



Chemical composition and health benefits of some medicinal plants

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Abstract. Medicinal plants are plants which contain a lot of substances with benefic properties for human health. It is preferable to use this plants for prevention, not as a treatment. Many medicinal plants are often use to prevent the occurrence of breast cancer, lung cancer, colon cancer, coronary diseases, oral cavity diseases. A high antioxidant activity realised by this plants prevent the oxidative stress which can cause the occurrence of diseases. For a better understanding of this subject is usefully to know about the chemical composition of them and the health benefits. We studied four plants: *Calendula officinalis*, *Equisetum arvense*, *Lycopodium clavatum*, *Ginkgo biloba*.

Key Words: *Calendula officinalis*, *Equisetum arvense*, *Ginkgo biloba*, health, *Lycopodium clavatum*, treatment.

Introduction. Medicinal plants bring many health benefits to those who consume them. Different types of plant extracts can have therapeutic effects on consumers. Medicinal plants present a variety of secondary metabolites that can be extremely beneficial in various industries such as perfumes, food additives, flavors, pharmaceuticals, food industries, and others. For example, studies conducted on *Equisetum arvense* demonstrate that it has antimicrobial, antioxidant, anti-inflammatory, immunological and antidiabetic effects (Al-Snafi 2017). *Calendula officinalis* or marigold has antioxidant, immunomodulatory action and is useful in various pathologies such as gingivitis and periodontitis (Potra-Cicalău et al 2022). *C. officinalis* has been used since ancient times to heal some wounds and dermatological problems (Leach 2008). Various studies conducted on laboratory animals provide evidence of recovery from the inflammatory phase for groups that were treated with *C. officinalis* extracts. To highlight the effect of *C. officinalis* on very complex wounds, much more complex studies are needed to highlight wound healing (Givol et al 2019). *Lycopodium clavatum* is still widely used in traditional medicine. It has anti-inflammatory effects and has beneficial effects on the reproductive system (Banerjee et al 2014). *Ginkgo biloba* brings improvement to people suffering from Alzheimer's, but detected in the early stages (Sierpina et al 2003).

Calendula officinalis. *C. officinalis* is native to southern Europe. The plant is part of the family Asteraceae. *C. officinalis* can be dried to make various spices or can be used raw, in salads. Preparing teas, compresses, creams, oils are antoher uses of this plant. Internal uses can be reliable for the treatment of colds, hepatitis, different endocrine disarruptions. Externally, *C. officinalis* treats varicose veins, skin diseases, acne. The mariogold cream has moisturizing properties for the skin (Ardelean & Mohan 2008; Zanetti 2019; Ion 2022).

Chemical composition. Chemically, *C. officinalis* contains bitter substances, malic acid, carotenoids, flavonoids, volatile oils, vitamin C, protein substances, saponins. Macroelements, such as calcium which supports the integrity of the cell wall, sodium

which ensures osmotic balance, potassium which ensures cold resistance are very important. *C. officinalis* contains 1.151% calcium, 0.327% magnesium, 1.224% potassium, 0.624% sodium; microelements concentration found by: are zinc 14.8 ppm, copper 10.5 ppm, manganese 59 ppm, nickel 3.6 ppm, cobalt 1.1 ppm, iron 826 ppm (Ardelean & Mohan 2008; Stef et al 2010). Also, these compounds have antibacterial, antiviral, anti-inflammatory properties (Shahane et al 2023).

Carotenoids. Carotenoids such as β -carotene, lutein, flavoxanthin and zeaxanthin, lycopene, luteoxanthin, α -carotene, neoxanthin have a high antioxidant capacity. Also, carotenoids confer the color to the plant. Using the HPLC method, the total contents of the carotenoids were measured for *C. officinalis* grown in the sun (0.872 mg g⁻¹ in petals) and in the shade (1.154 mg g⁻¹ in petals). Lutein, zeaxanthin, lycopene are known for their antioxidant potential (Bernatoniene et al 2011; Balázs et al 2023; Shahane et al 2023).

Terpenoids. Terpenoids play a crucial role in the antioxidant capacity of the plant. Terpenoids can be found in roots, flowers and have effects against Alzheimer disease, skin hyperpigmentation, diabetes. Faradiol, known for its anti-inflammatory properties, contributes to cells protection against oxidative stress. Lupeol has anticarcinogenic uses (Shahane et al 2023).

Flavonoids. Flavonoids, such as quercetin, rutin, kaempferol, luteolin have also a main role in antioxidant capacity of *C. officinalis*. Quercetin protects the cells against oxidative stress, rutin helps in blood vessels consolidation. Luteolin is known for its neuroprotector effects because it prevents the neuronal degradation and it improves cognitive function (Shahane et al 2023).

