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PHARMACOLOGICAL ASPECTS OF HERBAL REMEDIES IN THE TREATMENT OF FUNCTIONAL DISORDERS OF THE GASTROINTESTINAL TRACT AND THEIR ROLE IN PEDIATRIC PRACTICE

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Abstract. *Introduction.* In the complex treatment of patients with diseases of the gastrointestinal tract non-pharmacological methods of influence are widely used. More and more attention is being paid to herbal medicines, as well as various phytocomplexes.

The aim. To investigate and analyze information sources of thematic focus, which included an analysis of the development of gastrointestinal functional disorders and the role of phytotherapeutic correction in treatment.

Materials and methods. A systematic information search and analysis of literature sources was carried out, including publications over the past ten years in the databases PubMed, Scopus and Web of Science, Cochrane Library, Embase, Clinical Trials.gov., UpToDate/DynaMed, Vernadsky National Library, professional Ukrainian journals (according to the requirements of the Higher Attestation Commission, Ministry of Education and Science). The selection of articles was carried out by keywords.

Results. The active substances that make up medicinal plants determine their medicinal properties.

Essential oils are part of plants such as peppermint *(Mentha piperita)*, common oregano *(Oreganum vulgare)* and common tansy *(Tanacetum vulgare)* have the following effects: bacteriostatic, antiseptic, antispasmodic, choleretic, diuretic, immunostimulating, fungicidal. Flavonoids, contained in tansy *(Tanacetum vulgare)* and hyssop *(Hyssopus officinalis)*, are characterized by choleretic, spasmolytic, diuretic, cardioprotective, anti-inflammatory, hypotensive and hypoazotemic activity. Tannins of hyssop *(Hyssopus officinalis)*, tansy *(Tanacetum vulgare)* and oregano *(Oreganum vulgare)* have antioxidant, anti-inflammatory, detoxifying, antiulcerogenic properties, form a protective film on the mucous membrane of the biliary system. Inulin from *Echinacea purpurea* exhibits bifidogenic activity and immune modulating properties, enhances glycolysis, regulates lipid metabolism. Chlorogenic acid of *Tanacetum vulgare* is considered a growth regulator and a protective factor against some microorganisms. Oxycinnamic acids of *Echinacea purpurea* have detoxifying and anti-inflammatory properties. Ascorbic acid (vitamin C) is contained in most components of herbal teas to improve digestion *(Echinacea purpurea, Oreganum vulgare, Hyssopus officinalis)* regulates redox processes in the body, carbohydrate metabolism, blood clotting, normalizes capillary permeability, participates in tissue regeneration and the formation of steroid hormones, in the synthesis of collagen and procollagen. The provitamin of retinol (vitamin A), carotene, is a component of peppermint, has a protective effect on the mucous membranes and epithelial cells of the gastrointestinal tract, is necessary for the production of mucus and protective immune factors. Peppermint (*Mentha piperita*) is a source of essential trace elements, such as copper (Cu), molybdenum (Mo), chromium (Cr) and nickel (Ni).

Conclusions. The problem of functional dyspepsia is of great interest in pediatrics. It should be considered appropriate to use herbal remedies in the complex treatment of functional dyspepsia, which have a mild effect and cause a small number of side effects.

Key words: gastrointestinal functional disorders, phytotherapy, children

Фармакологічні аспекти рослинних препаратів у лікуванні функціональних розладів шлунково-кишкового тракту та їх роль у педіатричній практиці

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Резюме. *Вступ.* У комплексному лікуванні хворих із захворюваннями шлунково-кишкового тракту широко використовуються немедикаментозні методи впливу. Все більше уваги звертають на себе офіцинальні лікарські засоби рослинного походження, а також різні фітокомплекси.

Мета дослідження. Дослідити та проаналізувати інформаційні джерела тематичного спрямування, які включали аналіз розвитку гастроінтестинальних функціональних розладів і роль фітотерапевтичної корекції в лікуванні.

