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Comprehensive Review On Micro-Encapsulation

Miss. Kamble Neha Annasaheb[1], Mrs. Maske Deepti N.[2] ,Mrs. Devale Rasika [3]

YSPM's Yashoda Technical Campus, Faculty of pharmacy, wadhe, satara.
Corresponding Author E-mail- kambleneha2008@gmail.com

ABSTRACT:

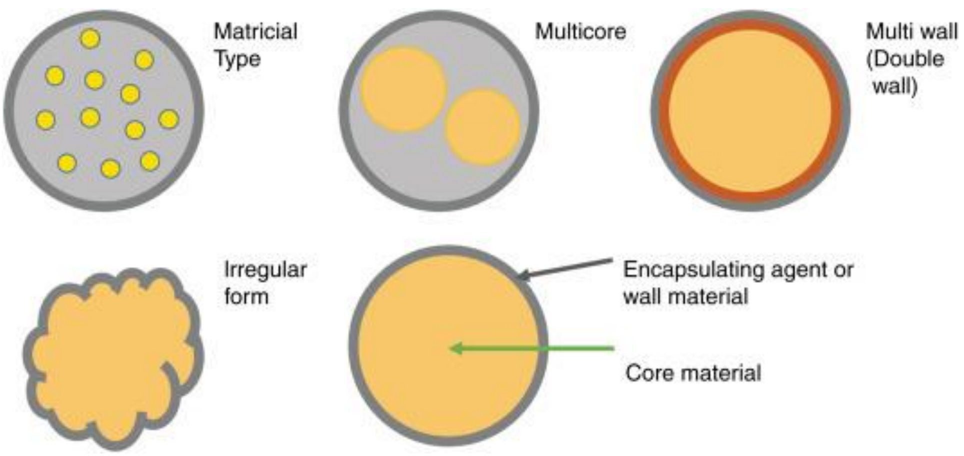
The purpose of this review is to define microencapsulation, which is the process of encapsulating micron-sized particles or liquids or gases in an inert shell, thus isolating and protecting them from the external environment and controlling drug release profiles. In this review, the background of this technology and its applications in medicine will be examined. Encapsulation efficiency of microcapsules, solubility and concentration of polymer in solvent, solvent removal rate, etc. It depends on many factors such as. This also includes the evaluation of microcapsules and related materials, the technology, the release process, and the new material creation process.

INTRODUCTION:

Microencapsulation is the process of encapsulating small particles or droplets into a layer to create effective small capsules. Microencapsulation is a rapid modification.

Microencapsulation includes bioencapsulation, which is limited to encapsulating biological substances and often improving their properties to extend shelf life. Microcapsules are systems in which small droplets or particles of liquid or solid are surrounded or coated by a non-degrading film of polymeric material.

Fig: Structure of outer and inner material



Several of these properties can be attained by micro packaging technique:

- Microencapsulation is a system through which very tiny droplets or debris of liquid or stable fabric are surrounded or covered with a non-stop movie of polymeric fabric.
- Microencapsulation is more limited to bioencapsulation, where bioencapsulation of bioenergetic substances (from DNA to negative molecules or cellular tissue) is usually encapsulated to improve their performance and enhance their shelf life.
- Microencapsulation offers a way to convert water into solids, replace the colloidal material and substrate, provide environmental protection, and control emission properties or have a cap.

TECHNIQUES INVOLVED IN MICROENCAPSULATION:

1)Physical methods-

a) Pan coating:

- The Coating system is widely used in the pharmaceutical industry and is one of the oldest industries for the production of small coated granules or tablets.
- This method uses a standard process to convert solid waste while using hot air to promote the evaporation of the solvent.
- Roll the product in a pan or other utensil while working slowly over the fabric.

