

Medicinal Powders from Neem Leaves, Bark and Seeds: A Review of Preparation and Evaluation

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Abstract: Medicinal powders (churna) are the oldest and simplest herbal dosage forms, in which the dried drug is reduced to a fine powder, sieved and packed. Neem (*Azadirachta indica*) is one of the most widely used medicinal trees of India, and its leaf, bark and seed are the parts most commonly used. These parts differ in their structure and chemical composition: the leaf is rich in flavonoids and phenolic acids, the bark in tannins and calcium oxalate crystals, and the seed kernel in fixed oil, protein and fibre, so each has to be powdered and standardised separately. Neem powders in the market are often not standardised. The present review discusses medicinal powders as a dosage form, their advantages and limitations, the profile of the neem leaf, bark and seed, the method of preparation of powders by drying, grinding and sieving through sieve no. 85, the tests used for standardisation and evaluation, including flow properties, ash and extractive values, phytochemical screening, TLC fingerprinting, microbial load and stability, and the important reports on the subject. The review shows that controlled preparation and evaluation are needed to obtain reproducible, standardised neem powders.

Keywords: Neem, *Azadirachta indica*, Medicinal powder, Churna, Standardisation, Sieve no. 85, TLC fingerprint.

I. INTRODUCTION

Herbal medicines are therapeutic products obtained from plants, and they form the basis of traditional systems such as Ayurveda. They are widely used because they are easily available, relatively inexpensive and generally well tolerated. One of the oldest and simplest ways of using a herbal drug is as a medicinal powder (churna), in which the dried drug is reduced to a fine powder, passed through a sieve (sieve no. 85 as described in the Ayurvedic Formulary of India) and packed for use.[1]

Neem (*Azadirachta indica* A. Juss., family Meliaceae; Sanskrit name Nimba) is one of the most widely used medicinal trees of the Indian subcontinent. Almost every part of the tree is used in Ayurvedic, Unani and folk medicine, and the leaf, bark and seed are the parts most commonly used. The tree contains limonoids such as azadirachtin and nimbin, together with flavonoids such as quercetin and phenolic compounds, and a wide range of antioxidant, antibacterial, antifungal and anti-inflammatory activities has been reported.[2,3]

The leaf, bark and seed differ in their structure and chemical composition. The leaf is rich in flavonoids and phenolic acids, the bark in tannins and calcium oxalate crystals, and the seed kernel in fixed oil, protein and fibre.[4,5,6] Each part therefore behaves differently during powdering and storage, and each needs its own quality standards.



