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Development and Evaluation of Natural Gum-Based Sustained-Release Tablets for Levosulpiride and Alprazolam

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ABSTRACT

Natural gums derived from plants, being both renewable and biocompatible, offer promising uses in pharmaceutical formulations. In this research, hydrophilic gums obtained from Velama, Rekka, and Mardi plants were analyzed for their potential in sustained-release tablet formulations. The gums extracted displayed adequate yields and beneficial physicochemical characteristics, such as low moisture content and approximately neutral pH, suggesting their appropriateness for moisture-sensitive medications and minimized irritation. Micromeritic assessments validated acceptable flow characteristics, while FTIR spectra revealed the existence of functional groups favorable for matrix creation. Sustained-release tablets containing Levosulpiride and Alprazolam were developed using a mixture of these natural gums. Both preformulation and post-compression assessments indicated outstanding compatibility, mechanical strength, and stability under accelerated conditions. In vitro and in vivo investigations demonstrated controlled drug release profiles, with Velama and Mardi gums exhibiting better matrix-forming abilities compared to Rekka gum. This research underscores the effectiveness of natural polymers in improving drug release efficiency, dosing precision and patient adherence in pharmaceutical applications..

Keywords: *Levosulpiride, Alprazolam, Velama, Rekka, Mardi, Sustaied release tablet*

1. INTRODUCTION

In recent times, the pharmaceutical sector has put more emphasis on creating controlled and sustained-release drug delivery systems to enhance therapeutic effectiveness, decrease dosing frequency, and improve patient adherence. These systems aim to sustain ideal drug levels in the blood over a prolonged duration, reducing variations in drug concentration that might cause adverse reactions or treatment failures. The selection of excipients is vital in assessing the success of these formulations, with increasing attention given to natural polymers because of their biocompatibility, renewable sources, and cost-efficiency.

The pharmaceutical potential of these natural gums was evaluated in the formulation of sustained-release tablets for two model drugs: Levosulpiride and Alprazolam. Levosulpiride, a prokinetic agent used to treat gastrointestinal motility disorders, and Alprazolam, an anxiolytic medication, were chosen due to their therapeutic relevance and the need for consistent plasma levels to ensure efficacy and reduce side effects. By incorporating these drugs into matrix tablets using natural polymers, the study aims to provide a controlled release mechanism that enhances dosing accuracy and reduces the frequency of administration.

Comprehensive preformulation studies, including FTIR and DSC analyses, confirmed the compatibility of the gums with the drugs, while post-compression evaluations demonstrated adequate mechanical strength, thickness, and friability of the formulations. In vitro and in vivo release studies highlighted the ability of these natural gums, particularly Velama and Mardi gums, to sustain drug release over extended periods, outperforming Rekka gum in matrix formation. Stability testing under accelerated conditions further supported the suitability of these formulations for scale-up and commercialization.

This research emphasizes the value of plant-derived polymers as viable alternatives to synthetic excipients in pharmaceutical applications. The findings demonstrate that Velama and Mardi gums, in particular, exhibit the necessary properties to

function as effective matrix-forming agents in sustained-release drug delivery systems. This work not only advances the

understanding of natural polymers in controlled drug delivery but also underscores their potential to improve therapeutic outcomes, reduce costs, and promote sustainability in pharmaceutical manufacturing.

2. MATERIALS AND METHODS

Purification of Exudates

The purification of the exudate gums was performed using a modified version of the method reported by Girish K. Jania et al., 1996.

Procedure

The powdered gum was placed in 500 mL of distilled water in a 1000 mL beaker.The mixture was heated and stirred continuously for approximately 4 hours.The concentrated solution was then filtered through muslin cloth and cooled at 4 to 6°C. For gum precipitation, 3/4th volume of acetone (1:3 ratio) was added to the extract.The precipitated gum was washed again with acetone and collected through filtration using muslin cloth.The gum was further dried in a hot air oven at a temperature below 40°C.The dried gum was ground and passed through a #60 sieve.Finally, the purified gum was stored in an airtight container for further use.

Determination of Acid-Insoluble Ash

The ash was boiled with 25 ml of 2 M HCl for 5 minutes.The insoluble matter was collected on ashless filter paper, washed with hot water, ignited, cooled in a desiccator, and weighed.The percentage of acid-insoluble ash was calculated based on the dried sample.

