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FORMULATION AND EVALUATION OF NAPROXEN AND DOMPERIDONE MICROBEADS AS CONTROLLED DRUG DELIVERY SYSTEM

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ABSTRACT

Any drug delivery system's two basic objectives are to deliver a therapeutic dose of the medication to the right location in the body and to reach and maintain the target drug concentration. This might be accomplished by using many dosage form-resembling beads that are separated into several smaller units, or "subunits," each of which displays a few desirable properties. Systems for delivering drugs in micro particulate form offer several established benefits over single unit dose forms. Making medication delivery microbeads is one of the methods that does not require using strong chemicals or high temperatures. The utilization of ionotropic gelation, emulsion gelation, polyelectrolyte complexation, and other standard procedures is included. The ionotropic gelation process has been the focus of most research when it comes to microbeads preparation because it is easier to prepare than other techniques. The foundation of the ionotropic gelation process lies in polyelectrolytes' capacity to counter link with ions and create a hydrogel sustained release formulation.

Keywords: Naproxen, Controlled drug delivery system, technology, emulsion gelation, polyelectrolyte.

1. Introduction:

1.1. Drug Delivery system: Drug delivery systems, or DDS, are essential parts of the pharmaceutical and medical industries. They cover a broad range of technologies intended to deliver a medicinal substance to the intended location within the body in order to produce the intended therapeutic effect. Developments in DDS during the past few decades have improved patient outcomes, decreased side effects, and greatly increased the efficacy and specificity of pharmacological therapy. The many forms of DDS, its mechanics, uses, difficulties, and potential are all examined in this essay. [1]

1.1.1. Types of Drug Delivery Systems

1.1.1.1. Traditional Drug Delivery: Traditional drug delivery methods include oral administration, injections [intravenous, intramuscular, subcutaneous], and topical applications. These methods rely on passive diffusion to reach the target site and are often associated with several limitations, such as poor bioavailability, systemic side effects, and frequent dosing

requirements. [2]

1.1.2. Oral Administration: Oral administration is the most common and convenient route of drug delivery. It includes tablets, capsules, and liquids. However, it faces challenges like first-pass metabolism, where the drug is significantly metabolized in the liver before reaching systemic circulation, and degradation in the acidic environment of the stomach. [3]

1.1.3. Injections: Injections provide a direct route to systemic circulation, offering rapid onset of action. Intravenous [IV] injections deliver the drug directly into the bloodstream, ensuring 100% bioavailability. Intramuscular [IM] and subcutaneous [SC] injections are slower but provide a sustained release of the drug. Despite their efficacy, injections can cause pain, require skilled administration, and carry risks of infection. [4]

1.1.4. Topical Applications: Topical medication delivery refers to the application of lotions, gels, and patches to the skin. Transdermal patches are mostly used for local therapy; however, they can also be utilized to administer medications systemically. Difficulties include the skin's low permeability and irritability. [5]

1.1.5. Controlled Release Systems: By releasing the medication at a set pace, controlled release devices help to extend the medication's therapeutic benefit and lower the frequency of administration. These technologies reduce adverse effects and increase patient compliance. [6]

1.1.6. Sustained Release: The medication is released gradually over time in sustained release formulations. Numerous methods, such as matrix systems, reservoir systems, and osmotic pumps, can do this. Oral extended-release tablets and injectable depot formulations are two examples. [7]

1.1.7. Targeted Drug Delivery: In order to reduce systemic exposure and adverse effects, targeted drug delivery seeks to deliver the medication precisely to the site of action. This can be accomplished by either active targeting—which uses ligands or antibodies to drive the medicine to particular cells or tissues—or passive targeting, which takes use of the drug's natural distribution mechanisms. [8]

1.1.8. Advanced Drug Delivery Systems: Advances in nanotechnology, biotechnology, and materials science have led to the development of sophisticated DDS that offer precise control over drug release and targeting. [9]

1.1.9. Nanoparticles: Drugs can be encapsulated in nanoparticles, which are generally between one and one hundred nanometers in size, and kept safe from deterioration. Their increased permeability and retention [EPR] function enables the accumulation of materials preferentially in tumour tissues. Liposomes, dendrimers, and polymeric nanoparticles are among the several kinds of nanoparticles. [10]

1.1.10. Liposomes: Drugs that are both lipophilic and hydrophilic can be enclosed in spherical vesicles called liposomes, which have a phospholipid bilayer. Surface ligands can be added to them to provide targeted distribution. Cancer treatment uses liposomal formulations like Doxil [doxorubicin]. [11]

