



Notes by PharmacoLearn

Introduction to Pharmacognosy

BP105T — B.Pharm Semester I

Exam Success Notes

Theory-exam mastery: complete answers, the way examiners want them

As per PCI B.Pharm (NEP 2020) syllabus

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Unit I — Fundamentals of Pharmacognosy

What pharmacognosy is

Definition (learn this line word-for-word): Pharmacognosy is the scientific study of crude drugs obtained from natural sources — plants, animals, minerals, microbes and marine organisms — covering their history, cultivation, collection, processing, storage, identification, evaluation and therapeutic use.

The word comes from Greek: pharmakon (drug) + gnosis (knowledge). The term was first used by C. A. Seydler in 1815 in his book *Analecta Pharmacognostica*. In the old days pharmacognosy was mostly about recognising and describing crude drugs — what the drug looks like, where it comes from. Today it has grown into the study of the active constituents themselves: their chemistry, how they act, and how plant-based products are turned into safe, standardised modern medicines.

Present status — why the subject came back strong: Around the middle of the 20th century, synthetic drugs pushed natural products aside. Then pharmacognosy revived, and the reasons are worth remembering because examiners ask for them:

- Drug resistance and side effects made people look back at natural remedies.
- The World Health Organization started supporting traditional medicine programmes.
- Blockbuster plant-derived drugs proved the point — taxol for cancer and artemisinin for malaria showed that nature still invents molecules better than the lab does.
- The herbal and nutraceutical industry created a real market demand for trained pharmacognosists.

Exam tip: "Who coined the term pharmacognosy?" is a guaranteed 2-mark question. Answer: C. A. Seydler, 1815. Also memorise the Greek roots — pharmakon + gnosis — because "derive the word" shows up too.

Scope of pharmacognosy — where a pharmacognosist actually works

Pharmacognosy is not just identifying leaves in a lab. A pharmacognosist finds work in four directions:

- Industry: herbal drug formulation, quality control of raw materials, standardisation of extracts, and GMP documentation for herbal products.
- Research and development: hunting for new drug leads from natural sources — anticancer, antimalarial and antibiotic candidates still come from plants, fungi and marine organisms.
- Regulation: writing pharmacopoeial standards, testing market samples for adulteration, and approving herbal product licences.

- Traditional medicine: giving scientific backing to Ayurveda, Unani, Siddha and Homoeopathy — correct botanical identification of classical drugs and quality standards for formulations.

Development of the subject

Pharmacognosy grew in stages. First came the era of description — crude drugs identified by sight, smell and taste. Then came the era of isolation — Sertürner's morphine (1804) proved that a plant's activity sits in a single chemical compound, and suddenly every lab wanted to isolate the "active principle." The third stage is standardisation and validation, where we are now: WHO guidelines, pharmacopoeial monographs, DNA barcoding, and clinical evidence for herbal drugs. Examiners like this three-stage story as a short-note answer.

Sources of drugs

Drugs of natural origin come from six broad sources. The classic exam question is: "Give one example of a drug from each source." Learn this table cold.

Source	What it means	Examples to remember
Plants	Whole plant or parts — leaf, bark, root, seed, flower, fruit	Senna leaf (laxative), Cinchona bark (quinine)
Animals	Animal products, secretions or organs	Honey (demulcent), cod-liver oil (vitamins A and D), musk
Microbial	Antibiotics and products from bacteria and fungi	Penicillin (<i>Penicillium notatum</i>), streptomycin (<i>Streptomyces griseus</i>)
Marine	Drugs from sea organisms	Agar (from red algae <i>Gelidium</i>), carrageenan; anticancer agents from sponges
Mineral	Inorganic substances used as drugs	Talc (dusting powder base), kaolin (adsorbent in diarrhoea)
Plant tissue culture	Drugs produced by growing plant cells or tissues in the laboratory	Shikonin (from <i>Lithospermum</i> cell culture); secondary metabolites produced without harvesting whole plants

Why plant tissue culture matters as a source: it gives a uniform, contamination-free supply of medicinal compounds; it works for slow-growing or endangered plants; and production does not depend on season or climate. Its limitation is cost — and scaling up from flask to factory is difficult. This "advantages vs limitations" framing is exactly how it appears in 5-mark questions.

Exam tip: Students always forget marine and mineral sources. Remember them with the pair: agar from the sea, talc from the earth.

Historical milestones in drug discovery

The syllabus names eight drugs. For each one, learn drug → biological source → who and when → why it mattered. This table is one of the most-asked 5-mark questions in the whole subject.

Drug	Biological source	Milestone
Morphine	Opium (<i>Papaver somniferum</i>)	Isolated by Sertürner (1804) — the first alkaloid ever isolated. Proved that plant activity lies in a single chemical compound. Strong analgesic.
Quinine	Cinchona bark	Isolated by Pelletier and Caventou (1820). First effective antimalarial; later led to synthetic antimalarials like chloroquine.
Aspirin	Willow bark (salicin)	Hoffmann at Bayer (1897) acetylated salicylic acid to make aspirin — the first semi-synthetic blockbuster. Anti-inflammatory, antipyretic, antiplatelet.
Warfarin	Spoiled sweet clover (dicoumarol)	Karl Link traced a cattle bleeding disease to dicoumarol; warfarin was developed from it. Anticoagulant.
Penicillin	<i>Penicillium notatum</i> mould	Alexander Fleming (1928) saw the mould killing bacteria; Florey and Chain developed it into the first antibiotic. Started the antibiotic era.
Cephalosporin	<i>Cephalosporium acremonium</i> (fungus from Sardinian seawater)	Giuseppe Brotzu; developed by Florey and Abraham. Broad-spectrum antibiotics that followed penicillin.
Taxol (paclitaxel)	Bark of Pacific yew (<i>Taxus brevifolia</i>)	Wani and Wall (1971). Anticancer drug (ovarian and breast cancer). Showed the value of screening plant extracts for cytotoxic activity.
Artemisinin	Sweet wormwood (<i>Artemisia annua</i> , "qinghao")	Tu Youyou extracted it guided by ancient Chinese texts; Nobel Prize 2015. Fast-acting antimalarial, backbone of ACT (artemisinin combination therapy).

Notice the pattern the examiner is testing: each milestone moved pharmacognosy forward — morphine proved the single-compound idea, penicillin opened antibiotics, taxol and artemisinin proved natural products still beat the lab. When you write this as a long answer, group them:

alkaloid era (morphine, quinine), semi-synthetic era (aspirin, warfarin), antibiotic era (penicillin, cephalosporin), and modern revival (taxol, artemisinin).

Exam tip: For artemisinin, always add "Nobel Prize 2015 to Tu Youyou" — examiners award the extra half-mark for the Nobel detail.

