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Review Paper

A Brief Overview of *Panchanimba Churna*: A Classical Ayurvedic Formulation for Skin Disorders

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ABSTRACT

Ayurvedic Churna is one of the most basic forms of Ayurvedic medicine and can be prepared easily. The Churna one will make should be referenced from an established Ayurvedic text or the Ayurvedic Formulary of India (AFI). Panchanimba Churna, an Ayurvedic formulation referenced in Bhaisajya Ratnavali and AFI (Part II), has attracted interest for its therapeutic potential in managing various health conditions, particularly skin disorders. This review examines the pharmacological properties, traditional uses, and contemporary research findings related to the Panchanimba churna. Sourced from the neem tree (*Azadirachta indica*), this churna possesses notable antimicrobial, anti-inflammatory, and antioxidant properties. Traditionally, it has been used to treat skin issues such as eczema, acne, and psoriasis, with modern research supporting its effectiveness in reducing inflammation, fighting microbial infections, and promoting skin healing. Additionally, Panchanimba churna shows promise in complementary therapies for dermatological conditions, highlighting its potential as a valuable alternative treatment in integrative medicine. This review consolidates current knowledge and emphasizes the therapeutic relevance and future research opportunities of Panchanimba churna in dermatological care.

INTRODUCTION

The term "Ayurveda" is derived from the Sanskrit words *ayur* (which means life) and *veda* (which means science or knowledge), and it is one of the oldest traditional medicinal systems that represent

a comprehensive approach to healthcare, emphasizing the interconnectedness of mind, body, soul, and spirit [1]. Ayurveda, often called the 'science of longevity', provides a holistic approach to achieving a long and healthy life by

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revitalizing the body through proper diet and nutrition [2]. Ayurveda has a long history dating back to the *Vedic* era. Today, many people choose Ayurveda as an alternative to allopathic medicine because it is cheaper and has less risk of side effects [3]. Ayurvedic classics like the *Vedas*, *Samhitas*, and *Puranas* hold a vast collection of medicinal plants traditionally used for treating, managing, and controlling various diseases. The knowledge of the healing properties and therapeutic uses of these plants, as described in Ayurvedic texts, is the result of keen clinical observations accumulated over centuries [4]. In addition, later compilations known as *Nighantus* also offer extensive information. Given the global trend towards using plant-based natural remedies, there is a growing need for accurate, up-to-date information on the properties, uses, efficacy, safety, and quality of medicinal plant products and formulations. Therefore, reviewing traditional medicinal plants and formulations mentioned in Ayurvedic classics is essential today. So, an effort has been made to compile all the details and data available of *Panchanimba Churna* (PNC) formulation so that it can be studied in depth, and we anticipate that it will serve as the standard reference of *Panchanimba Churna* formulation for future reference. *Panchanimba Churna* (PNC), often known as *Panchanimbadi Churna*, is a polyherbal powdered formulation that falls under the *tikta barga* (bitter taste), described in the Ayurvedic text *Baishajya Ratnavali* in the *Kushthadhikara* chapter for treating skin ailments. Its main ingredient is Neem (*Azadirachta indica*), known for its Kapha-Pitta alleviating properties and ability to cleanse the blood [5, 6]. Ayurveda revolves around the concept of *Tridosha*, which represents the three fundamental elements of the universe. These are *Vata*, associated with Air; *Pitta*, linked to Fire; and *Kapha*, related to Water. The imbalance of Pitta and Kapha results in the generation of *Ama*, which is believed to be the

primary underlying cause of all diseases [7]. PNC combines medicinal herbs, including five parts of the Neem (Root, Stem bark, Flower, Fruit and Seed), *Triphala* (Amalaki, Bibhitaki and Haritaki), *Trikatu* (Long piper, Black piper and Ginger), Chitrak, Turmeric, Daruharidra, Giloy (Guduchi), Vidanga and several others [8]. The ingredients of this preparation primarily alleviate *Kapha* and *Pitta Doshas* and cleanse the *Raktha Dhātu* (blood tissue). PNC is a well-celebrated and prescribed drug for treating *Kushtha*. In Ayurveda, *Kushtha* encompasses various skin diseases, including leprosy [9]. Nimba, the main ingredient of PNC, demands special attention over other ingredients. Nimba (*Azadirachta indica* A. Juss) falls under the Mahogany family and has been used in Ayurveda since the remote past [10]. It finds its applications in fever, piles, jaundice, ulcers, blood disorders, *kushtha* (leprosy and skin ailments), diabetes, are a description of its inherent properties – Laghu, Ruksha (*Guna*), Tikta (*Rasa*), Katu (*Vipaka*), Sita (*Virya*) [10, 11]. The five parts of Nimba (St. Bk., Lf., Rt., Fr., Fl.) are used separately or collectively in various diseases. The mention of *Azadirachta indica* (Sanskrit: *Nimba* or *Picumaradah*, commonly called Neem or Indian lilac) can be found in ancient Ayurvedic texts comprising *Charaka Samhita*, *Susruta Samhita* (written during 1500 B.C. – 400 A.D. by *Acharya Charaka* and *Acharya Susruta* respectively), books authored by *Vaghbata* (~ 500 AD) as well as in *nighantus* (medical lexicon) written across the ages [12]. The decoction made from five parts of Nimba cures all types of *Prameha*, especially *Surameha*. *Aristha Dhupa*, used for fumigation, is made from all five parts of Nimba and mixed with ghee. The formulation "*Panchanimba Churna*" (comprising five beneficial parts of Nimba) effectively treats *Kushtha*, various skin diseases, fistula, *Vatarakta*, wounds, *Prameha*, *Pradara*, etc. Additionally, *Panchanimba Churna* is effective against *Amla-pitta* [13]. The skin protects



internal organs from external harm, making it one of the body's most essential organs. Survival is impossible without intact skin. The skin is affected by various physical, chemical, biological, and environmental influences. Biological agents like infectious or parasitic organisms can thrive on the skin and cause diseases. Fortunately, the skin has several built-in defences to protect against these irritants and usually defends itself [14]. In Ayurvedic medicine, skin problems are viewed differently and collectively called "*Kushtha roga*." These conditions are primarily caused by poor dietary habits, including the consumption of heavy, inappropriate, and unhealthy foods, as well as improper medication for indigestion. Exposure to heat sources such as sunlight or fire, followed by applying cool water, can further aggravate the situation. This imbalance leads to the aggravation and dispersion of pitta and kapha doshas throughout the body, eventually manifesting as skin lesions. If left untreated, these doshas can penetrate deeper into the body and disturb the *dhatus* (tissues), leading to widespread skin infections. The symptoms of these infections reflect the predominance of the affected doshas [15, 16]. "*Vicharchika*" in Ayurveda, exhibits symptoms similar to eczema, including severe itching, pustule formation, discolouration, oozing, lichenification, discomfort, and excessive dryness (Figure 1) [17]. Atopic dermatitis, another term for eczema, is characterised by skin irritation with scaly or crusty patches, redness, blistering, and itching. Both children and adults can suffer from atopic dermatitis, with pruritus being the primary symptom affecting health-related quality of life. The pathogenesis of eczema involves both cutaneous immunological and systemic dysfunctions. Ayurvedic treatment offers various remedies, with several indigenous plants proving effective in treating *Vicharchika*. The "*Bhaishajya Ratnavali*" and "*Bharat Bhaishajya Ratnakar*" texts recommend the use of *Panchanimba Churna*

as an appropriate treatment for *Vicharchika*, and ongoing research continues to advance our understanding of these treatments [18, 19]. Reports have shown that PNC successfully manages Psoriatic Erythroderma (PsE) in patients [20].



Figure 1. (a) Itching, (b) Pustule formation, (c) Oozing, (d) Lichenification

Emphasis laid by ancient Ayurvedic text(s) on Panchanimba Churna In the ancient Ayurvedic text *Bhaishajya Ratnavali*, the formulation Panchanimba Churna is mentioned. In addition to this, it is also mentioned in the Ayurvedic Formulary of India.

The detailed reference of PNC is as follows-

- Bhaishajya Ratnavali (Chapter: Kushthadhikara, Verse No. 86-91)
- Ayurvedic Formulary of India (AFI), Part- II, Pg. No. 121-122

Following Shloka in the footnote is taken from *Baishajya Ratnavali*, which briefly presents the overview of Panchanimba churna formulation.

