Pharmacological Properties of Bixa Orellana – A Review

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Abstract: Bixaorellana popularly known as “urucum,” has been used by indigenous communities in Brazil and other tropical countries for several applications in India and is best known as the source of the natural pigment annatto, produced from the fruit. Parts of the plant has been used to make medicinal remedies. Bixaorellana is well known for its coloring agent and medicinal value. Annatto is being used in food dye, body paint, treatment for heart burn and stomach distress, sunscreen and insect repellent. The main actions of annatto color are it kills bacteria, parasites, germs, increases urination, stimulates digestion, lowers blood pressure, mildly laxative, and protects liver. The other actions of annatto color includes it reduces inflammation, cough, cleanses blood, soothes membrane, reduces fever, blood sugar, heals wounds. Therefore, this work comprises a systematic review about the use of Bixa Orellana. This study shows the well-characterized pharmacological actions that may be considered relevant for the future development of an innovative therapeutic agent.

Keywords: Bixaorellana, natural dye, annatto, antimalarial, hepatoprotective, antimicrobial, antioxidant, antifungal.

1. Introduction

Bixaorellana is a plant native to Brazil but grows in other regions of South and Central America. It is grown in tropical countries such as Peru, Mexico, Ecuador, Malaysia, Indonesia, India, Kenya, and East Africa[1]. Bixaorellana is popularly familiar as annatto plant belonging to Bixaceae. The species name of this plant is named after the Spanish scientist conquistador, Franciscso de Orellana. The Bixaceae family is one of the smallest plant families, consisting only of one genus, Bixa. There are only five species grouped under a single genus, and the most common species is Bixaorellana, an evergreen shrub grown not only because of its beautiful red flowers and ornamental red spiny fruits, but also for its economic value. Bixaorellana, also known as “annatto”[3]. It is a tree reaching 4 to 6 meters. Leaves are entire, ovate, 8 to 20 cm long, 5 to 12 cm wide, with a broad and heart-shaped base, and a pointed tip. Leaf shows the glossy cordate acuminate leaves are ever green with reddish veins with a thin long petiole. Leaves spirally arranged, simple, stipulate, ovate, shallow cordate to truncate at base, longly acuminate at apex, green or dark green above grey or brownish green beneath. Microscopically the leaf is dorsiventral, the midrib and the laminar region showed single layered epidermis on both the surfaces and covered with thick cuticle. The microscopy shows the presence of vascular bundle, collenchymas, spongy parenchyma and palisade cells[2]. The flowers are white or pinkish, 4 to 6 cm diameter, 4 to 6 cm in diameter on terminal panicles. Capsules are ovoid or rounded, reddish brown, about 4 cm long and covered with long, slender and soft spines containing many small seeds covered with a dye-yielding red pulp[5][6]. It bears clusters of brown or crimson capsular fruits, containing 10 to 50 seeds covered with thin, highly colored resinous coatings[4].

2. Uses

Parts of the plant has been used to make many medicinal remedies.

1) Natural Dye

The Annatto seed extract contains many color principles among all bixin, oil soluble and norbixin, water soluble principles are responsible for its dye characteristics. Bixin responsible for imparting reddishness and norbixin for yellow[10]. Annatto color imparts yellow to red with varied hue index as it possesses high tintorial value, hence have significance in the food industry as a natural food grade colour, and stands second in rank among economically important natural food colourants [12][13], apart from its wide use insome regions of the world for non-food applications viz., to color textiles [14][7][8], fabrics and weapons [15][9][11]. Isolated pure bixin and norbixin were subjected for color intensity stability. Annatto used in food dye, body paint, treatment for heart burn and stomach distress, sunscreen and insect repellent.

The main actions of annatto color are it kills bacteria, parasites, germs, increases urination, stimulates digestion, lowers blood pressure, mildly laxative, and protects liver. The other actions of annatto color includes it reduces inflammation, cough, cleanses blood, soothes membrane, reduces fever, blood sugar, heals wounds[16], the formation of hydroperoxide of triglycerides in the presence of γ-tocopherol and annatto extracts revealed that both the extracts inhibited the formation of hydroperoxide. Addition of γ-tocopherol retarded the loss of carotenoid, and hence this combination was more effective in inhibiting the hydroperoxide formation. This particular principle is having significance in making food formulations with annatto colour, wherein it enhances pigment stability[17].

