

**FORMULATION AND EVALUATION OF HERBAL ANTACID
CAPSULE CONTANING LIQUORICE AND GINGER****Suhani Pradeep Kamble*, Sakshee Kishor Kanim, Tushar Tatya Karade, Swati A. Patil,**

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ABSTRACT

The present study focuses on the development and evaluation of a novel herbal antacid capsule formulated using liquorice and ginger powders. Initially, a comprehensive pre-formulation study was conducted to assess the physicochemical properties of the raw materials, including organoleptic characteristics, solubility, and compatibility. Based on these findings, herbal antacid capsules containing standardized amounts of liquorice and ginger were prepared and subjected to evaluation. The physical parameters of the capsules, such as weight variation, disintegration time, pH and dissolution time were systematically tested to ensure quality and consistency. Furthermore, the acid neutralizing capacity of the formulation was verified through back titration using hydrochloric acid, thereby confirming its potential efficacy in reducing gastric

acidity. The results of this study highlight the promising role of liquorice and ginger as natural agents in the formulation of safe and effective herbal antacid capsules, offering an alternative to conventional synthetic antacids.

KEYWORD: herbal antacid capsule, liquorice, ginger, hyperacidity.

INTRODUCTION

The stomach plays a vital role in the human digestive system, acting as a primary hub for breaking down food. It secretes specialized gastric acids designed to process food already softened by saliva. However, when the stomach produces an excessive amount of these acids, it leads to a condition known as hyperacidity.^[1] Heartburn, flatulence, and dyspepsia are

symptoms of gastric acidity. It is a prevalent illness that impacts many individuals everywhere in the world. The cause of gastric acidity is excessive HCl, or stomach acid, is secreted and can cause stomach inflammation and result in ulcers.^[2]

For the relief of acidity, people commonly take antacid drugs which help to rapidly reduce the symptoms. Antacids are commonly used self-prescribed medications and are easily available in all pharmaceutical outlets as Over-The-Counter Drugs (OTC). According to Food and Drug Administration, antacids are medicines that neutralize stomach acids. Antacids work by either increasing the pH, neutralizing acidity, or by lowering or blocking the secretion of acid by gastric cells to reduce acidity in the stomach. They also inhibit the proteolytic enzyme, pepsin.^[2]

Antacids

The components utilized to neutralize the acid produced in the stomach are referred to as antacids. They may be in semi-solid, both in liquid and solid dosage forms. It is given Orally. These are employed to restore the eroded stomach's mucous membrane. Antacids are primarily created using either herbal ingredients or chemicals.

Classification of Antacids

1) Systemic antacids

These are antacids that are taken up by the bloodstream and result in systemic consequences. Electrolyte imbalance and alkalosis are the most typical adverse reactions to systemic antacids. Systemic antacids are included Bicarbonate of sodium and carbonate of calcium.

2) Non-Systemic antacids:

Antacids that are not absorbed are known as non-systemic antacids. Into the circulation and exhibit direct action without Non-systemic binding to the receptors antacids. These could result in gastrointestinal discomfort and prevent some drugs from being absorbed. Non-systemic antacids are included: Magnesium hydroxide as well as aluminium hydroxide.^[3]

Side effect of Antacids

- An excessive quantity of antacids containing aluminium results in constipation.
- Excessive consumption of antacids containing magnesium results in diarrhea.
- Excessive use of antacids containing calcium results in
- Constipation and could result in elevated calcium levels, which could result in kidney

stones.

- An electrolyte imbalance may result from using antacids excessively.
- Prolonged use of materials containing magnesium and aluminium Antacids may disrupt renal function and result in kidney problems.^[4]

Herbal Antacids

The naturally occurring components utilized in the formulation of antacids to neutralise the acid produced in the stomach are referred to as herbal antacids. These are offered over-the-counter without requiring a certified medical Doctor's prescription. These are more effective and safety with minimal adverse effects compared to chemically created antacids. Several popular herbal antacids on Digene, Dabur Pudina Hara, Himcocid, etc.^[5]

Herbal antacid is well-known for its acid-neutralizing and digestive properties. It was created as a more comprehensive and safe substitute for synthetic antacids, which are frequently linked to adverse effects. Such as rebound hyperacidity, constipation, or electrolyte imbalance. By calming the stomach mucosa, this herbal remedy reduces improving overall digestive function and reducing excessive stomach acid secretion.

Ayurveda and other traditional medical systems make extensive use of herbal antacid, which provide a natural method of preserving a healthy digestive system without upsetting the body's normal acid-base equilibrium. As interest in integrative and plant-based medicine solutions keeps expanding, such herbal products are growing in popularity for both therapeutic and preventive use in gastrointestinal conditions.^[1] It is One of the important pharmaceutical categories preparation whose activity is improved or expedited by Probiotics are either natural or herbal medications. One of the most common medical preparations in a condition or concentration comparable to that of nature, like by consuming a leaf, stem, root, or flower, seed, yeast, mold, spore, pollen, hip, node, or something similar is known as a natural or herbal medication. Most herbal remedies are derived from plants. and a blooming plant valued for its therapeutic properties qualities that could be regarded as a herb.^[6]

Merits of Herbal Antacid over chemically formulated antacids

1. These are safer and more effective than chemically created antacids.
2. Compared to chemically formulated, these are less expensive antacids.
3. Compared to chemically created antacids.
4. These offer more health advantages than antacids with chemical formulations.

