Antioxidant activity of medicinal substances and biologically active substances

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SUMMARY

Comparative studies of the antioxidant activity by the amperometric method of some biologically active substances contained in medicinal plant raw materials, synthetic substances and drugs of various chemical structures have been carried out. The results of the work make it possible to reveal the dependence of the indicator of antioxidant activity on the chemical structure of compounds, which makes it possible to create complex drugs that combine specific therapeutic properties with an antioxidant effect, as well as facilitate the search for new antioxidant medicinal plants.

Key words: antioxidants, antioxidant activity, substances,medications.

Introduction

In almost all living organisms, redox reactions are involved in the life process. However, in this case, activated derivatives of molecular oxygen or reactive oxygen species are formed, which are involved in free radical oxidation reactions, including lipid peroxidation (LPO). Excessive accumulation of reactive oxygen species leads to disruption of the normal functioning of antioxidant defense systems, which causes increased oxidative damage and chemical modification of biomolecules and leads to the development of dysfunction of cells and tissues of the body. It should be noted that the contribution of various links of free radical oxidation to the occurrence of pathologies can differ significantly: in atherosclerosis, LPO reactions are important, in neurodegenerative diseases - oxidative damage to proteins, in tumors - modification of nucleic acids. An increase in the intensity of lipid peroxidation and impaired repair of oxidative damage to nucleic acids is also facilitated by oxidative inactivation of enzymes of the body's defense systems.

Natural and synthetic antioxidants of various chemical structures are used to reduce oxidative stress. Accordingly, this determines both the magnitude of the antioxidant effect and the target of the action of antioxidants in the correction of antioxidant stress [1]. This relationship may be useful in the development of new antioxidant drugs. By the presence in the structure of the molecule of certain functional groups associated with the antioxidant effect, antioxidants can

grouped into five main categories: proton donors (flavonoids, phenolic acids, 1,4-dihydropyridine derivatives, thiols, ascorbic acid), polyenes (rethionides, carotenoids), catalysts (superoxide dismutase), radical scavengers (phenyl-tert-butylnitrone), complexing agents (ethylenediaminetetraacetic acid, desferoxamine, carnosine, carvedilol, isonicotinoyl compounds) [1, 2].

Purpose of the study

Determination of antioxidant activity (AOA) of some biologically active substances (BAS) of medicinal plant materials, substances and drugs.

Materials and research methods

It is known that the content of biologically active substances in a dosage form or medicinal plant material correlates with the value of AOA [3]. We carried out comparative studies of the AOA of hydrophilic biologically active substances belonging to different chemical structures contained in medicinal plant raw materials. And also studies of the AOA of synthetic substances of some drugs and the drugs themselves of various pharmacological actions, including antioxidant ones, have been carried out [4, 5]

Antioxidant activity was measured by the amperometric method on a Tsvet Yauza 01-AA device created by NPO Khimavtomatika [6]. The method is based on the measurement of the electric current arising from the oxidation of antioxidant molecules on the surface of a working glassy carbon electrode at a certain potential, which, after amplification, is converted into a digital signal. The electrochemical oxidation that occurs at the electrode can be represented by the example of flavonoids in accordance with the following equations:

flavonoid-O-HÒ → -flavonoid-O. +ē + H
(oxidation at maximum potential)
flavonoid-O-HÒ → -flavonoid-O. + H. (free
radical scavenging)

Both reactions involve the breaking of the same O-H bond, where N. consists of ē + H +. Thus, the ability to capture free radicals by flavonoids or other polyphenols (i.e., their antioxidant activity) can be measured by the oxidizability of these compounds at the working electrode of an amperometric detector. The signal from the detector in the form of an electrical pulse enters the amplifier, and then to the computer, where it is recorded in the form of differential output curves.

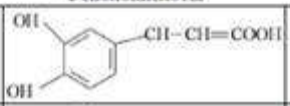
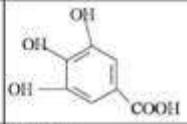
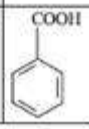
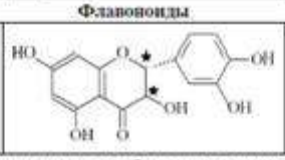
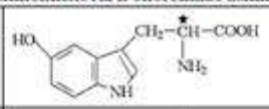
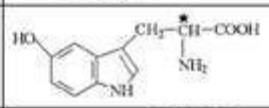
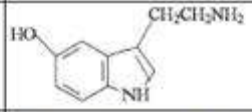
AOA was assessed according to the calibration graph of the quercetin standard.

Results and its discussion

Table 1 shows the results of the study of the AOA of some biologically active substances contained in medicinal plant raw materials.

