Microencapsulation by Simple Coacervation Phase Seperation

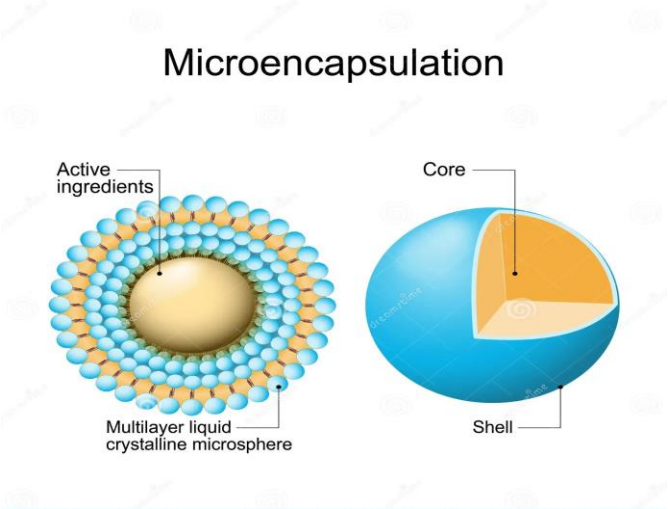
Sivasubramaniam. R[1], S. Mohan Kumar. M. Pharm [2]
[1, 2] Dept of Pharmaceutics
[1, 2] PALLAVAN PHARMACY COLLEGE, KANCHIPURAM

Abstract- *Microencapsulation is a promising technique and emerging technology that offers potential progress in nanomedicines. Coacervation phase separation is a process in which homogenous polymer is partially dispersed in two phases (i.e.) polymer rich phase (coacervate) and poor polymer phase (coacervation medium). Simple coacervation is a type of liquid-liquid phase separation that occurs when a single type of polymer or surfactant is dissolved in a solvent. Simple coacervation phase separation is a type of liquid-liquid phase separation. This technique results in formation of microcapsules or microspheres that incorporates food, pharmaceuticals, other ingredients in core material and is covered by a coating film. Coacervation phase separation emerges as a valid technique in pharmaceutical industries, cosmetics, textiles, food processing, printing and defense sector.*

Keywords*: Microencapsulation, simple coacervation, coacervation phase separation, microcapsules*

I. INTRODUCTION

Microencapsulation is a process in which solids, liquid or gases are enclosed within a microscopic particle by forming a continuous thin polymer coating. Microcapsules or microspheres are formed because of microencapsulation. First research on microencapsulation procedure of pharmaceuticals was nearly 1930's and it dealt with preparation of gelatin spheres by Bungen burg de jong and kan. Incorporation of enzymes, cells, volatile oils, nutrients, probiotics, prebiotics, pharmaceuticals in a micrometric scale is held in microencapsulation. This provides slow, controlled and targeted drug delivery of API in patient body. Microcapsules are spherical or non-spherical reservoir particles varying in size ranges from 100-150 µm.



Coacervation phase separation is a process in which a homogenous polymer is partially dissolved in polymer rich phase (coacervates) and poor polymer phase (coacervation medium). In simple term it is the separation of liquid phase of coating material from polymeric solution and is uniformly coated over the suspended core materials. The word coacervation originated from Latin word "acervus" (heap) which means dense liquid droplets.

Coacervation phase separation technique is of two types

- Simple coacervation phase separation:
  This type includes only one homogenous polymer for phase separation
  Example: gelatin, polyvinyl alcohol, alginates, cellulose

- Complex coacervation phase separation:
  This type involves two oppositely charged polymers to attain polymer-polymer interaction
  Example: gelatin-gum arabica system

II. SIMPLE COACERVATION PHASE SEPARATION

Simple coacervation in microencapsulation technique involves entrapping of active pharmaceutical compounds in core material by a coating material using a homogenous polymeric solution.

Phase separation is achieved by desolvation (dehydration) of polymeric phase.

