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Formulation and Evaluation of Nasal Mucoadhesive Microspheres of *Mucuna Pruriens*

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Abstract:

Objective: The goal of the experiment was to create and assess mucoadhesive microspheres of Mucuna Pruriens (MP) for the treatment of Parkinsonism by combining the potential benefits of continuous drug delivery with mucoadhesion. **Method:** In order to create mucoadhesive microspheres, the orifice ionic gelation process was used and prepared nine formulations by varying the percentage of mucoadhesive polymers like sodium alginate, Hydroxypropyl methyl cellulose (HPMC), and methyl cellulose (MC). **Evaluations:** Prepared microspheres evaluated for the Fourier transform-infrared spectroscopy (FT-IR), SEM, particle size, percentage yield, drug content, entrapment efficiency, percentage moisture content, invitro wash off test, *invitro* drug release ex-*vivo* permeation and stability studies. **Results:** The infrared spectral data revealed the presence of characteristic functional groups of amines, amides, phosphine, flurides, bromides, iodide, aliphatic and aromatic nitro compounds. The prepared microspheres to be separate, round, and free-flowing. This can be reduced by making it as mucoadhesive microspheres, which would increase the residence time at the absorption site to encourage

intimate contact with the absorption surface and so enhance and improve bioavailability. In an in vitro wash off test, the microspheres demonstrated strong mucoadhesive properties and great drug entrapment efficiency. Depending on the type of polymers utilised, the release of Mucuna Pruriens from these microspheres was slowed and sustained. **Conclusion:** The formulation F9 demonstrated constant drug release for a duration of 10 hours. While compared to all of the formulations, F9 had the best mucoadhesive profile and good surface morphology, which also contained sodium alginate and methyl cellulose. The research has shown that, among all the microsphere formulations, particularly appealing candidates for the delayed release of Mucuna Pruriens are those of formulation F9.

Keywords: Mucoadhesive Microspheres, Parkinsonism, *Mucuna Pruriens*, Mucoadhesion test, *In-vitro* drug release studies.

Introduction:

Microspheres are tiny, spherical particles, typically between 1 and 1000 micrometers in diameter. Microparticles are another name for microspheres. An essential component of an innovative medication delivery method is mucoadhesive microspheres. By adding bioadhesion characteristics to the microspheres and creating bioadhesive microspheres, the short residence period of the microspheres at the site of absorption can be overcome[1]. By making close contact with the mucous layer and precisely directing the drug to the absorption site, mucoadhesive microspheres help to overcome the relatively short GI residence period and to improve localization of oral controlled or sustained release drug delivery systems.

The primary goal of the innovative design of an oral controlled drug delivery system should be to increase and predictably increase medication bioavailability. However, there are a number of challenges, including locating the medication delivery mechanism within the gastro intestinal tract and the wildly inconsistent nature of the gastro emptying process. The primary absorption zone (stomach or upper section of intestine) can cause the drug delivery system to release the medication insufficiently, which will reduce the effectiveness of the dose that was delivered. Due to its mucoadhesiveness, a drug delivery system that is restricted to a particular area of the gastro intestinal tract enhances the proximity and time of contact between a drug-containing polymer and mucus surface. Such a drug delivery technology has many benefits, especially for medications with an absorption window or stability issues[2]. Due to its high L-DOPA concentration and other phytochemicals, Mucuna Pruriens has been researched as a treatment for

Parkinson's disease. It is typically given as an extract based on L-DOPA dose[2]. Researchers compared the effects of Mucuna pruriens to pharmaceutical L-Dopa and other medications for this aim because L-DOPA is a therapy for Parkinson's disease.

The velvet bean, or Mucuna pruriens Linn. (Fabaceae), is a climbing annual legume that is native to India and other tropical regions. In India, you may find 15 different species of Mucuna in the wild. There is a need for Mucuna in the Indian pharmaceutical industry due to the widespread recognition of the plant's beneficial therapeutic characteristics. M. pruriens is the real deal when it comes to treating Parkinson's disease, and it works wonderfully. A number of therapeutic properties have been attributed to the seed, including those related to Parkinson's disease, libido, blood sugar, inflammation, infection, and cancer. Therefore, it is crucial to assess the safety of the phytochemicals found in herbal plants. Here, we perform a qualitative analysis of the phytochemical components of a methanolic extract of M. pruriens seed [3, 4].

Materials and Methods

Plant sample collection

Traditional and modern plant biologists both agreed that the seeds were really those of *Mucuna pruriens* (MP) that had been purchased from a small ayurvedic store in Pondicherry. After being air dried in the shade, the seeds were ground into a powder in an electric blender and kept in an airtight container.

