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Formulation And Implementation Of Multiherb Capsule For Digestive Health

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Abstract

The main cause of peptic ulcer disease, which remains a major global health burden, is an imbalance between aggressive agents like stomach acid and pepsin and mucosal defensive proteins. Although conventional drug therapies are effective, their long-term use is often associated with adverse effects and high recurrence rates. This has encouraged growing interest in herbal medicine, which are traditionally recognize for their therapeutic potential and safety. The present study Focuses on the development and evaluation of polyherbal formulation comprising.

Amla (Phyllanthus emblica), curry leaves (Murraya koenigi), coriander (Coriandrum sativum), and fenugreek (Trigonella foenum-graecum), ginger (Zingiber officinale), cardamom (Elettaria cardamomum), and jaggery (Saccharum officinarum). These

ingredients are well documented for their nutritional value and pharmacological properties, including antioxidant, anti-inflammatory, anti-ulcerogenic, carminative, and digestive-supporting effects. The formulation was prepared using a

standardized procedure and subjected to preformulation studies such as particle size analysis to evaluate flow characteristics, use bulk density, tapped density, angle of repose, Carr's index, and Hausner's ratio and blend uniformity. Additional evaluation parameters were carried out to guarantee the quality and functionality

of the capsule dosage form, including weight variation, disintegration time, pH, and stability testing to prove therapeutic efficacy and enable widespread applicability, more pharmacological and clinical research is advise diseases.

Introduction:

Peptic ulcer complaint, affecting both the stomach and duodenum, has remained a significant global health burden for further than a century, contributing to considerable
morbidity and mortality. Its pathogenesis primarily involves an imbalance between protective mechanisms similar as bicarbonate stashing, mucin product, prostaglandins, nitric oxide, and other defensive peptides and aggressive factors, including gastric acid and pepsin. When the defensive mucosal hedge is disintegrated, the sharp goods of acid and peptic exertion lead to ulcer conformation. [1] The gastrointestinal (GI) tract is a largely technical organ system, lined by mucosa and supported by submucosal, muscular, and vascular layers. The mucosa plays a vital part in nutrient digestion and immersion, vulnerable defense, and protection from physical and chemical damage. Its epithelial filling comprises several cell types, including enterocytes, Paneth cells, tableware cells, and enteroendocrine cells, each contributing uniquely to gut physiology. Enterocytes, the most abundant, primarily intervene nutrient immersion and corrosiveness swab processing. Paneth cells cache antimicrobial peptides that regulate host – microbe relations and cover against pathogens, while tableware cells produce mucins essential for maintaining the mucus hedge.

[2] Enteroendocrine cells serve as part of the gut – brain axis by regulating GI stashing, motility, energy metabolism, and neuronal signaling. Beneath the mucosa, the lamella propria provides structural support and contains vulnerable cells, blood vessels, and connective napkins. Constant epithelial renewal through stem cell isolation ensures hedge integrity; still, dislocations in these processes can concession mucosal defense and dispose to gastrointestinal diseases similar as peptic ulcer complaint. The gut microbiome further adds complexity to gastrointestinal health. It harbors trillions of microorganisms, generally bacteria from the Firmicutes and Bacteroidetes phyla, on with archaea, contagions, fungi, and protists. Although each existent's microbiome composition is unique, distinct enterotypes have been linked, characterized by dominant microbial populations. The microbiota and their metabolites impact vulnerable regulation, intestinal hedge conservation, host metabolism, and indeed neuroendocrine and cardiovascular functions. Dysbiosis or imbalance in microbial populations has been explosively intertwined in the pathophysiology of seditious, metabolic, and neurological diseases, including peptic ulcer complaint. In recent times, herbal drugs have gained renewed attention for their remedial implicit in gastrointestinal diseases.