Матеріали та методи. Здійснено системний інформаційний пошук та аналіз літературних джерел, включаючи публікації за останні десять років у базах даних PubMed, Scopus та Web of Science, Cochrane Library, Embase, Clinical Trials. gov., UpToDate/DynaMed, Національна бібліотека ім. Вернадського, фахові українські журнали (за вимогами ВАК, МОН). Відбирання статей здійснювалося за ключовими словами.

Результати досліджень. Активні речовини, що входять до складу лікарських рослин, зумовлюють їх лікувальні властивості. Ефірним оліям, які є у таких рослин, як м'ята перцева *(Mentha piperita),* материнка звичайна *(Oreganum vulgare)* та пижмо звичайне *(Tanacetum vulgare)*, властиві такі ефекти: бактеріостатичний, антисептичний, спазмолітичний, жовчогінний, сечогінний, імуностимулюючий, фунгіцидний. Флавоноїди, що входять до складу пижма звичайного *(Tanacetum vulgare)* та гісопу лікарського *(Hyssopus officinalis)*, характеризуються жовчогінною, спазмолітичною, сечогінною, кардіопротекторною, протизапальною, гіпотензивною та гіпоазотемічною активністю. Дубильним речовинам гісопу лікарського *(Hyssopus officinalis)*, пижма звичайного *(Tanacetum vulgare)* та материнки звичайної *(Oreganum vulgare)* притаманні антиоксидантні, протизапальні, детоксикуючі, антиульцерогенні властивості, вони утворюють захисну плівку на слизовій оболонці жовчовивідної системи. Інулін ехінацеї пурпурової (*Echinacea purpurea)* проявляє біфідогенну активність та імуномодулюючі властивості, посилює гліколіз, регулює ліпідний обмін. Хлорогенова кислота пижма звичайного (*Tanacetum vulgare)* розглядається як регулятор ростових процесів та захисний фактор щодо деяких мікроорганізмів. Оксикоричні кислоти ехінацеї пурпурової володіють детоксикуючими та протизапальними властивостями. Аскорбінова кислота (вітамін С) міститься в більшості компонентів трав'яних чаїв для покращення травлення *(Echinacea purpurea, Oreganum vulgare, Hyssopus officinalis)*, регулює окисно-відновні процеси в організмі, вуглеводний обмін, згортання крові, нормалізує проникність капілярів, бере участь у регенерації тканин та утворенні стероїдних гормонів, у синтезі колагену та проколагену. Провітамін ретинолу (вітамін А), каротин входить до складу перцевої м'яти, здійснює захисний вплив на слизові оболонки та епітеліальні клітини шлунково-кишкового тракту, є необхідним для продукції слизу та захисних імунних факторів. М'ята перцева (Mentha piperita) є джерелом есенціальних мікроелементів, таких як мідь (Cu), молібден (Mo), хром (Cr) та нікель (Ni).

Висновки. Проблема функціональної диспепсії викликає велику зацікавленість. Слід вважати доцільним використання в комплексному лікуванні функціональної диспепсії рослинних засобів, які мають м'яку дію та викликають невелику кількість побічних ефектів.

Ключові слова: гастроінтестинальні функціональні розлади, фітотерапія, діти.

Introduction

In the complex treatment of patients with diseases of the gastrointestinal tract, diet therapy, physiotherapy, physical therapy, massage and other non-pharmacological methods of influence are widely used. At the same time, more and more attention is being paid to official herbal medicines, as well as various phytocomplexes. To increase the effectiveness of treatment with phytotherapy methods, the following principles must be observed [1,2]:

1. Treatment with herbal medicines should be carried out only as prescribed and under the supervision of a healthcare professional.

2. Herbal medicines are recommended to be widely used during the period of reparation, as well as at the outpatient and sanatorium stages of rehabilitation.

3. For treatment, preference should be given to herbal blends, rather than individual species of plant-based raw materials.

4. The optimal number of different types of raw materials in a collection should not exceed 3–5.

5. The composition of the collection should include 2–3 types of plant-based raw materials with the same main effect, but with different concomitant ones.