Coumarins. Umbelliferone, scopoletin, esculetin are the main coumarins found in the flowers of this plant. Umbelliferone protects the skin against the sun rays, UV rays and prevents the skin degradation. It is also found in sunscreens. Squelitin is anticarcinogenic, antithrombotic. Scopoletin is used as a spasmolytic and also for treating inflammation (Shahane et al 2023).

Phenolic acids. Caffeic acid, vanillic acid, coumaric acid, chlorogenic acid, rosmarinic acid, salicylic acid are fundamentally constituents of *C. officinalis* (Shahane et al 2023).

Fatty acids. The fatty acids present in the highest concentration in *C. officinalis* are: linoleic acid, oleic acid, palmitic acid, calendic acid. Calendic acid is in the highest amount, having cytotoxic action, moisturizing effect, supporting skin healing. It inhibits cancer cell proliferation, also having anti-inflammatory role (Shahane et al 2023).

Benefits

Antibacterial and antifungal. Bacteria like *Klebsiella pneumoniae*, *Escherichia coli*, *Bacillus cereus*, *Pseudomonas aeruginosa*, and *Bacillus subtilis* are inhibited by the *C. officinalis* extracts. Also, some fungi which carcinogenic potential like *Candida albicans*, *Aspergillus flavus*, *Aspergillus niger*, and *Aspergillus fumigatus*, are destroyed by these extracts. Efstratiou et al (2012) used methanolic and ethanolic extracts. Methanolic extract has better antibacterial activity than ethanolic extract. Both extracts were highly effective against all fungi.

Essential oil with *C. officinalis* has the highest antibiotic effects on the Gram negative bacteria. The test results of the study of Chaleshtori et al (2016) showed that the highest zone of inhibition was for *E. coli* and the lowest for *Staphylococcus aureus*.

Skin health. The skin it is known as the biggest organ in human body. Every day, this organ is affected by different chemical, mechanical, physical factors, like the temperature, air humidity, UV radiations. Using a cream with *C. officinalis*, which has

been applied to the skin of 21 people for 8 weeks the skin health had to win. After this period, skin firmness, hydration, elasticity of the skin have improved (Akhtar et al 2011).

Antidiabetic effects. Rats were treated with hydroalcoholic extracts of marigold. After performing certain tests, changes were found in various parameters necessary to identify this disease such as blood glucose and urine sugar levels which decreased significantly at doses of 25 and 50 mg kg⁻¹ body. By administering doses of 100 mg kg⁻¹ body weight, the parameters were found to return to normal and the effects were similar to insulin (Ashwlayan et al 2018).

Lycopodium clavatum. *L. clavatum* can be found in mountainous areas, in Europe, Asia and America. The plant has small, thick leaves with a spiral arrangement. The spores and the aerial part of the plant are used and the plant can be harvested between the months of July and August (Ardelean & Mohan 2008).

It is used as a dry shampoo, talcum powder, treating mole, treating colon cancer, treating botulinum neurotoxin A infection. Externally, it is used for dermatitis, hemorrhoids, rheumatism, eczema, and for internal use it is used to combat excessive consumption of tobacco and alcohol, kidney lithiasis, cirrhosis, hepatitis, diseases of the genital tract (Ardelean & Mohan 2008; Ion 2022).

Chemical composition

Terpenoids. Terpenoids are major constituents of this plant. Some examples are: lycopodin, lycopene, lycoflavin, lycoflexin. Lycopodin has a role in treating infections and respiratory ailments and lycopene contributes to eye and epithelial tissue health (Das et al 2013).

Flavonoids. Apigenin is used for anticarcinogenic effects and against cardiovascular diseases. Also, it has antioxidant properties and it protects the DNA. Analyzing keratinocytes from the rats skin, this flavonoid shows an important effect against UV radiation type B. Another flavonoid present in high quantities is luteolin (Das et al 2013).

Alkaloids. Alkaloids play a crucial role in antioxidant capacity and help enzymatic inhibition of acetylcholinesterase. One of the most important alkaloids is huperzine A. HupA has better penetration through the blood-brain barrier and a longer duration of AChE inhibitory action. This property could help for finding a treatment for Alzheimer disease. Also, the alkaloids improve the digestive system health, calm the skin, healing the inflammation. Another important alkaloid is nicotine which stimulates the central nervous system (Ciesla et al 2016).

Phenolic acids. Phenolic acids present in *L. clavatum* are: vanillic acid, coumaric acid, ferulic acid, syringic acid. Dihydrocaffeic acid is also present in this plant (Khare 2007; Dymek et al 2021).

