RESEARCH ARTICLE

Design and Characterization of Mangiferin Sustained-Release Tablets

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ABSTRACT

Background: Mangiferin is a natural bioactive compound used for various pharmacological activities like antidiabetic, anticancer, and anti-inflammatory.

Objective: The development of unique sustained-release matrix tablets of mangiferin is the purpose of the work that is being presented here.

Method: In this study, an effort is made to formulate mangiferin sustained-release matrix tablets by combining the sustained-release polymers HPMC K100M, Kollidone@SR, Keltone LVCR. Mangiferin matrix tablets have been synthesized by wet granulation utilizing the lactose works as the diluent. Systems were developed with different polymer percentages.

Results: Refine the design based on observed differences in weight, hardness, thickness, percent friability, percent drug content, and *in-vitro* drug release. *In-vitro* release trials conducted by utilizing a USP type II device utilizing a 6.8 pH phosphate buffer as the separation medium revealed that the most successful F2 formulation, which included 20% polymer, was capable of supporting the mangiferin release for a time of 12 hours period. This sample showed the greatest coefficient (R) value in the Hixson-Crowell model, and release kinetics studies showed that this sample exhibited an erosion process and followed zero-order kinetics.

Conclusion: We can conclude that Kollidone@Sr can be used to prepare sustained-release mangiferin.

Keywords: Mangiferin, Extraction, Isolation, Sustained release tablets.

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INTRODUCTION

Sustained Release Matrix tablets

The extended dosage form is a system that releases the active pharmaceutical ingredient for an extended time. Due to the metabolism, rapid distribution, and exclusion of some drugs, patients need to take the drug continuously within a short period of 2 to 3 times a day to maintain the drug's quality. Some methods of pain management are difficult and patients may react badly or forget to take their medication.[1] Therefore, the drug was made in a sustained-release formulation. From some special ideas and tools, the drug release time in the body is long, so the blood concentration of the drug in the body needs to be maintained for a long time. For example, some drugs can last for a few days or longer, which can prolong drug use and reduce patients' painless dosing frequency. Improves patient compliance. May reduce blood transfusion properties.[2]

Advantages[3]

- Better drug absorption control.
- Improves efficacy.
- The characteristic blood level variations can be reduced.
- Effective treatment.
- Economical.

Process of Formulating Sustained-release Tablets[4]

There are two ways to make tablets with a sustained release matrix.

- Direct compression approach.
- Wet granulation approach.

Direct compression method

In this method, the mixture of drugs, Polymers, and excipients will be compressed as a tablet directly.

Wet granulation method

In this method, the mixture is converted into granules and then granules are compressed as a tablet.

The method selection will depend on the drug's nature, polymers, and excipient

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Table 1: Configuration of prepared tablets with kollidon@SR*

Formulation code	*Drug (mg)*	*kollidon@SR (mg)*	*Microcrystalline cellulose (mg)*	*Polyvinyl pyrrolidine-K90 (mg)*	*Iso propyl alcohol (mL)*	*Magnesium stearate (mg)*	*Talcum powder (mg)*	*Complete weight (mg)*
F1	600	10	43	6	qs	5	6	670
F2	600	20	33	6	qs	5	6	670
F3	600	30	23	6	qs	5	6	670
F4	600	40	13	6	qs	5	6	670

Table 2: Configuration of prepared tablets with HPMCK100M*

Formulation code	*Drug (mg)*	*HPMCK100M (mg)*	*Microcrystalline cellulose (mg)*	*Polyvinyl pyrrolidine-K90 (mg)*	*Iso propyl alcohol (mL)*	*Magnesium stearate (mg)*	*Talcum powder (mg)*	*Complete weight (mg)*
F5	600	15	38	6	qs	5	6	670
F6	600	25	28	6	qs	5	6	670
F7	600	35	18	6	qs	5	6	670
F8	600	45	8	6	qs	5	6	670

Table 3: Configuration of prepared tablets with Keltone LVCR*

Formulation code	*Drug (mg)*	*Keltone LVCR (mg)*	*Microcrystalline cellulose (mg)*	*Polyvinyl pyrrolidine-K90 (mg)*	*Iso propyl alcohol (mL)*	*Magnesium stearate (mg)*	*Talcum powder (mg)*	*Complete weight (mg)*
F9	600	15	38	6	qs	5	6	670
F10	600	25	28	6	qs	5	6	670
F11	600	35	18	6	qs	5	6	670
F12	600	45	8	6	qs	5	6	670

MATERIALS AND METHOD

Mangiferin was isolated in the lab.

