Comparative assessment of the antioxidant activity of some wild-growing and cultivated plants of the Republic of Bashkortostan

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Comparison of antioxidant activity of wild and cultured plants of Bashkortostan

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SUMMARY

The article presents studies on the antioxidant activity of the leaves of blood-red hawthorn, schisandra chinensis and their mixtures. Antioxidant activity was determined by two methods. The spectrophotometric method was used to study the ability to inhibit the autooxidation of adrenaline in an alkaline medium. The second method for in vitro determination of antioxidant activity was used to study the ability of objects to reduce the intensity of chemiluminescence. In the experiment, the leaves of blood-red hawthorn, schisandra chinensis and their mixture in various model systems in one way or another inhibited the rate of formation of reactive oxygen species and reduced the rate of lipid peroxidation.

Keywords: hawthorn leaves bloodyred, Schisandra chinensis leaves, herbal composition, antioxidants, chemiluminescence, free radical oxidation.

RESUME

The article presents the research of antioxidant activity hawthorn leaves of bloodred, leaves of schizandra chinensis and their mixture. Antioxidant activity was determined by 2 methods. The first method is spectrophotometry. Antioxidant properties were determined by their ability to inhibit the autooxidation reaction of adrenaline. The second method is chemiluminescence. It is based on the ability to reduce the intensity of luminescence. In the experiment the leaves of the hawthorn bloodred, leaves of schizandra chinensis and their mixtures reduced the rate of formation of reactive oxygen species and reduced the rate of lipid peroxidation.

Keywords: the leaves of hawthorn bloodred, leaves of schizandra chinensis, plant composition, antioxidants, chemiluminescence, free radical oxidation.

INTRODUCTION

Currently, in official medicine there are no examples of the use of medicinal plants for prenatal prevention of congenital anomalies of the maxillofacial region. The causes of these anomalies are a combination of endogenous (mutations, metabolic diseases, "overripe" of germ cells) and exogenous (radiation, medicinal and chemical substances, hypoxia, viruses, mycoplasmas, etc.) etiological factors. That is, for the emergence of such forms, it is necessary to have genetic susceptibility (predisposition) and the impact of any unfavorable environmental factors that contribute to the realization of susceptibility to developmental defects [4, 7]. Therefore, it is urgent to search for safe products of natural origin with antihypoxic and antioxidant effects, for use as prophylactic purposes in this pathology. Nowadays, much attention is paid to the study of the antioxidant properties of medicinal plant materials and preparations based on them. This is due to the fact that many vital metabolic and physiological processes in the body are closely associated with free radical oxidation and a decrease in natural antioxidant activity, which cause significant pathological changes in the body that can cause various diseases.

Leaves of hawthorn and lemongrass are promising types of medicinal plant materials. On the territory of the Russian Federation there are 36 species of the genus hawthornCrataegus. On the territory of the Republic of Bashkortostan, one species grows in the wild

hawthorn - blood-red hawthorn - Crataegus sanguinea Pall. Schisandra chinensisShisandra chinensis Baill. is a plant of the Far Eastern flora, which has perfectly adapted in the Republic of Bashkortostan.

PURPOSE OF THE STUDY

Study of the antioxidant activity of the leaves of Schisandra chinensis and hawthorn, as well as the plant composition of the above-mentioned plants by spectrophotometric and chemiluminescent methods.

MATERIALS AND RESEARCH METHODS

The following samples of raw materials were used for the study: leaves of schisandra chinensis (Shisandra chinensis Baill., Shisandraceae), harvested from plants cultivated on the territory of the Republic of Bashkortostan, leaves of blood-red hawthorn (Crataegus sanguinea Pall., Rosaceae), harvested from wild plants of the flora of Bashkortostan in 2014–2016, and a mixture of leaves of the above-mentioned plants, taken in equal quantities, to which we have given the name “Limbor”.

Aqueous extractions of the studied objects were prepared according to the method of the State Pharmacopoeia of the XIII edition (ratio 1:10) [2]. Antioxidant activity was determined by two methods. When using the spectrophotometric method, the reaction rate was estimated from the optical density of the accumulating product of autooxidation of adrenaline, which has an absorption at a wavelength of 347 nm, formed in the used model system [5].

