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Research Article

Formulation and Evaluation of Herbal Antidiarrheal activity of *Psidium guajava*

Amruta Patil, Patil R. R.

Dept of pharmacy, Late Narayandas Bhawandas Chhabada Institute of Pharmacy, Raigaon, Satara, India.

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ABSTRACT

The well-known tropical tree Psidium guajava, or guava, is widely farmed for its fruit. Guava has a lengthy history of use in medicine in many nations. In addition to improving locomotor coordination, this plant is used to treat diarrhea, dysentery, gastroenteritis, hypertension, diabetes, dental cavities, and discomfort. Its leaf's extract is being used as a medicine in cough, diarrhea, and oral ulcers and in some swollen gums wound. It's fruit is rich in vitamins A, C, iron, phosphorus and calcium and minerals. It contains high content of organic and inorganic compounds like secondary metabolites e.g. antioxidants, polyphenols, antiviral compounds, anti-inflammatory compounds. There are relaxation effects when terpenes, caryophyllene oxide, and p-selinene are present. Numerous substances found in guava leaves have bacteriostatic and fungistatic properties. Guava possesses radioprotective properties and a high concentration of vital antioxidants. Guava leaves' most potent antioxidant, quercetin, is what gives them their spasmolytic properties. Its ethyl acetate extract can prevent the growth of thymus and germ infection. Guava has anti-inflammatory, anti-viral, anti-plaque, and anti-mutagenic properties. In addition to having antinociceptive properties, guava extract reduces inflammation and serum production associated with liver injury. Guava ethanolic extract can be used to treat male infertility by increasing both the amount and quality of sperm. A number of common intestinal illnesses, including Salmonella, Shigella, Escherichia coli, Aeromonas, Staphylococcus aureus, and Candida, were tested for in guava leaves, or Psidium guajava. The alcoholic and aqueous extracts of Psidium guajava leaves were made using the Soxhlet apparatus. The extracts' antibacterial activity was assessed on Mueller Hinton Agar using the punch well technique. Significant inhibitory effects against the isolates under test were observed. Significant efficacy was demonstrated by ethanolic extract against Vibrio, Shigella, Salmonella, and Aeromonas species. The aqueous extract showed significant efficiency against candida and Escherichia coli.

***Corresponding Author:** Amruta Patil
Address: *Dept of pharmacy, Late Narayandas Bhawandas Chhabada Institute of Pharmacy, Raigaon, Satara, India*
Email ✉: pamruta606@gmail.com

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INTRODUCTION

The condition known as diarrhea is characterized by increased stool volume or fluidity, increased frequency of bowel movements, and, most often, cramping. According to the most recent data, the condition affects roughly 3–5 billion people annually and causes 5–6 million fatalities in children under the age of five. For underdeveloped nations like India, diarrhea has been a serious problem because of inadequate and compromised cleanliness, a lack of safe drinking water, and malnutrition (Thapar and Sanderson, 2004; Palla et al., 2015; Prasad et al., 2017). Shigella species, Vibrio cholera, and pathogenic Escherichia coli are thought to be the most frequent causes of human diarrhea, accounting for 14–17% of cases in developing nations. Although antibiotics have been shown to be useful in treating a number of infectious disorders, including diarrhea, their improper, erratic, and ongoing usage may result in the emergence of resistant bacteria, which would reduce the effectiveness of treatment regimens. As a result, people are turning to medicinal plants to meet their fundamental medical needs and fight off a variety of illnesses (Barbour et al., 2004; Parmar et al., 2019). Native to the Caribbean and Central and South America, the plant Psidium guajava L. (Myrtaceae), also known as guava, is grown for food and medicine all throughout the world's tropical and subtropical regions (Piña-Vázquez et al., 2017; Machado et al., 2018). The herb has been used historically all throughout the world as an antiamoebic and antispasmodic to treat diarrhea, dysentery, gastroenteritis, stomachaches, indigestion, inflammation, ulcers, and more (Gutiérrez et al., 2008; Tetali et al., 2009; Birdi et al., 2010; Koriem et al., 201 9.

Its antitrypanosoma, antileishmania, cytotoxic, antimalarial, antidiarrheal, and antiparasitic properties have been documented in pharmacological investigations (de Souza et al., 2017; Machado et al., 2018). According to phytochemical analyses, the main active ingredients include quercetin, quercetin-3-O-arabinoside, gallic acid, rutin, morin, morin-3-O-lyxoside, and morin-3-O arabinoside.