Polymers Procurement

Sodium alginate, HPMC, methylcellulose was procured from Loba Chemie, Mumbai. Calcium chloride were purchased from Research lab fine chem industries, Mumbai. The experiment was conducted using distilled water and other analytical-grade chemicals and reagents. Microspheres that adhere to mucus were created using the orifice ionic gelation process.

Preparation of *Mucuna pruriens* -containing mucoadhesive microspheres:

Orifice ionic gelation method

In this method, calcium chloride solution was used for cross-linking in order to release the medication over time. Sodium alginate, HPMC, and methylcellulose were added to 32 ml of water with constant stirring to create a homogeneous solution in order to create microspheres using the orifice ionic gelation process. The air dried extract of *Mucuna pruriens* was then added

to the aforementioned solution after 20 minutes of sonication to create a clear solution. A 22# gauge needle was used to pour the drug polymer mixture into solution 1.5% calcium chloride while being stirred at 50 rpm. The resulting microspheres were left alone for 30 minutes. Following the decantation of the calcium chloride solution, the mucoadhesive microspheres were created, rinsed in distilled water, and allowed to air dry for an entire night at room temperature[5].

Table 1 Composition of Mucoadhesive microspheres of *Mucuna pruriens*

Ingredients (mg)	**Formulation Code**								
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**
Mucuna pruriens	100	100	100	100	100	100	100	100	100
Sodium alginate	100	200	300	100	200	300	100	200	300
Hydroxypropyl methyl cellulose (HPMC)	-	-	-	50	100	150	50	100	150
Methylcellulose (MC)	-	-	-	-	-	-	100	100	100
Calcium chloride (%)	5	5	5	5	5	5	5	5	5

Evaluation of Mucoadhesive microspheres of *Mucuna pruriens*

Drug polymer compatibility

The qualitative analysis of the active principles of *Mucuna pruriens* seed extract was done by FTIR method. IR spectroscopy was used to observe drug and polymer interaction. By using the KBr dispersion method, FTIR studies of pure Mucuna pruriens and a physical mixture of Mucuna pruriens with polymers were conducted[6].

Particle Size Determination

The microspheres' particle size distribution was examined using a set of conventional sieves to establish their composition. Particle sizes between 50 and 1500 m are estimated using the sieve method. This approach directly determines weight distribution. The sifting process can be advantageous for the creation of dosage forms in the shape of tablets and spheres[7].

Percentage Yield

The total number of microspheres produced was measured, and the yield percentage was assessed[8].

$$\text{Percentage yield} = \frac{\text{Practical yield}}{\text{Theoretical yield}} X\ 100$$

Scanning electron microscopy (SEM):

Examined the microspheres using scanning electron microscopy to measure the size and shape of the microspheres. They were coated with gold film, fitted with an ion spiller and gold target with resolutions of 3 nm (30 KV HV Mode), 10 nm (30 KV HV Mode), and 40 nm, and directly mounted to the SEM sample stub using double-sided sticky tape (30 LV Mode)[9].

Drug content

Mucuna pruriens' standard curve was performed using a UV-VIS spectrophotometer at a maximum wavelength of 280 nm in pH 6.8. (UV-1700, Shimadzu Corporation)[10]. It followed Beer's rule. The concentration range used for the calibration curve was 5–25 g/ml.

Entrapment efficiency

A 3 ml solution of sodium citrate solution (1%w/v) was used to fully dissolve 100 mg of Mucuna pruriens microspheres from each batch. 7 ml of methanol were added to the aforementioned solution to dissolve the Mucuna pruriens. By measuring the filtrate's absorbance at 280 nm following an appropriate dilution by a UV-Visible spectrophotometer, the concentration of the medication was determined. Using the procedure, encapsulation effectiveness was determined[11].

$$\text{Entrapment efficiency } = \frac{\text{Estimated \% drug content in microspheres}}{\text{Theoretical \% drug content in microspheres}} X100$$

Percentage moisture content:

The Mucuna pruriens -loaded microspheres were assessed for moisture content in order to estimate their hydrophilic nature. The microspheres, which initially weighed (w1), were maintained at 37° C in a desiccator with calcium chloride for 24 hours. When there was no longer any change in the sample's weight, the final weight (w2) was recorded[12].

$$\text{Moisture Percentage} = \frac{W1 - W2}{W2} \times 100$$

In -vitro wash off test for mucoadhesion:

The ability of the Mucuna pruriens microspheres to adhere to mucous membranes was evaluated using the wash-off method, an in-vitro adhesion testing procedure. Using poly cyanoacrylate adhesive, freshly removed sheep intestinal mucosa samples (4 x 5 cm) were mounted onto glass slides (3 x 1 inch)[13]. Two glass slides were joined together with an appropriate sample of each wet-rinsed tissue, and then the support was instantly attached onto the arm of a USP pill dissolving test device. In the course of the disintegration test apparatus's operation, the tissue sample was slowly and consistently moved up and down in a 400 ml vessel of test fluid heated to 37 ^{o}C. The machine was shut off after one hour and then every hour for the next eight hours so that the amount of microspheres still adhered to the tissue could be counted[14].

