LEMNA MINOR L. – A NEW PROMISING ANTIOXIDANT AND PROTECTOR

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Abstact

In the conditions of the modern fast-paced and often uncertain life, a number of damaging factors can have an adverse effect on human health, attacking and disrupting our natural antioxidant defense systems, with the subsequent development of a number of severe, socially significant diseases, such as cardiovascular, oncological, neurodegenerative, endocrine, autoimmune, etc. An important role in the fight against them is the discovery and use of antioxidant preparations, a central place among which is occupied by natural antioxidants of plant origin. Today, the search and research of promising plants with a high content of compounds and biologically active substances with antiradical and/or antioxidant properties is particularly relevant. The published report presents in a systematized form the results of a study conducted on the basis of an analysis of the published and available scientific data regarding the antioxidant potential of the various extracts obtained from the Lemna Minor L plant and its main components which have been isolated so far with an already proven antioxidant and/or antiradical effect.

Key words: *Lemna minor, antiradical activity, antioxidant activity, plant extract*

Introduction

In the conditions of our modern hectic and uncertain life, a person is often subjected to a number of damaging factors such as chronic emotional stress, lack of sleep, lack of physical activity, polluted environment, use of unhealthy food, smoking, drug abuse, etc. These factors can have an adverse effect on human health, attacking and disrupting the natural fine balance between the body's generating pro-oxidants and the antioxidant defense systems. The developing oxidative stress plays an important role in the pathogenesis of a number of severe, socially significant diseases such as cardiovascular, oncological, neurodegenerative, endocrine, autoimmune and many other ones [1, 6, 19].

The discovery, development and implementation of antioxidant preparations and compounds, among which the natural antioxidants of plant origin play a central role and are of significant importance in the fight against free radical processes. In recent years, the search and research of promising plants with a high content of compounds and biologically active substances with antiradical and/or antioxidant properties has been particularly relevant.

Aim and tasks

The purpose of the paper is to study, summarize and analyze the existing published data on the antioxidant and/or antiradical potential of the various extracts obtained from the plant Lemna Minor L., as well as its main components isolated so far with already proven antioxidant and/or antiradical effects.

Main part

Lemna Minor L. (LM) is a perennial aquatic plant that belongs to the genus Lemna, the family Lemnaceae and is spread almost ubiquitously.

In folk medicine it is used in the treatment of allergies, asthma, vitiligo, jaundice, glaucoma, rheumatism, gout and others [15].

In recent years it has become clear that its chemical composition consists of: proteins (up to 35%), vegetable fibers (up to 17%), fats (up to 5%), polysaccharides, flavonoids, amino acids, aliphatic acids, phenolic acids, triterpene compounds, vitamins, micro- and macro-elements [3, 8, 12, 13, 21, 23]. Studies on the amino acid composition of LM indicate the presence and content of 18 natural amino acids, 8 of which are essential [11]. I. N. Vladimirova and V. A. Georgiyants, 2014,

investigating LM, identify the presence of 32 biologically active substances from different chemical groups. Most phytosteroids (52.8 mg / kg), saturated hydrocarbons (23.1 mg / kg), aldehydes and ketones (20.2 mg/ kg), fatty acids and their derivatives (11.1 mg / kg) [21]. Vitamin A, Vitamin C, and Group B vitamins predominate in the content of LM [13].

Antioxidant and antiradical activity studied

In recent years, LM and its extracts have been the subject of many studies for antioxidant and/or antiradical activity, some of which are mentioned very briefly below.

1.1. In vitro studies:

✓ İlhami Gülçin et al., 2010 investigated the antioxidant and antiradical activity of lyophilized aqueous and ethanol extract of LM using a series of different in vitro methods: 2,2′-azino-bis(3-ethylbenzthiazoline-6-sulfonic acid) (ABTS•+) radical scavenging, 1,1-diphenyl-2-picryl-hydrazyl (DPPH) free radical scavenging, total antioxidant activity by ferric thiocyanate, total reducing power by potassium ferricyanide reduction method, superoxide anion radical scavenging, hydrogen peroxide scavenging and ferrous ions chelating activities. They found that 100% and 94.2% inhibition of lipid peroxidation of the linoleic acid emulsion was obtained when 45 μg/ml of lyophilized aqueous or ethanolic extract was administered, respectively. When using the reference antioxidant compounds α-tocopherol, trolox, butylated hydroxyanisole and butylated hydroxytoluene, applied in the same concentration, 84.6%, 95.6%, 92.2% and 99.6% inhibition of the lipid peroxidation of the linoleic acid emulsion was found, respectively [4].

