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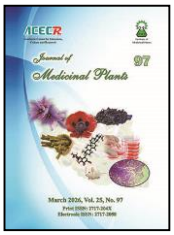

Research Article

Preparation and evaluation of an oral dosage form effective in improving digestion based on the Traditional Persian Medicine

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ABSTRACT

Background: The rising prevalence of digestive disorders is a significant issue in modern societies. Among the most important conditions in this category is dyspepsia, which is managed through various medicinal and lifestyle interventions. **Objective:** This study aimed to develop and conduct control tests to determine the active substance content in granules derived from a mixture of medicinal plants in a multi-ingredient formulation. **Methods:** Several multi-ingredient formulations effective for digestion were extracted from key texts of traditional Persian pharmaceuticals, namely Qarabadin textbooks. **Results:** From *Qarabadin-e-Azam*, an oral powder of Cloves (*Safoof-e-qaranfol*) formulation containing mastic, ginger, cloves, anise, and fennel was selected. The yielded essential oil of the mixture was analyzed using a gas chromatography device linked to a mass spectrometer. Granules were prepared using the wet granulation method, and their taste was enhanced by coating them with candy. Ethyl cellulose was sprayed onto the granules to create a coating. The prepared granules exhibited proper flow - properties as determined by the angle of repose test. The eugenol content, the primary compound in the essential oil, was analyzed in the optimized granules, revealing approximately 111.54 ± 9.63 µg of eugenol per gram of granules. **Conclusion:** The adjusted formulation could be marketed as a traditional Persian medicine product for further clinical evaluation.

1. Introduction

Functional dyspepsia (FD), also referred to as non-ulcer dyspepsia, is one of the most frequently recurring disorders characterized by complex symptoms in the gastroduodenal region [1, 2]. Approximately 10-20 percent of the global population experiences FD at least six times per year [3]. The common symptoms of FD include epigastric pain, pressure, and fullness in the upper abdomen during or after meals, along with nausea and early satiety, or a combination of these symptoms [1, 3-5].

Abbreviations: FD, Functional dyspepsia; TPM, Traditional Persian Medicine; GC/MS, Gas Chromatography/Mass Spectroscopy; GC/FID, Gas chromatography connected to a flame ionization detector

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The management of FD depends on the type and duration of symptoms, as well as the patient's quality of life. Treatment options for FD primarily include proton pump inhibitors, prokinetics, antisecretory agents, medications for eradicating Helicobacter pylori, and central nervous system modulators [6 - 8]. Individualized diagnostic procedures may also be conducted for patients who do not show improvement with the treatments mentioned above. Additionally, screening for mental health conditions such as anxiety, depression, and stress is advisable for patients who do not respond to treatment [9, 10].

In recent years, there has been a growing interest in the therapeutic potential of herbal medicine as a supplementary treatment for managing FD [11]. Many suggested therapeutic approaches involve combinations of various plants from different traditional medicine practices worldwide. The appeal of this method lies in its potential to simultaneously address multiple pharmacological effects, targeting gastrointestinal motility, secretory functions, and cell protective properties [12-14].

In Traditional Persian Medicine (TPM), a valuable resource of rigorously conducted applied medical practices, digestive disorders, including indigestion (za'f-ol-hazm), are addressed [1, 11, 15]. This disorder is defined as a condition where food does not leave the stomach promptly, resulting in symptoms such as stomach fullness, nausea, belching, and bloating [16].

The study aimed to design and formulate a modified oral dosage form based on TPM for treating digestive insufficiency. Considering the numerous benefits associated with TPM, a Safoof-e-qaranfol consisting of five ingredients - clove, anise, mastic, fennel, and ginger - was selected, reconfigured into granules, and standardized as an effective dosage form to address digestive insufficiency, along with symptoms of phlegm, dampness, and coldness in the stomach.

2. Materials and methods

2.1. Materials

The solvents, including methanol and ethanol, and ethyl cellulose, were purchased from Merck (Merck, Darmstadt, Germany). An analytical-grade standard of eugenol was purchased from Sigma-Aldrich (Sigma-Aldrich, Zwijndrecht, Netherlands). Stock solutions were kept at 2 °C. The experiments were approved (IR.SUMS.REC.1401.431) by the Research Ethics Committee, Shiraz University of Medical Sciences.

2.2. Manuscript review and formulation selection

Various traditional pharmaceutical encyclopedias (Qarābādins), including Qarābādin-e-Salehi, Qarābādin-e-Ghāderi, and Qarābādin-e-Azam, were examined to choose the best formulation [17 - 19]. Several factors were taken into account during the selection process: the formulation should contain between 3 and 5 readily available ingredients. A formulation with frequent mention in Qarābādin-e-Azam was chosen to proceed to the experimental stages [18]. The formulation preparation instructions outlined the following: "Three derams each of cloves and fennel, two derams of anise and mastic each, one deram of ginger, sugar candy in an amount equal to the total of the previous ingredients, and two derams of baked meatballs should be consumed before meals". (Deram is a unit of weight measurement used in TPM references. Each deram is about 3.5 g) [20]. Sugar candy, known as nabāt or Persian sugar, is a type of rock candy prepared from sugar syrup. The syrup is boiled and then poured into a container with

threads, around which nabāt crystals form as it cools down.)