6. It is recommended to have several collections of different plants with a single-directional effect, which, to prevent addiction, should be alternated for 2–3 months for 10–15 days each.

7. When using only one collection, after 1 month it is necessary to take a break for 10–15 days.

8. In the absence of a positive effect from the collection after 2 weeks, it should be replaced with another.

The correct dosage of raw materials and herbal preparations plays an important role [3].

Of the herbal medicines, combined preparations containing a large number of active

substances with different points of application are recommended for use.

In recent years, the possibilities of using herbal medicines for therapeutic and prophylactic purposes, which are specially designed for use in infants and young children, have significantly expanded.

The aim

To investigate and analyze information sources of thematic focus, which included an analysis of the development of gastrointestinal functional disorders and the role of phyto-therapeutic correction in treatment.

Materials and methods

A systematic information search and analysis of literature sources was carried out, including publications over the past ten years in the databases PubMed, Scopus and Web of Science, Cochrane Library, Embase, Clinical Trials.gov., UpToDate/ DynaMed, Vernadsky National Library, professional Ukrainian journals (according to the requirements of the Higher Attestation Commission, Ministry of Education and Science). The selection of articles was carried out by keywords.

Results

The active substances that make up medicinal plants determine their medicinal properties. Essential oils are part of plants such as peppermint *(Mentha piperita)*, common oregano *(Oreganum vulgare)* and common tansy *(Tanacetum vulgare)*. Essential oils are multicomponent mixtures of volatile oily organic substances belonging to the class of terpenoids. They are called essential for their volatility and characteristic odor, and oils for their oily consistency. The role of oils in plant life and the reasons for their formation are still subject to study. It is assumed that they serve to protect plants from diseases and pests, and their aroma attracts insects and thereby promotes pollination of flowers [4].

The biological effects of essential oils are extremely diverse. In general, they have the following effects: bacteriostatic, antiseptic, antispasmodic, choleretic, diuretic, immuno-stimulating, fungicidal. Essential oils are able to improve the functioning of the gastrointestinal tract and improve appetite due to the presence of aromatic bitterness in them. Under the influence of bitterness, the secretion of saliva, gastric juice, bile, pancreatic secretion increases, the activity of enzymes rises and thereby the entire process of food digestion improves. As a result, the feeling of fullness, bloating decreases, and bowel movements improve [4].

Peppermint essential oil belongs to mono-cyclic monoterpenoids, the oxygen derivatives of which are menthol alcohol (41-64%), ketones, menthone (9-25%), and carvone.

Peppermint essential oil has the ability to stimulate digestion by increasing intestinal peristalsis, gastrointestinal motility, and secretion of digestive glands, thereby contributing to faster digestion of food and emptying of the stomach and intestines. Menthol, when applied to the mucous membrane of the digestive tract, stimulates cold receptors and causes a feeling of cold: the superficial blood vessels narrow, and the vessels of the internal organs dilate, while a local anesthetic effect on the digestive organs is observed [5,6].

The composition of *Oreganum vulgare* essential oil includes: anethole, thymol, and corvacrol [6]. These are natural substances, aromatic compounds that, according to biosynthetic characteristics, belong to isoprenoids, despite their phenolic structure.

The composition of *Tanacetum vulgare* essential oil includes bicyclic monoterpenoids: α- and β-thujone, borneol, thujol, pinene, and l-camphor [7,8].

Thujone relaxes the muscles of roundworms and pinworms, helping them to be eliminated from the body. In addition, the essential oil of *Tanacetum vulgare* has an antibacterial effect.

Flavonoids, contained in tansy *(Tanacetum vulgare)* and hyssop *(Hyssopus officinalis)*, are biologically active substances of a phenolic nature, the molecule of which consists of two phenolic residues connected by a propane link, which can be closed into an oxygen heterocycle. They got their name from the Latin word "flavus" (yellow), because the first flavonoids isolated from plants had a yellow color. In their pure form, flavonoids are yellow, red, blue or colorless crystalline substances. Depending on the structure and degree of oxidation, they are divided into flavonols, flavones, flavonones, catechins, anthocyanins, etc. In plants, flavonoids are represented by glycosides (the most famous is rutin), and are also found in the form of aglycones (quercetin – at least 2,5% in common tansy) [7,8].