Determination of Water-Soluble Ash

In the crucible containing the total ash, 25 ml of water was added and boiled for 5 minutes.The insoluble matter was collected on ashless filter paper, washed with hot water, and ignited for 15 minutes at a temperature not exceeding 450°C.The weight of the residue obtained was subtracted from the weight of the total ash. The difference represented the water-soluble ash.The percentage of water-soluble ash was calculated with reference to the air-dried sample.

Angle of Repose

The angle of repose is used to measure the frictional force in loose powder. It is defined as the maximum angle possible between the surface of a pile of powder or granules and the horizontal plane.

$\tan\Theta = h/r$

$\Theta = \tan^{-1}(h/r)$

Where,Θ = angle of repose

H = height

r= radius

Five grams of each sample powder were poured through funnels from a fixed height onto graph paper. The height of the heaps was measured, and the circumference of each heap was marked with a pencil. The area of the circles formed was calculated based on the large and small squares present inside the circle. The angle of repose was then calculated using the radius, "r," derived from the area of the circle.

Bulk Density (Db)

An accurately weighed quantity of 50 grams of each gum was taken into a graduated measuring cylinder.The cylinders were fixed on a bulk density apparatus, and the volume occupied by the powder was noted.This initial volume is termed the bulk volume.The bulk density is calculated using the following formula:

Bulk Density (Db)=Weight of Powder (M)/Bulk Volume (Vb)

Tapped Density (Dt)

After noting the bulk volume, the same quantity of samples (50 g of each gum) was taken into graduated measuring cylinders. The powder was subjected to tapping in a bulk density apparatus for 100 times. The final volumes were noted. Tapped density is calculated using the following formula:

Dt=M/Vt

Where M is the mass of the powder, and Vt is the volume of the tapped powder

Carr’s Index

Measurement of the free flow of powder is the compressibility, calculated using the following formula:

Carr's Index=(Dt−Db/Dt)×100

Where DtDtDt is the tapped density of the powder, and DbDbDb is the bulk density of the powder.

Hausner Ratio

The Hausner ratio is an indirect index of the ease of powder flow. It is calculated using the following formula:

Hausner Ratio=Dt/Db

Where:

Dt = Tapped density

Db= Bulk density

A lower Hausner ratio (<1.25) indicates better flow properties compared to higher values (>1.25).

Determination of Melting Point by DSC Study

Thermograms of samples were recorded on a TA-60 WS Thermal Analyzer (Shimadzu). The samples were hermetically sealed in aluminum pans and heated at a constant rate of 10°C/min over a temperature range of 40 to 300°C. An inert atmosphere was maintained by purging nitrogen gas at a flow rate of 50 ml/min.

Determination of pH (1% w/v Solution in Water)

Procedure: About 100 mg of the powder was dissolved in 100 ml of distilled water with sonication and filtered. The pH of the filtrate was checked using a standard glass electrode.

FTIR Spectroscopy Study

The infrared absorption spectra of samples were recorded with a PRESTIGE 21 (Shimadzu) over the wavenumber range of 4000 to 400 cm^{-1} on an FTIR.

Microbial Studies

Detection of E. coli

25 g of gum samples were suspended in pre-enrichment medium (peptone water) and incubated at 37°C for 4 hours. Selective enrichment was done in MacConkey broth for about 18 hours at 37°C at a 1:10 dilution. The enriched samples were serially diluted and plated on selective plating media, then incubated again at 37°C for 18 hours. Probable E. coli colonies were tested for biochemical parameters using different biochemical tests, including the Urease test, Methyl Red test, TSI test, Indole test, Voges-Proskauer test, Gram staining, Motility, and Citrate utilization tests.

Detection of Salmonella

25 g of different samples were suspended in pre-enrichment medium (peptone water) and incubated at 37°C for 20 hours. Selective enrichment was done in selenite cystine medium for 24 hours at 37°C at a 1:10 dilution and in RV medium at 42°C for 24 hours at a 1:100 dilution. The enriched samples were serially diluted and plated on selective plating media, such as Brilliant green agar medium, then incubated at 37°C for 24 hours. Probable colonies of Salmonella were tested biochemically using the Indole test, TSI test, L-Lysine test, Urease test, β-galactosidase test, decarboxylation test, and Voges-Proskauer test on representative colonies from each plate.

Development and Evaluation of Levosulpiride SR Tablet Using Polymers

Sustained release tablets were developed using natural gums such as velama gum, rekka gum, and mardi gum, along with synthetic HPMC, both as single retardant materials and in combination to observe the release effect.

