

PHARMACOLOGICAL AND MEDICINAL PROPERTIES OF THE PLANT SAFFLORIE  
FLOWER (LITERATURE REVIEW)

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ФАРМАКОЛОГИЧЕСКИЕ И ЛЕЧЕБНЫЕ СВОЙСТВА РАСТЕНИЯ ЦВЕТOK  
САФЛОРИ (ОБЗОР ЛИТЕРАТУРЫ)

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МАХСАРГУЛИ ЎСИМЛИГИНИНГ ФАРМАКОЛОГИК ВА ДОРИВОРЛИК  
ХУСУСИЯТЛАРИ (АДАБИЁТЛАР ШАРҲИ)

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**Abstract:** The article provides information on the botanical structure, distribution, composition of plant materials and medicinal properties of marigolds, which are widely used in folk medicine today. It is emphasized for which diseases the chemicals contained in safflower (*Carthamus tinctorius* L.) are effective and in which cases they should be used.

**Keywords:** Folk medicine, safflower flower and luteolin.

**Аннотация:** В статье приведены сведения о ботанической структуре, распространении, составе растительного сырья и лекарственных свойствах бархатцев, которые сегодня широко используются в народной медицине. Подчеркнуто, при каких заболеваниях эффективны химические вещества, содержащиеся в сафлоре красильном (*Carthamus tinctorius* L.), и в каких случаях их следует применять.

**Ключевые слова:** Народная медицина, цветок сафлора и лютеолин.

**Аннотация:** Мақолада ҳозирги даврда халқ табобатида кенг қўлланилаётган махсаргулининг ботаник тузилиши, тарқалиши, ўсимлик таркиби ва дориворлик хусусиятлари тўғрисида маълумотлар келтирилган. Махсаргули (*Carthamus tinctorius* L.)нинг таркибидаги химиявий моддалар қайси касалликларда яхши таъсир қилиши ва қандай ҳолатда берилиши кераклиги таъкидлаб ўтилган.

**Калит сўзлари:** Халқ табобати, махсаргули ўсимлиги ва лютеолин моддаси.

**Relevance.** Today, plants are one of the most important sources of medicines used in various areas of medical practice. This is explained by the fact that herbal medicines have a wide range of pharmacological activity and, as a rule, do not cause side effects when used wisely. The combination of biologically active substances included in the composition of medicinal raw materials has a complex and complementary effect.

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In this regard, the study of new types of medicinal raw materials and their introduction into scientific medicine is one of the main tasks of modern medicine.

*Carthamus tinctorius* is the only cultivated species of the genus *Carthamus* [1,5,7].

Safflower or safflower plant (syn. safflower, American saffron, wild saffron, yellow thistle, dye thistle, crocodile (Latin *Carthamus tinctorius* L.) is an annual herbaceous plant similar to asparagus, belonging to the subfamily *Cartduoideae* of the family *Asteraceae*, with many branches and stems.

The Latin botanical name of safflower - *Carthamus* - comes from the Arabic word "kurthum", which means yellow dye, which is due to the fact that safflower has been cultivated as a dye plant since ancient times [16, 18]. Its natural range covers Asia (India) and the Middle East. The plant has a bushy appearance and reaches a height of 100-130 cm. The leaves are large, pinnate, with serrated edges. At the end of each stem is a spherical flower head, surrounded by branches. As the head develops, each of them produces 15 to 30 or more seed pods. The tetrahedral carpels are usually white and smooth, covered with a thick husk [23,26].

The flowers of safflower are radial and tubular, forming large racemes (flower heads). It is grown for a variety of purposes, including medicinal use, fabric dyes, food coloring, ornamental use, biofuel, and animal feed. The safflower flower is known for its ability to withstand drought, salinity, extreme temperatures, and hail, and is a plant that can adapt to growing in a wide variety of conditions around the world. It is currently grown in over 60 countries, including India, Mexico, America, Kazakhstan, Russia, Argentina, China, Turkey, Kyrgyzstan, Australia, Egypt, France, Japan and Pakistan, mainly in arid and semi-arid regions. [19,23]

The mahsarguli plant has been known as a medicinal plant since ancient times and is widely used in folk medicine. Valuable mahsar oil is extracted from mahsarguli seeds. A decoction of marigold inflorescences is known among the population as an effective remedy for allergies. In Chinese folk medicine, decoctions of marigold flowers are used to treat diseases such as amenorrhea, endometritis, adnexitis, pneumonia and insomnia. [3,13,24]

In medicine, many studies are being conducted to study the healing properties of the marigold plant. The results of the studies show that the plant has antioxidant, anti-inflammatory, analgesic, anti-allergic, sedative, immunostimulating, neuroprotective, cardioprotective, hepatoprotective, nephroprotective, hypotensive, antitumor, hypoglycemic and other properties. [3,10,12] The safflower flower is well known among the population as an anti-allergic agent and is most effectively used for these diseases. The yellow pigment contained in the marigold extract has anti-allergic, anti-inflammatory and analgesic properties. Experimental studies have shown that it has anti-allergic properties. [27].

