COMPLETE SERIES · PREMIUM EDITION

B.PHARMA · BP105T · 2026-27 · PCI / NEP-2020

Introduction to Pharmacognosy

COMPLETE NOTES · UNITS I – V

From crude drug to clinic – sources, cultivation, quality, metabolites and phyto-therapeutics, one series.

5 Units | 45 Lectures | Drug Cards | Timelines | Exam Ready

Pills and Python · Signature Edition

§ INDEX VOLUME MAP

I Where Everything Lives

Unit I

Fundamentals of Pharmacognosy

Pages 3–26 · 24 pages

Unit II

Cultivation, Collection & Storage

Pages 27–47 · 21 pages

Unit III

Quality Control (WHO)

Pages 48–67 · 20 pages

Unit IV

Metabolites & Traditional Systems

Pages 68–92 · 25 pages

Unit V

Phyto-therapeutic Agents

Pages 93–113 · 21 pages

How to use this volume

Each unit restarts its own page numbers and keeps its footer seal. The range above is the volume-level map for classroom reference.

PREMIUM EDITION

B.PHARMA · IST YEAR · 2026-27

Pharmacognosy Fundamentals

UNIT-I · INTRODUCTION TO PHARMACOGNOSY

Definition, sources, milestones, pharmacopoeias and classifications – the foundation of Units II to V.

Core Concepts | Timelines | Infographics | Case Drill | Smart Revision | Exam Points

Inside Unit I

1.1 Definition, history, scope

1.2 Sources of crude drugs

1.3 Milestones + pharmacopoeias

1.4 Official / codified drugs

1.5 Six classifications

Levels: Remember to Understand

Pills and Python · PCI-aligned · Remember to Understand

§ UNIT OVERVIEW

1 Unit-I at a Glance

1.1 Definition

- **Pharmacognosy** = study of crude drugs from nature
- History: traditional use to modern science
- Scope: industry, research, regulation

1.2 Sources

- **Six sources:** plant, animal, microbial
- Marine, mineral, tissue culture
- One example for each source

1.3 Milestones

- **8 discoveries:** morphine (1806) to
- Artemisinin (1972) – Tu Youyou
- Timeline infographic + detail table

1.3 Pharmacopoeias

- **Six books:** IP, API, UPI
- BHP, USP-HMDS, AHP
- Comparison table – exam favourite

1.4 Status terms

- **Official** vs non-official
- **Codified** vs non-codified
- Card pairs with examples

1.5 Classifications

- **Six systems** with tree diagram
- Merits / demerits table
- Which-system-where decision card

Learning Roadmap



§ 1.1 DEFINITION AND SCOPE

1 What Pharmacognosy Is

Definition

Pharmacognosy is the study of crude drugs from natural sources – their source, history, collection, cultivation, constituents, uses and evaluation. It links **traditional knowledge** with **modern pharmaceutical science**.

The word itself

Pharmakon (drug) + **gnosis** (knowledge). In one line: knowledge of drugs from nature. Examiners accept any definition carrying three words – **natural source**, **crude drug** and **study / evaluation**.

Crude drug – the working unit

A **crude drug** is a natural material – plant part, animal product, mineral or fermentation product – used as a drug **with little or no processing**. Examples met in this unit: opium latex (**Papaver somniferum**), penicillin fermentate (**Penicillium**), agar (marine algae).

Scope in four directions

- **Industry:** sourcing, QC and standardisation of herbal products
- **Research:** new leads from nature – artemisinin and taxol began as plant extracts
- **Regulation:** pharmacopoeial monographs (IP, API, UPI) set legal quality
- **Practice:** AYUSH systems – Ayurveda, Yoga and Naturopathy, Unani, Siddha, Homoeopathy

Professor's Note

A 2-mark 'define + scope' answer: one definition sentence, then four scope words – **industry, research, regulation, practice**. That skeleton fits every year.

§ 1.1 STATUS AND SCOPE TODAY

Present status of pharmacognosy

Why the subject is growing

- **Herbal market boom:** global demand for standardised herbal medicines keeps rising
- **Drug discovery engine:** morphine, quinine, taxol and artemisinin all came from nature
- **AYUSH recognition:** API and UPI give Ayurveda and Unani drugs official monographs
- **Conservation pressure:** endangered species (e.g. Kutki – *Picrorhiza kurroa*) need cultivation and tissue-culture backup

Allied fields you must name

- **Botany + chemistry:** identification and constituent analysis
- **Pharmacology + pharmaceutics:** action testing and formulation of herbals
- **Biotechnology:** tissue culture and fermentation for uniform supply
- **GACP:** WHO Good Agricultural and Collection Practices govern sourcing

Work area	Pharmacognosist does …	Unit where it returns
Herbal industry	identification + QC of raw drugs	Units II, IV
Drug discovery	screening natural leads	Milestones, Unit III
Regulatory / AYUSH	monographs, GACP compliance	Pharmacopoeias, Unit IV

Remember

Status answers always pair `demand (market)` with `duty (quality + conservation)`. One line on GACP or AYUSH shows the examiner you read beyond the definition.

§ 1.1 HISTORY – TIMELINE A

2 History: Roots to 1806

Reading this timeline

History questions ask for ***sequence + significance***, not dates alone. Learn each era as what changed : traditional use, isolation of actives, industrial production, modern revival.

From traditional use to pure alkaloids

Ancient	Early 1800s	1806	1820
1	2	3	4
Traditional systems use whole plants and minerals	Active principles isolated from crude drugs	Morphine – Sertuerner (Papaver somniferum)	Quinine – Pelletier + Caventou (Cinchona)

Era order is the mark-carrier: traditional whole-drug use came first; pure-compound isolation (morphine 1806, quinine 1820) founded modern pharmacognosy.

Exam Tip

If asked 'history of pharmacognosy', open with the definition, walk these four nodes, and close on page 6 (industrial + modern era). Two dates – *1806* and *1820* – are compulsory.

§ 1.1 HISTORY – TIMELINE B

Industrial era to present

From factory synthesis to back-to-nature

1897	1928+	1967	1972
5	6	7	8
Aspirin – Hoffmann / Bayer (willow salicylates)	Penicillin – Fleming; Florey / Chain develop it	Taxol – Wani, NCI programme (Taxus brevifolia)	Artemisinin – Tu Youyou (Artemisia annua)

Arc of the story: synthesis and antibiotics (1897–1928) shrank plant work; taxol (1967) and artemisinin (1972) proved nature still delivers blockbusters.

Professor's Note

Warfarin (Link, from dicoumarol of spoiled sweet clover – *Melilotus*) and cephalosporins (Brotzu, *Cephalosporium / Acremonium*) belong between penicillin and taxol – the full 8 appear on the milestones pages.

§ 1.2 SOURCES OF DRUGS – A

3 Six Sources: First Three

Plant source – the largest

Source: whole plants or parts – leaves, bark, roots, seeds, latex, oils
Example: Opium latex from *Papaver somniferum* (morphine); Cinchona bark (quinine); *Artemisia annua* herb (artemisinin)
• Most crude drugs of Units II–V are plant drugs.

Animal source

Source: glandular products, fats, waxes, venoms, gland secretions
Example: Honey (Apis species) – demulcent and vehicle; musk, cod-liver oil and beeswax are classic companions
• Identity tests focus on adulteration with artificial substitutes.

Microbial source

Source: antibiotics and metabolites from fermentation cultures
Example: Penicillin from *Penicillium* (Fleming 1928; Florey / Chain); cephalosporins from *Cephalosporium / Acremonium* (Brotzu)
• Fermentation gives bulk, uniform supply – no seasons, no forests.

Remember
Plant = *Papaver* · Animal = *honey* · Microbial = *Penicillium*. Three sources, three anchor words – never swap them.

§ 1.2 SOURCES OF DRUGS – B

Remaining three sources

Marine source

Source: seaweeds, sponges and marine organisms
Example: Agar from red algae (Gelidium / Gracilaria) – laxative and culture medium
• Oceans are the newest frontier for cytotoxic and antimicrobial leads.

Mineral source

Source: purified earths, salts and oxides – non-living natural stock
Example: Talc (hydrated magnesium silicate) – dusting powder and excipient; kaolin and bentonite are fellow adsorbents
• Quality means freedom from lead, arsenic and grit – tested as in Unit IV.

Tissue-culture source

Source: cells, callus or plantlets grown sterile on defined media
Example: micropropagation of endangered medicinals (e.g. Kutki) for uniform planting stock
• Needs plant hormones – ***auxins, gibberellins, cytokinins, ABA, ethylene*** – the same five named in growth regulation.

Remember
Marine = ***agar*** · Mineral = ***talc*** · Tissue culture = ***sterile micropropagation***. Six sources complete – drill them on the case page.

§ 1.2 SOURCES AT A GLANCE

Six sources, one page

Source	What it is	Example	Why it matters
Plant	parts, latex, oils	Papaver somniferum (opium)	largest group; Units II–V
Animal	glands, waxes, fats	Honey (Apis species)	demulcent + vehicle
Microbial	fermentation products	Penicillin (Penicillium)	bulk antibiotics
Marine	seaweeds, sponges	Agar (Gelidium)	new cytotoxic leads
Mineral	earths, salts	Talc (Mg silicate)	excipients, adsorbents
Tissue culture	sterile cell / plantlet growth	micropropagated Kutki stock	saves endangered species

How examiners test sources

- **Give-one-example** questions pick the rarest sources – marine, mineral, tissue culture
- **Classify-the-drug** drills (case page): agar = marine, talc = mineral, penicillin = microbial
- **Reason-out**: tissue culture answers every 'endangered species' conservation question

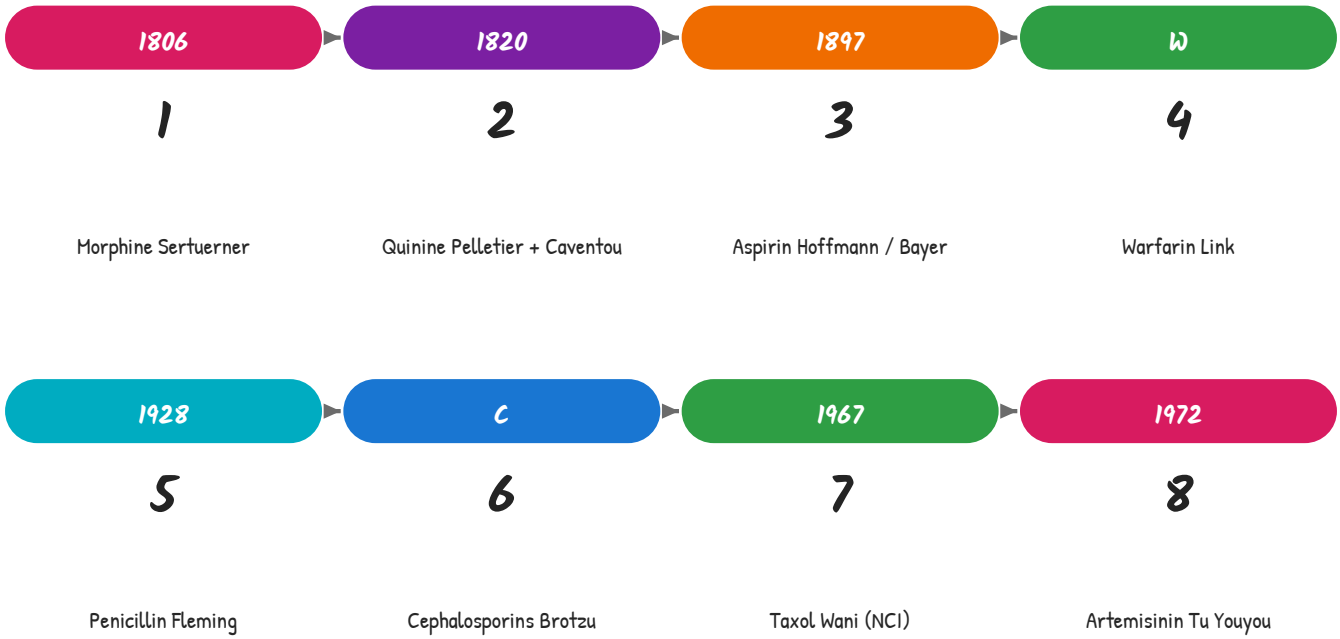
Professor's Note

Never write agar as a plant drug or talc as synthetic – source classification follows origin, not chemistry. That single confusion costs the full 2 marks.

§ 1.3 MILESTONES - TIMELINE

4 Eight Milestones: 1806 to 1972

Morphine to artemisinin - the discovery arc



W = Warfarin era (dicoumarol of spoiled sweet clover, Melilotus) · C = Cephalosporin era (Brotzu). Full scientist-drug pairs sit in the detail table next.

How to memorise

Chain story: *pain (morphine) - fever (quinine) - industry (aspirin) - clot (warfarin) - germ (penicillin, cephalosporins) - cancer (taxol) - malaria (artemisinin)*. Eight stations, one story.

§ 1.3 MILESTONES - DETAIL TABLE

Scientist - drug - source

Year	Drug + scientist	Natural source	Note
1806	Morphine - Sertuerner	Papaver somniferum (opium)	first pure alkaloid
1820	Quinine - Pelletier + Caventou	Cinchona bark	antimalarial classic
1897	Aspirin - Hoffmann / Bayer	willow salicylates	semi-synthetic success
1940s	Warfarin - Link	dicoumarol, spoiled Melilotus	rat poison to medicine
1928	Penicillin - Fleming; Florey / Chain	Penicillium	antibiotic era opens
1940s	Cephalosporins - Brotzu	Cephalosporium / Acremonium	beta-lactam cousins
1967	Taxol - Wani (NCI)	Taxus brevifolia	anticancer diterpene
1972	Artemisinin - Tu Youyou	Artemisia annua	sesquiterpene antimalarial

Exam Trap - shuffled pairs

Examiners shuffle the scientist column: Sertuerner = ***morphine***, Pelletier + Caventou = ***quinine***, Hoffmann = ***aspirin***, Fleming = ***penicillin***, Wani = ***taxol***, Tu Youyou = ***artemisinin***. Link = warfarin, Brotzu = cephalosporins.

§ 1.3 PHARMACOPOEIAS COMPARED

Six Pharmacopoeias

Short	Full name	Covers	Use-line
IP	Indian Pharmacopoeia	allopathic + herbal monographs of India	legal standard in India
API	Ayurvedic Pharmacopoeia of India	Ayurvedic drugs + formulations	AYUSH Ayurveda QC
UPI	Unani Pharmacopoeia of India	Unani drugs + formulations	AYUSH Unani QC
BHP	British Herbal Pharmacopoeia	herbal drugs, British practice	Western herbal reference
USP-HMDS	USP Herbal Medicines + Dietary Supplements	US herbal + supplement monographs	US market standard
AHP	American Herbal Pharmacopoeia	in-depth herbal monographs	research-grade reference

One-line differentiator

IP is the law in India; **API / UPI** are AYUSH companions for **Ayurveda / Unani**; **BHP / USP-HMDS / AHP** are **foreign herbal references**. Say that sentence and the 5-mark comparison is half done.