2.3. Plant authentication and preparation

All plant ingredients were purchased from a well-known medicinal plant market in Shiraz and verified with a specific voucher number in the herbarium of the School of Pharmacy at Shiraz University of Medical Sciences (Table 1). The ingredients were dried, individually ground using an electric miller, sieved through a 20 British mesh, and then mixed for the extraction of essential oils.

Table 1. Ingredients of the formulation

Name	Scientific Name	Voucher Number	Plant Part	Weight Ratio
Clove	*Syzygium aromaticum* (L.) Merr. & L.M.Perry	PM 1388	Flower (bud)	3
Fennel	*Foeniculum vulgar* Mill.	PM 1389	Fruit (seed)	3
Anise	*Pimpinella anisum* L.	PM 1390	Fruit (seed)	2
Mastic	*Pistacia lentiscus* L.	PM 1140	Gum	2
Ginger	*Zingiber officinale* Roscoe	PM 1387	Rhizome	1

2.4. Essential oil extraction

Specified amounts of the plant powder mixture, in the mentioned ratios, were soaked in a specific quantity of distilled water. The mixture was then heated in a Clevenger-type apparatus for 3 hours. The yield of essential oil extraction was calculated based on dry weight. The essential oil was dried using anhydrous sodium sulfate and stored at -20 °C for subsequent analysis.

2.5. GC/MS Analysis of Essential Oil

Gas Chromatography/Mass Spectroscopy (GC/MS) analysis was conducted using an Agilent GC-MSD system (model 7890A). A capillary column of DB-1 type (phenyl methyl siloxane, dimensions 30 m × 0.25 mm, with 0.25-µm film thickness) was utilized with Helium as the carrier gas at a flow rate of 1 mL/min. The GC oven temperature was programmed from 60 to 250 °C at a heating rate of 5 °C/min. The mass spectrometer (Agilent Technologies 5975 C) was operated at 70 eV. The mass range was set from 30 to 600 m/z, and the injection temperature was set at 280 °C. Kovats indices were calculated using the retention times of synchronously injected normal alkanes (C9-C24), and their mass spectra were compared with the Wiley (nl7) and Adams libraries to identify the components of the essential oil.

2.6. Powder flowability

The flowability of powder was assessed by measuring the angle of repose, which was determined using the Erweka Flow tester (GTB series). The specified quantity of powder was discharged from the funnel, and the angle of repose was computed. Each experiment was conducted thrice. The powders were classified according to the USP flowability table [21].

2.7. Granulation

The herbal components, milled and sieved beforehand in the specified ratio, were blended to create a uniform mixture. Distilled water was utilized as a granulating fluid in the wet granulation process to form the granules, enhancing adhesion and flowability. The resultant particles were then dried in an oven at 40 °C for 48 hours, sifted through two sets of sieves, and the granules measuring 1-2 mm were collected.

2.7.1. Taste enhancement of granules

To administer the granules, different amounts of sugar candy were mixed with plant powders. The weight ratios of the plant powder mixture to the candy were: 1:1, 1:0.7, 1:0.5, 1:0.3, 1:0.1, and 1:0. Prepared granules were tested on 10 volunteers. The taste of the granules was categorized as bitter, suitable, or sweet. The optimal granule formulation was further examined in the remaining study.

2.7.2. Coating of granules

To slow down the dissolution rate of the granules, a water-insoluble polymer (1 % w/v ethyl cellulose) was applied as a coating and taste-masking agent. Ethyl cellulose was dissolved in 96 % ethanol and sprayed onto the granules using coating pans. The prepared granules were dried at 40 °C for 24 hours to eliminate any ethanol residue, and the effectiveness of taste masking was evaluated in volunteers.

2.8. Granule Characterization

2.8.1. Granule Flowability

The flowability of the granules was assessed following the method outlined in section 2.6.

2.8.2. Disintegration of granules

The disintegration time for a specific quantity of coated and uncoated granules was measured using a Disintegration test apparatus. Purified water at 37 ± 1 °C was utilized as the medium [22]. Each test was conducted in triplicate.

2.8.3. Granule content assay (determination of the yielded essential oil)

A Gas chromatography device was used to measure the content of the granules. GC connected to a flame ionization detector (GC/FID) was conducted using an Agilent system (model 7890A) equipped with an HP-5 column (phenyl-methyl siloxane, dimensions 30 m x 0.32 mm, with a 0.25-µm film thickness). Nitrogen (5 th grade) was utilized as the carrier gas at a flow rate of 1 mL/min. The column temperature was maintained at 250 °C for 10 minutes. The injector and detector temperatures were set at 250 °C and 300 °C, respectively.