In- vitro drug release studies

The USP Type-2 Paddle Operation 37±0.5^{0}c was used to conduct an in-vitro drug release investigation. The temperature was held constant at 37^{o}C throughout the trial. Microspheres of Mucuna pruriens in an amount equivalent to 100 mg were kept in a basket-shaped apparatus and dissolved in 900 ml of (pH 6.8) in a 1000 ml dissolving flask. Using a syringe equipped with a prefilter, 2 ml of samples were taken out at regular intervals and put back into the dissolution flask containing pH 6.8. When the sample had been diluted as needed with fresh medium, the absorbance was measured at 280 nm (pH 6.8). There were three duplicates of each study[15-18].

***Ex-vivo* Permeation studies through Nasal mucosa**

Permeation studies were carried out using nasal mucosa. The modified Franz diffusion cell assembly was used. Throughout the study the whole assembly was kept at 37^{o}C ±2^{o}C. The medium used in acceptor compartment was 6.8 buffer solution, which was continuously stirring by placing on a magnetic stirrer. At predefined, regular intervals, the samples were taken out and replaced with an equal amount of new medium[18-22]. Amount of drug in the withdrawn samples was determined after suitable dilutions

Stability study:

The formulation (F9) was kept in aluminium foils for three months at accelerated conditions (40. °C ± 2 C at 75% RH ±5% RH). After the first, second, and third months, the samples were withdrawn. The samples' drug content and in vitro drug release were examined[23-25].

Results and Discussion:

Drug-polymer compatibility

Fourier transform infrared spectroscopy (FT-IR)

IR spectra of individual Mucuna pruriens and the combination of drug with polymers were shown in figure 1 (A-D). An IR spectrum of pure Mucuna pruriens showed the peaks 3648 cm1 (O-H stretching), 3221-3101 cm1 (N-H Stretching), 2982-2937cm1 (C-H Stretching), 1354-1265cm1 (C-O stretching), 1428-1368cm1 (C-H bending(in plane)), 1340 cm1 (C-C stretching) ,These peaks can be considered as characteristic peaks of Mucuna pruriens and there was no significant change was noticed in IR spectra of Mucuna pruriens along with polymers as shown in the figure (B-D). Among the functional groups observed in the extracts, OH group was found in the seed of M. pruriens. As OH group has got the ability of forming hydrogen bonding capacity, presence of OH group indicates the higher potential towards inhibitory activity against microorganisms.

Percentage Yield:

The total number of microspheres that were obtained, weighed, and tested for percentage yield. Out of all the formulations prepared, F9 demonstrated the highest percentage yield (89.48%) represented in table 1.

Particle Size Determination:

By analyzing the average microsphere particle size for each formulation, standard sieves were used in the sieving procedure. According to the results values, the formulation F9 had produced particles with a smaller average size (647.38µm) than the other formulations represented in table 2.

Drug content estimation

For all of the formulations (F1 to F9), the drug content of microspheres was determined, and values are shown in Table 3. In comparison to the other prepared formulations, formulation F9 had the highest drug content.

Entrapment efficiency:

For all of the formulations (F1 to F9), the entrapment efficiency of microspheres was determined, and values are shown in the table (3). Formulation F9 had the highest entrapment efficiency (88.12%) in compared to other formulations

Percentage moisture content:

For all of the formulations (F1 to F9), the percentage moisture content was calculated using a desiccator containing calcium chloride at 37°C for 24 hours. The final weight was calculated and contrasted with the starting weight, Table 4 represented the values. Formulation F9 was determined to be the best one by comparing other formulations. The moisture content in the formulation F9 was lower. The order was F9<F8<F6<F7<F5<F4<F3<F2<F1.

Scanning electron microscopy (SEM):

Scanning electron microscopy was used to observe the microspheres. A vacuum system is attached to the SEM equipment, which has resolutions of 25 nm and 100 nm. Scanning electron microscopy revealed that the Mucuna pruriens microspheres were consistently dispersed and spherical in shape represented in figure 2.