For this, 0.2 ml of a 0.1% solution of epinephrine hydrochloride was added to 4 ml of 0.2 M sodium carbonate solution (pH = 12), mixed thoroughly and the optical density was measured on a spectrophotometer after 10 minutes at a wavelength of 347 nm in a cuvette with a thickness of 10 mm (D_{one}). Then to 4 ml of 0.2 M sodium carbonate solution (pH = 12) were added 0.02 ml of the studied extract and 0.2 ml of 0.1% solution of epinephrine hydrochloride, stirred and measured the optical density, as described above (D_2). To take into account the effect of the intrinsic color of extracts that absorb a certain wavelength in the visible part of the spectrum, 0.2 M sodium carbonate solution with the addition of 0.02 ml of the investigated extract was used as a control sample. The measurement was carried out on a Shimadzu UV1800 spectrophotometer in six replicates under the same conditions. Antioxidant activity (AOA) of the studied samples was expressed as a percentage of inhibition of adrenaline autooxidation and was calculated by the formula: $AOA = (D_{one} - D_2) \times 100 / D_{one}$.

AOA value above 10% indicated the presence of antioxidant activity in the test object.

In method 2 for the determination of antioxidant activity in vitro used the ability investigated objects to reduce the intensity of chemiluminescence [1].

Aqueous extracts (from 0.01 to 0.5 ml) were introduced into various model systems (20 ml), in which the formation of reactive oxygen species (ROS) was generated, and lipid peroxidation (LPO) reactions proceeded as the most common free radical oxidation processes. ...

The first model system was 20 ml of phosphate buffer with addition of citrate and luminol (pH = 7.5). 1 ml of 50 mM ferrous sulfate solution was added as an oxidation initiator. Oxidation of iron salts leads to the appearance of oxygen radicals and is accompanied by chemiluminescence, which is enhanced in the presence of luminol. The glow was recorded for 5 minutes.

Lipoprotein complexes similar to blood lipids were prepared as a second model to assess the effect of drugs on LPO from chicken yolk. The yolk was mixed with phosphate buffer in a ratio of 1: 5 and homogenized. Chemiluminescence was initiated by the addition of 1 ml of 50 mM ferrous sulfate solution, which triggers the oxidation of unsaturated fatty acids that make up lipids.

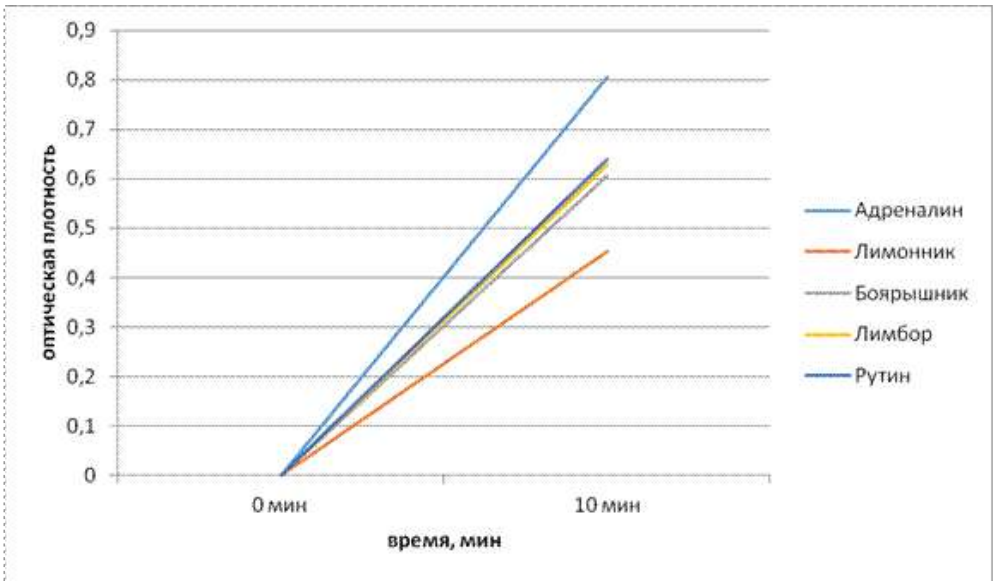
Model systems without the addition of the studied types of medicinal plant materials served as control. The luminescence was recorded on a KhLM003 device.

Antioxidant activity was assessed by a decrease in the intensity of luminescence (Table 2).

A 0.05% solution of rutin, a flavonoid of plant origin, the antioxidant effect of which was established [3], was used as a reference drug. The choice of rutin as a comparison drug is due to the fact that, according to numerous studies, the antioxidant activity of plant objects is mainly due to the presence of flavonoids in them [6].

