



A REVIEW ON RECENT DEVELOPMENTS IN NOVEL HERBAL DRUG DELIVERY SYSTEM

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Abstract: A novel drug delivery system is a new approach to drug delivery that the limitations of traditional drug delivery systems. Our country has a vast Ayurvedic knowledge base whose potential has only recently been realized. However, the drug delivery system used to administer the herbal medicine to the patient is outdated, resulting in reduced drug efficacy. If novel drug delivery technology is used in herbal medicine, it may improve the efficacy and reduce the side effects of various herbal compounds and herbs. Herbal formulations for novel drug delivery systems are more advantageous and beneficial than others. The use of herbal formulations containing liposomes, ethosomes, phytosomes, emulsions, microspheres, and solid lipid nanoparticles has improved the therapeutic effects of plant extracts. With the use of all of these, targeted delivery of the formulation is achieved, resulting in the formulation demonstrating effect on the site and increasing the formulation's bioavailability. This article attempts to cover different aspects related to the development of novel herbal formulations, biological activity and applications of novel formulations.

Keywords: NDDS, Application of NDDS, Recent Development in NDDS, Herbal drug delivery system, etc.

1. INTRODUCTION:

1.1 Novel Drug Delivery System:

Novel drug delivery system is advanced drug delivery system rather than the conventional drug delivery system. A novel drug delivery system (NDDS) can be Defined as new approaches that combines innovative development, formulations, New technologies for delivering the drug in the body with safety achieves its desired Pharmacological effect.^[1]

1.2 Necessity of NDDS in herbal drugs:

- To maximise patient compliance and prevent repetitive administration.^[2]
- Novel herbal drug carriers treat specific diseases by directing the drug only to the affected area of the patient's body.^[3]
- To minimize drug degradation and loss, to Prevent harmful side effects and to increase Drug bioavailability.^[4]
- For "multi drugs and multi targets" mode for combination therapies for complex diseases, such as cardiovascular disease and diabetes.^[5]

1.3 Physiochemical properties of herbal drug:

- Determination of moisture content
- Solubility
- Ash value
- Total ash value
- Acid in soluble ash
- Water soluble ash
- Sulphated ash
- Specific Gravity

- i) Viscosity
- j) Melting point
- k) Refractive index^[3]

1.4 Advantages and Disadvantages of Novel Drug Delivery System in Herbal Drug:

- **Advantages**

- a) The novel herbal drug delivery system can be used to achieve site specificity.
- b) Improved solubility & bioavailability.
- c) Controlled drug delivery.^[4]
- d) Protection from physical and chemical degradation.
- e) Sustained delivery.^[1]

- **Disadvantages**

- a) Physical instability.
- b) Leaking of entrapped drugs.
- c) There are limits on bio acceptability.
- d) Effects may be unpredictable.
- e) If you are on medicine some can cause adverse effects.^[4]

1.5 Current challenges in upgrading and modernization of herbal formulations.

- a) Standardization Safety, and efficacy assessment.
- b) Evaluating “drug” interactions
- c) Communication of uncertainty
- d) Pharmacological, toxicological, and clinical documentation
- e) Pharmacovigilance
- f) Constraints with clinical trials and people available.^[3]

1.6 Application of Novel Drug Delivery System:

Due to the challenges of pharmacological therapy faced and the superiorities of nanoparticles (NPs) in drug delivery and imaging, researches have put increasing interest in nano carriers in the treatment and management of diabetes mellitus. They could also act as an intelligent automatized system to mimic endogenous insulin delivery and possess a non-linear response to an external signal, which reduces the risk of hypoglycaemia and obtain better compliance of patients. NPs are widely applied to the detection of pH and chemical analytes and imaging in drug delivery because of their unique photo luminescent properties. At the same time, the properties of polymer materials, the mean particle size and polydispersed, the surface electrical charge and hydrophilicity of nanoparticles are crucial for the delivery of antidiabetic drugs. Therefore, it is quite necessary and significant to develop appropriate NP delivery systems for effective diabetes treatment.^[6]

2. METHODOLOGY:

- **Recent Developments in Novel Drug Delivery System:** Various approaches in case of novel herbal drug delivery system includes different types of formulations such as Liposomes, phytosomes, pharmacosomes, niosomes, nanoparticles, microspheres, transferosomes, ethosomes, microemulsion, Nanoparticles Transdermal drug delivery system and, etc are discussed below.^[8]

