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Review article

A Comprehensive Review on Bixin Seeds : Benefits and Future Scope

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Abstract

Annatto seeds derived from the plant *Bixa orellana* L. (BOL) of the *bixaceae* family. Bixin seeds are another name for annatto seeds. Which offers different number of phytochemical and therapeutic benefits that are not widely understood. Bixin is an active component of *Bixa orellana* L. It is also known as the Sindoor plant or the Lipstic tree. Bixin is an alkaloid found in this plant that has number of aesthetic and therapeutic applications. A active molecule shown multiple pharmacological actions like, antioxidant, anti-inflammatory, antimalarial, diuretic, hyperglycemic, antidysenteric, laxative, and anticancer activity. Different studies revealed its use safe and effective to in different food products. In future perspective this review will help to focus on different aspects of plant active with extensive research work with different phytochemical and pharmacological investigation, which will be beneficial to use in various food or medicinal products in food, cosmetic and medicinal industries.

Introduction

The *Bixaceae* plant family is the smallest, with only one genus, Bixa. It has only just five number of species in a single genus, with BOL being the most frequent. Bixa is often cited by botanists as a monotypic genus represented solely by BOL. This plant is native to brazil but it grow in various regions of America. It is also grown in tropical countries such as Mexico, Indonesia, India, Kenya, Ecuador, Peru, and East Africa. It is most widely used dyes in the world specifically it was prepared from plant seeds. This dye has versatile use in textile and pain industry also useful in cosmetic industries and food industries.

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The use of this dye is drastically increased due to restriction on use of synthetic dye in food industry and cosmetic industry. It is recognised dye from World Health Organization (WHO), because it is nontoxic and does not appear to modify the food value. (Daniela de AraújoVilar et al. 2014)

BOL is a plant native to Brazil and American Amazon that was cultivated and domesticated since pre-Hispanic times. It is typically a small heighted tree with thickest foliage and a wide trunk. The most appealing aspect of the plant is its fruits, which have a capsular form and contain deep crimson seeds inside. Currently, the plant's leaves, stems, and seeds have a variety of uses in health sciences (new pharmaceuticals with therapeutic potential), cosmetic industry, and textile industries (natural dye for clothing).

In various food dishes annatto dye is used with different concentrations. The oil-soluble annatto colour, in particular, is utilized in dairy and fat-based goods such as butter, margarine, cheese, baked and snack meals, as well as in pharmacy, leather dyeing, and cosmetics. As considered wide use of plant dye for non-food applications such as colouring textiles, fabrics, and weapons, annatto colour has high tinctorial value and is therefore significant in the food industry as a natural food grade colour. It ranks second among economically significant natural food colorants.(Sandeep Pandey et al. 2019) According to numerous reports, the quality of the seeds and their geographical location had an impact on annatto dye output, with Peruvian seeds having the highest bixin concentration at 3-4%.Even though annatto is grown in many different countries, the economic importance of the seed's colour, which varies from 1% to 4% depending on morphotypes (varieties), cultivation conditions, and post-harvest techniques used to separate seeds from capsules, drying, etc. An occasional study on this feature in India showed substantial variance in bixin content of seeds gathered from several places in the Western Maharashtra area. (Priyanka Gupta et al. 2016)

The present review highlights the benefits and future scope of Bixin seeds obtained from BOL Plant. Further, the active constituent has some potential pharmacological activities that have already been reported. The paper will provide an extensive overview of research on this plant.

Taxonomy

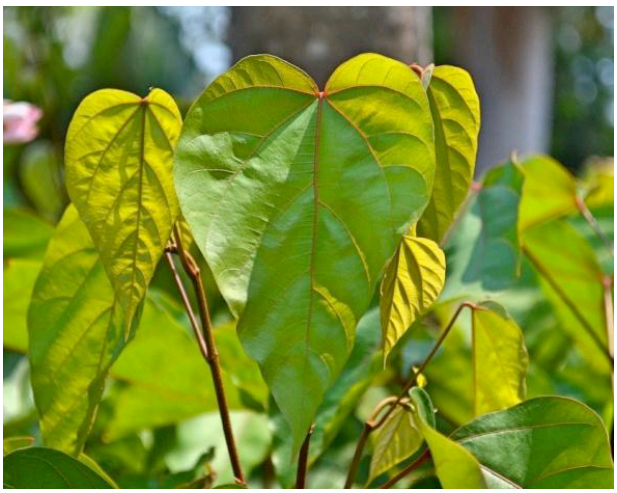
The plant is an evergreen shrub or small tree that ranges in height from 2 to 8 meters. Leaves of this plant are simple and have acute apexes and bases. They are typically 7.5 cm long and 4.6 cm wide. The fresh leaves and powder from leaves have a slightly bitter flavour and are green in colour. The colour of the bark is a firm, smooth light to dark brown. Flowers are pediculate terminal branched panicles with 8 to 50 flowered, fragrant, 4-6 cm across flowers; the pedicel is scaly, thickened at the tip, carrying 5-6 big glands; the petals are 4 to 7 and obviate with scaly stalks; and the stamens are infinite. BOL plant produces three different coloured flowers. The production of pigment from the flower is also varying as per the colour.

