BP102T · B.PHARM THEORY

BP102T General Pharmacy

Unit V — Semisolid Dosage Forms

Final Unit Notes

Pills & Python Notes

From-zero teaching standard: every technical term is defined before use.

Syllabus coverage: Unit V (9 hours).

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CHAPTER 14: SEMISOLID DOSAGE FORMS AND SUPPOSITORIES

Unit V · ~9 hours

14.1 Introduction

Between solids and liquids lie the semisolids — the ointments, creams, gels and pastes you rub on skin — and the suppositories you insert into body cavities. A tube of antiseptic cream, a jar of pain-relief gel, a medicated suppository for a vomiting child: all belong here. This chapter covers how they're built on special bases, how they're made, and the one calculation (displacement value) that examiners never fail to ask.

Learning objectives — after studying this chapter, you should be able to:

- define semisolids and suppositories/pessaries;
- classify semisolids and ointment bases with examples;
- list the advantages and disadvantages of semisolids and suppositories;
- name the excipients used in semisolid dosage forms;
- describe the general methods of preparation of ointments, pastes, creams and gels;
- list the properties of an ideal suppository base and the types of suppository bases;
- define displacement value and use it in a calculation;
- describe the general method of preparation of suppositories.

14.2 Definitions

Scientific definitions:

- **Semisolid dosage forms** are preparations of ointment-like consistency intended for application to the skin or mucous membranes (or, for suppositories, insertion into body cavities).
- **Ointment** — a semisolid preparation for external application, usually greasy/oleaginous.
- **Cream** — a semisolid emulsion (o/w or w/o) for external use; lighter than ointments.
- **Gel** — a semisolid of a gelling agent in liquid; clear, non-greasy.
- **Paste** — an ointment containing a high proportion of solid powder (stiff, less greasy).
- **Suppository** — a solid dosage form for insertion into a body cavity (rectum, vagina, urethra), which melts, softens or dissolves at body temperature to release the drug.
- **Pessary** — a suppository for the **vagina** (larger, often ovoid). **Bougie** — a suppository for the **urethra** (thin, pencil-shaped).

Simple explanation: Semisolids are "in-between" medicines — not hard like tablets, not runny like syrups. Suppositories are solid bullets/cones that melt inside the body where you place them.

14.3 Key Terminology

Term	Meaning	Simple explanation
Ointment base	The vehicle carrying the drug in an ointment	The "foundation cream"
Oleaginous	Oily/greasy	"Tel-like" (oil-like)
Occlusive	Forms a film that blocks water loss from skin	"Seals moisture in"
Displacement value	Parts of drug displacing one part of base	"How much base one gram of drug pushes out"
Mould	The shaped cavity suppositories are cast in	The "kulfi mould" for suppositories
Rancidity	Spoilage of fats/oils with bad smell	Oils "going bad"

14.4 Detailed Explanation

14.4.1 Classification of semisolids

Type	Character	Example use
Ointments	Greasy, anhydrous or emulsion-based	Antiseptic ointment, eye ointments (sterile)
Creams	o/w or w/o emulsions, lighter, washable (o/w)	Moisturising/medicated creams
Gels	Clear, non-greasy, water-based	Pain-relief gels
Pastes	High solid content, stiff, less penetrating	Protective pastes (e.g., zinc oxide paste)

14.4.2 Ointment bases — classification

Base type	Character	Examples
Oleaginous (hydrocarbon) bases	Greasy, occlusive, anhydrous; don't absorb water	White soft paraffin, hard paraffin, wool fat
Absorption bases	Absorb water to form w/o emulsions	Anhydrous lanolin, hydrophilic petrolatum
Emulsion (water-removable) bases	o/w or w/o emulsions; o/w wash off easily	Hydrophilic ointment (o/w)
Water-soluble/misicble bases	Dissolve in body fluids; non-greasy, washable	Macrogols (polyethylene glycols, PEG)

Which base for which drug? Water-soluble drugs suit oleaginous/absorption bases; the base choice controls drug release and skin feel — a favourite exam discussion.