In the previous section, eugenol was identified as the main compound in the essential oil. This compound was then utilized to calculate the content. Initially, pure eugenol as a reference compound was diluted in methanol and its calibration was prepared. The calibration was verified, and based on the obtained results; the content of the granules was standardized using eugenol.

To plot the calibration curve, dilutions of eugenol (437, 875, 1750, 3500, 7000, and 14000 µg/ml) were prepared in methanol, and approximately 1µg of each sample was injected into the GC/FID three times per day for three consecutive days to evaluate inter-day variation and intraday consistency. The limit of detection (LOD) and limit of quantification (LOQ) were determined.

Furthermore, the essential oil extracted from optimized granules was prepared and injected into the GC/FID three times to assess the eugenol content in the granules. The method for extracting essential oils from the granules was similar to that described for the powders in Section 2.4.

2.9. Analysis of data

Statistical analyses were performed using Microsoft Excel 2010 (Microsoft Corporation, Redmond, WA, USA).

3. Results

3.1. Traditional literature review

A total of over 30 remedies were extracted from the traditional encyclopedias mentioned. Ultimately, a five-ingredient formulation in

Qarābādin-e-Azam was chosen for further procedures, comprising clove, fennel, anise, mastic, and ginger.

3.2. GC/MS of mixed powders

Table 2 displays the GC/MS analysis of compounds in a plant mixture sample containing clove, fennel, anise, mastic, and ginger.

The extraction of essential oil from the powder was conducted through the distillation method using water and the Clevenger apparatus for 3 hours. The process yielded approximately 4.6 % v/w, calculated as follows:

$$yield\ of\ extraction: \frac{\text{Amount of essential oil obtained (ml)}}{\text{Raw material powder mixture (g)}} * 100$$

3.3. Powder flowability

Flow rate is one of the most crucial characteristics of powders, assessed by the angle of repose factor. According to the pharmacopeia, a lower angle of repose indicates a better flow rate for the powder [21]. An angle of repose between 25 and 35 degrees demonstrates excellent to good flow properties. When these values exceed 45 degrees, the flow rate is considered weak or very weak [21]. The angle of repose serves as an indicator of powder flow characteristics, as detailed in Table 3.

According to Table 3, since most components do not have proper flowability, it was necessary to alter the formulation to create granules.

3.4. Granulation, taste enhancement, and coating

Granules were prepared using the wet granulation method, and granules of appropriate size were chosen. Granules ranging between 1 and 2 mm were deemed suitable particle sizes. This size is commonly found in edible granules available in the market. Granules without candy content were not palatable, necessitating the inclusion of a flavoring agent. Based on taste evaluation (Table 4), 0.7 grams of sugar candy was determined to produce granules with an acceptable taste. Consequently, the ingredient ratios for the final granule were set as follows: cloves: fennel: anise: mastic: ginger: candy; 3:3:2:2:1:8.

Table 2. Volatile content analysis in the plant mixture

Peak	Name	RT	Area %	KI_C	KI_R	Ref
1	D-Limonene	8.76	0.34	1015.97	1014	[23, 24]
2	Fenchone	10.31	0.48	1062.32	1060	[23, 25]
3	Anethole	17.74	15.15	1258.18	1257	[26, 27]
4	Eugenol	20.70	76.65	1331.91	1332	[28, 29]
5	Caryophyllene	23.84	5.16	1410.80	1408	[28, 29]
6	Humulene	25.07	0.38	1442.55	1440	[23, 24]
7	Zingiberene	25.97	0.21	1465.82	1469	[30, 31]
8	Eugenyl acetate	26.61	1.33	1482.12	1485	[28, 29]
9	Curcumene	27.62	0.13	1508.10	1503	[28, 29]
Identification (%)				99.83		

Table 3. Flowability of the components in the formulation

Powder	Cloves	Fennel	Mastic	Anise	Ginger
Angle of repose (degree)	60	47	27	49	56
Flow type	Very weak	Weak	Excellent	Weak	Very weak

Table 4. Taste test of granules after flavoring with sugar candy

Mixed herbs: sugar candy (weight ratio)	Bitter	Appropriate	Sweet
1:0	10	0	0
1: 0.1	9	1	0
1:0.3	8	2	0
1:0.5	3	7	0
1:0.7	1	8	1
1:1	0	1	9

3.4.1. Flowability of granules

The angle of repose of the granules was approximately 26° ± 2°, indicating excellent particle flow.

3.5. Disintegration time of granules

The disintegration time for uncoated granules was 5.3 ± 1.7 minutes. However, this time increased to about 9.8 ± 2.8 minutes for coated granules, highlighting the impact of ethyl cellulose as a coating agent on reducing disintegration time.

3.6. Granule content

According to the analysis of GC/MS data, the main volatile compound in the essential oil of the final formulation is eugenol. In the following, the two spectra were matched after injecting the essential oil obtained from the formulation and the standard with the same temperature program (Fig. 1), confirming the presence of eugenol in the final formulation.