Preformulation Studies

Preformulation studies are the initial step in the development of a dosage form. These studies investigate the physical and chemical properties of a drug substance alone and in combination with excipients. The main objective is to provide useful information to the formulator for developing stable and bioavailable dosage forms.

Organoleptic PropertiesLevosulpiride was evaluated for color and odor.

Melting Point The melting point was determined from the DSC thermograph of Levosulpiride as discussed in section 6.3.3.9.

FTIR Spectroscopy Infra-red spectrum analysis provides sufficient information about the structure of a compound. The spectrum, which contains numerous absorption bands, allows for detailed structural analysis. The Near Infra-red region is from 0.8 µm to 2.5 µm, and the Far Infra-red region is from 15 µm to

200 µm. Identification of Levosulpiride was done by FTIR Spectroscopy as per the procedure given in section 7.3.3.11.

Determination of pH (1% w/v Solution in Water)The pH of a 1% w/w solution of Levosulpiride in water was determined as described in section 7.3.3.10.

Partition Coefficient of Levosulpiride The partition coefficient of Levosulpiride was determined in a n-Octanol system. 5 mg of the drug was placed in three separating funnels containing 5 ml of n-Octanol and 5 ml of water. The separating funnels were shaken for 2 hours in a wrist action shaker to reach equilibrium. The phases were then separated, and the amount of drug in the aqueous phase was analyzed spectrophotometrically at 223 nm. The partition coefficient (K) was calculated using the formula:

Partition coefficient,K=Concentration in Octanol phase/ Concentration in Aqueous phase

Characterization of Powder Blends of API and Excipients

All materials were passed through mesh No. 60. The required quantity of each ingredient was taken for each specified formulation, and all the drug and excipients without lubricant were first mixed for 15 minutes with mortar and pestle. After the addition of Magnesium stearate (mesh 30), the mixing continued for 5 minutes.

Evaluation of Flow Properties

The powder blends were evaluated for different flow properties like angle of repose, bulk density, tapped density, Carr's index, and Hausner ratio, as discussed in sections 7.4.3.4 to 7.4.3.8.

Drug and Polymer Interaction Study

The compatibility of drug-excipient mixtures was investigated using differential scanning calorimetry (DSC). The DSC thermograms of pure drug and excipient mixtures (1:1 w/w) were recorded. The samples were sealed in aluminum cells and analyzed with a Shimadzu thermal analyzer (Shimadzu DSC 60, TA-60 WS, Japan) under a nitrogen atmosphere. The thermal analysis was conducted at a heating rate of 10°C/min over a temperature range of 30–250°C.

In Vitro Dissolution Rate Studies

The prepared tablets were evaluated for in vitro drug release using a USP XXII paddle-type dissolution test apparatus. The dissolution study was carried out in 900 ml of dissolution medium, stirred at 50 rpm, and maintained at 37±0.2°C for Levosulpiride. The study used different simulated fluids at different timings:

A tablet was placed in the dissolution media at 37±0.2°C.

A 2-hour study was performed in 0.1 N HCl, followed by testing in 6.8 phosphate buffer.

A 5 ml sample was withdrawn at different time intervals and compensated with the same amount of fresh dissolution medium. The volume of the sample withdrawn was made up to 5 ml by 0.1 N HCl and pH 6.8 phosphate buffer.

The withdrawn samples were assayed spectrophotometrically at 223.0 nm using a UV-visible spectrophotometer.

The release of the drug was calculated using the standard curve of Levosulpiride.

Mathematical Treatment of In-Vitro Release Data

The quantitative analysis of the values obtained in dissolution/release tests is facilitated when mathematical formulas are used to express the dissolution results as a function of some characteristics of the dosage forms from zero-order kinetics, first order kinetics, Higuchi model and Korsmeyer-peppas model.

3. RESULT AND DISCUSSION

Evaluation of Gum

Physiochemical Properties of Gum

Organoleptic properties

All three gums are screened for colour, odor, taste and nature and obtained results are given in table 4

Table 1: Results of organoleptic properties

S. No.	Parameters	Observation		
		Velama Gum	Rekka Gum	Mardi Gum

1	Color	Brownish	Dark Brown	White
2	Odor	Characteristic	Characteristic	Characteristic
3	Taste	Mucilaginous	Characteristic	Mucilaginous
4	Nature	Amorphous	Amorphous	Amorphous

Velama gum was brownish, rekka gum was dark brown and mardi gum was white in colour, for all gums odor was characteristic, and taste was mucilaginous for velama and mardi gum and characteristic for rekka gum. All three gum has amorphous in nature.