1.1.11. Polymeric Micelles: Amphiphilic block copolymers self-assemble to generate polymeric micelles, which are colloidal structures. They have the capacity to improve the bioavailability of medications that are poorly soluble in water. Targeted medication distribution and controlled release are achieved through the use of polymeric micelles. [12]

1.1.12. Hydrogels: Hydrogels are networks of hydrophilic polymers that are three- dimensional and have a high capacity to absorb and hold water. They may be made to respond to temperature and pH changes in the environment and to be released gradually. Hydrogels have

application in tissue engineering and wound healing. [13]

1.1.13. Implantable Devices: Long-term, regulated medication release is made possible via implantable devices. Drug-eluting stents for cardiovascular conditions and implanted pumps for the treatment of chronic pain are two examples. These gadgets can be set up to deliver medication in response to physiological cues or at predetermined intervals. [14]

1.1.14. Biologically Responsive Systems: Biologically responsive systems release drugs in response to specific biological signals, ensuring precise delivery and minimizing side effects. [15]

1.1.15. pH-Sensitive Systems: pH-sensitive systems release drugs in response to changes in pH. They are particularly useful for targeting acidic environments, such as tumor tissues or the stomach. [16]

1.1.16. Temperature-Sensitive Systems: Temperature-sensitive systems release drugs in response to changes in temperature. These systems can be designed to release drugs at body temperature or when externally heated. [17]

1.1.17. Enzyme-Responsive Systems: Enzyme-responsive systems release drugs in the presence of specific enzymes. These systems can target areas with high enzyme activity, such as inflamed tissues or tumors. [18]

1.2. Microbeads: Oral administration, injections (intramuscular, intravenous, subcutaneous), and topical treatments are examples of traditional drug delivery techniques. These techniques, which frequently have a number of drawbacks, including low bioavailability, systemic side effects, and frequent dosage needs, rely on passive diffusion to reach the target region. [19]

Microspheres or Microbeads play an important role of these Multiple unit dosage form system because of their small size and efficient carrier capacity. due to small size microspheres are widely used in drug delivery system. Microbeads are defined as small, solid, free flowing powder consisting a polymer. microbeads carry drug either in dispersed drug particle solution or either in crystalline form to allow controlled release at the various site of action with lesser side effect. [20]

The popularity of Microbeads has recently arisen more in oral drug delivery system due to microbeads having more uniform distribution of drug in the gastrointestinal tract. They have uniform drug absorption, lesser local irritation and elimination of unwanted intestinal retention of polymeric material. [20]

1.2.1. Advantages of Microbeads:

- Microbeads reduces the dosing frequency and thereby increase the patient compliance.
- Microbeads produces a prolonged and constant therapeutic action.
- Microbeads could be injected in to the body due to their smaller size and spherical shape.
- In microbeads better drug utilization will improve the bioavailability of drug and reduce the chance of adverse effects.

1.2.2. Disadvantage of Microbeads:

- Microbeads having difference in the release rate from one dose to other.
- The controlled release formulations consist a higher drug concentration and hence any loss of integrity of the release characteristics of the dosage may lead to potential toxicity.
- Microbeads dosage form should not be crushed or chewed.
- Microbeads modified release from the formulations.

1.2.3. Type of Microspheres or Microbeads: [21]

1.2.3.1. Buoyant/flonate microbeads: The buoyant/flonate microspheres have the bulk density less than the gastric fluid hence remains buoyant in stomach without affecting gastric emptying rate. It reduces chances of striking and dose dumping. In Buoyant/flonate microspheres drug is released slowly at the desired rate, if the system is buoyant/flonate on gastric content and increase gastric residence and increase fluctuation in plasma concentration.

1.2.3.2. Bio adhesive microbeads: Adhesion of drug to the mucosal membrane such as nasal, ocular, buccal, rectal etc. can be termed as bio adhesion. Bio adhesive microspheres give a prolonged residence time at the site of administration and causes intimate contact with the absorption site and produces better therapeutic action. [22]

1.2.3.3. Polymeric microbeads: Polymeric microspheres are of two types: [23]

- **Biodegradable microbeads:** Biodegradable polymer is made up of natural polymer such as starch, protein etc. biodegradable microspheres have a high degree of swelling property with aqueous media hence able to formed gel. they have prolonged residence time. in biodegradable polymer rate and extent of drug release is controlled by concentration of polymer.
- **Synthetic microbeads:** Synthetic microspheres are mostly used in bulking agent, clinical application, drug delivery, fillers etc.