To determine the eugenol content, serial concentrations of the standard eugenol sample were prepared, and the unknown amount in the sample was calculated. In this method, serial concentrations of eugenol (437, 875, 1750, 3500, 7000, and 14000 µg/ml) were prepared from the initial stock. After injection (three times for each concentration), a standard curve was prepared, and the best calculations were considered (Fig. 2). The equation of the calibration curve of the mentioned concentrations is equal to $y = 0.33x - 34.3$, where y is the area of the peaks and x is the amount of concentrations.

Relative standard deviation (RSD) % was also utilized to validate the plotted calibration, and the small RSD amounts suggest the suitability of the obtained data and their higher precision (Table 5). Additionally, the LOD and LOQ data were found to be appropriate, indicating the validity of the calibration data in the study (Table 6).

With the standard curve drawn from the equation, the amount of eugenol in the essential oil sample and subsequently in the modified granule formulation can be determined. The unknown concentration in 1 ml of injected essential oil (calculated from the volume of one µl of actual injection) was equivalent to 3913.53 ± 337.77 µg/ml. The eugenol used has a purity of 95 %, so the actual amount of this marker in the essential oil obtained from the modified granule is 3717.85 ± 320.88 µg/ml. The extraction yield of the essential oil obtained from the product was approximately one-third of the total yield, or 3 %, which means that the amount of essential oil in a 5 g sachet is 0.15 ml. According to the eugenol amount in 1 ml of essential oil, the amount in the corresponding sachet is 557.68 ± 48.13 µg.

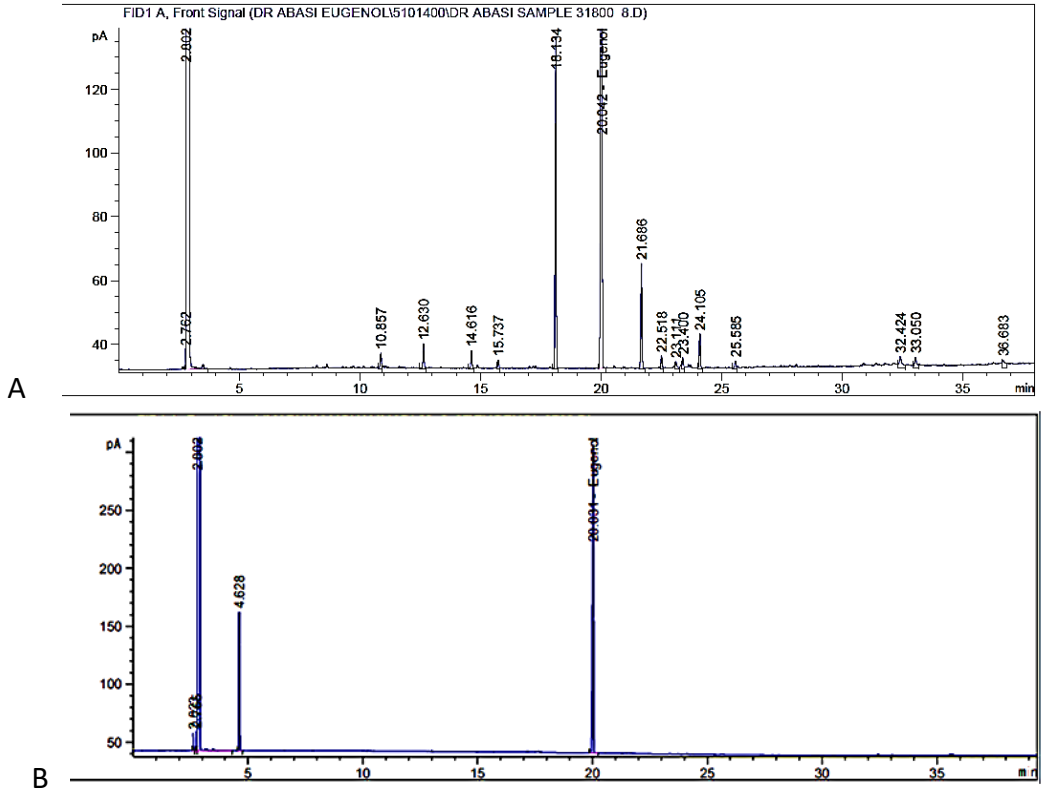

Fig. 1. GC/FID chromatogram of product A: essential oil sample and B: eugenol standard

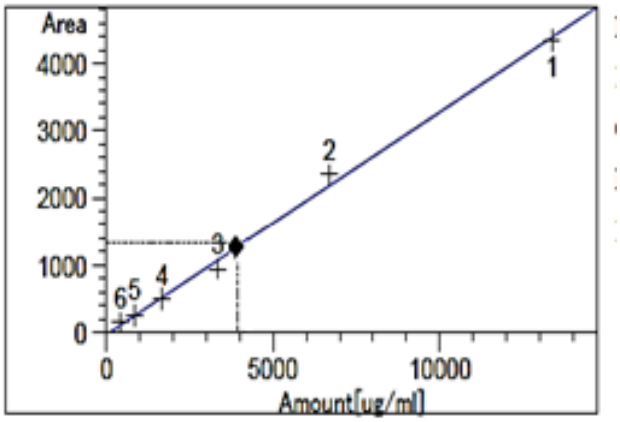

Fig. 2. Eugenol standard curve, and the position of the unknown sample (eugenol present in the produced essential oil) on the eugenol calibration curve

