

## Antimicrobial agent from *Semambu* tree extract in cosmetics: an advantage of natural product

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KEYWORDS	ABSTRACT
Neem oil extract Neem balm Antimicrobial activity Active compounds	Currently, the market is flooded with many synthetic cosmetics which comprise heavy metals like arsenic, lead, copper, chromium; and while applying these, some of those toxic substances are absorbed by the skin. <i>Azadirachta indica</i> or known as the neem tree is widely used in the folk medicine of South-Eastern Asia. This short review discussed various methods that are applied to extract neem oil. The obtained oil contains several active ingredients that are useful as antimicrobial agents. Neem cosmetics have the potential to be commercialized and function as an antibactericidal product.

### 1.0 INTRODUCTION

The neem (*Azadirachta indica*) belongs to the *Meliaceae* (mahogany) family. Although it is now grown in tropical and subtropical regions of Africa, America, and Australia, its origins are primarily in southeastern Asia. It is frequently found in Bangladesh, Pakistan and India. In Malaysia, the tree is known as the *Semambu* tree. The leaves, barks, fruits, seeds, and roots of this plant contain substances that have been shown to have anti-inflammatory [1][2], antipyretic [3], anti-fungal, anti-histamine, antibacterial, anti-ulcer, anti-tubercular, anti-arthritis, anti-malarial [4] and insect repellent. Neem is therefore also known as "A tree for tackling world problems", "Tree of the 21st century," and "Village Pharmacy" [5]. Figure 1 shows the beneficial parts of the neem tree.

### 2.0 OVERVIEW OF NEEM EXTRACTION

Various methods can be applied to extract neem oil from the parts of the neem tree. In a prior investigation, ethanol was used as a solvent to synthesize the neem extract [6]. In this work, two extraction techniques; Soxhlet and immersion techniques were used to determine which yields a higher concentration of neem extract. Several solvents, including ethanol, methanol, ethyl acetate, and hexane, were employed as the extraction medium. Distilled water was used as a medium in the immersion method and the appearance of fungus was seen on the top of neem oil as shown in Figure 2. In the meantime, the Soxhlet extraction method was used to extract the essential neem

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oil from neem seeds utilising various organic solvents and conditions [7]. The physico-chemical property of the extracted oil was also done by using the traditional wet chemical method.

Another study used hexane, ethyl acetate, and ethanol as solvents in a sequential pressured liquid extraction process in a fixed bed extractor to generate extracts from neem leaves with possible antiproliferative effects [8]. To relate the traits of the fractionated extracts, ethanol extractions were also carried out. Elaigwu and colleagues investigated the neem leaf extract produced by cold maceration with ethanol serving as the extraction solvent [9]. The leaf extract was assessed for chemical composition using GCMS and UV-spectroscopy.

Without any artefact development, the extraction method using Supercritical fluid carbon dioxide (SCF) produces bioactive chemicals that are close to their native forms. Neem seed was exposed to SCF under various pressure and temperature settings [10]. In addition to the volatiles obtained from the hydro-distillation procedure, these extracts were divided into distinct volatile fractions and evaluated by Gas Chromatography-Mass Spectroscopy. Additionally, two solvents; ethanol and hexane were extracted using steam and solvent techniques [11]. The crude oil extracted was analyzed using GC-MS.

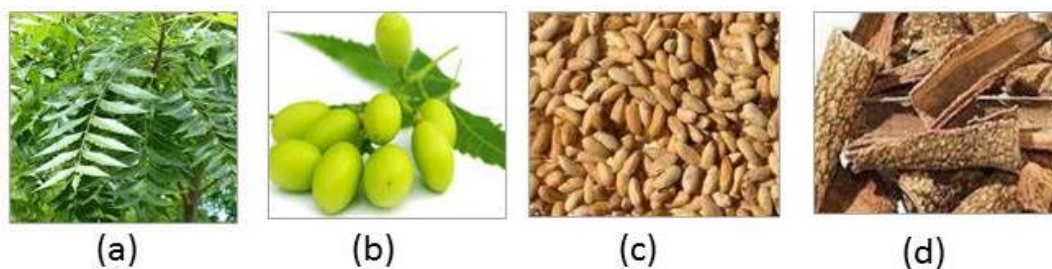


Figure 1: Parts of the neem tree (a) leave; (b) fresh fruit; (c) seed; and (d) bark.