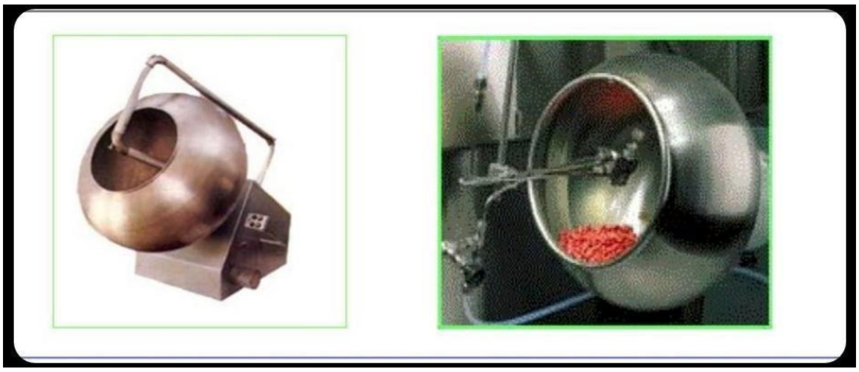


Figure: Pan coater

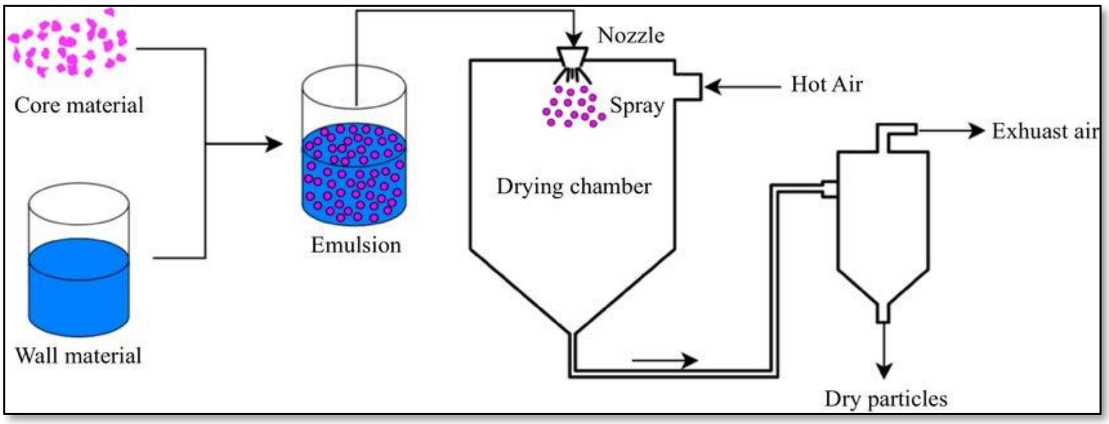
b) Air-suspension coating:

- Air suspension coating was first described in 1959 as professionally provided by Professor Dale Erwin Wurster of the University of Wisconsin . operability and versatility compared to cap plating.
- In this process, intermediate particles are dispersed in an air support and these dispersions are primed with polymer in a solvent-free company and a thin layer is left on them.
- This air suspension process depends on the layer thickness etc. It is repeated hundreds of times until the requirements are met. The temperature of the airflow will also affect the performance of the process.

c) Centrifugal Extrusion :

- This is another encapsulation method that has been investigated and utilized by a few manufacturers.
- This is another encapsulation method being studied and used by some companies.
- Many food-approved coatings are designed to encapsulate products such as herbs,seasonings and vitamins.
- Centrifugal extrusion is a method of liquid coextrusion that uses a nozzle with concentric holes around the circumference of a rotating cylinder (e.g., a spike).

d) Spray drying:



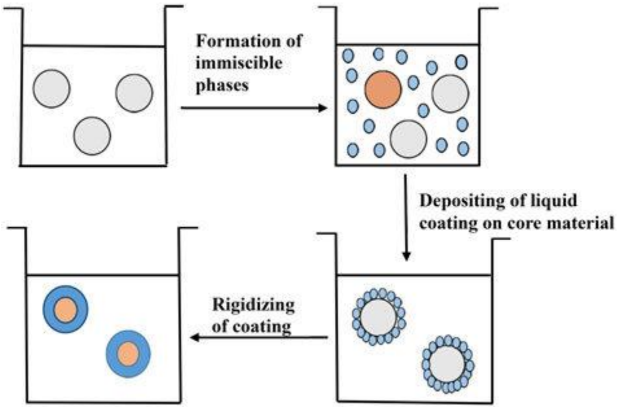
- It is one of the most used microencapsulation and drying technologies in the food and pharmaceutical industry. It is flexible, economical, efficient, clean, scalable and easy to use with equipment. and produce quality powder.
- It has been used for many years mainly for the encapsulation of bioactive foods including protein, fat, vitamins, enzymes, colorants and flavors.

- However, its use in hot energy products (such as bacteria and essential oils) is limited because the extreme temperatures specified may cause evaporation and/or destruction of the product.

2) Physico-chemical methods:

a) Coacervation-

- The fact the middle fabric is absolutely entrapped via way of means of the matrix.
- Actually, it is all the way the medium enters the matrix.
- This method involves separating and precipitating the colloidal fraction from the aqueous fraction.
- Both simple and complex agglomeration techniques can be used.
- Simple coagulation uses non-solvent products or more water-soluble polymers.
- Polymers compete for solubility of gelatin protein responses through hydrophobic interactions.



b) Polymerization-

- It is a new microencapsulation technology that uses the idea of polymerization to create protective microcapsules in space.
- This process involves the response of the monomer unit to the flow coupling between the primary and continuous materials in which the central fabric breaks.
- The interference-free or coating surface is usually liquid or oil, so polymerization reaction occurs between liquid-liquid, liquid-oil, material-liquid or oil-oil camoflagements.

I. Interfacial polymerization:

- The materials which are employed involves multifunctional monomers, which include multifunctional isocyanates multifunctional acid chlorides.
- These can be used both personally or in combination.The multifunctional monomer dissolved in liquid center material.
- A coreactant multifunctional amine go through directly be delivered to the mixture.
- Base is delivered to neutralize the acid fashioned all through the reaction.

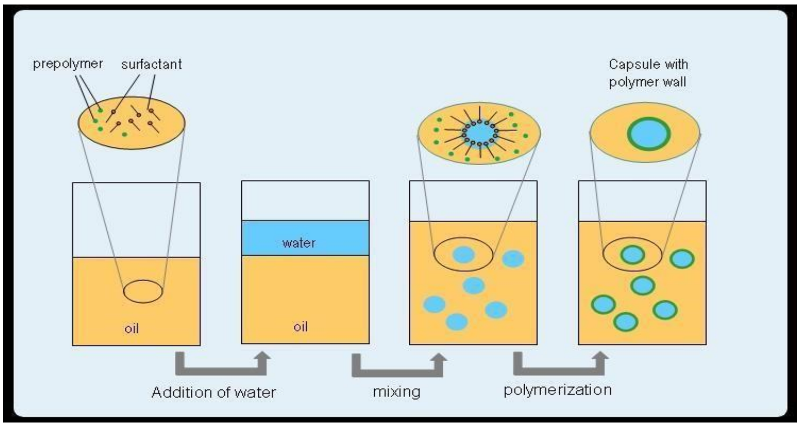


Figure: Interfacial polymerization

II. In situ Polymerization-

- Polymerization happens completely within side the continuous segment and at the non-stop segment side of the interface shaped with an aid of using the dispersed core material and non-stop segment.
- First, a high molecular weight prepolymer is created, which increases in size over time.