2.1 Liposomes:

Liposomes derived from two Greek words: Lipo (FAT) and soma (BODY). Liposome is a spherical vehicle having at least one lipid bilayer. The liposomes can be used as a Vehicle for administration of nutrients and pharmaceutical drugs. Liposomes can be prepared by Disrupting biological membranes (such as by sonication). Size range: 25-5000nm.^[8]

It is so named because Of its composition is primarily of phospholipid. Liposome's, sphere-shaped vesicles consisting of one or more phospholipids bilayers. Liposomes characterize an advanced technology to deliver active molecules to the site of action. Liposomes are colloidal, vesicular structures composed of one or more lipid bilayers surrounding an equal Number of aqueous compartments. The sphere like shell encapsulated a liquid interior which contain Substances such as peptides and protein, hormones, enzymes, antibiotic, anti-fungal and anticancer agents. [5]

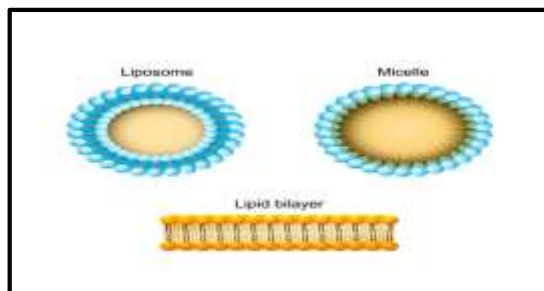


Fig. No. 1: Liposome

- **Advantages of liposome:**

- Suitable for delivery of hydrophobic, hydrophilic and amphipatic drugs and agents
- Improved pharmacokinetic properties. Can be made into Varity of drug.
- Minimum antigenicity.[8]
- Increased efficacy and therapeutic index.
- Flexibility to couple with site specific ligands to achieve active targeting.[5]

- **Disadvantages of Liposome:**

- Short half-life
- Production cost is high.
- Sometimes phospholipids undergo oxidation and hydrolysis-like reaction.[5]
- Possibility of dumping due to faulty administration.[8]

- **Method of Preparation:** The following methods are used for the preparation of liposome:

- Passive loading techniques.
 - Mechanical dispersion method.
 - Solvent dispersion method.
 - Detergent removal method (removal of non-encapsulated material).[5]
- Active loading technique.

2.2 Phytosomes:

The term “Phyto” means plant and “some” means cell It is also mentioned as herbosomes this is a new patented Technology, where standardized plant extracts or water soluble phytoconstituents are complexed with phospholipids to produce lipid compatible molecular complexes, there by greatly increasing absorption and bioavailability.[11] Phytosomes are prepared by reaction of stoichiometric Amount of phospholipid with the Phyto-constituents in An aprotic solvent The size of phytosome varies from 50nm to a few hundred μm . [11]

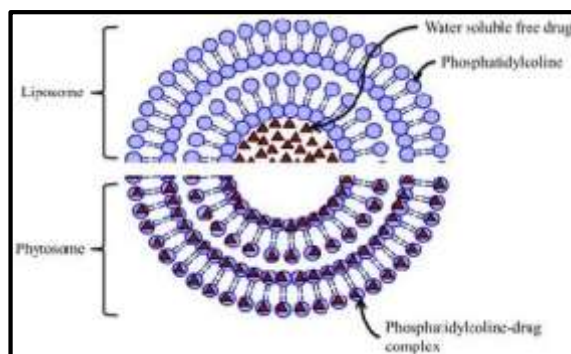


Fig. No. 2: Phytosomes

- **Advantages of Phytosomes**

- Chemical bonds are formed between phosphatidylcholine molecule and phytoconstituent, so the phytosomes show better stability profile.^[12]
- Phytosomes possess better drug entrapment efficiency.^[10]
- The dose requirement is reduced due to improved Absorption of the main constituent. They can also give In smaller quantities to achieve the desired results.^[11]

- **Disadvantages of phytosomes**

- The phytoconstituent in the phytosome is quickly removed.^[13]

- **Method of preparation**

- Solvent evaporation/thin film hydration method.
- Anti-solvent precipitation
- Freeze drying or lyophilisation.^[10]

2.3 Niosomes:

Niosomes is the type of delivery system in which medication is encapsulated in a vesicles. Niosomes exhibit various properties that is they are Biodegradable, biocompatible non-immunogenic And has flexibility in their structure.^[14]