Method for Preparation of Sustained-release Mangiferin SR Tablets

By applying the wet granulation process, several tablet batch formulations (F1–F12) were created. Polymers (HPMC K-100, Keltone LVCR, Kollidon SR) and pure drug (Mangiferin) were each separately passed through #40 sieves before being thoroughly combined for 10 minutes in a mortar and pestle. This mixture underwent granulation with the addition of a binder solution. After passing through #40 sieves, lactose (the diluent) was added and vigorously mixed for 5 minutes (Tables 1–3).

After passing through #60 sieves, the produced granule was greased with enough magnesium stearate and talc, and then immediately compacted into tablets using a rotary tablet machine and 10 mm flat punches. The tablets had a hardness that was maintained between 6 and 8 kg/cm^2, as specified.

Assessment of Pre-compression and Post-compression Mixture[5]

Angle of repose

The dust layer and horizontal plane are at their greatest angle at this point. The stopping angle may be used to calculate the powder friction. The coefficient of friction (μ) between the tangent of the stopping angle and the particles are the same. Therefore, the tilt angle increases as the particle surface becomes rougher and more irregular.

Procedure: Place the heavy object in the funnel. Mix and gently pour through a pinned funnel 2 cm above the horizontally-placed photo paper. The pellets should be poured until the cone's apex reaches the funnel's tip. The table shows the correlation between the stopping angle and the characteristics of the powder flow. Calculate the line and stance angle of the measuring cone by applying the formula given below.

$$\theta = \mathrm{Tan}^{-1}(h/r)$$

Here;
h = powder cone height,
θ=angle of repose,
r=pile radius.ht,

Bulk density

Procedure: The apparent density, denoted by b, could be calculated by adding the liquid to a graduated cylinder. Determine the (V*) as the volume and (M) as the mass of the powder. The formula is used to compute the bulk density.

$$b = M/V^*$$

Tapped density

A certain time was spent tapping the determining cylinder carrying a specified mass of the mix (about 250). The lowest volume that the cylinder may carry (V_t) and the weight (M) of the mixture were also determined. To calculate the tapped density (*t), the formula was employed.

$$*t=M/Vt$$

Compressibility index (Carr's Index)

A significant measurement that may be derived from the tapped and bulk densities is the CI index. Theoretically, a material is more flowable if it is less compressible.

$$C.I\ (\%) = \frac{\text{Tapped density} - \text{Bulk density}}{\text{Tapped density}} \times 100$$

Hausner ratio

It is the comparison of the tapped to the bulk density. Hausner discovered that the ratio has been connected to inter-particle friction and that it can be applied to estimate the properties of powder flow. (Lachman, 1987). A score of less than 1.25, or 20% of CI, often signifies good flow properties. The Hausner ratio can be thought of as an indirect index of the powder flow simplicity (Table 4). The given formula is used to compute it:

Hausner ratio=dt/db.…….(3.5)

Where; tapped density is denoted by, and bulk density by db.

Post-compression Parameters of Sustained-release Tablets[6]

Tablets evaluation

- *Weight variation*

Each tablet in a quantity must fit in the permitted weight and burden range. From each lot, 20 pills were randomly chosen, and every lot was weighed (in mg) using analytical stability. The SD, mean weight, and relative SD should be determined.

- *Thickness*

Used a Vernier caliper to measure.
Hardness randomly decided pills' hardness was computed with the usage of the Pfizer pill Hardness Tester. In line with Kilo Dam reviews.

