

REVIEW ARTICLE

OAK: Overview

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ABSTRACT:

Objective. Natural herbal compounds and medicines based on them take a significant place in modern medicine. The article presents an analysis of published data on the oak, its botanical characteristics, chemical composition and medical use. The use in medicine is divided, in accordance with directions. Also represented the most a widely use prescription which include oak bark.

Methods. The analysis of the literature has been conducted, and current literature data on botanical characteristics, chemical composition, application in medicine oak bark have been summarized.

Results, and Conclusion. The range of combined medicines containing oak bark has been studied. Due to its chemical structure (tannin, gallic and ellagic acids) and pharmacological activity (astringent, anti-inflammatory, antimicrobial and antiviral properties) promising outlook of using it in the development of medicinal preparations has been demonstrated.

KEYWORDS: Oak, bark, botanical characteristic, chemical composition, medical application.

INTRODUCTION:

The centuries-old traditions and experience of application in traditional medicine formed a deep reliance upon medicinal plants in all social strata. Natural herbal compounds and medicines based on them take a significant place in modern medicine. In the global pharmaceutical industry, every third medicine is produced from medicinal plants. The reason is their low toxicity and the possibility of long-term use without significant side effects [1, 2].

Nowadays about 600 types of herbal raw materials are used in medicine. One of these plants is oak (*Quercusrobur*), which has long been used to treat a number of diseases [3,4, 5].

RESULT AND DISCUSSION:

Oak (*Quercusrobur* L.) belongs to the *Quercus*genus of the *Fagaceae* family.

The *Quercus*genus has about 600 species, found in mild and tropical climate. Mexico is considered to be the place where oaks appeared, there are about 90 species of mainly evergreen oaks. In Ukraine there are 23 species of oaks. The most common ones are oak, stalkless flowered oak, pubescent oak, Adriatic oak, Spanish oak, Mongolian oak, etc.

Oak (*Quercusrobur* L.) is a deciduous tree of the *Fagaceae*family, 20-40 m high, with a marquee-like or wide pyramidal crown. The bark is dark gray, thick with deep longitudinal cracks. Young shoots are bare, hard, dotted with lenticels, reddish-brown or olive-brown, ribbed, with dull red oval buds up to 5 mm long. At the ends of sprouts buds are arranged in a verticil [1, 5].

The arrangement of leaves is alternate. Leaves are brevipedicelate, elongated, obovate, narrowed down, pinnatifid, 7-40 cm long. The laminae are obtuse, rounded, with shallow cuts between them. Young leaves pubescent, pubescence old has only veins.

The root is wide fibrous and forms a deep taproot system [5].

The flowers are imperfect, staminal, arranged in cemuous aglets. Each flower has 6- or 8-loculedgreenish floral envelope and 6 or 10 stamens. Pistillate flowers are small, up to 2 mm in diameter, arranged by 2 or 5 in the upper leaf angle on long flower-bearing stems with reduced floral envelope. There is one pestle with reddish 3-loculed stigmas and inferior [1, 3, 5, 6].

The oak is a part of mixed forests in the forest and steppe zones of Europe, including southern Scandinavia, the British Isles, the northern part of the Iberian Peninsula, the Italian peninsula (except the southern part), the northern part of the Balkan Peninsula, the Crimea, the Caucasus, the western slope of the Ural Mountains.

In Ukraine, the oak is found mainly in water gaps, often forming dense stands or growing among other wood species.

The oak bark consists of 10-20% of tannins and also organic acids, carbohydrates, mucus, pentosans (13-14%), quercetin flavonoid, proteins, minerals (mg/g): K-1,40, Ca – 23,00, Mn – 0,60, Fe – 0,20; and macroelements (mkg/g): Mg – 142,60, Cu – 12,30, Zn – 10,20, Cr – 0,80, Al – 116,08, Ba – 537,12, V – 0,08, Se – 0,04, Ni – 1,84, Sr – 212,00, Pb - 3,04, B – 74,80. Ca, Ba, Se, Srare concentrated [6,7, 8, 9].

Tannins are a complex of plant polyphenols, tanning matters and phlobaphenes. According to the chemical structure, tannins can be classified as hydrolyzed and condensed.

