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TECHNOLOGY FOR THE EXTRACTION OF BIOLOGICALLY ACTIVE COMPOUNDS FROM THE MEDICINAL PLANT CALENDULA (CALENDULA OFFICINALIS L.) AND ITS CULTIVATION FOR USE IN FOLK MEDICINE

Mangliyeva Marjona Rashid qizi

Osiyo xalqaro universiteti o'qituvchisi ,Buxoro shahri

Annotatsiya. Maqolada olib borilgan izlanishlar natijasida dorivor tirnoqgul (Calendula officinalis) o'simligining dorivorlik xususiyatlari, yashash sharoiti, geografik tarqalishi, kimyoviy tuzilishi va makro-mikroelementlari yoritilgan bo'lib, zamonaviy texnologiyalarni qo'llagan holda ushbu o'simlik asosida turli dori turlarini yaratish, hamda import o'rnini bosuvchi dori vositalarni ishlab chiqarish, farmatsevtika bozorini boyitishda muhim ahamiyatga ega.

Kalit so'zlar: Tirnoqgul, kalendula officinalis, gul, elementlar, efir moy, damlama, preparat, mikro va makroelementlar, flavonoidlar, efir moylari,karotinoidlar.

Abstract. The research presented in this article highlights the medicinal properties, habitat, geographical distribution, chemical composition, and macro- and microelements of the medicinal plant *Calendula officinalis*. The study emphasizes the importance of using modern technologies to develop various pharmaceutical products based on this plant, as well as producing import-substituting medicines, thereby contributing to the enrichment of the pharmaceutical market.

Keywords: Calendula, calendula officinalis, flower, elements, essential oil, tincture, preparation, micro and macro elements, flavonoids, essential oils, carotenoids.

Аннотация. В статье проведены исследования, в которых освещены лечебные свойства, место произрастания, географическое распространение, химическая структура, макро- и микроэлементы растения ноготки лекарственные (Calendula officinalis), что имеет большое значение при создании различных видов лекарственных средств на основе этого растения с использованием современных технологий, а также при производстве импортозамещающих лекарственных средств, обогащающих фармацевтический рынок.

Ключевые слова: Календула, календула лекарственная, цветок, элементы, эфирное масло, настойка, препарат, микро- и макроэлементы, флавоноиды, эфирные масла, каротиноиды.

INTRODUCTION.

At present, the introduction of plants with beneficial properties and their cultivation under new environmental conditions is one of the most important tasks. In the current stage of rapid societal development, it is essential to efficiently utilize

ISSN 3030-3907

plant raw materials in food, pharmaceutical, and medical industries to improve public welfare.

Therefore, scientists in our country are consistently conducting research on the domestication, introduction, and breeding of new varieties of wild plants with useful properties. In recent years, the share of plant-based medicines in healthcare has been steadily increasing, currently exceeding 60%. The growing demand for herbal medicines is mainly due to their mild effect on the human body, low incidence of side effects, and affordability. According to the Resolution No. PQ-251 of the President of the Republic of Uzbekistan dated May 20, 2022, systematic work is being carried out to cultivate medicinal plants, process them, and widely use them in treatment.

Origin and Distribution of Calendula officinalis.

The homeland of **Calendula officinalis** *is Southern and Central Europe. It is widely* distributed in all republics of Central Asia as an ornamental and medicinal plant. This plant belongs to the Asteraceae family and is commonly known as calendula.

It has been widely used in folk medicine since ancient times and is now also extensively applied in modern medicine. More than 20 species of this genus are known, mainly distributed in the Mediterranean region, Iran, and the Canary Islands. It is cultivated in many countries as both an ornamental and medicinal plant.In Uzbekistan, it does not grow wild but is cultivated. It is also grown in Moldova, Ukraine, southern regions of European Russia, the Caucasus, Krasnodar region, Poltava, and Moscow regions.

MATERIALS AND METHODS.