Herbal Syrup

A concentrated decoction, honey, sugar, and occasionally alcohol are combined to create herbal syrup. Cough syrup is just one of many illnesses that can be treated with herbal plants and medicines. Funnel, lemon grass, jeera, clove, and psidium guavaja are all present in herbal hand syrup.

Benefits of herbal syrup:

- No side effect.
- Low cost.
- Easily available.
- No harmless.
- Herbs grow in common place.

Mechanism of Action:

In many cultures, guava, or Psidium guajava, has long been used as a remedy for diarrhea. Several factors are believed to be involved in Psidium guajava's mode of action in diarrhea:

1. Antimicrobial activity: Antimicrobial substances found in guava leaves include flavonoids, tannins, and essential oils. These substances aid in preventing the development of bacteria, viruses, and other pathogens that might be responsible for the diarrhea.

2. Anti-inflammatory effects: Extracts from guava leaves have anti-inflammatory qualities that may help lessen intestinal inflammation brought on by irritations or infections. The symptoms of diarrhea may be lessened by doing this.

3.Astringent qualities: Guava leaves' high tannin content has astringent qualities that might cause the intestinal mucosa to constrict. By lowering the amount of water and electrolyte secreted into the

intestines, this helps prevent fluid loss and regulates the frequency and intensity of diarrhea.
4.Antioxidant effects: Rich in vitamin C and other antioxidants, guava can help shield the intestinal lining from oxidative stress, promoting the digestive tract's recovery and halting additional damage during diarrhea
5.Gut motility reduction: Guava leaf extracts may slow down gut motility, which would provide the intestines more time to absorb electrolytes and water. This would lessen the watery stool that is typical of diarrhea.

Physiology of Stomach:

1. Structure and Anatomy:

The muscular, J-shaped stomach is situated between the small intestine and the esophagus. The cardia, which is where food enters, the fundus, which is the upper part, the body, which is the central area, and the pylorus, which is where food leaves to go to the small intestine, are its four main regions. Mucus coats the stomach lining to shield it from the acidic environment.

2. The Digestive System:

Mechanical digestion involves the stomach's muscular walls churning food, combining it with acids and digestive enzymes to create chyme, a semi-liquid combination.
Chemical digestion: Proteins are broken down into smaller peptides by the digestive enzymes like pepsin and hydrochloric acid (HCl), which are secreted by the stomach's gastric glands.
Secretion of gastric juices: Hydrochloric acid (HCl), which is secreted by parietal cells, aids in the denaturation of proteins and the activation of enzymes. Mucus secreted by mucous cells shields the stomach lining from digesting enzymes and acid.

3. Regulation of stomach Secretion:

Hormonal and neurological (vagus nerve) signals govern the release of stomach juices. When food enters the stomach, the G-cells in the stomach release the hormone known as gastrin. It promotes the release of acid.Sensors also measure the stomach's acidity (pH), and when it drops too much (high acidity), less acid is produced.
4. Motility (stomach movement): Peristalsis: Food and liquids are moved through the digestive tract by waves of muscle contractions.The pyloric sphincter allows the stomach to release modest amounts of its contents into the small intestine.Food composition (liquids flow more quickly than solids) and hormones such as gastric inhibitory peptide (GIP), which delays stomach emptying when necessary, control gastric emptying.
5.Absorption:Small amounts of water, alcohol, and some drugs, such as aspirin, are absorbed by the stomach, but the majority of nutrients are not.
In conclusion, the stomach is essential for the mechanical and chemical breakdown of food, the secretion of digestive enzymes and acids, and the control of the movement of chyme into the small intestine for subsequent digestion and absorption.

1. Aim and Objective:

- **Aim:**

To manage and lessen diarrhea's occurrence and intensity.
To replenish fluids and regain regular bowel movements.
To avoid dehydration brought on by severe diarrheal fluid loss.

- **Objectives:**

To alleviate the symptoms of diarrhea.
To lessen fluid and electrolyte loss in order to avoid dehydration.
To relieve related symptoms like cramping and discomfort in the abdomen.
To guarantee this syrup's efficacy and safety, it is

crucial to utilize it as prescribed by a healthcare professional.

2. Drug Profile

- **Psidium guajava**[2]

Biological Name: Pisidium guajava L.

Kingdom	Plantae
Order	Myrtales
Family	Myrtaceae
Clade	Myrtales
Genus	Myrtales
Species	Psidium guajava

Table : 01

Fig : 01

Synonyms: Psidium littorale, Strawberry guava, Yellow cattley guava.