Steps involved in simple coacervation phase separation technique:

Step 1: Formation of three immiscible liquid phases:

- Solvent for coating material
- Core material phase (insoluble in solvent)
- The coating material phase (made by separating the polymer from solvent)

Methods to achieve coacervation:

- Change in temperature
- Addition of incompatible polymer
- Addition of non-solvents
- Addition of salts
- Polymer-polymer interaction

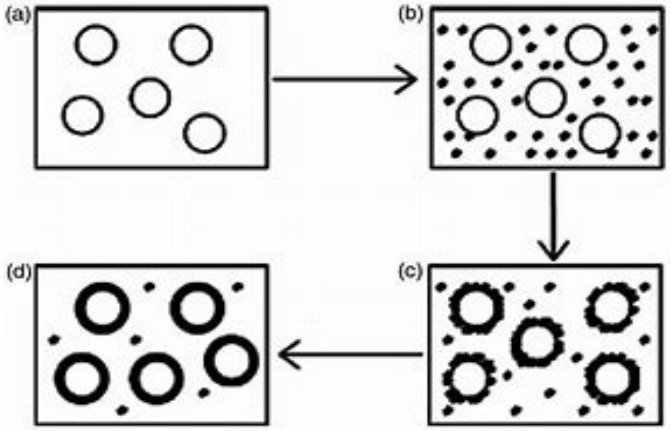
Step 2: Deposition of coating material around the core

In this step the separated polymeric coating material deposit around the coating material, only if the interfacial tension of the coat is less then the coat. The deposit rate can be controlled by conditions like viscosity, speed, temperature.

Step 3: Solidification of the coat

Viscosity of the core material increases and the microcapsule obtained undergo aggregation. The coat material solidifies after desolvation of microcapsule.
Hardening of core material can be done by:

- Desolvation
- Change in in pH R
- educe in temperature
- Cross linking or gelation,etc...



a) Core material dispersed in solution of polymer
b) Separation of coacervate from solution
c) Coating of core material by coacervate
d) coalescence of coacervate to form uniform shell

Advantages:

- Increase stability
- Decrease degradation of drugs
- Reduce dose frequency
- Improve patient compliance
- It provides sustained, prolonged, delayed or controlled release of drugs
- It mask, odour, unpleasant taste of some drug

Application:

- Pharmaceutical industry
- Textile industry
- Agriculture
- Food industry
- Printing
- Cosmetic preparation
- Defense

III. CONCLUSION

Microencapsulation is effective and emerging technology that offers potential in future in formulation of nanomedicines. this technique incorporates food, enzymes, cells, volatile oils, probiotics, prebiotics and other substances in micrometric scale to increase shelf life, reduce potential danger while handling toxic substances. This technique aims to protect core material from external environment and acts as a barrier to physiochemical degradation of drug substances.

REFERNCES

[1] Singh MN, Hemant KS, Ram M, Shivakumar HG. Microencapsulation: A promising technique for controlled drug delivery. Res Pharm Sci. 2010 Jul;5(2):65-77. PMID: 21589795; PMCID: PMC3093624.
[2] Wu, K.G. and Xiao, Q., 2005. Microencapsulation of fish oil by simple coacervation of hydroxypropyl methylcellulose. Chinese Journal of Chemistry, 23(11), pp.1569-1572
[3] Mauguet, M.C., Legrand, J., Brujes, L., Carnelle, G., Larré, C. and Popineau, Y., 2002. Gliadin matrices for microencapsulation processes by simple coacervation method. Journal of microencapsulation, 19(3), pp.377-384.

[4] Jyothi, S.S., Seethadevi, A., Prabha, K.S., Muthuprasanna, P. and Pavitra, P., 2012. Microencapsulation: a review. Int. J. Pharm. Biol. Sci, 3(2), pp.509-531.

