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Formulation and Evaluation of Chocolate Coated Herbal Mukhshuddhi Granules as a Novel Mouth Freshener

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Abstract: *This study explores the development of a new herbal mouth freshener: chocolate-coated Mukhshuddhi granules designed to improve taste and user appeal. While traditional Mukhshuddhi effectively supports breath freshness and digestion, its intense bitterness and unattractive appearance often discourage regular use. To address this, each granule is coated with a thin layer of chocolate, which helps mellow the strong flavor while enhancing both texture and visual appeal. The core consists of natural ingredients such as fennel, cardamom, clove, peppermint, and other aromatic compounds, combined using a moist granulation method to form small, uniform particles. After shaping, the granules are thoroughly dried, sieved for consistent sizing, and then coated with a rich cocoa-based glaze that masks harsh flavors and contributes to longer shelf stability. The final product was evaluated for aroma, taste, flow properties, bulk and tapped density, particle size distribution, moisture content, and stability over time. Results showed good flow characteristics due to uniform particle sizing, a pleasant chocolate fragrance, and an overall appearance likely to appeal to consumers. Samples stored under normal conditions exhibited minimal changes in color, scent, or moisture, indicating solid physical stability. The chocolate coating significantly improved the sensory experience, making the herbal blend more palatable and increasing the likelihood of continued use. Overall, this reimagined version of Mukhshuddhi maintains structural integrity, offers unexpectedly enjoyable flavor, stands out visually, integrates easily into daily habits, subtly promotes health, and naturally extends its role from simple breath freshening to broader wellness support.*

Keyword: Mukhsuddhi, Herbal Nutraceutical, Digestive, Chocolate coated, Oral hygiene.

I. INTRODUCTION

Globally, around 3.5 billion people suffer from gum disease or tooth decay, highlighting oral health as a widespread concern. Since the mouth serves as a gateway to the body, poor dental hygiene has been linked to broader health issues such as heart disease, blood sugar imbalances, respiratory infections, and complications during pregnancy. For decades, conventional toothpastes and mouthwashes have relied on synthetic ingredients like chlorhexidine, triclosan, and sodium lauryl sulfate. However, growing awareness of side effects such as unpleasant aftertastes, mouth irritation, tooth staining, and concerns about microbial resistance has led many to seek alternatives. This shift has revived interest in traditional, plant-based approaches. The concept of Mukhshudhi, derived from the Sanskrit words “Mukh” (mouth) and “Shudhi” (purification), reflects an age-old holistic approach to oral care rooted in traditional healing systems. In Ayurveda, India’s traditional medicine, numerous plants have long been used for their antimicrobial, anti-inflammatory, astringent, and tissue-repairing properties in supporting oral health.[13] When these time-tested botanicals are combined with modern pharmaceutical science, they can yield innovative solutions that are both effective and naturally based. Today, the line between food and medicine is blurring, as edible formulations increasingly serve therapeutic roles evidenced by the rising popularity of nutraceuticals worldwide. The expansion of the global nutraceutical market is closely tied to increasing consumer preference for preventive care and plant-derived products. Oral health supplements, in particular, are gaining attention for delivering health benefits in enjoyable forms. For instance, herbal extracts coated in chocolate not only improve compliance by masking bitterness but also enhance functionality. The chocolate coating protects sensitive plant compounds from light and air, helps control the release of active ingredients, and adds beneficial components like polyphenols, flavonoids, and theobromine, which may amplify the herbs’ effects. Ultimately, this approach transforms routine wellness practices into experiences that feel more like a treat than treatment. [1], [2].



