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Research Article

Ice-Cream Soda Flavoured Effervescent Granules Containing Fennel and Coriander: A Preliminary Formulation Study

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Abstract

Background: Gastric discomfort is a common implication and the poor palatability of conventional antacid formulations often results in reduced compliance. **Objectives:** To develop dessert-inspired effervescent granules incorporating Foeniculum vulgare (fennel) and Coriandrum sativum (coriander) as mild carminatives. **Materials and Methods:** A balanced citric acid–tartaric acid–sodium bicarbonate system was utilized to produce controlled effervescence for enhanced patient acceptability. The formulation utilized sodium bicarbonate as a mild antacid and a taste-masking system comprising sucralose, vanillin, maltodextrin, and mannitol to impart a pleasant ice cream soda flavour. Effervescent granules were prepared using the dry blending method. The study included physicochemical characterization of the herbal powders and preliminary evaluation of the granules for flow properties, effervescence time, pH, and preliminary short-term stability. **Results:** The developed formulation exhibited rapid effervescence and enhanced palatability. The inclusion of natural carminatives along with a mild antacid ensures safety and suitability. The granules represent a promising, palatable, and effective alternative to conventional formulations, with potential to improve compliance. **Conclusion:** The present study demonstrates a proof-of-concept effervescent formulation integrating herbal carminatives with an ice-cream soda flavoured taste-masking system, highlighting its potential for improved palatability and patient acceptability.

Keywords: Dry Blending Method, Effervescent granules, Gastric discomfort, Herbal Carminatives, Taste masking

INTRODUCTION:

Gastric discomfort including symptoms such as acidity, bloating, and indigestion is a common complaint where effective management is often challenged by poor acceptability of conventional dosage forms. Oral formulations such as suspensions, syrups, chewable tablets, and dispersible systems frequently present limitations including unpleasant taste, chalky mouth feel, dosing inaccuracies, and dependence on chewing ability, all of which can negatively impact adherence in patients. Although effervescent systems offer advantages such as rapid dispersion and improved taste masking, conventional effervescent tablets are associated with manufacturing and stability challenges. Therefore, there is a need for the development of palatable, convenient, patient-friendly formulations that can enhance compliance while providing rapid symptomatic relief.[1-3]

Effervescent dosage forms have gained considerable attention in pharmaceutical development due to their rapid onset of action, improved bioavailability, and ease of administration.[4,5] Upon contact with water, effervescent granules release carbon dioxide through an acid–base reaction, resulting in a palatable solution that is easy to ingest. These characteristics make effervescent formulations particularly suitable for patients, as they eliminate swallowing difficulties and enhance acceptability.[6–8]

Herbal medicines continue to play a significant role in the management of gastrointestinal disorders owing to their safety profile and traditional usage. Among these, Foeniculum vulgare and Coriandrum sativum are well-known carminative agents widely used for relieving gastric discomfort. Fennel contains volatile oils such as anethole, which exhibit antispasmodic and digestive properties, while coriander is known for its anti-flatulent and digestive-enhancing effects.[9,10] The

incorporation of these herbal agents into modern dosage forms provides a promising approach for developing safe and effective therapeutics.

Despite the therapeutic potential of herbal agents, one of the major challenges in formulation development is palatability. Unpleasant taste and odour can significantly reduce patient compliance. Therefore, the incorporation of an effective taste-masking system is essential. Previous studies have highlighted the importance of sweeteners, flavouring agents, and suitable excipients in improving patient acceptability.[11,12] The ice-cream soda flavour was selected due to its high acceptability.

Based on these considerations, the present study focuses on the formulation and evaluation of palatable ice-cream soda flavoured effervescent granules containing herbal carminatives for relief of gastric discomfort. The study includes pharmacognostic standardization of herbal materials, formulation development and evaluation of physicochemical and performance parameters to assess product quality and preliminary patient acceptability.

MATERIALS AND METHODS:

Materials

Sodium bicarbonate, citric acid (anhydrous), tartaric acid, and maltodextrin were procured from standard pharmaceutical suppliers. Mannitol, sucralose (Merck) was used as sweetening agents, while vanillin was used as a flavouring agent. The dried fruits of Foeniculum vulgare and Coriandrum sativum were procured from a local market and authenticated. All chemicals and reagents used were of analytical grade.

Methods

Preparation of Herbal Powders

The collected fennel and coriander were cleaned, dried, and coarsely powdered using a mechanical grinder. The powders were sieved and stored in airtight containers for further use.

Pharmacognostic and Physicochemical Evaluation

The powdered drugs were evaluated for organoleptic properties (colour, odour, and taste), powder microscopy (presence of oil glands, parenchymatous cells, and vascular elements), loss on drying (LOD), and preliminary phytochemical screening (alkaloids, flavonoids, carbohydrates, etc.). The characteristic microscopic features of Foeniculum vulgare are shown in Figure 1. The preparation of herbal extracts for phytochemical analysis is illustrated in Figure 2.

