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DESIGN AND EVALUATION OF HERBAL HARD CANDY AS A NATURAL THROAT SOOTHING FORMULATION

Vaibhav Adhao, Manaswi Raibagkar * and Swati Katone

Dr. Rajendra Gode College of Pharmacy, Malkapur, Buldhana - 443101, Maharashtra, India.

Keywords:

Herbal candy, Throat soothing, *Foeniculum vulgare*, *Zingiber officinale*, *Citrus limon*, Physicochemical evaluation, Stability

Correspondence to Author:
Manaswi Raibagkar

B.Pharm Students,
Dr. Rajendra Gode College of Pharmacy,
Malkapur, Buldhana - 443101,
Maharashtra, India.

E-mail: manaswijain14@gmail.com

ABSTRACT: Herbal candy is an innovative solid oral dosage form designed for localized soothing relief in the oral cavity and throat. Three formulations (F1, F2, F3) were prepared using fennel (*Foeniculum vulgare*), ginger (*Zingiber officinale*), and lemon (*Citrus limon*) in a sucrose base by the heating and molding method with varying herbal concentrations. All formulations were evaluated for organoleptic properties, weight variation, hardness, dissolution time, surface pH, moisture content, ash value, melting point, and stability over four weeks. Formulation F2 demonstrated the optimum profile: smooth texture, green color, aromatic odor, hardness 6.8 kg/cm², dissolution time 13 min, surface pH 4.5, weight 5.4±0.04 g, and complete stability at 25°C and 35°C for four weeks. The study confirms herbal candy as a safe, patient-friendly dosage form for mild throat discomfort, combining traditional herbal knowledge with modern pharmaceutical formulation techniques.

INTRODUCTION: Herbal medicines derived from plant sources have been integral to traditional healthcare systems such as Ayurveda, Unani, Siddha, and Traditional Chinese Medicine. Bioactive phytoconstituents including alkaloids, flavonoids, tannins, glycosides, terpenoids, and phenolic compounds confer diverse pharmacological activities: antimicrobial, anti-inflammatory, antioxidant, and soothing effects [1, 2]. Their synergistic interactions frequently amplify therapeutic potential beyond that of isolated compounds [3]. Compared to synthetic drugs, herbal medicines exhibit milder pharmacological effects and are considered relatively safe when used appropriately. Their long history of traditional use and lower incidence of adverse reactions have contributed to their increasing global acceptance [1, 4].

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Throat-related discomforts-irritation, dryness, (Em dash missing between "discomforts" and "irritation"), hoarseness, and mild cough are increasingly prevalent due to environmental pollution, allergens, climatic variation, and lifestyle factors [39, 42]. Conventional synthetic preparations carry adverse effects such as drowsiness, gastrointestinal disturbance, and drug interactions, limiting their use in mild or self-limiting conditions [1, 44]. Herbal candy is a solid oral dosage form incorporating herbal ingredients into a sweetened base, dissolving slowly in the oral cavity to provide sustained localized action through prolonged mucosal contact, salivation stimulation, and demulcent protection [5, 6]. It does not require water for administration and is suitable for all age groups, thus improving patient compliance [7, 8]. The present study aimed to formulate herbal candy using fennel, ginger, and lemon in a sucrose base and to evaluate the prepared formulations for physicochemical and stability parameters.

MATERIALS AND METHODS:

Plant Materials and Ingredients: Fennel seeds (*Foeniculum vulgare*, Fam: Apiaceae), fresh ginger

rhizome (*Zingiber officinale*, Fam: Zingiberaceae), and lemon (*Citrus limon*, Fam: Rutaceae) were procured from the local certified market. Sucrose and distilled water were used as excipients. All ingredients were of pharmaceutical grade unless otherwise stated [9, 10].

FIG. 1: FENNEL (*FOENICULUM VULGARE*)

FIG. 2: GINGER (*ZINGIBER OFFICINALE*)

FIG. 3: LEMON (*CITRUS LIMON*)

FIG. 4: SUGAR (SUCROSE)

TABLE 1: MATERIALS SELECTED FOR PREPARATION OF HERBAL CANDY

Sr.	Ingredient	Synonym	Biological Source	Family	Uses
1	Fennel	Saunf	*Foeniculum vulgare* (fr.)	Apiaceae	Carminative, soothing, expectorant
2	Ginger	Adrak	*Zingiber officinale* (rhiz.)	Zingiberaceae	Anti-inflammatory, antioxidant
3	Lemon	Citrus	*Citrus limon* (fruit)	Rutaceae	Antioxidant, antimicrobial, flavoring
4	Sugar	Sucrose	*Saccharum officinarum*	Poaceae	Base, sweetener, demulcent
5	Water	—	—	—	Solvent

Formulation Design: Three formulations (F1, F2, F3) were prepared with a constant sucrose base (50 g) and increasing concentrations of herbal ingredients as outlined in **Table 2** [10, 11].