***In -vitro* wash off test for mucoadhesion:**

Table 5 shows the results of the wash-off tests for mucoadhesion for all formulations (F1 to F9) In the in-vitro wash off test, microspheres with a mucoadhesive polymer and alginate coating demonstrated good mucoadhesive characteristics. At pH 6.8, the wash-off test went more quickly (stomach pH). It was demonstrated that the degree of hydration, solubility, and mucoadhesion of the polymers was significantly influenced by the pH of the medium. With more than 63.28% retention for 8 hours in pH 6.8, the wash off test results showed that the formulation F9 exhibited very good mucoadhesive characteristics.

***In- vitro* drug release studies:**

Studies on the in vitro release of mucoadhesive microspheres were conducted using pH 6.8 as the dissolving media and a spectrophotometric measurement of the drug absorbance at 280 nm. With formulation 9, there was a greater medication release. According to the type and composition of the polymer, using mucoadhesive microspheres, the in-vitro drug release varied. By increasing

concentrations of more hydrophilic polymers, it was discovered that the mucoadhesive microspheres released more drugs. Among the formulations (F1 to F9), F9 was shown to be the most effective. In vitro drug release of all formulations was shown in figure 3, and the values were reported in table 6. Formulation F9's in-vitro drug release was 81.76% over a period of 10 hours.

To understand the release kinetics of Mucuna pruriens from these mucoadhesive microspheres, data from the in vitro release were fitted to several equations and kinetic models. The kinetic models that were applied were the Higuchi release, zero-order equation, first-order equation, and Korsemeyer & Peppas models. The Korsemeyer and Peppas model had the best fit with the highest correlation coefficient (r = 0.9907). All of the formulations' "n" values are smaller than 0.5, which indicates that they all adhere to the Fickian model of drug release represented in the table 8.

***Ex-vivo* Permeation studies through Nasal mucosa**

In table 7 Ex-vivo permeation studies through nasal mucosa of all the formulations represented and the formulation F9 shows the cumulative highest nasal permeation (80.16%) at the end of 10 hours while compared to other formulations. The order of all the formulations based on their *ex-vivo* nasal permeation is represented as F9>F8>F7>F6>F5>F4>F3>F2>F1.

Stability Study:

Investigations on mucoadhesive microspheres that had been chosen and optimised were done to determine their short-term stability. The stability results showed that neither the drug content nor in-vitro drug release had undergone any significant alterations. The optimized formulation (F9) drug content and in-vitro drug release values are reported in table 9, and the findings are represented graphically in figure 4.

Table1: Percentage yield of all microspheres formulations

S. No	Formulation Code	Percentage yield (%)
1.	F1	75.32
2	F2	79.09
3	F3	75.64
4	F4	80.89
5	F5	83.17

6	F6	73.18
7	F7	67.44
8	F8	87.43
9	F9	89.48

Table2: Average particle size of microspheres

S. No	Formulations	Average particle size (µm)
1	F1	650.38±1.45
2	F2	694.18±0.52
3	F3	726.64±2.54
4	F4	748.28±0.81
5	F5	762.58±0.34
6	F6	798.56±0.44
7	F7	667.85±1.14
8	F8	698.48±0.44
9	F9	647.38±1.94

*All values are expressed as mean ± S.D. n=3

Table 3: Drug content and Entrapment efficiency

S. No	Formulations	Mean drugcontent (%) ± S.D*	Entrapment efficiency (%)
1	F1	43.22±0.76	71.89
2	F2	37.44±1.62	72.16
3	F3	39.82±1.45	81.75
4	F4	41.72±1.92	84.16
5	F5	42.19±0.78	79.39
6	F6	40.14±2.34	83.18
7	F7	35.06±0.85	72.12

8	F8	33.12±1.92	78.67
9	F9	47.12±0.78	88.12

*All values are expressed as mean ± S.D. n=3

Table 4: Percentage moisture content of microspheres

S. No	Formulations	Percentage moisture content (% ± S.D)
1	F1	8.723±0.234
2	F2	7.637±0.040
3	F3	5.876±0.078
4	F4	4.158±0.121
5	F5	3.529±0.132
6	F6	3.069±0.050
7	F7	2.516±0.080
8	F8	1.944±0.138
9	F9	1.116±0.130

*All values are expressed as mean ± S.D. n=3

Table 5: Data of *in- vitro* wash off test to assess mucoadhesive properties of microspheres

Formulations	1 hour	2 hour	4 hour	6 hour	8 hour
F1	96.77±0.14	89.45±0.45	69.14±0.98	57.35±1.78	42.68±1.78
F2	95.36±1.46	86.31±0.98	79.12±0.18	62.86±1.24	40.96±0.23
F3	98.89±0.17	83.82±1.45	77.99±0.45	67.96±1.11	47.86±0.57