5. These lessen the imbalance of minerals, such as chemically created antacids.^[4]

Polyherbal formulation

Polyherbal formulations include two or additional herbs. The formulation of Ayurvedic medicine is based on two guidelines: taking multiple drugs and using a just one medication. The final one is known as a polyherbal formulation.^[7] Multiple herbal extracts used in herbal remedies are considered to be more extensive than just the Indian traditional healthcare system. Additionally, it is widely known that there are a Many Ayurvedic polyherbal drugs (PHFs) include accessible upon request. Due to the synergistic effect, there are some benefits to polyherbalism that cannot be accomplished by creating each medication. Creating an active Remedial action will be improved by phytoconstituent. The herbal expression's least effective treatment would be required to have the desired corrective effect, which lessens side and adverse goods' liability.^[8]

To formulate safe polyherbal formulations, numerous pharmacological and toxicological investigations, as well as phytochemical standardisation, are necessary.^[9]

Advantages of poly herbal formulation

1. There are more benefits to using poly herbal mixtures than taking a single plant due to their mutually beneficial effects.
2. The quantity of doses and the intensity of adverse effects declined with the introduction of poly herbal combinations.
3. Reducing the quantity of medication taken all at once improves the convenience of patients.
4. Despite the fact that the active Certain plants' phytochemical components have a well-established history, they are usually limited to trace amounts and are rarely sufficient to generate the intended medicinal outcomes.
5. Additionally, they have a favourable effect and are safe in large doses ratio of risk to benefit.^[6]

Marketed Poly herbal Antacid Capsule Formulation.**Table NO 01: Marketed Poly herbal Antacid Capsule Formulation.^[6]**

Sr. No.	Formulation	Brand	Type	Ingredients	Uses
1.	Triphala	Himalaya	Capsule	Terminalia chebula, Terminalia belerica, Emblica officinalis	help in digestion and promotes general gastrointestinal health
2.	Jark Pharm Acidon Herbal Capsule	Jark Pharm	Capsule	Hingwastak Churna Lavan Bhaskar Churna Katuki Churna Swarjika kshar	It is useful in treating indigestion. It helps in treating hyperacidity. It is used to fight free radical damage provides relief from acidity Dyspepsia
3.	Dr Vaidya's Acidity Relief Capsule	Dr Vaidya's	Capsule	Avipattikar Churna Shankha bhasma Mukta Pishti: Amla Yashtimadhu	provide fast and long-lasting relief from acidity. Relieve GERD and gastritis. Relieve constipation. Relieve appetite and indigestion
4.	Dharishah Ayurveda Dezyme Herbal Antacid Capsule	Dharishah Ayurveda	Capsule	Badi Harad Pudina Patpita Avipattikar Churna	hyperacidity GERD Indigestion Heartburn gastritis

General Anatomy of Stomach

Stomach anatomy in general the stomach is a cylindrical, J-shaped organ with an oesophagus at its top and a linked to the duodenum. The convex curvature of the stomach extends to the liver and concave border that extends to the wall of the abdomen.^[10]

There are four sections to the stomach

- 1) Cardia: It joins the stomach and oesophagus. Additionally, it has a sphincter muscle That stops food from returning to the duodenum from the stomach.
- 2) Fundus: This grey, dome-shaped structure is situated next to the cardia on the upper Left side.
- 3) Body: It covers nearly 80% of the food and aids in its proper storage and churning Entire stomach area.
- 4) Pylorus: Its funnel-like shape facilitates food passage from the stomach to the duodenum. It comprises the pyloric sphincter, a muscular valve that control The passage of chyme and stop it from flowing backward from the stomache Into the duodenum.^[11]

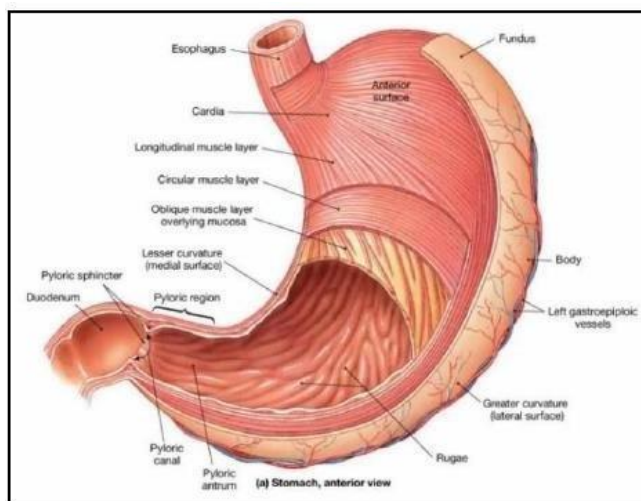
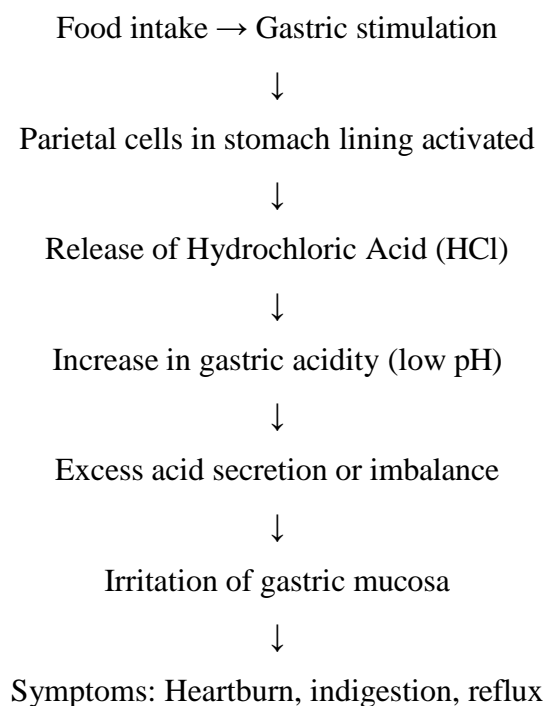


Fig. No.: 01 General Anatomy of Stomach.^[10]

Mechanism of acidity



Acidity in the stomach begins when food intake triggers gastric stimulation, which activates the parietal cells in the stomach lining. These specialized cells then release hydrochloric acid (HCl), lowering the pH and increasing gastric acidity. When acid secretion becomes excessive or imbalanced, the protective mechanisms of the stomach lining are overwhelmed. This leads to irritation of the gastric mucosa, which manifests as common symptoms such as heartburn, indigestion, and acid reflux.^[12]