Seeds:

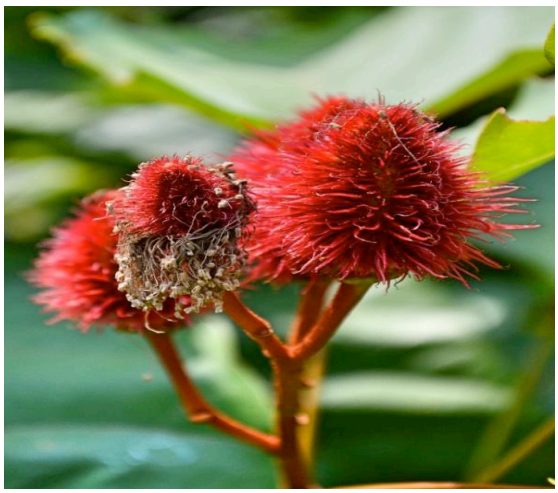
These come in large numbers, have an oval form, with a red coating that is 5 mm in diameter. Capsules or seed maceration are typically utilized.

Leaves

Large, pointed leaves are 5–15 cm long, 4–11 cm broad, and green. Typically, leaf infusion is employed.



Bixa orellana Leaves



Bixa orellana Fruit

Bixa orellana Seed

Chemistry of Bixin

Bixin is primarily found in annatto/bixin seeds. Bixin contains high amount of carotenoid with a red tint. It is primary agent responsible for the predominant dying action. The concentration of this red tint might reach up to 5.0%. In spite of the fact that many of the seeds which contain low concentration up to 2.0 %, levels greater than 2.5% are often needed for export since the economic worth of the seeds is based on percentage of the bixin. Bixin is the main content which found in seeds of BOL and isolated from the same, and its complete chemical structure and stereochemistry were discovered by 1H and 13C-NMR in 1875 and 1961, respectively.

Bixin is a member of the very small class of naturally occurring apocarotenoids, which are created when C40 carotenoids undergo oxidative degradation. Bixin contains 25 carbon chain and having chemical formula $C_{25}H_{30}O_4$ (M.W. = 394.51). At the endpoints of the chain, it has methyl ester and carboxylic acid groups. It is found in nature as the 16-Z (cis) form, but after extraction, it isomerizes to produce the 16-E form (trans), which is known as isobixin. *Bixa orellana* has a large number of other carotenoids (C19, C22, C24, C25, C30, and C32), however they only make up a small portion of the pigments. (Uday M. Muddapur et al. 2023)

In spite of being a naturally available substance, norbixin is available after saponication of main content Bixin and called as demethylated derivative of this main content. More than 20 different compounds have so far been identified from this plant seeds.

The seeds of the annatto plant contain a variety of additional substances in addition to bixin and norbixin, including isobixin, the pigment beta-car cryptoxanthin, a substance called zeaxanthin, orellin, bixein, bixol, crocetin, ishwarane, the acid ellagic, salicylic acid, threonine, tomentosic acid, tryptophan, and phenylalanine. These seeds also contain the following substances in the amounts that correspond to them: 1.0 to 4.5% pigments, 40–45% cellulose, 3.5–5.5% sugars, 0.3–0.9% essential oils, 3% fixed oils, 13–16% proteins, alpha and beta-carotene, tannins, and saponins. (Bekri Melka et al. 2017)

Bixin stands out from other naturally occurring carotenoids not just because it contains a carotene in its 91-cis structure. Although cis-bixin is insoluble in vegetable oil, it is soluble in the majority of polar organic solvents, giving them an orange tint. Its instability in the isolated form in solutions makes it easily convertible to the all-trans isomer. The more stable isomer of bixin, trans-bixin, shares many characteristics with cis-bixin but has a red hue in solution and is soluble in vegetable oil.