F4	98.12±0.13	87.61±1.12	73.67±0.56	59.67±1.45	45.29±1.32
F5	95.99±1.98	83.82±0.56	78.19±0.89	55.18±0.89	53.86±0.12
F6	97.44±1.56	92.45±0.58	83.92±1.57	67.64±0.97	55.14±1.45
F7	98.16±0.45	89.73±0.13	83.79±0.98	65.16±1.78	45.19±0.59
F8	96.78±1.87	92.81±0.19	79.17±1.67	59.19±1.55	43.18±1.12
F9	99.94±0.55	96.86±1.13	93.18±0.98	85.32±1.67	63.28±0.32

*All values are expressed as mean ± S.D. n=3

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Table 6: Data of *In-vitro* drug released profile of *Mucuna Pruriens* loaded nasal mucoadhesive microspheres*

S. No	Time in hours	Formulations								
		F1	F2	F3	F4	F5	F6	F7	F8	F9
1	1	13.89±0.11	10.68± 1.54	17.42 ±1.04	11.58 ±1.54	15.46 ±1.56	12.65 ±0.45	18.35± 1.78	16.93±0.45	19.84±1.54
2	2	23.36±1.23	16.98± 1.89	21.54±1.66	17.29±0.61	19.75±1.05	20.67±0.15	25.90±1.96	22.76±0.55	26.72±1.45
3	3	29.07±1.54	25.37±0.54	27.65±0.20	21.45±0.02	23.67±1.51	26.74±1.63	30.05±0.12	28.23±0.56	31.36±1.52
4	4	36.64±1.56	32.46±1.65	31.56±1.53	28.87±0.91	29.56±1.55	33.45±1.55	39.45±0.56	35.98±0.22	38.43±0.01
5	5	42.34±0.57	45.36±0.22	39.78±1.01	35.47±0.78	34.78±0.45	39.87±1.23	44.89±1.56	41.87±1.51	46.64±0.12
6	6	49.07±0.23	47.48±0.55	48.97±0.50	41.68±0.51	40.56±0.61	43.75±1.25	52.98±3.45	48.24±1.02	51.28±0.65
7	7	53.03±1.54	50.67±0.23	51.87±1.21	48.89±0.05	46.78±0.49	49.56±0.61	59.56±1.56	52.76±1.55	57.14±0.54
8	8	61.96±1.45	56.89±1.55	58.16±0.54	52.98±0.07	54.81±0.61	53.23±0.74	64.87±1.26	59.56±1.16	66.49±1.55
9	9	66.76±0.77	61.87±0.54	64.89±0.26	59.89± 0.07	63.46±1.54	65.56±0.07	69.90±0.16	67.87±1.55	72.38±0.65
10	10	69.26 ±0.54	65.08±1.54	71.08±0.50	63.47±0.52	67.89±0.91	70.45±0.21	74.13±1.51	76.12±1.16	81.76±0.55

*All values are expressed as mean ± S.D. n=3

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Table 7: Data of *ex vivo* drug released profile of *Mucuna Pruriens* loaded nasal mucoadhesive microspheres*

S. No	Time in hours	Formulations								
		F1	F2	F3	F4	F5	F6	F7	F8	F9
1	1	12.13±0.54	11.24± 0.49	16.12 ±1.67	12.28 ±0.59	14.76 ±0.56	11.15 ±1.45	17.35± 1.78	17.13±0.75	18.94±0.54
2	2	22.76±0.22	15.81± 1.29	20.41±1.56	18.69±0.71	20.15±1.95	19.78±1.15	24.93±1.36	23.16±0.85	25.82±0.45
3	3	28.17±0.26	24.57±0.84	26.25±0.50	20.95±0.32	22.17±1.51	25.34±1.93	29.15±0.32	27.13±0.36	30.16±1.72
4	4	35.14±1.56	30.36±1.75	32.56±1.58	29.77±0.61	30.76±1.65	32.15±1.35	38.15±0.56	34.58±0.42	39.13±1.01
5	5	41.14±0.45	44.26±1.22	38.28±1.81	34.17±0.98	35.88±0.35	40.27±1.43	45.19±0.56	43.17±1.51	47.84±1.12
6	6	50.27±0.32	48.78±1.55	49.57±0.80	42.88±0.31	41.66±0.71	44.55±1.35	53.68±1.45	49.44±1.72	52.98±1.65
7	7	54.03±1.74	51.57±0.34	52.57±1.91	49.69±0.25	47.28±0.99	50.46±1.61	60.16±1.66	53.96±1.55	58.24±1.54
8	8	62.86±1.56	57.19±1.65	57.16±0.59	53.18±0.57	55.91±0.31	54.93±0.34	65.73±1.96	60.76±1.16	67.99±0.55
9	9	65.61±1.77	61.87±0.84	64.89±0.56	59.89± 0.87	63.46±1.64	65.56±1.07	69.90±0116	67.87±1.55	72.38±0.85
10	10	67.16 ±1.59	64.48±1.59	70.28±0.20	62.12±0.72	66.19±0.41	69.15±1.21	73.23±1.58	76.92±2.16	80.16±1.55