Table 5. Calculation of intra-day and inter-day difference of eugenol (concentration 875 µg/ml)

Days	Conc. (875 µg/ml)			Mean ± SD	RSD%	RSD%
	C_1	C_2	C_3	(intra-day)	(intra-day)	(inter-day)
1	840.52	837.27	827.17	843.96 ± 6.96	0.82	
2	821.75	839.10	833.81	831.55 ± 8.89	1.10	1.24
3	819.45	810.78	822.11	817.45 ± 5.92	0.72	

Table 6. Calculation of the amount of eugenol in the pure essential oil sample from the final formulation with an input concentration of 31800 µg/ml

Sample	Area (%)	Product (µg/ml)	Mean ± SD	RSD (%)	LOD (µg/ml)	LOQ (µg/ml)
1	1314.70	4059.75	3913.53 ± 337.77	8.6	60	180
2	1345.87	4153.57				
3	1137.77	3527.28				

4. Discussion

Modifying existing formulations from traditional sources and developing more convenient pharmaceutical dosage forms is an extensively studied field. Numerous formulations and preparation methods are outlined in *Qarābādin* textbooks as part of a general pharmacopeia that serves as the foundation for many pharmaceutical products [17, 18, 32]. Over 33 oral indigestion formulas have been derived from these references. According to TPM, stomach weakness is identified as one of the causes of digestive issues. Stomach weakness refers to the stomach's inability to digest food properly, often characterized by a cold dystemperament. Given these factors, it is recommended that most formulations include herbs or ingredients with contrasting temperaments. The majority of these formulations consist of ingredients that have hot and dry temperaments. A notable formulation in Qarābādin-e-Azam is an oral powder of Cloves (Safoof-e-qaranfol), which includes clove, fennel, anise, mastic, and ginger, all possessing hot and dry traits. The individual effects of each component on digestive disorders have been validated through various studies. Clove is a valuable spice worldwide. Its essential oil is used as a pain reliever for dental emergencies. It also acts as an antioxidant, antiperspirant, carminative, digestive, stimulant, antibacterial, and antiparasitic agent [13, 33, 34]. Fennel, recognized as a culinary herb and a valuable warming carminative, has been used for treating dyspepsia, bloating, flatulence, and poor appetite since ancient times [35]. Anise exhibits various therapeutic properties, such as preventing stomach mucosal damage, reducing constipation, and alleviating nausea [13, 36-38]. Several clinical studies have confirmed the efficacy of mastic resin in treating functional dyspepsia and eradicating *Helicobacter pylori* in dyspeptic patients [39 - 41]. Ginger, an ancient cultivated spice in various cultures, plays a significant role in treating dyspepsia, flatulence, and vomiting by stimulating saliva, bile, and gastric secretions [13, 42, 43]. The formulation mentioned was in the form of the Safoof, a powdered dosage form that comes with its own set of disadvantages [44, 45]. Powders are affected by particle density and size, influencing settling, flow, and fluffiness. Additionally, issues such as inaccuracies in administration, humidity absorption, and changes in flow rate are other drawbacks associated with powders. Conversely, granules are more compact, easier to store, carry, and dispense, and can also help mask unpleasant odors and tastes [45]. In this study, the powder was transformed into granules, the taste was modified, and the prescription characteristics were controlled and standardized. Initially, the flowability of each powder was measured, revealing predominantly weak flow. As a result, a change in formulation was deemed necessary [45]. Granulation was carried out using the wet granulation method, with water serving as the granulating fluid. Mastic was used as a binder, facilitating the granulation process of the powders. The prepared granules had a bitter taste and

exhibited low compliance. Non-compliance can lead to inadequate efficacy or hinder disease mitigation efforts. Candy was added to the granule formulation, serving two purposes. It was used as sweetener and flavor enhancer, as well as a binder in the granules. The original recipe included an equal amount of candy as the plant powders. In this study, lower amounts were also tested to evaluate their impact on taste. According to the volunteers' feedback, including sugar candy in an equal ratio to the powder mixture or at 0.7 times the amount of herbal powder resulted in a favorable flavor. Although this study aimed to lower the amount of sweetener in the final product, it is still advisable for diabetics to consume this product cautiously due to its high candy content.

