

Unit 4: Analytical Profiles of Herbal Drugs

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4.1 The analytical profile: what it contains

An analytical profile is the complete standard description of one herbal drug for quality purposes: its botanical identity and official part, the characters by which the genuine article is recognised, the constituents that serve as markers, the methods by which identity, purity and strength are measured, and the uses the standardised drug serves. This unit profiles the six drugs named in the syllabus in that order, and the pattern matters as much as the individual facts, because the same pattern is the student's template for profiling any drug in practice. Identity rests on macroscopy and microscopy supported by chemical fingerprint; strength rests on assay of the named marker; and the marker is chosen, in each case, because it is characteristic of the species and connected, directly or by association, with the drug's activity. The summary table fixes the six before the sections develop them.

Each profile below is anchored in the pharmacopoeial and standardisation framework around the drug: the Ayurvedic Pharmacopoeia of India and the Indian Pharmacopoeia carry monographs for several of these drugs, the WHO monographs on selected medicinal plants treat some of them, and commercial standardised extracts are traded against the marker specifications the profiles name. Where a drug's marker is also its principal active, as with forskolin and psoralen, the assay reads almost as a potency test; where the marker is a representative of a family, as with the amla tannins, it reads as an identity and consistency test, and the student should be able to say, for each of the six, which kind of marker they are handling and why it was chosen.

The six profiled drugs and markers

Andrographis paniculata	Aerial parts	Andrographolide
Boswellia serrata	Gum resin	Boswellic acids, AKBA
Coleus forskohlii	Roots	Forskolin
Curcuma longa	Rhizome	Curcuminoids, curcumin
Emblica officinalis	Fruit	Emblicanins, gallic acid
Psoralea corylifolia	Fruit	Psoralen, bakuchiol

One pattern for every profile: source, markers, methods, uses

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Figure: The six drugs of this unit with their official parts and principal markers. Every profile that follows is built on this one pattern: source, markers, methods and uses.

Drug	Official part	Principal markers	Standard analytical approach
Andrographis paniculata	Aerial parts	Andrographolide and related diterpene lactones	HPTLC fingerprint, HPLC assay of andrographolide
Boswellia serrata	Gum resin	Boswellic acids, including AKBA	HPTLC and HPLC of boswellic acids
Coleus forskohlii	Roots	Forskolin	TLC and HPLC assay of forskolin
Curcuma longa	Rhizome	Curcuminoids, curcumin chief	Colour reactions, TLC, HPLC of curcuminoids
Emblica officinalis	Fruit	Emblicanins, gallic and ellagic acids	HPLC of phenolic markers, tannin assay
Psoralea corylifolia	Fruit	Psoralen, bakuchiol	TLC and HPLC of psoralen

4.2 Andrographis paniculata: Kalmegh

Andrographis paniculata, family Acanthaceae, known in Indian practice as Kalmegh and in commerce as the king of bitters, is used as the dried aerial parts, the leaf and stem harvested at flowering. The profile opens with recognition: the plant is an erect annual herb with lanceolate leaves and a characteristically intense bitterness present in every part, a taste so reliable that it serves as a first field and bench test, since substitutes and exhausted material declare themselves by its absence or weakness. The chemistry is dominated by diterpenoid lactones of the labdane type, of which **andrographolide** is the principal bitter constituent and the universal marker, accompanied by neoandrographolide, dehydroandrographolide and related glycosides, with flavonoids in the roots and aerial parts as supporting constituents. Analysis follows the unit pattern: identity by macroscopy and microscopy of the leaf and stem, by the bitterness, and by thin layer and high performance thin layer chromatographic fingerprints in which andrographolide appears as the reference band; strength by HPLC assay of andrographolide in the drug and its extracts, against which commercial standardised extracts are specified. The drug's recorded uses, in Ayurvedic and other Asian traditional practice, are as a bitter tonic and febrifuge and in liver disorders, dyspepsia and respiratory infections, and modern investigation has concentrated on these same areas, which makes Andrographis a clean teaching example of Section 3.5: traditional claim, characteristic marker, standardised product, testable activity.

4.3 Boswellia serrata: Shallaki

Boswellia serrata, family Burseraceae, is an Indian frankincense: the drug is the gum resin, called Shallaki in Ayurvedic practice and salai guggul in trade, obtained by incising the bark of the tree and collecting the exudate that hardens on exposure. Its profile differs from the leaf drugs around it in kind, because a gum resin is a mixture of three fractions that the analyst separates before judging any of them: a resin fraction carrying the actives, a gum fraction of polysaccharides, and a volatile oil fraction. The markers sit in the resin: the **boswellic acids**, pentacyclic triterpene acids of which beta boswellic acid and its acetyl derivative are abundant, while 11-keto-beta-boswellic acid, abbreviated KBA, and its acetyl form AKBA are the constituents most studied for the drug's anti-inflammatory activity and therefore the markers quoted for enriched extracts. Identity rests on the appearance and behaviour of the tears of gum resin, their burning and solubility characters, and on the fingerprint; strength is measured by HPTLC and HPLC determination of the boswellic acids, reported for standardised products as total boswellic acids or as specified AKBA content. Adulteration pressure on this drug takes the Unit 2 forms: gum resins of other Boswellia species and cheaper resins enter the trade, and exhausted or low resin material dilutes strength, both of which the acid profile exposes. The traditional and investigated use is concentrated in inflammatory joint conditions, where the drug's long Ayurvedic record in arthritis made it a natural subject for the validation programme of Unit 1.