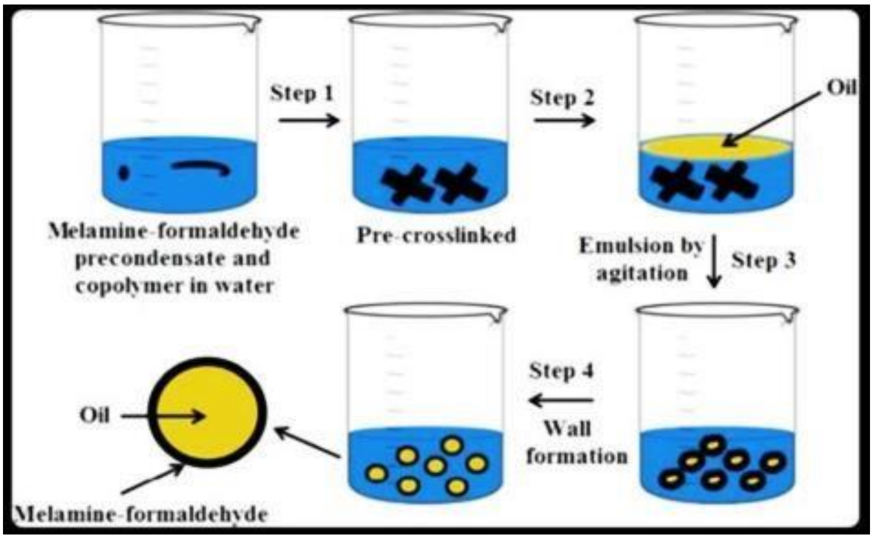


Figure: In situ polymerization

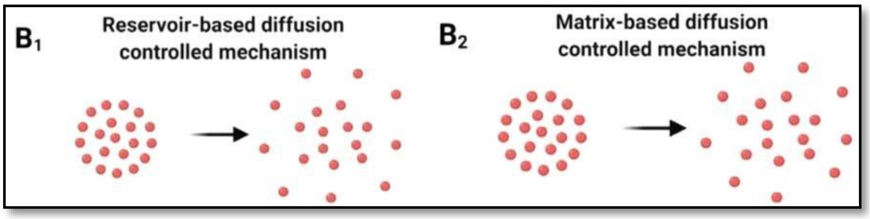
MECHANISM AND KINETICS OF DRUG RELEASE:

a) <u>Diffusion:</u>

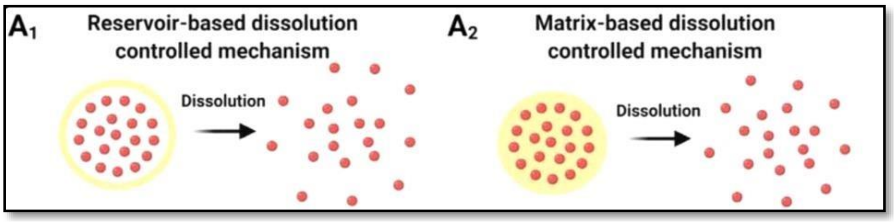
- It is the most common chemical release (parent material), in which the dissolution liquid enters the shell, and then contacts the parent material with the liquid dissolution and it is done through intermediate channels or pores.
- The release of the drug depends on the amount of drug in the liquid dissolution, the penetration of the dissolved drug into the microcapsules, and the amount of drug dissolved in the microcapsules.

b) <u>Dissolution</u>:

- When the layer is soluble in the dissolving liquid, the amount of drug released from the microcapsules depends on the dissolution rate of the polymer layer.



- Solubility in the eluent and layer thickness both affect the release rate.



c) <u>Osmosis</u>:

- The essential term of an osmosis is semi permeable membrane and in microcapsule polymer coat mainly serves the main purpose.
- As the process progress an osmotic pressure is generated comprising the outside and the inside membrane of microcapsule which result in