Another method used to mask the taste of the granules and reduce their disintegration rate was the application of ethylcellulose on the prepared granules. Ethylcellulose is a water-insoluble polymer commonly used in film coating. It allows for precise control of drug release and enhances the stability of the granules [46]. The addition of ethylcellulose increased the disintegration time by approximately 1.9 times. The flow of the granules was rated at about 26, indicating excellent flowability [21]. Flow rate measurements can be utilized to determine the filling capacity of capsules or sachets by granules, as well as for bulk storage purposes [45]. The analysis of the volatile compounds in the powder mixture indicated that eugenol, anethole, and caryophyllene were the main components of the essential oil. Eugenol, caryophyllene, eugenyl acetate, and curcumene are the primary components found in clove [33, 47]. Anethole, estragole, limonene, fenchone, and humulene are the main volatile compounds in fennel [36]. In anise, trans-anethole and estragole are dominant [37, 48], while cineole, zingiberene, β-bisabolene, and β-sesquiphellandrene are the main components in ginger [31, 49]. Eugenol was identified as the primary marker, with a percentage exceeding 70%, and was assessed using the GC/MS technique. According to the calculations, each deram of granules contained approximately 401.53 µg of eugenol.

5. Conclusion

Several manuscripts by medieval Persian physicians regarding herbal therapy for FD in Iran have been preserved. One such preparation is Safoof-e-qaranfol, which is currently being transformed into granules for a more convenient oral dosage form. The essential oil from the granules was subjected to GC/MS analysis, revealing that eugenol is the main component. Pharmaceutical control and standardization of the obtained essential oils were conducted. The results confirmed that the prepared granules possess acceptable properties. Nevertheless, further additional tests, such as product stability testing, are necessary to confirm the stability of the volatile content in the granules. This will enable the product to be utilized in further studies, including clinical trials.

Author contributions

MM.Z. and E.P. designed the study. All authors performed the experiment and wrote the article. MM.Z. and E.P. contributed to the research design and implementation.

Conflict of interest

The authors declare that there is no conflict of interest.

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References

1. Babaeian M, Naseri M, Kamalinejad M, Ghaffari F, Emadi F, Feizi A, Yekta N.H and Adibi P. Herbal remedies for functional dyspepsia and traditional Iranian medicine perspective. *Iran. Red Crescent Med. J*. 2015; 17(11): e20741. doi: 10.5812/ircmj.20741.

2. Pasalar M, Nimrouzi M, Choopani R, Mosaddegh M, Kamalinejad M, Mohagheghzadeh A and Lankarani K.B. Functional dyspepsia: A new approach from traditional Persian medicine. *Avicenna J. Phytomed*. 2016; 6(2): 165-174.

3. Gwee K.A, Holtmann G, Tack J, Suzuki H, Liu J, Xiao Y, Chen M.H, Hou X, Wu D.C and Toh C. Herbal medicines in functional dyspepsia—Untapped opportunities not without risks. *Neurogastroenterol Motil*. 2021; 33(2): e14044. doi: 10.1111/nmo.14044.

4. Darvishpor, S., Hosseini, A., Davoodi, A., Salehifar, E., Akbari, J. and Azadbakht, M. A review on medicinal plants used for nausea and vomiting in Persian medicine. *Glob J Med Res*. 2018; 18(1): 29-45.

5. Tafti, L. D., Shariatpanahi, S. M., Damghani, M. M. and Javadi, B. Traditional Persian topical medications for gastrointestinal diseases. *Iran J Basic Med Sci*. 2017; 20(3): 222-241. doi:10.22038/ijbms.2017.8349

6. Sayuk, G.S and Gyawali C.P. Functional dyspepsia: diagnostic and therapeutic approaches. *Drugs*. 2020; 80(13): 1319-1336. doi: 10.1007/s40265-020-01362-4.

7. Harer K.N. and Hasler W.L. Functional dyspepsia: a review of the symptoms, evaluation, and treatment options. *Gastroenterol Hepatol*. 2020; 16(2): 66-74.

8. Oshima T. and Miwa H. Functional dyspepsia-a revolution in management. *Am. J. Gastroenterol*. 2018; 113(10): 1420-1422. doi: 10.1038/s41395-018-0264-8.

9. Esterita T, Dewi S, Suryatenggara F.G and Glenardi G. Association of Functional Dyspepsia with Depression and Anxiety: A Systematic Review. *J. Gastrointestin Liver Dis*. 2021; 30(2): 259-266. doi: 10.15403/jgld-3325.

10. Adibi P, Keshteli A.H, Daghaghzadeh H, Roohafza H, Pournaghshband N and Afshar H. Association of anxiety, depression, and psychological distress in people with and without functional dyspepsia. *Adv. Biomed. Res*. 2016; 5(1): 195. doi: 10.4103/2277-9175.190936.

11. Taghipour A, Hosainzadeh H, Yousefi M. and Hosaini M. Comparison of dyspepsia symptoms from the viewpoints of persian traditional and modern medicine: A qualitative study using content analysis approach. *Middle East J. Fam. Med*. 2017; 7(10): 111-114.

12. Valussi M. Functional foods with digestion-enhancing properties. *Int. J. Food Sci. Nutr*. 2012; 63(sup1): 82-89. doi: 10.3109/09637486.2011.627841.

