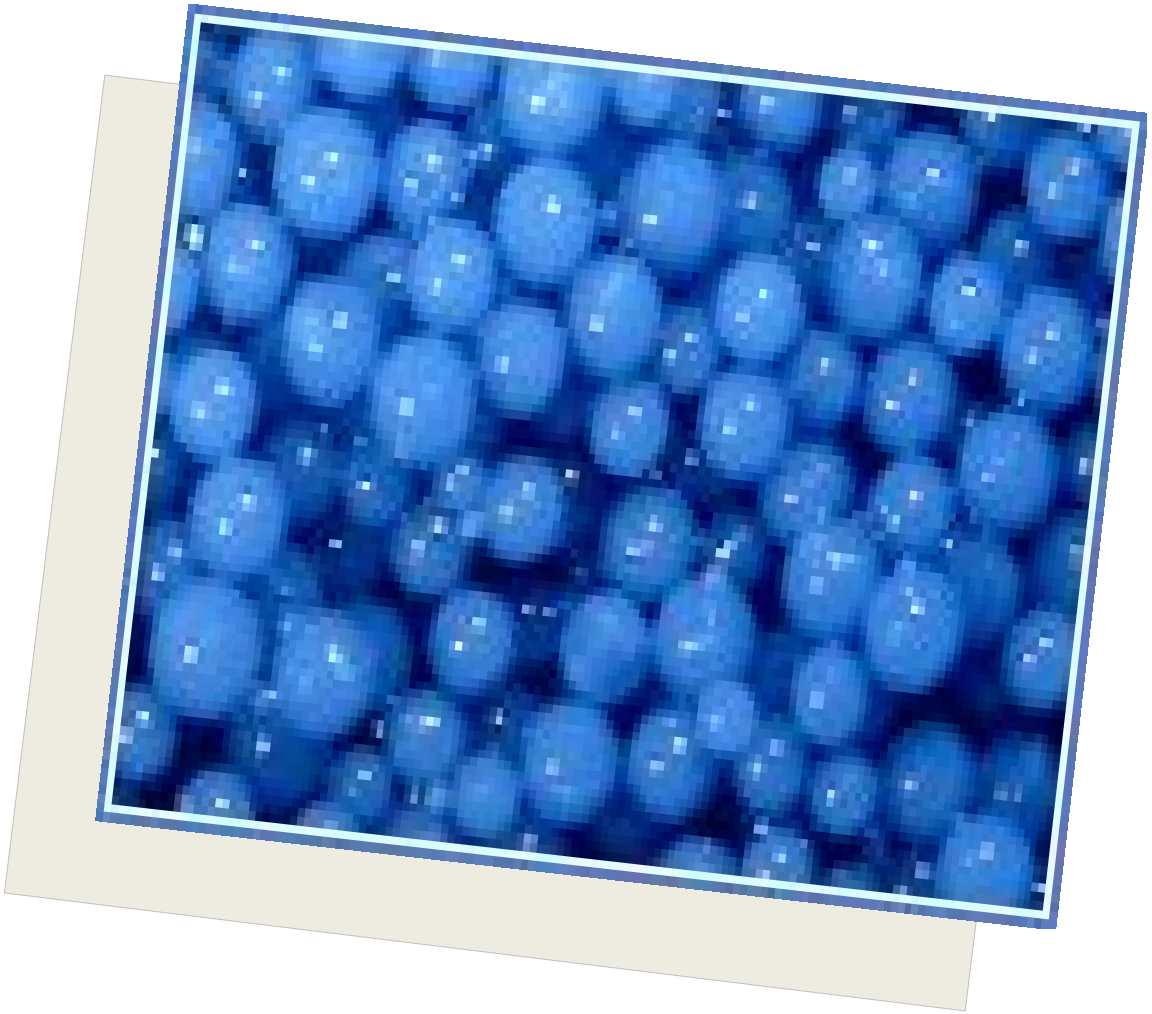
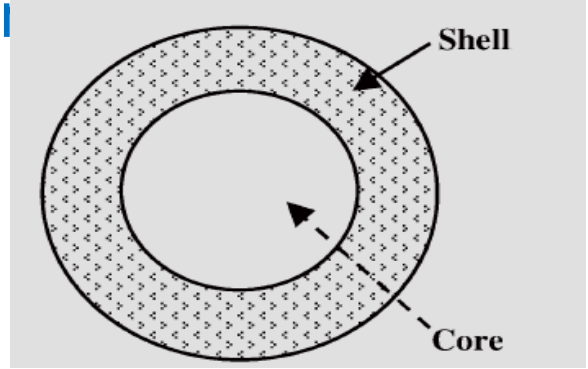
MICROENCAPSULATION



DEFNITION

- Microencapsulation is a mean of applying relatively thin coatings to small particle of solids or droplets of liquids and dispersions.

