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Review Article

A Review on medicinal aspects of *Chrozophora tinctoria* (L.) A. (Euphorbiaceae)

Sumaiya Fatima*, Patil MS, Khan PA and Patil MB

Department of Botany for UG, PG, Research, J.E.S s, Arts, Science and Commerce College, Nandurbar-425412, India

E-mail: drmadhukarpatil@gmail.com

Abstract

Chrozophora tinctoria (L.) A. Juss is an herb belongs to the family Euphorbiaceae having various medicinal and therapeutic importance. The current review article covers an emphasis on the key aspects of plant *Chrozophora tinctoria* with regards to their common uses as well as regarding its biological activity; Antimicrobial activity, Phytochemical studies, Cytotoxicity, Cytotoxonomic significance, wound healing potential and anticancer activity.

Keywords: Chrozophora tinctoria, Euphorbiaceae, Phytochemical, Antimicrobial activity.

INTRODUCTION

Euphorbiaceae is a large family of flowering plant the spurge family with 228 genera and around 6,547 species. Most spurges are herbs, but some especially in the tropics, are shrubs or trees and cactus type. This family occurs mainly in the tropics, warmer climate with the majority of the species in the Indo-Malayan region and tropical America they extend into the temperature regions of Northern and Southern hemisphere but are not reported from arctic region. The fruit is usually a schizocarp, but sometimes a drupe, usually three-celled capsules, each cell containing a single seed. Some species constitutes vesicating, toxic and irritant seed oils which may be obtained. This family contains a large variety of phytotoxins, mainly diterpene esters, alkaloids, glycosides, and ricin-type toxins (Betancur-Galvis et al., 2002). Euphorbiaceae family members are usually grown as ornamental plants and some species proved to be effective against genital herpes (HSV-2) (Hecker, 1968).

Chrozophora tinctoria A. Juss

Botanical description

It is a prostrate herb or undershrub, Monoecious, Indumentums. Consisting of very dense, sessile and peduncle stellate or hairs, next to simple hairs. Leaves spirally arranged and simple, Stipules narrowly triangular, scars very indistinct. Flowers actinomorphic, staminate flowers usually 2 per node, pistillate flowers usually single and fruits, slightly lobed capsules, triangular in transverse section, dehiscing usually septicidally and partly loculicidally into 3 bivalved parts, outside densely stellate, inside glabrous, thin-walled, column slender with frayed remnants of the septa apically triangular; septa single veined. Seeds 3 per fruit, obviate, angular; Covered by a thin, incomplete sarcotesta; The latter carunculate apically, Embryo flat, Endosperm copious (Baslar, 2000).

Scientific classification

Kingdom: Plantae; Clade: Angiosperms; Clade: Eudicots; Clade: Rosids; Order: Malpighilales; Family: Euphorbiaceae; Subfamily: Acalyphoideae; Tribe: Chrozophoreae: Subtribe: Chrozophorinae: Genus: *Chrozophora* Neck. Ex A. Juss. (1824), Pax and K. Hoffm. (1919); Species: *Chrozophora tintoria.*

Chemotaxonomic significance

All the species of the genus *Chrozophora* are common in their flavonoids content, thus it reveals the possibility that they could be useful as chemo systematic markers. Around 35 flavonoids have been reported to occur in various

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species belonging to *Chrozophora*, and among them six novel flavonoids have been recently reported (Marzouk et al., 2016).

Traditional uses

Chrozophora tinctoria, is an annual plant and is the only species of *chrozophora* found in Turkey, used as a source of dyeing material in Carpet, Kilims and in other crafts in Western Anatolia and benefits the economy of Turkey. It is native to a number of countries in Africa, temperate and tropical Asia and Europe, and commonly known as dyer's-croton. Purple dyes obtained from liquen species such as *Roccella, Lecanora* and *Varialaria* and the seeds from the flower *Chrozophora tinctoria* were possibly used since Antiquity to dye textiles. Purples obtained from the above *Chrozophora tinctoria* plants dried symbolic meanings and in the Early Middle Ages and from the 14th c. on orcein purples were used in the illuminations of precious manuscripts. *Chrozophora tinctoria*, has a high solubility in water, and produced dark red color, but it did not show reaction with wool fiber. The plant is traditionally used to treat warts, also has been used as an emetic, cathartic, and for the treatment of fever else (Ugulu et al., 2009).