- **Fennel (Foeniculum vulgare)**[7]

Biological Name: Foeniculum vulgare

Kingdom	Plantae
Order	Apiales
Family	Apiaceae
Clade	Tracheophytes
Genus	Foeniculum
Species	F.Vulgare

Table: 02

Fig : 02

Synonyms: Common fennel, Sweet fennel, Florence fennel.

- **Clove (Syzygium aromaticum)**[8]

Biological Name: S. Aromaticum.

Kingdom	Plantae
Order	Myrtales
Family	Myrtaceae
Clade	Roslds
Genus	Syzygium
Species	S. Aromaticum

Table: 03

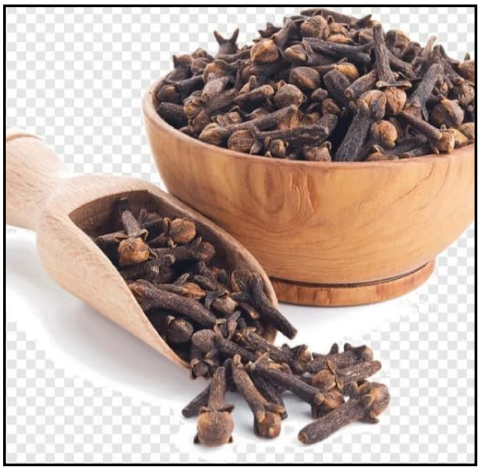

Fig : 03

Synonyms : Caryophyllum, Clove flower, Clove bud.

- **Lemon Grass**[15]

Biological Name : C.Citratus.

Kingdom	Plantae
Order	Poales
Family	Poaceae
Clade	Diaphoretickes
Genus	Cymbopogon
Species	C. Citratus

Table : 04

Fig : 04

Synonyms : Cochin grass, Malabar grass.

- **Jeera**[18]

Biological Name : Cuminum cyminum

Kingdom	Plantae
Order	Apiales
Family	Apiaceae
Clade	Angiosperms
Genus	Cuminum
Species	Cuminum cyminum

Table : 05

Fig : 05

Synonyms : Ajaji, Jiraka, Jira, Sadajira, Jiru.

3. Plant Overview:

- Psidium guajava [1-6]

Guava, also known as Psidium guajava (P. guajava), is a tropical fruit that is widely grown around the world, including in South America, Egypt, India, Indonesia, Syria, Pakistan, and Bangladesh. It is a compact tree or evergreen shrub that is a member of the Myrtaceae family.

Guava has a wide range of phytochemical elements and substances with antioxidative qualities, including polysaccharides, essential oils, minerals, vitamins, enzymes, triterpenoid acid alkaloids, steroids, glycosides, tannins, flavonoids, and saponins. These components are essential in giving the plant many health benefits, such as its anti-inflammatory, anti-oxidant, and perhaps anticancer properties. Guava is known for being a notable source of minerals and phytochemical antioxidants, including ascorbic acid, carotenoids, dietary fiber that is high in antioxidants, and polyphenolics.

- Fennel (Foeniculum vulgare)[7-8]

A fragrant perennial herb with golden blossoms is fennel. Despite its Mediterranean origins, it is now commonplace all throughout the world.An anise-flavored spice that is frequently used in cooking is dried fennel seeds. But even though they look and taste alike, fennel and anise are not the same. The dried, ripe seeds and oil of fennel are used to make medicine. Among other digestive problems, fennel is used to treat heartburn, intestinal gas, bloating, appetite loss, and colic in infants. Cholera, coughs, bronchitis, upper respiratory tract infections, backaches, bedwetting, and vision problems are also treated with it. Snake bites are treated with a fennel powder poultice. Food and drink items use fennel oil as a flavoring.

- Clove (Syzygium aromaticum)[8-10]

Clove, or Syzygium aromaticum, is a native Indonesian tree. In addition to being a common spice, dried flower buds from this plant are utilized in Chinese and Ayurvedic medicine. Clove oils are mixed with dried flower buds, leaves, and stems to manufacture medication. Clove oil contains eugenol, which may help prevent infections and lessen discomfort. Clove is also a common ingredient in cigarettes. There isn't enough trustworthy scientific evidence to support the widespread usage of clove to treat a variety of conditions, including hangovers, indigestion, toothaches, and dental plaque.

- Lemon Grass (Cymbopogon Citratus)[15-17]

One plant that is a member of the grass family is lemongrass. Cymbopogon citratus, one of the more than 100 species of lemongrass, is frequently used in both food and medicinal. Chemicals found in lemongrass leaves and essential oil may help stop some germs and yeast from growing. Chemicals in lemongrass can also lessen swelling and pain. Although there isn't any solid scientific proof to back up its efficacy, people use lemongrass to treat a variety of ailments, including thrush, gingivitis, excessive cholesterol, dandruff, and stomachaches. Lemongrass should not be confused with other herbs and compounds that share the same name, such as citronella, oil, and lemon eucalyptus.