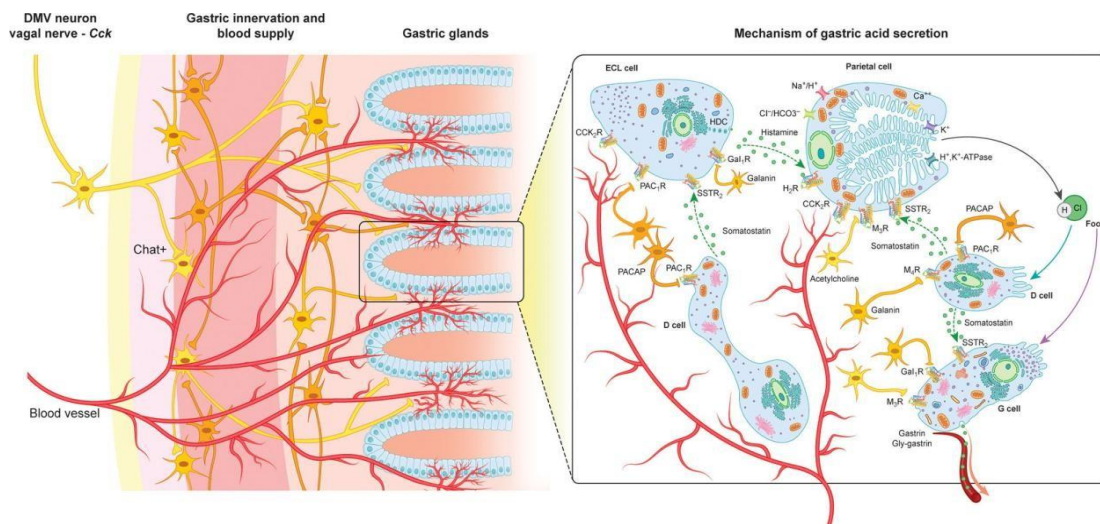


Fig. No. 02: Mechanism of Gastric acid Secretion. [13]

Need of study

The need for the study of herbal antacid capsules arises due to the increasing prevalence of digestive disorders such as acidity, heartburn, indigestion, bloating, and acid reflux among individuals because of unhealthy dietary habits and stressful lifestyles.

Conventional chemical-based antacids may provide temporary relief but are often associated with side effects during long-term use.

Therefore, there is a growing demand for safe, natural, and effective alternatives. Herbal ingredients such as liquorice and ginger possess significant gastroprotective, anti-inflammatory, and digestive properties, making them suitable for the management of gastric disorders. This study is needed to develop a herbal antacid capsule that can provide multi-symptom relief, support gut health, improve digestion, and reduce gastrointestinal discomfort with minimal adverse effects. The formulation may also improve the quality of life by offering a gentle and long-lasting solution for digestive health management. [14]

Reason for choosing an herbal antacid capsule

- Pharmaceutical formulations known as herbal antacid capsule are intended to reduce the symptoms of acidity and heartburn by balancing out too much stomach acid
- These capsule are usually include a blend of herbal components with antacid qualities, carefully chosen and prepared to offer
- Give the efficient alleviation of gastrointestinal distress.
- The goal of using several herbs in these formulations is to increase their effectiveness by synergistic effects, providing a comprehensive strategy for digestive health Instead of using

traditional antacids, Because of their natural ingredients, perceived safety, and potential benefits, herbal tablets are becoming more and more popular health advantage.

- A polyherbal mixture made from organic plant sources, herbal antacid capsule is renowned for their acid-neutralizing and digestive qualities.
- It was created as a more comprehensive and secure substitute for synthetic Antacids that frequently cause adverse effects such as rebound, constipation, or electrolyte imbalance excessive acidity.
- This herbal remedy reduces excessive stomach acid secretion by calming the gastric mucosa and improving the digestive system as a whole.
- Ayurveda and other traditional medical systems make extensive use of herbal antacid capsule , which provide a natural strategy for preserving a healthy digestive system without upsetting the body's normal acid-base equilibrium.^[14]

OBJECTIVE

1. To perform per formulation study of powder of liquorice and ginger.
2. To formulate and evaluate herbal antacid capsule of liquorice and ginger.
3. To evaluate physical tests for herbal antacid capsule.
4. To verify acid neutralizing capacity through back titration with Hydrochloric acid.

Overview of Medicinal Plant

Ginger:

- **Synonym:** Ginger, Adrak, Sunthi
- **Biological source:** Ginger is obtained from the fresh or dried rhizome of *Zingiber officinale* Roscoe, a perennial herb belonging to the Zingiberaceae family.
- **Geographical source:** South East Asia is where it originated. Tropical climates are ideal for growing ginger parts of the globe. China, Taiwan, and India are the main producers. Saudi Arabia, Jamaica, Nigeria, Australia, Japan, and Fiji. Kerala, Meghalaya, about 70% is produced in Arunachal Pradesh, Sikkim, Nagaland, Mizoram, and Orissa of the ginger grown in India. Ginger comes in about 85 different species worldwide. Nowadays, this plant is grown in tropical climates all over the world. In South and Southeast Asia (India, China, Nepal), tropical Africa, portions of Central America and the Caribbean, and Australia, it is grown for commercial purposes. Planting takes eight to ten months.^[15]
- **Chemical constituents:** Gingerols, mainly 6-gingerol. On drying or heating, gingerols

convert to shogaols like 6-shogaol, which are more pungent. Zingerone forms from gingerol during cooking. It contains sesquiterpenes like zingiberene, β -bisabolene. Also, monoterpenes like camphene, β -phellandrene, cineole, and citral that give the aroma.^[16]

- **Morphology:** Ginger is a erect perennial that reaches a height of one to three feet. The stem stick of the plant has two leaves surrounding it, and it reaches a height of roughly twelve inches off the ground.

Roots: Although roots have similar aromatic qualities, they should not be eaten because they contain aristolochic acid, a substance linked to long-term kidney damage.

Rhizome: A rhizome, which is an underground stem rather than a root), this plant is rhizomes should be handled carefully to prevent damage that could cause spoiling because they have a corky, brown to golden outer skin that is extremely thin and easily abraded. The interior has a spicy, almost lemony smell and is pale yellow. The rhizomes have a very mild flavour and are juicy and fleshy when they are young, but as they get older, they get hotter, more fibrous, and drier.

Leaf: Leaf sheaths that were firmly encircling each other. The medium green, alternating leaves have two ranks of long, narrow (7 by $\frac{3}{4}$ inch) blades on each stem.