Solubility properties of Gums

Solubility of all three gums were performed as per procedure given in 6.4.1.2 obtained result were enlisted in table 2.

Table 2: Results of solubility study

Solvents	Solubility observations		
	Velamma Gum	Rekka Gum	Mardi Gum
Cold water	Swell to form a gel	Forms viscous solution	Swell to form a gel
Hot water	Form viscous colloidal solution	Form viscous solution	Form viscous colloidal solution
Methanol	Insoluble	Insoluble	Insoluble
Ethanol	Insoluble	Insoluble	Insoluble
Diethyl ether	Insoluble	Insoluble	Insoluble
Pet ether	Insoluble	Insoluble	Insoluble
Acetone	Insoluble	Insoluble	Insoluble

It was found that velama gum and mardi gum were not freely soluble in water and hot water but they form colloidal solution although it was observed that rekka gum form viscous solution with water otherwise all these three gums are insoluble in organic solvents. It shows that velama gum and mardi gum has more viscous in nature as compare to rekka gum.

Phytochemical study of Gums

Obtained purified gums were screened for phytochemical studies as procedures given in 6.4.2.1- 6.4.2.8. It was observed that the all three gums did not contain any glycoside, Tannins, saponins, steroid, flavonoids, starch, but it contain carbohydrates, and gums. As shown in table 6.

Physicochemical and Micrometrics properties of gums

Table 3: Results of Physicochemical and micrometrics properties

Parameters	Observations		
	Velama Gum	Rekka Gum	Mardi Gum
pH (1% w/v solution)	5.2 ± 0.00	6 ± 0.01	5.6 ± 0.01
Swelling index (%)	6.6923 ± 0.00	-	2.6923 ± 0.58
Bulk density (g/cm^3)	0.63 ± 0.0046	0.6055 ± 0.0003	0.73 ± 0.01
Tapped density (g/cm^3)	0.81 ± 0.0075	0.7732 ± 0.0015	0.91 ± 0.01
Bulkiness	1.59 ± 0.0058	1.59 ± 0.0058	1.37 ± 0.02

Hausner's Ratio	1.29 ± 0.0214	1.2768 ± 0.0019	1.25 ± 0.01
Carr's index	22.20 ± 1.28	27.69 ± 0.1841	19.78 ± 0.12
Angle of repose	29.35 ± 0.0408	30.35 ± 0.0499	30.62 ± 0.4
LOD (%w/w)	4.2076 ± 0.0736	3.82 ± 0.1	6.2 ± 0.1
Total ash (%)	2.7733 ± 0.0188	3.26 ± 0.1	3.20 ± 0.1
Acid insoluble ash	0.63 ± 0.0094	0.86 ± 0.0599	0.82 ± 0.12
Water soluble ash	1.2733 ± 0.0249	1.58 ± 0.18	1.62 ± 0.13
Melting point	273.60ºC	306.09ºC	259.40ºC

Physicochemical and micromeritic properties of Velama, Rekka, and Mardi gums were evaluated, revealing that all three gums were slightly acidic but near neutral, with pH values of 5.2, 6, and 5.6 for Velama, Rekka, and Mardi gums, respectively. This neutral pH suggests that these gums may cause less irritation in the gastrointestinal tract when used in uncoated tablets and are suitable for formulating acidic, basic, and neutral drugs. The low moisture content of the gums indicates their suitability for moisture-sensitive drug formulations. Velama and Mardi gums exhibited high swelling indices, making them promising matrixing agents, whereas Rekka gum showed little swelling activity, instead forming a viscous solution. Bulk densities of the gums ranged from 0.6055 to 0.73, while tapped densities were between 0.81 and 0.91, indicating passable flow properties. The flow properties, along with low acid-insoluble ash values (0.63–0.82%), suggest high purity and suitability for formulation. Melting points of the gums, determined by DSC, were 273.60ºC, 306.09ºC, and 259.40ºC for Velama, Rekka, and Mardi gums, respectively, further supporting their potential as effective excipients in pharmaceutical formulations.

FTIR spectroscopy study

FTIR spectrums of all gums were studied, the data given in table 6.6. Spectrums of gums have been shown in following figures 7.4, 7.5, 7.6.