Fig no. 1: Herbal Nutraceutical Mukhshuddhi Granules

II. OBJECTIVE

The primary objectives of this research project are:

- 1) Creating little balls of herb extract, covered in chocolate. These have been tested to support healthy teeth and gums when taken by mouth
- 2) For better results in shaping and covering particles, adjustments help meet target qualities. Moving slowly through each phase allows control over texture. Tweaking settings at key points influences how materials bind together. Watching changes step by step supports consistent outcomes. Small shifts during processing affect surface finish. Keeping variables balanced leads to uniformity across batches
- 3) Checking how the made-up granules behave physically and chemically
- 4) Checking how clean and safe the product stays over time
- 5) One way to check how well it fights mouth bacteria is by lab tests. Checking taste and feel comes early so people might like using it

III. SCOPE

This study outlines the entire process of developing a new herbal supplement, from ingredient selection to final product testing. Its significance is evident in several areas. Scientific understanding advances through the examination of traditional plant-based remedies using modern laboratory methods and biological assays. Innovations in medicinal coating techniques improve the delivery and effectiveness of plant-derived treatments. Additionally, increased availability of natural products for oral care may contribute to reducing the global prevalence of dental issues.[8]

IV. AIM AND OBJECTIVE

A. Aim of the Study

The study aimed to develop chocolate-coated Mukhshuddhi granules using natural plant-based components, evaluating their potential to relieve gas, combat oxidative stress, and promote fresh breath. The effectiveness of the formulation was assessed through systematic evaluation techniques.

B. Research Objectives

- 1) To identify appropriate herbal and nutraceutical ingredients for formulating Mukhshuddhi granules
- 2) Begin with fresh carrot (*Daucus carota*), followed by an equal quantity of beetroot (*Beta vulgaris*). Add amla (*Phyllanthus emblica*) as the third component. Dry and grind these plant materials into fine powders separately, then combine and mix thoroughly to achieve a consistent blend. Gradually shape the mixture into small pellets and allow each batch to dry under shade. Finalize the process once the granules are firm and maintain their structure properly.
- 3) Incorporate fennel (*Foeniculum vulgare*), followed by ajwain (*Trachyspermum ammi*). Add clove (*Syzygium aromaticum*), then cardamom (*Elettaria cardamomum*), and finish with peppermint (*Mentha piperita*).

- 4) Gently melt chocolate until it reaches a smooth consistency. Carefully mix in the prepared granules to ensure even coating. Spread the coated granules on a tray and let them cool and solidify. Once hardened, store them in an airtight container, protected from heat.
- 5) Assess the granules for physical characteristics including appearance, texture, flow properties, moisture content, and stability over time.
- 6) To enhance the taste, patient compliance, and overall nutritional quality of traditional Mukhshuddhi. [4]

V. DRUG PROFILE

A. Avla (Amla)

Avla is the common Marathi/Gujarati name for Amla, also called Indian gooseberry. It is one of the most important medicinal plants in Ayurveda and is a key ingredient of Triphala and Chyavanprash. Valued as a "superfruit" for its high vitamin C content and antioxidant properties.

- Synonyms / Common names -Amla, Awala, Avla, Aamlak, Dhatri, Vyastha, Amalaki, Indian gooseberry
- Biological Source: The biological source of amla (Indian gooseberry) is the fresh or dried fruit of the deciduous tree *Phyllanthus emblica* (also known botanically as *Embllica officinalis*).
- Family: Phyllanthaceae (earlier placed in Euphorbiaceae)

Uses:

1. Traditional/Ayurvedic:

Used in traditional and Ayurvedic medicine to treat coughs, colds, and long-term respiratory conditions. It is also employed for managing bleeding, diarrhoea, diabetes, dysentery, jaundice, and various digestive issues. Additionally, it supports digestion, acts as a mild laxative, serves as an aphrodisiac, and is used as a tonic to promote hair health.

2. Modern Applications:

Recognized for its antioxidant, antibacterial, antifungal, and antiviral properties. It helps reduce cholesterol levels, supports weight management, aids in regulating blood sugar, may help prevent cancer, and enhances skin complexion and hair growth. Widely utilized in the food and cosmetics industries, particularly in skincare and haircare products.

3. Distinctive Benefit:

A notable advantage of Amla is that its vitamin C content remains stable and is not degraded by drying, grinding, or cooking.