13. Czigle S, Bittner Fialova S, Tóth J, Mučaji P, Nagy M and Oemonom. Treatment of gastrointestinal disorders—Plants and potential mechanisms of action of their constituents. *Molecules* 2022; 27(9): 2881. doi: 10.3390/molecules27092881.

14. Hota D, Srinivasan A, Panigrahi M.K, Dalua S.S, Tiwari P and Valavan R. A clinical study on the efficacy and safety of poly-herbal formulation in managing functional dyspepsia. *Phytomed. Plus*. 2025; 5(1): 100671. doi: 10.1016/j.phyplu.2024.100671.

15. Derakhshan, A. R., Yousefi, M., Dehghan, S., Zargaran, A. and Khodadoost, M. Digestion process and causes of indigestion based on Avicenna's view and modern medicine. *Tradit. Med. Res*. 2019; 4(3): 140.

16. Jahromi M.M, Pasalar M, Afsharypuor S, Choopani R, Mosaddegh M, Kamalinejad M, Mohagheghzadeh A, Tamaddon A.M. and Lankarani K.B. Preventive care for gastrointestinal disorders; role of herbal medicines in traditional persian medicine. *Jundishapur J. Nat. Pharm. Prod*. 2015; 10(4): e21029. doi: 10.17795/jjnpp-21029.

17. SalehHeravi M and Gharabadin-e- Salehi. Tehran: Iran, University of Medical Sciences, Institute of Medical History Studies, Islamic and Complementary Medicine. 2004. [in Persian]

18. Nazim Jahan M and Gharabadin-e- Azam. Tehran: Iran, University of Medical Sciences, Institute of Medical History Studies, Islamic and Complementary Medicine. 2004. [in Persian]

19. Shaharzani, M. Gharabadin-e- Ghaderi. Tehran: Iran, University of Medical Sciences, Institute of Medical History Studies, Islamic and Complementary Medicine. 2007. [in Persian]

20. Askari S.F, Azadi A, Namavar J.B, Tansaz M, Mirzapour N.A, Mohagheghzadeh A and Badr P. A comprehensive review about *Quercus infectoria* G. Olivier gall. *Res. J. Pharmacogn*. 2020; 7(1): 67-75. doi: 10.22127/rjp.2019.184177.1494.

21. Chapter: 1174. Flow, Powder The United States Pharmacopeia 30/National Formulary 25 (USP/NF). USA: United States Pharmacopeial Convention; 1. 2007.

22. Chapter: 701. Disintegration. The United States Pharmacopeia 30/National Formulary 25 (USP/NF). USA: United States Pharmacopeial Convention; 1. 2007.

23. Aprotosoaie A.C, Spac A, Hancianu M, Miron A, Tanasescu V.F, Dorneanu V and Stanescu U. The chemical profile of essential oils obtained from fennel fruits (*Foeniculum vulgare* Mill.). *Farmacia*. 2010; 58(1): 46-53.

24. Diao W.-R., Hu Q.-P., Zhang H and Xu J.-G. Chemical composition, antibacterial activity and mechanism of action of essential oil from seeds of fennel (*Foeniculum vulgare* Mill.). *Food Control*. 2014; 35(1): 109-116. doi: 10.1016/j.foodcont.2013.06.056.

25. Pastor, K. Emerging Food Authentication Methodologies Using GC/MS: Springer; 2023.

26. Orav A, Raal A and Arak E. Essential oil composition of *Pimpinella anisum* L. fruits from various European countries. *Nat. Prod. Res*. 2008; 22(3): 227-232. doi: 10.1080/ 14786410701424667.

27. Arslan N, Gürbüz B, Sarihan E.O, Bayrak A and GÜMÜŞÇÜ A. Variation in essential oil content and composition in Turkish anise (*Pimpinella anisum* L.) populations. *Turk. J. Agric. For*. 2004; 28(3): 173-177.

28. Mbaveng A and Kuete V. *Syzygium aromaticum*. Medicinal spices and vegetables from Africa: Academic Press. 2017, 611-625.

29. Singh V, Pahuja C, Ali M and Sultana S. Analysis and bioactivities of essential oil of the flower buds of *Syzygium aromaticum* (L.) Merr. et LM Perry. *J. Med. Plants Stud*. 2018; 6(6): 79-83.

30. Sultana S and Ali M. Chemical composition of volatile oil of the rhizome of *Zingiber officinale* Roscoe and its antimicrobial activity. *World J. Pharm. Pharm. Sci*. 2015; 4: 741-752.

31. Haniadka R, Saldanha E, Sunita V, Palatty P.L., Fayad R and Baliga M.S. A review of the gastroprotective effects of ginger (*Zingiber officinale* Roscoe). *Food Func*. 2013; 4(6): 845-855. doi: 10.1039/C3FO30337C.

32. Zare F, Ayati M.H, Shams-Ardekani M.R and Baghbani M. Pathology of Nomenclature of Compounded Drugs in Persian Medicine Based on Gharabadin-e-Salehi, Gharabadin-e-Kabeer, and Gharabadin-e-Azam. *Iran. J. Med. Ethics. Hist. Med*. 2024; 16(2): 1-15. doi: 10.18502/ijme.v16i2.15810.