2. Materials And Methods

2.1. List of Chemical used

Table 1 List of materials used and their manufacture/suppliers

S. No	Chemicals/Materials	Manufactures/Suppliers
1	Domperidone	Akums drugs and pharmaceuticals Pvt. Ltd Company SIDCUL Haridwar
2	Naproxen	Akums drugs and pharmaceuticals Pvt. Ltd company SIDCUL Haridwar
3	Sodium alginate	Central drug house [p] Ltd. New Delhi
4	Calcium Chloride	Merck
5	Purified water	Fisher Scientific

2.2. List Of Equipment's

Table 2 List of equipment's used during the research work

S. No	Name of Equipment's	Manufactures/Suppliers
1	Digital electronic balance	Metter Toledo
2	Magnetic stirrer	Electrolab
3	Digital hot air oven	Biogen scientific pvt.ltd
4	Digital melting point apparatus	Veego
5	Ultraviolet-visible spectrophotometer	Shimazu 1800
6	Tapped density apparatus	Electrolab
7	Dissolution apparatus	Lab India pvt.ltd

8	Ph meter	Rocho lab electronics

2.3. Drug Release Studies

2.3.1. Description: Naproxen is a white to off-white crystalline powder. Odour Characteristic. Domperidone is a white colour powder.

2.3.2. Melting point determination: Melting point of Domperidone and Naproxen was evaluated by using digital melting point [auto] apparatus. A capillary tube is taken and fused at one end, now a small quantity of Domperidone and Naproxen was pressed inside the free end of the capillary tube. The capillary tube was placed in the space provided in digital melting point apparatus. The temperature at which the drug started to melt was noted and compared with the literature value.

2.4. FTIR Study

The FTIR study was used to identify and confirm the purity of drug. FTIR Spectroscopy was used to identify any possible interactions between the formulation components and is done by comparing the IR spectra of the formulation with the drug.

2.5. UV Spectrophotometer study

The stock solution was prepared by accurately weighing 100 mg of Domperidone and Naproxen was dissolved in 100 ml of distilled water in a 100 ml volumetric flask. From the stock solution 1 ml of solution was pipette out and make up to 10 ml. now make the solution 100 micro gm/ml.

Now 1ml of solution was pipette out from the stock solution and make up 10 ml and make the dilution 10 micro gm/ml. again 1,2,4 ml was pipette out and make up to 10 ml with distilled water to prepare the final concentration of 1,2, and 3 micro gm/ml. the prepared solution was scanned in the scanning range of 200-400 nm and values obtained were recorded and compared with literature value.

2.6. Preparation Of Calibration Curve

2.6.1. A Preparation of 0.1N HCl buffer [pH 1.2] : Take 8.5 ml of concentrated hydrochloric acid in 1000 ml of volumetric flask, and make up volume up to the marks with distilled water to produce 0.1 N HCl.

Preparation of Calibration curve in 0.1 N Hydrochloric acid Buffer [pH 1.2]: 100 mg of Domperidone and Naproxen was dissolved in 0.1 N HCl buffer [pH 1.2] in 100 ml volumetric flask so the stock solution was prepared. Now 1 ml of the solution was pipette out from the stock solution and make up to 10 ml. make the dilution 100µg/ml. 1ml was again pipette out from the last stock solution and make up to 10 ml, and made the dilution 10µg/ml. now from this solution 1, 2, 3, 4, 5 ml was pipette out in 10 ml of volumetric flask and make up volume up to the mark with distilled water to prepare final concentration 1, 2, 3, 4, 5 µg/ml. the final dilution was analyzed at 262 nm.

2.6.2. Linearity of the calibration curve: The linearity of the calibration curve was determined by plotting the absorbance [y] versus the nominal concentration [x] of Domperidone and Naproxen. A calibration curve for Domperidone and Naproxen was obtained by measuring the absobance at the ʎ max of 287 nm and 271nm. Statistical parameter like slope, intercepts, coefficients of correlation, standard deviation was calculated.

2.7. Preparation Of Microbeads

Domperidone and Naproxen microbeads were prepared by using blends of sodium alginate as the coat material by ionic gelation method. The sodium alginate mixture of different ratios were prepared. The drug Domperidone and Naproxen [1gm] was added to this mixture and homogenized thoroughly with the help of magnetic stirrer to form a homogeneous dispersion.

