CHAPTER 12

CAPSULES

Author

Mr. Gourab Saha

Assistant Professor, College of Pharmaceutical Sciences, Berhampur, Ganjam, Odisha, India

Abstract

Capsules are versatile solid dosage forms that offer unique advantages in drug delivery and patient acceptance. This section covers both hard and soft gelatin capsules, exploring their composition, manufacturing processes, and applications. The properties of gelatin and alternative shell materials, including vegetable-based and hydroxypropyl methylcellulose (HPMC) capsules, are discussed in relation to their impact on drug stability and release. Capsule filling processes for powders, granules, pellets, and liquids are examined, including manual, semi-automatic, and fully automatic filling methods. The formulation considerations for capsule contents, including powder flow properties and compatibility with shell materials, are addressed. Modified-release capsule technologies, such as multi-particulate systems and liquid-filled hard gelatin capsules, are explored for their role in controlled drug delivery. Quality control tests specific to capsules, including weight variation, disintegration, dissolution, and content uniformity, are outlined. Common capsule defects, their causes, and prevention strategies are discussed to ensure product quality. The advantages of capsules in terms of taste masking, ease of swallowing, and potential for combination products are highlighted.

Keywords: *Gelatin, Encapsulation, Fill material, Dissolution, Modified release, Quality control*

Learning Objectives

After completion of the chapter, the student should be able to:

- Define capsules and compare their advantages to other dosage forms.
- Describe the different types of capsules (hard and soft) and their applications.
- Explain the composition and properties of capsule shell materials.
- Outline the manufacturing processes for hard and soft gelatin capsules.
- Discuss the quality control tests and specifications for capsules.
- Analyze the factors affecting capsule stability and dissolution.
- Evaluate the role of capsules in modified release drug delivery systems.

Capsules are solid dosage forms in which the drug substance is enclosed in either a hard or soft, soluble container or shell of a suitable form of gelatin.

Advantages of capsule dosage forms

1. They obscure the taste and odour of unpleasant drugs.
2. They are attractive in appearance.
3. They are slippery when moist and, hence, easy to swallow with a draught of water.
4. If properly stored, the shells contain 12-15% of moisture which gives flexibility and, consequently very considerable resistance to mechanical stresses (cf. cachets).
5. Less adjuncts are necessary than tablets.
6. The contents are usually in fine powder which combined with adjuncts, provides rapid and uniform

release of medicament in the GIT.

7. The shells can be opacified with TiO_2 or coloured to give protection from light.
8. The shells are physiologically inert and easily and quickly digested in the GIT.
9. Presentation of a drug in capsules, rather than in tablets, allows quicker submission of anew drug for clinical trials, because fewer development problems are involved. Also it is easier to vary the dose.

Disadvantages of capsule dosage forms

1. Capsules are not used for administering extremely soluble materials such as potassium chloride, potassium bromide, or ammonium chloride since sudden release of such compounds in the stomach could result in irritation.
2. Capsules should not be used for highly efflorescent or deliquescent materials.
3. Efflorescent materials may cause the capsules to soften.
4. Deliquescent materials may dry the capsule shell to excessive brittleness.

MATERIALS

Capsules are made principally of gelatin blends and may contain small amounts of certified dyes, opaquing agents, plasticizers and preservatives.

To modify the solubility of the capsules (e.g. to impart enteric property) methyl cellulose, polyvinyl alcohols and denatured gelatin are used.

GELATIN

Gelatin is a heterogeneous product derived by irreversible hydrolytic extraction of treated animal collagen (obtained from animal skin and bone).

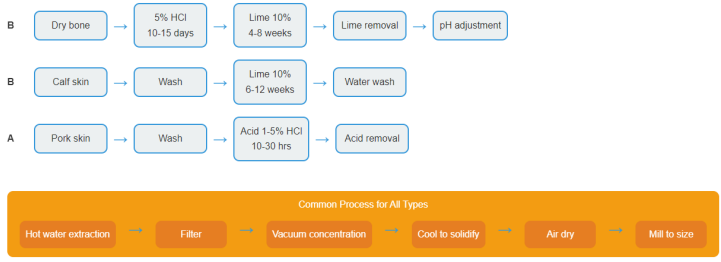
Common sources of collagen are animal bones, hide

portions, and frozen pork skin.

There are mainly two types of gelatin commercially available:

Type A: Gelatin is derived mainly from pork skin by acid treatment. This gelatin has an isoelectric point in the region of pH 9.

Type B: Gelatin is derived from bones and animal skins by alkaline processing (pH 4 – 5).



Blends of Gelatin A and Gelatin B are used.

- Bone gelatin produces a tough, firm film, but tends to be hazy and brittle.
- Pork skin gelatin contributes plasticity and clarity to the blend, hence bone gelatin and pork skin gelatin are generally used in blends.

Method of production of empty hard gelatin capsule shells

1. Hundred and fifty (150) pairs of stainless mold pins (on which capsule is formed) are dipped into a gelatin sol (melted gelatin) of carefully controlled viscosity to form the caps and bodies simultaneously.
2. The pins are usually rotated to distribute the gelatin uniformly during which time the gelatin may be set or gelled by a blast of cool air.
3. The pins are moved through a series of controlled air

drying kilns for the gradually and precontrolled removal of water.

