THE CHEMICAL CONSTITUENTS AND PHARMACOLOGICAL IMPORTANCE OF CHROZOPHORA TINCTORIA

Ali Esmail Al-Snafi*

Department of Pharmacology, College of Medicine, Thi qar University, Nasiriyah, Iraq.

ABSTRACT
Chemical analysis of Chrozophora tinctoria showed that it contained dye substances, flavonoids, alkaloids, oils, diterpenoids, xanthones, coumarins, chromones, diterpenoids, and phenylpropanoid glycosides. The plant possessed antioxidant, cytotoxic, antibacterial, antifungal, antiparasitic and other biological effects. This review highlight the chemical constituents and pharmacological effects of Chrozophora tinctoria.

Key words: Chrozophora tinctoria, Chemical constituents, Pharmacology.

INTRODUCTION
Medicinal plants have been identified and used throughout human history. Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions. The World Health Organization (WHO) estimates that 80 percent of the population of some Asian and African countries presently use herbal medicine for some aspect of primary health care. In 2001, researchers identified 122 compounds used in modern medicine which were derived from traditional human use. However, the recent pharmacological and therapeutic studies showed that plants possessed wide range of pharmacological activities and can be utilize to maintain disease-free healthy life [1-57]. This review was designed to highlight the chemical constituents and pharmacological effects of Chrozophora tinctoria.

Synonyms
Chrozophora hierosolymitana, Chrozophora verbascifolia Baill, Chrozophora oblique, Croton tinctorium L[58-59].

Classification

Common names

Description
The plant has an ash-gray green appearance, because it is densely covered with white, wool-like (tomentose) hairs. The hair is described as stellate (star-shaped) since groups of hair bristles are arranged as radiating out from a common point and so they have the shape of a pointed star. The plant produces few simple branches starting at least one third up of the plant height. The basal stem is thin and yellow-amber in colour. Leaves grow alternately along the stem and are not found in large numbers per plant. The mature leaves have a long petiole (longer than the leaf length) and a rhombic to ovate shape. Leaf margins are sinusoidal (wavy) in a perpendicular plane to the lamina plane. The plant is monoecious hence producing male and female flowers separately, which both are tiny (1-2 mm) and therefore inconspicuous. The male flowers have a 5-sepal calyx, 5 yellow petals and a cluster of 5 central stamens which have dark or black anthers. The female flowers have a 10-sepal calyx around a spherical ovary, no petals and 3 styles which each subdivide into 2 stigma. The male and female flowers outgrow as a raceme at the top of the branch, but they are so densely packed that appear to be a spike. Male flowers are above the basal

*Corresponding Author  Ali Esmail Al-Snafi  E mail: aboahmad61@yahoo.com
female flowers in the spike-like raceme. Flowers are pollinated by a small-sized species of ants. Without doubt, the most conspicuous part of the plant is its fruit. The fruit is a strange looking capsule with the shape of 3 spherical bodies fused in a rather rounded-triangular structure. Additionally the fruit has perpendicular stubby projections and white scales outlasting with the dark green wall of the fruit. Each fruit holds 3 seeds. When reaching full maturity, the fruit darkens to a dark green colour and eventually burst open with an incredible strong and sudden twist of its walls, sending the seeds inside to a considerable distance away. The seeds are oval or teeth shaped with a rough texture. They are 4mm in size and grey to light brown colour. The remnants of the fruit wall (found on the soil under the plant) rapidly turn black [62-63].

Distribution
This plant is mainly found in the Mediterranean region and central/south Asia. It is described as native to the following countries: Africa, (Algeria, Egypt, Libya, Morocco, Tunisia and Yemen) temperate and tropical Asia (Kuwait, Saudi Arabia, Afghanistan, Iran, Iraq, Israel, Jordan, Lebanon, Syria, Turkey, Kazakhstan, Turkmenistan, India and Pakistan), and Europe (Ukraine, Albania, Bulgaria, Greece, Italy, Malta, France, former Yugoslavia, Portugal and Spain) [61,63-64].

Traditional uses
It is an old dye plant widely used in the Middle Ages in the illuminations. Turnsole also called (folium) pigment is more correctly a range of colours from blue through purple to red depending on the PH of the solution. It was considered as another kind of Litmus and sometimes was used for coloring Dutch cheese and certain liquors. Traditionally it is used for the treatment of warts [64-66]. It was also used as an emetic, cathartic, and for the treatment of fever [67]. The leaves are boiled in water and the obtained juice is given orally to relieve chest burning of digestive origin [68].

Chemical constituents
The preliminary analysis of *Chrozophora tinctoria* ( whole plant, %) showed that it contained 50.00, organic matter 92.73, crude protein 9.13, neutral detergent fiber 31.06 and acid detergent fiber 54.10 [69].