Fatty acids. Compounds such as: phytosterines, dioxistearic acid have been identified in the composition of this plant. Fatty acids are found in the spores of *L. clavatum* and have anti-inflammatory effects (Banerjee et al 2014; Ciesla et al 2016).

Benefits

Effects against botulinum toxin A. *Clostridium botulinum*, a Gram-positive bacteria that produces BoNTs A-G neurotoxins. These toxins are responsible for botulinum poisoning and peripheral neuromuscular blockage. BoNTs can be found in contaminated food or in soil. Just a quantity of 1 ng kg⁻¹ body are lethal for human. These toxins are in A category for the bioterrorist agents. To stop their action, a compound found in *L. clavatum* called 3,4-diaminopyridine is essential. This compound stops the paralysis caused by botulinum neurotoxin (Serhan et al 2019).

Anticarcinogenic action. *L. clavatum* has benefic effects against different types of cancer, including breast cancer or colon cancer. Lycopodin, an important component of this plant inhibits the HeLa cells, known for this type of cancer. Extracts of this plant could be a treatment for this disease. Ethanolic extract with the leaves of this plant inhibit the cellular line SKBR-3, known for breast cancer. It causes the cells apoptosis and this extract could be a source of treatment for this hard disease which causes a lot of deaths globally (Paramita et al 2018; Dastouri & Küçükbağrıaçık 2023).

Supporting the urinary system. A common disease of urinary system is urolitiasis. In serious cases, surgery is necessary, but extracts with *L. clavatum* could help. The patients consumed this extracts and eliminated kidney stones bigger than 8 mm, which normally requires surgical intervention. Even 23 mm kidney stones were eliminated. It is belived that this plant could replace with succes another treatments which requires chirurgical intervention (Sumreen et al 2021).

Ginkgo biloba. *G. biloba* was found 200 million years ago and is considered a living fossil and the best selling medicinal plant. It is found nearby rivers and it belongs to the Ginkgophyta (Singh et al 2008).

This tree can be easily recognized by its fan-shaped and 30 meter stem. The seeds grow to the size of an apricot, with an unpleasant-smelling integument. From October to December is the harvesting period. Numerous researches attest that extracts from *G. biloba* leaves improve blood circulation. Positive effects have also been obtained in the treatment of diabetic nephropathy, various diseases of the nervous system, cerebrovascular ischemia, Alzheimer's (Van Beck 2002; Ardelean & Mohan 2008; Liu et al 2021).

Chemical composition

Carotenoids. α -caroten, γ -caroten, lutein and zeaxantin are often found in *G. biloba* (Singh et al 2008). Carotenoids content varies from season to season. For example it increases from May to July and decreases from August to September. When autumn is coming, the leaves turn yellow because of these pigments (Šangut & Samec 2024).

Flavonoids. There are more than 110 flavonoids present in *G. biloba* leaves. Quercetin, kaempferol, luteolin, biginkgolid are mentioned. They have anticarcinogenic, antimicrobial, antiviral potential, preventing neuronal degeneration. Their identification was done by liquid chromatography coupled mass spectrometry (LC-MS) (Singh et al 2008).

Terpenoids. *G. biloba* contains ginkgolides, bilobalides, sesquiterpene, lactones. Ginkgolides A, B, C, J, K, L, M, N, P, Q, bilobalides stimulate memory capacity, improve learning function, and help reduce the symptoms of epilepsy. They also inhibit platelet activity, preventing cardiovascular disorders (Singh et al 2008).

Phenolic acids. These include caffeic acid, gallic acid, vanillic acid, coumaric acid. Gallic acid has activity against tumor cells, neutralizes free radicals (Liu et al 2021).

Polysaccharides. Arabinose, glucose, mannose, galactose have an important role in arresting diabetic retinopathy and alleviating symptoms of fatty liver disease. These polysaccharides support cell apoptosis, inhibit proliferation of breast 4T1 cells (Liu et al 2021).

Benefits

Improving the cognitive function. Extracts that contain this plant have a crucial role in this process. Liu et al (2021) demonstrated that the ability to memorize of the mice that have been treated with *G. biloba* extracts for 4-8 weeks has improved.

Acetylcholinesterase has an important role in degenerative diseases such as Alzheimer's, Myasthenia gravis. Acetylcholinesterase inhibitors are used to treat these diseases. However, too high levels and an increase in their levels due to the presence of free radicals can have negative effects. Oxidative stress also occurs. Oxidative stress can be minimized with the help of antioxidant capacity of *G. biloba* extracts due to phenolic compounds (Necip & Isik 2019).