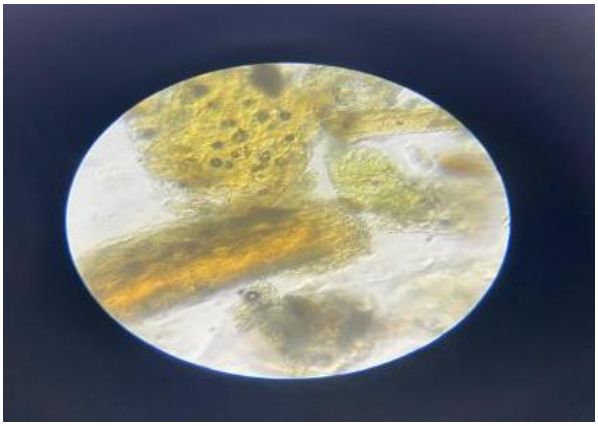

Figure 1: Powder microscopy of Foeniculum vulgare showing characteristic oil glands, endosperm parenchyma, and reticulate vessels (Scale bar: 100 µm).

Figure 2: Preparation of herbal extracts of fennel and coriander for qualitative phytochemical screening.Determination of Volatile Oil Content

Volatile oil content of fennel and coriander powders was determined by hydro distillation using a Clevenger type apparatus for 3 hours under controlled boiling conditions. The volume of oil collected was measured and expressed as percentage v/w. The experimental setup and oil collection are shown in Figure 3.

Figure 3: Determination of volatile oil content of herbal materials using Clevenger apparatus by steam distillation.

Formulation of Effervescent Granules

Effervescent granules were prepared by the dry blending method under moisture-controlled conditions. All ingredients were pre-dried prior to mixing to minimize moisture-induced premature effervescence. Citric acid and tartaric acid were dried at 40–50°C, sodium bicarbonate at 50–60°C, and the herbal powders of Foeniculum vulgare and Coriandrum sativum at 40°C. The dried materials were allowed to cool in a desiccator before further processing. All ingredients including acids, sodium bicarbonate, mannitol, maltodextrin and herbal powders, were individually passed through a standard laboratory sieve to ensure uniform particle size. In a clean and completely dry mortar, accurately weighed quantities of citric acid and tartaric acid were mixed gently for 3–5 minutes to obtain a uniform acid mixture and to break any agglomerates. Sodium bicarbonate, mannitol, and maltodextrin were mixed thoroughly in a dry mortar for 5 minutes to obtain a homogeneous base mixture. The sieved herbal powders were gradually incorporated into the base mixture using geometric dilution and blended uniformly for 5 minutes. The prepared base mixture was transferred to a larger dry mortar, and the acid mixture was added in small portions with continuous gentle mixing carried out for 5–7 minutes to avoid premature effervescence. Finally, sucralose and vanillin were added and mixed gently for an additional 2–3 minutes to ensure uniform distribution of the taste-masking agents. The prepared effervescent granules were evaluated for uniformity and free-flowing nature and stored in airtight containers to protect from moisture. The prepared granules are shown in Figure 4. The formulation of ice cream soda flavored effervescent granules comprised fennel (8 g), coriander (8 g), sodium bicarbonate (28 g), citric acid (14 g), tartaric acid (7 g), mannitol (18 g), maltodextrin (16 g), sucralose (0.5 g), and vanillin (0.5 g).

Figure 4: Prepared ice cream soda flavoured effervescent granules.

Pre-formulation Studies

The prepared granules were evaluated for flow properties: Bulk density, Tapped density, Angle of repose, Carr's index and Hausner's ratio.

Evaluation of Effervescent Granules

The formulated granules were evaluated for properties like effervescence time (in distilled water), pH of solution, moisture content, solution clarity and particle size distribution.

Palatability Study

Palatability was evaluated using a sensory panel of healthy adult volunteers. The reconstituted solution was assessed using a 5-point hedonic scale ranging from very unpleasant to very pleasant. The reconstituted effervescent formulation evaluated by the volunteers is shown in Figure 5.

Figure 5: Reconstituted ice cream soda flavoured effervescent granule formulation after dispersion in water.

Ethical Statement

Palatability was assessed as an informal organoleptic screening using a minimal laboratory panel (n=3) to verify successful taste-masking of the bitter herbal volatile oils. Because this evaluation was limited to organoleptic tasting without swallowing or clinical administration, it did not constitute a human clinical trial. Informed consent was maintained.

Statistical Analysis

Measurements performed in triplicate were expressed as mean ± standard deviation (SD).

Parameters for which triplicate measurements were not possible are reported as individual observations (LOD).