Definition of Churna

Churna is defined as totally dried raw material which is powdered very minutely to make their small size and again filtered through cloth's grid and obtained fine powder is called as "Churna"

Churna is defined as totally dried raw material which is powdered very minutely to make their small size and again filtered through cloth's grid and obtained fine powder is called as "Churna" Churna refers to a finely powdered substance made from specific drugs or combinations of drugs. It is powdered very minutely to make particles of small size and then filtered through a

particular sieve to obtain a fine powder as per requirement [21]. Each ingredient undergoes individual pulverisation before being mixed. A wide variety of churnas exist, each with its market demand. The preparation of Ayurvedic powdered medicines involves drying the ingredients, which are then powdered using a crusher or grinder. These powders are carefully blended in stainless steel cone blenders in requisite proportions. After thorough testing, they are packaged in air-tight containers. The manufacturing process requires direct oversight by an Ayurvedic chemist. The churna is categorised into various sub-categories by the particle size of the churna [22]. Powders can be utilised internally and externally, such as for topical applications on the skin, and are especially

beneficial for patients who have difficulty swallowing solid forms like tablets or capsules. Despite their limited direct therapeutic use, powders are crucial in formulating various dosage forms. Drugs in powder form can be combined with other materials before being processed into different solid dosage forms. Essential properties of powders in pharmaceutical applications include individual particle characteristics, overall bulk properties, interactions between particles, particle size, surface area, porosity, shape, mixing mechanisms, types of equipment used, and methods to prevent segregation [23]. As per US pharmacopoeia, the following (Table 1) are the sub-categories of churna [22, 24]-

Table 1. Various forms of Churna and its requirements

Sub-categories of Churna	Max. diameter of the particle (dm)	Must pass through the following sieve
Very Fine	≤ 0.0018	Sieve No. 80
Fine	≤ 0.0025	Sieve No. 60
Moderately Coarse	≤ 0.00425	Sieve No. 40
Coarse	≤ 0.0085	Sieve No. 20
Very Coarse	≤ 0.0236	Sieve No. 8

Scientific approach of Ayurveda and Churna

Ayurvedic principles suggest that everyone has a unique personality type, determined by the balance of their *doshas* or inner life energies. "*Prakriti*" refers to the original balance of these energies at birth, while "*vikruti*" describes their current state, shaped by life's stresses, experiences, and imbalances from external influences. Ayurvedic *churna*/ *churna* formulations, made from a mix of medicinal herbs, can address these imbalances. These *churnas* contain fresh herbs with healing properties that help neutralise toxins from *dosha* imbalances. *Churnas* incorporate all six Ayurvedic tastes: sweet, sour, salty, pungent, bitter, and astringent, and can be added to almost any dish. Not only do they enhance flavour and nutrition, but they also unlock the medicinal qualities of the food. Each spice in a *churna* has powerful medicinal benefits. For example, Neem is known to lower blood sugar levels, heal digestive tract ulcers, act as a contraceptive, prevent oral plaque formation and

beneficial in skin diseases. Turmeric, which contains curcumin, is known for its ability to lower cholesterol, boost immunity, support liver detoxification, and reduce allergic reactions. Its antioxidant properties also help the body combat harmful free radicals linked to heart disease and cancer. Cumin, similarly, promotes detoxification and smooth digestion. *Amalaki* is rich in Vitamin C and antioxidants, which reduce the risk of heart disease, Type 2 diabetes, and cancer. In essence, Ayurvedic *churnas* not only elevate the taste of meals but also provide numerous health benefits, making it easy to incorporate wellness into everyday eating [25-29].

Skin diseases/disorders in Ayurvedic perspective

From an Ayurvedic perspective, assessing an individual's *prakriti* (nature) and specific skin condition(s) is essential when treating skin diseases. At first, the doctor assesses the person's *doshika* composition, lifestyle, and skin condition(s). The primary goal of Ayurvedic treatment is to restore



balance to the *doshas* (*Vata*, *Pitta*, and *Kapha*), and it can be achieved by maintaining a healthy diet and proper lifestyle routines. A key treatment for eliminating toxins from the body is *Shodhana*, which serves as a comprehensive detoxification process. By cleansing the body at the cellular level, *Shodhana* removes toxins, restoring balance to the *doshas*, *agni* and *dhatu*s, thereby leading to the body's normal functioning. Repeated *Shodhana* processes are recommended for patients having skin diseases at regular intervals to maintain this balance [30]. Right from the ancient times *Acharyas* have emphasized the importance of *Shodhana* therapy in the management of *Kushta* (skin diseases). Although *Kushta* is inherently difficult to cure, *Shodhana* therapy facilitates healing by addressing the root cause of the disease, making it especially valuable in multifactorial conditions (*Bahudosha avastha*). *Acharya Sushruta* recommends specific treatments: *Vamana* (medicated emesis) every fortnight, *Virechana* (medicated purgation) once a month, *Rakta mokshana* (blood-letting) twice a year, and *Nasya* (nasal therapy) every three days in chronic cases, based on the involvement and strength of the *dosha-dushya* condition [31]. According to *Acharya Charaka*, for *Kushta* dominated by *Vata*, the patient should first receive internal administration of *Ghee* (clarified butter). For *Kushta* dominated by *Kapha*, *Vamana* therapy is recommended, and for cases dominated by *Pitta*, *Virechana* therapy should be administered for optimal results. [32]

Skin disease is a prevalent condition that affects individuals of all ages, from newborns to the elderly, and can cause various forms of harm. In addition to the physical effects, those with skin diseases often face social stigma. The skin, the body's largest organ and exposed externally, is vulnerable to various disorders, primarily caused by infections such as bacteria and fungi. In Ayurveda, all skin diseases fall under the broad category of *Kuṣṭha*, further classified into *Maha kushta* and *Kshudra kushta*. Ayurvedic principles provide unique methods for diagnosing and treating these diverse skin conditions under the collective term *Kuṣṭha* [33]. *Kuṣṭha* (In Sanskrit: कुष्ठ) refers to any skin ailments, including leprosy. The term '*Kushta*' is frequently found in ancient Ayurvedic texts like the *Carakasamhitā* and the *Suśrutasamhitā* [34]. "Maha" refers to more severe or significant conditions with complex pathology and challenging prognosis. Conversely, "*Kshudra*" indicates milder conditions that are generally easier to treat than *Maha Kushta*-type skin diseases. Based on their manifestation, complexity, severity, prognosis, and treatment options, the 18 types of *Kushta* are sub-classified into seven (07) types of *Maha Kushtas* (major skin diseases) and eleven (11) types of *Kshudra Kushtas* (minor skin diseases) [35]. Table 2 documents the sub-classification of *Kuṣṭha* and a brief discussion of the eighteen (18) subclasses of *Kuṣṭha*.

Table 2. Categorization of *Kushta* [35]

Types of <i>Kuṣṭha</i>	Subclass of <i>Kuṣṭha</i>	Symptoms
<i>Maha Kushta</i>	<i>Kapala Kushta</i>	The skin appears like a brown fragment of pottery—rough, coarse, thin, and both painful and difficult to treat.
	<i>Audumbara Kushta</i>	There is pain, a burning sensation, redness, and itching, with hair turning pink and nodules forming that resemble the fruit of the Udumbara tree (<i>Ficus infectoria</i>).
	<i>Mandala Kushta</i>	The skin appears white or red, feeling tight, thickened, and smooth, with raised round patches that are interconnected.
	<i>Rushyajivha Kushta</i>	The skin is extremely rough, red on the outside and black on the inside, painful, and resembles the tongue of a black deer.

	<i>Pundarika Kushta</i>	The skin is white in the centre with red edges, resembling lotus petals, and marked by reddish raised patches.
	<i>Sidhma Kushta</i>	The skin is white or coppery red, thin, with scales that flake off when scratched, commonly seen on the chest, and resembling the flower of a pitcher gourd.
	<i>Kakanaka Kushta</i>	The skin resembles the colour of Gunja seeds (<i>Abrus precatorius</i>), forms pus, is extremely painful, is caused by an imbalance of all three Doshas, and is resistant to treatment.
<i>Kshudra Kushta</i>	<i>Eka Kushta</i>	The skin lacks perspiration, covers a large area, and resembles fish scales.
	<i>Charmakhya Kushta</i>	The skin is becoming as thick as elephant skin.
	<i>Kitibha Kushta</i>	Dark (black) spots that are rough and hard to the touch.
	<i>Vipadika Kushta</i>	The hands and feet are cracking and developing painful fissures.
	<i>Alasaka Kushta</i>	Red nodules are forming, accompanied by itching.
	<i>Dadru Kushta</i>	Elevated patches dotted with small, itchy, reddish papules.
	<i>Charmadala Kushta</i>	Skin covered with red, painful, itchy nodules that are too sensitive to touch.
	<i>Pama Kushta</i>	Small, numerous pustules that ooze and cause itching and a burning sensation are known as Pama. When the same symptoms of Pama appear on the hands and buttocks, accompanied by severe pain and itching, it is called <i>Kacchu</i> .
	<i>Visphotaka Kushta</i>	Boils on the skin that are black or blackish-red in colour, along with skin thinning.
	<i>Shataru Kushta</i>	Countless small ulcers that are red or blue in colour, accompanied by intense burning sensation and pain.
	<i>Vicharchika Kushta</i>	Nodules that are black in colour, itchy, and produce exudate.