Flower: A sequence of greenish or yellowish bracts with translucent margins makes up the dense, cone-shaped flower spikes. Just past the green bracts are cream to yellowish green flowers, each with a mauve or deep purple lip. Typically sterile, culinary ginger flowers hardly ever produce seeds.^[17]

- **Uses**

1. It is used to treat stomach related problem and nausea.
2. It is used to treat stiffness, distraught seizure, breakdown, scabies, blockage, heartburn.
3. It is used to treat kapha and vatta sedative.
4. It is used to treat cough, hicckups, rhinitis etc.
5. It is gastro-protective, hepato-protective and neuroprotective.
6. It is anti-viral, anti-bacterial, anti-diabetic, anti-ulcer, anti-oxidant and anti-inflammatory.^[15]



Fig No: 03 Ginger.^[1]

Liquorice

- **Synonym:** Liquorice, Yashti-Madhu, Jeshtamadha.
- **Biological source:** It is obtained from dried unpeeled or peeled stolon and roots of *Glycyrrhiza Glabra* Linn and belonging to the family Leguminosae.
- **Geographical source:** The therapeutic plant is originally from different parts of Asia; they can also be found in some parts of Europe. The species *G. Glabra* is found in many different places, such as Spain and Italy. Turkey, Caucasus, Western China, and Central Asia. In contrast, *G. uralensis* is Located primarily in Central Asia, but also in China and Mongolia. Liquorice is cultivated. Commercially available in several countries, including India, China, Italy, Spain, Greece, Iran, and Iraq. Turkmenistan, France, Syria, England, Azerbaijan, United States, and Afghanistan.
- **Chemical constituents:** The medicinal qualities of liquorice are attributed to a number of significant chemical components. Glycyrrhizin or glycyrrhizin acid, a sweet-tasting saponin glycoside. Additionally, flavonoids like glabridin, isoliquiritin, and liquiritin are found in liquorice. Saponins, chalcones, coumarins, tannins, sugars, starch, resins, sterols, and trace amounts of volatile oils are additional components.
- **Morphology**

Leaves

This plant has compound leaves with an unusual quantity of leaflet that are alternately positioned along the stem. Every single usually, a leaf has four to seven pairs of oblong, elliptical, or lanceolate leaflets with soft hairs on the underside.

Fruit

The fruit is a flattened pod or legume that can grow up to the length is 1.5 cm. It is smooth, upright, and displays a its surface has a somewhat reticulated pattern. Inside, it typically has

three to five kidney-shaped, brown see.

Flowers

The axillary arrangement of slender flowers spikes, ranging in hue from violet to lavender. The calyx which is short, bell-shaped, and encircles the flower. Glandular hairs and lanceolate tips.

Root

There is roughly one main root in the root system. 1.5 cm in length, which produces subsidiary roots that are roughly 1.25cm in length. Horizontal woody stolon's grow from these roots which has a maximum length of 8 meters. After drying and cut, the stolons and these roots are sold commercially referred to as licorice. The root fragments can be found either peeled or not peeled. They have a fibrous texture when broken, with a yellowish interior with a unique smell and sweet.^[18]

• Uses

1. It is frequently used in traditional Chinese medicine to treat bronchitis, arthritis, coughs, and gastrointestinal problems.^[19]
2. It is still frequently utilized in traditional medicine to treat tremors, respiratory infections, gastritis, and peptic ulcers.^[19]
3. In actuality food production is *G. glabra*'s most significant industrial application additives, including sweeteners and flavours.^[20]
4. Traditional healers have asserted that *Glycyrrhiza* species are effective as a insecticide, choleric, and diuretic for a range of pathological conditions.^[19]
5. Coughs, colds, and uncomfortable swellings are treated with it in traditional medicine.^[19]
6. When it comes to cosmetics, *G. glabra* is it is being used as a skin depigmentation agent in topical products intended for that use.^[20]



Fig No: 04 Licorice.^[12]

Pharmacognostic Evaluation

Test for carbohydrates

Table No: 02 Test of carbohydrate of ginger and liquorice.

Sr. No	TEST	OBSERVATION	INFERENCE OF GINGER	INFERENCE OF LIQUORICE
1.	Fehling's Test: Mixed 1ml Fehling A and Fehling B solution boiled for 1min, added equal test solution	Yellow ppt	Carbohydrates are present	Carbohydrates are present
2.	Benedict's Test: Mixed equal volume of Benedict's reagent in test solution then test tube was heated on boiling water bath for 5 min	Brick red ppt	Carbohydrates are present	Carbohydrates are present



Fig. No. 5.1 Fehlings test.



Fig No. 5.2 Fehlings test for ginger for liquorice.



Fig No. 5.3 Benedicts test.

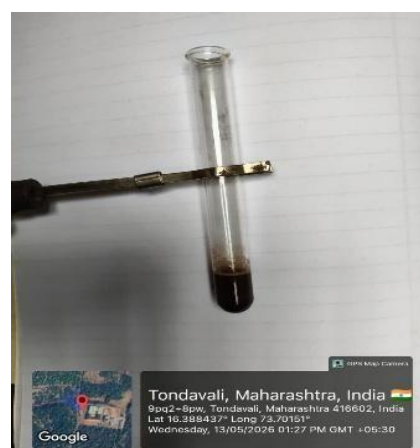


Fig No.5.4 Benedicts test for ginger for liquorice.

Test for tannins

Table No: 03 Test of tannins for ginger and liquorice.

Sr. No	TEST	OBSERVATION	INFERENCE OF GINGER	INFERENCE OF LIQUORICE
1.	Lead Acetate Test: To sample extract added, few drops of 10% solution of aqueous basic lead acetate and observed change	White ppt present	Tannis are present	Tannis are present
2.	Ferric Chloride Test: Add few drops of ferric chloride solution to the extract	No violet colour	Tannis are present	Tannis are present

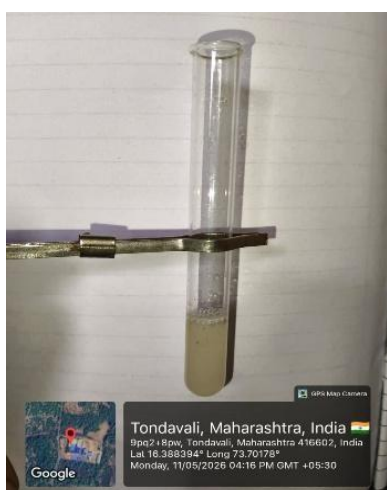


Fig No. 6.1 Lead acetate test for ginger.

