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RESEARCH ARTICLE

Development of fast dissolving tablets of polyherbal extracts of turmeric, cinnamon and ginger

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ABSTRACT

Herbal fast-dissolving tablets (FDTs) are formulated to disintegrate and dissolve quickly in the oral cavity, offering a convenient dosage form for patients who have difficulty swallowing. This study highlights the development and evaluation of polyherbal FDTs containing turmeric, cinnamon, and ginger extracts, utilizing superdisintegrants such as sodium starch glycolate and croscarmellose sodium. The tablets were manufactured using the direct compression method and assessed for parameters including weight variation, hardness, friability, disintegration time, and *in vitro* dissolution. The findings demonstrated that all formulations complied with pharmacopeial standards, with formulation F4 showing the fastest disintegration time (47.66±1.1 seconds) and the highest drug release within 12 minutes. These results indicate that herbal FDTs are a promising and patient-friendly approach for delivering herbal medicines.

INTRODUCTION

Herbal fast-dissolving tablets (FDTs) are an advanced dosage form engineered to quickly disintegrate and dissolve in the oral cavity without requiring water. This formulation is especially beneficial for individuals who struggle with swallowing traditional tablets, including pediatric, elderly, and bedridden patients. The increasing preference for herbal medicines, due to their natural origin and fewer side effects, has spurred interest in developing FDTs incorporating herbal extracts. Herbal FDTs combine the benefits of fast-dissolving technology with the therapeutic advantages of herbal medicines. Herbs have been used for centuries in traditional medicine systems across the world for their various pharmacological properties. Incorporating these herbal extracts into fast-dissolving formulations can enhance patient compliance and provide rapid onset of action [1, 2].

One of the key challenges in developing herbal FDTs is ensuring the stability and bioavailability of the herbal extracts. Techniques such as solid dispersion, inclusion complexes, and the use of super disintegrants are often employed to overcome these challenges and enhance the performance of the tablets. Recent research has focused on the incorporation of various herbal extracts into FDTs. For example, ginger (*Zingiber officinale*) and amla (*Emblica officinalis*) are widely recognized for their medicinal properties, including antioxidant, anti-inflammatory, and digestive benefits. Studies have shown that these extracts can be successfully formulated into FDTs while maintaining their therapeutic efficacy [3, 4].

The formulation of herbal FDTs requires careful selection of excipients. Super disintegrants like croscarmellose sodium, sodium starch glycolate, and crospovidone play a crucial role in ensuring the tablets disintegrate and dissolve quickly. Additionally, taste masking of herbal extracts, which can have strong and unpleasant flavors, is essential to enhance patient acceptability [5-7].

MATERIALS AND METHODS

Turmeric, Cinnamon and Ginger powder was purchased from local market of Karad, Maharashtra, India. Sodium Croscarmellose**,** Sodium Starch Glycolate**,** Avicel PH 102, D-Mannitol, were obtained from Research-Lab Fine Chem Industries, Mumbai India. Magnesium Stearate was obtained from Loba Chemie pvt. Ltd, Mumbai India. Aerosil was obtained from Ozone International, Mumbai India.

Preparation of Poly-Herbal Churna

All herbal ingredients were shade dried and powdered separately. Turmeric, Cinnamon and Ginger are the components were weighed and sieved individually with a 85# no. sieve and then mixed together in 2:1:2 ratio to get uniformly blended churna. The sieved materials were triturated to form a uniform blend, which was subsequently stored in an airtight container [8].

Preparation of Extract

The prepared polyherbal churna was accurately weighed and subjected to extraction. It was macerated in 30% alcohol within a 500 mL conical flask for 2–3 days, with regular shaking to enhance extraction. Afterward, the mixture was filtered under vacuum using a rotary evaporator. The concentrated extract was subsequently dried and stored in an airtight container [9].

Direct Compression Method

The direct compression method is a widely used technique for the preparation of fast dissolving tablets (FDTs) due to its simplicity, cost-effectiveness, and suitability for heat-sensitive materials. Accurately weigh the required quantities of the herbal extracts, superdisintegrants, binders, diluents, and other excipients (as shown in Table 1). Pass all the ingredients through a suitable mesh sieve size 40 to ensure uniform particle size distribution and to remove any lumps. Mix the herbal extracts with the diluent (mannitol) in a powder blender to achieve a homogeneous blend [8]. This step is crucial to ensure uniform distribution of the active ingredients. Add the superdisintegrants (sodium starch glycolate, croscarmellose sodium) the binder (Avicel PH 102), lubricant (magnesium stearate) and glidant (Aerosil) to the blend. Mix thoroughly and compress the powder blend into tablets using a tablet compression machine fitted with appropriate punches (e.g., 6-8 mm diameter flat or round punches). Adjust the compression force and machine settings to obtain tablets of uniform weight, thickness, and hardness [10, 11].