A typical niosome vesicle would consist of a vesicle forming amphiphilic i.e. a non-ionic surfactant such as Span-60, which is usually stabilized by the addition of cholesterol and a small amount of anionic surfactant such as dicetyl phosphate, which also helps in stabilizing the vesicle^[15]

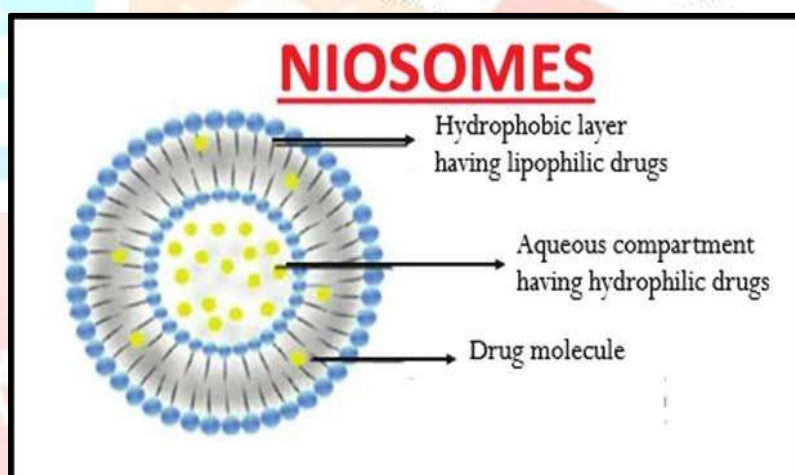


Fig. No. 3: Structure of Niosomes

- **Advantages of Niosomes:**

- The less amount of dose is effective to get the Proper effective effect
- Can enhance the skin penetration of drugs
- Vesicles act as depot to release the drug slowly.^[14]
- They're osmotically active and stable.
- They increase the steadiness of the entrapped drug.^[15]

- **Disadvantages of Niosomes:**

- May require specialized equipment
- High production cost
- Aggregation
- Leaking of entrapped drugs^[14]

- **Method of preparation:**

- Handshaking method:**

(Thin film hydration technique) Another round bottom flask dissolves during a volatile organic solvent the mixture of vesicles that shape Ingredients including surfactant and cholesterol. At room temp (20 °C), the organic solvent is collected and use

a rotary evaporator that Leaves a surface layer of solid mixture accumulated on the flask rim. To gentle agitation, its dried surfactant film might be rehydrated at 0-60 °C to the aqueous phase. Standard multilamellar niosomes form this technique.

- b) 2. Micro fluidisation
- c) 3. Reverse Phase Evaporation Technique (REV)
- d) 4. Ether injection method
- e) The “Bubble” Method^[14]

2.4 Ethosome:

Ethosomes are soft, malleable lipid vesicles Composed mainly of phospholipids, alcohol (ethanol or isopropyl alcohol) in relatively high concentration (20-45%) and water.^[16] Ethosomes contain higher concentrations of ethanol and Lipids, it is important to understand its effects on the skin.^[17]

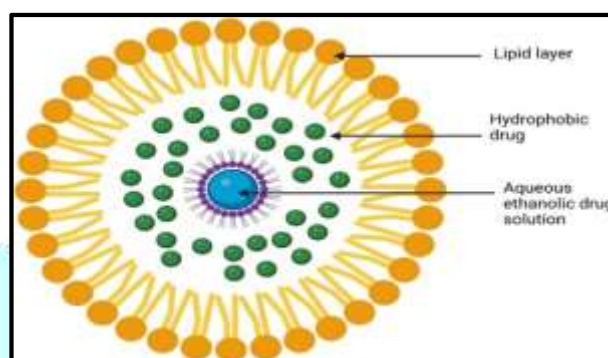


Fig No.4: Structure of ethosomes

• Advantages of ethosomes

- a) Enhanced permeation of drug through skin for Transdermal drug delivery.
- b) Delivery of large molecules (peptides, protein Molecules) is possible.
- c) Simple method for drug delivery in comparison to other Complicated methods.
- d) High patient compliance the ethosomal drug is administered in semisolid form (gel or Cream) hence producing high patient Compliance.^[15]
- e) The cost of manufacturing ethosomes is very cheap.^[17]

• Disadvantages Of Ethosomes

- a) Very poor yield so may not be economical.
- b) Loss of product during transfer from organic to water Media.
- c) It is limited only to potent molecules, those requiring A daily dose of long or less.
- d) Adhesive may not adhere well to all types of skin.^[17]