2) Cosmetics

Annatto is being used increasingly in body care products[18]. Annatto oil is an emollient, and its high carotenoid content provides antioxidant benefits on body care products, while adding a rich, sunny colour to creams, lotions, and shampoos. Protection from ultraviolet rays of sunlight, thereby protecting the skin from excessive sunburn. Dyes for lipstick are also obtained from
Bixaorellana, hence, the name lipstick tree. It is also used as a colouring agent for the preparation of sindoor[20][23].

3) Pharmaceutical Uses
Annatto is commonly used as a colouring agent for pharmaceutical ointments and plasters[21]. It has been used in direct compression tablet coating and oral liquid drugs [22]. The pulp, which includes the seed, is used for soft drinks and febrifuge[24-26].

4) Systemic Uses
Annatto extracts from leaves, roots and seeds have traditionally been used for medicinal purposes like asthma[27]. Extracts of leaves, bark, and roots are reported to be antidiotes for poisoning and antivenin for snakebites[28][29]. The entire plant is used against fever and dysentery[33]. A decoction of the leaves is used to stop vomiting and nausea; treat heartburn, prostate and urinary difficulties, stomach problems and internal inflammation, arterial hypertension, high cholesterol, cystitis, obesity, renal insufficiency, and to eliminate uric acid and as a mild diuretic .[30][31]. It is used as an aphrodisiac and astringent and to treat skin problems and hepatitis [32] as well as to avoid phlegm in newborn babies. The seeds are believed to be an expectorant, while the roots are thought to be a digestive aid and cough suppressant [33]. Its efficiency against STD such as gonorrhea was reported[34-36].

5) Hepatoprotection
Methanol extract of B. orellanaseeds illustrated hepatoprotective activity against liver damage induced by carbon tetrachloride (CCl4) [37]. B. orellana, showed significant decrease in the levels of serum markers, indicating the protection of hepatic cells.

ANTIMALARIAL ACTIVITY has been determined against Plasmodium gallinaceum, Plasmodium lophurae, falciparum and Plasmodium berghei .[38] B. orellanaeextracts possess antiprotozoal, anthelmintic and plateletantiaggregant activity [39][40].

6) Diabetes Mellitus
Bixaorellana has been used for the treatment of diabetes mellitus. B. orellanaloowered blood glucose by stimulating peripheral utilization of glucose, [41]. B. orellana had antihistamine activities anti-inflammatory activity anticonvulsant activity antidiabetic activity [42-44].

7) Antimicrobial Activity
Bixaorellanashowed a broad spectrum of antimicrobial activity [45][46]. B. orellanaain traditional medicine used as a gargle for sore throats and oral hygiene. Seedsurcurem is used as a condiment as well as laxative, cardiotonic, hypotensive, expectorant, and antibiotic [47-49]. It has anti-inflammatory activity for bruises and wounds and has been used for the treatment of bronchitis and for wound healing purposes. Oil is also obtained from this plant. The infusion of the leaves has been shown to be effective against bronchitis, sore throat, and eye inflammation [50][65]. Bixaorellana leaves exhibits antifungal activity [51][34][44][52].

8) Antioxidant
Annatto has been reported to contain tocotrienols (T3), a less prominent isomer of vitamin E which has been reported to possess in vitro and in vivo anti-cancer activity in mutagenic rodents and this was recently confirmed via oxidative effect, senescent-like growth inhibition and immune modulation effect as well as in tumoral mammary glands of transgenic mice expression of HER-2/neu. Anti-apoptotic effect of δ-T3 and γ-T3 components of annatto have been established in vitro in human and mice tumor cell lines. Among the natural carotenoids, bixin is one of the more effective biological singlet molecular-oxygen quenchers and may contribute to the protection of cells and tissues against deleterious effects of free radicals [54]. Bixin is also an effective inhibitor of lipid peroxidation [55], inhibited TBARS production in peripheral macrophages, and this could be the mechanism by which carotenoids in vivo protect cells and tissues from damage induced by oxygen metabolites [56]. It is an antioxidant inhibitor of lipoxygenase activity[57]. Methylbixin has shown enhancement activity of gap junctional communication which is important in cancer prevention [58].

