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Research Article

Food, medicinal and ornamental significance of Kumkum (*Bixa orellana* L.)

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Abstract
Kumkum (*Bixa orellana*), belonging to the Bixaceae family, is native to the tropical regions of the Americas. The essential natural color obtained from the seeds, namely bixin, is broadly used in the food, medicinal, cosmetic, and textile industries. It is also important for landscaping and gardening due to its beautiful pinkish flowers. Various parts of this plant are used in curing various ailments like diarrhea, fever, skin infections, etc. It also possesses pharmacological effects like antifertility, anticancer, antidiabetic, antifungal activities, etc. This review highlights the food, medicinal, and ornamental significance of Kumkum.

Keywords: Kumkum, *Bixa*, food values, medicinal values, ornamental values

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Introduction

Bixa orellana, commonly known as Kumkum or Lipstick Tree, is a diverse plant that is native to the tropical regions of the Americas (Figure 1). It is important in various domains, including food, medicine, and ornamental applications. Bixin and norbixin, carotenoid pigments widely used as natural food coloring agent, make the plant primarily recognized for its seeds. *Bixa orellana* is a preferred alternative to synthetic dyes because it gives food products a vibrant orange-red hue, often associated with environmental toxicity (Dequigiovanni et al. 2018; Villacres-Vallejo et al. 2020). The food industry has been cultivating and using annatto, a natural food color and condiment derived from the seeds of *Bixa orellana*, more frequently as a colorant due to the growing demand for natural colorants (Chiste et al. 2011; Villacres-Vallejo et al. 2020), particularly as consumers become more health conscious and environmentally aware. Particularly in culinary practices, *Bixa orellana* serves as a flavour and coloring agent. Latin American and Caribbean dishes

occasionally use the powdered seeds (Chiste et al. 2011). In addition to these applications, traditional medicine has utilized the seeds to alleviate various ailments such as digestive disorders and dermatological conditions, thereby highlighting the plant's culinary and medicinal properties (Vilar et al. 2014; Tagne et al. 2019). *Bixa orellana* is also important for landscaping and even gardening. According to Nolasco-Chumpitaz et al. 2020 and Silva et al. 2023, the bush can reach a height of 10 m and is renowned for its stunning pinkish flowers, accompanied by fruit pods that contain seeds. Such characteristics attract the plant for use in decorative gardens. Additionally, the plant's ability to thrive in a variety of soil types and its resistance to pests are additional factors that appeal to gardeners (Nolasco-Chumpitaz et al. 2020; Nascimento et al. 2022). *Bixa orellana*'s incorporation into aspects that promote sustainability has also seen an increase in the last few years. The environmentally friendly dyeing processes currently employed by the textile industry make it easy to appreciate the significance of the plant as a source of natural dyes, thus minimizing the use of synthetic dyes, which are harmful to the environment (Dequigiovanni et al. 2018; Marikani et al. 2022). Furthermore, the discovery of *Bixa orellana* in cosmetic lines expands its application, as studies demonstrate its potential in skin care products due to its antioxidant and anti-inflammatory properties (Molina-Romani et al., 2023).

Botanical description

Kumkum is a member of the Bixaceae family, although there are other species of the genus *Bixa*, the most common in the world is *Bixa orellana* L., named after Francisco Orellana, who was the first European to navigate the Amazon (Hirko and Getu 2022). It is a shrub or small tree, evergreen, typically ranging from 2 to 5 meters in height, with some species reaching up to 10 meters. Bark is grey (Figure 2). The branches exhibit a brown coloration and are densely covered in red-brown glandular hairs. The petiole is erect and glabrous. The leaf blade is pale green on the abaxial side, featuring resin-like glandular dots, while the adaxial side is a deep green. The leaves are cordate-ovate or triangular-ovate in shape, palmately veined with five main veins, glabrous, and have a base that is rounded or subtruncate, occasionally slightly cordate (Figure 3). The leaf margin is entire, and the apex is acuminate. The panicles are robust and often flat-topped, and are densely covered in red-brown scales and glandular hairs. The bracts are caducous, leaving behind scalelike scars. The flowers have a diameter of 4 to 5 centimetres, with pedicels (Figure 4). The sepals are obovate and are densely covered in red-brown scales with glands at the base. The petals are bright pink, mauve, or white with pale red veins, obovate in shape. The plant has numerous stamens, with yellow anthers that dehisce at the apex. The capsule is subglobose or ovoid, slightly compressed laterally, and is densely covered in purple-brown spines, though some may be smooth. The seeds are numerous, red-brown, and obovoid-angular. This species is cultivated and is tolerant of poor soil conditions but does not thrive in shaded environments (Win et al. 2023).