• Method of preparation:

a) Hot Method:

In this method disperse phospholipid in water by Heating in a water bath at 40°C until a colloidal Solution is obtained. In a separate vessel properly Mix ethanol and propylene glycol and heat up to 40°C. Add the organic phase into the aqueous Phase. Dissolve the drug in water or ethanol Depending on its solubility. The vesicle size of Ethosomal formulation can be decreased to the Desire extent using probe sonication or extrusion Method.^[16]

2.5 Transferosomes:

Transferosomes are one of the novel vesicular systems for Transdermal delivery of the active substance. They are Capable of transdermal delivery of drugs with a low and High molecular weight with the uniqueness of Accommodating the hydrophilic, lipophilic, and amphiphilic Nature of molecules.^[18] Transferosomes have been defined as specially designed vesicular particles consisting of at least one inner aqueous compartment enclosed by lipid vesicles. Transferosomes can pass Through tiny pores nearly as efficiently as water, which is 1500 times smaller.^[19]

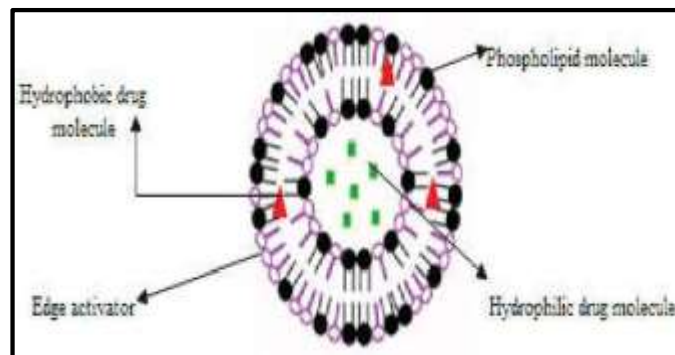


Fig. No. 5: Structure of Transferosomes

- **Advantages of Transferosomes.**

- They protect the encapsulated drug from metabolic degradation, atmospheric degradation.
- Transferosomes shows greater permeation of the drugs through the skin.
- These serves as carrier for both small and large molecular weight drugs..
- They can be used for both systemic as well as topical delivery of drug.^[19]
- Reduced side effects and improved therapy Because of plasma level maintenance, until the End of the dosage interval.
- Avoid inter-patient and intra-patient Variations and improve therapeutic efficacy.^[20]

- **Disadvantages of Transferosomes**

- Transferosomes are chemically unstable because of their predisposition to oxidative degradation.
- These formulations are very expensive.
- Drug molecule which is using for transferosomal delivery must be potent.^[19]
- Drugs that required high blood levels cannot be administered.
- Skin irritation or hypersensitivity reaction may occur.

- **Method of preparation**

- Ethanol Injection Method
- Rotary Film Evaporation Method
- Vertexing Sonication Method
- Reverse phase Evaporation Method
- Freeze Thaw Method
- Modified Hand Shaking Method^[20]
- Thin film hydration technique

a) **Ethanol Injection Method:** In this method, drug along with aqueous solution is heated with continuous stirring at constant temperature Ethanolic solution containing phospholipids and edge activators are injected into an aqueous solution drop Wise. When the solution comes in contact with aqueous media the lipid molecules get precipitated and form Bilayered structures. This method is more advantageous than other methods.^[19]

2.6 Microspheres:

Microspheres are small spherical particles, with diameters in the micrometer range (typically 1 μm to 1000 μm). Microspheres are Sometimes referred to as micro particles.^[21] Microspheres are of two types; Microcapsules and Micrometrics. Microcapsules are those in which Entrapped substance is surrounded by distinct capsule wall and micrometrics in which entrapped substance is Dispersed throughout the microsphere matrix ^[22]. Most common types of polymer microspheres Includes Polyethylene and polystyrene microspheres are Popular among other. Polyethylene microspheres are most commonly used as permanent or temporary filler whereas Polystyrene microspheres are used in biomedical applications ^[23]

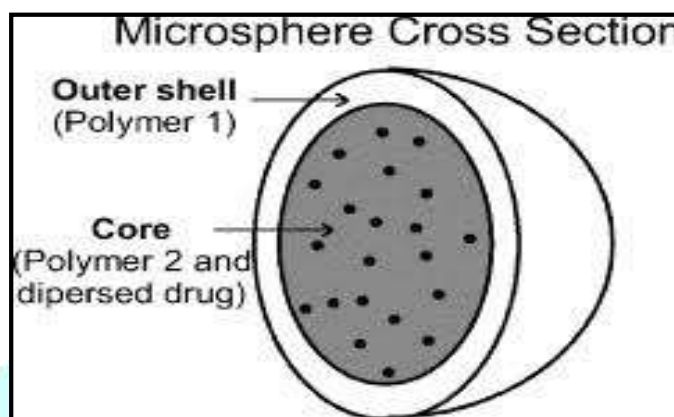


Fig. No. 6: structure of Microspheres.