Fig no. 2: Amla

B. Pudina (Mint)

Mint refers to aromatic perennial herbs of the genus *Mentha* in the Lamiaceae family. Used for thousands of years in traditional medicine, food, and cosmetics for its cooling, aromatic, and therapeutic properties. Most commercially important mints are peppermint (*Mentha × piperita*) and spearmint (*Mentha spicata*).

- Synonyms / Common names - Mint, Garden mint, Peppermint, Spearmint, Pudina
- Biological Source: Pudina (mint) is derived from the dried leaves and flowering tops of plants in the genus *Mentha*.
- Family: Lamiaceae (Mint family)

Uses:

1. Pharmaceutical/Medicinal: Used to support digestion by alleviating indigestion, irritable bowel syndrome (IBS), and gas; employed in respiratory care for colds, coughs, asthma, and sore throats; applied topically for pain relief, reducing inflammation, and as an antiseptic; also utilized for fever, headaches, nausea, and inflammation of the oral mucosa.

2. Food Industry: Serves as a flavor additive in candies, chewing gum, toothpaste, syrups, and chewable tablets.
3. Pharmaceutical Excipient: Functions as a natural or synthetic flavoring in syrups, suspensions, and gums though pharmacologically inert, it enhances patient adherence by improving taste.
4. Cosmetics: Incorporated as a fragrance and cooling ingredient in skincare and haircare formulations.
5. Aromatherapy & Phytotherapy: Peppermint is widely used in herbal medicine, primarily valued for its beneficial effects on digestive function.[21]

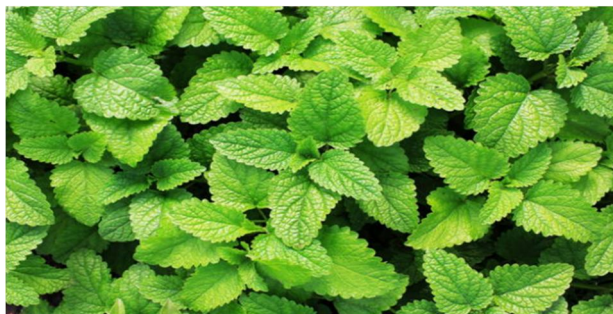


Fig no. 3: Pudina

C. Beetroot

Beetroot is a biennial root vegetable cultivated for its edible taproot and leaves. It's known for its deep red/purple color due to betalain pigments and is used as food, natural colorant, and functional ingredient.

- Synonyms - Garden beet, table beet, red beet, blood beet, sugar beet
- Biological Source: Beetroot is the swollen taproot of *Beta vulgaris* subsp. *vulgaris* (Conditiva Group)
- Family: Amaranthaceae

Uses:

1. Culinary: Commonly used in salads, pickles, juices, and soups; also serves as a natural source of red coloring.
2. Pharmaceutical/Nutraceutical: Found in supplements aimed at supporting blood pressure regulation, enhancing physical performance, and managing blood sugar levels.
3. Kidney Health: Shows potential to lower mortality rates and support improved kidney function in individuals with renal conditions.
4. Traditional Use: Medicinal application of the leaf's dates back to ancient times.[18], [23]



Fig no. 4: Beetroot

D. Carrot

Carrot is one of the world's most cultivated root vegetables, valued for nutrition, flavor, and health benefits. The cultivated form is *Daucus carota* L. ssp. *sativus*.

- Synonyms - carrot, garden carrot, edible carrot
- Biological Source: The biological source of the domestic carrot is the plant *Daucus carota* subsp. *sativus*.
- Family: Apiaceae (Umbelliferae)

Uses:

1. Nutritional: Consumed raw, cooked, or as juice; a significant dietary source of vitamin A
2. Pharmaceutical: Investigated for potential roles in preventing cancer, cardiovascular conditions, and diabetes

3. Traditional Medicine: Wild carrot historically used to treat urinary stones, cystitis, gout, prostatitis, and as a diuretic and carminative agent
4. Cosmetic and Industrial Uses: Carrot oil and extracts are utilized in skincare products, as natural coloring agents, and in the flavoring industry. [3], [19]



Fig no. 5: Carrot

E. Clove

Clove is the dried unopened flower bud of an evergreen tree. It's one of the oldest and most valuable spices, used for flavoring, preservation, and medicine due to its strong aroma and high eugenol content.