✓ L. P. Loseva et al., 2011 studied the quantitative content of essential macro- and microelements and the antioxidant activity of 12 types of medicinal plants (Echinacea purpurea, Lophantus adans S., Calendula officinalis L., Leonurus cardiaca L., Melissa officinalis L., Origánum vulgáre, Salvia officinalis L., Eucalyptus, Thymus serpilium L., Rubus idaeus, Mentha piperita L. and Urtíca dióica), on 7 of the most common higher aquatic plants in Belarus (Ceratophyllum demersum L., Acorus calamus L., Phragmites australis Cav. Trin. ex Steud., Spirodela polyrrhiza L., Lemna Minor L., Stratiotes aloides L., Menyanthes trifoliata L.) and 9 types of algae (Fucus vesiculosus, Chlorella vulgaris, Laminaria J. V. Lamouroux, Spirulina platensis, and also spirulina grown in media containing zinc; selenium; zinc, copper and selenium; Porphyridium cruentum and Haematococcus pluvialis). According to the obtained mean values of antioxidant activity of the plant extracts, the authors ranked the plants in descending order. According to the content of fat-soluble components, this descending order is Spirodela polyrrhiza L. Schleid. > Acorus calamus L. > Lemna minor. L. > Phragmites australis Cav. Trin. ex Steud. > Ceratophyllum demersum L. > Elodea canadensis Michx., and according to the content of water-soluble components, the descending order is Acorus calamus L. > Spirodela polyrrhiza L. Schleid. > Phragmites australis Cav. Trin. ex Steud. > Lemna minor L. [9].

✓ K. Saritha and U. Saraswathi, 2014 studied the antioxidant and antiradical activity of synthesized gold nanoparticles from Lemna minor using DPPH assay, Superoxide radical scavenging, Nitric oxide radical scavenging and Hydrogen Peroxide scavenging. The manifested activities of gold nanoparticles synthesized using Lemna minor were compared with the activities manifested by the independent application of Lemna minor as well as with reference compounds suitable for the respective studies (BHT or Quercetin). The results obtained from the independent application of Lemna minor show significant scavenging effects in all conducted studies, but are lower compared to the results obtained with the application of gold nanoparticles synthesized using Lemna minor [18].

✓ R. Bright and M. Kanagappan, 2016, in the study of 5 aquatic weeds: Ceretophyllum demersum, Hydrilla verticillata, Lemna minor, Nelumbo nucifera and Pistia stratiotes with the DPPH free radical scavenging assay found the smallest IC50 (ie Maximum free radical scavenging) value 26.22±0.39 μg/ml when using the methanol extract of Lemna minor. Ascorbic acid, which was used as a reference compound in the study, exhibits an IC_{50} of 14.02±0.04 μg/ml [2].

✓ I. V. Voronov et al., 2019 studied the antiradical and antioxidant action of Phlojodicarpus sibiricus Steph plant extracts ex Spreng, Rhodiola rosea L., Rhodiola borealis Boriss and Lemna

minor by a complex of methods: DPPH method, ABTS method, superoxide radical scavenging assay, nitric oxide radical scavenging assay and investigation of total antioxidant activity with Inhibition of lipid peroxidation (LPO). The measured anti-radical activity of the LM extract against DPPH and $ABTS^{+}$ radicals is 99.0±4.9% and 99.1±4.7%, respectively. The same extract showed no antioxidant activity against O2- radical. The measured/established inhibition of NO-radicals is 7.6±0.4%, and in model of induced LPO, efficiency of inhibiting free radical oxidation is 21.9±1.1% [22].

✓ S. Y. Dogan et al., 2022 studying the chemical composition of LM found that the plant contains 25 different essential oils and has a high phenolic content of 24.44 mg GAE/100 g total phenol. Their results also confirm that the methanolic extract has a high antioxidant activity, with the highest efficacy at 400 mg/ml, when 72% DPPH removal and 71% iron chelating ability were found [3].

1.2. Studies using in vivo models:

✓ Yanka Karamalakova et al., 2021 studied the protective effect of an aqueous extract of LM on bleomycin-induced chronic lung inflammation in Balb/c male mice. Their results show that the administration of the LM extract (120 mg/kg bwt, i.p.) alone and in combination (aquatic extract of Lemna minor (120 mg/kg bwt, i.p.) administered two hours prior to the Bleomycin) inhibits the bleomycin-induced expression by significantly reducing EPR-ascorbate, ROS production and by increasing enzyme antioxidants (superoxide dismutase, catalase, malondialdehyde concentration and total cholesterol) [7].

1.3. Biologically active substances with antioxidant activity isolated from Lemna Minor

In our previously written article [17], 12 biologically active substances with proven antioxidant and/or antiradical activity isolated from Lemna Minor L. were described. These compounds are: phytol, campesterol, loliolide, dihydroactinidiolide, ascorbic acid, vanillic acid, 2, 3-dihydroxybenzoic acid, caffeic acid, chlorogenic acid, esculetin, esculin and fraxetin [17]. Other substances can be added to them, such as the ingredients isolated from LM: β-carotene, lycopene, 2,4-Di-tert-butylphenol and thymol, investigated in the researches of S. Y. Dogan et al., 2022 [3], which also exhibit antioxidant activity [5, 10, 14, 20].

1.4. Other pharmacological effects which were studied

In another previously written article of ours [16], the investigated pharmacological activities of various LM extracts are described. In addition to antioxidant and/or antiradical actions, LM extracts exhibit also antibacterial, antifungal, anti-inflammatory, immunomodulating, thyrostatic and cryoprotective effects [16].

Conclusion

The analysis of the literature data shows that the Lemna Minor plant is a rich source of biologically active substances, with a wide range of useful effects for medical practice, such as anti-inflammatory, antioxidant, antibacterial, immunomodulating, etc. It is a reliable and promising antioxidant and protector. Its application in medical practice requires additional conducting of in-depth experimental and clinical studies.

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