Comparative evaluation of antidiabetic properties of decoctions from Caragana Lam species.

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SUMMARY

On a model of alloxan diabetes in rats and mice, a primary screening comparative assessment of the antidiabetic activity of decoctions of deciduous branches of 17 species of Caragana of the legume family was given. An antihyperglycemic effect, an increase in the level of insulin and C-pepstide against the background of treatment with decoctions of most of the studied species, comparable to those of control drugs (butamide, blueberry shoots, ginseng leaves), has been proven. According to the total index of antidiabetic activity, 10 out of 17 species deserve further, more in-depth study.

Key words: phytopharmacology, Karagana species, alloxan diabetes in rats and mice,insulin production.

RESUME

Primary screening comparative assessment of the antidiabetic activity of the leaves of 17 species of Caragana lam species was done on the model of alloxan diabetes in rats and mice.

Antihyperglycemic action, ability to raise level insulin and C-peptide in blood were observed during therapy with decoctions of the majority of the studied spices. Antidiabetic action was comparable with control therapy (butamid, sprouts Vaccinium myrtillis, leaves Panax ginseng). According to the total index of antidiabetic activity, 10 out of 17 types deserve further, more in-depth study.

Keywords: Phytopharmacology, Caragana species, alloxan diabetic rats and mice, insulin production.

INTRODUCTION

The use of medicinal plants in the treatment of patients with type 1 and 2 diabetes mellitus (T1DM, T2DM) is not often generally accepted by diabetologists in Russia, but nevertheless a number of plants are recommended for use, in particular, representatives of classical adaptogens: preparations of Eleutherococcus prickly ginseng, Rhodiola rosea, high lure , as well as types of licorice, goat's rue (galegi) medicinal, blueberry leaves. In rare cases of the use of phytopreparations, for example, in type 2 diabetes, they are considered exclusively as an additional and ineffective therapy. In general, 73% of patients worldwide use herbal medicine for diabetes mellitus [19]. The urgency of the problem of treating patients with diabetes, preventing its complications has become the reason for a large number of studies, reviews of the possibilities of using plants in this disease [19–25].

S. Verma et al. List 35 plants used in traditional Indian
medicine for diabetes. One of the last places is the alcoholic extract of ginseng root, which, contrary to the data on the ability to initiate the restoration of the insulin-producing function of the pancreatic islet apparatus in alloxan diabetes in rats [2, 3, 4], is considered an inhibitor of α-glucosidase activity and an agent that reduces glucose absorption [25].

The well-known spices available to domestic phytotherapists - rhizome of ginger, turmeric long, coriander seeds, bark of cinnamon species and a number of other plants - have been recognized as the ability to experimentally increase blood insulin levels and restore the functions of β-cells of the islets of Langerhans. Cinnamon bark Cinamomum cassia increases the sensitivity of receptors to insulin, which is especially important in T2DM. Fruits of the clove species Eugenia jambotana inhibit the activity of liver and kidney insulinase [20].

I would like to note some mechanistic nature of the authors in the designation of "active substances", although it is Ayurvedic medicine that recognizes the preservation of the integrity of the complex of natural plant compounds, the use of total extracts from them and their combinations [21]. In this regard, reviews of plants used in diabetes mellitus, recipes for collections containing several plants, data by S.M. Keith and co-authors back in the 90s of the twentieth century. are the most

professional and useful for domestic phytotherapists, diabetologists [12, 13].

Whatever attempts are made to attribute antidiabetic properties to one or another group of substances, information on the use of a number of available spices in Indian traditional medicine for diabetes is important, which confirms our proposal on the legitimacy of the use of a "spice cocktail" [5] in accordance with the tactics of traditional combination medicine collecting the ribbon of synergists. However, the authors note that Indian traditional medicine is characterized by the use of a combination of antidiabetic plants in multicomponent collections containing 3–25 species. Water extracts or powders are used [24], which emphasizes the rule of traditional medicine to preserve unique complexes of natural compounds of medicinal plants.