4.4 *Coleus forskohlii*

Coleus forskohlii, family Lamiaceae, also encountered under its later botanical name *Plectranthus barbatus*, is profiled on its roots: fleshy, tuberous roots of a perennial herb of the Indian hills, collected and dried as the commercial drug. This is the unit's single constituent drug, the profile of one molecule carried by one part. The marker and active is **forskolin**, also named coleonol, a labdane diterpene whose pharmacology is unusually precise for a plant constituent: it directly activates the enzyme adenylate cyclase, raising cyclic AMP in cells, and it is used worldwide as a laboratory tool for exactly that action. The root contains forskolin in modest proportion alongside related diterpenes, and because the molecule is the product, analysis is direct: identity by the root's macroscopy and microscopy and by thin layer chromatography of forskolin, strength by HPLC assay of forskolin, with standardised extracts specified by their forskolin content for the supplement and research trades. The profile teaches two cautions as well. First, a single marker drug is the exception that proves Unit 1's rule: most herbal drugs cannot be reduced to one constituent, and *Coleus* can be profiled this way only because its use follows its one famous molecule. Second, the plant is collected heavily from the wild and has been under pressure, so cultivation and the biotechnology of Semester 1 and MPG201T enter its modern story as supply answers. Traditional uses recorded for the plant in Indian practice are various, but its contemporary profile is written, unusually, in the laboratory language of its single diterpene.

4.5 *Curcuma longa*: Turmeric

Curcuma longa, family Zingiberaceae, supplies turmeric from its rhizomes, the primary central rhizomes and their lateral fingers boiled, dried and polished into the most familiar coloured drug of Indian commerce. Identity is the easiest in the unit and adulteration correspondingly bold: the rhizome's deep orange yellow interior, aromatic odour and colouring power are its characters, and the classical chemical tests belong to its chemistry, the colour reactions of curcumin with alkalis and with boric acid among them. The markers are the **curcuminoids**, the yellow diarylheptanoid pigments of which **curcumin**, diferuloylmethane, is the chief, accompanied by demethoxycurcumin and bisdemethoxycurcumin, together with a volatile oil fraction carrying turmerones that contribute the aroma. Analysis runs from the simple to the exact: colour and fluorescence behaviour for rapid identity, thin layer and HPTLC fingerprints showing the three curcuminoid bands, and spectrophotometric or HPLC determination of total curcuminoids and of curcumin itself for strength, against which oleoresins and standardised extracts are traded. The adulteration lesson of Unit 2 sits inside this profile, since turmeric powder has been a documented target for added colour, including toxic lead chromate in some supply chains, which converts a colour fraud into a heavy metal poisoning and is the standing justification for the metal testing of Section 2.7 on coloured drugs. The uses divide honestly: turmeric is at once a food colour and spice of daily life, a traditional drug for digestive complaints, wounds and skin, and a modern research subject in inflammation, and its profile must keep the colour value, the culinary identity and the medicinal claims analytically separate.

4.6 *Emblica officinalis*: Amla

Emblica officinalis, family Phyllanthaceae in modern classification and listed in older texts under Euphorbiaceae, now also named *Phyllanthus emblica*, gives the fruit drug Amla, one of the most esteemed rasayana drugs of Ayurveda and one of the three fruits of the Triphala combination. The fresh fruit is fleshy and richly astringent; the dried fruit, dark and wrinkled, is the usual article of analytical commerce. The chemistry is a tannin chemistry: the fruit carries hydrolysable tannins in quantity, of which **emblicanin A** and **emblicanin B** are named as the characteristic markers, breaking down toward gallic acid and ellagic acid, both of which serve as practical HPLC markers, together with a notable content of ascorbic acid, vitamin C, whose lability in drying and storage is itself an analytical lesson in deterioration from Unit 2. Identity rests on the fruit's macroscopy, its astringent taste and the iron and colour reactions of its tannins;

strength is approached through total tannin determination and HPLC assay of gallic and ellagic acids as the stable, measurable representatives of a constituent group that changes as it is handled. The profile therefore teaches the general problem of drugs whose actives are a family rather than a molecule: the analyst standardises by representative markers and total content together, accepting that the fingerprint, Section 3.3's philosophy, describes such a drug more truthfully than any single peak. The recorded uses span the rasayana tradition of rejuvenation and the modern antioxidant interest that the same tannin chemistry predicts, with the fruit also serving as a food, a mordant and a hair care ingredient across Indian practice.

4.7 *Psoralea corylifolia*: Babchi

Psoralea corylifolia, family Fabaceae, now also classified as *Cullen corylifolium*, completes the unit with the fruit drug Babchi, the small, dark, kidney shaped fruits, commonly called seeds in trade, of an annual herb widespread in India. Its profile is the unit's safety profile, because this drug's famous constituent is powerful in a way that cuts both ways. The marker is **psoralen**, a furanocoumarin, present with its isomer isopsoralen in the fruit coat, accompanied by the meroterpene **bakuchiol**, now itself a cosmetic ingredient of interest, and by psoralidin and flavonoids as supporting constituents. Psoralen is photosensitising: on skin exposed to ultraviolet light it reacts to stimulate pigmentation, a mechanism that is the drug's traditional use in leucoderma and other depigmenting skin conditions, and the basis, in purified medicine, of psoralen plus ultraviolet A therapy. The same mechanism burns when dose and sunlight are uncontrolled, so the profile carries the unit's clearest statement that activity and toxicity are one property read at two doses, Unit 1's teaching in a single fruit. Analysis follows the pattern: identity by the fruit's distinctive appearance and odour and by thin layer chromatography of psoralen, strength by HPLC assay of psoralen, with attention to the proportion present in pericarp rich material. Adulteration takes the form of other seeds substituted in the small dark fruit trade, which microscopy and the psoralen fingerprint detect. The student should leave this profile able to state, for Babchi as for the other five, the four line summary this unit exists to teach: the plant and part, the markers and their chemical family, the methods that prove identity and strength, and the use, with its attendant caution, that the standardised drug serves.

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