- Synonyms / Common names: Lavang, Laung
- Biological Source: The biological source of clove is the dried flower bud of *Syzygium aromaticum* (synonym: *Eugenia caryophyllus*). Harvested before blooming.
- Family: Myrtaceae

Uses:

1. Culinary: Employed as a spice in curries, baked goods, and sauces; also used to preserve meats
2. Pharmaceutical: Utilized in dental pain relief, mouthwashes, and antiseptic preparations; helps manage digestive issues such as flatulence, nausea, and disorders of the liver and stomach
3. Cosmetic and Industrial: Found in soaps and fragrances; serves as a clearing agent in histology and acts as a larvicide targeting dengue-carrying mosquitoes
4. Agricultural: Functions as an organic pesticide and fumigant. [10], [22]



Fig no. 6 Clove

F. Fennel Fruit

Fennel is an aromatic herb from the Apiaceae family. The dried ripe fruits, called fennel seeds, are used as spice, carminative, and galactagogue. Known since antiquity for digestive and respiratory ailments.

- Synonyms - Sompu, Saunf
- Biological Source: Fennel consists of the dried ripe fruits of *Foeniculum vulgare* Miller, a hardy, aromatic perennial herb.
- Family: Apiaceae / Umbelliferae

Uses:

1. Culinary: Enhances the taste of meats, fish, soups, breads, pastries, alcoholic drinks, and salads
2. Medicinal: Employed to address infant colic, indigestion, cough, and bronchitis; part of traditional Ayurvedic and Unani medicine

3. Industrial: The essential oil is incorporated into soaps, fragrances, drinks, and oral care products
4. Traditional Medicine: Historically utilized in remedies for more than 40 conditions affecting the digestive, endocrine, reproductive, and respiratory systems. [5], [9], [20]



Fig no. 7: Fennel

G. Carom Seeds / Ajwain

Carom seeds, also called ajwain or bishop's weed, are the dried fruits of an annual herb. They have a strong, thyme-like aroma due to thymol and are widely used as a spice and carminative in Ayurveda, Unani, and folk medicine.

- Synonyms: Ajwain, ajowan caraway, thymol seeds, bishop's weed, carom, ajma, ajmodika
- Biological Source: Carom seeds (commonly known as ajwain) are botanically the dried, seed-like fruits of the *Trachyspermum ammi* (L.) Sprague plant.
- Family: Apiaceae / Umbelliferae

Uses:

1. Medicinal: Treats gastrointestinal issues such as indigestion, dyspepsia, diarrhea, *H. pylori* infection, and abdominal pain. Also used for respiratory conditions including bronchitis, asthma, and the common cold. Externally applied to relieve rheumatic pain, neuralgia, and joint discomfort.
2. Traditional medicine: Employed for eye infections, amoebiasis, common cold, and acute pharyngitis.
3. Culinary: Used as a spice in breads, parathas, pakoras, pickles, and chaat masala. Added sparingly due to its strong pungency and bitterness.
4. Industrial: Source of thymol, which is extracted for use in pharmaceuticals, cosmetics, and disinfectants.
5. Historical: Has been part of Indian, Persian, and Unani medicinal traditions for thousands of years.[24]



Fig no. 8: Carrom Seeds

H. Cardamom

Cardamom is called the "Queen of Spices". It's the dried fruit of a perennial herb, valued for its sweetaromatic flavor and medicinal properties. Used widely in food, beverages, perfumery, and Ayurveda.

- Synonyms - Green cardamom, small cardamom, true cardamom, ela, elachi, chhoti elaichi
- Biological Source: Cardamom is a highly prized aromatic spice obtained from the dried ripe seeds of the *Elettaria cardamomum* (L.) Maton plant.
- Family: Zingiberaceae.

