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Sindoor (*Bixa Orellana* L.): Therapeutic Uses and Scientific Studies in Unani Perspective - A Review

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ABSTRACT

Background: Bixa Orellana L., a species of the Bixaceae family and known by a variety of names such as Achiote, Kerry, Sindoor plant, and Lipstick tree, has long been used for its therapeutic qualities. It is indigenous to South and Central America. Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Odisha, Gujarat, Maharashtra, Madhya Pradesh, and Chhattisgarh represent the Indian states in which it is widely cultivated. It is also grown as an ornamental plant and for the commercial production of seeds.

METHODS AND MATERIALS

Results: Bixa Orellana has various phytochemical and pharmacological uses, and has laxative and antidote properties against snake bites, with a focus on cancer treatment and prevention. Pharmacological activity has been studied in in vitro and in vivo models, and ethnobotanical applications, including their pharmacological and safety aspects, have been reported to have antioxidant, anti-inflammatory, antimalarial, diuretic, hyperglycaemic, and antidysentery potential.

Conclusions: Although Bixa Orellana is widely employed in traditional medicine, research indicates that it may have uses in biotechnology, pharmaceuticals, and medicine. Finding the precise compounds causing its biological activities and investigating its possible therapeutic uses, however, still requires scientific validation within experimental and clinical studies.

KEYWORDS: *Bixa Orellana* L., Annatto, Sindoor, norbixin, or bixin

INTRODUCTION

Bixa Orellana L.[1] It is a small tree or shrub that grows to a height of three to five meters. The short, 20–30 cm diameter trunk has dark grey bark with vertical rows of lenticels. The leaves are alternating, sharp, green on both sides, and have long petioles[2]. They are 10–20 cm long and 5–10 cm wide. Bixa originates in three varieties based on fruit shape and flower colour: one with green capsules and white flowers, the other with purple flowers and brownish-red capsules, and a third with pink flowers and red capsules[3]. Of the five recognized species in the genus Bixa (Bixaceae) (Baer 1976; The Plant List 2019), *Bixa Orellana* (achiote)[4]. It is the most widely used and commercially exploited[4]. One of the most important plant species for producing biocolorant is annatto (*Bixa Orellana* L.), which grows in many tropical areas[5]. Numerous phytochemical groups, including phenolic compounds, glycosides, tannins, steroids, alkaloids, and saponins[7], are found in sindoor. The plant is the main source of bixin, a biocolorant which is used extensively in the food industry, particularly as a component in the production of dairy products, chocolates, butter, margarine, cheese, and biscuits. It has been shown in many studies to be both safe and effective. Annatto plants have an extensive variety of uses and colours, ranging from orange (norbixin) to red (bixin), according to the ratio of bixin to norbixin. Aphrodisiac, antipyretic, antidiarrheal, antidiabetic, antiviral, antitumor, anti-inflammatory, antiallergic, anticancer, antileishmanial, anticonvulsant, and cardioprotective are just a few of the numerous biological qualities of sindoor seeds[5]. Several ailments, such as jaundice, gonorrhoea, blood issues, fever, epilepsy, and dysentery, are frequently prevented and treated with *Bixa Orellana*.

It has historically utilized the easily available leaves in Ngaoundere, Cameroon, and Sindoor to treat fever, gastrointestinal discomfort, jaundice, and joint pain. In addition to their traditional use as a gargle for sore throats, they are also used to treat asthma. The fever is treated with the bark and root. Sindoor leaves are used to treat diabetes, hypertension, jaundice, and snakebite. Antimicrobial, antifungal, anti-leishmanial, anti-inflammatory, analgesic, and anti-convulsive characteristics are all present in Sindoor leaves[3].

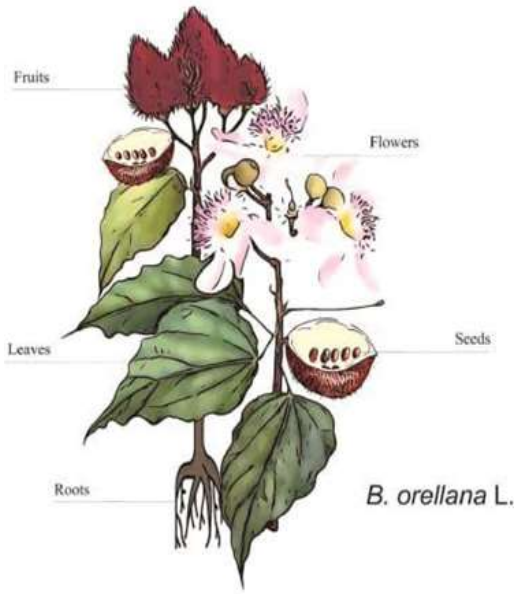

Figure 1: Botanical illustration of *Bixa Orellana L*[5,1].