Herbal and traditional pharmacopoeias

A pharmacopoeia is an official book of drug standards. It tells you how to identify a drug, what tests it must pass, and how pure it must be. The syllabus names six pharmacopoeias that carry herbal monographs:

- 1 Indian Pharmacopoeia (IP): published by the Indian Pharmacopoeia Commission, Ghaziabad. Carries monographs on herbal drugs alongside synthetic drugs.
- 2 British Herbal Pharmacopoeia (BHP): standards specifically for herbal medicines used in the UK.
- 3 United States Pharmacopoeia — Herbal Medicines and Dietary Supplements (USP): quality standards for botanicals and dietary supplements sold in the US.
- 4 Ayurvedic Pharmacopoeia of India (API): published by the Government of India (Ministry of AYUSH). Monographs on Ayurvedic raw drugs and formulations.
- 5 Unani Pharmacopoeia of India (UPI): standards for Unani (Greco-Arab) medicines.
- 6 American Herbal Pharmacopoeia (AHP): a non-profit body publishing detailed monographs on botanicals sold in North America.

Exam tip: "Name the pharmacopoeias that include herbal drug monographs" — write all six with one identifying line each. Don't mix up API (Ayurvedic Pharmacopoeia of India) with the IP (Indian Pharmacopoeia).

Official, non-official, codified and non-codified drugs

Four terms students constantly confuse. Sort them out once and they stay sorted:

- Official drugs: drugs listed in an official pharmacopoeia (IP, BP, USP). Example: Senna (listed in the IP).
- Non-official drugs: drugs not listed in any pharmacopoeia but still in use. Example: many folk remedies that never made it into a pharmacopoeia.
- Codified drugs: drugs described in classical, codified traditional texts — Charaka Samhita, Sushruta Samhita (Ayurveda) — or in official pharmacopoeias. Their identity and use are written down in an authoritative book.
- Non-codified drugs: drugs of folk and tribal medicine, known through oral tradition, not recorded in any classical text. Example: many tribal plant remedies.

The memory hook: official = in the pharmacopoeia; codified = written in a classical book. And a drug can be codified but non-official — described in the Charaka Samhita but not listed in the IP. That one line is a favourite 2-mark trap.

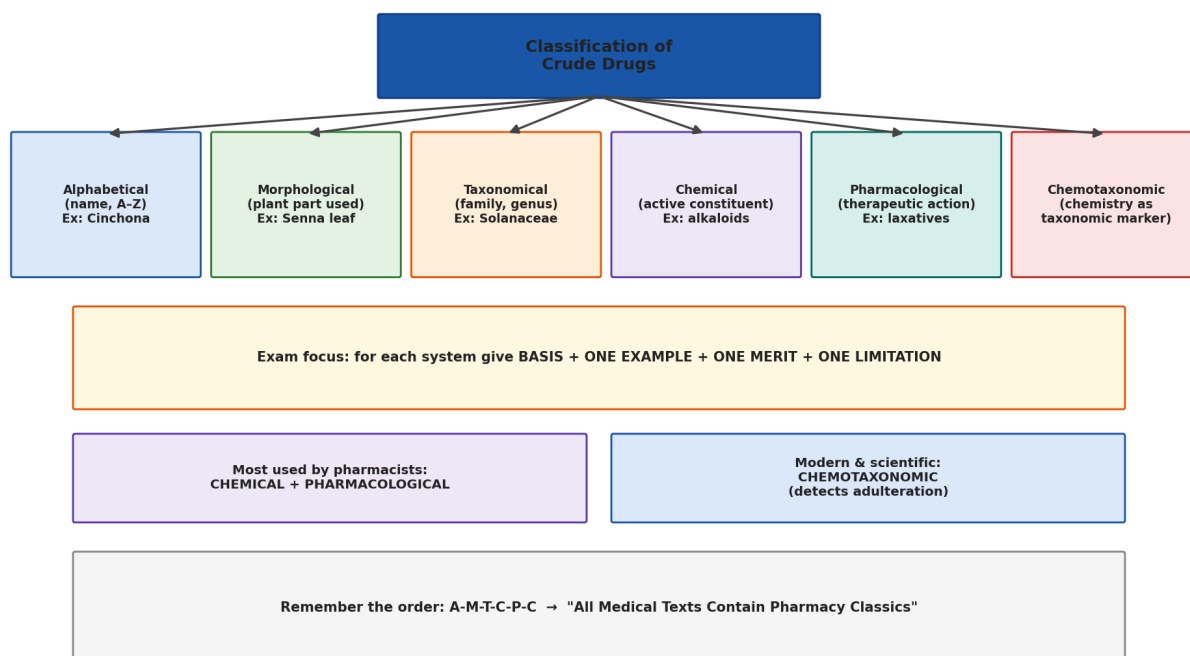
Classification of crude drugs

Classification means arranging crude drugs into groups so they are easy to study. The syllabus names six systems. For each one you must give basis + one example + one merit + one limitation. This is almost guaranteed as a 5- or 10-mark question, so the table below is the single most important table in Unit I.

System	Basis of grouping	Example	Merits	Limitations
Alphabetical	Latin or English name, arranged A to Z	Acacia, Benzoin, Cinchona...	Easiest for quick reference, like a dictionary	No relationship between neighbouring drugs; tedious and unscientific
Morphological	Plant part used; drugs divided into organized and unorganized	Leaves: Senna; Barks: Cinchona; Roots: Rauwolfia; Unorganized: gums, resins, oils	Useful for practical study and identification of the plant part	Chemically unrelated drugs sit together — one leaf may hold alkaloids, another glycosides
Taxonomical	Botanical classification — family, genus, species	Solanaceae: Belladonna, Datura, Stramonium	Scientific; shows evolutionary relationships	Chemically different drugs from the same family get grouped together; needs botanical knowledge
Chemical	Main active chemical constituent	Alkaloids: Nuxvomica, Ergot; Glycosides: Senna, Digitalis; Volatile oils: Clove, Eucalyptus	Best for studying chemistry and action together; very useful for pharmacists	One drug may contain two classes of constituents — where do you place it? Morphological identity is lost
Pharmacological	Therapeutic action or pharmacological effect	Laxatives: Senna, Castor oil; Cardiotonics: Digitalis, Strophanthus; Bitters: Gentian, Chirata	Directly useful for doctors and pharmacists — action-oriented	Drugs with two actions create confusion; chemically unrelated drugs grouped together

System	Basis of grouping	Example	Merits	Limitations
Chemotaxonomic	Distribution of chemical constituents across plant taxa — chemistry used as a taxonomic marker	Alkaloid and glycoside patterns used to confirm plant identity and relationships	Modern and scientific; helps detect adulteration and find new drug sources in related species	Needs specialised chemical analysis; expensive and technical for routine use

Which system should you actually use? The chemical and pharmacological classifications are the most useful for pharmacy students, because they connect the constituent to the action — exactly the source → constituent → use pattern that exams follow. Morphological classification is the most useful in practicals, where you identify the drug by looking at it.



