandy or loamy soils that drain well.
- The best conditions are low rainfall and full sun.

4. Global Demand and Trade:

- India imports resin mainly from Afghanistan, Iran, and Uzbekistan, making it the world's largest user of asafoetida.
- There are attempts to cultivate domestically in order to lessen reliance on imports.
- Bangladesh, Sri Lanka, Nepal, and Middle Eastern nations are among the other importers.

Chemical Composition of Asafoetida

The asafoetida plant (Ferula asafoetida) has a complex mixture of gum, volatile oils, and resins along with a number of bioactive chemicals that give it its antispasmodic properties. Here are details about the antispasmodic components:

1. Resin (40-64%)

- contains a variety of sesquiterpene coumarins, including galbanic acid, farnesiferols, and umbelliprenin, as well as ferulic acid and its esters and asaresinotannol.
- Ferulic acid's pharmacological effects are related to its ability to be converted to umbelliferone, a coumarin, in acidic environments.
- Assafoetidinol A and B, asacoumarin, conferol, and galbanic acid are further noteworthy resin components.

2. Volatile oil (4-20%)

- Packed with sulfur-containing substances (disulfides), which are principally in charge of the distinctive smell and a number of biological processes.
- The major sulphur compounds are:
  - (E)-1-proppenyl sec-butyl disulfide (up to 58.9%)
  - (Z)-1-prpoenyl sec-butyl disulfide
  - Isobutyl propanyl disulfide
  - 1-methylpropyl-1-propenyl disulfide
  - 2-butyl propenyl disulfide (E- and Z- isomers)

- Other volatile components: α- and β-pinene, phellandrene, myrcene, limonene, linalool, camphene, and various terpenoids

3. **Gum (20-25%)**
- Composed mainly of carbohydrates: glucose, galactose, arabinose, rhamnose, and glucuronic acid

Other notable compounds:

- Coumarins (e.g., umbelliprenin, conferol)
- Sesquiterpene coumarins
- Monoterpenes and other terpenoids
- Phenolic compounds (e.g., ferulic acid)

Taxonomy:

Category	Details
Kingdom	Plantae
Division	Magnoliophyta (Angiosperm)
Class	Magnoliopsida (Dicotyledons)
Order	Apiales
Family	Apiaceae (Umbelliferae)
Genus	Ferula
Species	Ferula asafoetida

Materials and Methods

Materials:

The asafoetida suspension was made with the following ingredients:

Ingredient	Function
Asafoetida (Ferula asafoetida) resin	Active antispasmodic agent
Sodium carboxymethylcellulose (Na-CMC)	Suspending agent
Glycerin	Viscosity modifier and sweetener
Sucrose	Sweetening agent
Methylparaben	Antimicrobial preservative
Propylparaben	Antimicrobial preservative
Citric acid	pH adjuster
Ginger oil or cardamon flavour	Flavouring agent
Purified water	Vehicle

Formulation Method:

Using the following procedures, which were altered from normal herbal suspension methods, the asafoetida suspension was made.

1.Preparation of Asafoetida Extract:

- A concentrated extract was made by triturating the finely powdered resin with a small amount of warm water.

- The mixture was filtered using muslin cloth to remove insoluble particles.

2.Preparation of Suspending Agent:

- With constant stirring, sodium CMC (0.5% w/v) was dissolved in a section of purified water and left to hydrate for 30 to 45 minutes.

3.Incorporation of Active Ingredient:

- The hydrated Na-CMC base was gradually mixed with the asafoetida extract while being constantly stirred to guarantee even dispersion.

4.Addition of Other Excipients:

- Methylparaben and propylparaben were dissolved in a small amount of warm water and added.
- Sucrose and sorbitol were added and dissolved completely.
- Flavoring agent (ginger or cardamom) and citric acid (to adjust pH to 5.5–6.0) were incorporated.

5.Final Volume Adjustment:

- The volume was adjusted to 100 mL with purified water, and the suspension was mixed thoroughly using a magnetic stirrer.

6.Packaging:

- The suspension was transferred into amber-colored bottles, labeled, and stored at room temperature.

Observations:

Ingredients	Quantity (per 100ml)
Asafoetida (Ferula asafoetida)	1g
Sodium carboxymethyl cellulose (NaCMC)	0.5g
Glycerin	5ml
Sucrose	20g
Methylparaben	0.15g
Propylparaben	0.05g
Citric acid	q.s.
Flavouring agent	1-2 drops
Purified water	Up to 100ml

Evaluation Parameters:

The following assessment procedures were performed on the prepared suspension in order to determine its physicochemical and possible pharmacological characteristics**.**

a) Organoleptic Properties

- Evaluation of colour, odour, taste and appearance.

b) pH Determination

- Measured using a digital pH meter calibrated at pH 4.0 and 7.0.

c) Sedimentation Rate

- Measured by observing the volume of sediment formed in a graduated cylinder over a 7-day period.

e) Redispersibility

- The ease of redistributing the sediment upon manual shaking was recorded.

f) Stability Testing

- Conducted under room temperature and refrigeration for 30 days.
- Parameters like colour, pH, viscosity, and odour were monitored at regular intervals.