Professor's Note

The classic confusion - IP vs API vs UPI - gets its own card on the errors page. Read this table first, then that card.

§ 1.4 OFFICIAL AND CODIFIED

6 Status of Drugs

Official drug

Listed in a pharmacopoeia (IP, API, UPI, USP).
- Has a **legal monograph**: identity, purity, assay
- e.g. opium, quinine-bearing Cinchona (IP)

Non-official drug

Not listed in any pharmacopoeia - yet.
- Traded or used **without** a legal standard
- May turn official once monographed

Codified

Recorded in classical / traditional texts.
- Ayurvedic Samhitas, Unani texts
- Traditional backing for use

Non-codified

Folk / tribal knowledge, not in classical texts.
- Ethnobotanical leads
- Need validation studies

The two axes are independent

A drug can be **codified yet non-official** (in Samhitas, no IP monograph yet) or **official yet non-codified** (IP monograph, no classical text entry). Official = pharmacopoeia; codified = classical text - different books, different axes.

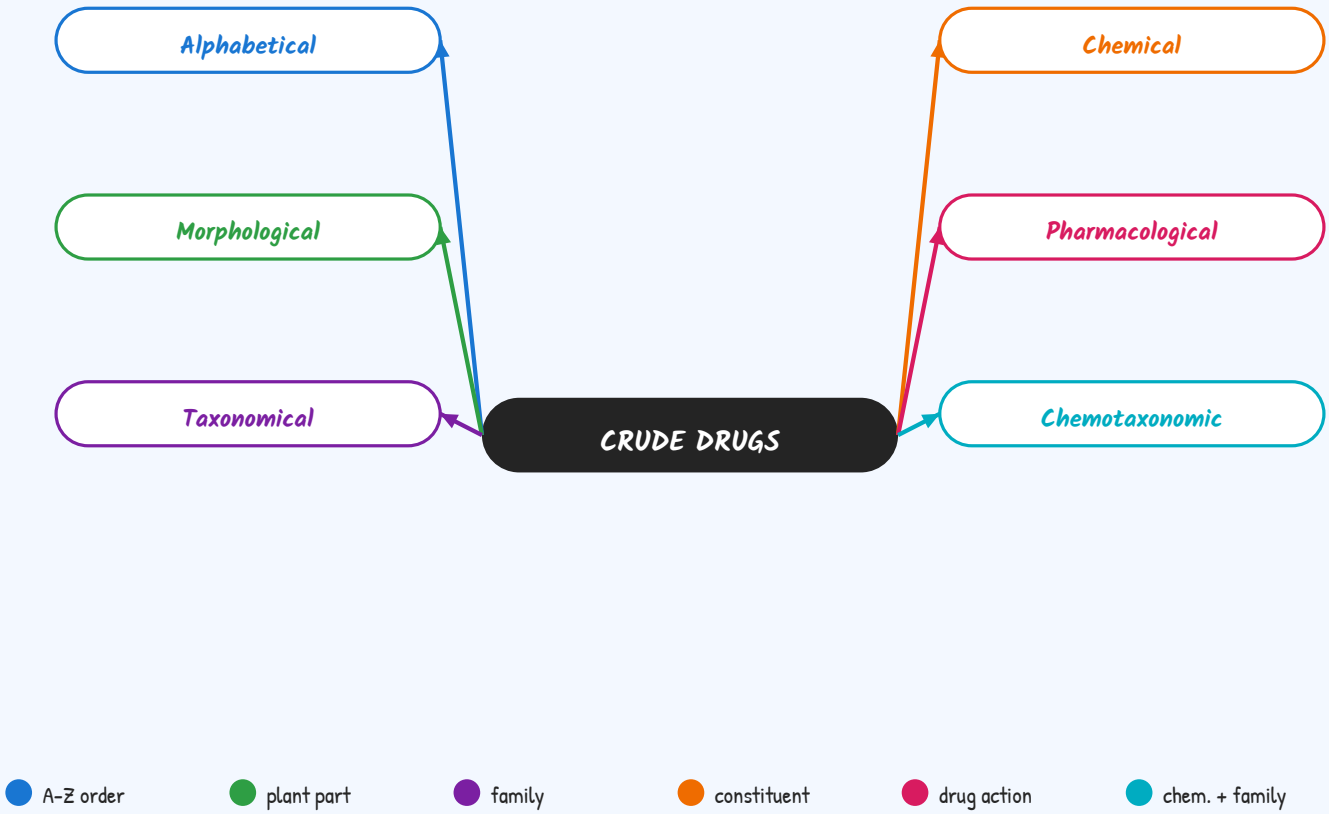
Remember

Official answers *'is it in the pharmacopoeia?'*; codified answers *'is it in the classical texts?'*. Two questions, two words.

§ I.5 SIX CLASSIFICATIONS - MAP

7 Classification Tree

Six ways to arrange crude drugs



Basis in one word each - alphabetical, part-used, family, constituent, action, chemistry-plus-family. Tables next give merits and demerits.

How to use this tree

Draw it from memory in 60 seconds: centre pill, three branches left, three right. Then hang one example on each branch from the tables.

§ 1.5 MERITS AND DEMERITS – A

First three systems

System + basis	Merit	Demerit
Alphabetical (A–Z name order)	fastest lookup; no science needed	splits related drugs apart
Morphological (part used: leaf, bark, root)	practical for identification + trade	chemically unlike drugs sit together
Taxonomical (botanical family)	groups evolutionary relatives	same-family drugs may act very differently

Examples that stick

- **Alphabetical:** Vasaka follows Tulsi follows Senna – pure A–Z
- **Morphological:** all barks together – Cinchona with Arjuna (*Terminalia arjuna*)
- **Taxonomical:** Solanaceae together – Ashwagandha (*Withania somnifera*) with its cousins

Professor's Note

Merit–demerit answers follow one logic: every system is best at its own basis, blind outside it. Morphology sees parts, not chemistry; taxonomy sees families, not actions.

§ 1.5 MERITS AND DEMERITS – B

Remaining three systems

System + basis	Merit	Demerit
Chemical (constituent: alkaloid, glycoside)	links chemistry to tests + uses	one plant has many constituents
Pharmacological (action: laxative, cardiotonic)	directly useful to prescribers	one drug has many actions
Chemotaxonomic (chemistry + taxonomy)	most scientific; predicts relatives	needs lab data; hardest to apply

Examples that stick

- **Chemical:** all alkaloid drugs together regardless of family
- **Pharmacological:** all laxatives together – Psyllium (*Plantago ovata*) beside unrelated purgatives
- **Chemotaxonomic:** withanolide-bearing Solanaceae flagged as one chemical clan

Exam favourite

Q: 'Which classification is most scientific?' A: ***chemotaxonomic*** – then add its demerit (needs chemical data) to show balance. Examiners reward the paired answer.

§ 1.5 CHOOSING A CLASSIFICATION

Which system, where?

Decision card – match need to system

- Dispensary shelf lookup by name? -> *alphabetical*
- Unknown sample, identify by part? -> *morphological*
- Studying relatives for similar drugs? -> *taxonomical / chemotaxonomic*
- Standardising by assay of actives? -> *chemical*
- Prescribing by therapeutic use? -> *pharmacological*

Task	Best system	Why
stock register	Alphabetical	name order is fastest
powder identification	Morphological	parts + surface characters
assay of alkaloids	Chemical	groups by constituent
ward formulary	Pharmacological	groups by action

Viva answer in one breath

No single system is complete – chemotaxonomic is most scientific, pharmacological most clinical, alphabetical fastest. Modern books combine them.

§ CASE IDENTIFY-THE-SOURCE DRILL

8 Identify the Source

Scenario

Six samples land on your bench: **Cinchona bark**, **honey**, **Penicillium culture filtrate**, **agar strips**, **talc powder** and a **sterile Kutki shoot culture**. Assign each to its source and give the reasoning in five words or fewer.

Sample	Source	Reasoning
Cinchona bark	Plant	bark of a tree
Honey	Animal	bee secretion
Penicillium filtrate	Microbial	fermentation product
Agar strips	Marine	red-algal extract
Talc powder	Mineral	magnesium silicate earth
Kutki shoot culture	Tissue culture	sterile micropropagation

Result Analysis

Six for six means the source chapter is closed: origin decides the class, and each class now owns an anchor example. Carry these six into every later unit – drugs keep arriving, sources never change.

§ TRAPS ERRORS AND CONFUSIONS

Three confusions that cost marks

IP vs API vs UPI – the big one

IP = **Indian Pharmacopoeia** – the national legal standard (allopathic + herbal). **API** = **Ayurvedic Pharmacopoeia of India** – Ayurvedic drugs only. **UPI** = **Unani Pharmacopoeia of India** – Unani drugs only. Memory hook: the letter before PI tells the system – I(ndian), A(yurvedic), U(nani).

Official vs codified – crossed axes

Official = in a **pharmacopoeia** (IP/API/UPI). Codified = in **classical texts** (Samhitas). A drug can be one, both or neither – never merge the two axes.

Morphological vs pharmacological – part vs purpose

Morphological groups by **part used** (all barks together). **Pharmacological** groups by **action** (all laxatives together). Part vs purpose – say it that way in viva.

Quick Tip

Before submitting any classification answer, write its **basis word** in the margin – part, family, constituent, action. If the basis is missing, the answer drifts.

§ DRILLS DEEP-DIVE DRILLS

9 Deep-Dive Drills

How to use this page

Cover the **Key** column, write your answer, then uncover. Three drills, full keys – six sources, four books, three users.

Drill 1 – sample	Your source?	Key
Cinchona bark	plant / animal / ...?	Plant – bark of a tree
Honey	plant / animal / ...?	Animal – bee secretion
Penicillium filtrate	plant / microbial / ...?	Microbial – fermentation
Agar strips	marine / plant / ...?	Marine – red-algal extract
Talc powder	mineral / synthetic / ...?	Mineral – Mg silicate earth
Sterile Kutki shoot culture	plant / tissue culture?	Tissue culture – micropropagation

Drill 2 – need a monograph	Which book?	Key
Ayurvedic drug monograph	IP / API / UPI?	API – Ayurvedic Ph. of India
Unani formulation standard	API / UPI / BHP?	UPI – Unani Ph. of India
Western herbal reference	UPI / BHP / IP?	BHP – British Herbal Ph.
Legal standard in India	IP / AHP / BHP?	IP – Indian Pharmacopoeia

Drill 3 – who asks?	Best system	Key – why
Retail pharmacist – arrange by use	which of the 6?	Pharmacological – groups by action
Taxonomist – find relatives	which of the 6?	Taxonomical – groups by family
Chemist – assay the actives	which of the 6?	Chemical – groups by constituent

Self-Mark

13 answers, 1 mark each. 11+ closes Unit I: sources by ***origin***, books by ***system***, classifications by ***user need***.

§ EXAM HIGH-YIELD POINTS

What to carry into the hall

Say it in one line

- Pharmacognosy = *study of crude drugs from nature*.
- Six sources: plant, animal, microbial, marine, mineral, tissue culture.
- Eight milestones run *morphine 1806 to artemisinin 1972*.
- Six pharmacopoeias; six classifications – tables carry full marks.

Most expected 2-mark questions

- Define pharmacognosy and crude drug
- Any two sources with examples
- IP vs API vs UPI
- Official vs codified with one example each

Most expected 5-mark questions

- Milestones of plant drugs in medicine (8, with scientists)
- Compare the six pharmacopoeias in a table
- Six classifications with merits and demerits

Answer protocol

- Open with a *definition*
- Show a *table or timeline*
- Close with one *example per head*
- Scientist names spelled right: Sertuerner, Pelletier, Tu Youyou

Viva Bite

"Most scientific classification?" – chemotaxonomic, because it fuses chemistry with botany. One sentence, full nod.

§ UNIT QUICK REVISION

Unit-I Quick Revision

Definition

- Study of **crude drugs** from nature
- Pharmakon + gnosis
- Scope: industry to AYUSH

Sources

- **6 sources** with one example
- Agar = marine, talc = mineral
- Tissue culture saves species

Milestones

- **8 discoveries** 1806–1972
- Sertuerner to Tu Youyou
- Timeline + table

Pharmacopoeias

- **IP, API, UPI** Indian trio
- BHP, USP-HMDS, AHP
- IP = law in India

Status

- **Official** = pharmacopoeia
- **Codified** = classical text
- Axes independent

Classifications

- **6 systems** + tree
- Chemotaxonomic = scientific
- Merits = basis strengths

Course Outcomes Coverage

CO mapping

- **CO-1a:** define pharmacognosy, trace its history and scope (Remember–Understand)
- **CO-1b:** list drug sources and milestones with examples (Remember)
- **CO-1c:** compare pharmacopoeias and classifications (Understand–Apply)

§ UNIT SELF-CHECK

Unit-I Self-Check

- ✓ I can define pharmacognosy and crude drug without help.
- ✓ I can name all six sources with one example each.
- ✓ I can order the 8 milestones with scientists and years.
- ✓ I can separate IP vs API vs UPI in one sentence.
- ✓ I can separate official vs codified on two axes.
- ✓ I can draw the six-branch classification tree from memory.
- ✓ I can give one merit and one demerit per classification.
- ✓ I can choose the right classification for a given task.

One-Line Summary

Unit 1 teaches you ***what natural drugs are***, ***where they come from***, ***how great discoveries reached us*** and ***how to arrange them*** – the map for Units II to V.

From definition to classification – the foundation is laid.

§ PINPOINTS MUST REMEMBER

Ten hooks – nothing else

#	Hook
1	Pharmacognosy = study of crude drugs from natural sources
2	Crude drug = natural material, used with little or no processing
3	1806 morphine – Sertuerner (Papaver somniferum); 1820 quinine – Pelletier + Caventou (Cinchona)
4	1897 aspirin – Hoffmann / Bayer (willow); 1928 penicillin – Fleming, Florey / Chain (Penicillium)
5	Warfarin – Link (spoiled Melilotus); cephalosporins – Brotzu (Cephalosporium / Acremonium)
6	1967 taxol – Wani, NCI (Taxus brevifolia); 1972 artemisinin – Tu Youyou (Artemisia annua)
7	Six books: IP, API, UPI, BHP, USP-HMDS, AHP – letter before PI tells the system
8	Six sources: plant, animal, microbial, marine, mineral, tissue culture
9	Six classifications: alphabetical, morphological, taxonomical, chemical, pharmacological, chemotaxonomic
10	Official = in a pharmacopoeia; codified = in classical texts – crossed axes, never merged

3 exam predictions

1. Milestones table – 8 scientist-drug pairs with years
2. IP vs API vs UPI comparison in a table
3. Six classifications with one merit + one demerit each

Milestone Mnemonic

My Queen Ate Warm Porridge, Two Apples = Morphine, Quinine, Aspirin, Warfarin, Penicillin, Cephalosporins, Taxol, Artemisinin – in order.