[5] Siddiqui, O. and Taylor, H., 1983. Physical factors affecting microencapsulation by simple coacervation of gelatin. Journal of Pharmacy and Pharmacology, 35(2), pp.70-73.

[6] Lazko, J., Popineau, Y. and Legrand, J., 2004. Soy glycinin microcapsules by simple coacervation method. Colloids and Surfaces B: Biointerfaces, 37(1-2), pp.1-8.

[7] Arshady, R., 1990. Microspheres and microcapsules, a survey of manufacturing techniques Part II: Coacervation. Polymer Engineering & Science, 30(15), pp.905-914.

[8] Paulo, F. and Santos, L., 2017. Design of experiments for microencapsulation applications: A review. Materials Science and Engineering: C, 77, pp.1327-1340.

[9] Murua, A., Portero, A., Orive, G., Hernández, R.M., de Castro, M. and Pedraz, J.L., 2008. Cell microencapsulation technology: towards clinical application. Journal of controlled release, 132(2), pp.76-83.

[10] Cook, M.T., Tzortzis, G., Charalampopoulos, D. and Khutoryanskiy, V.V., 2012. Microencapsulation of probiotics for gastrointestinal delivery. Journal of controlled release, 162(1), pp.56-67.

[11] Sarao, L.K. and Arora, M., 2017. Probiotics, prebiotics, and microencapsulation: A review. Critical reviews in food science and nutrition, 57(2), pp.344-371.

[12] Anal, A.K. and Singh, H., 2007. Recent advances in microencapsulation of probiotics for industrial applications and targeted delivery. Trends in food science & technology, 18(5), pp.240-251.

[13] Etchepare, M.D.A., Barin, J.S., Cichoski, A.J., Jacob-Lopes, E., Wagner, R., Fries, L.L.M. and Menezes, C.R.D., 2015. Microencapsulation of probiotics using sodium alginate. Ciência Rural, 45, pp.1319-1326.

[14] Gasperini, L., Mano, J.F. and Reis, R.L., 2014. Natural polymers for the microencapsulation of cells. Journal of the royal society Interface, 11(100), p.20140817.

[15] Park, J.H., Ye, M. and Park, K., 2005. Biodegradable polymers for microencapsulation of drugs. Molecules, 10(1), pp.146-161.

[16] Durán, N., Alvarenga, M.A., Da Silva, E.C., Melo, P.S. and Marcato, P.D., 2008. Microencapsulation of antibiotic rifampicin in poly (3-hydroxybutyrate-co-3-hydroxyvalerate). Archives of pharmacal research, 31, pp.1509-1516.

[17] Trojer, M.A., Nordstierna, L., Bergek, J., Blanck, H., Holmberg, K. and Nyden, M., 2015. Use of microcapsules as controlled release devices for coatings. Advances in colloid and interface science, 222, pp.18-43.

[18] van de Witte, P.J.D.P., Dijkstra, P.J., Van den Berg, J.W.A. and Feijen, J., 1996. Phase separation processes in polymer solutions in relation to membrane formation. Journal of membrane science, 117(1-2), pp.1-31.

[19] Kulkarni, A.R., Soppimath, K.S. and Aminabhavi, T.M., 1999. Controlled release of diclofenac sodium from sodium alginate beads crosslinked with glutaraldehyde. Pharmaceutica Acta Helvetiae, 74(1), pp.29-36.

[20] Aloys, H., Korma, S.A., Alice, T.M., Chantal, N., Ali, A.H., Abed, S.M. and Ildephonse, H., 2016. Microencapsulation by complex coacervation: Methods, techniques, benefits, and applications-A review. American Journal of Food Science and Nutrition Research, 3(6), pp.188-192.

[21] Bosnea, L.A., Moschakis, T. and Biliaderis, C.G., 2014. Complex coacervation as a novel microencapsulation technique to improve viability of probiotics under different stresses. Food and Bioprocess Technology, 7, pp.2767-2781.