14.4.3 Other excipients in semisolids

Excipient	Function	Examples
Preservatives	Prevent microbial growth (esp. water-containing)	Parabens
Antioxidants	Prevent rancidity of oils	BHT, tocopherol
Humectants	Keep preparation moist	Glycerin, propylene glycol
Stiffening agents	Give body/consistency	Hard paraffin, cetyl alcohol
Emulsifiers	Stabilise cream emulsions	As in Chapter 13
Penetration enhancers	Help drug cross the skin	(concept level)
Perfumes	Mask base odour	Approved fragrances

14.4.4 Advantages and disadvantages of semisolids

Advantages	Disadvantages
Direct local action on skin/mucous membrane	Greasy, stains clothes (oleaginous types)
Avoids first-pass metabolism (some systemic absorption)	Inaccurate dosing — hard to measure exact amount
Easy to apply; good for large skin areas	Poor patient acceptance for hairy/large areas
Suitable when oral route isn't possible	Stability issues (rancidity, phase separation)
Prolonged contact at the site	Some bases irritate broken skin

14.4.5 General methods of preparation

1. **Trituration (incorporation) method:** for soft bases — drug powder is levigated (ground) with a little base into a smooth paste, then diluted with the remaining base by geometric mixing.
2. **Fusion method:** for stiff bases — melt the waxy ingredients together (highest melting point first), cool with stirring, incorporate the drug as it thickens.
3. **Creams:** melt the oil phase and heat the water phase separately to the same temperature, mix with stirring to form the emulsion, cool, add heat-sensitive ingredients.
4. **Gels:** disperse the gelling agent (e.g., carbomer) in water with stirring, neutralise/thicken, add the drug.
5. **Pastes:** high solids are triturated with the base (like stiff ointments).

14.4.6 SUPPOSITORIES

Types by cavity:

Type	Cavity	Shape	Example use
Rectal suppository	Rectum	Torpedo/bullet (~2 g adult)	Constipation, vomiting patients, haemorrhoids
Pessary	Vagina	Ovoid (~4 g)	Local vaginal treatment
Bougie	Urethra	Thin pencil	Local urethral treatment
(Nasal suppositories)	Nose	Small	(concept level)

Advantages: usable when the patient can't swallow (vomiting, unconscious, children, elderly); avoids drug destruction in the stomach and first-pass metabolism (partly); local action (haemorrhoids); can give faster onset than oral for some drugs. **Disadvantages:** patient acceptance/embarrassment; leakage after melting; may irritate the mucosa; dose may be expelled before absorption; melt in hot climates — storage matters.

Formulation excipients: suppository bases, medicaments, preservatives, antioxidants.

Properties of an ideal suppository base:

1. Melts at body temperature (or dissolves in body fluids) to release the drug.
2. Non-irritating and non-toxic to mucous membranes.
3. Stable on storage; no rancidity or polymorphism problems.
4. Compatible with the drug.
5. Easy to mould and remove from the mould (contracts slightly on cooling).
6. Wets and spreads well at the site.

Types of suppository bases:

Base type	Examples	How drug is released
Oleaginous (fatty)	Cocoa butter (theobroma oil)	**Melts** at body temperature
Water-miscible/soluble	Glycerinated gelatin, macrogols (PEG)	**Dissolves** in body fluids

Cocoa butter note: melts around body temperature — ideal — but shows **polymorphism** (can crystallise in forms melting at different temperatures) if overheated during preparation, so it must be melted gently.

14.4.7 Displacement value — the calculation

> **Definition (from zero):** When you mix a drug into a melted base and pour it into a mould, the drug *takes up space* — it "pushes out" (displaces) some base. The **displacement value (DV)** of a drug is the number of parts by weight of the drug that displace **one part by weight** of the base.

- If DV = 1, then 1 g of drug displaces 1 g of base.
- If DV = 2, then 2 g of drug displace 1 g of base (the drug is "denser" in effect).