Among oak bark tannins there are a group of condensed substances and hydrolyzed tannins group as well [3, 10, 11].

The chemical structure of the hydrolyzed tannins group defines them as saccharides compound esters of and phenolcarboxylic acids that under the influence of acid hydrolysis are able to hydrolyze to primary components. Depending on phenolcarboxylic acid in its composition, hydrolyzed tannins are classified into:

- halo-tannins;
- elago-tannins;
- non-saccharousesters of phenolcarboxylicacids.

During acid hydrolysis the subgroup of halo-tannins splits into gallic acid and carbohydrates. The carbohydrate part is often represented by monosaccharides - pentosesand hexoses, and less often by disaccharides [3, 10, 12].

According to the literature [2, 9, 16] the gallic acid is known to be in plants in the form of dipcids (digallic acid (2 molecules), trigallic(3 molecules),etc.).

During acid hydrolysis the subgroup of elago-tannins

splits into hexadioxydiphenic acid and saccharous residual matter. During the reaction hexadioxydiphenic acid is converted into benzoaric acid (ellagic acid). Most ellagic acid derivatives can be got from hexadioxydiphenic derivative as a result of oxidation reactions, restoration and ring opening [7, 14].

Apart from sugars, gallic and ellagic acids can form esters with tetrahydroxy-cyclohexane carboxylic and hydroxy-cinnamic acid, - non- saccharousesters of phenolcarboxylic acids.

The group of condensed tannins does not split during acid hydrolysis, but, when heated, oxidizes to phlobaphenes directly in aqueous solution - brownish-red condensation compound [12, 14].

Polyoxyphenol, such as catechines (flavane-3-oly) and leucoanthocyanide (flavane-3,4-diol) are considered to be the predecessors of condensed tannins.

By chemical structure condensed tannins are classified into:

- derivatives of flavane-3-olys (catechines);
- derivatives of flavane-3,4-diolys (leucoanthocyanides);
- derivatives of dihydrochalcones;
- derivatives of pinosylvins.

In literature [8] there can be found such namesfor tannins as "proanthocyanidins" but it should be noted that the astringent properties are demonstrated only bytridimensional proanthocyanidins, and they increased whenthe degree of their condensation isincreasing [3].

Nowadays oak bark is actively used in medical practice. Experimental and clinical data suggest that medicinal preparations of oak bark due to the tannins in its composition have astringent, anti-inflammatory, antimicrobial and antiviral properties [1, 3, 4, 5, 15].

It is known that the external application of water extracts of bark oak on the wound surface or mucous membrane demonstrate of interaction oak bark tannins with proteins, as a result a protective film is formed that protects tissues from local irritation, which in its turn slows down the process of inflammation and reduces pain [10] . In addition, due to the cell membrane concretion under the influence of tannins, theexudative component of the inflammatory response is reduced and even eliminated [14].

Being taken internally, oak bark tannins affect the gastrointestinal tract membrane, the motor activity and secretory function of the stomach. In this way they help to reduce irritation of the mucous membrane and eliminate superficial erosions and ulcers [1, 4, 15].

Because the tannins by their chemical structure are polyphenols, interacting with oxidizing agents they form semiquinoid radicals and ion-radicals in the presence of which the intensity of peroxidation reduces, their antioxidant activity determined. The oak bark tannins also demonstrate anticarcinogenic and radioprotective activity, the ability to remove radioactive isotopes of cesium and strontium from the host [1, 5]. Condensed oak bark tannins, as well as flavonoids, have a P-vitamin activity, and increase the reabsorption of vitamin C, reduce blood cholesterol [3].

Due to this broad spectrum of pharmacological action of oak bark, nowadays, prepared medicines and medicines of extemporal preparation containing the crude drug have been created and used in medical practice.

The mechanism of local action of tannins is based at their ability to denature proteins of the tissues they directly interact with. The nature of the effect of tannins depends on their concentration. At low concentrations, the tannins, interacting with biological membranes, react only with the surface layer of cells that becomes less permeable and protects deeper layers from influence of bacteria and chemical agents, reduces irritation of mucous membrane and enhances healing of superficial erosions and ulcers [2, 6]. Small vessels constrict, the tissue is depleted of blood, its functional activity reduces. At the cellular level, low concentrations of tannins show a sclerosing effect on the protoplasm and subcutaneous water, stabilize the cell membrane that prevents the penetration of harmful agents into cells. Low concentrations of tannins demonstrate bacteriostatic effect on microorganisms [3, 4].

