Chemické Listy

Review

www.chemicke-listy.cz

# SARVA ROGA NIVARINI, GIFT OF THE GODS

**Michal Jurášek and Pavel Drašar**

*Department of Chemistry of Natural Compounds, University of Chemistry and Technology, Technická 5, 166 28 Prague 6, Czech Republic*
*drasarp@vscht.cz*

The article deals with the *Azadirachta indica* tree, called neem, which, as well as its products, is used in traditional medicine, agrochemicals, as a source of biologically active substances, but also as part of food. It describes the main chemical components, namely azadirachtin.

Keywords: neem, *Azadirachta indica*, natural biologically active substances


Fig. 1. **Azadirachta indica**[1]

In India and the surrounding Southeast Asian countries, it is believed that the tree called today "neem" ni:m, ( नीम, sometimes also nim, nimba, margosa, (azadirachta indická in Czech), belongs to the genus *Azadirachta*; classification in the related genus zederach (*Melia*) is incorrect, but both genera belong to the same subfamily *Melioideae*) apparently came originally from Myanmar (Burma) as a gift from the gods, as it is known that when amrita (the elixir of immortality) was carried to the heavens, a few drops of it fell on neem. The Vedas know this drug as "*sarva roga nivarini*" which means "he who cures all ailments and diseases". The name neem is derived from the Sanskrit "*nimbati svasthyamdadati*", meaning "giving good health". It is therefore also called the "*village pharmacy*" or the "*divine tree*". The article by the Mexican authors provides an extensive overview of neem products, their ingredients, and their described biological properties[2].

It has been used in traditional oriental medicine for over 4.500 years. Its Latin name is *Azadirachta indica* A. Juss. and comes from the Persian "*āzād-darakht-e-hindi*" which means free tree from India[3]. The description of therapeutic effects can be found already in the beginnings of modern medical literature[4]; interestingly, the cited English article uses the term "nim".

In countries where it is worshipped, a large, evergreen, and white-flowered neem tree, similar in wood to mahogany, usually grows in the center of every village, providing shade and coolness, along with spiritual inspiration under its branches, to the extent that many eminent wise men such as the well-known Shri Sai Baba[5] resided under it.

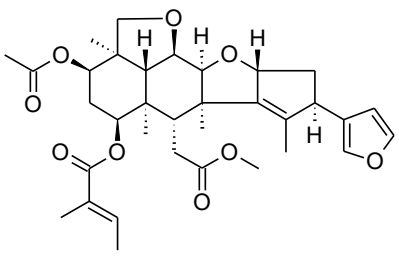
After wounding the bark, a resinous exudation containing abundant proteins oozes from the trunk and is used as glue. The bark contains plenty of tannins and a durable dye. Wood is traditionally used as fuel in households and is used to make good heating charcoal. The leaves and young twigs are used as fodder for domestic animals during the dry season. Thin twigs have been chewed since ancient times, which replaces brushing teeth and also strengthens oral health and immunity. Dried leaves repel various insects, for example, they are placed in books or between stored fabrics. The fruits are eaten fresh or cooked, or made into a dessert or lemonade. Blooming flowers are a component of various salads, young shoots are used to make soup in India. From the seeds, an oil unsuitable for consumption is pressed on an industrial scale, but it is used for the production of soap, cosmetics, healing procedures, as fuel for lamps or stoves, and as a lubricant for simple machines. Its usual production is about 50% of the weight of the seeds and in 2024 the oil price was several dollars per kilogram.

The whole plant, but mostly the seeds, and therefore also the oil with a smell reminiscent of garlic, contains dozens of triterpenes (limonoids), where examples of structural types include salannin, nimbin, meliantriol, azadiradione, gedunin, nimbolide and mainly azadirachtin, which have insecticidal, fungicidal, bactericidal, anti-inflammatory, anti-malarial, antioxidant and anti-tumor effects. The plant also contains other biologically active compounds such as flavonoids, catechins, saponins, etc.