RESULTS:

Table 1: Pharmacognostic and Phytochemical Evaluation of Fennel and Coriander Powdered Crude Drugs

A. Organoleptic Evaluation

S. No.	Parameter	Fennel Powder	Coriander Powder
1	Colour	Greenish	Brownish
2	Odour	Aromatic	Aromatic
3	Taste	Sweet and pleasant	Mild and spicy

B. Powder Microscopy

S. No.	Crude Drug	Diagnostic Features
1	Fennel	Large oil glands, endosperm parenchyma, reticulate vessels
2	Coriander	Smaller oil glands, polygonal parenchyma, spiral vessels

C. Preliminary Phytochemical Screening

S. No.	Test	Phyto-constituent	Fennel (Foeniculum vulgare)	Coriander (Coriandrum sativum)	Inference
1	Dragendorff's Test	Alkaloids	No orange/reddish-brown precipitate observed	No orange/red-dish-brown precipitate observed	Alkaloids absent or present in trace amounts
2	Alkaline Reagent Test	Flavonoids	Yellow coloration observed, disappearing on acidification (mild intensity)	Intense yellow coloration observed, disappearing on acidification	Flavonoids present; comparatively higher in coriander
3	Benedict's Test	Reducing Sugars	Green to orange precipitate formed on heating	Yellow to orange precipitate formed on heating	Moderate presence of reducing sugars in both samples
4	Ferric Chloride Test	Phenolics/Tannins	Light green coloration observed	Dark green coloration observed	Phenolic compounds present; comparatively higher in coriander
5	Foam Test	Saponins	No stable foam formation	No stable foam formation	Saponins absent or negligible

D. Volatile Oil Content Determination by Clevenger Apparatus (Steam Distillation)

S. No.	Sample	Volatile Oil (% v/w)
1	Fennel	2.5
2	Coriander	0.4

Table 2: Flow Properties of Effervescent Granules

S. No.	Parameter	Initial (0 day)	Room Temp (Mean ± SD, n=3)
1	Bulk Density (g/cm^3)	0.516	0.488 ± 0.027
2	Tapped Density (g/cm^3)	0.784	0.875 ± 0.131
3	Carr's Index (%)	34.2	43.0 ± 12.2
4	Hausner Ratio	1.52	1.80 ± 0.35
5	Angle of Repose (°)	45.8	28.5 ± 4.8

Table 3: Preliminary Stability Evaluation of Effervescent Granules after 1 Month

S. No.	Parameter	Storage Condition	Observation	Mean ± SD
1	Appearance	Room Temperature	Free flowing, no colour change, no caking	—
2	Effervescence Time (sec)	Initial	90 (1.5 min)	—
		Room Temperature (1 month)	52.7, 114.24, 130	98.98 ± 40.0
3	Loss on Drying* (LOD, %)	Room Temperature (1 month)	0.20	—
4	pH	Initial	6.5 – 7.0	6.75 ± 0.25
		Room Temperature (1 month)	6.0 – 6.5	6.25 ± 0.25

* LOD analysis could not be performed in triplicate due to limited sample availability.

Table 4: Palatability Study – Preliminary Palatability Evaluation of Reconstituted Effervescent Granules

S. No.	Parameter	Observation
1	Taste	Pleasant (ice-cream soda-like)
2	Mouth feel	Cooling sensation
3	Effervescence	Noticeable soda-like fizz
4	Overall Acceptability	Good (3/3 participants)

DISCUSSION:

The present study successfully demonstrated the formulation of palatable effervescent granules containing Foeniculum vulgare and Coriandrum sativum, which are well known for their carminative properties. Pharmacognostic evaluation confirmed the authenticity of the herbal materials through characteristic microscopic features such as oil glands and parenchymatous tissues. The physicochemical parameters obtained were within acceptable limits, indicating good quality and purity of the raw materials. The results of organoleptic evaluation, powder microscopy, phytochemical screening, and volatile oil determination are summarized in Table 1.

The taste-masking system containing sucralose, vanillin, and mannitol was associated with a pleasant ice-cream soda flavour in the volunteer panel, suggesting potential relevance for patient acceptability. The stability and palatability results are summarized in Tables 3 and 4. The pH remained within 6.0–7.0 throughout the study, indicating acceptable chemical stability. These findings indicate that storage conditions significantly influence the stability and performance of the formulation. These observations highlight the importance of adequate moisture-resistant packaging, such as aluminium foil sachets or airtight containers, to maintain the stability and quality of effervescent granules.

CONCLUSION:

Demonstrates a successful proof-of-concept for taste-masking crude carminative powders within a refreshing effervescent base. The prepared formulation exhibited satisfactory effervescence and preliminary palatability, supporting its potential as a patient-friendly dosage form. Preliminary palatability evaluation conducted using a 5-point hedonic scale with three adult volunteers indicated a pleasant ice-cream soda-like taste, cooling mouth feel, and characteristic effervescence, with overall good acceptability. Preliminary stability studies revealed that the formulation remained physically stable at room temperature. No significant changes in palatability parameters, including taste, mouth feel, and

effervescence, were observed .This study also emphasize the importance of appropriate packaging and storage conditions to maintain the stability and performance of effervescent granules. The results support the technical feasibility of this flavour and excipient combination as a starting point for further development.

Conflict of Interest: The authors declare no conflicts of interest regarding the publication of this manuscript.

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