Gupta et al. In a large review cite data on the use in traditional, folk medicine of 1300 species belonging to 750 genera, 190 families [21], emphasizing the continuity of their application over the centuries, as well as the search for the most effective species, and the study of their mechanism of action at the present time. time. For example, Paula PC et al. [22] describe in detail the isolation of insulin-like protein substances from various plant species and parts. But enteral administration means the cleavage of these proteins by proteases, while parenteral administration is fraught with a cascade of reactions to a foreign protein, which causes an exclusively cognitive, research interest in this type of work. Isolation of fractions, natural compounds, the study of their antidiabetic properties, as well as individual types of medicinal plants - an indispensable stage of analysis, the process of cognition itself, however, is not synonymous with the process of treatment. Experimental models of diabetes mellitus are by no means analogous to insulin-dependent human diabetes in the defeat of β-cells of the islets of Langerhans, and therefore the most important clinical results are, at present, by no means optimistic. Nevertheless, the relevance of prospecting works fully justifies screening, the primary experimental comparative assessment of the antihyperglycemic properties of medicinal plants used in traditional medicine.

RESEARCH MATERIAL

Studied antidiabetic properties of decoctions of leafy green young shoots in the phase of flowering, the beginning of fruiting of the following species: 1. Karagan Altai Caragana altaica. 2. K. tree-like C. Arborescens. 3.C. orange C. Surantiac., 4. K. shrub C. frutex (sample 1 - Kazakhstan, sample 2 - Moldova). 5.K. ManedC, jubata, 6.K. Kirgizov C. Kirghisorum. 7.K. is beautiful C. Lacta. 8.K. White-haired C. Leucophloea. 9. K. small-leaved C. Microphylla. 10.K.Buryatskaya C. Buriatica. 11. K. multifoliate C. Pleiophylla. 12. K. frosty C. Pruinosa. 13.K. Undersized C. Pumila. 14. K. dwarf C. Pygmaea. 15.C. Prickly C. Spinosa. 16. K. narrow-leaved C. Stenophylla. 17. Large-flowered C. grandiflora. For pharmacological studies, ex tempore was prepared from crushed raw materials no more thanthan for 2 days concentrated decoctions 1:10 according to the 10th State Pharmacopoeia. Tinctures 1:10 in 40% ethanol were prepared by the infusion method, completely dealcoholized before enteral administration to animals, since the presence of even small amounts of ethanol distorts the pharmacological properties of phytopreparations [2].

RESEARCH METHODS

The method of alloxan diabetes in mice was developed by us [2] taking into account the high metabolism, short life span of animals, and, accordingly, their high resistance to diabetogenic poison and rapid normalization of carbohydrate metabolism. "Myshification" of the method was undertaken with the aim of drastically reducing the amount of raw materials, samples of which in this and our other studies were sometimes in short supply. In rats and especially in mice, reliable diabetogenic doses of alloxan are close to toxic ones. For each contingent of mice, a diabetogenic dose of always freshly prepared alloxan solution was tested when injected intraperitoneally, and 20–30% of the animals died. The dose varied in the range of 310–340 mg / kg and was significantly higher than that for rats (100–140 mg / kg in terms of the base), of which only a few individuals died. Counts,

However, the creators of the classical model of experimental alloxan diabetes did not use the glucose tolerance test (GTT), which is generally accepted in the clinic, and did not take into account the high resistance of animals to alloxan and the possibility of its toxic effect only in high glucose intolerance with less pronounced differences in its basal level. They, when trying to get almost lifelong diabetes in rats with repeated injections of alloxan, did not

the rapid rate of reparative processes, the manifestation of increasing insensitivity to poison, a kind of mitridatism, and the ratio of the duration of pathology to the life of animals are taken into account.

Table 1

Comparative assessment of the effect of decoctions of aerial parts of the Caragana Lam species.
with preventive and therapeutic administration to the level of glycemia
at the 20th minute of the glucose tolerance test (GTT) in alloxan-diabetic mice