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Cultivation, Collection Processing and Storage

UNIT-II · CRUDE DRUGS: GROWTH TO GODOWN

From seed and soil to dried, graded and stored drug – GACP, hormones, breeding, conservation and value addition.

GACP + Factors | Hormones | Breeding | Conservation | Processing | Exam Points

Inside Unit II

2.1 Cultivation methods + GACP

2.2 Factors: soil to pests

2.3 Plant hormones table

2.4 Polyploidy, mutation, hybridization

2.5 Conservation + eco-pharmacognosy

2.6 Drying, storage, value addition

Pills and Python · PCI-aligned · Remember to Analyze

§ UNIT OVERVIEW

2 Unit-2 at a Glance

Definition

Cultivation is the deliberate growing of medicinal plants; *collection* is harvesting at the right stage; *processing* prepares the drug (drying, garbling); *storage* preserves potency till use. WHO GACP ties all four together for quality crude drugs.

2.1 Cultivation

- Sexual (seed) vs *asexual* (cutting, layering, grafting)
- Field layout, irrigation, manuring
- *GAP / GACP* quality backbone

2.2 Factors

- Altitude, temperature, *rainfall*, soil, light
- Collection time, pests, minerals
- Each factor shifts *secondary metabolites*

2.3 Hormones

- Auxins, gibberellins, *cytokinins*
- ABA and *ethylene*
- Rooting, flowering, ripening control

2.4 Breeding

- *Polyploidy* (colchicine)
- Mutation and *hybridization*
- Aim: richer active constituents

2.5 Conservation

- *In-situ* vs ex-situ banks
- Eco-pharmacognosy thinking
- Kutki and Chirata need protection

2.6 Processing

- Garbling, *drying*, grading
- Packing, storage, *value addition*
- Moisture and pest control

Roadmap: seed to shelf



§ 2.1 CULTIVATION METHODS

1 How Medicinal Plants Are Grown

Definition

Cultivation means growing medicinal plants under controlled conditions to get uniform, high-yielding, contamination-free crude drugs, instead of depending on wild collection.

Sexual vs asexual propagation

Method	How it works	Pharma examples / notes
Sexual (seed)	Sow true seeds; cheap, long life	Senna, Isabgol; variation possible
Cuttings	Stem or root piece roots anew	Rose, Mint; keeps parent traits
Layering	Branch rooted while attached	Jasmine; sure rooting
Grafting / budding	Scion joined on stock	Citrus, Rose; combines qualities
Tissue culture	Sterile micro-propagation	Rare or uniform elite clones

Field operations that decide quality

- ***Soil preparation + manuring:*** plough, compost, correct pH before sowing
- ***Sowing / planting:*** right season, spacing and depth for the species
- ***Irrigation + weeding:*** steady moisture, weed-free rows so the crop, not weeds, feeds
- ***Plant protection:*** pest and disease control with residues kept within limits

Professor's Note

Viva trap: asexual methods ***preserve the parent genotype*** so alkaloid or glycoside yield stays uniform; seed-raised crops vary. Say that line and the cultivation question is half won.

§ 2.1 WHO GACP / GAP

WHO Good Agricultural and Collection Practices

Definition

GACP (WHO Good Agricultural and Collection Practices) is the quality code for growing and wild-collecting medicinal plants: right identity, hygiene, documentation and traceability from seed or habitat to packing. **GAP** covers the farm part; GACP adds wild collection.

GACP pillar	What it demands on the ground
Site + soil	Unpolluted land, soil and water tested, previous-crop history recorded
Seed / planting stock	Authenticated botanical identity, voucher specimen, no adulterated stock
Cultivation care	Approved fertilizers and pesticides only, application logged, pre-harvest intervals kept
Wild collection	No endangered populations harmed, permits taken, habitat left intact
Harvest hygiene	Clean tools and containers, dry weather harvesting, foreign matter removed
Post-harvest	Prompt drying, batch coding, storage off floor, transport clean and dry
Personnel + records	Trained workers, hygiene rules, every batch traceable to field or site

Why examiners love GACP

One sentence wins marks: GACP converts a plant into a medicine-grade raw material by controlling identity, contamination and documentation. Link it to IP quality and Unit III evaluation.

PHARMACY • DATA • AI • HEALTHCARE

§ 2.2 FACTORS - CLIMATE AND SOIL

Factors influencing cultivation - climate and soil

Factor	Effect on growth	Effect on active constituents
Altitude	Temperature and UV change with height	High altitude often raises alkaloids and oils
Temperature	Each species has an optimum range	Heat or frost stress shifts glycoside levels
Rainfall / humidity	Water decides biomass and survival	Excess rain can dilute oils; drought may raise them
Soil type	Texture, minerals, drainage, pH	Alkaloid crops like rich loam; saline soils stunt yield
Soil pH + minerals	Nutrient uptake window pH 6-7	Nitrogen pushes vegetative growth; potash aids quality
Light	Duration and intensity of sun	Long days favour flowering and volatile-oil formation

Reading this table in the exam

Never write only growth effects. The examiner awards marks for the ***second column link***: every factor must end at quantity or quality of secondary metabolites. Quote one pair, e.g. altitude-alkaloid, to prove it.

Common slip

Do not claim a factor always increases yield. ***Optimum, not maximum***: too much rain, heat or fertilizer lowers drug quality even while the plant looks lush.

§ 2.2 FACTORS – COLLECTION AND BIOTIC

Collection, pests and other pressures

Factor	What happens	Quality consequence
Collection time	Age, season, hour of harvest	Peak constituent hour must be chosen
Pests + diseases	Insects, fungi eat or rot tissue	Damaged drug loses actives, gains toxins
Weeds	Compete for water and nutrients	Starved crop gives poor yield
Air pollutants	Dust, smoke settle on leaves	Contaminated drug fails GACP limits
Irrigation gaps	Drought checks growth	Uneven batches, variable assays
Storage climate	Heat, moisture after harvest	Mould and hydrolysis destroy constituents

Collection-time rules with examples

- **Leaves:** collect at flowering when alkaloids and oils peak (e.g. Vasaka, Tulsi)
- **Barks:** collect in spring when sap flow eases separation
- **Roots / rhizomes:** lift when aerial parts wither and reserves sink below ground
- **Flowers:** pick just before full opening; **fruits/seeds:** at full maturity
- **Volatile-oil herbs:** harvest in morning after dew dries, distil fast

Memory hook

Chant `AT-RS-LCP` : Altitude, Temperature, Rainfall, Soil, Light, Collection, Pests. Seven words cover the whole factors question.

§ 2.2 COLLECTION PRACTICE

Collecting right: stage, method, care

Definition

Collection is harvesting the correct plant part, at the correct stage, by the correct method, so the active constituents are at their peak and the material is clean.

Golden rules of collection

- **Right stage:** each organ has a peak-constituent window – never harvest blindly
- **Right weather:** dry day, after dew; wet material moulds in transit
- **Right tool:** sharp, clean knives and baskets; no soil, no mixed species
- **Right handling:** shade bulky herbs, ventilate, move to drying without delay
- **Wild-collection ethics:** permits, quotas, leave seed plants – the GACP promise

Organ	When to collect	Handling note
Leaves	At flowering peak	Shade-dry thin layers, turn often
Bark	Spring, easy peeling	Quill or strip, sun-dry
Root / rhizome	After aerial death	Wash, cut, dry fully
Flower	Bud to early bloom	Dry fast, keep colour
Fruit / seed	Full maturity	Dry, winnow, grade

Exam trap

Collecting at the wrong time is the costliest field error: ***beautiful material with poor assay***. Always pair stage with constituent peak in your answer.

§ 2.3 PLANT HORMONES

Plant hormones and their field applications

Definition

Plant hormones (phytohormones) are chemical messengers that steer growth – rooting, shooting, flowering, ripening and dormancy – and growers borrow them to time and shape the crop.

Hormone	Main roles	Cultivation application
Auxins (IAA, IBA, NAA, 2,4-D)	Apical dominance, root initiation	IBA/NAA root cuttings; NAA stops pre-harvest fruit drop; 2,4-D as weedicide at low dose
Gibberellins (GA)	Stem elongation, seed germination	GA breaks dormancy, boosts malt and cane growth, enlarges seedless fruit
Cytokinins	Cell division, side-shoot growth	Tissue-culture shoot multiplication, delayed leaf yellowing
Abscisic acid (ABA)	Dormancy, stress closure of stomata	Understood for drought response; hardening transplants against stress
Ethylene (ethephon)	Ripening, senescence, abscission	Ethephon ripens fruit uniformly, degreens citrus, aids latex flow

One-line memory

A-G-C-A-E : ***Auxins root, GA elongates, Cytokinins divide, ABA sleeps, Ethylene ripens.*** Five verbs, full marks.

§ 2.3 REGULATORS IN PRACTICE

Using regulators on medicinal crops

Nursery workhorse: rooting cuttings

IBA and NAA dusts or quick-dips root stem cuttings of mint, coleus and ornamentals in days instead of weeks. Uniform rooted stock means a uniform drug assay later – the commercial payoff.

Timing the harvest

- **NAA spray** holds fruit on the tree till the planned harvest date
- **Ethephon** ripens batches together so one harvest catches every plant at peak
- **GA soak** wakes dormant seed, giving even germination and one-age stands

Tissue culture pair

Auxin + cytokinin balance decides the dish: high auxin grows roots, high cytokinin grows shoots. Rare species such as Kutki are bulked this way without stripping wild slopes.

Dose discipline

Hormones are **dose-twins**: rooting dose vs weedicide dose of 2,4-D differ hugely. Wrong concentration injures the crop and breaches residue limits – record every spray per GACP.

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§ 2.4 CROP-IMPROVEMENT METHODS

4 Breeding Better Drug Crops

Definition

Crop improvement creates varieties with more active constituent, better yield and disease resistance through polyploidy, mutation and hybridization – then fixes the gain by selection.

Polyploidy

Colchicine doubles chromosome sets
- Bigger cells, bigger organs
- Often ***richer secondary metabolites***
- Triploid seedless types possible

Mutation breeding

X-rays, gamma rays or ***chemical mutagens***
- Random change, strict selection
- New chemotypes and dwarfs
- Screen generations for stability

Hybridization

Cross two ***chosen parents***
- Combines yield + quality
- Hybrid vigour in F1
- Stabilise by inbreeding

Selection next

Keep only the ***proven winners***
- Assay every generation
- Multiply elite lines
- Release as variety

Professor's Note

Exam sentence: polyploidy enlarges, mutation creates, hybridization combines. One verb per technique, then name colchicine for polyploidy – that pair alone earns the mark.

§ 2.4 BREEDING AND METABOLITES

What each technique does to secondary metabolites

Technique	Genetic change	Metabolite outcome aimed
Polyploidy	Chromosome sets doubled	Gene-dose lift in alkaloids, oils, glycosides
Mutation	Point or structural change	Novel chemotypes, altered pathways
Hybridization	Gene pools merged	High-yield parent plus high-content parent combined
Selection	Best chemotypes kept	Uniform high-assay commercial line
Tissue culture	Elite clone multiplied	Identical metabolite profile at scale

Why breeding matters to pharmacy

A wild plant varies bush to bush; a bred variety delivers ***batch-to-batch assay uniformity***. That uniformity is what IP monographs and factory extraction demand – breeding is quality by design.

Caution

Bigger is not always better: polyploids can be ***sterile or slow***, mutants mostly useless. Only assay-proven, stable lines enter cultivation – selection is non-negotiable.

§ 2.5 IN-SITU VS EX-SITU

Two strategies that save medicinal plants

Definition

In-situ conservation protects species in their natural habitat (sanctuaries, biosphere reserves); *ex-situ* protects them outside the habitat (botanical gardens, seed banks, tissue-culture repositories).

Point	In-situ	Ex-situ
Place	Wild habitat itself	Gardens, banks, labs
Evolution	Continues with nature	Paused or managed
Capacity	Whole communities	Selected accessions
Risk	Habitat loss hits all	Power or funding failure hits stock
Cost	Large reserves, patrols	Compact, technical, costly per sample
Best for	Ecosystems + wild gene pools	Elite lines, rare or endangered taxa

Exam line

Write: in-situ saves the home, ex-situ saves the seed - then argue both are needed. That balanced close is what full-mark answers do.

§ 2.5 ECO-PHARMACOGNOSY

Eco-pharmacognosy and two rescue stories

Definition

Eco-pharmacognosy studies crude drugs with their ecology : harvest without extinction, cultivate to relieve wild pressure, and price nature into every purchasing decision.

Kutki – rescue card

Source: Picrorhiza kurroa rhizome
Family: Scrophulariaceae [Plantaginaceae APG]
Actives: picroside I and II + kutkoside
Use: hepatoprotective bitter
Status: endangered – cultivate, do not strip Alps

Chirata – rescue card

Source: Swertia chirata whole herb
Family: Gentianaceae
Actives: amarogentin + swertiamarin
Use: bitter tonic, fever
Status: threatened – farm it, spare the forest

Eco-pharmacognosy in action

- *Cultivate the demand:* farm Kutki and Chirata so factories stop draining wild slopes
- *Quota + rotation:* licensed collection, seed plants left standing
- *Value at source:* local drying and grading keeps income – and stewardship – in the hills

Value-addition link

Grading, packing and branding at the farm gate raises grower income, which funds replanting. *Conservation pays when value stays local.*

§ 2.6 PROCESSING FLOW

From harvest to packed drug - the chain

Processing chain (follow the arrows)

Harvest → Garble → Dry → Grade → Pack

Harvest ripe - remove soil and weeds - dry fast - sort by grade - pack dry.

Every arrow is a quality gate: delay or dirt at any step lowers the assay.

Garbling: the cleaning step

Garbling removes sand, dust, foreign organs and damaged bits by sieving, winnowing, picking and washing. Clean material dries faster, stores safer and passes foreign-matter limits in evaluation.

Drying: why fast and right matters

Drying drops moisture to a safe level, halts ***enzyme action and mould***, fixes colour and concentrates actives. Slow or damp drying rots the drug - thin layers, air flow, right heat.

Professor's Note

Draw this five-box chain in the exam before writing a word. Label one quality risk under each box and the examiner sees GACP thinking, not rote lines.