- **Advantages of Microspheres:**

- Dose frequency and adverse effects can be reduced., Increased patient compliance.
- Enhances bioavailability.
- Gastric irritation can be reduced.
- Unpleasant odour and taste of the drug can be Masked. ^[22]
- Microspheres provide constant and Prolonged therapeutic effect. ^[21]
- They could be injected into the body due to the Spherical shape and smaller size. ^[24]

- **Disadvantages of Microspheres:**

- Reproducibility is less.
- The cost of materials and processing is high Compared to conventional preparations. ^[22]
- Dosage forms of this kind should not be Crushed or chewed ^[21]
- The process conditions like temperature change, pH, Solvent addition, and evaporation/agitation may influence the stability of core particles to be encapsulated. ^[23]

- **Method of preparation:**

- Single emulsion techniques
- Double emulsion techniques
- Phase separation coacervation technique
- Spray drying
- Solvent extraction
- Solvent evaporation
- Polymerization
- Normal polymerization
- Inter-facial polymerization ^[23]
- Spray drying:** Polymer dissolved in a suitable volatile organic solvent like Dichloromethane, Acetone, etc. Under high-speed homogenization it spreaded in the polymer Solution Then atomized in a stream of hot air. Development of the small droplets Evaporate the solvent Development of the microspheres which size range is 1-100 μm In this step by the use of cyclone separator micro particles are Separated from the hot air while the trace of solvent is take out By vacuum drying ^[23]

3. RESULT & CONCLUSION:

Novel Drug delivery System (NDDS) is a combination of advance techniques and newly designed dosage forms which are much better than conventional dosage forms. Advantages of Novel Drug Delivery System are Optimum dose at the right time and right location, Efficient use of expensive drugs, excipients and reduction in production cost, Beneficial to patients, better therapy, improved comfort and standard of living. It helps in the increase the therapeutic effects and increases the bioavailability and decreases the toxic effects of drug. The method by which a drug is delivered can have a significant effect on its efficacy. Novel drug delivery & drug is new techniques which are used in pharmaceutical science like targeting drug delivery, vaccine delivery, Gene therapy.

Thus, it concludes that, NDDS for herbal drugs will be a revolutionary application in the conventional herbal formulations which will save the time of preparations and will increase the patient compliance.