9) Antimitogenic Activity
It is potential against chromosomal damage induced by radiation [59-60] and clastogenic effects of antitumor agents [61] suggesting it as a promising agent against radiations. Bixaorellanaeextract are good radioprotectors of bone marrow at non-toxic dose suggests that it may be promising agents for human radiation [62].

The protective effect of Bixaorellana against DNA damage induced by UV radiation, hydrogen peroxyde and superoxide anions promoted us to go assessing it’radioprotective potential at chromosomal level [63-66], and it also displayed antimitogenic properties [67]. It thus has antigenotoxic properties and chemo-preventive effects.

10) Fuel
The wood of B.orellanais lightweight (specific gravity 0.4), weak, and not durable. It was used in former times to start fires by friction. Bixafruit pericarps that are by-product of annatto colour extraction industries can be used as a potential source of fuel[68].

3. Conclusion
Bixa Orellena is thus used for the treatment of conditions such as microbial infections, sunstroke, tonsilitis, burns, leprosy, pleurisy, apnoea, rectal discomfort, headache for the treatment of small burns, poisoning, thinning hair, headaches, gonorrhea, skin diseases, nausea and vomiting, snake bites etc.Bixahas also been suggested to possess antifertility, anticancer, antidiabetic, antifungal, antimicrobial, hepatoprotective, cardio protective, antiinmetric, antipsymodic, analgesic, adaptogenic and diuretic actions.

Although the commercial exploitation of this species is well established, there are very few studies on its pharmacological effects. Considering the need for developing a safe and effective product, more studies should...
be performed in order to confirm other biological activities supported by the popular uses of Bixaorellana.

References


Antibacterial and antifungal activities
A. Penna, M. Radice, G. O. Gutkind et al.,

[38] C. F. Spencer, F. R. Koniuszy, E. F. Rogers et al.,
“Survey of plants for antimalarial activity,” Lloydia,

Screening of 17 Guatemalan medicinal plants for
platelet antiaggregant activity. Phytotherapy Research 11
(6) 441-445.

[40] Barro AG, Grueiro MMM, Montero D, Nogal JJ,
Escario JA, Muelas S, Fernandez C, Vega C, Rolon M,
In vitro antiparasitic activity of plant extracts from
Panama. Pharmaceutical Biology 42 (4-5) 332-337.

[41] Russel KR, Omoruyi FO, Pascoe KO and Morrison EY
in the dog. Methods and Findings in Experimental and
Clinical Pharmacology 30 (4) 301-305.

[42] Yoke Keong Yong1, Zainul Amiruddin Zakaria1, Arifiah
Abdul Kadir2, Muhammad Nazril Somchit1, Gwendoline Ee
Cheng Lian3 and Zuraini Ahmad. Chemical constituents and
antihistamine activity of Bixaorellana leaf extract. BMC
Complementary and Alternative Medicine 2013, 13:52

[43] Sitakanta Patnaik*, S.R. Mishra, G.B. Choudhury,
S.K. Panda and M. Behera. Phytochemical Investigation
and Simultaneously Study on Anticonvulsant,
Antidiabetic Activity of Different Leafy Extracts of
BixaorellanaLinn. IJPBA, Sep - Oct, 2011, Vol. 2,
Issue, 5.

[44] Shilpi JA, Taufig-Ur-Rahman Md, Uddin SJ, Alam MS,
pharmacological screening of BixaorellanaL. leaves.
Journal of Ethnopharmacology108 (2) 264-271

[45] Huhtanen CN (1980). Inhibition of Clostridium
botulinum by spice extracts and aliphatic
alcohols. Journal of Food Protection 43 (3) 195-196

[46] Galindo-Cuspinera V, Westhoff DC and Rankin SA
(2003). Antimicrobial properties of commercial annatto
extract against selected pathogenic, lactic acid,
and spoilage microorganisms. Journal of Food Protection
66 (6) 1074-1078.