Table 1: Formulation of polyherbal fast dissolving tablets

Ingredients	F1	F2	F3	F4
Polyherbal Extract (mg)	500	500	500	500
Sodium Starch Glycolate (mg)	5	5	10	10
Croscarmellose Sodium (mg)	5	10	5	10
Magnesium stearate (mg)	1	1	1	1
Avicel PH 102 (mg)	100	100	100	100
Aerosil (mg)	4	4	4	4
D- Mannitol (mg)	15	10	10	5
Total weight of Tablet (mg)	630	630	630	630

Evaluations for Fast dissolving Tablets

Weight Variation

Ten tablets were selected randomly from the batch and weighted individually to check for weight variation by using formula [12, 13].

$$Weight\ Variation = \frac{Initial\ wt - Avg\ wt}{Avg\ wt} \times 100 \quad (1)$$

Table 2: Average Weight and Percentage Deviation as per BP

Average weight of tablet as per BP	% deviation
80 mg or less	10.0
More than 80 mg but less than 250 mg	7.5
250 mg or more	5.0

Hardness

Hardness testing of tablets is a crucial procedure to ensure tablets can withstand mechanical stress during handling, packaging, and transportation. First place a tablet between the anvils of the Monsanto hardness tester. Apply pressure steadily until the tablet breaks. Record the force required to break the tablet [14].

Friability

Friability testing assesses the resistance of tablets to abrasion and is an essential quality control step to ensure tablets maintain their integrity during handling and transportation. Use a friabilator (e.g. Roche Friabilator). Select a representative sample of tablets, usually around 10 tablets. Weigh the tablets collectively and record the initial weight (W_i). Place the tablets in the drum of the friabilator. Rotate the drum at 25 rpm for 4 minutes, resulting in 100 rotations. Remove the tablets, remove any dust and weigh

them again (W_f). Calculate the friability percentage using the formula [15, 16].

$$\% \text{ Friability} = \frac{\text{Wi} - \text{Wf}}{\text{Wi}} \times 100 \quad (2)$$

Disintegration

The disintegration test is a standardized procedure used to determine the time it takes for a tablet to break down into smaller particles under specific conditions. Place one tablet into each of the six tubes in the basket-rack assembly. Add a disk to each tube to prevent the tablet from floating. Lower the basket-rack assembly into the beaker containing the medium. The assembly should move up and down smoothly at a frequency of 28-32 cycles per minute. Record the time taken for each tablet to disintegrate completely. The test is complete when all six tablets have disintegrated within the specified time limit [17].

***In Vitro* Dissolution**

In vitro drug release testing of tablets, also known as dissolution testing, is a critical procedure used to evaluate the rate and extent to which the active pharmaceutical ingredient (API) is released from a tablet into a solution. This test is essential for ensuring the quality, efficacy, and consistency of oral dosage forms. Select the appropriate dissolution apparatus II (paddle type) used for tablets. Fill the dissolution vessels with the 900 mL of 0.1N HCL pH 6.8 dissolution medium, equilibrate to 37 ± 0.5°C and 75 rpm. Fill the dissolution vessels with the specified medium and equilibrate to 37 ± 0.5°C. Sample volume of 10 mL was withdrawn at regular time intervals at 2, 4, 6, 8, 10 and 12 min filtered and analysed under UV spectrophotometer using 0.1N HCl as a blank [18-21].

RESULTS AND DISCUSSION

The study successfully formulated and evaluated polyherbal fast-dissolving tablets containing turmeric, cinnamon, and ginger extracts. The use of superdisintegrants like sodium starch glycolate and croscarmellose sodium was crucial in achieving rapid disintegration and dissolution, which are essential characteristics of FDTs. The results demonstrated that formulation F4, with a higher concentration of croscarmellose sodium, had the shortest disintegration time and fastest drug release, indicating the effectiveness of this superdisintegrant in enhancing the performance of FDTs.

Weight Variation

The weight variation for all formulations is within acceptable limits, indicating uniformity in tablet weight. Formulation F4 showed the least weight variation (2.9± 0.15), suggesting excellent uniformity (Table 3).Weight variation across all formulations was within acceptable limits, ensuring uniformity in tablet weight, which is crucial for consistent dosing.