§ 2.6 DRYING AND STORAGE

Drying methods and storage rules

Method	How done	Suits / caution
Shade drying	Airy shed, no direct sun	Leaves, flowers – colour kept
Sun drying	Open yards, turned often	Barks, seeds – cheap, dust risk
Hot-air / tray dryer	Controlled warm air	Bulk herbs – fast, even
Vacuum / freeze drying	Low heat or sublimation	Delicate actives – costly
Storage – godown	Cool, dry, ventilated, off floor	Baled or boxed, labelled batches

Storage enemies and shields

- **Moisture:** the master enemy – mould, hydrolysis; shield with dry packing and low humidity
- **Insects + rodents:** bore and soil the drug; shield with fumigation, traps, clean pallets
- **Light + heat:** fade colour, volatilise oils; shield with amber packs and cool rooms
- **Mixing:** odours and powders migrate; shield with sealed, separated lots

Figure to quote

Stored drugs are re-checked for moisture, mould and assay – Unit III turns these shields into measured tests (ash, extractives, moisture).

§ 2.6 VALUE ADDITION

Making the harvest worth more

Definition

Value addition lifts farm produce toward finished quality: grading, cutting, powdering, extraction, packing and branding – each step adding price and audit-trail.

Step	What changes	Value gained
Grading / sorting	Uniform size and colour lots	Premium price per grade
Cutting / powdering	Ready-to-pack form	Saves buyer work, earns margin
Quality testing	Assay + limits certified	Entry to pharma buyers
Smart packing	Moisture-proof, labelled	Longer shelf life, brand trust
Extracts / oils	Concentrated actives	Highest margin, IP-grade input

Farmer-to-pharma ladder

Raw herb -> graded herb -> tested lot -> extract or oil. Each arrow needs GACP records; each record is what lets a factory pay more.

Adulteration link

Value addition done honestly fights adulteration; done dishonestly it enables it. *Tested, labelled lots are the antidote* – Unit IV shows how substitution is caught.

§ DRILLS DEEP-DIVE DRILLS

Three timed drills – write, then check the key

Drill 1 – collection-time rules

Task: write the rule for leaf, bark, root, flower – add one example per organ.
Key: ***Leaves:*** at flowering peak (e.g. Vasaka, Tulsi); ***Bark:*** spring, sap flow eases peeling; ***Roots/rhizomes:*** after aerial parts wither (e.g. Kutki rhizome); ***Flowers:*** bud to early bloom, dry fast to keep colour.

Drill 2 – hormone-use matching

Task: match each hormone to its verb: auxin, gibberellin, cytokinin, ABA, ethylene.
Key: ***Auxin roots*** (IBA/NAA root cuttings); ***GA germinates/elongates*** (breaks dormancy); ***Cytokinin divides*** (shoot multiplication); ***ABA sleeps*** (dormancy, stomatal closure); ***Ethylene ripens*** (ethephon uniform ripening).

Drill 3 – in-situ vs ex-situ choice

A: wild Kutki slope stripped by collectors – which strategy leads? B: elite assay-proven line to bulk and bank – which strategy leads?
Key: A = ***in-situ first*** (reserve, quota, seed plants left; farm Kutki to relieve slope). B = ***ex-situ*** (garden, seed bank, tissue culture for identical stock). Both needed.

Drill discipline

Cover each Key, write in 3 minutes, then uncover. Missed verb or stage = re-read pages 2.2–2.5 once.

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§ EXAM HIGH-YIELD POINTS

Exam points – say these first

GACP in one line

GACP = identity + hygiene + records from seed or habitat to pack; WHO quality code for crude drugs.

Factors mantra

AT-RS-LCP : Altitude, Temperature, Rainfall, Soil, Light, Collection, Pests – each ends at *secondary-metabolite quality*.

Hormone verbs

Auxins root, GA elongates, Cytokinins divide, ABA sleeps, Ethylene ripens – quote *IBA/NAA* for cuttings, *ethephon* for ripening.

Breeding verbs

Polyploidy enlarges, mutation creates, hybridization combines – *colchicine* doubles chromosomes.

Conservation close

In-situ saves the home, ex-situ saves the seed – Kutki (Picrorhiza kurroa) and Chirata (Swertia chirata) as *endangered examples*.

Chain + storage

Harvest -> garble -> dry -> grade -> pack; fight moisture, pests, light, mixing .

§ REVISION MAP + CO

Revision grid and CO mapping

Topic	One-line takeaway	CO
Cultivation + GACP	Controlled growing plus WHO quality code	CO2
Factors	AT-RS-LCP decides metabolite fate	CO2
Hormones	A-G-C-A-E verbs run the nursery	CO2
Breeding	Enlarge, create, combine – then select	CO2
Conservation	Home plus seed; farm Kutki/Chirata	CO2
Processing + storage	Clean, dry fast, store dry, add value	CO2

60-second recall drill

Cover the middle column. For each topic say its takeaway aloud: GACP code – **AT-RS-LCP** – five hormone verbs – three breeding verbs – home plus seed – clean-dry-store. Hesitation marks the page to re-read.

Summary

Unit II in one breath: grow right (GACP), time collection, steer with hormones, breed for assay, conserve both ways, dry-store-add value .

§ SELF CHECK + SUMMARY

Self-check - answer before you peek

Write, then verify

- 1. Expand GACP and list any four of its pillars.
- 2. Name the seven AT-RS-LCP factors and give one metabolite link.
- 3. Match: IBA/NAA, GA, ethephon - to rooting, dormancy-break, ripening.
- 4. One verb each: polyploidy, mutation, hybridization - plus the colchicine role.
- 5. In-situ vs ex-situ: place, evolution, best use - one line each.
- 6. Kutki and Chirata: family plus one active constituent each.
- 7. Five processing steps in order with one quality risk each.
- 8. Four storage enemies with their shields.

Answer Key

Answers (peek last): 1. WHO Good Agricultural and Collection Practices - site, stock, care, wild rules, hygiene, post-harvest, records. 2. Altitude, Temperature, Rainfall, Soil, Light, Collection, Pests - e.g. altitude lifts alkaloids. 3. IBA/NAA root cuttings; GA breaks dormancy; ethephon ripens uniformly. 4. Enlarges, creates, combines; colchicine doubles chromosome sets. 5. In-situ wild habitat, evolution continues, whole communities; ex-situ gardens/banks, managed stock, elite and rare taxa. 6. Kutki Scrophulariaceae [Plantaginaceae APG], picroside I/II; Chirata Gentianaceae, amarogentin. 7. Harvest-garble-dry-grade-pack; risks: wrong stage, dirt, damp rot, mixed grades, moist packing. 8. Moisture-dry packs; insects-fumigation; light/heat-cool amber packs; mixing-sealed separate lots.

One-line summary

From seed and soil to graded, tested stock: GACP discipline plus timely harvest, smart hormones, bold breeding and both conservations is Unit II.

§ PINPOINTS MUST REMEMBER

Ten hooks, three predictions, one mnemonic

Ten hooks - say aloud

1. **GACP** = WHO Good Agricultural and Collection Practices
2. **Auxins root** (IBA/NAA cuttings) 3. **GA germinates/elongates**
4. **Cytokinins divide** (shoots) 5. **ABA sleeps** (dormancy) 6. **Ethylene ripens** (ethephon)
7. **Colchicine = polyploidy** - doubles sets, enlarges, lifts metabolites
8. In-situ saves the home, ex-situ saves the seed
9. **Kutki + Chirata endangered** - Picrorhiza kurroa / Swertia chirata: farm, do not strip
10. **Dry fast, store dry, add value:** thin layers + airflow; cool-dry-sealed lots; grade-test-pack-extract.

Three exam predictions

P1. Expand GACP + any four pillars (site, stock, care, wild rules, hygiene, post-harvest, records).
P2. Five hormone verbs + one field use each (IBA/NAA, GA, ethephon).
P3. In-situ vs ex-situ table + Kutki/Chirata rescue argument.

One mnemonic

A-G-C-A-E roots, germinates, divides, sleeps, ripens; AT-RS-LCP for factors; home vs seed for conservation.

PREMIUM EDITION

B.PHARMA · IST YEAR · 2026-27

Quality Control of Crude Drugs

UNIT-III · PHARMACOGNOSY (WHO LENS)

Adulteration, evaluation and standardisation –
how the world checks that a drug is what it claims to be.

Adulteration · Microscopy · Evaluation · Constants · Bioassay · DNA Barcoding

Inside Unit III

3.1 Adulteration – 5 types
3.2 Organoleptic + microscopy
3.3 Quantitative microscopy
3.4 Physical + chemical tests
3.5 Bioassay + DNA barcodes
Levels: Remember to Apply

Pills and Python · PCI-aligned · Remember to Apply

§ UNIT OVERVIEW

3 Unit-3 at a Glance

3.1 Adulteration

- 5 types: **inferiority**, spoilage, admixture
- Sophistication + **substitution**
- Genuine vs fake table

3.2 Organoleptic

- 5 senses: colour, odour,
- Taste, size, texture, fracture
- First identity screen

3.3 Microscopy

- Stomata **4 types**
- Trichomes + Ca-oxalate
- Index, vein-islet, palisade

3.4 Physical

- Moisture, **4 ashes**
- Extractives, foreign matter
- Purity numbers

3.5 Chemical

- Acid / sap / **iodine** values
- Bitterness, foaming, swelling
- Haemolytic index

3.6 Bio + DNA

- Bioassay when chemistry fails
- **ITS / rbcL / matK** barcodes
- RI, rotation, viscosity

WHO Evaluation Map – 7 doors, one verdict



§ 3.1 ADULTERATION

1 Five Ways a Drug Goes Wrong

Definition

Adulteration is debasement of a genuine crude drug – by adding, removing, spoiling or swapping material so it no longer matches its pharmacopoeial standard. WHO evaluation exists to catch exactly these five tricks.

Type	What happens	Classic example
Inferiority	Same drug, substandard – exhausted or poor grade	Exhausted clove / ginger after oil is distilled off
Spoilage	Damage by microbes, insects or bad storage	Mouldy digitalis; worm-eaten roots
Admixture	Accidental mixing during collection	Stems in leaf drugs; soil, weed fruits
Sophistication	Deliberate fraud with worthless look-alikes	Saffron cut with dyed safflower; starch in powders
Substitution	Entirely different article sold as the drug	Cassia bark sold as true cinnamon

Professor's Note

Examiners love one-word classification drills: ***exhausted ginger*** = inferiority, ***cassia for cinnamon*** = substitution, ***starch in powder*** = sophistication. Train the reflex – the example names the type.

§ 3.1 GENUINE vs ADULTERANT

Know the famous swaps

Genuine drug	Common adulterant / substitute	How evaluation catches it
True cinnamon	Cassia bark (thicker, stronger)	Organoleptic + microscopy of bark
Saffron stigmas	Safflower / marigold florets	Colour, morphology, chemical tests
Senna leaflets	Dog-senna / argel leaves	Stomata + vein-islet numbers
Clove buds	Clove stalks / exhausted clove	Odour (oil), extractive values
Honey / beeswax	Invert sugar / paraffin	Chemical + physical constants

Adulteration alert

Powdered drugs are the easiest to fake and the hardest to judge by eye - ***starch, exhausted powder and look-alike species*** hide perfectly in a powder. That is why microscopy + chemical constants are compulsory for powders.

Why WHO insists on 7 evaluation doors

No single test catches every trick: ***senses*** catch coarse swaps, ***microscopy*** catches species swaps, ***ash and extractives*** catch exhausted and mineral-loaded stock, and ***DNA barcodes*** settle what the eye cannot. A drug passes only when all doors agree.

§ 3.2 ORGANOLEPTIC EVALUATION

2 The Five-Sense Screen

Definition

Organoleptic evaluation judges a crude drug with the sense organs – colour, odour, taste, size, shape, texture, fracture and sound – against the pharmacopoeial description. It is the first, cheapest screen; anything odd here sends the sample to the lab.

Sense / feature	What to record	Example vocabulary
Colour	Outer + inner, fresh vs dried	Senna grey-green; cinnamon light brown
Odour	Crush and smell; intensity	Clove strongly aromatic; capsicum pungent
Taste	Tiny trial on tongue tip	Gentian intensely bitter; honey sweet
Size + shape	Length, width, form	Senna lanceolate leaflets; fennel cremocarps
Texture + fracture	Touch, snap, break surface	Cinchona fibrous; nux-vomica horny

Professor's Note

Taste unknown powders straight is unsafe – record taste only ***as the monograph directs*** and never swallow. Examiners award the safety line; omitting it loses a mark even with a perfect table.

§ 3.3 MICROSCOPY – STOMATA

3 Four Stomatal Fingerprints

What you are looking at

A stoma = two *guard cells* around a pore. The fingerprint is the arrangement of *subsidiary (neighbouring) cells* around them. Four patterns cover almost every exam question – learn pattern + one drug each.

Type	Subsidiary-cell pattern	Remember with
Anomocytic	Irregular cells, no fixed pattern around stoma	Digitalis – A for Anarchy
Anisocytic	3 cells, one distinctly smaller	Datura – Tri unequal
Paracytic	2 cells parallel to the pore axis	Senna – Parallel Pair
Diacytic	2 cells at right angles to the pore	Mentha, Vasaka – Cross pair

Exam trap

Senna is paracytic – students who write anisocytic lose the mark every year. Mnemonic chain: *Senna-Parallel-Pair, Datura-Tri, Digitalis-Anarchy, Mentha-Cross*.

§ 3.3 MICROSKETCH PLATE

Draw these from memory – schematic, not to scale

Stomata – 4 wall patterns (guard cells green)



Anomocytic
e.g. Digitalis

Anisocytic
e.g. Datura

Paracytic
e.g. Senna

Diacytic
e.g. Mentha

All sketches schematic, not to scale – wall pattern only.

Trichomes + calcium-oxalate crystals



Covering
e.g. Senna

Glandular
e.g. Mentha

Raphides
needle bundle

Prism + cluster
rosette

schematic, not to scale

How to earn full marks

Label *guard cells*, *subsidiary cells*, *pore* on the stoma, *stalk + head* on the glandular hair, and name *one drug* under each sketch. Pattern + labels + drug = full marks.

§ 3.3 QUANTITATIVE MICROSCOPY

4 Stomatal Index – Worked

Definition

Stomatal index (Wallis) = S / (E + S) x 100, where *S* = stomata per unit area and *E* = epidermal cells in the same area. Unlike raw stomatal number it is *age- and size-independent* – hence a pharmacopoeial constant.

Worked example – Senna leaflet field

One microscope field shows *S = 18 stomata* and *E = 82 epidermal cells*.
Step 1: E + S = 82 + 18 = *100* Step 2: S / (E + S) = 18 / 100 = *0.18*
Step 3: 0.18 x 100 = stomatal index 18.0.

Output Stomatal index = 18.0 (hand-checked: 18 / 100 x 100 = 18.0)

Professor's Note

Write the *formula first, then substitute* – the formula line alone carries a mark. Common slip: dividing S by E alone (18/82) instead of by (E + S). Bracket the denominator every time.