Figure 2: *Bixa Orellana* L.[6].

Botanical name: *Bixa Orellana* L.[7,9]

Botanical description: Bixa Orellana is a 26-foot (8-meter) evergreen tree. shows large leaves, red fruit capsules with red seeds, and pink or white flowers[10].

***Mutradifat* (Synonyms):** Lipstick tree, Latkan, Annatto, Sindoor, and Sinduri[9].

Table 1: Taxonomic classification of *Bixa Orellana* L.

Kingdom	:	*Plantae*[8]
Class	:	*Magnoliopsida*[8]
Order		*Malvales*[8]
Family	:	*Bixacea*[4,8,9]
Genus	:	*Bixa*[8,10]

Species : *Bixa Orellana*[8]

Table 2: Vernicular names of *Bixa Orellana* L.

Arabic	:	Usrang[11]
English	:	Arnato tree[12], Annatto tree[4,12,13], Lipstick tree[12,13]
Hindi	:	Sindoor[12], Latkan[12,14]
Bengali	:	Latkan[12]
Gujarati		Sinduri[13]
Kannada	:	Rangumali[14,13], Kumkumipalada mara[14], Kesari mara[14]
Malayalam		Kurannumannal[13]
Marathi		Shendri[14,13]
Tamil	:	Sappiraviral[13]
Telugu		Jabra[14]

Habitat & Cultivation: Native to tropical forests in the Americas and the West Indies, annatto grows extensively in regions with comparable climates, most notably India[10]. Annatto is cultivated primarily for the extraction of bixin, a natural dye with substantial industrial importance, resulting in the generation of large quantities of residues that remain underutilized. Depending on the cultivar, climate, and local soil properties, the bixin content can range from 1% to 6%. However, a minimum threshold of 3% bixin is required for profitable production, making it essential for commercial viability. Although annatto seed processing still primarily focuses on bixin extraction, recent research investigated the possibility of further uses[15]. Initially utilized by indigenous peoples to extract dyes, annatto seeds are now commercially harvested for their pigment, bixin, with an estimated 14,500–17,000 tons produced worldwide each year. Bixin's substantial industrial and economic value is demonstrated by the fact that it is utilized extensively in the food, pharmaceutical, and cosmetic industries, which make up about 70% of the global market for natural colorants[15].

Folklore & History: Body painting has long been practiced in tropical South America using the seed pulp's vivid red pigment. Additionally, annatto dye is used to colour cheese and margarine[4].

Parts Used: Roots, leaves, and seeds[4,16].

***Miqdare Khurak* (Dose):** 7-12 grams [16]

Mizaj* (Temperament)*: Dry & cold [17]

***Musleh* (Corrective):** Mirch Siyāh; honey [16]

***Badal* (Substitute):** Murdār Sang [11]

***Af'aal* (Pharmacological actions):** *Jāli, Munaqqi, Mudammil-i-Quruh,* and *Musakkin*[16]

***Istemalat* (Indications/Uses):** Waram, Sūzāk[11]

Chemical constituents: Carotinoid coloring principles are present in the seed pulp[4].

Scientific reports

1. **Antioxidant activity:** In 800 µg/mL, the aqueous extract, ethanolic extract, and methanolic extract of Bixa Orellana leaves showed scavenging activity of 92.47%, 92.47%, and 91.72%, respectively, based on the antioxidant activity evaluated using the DPPH method (Ahmed et al., 2020)[18,19,20].
2. **Anti-inflammatory activity:** Leaf extracts from this plant proved anti-inflammatory activity in earlier research on ethanol-induced hepatotoxicity (Lopez et al., 2017). Furthermore, the fact that the active molecules are insufficient to inhibit the inflammatory process at this dose explains the non-significant decrease seen at the dose of 100 mg/kg. The bark infusion of Bixa Orellana has been shown in this study as an extract with anti-inflammatory and antioxidant potential in APAP-induced liver damage. These results correspond with the findings reported by Lee et al. (2019), who demonstrated that the protective effects of escin on APAP-induced liver injury are mediated by the inhibition of the pathway mediated by ERK (Lee et al., 2019)[21,22].
3. **Hepatoprotective activity**: Bixa Orellana seed methanol extract proved hepatoprotective activity against carbon tetrachloride-induced liver damage. Serum maker levels fall as a result, suggesting that hepatic cells are protected[2,23].