RESULTS AND DISCUSSION

Using the spectrophotometric technique for studying AOA, the following results were obtained (Fig. 1.).



Rice. 1. Changes in optical density in the presence of in the model system of research objects.

In fig. 1 shows that all the studied objects decreased the optical density, thereby reducing the rate of adrenaline autooxidation. Based on the data obtained, their AOA values were calculated according to the formula given above (Table 1).

Table 1

Antioxidant Activity Study Results spectrophotometric method (n = 6)

No.	Object of study	AOA value
one	Lemongrass leaf infusion	44.1 ± 2.4%
2	Infusion of blood-red hawthorn leaves	24.9 ± 1.3%
3	Infusion "Limbor"	22.2 ± 1.1%
4	Rutin 0.05% (reference drug)	20.7 ± 1.1%

According to the data obtained, all studied objects have antioxidant activity (more than 10%). The most pronounced AOA is observed in Schisandra chinensis leaves, exceeding the AOA of the reference drug ($p < 0.05$). The AOA of the leaves of the blood-red hawthorn is slightly higher than that of the mixture "Limbor" and the reference drug, but the differences in the data are not significant ($p > 0.05$).

The results of the study of antioxidant activity by the chemiluminescence method are presented in table. 2.

From the results presented in the table, it can be seen that the infusion of lemongrass leaves

Chinese reduces the formation of reactive oxygen species (light sum of luminescence) in doses from 0.01 to 0.5 ml from 39% to 91%, infusion of blood-red hawthorn leaves - from 66% to 81%, “Limbor” infusion - from 36% to 83%, rutin (reference drug) in the same doses from 39% to 85%. The studied objects also influenced the LPO rate, reducing it on average: an infusion of lemongrass leaves - from 23% to 90%, an infusion of blood-red hawthorn leaves - from 30% to 90%, an infusion of "Limbor" - from 22% to 86% , rutin (reference drug) in the same doses - from 26% to 46% depending on the dose. Analyzing the data obtained, we can say that all the studied objects reduce the formation of ROS, reduce the rate of LPO and are not inferior to the reference drug, and in the model they exceed LPO. It should be noted,

table 2

Influence of the studied objects in different concentrations on chemiluminescence in various model systems (n = 6)

	Volume, ml	AFK model		FLOOR model	
		Light sum glow	% decline control	Light sum glow	% decline control
Control		58.8 ± 3.54	one hundred	14.34 ± 0.43	one hundred
Leaves hawthorn (infusion)	0.01	19.8 ± 0.67	66.3 *	9.93 ± 0.49	30.8 *
	0.05	15.9 ± 0.65	72.9 *	2.74 ± 0.14	81.0 *
	0.1	10.8 ± 0.07	81.6 *	1.37 ± 0.05	90.5 *
Lemongrass leaves (infusion)	0.01	35.86 ± 2.61	39.0 *	11.0 ± 0.59	23.3 *
	0.05	16.21 ± 0.53	72.4 *	3.55 ± 0.14	75.2 *
	0.1	4.86 ± 0.25	91.7 *	1.33 ± 0.04	90.7 *
Limbor (infusion)	0.01	37.55 ± 2.06	36.1 *	11.19 ± 0.63	22.0 *
	0.05	19.44 ± 0.85	70.0 *	2.79 ± 0.16	80.5 *
	0.1	9.77 ± 0.42	83.4 *	1.97 ± 0.06	86.3 *
Rutin 0.05% solution (reference drug)	0.01	35.52 ± 1.52	39.6 *	10.61 ± 0.54	26.0 *
	0.05	27.52 ± 1.21	53.2 *	9.25 ± 0.44	35.5 *
	0.1	8.7 ± 0.47	85.2 *	7.72 ± 0.01	46.2 *

* - p <0.05

CONCLUSION

In an experiment on various model systems, it was found that Schisandra chinensis leaves, blood-red hawthorn leaves and a new plant composition based on them have a pronounced antioxidant activity, reducing the rate of formation of reactive oxygen species and the rate of lipid peroxidation. The presented results make it possible to recommend the use of the studied types of raw materials separately and in their joint presence for prenatal prevention of congenital malformations of the maxillofacial region.

CONCLUSIONS

1. An experimental study of the antioxidant properties of leaf infusions has been carried out Schisandra chinensis and blood-red hawthorn leaves (separately and with joint presence) for their use in dentistry.

2. It is shown that the new plant composition "Limbor" can be promising dosage form for prenatal prevention of congenital malformations of the maxillofacial region.

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