The homogenous dispersion was kept aside to remove the bubble. Now the bubble free dispersion was added drop wise manually with a 20ml syringe fitted with 22 gauge needle, 100 ml calcium chloride [CaCl2] solution kept under the stirring in a 250 ml beaker. The gel forming [gelation] time of 15 min was allowed to complete the reaction and produce spherical microspheres. The prepared beads was collected by decantation, washed with alcohol and dried at room temperature, and finally dried at < 40°C for 2 hrs.

2.8. Evaluation Of Prepared Microbeads

2.8.1. Product yield: Precent yield is calculated by the formula experimental yield divided by theoretical yield multiplied by 100%.

2.8.2. Bulk density: Microbeads was accurately weighed and transferred in to 100 ml of graduated cylinder to measure the bulk volumes or Apparent volume [Vb]. The measuring cylinder was tapped for a fixed period of time and tadded volume [Vt] is recorded. The bulk density and tapped density were calculated by using the formula:

Vb= Mass[gm]/volume[ml]

Vt=Mass[gm]/tapped volume[ml]

Bulk density and tapped density were measured in gram per milliliter.

2.8.3. Hauser's ratio: The value obtained for bulk density and tapped density were used to calculated hausner's ratio by using following equation;

HR=Tapped density/bulk density

2.8.4. Carr's compressibility index: The value obtained for bulk density and tapped density were used to calculated Carr's compressibility index

CI=Tapped density-bulk density/tapped density x 100

2.8.5. Angle of repose: A funnel was fixed in a stand. The top of the funnel was at a height about 3 cm from the surface. The microbeads/microspheres were passed from the funnel after that they formed a pile. The height and the radius of the heap were measured and angle of repose was calculated by using the formula;

$\theta = \tan^{-1} h/r$

2.9. Percentage Drug content: Drug content in the microbeads was calculated by UV-Spectrophotometric method at a wavelength of 262 nm in distilled water. The metod obeyed Beer's law in the concentration range 0-12µg/ml. Microbeads/ Microcapsules equivalent to 100 mg of Cephalexin were crushed in to fine powder form with the help of pestle and mortar, and dissolved in 100 ml of distilled water. 1ml of the solution was pipette out into 10 ml of volumetric flask and make up volume up to the mark with distilled water. The absorbance was measured at a wavelength 271 nm and 287nm. This process was repeated with the all formulation. The absorbance values of microbeads were measured and the % drug content was calculated.

2.10. Composition of various formulation-

Table 3 Table no Composition of various formulations of microbeads.

Formulation Code	Drug [gm]	Sodium alginate [%w/v]	CaCl2 [%w/v]	Water
F1	1	2	5	100
F2	1	3	5	100
F3	1	3	5	100
F4	1	4	5	100
F5	1	4.5	5	100
F6	1	5	5	100

1.1. Particle size distribution: The particle size of both blank and drug loaded formulations was calculated by an optical microscope fitted with the ocular and stage micrometer and particle size distribution was measured. The Olympus model having resolution of 10 x [eyepiece] and stage micrometer was used for this purpose. The instrument was calibrated as 1 unit of the eyepiece micrometer was equal to 1/30mm and 1 division of stage micrometer is equal to 0.1mm.

1.2. *In-vitro* drug release studies and release kinetics: The *in-vitro* drug release study of microbeads was carried out by using USP basket apparatus. The microbeads equivalent to 100 mg of Domperidone and Naproxen were enclosed in a muslin cloth and tie properly with the help of threads. Now the dissolution medium [0.1N HCl] was transferred about 900 ml in the bowl. Maintained the temperature 37±0.5°C and set the 100 rpm. During dissolution 5 ml of sample was withdrawn at different time intervals of 1 to 12 hrs. the withdrawn samples were filtered through whatmann filter paper no.42 and absorbance was measured at 287 nm and 271nm by using UV-visible spectrophotometer.

Cumulative percent drug released was calculated at each interval and graph was plotted between cumulative % drug release and time in hrs.

1.3. Scanning Electron Microscopy [SEM]: Scanning electron microscopy [SEM] was used to examine the surface morphology of microbeads/microspheres. SEM is also used to determine the internal and external morphology of the microbeads.

3. Results & Discussion:

3.1. Identification

3.1.1. Melting point determination: Melting point of drug found to be 152◦C and 242.5◦C, which is lies within the range of literature specification i.e. 152-155◦C and 242.5-244.5◦C .the result indicates the purity of drug means the given sample drug was Naproxen and Domperidone.

3.1.2. FTIR Study

- **Drug Excipients Compatibility studies using FTIR:** Fourier Transform Infrared [FT-IR] analysis measurement of pure drug, carrier and drug loaded microspheres formulation were obtained using a Perkin Elmer Spectrum Version with opus software. The pellets were prepared on KBr press under a hydraulic pressure of 150 kg/cm^2, the spectra were scanned over the wave scanned over the wave range of 4400-500cm^{-1}at the ambient temperature.