4. The capsules are stripped from the pins by bronze jaws and trimmed to length by stationary knives while the capsule halves are being spun in chucks or collets.
5. After being trimmed to exact length, the cap and body sections are joined and ejected from the machine.

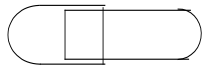
The entire cycle of the machine lasts approximately 45 minutes.

CAPSULE SHAPE

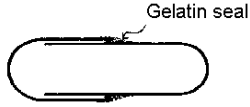
1. Simple telescoping hard gelatin capsules

Body moves easily inside the cap

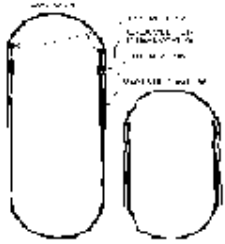
Disadvantages



(a) Body can come out of the cap easily spilling over the powder inside.
(b) In high speed capsule filling machines capsules may split and/or denting of the capsule shell may occur.



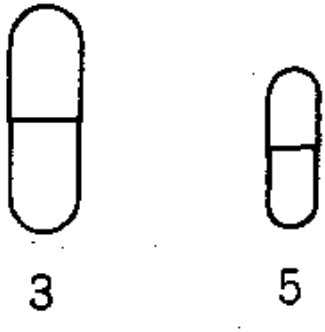
2. Gelatin seal fuses the two capsule halves to create a one-piece capsule that is tamper proof.



3. In the body:-

(a) Tapered rim is provided to prevent splitting / denting.

(b) Grooves which interlock the two halves together once the capsule has been filled.
(c) Indentations to prevent premature opening.



CAPSULE SIZE

Empty gelatin capsules are manufactured in various sizes, varying in length, in diameter, and capacity.
Their capacities vary with the bulk-density of the contents and the pressure applied during filling.
For human use, empty capsules ranging in size from 000, the largest, to 5, the smallest are commercially available.

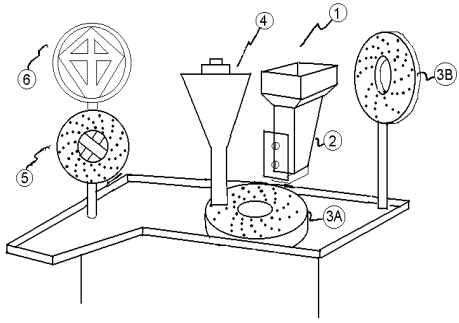
Capsule No.	000	00	0	1	2	3	4	5
Approx. vol (ml)	1.50	0.90	0.75	0.55	0.40	0.30	0.25	0.15

CAPSULE FILLING EQUIPMENT

There are several equipment available in the market but they may be classified into two classes depending on the mode of operation.

- **Lily**, Parke-Davis, Höfliger and Karg, Osaka and Perry
- **Zanasi**, Macofar, Farmatic and mG2 equipment

LILY TYPE CAPSULE FILLING EQUIPMENT



Number of operators required = 1

Number of capsule output = 200,000 capsules / day

(a) The empty capsules are fed from the storage hopper (1) and through the rectifying unit (2), into the two-piece filling ring (3A and 3B). Rectification is based on dimensional differences between the outside diameters of the cap and body portions of the capsule.

(b) As the ring (3A and 3B) is rotated, a vacuum is applied on its underside. The vacuum sucks the bodies into the lower half of the ring, while the caps are retained in the upper portion. The two pieces of the ring are separated, and the cap-containing portion is placed aside.

(c) The body containing portion of the ring is placed on a variable speed turntable and is mechanically rotated under the powder hopper (4), which contains an auger for the forced delivery of the powder.

(d) After one (or more) complete rotations of the rings, the powder hopper (4) is removed, and the two segments of the ring (3A and 3B) are rejoined.

(e) The intact ring is positioned in front of the peg ring (5) and the closing plate (6) is pivoted to a positioned approximately 180^0 from the position showed in the figure. Pneumatic pressure is applied to the peg ring (5), which forces the caps in position.

(f) After opening the closing plate 96) the capsules are ejected through the portion of the ring by giving slight hand pressure against the peg ring.
(g) The filled capsules are collected through the chute (7) into a collection chamber.

Turntable Speed	Effects
Highest turntable speed	• Minimum total fill weights • Maximum weight variation
Lowest turntable speed	• Maximum total fill weights • Minimum weight variation

ZANASI CAPSULE FILLING MACHINE

No. of operators required = 0 (automatic)
No. of capsules output = 4000 to 150,000 capsules / hr.
In this type of equipment the empty capsule shells come down from hopper through individual tubes and rectified. The capsule shells are seated in a holder with the body downward. Vacuum assists its placement.
Another vacuum is applied over the top of the holder to separate the cap from the body of the capsule.
The cap containing half is moved aside. The lower part of the holder is exposed for filling.
The powder is continuously mixed within the powder hopper and is maintained at a constant level prior to change. A set of volumetric dosing nozzles, each of which picks up the product from the constant level container, first compressing and then ejecting the powder into the capsule bodies.
The cap holder half is repositioned over the block and closing is accompanied by both upper and lower closing pins. Ejection is accomplished by compressed air.