Antidiabetic. The insulin level and plasma glucose level are reduced with the help of *G. biloba*. Also, it is beneficial for losing weight, reducing waist circumference, and modulates the visceral fat deposition index (Barbalho et al 2022). In the early stage of diabetes disease, an increased albumin excretion rate is noted, identified by the UAER index. Extracts with *G. biloba* could decrease the level of this index (Liu et al 2021).

Actions against cardiomyopathy. Cardiomyopathy, a serious heart disease could cause heart failure. Because of the bioactive components, *G. biloba* extracts ensure a good blood circulation. Also, the oxidative stress which may occur, can be avoided. Ginkgolide A has antithrombotic effect which is beneficial for heart health (Barbalho et al 2022).

Equisetum arvense. *E. arvense*, a herbaceous plant with adventitious root, is found in humid areas such as river banks. The stem has a spike with spores at the end. The sterile part of the stem has a green colour. Harvest period is between July and October (Ardelean & Mohan 2008).

Internally, it can be used for some diseases such as bleedings, cardiac diseases, rheumatic pains, ulcers. External application of different preparations with this plant are suitable for hemorrhoids, contusions. Also, they are beneficial for wound disinfection and healing (Ardelean & Mohan 2008; Ion 2022).

Chemical composition. *E. arvense* is rich in active principles such as: vitamin C, oleic acid, linoleic acid, malic acid, potassium salts, glutelone (Ardelean & Mohan 2008).

Macroelements and microelements. Skeletal system is supported by silicon, calcium, magnesium, potassium, iron, selenium, zinc present in *E. arvense*. It contains 2.197% calcium, 0.433% magnesium, 1.117% magnesium, 0.078% sodium, defining macroelements in the plant's metabolism (Ştef et al 2009; Suciuc & Ardelean 2012; Borloveanu 2021). Because of the significant silicon content, this plant could improve the mobility of the joints. The production of the collagen is also higher. Silicon is present in rhizome, leaves, spores, stem (Ardelean & Mohan 2008; Law & Exley 2011).

Benefits

Hepatoprotective effects. Since ancient times, Oriental medicine has used *E. arvense* for liver diseases such as hepatitis (Oh et al 2004). The hepatoprotective effects were tested on a human liver cell line, Hep G2. Tacrine produces cytotoxicity on this type of cell. The acetylcholinesterase inhibitor, tacrine, is used to improve the symptoms caused by Alzheimer's disease. Compounds such as the phenolic petrosins, onitin and onitin-9-O-glucoside, together with four flavonoids, apigenin, luteolin, kaempferol-3-O-glucoside and quercetin-3-O-glucoside present in the plant inhibit the harmful action of tacrine on liver cells. *E. arvense* extract was used at a concentration of 400 µg mL⁻¹ (Oh et al 2004).

Antimicrobial effects. *Escherichia coli*, *K. pneumoniae*, *P. aeruginosa*, *S. aureus* are inhibited by *E. arvense* extracts. Also, the extracts have effects against some fungi such as *A. niger* and *C. albicans*. Petri dishes with 5 µL extract and some bacteria have been cultivated. After 24 h, the greatest sensitivity was detected at *P. aeruginosa* and the most resistant bacteria was *S. aureus* (Bessa Pereira et al 2012).

Bone tissue recovery. It is mentioned that *E. arvense* has a role in treating bone diseases, but also in bone regeneration after a fracture. The accumulation of flavonoids

and phenolic acids in this plant has a positive impact on bone tissue. Long-term bone health is maintained by these compounds. At the same time, significant amounts of silicon play an important role in bone regeneration. Silicon contributes to the absorption of calcium, supporting the synthesis of collagen, important for bones. *E. arvense* is also effective in treating osteoporosis (Bessa Pereira et al 2012; Costa-Rodrigues et al 2012).

Conclusions. This four medicinal plants, known as *Calendula officinalis*, *Lycopodium clavatum*, *Equisetum arvense*, *Ginkgo biloba* contain a lot of terpenoids, flavonoids, phenolic acids and many other chemical substances. They improve people's health, because using them as tinctures, creams, internally or externally, they could treat bone diseases, hepatic diseases. Also, this plants have antimicrobial effects against a lot of bacteria, antidiabetic properties, anticarcinogenic functions and support the urinary system.

Conflict of interest. The authors declare that there is no conflict of interest.

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Received: 18 September 2025. Accepted: 30 October 2025. Published online: 22 December 2025.

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How to cite this article:

Simion L., Pece O. A., Sabou A., Coroian A., 2025 Chemical composition and health benefits of some medicinal plants. *AAB Bioflux* 17(1):61-68.