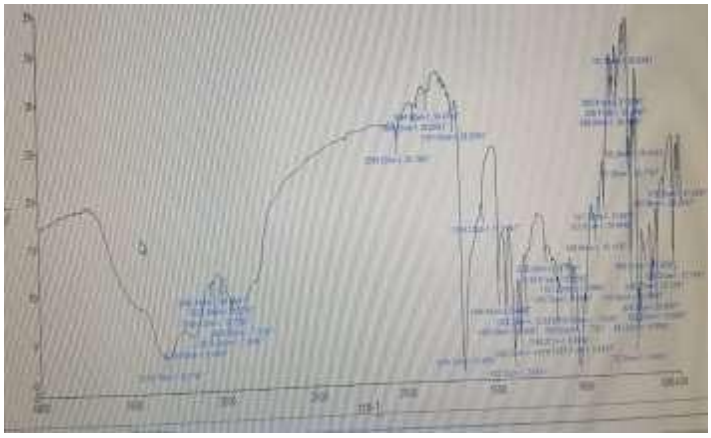

Figure 13 [A] FTIR graph of Domperidone

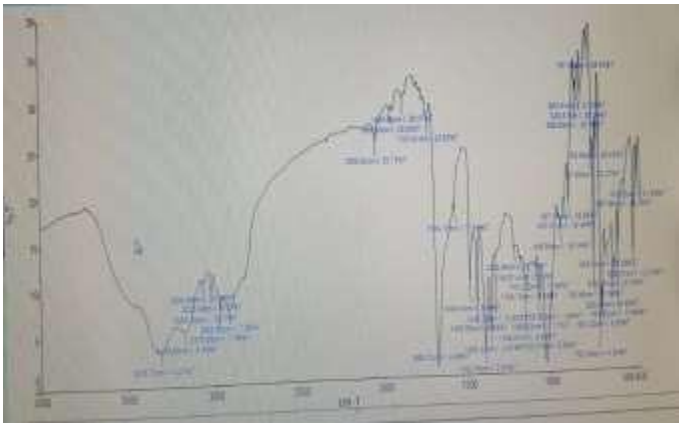

Figure 14 [B] Figure no FTIR Graph Naproxen

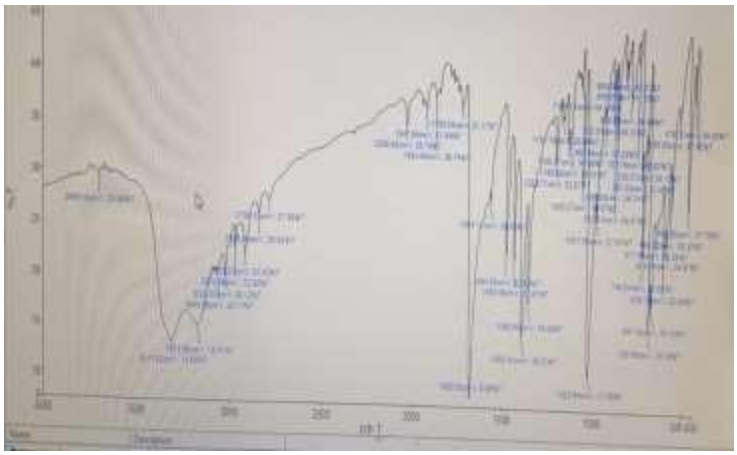

Figure 15 [C] FTIR graph of Sodium Alginate
Table 4 IR Spectra

S. No.	Assignment of bands	Literature value[cm^{-1}]	Absorption band for Domperidone pure drug sample[cm^{-1}]	Absorption band for Naproxen pure drug sample [cm^{1}]	Absorption band for Sodium Alginate
1.	C-O	1690-1594	1597	1598	1598
2.	C=O	1393-1354	1378	1375.6	1375.6
3.	C-N	1125-1070	1123	1060	1060
4.	C-H	3857-3843	3848	3843.5	3843.5

The IR spectra of pure drug Domperidone, Naproxen and excipients are as shown in Figure [A], [B], [C] of pure model drug and Excipients respectively. Pure drug Domperidone and Naproxen exhibited various peaks due to the presence of specific functional groups mentioned in the table. Peaks of the major functional groups of the pure drug 1598,1375.6,1060,3843.5 are observed. Hence it was concluded that no chemical interaction was found between the drug and excipients.