Safflower flower extracts have proven sedative and antidepressant properties. [17,40]. The best known pigment extracted from marigold leaves is the yellow pigment hydroxysaflor Y (HSY), which has antibacterial, anti-inflammatory and antioxidant properties. The above-ground parts contain a large amount of carbon (42.7–49.1% of dry weight) and relatively little nitrogen (0.36–1.23%). [27]. They contain carthesin A,  $\beta$ -daucosterol and stigmasterol. The chemical composition of marigolds is interesting and rich; to date, 200 substances have been identified in it [9,42]. Marigold leaves contain 1.82% protein, 4.8% lipids, 11.6% crude fiber and 10.8% miscellaneous substances, and the moisture content is 4.7%. [3,17,41]. They contain alkaloids, flavonoids, lignans, organic acids and polyacetylenes, alkanediols, riboflavin, steroids and quinochalcone C-glycosides. Most of the pigments found in the flower petals are flavonoids of the C-glucosylquinochalcone group. The best known are carthamin (also called safflower yellow, safflower red or carthamin) and cartamidin

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(synonyms include carthamic acid). Carthamin (C<sub>43</sub>H<sub>42</sub>O<sub>22</sub>), a red pigment, is a flavonoid compound consisting of two chalconoids. It is formed by oxidation with precarthamine.

It is insoluble in water and usually makes up 3–6% of the petal composition. However, in some parts of the flower its content is less than 1%. [15] During the biosynthesis of safflower flowers, their color gradually changes from yellow to red. [32,38] The yellow pigment, carthamide, makes up 24–30% of the compounds in marigold flowers. This tetrahydroxyflavanone, a derivative of (C)-naringenin, is a water-soluble substance, in which the following flavonoids have been identified: hydroxysafflower yellow A (HSYA; also known as saflamin A), 6-hydroxykaempferol 3,6-di-O-β-D-glucoside-7-O-β-D-glucuronide, 6-hydroxykaempferol 3,6,7-tri-O-g, 6-hydroxykaempferol 3-O-β-rutinoside-6-O-β-D-glucoside, 6-hydroxykaempferol 3,6-di-O-β-D-glucoside, 6-hydroxyapigenin 6-O-glucoside-7-O-glucuronide, kahydrosafflower yellow 3-O-β-rutinoside and two compounds from other groups: guanosine and syringin.

In the course of subsequent studies, the following substances were also isolated: (2C)-4,5-dihydroxy-6,7-di-O-β-D-glucopyranosylflavanone, 6-hydroxykaempferol 3-O-β-D-glucoside, 6-hydroxykaempferol-side, O-D3-6-hydroxykaempferol 6,7-di-O-β-D-glucoside and 6-hydroxyquercetin 3,6,7-tri-O-β-D-glucoside. Other ingredients isolated from aqueous extracts of the flower petals are quinohalogens (cartormin, isosaflamin C, precartormin, safflamine B, safflamine C, saffron yellow A, saffron yellow B and tinctormin) and flavonoids (azalieatin) (3,7,3 β,4 β -tetrahydroxy-5-methoxyflavone), safflower (3,7,3 β,4 β -tetrahydroxy-5-methoxyflavone 7-O-β-D-glucopyranoside), 5-O-methylucidin [36 arolin37] (5,7,3 β,4 β -tetrahydroxyflavone 7-O-β-D-glucopyranoside) and 6-hydroxykaempferol-3-O-β-D-glucoside-7-O-β-D-glucuronide [18,25].

Substances isolated from safflower flowers are used in medicine. Of particular importance in this case are the water-soluble components, especially the intravenously administered chalconoids and C-glycosides. [14] Safflower also has analgesic, anti-inflammatory, and anti-aging properties ([11]. Most studies have focused on the use of the pigment hydroxysafflower A (HSYA); however, safflower yellow (SY), safflower A (SR), safflower yellow (SY), hydroxysafflower B (HSYB), hydroxysaccharide C (HSYA), and some water-soluble polysaccharides have also been shown to have beneficial effects on human health.

Studies with the yellow pigment hydroxysafflower have shown that products containing HSYA prevent acute anaphylaxis in mice. Anaphylaxis is associated with the rapid activation of mediators (such as tumor necrosis factor, histamine, β-hexosaminidase, or mast cell chemotactic protein) that can occur upon exposure to an allergen or drug and can be fatal. HSYA inhibits mast cell degranulation by inhibiting transport of Ca<sup>2+</sup> and release of cytokines and chemokines [5,13].

The yellow pigment hydroxyapatite Y has antioxidant activity, which allows cells to survive under stress conditions due to the oxidative effect [4,9]. Antioxidant activity is also exhibited by hydroxysafflower yellow B [51], hydroxysafflower yellow Y (HSY), hydroxysafflower red R (HSR) and carthamin. However, marigold extract, as well as HSY and HSA, act in this way only in low concentrations, whereas in higher concentrations they have a prooxidant effect, promoting the formation of reactive oxygen species in cells [19,27].