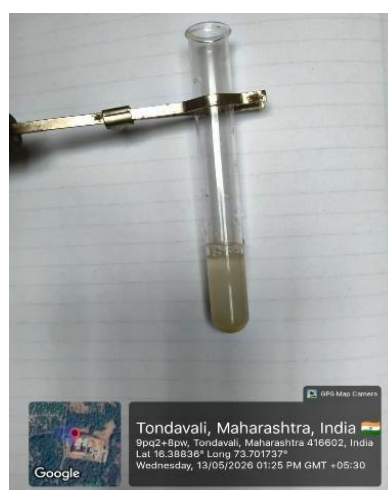


Fig No. 6.2 Lead acetate test for liquorice.



Fig No. 6.3 Ferric chloride test for liquorice.



Fig No. 6.4 Ferric chloride test for ginger.

Test for saponin.

Table No: 04 test for saponin of ginger and liquorice.

Sr. No	TEST	OBSERVATION	INFERENCE OF GINGER	INFERENCE OF LIQUORICE
1.	1ml of extract added 2ml of distilled water shaken well and observed change	Formation of foam	Saponin are present	Saponin are present



Fig No. 7.1: Saponin test for ginger.

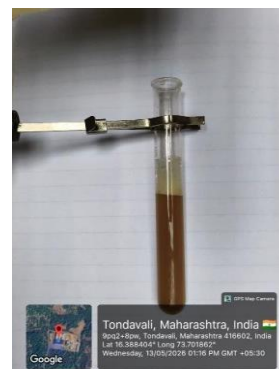


Fig No.7.2: Saponin test for liquorice.

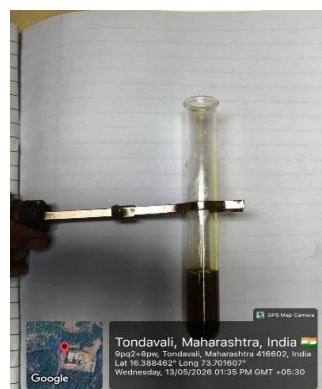
Test for flavonoids

Table No: 05 Test for flavonoids of ginger and liquorice.

Sr. No	TEST	OBSERVATION	INFERENCE OF GINGER	INFERENCE OF LIQUORICE
1.	With Sodium Hydroxide: 1ml Sodium Hydroxide solution was added to the extract	Yellow to Orange Colour	Flavonoids are present	Flavonoids are present
2.	With Conc. Sulphuric Acid: Concentrated Sulphuric acid was added to the extract	Orange to red tint	Flavonoids are present	Flavonoids are present



Fig No.8.1 Test with sodium hydroxide of ginger.

Fig No.8.2 Test with sodium hydroxide
of liquorice.



**Fig No.8.3 Test with conc.
Sulphuric acid of ginger**



**Fig No.8.4 Test with conc.
Sulphuric acid of liquorice**

FORMULATION DESIGN

A statistical research methodology called factorial design acknowledges the interdependent impact of every possible combination of variables within a set of experiments. Experimental designs for first-degree models are another name for factorial design. the most popular method. A design of experiments (DOE) can be set up as simply as test at various levels using two or more variables (n).

Each factor has only two levels in the great majority of factorial experiments. For instance a factorial experiment would have four treatments if each of the two factors had two levels. combinations overall, and it's commonly referred to as a 2x2 factorial design. Factorial design has been applied to the development of formulations by Pharmaceutical process and product development optimization using a methodical approach which maximize efficacy and minimize effort to produce the best results. By reducing the number of experimental tests while developing a formulation, optimization techniques can assist in lowering product prices. Additionally, the enhanced experimental designs are helpful for looking at exact quality guarantees regarding enhanced product quality for regulatory agencies.^[22]

Merits of factorial designing

- Scientific knowledge is the foundation for quality that is integrated into both the process and the final product.
- The product's performance will determine the specifications.
- Pay attention to understanding, controlling, and robustness.
- Product and process knowledge will be used to explain report submission.^[22]

Types of factorial design

1. Fractional factorial design

A fractional factorial design, where a portion of the potential combinations are excluded (typically at least half), if a full factorial design's number of combinations is too high enough to be useful in terms of logistics.^[22] Accordingly, for this fractional factorial Assuming that fourth-order and higher-order interactions are insignificant, which is quite reasonable in practice, we can estimate all main effects and all two-factor interactions. Additionally, each three-factor interaction is aliased with another three-factor interaction and so we are limited to estimating their total.^[23]

Fractional factorial designs are divided into two categories: regular and non-regular designs. Regular designs are created by establishing the relationships between various elements. The basic aliasing structure of these designs is that Any two effects are either completely aliased or orthogonal. The run sizes are consistently a prime, a power of two, or three, so the "gaps" between potential run sizes are expanding as the power rises. Non-regular designs, such as Plackett-Burman and other orthogonal, because of their flexibility and run size economy, arrays are frequently used in a variety of screening experiments.^[24]

2. Full factorial design

When examining two or more factors in full factorial designs are highly effective impact of a factor can be characterized as the shift in reaction brought about by a shift in the factor's level.^[23] An experiment that is fully factorial is a statistical design with two or more variables, each with a distinct potential value or "level," and whose experimental units comprise every possible pairing of these levels throughout all of these elements. As an experiment allowed the researcher to look at the individual parts' and the response variable as a result of their interactions. When using a full factorial approach, every factor are integrated across all levels and the quantity of experiments turns into f^n where n is the level and f is the factor. 3^2 give nine components make up a full factorial design experiments, 4^2 includes 16 and 5^2 includes 25.^[22]

In the three factors design we have two independent variables, each of which has three values or levels. This is known as three by two factorial design because of the three levels of each factor. Using a 3^2 -factorial design to determine there is a significant impact from independent variables on the variables that are dependent. When could the size of particle size as well as drug ratio for greater accuracy. Additionally, design reveals the relationship between the

independent variables, which refers to the impact of a single variable is dependent upon the degree of the other.^[15]

In the given study, ratio of ingredients and particle size of ingredients were selected as the independent variables. An ingredient is liquorice and ginger where liquorice act as natural antacid and ginger is enhance gastric motility. Particle size varies from coarse, medium and fine.