Formulation composition of *Panchanimba Churna*

PNC is a polyherbal formulation, and Neem is the main ingredient. In this formulation, thirty-two (32) ingredients/items are present, whether in the

form of herbs or *bhasma*. Here, *Lauha Bhasma* and sugar (*sarkara*) are one of the active ingredients. Besides this, four (04) kinds of *ghana kvatha* are present in PNC. Ingredients present in PNC are listed in the following table (Table 3).

Table 3. List of ingredients of PNC [36]

Sl. No.	Name of the plant	Scientific Name	Part used	Proportion
01	Neem	<i>Azadirachta Indica</i>	St. Bk.	2 parts
02			Rt.	2 parts
03			Lf.	2 parts
04			Fr.	2 parts
05			Fl.	2 parts
06	Haritaki	<i>Terminalia chebula</i>	Fr. P.	1 part



07	Bibhitaki	<i>Terminalia bellirica</i>	Fr. P.	1 part
08	Amalaki	<i>Embllica officinalis</i>	Fr. P.	1 part
09	Zinger	<i>Zingiber officinale</i>	Rz.	1 part
10	Maricha	<i>Piper nigrum</i>	Fr.	1 part
11	Pippali	<i>Piper longum</i>	Fr.	1 part
12	Brahmi	<i>Bacopa monnieri</i>	Pl.	1 part
13	Goksura	<i>Tribulus terrestris</i>	Fr.	1 part
14	Suddha Bhallataka	<i>Semecarpus anacardium</i>	Fr.	1 part
15	Chitraka	<i>Plumbago zeylanica</i>	Rt.	1 part
16	Vidanga	<i>Embelia ribes</i>	Fr.	1 part
17	Varahi	<i>Dioscorea bulbifera</i>	Rt. Tr.	1 part
18	Lauha Bhasma	-	-	1 part
19	Guduchi	<i>Tinospora cordifolia</i>	St.	1 part
20	Haridra	<i>Curcuma longa</i>	Rz.	1 part
21	Daruharidra	<i>Berberis aristata</i>	St.	1 part
22	Bakuchi	<i>Psoralea corylifolia</i>	Sd.	1 part
23	Aragvadha	<i>Cassia fistula</i>	Fr. P.	1 part
24	Sarkara	-	-	1 part
25	Kustha	<i>Saussurea lappa</i>	Rt.	1 part
26	Indrayava	<i>Holarrhena antidysenterica</i>	Sd.	1 part
27	Patha	<i>Cyclea peltata</i>	Rt.	1 part
28	Khadira Ghana Kvatha	<i>Acacia catechu</i>	Ht. Wd.	Q. S
29	Asana Ghana Kvatha	<i>Pterocarpus marsupium</i>	Ht. Wd.	
30	Nimba Ghana Kvatha	<i>Azadirachta Indica</i>	St. Bk.	
31	Panchanimba kvatha	<i>Azadirachta Indica</i>	St. Bk., Rt., Lf., Fl., Fr.	
32	Markava svarasa (Bhringraj)	<i>Eclipta alba</i>	Pl.	

* Ingredients mentioned in Sl. No. 28 – 32 will be required in the Q.S. amount for Bhavana (7 times). As per AFI (Part-II), the dosage amount of PNC is 1-5 g. In *Anupana*, honey is used [25].

A brief overview of the Five parts (*Pancha*) of Neem (*Nimba*) present in *Panchanimba Churna*

Neem is one of the most celebrated trees in our ancient texts [37]. Every part of Neem has therapeutic benefits [38, 39]. In PNC, almost every part of Neem is present, which in turn highlights the potency of PNC itself. In PNC, Neem is the main ingredient. Five parts of Neem, i.e., Stem bark, Root, Leaf, Flower, and Fruit, are present in PNC. In Ayurveda, the Neem tree is utilised

for skin care and enhances the skin's beauty [40]. The neem tree is one of the most multifaceted, versatile and potent plants grown in tropical regions. It is recognised for a wide array of medicinal properties, i.e., anti-allergenic, anti-inflammatory, antifeedant, and anti-fungal, and acts as an antiseptic, scabicide, heart tonic, diuretic, insecticide, larvicide, nematicide, and spermicide. These properties have led to widespread use, establishing neem as a valuable ecological asset [41, 42]. The following table (Table 4) documents the therapeutic effects of the neem plant and its various parts.

Table 4: Various parts of the Neem tree (Stem bark, Root, Leaf, Flower, Fruit) along with their photographs and therapeutic effects

Plant part		Therapeutic effects
Whole Plant and Root [43, 44]		All parts of the neem tree, i.e., stem and root bark, flowers, leaves, fruits, and seeds, have been traditionally used to treat inflammation, infections, fever, skin diseases and dental disorders.
Stem Bark [45]		Analgesic, Stomach and intestinal ulcers, Skin ailments, Fever, etc.
Leaf [46]		Leprosy, Eye problems, Bloody nose, Diseases of the heart and blood, Skin ulcers, Diabetes, Gum disease, useful for birth control and to cause abortions, etc.
Flower [47]		Bile suppression, Elimination of intestinal worms, etc.
Fruit [48]		Piles, Urinary tract disorders, Mouth ulcers, Bloody noses, Hair problems, and to kill lice, Pimples, Cholera, Phlegm, Piles, etc.
Gum [49]		The older trees excrete sap, used to treat skin diseases and provide oral health care.

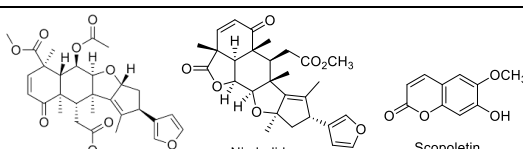
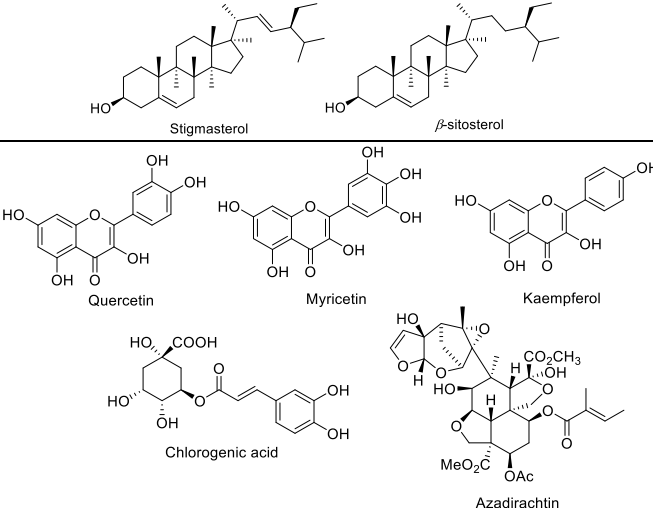
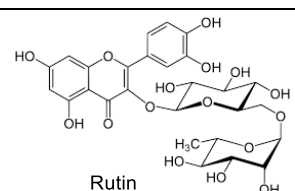
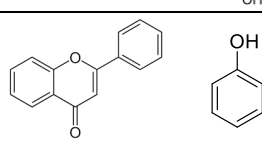
The neem tree is often called a "reservoir" of plenty of phytochemicals, with over 300 extracted and identified [50]. The isolated phytocompounds can be categorised primarily into two groups, i.e., isoprenoids, which include diterpenoids, triterpenoids, and limonoids, and non-isoprenoids,