IMPORTANCE

Chrozophora genus

It is a plant of the family Euphorbiaceae and the single genus comprised in the sub tribe Chrozophorinae. These are mostly monoecious herbs under shrubs of the family Euphorbiaceae, comprises about nine species distributed in the Mediterranean regions tropical Africa, West Africa, West Asia, Pakistan and India. Five species of *Chrozophora* are known to occur in India. These plants occur naturally in tropical African, Asia and India.

Chrozophora genus has great medicinal uses and properties, *Chrozophora plicata* has an emetic, drastic and corrosive property. Its seeds are used as cathartic. While *Chrozophora rottleri* is traditionally used for the treatment of various diseases. The plant also used in Saudi Arabia and India to treat Jaundice and purifying blood. The fruit juice is given in cases of cough and cold in Nepal. The leaves of *Chrozophora rottleri* are used as a depurative agent and they are very much useful in treatment of skin diseases seeds are used as cathartic and valued with purgative properties. *Chrozophora tinctoria* is used in coloring foods, textiles, cosmetics and pharmaceutical formulations (Mohamed, 2001).

Chrozophora plants are traditionally used to cure skin disorders, jaundice, diarrhea, mouth ulcer, skin burns, fever, joint pain and swelling, abdominal pain, migraine, menstrual problems, wounds, and to expel intestinal worms and the screening and analysis for phytochemical and pharmacological studies of these plants suggest their use in food, feed, personal body care and medicine provides scientific evidence for their rational use in food and prevention and treatment of infectious and oxidative stress related diseases (Priyanka et al., 2010)

Phytochemical analysis of the *Chrozophora* genus resulted in the isolation of several types of chemical constituents including essential oils, terpens, sterols, phenylpropanoid glycosides, xanthones, chromone and flavonoids (Hashim et al., 1990). *Chrozophora* genus were reported for various biological activities; antioxidant (Delazar et al., 2006); (Hawas, 2007) antimicrobial (Usman et al., 2007) and traditional medicine for the treatment of diverse ailments (Dipankar et al., 2011). Many phytochemical constituents have been reported from few species of the genus *Chrozophora*, including alkaloids, coumarins, diterpenoids (Mohamed et al., 1995); (Tabussum et al., 2013), phenylpropanoid glycosides, phenolic acids, tannins, anthraquinones, saponins and xanthones (Agrawal & Singh 1988). Flavonoids were commonly reported in all species of the genus *Chrozophora* (Vassallo et al., 2006).

Antimicrobial activity

Chrozophora. tinctoria methanol extract showed highest inhibition against *Pseudomonas aeruginosa* and low antibacterial activity against *Staphylococcus aureus* and *Klebsiella pneumoni* (Kensa & Yasmin, 2011) and n-hexane extract *C. tinctoria* showed highest inhibition against *Staphylococcus aureus* and *Klebsiella pneumoniae* and low antibacterial activity against *Escherichia coli* and notable in *Pseudomonas aeruginosa.* However, methanol extract of *C. tinctoria* showed notable antibacterial activity against *Salmonella typhi* and *Escherichia coli* as well as *P. aeruginosa, S. aureus*, and *K. Pneumonia*. However, acetone and methanol extracts of *C. tinctoria* showed the greatest antibacterial activities, while the aqueous extract had the lowest as acetone extract of *C. tinctoria* is effective on both Gram-positive (*S. aureus* and *B. subtilis*) and Gram-negative (*K. pneumoniae* and *P. aeruginosa*) bacteria. Leaf extract of *C.tinctoria* shows higher antiradical activity than the stem extract, and the methanol leaf extract had the maximum antiradical activity *C. tinctoria* has antioxidant and antimicrobial potential and may be useful in pharmaceutical and phytotherapeutic applications. *C. tinctoria* leaves extract following standard procedure, reveals the presence of alkaloids, mucilage, anthraquinone, saponins, tannins, flavonoids, steroids, terpenoids, glycosides and reducing sugar.

C. tinctoria is chemically, morphologically and anatomically different from the other surveyed species. The plant species is characterized by thin-woolly rombical leaves and lunate vascular bundles in the midrib (Meelad & Dahhan, 2000) and a prostrate herb, stamens 15 in two whorls.

Wound healing ability

Diabetes is one of the critical conditions which hurdles the faster wound healing process. *Chrozophora tinctoria* showed an increase in the rate of wound reduction (healing) on treated group of rats which leads to quick healing as established by decreased period of epithelialisation (14.67±0.28 days) when compared to disease control wounds that is 19.83 ± 0.37 days. It shows that the treatment of wound in diabetic rats with application of hydroalcoholic leaves extract of *C. tinctoria* may be probably beneficial for the control of wound healing because it improves the maximum levels of collagen in the granulation tissues. This action is likely due to the presence of active chemical constituents that is a novel chrozophorin, apigenin, rutin, and acacetin (Sharifi-Rad et al., 2015).