3.1.3. UV Spectrophotometric studies: The absorbance maximum was found to be 287 nm and 271 nm in a 0.1 N HCl [pH 1.2] buffer solution and phosphate buffer [pH 6.8]

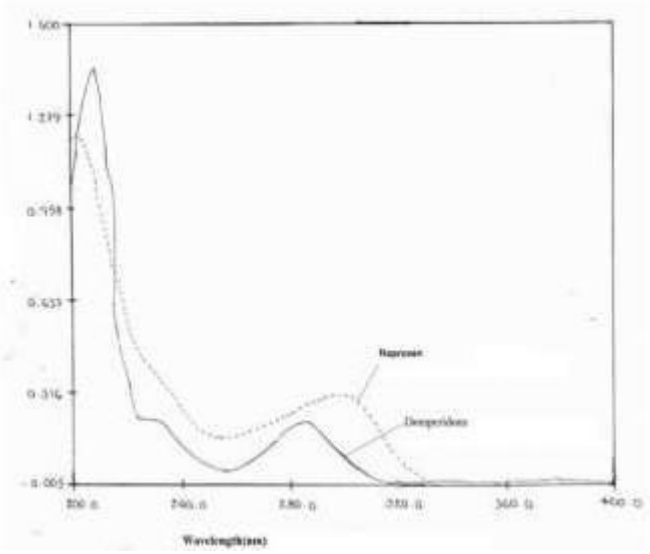

Figure 16 UV Wavelength UV Scan spectra of Domperidone and Naproxen

3.1.4. Calibration curve

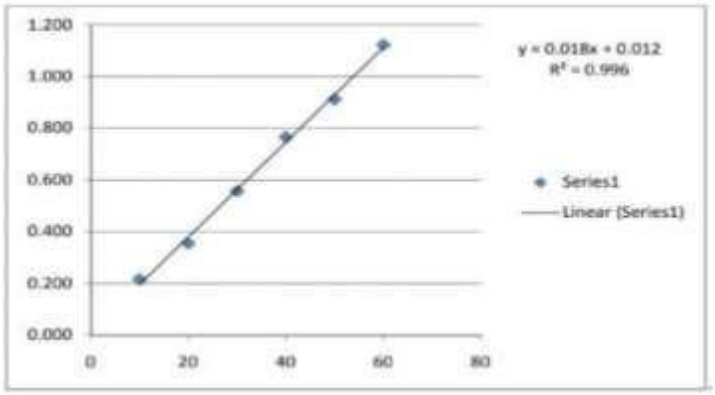

Figure 17 Calibration curve of Domperidone in 0.1 HCl buffer pH 1.2

Table 5 Data obtained from calibration curve of Domperidone in 0.1 N HCl buffer pH1.2

S. No	Parameters	Value
1	**Absorption maximum**	287nm
2	**Coefficient of correlation**	$_R$2=0.996
3	**Intercept**	0.018
4	**Slope**	0.012

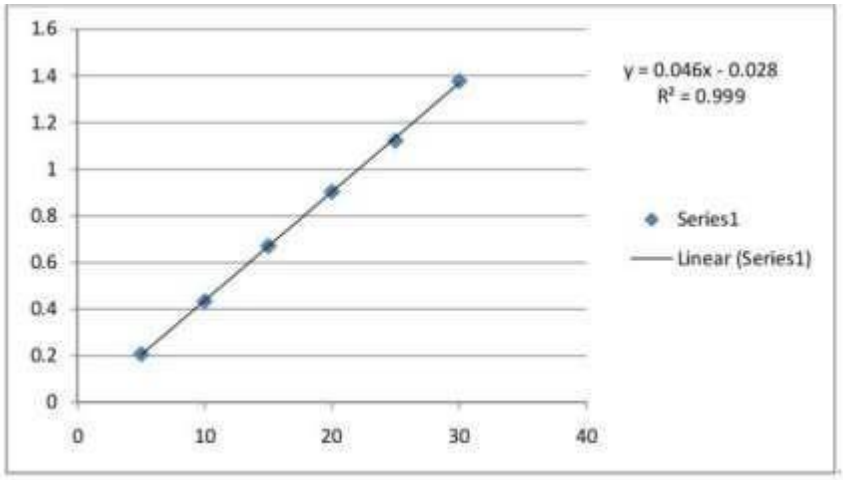

Figure 18 Calibration curve of Naproxen in 0.1 N HCl buffer pH 1.2

Table 6 Table no Data obtained from Calibration curve of Naproxen in 0.1 N HCl buffer pH 1.2

S. No	Parameters	Value
1	**Absorption maximum**	271
2	**Coefficient of correlation**	0.999
3	**Intercept**	-0.028
4	**Slope**	0.046

3.1.5. Linearity and Range: Linearity means that the analytical method is linear at different concentration. It's had ability to elict test result in mathematical forms. The calibration curve of Domperidone and Naproxen was found to be linear. The data of linearity of Domperidone and Naproxen in 0.1 N HCl buffer pH 1.2 is R^2=0.996 and R^2=0.999.