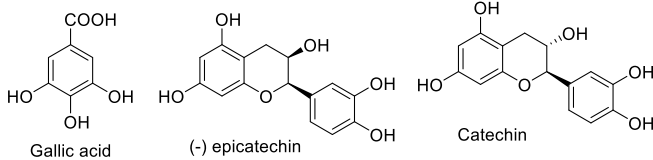
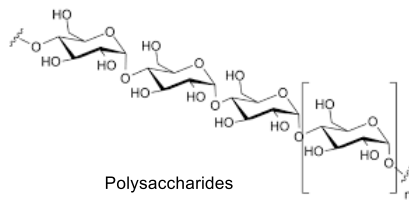
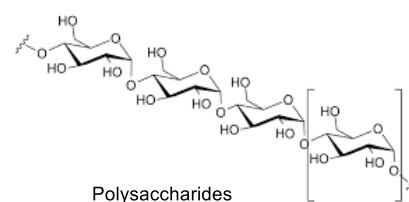
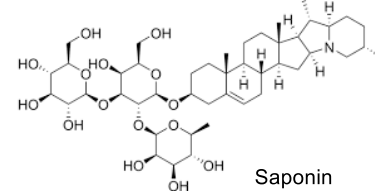
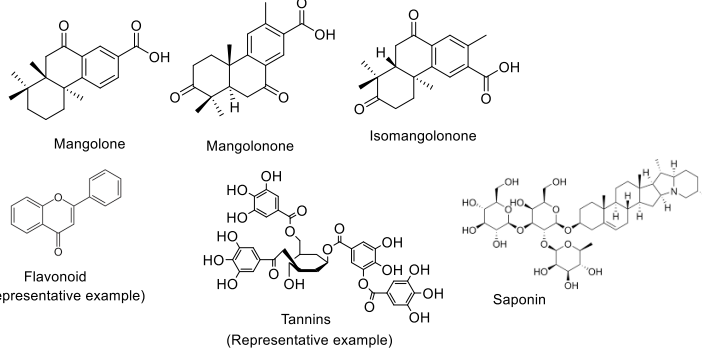
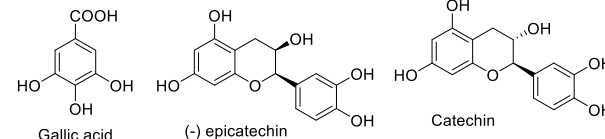
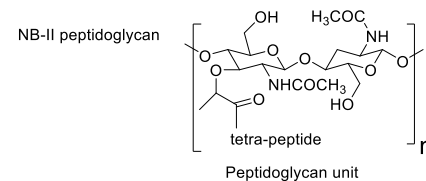
which contain proteins, polysaccharides, tannins, flavonoids, glycol-flavonoids, dihydrochalcone, coumarin, various aliphatic compounds, and phenolic acids [51, 52]. Every component of the neem tree, including its leaves, fruits, seeds, oil, roots, bark, and twigs, is a treasure of

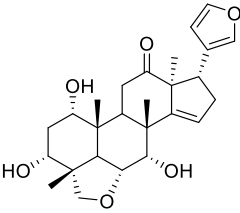
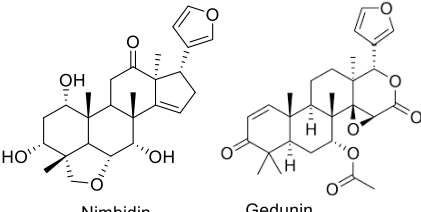
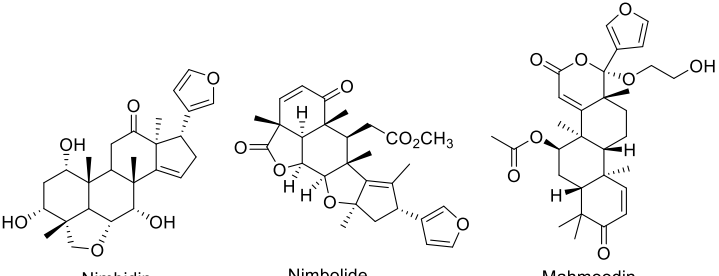
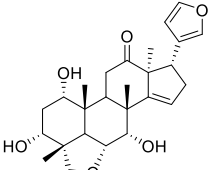
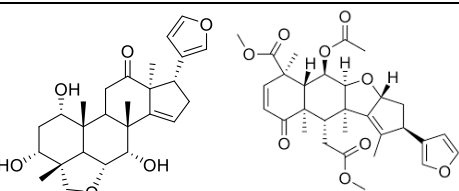
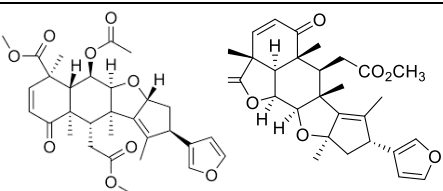
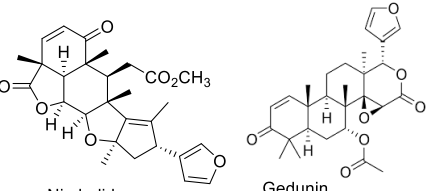
phytochemicals known for their antimicrobial, antiviral, antifungal, anti-inflammatory, anti-plasmodial, antiseptic, antipyretic, anti-diabetic, and anti-ulcer activities [41]. Nimbin was the first compound to be explored. Other significant phytochemicals obtained from neem include nimbolide, azadirachtin, azadiradione, gedunin, and azadirone. Azadirachtin comprises seven isomeric chemical entities, known as azadirachtin A-G, with azadirachtin E being the major. The most biologically potent triterpenoid, Nimbin, is found in neem seed oil and is recognised for its

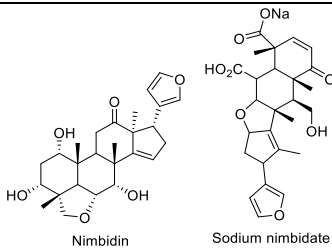
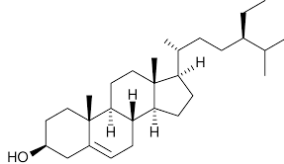
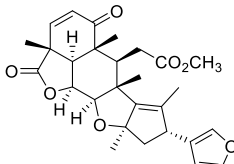
antipyretic, antiseptic, anti-inflammatory, fungicidal, and antihistamine effects [53, 54]. Neem Leaf Glycoprotein (NLGP), derived from neem leaves, is a purified protein known to decelerate tumour cell proliferation. Rather than directly killing cancerous cells, this protein alters immune cell behaviour within the cancerous environment and the bloodstream, effectively hindering cancer progression [55]. Table 5 lists some essential phytochemicals in the Neem plant and their bio-activity.

Table 5: Bio-activity of phytochemicals extracted from various parts of the Neem plant

Plant part	Bio-activity	Responsible phytochemicals
Leaf [56]	Anti-oxidant	 Nimbin, Nimbolide, Scopoletin
	Anti-inflammatory	 Stigmasterol, β -sitosterol, Quercetin, Myricetin, Kaempferol, Chlorogenic acid, Azadirachtin
	Anti-hyperglycaemic	 Rutin
Bark (Stem and Root) [57]	Anti-oxidant	 Flavonoid, Phenol (Representative example)

	Anti-inflammatory	 Gallic acid (-) epicatechin Catechin  Polysaccharides
	Anti-tumour	 Polysaccharides
	Haemolytic	 Saponin
	Antimicrobial	 Mangolone Mangolonone Isomangolonone Flavonoid (Representative example) Tannins (Representative example) Saponin
	Immunomodulator	 Gallic acid (-) epicatechin Catechin  NB-II peptidoglycan tetra-peptide Peptidoglycan unit
Fruit and Seed [58, 59]	Hypoglycaemic	
	Anti-arthritis	

Anti-gastric	 Nimbidin
Anti-fungal	 Nimbidin Gedunin
Anti-bacterial	 Nimbidin Nimbolide Mahmoodin
Diuretic	 Nimbidin
Antipyretic	
Spermicidal	 Nimbin Nimbin
Antioxidant	 Nimbin Nimbolide
Anti-malarial	 Nimbolide Gedunin

	Anti-inflammatory	 Nimbidin Sodium nimbidate
	Anti-ulcer	 Phytosterol (representative structure)
Flower [60]	Anti-arthritis	 Nimbolide

* The list is not exclusive. Plenty of compounds are present in the Neem plant; only important compounds in terms of their therapeutic properties are listed here.

Brief Discussions on the ingredients of *Panchanimba Churna* other than Neem

Neem is the main ingredient of PNC. Hence, a detailed discussion about Neem has been made above. Besides Neem, PNC has several other

herbal ingredients [twenty-three (23) ingredients], *Lauha Bhasma* and *Sarkara*. As this review intends to give insight into PNC formulation, we will restrict ourselves to a detailed discussion of its main ingredient, Neem, only. Despite that, a short account of other ingredients has also been made below (Table 6) to highlight the importance and efficacy of these ingredients.