Uses:

1. Culinary: Commonly used as a spice in sweets, tea, biryani, curries, and masalas; also serves as a flavoring agent in confectionery and drinks
2. Medicinal: Employed in Ayurvedic and Unani systems to treat asthma, bronchitis, cough, nausea, diarrhea, oral infections affecting teeth and gums, kidney conditions, and bad breath
3. Digestive aid: Helps relieve gas, indigestion, and colic due to its carminative properties
4. Industrial applications: Found in perfumes, cosmetics, breath fresheners, and aromatherapy products
5. Historical use: Has been utilized since the 4th century BC in traditional medicine practices of Ayurveda, Greece, and Rome



Fig no. 9: Cardamom

I. Dry Ginger

Dry ginger is the dried rhizome of ginger, used as a spice and medicine for over 3000 years. Drying converts gingerols to shogaols, making it more pungent and stable. It's a key drug in Ayurveda, TCM, and Unani systems.

- Synonyms - Sunth, Soonth, dried ginger, shunthi, Jeung, Adrack, Gingembre, Jengibre
- Biological Source: The biological source of dry ginger is the dried rhizome of the plant *Zingiber officinale* Roscoe
- Family: Zingiberaceae

Uses:

1. Culinary: Employed as a spice in curries, teas, baked goods, confections, and pickles, either whole, sliced, or ground into powder
2. Medicinal:
 - Digestive issues: Helps with indigestion, constipation, colic, and diarrhea
 - Respiratory conditions: Used to relieve cough, cold, and sore throat
 - Nausea control: Effective against motion sickness, post-surgical nausea, and nausea caused by chemotherapy
 - Inflammation relief: Applied in managing arthritis, rheumatism, and muscle pain
3. Traditional medicine: Utilized in Ayurvedic, Chinese, and Unani systems for treating colds, headaches, joint pain, and menstrual disorders
4. Industrial applications: Ginger oil and oleoresin are ingredients in perfumes, soaps, cosmetics, and drinks
5. Pharmaceutical: Incorporated into medicines targeting digestion, cold symptoms, and nausea prevention. [7], [12]



Fig no. 10: Dry Ginger

VI. MATERIALS AND METHODS

A. Materials Required

- 1) Clove powder
- 2) Cardamom powder
- 3) Fennel powder
- 4) Beetroot powder
- 5) Carrot powder
- 6) Cocoa powder
- 7) Sugar syrup
- 8) Honey
- 9) Chocolate base
- 10) Talc and flavoring agents

VII. FORMULATION TABLE

Table no. 1: Formulation Table

Sr. No.	Name of Ingredient	Formulation 1	Formulation 2	Formulation 3	Formulation 4
1.	Fennel	9 gm	9 gm	10 gm	10 gm
2.	Amla	10 gm	12 gm	13 gm	11 gm
3.	Beetroot powder	8 gm	8 gm	8 gm	9 gm
4.	Carrot powder	8 gm	8 gm	8 gm	9 gm
5.	Clove powder	3 gm	2.5 gm	3 gm	3 gm
6.	Cardamom powder	5 gm	5 gm	3 gm	3 gm
7.	Carrom seed powder	4 gm	3 gm	3 gm	3 gm
8.	Dry ginger powder	3 gm	2.5 gm	2 gm	2 gm
9.	Pudina (Mint)	q.s.	q.s.	q.s.	q.s.
10.	Cornflour	q.s.	q.s.	q.s.	q.s.
11.	chocolate	q.s.	q.s.	q.s.	q.s.

VIII. METHOD OF PREPARATION

A. Collection of Herbal Ingredients

Fresh carrot, beetroot, and amla were obtained from the local market in Baramati, Maharashtra. Fennel, ajwain, clove, cardamom, and peppermint powder were sourced from a local herbal supplier. All collected materials were thoroughly cleaned to eliminate dirt, foreign matter, and other contaminants.

B. Verification of Herbal Materials

The herbal ingredients were authenticated by a specialist professor from the Department of Pharmacognosy. The identification process was based on:

- Morphological features
- Organoleptic assessment
- Established pharmacognostic criteria

Once confirmed, the materials were approved for use in subsequent experimental procedures.