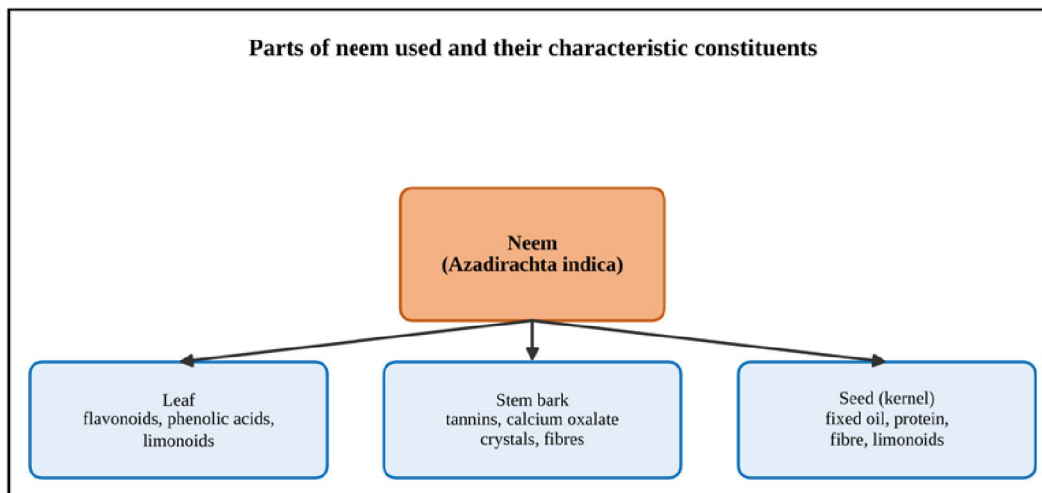


Fig. No. 1: Parts of Neem Used and Their Characteristic Constituents

Medicinal Powder as a Dosage Form

A medicinal powder is a fine, dry, free-flowing preparation of the dried herbal drug. The drug is cleaned, dried, powdered, passed through a fine sieve and packed in airtight containers.[1] Powders can be taken orally with a suitable vehicle (anupana) or used externally, and they are also the starting material for tablets, capsules and creams.[7] The medicinal powder is compared with other dosage forms of herbal drugs in the table below.

Table: Dosage Forms of Herbal Drugs in Ayurveda[1,7]

Sr. No.	Dosage form	Description	Mode of use
1	Powder (churna)	Fine powder of the dried drug, sieved and packed	Taken with warm water or honey, or applied externally
2	Vati / Gutika	Tablet or pill prepared from the drug powder or extract with a binder	Swallowed with water
3	Kwatha	Decoction prepared by boiling the coarse drug powder in water	Taken as a liquid
4	Taila / oil	Fixed oil obtained from the drug (for example from neem seeds)	Applied externally
5	Cream/ointment	Semisolid base with the herbal extract	Applied on the skin

Advantages and Limitations

Table: Advantages and Limitations of Herbal Powders[1,6,7]

Sr.No.	Advantages	Limitations
1	Simple and low-cost dosage form with a long tradition of use	Neem is very bitter, so the powder is unpalatable for oral use
2	The whole part of the drug is used, so all the constituents are present and no excipient is needed	Hygroscopic; absorbs moisture, which favours microbial growth and shortens the shelf life
3	The dose and the proportion of the parts can be easily adjusted	The seed powder is rich in fat and may become rancid, caked or sticky



Sr.No.	Advantages	Limitations
4	Quick preparation; can be used orally or externally	Bulky dose and poor accuracy of dose with spoon measures
5	Can be used as the raw material for tablets, capsules and creams	Quality varies with the source of the raw material and the part used

Herbal materials are natural products, so their composition changes with the species, the part used, the place and time of collection, drying and storage. Adulteration, microbial contamination, pesticide residues and heavy metals can also affect the quality. For this reason the WHO has published methods for the quality control of herbal materials, and the Indian Pharmacopoeia and the Ayurvedic Formulary give standards and methods of preparation.[1,8,9]

Profile of Neem

Three parts of the neem tree are used for the preparation of medicinal powders: the leaves, the stem bark and the seeds (kernels). The source and the main constituents of each part are given below.[4,5,6]

Table: Parts of Neem Used for Medicinal Powders[4,5,6,10]

Sr. No.	Part	Source	Main constituents reported	Traditional use
1	Leaf	Fresh, mature leaves of <i>Azadirachta indica</i>	Flavonoids (quercetin, rutin), ellagic acid, limonoids	Skin disorders, wound healing, antiseptic
2	Stem bark	Dried stem or trunk bark	Tannins, calcium oxalate crystals, fibres and stone cells	Fever, skin diseases, astringent
3	Seed	Dried kernel of ripe fruits	High fat, fibre and protein; limonoids	Skin diseases, insect repellent (oil), antimicrobial

The leaf of neem has been profiled for its physicochemical, microscopic and phytochemical characters and has been reported to contain rutin, ellagic acid and quercetin along with antioxidant and antimicrobial activity.[5] The stem bark shows cork cells, calcium oxalate prismatic crystals, starch grains and tannins in powder microscopy, and these are used as diagnostic markers of its identity.[4,10] A comparison of leaf, seed, stem and bark showed that the seeds had the highest fat, fibre and protein content and the leaves the highest ash content.[6] Neem seed products should be used with care, because the safe dose of the seed is not established.