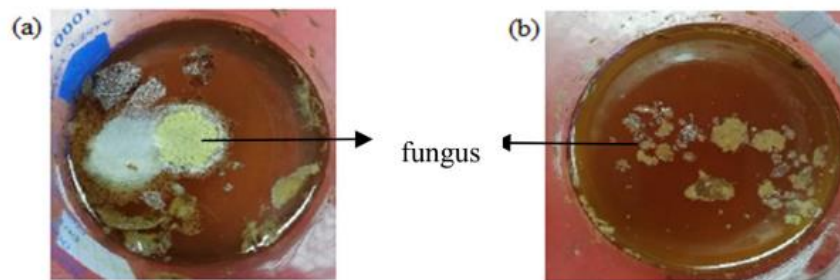


Figure 2: Presence of fungus on the surface of neem oil extracted by immersion technique by using distilled water at (a) 25 °C and (b) 50 °C [6].

### 3.0 ANTIMICROBIAL PROPERTIES OF NEEM TREE

Numerous researches have been done to study the antimicrobial activity of the neem extract. Neem oil extract contains active compounds to fight several illnesses as shown in Table 1. In the year 2020, Uthaya Kumar et al. assimilated neem leaves extract into the matrix of seaweed biopolymer [12]. The adding of 5% w/w neem leaf extract into a seaweed-based film, along with a 2.5 kGy gamma irradiation dose, was most effective in enhancing the film's characteristics. The antimicrobial properties of the film were enhanced against bacteria. In another study, the Minimum Inhibitory Concentration (MIC) test was used to determine the antibacterial activity of

the neem extracts against *M. roseus*, *E. coli*, *B. licheniformis*, *M. luteus*, and *S. aureus* [13]. Another study found that the methanolic neem extract had strong antibacterial effects against *salmonella*, *pseudomonas*, and *E. Coli* [14].

**Table 1:** Compounds identified from neem leaf extract (Khan & Javaid, 2021) [15]

Component	Nature	Function
2-Pentanol, acetate	Ester	-
Decane	Alkane	Antimicrobial, antifungal, antibacterial
11-Oxa-dispiro[4.0.4.1]undecan-1-ol	Alcohol	Antimicrobial
Nonanoic acid, 9-(3hexenylidenecyclopropylidene)-, 2-hydroxy-1-(hydroxymethyl)ethyl ester, (Z,Z,Z)-	Ester	Antimicrobial, antioxidant therapeutic agent, antiproliferative activity,
Quinoline-4-carboxamide, 2-phenyl-N-n.-octyl-	Ester	-
Nonacosane	Aliphatic hydrocarbon	Antibacterial, antimicrobial, anti-inflammatory and antidiabetic
Tetratriacontane Aliphatic	Aliphatic hydrocarbon	Antimicrobial, antibacterial, anticancer, antioxidant, hypoglycaemic

In a study, the neem seed oil is emulsified with an alkyl polyglucoside, Montanov 202™, to produce a topical application [16]. Inhibition of paw swelling by 39–60% over 30-180 min was seen in anti-inflammatory studies using the paw edoema model in female Wistar rats with this topical application. Similarly, when this applicant was applied after induction, wounds caused by incision procedures also had a significantly greater breaking strength ( $353.46 \pm 7.95$  g). Using the agar well diffusion method, *Staphylococcus aureus*, *Pseudomonas aeruginosa* (ATCC 27853), and *Escherichia coli* were subjected to the *Azadirachta indica* leaf extract's antibacterial properties [17]. Various amounts of the plant's ethanolic, aqueous, and methanolic extracts were employed, including 200 mg/ml, 100 mg/ml, 50 mg/ml, 25 mg/ml, 12.5 mg/ml, 6.25 mg/ml, 3.125 mg/ml, and 1.56 mg/ml, respectively. The ethanolic extract had more antibacterial activity than the methanolic and aqueous extracts, although all three extracts were determined to have extremely strong antimicrobial activity.