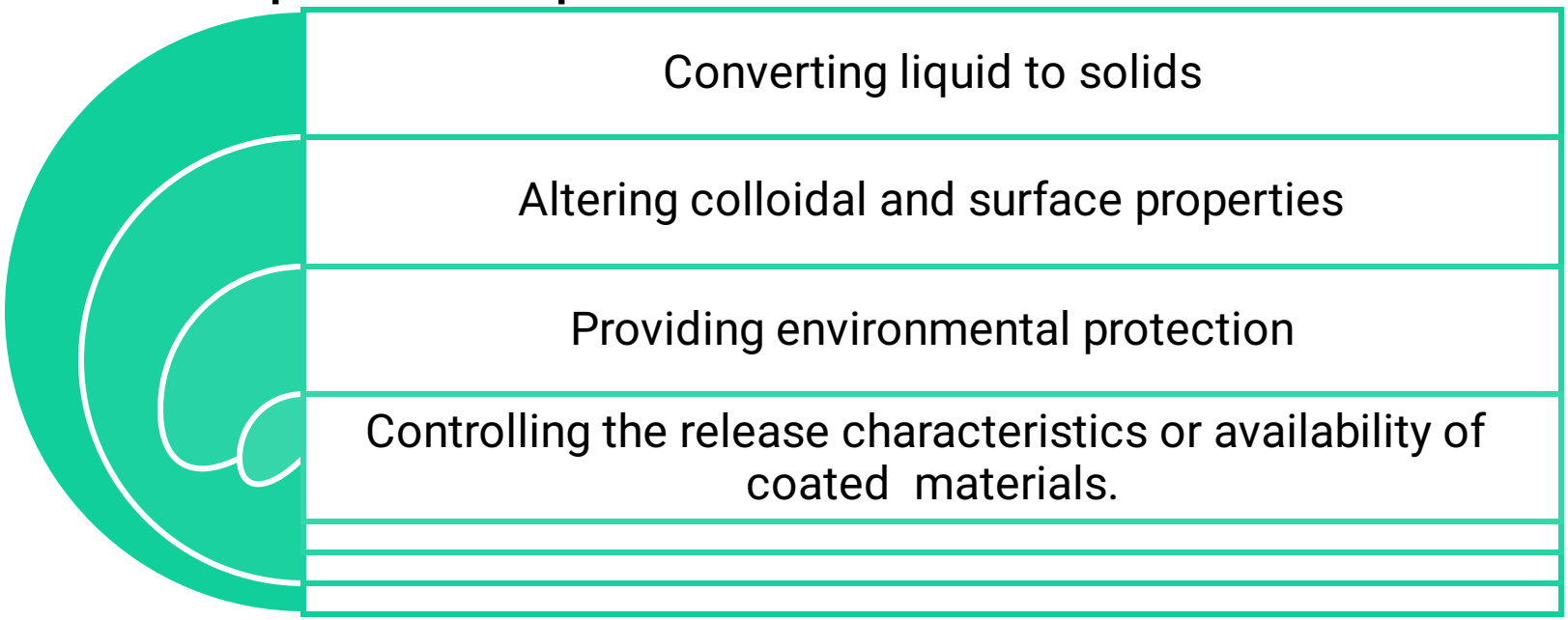
- Microencapsulation also means the process by which individual particles or droplets of solid or liquid material [the core] are surrounded or coated with a continuous film of polymeric material [the shell] to produce capsules in the micrometer to millimeter ra



- Microencapsulation differ from macrocoating technique in the former involves coatings of particles ranging from several tenths of a micron to 500 micron in size but some macrocoating may reach 5000 micron

Advantages of ME:

Microencapsulation provide the mean of :



Note: Uniqueness of microencapsulation is the smallness of the coated particles and their subsequent use in variety of dosage forms.