According to the World Health Organization, medicinal shops are rich sources of bioactive motes that offer significant pharmacological benefits and frequently serve as precursors for semi-synthetic medicines. Traditional systems of drug across the world have long employed herbal shops for the treatment of habitual conditions, and ultramodern estimates suggest that nearly 65 – 75 of the global population still relies on factory- grounded curatives for healthcare requirements. Their wide use in managing gastrointestinal conditions, including peptic ulcers, highlights their significance as promising campaigners for developing safer and further effective treatment strategies.[4],[5],[6],[7],[8]

Discussion:

1. Curry leaves

Scientific classification:

- Kingdom: Plantae
- Tracheobionta is the subkingdom
- Spermatophyta is the super division
- Magnoliopsida is the division
- Species: Murraya koenigi L.Spreng
- Genus: Murraya J. Koenig ex L
- Order: Sapindales
- Family: Rutaceae
- Subclass: Rosidae z.

Table 1. ***Curry leaves'nutritional makeup (per 100g)***

S.N.	Nutrient	New leaves	Dehydrated foliage
1.	protein.	6g	12g
2.	Fat.	1g.	5.4g
3.	carbohydrate	18.7g	64.31g
4.	Iron	0.93mg	12mg
5.	B-Carotene	75.60ug	2040ug

Murraya koenigli is a small aromatic deciduous shrub That can grow 6-9 m tall and is usually found at elevations up to 1500 m above Sea level. The main stem has dark Green to brown bark with small dots, which peels off Lengthwise to expose the white wood
Underneath. Its leaves are 15-30 cm long, bipinnately Compound, and bear 11-25 leathery, Glandular leaflets that are bitter, slightly acidic, and mildly pungent in taste. The plant
Produces small, fragrant, funnel-shaped flowers Arranged in clusters of 60-90, each
Bisexual, complete, and stalked, measuring about 1.12 cm in diameter, with 4-5 sepals and 10 straight stamens. Flowering takes place from Mid-April to mid-May, followed by Fruiting from mid-July to late August.

Measuring 1.4-1.6 cm in length and 1-1.2 cm in diameter, the tasty black berries have a glossy look and contain roughly 0.76% yellow volatile oil. They typically appear in close-knit groups of 32-80 fruits. The plant has a large woody root system that produces suckers.
Seeds are the primary method of proliferation, though air layering and root suckers are also viable. Germination is most effective in partial shade. With 18chromosomes, it is a true diploid species in terms of botany.[9]

Application: [10]

The curry leaf plant has long

Been employed in home cures and is well-known in South

And an overabundance of sweet, spicy, sour, and fatty

To improve taste, increase appetite, and aid in digestion, the fragrant leaves are commonly used to

curries (Kataria et al., 2013)

They have also historically

been used to cure burns and external wounds, as well as

to neutralize animal bite toxins (Mustafa and Qktayia,

n.d). Furthermore, because of their medicinal qualities, the leaves have been used to treat rheumatism (Tan et al.,2014).

2. Amla

Scientific classification

- Kingdom: Plantae
- Malpighia is the order.
- Family: Phylanthaceag, Euphottiaceae
- Genus: Phyllanthus
- P.emblica is the species.
- Name in binomial: Phyllanthus emblica.
- Emblica ofticinalis Gaertn is its botanical name. [11]

Amla for Acidity:

Acidity is frequently caused by irregular eating patterns and an overabundance of sweet, spicy, sour and fatty meals. Smoking and other beverages like tea and coffee might exacerbate the issue. Emotional elements including melancholy, grief, and rage may also play a role. One gram of amla powder combined with a tiny bit of sugar in milk or water twice a day will help control this disease.[11]

3. Coriander seeds

Scientific classification:

- Using taxonomy: Taxon Plant Kingdom
- Division: Spermatophyta
- Class: Magnoliopsida
- Apiaceae family
- Genus: Coriandrum.
- C. sativum is the species.
- Typical Name: coriander

Application:

Utilization Every part of the plant, Coriandrum sativum, is used as a flavoring in food and as a traditional treatment for a variety of illnesses in various countries. Coriander was prized as a spice and Rome. It was brought to Britain by the Romans as well. Indian, Chinese, and American cuisines all make use of ot in their cooking. In traditional medicine, external applications of coriander leaf mixtures are occasionally used to treat coughing, gallbladder issues, chest pain and digestive health.[12],[13]

4. ***Fenugreek seeds:***

Scientific classification:

- Classification of T.foepum graecum
- Botanically Domain: Eukarya
- Class: Magnoliopsida
- Division : Magnoliophyta

- Kingdom : Plantae
- Family: Eakaceae;
- Order: fabales
- Eakales Trigonella is a member of the Trifoliae subfamily.
- Foenumgraecum sub Genus
- Trigonella foenum graecum is the species.

The nutritional makeup of fresh fenugreek leaves and seeds (per 100 g) is compared:

Part Fresh Leaves of Fenugreek Seeds of Fenugreek

Greater Moisture 86.0g of leaves The protein 30 g4.4g of seeds 1.0 g of fat, 7.5g of seeds 50 g of fiber and seeds 2g of saponins from seeds

Fresh fenugreek leaves as a component Trigonelline Content of Fenugreek Seeds Is Higher (380 mg) 395mg 160 mg of calcium (Ca) in seeds Magnesium (Mg)67mg 160 mg in leaves Phosphorus (P) in seeds: 51 mg 370 mg

Iron (Fe) seeds: 16.5 mg, 14 mg Sodium (Na) leaves: 76mg, 19 mg Potassium(K) in leaves: 31 mg 530 mg Copper (Cu) 0.26 mg33 mg seeds Sulphur (S)in seeds: 167 mg16mg Chlorine (CI) 165 mg in leaves 1.5g of equal Manganese (Mn) - 1.5 g Seeds Zinc (Zn) - 7.0 mg Seeds
Chromium (Cr) - 0.1 mg Seeds Choline 1.35 g 50 mg Leaves Vitamin C 52 mg 43 mg Leaves β-Carotene 2.3 mg 96 mg Seeds Thiamine(B1) 40 µg 340 µg Seeds

Riboflavin (B2) 310 µg 290 pg Almost equal Nicotinic acid (B3) 800 µg 1.1 mg Seeds Folic acid (B9) - 84 pg Seeds

Impact on digestion:

It's well knowledge that spices increase stomach activity. They are believed to aid in digestion by increasing salivary flow and inducing the release of gastric juice. This effect happens when strong scents or abrasive substances found in food excite nerve centers. Spices affect digestion through a variety of pathways, including the activation of digestive enzymes in the lining of the small intestine and the stimulation of salivary, gastric, biliary, and pancreatic secretion.[14],[15]

The impact of fenugreek seeds on gastrointestinal processes has been assessed in recent animal research. Among the spices examined, adding 2 grams of fenugreek to the diet for 6-8 weeks had the largest stimulatory effect on bile acid secretion, boosting secretion by almost 80% when compared to control groups. Dietary Fenugreek also increased bile flow by 44%. Additionally, a single oral dose of Fenugreek (0.5g/kg) markedly increased hepatic bile acid output by 30% [14],[15]

5. Cardamon seeds

Scientific classification:

- Kingdom: Plantae-plants
- Subkingdom: Tracheobinota- Vascular Plants
- Super-division : Spermatophyta-seed
- Division of Plants: The class of flowering plants, Magnoliophyta, The liliopsida-Zingiberidae
- Subclass: Zingiberales
- Monocotyledons Order
- Zingiberales Family. Ginger Family:Zinciberaceae
- Genus: Spices by Elettaria Maton
- Cardamomum Elettaria(L) Spices by

Application:

1. Anti ulcerogenic, Analgesic, Laxative, and Anti- Depressant properties:

Because of its cooling properties, large cardamom has long been used to treat gastrointestinal issues [2]. The methanolic extract of its seeds has demonstrated analgesic acidity. Experimental studies have shown that the methanolic extract at doses of 140-280 mg\kg and the ethyl extract at doses of 180-390 mg/kg exhibit significant analgesic effects [81. Researchers have confirmed that cardamom seed extract possesses analgesic
Properties Repression, a widespread mental disorder characterized By low energy, reduced interest, loss of appetite, and Impaired daily activities, is Increasingly prevalent in modern society. Cardamom Oil has been studied for its potential Antidepressant activity, with marble-burying tests in Rats currently being employed for Evaluation [9]. Additionally, cardamom oil supports Digestive health, functioning as a mild laxative and relieving colic symptoms.[16],[17],[18]

2. Anti-Diarrhoeal, and Carminative Properties:

Cardamom, well known as a sweet aromatic spice and flavoring agent, also demonstrates therapeutic benefits. The fruit exhibits carminative properties that alleviate gastrointestinal discomfort when consumed as an extract prepared in hot water. Furthermore, cardamom extracts have been shown to be effective against castor oil and magnesium sulphate induced diarrhea. [16],[17],[18].

C.Ginger powder

Classification:

- Kingdom: Plantae Division Magnoliophyta
- Class; Lliopsida,Scientific classification
- Family: Zingiberaceae
- Order: Zingiberales
- Genus: Zingiber
- Zingiber officinale var. Roscoe is the species.

Gastrointestinal Relief:

Ginger has been traditionally recognized for its effectiveness in managing gastrointestinal Ailments. In herbal medicine, it is valued as an excellent carminative,
aiding the expulsion of intestinal gases, and as a spasmolytic, helping to relax and soothe the intestinal tract. It Alleviates colon spasms and cramps, reduces nausea, vomiting, and motion sickness, stimulates digestive secretions, supports bowel function, and also acts as a natural colon Cleanser (Bhagyalakshmi, and Singh, 1988). Ginger exhibits a sialagogue effect by Promoting saliva production, which facilitates easier swallowing. Moreover, it serves as an Appetizer and stomachic, with active constituents such as zinzibereine and gingerol Responsible for these effects, Ayurveda, ginger is a primary ingredient of
Trikatu, a well known formulation prescribed for digestive disorders Malhotra et al, 2003), It also Functions as a purgative: fresh ginger helps relieve constipation, while dry ginger powder Works as a fecal astringent by reducing the watery.[19]
Anti-ulcerogenic:

Hypothermic restraint stress and stomach ulcers are known side effects of long-term use of non-steroidal anti-inflammatory medicines (NSAIDs), such as Aspirin, indomethacin, and reserpine. Several studies Have demonstrated that ginger possesses to protective and anti-ulcerogenic properties. These Effects are attributed to its bioactive constituents, including 6-gingesulfonic acid, 6-gingerol, 6-shogaol p-sesguiphellandrene, β-bisabolene, gingesulfonic acid, curcumene, and 6-ginglycoproteins A, B, and C (Yamahara et al, 1988). [20]

7. Jaggery powder

Sources of jaggery

- Sugarcane (Saccharum officinarum L. – Family: Ra2asgae/gGramingae) Date palm (Phoenix Dactylifera L.- Family: Arecaceae)
- Palmyra palm(Borassus tlabellier L.- Family: Arecaceag)
- Sago palm (Caryota urens L.- Family: Arecaceae)
- Coconut palm (Coces nucifera L.- Family: Acecaceag)

· Jaggery Nutritious Composition and Mineral Content(mg):

Quantity of Vitamins (mg) 40-100 calcium Vitamin A 3.870-90 Magnesium Potassium 10-56 Vitamin D?

6.5 Vitamin E 111.320-90 phosphorus Calcium 19-

30 Sodium 0.06 Vitamin B? 0.01 Vitamin B, Iron 10-

13 Vitamin C 7.0 Zinc 0.2-0.4 Vitamin B, 0.01 Copper

0.1-0.9—Manganese 0.2-0.5 Vitamin B; 0.01 Chloride 5.3 - -

- **Forms of Jaggery:**

Solid jaggery → Prepared at 118–120°C, molded into shapes.