Crude-drug classification systems — Unit I

Crude-drug classification systems: the six systems at a glance

Very short questions (2 marks)

- 1 Define pharmacognosy and give the Greek roots of the word.
- 2 Who coined the term pharmacognosy and in which year?
- 3 Give one example each of a drug from animal, marine and mineral sources.
- 4 Differentiate between official and codified drugs with one example each.
- 5 Name the six systems of crude drug classification.

Short questions (5 marks)

- 1 Write a short note on the scope of pharmacognosy.
- 2 Describe the eight historical milestones in drug discovery (drug, source, discoverer).
- 3 Write short notes on any two herbal/traditional pharmacopoeias.

Long questions (10 marks)

- 1 Describe the classification of crude drugs. Give the basis, one example, one merit and one limitation of each system.
- 2 Discuss the definition, history, present status and development of pharmacognosy, with the sources of drugs of natural origin.

How to approach these answers

- Very-short Q1: one-line definition + the two Greek words; keep it to two lines.
- Very-short Q2-Q5: single fact each — name, year, example, or a plain list; no explanation needed.
- Short Q1: open with what scope means, then the four work areas (industry, research, regulation, traditional medicine) with one line each.
- Short Q2: make a small table — drug, source, discoverer/year — eight rows, no long sentences.
- Short Q3: name the pharmacopoeia, who publishes it, and what it covers — three lines per pharmacopoeia.
- Long Q1: structure — one-line intro, then a six-row table (system, basis, example, merit, limitation), close with which system suits pharmacists and why.
- Long Q2: structure — intro (definition + term origin), history in three stages, present status (four revival reasons), then the six sources in a table; conclusion one line.

Unit II — Cultivation, Collection, Processing and Storage of Drugs of Natural Origin

Methods of plant cultivation

Medicinal plants are cultivated rather than just wild-collected so that the supply stays steady and the quality stays uniform. Three propagation methods, each with its trade-off:

- Sexual propagation (seeds): cheap and easy for large areas. Limitation: genetic variation — every seedling is slightly different, so the active constituent content varies from plant to plant. Examples: Senna, Isabgol.
- Asexual / vegetative propagation: cuttings, grafting, layering, suckers. Gives genetically identical plants, so the constituent content is uniform. Examples: sugarcane setts, mint stolons.

- Micropropagation (tissue culture): growing plantlets from small tissue pieces under sterile laboratory conditions. Used for rare plants and for producing disease-free planting material.

Wild vs cultivated — a comparison examiners like:

Point	Wild plants	Cultivated plants
Constituent content	Often higher — environmental stress increases secondary metabolites	More uniform, but sometimes lower
Supply	Unreliable, seasonal, shrinking	Steady and plannable
Quality	Variable from batch to batch	Consistent
Conservation	Over-collection threatens species	Protects wild populations

For industry, cultivation wins because factories need the same quality in every batch. The one-line logic: wild gives strength, cultivation gives consistency.

Good Agricultural and Collection Practices (WHO / GAP / GCP guidelines)

The syllabus writes this as "WHO / GAP / GCP guidelines." Here is the exact terminology to carry into the exam: the WHO document is titled Good Agricultural and Collection Practices (GACP) for medicinal plants. GACP covers how medicinal plants are grown and collected. GCP — Good Clinical Practice — belongs to clinical trials, not to plant cultivation. If the examiner asks, quote the syllabus phrase, but show you know GACP is the correct standard for medicinal plants.

The key requirements of WHO GACP:

- Site selection: soil must be free of heavy metals, pesticides and industrial pollutants; irrigation water must be clean.
- Seeds and propagation material: botanically identified, free of disease, preferably from authenticated sources.
- Cultivation: no banned pesticides; all fertilizer use recorded; crop rotation to protect the soil.
- Collection: the correct plant species, the correct part, at the correct season and time of day; collectors trained so similar-looking species don't get mixed in.
- Post-harvest handling: proper drying, cleaning and grading; storage protected from moisture, pests and light.
- Documentation: every batch traceable — where it was grown, when it was harvested, how it was processed. This is what "quality starts in the field" means.

Exam tip: If a question asks "write WHO guidelines for medicinal plants," don't write an essay — write the six points above as numbered steps from field to storehouse. That field-to-storehouse order is what examiners want to see.

Factors influencing cultivation, collection and storage

Examiners ask this as "factors affecting the quality of crude drugs." Group them into four stages so the answer has structure:

1. Environmental factors (before harvest):

- Altitude and climate: temperature, rainfall and humidity decide where a plant thrives. Example: Cinchona needs tropical highlands.
- Soil: pH, minerals and drainage matter. Liquorice grown in different soils varies in glycyrrhizin content.
- Light and photoperiod: affects flowering and the formation of active constituents.

2. Biological factors:

- Plant age and growth stage: constituents peak at a particular stage — alkaloids in Belladonna leaves are highest at flowering.
- Pests and diseases: reduce yield and can introduce toxins.

3. Collection-stage factors:

- Time of collection: season and even time of day. Volatile-oil plants are collected in the morning when oil content is highest; barks are collected in spring.
- Method of collection: only the correct part, with no adulterant species mixed in.

4. Post-harvest factors:

- Drying: too slow → fungal growth; too fast or too hot → loss of volatile oils and breakdown of glycosides. Rule of thumb: shade-dry leaves and flowers; sun-dry barks and roots.
- Storage: moisture causes mould, light degrades constituents, insects eat stored drugs. Store cool, dry, airtight and dark.

Plant hormones and their applications in cultivation

Plant hormones (phytohormones) are used to improve the cultivation of medicinal plants — faster multiplication, better rooting, more uniform crops:

Hormone	Main application in medicinal plant cultivation
Auxins (e.g., IBA, NAA)	Rooting of stem cuttings — faster, uniform propagation
Gibberellins	Breaking seed dormancy; increasing stem growth and flowering
Cytokinins	Shoot multiplication in tissue culture; delaying leaf ageing

Hormone	Main application in medicinal plant cultivation
Absciscic acid	Stress tolerance and dormancy control
Ethylene	Fruit ripening; also used to stimulate latex flow in some plants

The practical angle: hormones let growers multiply elite, high-yielding plants quickly and uniformly — which directly raises the active-constituent yield per hectare. For a 5-mark answer, give the table plus that one closing line.

Exam tip: Auxins = roots, gibberellins = dormancy/growth, cytokinins = shoots. That three-word mapping answers most hormone questions.

Polyploidy, mutation and hybridization

These are plant-breeding tools with one purpose: make the plant produce more secondary metabolites, because secondary metabolites are the drug.