Table 6: A brief discussion on the plants/ingredients of PNC formulation other than Neem

Plant Name	Brief overview
Haritaki (<i>Terminalia chebula</i>) Family: Combretaceae 	Haritaki is a highly esteemed herb in Ayurvedic medicine, often called the 'king of herbs'. In the Ayurvedic formulation, '<i>Triphala churna</i>', Haritaki, Amalaki, and Bibhitaki are the ingredients. The Haritaki tree is mainly found across India, Bangladesh, China, Myanmar, Iran, Egypt etc. In India, it predominantly grows in deciduous forests and areas with light rainfall, though it can also be found in moderately moist forests. The tree blooms between April and August, with fruits maturing from October to January. Its fruit is a drupe-like structure, measuring 2–4.5 cm in length and 1.2–2.5 cm in width, blackish with five distinct longitudinal ridges. Hydrolyzable tannins, chebulic acid, chebulinic acid, chebulagic acid, ellagic acid, gallic acid, etc., are the main phytoconstituents of Haritaki. Its pharmacological activities include

	Antibacterial, antioxidant, anticancer, antifungal, antiviral, antidiabetic etc. [61, 62].
Bibhitaki (<i>Terminalia bellirica</i>) Family: Combretaceae 	Bibhitaki is an Ayurvedic herb and one of the three components of '<i>Triphala churna</i>', formulation. It is widely distributed across the Indian subcontinent, Sri Lanka, and Southeast Asia. The Bibhitaki tree grows to a height of 60 to 80 feet. Its leaves are large, measuring around 15 cm in length. The colour of the flowers is either white or pale yellow. Its therapeutic effects are attributed primarily to glucoside, tannins, chebulanic acid, gallic acid, ellagic acid, ethyl gallate, etc. Its pharmacological activities include antioxidant, antimicrobial, antidiarrheal, anticancer, antidiabetic, antihypertensive, and liver-protective properties [63].
Amalaki (<i>Emblica officinalis</i>) Family: Phyllanthaceae 	Amalaki is an Ayurvedic herb known for its rejuvenating and nourishing qualities and one of the three components of '<i>Triphala churna</i>', formulation. Amalaki trees grow across tropical and subtropical regions of India, primarily in dry deciduous forests and up to 1,400 meters in the Himalayas. They are generally found all over India. This deciduous tree is small to medium-sized, reaching an average height of 8-18 meters, with thin, light grey bark that peels off in small, irregular flakes. The fruit is fleshy, nearly globose, 2.1-2.4 cm in diameter, weighing 5.3-5.7 g. All parts of Amalaki help to treat various diseases, although fruit is the most important part. The fruits of Amalaki are extensively used in Ayurvedic preparation, increasing defence against diseases. Amalaki is beneficial in managing degenerative diseases such as cancer, diabetes, liver disorders, ulcers, anaemia, eye conditions, and heart issues. It is also a key ingredient in various hepatoprotective and rejuvenating formulations. Tannins, gallic acid, ellagic acid, emblicanin A & B, quercetin, ascorbic acid, etc., are the major phytochemicals present in Amalaki [64].
Ginger (<i>Zingiber officinale</i>) Family: Zingiberaceae 	Ginger is one of the most important spices used in the kitchen and is known for its rich phytochemical composition that offers various health benefits. It is commonly used as a home remedy for ailments like the common cold and headaches, and it possesses pharmacological properties, including anti-inflammatory, antioxidant, antiemetic, antiulcer, anticancer, antiplatelet, anti-diabetic, and lipid-lowering effects. Gingerol, zingerone, shogaols are the main bio-active compounds present in ginger. and parasols. 6-gingerol and 6-shogaol exhibit

	pharmacological effects beneficial for antipyretic, analgesic, and hypotensive purposes [65].
Maricha (<i>Piper nigrum</i>) Family: Piperaceae 	<i>Piper nigrum</i>, considered the 'King of spices', is a popular spice that imparts unique flavour and taste to dishes. It is commonly known as black pepper and is a flowering, woody perennial vine; it thrives in shaded environments and can climb on supporting trees, trellises, or poles, reaching heights up to 4 meters. Piperine, piperic acid, piperlonguminine, pellitorine, piperamide, piperettine, etc. are some active phytoconstituents present in <i>P. nigrum</i>. Piperine enhances the bioavailability of various drugs and nutrients by restricting several metabolizing enzymes. <i>P. nigrum</i> and its active compound, piperine, have a wide range of pharmacological effects, including antihypertensive, antioxidant, antitumor, analgesic, anti-inflammatory, anti-diarrheal, antispasmodic, antidepressant, immunomodulatory, antibacterial, antifungal, hepato-protective, as well as larvicidal and insecticidal activities [66, 67].
Pippali (<i>Piper longum</i>) Family: Piperaceae 	<i>Piper longum</i>, commonly known as long pepper, is a perennial shrub or herbaceous vine. It is native to the Indo-Malaya region and is commonly found in tropical and subtropical areas, including the Indian subcontinent, Sri Lanka, the Middle East, and America. The fruits of this plant are primarily used as a culinary spice and preservative, as well as a potent remedy in various traditional medicine systems for conditions like bronchitis, coughs, colds, snake bites etc; it is also utilized as a contraceptive. The plant contains various bioactive phytochemicals, such as alkaloids, flavonoids, esters, and steroids. Extracts and essential oils from its roots and fruits have been reported to exhibit antimicrobial, antiparasitic, anthelmintic, anti-inflammatory, analgesic, antioxidant, anticancer, neuro-pharmacological, antihyperglycemic, hepatoprotective, immunomodulatory, antiarthritic, antiulcer, cardioprotective etc., properties. Many of these pharmacological activities are attributed to their antioxidative and anti-inflammatory effects, as well as their ability to modulate various signalling pathways and enzymes [68].
Brahmi (<i>Bacopa monnieri</i>) Family: Plantaginaceae 	Brahmi is a highly valued Ayurvedic herb known for its wide-ranging benefits, particularly in supporting memory, reducing stress, and protecting brain health. Incorporating Brahmi into a wellness routine, with guidance from a healthcare provider, can be especially beneficial for enhancing cognitive function and mental well-being. The primary phytochemicals in <i>B. monnieri</i> are known as

	bacosides (triterpenoid saponins); there are 12 identified analogues of bacosides. The plant also contains several alkaloids, including brahmine, apigenin, herpestine, hersaponin, plantainoside B, monnierasides I–III, cucurbitacin etc. The methanolic extract of <i>B. monnieri</i> exhibits radical scavenging properties, which help protect against DNA cleavage. Additionally, it is believed to offer antioxidant, anti-stress, anti-inflammatory, cognition-enhancing, immunomodulatory, and anti-ageing effects [69].
Goksura (<i>Tribulus terrestris</i>) Family: Zygophyllaceae 	Gokshura has long been utilized in both Indian and Chinese traditional medicine for treating a range of diseases. It grows widely across India, reaching elevations of up to 11,000 feet in Kashmir, and is also found in Ceylon and warm regions worldwide. This small shrub stands 10-60 cm tall with a hairy and silky texture. The fruits and roots of Gokshura are primarily used in folk medicine for various ailments. Various parts of Gokshura are rich in medicinal compounds, including flavonols, flavonoids, glycosides, steroidal saponins, and alkaloids. It possesses multiple therapeutic effects, such as diuretic, antiurolithic, immunomodulatory, antidiabetic, cardiotonic, hepatoprotective, anti-inflammatory, analgesic, antispasmodic, anticancer, antibacterial, anthelmintic, larvicidal, anticarcinogenic etc. properties [70].
Bhallataka (<i>Semecarpus anacardium</i>) Family: Anacardiaceae 	Bhallataka, commonly referred to as the 'marking nut', is widely distributed across the sub-Himalayan regions, as well as tropical and central India. This medium sized, deciduous tree, growing up to 15-25 meters, is found in the outer Himalayas and warmer areas of India, up to 3500 feet elevation. It is particularly abundant in regions like Bihar, Assam, West Bengal, Odisha, central India, the western peninsula, the East Archipelago, and Northern Australia. The tree has grey bark that flakes off in small, irregular pieces and holds significant medicinal value in Ayurveda and Siddha. Chemical and phytochemical studies on its nut showed the presence of flavonoids, phenolics, bhallawanols, minerals, vitamins, and amino acids. Nut extract formulations effectively treat various health conditions, including arthritis, tumours, infections etc. [71].
Chitraka (<i>Plumbago zeylanica</i>) Family: Plumbaginaceae	Chitraka, a perennial herb, is often seen in areas like U.P, West Bengal, Maharashtra and South India. It is one of the oldest herbs reported to be used in Ayurveda for several disorders over thousands of years. It is rich in secondary metabolites like alkaloids, flavonoids,