§ 3.3 LEAF CONSTANTS + LYCOPODIUM

Three more numbers that name a leaf

Vein-islet number

Number of vein islets per sq mm, counted midway between midrib and margin. Fixed for a species - detects admixed foreign leaves in Senna-type drugs.

Palisade ratio

Average palisade cells beneath each upper epidermal cell. Count 4 contiguous epidermal cells, average the palisade cells under them. Constant for a species at a given maturity.

Lycopodium spore method - 94,000 spores per mg

Lycopodium spores are uniform tracers: 1 mg = 94,000 spores. Mix weighed sample with weighed lycopodium, count spores vs diagnostic particles (pollen, starch) in the field, and back-calculate ***particles per mg of drug*** - the classic assay for powdered drugs.

Constant	Unit	Why it is trusted
Stomatal index	Percent	Independent of leaf age and size
Vein-islet number	Per sq mm	Fixed venation per species
Palisade ratio	Cells per cell	Stable anatomy per species

§ 3.4 PHYSICAL EVALUATION - I

Moisture, Ash, Foreign Matter

Moisture content (loss on drying)

Excess water invites ***mould, hydrolysis and insect attack***. Measured by drying to constant weight (or toluene distillation / Karl Fischer for volatiles). High moisture = reject or re-dry.

Foreign organic matter

Anything that is not the drug - other plant parts, insects, soil, weed fruits. Separated by hand/sieve and weighed; IP monographs commonly cap it at NMT 2% unless otherwise stated.

Ash - the mineral fingerprint

Incinerate the drug; the residue is ***total ash*** (physiological + adhering minerals). From it derive three selective ashes - ***acid-insoluble, water-soluble, sulphated*** - each hunting a different impurity. Details on the next page.

§ 3.4 ASH + EXTRACTIVES

Read ash like a detective report

Ash type	Reagent / step	What high value betrays
Total ash	Ignite to constant weight	General mineral load
Acid-insoluble ash	Boil total ash with dilute HCl	Sand, silica, earth – NMT limits
Water-soluble ash	Extract total ash with water	Exhausted drug (solubles leached)
Sulphated ash	Moisten with H_2SO_4 before ignition	Volatile-alkali drugs, precise residue

Extractive values – how much chemistry is still inside

Alcohol-soluble extractive (resins, alkaloids, oils) and **water-soluble extractive** (glycosides, mucilage, sugars): exhaust the powder with the solvent, evaporate, weigh. Low extractive = exhausted or substituted stock.

Professor's Note

Pair them in answers: ***high acid-insoluble ash = sandy drug, low extractive = exhausted drug***. Examiners gift one mark for each correct pairing.

§ 3.5 CHEMICAL CONSTANTS – I

6 Acid, Sap, Iodine, Ester

Value	Definition (per pharmacopoeia)	Reads as
Acid value	mg KOH to neutralise free acids in 1 g	Rancidity / free fatty acids
Saponification value	mg KOH to saponify 1 g completely	Mean molecular weight of fats
Iodine value	g iodine absorbed by 100 g of oil	Unsaturation – drying power
Ester value	Saponification minus acid value	Bound esters only

Memory hook – A S I E

Acid hunts free acids, **S**aponification totals everything, **I**odine counts double bonds, **E**ster = Sap minus Acid. Fixed oils and fats (castor, olive, ghee) are identified and graded by exactly these four.

⚠ Unit trap

Ester value is ***derived, never titrated directly***: Ester = Sap – Acid. Writing a titration for ester value is a zero for that bit.

§ 3.5 CHEMICAL CONSTANTS - II

Bitterness, foam, swell, blood

Index	What it measures	Drug family it grades
Bitterness value	Dilution still tasted bitter vs quinine standard	Bitters - gentian, chirata
Foaming index	Height / persistence of shaken foam	Saponin drugs - liquorice, shatavari
Swelling index	mL occupied by 1 g after swelling in water	Mucilages - ispaghula, agar
Haemolytic activity	RBC lysis vs digitonin standard	Saponin drugs - safety + strength

Why taste becomes a number

Bitterness cannot be weighed, so WHO compares the drug's threshold dilution with a *quinine standard* and reports units per gram. Same logic everywhere on this page: turn a property into a *standardised number*.

Professor's Note

Match drug to index without hesitation: *ispaghula-swelling, saponins-foaming/haemolytic, chirata-bitterness*. Three such pairings routinely fill a 5-mark answer.

§ 3.6 PHYSICAL CONSTANTS + BIOLOGICAL

Instruments first, living tissues next

Constant	Instrument	Catches
Refractive index	Abbe refractometer	Diluted / substituted volatile and fixed oils
Optical rotation	Polarimeter (+ / −)	Wrong enantiomer or adulterated oils, honey
Viscosity	Viscometer (flow time)	Thinned mucilages, gums, oils

Definition

Biological evaluation measures potency on living systems – animal, isolated tissue or microbe – when chemistry alone cannot grade activity. Examples: ***cardiotonic assay of digitalis-type glycosides***, antibiotic zone-of-inhibition assays, oxytocic assay on uterine tissue, and potency tests of vaccines and sera.

When is bioassay compulsory?

When the active principle is ***unknown, unstable or a mixture*** – chemistry can weigh it but only living tissue can prove it still works.

§ 3.7 DNA BARCODING

7 ITS, rbcL, matK

Definition

DNA barcoding identifies a species from short standard gene regions - a molecular fingerprint that survives powdering, drying and mixing, where morphology gives up. The drug's sequence is matched against a reference library.

Barcode locus	Genome	Role in QC
ITS	Nuclear ribosomal	High variation - separates close species
rbcL	Chloroplast	Universal plant barcode, easy to amplify
matK	Chloroplast	Fast-evolving - resolution partner of rbcL

Where it fits in the WHO workflow

Collect right (GACP) - check **senses** - confirm **microscopy** - quantify **ash / extractives / constants** - prove activity by **bioassay** - and settle disputes with **barcodes**. DNA never replaces the earlier doors; it locks the verdict.

§ 3.4-3.5 DEEP-DIVE CALCULATIONS

$ Worked Numbers – Hand-Checked

Calc 1 – Total ash %

Formula: ash % = (ash weight / sample weight) x 100.
Weigh **2.0 g** powdered drug, ignite to constant weight, residue = **0.14 g**. Step 1: 0.14 / 2.0 = **0.07**. Step 2: 0.07 x 100 = 7.0 % total ash.

Calc 2 – Alcohol-soluble extractive %

Formula: extractive % = (dried extract / sample weight) x 100.
Exhaust **5.0 g** powder with alcohol, evaporate, dried residue = **0.55 g**. Step 1: 0.55 / 5.0 = **0.11**. Step 2: 0.11 x 100 = 11.0 % alcohol-soluble extractive. **Low value = exhausted or substituted stock.**

Calc 3 – Acid value + ester link

Acid value = mg KOH to neutralise free acids in **1 g** of oil/fat. Representative figures: sap value **185**, acid value **8**, so ester value = 185 – 8 = 177 (ester = sap – acid). **High acid value = more free fatty acids = rancid or badly stored oil.**

Professor's Note

Show **formula, substitution, answer with unit** in every numerical – each line carries a mark. Bracket denominators: S/(E+S), never S/E+S.

§ EXAM HIGH-YIELD POINTS

What to carry into the hall

Say it in one line

- Five adulterations: inferiority, spoilage, admixture, sophistication, substitution.
- Stomatal index = S / (E + S) x 100 · Lycopodium: 94,000 spores / mg
- Ester value = Sap - Acid · Barcodes: ITS, rbcL, matK.

Most expected 2-mark questions

- Define adulteration with one example · Stomatal index formula
- Vein-islet vs palisade ratio · Any two ash types · ITS / rbcL / matK expands to?

Most expected 5-mark questions

- Five adulteration types with examples
- Stomata 4 types with sketches + drug examples
- Ash types + extractives as purity tools · Chemical constants of oils

Viva Bite

"Why is stomatal index better than stomatal number?" - index divides by total cells, so leaf age and size cancel out. One sentence, full marks.

§ UNIT QUICK REVISION

Unit-3 Quick Revision

Adulteration

- 5 types with 1 example each
- Cassia-cinnamon swap
- Powders need lab proof

Organoleptic

- 5 senses + fracture
- First cheapest screen
- Taste per monograph only

Stomata

- Anom / anis / para / dia
- Senna = paracytic
- Index S/(E+S)x100

Leaf numbers

- Vein-islet per sq mm
- Palisade ratio
- Lycopodium 94,000/mg

Ash + Extr.

- Total / acid / water / sulph.
- Low extractive = exhausted
- FOM often NMT 2%

Bio + DNA

- Bioassay proves activity
- ITS, rbcL, matK
- RI, rotation, viscosity

Course Outcomes Coverage

CO-3 mapping

- **CO-3a:** classify adulteration with examples (Remember-Understand)
- **CO-3b:** apply microscopic and physical tests to judge purity (Apply)
- **CO-3c:** interpret chemical, biological and DNA data for standardisation (Apply-Analyze)

§ UNIT SELF-CHECK

Unit-3 Self-Check

- ✓ I can name the 5 adulteration types with one example each.
- ✓ I can run the organoleptic screen: colour, odour, taste, size, fracture.
- ✓ I can draw and label all 4 stomatal types with a drug for each.
- ✓ I can compute stomatal index from S and E without error.
- ✓ I can state vein-islet, palisade ratio and the 94,000 spores/mg figure.
- ✓ I can explain all 4 ashes plus alcohol- and water-soluble extractives.
- ✓ I can define acid, saponification, iodine and ester values correctly.
- ✓ I can match bitterness, foaming, swelling and haemolytic tests to drugs.
- ✓ I can expand ITS, rbcL, matK and say where barcoding fits in QC.

One-Line Summary

Unit 3 teaches you to prove a drug is genuine - senses first, microscope next, numbers for purity, chemistry for strength, bioassay for action and DNA for the final word.

Seven doors, one verdict - genuine or adulterated.

PILLS AND PYTHON
PHARMACY • DATA • AI • HEALTHCARE

§ FINAL PINPOINTS - MUST REMEMBER

Ten hooks, three predictions, one mnemonic

10 hooks - say each in one breath

1. Ash trio: ***total, acid-insoluble, sulphated*** - sand vs mineral load.
2. Stomatal index = `S / (E + S) x 100` - age- and size-independent.
3. Lycopodium: `94,000 spores / mg` - tracer for powdered drugs.
4. Barcodes: ***ITS (nuclear), rbcL + matK (chloroplast)***.
5. Bitterness value vs ***quinine standard*** - bitters (gentian, chirata).
6. Foaming index - ***saponin drugs*** (liquorice, shatavari).
7. Swelling index - ***mL per 1 g*** - mucilages (ispaghula, agar).
8. Ester value = `sap - acid` - derived, never titrated.
9. RI by ***refractometer***, rotation by ***polarimeter***.
10. Bioassay on ***living systems*** when chemistry cannot prove activity.

3 exam predictions + mnemonic

P1: 4 stomata + SI numerical with S/(E+S)x100 substitution.
P2: Ash trio + extractives as exhausted-vs-sandy verdict.
P3: Acid/sap/iodine/ester + ITS/rbcL/matK one-liners.
Mnemonic ***SALI-BFS***: Sap-Acid, Lycopodium, ITS; Bitterness, Foaming, Swelling.

PREMIUM EDITION

B.PHARMA · BP105T · 2026-27

Plant Metabolites & Traditional Systems

UNIT-IV · INTRODUCTION TO PHARMACOGNOSY

What plants make, why they make it, and how AYUSH and TCM turned those chemicals into medicine.

Primary | Secondary | AYUSH | TCM | Drug Cards | Exam Ready

Inside Unit IV

4.1 Primary metabolites

4.2 Alkaloids + glycosides

4.3 Flavonoids + tannins

4.4 Terpenoids + oils + resins

4.5 AYUSH + TCM systems

Levels: Remember to Analyze

Pills and Python · PCI-aligned · Remember to Analyze

§ UNIT OVERVIEW

4 Unit-4 at a Glance

4.1 Primary

- Carbohydrates, proteins, lipids
- Growth-direct roles
- Excipients: starch, acacia, gelatin

4.2 Alkaloids

- Basic N-compounds, bitter
- Morphine, quinine
- True / proto / pseudo

4.3 Glycosides

- Sugar + aglycone
- Digitalis cardiotonic
- Cardiac, saponin, anthra types

4.4 Flavonoids+Tannins

- Rutin vascular guard
- Myrobalan astringent
- Shinoda + goldbeater tests

4.5 Terpenoids+Oils

- Menthol, artemisinin
- Eucalyptus, benzoin
- Volatile vs fixed oil

4.6 AYUSH+TCM

- Five AYUSH systems
- Yin-yang, qi, five phases
- 8 dosage forms

Learning Roadmap



§ 4.1 PRIMARY METABOLITES

4 Metabolites Plants Cannot Live Without

Definition

Primary metabolites are compounds directly involved in growth and development – made by *all plants*, Universally distributed. Three families: *carbohydrates*, *proteins*, *lipids*.

Carbohydrates

Energy + structure: starch, sugars, gums, mucilages. Pharmacy face: *excipients* – binders, disintegrants, suspending agents.

Proteins

Enzymes + structure: gelatin, papain, soya. Pharmacy face: *capsules*, digestives, culture media.

Lipids

Energy reserve + barriers: fixed oils, fats, waxes. Pharmacy face: *bases and vehicles* – ointments, suppositories, syrups.

Professor's Note

Examiner's favourite confusion: primary = SAME chemistry in every plant (starch is starch); secondary = each plant's private arsenal. One sentence earns the distinction mark.

§ 4.1 CARBOHYDRATES

Sugars, starches, gums and mucilages

Starch

- **Source:** Grains of maize, rice, potato – Zea mays
- **Family:** Poaceae (Gramineae)
- **Part:** Endosperm
- **Constituents:** Amylose + amylopectin; blue with iodine
- **Uses:** Tablet disintegrant, dusting powder

Acacia

- **Source:** Dried gum of Acacia arabica
- **Family:** Fabaceae (Leguminosae)
- **Part:** Stem exudate
- **Constituents:** Arabin – calcium salts of arabic acid
- **Uses:** Emulsifier, binder, demulcent

Agar

- **Source:** Gelidium and Gracilaria species (red algae)
- **Family:** Gelidiaceae
- **Part:** Whole thallus extract
- **Constituents:** Agarose + agaropectin
- **Uses:** Culture medium, laxative, disintegrant

Tragacanth

- **Source:** Astragalus gummifer exudate
- **Family:** Fabaceae
- **Part:** Stem gum
- **Constituents:** Tragacanthin + bassorin; swells in water
- **Uses:** Suspending agent, emulsion stabilizer

Remember

Gums ***dissolve*** (acacia); mucilages ***swell*** (tragacanth, psyllium). Swelling index is literally built on this difference – Unit III will test it.