Advantages of Asafoetida suspension for Antispasmodic activity

1. **Natural and Plant-Based origin**

- Ayurvedic and Unani medicine have long used asafoetida (Ferula asafoetida), a traditional herbal cure.
- provides a less harmful substitute for artificial antispasmodics.

2. **Effective Smooth Muscle Relaxation**
    - The smooth muscles of the gut are affected by active ingredients such as ferulic acid and volatile oils (limonene, α-pinene, etc.).
    - Reduces cramping, bloating, and intestinal spasms by preventing contractions brought on by acetylcholine.

3. **Mild and Minimal Side Effects**
    - Well tolerated in most cases when taken as prescribed.
    - Doesn't have the serious side effects that synthetic anticholinergics frequently have, such drowsiness, dry mouth, or constipation.

4. **Potentially Safe in Pediatrics**
    - Used historically to treat gas and colic in infants (e.g., in "hing water").
    - It might be safe for kids and babies if taken and prepared appropriately.

5. **Formulation Flexibilty**
    - Easily made into a suspension, which enables:
        I. Improved dosage management for older adults and children.
        II. Simple administration free of pills or capsules.
        III. Adding flavoring agents to cover up a bitter taste.

6. **Antioxidant and Anti-inflammatory Effects**
    - Asafoetida promotes intestinal healing with its anti-inflammatory and antioxidant qualities.
    - Decreases the gastrointestinal tract's local inflammation, which could provide long-term comfort.

7. **Cost-Effective and Accessible**
    - Cheaper than a lot of brand-name antispasmodic medications.
    - Affordable in many nations, particularly in local and herbal markets.

Results

The formulated asafoetida suspension was evaluated for its organoleptic, physicochemical, and pharmacological parameters. The data obtained from various evaluation tests are summarized below.

Organoleptic and Physicochemical Characteristics

Parameter	**Observation**
Appearance	Uniform brownish suspension
Odor	Characteristic aromatic (asafoetida)
Taste	Bitter with mild pungency
pH (initial)	5.7 ± 0.05
pH (after 30 days)	5.6 ± 0.03
Sedimentation volume (F)	0.92
Redispersibility	Easy with 2–3 manual shakes

Stability Observations:

Parameter	Day 0	Day 15	Day 30m
Colour	Brownish	Brownish	Slightly faded
Odour	Characteristic	Unchanged	Slightly weaker
pH	5.7	5.6	5.6
Sedimentation Volume (F)	0.92	0.91	0.90
Viscosity (cP)	215	210	208

Future Directions

1. **Preclinical and Clinical Studies**
   - To perform controlled animal studies to evaluate:
     I. Spasmolytic activity on isolated intestinal smooth muscle.
     II. Anti-inflammatory and gut microbiota-modulating effects.
   - Begin with human clinical trails to establish:
     I. Safety and effectiveness in treating infantile colic and other functional gastrointestinal disorders (FGIDs), such as IBS.
     II. Optimal dosage and duration of use.

2. **Novel Delivery Systems**
   - Examine emulsions, suspensions, or mucoadhesive compositions based on nanoparticles to:
     I. Enhance bioavailability.
     II. Improve taste masking.
     III. Achieve sustained or targeted drug delivery in the gut

3. **Targeted Therapeutic Application**
   - Extend indications beyond gastrointestinal spasms in general:
     I. Irritable Bowel Syndrome (IBS) management
     II. Infantile colic and functional dyspepsia.
     III. Menstrual cramps (in combination with other herbs or mild NSAIDs).

4. **Regulatory Recognition and Global Market Expansion**
   - Aim to be recognized by regulatory agencies (FDA, EMA, AYUSH) as a standardized herbal remedy.
   - Promote asafoetida suspension as an alternative or complementary treatment in the international market for herbal pharmaceuticals.

Discussion

The asafoetida suspension's potential use as a natural antispasmodic treatment was supported by its good physical stability, uniformity and palatability. Asafoetida, which has long been used to treat gastrointestinal issues, was successfully added to a solution that was appropriate for both young and elderly individuals. Sodium carboxymethyl cellulose was used to minimize sedimentation and provide adequate dispersion. Over the course of 30 days, the formulation's pH, color, and odor stayed constant. This implies that herbal suspensions may be a patient-friendly, safe, and efficient substitute for synthetic medications. Its therapeutic efficacy and safety need to be confirmed by more clinical research.

Conclusion

According to the study's findings, the asafoetida-containing herbal suspension exhibits encouraging potential as a natural antispasmodic formulation. It is appropriate for all age groups due to its steady physical characteristics, simplicity of administration, and pleasant flavour. During the evaluation period, the formulation remained consistent and effective. The traditional use of asafoetida for gastrointestinal diseases is supported by these findings, which also call for more study and clinical trials to confirm its effectiveness and advance its usage as a safe herbal substitute.

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