Applications

1. Sustained release or prolonged action medications
2. Single layer tablet containing chemically incompatible ingredients
3. Pharmaceutically related areas such as hygiene, diagnostic aid, and medical equipment design.
4. Taste masked chewable tablets, powders and suspension
5. New formulation for creams, ointment, aerosols, injectables, plasters, dressings and suppositories.
6. Decrease the gastric irritation e.g.: KCl, and protection of core material from air , light , pH and enzymes.

Selected stability, release and other properties:

- The three important areas of microencapsulation application are:

√ Stabilization of core materials: stabilization of vitamin A palmitate oil against oxidation and to retard degredative loses.

√ The control of the release or availability of core materials: e.g. (sustained release of small aspirin crystals by ethylcellulose coating and release of aspirin is achieved by diffusion since the polymer is inert and pH-insensitive coating)

√ Separation of chemically reactive ingredients within a tablet or powder mixture : An example of stability enhancement accomplished by microencapsulation of incompatible admixed constituents (aspirin and chlorpheniramine maleate).

Disadvantages of ME:

- 1-no single process is adaptable to all core materials
- 2-incomplete coating
- 3- non reproducible
- 4- unstable release characteristics of coated product
- 5-economical limitation

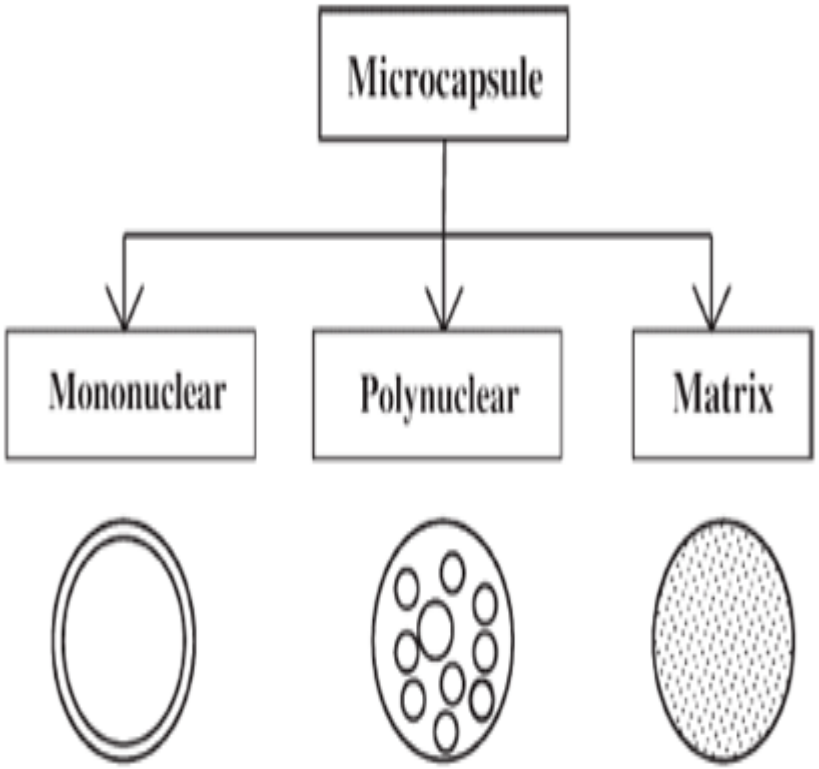
- We have to study core , coat, methodology of ME, mechanism of drug release and stability .