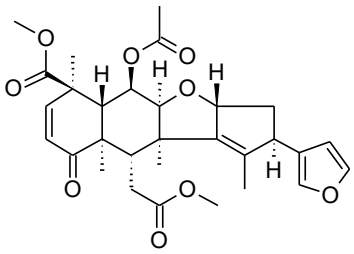
In folk medicine, the oil, known as nimbus oil, is used against external mycoses, and intestinal parasites and as a calming sedative. However, long-term use damages the liver and kidneys[6].



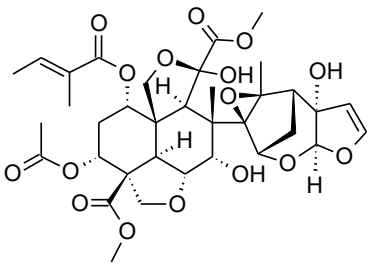
https://doi.org/10.54779/chl20240475



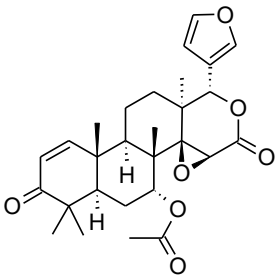
salannin



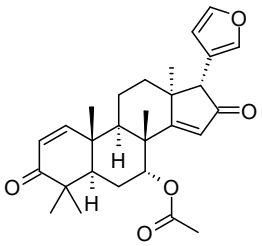
nimbin



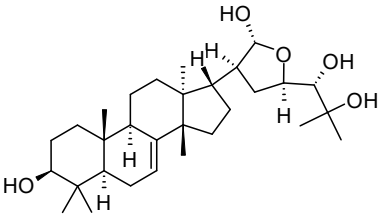
azadirachtin



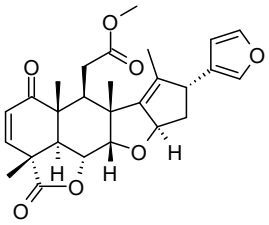
gedunin



azadiradione



meliantriol



nimbolide

The insecticidal activity of neem products, pomace after oil extraction (neem cake), and nimbus oil itself are used in agriculture, fruit growing, and the production of rice, cotton, vines, etc.[7]. Such a widely used insecticide is, for example, NeemAzal (Trifolio-M GmbH, Lahnau), containing the purified active component of neem seed kernels. The active substance (azadirachtin) penetrates the leaves and is distributed partially systemically in the plant. Pests ingest it by sucking or eating. NeemAzal does not have an immediate toxic effect (so-called "knock down"); within a few hours after applying the product, a wide range of free-living sucking, chewing, or leaf-eating insects, such as Colorado potato beetle, aphids, whiteflies, and thrips, will be inactivated. Insects will stop their main eating activity and thus gradually reduce their activities damaging the plants. In addition, the processes of development and moulting are inhibited, which leads to the death of the individual after a few days. In addition, the fertility of adult organisms is significantly reduced.

If we take as an example the use of NeemAzal (1% azadirachtin is declared in the product) against Colorado potato beetle on potatoes, then 2.5 g of azadirachtin is applied to 1 ha, which is 0.25 mg per $m^2$, the dose of a natural substance in agriculture or cultivation, comparable to, for example, brassinolides[8]. One can dream of an agrochemical product where "almost homeopathic" doses of absolutely natural and human-safe compounds will protect crops from pests and stress. In addition to NeemAzal, the Czech Register of Plant Protection Products (Registr přípravků na ochranu rostlin) allows the use of a few more products containing azadirachtin, two products containing nimbus oil, in the Czech Republic. On the other hand, Decree No. 58/2018 Sb. on dietary supplements and the composition of foods, neem is among the substances prohibited in food production.

Neem pomace itself is a suitable additive to composts and soils, because in addition to organic matter, the content of nutritional components (mainly NPK), it still exhibits insecticidal and bactericidal activity, and in addition, it has a very positive effect by retaining moisture and nitrogenous compounds during plant cultivation[9]. An

article by Ghanaian authors provides a comprehensive overview of plants and pests, where useful uses of neem products were described[10].