- Polyploidy: doubling the chromosome sets (using colchicine). Polyploid plants are often bigger and richer in secondary metabolites. Classic examples: tetraploid *Datura* and *Artemisia* strains with higher alkaloid and artemisinin content.
- Mutation: inducing changes with radiation or chemicals (e.g., EMS), then selecting the mutants with higher constituent yield. Example: high-morphine mutants of the opium poppy.
- Hybridization: crossing two varieties or species to combine good traits — the high yield of one parent with the high constituent content of the other. Example: *Cinchona* hybrids with higher quinine.

One line to carry: breeding aims to make the plant produce more of the compound we want. In the exam, define each term in one line and attach its example — three definitions plus three examples is a complete 5-mark answer.

Conservation: in-situ, ex-situ, value addition and eco-pharmacognosy

- In-situ conservation: protecting plants in their natural habitat — national parks, wildlife sanctuaries, biosphere reserves, sacred groves.
- Ex-situ conservation: protecting plants outside their natural habitat — botanical gardens, seed banks, gene banks, cryopreservation, tissue-culture repositories.
- Strategies for value addition: instead of selling raw dried herbs cheaply, process them into standardized extracts, powders, capsules or essential oils. The grower earns more and the buyer gets better quality.

- Eco-pharmacognosy: using ecological knowledge to conserve medicinal plants sustainably — harvesting in a way that doesn't destroy the population, so the resource survives for future use.

Endangered examples from the syllabus — Kutki and Chirata:

- *Kutki (Picrorhiza kurroa):* a Himalayan herb, hepatoprotective; over-collected from the wild for the herbal industry and now threatened. Needs organized cultivation and regulated collection.
- *Chirata (Swertia chirata):* a Himalayan bitter tonic; wild populations are declining under heavy demand.

Exam tip: "In-situ vs ex-situ" is a standard 5-mark comparison. Draw it as a two-column table: in = in nature (sanctuaries, parks), ex = outside nature (gardens, seed banks). Then add Kutki and Chirata as the syllabus's endangered examples for the closing line.

Very short questions (2 marks)

- 1 What is the WHO guideline for medicinal plant cultivation and collection called?
- 2 Name any two plant hormones and give one use of each in cultivation.
- 3 Differentiate between in-situ and ex-situ conservation with one example each.
- 4 Name the two endangered medicinal plants given in the syllabus.
- 5 Why are volatile-oil plants collected in the morning?

Short questions (5 marks)

- 1 Write a short note on WHO Good Agricultural and Collection Practices (GACP) for medicinal plants.
- 2 Discuss the factors influencing the cultivation, collection and storage of medicinal plants.
- 3 Write a short note on eco-pharmacognosy with reference to Kutki and Chirata.

Long questions (10 marks)

- 1 Describe the methods of cultivation of medicinal plants. Add a note on the applications of plant hormones, polyploidy, mutation and hybridization with reference to secondary metabolites.
- 2 Discuss in-situ and ex-situ conservation of medicinal plants along with strategies for value addition.

How to approach these answers

- Very-short Q1: name the guideline (GACP) and expand it; add the syllabus-phrase caution in one line.
- Very-short Q2-Q5: one fact each — hormone + use, in/ex + example, the two plant names, the morning-collection reason.

- Short Q1: six numbered GACP points in field-to-storehouse order; no paragraph writing.
- Short Q2: four groups (environmental, biological, collection, post-harvest) with two points each — structure carries the marks.
- Short Q3: define eco-pharmacognosy, then Kutki and Chirata with why each is threatened.
- Long Q1: structure — intro (why cultivate), three propagation methods in a table, hormones table, then polyploidy/mutation/hybridization with one example each; conclusion one line.
- Long Q2: structure — intro, in-situ vs ex-situ comparison table, value-addition strategies as points, conclusion on sustainable use.

Unit III — Quality Control of Drugs of Natural Origin (WHO Guidelines)

Adulteration of drugs of natural origin

Definition (learn it exactly): Adulteration is the partial or complete substitution of a genuine drug with a spurious, inferior or otherwise foreign material — or the mixing of such material into the genuine drug.

Why it matters: adulteration reduces therapeutic effect and can cause poisoning. The whole of quality control exists to catch it. There are five types — learn each with one example, because "types of adulteration with examples" is a repeat 5-mark question.

Type	What happens	Example
Substitution with inferior varieties	A cheaper, related species replaces the genuine drug	Senna alexandrina replaced by other Cassia species
Substitution with exhausted drugs	Drug already used for extraction — no active constituents left — is mixed back in	Exhausted clove or fennel (volatile oil already distilled out)
Artificially manufactured substitutes	A fake drug made to look genuine	Artificial invert sugar passed off as honey; paraffin wax in beeswax
Harmful adulterants	Toxic material added, often just for weight	Lead shot in opium; stones mixed with liquorice root
Adulteration by admixture	Genuine drug mixed with inferior material	Stems mixed with leaf drugs; excess foreign organic matter