TABLE 2: FORMULATION COMPOSITION OF HERBAL CANDY

Sr.	Ingredient	F1	F2	F3	Function
1	Sugar	50 g	50 g	50 g	Base & sweetener
2	Fennel Powder	4 g	6 g	8 g	Carminative, soothing
3	Ginger Extract	1 ml	1.5 ml	2 ml	Anti-inflammatory
4	Lemon Juice	3 ml	5 ml	7 ml	Flavoring, salivation
5	Water	100 ml	100 ml	100 ml	Solvent

Equipment Used:

TABLE 3: EQUIPMENT USED FOR FORMULATION AND EVALUATION

Sr.	Equipment	Company	Sensitivity	Purpose
1	Weighing Balance	Systronic	0.1 mg	Accurate weighing of ingredients
2	Thermometer	Borosil	1°C	Temperature monitoring during heating
3	Hot Plate	Remi	±1–5°C	Uniform heating of sugar syrup
4	Muffle Furnace	Equiptronics	±1–5°C	Ash value determination
5	Dissolution Apparatus	Electrolab	±1 RPM	Dissolution time measurement
6	Hardness Tester	Monsanto	1 kg/cm²	Mechanical strength evaluation
7	Friability Tester	Electrolab	±1 RPM	Friability assessment

Preparation of Herbal Candy: The heating and molding method was employed for all three formulations [12, 13]. Accurately weighed sucrose was dissolved in measured distilled water in a stainless steel vessel and heated with continuous stirring until a clear homogeneous syrup formed.

Temperature was carefully monitored throughout to prevent caramelization. The syrup was allowed to cool slightly to prevent thermal degradation of herbal constituents [16, 35]. Fennel powder, ginger extract, and lemon juice were incorporated and mixed thoroughly to ensure uniform distribution. The mass was poured into pre-lubricated molds, cooled at room temperature until complete solidification, carefully demoulded, and stored in airtight containers pending evaluation [15, 18].

Evaluation Parameters:

Organoleptic Evaluation: Color, odor, taste, texture, and overall appearance were assessed by visual and sensory examination [6, 14].

Weight Variation: Ten candies were individually weighed on a calibrated balance; mean weight and standard deviation (SD) were calculated [18, 20].

Hardness: Resistance to crushing force was measured using a Monsanto hardness tester and expressed in kg/cm² [13, 16].

Friability: Candies were subjected to controlled agitation; percentage weight loss after the test was calculated [15, 18].

Dissolution Time: Time for complete dissolution under simulated oral conditions was recorded in minutes [5, 13].

Surface pH: Candy was dissolved in distilled water and pH was measured using a calibrated pH meter [34, 37].

Moisture Content and Ash Value: Moisture content (%) was determined by loss on drying; ash value was estimated by incineration in a muffle furnace [19, 41].

Melting Point: Determined using the capillary method [16, 35].

Stability Study: Prepared candies were evaluated at 25°C and 35°C for four weeks; organoleptic and physical parameters were monitored weekly [19, 49].

RESULTS AND DISCUSSION:

Organoleptic Properties: All three formulations exhibited a characteristic green color attributable to fennel, a pleasant aromatic odor due to volatile oils such as anethole and fenchone, and a predominantly sweet taste with a characteristic fennel note [22, 23]. F2 showed uniform glossy appearance and smooth texture, considered optimal for patient acceptability. F1 was slightly grainy, possibly due to partial crystallization in the absence of liquid glucose [35]. F3 exhibited an intense herbal taste owing to higher concentrations, which marginally affected palatability. The agreeable sensory profile of herbal candy enhances compliance particularly in pediatric and geriatric populations [6, 14].