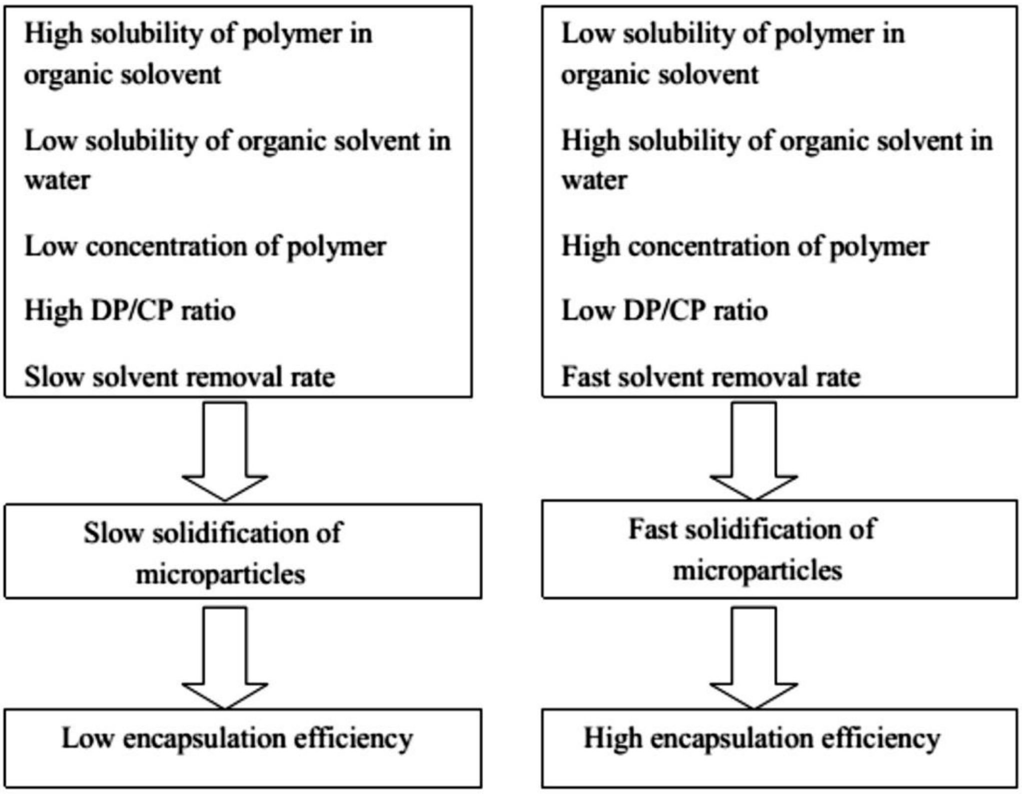
release of drug through small pores.

d) Erosion:

- It normally happens because of pH or enzymatic hydrolysis and causes drug release with certain coat materials like bee's wax, stearyl alcohol and glyceryl monostearate.
- The physiochemical homes of middle materials like solubility, diffusibility and partition coefficient and of coating materials like variable porosity, thickness and inertness which makes hard to modelling of drug release.

FACTORS INFLUENCING MICROENCAPSULATION:

i. Material properties: -



a. Dispersed phase-

- With the smash in attention of polymer, there can be upward drive in encapsulation in performance of medicine and if the disperse member is simply too thick it reduces microcapsules porosity hence sustained the medicine release.
- The charge of solvent elimination is always depend on temperature, a fast rise within the temperature goods inside the conformation of skinny-walled microcapsules.
- Additionally, improvement of temperature reduces the scale of the center lading to controlled medicine launch.
- The interpretation in the middle cloth composition affords specific inflexibility and application of this
- characteristic also permits effective design and enhancement of the preferred microcapsule parcels.