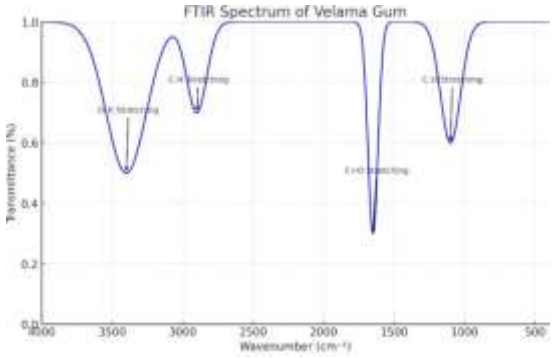

Figure 1: FTIR spectrum of Velama Gum

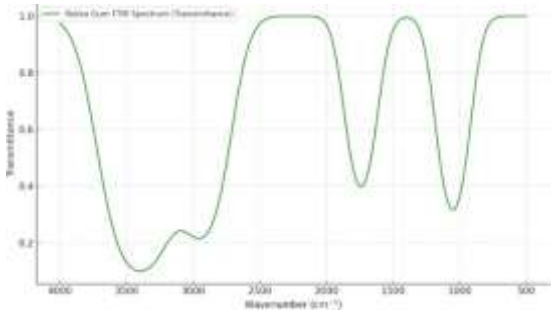

Figure 2: FTIR spectrum of Rekka Gum

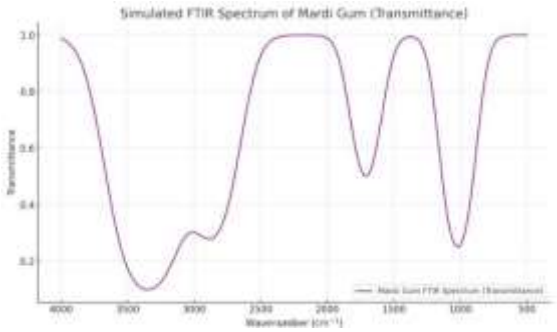

Figure 3: FTIR spectrum of Mardi Gum

On above FTIR study, it was observed that all gums contain alkane, ester whereas, velama gum additionaly contain alkenyl group, amine and amide. In rekka gum contains ether, amide, alcohol and carboxylic acid and mardi gum contain alcohol, carboxylic acid and amine.

Table 4: Results of FTIR study

S. No.	Functional Group present	Wave numbers (cm^{-1})		
		Velama Gum	Rekka Gum	Mardi Gum
1	C-H Stretch (Alkanes)	2891.30	2937.59	2887.44
2	C-H Stretch (Alkenyl)	3076.46	-	-
3	O-H Stretch (Alcohol)	-	2789.07	3558.67
4	O-H of –COOH Stretch (Carboxylic acid)	-	2520.96	2509.39
5	C-N Stretch (Amine)	1610.56	-	1604.77
6	N-H bend (Amide)	1417.68	1417.68	-
7	C-O Stretch (Ether)	-	2937.59	-
8	C-O Stretch (Ester)	1166.93	1161.35	1055.06

Microbial Study

Microbial studies performed by using procedure given in material methods, On the biochemical tests, it was observed that the presumptive colonies so obtained may not be e coli and salmonella typhi and all the gum were isolated by using acetone hence after purification gum were free from mirobes.

Development of Levosulpiride SR Tablet Using Polymers

Preformulation Studies

Physiochemical Properties of Levosulpiride

Organoleptic properties

Levosulpiride was found to be white in color and odourless

Table 5: Results of organoleptic properties of drugs

Drug	Test	Specification	Observation

Levosulpiride	Color	White-Crystalline powder	White powder
	Odor	Odorless	Odourless

Melting Point

The endothermic peak of Levosulpiride was seen at 157.59˚C with an onset 153.12 ˚C these complies with the reported literature value, thus indicating purity of sample.

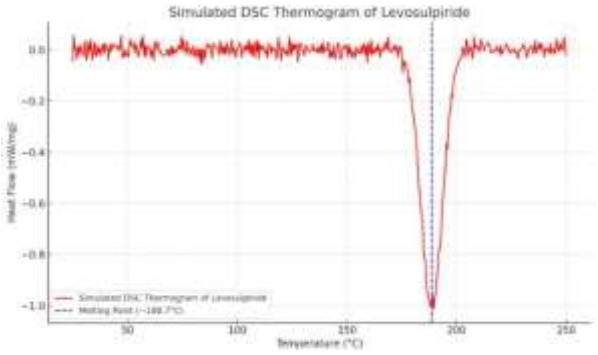

Figure 2: DSC Thermogram of Levosulpiride

FTIR Spectroscopy analysis

The IR spectrum of the drugs showed characteristic peaks of pure drug (figure 8 and Table 8).