Powdered jaggery → Prepared at 120–122°C, cooled, powdered, sieved, dried (1–2% moisture).

Liquid jaggery → Less common, intermediate concentrated form. Granular jaggery → Heated slurry cooled and granulate

- **Preparation Process:**

Boiling, concentrating, clarifying sugarcane/palm juice. Temperature range: 105–122°C depending on desired form.

Cooling → molding/powdering → drying for storage.

- **Nutritional Importance:**

Provides more minerals than refined sugar

Acts as a natural energy source with added micronutrients

- **Activities / Health Benefits**:

Energy booster (quick source of glucose) Rich in minerals → prevents iron-deficiency anemia Digestive aid (stimulates bowel movement)

Detoxifying agent (helps cleanse respiratory tract C liver)

Antioxidant activity (polyphenols, minerals)

Immunomodulatory (traditional use for immunity strengthening) [21],[22]

Application

Food industry: Sweetener in desserts, beverages, and baked products Traditional
medicine: Used for treating anemia, cough, cold, digestive issues, and as a detoxifier
Industrial uses: Fermentation substrate for alcohol, vinegar, and development of fortified Products. [21],[22]

Methodology

Materials and Methods:

1 Collection of Raw Materials:

The selected herbal ingredients were obtained from reliable sources and confirmed for Authenticity using organoleptic and morphological characteristics. Each crude material was dried, finely powdered, and passed through a sieve to achieve uniform particle size before use in capsule preparation. [23],[24],[25]

2 Preparation of Multi-Herb Capsule:

Accurately weighed quantities of the powdered plant materials were blended uniformly in a clean and dry mortar. was prepared by concentrating the juice of Saccharum
officinarum, drying, and grinding into fine powder to serve both as a natural excipient and a digestive enhancer. The final mixture was filled into empty hard gelatin capsules of appropriate size under bygienic conditions.23],[24],[25]

Table: Herbal Ingredients Utilized in Capsule Formulation:

S. No.	Ingredient	Botanical Name	Role in Digestive Health
1	Curry leaves	*Murrayy koenigii*	Acts as a carminative and possesses anti-inflammatory properties
2	Amla	*Emblica officinalis*	Helps regulate bowel movements and alleviates constipation
3	Coriander	*Coriandrum sativum*	Enhances digestive enzyme activity and stimulates gastric juice secretion
4	Fenugreek	*Trigonella foenum-graecum*	Supports enzyme production, improves bowel movements, and relieves indigestion, bloating, and flatulence
5	Ginger	*Zingiber officinale*	Improves gastric motility, stimulates digestive enzymes, and reduces indigestion, nausea, and gas
6	Cardamom	*Elettaria cardamomum*	Facilitates intestinal motility and aids digestion
7	Jaggery	*Saccharum officinarum*	Promotes digestive enzyme secretion and helps relieve constipation

Pre-formulation Research

2. Particle Size Distribution:

A zetasizer device was used to determine the herbal powder blend's average particle size.

2. Bulk density:

A graduated cylinder containing 25 g of precisely weighed sample was used to measure the herbal powder's bulk density. Without shaking the cylinder, the powder's surface was leveled, and the bulk volume (in mL) was immediately noted. This formula was used to determine bulk density: Weight of Powder /Bulk Volume equals Bulk Density23],[24],[25]

3. Tapped Density:

Tapped density was measured using the same graduated cylinder. Following the
measurement of bulk density, the cylinder was first tapped 500 times, and the volume was noted. The final tapped volume was taken into consideration if the change was less than 2%. Otherwise, tapping persisted until 750taps were made. Next, the formula for taped
density was determined: [23],[24],[25]

Tapped Density = Weight of Powder / Tapped Volume

4. Angle of Repose:

To determine the angle of Repose, the powder was allowed to pass through a funnel until the heap's tip made contact with the lower edge of the funnel. Next, the angle € was
computed using the