3.1.6. Preparation and characterization of microbeads

The 6 formulations of Domperidone and Naproxen microbeads was successes fully prepared by ionic gelation method using sodium alginate polymer. In the method we first take the accurate amount of calcium chloride and dissolved it in to distilled water. We used calcium chloride instead of calcium carbonate because the presence of chlorine molecule. According to periodic table chlorine is the best leaving agent. Calcium chloride was properly dissolved in water. Now sodium alginate was dissolved in water and kept it on magnetic stirrer for uniform mixing. Sodium alginate dispersed in the water properly to form uniform solution. now add the adequate quantity of [drug] Domperidone and Naproxen in sodium alginate solution, and mix it well. After the preparation of calcium chloride solution and sodium alginate with drug solution, added sodium alginate drop wise in to calcium chloride solution with the help of 22 gauze syringe sized. As the drop of sodium alginate come in the contact of calcium chloride solution cross-linking takes place and quick gel formation takes place. Ionic exchange take place between calcium ion and sodium ion. After a sufficient time, calcium alginate was formed. The calcium alginate has a good mechanical strength. Calcium alginate formed a spherical shaped structure and the Domperidone and Naproxen [drug] was entrapped inside the structure. After that washed the microbeads with the alcohol. At last dried microbeads in the room temperature to remove the excess amount of vehicle. After that dried in hot air oven for 2 hrs.

3.1.7. Evaluation Parameters: The evaluation of prepared microbeads is as follows

Table 7 Percentage final product yield

Formulation Code	**Product yield [%]**
F1	58.79
F2	85.0
F3	98.0
F4	79.0
F5	60.56
F6	95.0

Table 8 Result of bulk density, tapped density, hausner' ratio, Carr's index and angle of repose.

Formulation code	**Bulk density**	**Tapped density**	**Hausner's ratio**	**Carr's index**	**Angle of repose**
F1	0.56	0.60	1.07	6.67	8.56
F2	0.76	0.78	1.02	2.56	11.20
F3	0.59	0.65	1.10	9.23	16.64
F4	0.71	0.77	1.08	7.79	16.64

F5	0.66	0.72	1.09	8.33	11.20
F6	0.66	0.69	1.04	4.34	11.30

Table 9 Drug content of formulation

Formulation Code	Drug content [%]
F1	82.5
F2	79.86
F3	76.83
F4	68.78
F5	72.89
F6	69.76

In the formulation F1 shows higher amount of drug while the F4 shows lesser amount of drug.

3.1.8. Particle Size Analysis: In particle size determination evaluate all the formulations lies the particle size under the specified range between 10µm-1000 µm.

Table 10 Particle Size of different formulation

Formulation code	Particle size range [µm]
F1	**622.15**
F2	**576.36**
F3	**614.24**
F4	**569.78**
F5	**578.75**
F6	**558.25**

3.1.9. *In-Vitro* Drug Release Kinetics

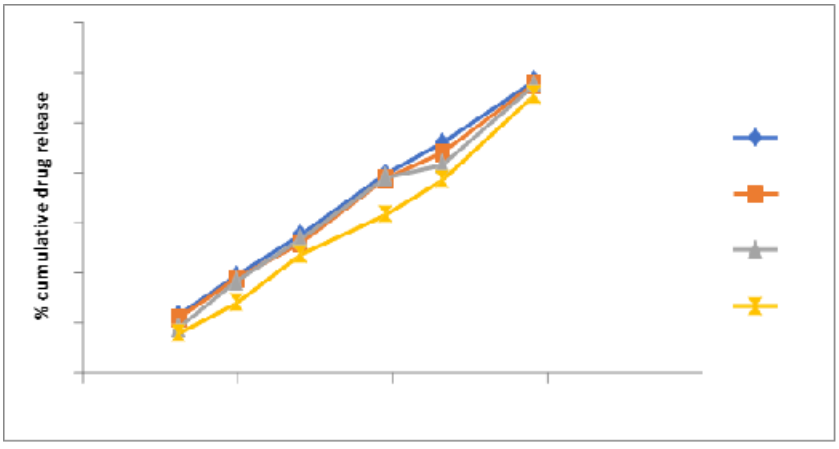

Figure 19 % cumulative drug release

Table 11 % Cumulative drug release

Formulation code	Cumulative % Drug Release of F3 to F6					
F3	11.45	19.45	27.56	39.80	46.06	58.45
F4	10.92	18.92	25.98	38.9	44.09	57.82
F5	8.92	18.34	26.78	39.18	41.76	57.78
F6	7.89	13.98	23.78	31.78	38.67	55.78