Analysis of *Chrozophora tinctoria* showed that it contained dye substances, flavonoids, alkaloids, diterpenoids, xanthones, coumarins, chromones, diterpenoids, and phenylpropanoid glycosides [70-74].

However, analysis of *Chrozophora tinctoria* stems, leaves, and seeds collected during winter from two habitats in Sinai (Egypt), showed the presence of tannins, flavonoids, phenolics, alkaloids, glycosides, reducing sugars, chlorides, and sulfates were detected in samples from both habitats. HPLC analysis revealed the presence of arabinoose, ribose, fructose, glucose, and raffinose in the free form, and sucrose in the combined form. Ten amino acids were also isolated from the plant [75].

Phytoanalysis of the plant parts showed that the plant contained alkaloids (stems and roots), saponins (leaves, stems and roots), anthraquinones (leaves, stems and roots), terpenoids (leaves), flavonoids, flavones (leaves and roots), tannins (leaves and roots) and cardiac glycosides (stems) [76].

From the aerial parts of the plant, two phenylpropanoid glucosides: 4-O-methyl guaiacylglycerol 9-O- beta- glucopyranoside and 4-O-methyl guaiacylglycerol 8-O-beta-glucopyranoside together with syringin, benzyl alcohol glucoside, isorhamnetin-3-O-beta-glucopyranoside-7-O-alpha-rhamnopyranoside and quercetin-3-O-beta-glycopyranoside-7-O-alpha-rhamnopyranoside have been isolated [74].

The methanol extract of the aerial parts of *Chrozophora tinctoria* yielded five flavonoid glycosides, quercetin 3-O-rutinoside (rutin), acacetin 7-O-rutinoside, apigenin 7-O-[beta-D-(6-p-coumaryl)]-glucopyranoside, apigenin 7-O- [beta-D-glucopyranoside and apigenin 7-O-[beta-D-([6-(3,4-dihydroxybenzoyl)]-glucopyranoside (named, chrozophorin) [64]. Three novel dolabellane diterpene glucosides and one new dolabellane diterpenoid have been isolated from the plant [72]. The composition of *Chrozophora tinctoria* oil were: eugenyl methy 3.692%, cyclohexyl ketone 13.742%, 2(4H)-benzofuranone, 5,6,7,7 a- tetrahydro - 4,4,7a – trimeth 50.718%, IH - cycloprop[e] azulen - 7- ol, decahydro - 1,1,7 trimethyl 9.845%, alpha cedrol 3.497%, elemicin 8.558% and capillin 9.948 % [77].

Minerals contents of *Chrozophora tinctoria* were P: 0.15, K: 0.99, Na: 0.11, Ca: 1.38, Mg: 0.32, Fe: 0.010, Cu: 4.40, Mn: 8.30 and Zn: 49.30 %/ dry matter [69].

Pharmacological effects
Antioxidant effects
The free-radical scavenging activity of the methanol extract (RC<sub>50</sub> = 2.24 x 10<sup>-5</sup> mg/ml) as well as the isolated five flavonoid compounds (RC<sub>50</sub> = 4.38 x 10<sup>-5</sup> , 2.26 x 10<sup>-5</sup>, 7.69 x 10<sup>-5</sup>, 8.71 x 10<sup>-5</sup> and 3.19 x 10<sup>-5</sup> mg/ml, respectively) were assessed by the DPPH assay [64].

It was suggested that its antitumor effect against chemically induced skin cancer was attributed to its scavenging of free radicals which play an important role in skin cancer [66].

Cytotoxic effects
The cytotoxicity of the plant leaves , roots and stems extracts was studied using brine shrimp assay, antitumor activity using potato disc assay, and phytoxicity activity using radish seed bioassay. Mortalities (%) of brine shrimps at concentrations of 1000,100 and 10 ppm of the plant leaves, roots and stems extracts were (80,30 and 20), (33.3, 26.6 and 20) and (36.6,20 and 20) respectively. In antitumor potato disc assay, the tumor inhibition (%) at concentrations of 1000,100 and 10 ppm of the plant leaves , roots and stems extracts were (55.43, 47.83 and 41.30), (58.82, 49.41 and 17.65 ) and (61.96, 45.65 and 35.87 ) respectively. In radish seed phytoxicity assay, the percentage root growth inhibition or stimulation (%) at concentrations of
7. Marbin M Ideen and Al-Snafi AE. The probable therapeutic effects of Date palm pollens in treatment of male infertility. 
60. https://plants.usda.gov/java/ClassificationServlet?source=display&classid=CHTI2
75. Ahmed FA. Phytochemical studies on Chrozophora tinctoria L. Raf. growing naturally in South Sinai. Bulletin of Faculty of Agriculture, Cairo University, 54(1), 2003, 93-110.