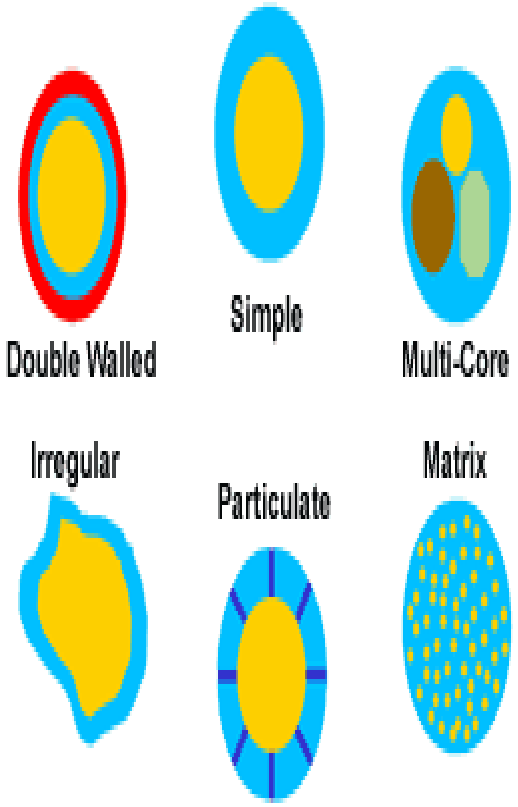
Morphology of Microencapsulation

- Depends mainly on the core material and the deposition process of the shell.

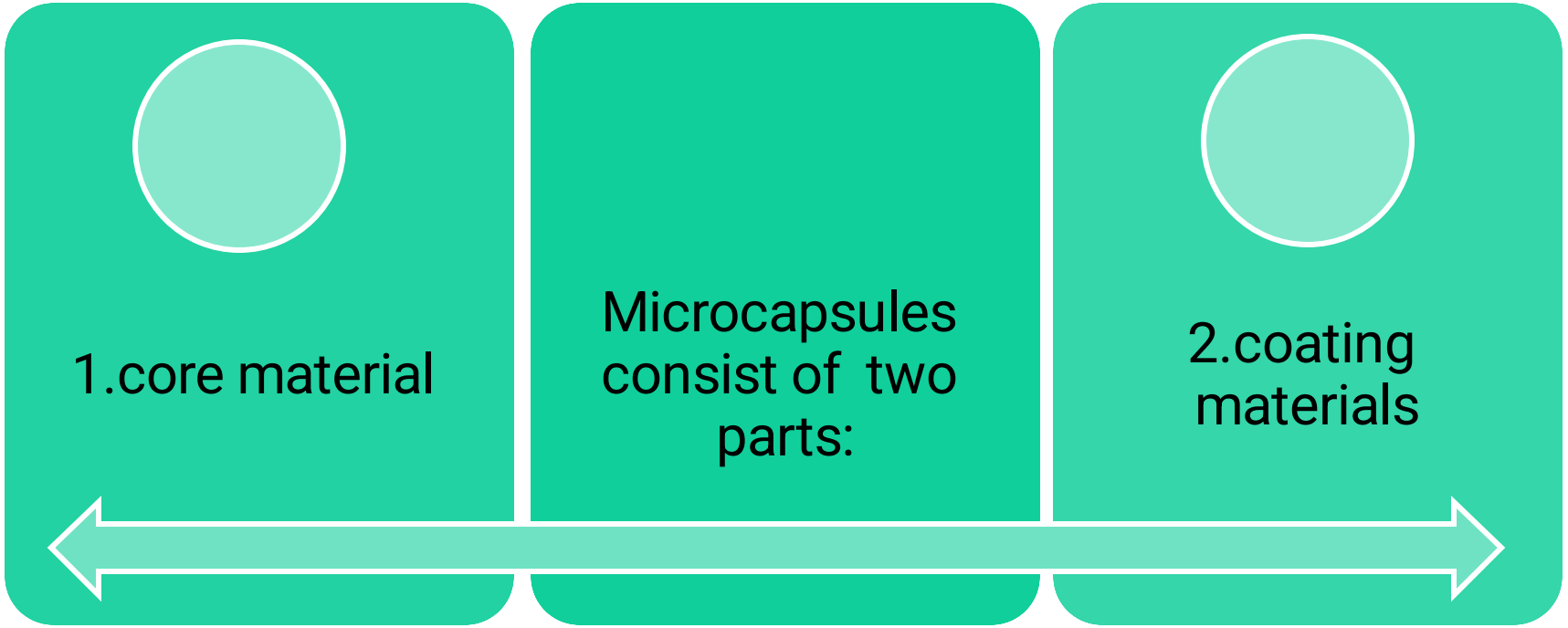
1. Mononuclear (core-shell) microcapsules contain the shell around the core.
2. Polynuclear capsules have many cores enclosed within the shell.
3. Matrix encapsulation in which the core material is distributed homogenously into the shell material.