Flavonoids of *Hyssopus officinalis* are represented by compounds as diosmin, hyssopin and hesperidin. Flavonoids have a wide spectrum of biological action. By changing the activity of many

enzymes (transport ATPases, phosphodiesterases, cyclic nucleotides, protein kinases, phospholipases, etc.), plant flavonoids affect immunological, secretory, excretory, contractile and motor processes, they are characterized by choleretic, spasmolytic, diuretic, cardioprotective, anti-inflammatory, hypotensive and hypoazotemic activity, stimulate protein synthesis with accelerated regeneration of damaged tissues, have a membrane-stabilizing effect (contribute to the stabilization and normalization of membrane functions in general and, in particular, of hepatocytes) [9].

Flavonoids participate in redox processes, perform antioxidant functions (prevent the occurrence of bioreactive oxygen species and neutralize them by peroxidation of lipids and the formation of chelate complexes with metals). The P-vitamin activity is the most studied effect of flavonoids, the mechanism of action lies in reduction of hyaluronidase level by compounds with P-vitamin action, prevention of oxidation of ascorbic acid and adrenaline, which increase the strength of blood vessels and capillaries. It is believed that the use of plant flavonoid preparations is a factor in the prevention of diseases of the stomach, liver, and cardiovascular system. Plant flavonoids are well absorbed in the digestive tract, the maximum concentration in the blood is determined within 30-60 minutes. They are distributed in the body unevenly: they accumulate in large quantities in the liver and kidneys. Metabolism is carried out in the liver, excreted from the body mainly with bile, to a lesser extent with urine [10,11].

Tannins - are found in plants such as hyssop *(Hyssopus officinalis)*, tansy *(Tanacetum vulgare)* and oregano *(Oreganum vulgare)*, are plant polyphenolic compounds that have the ability to interact with collagen to form structures that are resistant to the process of decay.

Tannins have antioxidant, anti-inflammatory, detoxifying, antiulcerogenic properties. They form a protective film on the mucous membrane of the biliary system, relieving symptoms of inflammation [10,11,12,13].

Polysaccharides are polymeric carbohydrates built from monosaccharides linked by glycosidic bonds, forming linear or branched chains. Inulin from *Echinacea purpurea* belongs to homopolysaccharides (built from residues of one monosaccharide – D-fructose). It exhibits bifidogenic activity and immune modulating properties, enhances glycolysis, regulates lipid metabolism and is used in therapeutic and prophylactic nutrition to normalize carbohydrate metabolism [14].

Inulin, entering the gastrointestinal tract, is split by hydrochloric acid and enzymes into fructose molecules and fructose chains, which penetrate into the blood vessels. The part of inulin that remains unsplit is quickly excreted, having previously bound such substances as heavy metals, radionuclides, cholesterol crystals, and various toxic compounds. In addition, inulin is able to stimulate the contractile ability of the intestinal wall [15,16,17]. Natural fructose, which inulin consists of, is able to participate in the same metabolic processes as glucose and fully replace it in situations where glucose is not absorbed by cells. Phenolcarboxylic acids and their derivatives - echinacoside (glucoside of 2,3-O-dicaffeoyl tartaric acid), chicory (2,33-O-dicaffeoyl tartaric acid) and chlorogenic acids - have antimicrobial and immune modulating effects.

Common tansy *(Tanacetum vulgare)* contains chlorogenic acid, which also belongs to phenolic compounds, it is an intermediate in the synthesis of lignin from amino acids. Chlorogenic acid is considered a growth regulator and a protective factor against some microorganisms. Oxycinnamic acids - contained in *Echinacea purpurea*, have detoxifying and anti-inflammatory properties [18].