*All values are expressed as mean ± S.D. n=3

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Table 8: *In-vitro* drug released kinetics studies of all formulations

Formulation code	Zero order R^2	First order R^2	Higuchi R^2	Korsemeyer Peppas		Best fit model
				R^2	n	
F1	0.9621	0.9501	0.9723	0.9908	0.432	Peppas
F2	0.9650	0.9705	0.9663	0.9909	0.456	Peppas
F3	0.9900	0.9471	0.9530	0.9985	0.402	Peppas
F4	0.9503	0.8439	0.9782	0.9908	0.485	Peppas
F5	0.9592	0.8811	0.9729	0.9903	0.365	Peppas
F6	0.9622	0.9307	0.9684	0.9903	0.462	Peppas
F7	0.9540	0.8611	0.9770	0.9901	0.398	Peppas
F8	0.9597	0.9162	0.9756	0.9907	0.441	Peppas
F9	0.9647	0.9609	0.9663	0.9907	0.356	Peppas

Table 9: Data of stability studies of formulation (F9)

Characteristics	Initials*	1 month*	2 month*	3 month*
Drug content (%)	47.12±0.78	46.92±0.18	46.62±3.46	45.84±0.03
In-vitro drugreleased	81.76	81.26	81.12	81.04

*All the values are expressed as mean± S.D., n=3

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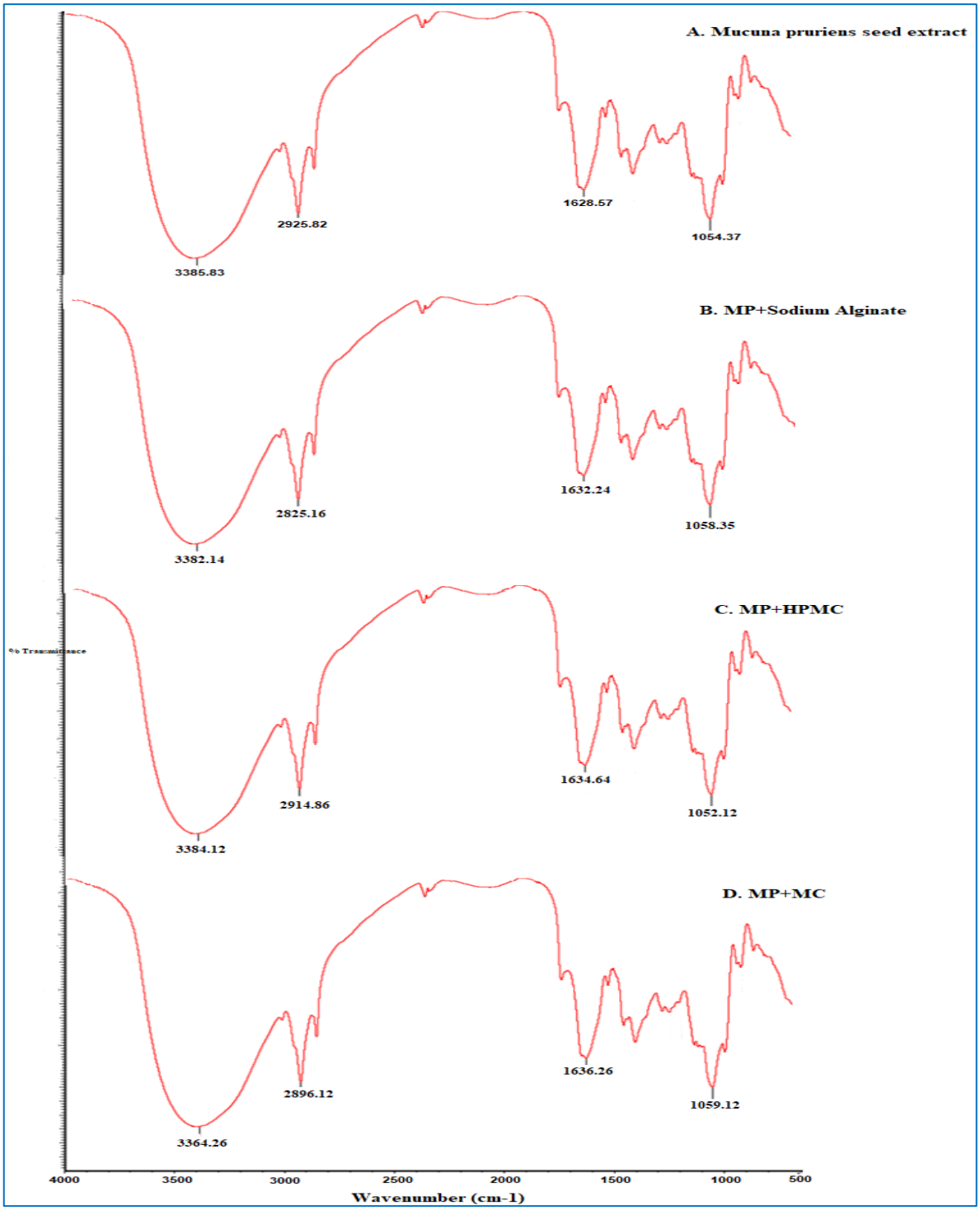