In addition to these 3 basic morphologies, microcapsules can also be mononuclear with multiple shells or they may be clusters of microcapsules.


Microcapsule
Mononuclear
Polynuclear
Matrix


Double Walled
Simple
Multi-Core
Irregular
Particulate
Matrix

Fundamental considerations



Core material :

It is defined as the specific material to be coated, can be liquid or solid in nature .

The composition of core material can be varied:

- Liquid core: dispersed or dissolved materials
- Solid core: mixture of active constituents, stabilizers, diluents, and release retardants or accelerators._

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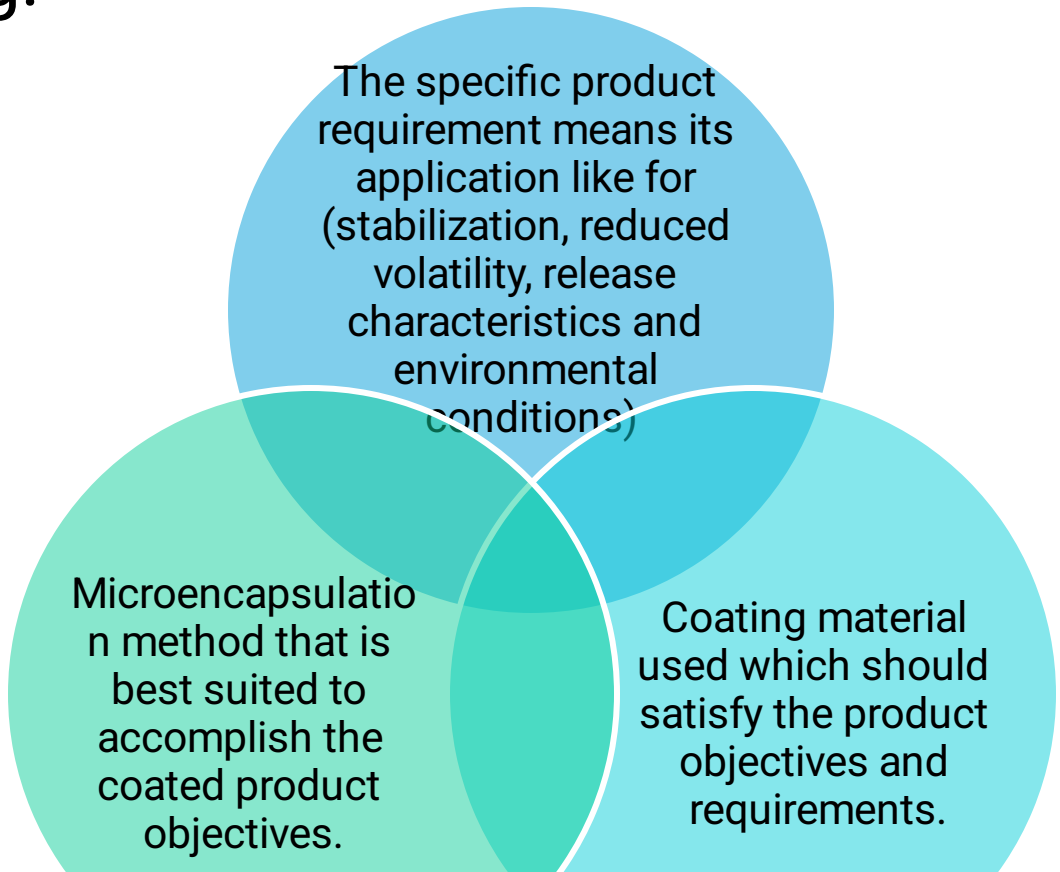
Properties of Some Microencapsulated Core Materials