4. **Anthelmintic activity:** Padhi and Panda (2016) reported that B. Orellana leaf extracts have anthelmintic properties and demonstrated that petroleum ether, ethyl acetate, methanol, and ethanol extracts have anthelmintic properties against Pheretima posthuma[2].

5. **Antidiarrheal activity:** Shilpi et al.'s study found that methanol leaf extract (125 and 500 mg/kg BW) prevented mice from getting diarrhoea caused by castor oil. A statistically significant reduction in the total number of stools, including wet stools, as well as a dose-dependent decrease in the total number of faces and wet faces, with an IC50 value of 22.36 µg/ml, supported the antidiarrheal activities[24].

6. **Antibacterial activity:** At a minimum inhibitory concentration of 62.5 µg/ML, the ethanolic leaf extract from B. Orellana showed a potential antibacterial effect against Staphylococcus aureus ATCC 25923. At levels of roughly 3200 and 800 & 3200 g/mL, respectively, the methanolic and dimethyl sulphide samples from B. Orellana seeds proved antibacterial activity against Staphylococcus aureus and Salmonella typhi[25,26,27].

7. **Gastroprotective action:** Several studies using leaf extracts from B. Orellana also assessed the gastroprotective action. Using doses of 200 and 400 mg/kg, respectively, treatment with the ethanolic extract inhibited gastric lesions in 21.7% and 28.3% of patients[28].

8. **Anticholinesterase activity.** The spectrophotometric method was used to measure the anticholinesterase (anti-AChE) activity. The normalized response rate of the acetylcholinesterase reaction and the log of the EO concentration. The half-maximal inhibitory concentration (IC50) value is used to report the results. The IC50 value for Bixa Orellana EO was 39.45 1.06 g/ml. The IC50 value for donepezil, the positive control, was 12.40 1.35 g/mL[29].

9. **Leishmanicidal activity:** Compared to free annatto essential oil, nano cochleate formulations containing the oil demonstrated reduced in vitro leishmanicidal activity in amastigote forms of L. amanuensis, according to the Machin et al. (2019) study. Nevertheless, in an in vivo model, nano cochleates were able to reduce the size of lesions in animals infected with L. amanuensis to a greater extent compared to the free essential oil and in a similar way to animals treated with glucantime[30].

10. **Anti-diabetic activity:** 500 mg of Bixa Orellana seed extract reduced the FBG levels of rats with Alloxan-induced diabetes. The findings indicate that during the course of the study, the extract group's blood glucose level was lower than that of the diabetic control group. Group II's blood glucose level on day 21 was 14.98±7.77 mmol/L, while groups I and III had blood glucose levels of 6.050.16 mmol/L and 6.5±0.605 mmol/L, respectively. Consequently, FBG levels in diabetic rats were significantly ($p<0.01$) decreased and were almost 19.3 after treatments with Bixa Orellana seed, which were identical to those in the normal extract (500 mg)[31].

11. **Antimalarial activity:** B. Orellana has been shown to have antimalarial activity against Plasmodium berghei2, Plasmodium falciparum, Plasmodium gallinacean, and Plasmodium lourie[2].

12. **Antifungal activity:** According to Tamil Selvi et al. (2011), the methanol extract of Bixa Orellana leaves and seeds exhibited antifungal activity against Aspergillus Niger, Trichophyton rubrum, Trichophyton mentagrophytes, and Candida albicans. Likewise, the ethanol extract from Bixa Orellana leaves also prevented Candida albicans from growing (Poma-Castillo et al., 2019). Dermatophytes like Candida albicans, Microsporum gypsum, Trichophyton tonsurans, Trichophyton rubrum, and Trichophyton mentagrophytes were all inhibited in their growth by the methanolic extract of young Bixa Orellana leaves (Singh and Vidyasagar, 2017)[18].

    The highest antidermatophytic activity was found against Candida albicans (20 mm) in a different study using methanolic extract. T. rubrum (12.6 mm), Microspores gypsum (10.33 mm), T. tonsurans (9.33 mm), and T. mentagrophytes (9 mm) were next in line (Singh & Vidyasagar, 2017)[18].

13. **Antidermatophytic activity:** The highest antidermatophytic activity was found against Candida albicans (20 mm) in a different study using methanolic extract. T. rubrum (12.6 mm), Microspores gypsum (10.33 mm), T. tonsurans (9.33 mm), and T. mentagrophytes (9 mm) were next in line (Singh & Vidyasagar, 2017). Furthermore, at a concentration of 1 mg/mL, the chloroform extract demonstrated 10–40% biomass inhibition against two Aspergillus species, A. flavus and A. Niger (Jena & Bhatnagar, 2021)[28].