33. Sarker J and Islam M.N. Comparative summary of the ethnomedicinal use, phytochemical constituents, and pharmacological properties of *Syzygium aromaticum* and *Ocimum sanctum*. *Pharmacother. Pharmascience Discov*. 2022; 1: 82-100. doi: 10.13140/RG.2.2.14143.59045.

34. Taghipour Z. *Syzygium aromaticum* (L.) Merr. & L.M.Perry. In: Rahimi R, Bahramsoltani R, editors. Therapeutic Medicinal Plants in Traditional Persian Medicine. United Kingdom: CRC Press. 2023, 234-241.

35. MehriArdestani, M. *Foeniculum vulgare* Mill. In: Rahimi R, Bahramsoltani R, editors. Therapeutic Medicinal Plants in Traditional Persian Medicine. United Kingdom: CRC Press. 2023, 87-94.

36. Díaz-Maroto M.C, Pérez-Coello M.S, Esteban J and Sanz J. Comparison of the volatile composition of wild fennel samples (*Foeniculum vulgare* Mill.) from Central Spain. *J. Agric. Food Chem*. 2006; 54(18): 6814-6818. doi: 10.1021/jf0609532.

37. Shojaii A and Abdollahi Fard M. Review of pharmacological properties and chemical constituents of *Pimpinella anisum*. *Int. Sch. Res. Notices*. 2012; 2012(1): 510795. doi: 10.5402/2012/510795.

38. Rahimi R. *Pimpinella anisum* L. In: Rahimi R, Bahramsoltani R, editors. Therapeutic Medicinal Plants in Traditional Persian Medicine. United Kingdom: CRC Press. 2023, 179-184.

39. Tabanca N, Nalbantsoy A, Kendra P.E, Demirci F and Demirci B. Chemical characterization and biological activity of the mastic gum essential oils of *Pistacia lentiscus* var. chia from Turkey. *Molecules*. 2020; 25(9): 2136. doi: 10.3390/molecules25092136.

40. Eftekharafzali M, Mehrabani M, Tajadini H, Ahmadi B and Zahedi M.J. Effect of "*Pistacia atlantica*" resin (baneh) on functional dyspepsia: A double-blind, randomized clinical study. *Iran. Red. Crescent. Med. J*. 2018; 20(7): e63822. doi: 10.5812/ircmj.6382.

41. Karimi S.M. *Pistacia lentiscus* L. In: Rahimi R, Bahramsoltani R, editors. Therapeutic Medicinal Plants in Traditional Persian Medicine. United Kingdom: CRC Press. 2023, 190-195.

42. Zachariah T.J and Leela N. Spices: Secondary metabolites and medicinal properties. Indian Spices: The Legacy, Production and Processing of India's Treasured Export: Springer. 2018, 277-316.

43. Mosleh G and Zaeri M. *Zingiber officinale* Roscoe. In: Rahimi R, Bahramsoltani R, editors. Therapeutic Medicinal Plants in Traditional Persian Medicine. United Kingdom: CRC Press. 2023, 277-287.

44. Tauheed A, Hamiduddin S.K, Soofi G and Ali M.A. Formulation, physicochemical, and mating behavior evaluation of tablet modified from Safoofe kharekhasak: A Unani Pharmacopoeia aphrodisiac powder. *Int. J. Green Pharm*. 14(1): 23-37. doi: 10.22377/ijgp.v14i1.2767.

45. Aulton's pharmaceutics: the design and manufacture of medicines: Sixth ed. London: Elsevier Health Sciences; 2022, 463-483.

46. Rowe R.C, Sheskey P.J and Weller P.J. Handbook of pharmaceutical excipients: Sixth ed: Pharmaceutical press London; 2006, 262-266.

47. Arrout A, El Ghallab Y, Elmakssoudi A, Kasrati A, Lefriyekh M.R and Said A.A.H. Black cumin and clove: Litholytic volatile compounds and inhibitors of inflammation-induced gallstone. *Scientific African*. 2024; 23: e02110. doi: 10.1016/j.sciaf.2024.e02110.

48. Ghoshegir S.A, Mazaheri M, Ghannadi A, Feizi A, Babaeian M, Tanhaee M, Karimi M and Adibi P. *Pimpinella anisum* in modifying the quality of life in patients with functional dyspepsia: A double-blind randomized clinical trial. *J. Res. Med. Sci*. 2014; 19(12): 1118-1123.
49. Attari V.E, Somi M.H, Jafarabadi M.A, Ostadrahimi A, Moaddab S.-Y. and Lotfi N. The gastro-protective effect of ginger (*Zingiber officinale* Roscoe) in Helicobacter pylori positive functional dyspepsia. *Adv. Pharm. Bull*. 2019; 9(2): 321-324. doi: 10.15171/apb.2019.038.

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