> **Formula:** Base required per suppository = (mould capacity for base) − (drug weight ÷ DV) Total base = per-suppository base × number of suppositories.

> **Worked example:** *Prepare 6 rectal suppositories, each containing 0.3 g of a drug with displacement value 1.5. The mould makes 1 g cocoa-butter suppositories. How much base and drug are needed?*

- Drug per suppository = 0.3 g → for 6 = **1.8 g drug**.
- Base displaced per suppository = 0.3 ÷ 1.5 = 0.2 g.
- Base per suppository = 1.0 − 0.2 = **0.8 g** → for 6 = **4.8 g base**.
- Check: each suppository = 0.3 g drug + 0.8 g base = 1.1 g total, which exactly fills the mould volume (0.2 g of base volume taken by drug + 0.8 g base = 1.0 g base-volume). ✓

> **Second quick example:** *DV = 1, drug 0.5 g, mould 2 g:* base per suppository = 2 − (0.5 ÷ 1) = **1.5 g**.

14.4.8 General method of preparation (moulding)

1. **Calibrate the mould** — know its capacity with the chosen base.
2. **Calculate** drug and base quantities using the displacement value.
3. **Melt** the base gently (avoid overheating cocoa butter).
4. **Incorporate** the drug (dissolved or finely dispersed) with stirring.
5. **Pour** into clean, lubricated, chilled moulds; allow to set.
6. **Trim, remove, wrap** individually; label with storage conditions ("store in a cool place").

(Older methods: **hand-rolling/shaping** and **cold compression** — asked as names in exams.)

14.5 Easy Analogy

- Choosing an ointment base is like choosing **cooking oil vs water for a tadka**: oil (oleaginous base) seals and stays; water-based (gel/cream) feels light and washes off. The dish (drug) behaves differently in each.
- **Displacement value** is like packing a *tiffin*: if you add extra *sabzi* (drug), you must remove some *rice* (base) — the tiffin (mould) holds a fixed volume. DV tells you exactly how much rice one spoon of sabzi replaces.
- A suppository is a **kulfi on a stick in reverse** — instead of melting in your hand, it melts inside the body to release its contents.

14.6 Diagram — Ointment Base Classification & Suppository Mould

Two panels: (a) tree chart — Ointment Bases → Oleaginous (white soft paraffin) / Absorption (lanolin) / Emulsion o/w–w/o (hydrophilic ointment) / Water-soluble (macrogols), each with a one-line character; (b) suppository mould — a metal block with torpedo-shaped cavities, one suppository shown beside it, arrows: melt → pour → cool → remove.

AI Image Prompt: "Clean educational textbook diagram, white background, two panels: left, a classification tree titled 'Ointment Bases' with four branches (oleaginous, absorption, emulsion, water-soluble) each with a small jar icon and one-line description; right, a suppository mould block with torpedo-shaped cavities and a finished suppository beside it, arrows showing melt-pour-cool-remove steps, clear black labels, minimal decoration, professional pharmacy textbook style."

14.7 Flowchart — Preparation of Suppositories by Moulding

```
Calibrate mould (capacity with chosen base)
        ↓
Calculate drug + base using displacement value
        ↓
Melt base gently with stirring
        ↓
Incorporate drug (dissolve/disperse uniformly)
        ↓
Pour into lubricated, chilled moulds
        ↓
Cool → trim → remove → wrap individually
        ↓
Label ("Store in a cool place")
```

14.8 Examples

- **Antiseptic cream** — o/w cream for minor cuts.
- **Pain-relief gel** — non-greasy gel rubbed on muscles/joints.
- **Zinc oxide paste** — stiff protective paste.
- **Glycerin suppositories** — rectal, for constipation (local lubricant action).
- **Antifungal pessaries** — vaginal suppositories.

14.9 Pharmacy Relevance

- **Dispensing:** semisolids are packed in collapsible tubes or wide-mouth jars; suppositories are wrapped individually.
- **Counselling:** "Apply a thin layer to clean skin"; "Store suppositories in a cool place — they melt in heat"; explain insertion simply and sensitively, with privacy.
- **Problem-spotting:** a prescription for suppositories in peak summer needs a storage warning; rancid-smelling fatty bases should not be dispensed.