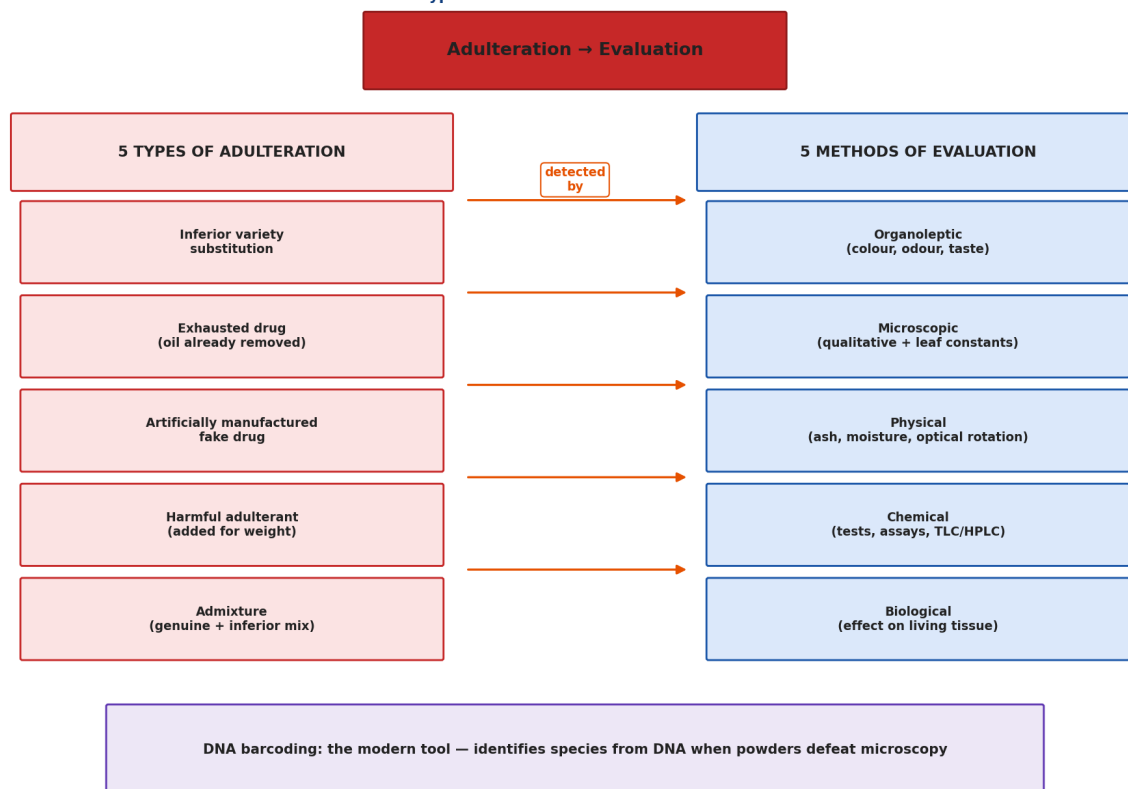
Evaluation of drugs — the five methods

Evaluation means testing a crude drug to confirm its identity, purity and quality. The syllabus lists five approaches, and the examiner expects you to define each with one example:

- 1 Organoleptic evaluation: using the sense organs — colour, odour, taste, size, shape, texture, fracture. Example: liquorice has a sweet taste; clove has a strong aromatic odour. Quick and cheap, but subjective.
- 2 Microscopic evaluation:
 - Qualitative: studying tissue structure — stomata type, trichomes, calcium oxalate crystals, fibres. Confirms identity — e.g., Senna leaf shows paracytic stomata and unicellular trichomes.
 - Quantitative (leaf constants): numbers that do not change with the environment — stomatal number, stomatal index, vein-islet number, veinlet termination number, palisade ratio. Used to detect adulteration in powdered leaf drugs, where you can't see the whole leaf anymore.
- 1 Physical evaluation: measuring physical constants — moisture content, melting point, viscosity, optical rotation, refractive index, ash values. Deviations reveal impurity.
- 2 Chemical evaluation: chemical tests and assays for the active constituents — e.g., acid value and saponification value for fixed oils, alkaloid assays, TLC and HPLC fingerprinting of extracts.
- 3 Biological evaluation: testing the drug's effect on living organisms or tissues, used when chemical tests are not enough — e.g., testing digitalis on cardiac muscle, or the microbiological assay of antibiotics.

Exam tip: The five methods follow a natural order — see it, magnify it, measure it, test its chemistry, test its action. Remember "O-M-P-C-B" (Organoleptic, Microscopic, Physical, Chemical, Biological).

Adulteration types and how evaluation catches them — Unit III



Adulteration types and how the five evaluation methods detect them

Physicochemical parameters

This is the longest list in Unit III, and it is asked as "define and give the significance of..." — pick any four for a short note. The trick is that every parameter has the same two-part structure: what it measures + what fault it reveals. Learn the table that way.

Parameter	What it measures	Significance — what it detects
Extractive values (water-soluble, alcohol-soluble)	Amount of constituents extracted by a solvent	Low value → exhausted or adulterated drug
Moisture content	Water present in the drug	High moisture → fungal growth, enzyme activity, spoilage
Foreign organic matter	Plant parts or materials not part of the drug	Measures cleanliness of collection
Ash values (total ash, acid-insoluble ash, water-soluble ash)	Inorganic residue left after burning	High acid-insoluble ash → sand or silica contamination
Bitterness value	Bitterness compared with quinine	Quality check for bitter drugs (Gentian, Chirata)
Foaming index	Frothing power of a water decoction	Detects saponins

Parameter	What it measures	Significance — what it detects
Haemolytic potential	Ability to burst red blood cells	Another saponin check — saponins haemolyse RBCs
Swelling index	Volume increase in water	Detects mucilage and gum content (Isabgol, Agar)
Viscosity	Thickness of a liquid	Quality of gums and mucilages
Optical rotation	Rotation of plane-polarized light	Identifies optically active drugs (e.g., sugars, volatile oils)
Refractive index	Bending of light through the drug	Purity check for fixed and volatile oils
Acid value	Free fatty acids in an oil or fat	High value → rancidity
Saponification value	Alkali needed to saponify the oil	Indicates average molecular weight of fatty acids; detects adulteration of oils

Physicochemical evaluation parameters grouped by purpose — Unit III

Quality-Control Parameters (WHO)

Detects SPOILAGE & contamination	Detects ACTIVE constituent level	Checks PURITY & identity of oils
Moisture content → fungal growth	Extractive values → exhausted drug	Acid value → rancidity
Foreign organic matter → cleanliness	Bitterness value → bitter drugs	Saponification value → oil adulteration
Ash values → sand / silica	Foaming index → saponins	Refractive index → oil purity
Total ash → inorganic residue	Haemolytic potential → saponins	Optical rotation → optical activity
	Swelling index → mucilage	Viscosity → gum quality

Exam habit: every parameter = WHAT it measures + WHAT FAULT it reveals

Quality-control parameters grouped by what fault they reveal

Exam tip: Students mix up acid value and saponification value. Fix it like this: acid value = free acids already present (rancidity); saponification value = total saponifiable matter (catches oil adulteration).

DNA barcoding

Definition: DNA barcoding identifies a plant species from a short, standard DNA sequence — like a supermarket barcode identifies a product. Commonly used regions are *rbcl*, *matK* and *ITS*.

Why it matters in pharmacognosy:

- Identifies powdered or processed drugs where microscopy fails because the structure is destroyed.
- Catches substitution with closely related species that look identical to the eye.
- Works even on tiny or degraded samples.

Limitation: it needs a laboratory, a reference database and trained staff — it is not a field test. For a 5-mark answer: definition, the barcode analogy, three uses, one limitation.

Very short questions (2 marks)

- 1 Define adulteration of crude drugs.
- 2 Name the five leaf constants used in quantitative microscopy.
- 3 What does a high acid-insoluble ash value indicate?
- 4 What is DNA barcoding?
- 5 Give one example each of harmful adulteration and admixture.

Short questions (5 marks)

- 1 Describe the types of adulteration of drugs of natural origin with examples.
- 2 Discuss the five methods of evaluation of crude drugs.
- 3 Write short notes on any four physicochemical parameters used in quality control.

Long questions (10 marks)

- 1 What is adulteration? Describe its types with examples, and explain how the five evaluation methods detect adulterated drugs.
- 2 Discuss the WHO physicochemical parameters for quality control of crude drugs, giving the significance of each. Add a note on DNA barcoding.

How to approach these answers

- Very-short Q1-Q5: one definition or one fact each — keep every answer under three lines.
- Short Q1: five-row table — type, what happens, example; no extra theory.