Botanical Description.**Medicinal calendula (*Calendula officinalis* L.)** belongs to the Asteraceae family (Compositae). It is an annual herbaceous plant reaching a height of 30–50 cm (sometimes up to 60 cm). The root system consists of a branched taproot. The stem is firm, erect, branched from the base, ribbed, and covered with glandular hairs in its upper part. The leaves are simple, petiolate, oblong to inversely ovate, pubescent, and arranged alternately along the stem. The upper leaves are sessile, ovate or lanceolate. The flowers are arranged in capitula (flower heads). The fruit is an achene. The plant blooms from June until late autumn, and fruiting begins in July. Many varieties of calendula have been cultivated. The flowers are yellow or light orange in color, formed in heads, and have a pleasant aroma. The flower head is surrounded by short ligulate (ray) flowers. These ray flowers are yellow to light-colored, glossy on the upper side and darker underneath. The tubular flowers in the center are small, yellow or dark brown. In its native habitat, flowering continues from July until temperatures drop

ISSN 3030-3907

(until November). Fruits and seeds ripen, and seed viability is maintained for 4–5 years. Currently, the plant is propagated by seeds. It has been cultivated as an ornamental plant since the 11th century.

The cultivation of calendula seedlings begins in April in greenhouses or hotbeds, and the prepared seedlings are transplanted into small furrows. The finished raw material consists of whole flower heads with a diameter of 3–8 cm (on average 5 cm), either without peduncles or with peduncles not exceeding 3 cm, and having a yellow or dark orange color. The involucre bracts of the flower head are grayish-green, arranged in one or two layers, narrow lanceolate in shape, and pointed at the tip. The receptacle is flat, slightly concave, and hairless. The marginal ligulate (ray) flowers number 25–250, arranged in 2–3 rows (up to 15 rows in special varieties), and have 2–3 small teeth at the apex. The central flowers are tubular and five-toothed.

The product has a weak, pleasant aroma and a slightly salty and bitter taste. According to the XI State Pharmacopoeia (DF XI), the product must meet the following standards: moisture content not more than 14%, total ash not more than 11%, ash insoluble in 10% hydrochloric acid not more than 2%, peduncle residues (including those separated during analysis) not more than 6%, flower heads with fallen petals not more than 20%, browned flower heads not more than 3%, admixture of stems and leaves not more than 3%, organic impurities not more than 0.5%, and mineral impurities not more than 0.5%. Additionally, the extractive substances obtained with 70% ethanol must be at least 35%. Medicinal calendula contains essential macro- and microelements such as boron (B), phosphorus (P), iron (Fe), potassium (K), mercury (Hg), zinc (Zn), calcium (Ca), manganese (Mn), sodium (Na), magnesium (Mg), and silver (Ag), all of which are important for the human body. The composition of the plant includes 7.6–7.8 mg% of carotene (with carotenoids in the marginal ligulate flowers comprising 3% of the total), 0.4–0.62% essential oils, 0.33–0.88% flavonoids (quercetin, isorhamnetin, isoquercetin, among others), and coumarins (esculetin, scopoletin, umbelliferone). It also contains 3.44% resins, up to 4% mucilage, 10.4–11.2% saccharides, up to 19% bitter substance calendine, 6.84% malic acid, pentadecylic acid, and small amounts of salicylic acids, triterpenoid diols (arnidiol and faradiol), triterpenoid saponins (calendulosides), and alkaloids. The leaves and roots of ***Calendula officinalis*** contain glycosides. From the total glycosides, the glycosides calenduloside S and calenduloside D have been isolated. Upon hydrolysis, calenduloside S breaks down into two molecules of glucose, one molecule of galactose, and oleanolic acid as the aglycone.

ISSN 3030-3907

Medicinal Properties. Medicinal calendula is cultivated in many regions of our country due to its wide range of therapeutic properties. The flowers of ***Calendula officinalis*** contain carotene and related compounds, essential oils, nitrogenous mucilages, resins, and organic acids. The aerial parts of the plant contain the bitter compound calendine, saccharides, triterpenoid diols, and saponins. Its seeds are rich in fatty oils and contain small amounts of alkaloids. The high content of carotenoids, calendine, carotene, resins, organic acids, essential oils, glycosides, tannins, and phytoncides in the flowers allows for their maximum therapeutic use. Calendula has long been recognized for its excellent medicinal properties and soothing effects. Traditional physicians used it as a diuretic and expectorant. Additionally, it has been employed in the treatment of hepatitis, cholecystitis, gastric ulcers, hypertension, and kidney stone disease. Various preparations of calendula were also prescribed for sore throats, dental tissue inflammation, and oral ulcers. Historically, Ibn Sina (Avicenna) used calendula to treat baldness and bruises, as well as for snake and scorpion bites. In France, it was widely applied as a remedy for wound healing and to induce perspiration. In traditional Indian medicine, it was used as a tonic and revitalizing drug. It is especially recommended to briefly expose calendula flowers to steam and then infuse them in tea. Consuming this tea 3–4 times a week is considered beneficial.