Core Material	*Characteristic Property*	*Purpose of Encapsulation*	*Final Product Form*
Acetaminophen	Slightly water-soluble solid	Taste-masking	Tablet
Activated charcoal	Adsorbent	Selective sorption	Dry powder
Aspirin	Slightly water-soluble solid	Taste-masking; sustained release; reduced gastric irritation; separation of incompatibles	Tablet or capsule
Islet of Langerhans	Viable cells	Sustained normalization of diabetic condition	Injectable
Isosorbide dinitrate	Water-soluble solid	Sustained release	Capsule
Liquid crystals	Liquid	Conversion of liquid to solid; stabilization	Flexible film for thermal mapping of anatomy
Menthol/methyl salicylate camphor mixture	Volatile solution	Reduction of volatility; sustained release	Lotion
Progesterone	Slightly water-soluble solid	Sustained release	Varied
Potassium chloride	Highly water-soluble solid	Reduced gastric irritation	Capsule
Urease	Water-soluble enzyme	Permselectivity of enzyme, substrate, and reaction products	Dispersion
Vitamin A palmitate	Nonvolatile liquid	Stabilization to oxidation	Dry powder

Coating materials:

The selection of a specific coating material from a list of candidate materials depends on the following:



Classification of coating material

Water soluble resin

Gelatin
Gum Arabic
PVP
CMC
MC
Hydroxy ethyl
-cellulose

Water insoluble resin

Ethyl cellulose
Polyethylene
Polyamide (nylon)
Polymethacrylate
Cellulose nitrate
-silicones

Waxes and Lipids

Paraffin
Carnauba
Beewax
Stearic acid
Stearyl alcohol
Glyceryl stearates

Enteric resin

Shellac
Cellulose
acetate-
phthalate
Zein

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Representative Coating Materials and Applicable Microencapsulation Process

Coating Materials	*Processes*					
	Multiorifice—Centrifugal	*Phase Separation—Coacervation*	*Pan Coating*	*Spray Drying and Congealing*	*Air Suspension*	*Solvent Evaporation*
Water-soluble resins						
Gelatin	X	X	X	X	X	X
Gum arabic		X	X	X	X	X
Starch		X	X	X	X	
Polyvinylpyrrolidone	X	X	X	X	X	
Carboxymethylcellulose		X	X	X	X	
Hydroxyethylcellulose		X	X	X	X	X
Methylcellulose		X	X	X	X	
Arabinogalactan		X	X	X	X	
Polyvinyl alcohol	X	X	X	X	X	X
Polyacrylic acid		X	X	X	X	X
Water-insoluble resins						
Ethylcellulose		X	X	X	X	X
Polyethylene	X				X	X
Polymethacrylate		X	X	X	X	X
Polyamide (Nylon)					X	X
Poly [Ethylene-Vinyl acetate]	X	X	X	X		X
Cellulose nitrate	X	X	X	X		X
Silicones			X	X		
Poly (lactide-co-glycolide)		X	X			X
Waxes and lipids						
Paraffin	X	X	X	X	X	
Carnauba			X	X	X	
Spermaceti		X	X	X	X	
Beeswax			X	X	X	
Stearic acid			X	X		
Stearyl alcohol			X	X	X	
Glyceryl stearates			X	X	X	
Enteric resins						
Shellac		X	X	X	X	
Cellulose acetate phthalate		X	X	X	X	X
Zein		X			X	

The coating material should be:

- Capable of forming a film that is cohesive with the core material
- Be chemically compatible and non reactive with the core
- Provide the desired coating properties, such as strength, flexibility, impermeability, optical properties and stability.