§ 4.1 PROTEINS AND LIPIDS

From capsules to ointment bases

Gelatin

- **Source:** Partial hydrolysis of animal collagen (skin, bone)
- **Family:** Animal origin
- **Part:** Purified protein
- **Constituents:** Glutelin + albuminoids; sets to gel
- **Uses:** Hard/soft capsules, suppository base

Papain

- **Source:** Dried latex of Carica papaya fruits
- **Family:** Caricaceae
- **Part:** Fruit latex
- **Constituents:** Proteolytic enzymes papain + chymopapain
- **Uses:** Digestive aid, meat tenderizer, wound cleaning

Castor Oil

- **Source:** Cold-expressed seeds of Ricinus communis
- **Family:** Euphorbiaceae
- **Part:** Fixed oil
- **Constituents:** Ricinoleic acid glycerides
- **Uses:** Purgative, emollient, contraceptive creams base

Beeswax

- **Source:** Purified wax of Apis mellifera honeycomb
- **Family:** Animal origin
- **Part:** Secreted wax
- **Constituents:** Myricin + cerotic acid esters
- **Uses:** Ointment stiffener, cold-cream base

⚠ Caution – natural is not harmless

Castor SEEDS carry ricin, a deadly poison; the expressed oil is safe only after proper processing. Examiners love this paradox – quote it.

§ 4.2 SECONDARY METABOLITES

The Plant's Private Arsenal

Definition

Secondary metabolites are compounds NOT directly used for growth – made for **defence, attraction and survival**, in **restricted plant groups only**. This restriction is why they are drugs: potent, specific, and worth hunting.

Seven classes, one map

- **Alkaloids** – basic nitrogen rings (morphine)
- **Glycosides** – sugar + active part (digitalis)
- **Flavonoids** – yellow polyphenols (rutin)
- **Tannins** – protein-tanners (myrobalan)
- **Terpenoids** – isoprene chains (menthol, artemisinin)
- **Volatile oils** – steam-born aromas (eucalyptus)
- **Resins** – oxidised leftovers (benzoin, myrrh)

Professor's Note

Read every class card with the same five eyes – source, family, part, constituent, use. Examiners rotate the SAME five questions across all seven classes.

§ 4.2 ALKALOIDS

Bitter bases with big effects

Three birth certificates

- **True** – from amino acids, heterocyclic N (morphine, quinine)
- **Proto** – amino-acid born, open-chain N (ephedrine)
- **Pseudo** – NOT amino-acid born (caffeine, colchicine)

Tests: `Mayer` creamy white `Dragendorff` orange-red `Wagner` brown

Morphine (Opium)

- **Source:** Dried latex of Papaver somniferum capsules
- **Family:** Papaveraceae
- **Part:** Unripe capsule latex
- **Constituents:** Morphine + codeine + thebaine; methylated with care
- **Uses:** Gold-standard analgesic; strict NDPS control

Quinine (Cinchona)

- **Source:** Bark of Cinchona species
- **Family:** Rubiaceae
- **Part:** Stem bark
- **Constituents:** Quinine + quinidine + cinchonine
- **Uses:** Antimalarial classic; quinidine is antiarrhythmic

Dose defines

Most alkaloids are poisons above the therapeutic window – strychnine, aconitine, atropine. Potency is the point AND the peril; never skip the caution line in answers.

§ 4.2 GLYCOSIDES

Sugar plus a warhead

Definition

A *glycoside* = sugar (glycone) + active part (aglycone), joined by a glycosidic bond. *Hydrolysis* (acid, enzyme, bacteria) splits them – and often switches the activity ON.

Type	Flagship	Use
Cardiac	Digitalis	heart failure
Anthraquinone	Senna / Aloe	laxative
Saponin	Liquorice / Dioscorea	expectorant / steroid base
Cyanogenetic	Bitter almond	flavour (trace); poison (dose)

Digitalis

- **Source:** Dried leaves of Digitalis purpurea
- **Family:** Scrophulariaceae [Plantaginaceae sensu APG]
- **Part:** Leaf
- **Constituents:** Digoxin + digitoxin (cardenolides)
- **Uses:** Cardiotonic – congestive heart failure

Remember

Tests examiners name-drop: `Keller-Kiliani` for deoxy-sugars, `Baljet` + `Legal` for cardenolides, foam test for saponins. Learn test-drug pairs, not tests alone.

§ 4.3 FLAVONOIDS AND TANNINS

Yellow pigments and protein-tanners

Rutin

- **Source:** Ruta graveolens herb; also buckwheat
- **Family:** Rutaceae
- **Part:** Herb / flowers
- **Constituents:** Rutin (quercetin-3-rutinoside) + quercetin
- **Uses:** Capillary protectant; CIPP-adjunct in venous care

Myrobalan (Haritaki)

- **Source:** Dried fruits of Terminalia chebula
- **Family:** Combretaceae
- **Part:** Fruit pericarp
- **Constituents:** Chebulinic + chebulagic acids (hydrolysable tannins)
- **Uses:** Astringent; Triphala pillar; mild laxative

Tannin split in 10 seconds

- **Hydrolysable** – gallo/ellagi-tannins, acid-cleavable (myrobalan, galls)
- **Condensed** – phlobatannins, heat into red phlobaphenes (catechu, cinchona bark)

Tests: `FeCl3` blue-black `goldbeater skin` tans the skin `Shinoda` pink for flavonoids

Professor's Note

Tannins tan protein – that single mechanism explains astringency, styptic action AND leather-making. One mechanism, three exam answers.

§ 4.4 TERPENOIDS AND VOLATILE OILS

Isoprene chains and steam-born aromas

The C5 ruler

Terpenes stack C5 isoprene bricks: **C10 mono** (menthol) · **C15 sesqui** (artemisinin) · **C20 di** (taxol, stevioside) · **C30 tri** (glycyrrhizin). Name the carbon count and you have named the class.

Menthol (Mint)

- **Source:** Mentha piperita herb, steam distilled
- **Family:** Lamiaceae
- **Part:** Leaves / flowering tops
- **Constituents:** Menthol + menthone
- **Uses:** Cooling carminative, rubefacient, lozenges

Artemisinin

- **Source:** Artemisia annua herb
- **Family:** Asteraceae
- **Part:** Leaves
- **Constituents:** Sesquiterpene endoperoxide lactone
- **Uses:** Falciparum malaria; Nobel 2015 (Tu Youyou)

Eucalyptus Oil

- **Source:** Eucalyptus globulus leaves, distilled
- **Family:** Myrtaceae
- **Part:** Leaves
- **Constituents:** Cineole (eucalyptol) 70%+
- **Uses:** Expectorant, inhalant, antiseptic rubs

Don't confuse

Volatile oils **evaporate** (spot fades on filter paper); fixed oils leave a **permanent grease stain**. One filter-paper test separates the two families.

§ 4.4 RESINS

Oxidised leftovers, hardened useful

Definition

Resins are amorphous oxidation products of volatile oils – hard, brittle, insoluble in water, soluble in alcohol. With gum they form ***oleo-resins*** and ***oleo-gum-resins***.

Benzoin

- ***Source:*** Balsamic resin of Styrax benzoin trunks
- ***Family:*** Styraceae
- ***Part:*** Incised stem resin
- ***Constituents:*** Benzoic + cinnamic acids, vanillin traces
- ***Uses:*** Expectorant, antiseptic; Friar's Balsam

Myrrh

- ***Source:*** Oleo-gum-resin of Commiphora molmol
- ***Family:*** Burseraceae
- ***Part:*** Stem exudate
- ***Constituents:*** Volatile oil + gum + resin (myrrhol)
- ***Uses:*** Mouthwash, gargles, incense; wound dusting

Resin family photo

- ***Oleo-resin*** – oil + resin (turpentine, capsicum)
- ***Oleo-gum-resin*** – oil + gum + resin (myrrh, asfoetida)
- ***Gum-resin*** – gum + resin, little oil (ammoniacum)

Remember

Alcohol dissolves resins, water dissolves gums – tinctures vs mucilages fall straight out of that one solubility line.

§ SUMMARY CLASS MASTER TABLE

Seven classes, one glance

Class	ID test	Flagship	Use
Alkaloids	Mayer / Dragendorff	Morphine	analgesic
Glycosides	Keller-Kiliani	Digitalis	cardiotonic
Flavonoids	Shinoda	Rutin	vascular guard
Tannins	Goldbeater / FeCl3	Myrobalan	astringent
Terpenoids	Salkowski	Menthol	cooling
Vol. oils	Fading spot	Eucalyptus	expectorant
Resins	Alcohol-soluble	Benzoin	antiseptic

Exam Tip

Cover the last two columns and recite: test + flagship + use for all seven. That single drill converts this whole unit into 5-mark answers.

PILLS AND PYTHON
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§ 4.5 AYURVEDA

6 Ayurveda – the Science of Life

Tridosha in one card

Health = balance of three humours: **Vata** (air+space, movement) · **Pitta** (fire+water, metabolism) · **Kapha** (earth+water, structure). Disease = aggravated dosha; treatment = pacify it with opposite qualities.

Texts + building blocks

- **Charaka Samhita** – medicine; **Sushruta Samhita** – surgery; **Ashtanga Hridaya** – compendium
- **Panchamahabhuta** – five elements compose matter
- **Sapta dhatu + mala** – seven tissues, three wastes; srotas carry them

How treatment is chosen

- Diagnose dosha + agni (digestive fire) + prakriti (constitution)
- Prescribe opposite-quality drugs + diet + routine (dinacharya)
- Fumigation of classic example: **Triphala** (three myrobalans) for gut regulation

Professor's Note

Ayurveda treats the PATIENT's imbalance, not the disease label – that one sentence answers every 'contrast with allopathy' 5-marker.

§ 4.5 YOGA, NATUROPATHY, UNANI

Drugless paths and Greco-Arab medicine

Yoga + Naturopathy

- **Ashtanga** – eight limbs: yama to samadhi; therapy uses asana + pranayama + dhyana
- **Naturopathy** – drugless: five elements, fasting, hydro/mud therapy
- Pharmacognosy link: shatavari, ashwagandha ride both yoga diet and naturopathic tonics

Unani – four humours

Roots: **Hippocrates + Galen**, systematised by **Avicenna (Canon)**. Health = balance of **Dam (blood)** · **Balgham (phlegm)** · **Safra (yellow bile)** · **Sauda (black bile)**. Treatment by temperament (mizaj) opposites – strikingly parallel to tridosha.

	Ayurveda	Unani
Root	Vedic tradition	Greco-Arab
Humours	3 doshas	4 humours
Key text	Charaka Samhita	Avicenna's Canon

Remember

Unani jam: **Khamira**; Ayurveda jam: **Chyawanprash**. One fermented/preserved example per system kills confusion questions.

PHARMACY • DATA • AI • HEALTHCARE

§ 4.5 SIDDHA AND HOMOEOPATHY

Alchemy of the south, dilution of the west

Siddha

- Sage **Agastya** tradition; Tamil alchemy-first medicine
- **Rasa shastra** - purified metals/minerals (bhasma logic) alongside herbs
- Strong in **skin, liver and chronic** formulations; pharmacognosy overlap via herbo-mineral QC

Homoeopathy

- **Hahnemann**: similia similibus - like cures like
- **Potentization** - serial dilution + succussion; minimum-dose doctrine
- **Single remedy** after totality-of-symptoms; mother tinctures ARE crude-drug extracts

One-line separators

- Siddha leans **mineral**; Homoeopathy leans **dilution**
- Both need pharmacognosy: identity of starting crude drug decides everything downstream

Professor's Note

Mother tincture = the ONLY homoeopathic dosage form a pharmacognosist standardises like a tincture. Quote it and the examiner knows you read the syllabus.

§ 4.5 TRADITIONAL CHINESE MEDICINE

7 TCM – Balance as Medicine

Three pillars

- **Yin-yang** – complementary opposites; disease is their tilt
- **Qi + meridians** – vital flow through channels; acupuncture/moxa regulate it
- **Five phases** – wood, fire, earth, metal, water generate and restrain each other

Diagnosis + pharmacy

- **Pulse + tongue** reading before any prescription
- Multi-herb **formulas** (e.g. Ma Huang Tang for wheeze) – synergy by design, like Triphala logic
- Modern bridge: **artemisinin** isolated from a TCM fever recipe – pharmacognosy's favourite success story

Lens	AYUSH	TCM
Balance of	dosha / mizaj	yin-yang, qi
Matter theory	five elements	five phases
Star example	Triphala	artemisinin source text

Remember

TCM is exam-compact: three pillars + one formula example + artemisinin bridge. Four lines, full marks.

§ SUMMARY AYUSH DOSAGE FORMS

Eight forms, never confused again

Form	Made how	Classic example
Churna	dry powder	Triphala churna
Kwatha	decoction	Dashmula kwatha
Vati / Gutika	pills	Chandraprabha vati
Asava-Arista	fermentation	Ashwagandharista
Taila	medicated oil	Anu taila
Ghrita	medicated ghee	Brahmi ghrita
Bhasma	calcined metals	Loha bhasma
Leha	confection	Chyawanprash

Exam Tip

Asava vs Arista (unboiled vs boiled base) and Taila vs Ghrita (oil vs ghee base) are the two paired confusions examiners set. Learn them as pairs.

§ CASE ALLOPATHY MEETS TRADITION

8 One Plant, Two Medicines

What allopathy borrows

- **Leads** – artemisinin, taxol, morphine all began as traditional use
- **Standards** – marker compounds, assay limits, GACP farms
- **Safety nets** – dose, interaction and toxicity data the old texts lacked

What tradition keeps

- **Holism** – constitution, diet, routine alongside the drug
- **Synergy** – Triphala and Ma Huang Tang work as teams, not singles
- **Access** – low-cost primary care where clinics are thin

Mini-case: sweet wormwood to ACT

Fever recipe in a 4th-century Chinese handbook -> cold extraction -> artemisinin -> ACT combination therapy saving millions. Pharmacognosy is the bridge profession – say exactly that.

Professor's Note

'Role of pharmacognosy' answers need BOTH directions: tradition gives leads, science gives proof. One-sided answers cap at half marks.

§ TIMELINE MEDICINE THROUGH AGES

Whose shoulders we stand on

Era	Voice	Gift
Classical India	Charaka, Sushruta	dosha theory, surgery
Classical China	Shennong tradition	materia medica order
Greece-Rome	Dioscorides, Galen	De Materia Medica, galenicals
Golden age	Avicenna (Canon)	Unani systematised
Colonial era	Botanic gardens	cinchona, tea transplanted
20th century	Trease, Wallis, Evans	modern pharmacognosy texts
Today	WHO, DNA barcodes	GACP + molecular ID

Remember

Galenicals = Galen's legacy in every tincture you standardise. Drop that etymology once and the examiner smiles.