When the concentration of tannins increases, there is congelation of proteins cells cytoplasm, which can lead to cell death. This is how bactericidal effect of high doses of tannins on microorganisms occurs [8, 14].

Polycomponenty is typical for the antioxidant action of vegetable tannins. Thus, some authors in their studies in vitro and in vivo studies found that the presence of the aromatic ring in combination with active hydroxyl groups in the compound reduces the formation of active forms of oxygen, stops the free radical oxidation reactions. Due to the high complexing properties, the tannins bind Fe^{3+} ions, which also leads to a reduction in the intensity of the process [3].

Number of authors found that the tannins are also able to inhibit enzymatic oxidation processes and the process of oxidative phosphorylation connected with them [10].

Anti-inflammatory properties of tannins are implemented through several mechanisms. It is found

that polyphenolic compounds are able to stimulate the function of the adrenal cortex, glucocorticoids of which have anti-inflammatory activity [2, 10].

In experimental studies of various patterns of inflammation (dextran, carrageenan, formalin, crotonic, aeropower, kaolin, burn) it was found that the decisive role in the anti-inflammatory effect of polyphenols of tannin group belongs to antioxidant and, as a result, membrane-stabilizing and vessel-strengthening properties [3, 16]. Antimicrobial and antifungal effects also make their contribution to the implementation of the anti-inflammatory effect of tannins.

Reparative effect of tannins is defined by membrane-stabilizing and astringent effect of polyphenols. When tannins are applied locally on the wound surface, partial coagulation of the wound exudate occurs, leading to the formation of a film that protects sensitive nerve tissue ends that lie deeper from irritation. Local vasoconstriction and decrease of their permeability, restriction of secretory excretion and reducing pain encourage inhibition of the inflammatory response and therefore accelerate wound healing [10].

Applying oak bark in dentistry. Galen preparations of oak bark and herbal complex containing oak bark are widely used in dentistry for treating inflammatory diseases of the mouth cavity (gingivitis, stomatitis, amphotentosis, etc.) [2, 3, 16].

Oak bark has long been widely used in popular medicine for treating dental diseases. The most common prescriptions are the following.

- 1 tablespoon of chopped bark is poured with 1 cup of boiled water, infused for 3-4 hours, filtered. Used for rinsing the mouth with gingivitis.

- 4 tablespoons of chopped oak bark is poured with 500 ml of 40% spirit, infused for 31 days, filtered. Applied as rinsing for inflammatory diseases of the oral cavity [1, 14].

Applying oak bark in otolaryngology. Preparations of oak bark are widely used in otolaryngology for treating glossitis, pharyngitis, tonsillitis, etc.

There is also a number of traditional medicine prescriptions containing oak bark and used for treating to orhinolaryngologic diseases.

- Oak bark - 6.0; wild marjoram herb - 4.0; mortification root - 1.0. Preparation: 2 tablespoons of the mixture pour with 1 cup of hot boiled water, infuse for 1 hour, filter. Apply a warm infusion for gargling several times a day.

• 1 tablespoon of oak leaves; 4 tablespoons of chopped buckthorn branches. Preparation: Pour mixture with 1 cup of boiled water, infuse for 2 hours, filter. Take warm: 1 cup 3 times a day for colds, flu, acute respiratory infections [17].

Applying oak bark in dermatology. According to the literature [1, 3, 4, 15] oak bark is a part of compositions applied for treating psoriasis:

• *Verbena officinalis* herb - 10.0; chamomile flowers - 5.0; bark oak - 10.0; *Salvia officinalis* leaves - 5.0; horsetail herb - 10.0. Preparation: Pour the mixture with 500 ml of boiled water, infuse for 2 hours. Applied externally as an application.

Also, oak bark preparations are used for treating burns, frostbite, infected wounds, pressure ulcers, skin diseases accompanied by strong exudation [17].

In traditional medicine ointments for treating frostbite are prepared from oak bark [14, 17].