Group of animals, Types of Karagana	Glucose level mm / l		
	Preventive action	Therapeutic action	
		1st series of experiments	2nd series of experiments
Intact (water injection) 20th min. GTT:	4.56 ± 0.20 n = 15	4.03 ± 0.27 n = 10	4.89 ± 0.17 n = 13
Intact (water injection) Alloxan-diabetic untreated (control)	9, 24 ± 0.83 * n = 13 23.90 ± 3.88 n = 17	8.91 ± 0.81 * n = 11 13.23 ± 1.76 n = 22	8.31 ± 0.25 * n = 18 25.38 ± 2.64 n = 28
Alloxan-diabetic treated with decoctions:	23.48 ± 4.12 n = 14	14.37 ± 2.77 n = 11	25.16 ± 3.72 n = 9
Altai Karagan	20.10 ± 2.92 n = 15	10.92 ± 2.42 n = 8	24.31 ± 5.39 n = 10
K. white-haired	17.95 ± 3.38 * n = 15	13.71 ± 2.70 n = 10	18.82 ± 6.34 n = 9
K. grivastoy	19.06 ± 3.03 * n = 16	10.30 ± 1.52 * n =	13.59 ± 2.83 * n =
To the tree	17.68 ± 2.85 * n = 12	12	10
K. frosty	19.88 ± 2.99 n = 15	12.98 ± 2.09 n = 10	21.10 ± 5.08 n = 10
K. dwarf	23.51 ± 2.88 n = 9	11.33 ± 2.07 n = 8	20.95 ± 6.94 n = 8
K. Kirgizov	17.23 ± 2.98 * n = 13	10.96 ± 0.90 * n =	22.00 ± 5.25 n = 10
K. prickly	20.82 ± 3.22 n = 15	12	17.96 ± 5.43 * n = 9
K. beautiful	17.90 ± 3.16 * n = 15	15.03 ± 5.23 n = 9	23.23 ± 5.59 n = 9
K. shrub (sample 1)	15.85 ± 1.80 * n = 21	10.30 ± 2.03 * n =	19.61 ± 3.86 * n = 9
(sample 2)	17.92 ± 2.27 * n = 17	10	18.23 ± 3.25 * n = 9
K. small-leaved	21.65 ± 2.63 n = 15	9.58 ± 1.70 * n = 10	18.04 ± 2.72 * n = 9
K Buryat	19.90 ± 2.78 n = 14	11.59 ± 2.62 n = 9	24.24 ± 5.26 n = 8
K. multifoliate	19.09 ± 2.18 * n = 17	9.03 ± 1.16 * n = 9	24.54 ± 3.02 n = 9
K. undersized	20.26 ± 2.23 n = 16	9.97 ± 1.52 * n = 9	26.10 ± 2.46 n = 8
K. orange	17.07 ± 2.76 * n = 14	14.44 ± 2.75 n = 11	21.45 ± 4.65 n = 9
K. narrow-leaved	16.78 ± 2.18 * n = 15	12.43 ± 1.73 n = 8	19.06 ± 2.02 * n =
K. large-flowered		11.33 ± 1.29 n = 14	10
		11.84 ± 3.32 n = 9	18.50 ± 2.65 * n =
		9.45 ± 1.52 * n = 10	10

Our use of GTT (5 g / kg glucose solution through a tube into the stomach) revealed glucose intolerance in 97–100% of animals 9–12 days after alloxan injection. The peak of hyperglycemia during HTT in rats falls on 40–45 minutes, and in mice - at 20 minutes, during which the preventive (2 days after the injection of alloxan) or therapeutic (after 7 days) effect of phytopreparations was determined. The use of this method of registration of antidiabetic activity allowed us to reveal that in the leaves of Ginseng, a number of classical phytoadaptogens, plants of the order Heather, meadowsweet flowers [2–4, 6, 9, 10]; the method, taking into account the stated biological nuances, has been sufficiently tested with respect to the reliability and reproducibility of the results. Broths 1:10,

Blood was obtained from rats by an incision of the gums, from mice - during decapitation. The concentration of glucose in the blood was determined by the classical generally accepted enzymatic method [16], insulin and C-peptide - by the radioimmunological method [11]. Statistical processing was carried out according to the Fisher-Student's t test with the calculation of the confidence interval. The total efficiency index for HTT was calculated as a percentage (x100) according to the following formula: the value of the indicator in alloxan-diabetic

untreated animals (it is in treated animals) / the value of the indicator in alloxan-diabetic untreated animals (it is also in intact animals) (Table 4).

A number of studies with GTT were repeated to record the reproducibility of the effect. When determining the effectiveness of the preventive administration of decoctions of Caragana species to rats during statistical processing, we used not only the t test, but also the Wilcoxon-Mann-Whitney U test for nonparametric statistics, which is more capacious in small samples (6–7 animals). The experiments were performed on male mice of 20–23 g of the SHR line and on male outbred white rats 200–250 g. We used a blind method: those who determined the level of hyperglycemia, insulin, and C-peptide did not know whether the animals belonged to this or that group.