Figure 1: FT-IR Spectroscopic analysis of A. Mucuna pruriens (MP) seed extract, B. MP with Sodium alginate (SA), C. MP with Hydroxypropyl methylcellulose (HPMC) D. MP with Methylcellulose (MC)

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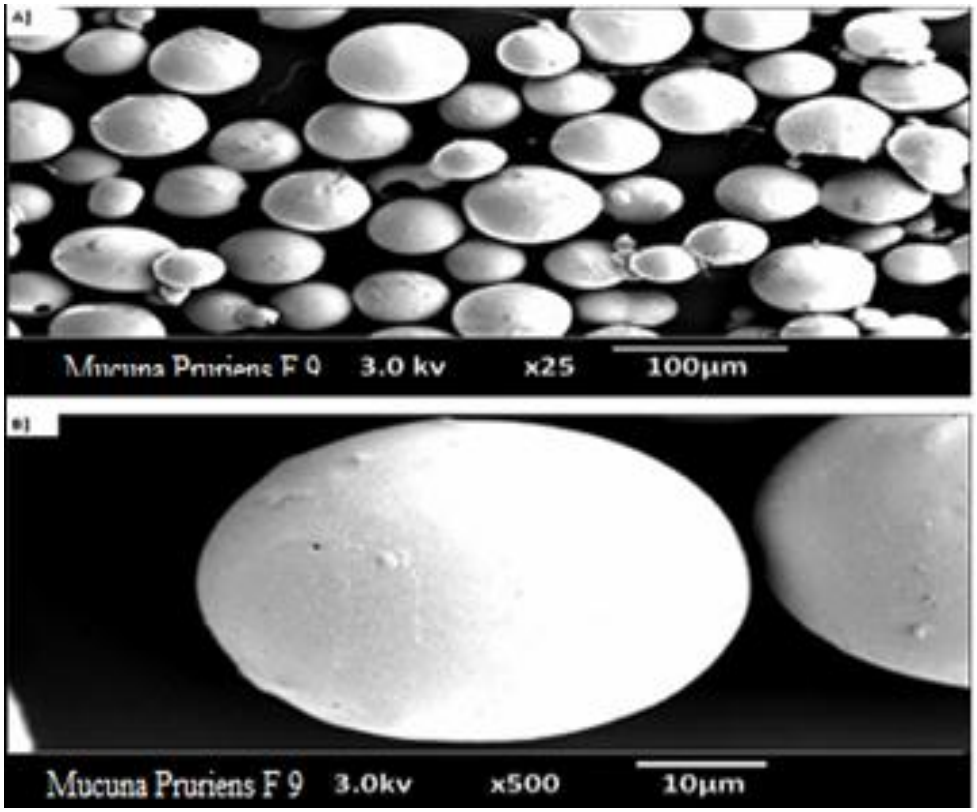

Figure 2: Scanning electron microscopy of *Mucuna Prurien* loaded Sodium Alginate and Methylcellulose (A. 100µm, B. 10µm)