- Short Q2: five numbered methods, each with definition + one example; the O-M-P-C-B order helps.
- Short Q3: pick four parameters you know best; each as measure + significance in two lines.
- Long Q1: structure — intro (definition), five types in a table, then the five evaluation methods with which type each catches best; conclusion one line.
- Long Q2: structure — intro, parameters grouped by purpose (spoilage / constituent level / oil purity) in a table, then DNA barcoding as a separate subhead; conclusion one line.

Unit IV — Introduction to Metabolites of Plant Origin; Traditional Systems of Medicine

Plant metabolites — primary vs secondary

Definition: Plant metabolites are chemical compounds produced by plant metabolism. They fall into two groups, and the difference between them is one of the most-asked 2- and 5-mark topics in this unit:

- Primary metabolites: compounds directly involved in growth, development and reproduction — needed for the plant to live. Found in all plants, in large amounts.
- Secondary metabolites: compounds not directly involved in essential life processes, but which help the plant survive — defence against pests, attraction of pollinators, protection from UV light. These are the source of most plant drugs. They are produced in smaller amounts, and their quantity varies with the environment.

Feature	Primary metabolites	Secondary metabolites
Role	Growth and survival	Defence, signalling, ecological interactions
Distribution	In all plants	Restricted to certain families or species
Quantity	Large	Small
Drug value	Mostly nutritional (some exceptions)	Most plant drugs come from here
Examples	Carbohydrates, proteins, lipids	Alkaloids, glycosides, flavonoids, tannins, terpenoids, volatile oils, resins

The metabolite classes in detail

The syllabus lists ten classes. For each one, learn definition + one drug example + one chemical test. Chemical tests are classic 2-mark questions, so they are included for every class that has one.

Primary metabolites

Carbohydrates: polyhydroxy aldehydes or ketones; the plant's energy source and structural material. Drug examples: starch (tablet diluent), acacia and tragacanth (suspending agents), agar (laxative, culture media). Test: Molisch's test.

Proteins: polymers of amino acids; enzymes are proteins. Drug examples: gelatin (capsule shells), papain — a protein-digesting enzyme from papaya, used as a digestant and anthelmintic. Test: Biuret test.

Lipids (fixed oils, fats, waxes): esters of fatty acids with glycerol. Drug examples: castor oil (laxative), cod-liver oil (vitamins A and D), beeswax (ointment base). Tests: saponification value, acid value; the spot test (translucent stain on paper).

Secondary metabolites

Alkaloids: nitrogen-containing compounds of plant origin with alkaline character, usually with strong physiological action. Drug examples: morphine (analgesic), quinine (antimalarial), reserpine (antihypertensive), vincristine (anticancer). Tests: Mayer's, Dragendorff's, Wagner's and Hager's reagents — all give characteristic precipitates with alkaloids.

Glycosides: compounds that yield a sugar part (glycone) and a non-sugar part (aglycone or genin) on hydrolysis. Drug examples: senna — sennosides (laxative); digitalis — digoxin (cardiotonic). Tests: Bornträger's test for anthraquinone glycosides; Keller-Kiliani test for cardiac glycosides.

Flavonoids: polyphenolic compounds, often yellow plant pigments; antioxidant and anti-inflammatory in action. Drug examples: rutin (capillary protectant), quercetin. Test: Shinoda test — magnesium + HCl gives a pink or red colour.

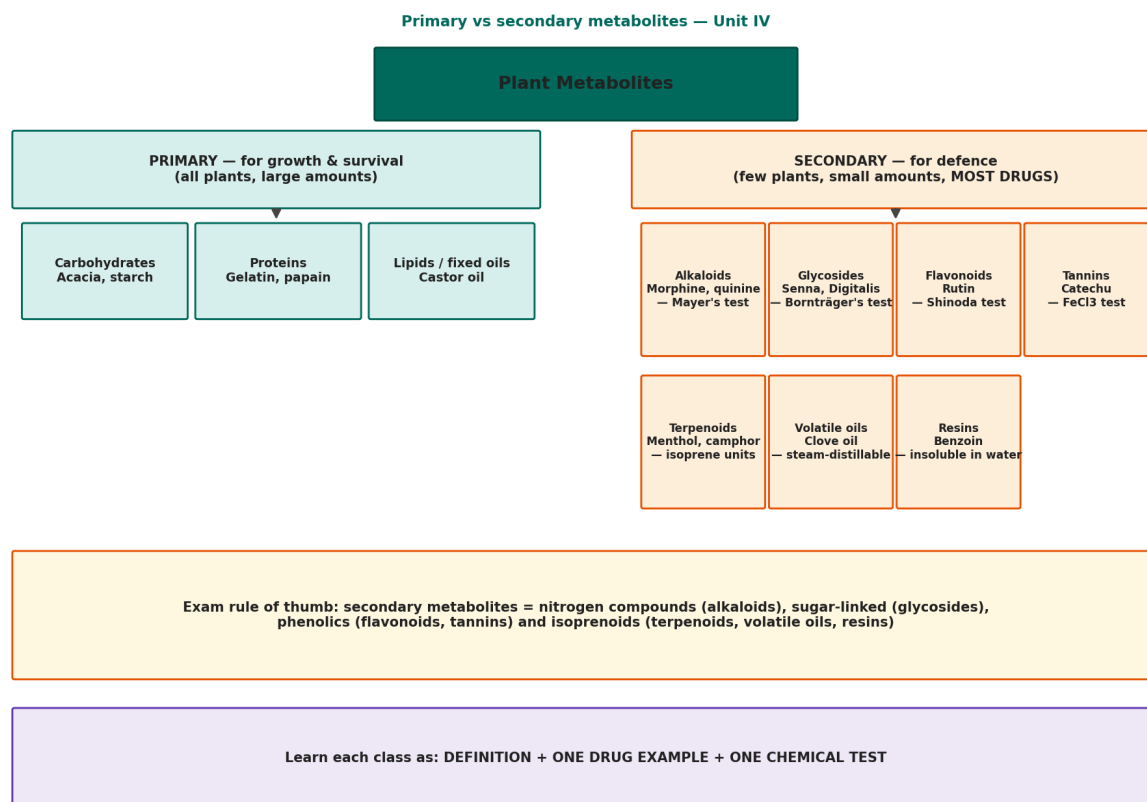
Tannins: polyphenolic compounds that precipitate proteins — this is what gives them their astringent action. Drug examples: catechu, myrobalan (a Triphala ingredient). Tests: ferric chloride (blue-black colour), gelatin test (white precipitate).

Terpenoids: built from isoprene units; a huge class that includes many essential-oil components. Drug examples: menthol (carminative, cooling agent), camphor.

Volatile oils: aromatic, steam-distillable oils; mostly made of terpenoids. They evaporate at room temperature and have a characteristic odour. Drug examples: clove oil (dental analgesic), eucalyptus oil (expectorant), peppermint oil (carminative).

Resins: solid or semi-solid plant exudates; insoluble in water, soluble in alcohol. Drug examples: benzoin (expectorant, antiseptic inhalation), asafoetida (carminative).