The *C.tinctoria leaves extract* has been observed to reduce the BSL after oral administration of Streptozotocin. This effect is potentiated due to the presence of alkaloids and tannin since, it has well-known coloring properties. This recent studies perpetrate that the wound healing process can be enhanced by the use of hydroalcoholic leaves extract of *C. tinctoria* given through oral and dermal route of administration. It plays a significant protective role against physically damaged tissues in diabetic rats and fairly improved healing of wounds.

Cyto-toxicity activity

The reported study on cytotoxicity of the plant leaves, roots and stems extracts using brine shrimp assay, antitumor activity using potato disc assay, and phytotoxicity activity using radish seed bioassay (Mohamed et al., 1994).The above studies shows considerable mortality (%) in brine shrimp assay at different concentrations, % mortality decreases as the decrease in concentration of plant part extract, antitumor activity in potato disc assay of leaves, root and stem shows inhibition in which leaves and stem extract at 100 and 10 ppm is considerable and in radish seed phytotoxicity of plant extract in which stem extract shows considerable growth inhibition (Jamil et al., 2012) **(Tables 1-4)**.

Table 1. Prostrate herb.

Solvent	Bacteria	Zone of inhibition (mm)	Percentage inhibition	Mean (no. of samples = 5)
Methanol extract	*Salmonella typhi*	15	54.5	(46.00) NS
	Pseudomonas aeruginosa	10	69.6	
	Escherichia coli	19	42.4	
	Staphylococcus aureus	25	24.2	
	Klebsiella pneumoniae	20	39.3	
n-hexane extract	*Salmonella typhi*	18	45.4	(41.16) NS
	Pseudomonas aeruginosa	24	27.2	
	Escherichia coli	30	9.09	
	Staphylococcus aureus	10	69.6	
	Klebsiella pneumoniae	15	54.5	

Table 2. Brine shrimp assay.

Concentration (ppm)	Mortality (%)		
	Leaves	Roots	Stems
1000	80	33.3	36.6
100	30	26.6	20
10	20	20	20

Table 3. Antitumor potato disc assay.

Concentration (ppm)	Tumor inhibition (%)		
	Leaves	Roots	Stems
1000	54.43	58.82	61.96
100	47.83	49.41	45.65
10	41.30	17.65	35.87

Table 4. Radish seed phytotoxicity assay.

Concentration (ppm)	Root growth inhibitor (%)		
	Leaves	Roots	Stems
10000	64.31	56.93	53.49
1000	13.02	13.13	4.01
100	7.61	2.80	-3.93
10	2.06	1.75	-8.60

However, effect of different concentrations of methanolic extracts of *Chrozophora tinctoria* against *Artemia salina* (a species of brine shrimp) (% mortality) showed 100 % mortality at concentration of 100, 300 and 1000 µl and n-hexane extracts of *Chrozophora tinctoria* 100, 48.13 and 100% mortality at concentration of 100, 300 and 1000 µl. The LD50 of *Chrozophora tinctoria* against *Artemia salina* for methanol extract was 47.22 and n-hexane extract was 151.77 µg/ml.

Anticancer activity

The inhibitory effect of *Chrozophora tinctoria* on mouse skin tumors was studied *in vivo*, tumor initiation was achieved by a single topical application of 7, 12-Dimethylbenze (a) anthracene (DMBA) (40 µg/100 µl acetane/mouse). After 7 days, tumor promotion was begun by twice-weekly topical application of Benzoyl peroxide (BPO) (20 mg/300 µl acetone/mouse) for a period of 32 weeks. Also before 4 hours of DMBA application, animals received a single topical dose of *Chrozophora tinctoria* extract (10 mg/gr carbopol gel/mouse). Results showed that there were higher yields of tumors in those animals receiving both DMBA and BPO. However, the *Chrozophora tinctoria* pretreated group showed complete inhibition of tumor incidence. The authors suggested that the antitumor effect of the plant was mediated by its scavenging of free radicals which play an important role in skin cancer. Some studies have been reported on the antiproliferative effects of the gallic acid and it was found that gallic acid had remarkable effects on some cancer cell lines including HeLa by inducing apoptosis and activating caspases.

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