4. REFERENCES:

1. Saurabh Jagtap, Akshay Adlinge, Shruti Sonawane; Novel Drug Delivery System A Review; JETIR; 2022, Volume 9, Issue 9, pp 590-603.
2. Ms Pranali Deshmukh, Mr Jungare; S.L. A Review on Novel Herbal Drug Delivery System; IJRPR; 2023; Volume 4, Issue 2, pp 1068 -1062.
3. Ms. Shital S. Shinde, Dr. Abhijeet S. Kulkarni, Mr. Omkar D. Kharade, Mr. Bhushan J. Patil, Mr. Kailas A. Pol, Mr. Aniket S. Patil; Recent advantages in novel herbal Drug Delivery System; JETIR: 2023, Volume 10, Issue 2, pp 85-92.
4. Kharat Amol and Pawar; Novel Drug Delivery System in herbal; IJCBS; 2014, 4(4), pp 910-930.
5. Yogesh Murti, Krishna Kumar Agrawal, Bhupesh C. Semwal, Jitendra Gupta, Reena Gupta; A review on Novel Herbal Drug Delivery System and it's application; Bentham Science Publishers, 2023; 9(2); 43-55
6. Mr. Gaurav Vinayak Tekade, Dr. L. D. Hingane; Herbal Drug used in treatment of Diabetes Mellitus; International Journal Of Creative Reasearch Thoughts (IJCRT) 2021; 9(12), 1-19.
7. Prajakta N. Dongare, Anuja S. Motule, Mahesh R. Dubey, Manisha P. More, Prerna A. Patinge, Ravindra I. Bakal and Jagdish V. Manwar; Recent Development in Novel Drug Delivery Systems for Delivery of Herbal Drugs: An Updates; GSC Advanced Research and Reviews, 2021, 008-018.
8. Ayesha Naeem, Liposomes: A novel Drug Delivery System, Hamdard University Faculty of Pharmacy Karachi, Pakistan 1-15.
9. M. Ramya Teja, M. Nandeesh, M. Siddu, D. Manilkanva, Dr. J. N. Suresh Kumar, A review on Liposome; International Journal Of Creative Reasearch Thoughts(IJCRT) ; 2022; 10(4), 648-657.
10. Mahadev B. Khazode, Archana D. Kajale, Madhuri A. Channawar, Shilpa R. Gawande; Review on Phytosomes: A Novel Drug Delivery System; 2020; GSC Biological and Pharmaceutical Sciences,13(01): 203-211.
11. K. Charana Sriya, Dividevara Sai, P. Ravi Sankar; Phytosomes: A Novel Approach for Herbal Phytochemicals for Enhancing the Bioavailability; international Journal of Pharmaceutical Sciences Review and Research(IJPSRR), 2020; 21-26.
12. Amith Kumar B, Prasanna Habbu, Thimmasatty, Lakshman, Prabha Hullatti, Ravi Kumar S; Phytosomes as Novel Drug Delivery System for Herbal Medicine-A Review; Systematic Review In Pharmacy ,2017; 8(1), 5-7.
13. Pooja P Kulkarni, Gururaj S Kulkarni, Padmaa M Paarakh; Phytosomes: A novel Drug Delivery System for Herbal Extracts; International Journal Of Creative Reasearch Thoughts (IJCRT); 2022; 10(10), 458-465.
14. Ansari Mohmmad Faiz Aftab Alam, Dr. Smita Takarkhede, Sujit Ubale; Niosomes as Novel Drug Delivery System: Review Article; International Journal of Pharmaceutical Research and Applications (IJPRA), 2022; 7(1), 171-178.
15. Amaragonda Ramadevi; Niosomes – Novel Drug Delivery System a review; International Journal Of Creative Reasearch Thoughts (IJCRT); 2020; 8(10), 430-435.
16. Hiranman P. Nandure, Dr. Prashant Puranik, Prabhanjan Giram, Vidya Lone, .Ethosome: A Novel Drug Carrier; International Journal of Pharmaceutical Research & Allied Sciences (IJPRAS); 2013; 2(4), 18-30.

17. Pratiksha K Jadhav, Kundan A Kapadnis, Dattatraya M Shinkar, Vasim T Pathan, Anil G Jadhav; Ethosomes as Novel Drug Delivery System: A Review, international Journal of Pharmaceutical Sciences Review and Research(IJPSRR); 2020; 173-182.
18. Manish Kumar Gupta, Santosh Govind Jadhav, Vivek Shamsundar Kulkarni; Transferosome: Novel Nanovesicular Drug Delivery System; International Journal Of Pharmacy And Pharmaceutical Research (IJPPR); 2021; 20(4), 425-437.
19. Dr. Sunitha Reddy M. And Anusha; Transferosomes Novel Drug Delivery System A Review; International Journal Of Creative Reasearch Thoughts (IJCRT); 2020; 8(9), 1735-1744.
20. Urvashi Sharma, Poojashree Verma and Neetesh K. Jain; A Review on Novel Vesicular Drug Delivery System: Transfersomes; International Journal Of Pharmacy And Life Sciences (IJPLS); 2020; 11(7), 6812-6824.
21. Kataria Sahil, Middha Akanksha, Sandhu Premjeet, Ajay Bilandi and Bhawana Kapoor; Microspheres a review; International Journal Of Research In Pharmacy And Chemistry (IJRPC); 2011, 1184-1198.
22. Athira K, K Vineetha, Krishnananda Kamath K, A R Shabaraya; Microspheres as A Novel Drug Delivery System – A Review. International Journal of Pharmaceutical Sciences Review and Research (IJPSRR); 2022, 160-166.
23. Ananta Choudhury, Debasish Deka, Kashmiri Sonowal, Rahela Eyachmin Laskar; Microspheres a promising approach for a drug delivery; Journal Of Applied Pharmaceutical Research (JOAPR). 2019; 7(2), 1-6.