Cardiovascular Diseases: Calendula helps improve overall body condition in patients with various cardiovascular disorders without causing adverse effects. It is used therapeutically to treat problems of the cardiovascular system. Modern medicine has shown that preparations of calendula can calm the central nervous system, lower blood pressure, regulate heart function, and exert lethal effects on many pathogenic bacteria.

These preparations are applied in the treatment of diseases of the liver, spleen, kidneys, stomach, and biliary tract, as well as hypertension, atherosclerosis, certain heart conditions, and menopausal symptoms. The pharmaceutical preparation Kaleflon is used to accelerate healing in gastric and duodenal ulcers, reduce inflammation, and treat gastritis. Calendula is also included as a component in certain anticancer medications.

Medicinal Forms: The main preparations include infusions, tinctures, calendula ointments, and *Kaleflon* (a tablet form containing purified flower extract). **Preparation of Medicinal Calendula at Home:** To prepare a herbal remedy from calendula flowers at home, place 2 teaspoons of calendula flowers into 2 cups of boiling water in a heat-resistant, tightly sealed container and let it steep for 15 minutes. The infusion is then strained through a fine cloth. The recommended dosage is half a cup, taken 4 times a day. Alternatively, 20 grams of

ISSN 3030-3907

crushed calendula flowers can be added to 400 grams of boiling water and boiled for 10 minutes. After cooling, the decoction is strained and taken orally, 1 tablespoon, 3 times a day.

Cultivation Technology of Calendula. Calendula can be cultivated in all soil and climatic conditions of the republic. However, it produces higher yields in fertile soils with sufficient moisture and medium mechanical composition. For proper plant development and to obtain high-quality and abundant inflorescences, it is necessary to pay special attention to fertilization, proper irrigation scheduling, and control of pests and weeds.

Before autumn plowing, the fields designated for calendula cultivation are enriched with 20–30 tons per hectare of organic fertilizers, along with 70% of the annual phosphorus fertilizer нормы, and plowed to a depth of 25–30 cm. Calendula is sown either in late autumn or early spring.When preparing seeds for sowing, the following GOST standards must be observed: the seeds must meet quality conditions and belong to Class I or II; purity should be 94–96%, and germination rate should not be less than 70–75%. Before early spring sowing, the soil is leveled and cleared of weeds. When the soil temperature reaches 20–22°C, seeds are sown at a depth of 2–3 cm, with a seeding rate of 10–12 kg per hectare. Seeds are sown using seeding equipment with a row spacing of 60 cm, and germination occurs within 7–8 days. The care of calendula begins as soon as the first seedlings emerge. After germination, the fields are weeded and thinned, leaving 1–2 plants in each spot at a distance of 15–20 cm within the rows. Weeds within the rows are removed manually using hoes, while inter-row cultivation can be carried out using tractor-mounted cultivators. The first fertilization is applied after seedling emergence, with 30 kg/ha of nitrogen and phosphorus fertilizers. Since calendula has high nutrient requirements, the second fertilization is carried out dmended to apply fertilizers before each irrigation. After irrigation, the soil between rows is loosenuring the budding stage, applying 40 kg/ha of nitrogen and 30 kg/ha of potassium fertilizer.



It is recomed and cleared of weeds. The final fertilization is carried out during the mass flowering stage, applying 40 kg/ha of nitrogen and 30 kg/ha of phosphorus fertilizers. When calendula is sown in autumn, seedlings emerge in April. Furrows are formed when each plant develops 3–4 leaves. During prolonged warm autumns, some seeds germinate and overwinter in the rosette stage, usually without being damaged by cold. These overwintered plants begin flowering within 35–40 days, typically in early May.