Table 6: FTIR peaks of Levosulpiride

S. No.	FTIR Peak	Attributed to
1	3200-4300 cm^{-1}	N-H Stretching
2	3000-3100 cm^{-1}	C-H Stretching
3	1700 cm^{-1}	C=O Stretching
4	1600 cm^{-1}	C=C Stretching
5	1200-1300 cm^{-1}	C-N Stretching
6	700-800 cm^{-1}	C-H bending

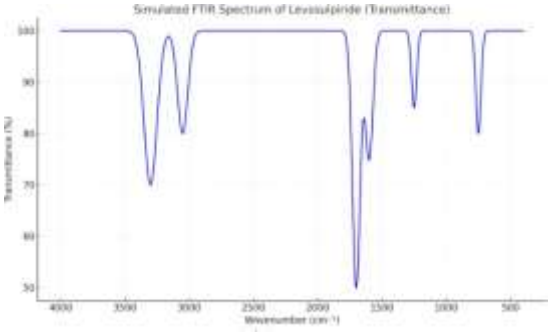

Figure 3: FTIR spectrum of Levosulpiride

pH (1% w/v)

pH of Levosulpiride was found to be 3.62 which is as per reported literature.

Partition coefficient:

From the above study, Partition coefficient value was determined as per the procedure given in methodology and it was found to be 1.02 of Levosulpiride (Standard 1.020) which shows Levosulpiride is hydrophilic nature.

In Vitro Drug Release Studies

The dissolution rate of a drug from a tablet significantly impacts its absorption in the gastrointestinal tract and influences bioavailability. Evaluating drug release is crucial for tablet formulations, especially for controlled, sustained, time-dependent, and targeted release systems. In vitro drug release studies were conducted using USP dissolution apparatus II in pH 6.8 buffer to assess the sustained release effect. These tests help understand the drug's release behavior in the gastrointestinal environment.

Dissolution study of Levosulpiride SR Tablet containing single rate retardant polymer

Table 7: Results of in vitro study Batch LS1-LS6

Time Hr	Formulation Batches					
	LS1	LS2	LS3	LS4	LS5	LS6
1	25.12	28.23	30.12	45.12	48.23	50.23
2	40.23	42.34	45.63	70.45	74.12	80.23
4	55.21	58.14	60.12	100	100	100
6	65.34	70.23	72.34	100	100	100
8	75.23	78.21	80.12	100	100	100
10	85.78	88.23	89.18	100	100	100
12	90.34	92.54	95.34	100	100	100

Table 8: Results of in vitro study Batch LS7-LS12

Time Hr	Formulation Batches					
	LS7	LS8	LS9	LS10	LS11	LS12
1	20.12	22.56	25.64	28.23	30.12	35.23
2	35.45	38.23	40.23	45.67	48.23	50.23
4	50.23	55.78	60.78	65.23	68.45	70.12
6	65.12	70.12	75.23	78.12	82.12	85.34
8	78.45	82.34	85.23	90.34	92.43	95.12
10	85.34	88.34	98.47	95.12	97.12	98.46
12	90.65	92.34	100	100	100	100

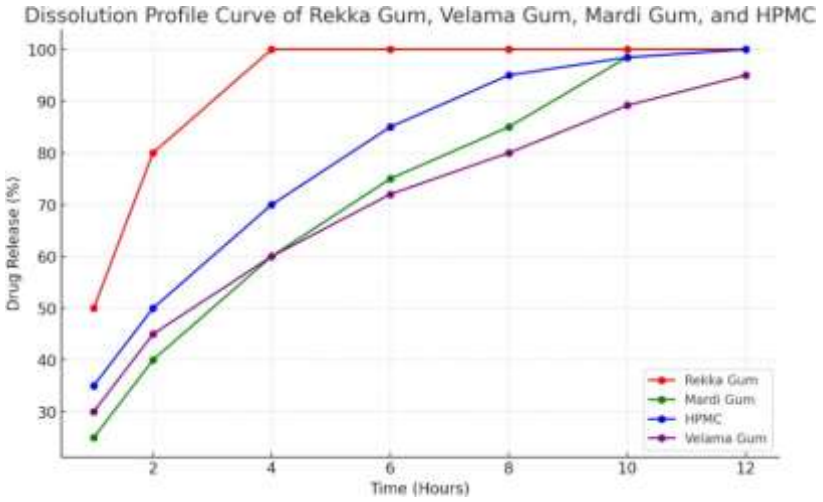

Figure 4: Velama gum, Rekka gum, Mardi gum and HPMC comparative dissolution profile