3.1.10. Scanning electron microscopy [SEM] of Domperidone and Naproxen: The morphology of the microbeads was examined by SEM study, the surface view of the microbeads showed a spherical shape with a rigid surface morpholgy. Result showed that all element analyzed were normalised. The peak was omitted 2.138 to 9.680 kev. The mean diameter of Domperidone and Naproxen loaded microbeads was found to be 595.34 and 558.56µm. The Domperidone and Naproxen microbeads was probably released.

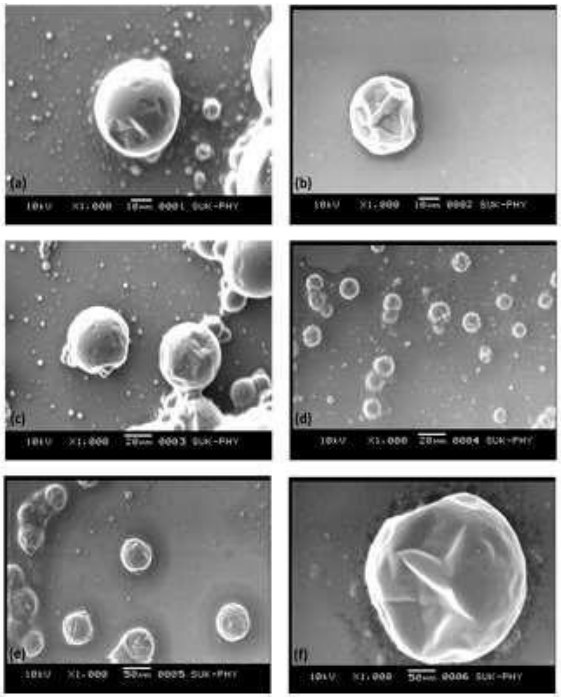

Figure 20 (SEM) Scanning electron microscopy of Microbeads

4. Conclusion:

The comprehensive investigation into the pharmaceutical properties and formulation of Domperidone and Naproxen microbeads has done. The melting points of Domperidone and Naproxen were determined to be 152°C and 242.5°C, respectively. These values fall within the established literature ranges of 152-155°C for Domperidone and 242.5-244.5°C for Naproxen, indicating the purity of the samples. The precise melting point determination is essential for confirming the identity and purity of pharmaceutical compounds, which directly influences their stability and efficacy in formulation.

FTIR spectroscopy was utilized to study the compatibility between the drugs and their excipients. The IR spectra of Domperidone, Naproxen, and Sodium Alginate showed characteristic absorption bands corresponding to their functional groups. For Domperidone and Naproxen, peaks were

observed at 1598 cm^{-1} [C-O], 1375.6 cm^{-1} [C=O], 1060 cm^{-1} [C-N], and 3843.5 cm^{-1} [C-H]. The consistent presence of these peaks in both the pure drug samples and their formulations with excipients indicates that there was no significant chemical interaction between the drugs and excipients, thereby confirming their compatibility.

The UV spectrophotometric analysis revealed that Domperidone and Naproxen exhibit maximum absorbance at 287 nm and 271 nm, respectively, in 0.1 N HCl [pH 1.2] buffer solution. The calibration curves for both drugs showed high linearity, with correlation coefficients [R^2] of 0.996 for Domperidone and 0.999 for Naproxen. This high degree of linearity confirms the reliability of the spectrophotometric method for quantifying these drugs in various formulations.

The evaluation of the microbeads revealed substantial variations in product yield, bulk density, tapped density, Hausner's ratio, Carr's index, angle of repose, drug content, particle size, and in-vitro drug release kinetics. The yields ranged from 58.79% to 98.0%, with the highest yield observed in formulation F3. The bulk and tapped densities, Hausner's ratio, and Carr's index indicated good flow properties of the microbeads, essential for uniform filling in capsules or tablets. The drug content analysis showed formulation F1 with the highest drug content [82.5%], indicating efficient drug encapsulation.

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