The dependent variables selected for evaluation includes ANC test, disintegration time and dissolution time. A total of nine formulations (F1-F9) were prepared according to factorial design model.

Table No.06 Independent variables of factorial design.

Independent Variables	Symbols	Low	Medium	High
Ratio of ingredients	X1	(2:1) (233:117)	(1:1) (175:175)	(1:2) (117:233)
Particles size	X2	COARSE	MEDIUM	FINE

Table No. 07 Dependent variables of factorial design.

Dependent Variables	Symbols
Acid Neutralizing Capacity Test	Y ₁
Disintegration test	Y ₂
Dissolution test	Y ₃

X1= Ratio of liquorice and ginger

-1=2:1(high liquorice) 0= 1:1(balanced)

+1=1:2(high ginger)

X2= Particles size of drug

-1=coarse 0=medium

+1=fine

Table No.08 Experimental layout of 3² factorial design.

Formulation Code	Liquorice	Ginger	Particle size	Coded value
F1	233	117	Coarse	(-1, -1)
F2	233	117	Medium	(-1,0)
F3	233	117	Fine	(-1, +1)
F4	175	175	Coarse	(0, -1)
F5	175	175	Medium	(0,0)

F6	175	175	Fine	(0, +1)
F7	117	233	Coarse	(+1, -1)
F8	117	233	Medium	(+1,0)
F9	117	233	Fine	(+1, +1)

Master Formula

Table No.09 Master Formula.

Formulation batch	Liquorice	Ginger	Particle size
F1	233mg	117mg	Coarse
F2	233mg	117mg	Medium
F3	233mg	117mg	Fine
F4	175mg	175mg	Coarse
F5	175mg	175mg	Medium
F6	175mg	175mg	Fine
F7	117mg	233mg	Coarse
F8	117mg	233mg	Medium
F9	117mg	233mg	Fine

METHODOLOGY

Manual method for capsule filling

1. Separate capsule shells

Pull apart caps from bodies manually or by rolling on a flat surface.

2. Load bodies

Place open capsule bodies into the holes of the filling tray, ensuring they sit flush and upright.

3. Spread powder

Pour powder over the tray and use a spreader card to evenly distribute across all bodies, filling them partially.

4. Tamp down

Gently press the tamper into the powder to compact it evenly; scrape off excess and repeat spreading/tamping 2-3 times until bodies are full to the desired level (avoid overfilling to prevent leakage.)

5. Cap capsules

Place the cap holder tray over the filled bodies, flip the assembly, add caps, and press down firmly to seal.

6. Eject and inspect

Remove filled capsules, check for proper fill weight (using a balance) and seal integrity.

7. Storage

The prepared capsules stored in ambered coloured bottle to protect them from light and

moisture.^[25]

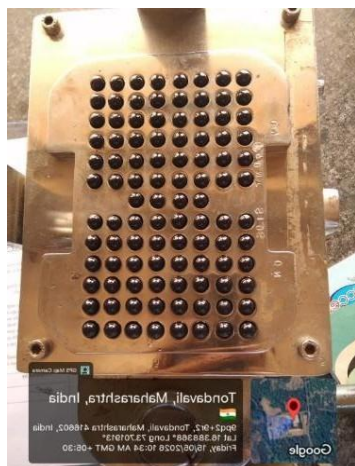


Fig no.09 Capsule put in the machine



Fig.no.10 Separate the cap and body of the capsule.

Pre-Formulation Studies

Pre-formulation research is the initial phase in creating a dosage form for a possible medication formulation. To find out more about the acknowledged attributes of components and the recommended schedule for formulation, In the drug development process, a primary study is being carried out. procedure. Consequently, this pre-formulation research has the benefit of confirming that there aren't many difficulties in creating the drug or creating the form of dosage. Pre-compressional factors were studied. such as tapped density, angle of repose, Hausner's ratio, indices of compressibility and bulk density.^[26]

1. BULK DENSITY

The mass of an untapped powder sample divided by its volume is known as the bulk density. Bulk density, also known as apparent or volumetric density, is a characteristic of granules, powders, and other masses of particulate or corpuscular matter. A 100ml measuring cylinder was filled with a 25g weight of each of the moringa powders to be used as carriers, and the volume was noted. Next, the bulk density was computed. Although the international unit is kilograms per cubic meter (1g/ml=1000kg/m³), the bulk density is expressed in grams per millilitre (g/ml).^[27]

$$\text{Bulk density} = M/V_o$$

Where,

M = mass of the powder

V_o = bulk volume of the powder.

2. TAPPED DENSITY

A graduated measuring cylinder filled with the powder is mechanically tapped to determine the tapped density. A 100ml measuring cylinder was filled with 25g of each moringa powder, and the volume was measured by tapping the cylinder 30 times from a height of about 2cm^[27]

$$\text{Tapped density} = M/V_t$$

Where,

M = mass of the powder

V_t = final tapping volume of the powder.

3. CARR'S INDEX

A comparison of bulk and tapped densities can provide a measure of the relative importance of the inter-particulate interactions that influence a powder's bulking properties and interface with powder flow. This comparison is frequently used as an indicator of the powder's flowability.^[28]

$$\text{Carr's Index} = \frac{(\text{bulk density} - \text{tapped density}) \times 100}{\text{Density of tapping}}$$

Table no.10 Standard value of Carr's index.

FLOW PROPERTY	CARR'S INDEX
Excellent	0-10
Good	11-15
Fair	16-20
Possible	21-25
Poor	26-31

4. HAUSNER'S RATIO

An indicator of a powder or granular material's flowability is the Hausner ratio. Henry H. Hausner, an engineer, is honoured by the name.^[28] The following relationship was used to calculate Hausner's ratio.

$$\text{Hausner's Ratio} = \frac{\text{Tapped density}}{\text{Bulk density}}$$

Table no.11 Standard value of Hausner's ratio.