Food values

Kumkum seeds are rich in carotenoids, particularly apocarotenes like bixin, isobixin and norbixin. Bixin, oil soluble and norbixin, water soluble principles are responsible for its dye characteristics. Bixin responsible for imparting reddishness and norbixin for yellow. Annatto color imparts yellow to red with varied hue index as it possesses high tinctorial value, hence have significance in the food industry as a natural food grade colour (Srineeraja 2015). The natural biocolorants yellow or orange colors bixin are safer for food use and exempted from certification category of FDA and EU (Aberoumand 2011). These natural colorants are used in food industry in many countries (Ganju and Ganju 2014, Dequigiovanni et al. 2018) mainly in dairy, confectionary and bakery products (Venugopalan et al. 2011; Shahid-ul-Islam et al. 2016; Srineeraja 2017). The dye is non-toxic and has vitamin A traces, making it suitable for coloring ice cream, candy, cheese, butter, and bakery products and oils. In Latin America, annatto is used to give red colour to fish, meat, and rice dishes and vegetable dyes as a turmeric supplement (Galindo-Cuspinera et al. 2002; Gupta 2016). In culinary applications, *B. orellana* is not only valued for its coloring properties but also for its flavor-enhancing capabilities. The seeds are often ground into a powder and used in various dishes, particularly in Latin American and Caribbean cuisines. The presence of carotenoids in annatto contributes not only to its color but also to its antioxidant properties, which can help in reducing oxidative stress in food products (Chiste et al. 2011).