- Cuminum cyminum[18-21]

Compounds found in cumin seeds can also aid in lowering intestinal inflammation, which may lessen the symptoms of diseases like Irritable Bowel Syndrome (IBS). Additionally, cumin seeds may have anti-cancer effects. Cumin seeds and their extracts have been proved in numerous trials to prevent the growth of stomach, liver, and colon cancer cells. Cumin seeds are believed to have an anticancer impact because of their high antioxidant content, which can help shield cells from damage brought on by free radicals.

4. Phytochemistry:

- **Psidium guajava[2-6]**

Flavonoids: These substances are known to possess antioxidant qualities, and when exposed to light, they may experience photochemical processes that improve their capacity to scavenge free radicals.

Carotenoids: Guava's carotenoids, including lycopene, can also have photoprotective qualities, shielding the fruit's cells from UV light-induced oxidative damage.

Ascorbic Acid: Guava's vitamin C is susceptible to UV rays, and extended exposure to sunshine can cause it to degrade. However, its antioxidant qualities are also linked to its photochemical activity, which aids in the neutralization of light-induced reactive oxygen species.

- **Fennel[8]**

Flavonoids:

Strong antioxidant quercetin has anti-inflammatory, anti-cancer, and antihypertensive qualities.

Rutin: A flavonoid glycoside that protects the heart and has anti-inflammatory and antioxidant properties.

Luteolin: Well-known for its anti-inflammatory and antioxidant qualities, luteolin may possibly have anticancer effects.

Phenolic Compounds:

Caffeic acid: Known for its anti-inflammatory and antioxidant qualities, caffeic acid may potentially help prevent cancer.Another phenolic molecule with antioxidant qualities that has been researched for its potential to stave off chronic illnesses is ferulic acid.

- **Clove[12]**

Eugenol:

The main bioactive ingredient in cloves, eugenol,

accounts for between 70 and 90 percent of the essential oil composition. It is in charge of giving cloves their distinct flavor and scent. The anesthetic, antibacterial, analgesic, anti-inflammatory, and antioxidant qualities of eugenol have all been investigated. Additionally, it may have antitumor properties.

Acetyleugenol

Another phenolic molecule present in cloves that adds to their antibacterial and antioxidant properties is acetyleugenol, a derivative of eugenol. It is also thought to contribute to the anti-inflammatory properties of the spice.

Caryophyllene beta:

Clove oil contains a sesquiterpene called beta-caryophyllene. Because it may bind to CB2 receptors in the body's endocannabinoid system, it has anti-inflammatory qualities and may be useful as a treatment for ailments including inflammation and pain.

- **Lemmon grass[15-16]**

Essential Oils:

Citral: The main active ingredient, which comes in neral and geranial isomers. Citral possesses antibacterial, antioxidant, anti-inflammatory, and anticancer qualities. It also gives off a distinctive lemony scent.

Myrcene is a terpene with antioxidant and anti-inflammatory qualities.

Limonene: Known for its citrusy scent, this compound may have antioxidant, antibacterial, and anticancer properties.

Flavonoids

Apigenin is a flavonoid that has anti-inflammatory, antioxidant, and perhaps anti-cancer properties.

Another flavonoid that might support lemongrass's anti-inflammatory and antioxidant qualities is luteolin.

Quercetin: renowned for its anti-inflammatory, anti-histamine, and antioxidant properties.

- **Jeera[17-18]**

Essential Oils

The main ingredient in cumin's essential oil, cuminaldehyde, is what gives jeera its distinct flavor and scent. It has been demonstrated that cuminaldehyde possesses anti-inflammatory, antibacterial, and antioxidant qualities.

Thymol: A substance with potent antifungal and antibacterial properties.

Alkaloids

Cuminine: A minor alkaloid present in cumin, it has some effects on the central nervous system and has been long believed to have digestive benefits.

5. Experimental Studies:

- **Methodology**

Materials Required

- Psidium guajava
- Fennel (Foeniculum vulgare)
- Clove (Syzygium aromaticum):
- Lemon Grass (Cymbopogon citratus):
- Cuminum Cyminum
- Sucrose
- Methyl paraben

Method of Extraction Processs

1. Extraction of Psidium guajava:

50g of Psidium guajava precatorius leaves were placed in a reflex condenser with 100 ml of water for two hours after being collected from various locations and cleaned with sterile water. Use filter paper to filter the solution once it has cooled.