FLOW PROPERTY	HAUSNER'S RATIO
Excellent	1.00-1.11
Good	1.12-1.18
Fair	1.19-1.25
Possible	1.26-1.34
Poor	1.35-1.45

5. ANGLE OF REPOSE

The greatest angle that can exist between the powder pile and its horizontal plane is known as the angle of repose. A glass funnel that was plugged and had its tip 10 cm above the bench's level surface was filled with a 5g sample. The granules were free to move from a heap whose height and diameter were measured through the funnel's orifice.^[29]

The following formula was used to determine the angle of repose

$$\text{Angle of repose } \theta = \tan^{-1} (h/r)$$

Where, h=height of the pile r = radius of pile

Table no. 12 Standard value angle of repose.

FLOW PROPERTY	ANGLE OF REPOSE (θ)
Excellent	25-30
Good	31-35
Fair	36-40
Possible	41-45
Poor	46-55
Very Poor	56-65
Very – very Poor	>66

EVALUATION TEST FOR HERBAL ANTACID CAPSULE

1. GENERAL APPEARANCE

The overall physical appearance of capsules determines their unique appearance and overall refinement, which is necessary to ensure that customers are satisfied. The color, taste, texture, and odour of antacid capsules were assessed.^[30]

2. Dissolution test

The capsule's dissolution was evaluated using a USP dissolution Device Type II. (Paddle Type). 900mL of 6.8 pH phosphate buffer was used for the dissolution. The paddle was submerged in a dissolving medium. A continuous temperature bath was used to maintain the flask at $37 \pm 2^\circ\text{C}$. The shaft was spun at fifty revolutions Per minute. The time was set for one hour. At every 15-minute interval, a 10mL sample was withdrawn from the bath. The sink's condition was maintained by replacing it with 10 millilitres of buffer solution. The withdrawn sample was moved. to a flask (100 mL) and the volume was increased using the Buffer solution. Then, 1 mL of sample was taken from the flask (100 mL) and transferred to the 10 mL flask, and the volume 10 mL of buffer was added, and the absorbance was measured at 251 nm. The procedure was repeated for several samples were collected at various time intervals (5,10,15,20,25,30). The absorbance was measured with a UV-spectrometer.^[31]

$$\% \text{ Drug Release} = \frac{\text{Amount of drug released} \times 100}{\text{Total drug content}}$$

3. Weight variation test

The weight uniformity test was performed in accordance with the Indian Pharmacopoeia (IP) 2007. Randomly selected 15 capsules were weighed (both individually and collectively) in a single pan balance. The average weight, variations in each capsule, and the standard deviation was calculated. The IP limit for weight variation in capsules weighing more than 300 mg is $\pm 5\%$.^[32]

$$\text{Weight variation} = \frac{\text{weight of capsule} - \text{average weight} \times 100}{\text{Average weight of capsule.}}$$

4. Disintegration test

The disintegration test was conducted by placing the capsule. Inside the six tubes of the testing apparatus, along with a disc. The basket rack assembly was suspended in water. maintained at $37 \pm 1^\circ\text{C}$. Then the apparatus was operated. until the capsules disintegrate and the residue passes. Through the mesh. The time was noted down. If capsules adhere to the disc, the test should be repeated without. The discs are added to the tube.^[32]

$$\text{Disintegration time} = \frac{t_1 + t_2 + t_3 + \dots + t_n}{N}$$

5. Acid neutralizing capacity test

The antacid mixture is dissolved in a predetermined volume of excess HCl and is titrated with NaOH (aq.), an alkali, until sufficient The NaOH solution's OH⁻ has been added to fully react with the excess H⁺ (from the solution's excess HCl). The antacid neutralizes a portion of the added acid, the NaOH is added to neutralize the remainder. A state of equilibrium is reached when the quantity of NaOH added in moles equals the quantity of HCl moles left over following the reaction with the antacid. The sources of H⁺ (aq.) are HCl and NaOH of OH⁻ (aq.), respectively. When the titration is finished, the acid will be completely neutralized by the base.

A mortar and pestle were used to weigh and crush 1 g of each formulation and after that, it was put into a conical flask with 25 millilitres of each sample received 0.1 molarity of HCL, two to three drops of they added the phenolphthalein indicator. After that, the samples were titrated in comparison to 0.1 M NaOH. Titrations were carried out repeatedly until concordant values were found. The tests were conducted in a typical laboratory setting. Uniformity of

NaOH and HCl was done using the USP method.^[2]

Moles of acid neutralized = (VolumeHCl X MolarityHCl) – (VolumeNaOH X MolarityNaOH)

6. PH Determination

A digital pH meter was used to measure the pH of the formulation's 1% solution.

RESULT AND DISCUSSION

Pre-formulation Studies

Organoleptic properties

Table no.13 Organoleptic property of ginger and liquorice.

Parameter	Result of ginger	Result of liquorice
Colour	Yellowish brown	Yellowish brown to brown
Taste L	Pungent and spicy	Sweet
Odour	Pleasant aromatic	Characteristic
Texture	Fine powder	Smooth and sightly fibrous

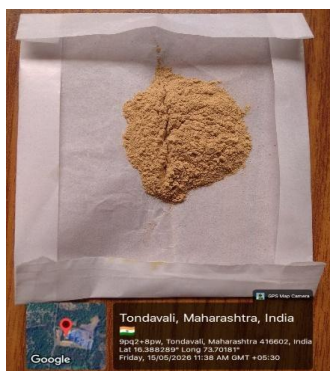


Fig No.11: Powder of Ginger.



Fig No.12: Powder of Liquorice.

Solubility test of ginger and liquorice

Table no. 14 Solubility test of ginger and liquorice.

Drug name	Result
Ginger	Slightly soluble
Liquorice	Partially soluble

Ginger and liquorice are slightly and partially soluble in water respectively. Liquorice dissolves more readily than ginger, but neither achieves complete solubility.



Fig. No.13: Solubility test for ginger.

Fig. No. 14: Solubility test for liquorice.