RESULTS AND ITS DISCUSSION

Preventive course administration of decoctions of caragana species to mice was effective for most of the studied samples. The results of GTT in alloxan-diabetic mice are given in table. 1, it is possible to arrange, in descending order of activity, plant species in the following order: Caragana shrub (sample 2) ≥ K. large-flowered ≥ K. narrow-leaved ≥ K. prickly ≥ K. frosty ≥ K. shrub (sample 1) ≥ K. small-leaved ≥ K. maned ≥ K. tree-like ≥ K. short. The differences between the extreme members of the series are statistically significant. 10 out of 18 studied samples are effective. It should be noted that none of the decoctions is complete, i.e. to the level of glycemia in intact mice with HTT did not protect mice from the diabetogenic effect of alloxan.

Without loading the article with tabular material, I will cite 9 species, the decoctions of which had a significant preventive effect in rats, in parentheses - the glucose level in mM / L at the 45th minute. GTT and efficiency index: small-leaved K. (4.2; 114) = small-leaved K. (4.2; 114) ≥ large-flowered K. (6.0; 98) ≥ multi-leaved K. (6.6; 90) ≥ K dwarf (6.8; 88) ≥ K. shrub, specimen1 (7.2; 84) ≥ K. orange (9.2; 64) ≥ K. small-leaved (9.4; 62) ≥ K. maned (9.8; 58). In this series of experiments, hyperglycemia in untreated alloxan-diabetic rats (15.6; 0) and intact (5.6; 100) differed 2.8 times. For the first two species, supercompensation is obvious: the decrease in the level of hyperglycemia is comparable and lower than that in intact rats. 9 out of 18 samples are effective, and 6 of them (isolated) showed antidiabetic activity in experiments on mice.

With all the relativity of the extrapolation of experimental data obtained on a model of alloxan diabetes in laboratory animals, we can nevertheless recommend at least a further study of the possibility of preventing the progression of T1DM and especially T2DM while taking a decoction of the Caragana species leading in this list. In this case, the experimentally confirmed vaso-, hepatoprotective, and anti-destructive properties of them should be taken into account [6, 7]. It is more correct, with positive results of clinical use, to include these non-toxic, edible, forage species in the ribbon of synergistic plants that act antidiabetic. With the therapeutic introduction of decoctions in at least one of the 2 series of experiments on mice, half (9 out of 18) of the samples were active.1. Highlighted species that are also effective in 2 series of experiments also with the preventive administration of decoctions to mice and rats. The detection of even 4 out of 18 samples showing high reproducible antidiabetic activity in all commented series of experiments should be considered a positive result of blind screening.

table 2

Comparison of the therapeutic effect of dealcoholized tinctures
aerial parts of the Caragana Lam species. on glycemia in alloxan-diabetic mice
at the 20th minute of the glucose tolerance test (GTT)

Group of animals, Types of Karagana	Qty animals	Glucose level in mM / L on the 20th min. GTT
Intact 20th minute GTT Intact (water	ten	4.60 ± 0.20 *
injection) Alloxan-diabetic untreated	7	8.29 ± 0.61 *
(control)	eleven	10.75 ± 1.55
Treated with tinctures:	7	13.32 ± 2.77
Altai Karagan	eight	9.88 ± 3.75
K. white-haired	nine	9.80 ± 3.55
K. grivastoy	eight	9.98 ± 2.19
K. tree-like	eight	11.90 ± 1.34
K. frosty	13	12.03 ± 3.39
K. dwarf	13	8.29 ± 1.56 *
K. Kirgizov	eight	9.23 ± 1.85
K. prickly	eleven	12.13 ± 2.44
To the beautiful	12	8.83 ± 2.71
K. shrub (sample 1)	eleven	9.69 ± 2.22
(sample 2)	eight	9.20 ± 2.06
K. small-leaved	fourteen	8.39 ± 2.93
K. Buryat	eight	8.99 ± 1.46
K. multifoliate	7	10.70 ± 2.88
K. undersized	13	9.24 ± 1.28
K. Ornazhevoy	eight	11.56 ± 1.88
K. narrow-minded	ten	8.81 ± 1.27
K. large-flowered		
Common blueberry leaves	fourteen	8.19 ± 1.19 *