The previous study sought to ascertain the radical scavenging, total polyphenol content, and antibacterial properties of *Azadirachta indica* and assess their impact on the shelf-life stability of raw beef patties when stored in refrigerators at 4 °C [18]. The findings from the anti-radical and antimicrobial properties of leaf extracts revealed proportional values of total polyphenol content and radical scavenging activity as they demonstrated their antimicrobial effect against some bacteria, including *Staphylococcus aureus* and *Micrococcus luteus*, among others. Another study examined the antimicrobial activity of polyherbal hand wash formulations F1, F2, and F3 using disc diffusion method against *S. aureus*, *Pseudomonas aureogenosa*, and *E. coli* pathogen. The herbs tested included Tulsi (*Ocimum sanctum*), Cinnamon (*Cinnamom zeylanicum*), Neem (*Azadirachta Indica*), and Lemongrass oil [19]. The F3 formulation (800 g/mL) shown a powerful effect against *E. coli* in compared to others due to the presence of medicinally active phytoconstituents, while

all formulations (800>400>200 g/mL) demonstrated substantial antibacterial action against all pathogens.

#### 4.0 NEEM COSMETICS AS A NATURAL PRODUCT

Nowadays, without knowing the real ingredients, consumers use cosmetic products. An alternative product by using natural ingredients that are safe to use should be developed. The aim of the present study was to create a cosmetic BB cream with anti-acne properties and a concealing effect [20]. BB creams are marketed as "beauty balms, blemish bases, and blemish balms" in the cosmetics industry and are created to act as a foundation, moisturiser, and sunscreen all at once. Neem oil was made in concentrations up to 25%w/w, and its look, pH, texture, spreadability, antibacterial capabilities, and in vitro release experiments were all assessed. A persistent dermatological inflammatory condition called acne vulgaris causes redness and blemishes to form on the face and neck. In this condition, *Propionobacterium acnes* is crucial. The effectiveness of each compound against *P. acnes* was confirmed. After 6 hours, the neem oil's sustained action was seen, as shown in vitro.

Another study examined how treatments with essential oil emulsion affected the physiological and hygienic qualities of creole corn seeds [21]. Neem, citronella (*Cymbopogon nardus*), lemon balm (*Cymbopogon citratus*), and melissa (*Melissa officinalis*) essential oils were assessed in the study. The results showed that treatment with the essential oils of citronella, lemon balm, and melissa significantly reduced the occurrence of the fungi *Fusarium sp.* and *Aspergillus sp.*, while the oil of neither decreased the occurrence of *Fusarium sp.* but enlarged the amount of *Aspergillus sp.* by almost four times.

Various components were combined with neem and tulsi (*Ocimum sanctum*) leaves to create a polyherbal lotion [22]. After centrifugation, stability testing, and no phase separation was observed, the cream was determined to be stable. *E. coli* and yeast growth were used to assess the microbiological stability. The outcomes showed that the cream's microbiological stability contained no microbial growth. For the creation of herbal hand wash, *Azadirachta indica* leaves, aloe vera, Gandhraj lemon fruit, and *Sapindus mukorossi* were utilised [23]. The outcomes showed that the manufactured herbal hand wash's advertised formulation and many assessment criteria were comparable. Another study created herbal handwashes including neem alcohol extract [24]. It has demonstrated the ability to combat *P. aeruginosa*.

#### 5.0 CONCLUSIONS

The present review concluded that the neem leaf extract is a source of the antibactericidal agent. It has the potential to be added to cosmetic products to reduce dependence on hazardous substances.

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