§ DEBUG CLASSIC CONFUSIONS

Traps set every single year

Trap 1 – primary vs secondary

Starch in every plant (primary) vs morphine in one poppy (secondary). 'Rare = secondary' fails for agar (primary, few sources) – use the *growth-role test*, not rarity.

Trap 2 – volatile vs fixed oil

Eucalyptus evaporates, castor stains. The `filter-paper test` decides in seconds – and it is a one-mark question almost yearly.

Trap 3 – natural equals safe

Aconite, nux-vomica, oleander kill. 'Herbal' never means harmless – processing (shodhana) and dose decide safety, exactly like synthetics.

Quick Tip

For every test-named answer (Mayer, Shinoda, Keller-Kiliani), write drug + colour + inference. Test alone earns half; the trio earns full.

§ DRILLS DEEP-DIVE DRILLS

Prove it before the hall

#	D1 - Test (+)	Key: drug
1	Mayer - creamy white	Morphine (Opium) - alkaloid
2	Dragendorff - orange-red	Quinine (Cinchona) - alkaloid
3	Shinoda - pink	Rutin - flavonoid
4	Goldbeater - tans skin	Myrobalan - tannin
5	Keller-Kiliani - deoxy-sugar	Digitalis - glycoside
6	Foam - honeycomb froth	Liquorice / Dioscorea - saponin
7	Salkowski	Menthol - terpenoid

#	D2 - Description	Key: form
1	Dry powder - Triphala	Churna
2	Decoction - Dashmula	Kwatha
3	Fermented - Ashwagandharista	Asava-Arista
4	Calcined metal - Loha	Bhasma

D3 - Tridosha scenarios (keys inside)

A. Restless, dry skin, constipation, racing thoughts, worse in cold wind -> *Vata* (air+space, movement).
B. Burning acidity, anger flares, worse with heat/spice -> *Pitta* (fire+water, metabolism). Pacify with opposite qualities.

Drill Key Logic

D1: alkaloid tests `Mayer/Dragendorff` D2: powder=churna, boiled=kwatha, fermented=asava, ash=bhasma. D3: wind=dry=Vata, heat=burn=Pitta.

§ EXAM HIGH-YIELD POINTS

What to carry into the hall

Say it in one line

- Primary feeds growth; secondary defends the plant and heals us.
- Glycoside = sugar + warhead; tannin = protein-tanner; resin = oxidised oil.
- AYUSH balances humours; TCM balances yin-yang and qi.

Most expected 2-mark questions

- True vs pseudo alkaloids
- Hydrolysable vs condensed tannins
- Volatile vs fixed oil test
- Asava vs Arista

Most expected 5-mark questions

- Alkaloid/glycoside class with two drug cards
- Tridosha vs four-humour comparison
- Eight AYUSH dosage forms with examples

Viva protocol

- Name class -> test -> drug -> use, in that order
- One traditional-vs-modern bridge example ready (artemisinin)

Viva Bite

'Why does the same plant give different drug strengths?' - geography, season, collection time. That answer opens Unit II revision too.

§ UNIT QUICK REVISION

Unit-4 Quick Revision

Primary

- Carbs / proteins / lipids
- Starch, gelatin, oils
- Excipient roles

Alkaloids

- `Mayer/Dragendorff`
- Morphine, quinine
- True/proto/pseudo

Glycosides

- Sugar + aglycone
- Digitalis cardiotonic
- `Keller-Kiliani`

Flav+Tannin

- Rutin, myrobalan
- `Shinoda` / goldbeater
- Astringent logic

Terp+Oils

- C5 ruler C10–C30
- Menthol, artemisinin
- Eucalyptus, benzoin

AYUSH+TCM

- 5 systems + TCM
- 8 dosage forms
- Balance doctrines

Course Outcomes Coverage

CO mapping

- **CO-4a:** classify primary vs secondary with examples (Remember–Understand)
- **CO-4b:** link tests, constituents and uses per class (Apply)
- **CO-4c:** contrast AYUSH/TCM doctrines and dosage forms (Analyze)

§ UNIT SELF-CHECK

Unit-4 Self-Check

- ✓ I can separate primary from secondary metabolites with the growth-role test.
- ✓ I can write source-family-part-constituent-use for morphine, digitalis and rutin.
- ✓ I can run the C5 ruler: menthol C10 to glycyrrhizin C30.
- ✓ I can pair each class with its ID test and colour.
- ✓ I can state tridosha, four humours and yin-yang without notes.
- ✓ I can list all eight AYUSH dosage forms with one example each.
- ✓ I can tell volatile from fixed oil with the filter-paper test.
- ✓ I can argue both directions of the allopathy-tradition bridge.

One-Line Summary

Unit 4 teaches you what plants make (`primary vs secondary`), how to prove it (`ID tests`) and how cultures healed with it (`AYUSH + TCM`).

From molecule to medical system - you now read the plant like a pharmacist.

§ PINPOINTS MUST REMEMBER

Ten hooks, three bets, one mnemonic

10 hooks

1. Classes: **bases**-alkaloids, **sugar**-glycosides, **yellow**-flavonoids, **tan**-tannins, **isoprene**-terpenoids, **aroma**-volatile, **oxidised**-resins
2. Colours: Mayer **creamy-white**, Dragendorff **orange-red**, Shinoda **pink**, FeCl3 **blue-black**
3. Primary feeds **growth** (starch); secondary **defends** (morphine) - growth-role test
4. 8 forms: Churna, Kwatha, Vati, Asava-Arista, Taila, Ghrita, Bhasma, Leha
5. Tridosha: **Vata moves** (air+space), **Pitta burns** (fire+water), **Kapha holds** (earth+water)
6. 4 humours: Dam, Balgham, Safra, Sauda - balance is health (Unani)
7. Yin-yang tilt = disease; qi flows meridians; five phases generate + restrain
8. Bridge: TCM fever recipe -> Artemisia annua -> artemisinin (Tu Youyou 1972) -> ACT
9. Spot test: volatile **fades**, fixed oil **grease stays**
10. Resin rule: **alcohol** dissolves resins, **water** dissolves gums

3 exam predictions

1. Test -> drug -> colour trio (Mayer / Shinoda / Keller-Kiliani) - 5 marks
2. Tridosha vs four-humour table + one pair (Asava vs Arista, Taila vs Ghrita)
3. Eight forms with examples OR alkaloid/glycoside class with two drug cards

Mnemonic - Chai Ka Vada

Churna Kwatha Vati Asava Taila Ghrita Bhasma Leha = **C K V A T G B L** - 'Chai Ka Vada, Aloo Tikki, Ghee Bhaji Lassi'. Classes: **A G F T T V R** - 'Aunt Gita Fried Tasty Tender Vada Rolls'.

PREMIUM EDITION

B.PHARMA · IST YEAR · 2026-27

Phyto-therapeutic Agents

UNIT-V · PHARMACOGNOSY

Twenty drugs in eleven therapeutic classes – one card per drug, exam traps, confusion pairs and a prescription-pattern drill.

20 Drug Cards | 11 Classes | Master Table | Case Drill | Exam Points | Self-Check

Inside Unit V

5.1 Adaptogens + hepatoprotectives

5.2 Cardiac + antidiabetic drugs

5.3 Anti-inflammatory + CNS drugs

5.4 Antimicrobial + GI + skin

5.5 Women's health + respiratory

Levels: Remember to Apply

Pharmacognosy · Fact-Pack grounded · Remember to Apply

§ UNIT OVERVIEW

1 Unit-5 at a Glance

Definition

Phyto-therapeutic agents are plant drugs grouped by therapeutic action – adaptogen, hepatoprotective, cardiac and eight more classes. This unit holds ***20 drugs in 11 classes***: learn each card as source – family – constituent – use, then drill the master table.

Therapeutic class	Drugs in this unit	You must recall
Adaptogens (3)	Ashwagandha, Tulsi, Amla	withanolides / eugenol / vitamin C
Hepatoprotectives (2)	Milk thistle, Kutki	silymarin / picrosides
Cardiac (2)	Garlic, Arjuna	allicin / arjunolic acid
Antidiabetic (2)	Gymnema, Fenugreek	gymnemic acids / diosgenin
Anti-inflammatory (2)	Turmeric, Boswellia	curcuminoids / AKBA
CNS (1)	Brahmi	bacosides – memory
Antimicrobial (3)	Giloy, Neem, Andrographis	cordifolioside / azadirachtin
GI (1) + Skin (1)	Psyllium, Aloe	mucilage / aloin + acemannan
Women's health (2)	Chasteberry, Shatavari	agnuside / shatavarins
Respiratory (1)	Vasaka	vasicine – expectorant

How to use this unit

Read one spread per class, cover the card and recite ***source – family – constituent – use*** aloud. Then test yourself with the master table (p12–13) and the prescription drill (p14).

§ 5.1 ADAPTOGENS

2 Adaptogens – Stress and Strength

Definition

Adaptogens help the body resist stress and build strength – the rasayana idea of Ayurveda. Three drugs: ***Ashwagandha, Tulsi, Amla***.

Ashwagandha

Biological source: Withania somnifera

Family: Solanaceae

Part used: Root

Key constituents: withanolides (withaferin A)

Uses: stress/strength

Tulsi

Biological source: Ocimum sanctum

Family: Lamiaceae

Part used: Leaf

Key constituents: eugenol + ursolic acid

Uses: respiratory/immunity

Amla

Biological source: Emblica officinalis (Phyllanthus emblica)

Family: Euphorbiaceae [Phyllanthaceae APG]

Part used: Fruit

Key constituents: vitamin C + tannins

Uses: rasayana

Professor's Note

Amla's family is the classic trap: write ***Euphorbiaceae*** first, then add [Phyllanthaceae APG] in brackets. Examiners award the bracket.

§ 5.1 HEPATOPROTECTIVES

3 Hepatoprotectives – Guarding the Liver

Definition

Hepatoprotectives protect liver cells from toxins and support recovery – **Milk thistle** (exotic) and **Kutki** (Himalayan).

Milk thistle

Biological source: Silybum marianum

Family: Asteraceae

Part used: Seed

Key constituents: silymarin (silybin)

Uses: liver

Kutki

Biological source: Picrorhiza kurroa

Family: Scrophulariaceae [Plantaginaceae APG]

Part used: Rhizome / root

Key constituents: picroside I/II + kutkoside

Uses: liver

Conservation alert – Kutki

Kutki (**Picrorhiza kurroa**) is endangered by over-collection – in-situ vs ex-situ conservation and eco-pharmacognosy apply here. Never suggest wild collection in answers; write cultivated or substitute-aware sourcing.

Professor's Note

Pair them as `silymarin vs picrosides` – one flavonolignan mixture, one iridoid pair. If a 5-marker asks for one hepatoprotective with constituents, either card earns full marks.

§ 5.2 CARDIAC DRUGS

4 Cardiac Drugs – Heart and Vessels

Definition

Cardiac drugs support the heart and vessels – ***Garlic*** for lipids and BP, ***Arjuna*** as the Ayurvedic cardiotonic.

Garlic

Biological source: Allium sativum

Family: Liliaceae [Amaryllidaceae APG]

Part used: Bulb

Key constituents: alliin -> allicin

Uses: lipids/BP

Arjuna

Biological source: Terminalia arjuna

Family: Combretaceae

Part used: Stem bark

Key constituents: tannins + arjunolic acid

Uses: cardiotonic

Professor's Note

Garlic's chemistry moves: odourless ***alliin*** converts to pungent ***allicin*** only on crushing – write the arrow, and add the APG bracket `[Amaryllidaceae APG]` after Liliaceae. Arjuna answers want the word **`bark`**.

§ 5.2 ANTIDIABETIC DRUGS

Antidiabetics – Sugar Destroyers

Definition

Antidiabetic herbs lower blood glycaemia – **Gymnema**, the sugar destroyer, and **Fenugreek** seed with amino-acid action.

Gymnema

Biological source: Gymnema sylvestre

Family: Asclepiadaceae

Part used: Leaf

Key constituents: gymnemic acids

Uses: sugar destroyer

Fenugreek

Biological source: Trigonella foenum-graecum

Family: Fabaceae

Part used: Seed

Key constituents: diosgenin + 4-hydroxyisoleucine + mucilage

Uses: glycaemia

Professor's Note

Gymnema's one-word viva answer is `sugar destroyer` – it dulls sweet taste. Fenugreek is the three-constituent card: **diosgenin + 4-hydroxyisoleucine + mucilage** – miss one and you lose the 2-marker.

§ 5.3 ANTI-INFLAMMATORY DRUGS

6 Anti-inflammatory Drugs

Definition

Anti-inflammatory herbs calm inflammation and joint pain – ***Turmeric*** rhizome and ***Boswellia*** gum-resin, the arthritis pair.

Turmeric

Biological source: Curcuma longa

Family: Zingiberaceae

Part used: Rhizome

Key constituents: curcuminoids

Uses: inflammation

Boswellia

Biological source: Boswellia serrata

Family: Burseraceae

Part used: Oleo-gum-resin

Key constituents: boswellic acids (AKBA)

Uses: arthritis

Professor's Note

Spell it ***AKBA*** in brackets after boswellic acids – that abbreviation is the examiner's favourite underline. Turmeric's answer is one word: curcuminoids .

§ 5.3 CNS DRUG

7 CNS Drug – Brahmi for Memory

Definition

Brahmi is the unit's memory drug – a Scrophulariaceae herb whose bacosides support cognition and recall.

Brahmi

Biological source: Bacopa monnieri

Family: Scrophulariaceae [Plantaginaceae APG]

Part used: Whole plant (herb)

Key constituents: bacosides

Uses: memory

Confusion pair – Brahmi vs Mandukaparni

The name ***Brahmi*** is also applied regionally to ***Mandukaparni (Centella asiatica)*** – a DIFFERENT plant. In this unit Brahmi means only Bacopa monnieri, bacosides, memory. Always answer with the Latin name attached; naked common names lose marks.

Professor's Note

Brahmi carries the same APG bracket as Kutki: [Plantaginaceae APG] after Scrophulariaceae. Two drugs, one bracket pattern – learn it once.

§ 5.4 ANTIMICROBIAL DRUGS

8 Antimicrobials – Fever and Immunity

Definition

Antimicrobial herbs fight microbes, fever and skin infection – ***Giloy, Neem, Andrographis***, the immunity trio.

Giloy

Biological source: Tinospora cordifolia

Family: Menispermaceae

Part used: Stem

Key constituents: tinosporin/cordifolioside

Uses: fever/immunity

Neem

Biological source: Azadirachta indica

Family: Meliaceae

Part used: Leaf / bark / seed

Key constituents: azadirachtin + nimbin

Uses: skin/antimicrobial

Andrographis

Biological source: Andrographis paniculata

Family: Acanthaceae

Part used: Whole plant (herb)

Key constituents: andrographolide

Uses: liver/fever

Professor's Note

Neem's bitter principle is ***azadirachtin*** – spell every syllable. Andrographis shares `Acanthaceae` with Vasaka (p11): same family, different constituents.