14.10 India Context

Ointments, creams and gels are OTC mainstays in Indian pharmacies (antiseptic creams, pain-relief gels, antifungal creams); ayurvedic *malhams* are traditional semisolids. Suppositories are less commonly used in India than in some countries, but glycerin suppositories for constipation are widely stocked. The IP includes standards for ointments, creams, gels and suppositories.

14.11 High-Yield Points

1. **Remember:** Semisolid = between solid and liquid; suppository = solid that melts/dissolves in a body cavity.
2. > **Exam Pearl:** Ointment (greasy) vs Cream (emulsion, lighter) vs Gel (clear, non-greasy) vs Paste (high solids, stiff).
3. > **Exam Pearl:** Four base types — oleaginous, absorption, emulsion, water-soluble (macrogols).
4. Pessary = vaginal; Bougie = urethral.
5. > **Exam Pearl:** Ideal base — melts at body temperature, non-irritating, stable, compatible, easy to mould.
6. Cocoa butter = melts at body temperature but **polymorphic** — melt gently.
7. > **Exam Pearl:** Displacement value = parts of drug displacing 1 part of base; Base = mould capacity − (drug ÷ DV).
8. Preparation: trituration (soft bases), fusion (stiff bases); suppositories by moulding.

14.12 Common Confusions & Common Mistakes

> **Do not confuse:**
>
> - **Cream ≠ Ointment ≠ Gel ≠ Paste:** cream is an emulsion; ointment is greasier; gel is clear/non-greasy; paste is stiff with high solids.
> - **Pessary ≠ Suppository (general):** every pessary is a suppository, but "suppository" usually means rectal; pessary = vaginal, bougie = urethral.
> - **Melting ≠ Dissolving (bases):** cocoa butter *melts*; glycerinated gelatin/macrogols *dissolve*.
> - **Displacement value direction:** DV = drug parts displacing ONE part of base (not the reverse).

> **Common mistakes:** overheating cocoa butter (polymorphism → wrong melting); forgetting to subtract displaced base (suppositories overflow the mould); storing suppositories in heat; confusing absorption bases with emulsion bases.

14.13 Memory Tricks

- "Bases: **O**ld **A**unties **E**at **W**atermelon — **O**leaginous, **A**bsorption, **E**mulsion, **W**ater-soluble."
- "Pessary = **P**rivate (vaginal); Bougie = **B**eginning of urethra (thin)."
- "DV formula chant: '**M**ould **m**inus **d**rug-over-**DV**'."

14.14 Exam-Oriented Summary

Semisolids (ointments, creams, gels, pastes) act on skin/mucous membranes. Ointment bases: oleaginous, absorption, emulsion, water-soluble (macrogols). Other excipients: preservatives, antioxidants, humectants, stiffening agents, emulsifiers. Advantages: local action, easy application; disadvantages: greasy, inaccurate dosing. Preparation: trituration (incorporation) for soft bases, fusion for stiff ones; creams by hot oil/water phase mixing; gels by dispersing gelling agents; pastes by high-solid trituration. Suppositories: rectal (torpedo), pessaries (vaginal, ovoid), bougies (urethral, pencil). Advantages: no swallowing needed, avoids first-pass partly, local action; disadvantages: acceptance, leakage, heat sensitivity. Ideal base: melts at body temperature, non-irritating, stable, compatible, mouldable. Bases: cocoa butter (melts; polymorphic — gentle heat) and water-soluble (glycerinated gelatin, macrogols — dissolve). Displacement value = drug parts displacing 1 part base; base needed = mould capacity − (drug ÷ DV). Moulding: calibrate → calculate → melt → incorporate → pour → cool → wrap.