	naphthoquinones, glycosides, saponins, steroids, terpenoids, coumarins, phenolic compounds, tannins, carbohydrates, fixed oils, fats and proteins. It possesses antibacterial, anti-plasmodial, antitumor, hepatoprotective, CNS-stimulating, antifungal, anti-inflammatory, antihyperglycemic anticancer and anti-atherosclerotic effects. Plumbagin, chitranone, 3-biplumbvagin, chloroplumbagin, elliptone, seselin, plumbaginic acid, β-sitosterol etc. are the major compounds present in Chitraka, with plumbagin being the most significant bioactive compound [72].
Vidanga (<i>Embelia ribes</i>) Family: Myrsinaceae 	Vidanga has long been valued in traditional medicine for its numerous therapeutic effects, including analgesic, antioxidant, anthelmintic, antibacterial, anticancer, antidiabetic, antihyperlipidemic, wound healing, and anti-spermatogenic activities. This plant is widely found in Southeast Asian countries like Cambodia, India, Laos, Malaysia, Sri Lanka, Thailand, Vietnam, South China etc. Embelin, a significant bioactive compound found in the <i>Embelia</i> genus, is noted for its hepatoprotective, anti-inflammatory, antioxidant, radioprotective, anticancer, antimitotic, contraceptive, anti-infective, antihyperlipidemic, anti-spermatogenic, antihyperglycemic, analgesic, antipyretic, and wound healing properties. Among its diverse biological effects, pharmacological studies have highlighted its potent anti-tumour, antioxidant, and anti-inflammatory activities [73].
Varahi (<i>Dioscorea bulbifera</i>) Family: Dioscoreaceae 	Varahi, a tuberous rooted climber plant commonly called air potato, is an important medicinal plant used to treat many diseases. The tuber is edible when it is boiled or cooked. One teaspoon of tuber powder, when taken orally with water, is a single-dose cure for abdominal ailments. Known for its ability to lower the glycemic index, Varahi has a significant role in managing diabetes and obesity. In traditional Indian and Chinese medicine, it is widely used in the treatment of goitre, sore throat, gastric cancer and rectal carcinoma [74].
Guduchi (<i>Tinospora cordifolia</i>) Family: Menispermaceae 	Guduchi, commonly known as Amrita or Giloy, is abundantly available all over India. Although nearly all plant parts are utilized in traditional medicine, the leaves, stems, and roots hold the greatest medicinal significance. Chemical investigations showed it contains alkaloids, terpenoids, lignans, glycosides, steroids, aliphatic compounds, essential oils, fatty acids, polysaccharides etc. Cordiofoliosides, tinosporine, tinosporide, β-sitosterol, berberine, etc., are the major phytoconstituents of <i>T. cordifolia</i>. Its

	pharmacological activities include anti-cancer activity, anti-oxidant activity, immunomodulatory activity, inflammatory activity, antipyretic activity, anti-diabetic activity, etc. [75]
Haridra (<i>Curcuma longa</i>) Family: Zingiberaceae 	Haridra, or turmeric, has a rich history of medicinal use in Unani and Ayurveda systems for conditions like hepatic disorders, jaundice, ulcers, and inflammation. The tuberous rhizome is the most important part of Haridra, which assumes a yellowish-brown colour with a dull orange on the inside upon maturation. It is also traditionally used for coughs, colds, dental issues, skin infections, blood purification, and other ailments. Curcumin, the key bioactive compound, is recognized for its therapeutic properties, such as antioxidant, anti-inflammatory, anticancer, hepatoprotective, neuroprotective, and cardioprotective effects [76].
Daruharidra (<i>Berberis aristata</i>) Family: Berberidaceae 	Daruharidra is an upright, thorny, deciduous shrub that grows up to 3.6 meters tall and is native to the Himalayas, growing at elevations between 1,000 and 3,000 meters, and can also be found in the Nilgiri Hills of southern India at elevations ranging from 1,000 to 2,400 meters. This shrub is primarily used to treat eye diseases, skin disorders etc. Clinical and experimental research has demonstrated that <i>B. aristata</i> possesses anti-inflammatory, antioxidant, hepatoprotective, and immunomodulatory properties. Berberine, oxyberberine, protoberberine, bis-isoquinoline, karachine, oxyacanthine, taxilamine, palmatine, tetrahydropalmatine, etc., are the major constituents of Daruharidra [77].
Bakuchi (<i>Psoralea corylifolia</i>) Family: Leguminosae 	Bakuchi holds a significant therapeutic value in both Ayurveda and Chinese medicine. It is an annual, erect herb that grows to a height ranging from 30 to 180 cm, requiring a warm environment with ample sunlight. <i>P. corylifolia</i> exhibits cardiotonic, vasodilatory, antitumor, antibacterial, cytotoxic, and anthelmintic activities. Traditionally, it is used to treat conditions such as alopecia, inflammation, leukoderma, leprosy, psoriasis, and eczema. Approximately 100 bioactive compounds have been isolated from its seeds and fruits, predominantly belonging to the coumarin, flavonoid, and meroterpene groups. Psoralen, isopsoralen, corylin, corylifolin, psoralidin etc., are the major phytochemicals in Bakuchi [78].
Aragvadha (<i>Cassia fistula</i>) Family: Caesalpiniaceae	<i>Cassia fistula</i> is a medium-sized deciduous tree that grows up to 9 meters in height with spreading branches. Its bark is smooth and ranges from light to dark brown. Fistucacidin, barbaloin, rhein, Sennoside-A and B, sitosterol, fistulic acid, etc., are

	the major phytoconstituents in <i>C. fistula</i>. The plant exhibits various pharmacological activities, which include antifungal, antipyretic, analgesic, antioxidant, antitumor, antimicrobial, larvicidal, anti-inflammatory, hepatoprotective, hypoglycaemic activities etc. [79].
Kustha (<i>Saussurea lappa</i>) Family: Asteraceae 	Kustha, commonly known as Kuth root or costus, is well known for its traditional medicinal uses. It is a tall, sturdy, perennial herb that grows upright to a height of 1–2 meters with an erect stem. Costunolide, Isodihydrocostunolide, dehydrocostus lactone, cynaropicrin, (+)-germacrene A, lappadilactone, Saussureamine A-E, saussureal etc., are the major phytocompounds present in <i>S. lappa</i>. Its pharmacological activities include angiogenesis effect, anti-bacterial activity, anti-cancer activity, anti-convulsant activity, anti-inflammatory activity, anti-ulcer activity, anti-viral activity, anti-hepatotoxic activity, anti-microbial activity etc. [80].
IndraYava (<i>Holarrhena antidysenterica</i>) Family: Apocynaceae 	IndraYava, commonly known as Kutaj, is mainly found in tropical and subtropical regions of the Asian and African sub-continent and India, mainly in the Himalayan ranges. In India, Kutaj holds significant traditional and folklore importance. Conarrhimine, conamine, conimine, conessimine, iso-conessimine, norconessine, kurchine, dimethyl conkurchine are the main phytoconstituents of Kutaj. Its pharmacological activities encompass anti-bacterial activity, antidiabetic activity, antihyperlipidemic activity, cytotoxic activity, anti-plasmodial activity, antidiarrheal activity etc. [81]
Patha (<i>Cyclea peltata</i>) Family: Menispermaceae 	<i>C. peltata</i>, commonly known as Pata root in English, is a climbing shrub abundantly found in Southern India. Roots and leaves are the most useful parts of this plant. Cycleapeltine, cycleacurine, cycleadrine, cycleanorine, tetrandrine are the major phytoconstituents of <i>C. peltata</i>. Its pharmacological activities encompass anti-bacterial activity, anti-ulcerative effect, larvicidal, neuropharmacological effect etc. [82]
Khadira (<i>Acacia catechu</i>) Family: Fabaceae 	It is a deciduous tree and has been extensively utilized in Ayurveda for years to treat and prevent various diseases and disorders. Protocatechuic acid, catechin, epicatechin, epicatechin gallate, taxifolin, epigallocatechin, gallic acid, procyanidin, L-arabinose, D-rhamnose, D-galactose, afzelechin, quercetin are the major phytoconstituents present in Khadira. Its pharmacological properties include antimicrobial, antidiarrheal, antinociceptive, antihyperlipidemic, antiulcer, antioxidant, antidiabetic, antiproliferative, haemolytic, and anti-