14. **Immunomodulatory activity:** All leaf extracts' immunomodulatory effects were tested in vitro using in vitro membrane stabilization of HRBCs at doses of 3 and 5 mg/ml. The results of this investigation were reported. The study's conclusions demonstrate the potent immunomodulatory effects of ethanol extract. It demonstrated dosage independence by offering roughly 67.47 percent protection at 3 mg/ml and 37.3 percent protection at 5 mg/ml. Methanolic and aqueous extracts showed less significant action than the ethanol extract[32].

15. **Antiosteoporosis activity:**Antiosteoporosis activity: In rats given Beuerlein, annatto to Cotroneo can prevent the degenerative changes to the bones. Annatto tocotrienol has demonstrated three characteristics of healthy bones: calcium content, biological strength, and bone microstructure. bone biomechanical characteristics, bone microstructure, and bone calcium content in a male osteoporosis model induced by the GnRH agonist Beuerlein. To artificially induce osteoporosis at a rate, an orchiectomy is performed, which lowers testosterone production. Rats that have had their orchis removed lose their androgens and become ill-like[3].

16. **Anticancer activity:** Through a combination of different mechanisms, including cell cycle arrest, growth inhibition, induction of apoptotic cell death via extrinsic and intrinsic pathways, inhibition of COX-1 and COX-2 enzymes, and growth inhibition against breast, colon, stomach, central nervous system, and lung tumour cells[1], Bixin exhibits anticancer activity in cultured Hep3B human liver cancer cells[3].

Supplementary Material

Scientific journals, books, reports, and databases like Scopus, ScienceDirect, Sc finder, Medline, Springer, and Google Scholar were used to gather a comprehensive and methodical review of the body of existing literature.

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References;

1. James A Duke. Handbook of medicinal herbs. Second. New York: CRC Press; 2002. 32 p.
2. Das S, Marndi S, Biswal SK, Baro T, Singh R, Devi RS, et al. Evaluation of Antihelminthic Activity of Bixa orellana. Asian Pacific J Heal Sci. 2021;8(4):227–32.
3. Devanand PS, Radha P, Kumar P, Sivakumar B, Sivaprakash M, Kiruba M, et al. e - Publishing Group Unveiling the multifaceted attributes of Bixa orellana : An insight into its chemical composition , industrial application and cultural significance. 1900;12(3):1–9.
4. Chevallier A. Encyclopedia of herbal medicine. Third. New York: Penguin Random House; 178 p.
5. Coelho dos Santos D, Silva Barboza A da, Ribeiro JS, Rodrigues Junior SA, Campos ÂD, Lund RG. Bixa orellana L. (Achiote, Annatto) as an antimicrobial agent: A scoping review of its efficiency and technological prospecting. J Ethnopharmacol. 2022;287(September 2021).
6. Sônia do Socorro do C. Oliveira. Bixa orellana L. from northern Brazil: morphological analysis, phenolic content, antioxidant and antibacterial activities. Brazilian J Bot. 2022;45:883–96.
7. https://www.easyayurveda.com/2019/07/13/sinduri-bixa-orellana/.
8. Raju SK, Chandrasekar S, Vengadhajalapathy P, Sundaram R, Periyasamyy S, Chinnaraj T, et al. Review on phytochemical composition and pharmacological activities of Bixa orellana. J Pharm Biol Sci. 2023;10(2):57–67.
9. Aktary N, Sultana S, Hossain ML. Assessment of analgesic and neuropharmacological activity of leaves of Bixa orellana (Family: Bixaceae). Int J Sci Reports. 2019;6(1):13.
10. http://www.worldfloraonline.org/taxon/wfo-0001005398.
11. G.N.Munsi. Makhzun Mufradat wa Murakkabad. New Delhi: CCRUM; 2007. 161 p.
12. https://apps.worldagroforestry.org.
13. https://indiabiodiversity.org/species/show/31096?lang=en.
14. http://indiafloraonline-ces.iisc.ac.in/plants.
15. Arruda-Peixoto VAS de, Vera Estacho P, Wrona M, Nogueira Carvalho PR, Aparecida Ferrari R, Nerin C, et al. Promoting Circular Economy by Leveraging Annatto Byproducts from Bixa orellana L. into Sustainable Antioxidant Food Packaging. Foods. 2025;14(4):1–19.
16. Mohammad Kabiruddin. Makhzan al-Mufradat. 1st ed. New Delhi: Idara Kitab-us-Shifa; 2007. 398–399 p.
17. Haleem LHMA. Mufradat -e- Azizi. New Delhi: CCRUM; 2009. 51 p.
18. Purushothaman T, Irfanamol K. Ethnobotany, Phytochemistry, and Pharmacological Efficacy of Bixaorellana: A Review. Shanlax Int J Arts, Sci Humanit. 2021;9(2):162–9.
19. Abayomi M, Adebayo AS, Bennett D, Porter R, Shelly-Campbell J. In vitro antioxidant activity of Bixa orellana (Annatto) seed extract. J Appl Pharm Sci. 2014;4(2):101–6.
20. Rivera-Madrid R, Aguilar-Espinosa M, Cárdenas-Conejo Y, Garza-Caligaris LE. Carotenoid derivates in achiote (Bixa orellana) seeds: Synthesis and health promoting properties. Front Plant Sci. 2016;7(September):1–7.
21. Djibersou DG, Rosnay B, Galani T, Djamen PD, Njintang NY. Anti-oxidant and anti-inflammatory potential of aqueous extracts of leaves , barks and roots of Bixa orellana L . (Bixaceae) on acetaminophen-induced liver damage in mice. 2020;10(4):428–39.
22. Shadisvaaran S, Chin KY, Mohd-Said S, Leong XF. Therapeutic potential of bixin on inflammation: a mini review. Front Nutr. 2023;10(September):1–8.
23. Binte S, Adnin S. Hepatoprotective Activity of Bixa orellana Plant Extract against Hepatotoxicity in Rodent. 2024;25(10):24–31.