One-Minute Revision: Ointment/cream/gel/paste differences. Four bases: O-A-E-W. Pessary vaginal, bougie urethral. Ideal base: melts at body temp. Cocoa butter melts (gentle heat); PEG dissolves. DV: base = mould − drug/DV. Moulding steps.

14.15 Questions

Very Short Answer (1–2 marks)

1. Define a semisolid dosage form. 2. Define a suppository. 3. What is a pessary? 4. What is a bougie? 5. Define displacement value. 6. Name the four types of ointment bases.

Short Answer (3–5 marks)

1. Classify semisolid dosage forms with one example each.
2. Classify ointment bases with examples.
3. Write the advantages and disadvantages of suppositories.
4. List the properties of an ideal suppository base.

Long Answer (5–10 marks)

1. Define semisolids. Classify ointment bases and describe the general methods of preparation of ointments, creams and gels.
2. Define suppositories. Describe their types, the ideal base properties, types of bases, and the moulding method of preparation including displacement value.

MCQs

1. A pessary is inserted into the: (a) rectum (b) vagina (c) urethra (d) nose — **Ans: (b)**. Pessary = vaginal suppository.
2. Which base melts at body temperature? (a) Macrogols (b) Glycerinated gelatin (c) Cocoa butter (d) Bentonite — **Ans: (c)**. Cocoa butter melts; the others dissolve.
3. Displacement value is defined as parts of drug displacing: (a) one part of drug (b) one part of base (c) the whole mould (d) water — **Ans: (b)**. Drug parts per one part of base.
4. Pastes differ from ointments mainly by: (a) colour (b) high solid content (c) sterility (d) alcohol content — **Ans: (b)**. Pastes are stiff with high solids.
5. Cocoa butter must be melted gently because it is: (a) explosive (b) polymorphic (c) water-soluble (d) antiseptic — **Ans: (b)**. Overheating changes its crystal form and melting behaviour.

Viva: Why are suppositories stored in a cool place? What is the difference between a cream and an ointment? When is the fusion method preferred over trituration? What happens if you ignore displacement value? Why is cocoa butter ideal yet tricky?

Application-based: 1. *Prepare 10 suppositories, each containing 0.4 g of a drug (DV = 2). The mould makes 2 g cocoa-butter suppositories. Calculate the quantities. (Ans: Drug = 4.0 g. Base per suppository = 2 − (0.4 ÷ 2) = 2 − 0.2 = 1.8 g → base = 18.0 g.)* 2. *A patient in a hot town complains their suppositories have melted into one lump in the strip. Explain and counsel. (Ans: Fatty bases melt near body temperature, so room heat in summer melts them; advise refrigerator/cool storage and to check the strip before use; offer water-soluble-base alternatives via the doctor if needed.)*

UNIT V INFOGRAPHIC — Semisolids & Suppositories at a Glance

> **Concept box for the PDF designer:** One-page visual panel titled "Semisolids & Suppositories — One Page". Left: four semisolid badges (ointment/greasy jar, cream/emulsion swirl, gel/clear tube, paste/stiff block) + four base badges (O-A-E-W). Centre: suppository mould icon with torpedo, pessary (ovoid) and bougie (pencil) shapes labelled. Right: displacement value formula card with the worked mini-example (0.3 g drug, DV 1.5 → 0.8 g base). Bottom strip: ideal-base checklist (melts at body temp, non-irritating, stable, compatible, mouldable). Footer: "Pills & Python · pillsandpython.com".

COMBINED REFERENCES — Units III, IV, V

1. Ansel, H.C., Allen, L.V. & Popovich, N.G. *Pharmaceutical Dosage Forms and Drug Delivery Systems.* (Standard textbook for dosage forms.)
2. Cooper & Gunn's *Dispensing for Pharmaceutical Students.* (Classic dispensing textbook — powders, liquids, semisolids.)
3. Bentley's *Textbook of Pharmaceutics.* (Covers all dosage forms in the syllabus.)
4. Indian Pharmacopoeia. (Official standards for dosage-form preparations.)
5. Remington: *The Science and Practice of Pharmacy.* (Background reference on dosage-form science.)