	inflammatory properties, which may be attributed to the presence of alkaloids, flavonoids, and tannins [83].
Asana (<i>Pterocarpus marsupium</i>) Family: Fabaceae 	Asana is a deciduous tree which can grow up to 30 meters and has been extensively utilized in Ayurveda for years to treat and prevent various kinds of ailments. Pterosupin, pterostilbene, liquiritigenin, isoliquiritigenin, epicatechin, kinotannic acid, kinoin, marsupol, marsupinol, carpusin are the primary phytoconstituents of <i>P. marsupium</i> . Its pharmacological activities include anti-diabetic activity, antioxidant activity, inflammatory activity, cardiogenic activity, antibacterial activity, analgesic activity etc. [84]
Bhringraj (<i>Eclipta alba</i>) Family: Asteraceae 	Bhringraj, also known as False Daisy, is well known for its diverse therapeutic applications. This medicinal plant is rich in phytochemical compounds that contribute significantly to health care. Coumestans, flavonoids, alkaloids, glycosides, triterpenoids, phenolic acids, saponins, sterols, sesquiterpene lactones, amino acids, proteins, carbohydrates, etc., are the major class of phytocompounds present in <i>E. alba</i> . Because of its rejuvenating effects on the mind and nervous system, it supports liver function, enhances body circulation, and promotes skin health. Its pharmacological activities include analgesic, antioxidant, anti-bacterial, anti-viral, anti-cancer, anti-myotoxic, antihyperglycemic, and immunomodulatory activities [85, 86].
Lauha Bhasma (Calcined iron) 	Lauha Bhasma is a traditional Ayurvedic preparation created by purifying and incinerating iron through a process known as " <i>bhasmikanana</i> ." This method involves extensive heating and purification, resulting in a fine, ash-like substance with high bioavailability, making it readily absorbable by the body. In Ayurvedic medicine, Lauha Bhasma is highly regarded for its therapeutic qualities, particularly as a hematinic that helps increase haemoglobin levels and red blood cell count. It is commonly used to address anaemia, fatigue, and general weakness. Additionally, it is valued for its rejuvenating, anti-inflammatory, and anti-diabetic properties, and it is often used to enhance immunity and promote skin health. Depending on the preparation, Lauha Bhasma contains trace amounts of iron and may include minerals like calcium and potassium, further supporting its health benefits [87].
Sharkara (Sugar)	Sugar, referred to as Sharkara in Ayurveda, has been a significant natural substance with medicinal and cultural relevance for centuries. It is utilized in



preparations like syrups, tablets, and decoctions, acting as a binder, preservative, or main ingredient. Sugar is derived mainly from *Saccharum officinarum* (sugarcane) and involves processes like milling, heating, and crystallization. Chemically it is sucrose ($C_{12}H_{22}O_{11}$) and other carbohydrates, contributing to its sweetness and energy content.

[88]

Medicinal importance of Panchanimba Churna

PNC is an Ayurvedic formulation that reduces skin-related diseases and promotes healthy skin. It helps to brighten the complexion and reduce the appearance of dark spots and pigmentation [8]. It is a celebrated drug mentioned in ancient Ayurvedic texts for treating minor skin disorders (Kshudra kushtas) like eczema, acne, and major skin diseases (Maha kushtas) [34, 35]. The following footnote describes the potential of PNC in hyper-acidity.

Physicochemical and phytochemical studies carried out on Panchanimba Churna

Meena and co-workers have carried out the physicochemical and phytochemical evaluation of PNC to access the quality control parameters of the said formulation [89]. They collected the PNC from the Department of Pharmacy of the Regional Ayurveda Research Institute (RARI), Gwalior, Madhya Pradesh. They carried out an organoleptic evaluation of PNC (Table 7). Besides this, qualitative estimation of primary (amino acid, etc.) secondary metabolites (Alkaloids, Flavonoids, Terpenoids, Saponins, Carbohydrates, etc.) present in ethanol and water extract of PNC were also carried out (Table 8) in conjunction with physicochemical experiments of PNC (Table 9) as per API and WHO guidelines [90, 91]. They also conducted experiments to determine the total phenolic content (TPC, in terms of gallic acid) and total flavonoid content (TFC, in terms of quercetin) present in PNC (Table 10).

Table 7. Organoleptic studies of PNC

Organoleptic parameters	Colour	:	Greenish brown
	Odour	:	Pleasant
	Taste	:	Bitter, Pungent

Table 8. Qualitative estimation of phytoconstituents present in PNC

Phytochemical test for		Ethanol extract	Water extract
Carbohydrate	:	(+)	(+)
Glycoside	:	(+)	(+)
Protein and amino acid	:	(+)	(+)
Alkaloid	:	(-)	(-)
Terpenoid	:	(-)	(-)
Flavonoid	:	(+)	(+)
Tanin	:	(+)	(+)
Saponin	:	(+)	(+)
Phenols	:	(+)	(+)
Steroid	:	(-)	(-)

(-): Absent; (+): Present

Table 9: Physicochemical parameters of PNC

Physicochemical parameters	LOD at 105 °C	:	3.47 % (w/w)
	Water soluble extractive	:	22.03 % (w/w)
	Alcohol soluble extractive	:	21.49 % (w/w)
	Total ash	:	10.14 % (w/w)
	Acid insoluble ash	:	5.20 % (w/w)
	pH	:	4.68 (at 22.9 °C)

Table 10. Quantitative estimation of TPC and TFC of PNC

Total phenolic content (TPC)	:	105 mg/g in terms of gallic acid equiv. (GAE)
Total flavonoid content (TFC)	:	43.82 mg/g in terms of quercetin equiv. (QE)

Chromatographic studies carried out on *Panchanimba Churna*

The same group has also conducted HPTLC studies with PNC and some markers (Nimbine, (b-

sitosterol, Quercetin, Gallic acid, and Azadirachtin) [89]. Figure 2 documents the HPTLC fingerprinting profile of PNC, and Table 11 summarises the R_f values of PNC and markers.

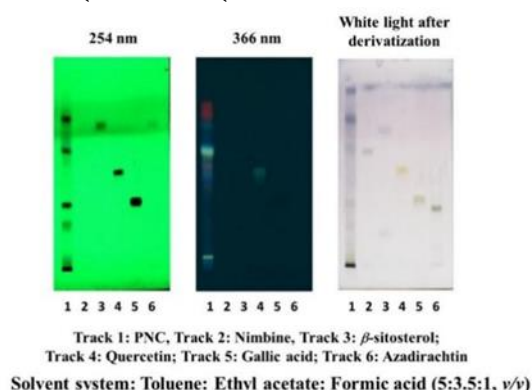


Figure 2: HPTLC fingerprinting profile of PNC (Ref: *Int J Pharm Chem Anal* 2022; 9(4):174-183)

Table 11: R_f values

Tracks	254 nm	366 nm	White light
1	0.23, 0.34, 0.48, 0.60, 0.75	0.48, 0.51, 0.58, 0.71, 0.77, 0.81	0.30, 0.34, 0.59, 0.70, 0.75, 0.88
2	-	-	0.59
3	0.70 (<i>b</i> -sitosterol)	-	0.70 (<i>b</i> -sitosterol)
4	0.48 (Quercetin)	0.48 (Quercetin)	0.48 (Quercetin)
5	0.34 (Gallic acid)	-	0.34 (Gallic acid)
6	0.70 (Azadirachtin)	-	0.30, 0.70 (Azadirachtin)

In vitro studies carried out on *Panchanimba Churna*

Meena *et al.* conducted *in vitro* antioxidant and anti-inflammatory studies with PNC [89]. These results support PNC as a potent candidate with anti-oxidant and anti-inflammatory properties. DPPH radical scavenging assay and Reducing

power assay were carried out to ascertain anti-oxidant activity. In contrast, Protein denaturation inhibitory activity and Anti-proteinase activity were checked to assess their anti-inflammatory activity. The results obtained in the above cases are summarised in the following table (Table 12)-

Table 12. *In vitro* antioxidant and anti-inflammatory activity

In vitro studies	Name of the process	Result
Anti-oxidant activity	DPPH radical scavenging assay	IC ₅₀ value = 662.5 mg/mL
	Reducing power assay	PNC (50-250 g/ml concentration range) showed its capability to reduce ferricyanide to ferrocyanide.
Anti-inflammatory activity	Protein denaturation inhibitory activity	IC ₅₀ value = 95.49 mg/mL
	Anti-proteinase activity	IC ₅₀ value = 593.6 mg/mL

Clinical studies carried out with *Panchanimba Churna*

PNC is an Ayurvedic drug known for its potency to combat various kinds of skin ailments. Comprehensive clinical trials on PNC have not been widely performed and documented in medical databases. Ayurvedic formulations are often supported by traditional use and anecdotal evidence or folklore of their effectiveness; there is generally a lack of rigorous clinical trials that adhere to modern scientific standards. Below, we furnish a few case studies mentioned in some research articles to shed light on the clinical study carried out with PNC.