Method of Preparation of Medicinal Powders

Powders can be prepared by traditional pounding in a mortar and pestle, by electric grinders, by hammer or cutter mills or by cryogenic grinding.[1,11] Powdering in an electric grinder followed by sieving through sieve no. 85 is the simplest and most reproducible method for a laboratory, and it is described below.

Table: Methods of Powdering[1,11]

Sr. No.	Method	Principle	Remarks
1	Traditional pounding	Drug pounded in a mortar and pestle (khalva) and sieved	Simple, small quantity; slow and variable
2	Electric grinder / pulveriser	Dried drug powdered mechanically and sieved	Fast; suitable for a laboratory
3	Hammer or cutter mill	Industrial size reduction followed by sieving	Large scale; needs special equipment



Sr. No.	Method	Principle	Remarks
4	Cryogenic grinding	Drug cooled before grinding	Useful for oily or heat-sensitive drugs; costly

Step 1: Collection and Authentication

The leaves, bark and seeds are collected from healthy, mature trees, and the identity of the plant is confirmed by a botanist. Mature leaves are collected in the morning, the stem bark is peeled from the trunk, and the seeds are taken from fully ripe fruits.[12]

Step 2: Cleaning and Drying

The leaves are washed and dried in shade, the bark is cleaned, cut into small pieces and dried, and the seeds are depulped, washed, dried and decorticated to get the kernels. The parts may also be dried in a hot air oven at not more than 50 °C.

Step 3: Size Reduction

Each part is powdered separately in an electric grinder, using short intervals with pauses so that the powder is not heated. This is especially important for the oily seed kernels, which tend to form a paste or cake if overheated.

Step 4: Sieving

The powder is passed through sieve no. 85.[1] The residue left on the sieve is ground again and re-sieved until the whole quantity passes.

Step 5: Mixing (for a Combined Powder)

The powders of the parts are weighed in the required proportions and mixed by geometric dilution, starting with the smallest quantity, for about 15 minutes, and the mixture is passed through the sieve once more to ensure uniform mixing.[11]

Step 6: Packing and Storage

The powders are packed in airtight, light-resistant containers, labelled with the batch number and date, and stored in a cool, dry place.

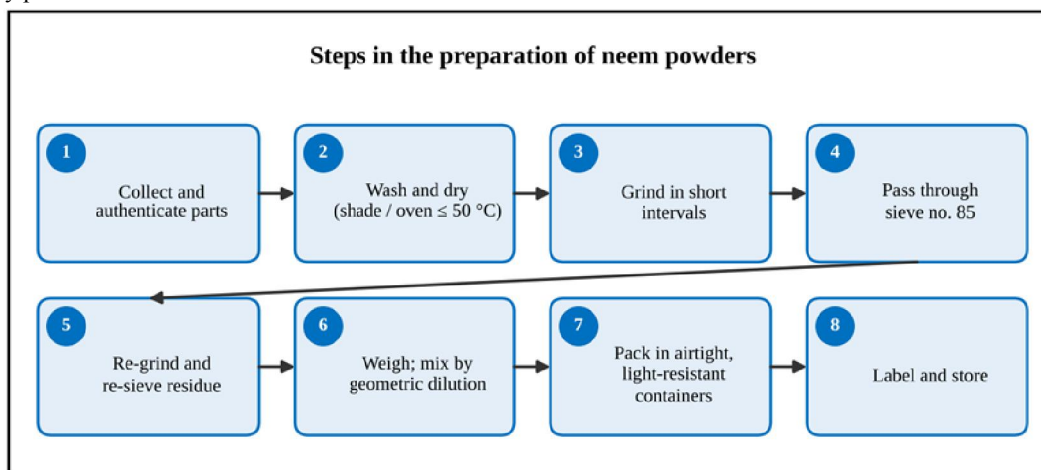


Fig. No. 2: Steps in the Preparation of Neem Powders

Standardisation and Evaluation of Powders

The identity and quality of the powders are established by the methods of the WHO guidelines and the Indian Pharmacopoeia.[8,9,12] The scheme of evaluation is shown below.