Hardness

Hardness of herbal fast dissolving tablet ranging from 3.9± 0.2 to 2.8± 0.2. It is well known to formulation scientists that the tablet with more hardness show longer disintegration time (Table 3). Hardness testing showed that all tablets had sufficient mechanical strength to withstand handling, yet remained within the range suitable for fast disintegration.

Friability

The friability of herbal FDTs was ranging from 0.26± 0.020 to 0.31± 0.023. The friability is less than 1% which acceptable according to IP criteria (Table 3). Friability testing further confirmed the tablets' physical robustness, as all formulations exhibited friability values below the 1% threshold, indicating minimal tablet loss during handling.

Disintegration Time

The disintegration time of herbal FDTs was ranging from 71.23± 1.2 to 47.66± 1.1 sec. According to IP, the FDTs must be disintegrate within 3 minutes this test was passed by prepared formulation (Table 3). The disintegration times were well within the 3-minute limit prescribed by pharmacopeial standards, with formulation F4 showing the fastest disintegration. This rapid disintegration is particularly beneficial for patients requiring immediate relief or those with swallowing difficulties.

***In vitro* Dissolution**

The dissolution profiles of the herbal FDTs indicate that all formulations are capable of providing fast drug release within 12-minutes. Formulations F4 shows fast drug release as compare to formulation F1, F2 and F3 as shown in Fig. 1. The *in vitro* dissolution studies supported these findings, as formulation F4 provided the quickest and most complete drug release profile within 12 minutes, making it the most promising candidate among the tested formulations.

Table 3: Evaluation of tablets

Formulation Batches	Weight Variation (%)	Hardness (kg/cm³)	Friability (%)	Disintegration Time (Sec)
F1	3.6± 0.15	3.9± 0.2	0.26± 0.020	71.23± 1.2
F2	3.3± 0.31	3.3± 0.3	0.30± 0.021	59.81± 0.9
F3	3.1± 0.19	3.7± 0.1	0.27± 0.019	63.52± 1.4
F4	2.9± 0.15	2.8± 0.2	0.31± 0.023	47.66± 1.1

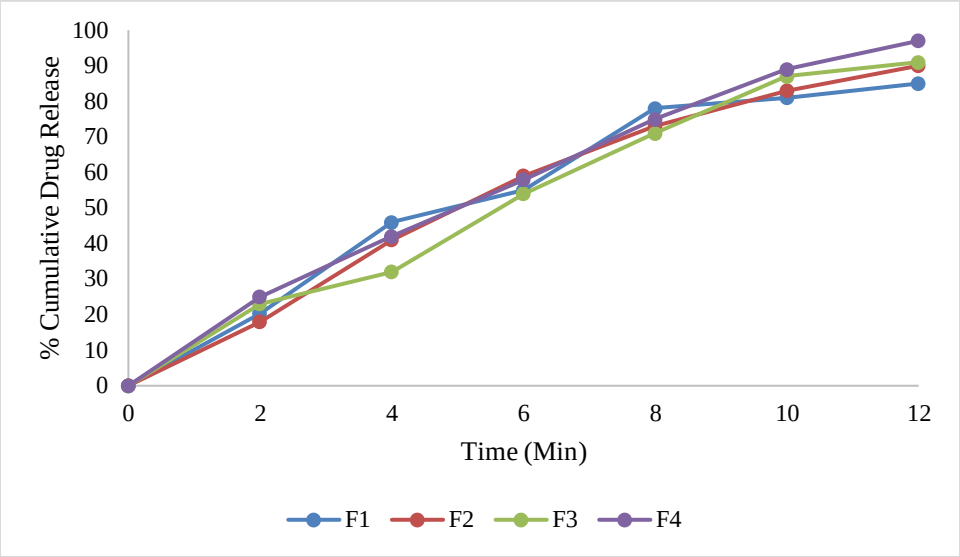

Figure 1: *In vitro* Dissolution Studies

CONCLUSION

This study demonstrates the feasibility of developing polyherbal fast-dissolving tablets using turmeric, cinnamon, and ginger extracts. The use of superdisintegrants like sodium starch glycolate and croscarmellose sodium is effective in achieving the desired disintegration and dissolution characteristics. Among the formulations tested, F4 showed the best overall performance, with rapid disintegration and the fastest drug release. These findings suggest that herbal FDTs have significant potential as a convenient and effective dosage form for delivering herbal medicines, particularly for patients who have difficulty swallowing conventional tablets. Further studies could explore the stability and bioavailability of these herbal FDTs *in vivo* to validate their therapeutic efficacy.

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