Formulations containing 15%, 30%, and 45% w/w of Rekka gum failed to demonstrate sustained release, whereas formulations with 15% and 30% w/w of Velama gum, Mardi gum, and HPMC showed comparatively better sustained release. Formulations with 15% and 30% w/w of polymer released almost the entire drug within 2 and 4 hours, respectively, while those with 45% w/w polymer released 36-42% of the drug in the same duration. Specifically, Velama gum (LS3), Mardi gum (LS9), and HPMC (LS12) exhibited approximately 89.18%, 98.47%, and 98.45% drug release by the end of 10 hours. The drug delivery order based on polymer concentration was 15% > 30% > 45%. Velama gum demonstrated the best sustained release, closely matching HPMC, while Mardi gum showed a good retardant effect. In contrast, Rekka gum showed poor retardant properties, with formulations containing Rekka gum releasing 100% of the drug within the first 4 hours due to its high water solubility. The retardant ability of Velama, Mardi, and HPMC gums was directly proportional to their concentration, while Rekka gum's retardant ability decreased with higher concentrations. Rekka gum's instant release effect made it unsuitable for further studies.

Dissolution study of Levosulpiride SR tablet containing combination of rate retardant polymers

Tablet 9: Results of in vitro study using combination of polymers (LSS1-LSS6)

Time Hr	Formulation Batches					
	LSS1	LSS2	LSS3	LSS4	LSS5	LSS6
1	11.11	15.12	13.68	16.85	15.45	14.68
2	19.85	19.68	18.45	17.84	16.75	15.12
4	35.12	32.56	30.34	28.56	27.34	26.23
6	50.10	47.12	45.56	42.12	40.45	38.34
8	65.34	60.34	58.23	55.23	52.67	50.89
10	80.25	75.12	72.56	68.34	66.12	63.12
12	98.18	85.23	80.12	75.67	70.23	68.15

Tablet 10: Results of in vitro study using combination of polymers (LSS7-LSS12)

Time Hr	Formulation Batches					
	LSS7	LSS8	LSS9	LSS10	LSS11	LSS12

1	15.12	16.5	19.68	13.68	12.5	11.1
2	20.18	18.75	19.85	18.5	17.25	16.75
4	32.12	30.45	28.12	27.23	25.67	23.67
6	48.56	45.12	42.56	40.34	38.79	36.45
8	62.78	60.34	58.23	55.67	52.05	50.23
10	78.12	75.14	72.12	70.21	68.13	66.12
12	90.56	88.22	85.14	80.21	78.34	75.23

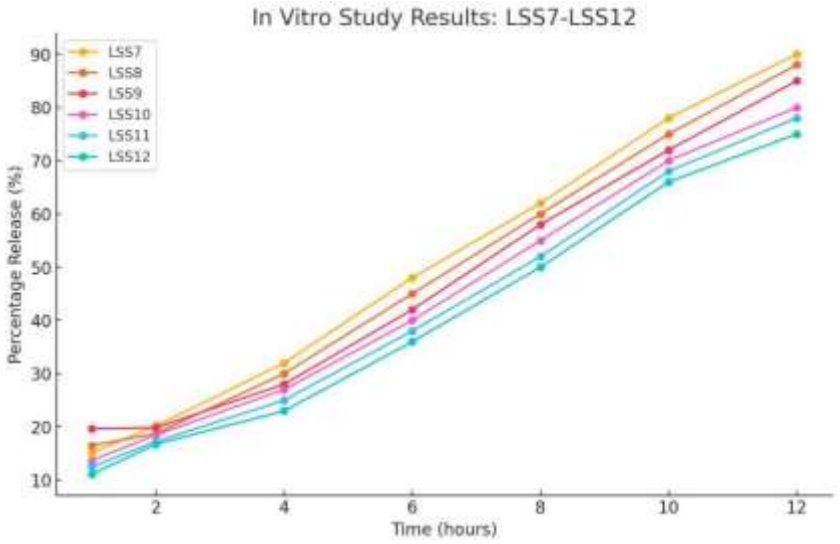

Figure 5: Velama gum with HPMC, Mardi gum with HPMC, Velama gum with Mardi comparative dissolution profile