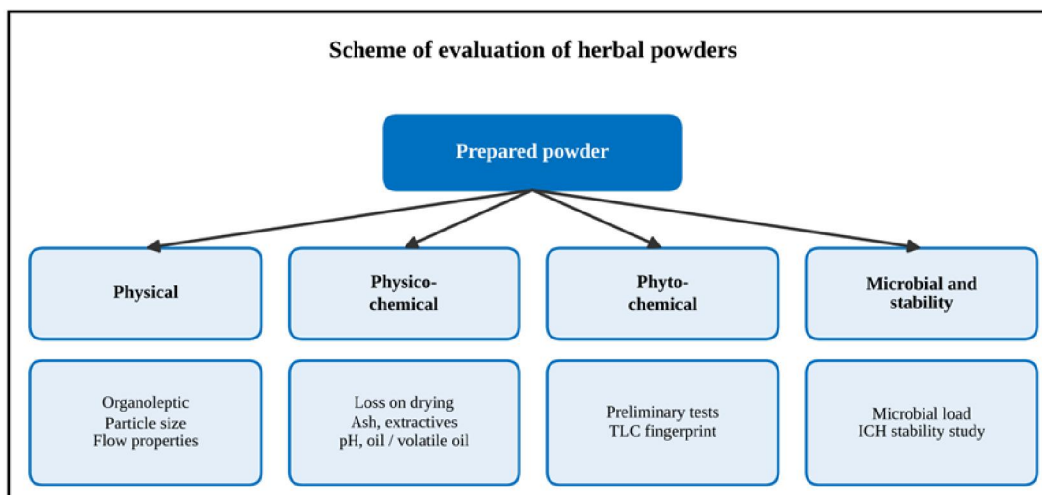


Fig. No. 3: Scheme of Evaluation of Herbal Powders

Table: Evaluation of Medicinal Powders[8,9,11,12]

Sr. No.	Test	Method	Expected Result
1	Organoleptic properties	Colour, odour, taste and texture noted visually	Characteristic of the drug
2	Foreign organic matter	Weighed sample spread out and foreign matter separated	Within the limit
3	Powder microscopy	Powder mounted in chloral hydrate and observed	Characteristic cells, crystals and tannins
4	Particle size	Sieve analysis; percentage retained on each sieve	Uniform fine powder
5	Flow properties	Bulk and tapped density, angle of repose, Carr's index, Hausner's ratio	Free-flowing powder
6	Loss on drying	2 g dried at 105 °C to constant weight	Low moisture; within the limit
7	Total ash and acid-insoluble ash	Incineration at about 450 °C; ash boiled with dilute HCl	Within the limit
8	Extractive values	Cold maceration of 5 g with 100 mL water or ethanol for 24 hours	Within the limit
9	pH	1% and 10% w/v aqueous suspension with a pH meter	Recorded value
10	Fixed oil content	Soxhlet extraction with petroleum ether (seed powder)	High in seed powder
11	Microbial load	Plate count for bacteria, yeast and mould; tests for E. coli and Salmonella	Within the limit; pathogens absent



Table: Preliminary Phytochemical Tests[12,13]

Sr. No.	Constituent	Test	Positive indication
1	Alkaloids	Mayer's and Dragendorff's tests	Cream and orange-red precipitate
2	Flavonoids	Shinoda test	Pink to red colour
3	Tannins and phenols	Ferric chloride test	Blue-black or green colour
4	Saponins	Foam test	Persistent foam
5	Glycosides	Keller-Killiani test	Brown ring at the junction
6	Carbohydrates	Molisch's test	Violet ring at the junction
7	Fixed oil	Spot test on filter paper	Translucent greasy stain

For TLC fingerprinting, a methanolic extract of each powder is spotted on silica gel G plates, developed in a suitable solvent system such as toluene and ethyl acetate, sprayed with vanillin-sulphuric acid reagent and heated, and the R_f values of the spots are recorded. The fingerprint is used to compare the parts of the plant and a marketed sample.[5,12]