Clinical Study 1

Angadi and Gowda from Shri J. G. C. H. Society's Ayurvedic Medical College, Karnataka, India and Government Ayurvedic Medical College, Karnataka, India performed a clinical trial on the management of *Vyanga* (facial melanosis) with *Arjunatwak Churna* and PNC [92]. They used *Arjunatwak Churna* and PNC as trial drugs for topical application and oral administration, respectively. A total of 30 patients with *Vyanga* were selected from the OPD and IPD of the Shalakya Tantra Department and randomly assigned to two groups. Group A patients received external application (*lepa*) of *Arjunatwak Churna* and honey for 3 weeks. Group B patients received PNC orally for 3 weeks in addition to the topical application of *Arjunatwak Churna*. The effect of the therapy on bluish-black pigmentation showed a 60% reduction in Group A and an 80% reduction in Group B. The clinical study demonstrated that combined therapy yields better results than topical treatment alone.

Clinical Study 2

The clinical trial was performed by Salunkhe *et al.* to assess the effectiveness of PNC and *Gandhak Pishti* in treating *Vicharchika* W.S.R to Eczema [93]. The study included 10 patients who were administered PNC internally with ghee and

Gandhak Pishti externally with mustard oil for local application over a 60-day duration. The findings demonstrated substantial improvement in symptoms such as itching, lesions, and oozing. All patients experienced complete relief from itching, showcasing the efficacy of PNC, which, due to its hot potency (*ushna virya*) and bitter taste (*tikta rasa*), acts as an anti-itch (*kandughna*) and anti-skin disease (*kushtaghna*) agent. Likewise, *Gandhak Pishti*, with its hot and oily properties, also contributed to alleviating symptoms. The clinical study found that the combination of internal and external treatments significantly relieved the symptoms of *Vicharchika*, with no reported side effects.

Clinical Study 3

Thiyagaraj *et al.* reported that this clinical trial was performed on a 54-year-old male suffering from typical symptoms of plaque psoriasis covering his body for the last five years [94]. The treatment plan included *Samshodhana* (therapeutic purgation) followed by *Sanshamana* (specific internal medication) using *Shuddha Gandhaka*, PNC, *Panchatikta Ghrita*, and *Aragvadha Phala-Majja Kwatha*. The Psoriasis Area and Severity Index (PASI) score significantly decreased from 65.7 to 0.9, with no recurrence of symptoms even after discontinuing treatment for the past two years, showcasing the effectiveness of this approach.

Clinical Study 4

Dhurve *et al.* conducted a clinical trial to assess PNC and *Arka taila*'s efficacy in treating *Vicharchika* (eczema) [95]. Participants were divided into three groups: Group A received PNC (3 grams twice daily with lukewarm water), Group B received *Arka taila* (applied externally twice daily), and Group C received both treatments and the treatment period lasted for 28 days, with weekly follow-ups. The study measured reducing *Vicharchika* symptoms, such as itching, discolouration, redness, pain, dryness, and



bleeding. Results indicated that Group C, which received the combined treatment, showed the most significant improvement across all symptoms, with high statistical significance ($p < 0.001$), compared to Groups A and B. No side effects were observed in any of the groups. The combination of PNC and *Arka taila* was particularly effective in managing *Vicharchika* without causing adverse effects, highlighting the potential of these Ayurvedic treatments for skin conditions.

Clinical Study 5

Shivani *et al.* conducted this clinical study at the Institute of Post-Graduate Ayurvedic Education & Research at Shyamadas Vaidya Shastra Pith Hospital, India with 60 patients suffering from *Vicharchika* [96]. These patients were divided equally into two groups. Group A received treatment consisting of *Shodhana Chikitsa* (*Virechana karma*) using *Trivrit Churna* at a dose of 10 g, along with *Shamana Chikitsa* involving PNC and *Amalaki Churna* (2.5 gms each) taken twice daily after meals with lukewarm water. Local application of a mix of *Gandhak* (1 part), *Tankan* ($1/4^{\text{th}}$ part), and *Chalmoogra taila* was also applied for 3 months. In Group B, patients were treated similarly but without *Shodhana Chikitsa* for the same period. The results showed significant improvement in patients in Group A. This study showcases that PNC and *Amalaki* have a role in symptom relief, with *Virechana karma* crucial for managing *Vicharchika*.

Clinical Study 6

Gupta *et al.* reported this report of a clinical study on a 60-year-old female patient suffering from *Vicharchika* (eczema) [97]. The patient experienced recurrent skin rashes, redness, skin edema, blistering, cracking, oozing, and bleeding on both hands for the last two years. *Aarogyavardhini Vati*, *Panchatikta Ghruta Guggulu*, *Gandhak Rasayan*, *Vidangarista* and *Khadirarista*, a decoction of *Guduchi*, *Lodhra*, *Patol*, *Sariva*, PNC, *Kiratikta* were given as

internal medicine. In contrast, *Prakshalana* with *Panchwalkal Kwath* and *Doshaghna* pack (*Anubhoot yoga*) were prescribed as an external medicine. After eight days of treatment, the patient experienced significant relief from all symptoms, with only blackish discolouration remaining. The study concludes that PNC, with other ayurvedic medicines, can successfully manage eczema without complications and side effects.

Clinical study 7

Badeghar *et al.* reported this clinical study, which encompasses the investigation reports on the effectiveness of *Avipattikara Churna* and PNC in managing *Amlapitta* (hyperacidity) [13]. 40 patients were equally divided into groups A and B. Patients in group A received *Avipattikara Churna*, and those in group B received PNC. In both cases, the dosage is 6 g twice daily for a month (30 days). Group A patients used milk as *anupan*, and group B patients used cold water as *anupan*. The symptoms found in the patients are indigestion, heaviness, heartburn, etc. This treatment was continued for 30 days. Table 13 documents the results after 30 days of treatment.

Table 13. Effect of Avipattikara Churna and PNC

Parameters	Groups	
	A	B
<i>Avipaka</i>	94% ↓	89% ↓
<i>Klama</i>	77% ↓	76% ↓
<i>Utklesha</i>	81% ↓	74% ↓
<i>Tiktaamlodgara</i>	86% ↓	72% ↓
<i>Gaurava</i>	97% ↓	85% ↓
<i>Hrutkanthadaha</i>	85% ↓	75% ↓
<i>Aruchi</i>	65% ↓	68% ↓
Complete remission	65%	40%
Marked improvement	35%	60%

* ↓: reduction

Both treatments demonstrated significant improvements in symptoms but *Avipattikara Churna* was more effective than PNC in managing hyperacidity.

Side effects of Panchanimba churna

The amount of work done by researchers with PNC, whether pre-clinical or clinical studies, is



much less. So, based on those reports, it is very difficult or baseless to conclude anything regarding the side effects of PNC. But at the end of the day, PNC is a drug/medicine which contains plenty of chemicals (phytochemicals) of different classes which might have some adverse effects if one takes it. So, some standard precautions should be taken to avoid any adverse situations. Following is the list of some precautions-

- Self-medication is strictly prohibited.
- Careful medical supervision should be followed.
- People with diabetes, high blood pressure, heart conditions, obesity, pregnant or breastfeeding women, and children should use this medication only under a doctor's supervision.
- Excessive use may cause gastritis, so doctor consultation is a must.
- Should be stored in a cool, dry place.
- Should be kept out of reach of children.

Conclusion And Future Planning

This review underscores the diverse therapeutic potential of PNC in addressing '*Kushta*'. By thoroughly examining recent research and traditional Ayurvedic literature, it is clear that PNC possesses notable anti-inflammatory and antioxidant qualities. These characteristics affirm its effectiveness in treating skin disorders and highlight its value as a safe and natural therapeutic option. Nonetheless, additional clinical studies are needed to confirm these results and determine the best dosages form and long-term effects or side effects. PNC emerges as a promising candidate for further investigation, aiming to merge Ayurvedic principles with modern scientific practices. This study reinforces the confidence in herbal remedies derived from natural sources to combat infectious diseases and other ailments, suggesting they may be incorporated into future medications. The literature does not provide any report on the assay of marker compounds in the PNC formulation.

Also, there is no report regarding the formulation's shelf-life study (accelerated or real-time). So, further investigation and research in this field are required to bridge these gaps and for proper scientific validation regarding the activities of PNC.

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Conflicts of interest

There are no conflicts of interest.

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