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# The genus *Cynomorium* in China: An ethnopharmacological and phytochemical review

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ABSTRACT

*Ethnopharmacological relevance:* Species of the genus *Cynomorium* (Cynomoriaceae), including *C. songaricum* Rupr. and *C. coccineum* L., have a long history of use in traditional medicine to treat various ailments such as impotence, premature ejaculation, kidney-*yang* deficiency, spermatorrhea, colic, and stomach ulcers. In addition, these species are used in health foods, tea, and cosmetics.
*Aim of the review:* The aim of this review is to provide comprehensive information on the botany, traditional uses, phytochemistry, pharmacological research, and toxicology of *C. songaricum* and *C. coccineum* and to explore the therapeutic potential and future research opportunities of these species.
*Materials and methods:* All available information on *C. songaricum* and *C. coccineum* was collected via electronic search (using PubMed, ACS, CNKI, Google Scholar, Baidu Scholar, and Web of Science).
*Results:* The ethnomedical uses of *C. songaricum* and *C. coccineum* in Saudi Arabia, China, Afghanistan, Mongolia, and Iran for several types of ailments were recorded. A phytochemical investigation revealed the presence of flavonoids, terpenoids, phloroglucinol adducts, saccharides, phenylpropanoids, steroids, organic acids, and other compounds. The crude extracts and pure compounds from *C. songaricum* and *C. coccineum* exhibited a wide spectrum of *in vitro* and *in vivo* pharmacological activity, including anti-fatigue, anti-hypoxia, anti-oxidation, anti-diabetic, immune system modulating, and antiviral activity.
*Conclusions:* *Cynomorium* species have emerged as a source of traditional medicine. Many studies have provided evidence for the therapeutic efficacy of these species in treating various conditions and possible mechanisms. However, further research is required for the development of new drugs and therapies for the treatment of various diseases, especially cancer and diabetes. Therefore, this review on the ethnopharmacology, phytochemistry, and toxicity of *Cynomorium* species will provide helpful data for further studies and commercial exploitation of the species.


**Contents**



*Abbreviations::* Aβ, amyloid-β peptide; cAMP, cyclic adenosine monophosphate; cGMP, cyclic guanosine monophosphate; ConA, concanavalin; CSP, *C. songaricum* polysaccharides; DA, dopamine; DAT, dopamine transporter; DPPH, 2,2-diphenyl-1-picrylhydrazyl; FSH, follicle-stimulating hormone; GABA, gamma-aminobutyric acid; GABA/5HT, gamma-aminobutyric acid/serotonin; GAT, gamma-aminobutyric transporter; GDNF, glial cell-derived neurotrophic factor; GSH-Px, glutathione peroxidase; ICSH, interstitial cell stimulating hormone; LH, luteinizing hormone; NE, norepinephrine; NET, norepinephrine transporter; NO, nitric oxide; SERT, serotonin transporter; SOD, superoxide dismutase

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## 1. Introduction

*Cynomorium* is a genus containing two species, *C. songaricum* Rupr. and *C. coccineum* L., and is in the family Cynomoriaceae. These two species are mainly distributed in dry, rocky, or sandy soils of the northern hemisphere and have been widely applied in folk medicine in Europe, North Africa, and Eastern and Western Asian countries for centuries.

*C. songaricum*, also known as *Suo Yang* (Chinese: 锁阳), which is found in China, Afghanistan, Mongolia, and Iran, is usually parasitic on the roots of Nitrariaceae, Tamaricaceae, and Chenopodiaceous plants. The fleshy stems of *C. songaricum* are used medicinally as a tonic for treating nocturnal ejaculation and impotence (Wan and Chen, 2000). In addition, the *Chinese Pharmacopoeia 2010* notes that this plant has been used primarily for the treatment of impotence, premature ejaculation, kidney-*yang* deficiency, and spermatorrhea (Committee for the Pharmacopoeia of PR China, 2010). In recent years, extracts and preparations of *C. songaricum* have been patented in China for preventing dizziness and sonitus, treating purpura hemorrhagica and female climacteric syndrome, improving immunity, lowering blood sugar, and resisting cancer (Liu, 2009a; Zhu et al., 2009; He, 2011; Miao et al., 2011; Yin, 2011).

Another *Cynomorium* species, *C. coccineum*, is known under different names, such as Maltese mushroom, fungus melitensis, champignon or éponge de Malt, fungo di Malta, and tarthuth in Arabic countries (Abd El-Rahman et al., 1999; IUCN, 2005; Duke et al., 2008; Dharmananda, 2011; Rosa, et al., 2012). The species is found from southern Spain to the southern Italian coast on the islands of Corsica, Sardinia, Sicily, Malta, and Crete. In addition, the species is found from the West African coast to the North African coast, in the eastern Mediterranean and the Arabian Peninsula (Abd El-Rahman et al., 1999; IUCN, 2005; Duke et al., 2008; Dharmananda, 2011; Rosa, et al., 2012). Similarly, *C. coccineum* is parasitic on the roots of Cistaceae and Amaranthaceous plants in the Mediterranean area, and the plant parasitizes Amaranthaceae, Tamaricaceae, and Chenopodiaceous plants in other regions. *C. coccineum* has been used as an aphrodisiac and a tonic in folk medicine (Ageel et al., 1987; Al-Yahya et al., 1990). In addition to alleviating erectile dysfunction and other sexual problems, the dried mature spike of *C. coccineum* is used to treat colic and stomach ulcers in Saudi Arabia (http://www.itmonline.org/arts/cynomorium.htm). Extracts and preparations of *C. coccineum* are patented for preventing skin aging, stimulating the growth of hair, and treating erectile dysfunction in the US and Japan (Ito et al., 1998, 2003; Wang et al., 2003; Tsuji et al., 2003). However, the chemical components and pharmacological activities of this species have not been investigated clearly.

This paper intends to provide comprehensive insight into the botany, history of traditional medicinal uses, phytochemical and pharmacological research, and toxicology of the genus *Cynomorium* to provide valuable data for further studies and for the development of clinical applications of these two medicinal plants.

## 2. Botanical characterization

*C. songaricum*, a perennial, erect, and herbaceous plant with upright and cylindrical stems, grows up to 10–100 cm in height and 3–6 cm in width with a slightly swollen stem base. The scale-like and ovate-deltoid leaves are 0.5–1.2 cm long, 0.5–1.5 cm wide and apex acute. The flowers resemble a spiciform, clavate spadix and are 5–10 cm long with a diameter of 2–6 cm. The male flowers are 3–6 mm long, with approximately 4 perianth lobes that are proximally whitish and distally purplish red, and the petals are oblanceolate or spatulate with thickened, dark red filaments. The female flowers have 5 or 6 perianth lobes that are linear-lanceolate and 1–2 mm wide. The flowers are purplish red, clavate, approximately 2 mm long, and with flat stigmas. The rare

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