Figure 1: Kumkum plant in urban areas of Bhubaneswar, Odisha, India

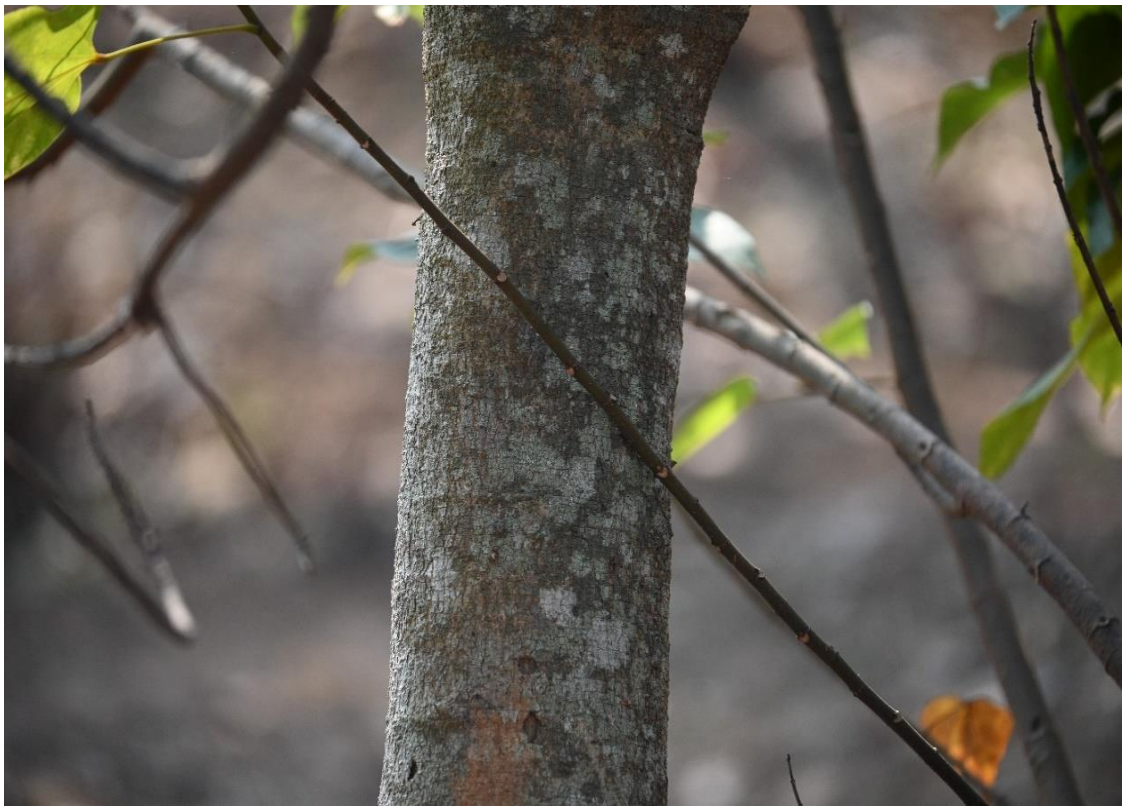

Figure 2: Bark of Kumkum

Figure 3: Leaves of Kumkum

Figure 4: Flowers of Kumkum

Medicinal values

From a medicinal point of view, it has been noted that *Bixa orellana* possesses a wide range of pharmacological effects. This plant has been shown to possess antimicrobial, antifungal, and anti-inflammatory properties, making it useful in traditional medicine (Martins et al. 2022; Tagne et al. 2021). The leaves and seeds have been used by different societies to cure illnesses such as diarrhoea and fevers, as well as, heal skin infections (Vilar et al 2014; Tagne et al. 2019). Like Kumkum, these seeds have also been referred to cure elevated levels of lipids in blood, digestive disorders, and skin conditions reaffirming how these seeds are used for culinary and medicinal purposes as well (Ferreira et al. 2013; Vilar et al. 2014; Tagne et al. 2019). As a colouring agent seeds have been used in oral liquid drugs and direct compression tablet coating. The seed is used in beverages and febrifuge. *B. orellana* in a traditional way is involved in a lot of medicine used for the prevention and treatment of a range of disorders, especially jaundice, gonorrhea, blood conditions, fever, epilepsy, dysentery, etc (Villar et al. 2014). In Cameroon's Ngaoundere region, people in the past used leaves of *B. orellana* to relieve joint pains as well as jaundice and stomach aches. Moreover, they can also be applied for the treatment of asthma, and they are also applied frequently as a mild antiseptic gargle for sore throats. While the leaves are more broadly used, the bark and root of the plant are also applied in the treatment of fever (Molina-Romani et al. 2023). Moreover, it is applied to blisters, as a blood purifier, for burns, cataracts, conjunctivitis, for external and internal cuts, diabetic foot, immunity boosting, eye diseases, for various food purposes, as a hair treatment, for migraine, for heartburn, to stop bleeding, to treat piles, liver infection, liver protecting conditions, renal problems, measles, inflammatory conditions of the oral cavity, muscle spasms, vomiting, urinary failure, and respiratory problems (Pillai et al. 2018; Molina-Romani et al. 2023).

Ornamental uses

One of the most beautiful aspects of *Bixa orellana* is its flowers. The tree bears racemes of showy five-petal flowers that are pale pink to bright white or lavender in color. Such flowers are a great cosmetic factor due to their light composition against the deep green of the plant's foliage in ornamental gardening (Pandey et al. 2019). The flowering phase, which typically takes place most parts of the year in warm geographies, serves to beautify the gardens even more in the tropics and subtropics. The possibility of blooming regularly and profusely aids in beautifying garden areas with nature's colors (Nolasco-Chumpitaz et al. 2020; Silva et al. 2023). It has fascinating seed pods which are unique features that add to the ornamental value of the plant. These heart-shaped, spiny pods are first green then turn reddish-brown or blackish-brown upon maturity (Silva et al. 2023). Finally, these pods split open containing seeds off which the seeds are covered in a bright red-orange dye. These striking seed envelopes not only serve as an enhancement to the beauty of the plant but also serve the purpose of contrasting the surface with its punctured envelope. The combination of colorful berries and big pods is used for decorative purposes which makes the tree very attractive to be grown in gardens. Heart-shaped, dense, and shiny leaves of *Bixa orellana* are key contributors to the reason entices. The extensively deep green and dulled color make it impart a

rich tropical landscape even to gardens and even cut-out landscaping (Nolasco-Chumpitaz et al. 2020; Nascimento et al. 2022). This allows *Bixa orellana* to be considered for ornamental uses in temperate wreaths, as most of the plant parts grow throughout the year. Because it is a shrub or small tree with many uses, *Bixa orellana* can be suited to different architectural styles (Nolasco-Chumpitaz et al. 2020). It has visually appealing fruit, which is bright red and orange and provides wildlife with food and shelter. Fruits tightly cover the tree when it is in season. The dense foliage provides cover to different species of birds during the rainy seasons and harbors nesting activities. In some areas, its foliage attracts different kinds of butterflies and their caterpillars.

Conclusion

Given its wide prospects and potentials, we should widely cultivate the Kumkum plant in most areas where the climatic conditions favour its optimum growth. Consequently, it is thus used for the treatment of conditions such as microbial infections, sunstroke, tonsillitis, burns, leprosy, rectal discomfort, headaches, and for the treatment of small burns, poisoning, thinning hair, headaches, gonorrhea, skin diseases, nausea, and vomiting, etc. Researchers have conducted numerous studies on various plant parts, noting that *Bixa orellana* exhibits a wide range of pharmacological effects, including antifertility, anticancer, antifungal, antimicrobial, hepatoprotective, cardioprotective, antispasmodic, analgesic, and diaphoretic actions. However, more detailed research is required to investigate each chemical component and its mode of action; there is potential for discovering new therapeutic agents, and continued exploration and conservation of this species are essential for sustaining its benefits for future generations.

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