§ 5.4 GI AND SKIN DRUGS

9 GI and Skin – Psyllium and Aloe

Definition

One drug moves the bowel (**Psyllium**, bulk laxative) and one heals skin (**Aloe**, burns and wounds).

Psyllium (Isabgol)

Biological source: Plantago ovata

Family: Plantaginaceae

Part used: Seed / husk

Key constituents: mucilage

Uses: bulk laxative

Aloe

Biological source: Aloe vera

Family: Liliaceae [Asphodelaceae APG]

Part used: Leaf (gel + latex)

Key constituents: aloin (latex) + acemannan gel

Uses: burns/wounds

Professor's Note

Aloe is TWO drugs in one leaf: bitter **aloin latex** vs soothing **acemannan gel** – name which half heals burns. Psyllium works by swelling index mucilage: link it to that evaluation parameter.

§ 5.5 WOMEN'S HEALTH + RESPIRATORY

10 Women's Health and Vasaka

Definition

Chasteberry and Shatavari serve women's health (PMS, galactagogue), while **Vasaka** is the cough expectorant that closes the unit.

Chasteberry

Biological source: Vitex agnus-castus

Family: Verbenaceae

Part used: Fruit

Key constituents: agnuside

Uses: PMS

Shatavari

Biological source: Asparagus racemosus

Family: Liliaceae [Asparagaceae APG]

Part used: Root

Key constituents: shatavarins

Uses: galactagogue/tonic

Vasaka

Biological source: Adhatoda vasica

Family: Acanthaceae

Part used: Leaf

Key constituents: vasicine + vasicinone

Uses: cough/expectorant

Professor's Note

Shatavari needs the APG bracket [Asparagaceae APG] - the third Liliaceae-split drug after Garlic and Aloe. Vasaka's alkaloid pair **vasicine + vasicinone** is pure 2-mark material.

§ TABLE MASTER CLASS x DRUG x CONSTITUENT (A)

Every drug, one row – part A

Class	Drug (source)	Key constituent	Core use
Adaptogen	Ashwagandha (W. somnifera)	withanolides	stress/strength
Adaptogen	Tulsi (O. sanctum)	eugenol + ursolic acid	respiratory/immunity
Adaptogen	Amla (E. officinalis)	vitamin C + tannins	rasayana
Hepatoprotective	Milk thistle (S. marianum)	silymarin (silybin)	liver
Hepatoprotective	Kutki (P. kurroa)	picroside I/II + kutkoside	liver
Cardiac	Garlic (A. sativum)	alliin -> allicin	lipids/BP
Cardiac	Arjuna (T. arjuna)	tannins + arjunolic acid	cardiotonic
Antidiabetic	Gymnema (G. sylvestre)	gymnemic acids	sugar destroyer
Antidiabetic	Fenugreek (T. foenum-graecum)	diosgenin + others	glycaemia
Anti-inflammatory	Turmeric (C. longa)	curcuminoids	inflammation
Anti-inflammatory	Boswellia (B. serrata)	boswellic acids (AKBA)	arthritis

How to memorise

Cover the middle two columns and read class -> use; then reverse. Eleven rows down, nine to go on the next page.

§ TABLE MASTER CLASS x DRUG x CONSTITUENT (B)

Every drug, one row – part B

Class	Drug (source)	Key constituent	Core use
CNS	Brahmi (B. monnieri)	bacosides	memory
Antimicrobial	Giloy (T. cordifolia)	tinosporin/cordifolioside	fever/immunity
Antimicrobial	Neem (A. indica)	azadirachtin + nimbin	skin/antimicrobial
Antimicrobial	Andrographis (A. paniculata)	andrographolide	liver/fever
GI	Psyllium (P. ovata)	mucilage	bulk laxative
Skin	Aloe (A. vera)	aloin + acemannan	burns/wounds
Women's health	Chasteberry (V. agnus-castus)	agnuside	PMS
Women's health	Shatavari (A. racemosus)	shatavarins	galactagogue/tonic
Respiratory	Vasaka (A. vasica)	vasicine + vasicinone	cough/expectorant

Constituent families behind the names

- **Steroidal/lactone bitter:** withanolides, picrosides, andrographolide, gymnemic acids
- **Phenolic/pigment:** silymarin, curcuminoids, tannins (Amla, Arjuna)
- **Volatile/alkaloid:** eugenol (Tulsi), vasicine (Vasaka), allicin (Garlic)
- **Glycoside/saponin:** bacosides, shatavarins, agnuside, cordifolioside

Professor's Note

Full 20-row table memorised = every 2-marker on constituents is free. Test a friend: they name the class, you fire drug + constituent + use.

§ CASE WHICH DRUG FOR WHICH CONDITION

II Prescription-Pattern Drill

The scenario

A community pharmacist sees six walk-in requests in one morning. Match each request to **ONE unit drug** with its **key constituent** – then check the key below. This is exactly how examiners convert drug cards into case questions.

No.	Patient request	Your pick (drug + constituent)
1	Middle-aged man, raised lipids and BP	.....
2	Student, forgetfulness before exams	.....
3	Woman with recurrent cold and low immunity	.....
4	Elderly patient, chronic constipation	.....
5	Young woman with PMS complaints	.....
6	Smoker's cough needing expectorant	.....

Answer key

1 Garlic (alliin -> allicin, lipids/BP) · **2 Brahmi** (bacosides, memory) · **3 Tulsi or Giloy** (eugenol / cordifolioside, immunity) **4 Psyllium** (mucilage, bulk laxative) · **5 Chasteberry** (agnuside, PMS) · **6 Vasaka** (vasicine, expectorant)

Professor's Note

Case 3 accepts two answers – say so and name both constituents. Examiners reward therapeutic reasoning, not single-word guessing: always attach the constituent to the choice.

§ TRAPS CONFUSION PAIRS + CONSERVATION

Where toppers lose marks

Pair 1 – Brahmi vs Mandukaparni

Regional shops sell ***Mandukaparni (Centella asiatica)*** under the name Brahmi – but this unit's Brahmi is strictly Bacopa monnieri, Scrophulariaceae, bacosides. Rule: ***no Latin name, no mark*** – always write Bacopa monnieri beside Brahmi.

Pair 2 – Kutki endangered + Chirata

Two Himalayan bitters are conservation flags: ***Kutki (Picrorhiza kurroa)*** and ***Chirata (Swertia chirata, Gentianaceae)***. Both face over-collection; answer with in-situ / ex-situ conservation and cultivated sourcing, never wild harvest.

Pair 3 – one family, three APG brackets

Liliaceae in the traditional sense splits three ways in this unit:
· Garlic – [Amaryllidaceae APG] · Aloe – [Asphodelaceae APG] · Shatavari – [Asparagaceae APG]
Write traditional first, APG in brackets – the bracket is the mark.

Pair 4 – same family, different drugs

- `Acanthaceae`: ***Andrographis*** (andrographolide, fever) vs ***Vasaka*** (vasicine, cough)
- `Scrophulariaceae`: ***Kutki*** (picrosides, liver) vs ***Brahmi*** (bacosides, memory)

One-line rule

Family alone never identifies a drug – ***family + constituent + use*** together do.

§ DRILLS DEEP-DIVE DRILLS (1/2)

12 Deep-Dive Drills – Match It

Drill 1 – condition to drug (write drug + constituent)

No.	Condition	Your answer (drug + constituent)
1	Stress / low stamina	.....
2	Liver protection needed	.....
3	Raised cholesterol / lipids	.....
4	High blood sugar	.....
5	Joint pain / arthritis	.....
6	Weak memory / recall	.....
7	Wet cough, need expectorant	.....
8	PMS complaints	.....

Drill 1 key

1 Ashwagandha (withanolides) · *2 Milk thistle / Kutki* (silymarin / picroside I/II)
3 Garlic (alliin -> allicin) · *4 Gymnema* (gymnemic acids) · *5 Boswellia* (boswellic acids AKBA)
6 Brahmi (bacosides) · *7 Vasaka* (vasicine + vasicinone) · *8 Chasteberry* (agnuside)

Drill 2 – constituent to drug (reverse)

No.	Constituent named	Which drug? (+ use)
1	withanolides	.....
2	silymarin (silybin)	.....
3	curcuminoids	.....
4	andrographolide	.....
5	vasicine	.....
6	aloin (latex)	.....

Drill 2 key

1 Ashwagandha (stress) · *2 Milk thistle* (liver) · *3 Turmeric* (inflammation)
4 Andrographis (fever) · *5 Vasaka* (cough) · *6 Aloe latex* (not the gel – burns need acemannan gel)

§ DRILLS DEEP-DIVE DRILLS (2/2)

13 Confusion Spot-Test

How this drill works

Four pairs below look alike. For each, write **one line** that separates them (Latin name + constituent + use). Then check the key.

No.	Confusion pair	Your one-line separator
1	Brahmi vs Mandukaparni	.....
2	Milk thistle vs Kutki (both liver)	.....
3	Andrographis vs Vasaka (both Acanthaceae)	.....
4	Kutki vs Brahmi (both Scrophulariaceae)	.....

Spot-test key

1 Brahmi = ***Bacopa monnieri, bacosides, memory***; Mandukaparni = Centella asiatica – different plant.
2 Milk thistle = ***Silybum, silymarin*** (exotic seed); Kutki = ***Picrorhiza, picroside I/II + kutkoside*** (Himalayan rhizome, endangered).
3 Andrographis = ***andrographolide, fever***; Vasaka = ***vasicine + vasicinone, cough*** – same family, different chemistry.
4 Kutki = ***picrosides, liver***; Brahmi = ***bacosides, memory*** – same family, different organ and use.

Professor's Note

If you nailed all 4 pairs plus both drills on the previous page, the master table is already in your head. Rule that never fails: ***family + constituent + use*** together identify every drug.

§ EXAM HIGH-YIELD POINTS

What to carry into the hall

Say it in one line

- Adaptogens resist stress; hepatoprotectives guard the liver; cardiotonics support the heart.
- Constituent is the answer: `bacosides` = Brahmi, `AKBA` = Boswellia, `agnuside` = Chasteberry.

Most expected 2-mark questions

- Biological source + family of Brahmi / Vasaka / Kutki / Garlic
- Key constituents of Turmeric / Boswellia / Gymnema / Fenugreek
- Brahmi vs Mandukaparni distinction · Psyllium as bulk laxative

Most expected 5-mark questions

- Adaptogens: Ashwagandha, Tulsi, Amla with sources and uses
- Hepatoprotectives: Milk thistle vs Kutki with constituents
- Women's health + respiratory: Chasteberry, Shatavari, Vasaka as drug cards

Answer-writing protocol

- One drug = *source + family (+ APG) + part + constituent + use*
- Latin names compulsory · Brackets for Amla, Kutki, Garlic, Aloe, Brahmi, Shatavari

Viva Bite

"Why Kutki and Chirata together?" – both Himalayan bitters, both endangered, both need conservation. That sentence closes any viva on this unit.

§ UNIT QUICK REVISION

Unit-5 Quick Revision

Adaptogens

- Ashwagandha: `withanolides`
- Tulsi: `eugenol`
- Amla: `vit C + tannins`

Liver + Heart

- Milk thistle: `silymarin`
- Kutki: `picrosides`
- Garlic / Arjuna

Sugar + Joints

- Gymnema: `gymnemic acids`
- Fenugreek: `diosgenin`
- Turmeric / Boswellia

Mind + Microbes

- Brahmi: `bacosides`
- Giloy / Neem /
- Andrographis

Gut + Skin

- Psyllium: `mucilage`
- bulk laxative
- Aloe: `aloin/gel`

Women + Lungs

- Chasteberry: `agnuside`
- Shatavari: `shatavarins`
- Vasaka: `vasicine`

Course Outcomes Coverage

CO mapping (COS)

- **CO-Sa:** classify phyto-therapeutic agents by action (Remember-Understand)
- **CO-Sb:** recall source, family, constituents and uses of 20 drugs (Remember)
- **CO-Sc:** select the right drug for a condition and justify it (Apply)

§ UNIT SELF-CHECK

Unit-5 Self-Check

- ✓ I can name all 11 therapeutic classes and their drugs without help.
- ✓ I can write source + family (+ APG bracket) for any of the 20 drugs.
- ✓ I can give the key constituent of each drug from memory.
- ✓ I can separate Brahmi (Bacopa) from Mandukaparni (Centella).
- ✓ I can explain why Kutki and Chirata need conservation.
- ✓ I can match a patient request to the right drug with its constituent.
- ✓ I can reproduce the 20-row master table from a blank page.
- ✓ I can write any 5-mark drug-card answer in full format.

One-Line Summary

Unit 5 maps ***20 plant drugs onto 11 therapeutic actions*** – one card each of source, family, constituent and use, so the right drug meets the right condition.

From adaptogen to expectorant – the whole phyto-pharmacy in one unit.

PILLS AND PYTHON
PHARMACY • DATA • AI • HEALTHCARE

§ FINAL PINPOINTS - MUST REMEMBER

11 class anchors - one drug each

Class	Anchor drug	Constituent	Use
Adaptogen	Ashwagandha	withanolides	stress
Hepatoprotective	Milk thistle	silymarin (silybin)	liver
Cardiac	Garlic	alliin -> allicin	lipids/BP
Antidiabetic	Gymnema	gymnemic acids	sugar
Anti-inflammatory	Boswellia	boswellic acids (AKBA)	arthritis
CNS	Brahmi	bacosides	memory
Antimicrobial	Neem	azadirachtin + nimbin	skin
GI	Psyllium	mucilage	laxative
Skin	Aloe	aloin + acemannan	burns
Women's health	Chasteberry	agnuside	PMS
Respiratory	Vasaka	vasicine + vasicinone	cough

Top-5 exam drugs - one constituent each

Brahmi - bacosides · **Vasaka** - vasicine · **Kutki** - picroside I/II
Garlic - alliin -> allicin · **Turmeric** - curcuminoids

3 exam predictions

1. 2-marker: source + family + constituent of Brahmi / Vasaka / Kutki.
2. 5-marker: Milk thistle vs Kutki as hepatoprotectives with constituents.
3. Case: match a condition (lipids, sugar, cough, PMS) to drug + constituent.

Mnemonic - carry 11 classes

"Strong Liver Hearts Sugar-free Joints Mind Microbes Gut Skin Women Breathe" = Adaptogen, Hepato, Cardiac, Antidiabetic, Anti-inflammatory, CNS, Antimicrobial, GI, Skin, Women's, Respiratory.