Exam tip: "Classify secondary metabolites with examples" and "give chemical tests for alkaloids / glycosides / tannins" are repeat questions. Learn each class as definition + one example + one test, and you can answer both.



Primary vs secondary metabolites: the ten syllabus classes with drug examples and tests

Traditional systems of medicine — AYUSH and TCM

AYUSH is the umbrella for India's officially recognized traditional systems: Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy. (Sowa-Rigpa is also officially recognized.) TCM is Traditional Chinese Medicine.

Fundamental principles of treatment — one line per system is enough for a short note:

System	Fundamental principle of treatment
Ayurveda	Balances the three doshas — Vata, Pitta, Kapha — using herbs, diet, Panchakarma detoxification and lifestyle
Unani	Based on the four humours — blood, phlegm, yellow bile, black bile — treated by regimental therapy, diet and herbal drugs

System	Fundamental principle of treatment
Siddha	South Indian system; balances the three humours (Vata, Pitta, Kapha); uses herbs plus herbo-mineral preparations
Homoeopathy	"Like cures like" — highly diluted remedies chosen by symptom similarity (law of similars, single remedy, minimum dose)
TCM	Balances Yin-Yang and the flow of Qi through meridians; treatment by herbal formulas, acupuncture, cupping and diet

Types of dosage forms in AYUSH medicines

Examiners ask you to "name AYUSH dosage forms" — learn these nine with their one-word meaning:

- Kwatha — decoction (boiled water extract)
- Churna — powder
- Vati / Gutika — tablets or pills
- Asava and Arishta — fermented liquid preparations
- Taila — medicated oils
- Ghrita — medicated ghee
- Bhasma — calcined herbo-mineral preparations
- Lehya / Avaleha — confections (linctus-like preparations)
- Arka — distillates

Exam tip: Remember them in pairs — Kwatha-Churna (simplest), Vati-Gutika (solid), Asava-Arishta (fermented), Taila-Ghrita (fatty bases), Bhasma (minerals). Arka and Lehya stand alone.

Role of pharmacognosy in allopathy and traditional systems

- In allopathy: pharmacognosy supplies lead compounds (morphine, taxol, artemisinin), standardizes herbal raw materials used in formulations, and detects adulteration in market samples.
- In traditional systems (AYUSH and TCM): it gives scientific backing — correct botanical identification of classical drugs, quality standards for pharmacopoeial monographs (API, UPI), and safety testing of formulations.

In one line: allopathy takes drug leads from pharmacognosy; traditional systems take scientific validation from it. That framing makes a clean closing line for a 5-mark answer.

Very short questions (2 marks)

- 1 Differentiate between primary and secondary metabolites with one example each.

- 2 Name the chemical tests used to identify alkaloids.
- 3 Expand AYUSH.
- 4 Name any two AYUSH dosage forms.
- 5 Give the chemical test for tannins.

Short questions (5 marks)

- 1 Classify secondary metabolites with one example of each.
- 2 Write a short note on the fundamental principles of treatment in AYUSH systems.
- 3 Describe the role of pharmacognosy in allopathy and traditional systems of medicine.

Long questions (10 marks)

- 1 Define plant metabolites. Distinguish between primary and secondary metabolites, and describe the ten classes of metabolites with examples and chemical tests.
- 2 Discuss the fundamental principles of treatment in Ayurveda, Unani, Siddha, Homoeopathy and TCM. Add a note on the types of dosage forms used in AYUSH medicines.

How to approach these answers

- Very-short Q1-Q5: one-line differences, test names, or expansions — no explanations.
- Short Q1: seven secondary classes as a small table — class, definition in a few words, one example.
- Short Q2: five systems in a table — system + one-line principle; that is the whole answer.
- Short Q3: two subheads — allopathy (three points), traditional systems (three points); close with the one-line framing.
- Long Q1: structure — intro (definition), primary vs secondary comparison table, then the ten classes with example + test for each; conclusion one line.
- Long Q2: structure — intro (AYUSH + TCM), principles in a five-row table, then AYUSH dosage forms as a nine-point list with one-word meanings; conclusion one line.

Unit V — Phyto-therapeutic Agents

This is the highest-yield unit in the paper. For every drug, learn the same three-step pattern: biological source (botanical name, family, part used) → major chemical constituents → uses. That pattern answers nearly every question here, whether it is a 2-mark "give the source and uses" or a 10-mark "write a detailed account."

Adaptogens and immunomodulators

Adaptogens help the body resist stress; immunomodulators strengthen the immune response.

Drug	Biological source	Major constituents	Uses
Ashwagandha	Dried roots of <i>Withania somnifera</i> , family Solanaceae	Withanolides (withaferin A), alkaloids	Adaptogen, anti-stress, immunomodulator; improves strength and stamina
Tulsi (Holy basil)	Leaves of <i>Ocimum sanctum</i> (<i>O. tenuiflorum</i>), family Lamiaceae	Eugenol, ursolic acid, rosmarinic acid	Immunomodulator, adaptogen; cold, cough and respiratory disorders
Amla (Indian gooseberry)	Dried fruits of <i>Phyllanthus emblica</i> (<i>Emblica officinalis</i>), family Euphorbiaceae	Vitamin C, tannins (emblicanin A and B), gallic acid	Immunomodulator, antioxidant, rejuvenative (Rasayana); ingredient of Triphala and Chyawanprash

Exam tip: Amla's claim to fame is vitamin C plus the emblicanin tannins — write both, because "vitamin C" alone is too thin for full marks.

Hepatoprotectives

Drug	Biological source	Major constituents	Uses
Milk thistle	Seeds/fruits of <i>Silybum marianum</i> , family Asteraceae	Silymarin — a mixture of flavonolignans (silybin, silychristin, silydianin)	Hepatoprotective — liver damage, hepatitis, cirrhosis support
Kutki	Dried rhizomes/roots of <i>Picrorhiza kurroa</i> , family Scrophulariaceae	Picroside I and II, kutkoside (iridoid glycosides)	Hepatoprotective, bitter tonic; jaundice and liver disorders

Note that Kutki appears twice in your syllabus — as an endangered plant in Unit II and as a hepatoprotective here. Examiners love that kind of cross-unit link, so mention both angles if you get a long question on it.

Cardiovascular drugs

Drug	Biological source	Major constituents	Uses
Garlic	Bulbs of <i>Allium sativum</i> , family Liliaceae (Amaryllidaceae)	Allicin (formed from alliin by the enzyme allinase), ajoene	Hypolipidemic, antihypertensive, antiplatelet; atherosclerosis
Arjuna	Dried stem bark of <i>Terminalia arjuna</i> , family Combretaceae	Arjunolic acid, tannins, flavonoids	Cardiotonic; angina, heart failure support, hyperlipidemia

Exam tip: For garlic, the alliin → allicin conversion by allinase is the detail that earns the extra mark. Allicin is what gives crushed garlic its smell and its action.