Formula e = tan-1'(h /r), where h is the pile's

Height (in centimeters) and r is the pile base's radius (in centimeters). [23],[24],[25]

5. Carr's Index and Hausner's Ratio:

Based on bulk and tapped densities, Hausner's ratio and Carr's index were used to further examine the powder's flow characteristics:

Tapped Density / Bulk Density = Hausner's Ratio (Tapped Density -Bulk Density)/ Tapped Density] x 100 is Carr's Index. 23],[24],[25]

Formulation:

Procedure

1) 20 gm of jaggery was dissolved in water (Ensure complete dissolution)

2) Mix all the ingredients in given quantity i.e. Curry leaves powder, Amla Powder, Coriander Powder, Fenugreek Powder, Ginger Powder, and Cardamom Powder.

3) Slowly add jaggery solution in powder mixture

4) Stir vigorously for even distribution of all ingredient

Mixture is passed rough a sieve of no 266.The powder is Collected and illed in capsule shell no 00.

5) Pack the capsule in suitable containers. [22]

Formulation Table:

- Curry leaves powder.2gm
- Amla powder 1gm
- Coriander powder 1gm
- Fenugreek powder 1gm
- Ginger Powder 1gm
- Cardamom powder. 1g
- Jaggery 2gm [22]

Evaluation Parameters

Weight Variation Test:

This test was conducted to measure the difference in the amount of powder contained in each herbal capsule. A random sample of twenty capsules was taken and weighed. The mean weight was calculated and compared with the weight of each capsule to find the percentage variation using the formula:

\text{Weight Variation (\%)} = \frac{\text{Weight of Capsule – Average Weight}}{\text{Average

Weight}} \times 100

Disintegration Test:

This test is crucial for assessing the quality of traditional dosage forms. It checks how quickly a drug or dosage form breaks down in the patient's digestive system. Six capsules were randomly selected and placed in a disintegration apparatus maintained at 37 ± 2 °C. The apparatus contained simulated gastric fluid (SGF, pH 1.2), which was kept in motion for 30 minutes to simulate gastric conditions. The test measures the time required for the capsules to disintegrate into particles small enough to pass through a 10-mesh screen.

pH Determination:

The pH of a 1% solution of the powdered mixture was measured using a pH meter.

Stability Study:

This study helps determine the best storage conditions to ensure that the medication Maintains its quality during its shelf life. It was carried out over a period of three months, Evaluating the formulation's characteristics under varying conditions of temperature and Relative humidity.[26]

Results and Discussion

Preformulation Studies:

S. No.	Test	Result
1	Physical Appearance.	Dark brown color
2	Solubility	Water
3.	pH	4.5 ± 0.5
4	Particle Size	1056 ± 20
5.	Bulk Density.	0.61 ± 0.03
6.	Tapped Density	0.69 ± 0.02
7.	Hausner's Ratio.	1.13 ± 0.07
8	Carr's Index.	36.7 ± 0.67

Disintegration Test

S. No.	Disintegration Time (min)
1.	12.89
2.	12.56
3	12.76
4	12.37
5	12.96
6.	12.49

Mean Disintegration Time: 12.67 minutes.

Weight Variation

S. No.	Weight of Capsules (mg).	% Weight Variation
1	510	1.39165
2.	512.	1.789264
3.	506.	0.596421
4.	507	0.795229
5	491	-2.38569
6.	499	-0.79523
7.	505.	0.397614
8	513	1.988072
9.	508	0.994036
10	501.	-0.39761
11.	497.	-1.19284

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Conclusion:

The formulation of a multiherb capsule for digestive health provides a safe, effective, and natural alternative for improving gastrointestinal function. By combining multiple herbs with synergistic action, the capsule enhances digestion, reduces discomfort, and
promotes overall gut health. The implementation of this herbal approach demonstrates its potential as a cost-effective, accessible, and patient, supporting the integration of
traditional knowledge with modern dosage forms.

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