ISSN 3030-3907

When calendula is cultivated on irrigated typical gray soils, excessive moisture in certain years may lead to the formation of a soil crust on the surface. This can lead to a reduction in the number of seedlings. To eliminate soil crust formation, rotary hoes, light harrows, and spiked rollers are used [4,6,9]. When these measures are applied, the seedlings are not damaged. In June and July, due to the intensive vegetative growth of calendula, inter-row cultivation becomes more difficult, and the plant produces a large amount of green biomass during the growing season. For this reason, it is considered a crop with high nutrient requirements. Taking this into account, it is recommended to include calendula in crop rotation systems. During the growing season, calendula fields are irrigated 9–10 times, depending on air temperature and moisture conditions. Plantations established on fertile soils, cleared of weeds, fertilized with 70–80 kg/ha of phosphorus in autumn, and deeply cultivated can be maintained and used for 2–3 years without replanting [1,3].

Each year, due to natural seed shedding, new seedlings emerge in winter and spring, which can be utilized. With proper care during the growing season (fertilization, irrigation, and pest and disease control), calendula blooms continuously from May until late autumn (until frost). During the vegetation period, flowers can be harvested 15–20 times. The yield of harvested flower heads can reach 10–18 centners per hectare or more. Like all cultivated crops, calendula can be affected during its growth by powdery mildew, flies, soil insect larvae, beetles, mites, weevils, fungi, aphids, butterflies, and other pests. To prevent diseases, a solution of 25 ml of Topaz preparation per 100 liters of water is sprayed. In addition, good results are obtained by spraying a 1% suspension of entobacterin (600 liters per hectare) against caterpillars. It is also recommended to release 40–45 thousand trichogramma per hectare in fields during the egg-laying period of butterflies. Fields affected by powdery mildew should be dusted with 30 kg/ha of finely ground sulfur during periods of high temperature. Against aphids, thrips, and butterflies, plants are treated twice during the growing season with a 40% emulsion of “Danadim.”

Harvesting and Drying The harvesting of calendula begins at the onset of flowering. Newly opened flowers are collected first, usually by hand. Due to the continuous opening of flower heads, harvesting is carried out every 3 days, and at most every 4–5 days. To prevent overheating and deterioration of quality, the harvested flower heads should not be stored in piles or containers for more than 3–4 hours. The collected material is dried using specialized drying equipment (such as SPK dryers) or air dryers (VPT-400, VPT-600) at a temperature of 40–45°C. The drying process lasts for 4–6 days. The dried product is then packed without

ISSN 3030-3907

compression into special paper bags, each containing up to 20 kg, and stored accordingly. The storage period of the product in dry warehouses should not exceed 2 years.

Results and Discussion. Based on the obtained results, considering the medicinal properties of ***Calendula officinalis***, the application of modern technologies for the development of various pharmaceutical products derived from this plant is of great importance. Furthermore, the production of import-substituting medicines based on calendula plays a significant role in enriching the pharmaceutical market.

Conclusion. ***Calendula officinalis*** is a valuable medicinal plant with high pharmacological potential. Its proper cultivation, processing, and application using modern technologies can significantly contribute to the development of the pharmaceutical industry.These components determine its wide spectrum of pharmacological activities such as anti-inflammatory, antimicrobial, wound-healing, sedative, and cardioprotective effects.The study confirms that the proper cultivation of calendula under suitable soil and climatic conditions, along with scientifically based agrotechnical measures—such as optimal fertilization, irrigation, and plant protection—ensures high yields and quality raw materials. The plant's adaptability to different environmental conditions and its relatively simple cultivation technology make it a promising crop for large-scale agricultural production. Furthermore, the application of modern extraction technologies enables the efficient isolation of biologically active compounds, which can be used to develop a wide range of pharmaceutical products, including infusions, tinctures, ointments, and tablet forms such as standardized extracts. These products are not only effective but also relatively safe and economically accessible compared to synthetic drugs.The increasing global demand for natural and plant-based medicines highlights the importance of expanding the cultivation and processing of ***Calendula officinalis***. Its use in producing import-substituting pharmaceuticals can significantly reduce dependency on foreign medicinal products and strengthen the national pharmaceutical industry.In conclusion, the integration of traditional knowledge with modern scientific approaches in the study and utilization of calendula provides significant opportunities for advancing healthcare, improving public health outcomes, and enriching the pharmaceutical market with effective, safe, and affordable herbal medicines.

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ISSN 3030-3907

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