- *Friability*

It became evaluated because of the %weight reduction of the pill when flipped onto the discussion board at 25 revolutions. The pills were then dedusted and the weight reduction because of breakage/attrition becomes assessed as %friability. The friability in keeping with IP ranges from 0.5 to 1% for the weight of a common pill.

Table 4: Comparison of Hausner ratio to flow properties

S. No	*Hausner's ratio*	*Powder flow*
1	1.00–1.1511	Excellent
2	1.12–1.18	Good
3	1.19–1.25	Fair
4	1.26–1.34	Passable
5	1.35–1.45	Poor
6	1.46–1.59	Very poor
7	>1.60	Extremely poor

- *Coating thickness*

The thickness of the uncoated & lined pills changed and computed and any variations were decided. Input the average.

- *Content uniformity*

Pick 20 pills randomly, weigh them, after then crush them into powder as necessary. Take a weight of mangiferin equal to 12 mg and dissolve it in the recommended quantity of water (500 mL). In a bath sonicator, sonicate the mixture for two hours, then put it aside. Then, the day after today, clear out the answer via a zero. 45 µ nylon filter and analyze in line with the appropriate general.

- *Dissolution studies*

Apparatus: USP Dissolution Apparatus Type II (Paddle)

- Dissolution Volume: 900 mL
- Dissolution Medium:
  - 0.1N Hydrochloric Acid first 2 hours
  - pH 6.8 Phosphate Buffer For the remaining 22 hours
  - Aliquot Volume: 5 mL
  - Replenishing Volume: 5 mL
  - Temperature: 37 ± 0.5°C
  - RPM: 100 rpm: 0.1 N Hydrochloric acid
- 50 rpm: pH 6.8 Phosphate buffer

To determine the present drug amount, a spectrophotometer at 244 nm was utilized.

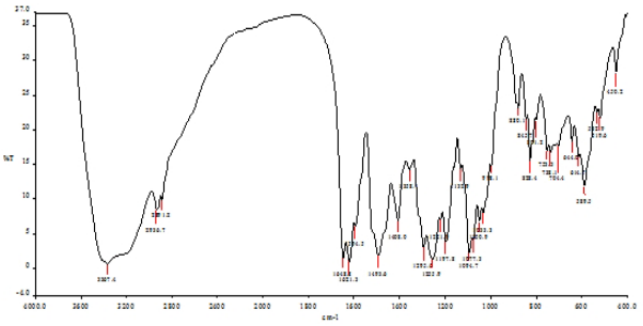

Figure 1: FTIR spectra of mangiferin

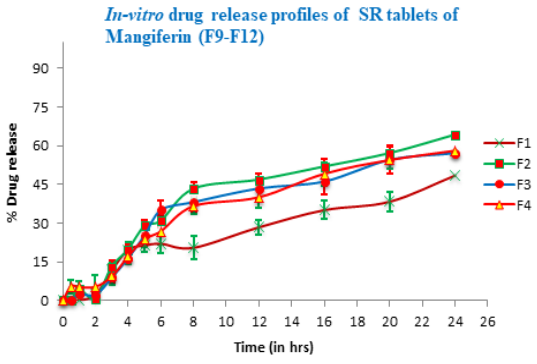

Figure 2: *In-vitro* drug release profiles of sustained release tablets of mangiferin (F13-F16)

Table 5: Pre-compression parameters of prepared formulations

Parameter	*F1*	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*	*F8*	*F9*	*F10*	*F11*	*F12*
Wt. variation (n = 20)	In limits	In limits	In limits	In limits	In limits	In limits	In limits	In limits	In limits	In limits	In limits	In limits
Thickness (mm) (n = 10)	4.31 ± 0.31	4.22 ± 0.3	4.52 ± 0.3	4.40 ± 0.2	4.42 ± 0.3	4.34 ± 0.3	4.24 ± 0.3	4.42 ± 0.2	4.31 ± 0.31	4.40 ± 0.2	4.22 ± 0.3	4.52 ± 0.3
Hardness (Kp) (n = 6)	6.6 ± 0.24	6.7 ± 0.4	6.7 ± 0.4	6.7 ± 0.4	6.7 ± 0.4	6.7 ± 0.4	6.7 ± 0.4	6.7 ± 0.4	6.6 ± 0.24	6.7 ± 0.4	6.7 ± 0.4	6.7 ± 0.4
Friability (%)	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Assay (%) (n = 3)	98.7 ± 0.2	100.7 ± 0.6	99.5 ± 0.2	100.1 ± 0.2	99.8 ± 0.2	96.6 ± 0.6	94.7 ± 0.2	101.1 ± 0.2	98.7 ± 0.2	95.1 ± 0.2	96.7 ± 0.6	99.5 ± 0.2