2. Extraction of Lemon grass:

First, a fresh Cymbopogon citratus was gathered and properly cleaned with tap water. For one hour, 30g of leaves per leaf were put in a separate reflex condenser with 50ml of water. Use filter paper to fiter the solution after cooling it.

3. Extraction of Clove and Fennel:

Put five to seven grams of each herbal component in a beaker.

The herbs were mixed with 50 milliliters of water.

For one hour, the substance was slowly cooked in a water bath.

Bring to a boil until the volume is one-fourth of what it was before.

After cooling, the liquid was filtered.

Method of Preperation of Anti-Dairrheal Syrup:

- Psidium guajav leaf extract was combined with clove, fennel, and cumin to create the finished cough syrup.
- Add methyl paraben and propylparaben as preservatives and lemongrass extract as a flavoring.
- Herbal hand syrup was made, and the solution's clarity was visually inspected to assess its solubility.

Formulation Table of Herbal Syrup :

- For Bottel A:

Sr.no.	Ingredients	Quantity	Uses
1	Psidium guajava	25 ml	API Antimicrobial activity
2	Fennel (Foeniculum vulgare)	2 ml	Flavouring agent
3	Clove (Syzygium aromaticum):	3 ml	Anti oxidant
4	Lemon Grass (Cymbopogon citratus	4ml	Flavoring agent
5	Cuminum Cyminum	4ml	Carminative
6	Methyl paraben	2ml	Preservative
7	Sucrose	10ml	Base

Table : 06

- For Bottel B :

Sr.no.	Ingredients	Quantity	Uses
1	Psidium guajava	15 ml	API Antimicrobial activity
2	Fennel (Foeniculum vulgare)	2 ml	Flavouring agent
3	Clove (Syzygium aromaticum):	3 ml	Anti oxidant
4	Lemon Grass (Cymbopogon citratus	4ml	Flavoring agent
5	Cuminum Cyminum	4ml	Carminative
6	Methyl paraben	2ml	Preservative
7	Sucrose	10ml	Base

Table : 07

6. Evaluation Test :

- **Colour examination**

5 ml of prepered syrup was taken in a watch glass Watch glass set against a white background in white tube light.The colour was observed with naked eye.

- **Odour examination**

2 ml of prepared syrup was taken and sniffed separately

The time interval between 2 sniffs was 2 minutes to nullify the previous effect.

- **Taste examination**

A pinch of the final syrup was taken and the taste buds of the tongue were examined

- **Determination of pH**

10 ml of prepared syrup taken in a 100 ml measuring bottle.
Sonicate for 10 minutes. – Measure pH

- **Determination of viscosity**

The viscosity of each preparation was determined with an Ostwald U-tube viscometer.

- **Determination of density**

Use density bottle. Density is calculated as a substances mass per the volume it occupies

RESULT AND DISSCUSION

Sr. No	Evaluation parameters.	Formulation A	Formulation B
1	Colour	Brownish	Brownish
2	Odour	Pleasant	Pleasant
3	Taste	Sweet	Sweet
4	pH	6.1	6.4
5	Viscocity	1.08 cp	0.99
6	Density	1.05 gm	1.07

Table : 08

CONCLUSION

The following succinctly describes the findings of the investigation into the creation and assessment of Psidium guajava herbal antidiarrheal syrup:

- Antidiarrheal Efficacy: In preclinical animals, the herbal syrup made from Psidium guajava showed strong antidiarrheal efficacy, lowering the frequency and length of diarrhea. This implies that the syrup can work well as a herbal remedy for diarrhea.
- Phytochemical Analysis: It was discovered that the Psidium guajava syrup included vital bioactive substances with antibacterial, anti-inflammatory, and antidiarrheal qualities, including tannins, flavonoids, and alkaloids. The reported therapeutic benefits are probably caused by these substances.
- Safety Profile: The syrup's fitness for human usage was demonstrated by the formulation's safety during evaluation, which revealed no significant negative effects. The syrup's promise as a safe herbal medicine was supported by the fact that its toxicity was negligible at the tested doses.
- Stability and Acceptability: The syrup formulation was able to be made and stored efficiently due to its good stability under various storage circumstances. Furthermore, the individuals responded favorably to the syrup, with no notable problems with palatability or flavor being mentioned.

In summary, the Psidium guajava antidiarrheal syrup showed great promise as a natural remedy for diarrhea and was discovered to be a stable, safe, and effective composition. To determine its long-term advantages and validate its therapeutic efficacy in human beings, more clinical research is advised.

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