C. Preparation of Herbal Mukhshuddhi Granules

Step 1: Washing

Fresh carrot, beetroot, and amla were washed thoroughly with water to remove surface dust and impurities.

Step 2: Peeling and Slicing

After cleaning, the vegetables and fruit were peeled and sliced into small pieces using a stainless-steel knife.

Step 3: Grinding

The cut pieces were ground in a mixer grinder to produce a coarse, moist mixture.

Step 4: Drying

The ground material was shade-dried to ensure complete removal of moisture.

Step 5: Powder Formation

Once dried, each ingredient was separately ground into a fine powder and sifted through a No. 60 sieve to achieve uniform consistency.

Step 6: Blending

The individual powders were combined uniformly with fennel, ajwain, clove, cardamom, and peppermint powder using the geometric dilution method.

Step 7: Granulation

A suitable binding agent (cornflour solution) was gradually added to the powder blend to form a damp mass. This mass was then extruded through a No. 10 sieve to produce granules.

Step 8: Drying the Granules

The wet granules were dried at room temperature until they became free-flowing.

Step 9: Coating

Chocolate coating was applied by melting chocolate using a double boiler technique and evenly coating the granules.

Step 10: Storage

The finished coated granules were placed in airtight containers for further analysis and stability testing.

IX. EVALUATION PARAMETERS

Assessing herbal granules is crucial for evaluating their quality, stability, flow characteristics, acceptability, and overall performance. The developed nutraceutical herbal Mukhshuddhi granules were examined using a range of organoleptic, physical, and physicochemical tests.[26], [27]

1) Organoleptic Evaluation

To evaluate the color, odor, taste, appearance, and texture of the prepared granules.

Procedure:

- A small amount of granules was placed on a clean glass surface. The sample was examined visually for color and overall appearance. The odor was assessed by gently sniffing. Taste and texture were then evaluated with care.

2) Bulk Density

To determine bulk density of granules.

Procedure:

- A known quantity of granules was poured into a measuring cylinder.
- Bulk volume was noted without tapping.

Formula:

$$\text{Bulk Density} = \frac{\text{Mass of the powder}}{\text{Total volume it occupies}}$$

3) Tapped Density

To determine tapped density of granules.

Procedure:

- Granules filled in measuring cylinder were tapped mechanically.
- Final tapped volume was recorded after constant volume was obtained.[25]

Formula:

$$\text{Tapped Density} = \frac{\text{Mass of powder (m)}}{\text{Tapped volume(vt)}}$$

4) Carr's Compressibility Index

To evaluate compressibility and flowability of granules.

Procedure:

- Bulk density and tapped density were calculated.
- Carr's index was determined using the formula.

Formula:

$$\text{Carr's index (cl)(\%)} = \frac{\text{Tapped DENSITY} - \text{Bulk DENSITY}}{\text{Tapped Density}} \times 10$$

5) Hausner's Ratio

To determine flow characteristics of granules.

Procedure:

- Bulk density and tapped density values were used to calculate Hausner ratio.

Formula:

$$\text{Hausners Ratio} = \frac{\text{Tapped Density (Pt)}}{\text{Bulk Density (Pb)}} = \frac{Pt}{Pb}$$

6) Moisture Content

To determine moisture content in granules.

Procedure:

- The granules were weighed and then placed in a hot air oven set to 105°C. Drying continued until the samples reached a constant weight. The weight loss was determined using the specified formula.

Formula:

$$\text{Moisture Content} \left(\% \frac{w}{w} \right) = \frac{\text{Weight of wet sample} - \text{weight of dry sample}}{\text{weight of wet sample}} \times 100$$

7) pH Determination

To determine pH of granule solution.

Procedure:

- 1 g granules were dissolved in distilled water.
- pH was measured using calibrated pH meter.

8) Stability Study

To evaluate stability of formulation during storage.

Procedure:

- Granules were stored at room temperature and accelerated conditions.
- Samples were evaluated periodically for color, odor, taste, and appearance.