Table 1

AOA of some biologically active substances contained in medicinal herbal raw materials

Соединение	Химическая формула	АОА, мг/г (на кверцетин)
Органические кислоты		
Аскорбиновая кислота		884,75
Лимонная кислота	$HOOCCH_2C(OH)CH_2COOH$ $\vert$ $COOH$	0,15
Янтарная кислота	CH_2-COOH $\vert$ CH_2-COOH	0,06
Фенолокислоты		
Кофейная кислота		1410,74
Галловая кислота		1277,80
Бензойная кислота		3,58
Флавоноиды		
Дигидрокверцетин		801,14
Аминокислоты и биогенные амины		
L-триптофан		3098,40
D-триптофан		2982,63
Серотонин		2161,27
L-серин	$CH_2(OH)CH(NH_2)COOH$	1,01

Antioxidant activity of biologically active substances

As a result of the studies carried out, it was shown that the antioxidant effect of compounds is determined by the presence of a mobile hydrogen atom in the structure of the compounds, the source of which is, for example, oxyaromatic groups. Thus, the effectiveness of gallic acid, which has 3 phenolic hydroxyls in the molecule, is much higher than the effect of benzoic acid, which has no phenolic hydroxyls. The presence of a side chain with

unsaturated double bond, conjugated with an aromatic ring, provides high efficiency of caffeic and phenylanthranilic acid. The high activity of dihydroquercetin is associated with the presence of two free hydroxyl groups in ring A, and ascorbic acid - with three hydroxyl groups.

Interestingly, the AOA of the left- and dextrorotatory tryptophan isomers is practically the same. The high activity of tryptophan and serotonin can probably be associated with the amino group in the side chain and free hydroxyl.

Tables 2 and 3 show the value of the antioxidant activity of drug substances and of various chemical structures and pharmacological action.

table 2

AOA of some biologically active substances contained in medicines

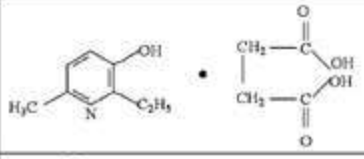
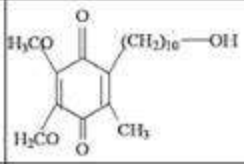
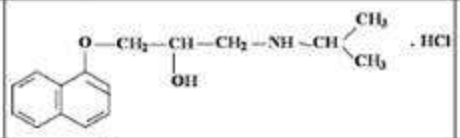
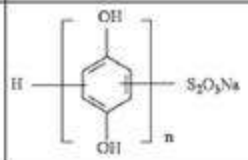
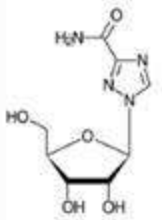
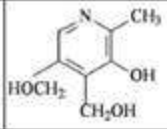
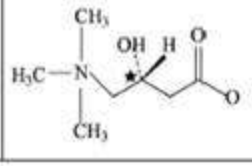
Наименование субстанции	Химическая формула	АОА, мг/г (на кверцетин)
Мексидол		1690,00
Идебенон		110,01
Анаприлин		168,40
Гипоксен		43,1
Рибавирин		0,68
Пиридоксина гидрохлорид		0,17
L-карнитин		0,03

Table 3

Antioxidant activity of drug substances

№	Наименование лекарственного препарата	Действующее вещество и его дозировка	Фармакологическое действие	АОА, мг/г (на кверцетин)
1	Мексидол	Мексидол 0,125г	Антиоксидантное, антигипоксическое, мембраностабилизирующее, ноотропное, анксиолитическое	825,84
2	Аскорутин	Аскорбиновая кислота 0,05г, рутин 0,05г	Стимулирующее окислительно-восстановительные процессы, капилляропротективное, тормозит действие гиалуронидазы, антиоксидантное	68,37
3	Гипоксен	Гипоксен 0,25г	Антигипоксическое, антиоксидантное	43,85
4	Анаприлин	Анаприлин 0,01г	β-адреноблокатор, гипотензивное, антиангинальное, антиаритмическое, мембраностабилизирующее	40,0
5	Капилар	Дигидрокверцетин 0,01г	Капилляропротективное, антиоксидантное, ангиопротективное, дезинтоксикационное	18,51
6	Рибавирин	Рибавирин 0,2г	Противовирусное	0,44
7	Лимонтар	Лимонная кислота 0,05г, янтарная кислота 0,2г	Стимулирующее окислительно-восстановительные процессы, энергетический обмен, регулирует тканевой обмен	0,24

The most active drug is Mexidol. More activity inidebenone, which is used as a metabolic-enhancing nootropicsubstances in the brain. In the presence of closely spaced hydroxyl groups in the compounds, the latter can exhibit strong intermolecular interaction with each other without separating the hydrogen ion, thereby reducing the antioxidant activity of the compound (hypoxene, ribavirin). However, the presence of thiol groups in hypoxene increases its AOA. Vitamin B6, pyridoxine hydrochloride, also has a fairly low AOA, while remaining an important vitamin of group B. The results obtained can also be used to create and study new antioxidant drugs.

Antioxidant activity of drugsThe antioxidant activity of drugs depends on the active substance in the dosage form, on how many active substances the dosage form contains - a monopreparation or complex, and possibly on excipients. So, for example, the drug Limontar has a large value in comparison with the individual active ingredients of the drug - citric and succinic acid (see table. 1). This is probably due to the synergistic action of these acids in relation to each other. The preparation ascorutin has a fairly high activity, which combines the bioflavonoid rutin and ascorbic acid.

conclusions

1. Assessment of the AOA of individual biologically active substances and Revealing the dependence of this indicator on the chemical structure of the compounds makes it possible to create complex drugs that combine specific therapeutic properties with an antioxidant effect.

2. Considering the correlation of the content of biologically active substances with antioxidant activity, the results obtained can also contribute to the search for new medicinal plants with a pronounced antioxidant effect.

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