Flow property

Table no.15 Flow property liquorice and ginger powder.

Parameter	Result	Inference
Bulked density	0.6 g/ml	-
Tapped density	0.7 g/ml	-
Carr’s index	14.28%	Good
Hausner’s ratio	1.16	Good
Angle of repose	30.54 ⁰	Excellent



Fig.no 15 Bulked density.



Fig.no.16 Tapped density.



Fig.no.17 Angle of repose.

Post-formulation evaluation

General appearance

Table no.16 General appearance of ginger and liquorice powder.

Parameter	Result
Colour	Light brown to brown
Texture	Sweet with slightly pungency
Taste	Mild aromatic
Odour	Fine powder, slightly fibrous

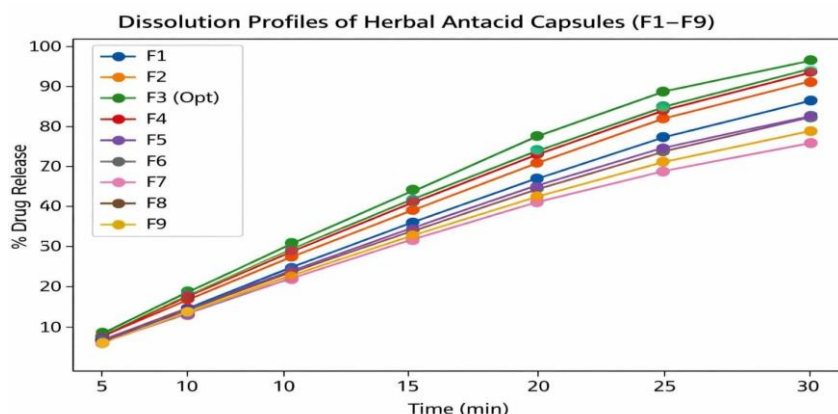
Dissolution test

$$\% \text{ Drug Release} = \frac{\text{Amount of drug released} \times 100}{\text{Total drug content}}$$

Table no. 17 Dissolution time of formulation batches.

Time	F1	F2	F3	F4	F5	F6	F7	F8	F9
5min	22%	24%	28%	25%	26%	24%	23%	25%	22%
10 min	38%	40%	46%	42%	44%	41%	39%	43%	38%
15 min	54%	58%	64%	60%	63%	61%	55%	62%	54%
20 min	68%	72%	80%	74%	77%	75%	69%	76%	68%
25 min	82%	86%	92%	88%	91%	89%	81%	90%	80%
30 min	92%	96%	99%	97%	98%	98%	90%	98%	89%

The dissolution study shows a progressive increase in drug release for all formulations with time. At every time point, F3 shows the greatest and quickest drug release of any batch. F1, F7 and F9 exhibits release profiles that are relatively slower. The dissolution behaviour of F2, F4, F5, F6 and F8 is moderate. Overall, F3 is determined to be the best batch because of its superior and full performance of drug release.

**Fig. no.18: Dissolution profiles of herbal antacid capsules.****Fig No.19 Dissolution time.**

Weight variation test

$$\text{Weight variation} = \frac{\text{Sum of total net fill weight}}{\text{Total number of capsules}}$$

$$= \frac{5.17}{15}$$

$$= 0.344 \text{ g}$$

Table no.18 Weight variation test of formulation batches.

Formulation Batch	Weight Variation
F1	0.344 g
F2	0.355 g
F3	0.352 g
F4	0.340 g
F5	0.336 g
F6	0.340 g
F7	0.343 g
F8	0.337 g
F9	0.339 g

Weight variation test was performed on 15 capsules from each batch. Average fill weight ranged from 0.336 g to 0.355 g across F₁ to F₉. All batches complied with USP limits of $\pm 7.5\%$ for capsules >300 mg, indicating uniform filling and acceptable dose accuracy. Formulation F₃ was identified as the optimized batch with an average weight of 0.352 g, demonstrating uniform filling and dose consistency.

Disintegration test

$$\text{Disintegration time} = \frac{t_1 + t_2 + t_3 + \dots + t_n}{N}$$

$$= \frac{17 + 16 + 17}{3}$$

$$= 17$$

Table no.19 Disintegration time of formulation batches.

Formulation batch	Disintegration time (min)
F1	17 min
F2	16 min
F3	15 min
F4	18 min
F5	19 min
F6	17 min
F7	18 min
F8	17 min
F9	19 min

The disintegration times vary between 15–19 minutes. F₃ (15 min) disintegrates the quickest. F₅ and F₉ (19 min) take the longest. Most batches cluster around 16–18 minutes, showing acceptable uniformity.



Fig. no. 19: Disintegration time.

Acid Neutralizing Capacity Test

$$\begin{aligned} \text{Moles of acid neutralized} &= (\text{VolumeHCl} \times \text{MolarityHCl}) - (\text{VolumeNaOH} \times \\ &\text{MolarityNaOH}) \\ &= (50 \times 0.1) - (20 \times 0.1) \\ &= 3.0 \end{aligned}$$

Table no.20 Acid neutralizing capacity test.

Formulation batch	Acid neutralizing capacity test value
F1	3.0 mEq/g
F2	3.02 mEq/g
F3	3.2 mEq/g
F4	3.05 mEq/g
F5	3.08 mEq/g
F6	3.1 mEq/g
F7	3.0 mEq/g
F8	3.04 mEq/g
F9	3.0 mEq/g

Most batches (F₁, F₇, F₉) show an ANC value of 3.0, indicating stable neutralizing capacity. F₃ (3.2) and F₆ (3.1) are slightly higher, suggesting stronger acid neutralization. Minor differences (± 0.1 – 0.2) are acceptable in pharmaceutical formulations, but F₃ may warrant closer review for uniformity.



Fig no. 20 Acid neutralizing capacity test.

pH Determination

Table no.21 pH determination of formulation batches.

Formulation Batch	PH
F1	4.10
F2	4.56
F3	4.04
F4	4.06
F5	5.16
F6	5.22
F7	5.20
F8	5.05
F9	5.19

PH of all formulation batches comes into the acceptable range.



Fig. no. 21: pH determination.

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