Antidiabetics

Drug	Biological source	Major constituents	Uses
Gymnema (Gurmar — "sugar destroyer")	Leaves of <i>Gymnema sylvestre</i> , family Asclepiadaceae	Gymnemic acids (triterpene saponins)	Antidiabetic; reduces sugar absorption and suppresses sweet-taste sensation
Fenugreek (Methi)	Seeds of <i>Trigonella foenum-graecum</i> , family Fabaceae (Leguminosae)	Trigonelline, diosgenin, 4-hydroxyisoleucine, mucilage	Antidiabetic, hypolipidemic; supports lactation

Anti-inflammatory drugs and analgesics

Drug	Biological source	Major constituents	Uses
Turmeric (Haldi)	Dried rhizomes of <i>Curcuma longa</i> , family Zingiberaceae	Curcumin (curcuminoids), volatile oil	Anti-inflammatory, analgesic, antioxidant; wound healing, arthritis
Boswellia (Salai guggul)	Gum resin of <i>Boswellia serrata</i> , family Burseraceae	Boswellic acids (especially AKBA)	Anti-inflammatory; osteoarthritis, rheumatoid arthritis, asthma

CNS drugs

Drug	Biological source	Major constituents	Uses
Brahmi	Whole plant of <i>Bacopa monnieri</i> , family Scrophulariaceae	Bacosides A and B (saponins)	Nootropic — memory enhancer; anxiety and epilepsy support; Medhya Rasayana

Naming caution — read this carefully: in some regional traditions the name "Brahmi" is also used for Gotu kola (*Centella asiatica*). In pharmacognosy textbooks and the Indian Pharmacopoeia, however, Brahmi = *Bacopa monnieri*. If the examiner asks, give the textbook answer (*Bacopa monnieri*) and add the one-line note about the ambiguity — it shows you actually know the subject.

Antimicrobials and antivirals

Drug	Biological source	Major constituents	Uses
Giloy (Guduchi)	Stems of <i>Tinospora cordifolia</i> , family Menispermaceae	Tinosporin, berberine, cordifolioside (alkaloids and glycosides)	Immunomodulator, antipyretic; recurrent infections, supportive care in dengue and chikungunya
Neem	Leaves/bark of <i>Azadirachta indica</i> , family Meliaceae	Azadirachtin, nimbin, nimbidin	Antimicrobial, insecticidal; skin diseases, dental care
Andrographis (Kalmegh)	Whole plant of <i>Andrographis paniculata</i> , family Acanthaceae	Andrographolide (diterpene lactone)	Antimicrobial, hepatoprotective, immunostimulant; the "king of bitters" for liver disorders and infections

Gastrointestinal drugs

Drug	Biological source	Major constituents	Uses
Psyllium (Isabgol)	Dried seeds/husk of <i>Plantago ovata</i> , family Plantaginaceae	Mucilage (arabinoxylan) — very high swelling index	Bulk laxative for constipation; also used in diarrhoea and hyperlipidemia

Psyllium connects straight back to Unit III: its mucilage content is exactly what the swelling index measures. Dropping that link into your answer shows the examiner you're thinking across units.

Dermatological agents

Drug	Biological source	Major constituents	Uses
Aloe (Ghrithkumari)	Dried juice of the leaves of <i>Aloe barbadensis</i> (Aloe vera), family Liliaceae	Aloin (barbaloin), aloe-emodin (anthraquinone glycosides), mucilage	Dermatological — burns, wounds, moisturizer; also a stimulant laxative

Exam tip: Aloe has two faces — the mucilage soothes skin, the anthraquinone glycosides (aloin) act as a laxative. If a question asks "uses of aloe," give both.

Drugs used in women's health

Drug	Biological source	Major constituents	Uses
Chasteberry	Dried fruits of <i>Vitex agnus-castus</i> , family Verbenaceae	Agnuside, casticin (flavonoids), essential oil	PMS, menstrual irregularities; acts through prolactin regulation
Shatavari	Dried roots of <i>Asparagus racemosus</i> , family Liliaceae (Asparagaceae)	Shatavarins (steroidal saponins)	Women's health — galactagogue (supports lactation), menopausal support, rejuvenative

Respiratory drugs

Drug	Biological source	Major constituents	Uses
Vasaka (Adulsa)	Leaves of <i>Adhatoda vasica</i> (Justicia adhatoda), family Acanthaceae	Vasicine, vasicinone (quinazoline alkaloids)	Expectorant, bronchodilator; cough, asthma, bronchitis

How to revise Unit V fast: cover the tables, say each common name aloud, and recite source → family → part → constituents → uses. The family names repeat — Acanthaceae appears for Vasaka and Andrographis, Solanaceae and Liliaceae pop up more than once — so grouping drugs by family is a good memory trick.

Exam tip: Count check before the exam — 21 drugs across 11 classes: 3 adaptogens, 2 hepatoprotectives, 2 cardiovascular, 2 antidiabetic, 2 anti-inflammatory, 1 CNS, 3 antimicrobial, 1 GI, 1 dermatological, 2 women's health, 1 respiratory. If your list has 21, nothing is missing.

Very short questions (2 marks)

- 1 Give the biological source and one use of Ashwagandha.
- 2 Name the active constituents of Turmeric and Vasaka.
- 3 Give the biological source of Psyllium and its main constituent.
- 4 Which drug is known as Gurmar and why?
- 5 Name the two hepatoprotective drugs in the syllabus with their major constituents.

Short questions (5 marks)

- 1 Write short notes on the adaptogens and immunomodulators of the syllabus (source, constituents, uses).
- 2 Describe the antidiabetic and cardiovascular phytotherapeutic drugs with their biological sources and uses.
- 3 Write a note on Brahmi, including the naming ambiguity.

Long questions (10 marks)

- 1 Describe the phytotherapeutic agents used as anti-inflammatory, antimicrobial and respiratory drugs, giving biological source, major constituents and uses of each.
- 2 Give a detailed account of the drugs used in women's health and the hepatoprotective drugs, with biological source, constituents and uses.

How to approach these answers

- Very-short Q1-Q5: botanical name + family + part (source), then constituents, then use — three short lines, no story.
- Short Q1: one small table per drug — source, constituents, uses; three drugs, three tables.
- Short Q2: group by class — antidiabetics first (two drugs), then cardiovascular (two drugs), each in source → constituents → uses form.
- Short Q3: textbook answer first (Bacopa monnieri, bacosides, nootropic), then the Gotu kola ambiguity in two lines at the end.
- Long Q1: structure — intro naming the three classes, then one subhead per class with a source → constituents → uses table under each; conclusion one line.
- Long Q2: structure — intro, women's health subhead (two drugs in a table), hepatoprotectives subhead (two drugs in a table); conclusion one line.