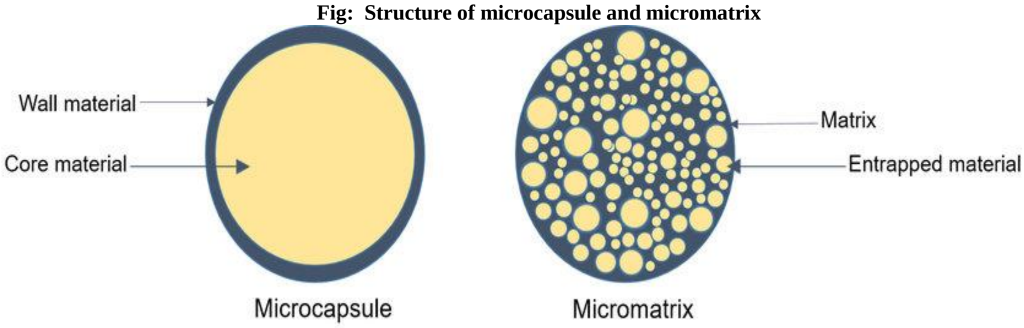
Liquid core material Examples:
Perfumes,Cosmetics,pesticides,Sugars,Salts,Pigments, nutrients

strong core material Examples:
Dextrins, Bases, Herbicides, prescription drugs, Biocides , Minerals

Coating material:

They mainly include inert polymers like ethyl cellulose and pH sensitive ones, such as carboxylate and amino derivatives, which swell or dissolve according to the degree of cross-linking.

Fig: Structure of microcapsule and micromatrix



PARAMETERS INVOLVED:

Particle size distribution:

Particle size analysis12 of the microcapsules can be done by sieving method using Indian Standard Sieves # 16, #20, #30, #40, #60 and #80 done by Indian Pharmacopoeia. 1996.

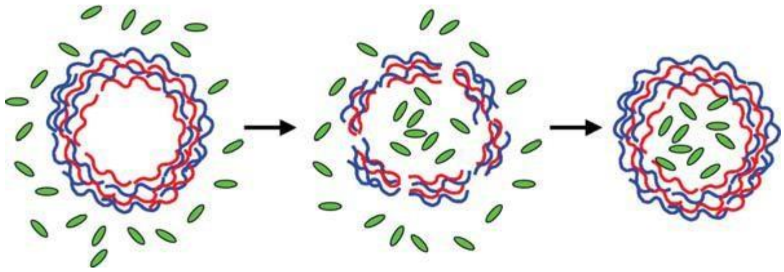


Fig: Encapsulation by permeability control.

Shape and surface morphology:

The shape and surface morphology of the microcapsules was studied by using scanning electron microscope are employed successfully by pharmacopeial standards.

Microcapsules were mounted directly onto the SEM sample stub consequently.

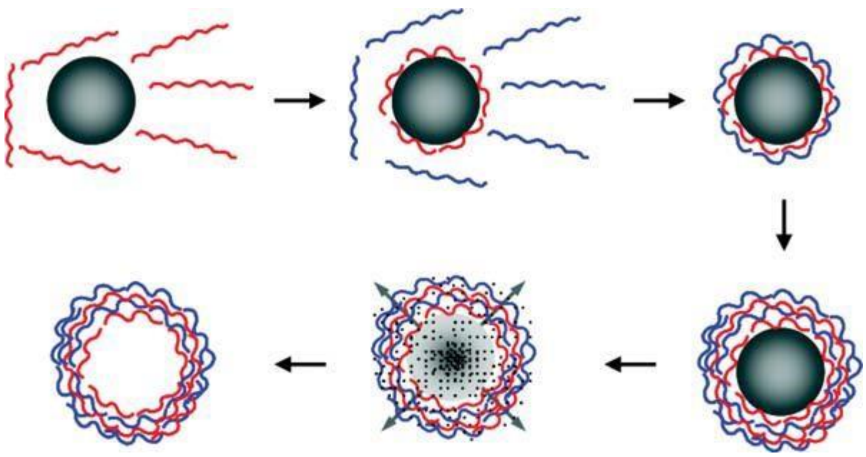


Fig: Schematic of hollow capsule preparation.

Isoelectric factor:

- The micro electrophoresis is an device this is used to degree electrophoretic mobility of microsphere via Which isoelectric element can subsequently calculated.
- The mobility is correlated to ground contained free as well as ionisable behaviour or ion absorption nature of the respective microcapsules.