For example: oak bark - 2.0, black poplar buds 1.0. Mix with 7.0 butter, 1.0 John's-wood oil and rose oil, infuse for 8 hours in a warm place; then boil over low heat, pour into a jar. Applied for treat bedsores, frostbite and wounds.

Applying oak bark in gastroenterology. Preparations of oak bark are widely used for treating gastritis, enteritis, colitis, combination therapy of stomach ulcers, stopping stomach bleeding [13, 16].

Among extemporal formulation for the treatment of gastrointestinal and proctological diseases the following prescriptions are most often used:

• 10.0 of oak bark is poured with 1 cup of boiled water, infused for 2 hours, filtered. Applied by 1-2 tablespoons 3-4 times daily before meals for gastric ulcer and duodenal ulcer, enterocolitis.

In traditional medicine teas containing oak bark are widely used to treat diseases of the gastrointestinal tract [14]

• Oak bark 30.0, flax seeds 30.0, chamomile flowers 40.0. Preparation: 2 tablespoons of mixture is poured with 500 ml of water of room temperature, infused for 6 hours, brought to boil, cooled, filtered. Take 1 cup of tea for enemas at proctological diseases [2, 4, 14].

Applying oak bark in urology and gynecology. According to literary sources it is known [11, 14, 17] that preparations of oak bark is used in traditional medicine to treat inflammatory diseases of the bladder. Most often, the following recipes are used:

• 40.0 of oak bark is poured with 250 ml of boiling water, boiled for 30 minutes, infused for 2 hours. The bark

decoction is used internally for chronic inflammation of the bladder and urinary tract.

• 100 of oak bark is poured with 400 ml of cooled boiled water, soaked for 6 hours, then filtered. Used internally 100 ml 3-4 times a day before meals for kidney disease [8, 16].

Thus, considering the above mentioned pharmacological properties of oak bark, it is advisable to explore the possibility of developing medicine based on it with astringent, hemostatic, anti-inflammatory, reparative and antimicrobial effects.

Applying oak bark in homeopathy. Oak bark is used in homeopathy.

Homeopathic therapy is specific and regulating therapy, which stimulates the host's self-regulation. This type of treatment is individual and purposeful. Homeopathy is efficiently used in case of increased sensitivity to many medications. This is particularly important in pediatrics, geriatrics [1, 4].

Homeopaths have been interested in oak for a long time. Even Rademacher, who lived in Germany at the beginning of the XIX century, used the wide arsenal of medicinal herbs, among which there was the infusion of peeled and chopped acorns –acorn alcohol, tincture of acorns (*Quercus*, *Quercus spirit*, *Spiritus glandium Quercus*) [1].

In his works he reports about trying to treat alcoholics with enlarged spleen, ascites and anasarca with this tincture; it is recommended to take 1 spoon of infusion 5 times a day.

English doctor Burnet proved that the infusion of oak bark can be used to treat chronic alcoholism [4].

In homeopathy oak bark is widely used as water and alcohol tincture for treating a number of diseases:

- Stomatitis, gingivitis;
- Chronic tonsillitis, pharyngitis, angina;
- Gastrointestinal diseases, whose specifics is bleeding;
- Diarrhea;
- Various skin lesions; burns, frostbite, pressure ulcers, infected wounds of various etiologies;
- Skin diseases, whose specifics is strong exudation;
- Hemorrhoids;
- Diseases of the urogenital system;
- Scurvy;
- Liver and spleen diseases;
- Dysentery;
- Sexually transmitted disease, *Trichomonas vaginitis* and gonorrhoea [3, 9].

Considering mentioned above, we can conclude that preparations of oak bark are used in dentistry, otolaryngology, dermatology, gastroenterology, urology, proctology. Also galena preparations of oak bark are widely used in traditional medicine. Oak bark is a part of ready-made complex medical products.

of wounds, burns, inflammatory diseases of the skin: method. recommendation, Kharkov, NUPh, 2013, 26 p.

CONCLUSIONS:

The analysis of the literature has been conducted, and current literature data on botanical characteristics, chemical composition, application in medicine oak bark have been summarized. The range of combined medicines containing oak bark has been studied. Due to its chemical structure (tannin, gallic and ellagic acids) and pharmacological activity (astringent, anti-inflammatory, antimicrobial and antiviral properties) promising outlook of using it in the development of medicinal preparations has been demonstrated.

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