Physicochemical Parameters: Results of physicochemical evaluation are presented in **Table 4**. The weight of all formulations was within acceptable limits (5.4–5.5 g), confirming batch uniformity and accurate molding [18, 20]. Hardness ranged from 5.2 to 6.8 kg/cm²; F2 demonstrated optimum hardness ensuring structural integrity during handling while permitting controlled dissolution [13, 16]. Surface pH values (3.9–5.9) were within the safe range for oral mucosal application, minimizing risk of mucosal irritation [34, 37]. Dissolution times of 13–16 min provide sustained soothing action by maintaining prolonged contact with the oral and throat mucosa [5, 36]. Moisture content (1.9–2.8%) and ash values (1.85–2.16 g) were within acceptable pharmaceutical limits [41, 47].

The higher lemon juice concentration in F3 contributed to a lower surface pH (3.9), which may explain the slight stickiness observed during storage, as acidic conditions can promote hygroscopicity in sugar-based systems [17, 34]. The melting points of all formulations (136–142°C) were consistent with the expected range for sucrose-based confectionery preparations, confirming proper processing and structural integrity [16, 35].

TABLE 4: PHYSICOCHEMICAL EVALUATION PARAMETERS OF HERBAL CANDY FORMULATIONS (F1, F2, F3)

Parameter	F1	F2	F3
Colour	Light green	Green	Pale green
Odour	Aromatic (fennel)	Aromatic (fennel dom.)	Fennel + citrus
Taste	Sweet, fennel	Sweet, strong fennel	Sweet, fennel + citrus

Texture	Slightly grainy	Smooth	Smooth
Appearance	Uniform	Uniform, glossy	Uniform
Surface pH	5.9	4.5	3.9
Moisture Content (%)	2.8	1.9	2.3
Hardness (kg/cm²)	5.2	6.8	5.9
Weight Variation (g)	5.5 ± 0.03	5.4 ± 0.04	5.5 ± 0.05
Ash Value (g)	1.85	2.16	1.95
Melting Point (°C)	138	142	136
Dissolution Time (min)	16	13	15
Shelf Life (4 Weeks)	Stable	Stable	Unstable (sticky)

FIG. 5: HARDNESS TESTER

FIG. 6: FRIABILITY TEST APPARATUS FIG. 7: DISSOLUTION APPARATUS

Stability Study: Stability evaluation was conducted at 25°C and 35°C over four weeks **Table 5**. Formulations F1 and F2 showed no change in color, odor, or texture at either temperature throughout the study period, confirming adequate stability under the test conditions [16, 19]. F3 developed stickiness at four weeks, attributed to the hygroscopicity associated with higher lemon juice content [17, 34]. These findings confirm F2 as the most stable formulation suitable for practical use.

TABLE 5: STABILITY EVALUATION OF OPTIMIZED FORMULATION (F2)

Time Point	Temperature	Colour	Odour	Texture	Stability
1 Week	25°C	No Change	No Change	No Change	Stable
1 Week	35°C	No Change	No Change	No Change	Stable
2 Weeks	25°C	No Change	No Change	No Change	Stable
2 Weeks	35°C	No Change	No Change	No Change	Stable
3 Weeks	25°C	No Change	No Change	No Change	Stable
3 Weeks	35°C	No Change	No Change	No Change	Stable
4 Weeks	25°C	No Change	No Change	No Change	Stable
4 Weeks	35°C	No Change	No Change	No Change	Stable

Selection of Optimized Formulation: F2, containing 6 g fennel powder, 1.5 ml ginger extract, and 5 ml lemon juice in 50 g sucrose base, exhibited the most balanced physicochemical profile. The fennel concentration provided adequate therapeutic soothing without compromising palatability [22, 23]. Ginger extract contributed anti-inflammatory and antioxidant activity [26, 27] while lemon juice enhanced salivation, flavor, and mild antimicrobial action [24, 25]. The sucrose base provided structural integrity, demulcent protection, and sweetness consistent with established confectionery formulation principles [35, 50]. Overall, F2 represents the optimized formulation with the best balance of therapeutic, physicochemical, and stability attributes.

CONCLUSION: The present study successfully formulated and evaluated herbal candy containing fennel, ginger, and lemon in a sucrose base using simple and reproducible pharmaceutical techniques. All formulations showed acceptable physicochemical properties and Formulation F2 was identified as the optimized batch based on its balanced profile of hardness, dissolution, pH, stability, and sensory acceptability. The study confirms herbal candy as a safe, effective, and patient-friendly dosage form for mild throat discomfort, integrating traditional herbal knowledge with modern formulation science. Future studies may explore sugar-free variants using natural sweeteners, standardized herbal extracts, and extended stability evaluation as per ICH Q1A(R2) guidelines [49].

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