Stability Study

The powders are stored in airtight, light-resistant containers at 25 °C and 60% relative humidity and at 40 °C and 75% relative humidity, and are checked for appearance, loss on drying, flow properties and microbial count at fixed intervals as per the ICH guideline.[14]

Review of Literature

Aarathi et al. (2023) carried out a pharmacognostic and physicochemical study of the stem bark of *Azadirachta indica*, using macroscopic, microscopic, powder, histochemical, preliminary phytochemical and physicochemical methods. Cork cells, calcium oxalate prismatic crystals, starch grains and tannins were shown to be diagnostic markers of the authenticity of the bark.[4]

Yadav et al. (2023) studied the pharmacognostic and pharmacological activities of neem leaves. Physicochemical and microscopic tests were carried out to set quality standards, and the methanolic extract showed strong antioxidant and α -amylase inhibitory activity and some antibacterial activity, while HPLC and HPTLC analysis identified rutin, ellagic acid and quercetin.[5] Gadekar et al. (2026) compared the trunk bark and trunk wood of *Nimba* by organoleptic, macroscopic, transverse-section and powder-microscopic methods, which helps to detect adulteration of the bark with wood.[10]

Salau and Gbajabiamila (2022) determined the proximate composition and phytochemicals of the leaf, seed, stem and bark of neem, and found that the seeds had the highest fat, fibre and protein content, the leaves the highest ash content and the stems the highest carbohydrate content.[6] Gupta et al. (2019) reviewed the therapeutic role of neem and its bioactive constituents, such as azadirachtin, nimbin and quercetin, and its antioxidant, antibacterial, antifungal, anti-inflammatory and hypoglycaemic activities.[2] Shah (2024) prepared and evaluated a herbal antiseptic cream containing neem, tulsi and aloe vera, which was stable without phase separation.[7]

Table: Summary of the Neem Studies Cited[2,4,5,6,7,10]

Sr. No.	Neem part	Study	Type of work	Main points examined
1	Stem bark	Aarathi 2023	Pharmacognostic and physicochemical study	Microscopy, histochemistry, phytochemical tests



Sr. No.	Neem part	Study	Type of work	Main points examined
2	Leaf	Yadav 2023	Pharmacognostic and biochemical study	Physicochemical, antioxidant, antimicrobial, HPTLC
3	Trunk bark and wood	Gadekar 2026	Comparative pharmacognosy	Organoleptic, anatomy, powder microscopy
4	Leaf, seed, stem, bark	Salau 2022	Proximate and phytochemical analysis	Fat, fibre, protein, ash, saponins
5	Whole plant	Gupta 2019	Review	Bioactive constituents and activities
6	Leaf (in cream)	Shah 2024	Formulation and evaluation	pH, spreadability, stability, microbial

Research gap

The reported studies describe the anatomy, the proximate composition or the activity of individual parts of neem, or a neem-containing cream, but few of them prepare the powders of the leaf, the bark and the seed under the same conditions and compare them for flow properties, physicochemical values, TLC fingerprints, microbial load and stability.[4,5,6,7]

II. CONCLUSION

A medicinal powder is the simplest herbal dosage form, and neem leaves, bark and seeds can be converted into powders by drying, grinding in short intervals and sieving through sieve no. 85. The three parts differ in their constituents, the leaf in its flavonoids and phenolics, the bark in its tannins and diagnostic crystals and the seed in its fat, fibre and protein, so each has to be authenticated, powdered and evaluated separately. Standardisation by organoleptic and microscopic characters, flow properties, loss on drying, ash and extractive values, phytochemical screening, TLC fingerprinting, microbial limits and a stability study makes the powders reproducible and reliable.

The powders have limits, such as bitterness, moisture uptake and rancidity of the seed powder, and the review is based on laboratory studies and does not show the clinical effect. Further work on the assay of marker compounds such as quercetin and azadirachtin by HPTLC, the formulation of the powders into tablets, capsules or creams, and studies of activity and safety is needed.

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