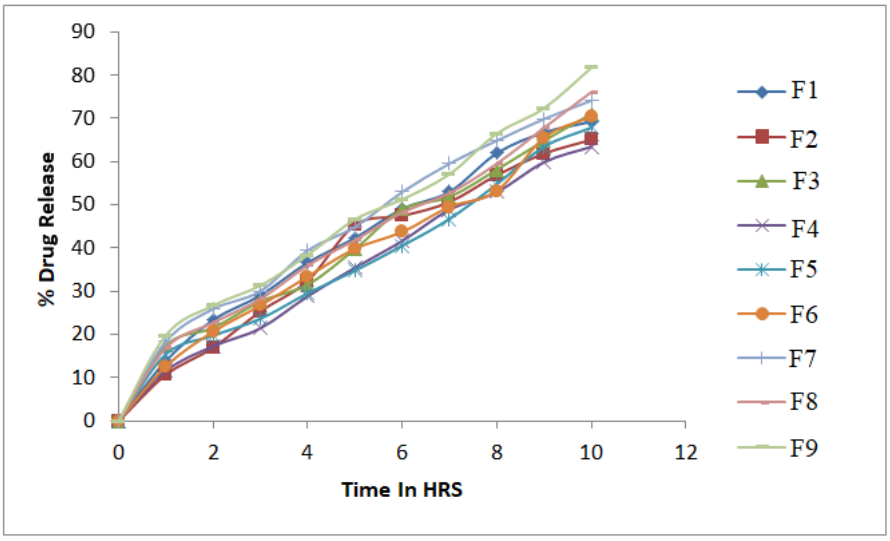

Figure 3: Zero order plot for comparison of *in- vitro* drug released for formulations F1 to F9

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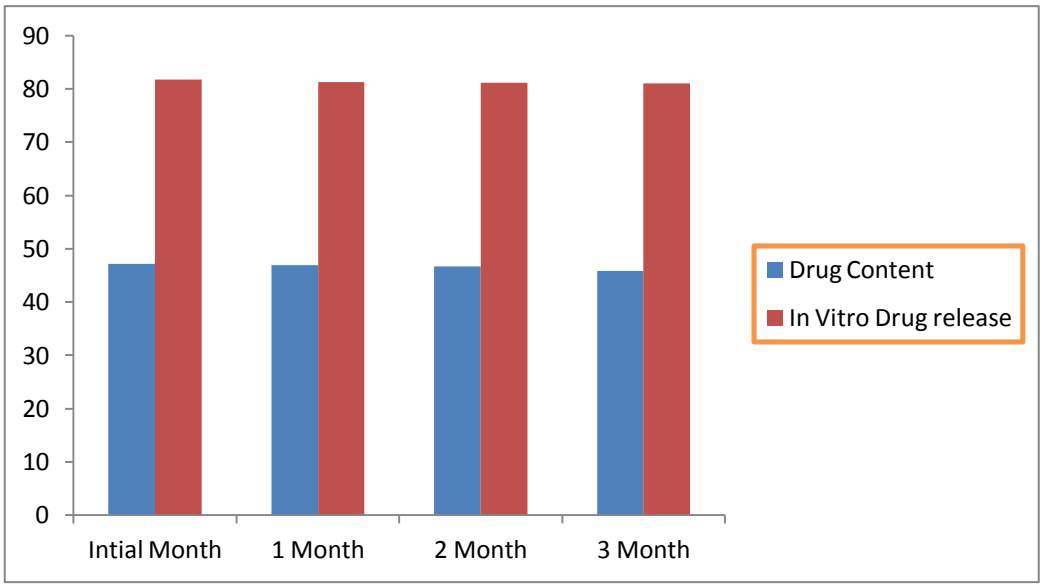

Figure 4: Stability study for optimized formulation F9

Conclusion

Mucoadhesive microspheres of Mucuna Pruriens were prepared by Orifice- ionic gelation method, composed of sodium alginate alone and in combination with HPMC and Methyl cellulose. The identification of the drug was done by the FTIR spectroscopy analysis and drug-polymers interaction was studied. It was concluded that no interaction was found between the Mucuna Pruriens and polymers. The *invitro* wash of test was carried out in pH 6.8 Mucoadhesive property of formulation F9 consisting of sodium alginate 3% along with methylcellulose 1% exhibited good mucoadhesive property. The particle size analysis was carried out by sieving method The particle size ranges from 647.38±1.94µm to 798.56±0.44µm. The percentage yield was found to be in range of 67.44 % to 89.48 % and The percentage moisture content were found to be in range of 8.723±0.234% to 1.116±0.130%.

The *in vitro* drug release studies were carried out in the pH 6.8. It was assumed that the drug molecules diffused out through a dissolving gel-like layer formed around the drug during the

dissolving process, On comparing the major criteria in evaluation such as drug content, encapsulation efficiency, *in vitro* wash off test and *in vitro* drug release characteristics, the formulation F9 was selected as the best formulation, as it showed the drug content as 47.12 % and encapsulation efficiency was 88.12%, showed a good mucoadhesive nature in the *in vitro* wash off test was nearly 63.28% up to 8 hours and *in vitro* drug released 81.76% up to 10 hrs. Based on all the above evaluation parameters it was concluded that the formulation F9 was found to be best formulation among the formulations F1 to F9 were prepared.

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