As a result of studying the chemical composition of aqueous-alcoholic extracts from the flowers of erect marigolds growing in the Samara region, 5 flavonoids were isolated and characterized for the first time. Among them is the safflower plant, which is characterized as the dominant component of this plant and is a new natural compound, the structure of which, the data of mass spectrometry, UV, <sup>1</sup>H-NMR spectroscopy and the results of chemical reactions (enzymatic and acid hydrolysis) are as

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follows: 7-O--D-glucopyranoside 3,7,31,41-tetrahydroxy-5-methoxyflavone. In addition, azaleatin (3,7,31,41-tetrahydroxy-5-methoxyflavone), 5-methyluteolin, cynaroside and luteolin were characterized for the first time in cultivated marigolds. [10,12]

Over the past decade, data have appeared on the immunotropic action of extracts from medicinal plant materials. It has been established that flavonoids and polyphenols in dry extracts obtained from safflower raw materials have immunomodulatory properties. It is polyphenols that stimulate humoral immunity and increase the functional activity of peritoneal macrophages, including against the background of immunosuppression (cyclophosphamide). Flavonoids in safflower flowers have the property of stimulating humoral and cellular immunity [15; 16; 17]. Apparently, safflower (*Carthamus tinctorius*) has antioxidant, anti-inflammatory, analgesic, antidiabetic, antiallergic, hepatoprotective and antilipidemic properties. In addition, calendula infusion helps prevent cell proliferation.

Flavonoids in safflower are pharmaceutical ingredients that are effective in the treatment of cardiovascular and cerebrovascular diseases. The biosynthetic functions of flavonoids in sulfur have been studied. Both groups are conducting a comprehensive collection of data on the chemical structure of flavonoids and organic acids. The substance luteolin, found in marigolds, has anti-allergic properties.

Luteolin is a flavonoid found in some medicinal and aromatic plants and fruits. Luteolin is the most potent xanthine oxidase inhibitor of all flavonoids. [1,4] It is a natural antioxidant with a lower prooxidant potential than the most studied flavonoid, the flavonol quercetin, but with a safer profile. It has excellent radical scavenging and cytoprotective properties, and may interact with other antioxidants such as vitamins, especially when tested in complex biological systems. Luteolin has anti-inflammatory activity by inhibiting cyclooxygenase-2, reduces the level of anti-inflammatory cytokines (IL-1 $\beta$  and TNF- $\alpha$ ).

Safflower (*Carthamus tinctorius*) is grown in different countries for its flavonoid compounds. These flavonoids are used in many fields as medicines and dyes. More than 60 flavonoids have been isolated from the safflower flower. These flavonoids can be divided into two groups: specific and general, both of which are considered active. A special group of compounds present in safflower has a unique structure and exhibits high activity in the treatment of cardiovascular and cerebrovascular diseases. These are almost exclusively quinochalcone compounds such as hydroxysafflower A (HSYA) and carthamin, which are present only in the safflower plant and are mainly C-glycosides [4,21]. Thus, the specific flavonoid biosynthetic pathway in marigold has attracted the attention of researchers, and some flavonoid biosynthetic genes and transcription factors have been successfully cloned in marigold plant.

Another study confirmed that Asteraceae extracts are novel monoamine transporters, modulators that act as dopamine transporter/norepinephrine transporter activators and/or serotonin transporter inhibitors, suggesting that these extracts have potential therapeutic effects. Flavonoids are known for their diverse biological activities, especially antioxidant and anti-inflammatory activities (Li et al., 2015; Yi et al., 2014). Therefore, studies on the antioxidant activity of *Carthamus tinctorius* have mainly focused on flavonoids (Roback and Gryglowski, 1988; Jueting et al., 1990; Li et al., 2002). When assessing the effects of flavonoids, it is important to consider the route of administration, as they are often extensively metabolized when taken orally. Safflower flavonoids are a general group and are present in many species, with diverse activity represented by kaempferol, hyperoside, naringenin, quercetin, and luteolin [5,8].

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Luteolin exhibits a unique anti-inflammatory effect at micromolar concentrations, which is only partly explained by its antioxidant activity. Luteolin activates enzymes with anti-inflammatory and antioxidant properties, and inhibits pro-inflammatory substances. When luteolin is administered to animals *in vivo*, it increases vascular permeability more effectively than when administered parenterally and orally.

Although luteolin is only a minor component of our diet (less than 1 mg per day), epidemiological studies have shown. It demonstrates potential protection against diseases associated with inflammatory processes, such as cardiovascular disease. Luteolin is often present in plants in the form of glycosides, but these are broken down and the aglycones coagulate and metabolize after the nutrients have been absorbed. Some epidemiological studies suggest that luteolin consumption may protect against cardiovascular disease or certain cancers, but prospective clinical trials are lacking.

**Finally**, it should be noted that some flavonoids and polyphenols in safflower have been studied and found to have immunomodulatory properties. This indicates that since ancient times, our people have always used the safflower plant due to its high efficiency and effectiveness in the treatment of allergic diseases, as well as its minor side effects. Currently, many studies have been conducted to study the composition of safflower and the results show that the substance luteolin, which is contained in marigolds, has anti-inflammatory properties due to its ability to block COX-2 and reduce the level of cytokines (IL-1 and TNF- $\alpha$ ).

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