Phytosterols are sterols isolated from the unsaponifiable part of plant lipids (animal sterols include cholesterol). *Echinacea purpurea* is rich in phytosterols. They are found in plants both in free form and in combination with carbohydrates, fatty acids, and are optically active crystalline substances. Organic acids of common tansy enhance the secretion of bile and pancreatic juice, saliva, participate in metabolism, and maintain acid-base balance; have the ability to restore normal intestinal microflora, prevent the development of fermentation processes [19].

Vitamins are low-molecular organic compounds of various chemical structures, necessary in small quantities for normal metabolism and vital activity of living organisms. Ascorbic acid (vitamin C) is contained in most components of herbal teas to improve digestion *(Echinacea purpurea, Oreganum vulgare, Hyssopus officinalis)* - is a crystalline substance, well soluble in water and alcohol and insoluble in organic solvents, is an unstable compound that is easily oxidized. Plants contain only the physiologically active cis-isomer of ascorbic acid. It regulates redox processes in the body, carbohydrate metabolism, blood clotting, normalizes capillary permeability, participates in tissue regeneration and the formation of steroid hormones, in the synthesis of collagen

and procollagen. Ascorbic acid is a catalyst for the transfer of hydrogen ions and activates the activity of a significant number of enzymes. It is used as a general strengthening, anti-inflammatory, antioxidant, and antiulcer agent [20].

The provitamin of retinol (vitamin A), carotene, is a component of peppermint. Carotene is a tetraterpene (C40H64) in its structure and occurs in the form of three isomers: α-, β-, γ-carotene, among which the β-isomer is the most common. In plants, it is found together with chlorophyll in the form of water-soluble protein complexes or in droplets of fatty oil. In the human body, under the action of enzymes, β-carotene breaks down to form two molecules of vitamin A. [21]. Carotene has a protective effect on the mucous membranes and epithelial cells of the gastrointestinal tract, is necessary for the production of mucus and protective immune factors.

Peppermint (*Mentha piperita*) is a source of the following essential (essential for life) trace elements [22]:

1. copper (Cu) - is a component of many enzymes, coenzymes, hormones, respiratory pigments, participates in the process of tissue respiration, anabolic processes, synthesis of hemoglobin and other iron porphyrins, skin pigments. In addition, copper participates in the body's antioxidant defense system as a cofactor of the enzyme superoxide dismutase by neutralizing free oxygen radicals.

2. molybdenum (Mo) - is a component of enzymes that play a role in urea metabolism, retains fluoride in the body and prevents caries.

3. chromium (Cr) – regulates blood sugar levels, participates in the regulation of lipid synthesis and carbohydrate metabolism, in the functioning of blood vessels and the regulation of heart muscle function, promotes the integrity of nucleic acid molecules and the removal of toxins, heavy metals, radionuclides from the body.

4. nickel (Ni) – participates in redox processes, respiration, and hematopoiesis.

Conclusions

Thus, after reviewing the scientific literature, it can be stated that functional diseases of the digestive system occupy a significant place in the structure of childhood morbidity and are most often found in young children. This is facilitated by age-related anatomical and physiological features of the digestive tract, immaturity of regulatory systems and high metabolic stress.

The problem of functional dyspepsia is of great interest, which is associated with the significant prevalence of dyspeptic disorders among young children, the presence of unspecified questions regarding the etiology and pathogenesis of the disease, as well as the complexity and ambiguity of approaches to their diagnosis and treatment, which require further study. Given the functional nature of the disease, it should be considered appropriate to use herbal remedies in the complex treatment of functional dyspepsia, which have a mild effect and cause a small number of side effects. The phytotherapeutic method of treatment is physiological, structural, well-balanced, systematic, has low toxicity and minimal side effects. The variety of biologically active substances that are part of plants determines their optimal effect on various organs and systems of the body, mobilization of defenses, regulation of physiological functions [23]. The expediency of the phytotherapeutic method of treatment in children is confirmed by a number of circumstances: problems of prevention and treatment of allergic diseases, the possibility of widespread use of phytotherapy for the prevention of exacerbations of chronic diseases, great prospects for the study and use of medicinal plants in the clinic [24].

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