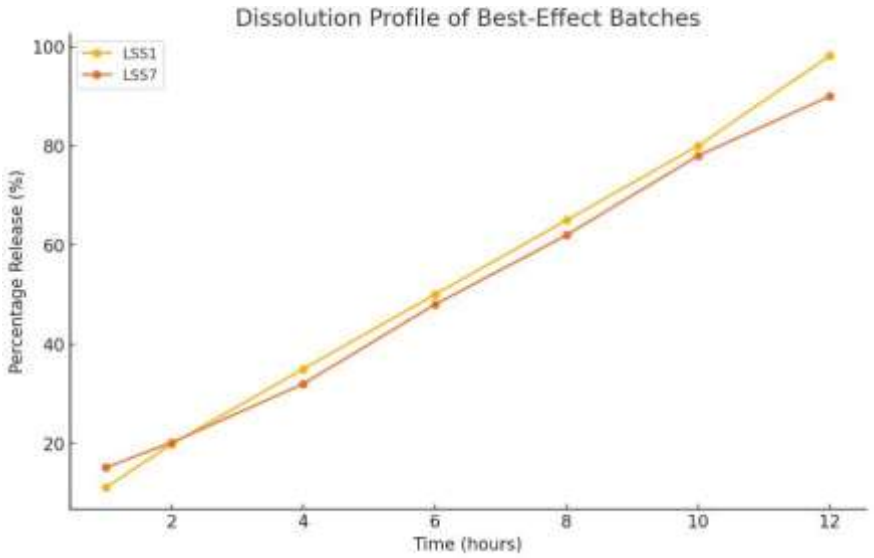

Figure 6: Dissolution profile of best effect batches

In a study comparing natural polymers (Velama gum, Mardi gum) and HPMC at a fixed total concentration of 45%, with varying ratios of 1:1, 1:2, and 1:3, the retardant effects on Levosulpiride release were observed to vary with increasing concentrations of gums. The in-vitro release data for matrix tablets containing Velama-Rekka, Velama-Mardi, Velama-HPMC, Rekka-Mardi, Rekka-HPMC, and Mardi-HPMC formulations showed significant influence of polymer concentrations and dissolution medium on the release profiles. The release was also impacted by the swelling behavior of the polymers, with higher swelling indices resulting in slower drug release. Initially, higher drug release was observed in all formulations during the first 6-7 hours, with approximately 15.12-19.68%, 11.1-19.85%, and 13.68-18.45% of Levosulpiride released from Velama-Mardi, Velama-HPMC, and Mardi-HPMC tablets, respectively. Afterward, drug release slowed, with nearly complete release by 12 hours, except for LSS9. Formulations with a 1:1 concentration ratio of Velama-Mardi, Velama-HPMC, and Mardi-HPMC achieved approximately 80% release within 10, 12, and 16 hours, respectively. LSS1, LSS4, and LSS7 were identified as effective formulations, with LSS1 demonstrating the best sustained release over 16 hours. The prolonged release was attributed to potential ionic interactions between crosslinking agents and negatively charged polymers, forming a loose network that facilitated dissolution media penetration. Higher concentrations of crosslinking agents improved swelling capacity and extended drug release, with Velama-HPMC combinations, particularly at 1:1 ratios, providing sustained release for up to 12 hours. Formulation LSS1, with minimal burst release and over 98% release by 16 hours, was selected for further study.

4. CONCLUSION

FTIR spectroscopy revealed functional groups such as alkane, alkyl, alcohol, amide, amine, ester, and ether in Velama and Mardi gums. Preformulation studies confirmed their suitability for direct compaction, with post-compression evaluations showing sufficient hardness, thickness, and friability. Sustained-release tablets of Levosulpiride and Alprazolam, formulated using combinations of these gums, underwent extensive evaluation, with FTIR confirming drug-excipient compatibility and DSC showing no chemical interactions. Pharmacokinetic studies supported the feasibility of scale-up, with acceptable weight variation, friability, and in vivo release profiles. The formulations were stable under accelerated conditions for six months, demonstrating the effectiveness of natural polymer matrices for controlled drug delivery, improving dosing efficiency and patient compliance.

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