Neem, as already mentioned, is also interesting from a medical point of view. Preclinical studies have shown that neem may be a potential preventive and therapeutic agent against various types of cancer. The anticancer effects of neem extract are associated with the modulation of the main characteristic phenomena in tumor cells, including inhibition of excessive proliferation, induction of cell death, suppression of angiogenesis, restoration of cellular redox balance, and strengthening of the immune response against tumor cells, but also to increase the effectiveness of other chemotherapeutic agents or as an adjuvant in immunotherapy and radiotherapy, with minimal or no side effects during therapy[11]. Studies to date show that the most attractive benefits of neem include the anti-cancer, anti-diabetic, fungicidal, bactericidal, and anti -inflammatory properties of its compounds. Stopping ROS (antioxidant activity) is a measure of prevention and mediation of potential exacerbation of metabolic diseases[2]. Contraceptive activity is interesting, apparently for both sexes[12,13].

Due to their especially bactericidal activities, neem products are also often used in cosmetics and body and hair care.

As a natural resource, neem has the advantages of easy availability, low cost, and human safety, which together make neem-derived compounds valuable candidates for further investigation for both biological, agronomic, and insecticidal properties. Here, too, it is necessary to draw attention to various quacks that promise products guaranteed to be "chemical-free" and 100% standardized, without indicating to which component the natural product standard was applied. Well, business is business. It should also be noted that information about neem, both on the web and in "professional" literature, is of a very diverse type. Some of the authors apparently did not even read the paper before publication.

We present this contribution as another contribution to a series of teaching texts describing for a long time various interesting aspects of the chemistry of natural substances[14–16] also because we want to respond in this way to the amount of fiction, half-truths, and nonsense that are being spread around natural compounds today. It is clear that researching natural substances, such as substances from renewable sources, is one of the ways to contribute to the general benefit in a cheap and effective way[17,18].

REFERENCES

1. https://www.herbalreality.com/herb/neem/, downloaded 30. 4. 2024.
2. Islas J. F., Acosta E., Buentello Z. G., Delgado-Gallegos J. L., Moreno-Treviño M. G., Escalante B., Moreno-Cuevas J. E.: J. Funct. Foods *74*, 104171 (2020).
3. Singh K. K., Phogat S., Tomar A., Dhillon R. S.*: Neem a Treatise*. I. K. Intl Publishing House Pvt. Ltd., New Delhi 2008.
4. Ganguli M. N.: Ind. Med. Gaz. *16*, 333 (1881).
5. Guru Vani: *Teachings of Reverend Dr. C. B. Satpathy – Teachings of Shri Sai Baba*; https://guruvani.us/index.php/2015/10/14/significance-of-the-neem-tree/, downloaded 19. 9. 2023.
6. https://cs.wikipedia.org/wiki/Azadirachta_indick%C3%A1, downloaded 30. 4. 2024.
7. https://www.trifolio-m.de/en/about-us/, downloaded 2. 5. 2024.
8. Jurášek M., Drašar P.*:* Chem. Listy *116*, 223 (2022).
9. Schmutterer H. (Ed.): *The Neem Tree: Source of Unique Natural Products for Integrated Pest Management, Medicine, Industry and Other Purposes*, 2nd Edition. VCH Verlagsgesellschaft, Weinheim 2002.
10. Adusei S., Azupio S.: J. Chem. *2022*, 6778554.
11. Hao F., Kumar S., Yadav N., Chandra D.: Biochim. Biophys. Acta *1846*, 247 (2014).
12. Talwar G. P., Upadhyay S. N., Dhawan S.: US5501855 (1996).
13. Asif M.: J. Pharmacogn. Phytochem. *1*, 61 (2013).
14. Jurášek M., Stárka L., Drašar P.: Chem. Listy *116*, 115 (2022).
15. Jurášek M., Drašar P.: Chem. Listy *117*, 278 (2023).
16. Lapčík O., Čopíková J., Uher M., Moravcová J., Drašar P.: Chem. Listy *101*, 44 (2007).
17. Jurášek M., Cabalka J., Drašar P.: Chem. Listy *117*, 547 (2023).
18. Jurášek M., Drašar P.: Chem. Listy *116*, 519 (2022).