Observation Table:

Table no. 2: Stability study observations

Parameter Evaluated (After 30 days)	Initial	Formulation 1	Formulation 2	Formulation 3	Formulation 4
Appearance	Uniform, soft coated granules	Slightly rough granules with uneven coating	Moderately uniform granules	Uniform, smooth granules	Dark granules with slight aggregation
Colour	Brown, dark and pink colour	Slight fading observed	Slight dull appearance	No significant change	No major change
Odour	Characteristic pleasant odour	Reduced aroma	Mild reduction aroma	Retain pleasant aroma	Slight reduction in aroma
Taste	sweet	Slightly bitterness develops	Slightly change	No significant change	More pungent

X. RESULTS

A. Observation Table

Table no. 3: Results of evaluation tests

Sr. no.	Evaluation Parameter	Formulation 1	Formulation 2	Formulation 3	Formulation 4
1.	Colour	Light brown	Brownish pink	Dark brown and pink	Dark brown
2.	Odour	Mild aromatic odour	Pleasant aromatic odour	Pleasant aromatic odour	Strong aromatic odour
3.	Taste	Slightly sweet	Sweet and spicy	Sweet	Strong herbal taste
4.	pH	5.98	6.15	6.32	6.25
5.	Moisture content	1.32 %	1.12 %	0.94 %	1.05 %
6.	Tapped density	1.5	1.6	1.8	1.7
7.	Bulk density	1.9	2.0	2.1	2.05
8.	Carr's index	21.0 %	19.5 %	16.6 %	17.1 %
9.	Hausner's Ratio	1.26	1.21	0.85	1.17
10.	Stability study	Slightly unstable in storage condition	Moderately stable under storage condition	Stable under storage condition	Fairly stable under storage condition

XI. FINAL RESULT

Of all the prepared batches, Formulation 3 demonstrated the most favorable physicochemical attributes, including enhanced flow behavior, reduced moisture levels, satisfactory taste, appealing visual appearance, and greater stability during storage. Based on these advantages, Formulation 3 was chosen as the optimal formulation.

XII. DISCUSSION

This study focused on developing and accessing herbal nutraceutical granules coated with chocolate, made from natural components including powdered beetroot, powdered carrot, dried chopped amla, fennel seeds, mint powder, corn flour, and compound chocolate. The aim was to create a product offering both nutritional value and breath-refreshing properties, while improving taste and overall consumer appeal.

The resulting granules displayed a consistent chocolate coating, appealing color, and a pleasing aroma. The sweetness and fragrance of the chocolate effectively concealed the inherent bitterness or sharpness of the herbal ingredients, enhancing palatability and user compliance. The combination of dark and white chocolate also contributed to the product's visual attractiveness.

Stability testing under various storage conditions indicated that the formulation remained stable both physically and chemically throughout the evaluation period. No notable changes occurred in color, odor, taste, pH, or other tested attributes, suggesting the product has good shelf life and storage resilience.

In conclusion, chocolate-coated herbal nutraceutical granules can be effectively developed with favorable physicochemical characteristics, improved flavor, strong stability, and high acceptability. This formulation holds potential as a functional food for health support and dietary enrichment.

XIII. CONCLUSION

This study successfully developed and evaluated herbal nutraceutical granules coated with chocolate, using natural ingredients including powdered beetroot, powdered carrot, dried chopped amla, fennel seeds, mint powder, and compound chocolate. The final product demonstrated favorable organoleptic qualities, such as an appealing appearance, pleasant aroma, sweet flavor, and satisfactory texture.

Various evaluation parameters like bulk density, tapped density, Carr's index, Hausner ratio, angle of repose, pH, moisture content, and friability were within acceptable ranges, suggesting the granules had good flow characteristics and physical stability. The chocolate coating enhanced the taste and overall consumer appeal of the herbal formulation.

Stability testing revealed no significant changes in color, odor, taste, pH, or physicochemical properties throughout the storage period, indicating the product's stability over time. Overall, the chocolate-coated herbal nutraceutical granules appear to be a stable, effective, and user-friendly option with potential health benefits and greater consumer acceptability.[2]

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