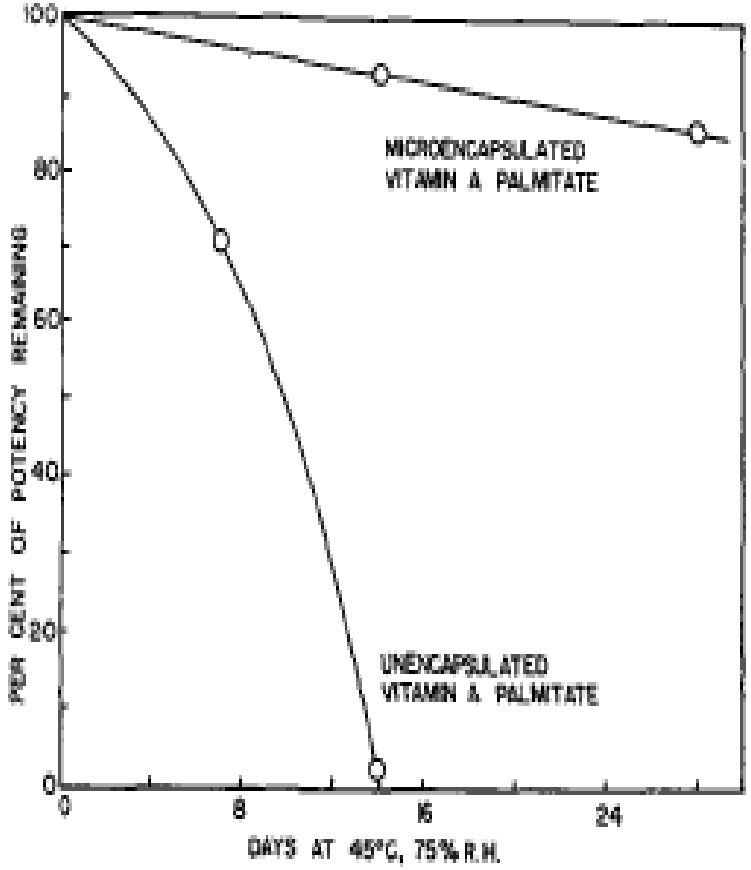

FIG. 13-32. *Stability of a microencapsulated vitamin A palmitate corn oil prepared by phase-separation/coacervation technique, compared with an unencapsulated control. (From Bakan.[3])*

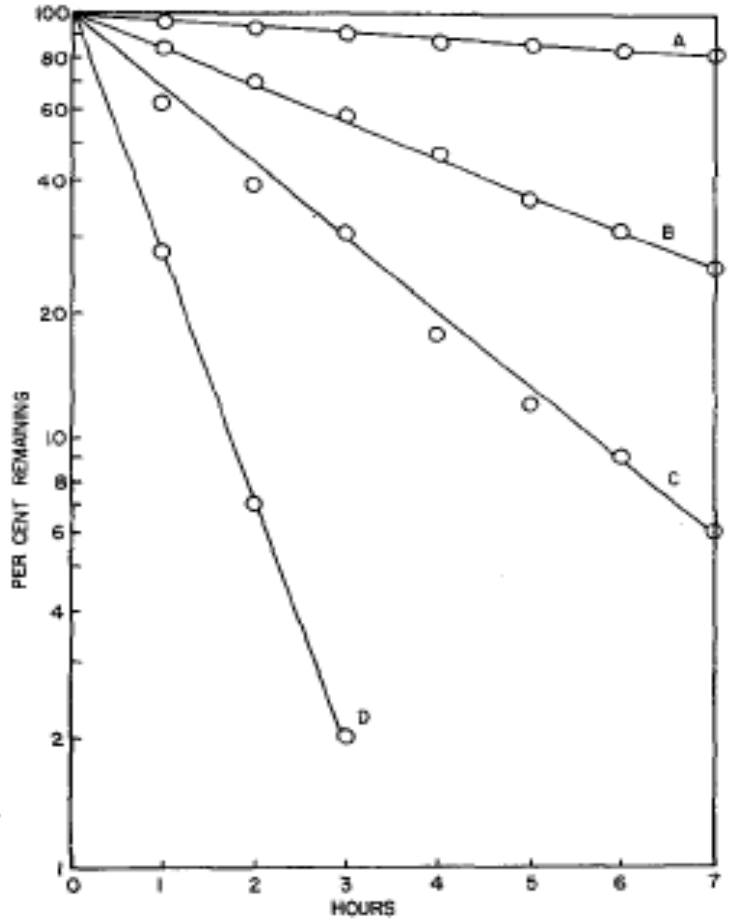

Fig. 13-35. *In vitro release patterns of crystalline aspirin coated with various amounts of ethylcellulose using phase-separation/coacervation techniques. A, 52% coating; B, 29% coating; C, 16% coating; D, 13% coating. (From The NCR Corporation.[4])*

Equipment and processing

- Processing: Microencapsulation of bulk materials is either as a dry powder or as a dispersed form and processed to final product form.

- Equipment: Microencapsulation done by either simple laboratory equipments or complex machines specially designed for e.g. (V-blenders, Tab. Machines, granulators, homogenizers, kneaders, H.G.C. filling machines or coating equipments).

To avoid rupture, attrition, dissolution