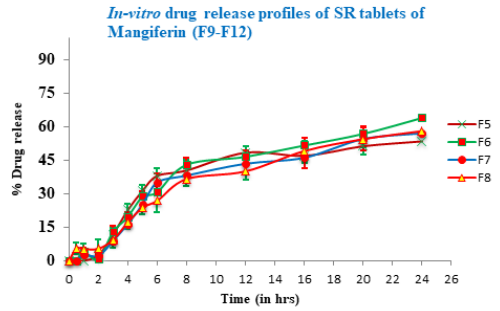

Figure 3: *In-vitro* drug release profiles of sustained release tablets of mangiferin (F17-F20)

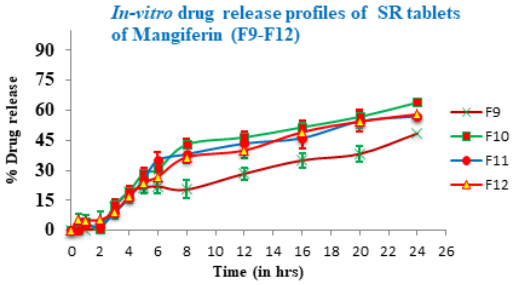

Figure 4: *In-vitro* drug release profiles of sustained-release tablets of mangiferin (F21-F24)

RESULTS AND DISCUSSION

FTIR Spectroscopy

FTIR spectrum of mangiferin was displayed in Figure 1.

Pre-compression Parameters

The pre-compression parameters of all the prepared formulations were calculated. All are in the accepted limits and the results are shown in Table 5.

In-vitro Release Studies

The *in-vitro* drug release studies were conducted in phosphate buffer using type-II apparatus for 24 hours. The results are shown in Figures 2-4.

CONCLUSION

The study has so far produced the following findings:

An adjusted polymer concentration is added to the tablet core to control the launch of mangiferin. Mangiferin was released as desired due to careful monitoring of a few formulation factors. The results of the sustained release trials also showed that consideration will be given to the device's intended consistency while maintaining the formulation's preferred launch properties. The effect of various polymers in different concentrations Affords desirable and favored release according to USP attractiveness criteria. It changed into glaring that a boom within the content of the discharge of the drug from the system expanded. Studies have shown that F5 is an optimized formulation that has been applied to further in-depth investigation and evaluation. The best system (F5) was shown to be stable and to provide mangiferin regardless of pH.

REFERENCES

1. Ranjitprasad swain T, Ratnakumari, satyajit panda. Formulation development and evaluation of sustained-release ibuprofen tablets with acrylic polymers (eudragit) and HPMC.International Journal of Pharmacy and Pharmaceutical Sciences.2016;8(2):131-135.
2. Mathur M and Mishra R. A review on osmotic pump drug delivery system. International Journal of Pharmaceutical Sciences and Research. 2016; 7(2): 453-71.
3. Bansode AS and Sarvanan K. Review on novel osmotic drug delivery system. Journal of Drug Delivery & Therapeutics. 2018; 8(5): 87-93.
4. USP- NF, US Pharmacopeia Convention. New York. 2005; 3504-08.
5. Sudhamani K. Formulation and evaluation of osmotically controlled release tablets of tramadol hydrochloride. World Journal Of Pharmacy And Pharmaceutical Sciences. 2017; 6(7): 1372-87.
6. Aulton ME. Eds. Pharmaceutics The Science of Dosage Form Design, Churchill Livingstone. Edinburgh. 2005; 133.