Pharmacology

The various parts of the tree are used as diuretics, laxatives, antibilious, antiemetic, and astringent agents as blood purifiers in different disease and disease conditioning treatments of jaundice, dysentery, diabetes, diarrhea, fever, fluid retention, heartburn, malaria, and hepatitis in Peru. It has special use as an antioxidant and bowel cleanser for the special treatment of wounds, diarrhea and asthma. It also have some uses like in weight-loss products, diabetes and obesity, tonsils, baldness and externally as scar-preventive, vaginal infections, to treat burns and as insect repellant. It is also used as traditional and old medicine in most countries to treat common issues in the form of decoctions, teas and juices. An infusion of the leaves was additionally utilized to treat skin ailments and burns. For finding new and possible alternative treatments using medicinal plants, this study proposes to test the antifungal activity of BOL. (Achiote) on Candida albicans, a microorganism that is majorly found in the oral cavity and causes an infection known as oral candidiasis.

Additionally, the infusion of leaves is used as a purgative and to cure dysentery. Leprosy was treated with oil made from the seed in several nations, and jaundice was treated with a decoction. Aphrodisiac, diuretic, astringent, and antipyretic activities have been reported for fruit, leaves, and seeds in Peru, while seeds are used for diabetes in Jamaica. Tumors are treated with seeds and latex, while oral cancer is treated with seeds gargled with rice water and vinegar. Costa Rica uses a leaf infusion to stop hair loss. Tonsillitis is treated by a leaf infusion gargled. Dysentery and renal illness are treated with astringent febrifugal fruit pulp. The reddish substance is used to soothe burns. Locally in Bangladesh it is used to treat a variety of maladies using the leaves, including diarrhea, insomnia and skin conditions. (Senthil Kumar Raju et al. 2022)

Heartburn and digestive issues are treated using leaf decoctions. This leaf decoction showed good results in the treatment of epilepsy when coupled with other fruits. To treat epilepsy, the juice is mixed with 12 different fruits and consumed two times daily for five days. Tea made from young shoots was used as an aphrodisiac, astringent and treatment for skin problems, fevers, diarrhea and hepatitis. The root is claimed to have cough suppressant effects.

The extract of root is used as a moderate purgative and astringent by Indian ayurvedic practitioners, who see it as a successful treatment for renal and dysentery. The root bark has antipyretic and antiparasitic properties. Bixa species, according to traditional healers, they are

strongly effective in treating infectious ailments than manufactured antibiotics. The preparations include decoction, pulp, and seed powder. Products containing bixa orellana extract are frequently promoted as natural remedies for ailments such as liver and urinary diseases, heartburn, digestive and prostate issues, internal inflammation, arterial hypertension, high cholesterol, cystitis, obesity, renal insufficiency, and immune system boosting.

The biological activities of BOL extracts covered antioxidant, hypotensive, molluscicide, and antimalarial properties against lung cancer A549 cells; other biological activities included allergy, hypoglycemia, antifungal, antioxidant, insect repellent, antigonococcal, and antivenom serum, some of which are in line with traditional uses. The seed extract has been used in Brazil for the use of pesticide and antimalarial, and research on the repellent properties of *Lutzomyia longipalpis* has been conducted in same country. Also the same study in Cuba about pharmacological action or antimalarial activity was carried out against *Plasmodium berghei*. As considering the traditional use the seed extract have been used in Brazil and Cuba as insect repellent and antimalarial. (Mahmoud yolmeh et al. 2015) Carotenoids and essential fixed oils are responsible for their antioxidant and insect-repelling properties. This activity has not yet been demonstrated, despite prior assertions that Bixa orellana extracts include compounds such as salicylic acid, lutein, polyphenols, and tannins that have anti-inflammatory properties. Similar to this, the plant's fixed and essential oils have demonstrated antibacterial effects, albeit this effect has not been confirmed.

Conclusion

In conclusion, the investigations included in this review provide an extensive amount of information on the properties of Bixa orellana and its possible applications, which suggests that phytopharmaceuticals may be effective in treating specific disorders anytime an antioxidant, hypotensive or hypoglycemic activity is required. Considering the variety of uses for which this plant has the potential. It must be widely grown in most regions where the climate supports its optimum development. The largest number of goods of various kinds for the benefit of humanity might be derived by maximizing the yield of its many useful portions. *Bixa orellana* is commonly used for antipyretic, aphrodisiac, antidiarrheal, antidiabetic and insect repellent in American countries, according to different studies that have been conducted on the plant's various parts in nations and other than India. However, systematic and scientific research in Indian heritage is needed to explore the plant's full potentials, which must be isolated and identified from various parts of the plant.

Future scope

After the extraction and purification process, essential oil from Annatto seeds can be used in the formulation of various liquid or semisolid dosages for the treatment of antioxidant as well as anti-inflammatory activity. Similarly, for antimicrobial, antifungal and anticancer formulations, different approaches can be taken for treating disease conditions.

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