24. Shahid-ul-Islam, Rather LJ, Mohammad F. Phytochemistry, biological activities and potential of annatto in natural colorant production for industrial applications - A review. J Adv Res [Internet]. 2016;7(3):499–514. Available from: http://dx.doi.org/10.1016/j.jare.2015.11.002

25. Jyoti Biswas Associate Professor S, Kumar Giri S, Chandra Saha Professor N, Banerjee P, Raha S, Pandey A, et al. Phytochemical evaluation, acute toxicity studies and antimicrobial efficacy of seed extract of Bixa orellana: A plant grown in wild in Purulia district. ~ 2065 ~ J Pharmacogn Phytochem. 2018;7(5):2065–71.

26. Pillai S, Soni S, Dhulap S, Hirwani RR. Pharmacological and cosmeceutical applications of Bixa Orellana L.: A review of the scientific and patent literature. Indian J Nat Prod Resour. 2018;9(4):281–9.

27. Tamil Selvi A, Dinesh MG, Satyan RS, Chandrasekaran B, Rose C. Leaf and Seed extracts of Bixa orellana L. exert anti-microbial activity against bacterial pathogens. J Appl Pharm Sci. 2011;1(9):116–20.

28. Molina-Romani SP, Bonilla-Rivera PE, de Albuquerque RDDG. A review of Bixa orellana L. (Annatto) leaves as medicinal resource: Use in the population as complementary medicine, phytotherapeutic action and quality parameters. Nat Resour Hum Heal. 2023;3(2):277–85.

29. Valarezo E, Torres-Torres S, Pineda-Guarnizo N, Jaramillo-Fierro X, Cartuche L, Morocho V, et al. Study of Essential Oil Isolated from Achiote (Bixa orellana) Leaves: Chemical Composition, Enantiomeric Distribution and Antimicrobial, Antioxidant and Anticholinesterase Activities. Antibiotics. 2023;12(4):1–13.

30. Ramos C, Beatriz E, Damas DO, Araujo PL, Silva GDO, Joanitti GA, et al. Annatto (Bixa orellana) -Based Nanostructures for Biomedical Applications — A Systematic Review. 2024;

31. Tonny TS, Sarkar AP, Nahar K, Jahan S, Afroze I, Sarkar BK, et al. Evaluation of Antidiabetic and Antioxidant Potential of Methanolic Extract of Bixa orellana Seeds. Biomed Pharmacol J. 2024;17(1):527–35.

32. Patil PM, Kanase DG, Rawal JA, Randive DS, Author C, Maruti P. Evaluation of in-Vitro and in-Vivo Immunomodulatory Activity of Aqueous and Ethanolic Extract of Prosopis Cineraria (L.). Volatiles Essent Oils. 2021;8(5):12722–46.