Drug release Kinetics:

It is incorporated to elaborate the mechanism of drug launch from the microcapsules, the discharge information have been analyzed the use of zero-order kinetics , Higuchi, Korsmeyer–Peppas, Kopcha, and Makoid–Banakar evaluation parameters.

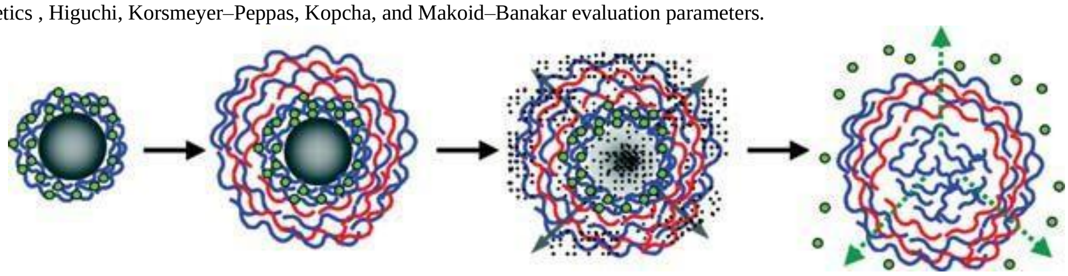


Table: Mathematical Models for Drug Release Microencapsulation

DRUG MODEL RELEASE	MATHEMATICAL EQUATION
Zero-order	Qt = Qo + Kot
Higuchi	Qt = Qo + KHt1/2
Korsmeyer–Peppas	Qt = KKP tn
Makoid–Banakar	Qt = KMB tne (-ct)

Microencapsulation Analysis

Scanning electron microscopy is used to perform microstructural analysis.

The samples were coated under a vacuum via cathodic sputtering before performing microscopy analysis.

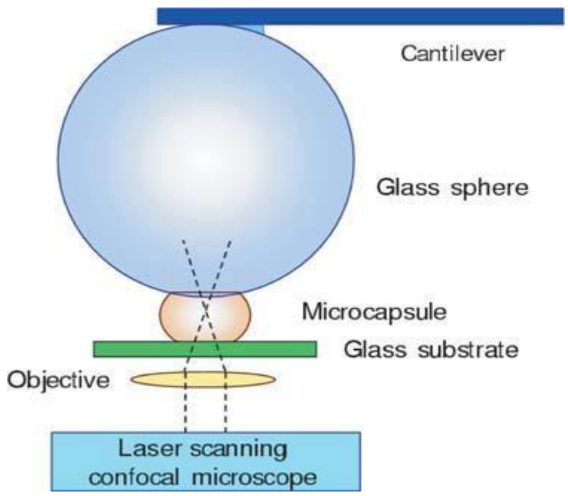


Figure: Schematic of an microstructural experiment

APPLICATIONS:

1. It provides protection of the liquid crystals.
2. In textiles mainly for imparting finishes
3. It also employed in beverage production
4. It provides the quality and safety in food, agricultural and environmental fields.

5. It is mostly used in cell immobilisation for plant cell cultures, human tissue which is turned into bio-artificial organs additionally in fermentation process.
6. For controlled release delivery system component.

CONCLUSION:

Microencapsulation especially shows the packaging of an active ingredient internal a shell or a capsule ranging in size from one micron to several millimetres. The capsule protects the energetic element from the entire surrounding environment till the precise time. Then, the material escapes through the tablet wall by means of diverse means, which include rupture, dissolution, diffusion. therefore, as it is science and an artwork it doesn't include one manner to formulate it. additionally, it affords a fresh assignment for the mastery of numerous extraordinary technologies.

REFERENCES:

1. Lachman L, Lieberman HA, Kanig JL, editors. The theory and practice of industrial pharmacy. 3rd ed. Ch. 13, Part III. 1991, Varghese Publishing House, Bombay 412-28.