Antimicrobial activity of Annatto (Bixaorellana)
extract. International Journal of Pharmacognosy34 (2)
87-90.

[48] Castello MC, Phatak A, Chandra N and Sharon M
(2002). Antimicrobial activity of crude extracts from
plant parts and corresponding calli of BixaorellanaL.
Indian Journal of Experimental Biology 40 (12) 1378-
1381

[49] Fleischer TC, Ameade EPK, Mensah MLK and Sawer
IK (2003). Antimicrobial activity of the leaves and seeds

[50] M. P. Corrêa, Dicionário das PlantasÚteis do Brasil e
das ExóticasCultivadas, vol. 4, Ministério da

[51] Freixa, R. Vila, L. Vargas, N, Lozano, T. Adzet, and S.
Canigueral, “Screening for antifungal activity of
nineteen Latin American plants,” Phytotherapy
Research, vol. 12, no. 6, pp. 427–430, 1998

[52] A. Penna, M. Radice, G. O. Gutkind et al.,
“Antibacterial and antifungal activities of some
Argentinean plants,” Fitoterapia, vol. 65, no. 2, pp. 172–

[53] A. Caceres, O. Cano, B. Samayoa, and L. Aguilar,
“Plants used in Guatemala for the treatment of
gastrointestinal disorders.1. Screening of 84 plants
against enterobacteria,” Journal of Ethnopharmacology,

[54] Di Mascio P, Devasagayam TPA, Kaiser S and Sies H
(1990). Carotenoids, tocopherols and thiols as biological
singlet molecular oxygen quenchers. Biochemical
Society Transactions 18 (6) 1054-1056.

Carotenoids enhance gap junction communication and
inhibit lipid peroxidation in C3H/10T1/2: relationship
to their cancer chemopreventive action. Carcinogenesis
12 2109-2114.

[56] Zhao W, Han Y, Zhao B, Hirota S, Hou J and Xin W
(1998). Effects of carotenoids on the respiratory burst of
rat peritoneal macrophages. BiochimiefortBiophysicaActa1381 (1) 77-
88.

[57] Canfield LM and Vanenzuela JG (1993). Cooxidations:
Significance to Carotenoid Action in vivo. Annals of the
New York Academy of Sciences 691 192-199

Effect of lutein, lycopene, annatto and gamma
tocopherol on autoxidation of triglycerides. Journal of
Agricultural and Food Chemistry 44 (8) 2096-2100.

Protective effect of curcumin, ellagic acid and bixin on
radiation induced genotoxicity. Journal of Experimental
and Clinical Cancer Research 17 (4) 431-434.

BixaorellanaL against radiation induced chromosomal
aberration in Swiss albino mice. International Journal of
Phytotherapy1 (1) 18-21.

[61] Antunes LM, Pascoal LM, de L Bianchi M and Dias FL
(2005). Evaluation of the clastogenicity and
anticlastogenicity of the carotenoid bixin in human
lymphocyte cultures. Mutation Research 585 (1-2) 113-
119.

Aoki H, Yasuhara K, Koda T, Nakamura M, Shirai T. A
thirteen-week oral toxicity study of annatto extract
(norbixin), a natural food color extracted from the seed
coat of annatto (BixaorellanaL...), in Sprague-Dawley

[63] Kunkel HO, Walter LN, Kioskias S; Gordon MH. The
effect of bixin and carotene on the oxidation of methyl
linoleate; Antioxidant properties of annatto carotenoids
Food chemistry 2001; 83(4), 523-529.

[64] Junior AC, Asad LM, Oliveira EB, Kovary K, Asad
NR, Felzenszwalb I. Antigenotoxic and antimutagenic
potential of an annatto pigment (norbixin) against

2013; 01(5):11-14 ANTIMICROBIAL EVALUATION
OF PHENOLIC FRACTION OF BIXA ORELLANA
L. BIXACEAE.

[66] Kovary K, Louvain TS, Costa e Silva MC, Albano F,
Pires ATG, Laranja ATG, Lage CLS and Felzenswalb I
(2001). Biochemical behavior of norbixin during in