2. Bansode SS, Banarjee SK, Gaikwad DD, Jadhav SL. Microencapsulation: a review. Inter J Pharm Sci Review and Research. 2010; 1:38–43.

3. Aulton ME. Pharmaceutics The science of dosage form design. New York: Churchill Livingstone: 1988.605-13.

4. Arshady R. Preparation of biodegradable microspheres and microcapsules of polylactides and related polyesters. J Control Rel.1991; 17:1-22.

5. Indian Pharmacopoeia. 1996. 3rd ed. Delhi: Controller of publications, vol.-II, A-7 pp 202-206.

6. Vyas S P, Khar R K. 2002. Targeted and controlled drug delivery. New Delhi, India: CBS Publisher and Distributer.

7. Desai, N.M.; Haware, D.J.; Basavaraj, K.; Murthy, P.S. Microencapsulation of antioxidant phenolic compounds from green coffee. Prep. Biochem. Biotechnol. 2019, 49, 400–406.

8. Singh M.K., Khare G., Iyer S., Sharma G., Tripathi D.K. Clerodendrum serratum: A Clinical approach. JAPS. 2012.

9. Olawuyi, I.F.; Park, J.J.; Lee, W.Y. Effect of extraction conditions on ultrasonic-assisted extraction of polyphenolic compounds from okra (Abelmoschus esculentus L.) leaves. Korean J. Food Preservatives. 2020, 27, 476– 486.

10. Bhaskar, D. Kahane, A. Singh, A. M. Uttam, J., Jayram, C.M. and Bhanudas, S.R. (2013). Plant exudates and Mucilage as Pharmaceutical Excipients.
11. Journal of Advance Pharmacy Education & Research, vol. 3, pp. 387-402.

12. Ameena, K. Dilip, C. Saraswathi, R. Krishnan, P.N., Sankar, C. and Simi, S.P. (2010). Isolation of the mucilages from Hibiscus rosasinensis Linn. and studies of the binding effects of the mucilages. Asian Pacific Journal of Tropical Medicine, pp. 539-543.

13. Sinha, P. Ubaidulla, U. and Nayak, A.K. (2014). Hibiscus esculentus gumalginate blend mucilage beads for controlled glibenclamide release. Journal of Biological Macromolecules, 2014.

14. Zaharuddin, N.D. Noordin, M. I. and Kadivar, A. (2014). The Use of Hibiscus esculentus Gum in Sustaining the Release of Propranolol Hydrochloride in a Solid Oral Dosage Form. BioMed Research International, vol. 3.

14. Pr akash K, Raju PN, Shanta KK, and Lakshmi MN. Preparation and characterization of lamivudine microcapsules usin g various cellulose polymers. Tropical J PharmRes. 2007;6(4):841 - 47.

15. Mendelsohn JD, Barret CJ, Chan VV, Pal AJ, Mayes AM, Rubner M. 2000. Fabrication of microporous thin films from polyelectrolyte multilayers. Langmuir 16:5017 _ 23 .

16. Lulevich VV, Radtchenko IL, Sukhorukov GB, Vinogradova OI. 2003. Mechanical properties of polyelectrolyte microcapsules filled with a neutral polymer. Macromolecules 36:2832 _ 37 .

17. Yakubov GE, Vinogradova OI, Butt HJ.2000. Contact angle on hydrophobic microparticles at water - air and water hexadecane interfaces. J. Adhesion Sci. Technol. 14:1783 _ 99 .

18. Goodwin JT, Sameville GR. Microencapsulation by physical methods. Chemtech 1974;4:623 - 6.

19. Dick SJ. The Biological Universe. Cambridge: Cambridge University; 1999 . p. 340.

20. Boh B, Hauser K, Dasilva A. Microencapsulation pollution prevention, International Journal of Scientific Study | July 2017 | Vol 5 | Issue 4 268 developing support for introducing clean technologies and products. Ljubljana: International Centre for Chemical Studies: S lovenian National Commission for Unesco; 1996. p. 205 - 22.