Table 2 shows the results of the ineffectiveness of the therapeutic use of dealcoholized tinctures of the Caragana species, while a similar preparation of leafy shoots of blueberry shrubs exhibited medicinal properties. The question of using low concentrations of ethyl alcohol as a preservative, and not an extractant, has been repeatedly raised by doctors and pharmacologists, but phytochemists and pharmacists are still in favor of the production of alcohol extracts from one plant, which is what we observe in our pharmacies. It is no coincidence that traditional medicine chooses water as a universal extractant, and extemporal forms as the most effective ones, is confirmed experimentally for many medicinal plants, in particular, for meadowsweet, Fisher's milkweed, Licorice species and others [2]. The results are shown in table. 2,

Alloxan-diabetic rats were more sensitive to the therapeutic effect of caragan broths. Considering the level of hyperglycemia reduction in alloxan-diabetic rats with HTT during treatment with phytopreparations, it can be noted that 14 out of 17 species (15 out of 18 samples) showed a significant therapeutic effect (Table 3), comparable to that of butamide in all parameters. 9 decoctions significantly increased the pancreas insulin-producing function. A decoction of blueberry shoots did not significantly reduce the level of hyperglycemia, but significantly increased the level of insulin and C-peptide. Decoctions of K. maned and K. short reduced the level of hyperglycemia, but did not increase the levels of insulin and C-peptide, which allows one to suspect non-insulin mechanisms of compensation for alloxan diabetes. In cases of an increase in the level of only C-peptide (K. multifoliate, K. treelike, K. beautiful) in combination with an antihyperglycemic effect, there is every reason to believe that decoctions are capable of initiating the restoration of the insulin-producing function of the islet apparatus of the pancreas. A high therapeutic antidiabetic effect in all 3 indicators, especially in relation to an increase in the concentration of insulin and C-peptide, was shown by the dealcoholized tincture of ginseng leaves (reference drug).

Table 3

Comparative assessment of the effect of decoctions from the aerial parts of Caragana Lam.

on glucose tolerance, insulin and C-peptide levels
at the 45th minute of the glucose tolerance test (GTT) in alloxan-diabetic rats

Group of animals View of caragana and other plants	Qty stomach- of those	Level		
		glucose in mm / l	insulin in μed / ml	C-peptide in ng / ml x 0.1
Intact Alloxan-diabetic 45 min. GTT:Intact Alloxan-diabetic	fourteen	6.27 ± 0.88 *	41.86 ± 8.24 *	0.27 ± 0.08 *
untreated (control)Alloxan-diabetic treated with	12	6.45 ± 0.37 *	19.19 ± 5.71	0.13 ± 0.06
decoctions:Caragans maned	12	7.37 ± 0.69 *	67.42 ± 30.50 *	0.54 ± 0.12 *
	16	14.06 ± 5.85	24.44 ± 5.18	0.09 ± 0.06
K. dwarf	fourteen	7.49 ± 1.30 *	22.36 ± 5.18	0.07 ± 0.04
K. shrub (sample 2) K.	12	9.72 ± 1.42 *	32.82 ± 7.53 *	0.48 ± 0.12 *
small-leaved	ten	9.32 ± 1.29 *	44.35 ± 12.14 *	0.41 ± 0.15 *
K. Buryat	12	7.19 ± 0.78 *	31.07 ± 5.05 *	0.59 ± 0.15 *
K. multifoliate	12	9.33 ± 2.31	27.32 ± 7.49	0.28 ± 0.11 *
Common blueberry	13	8.25 ± 1.33 *	24.68 ± 8.26	0.25 ± 0.10 *
Treated with butamide 100 mg / kg per day enterally	eleven	9.56 ± 2.25	32.97 ± 10.75 *	0.52 ± 0.12 *
	ten	7.44 ± 0.89 *	34.29 ± 10.89 *	0.51 ± 0.15 *
Intact Alloxan-diabetic 45 min. GTT: Intact Alloxan-diabetic	16	5.41 ± 0.46 *	30.10 ± 5.90	1.47 ± 0.24
untreated (control)Alloxan-diabetic treated with	16	7.55 ± 1.30 *	30.00 ± 6.2	1.60 ± .027
decoctions:To large-flowered	22	6.25 ± 0.82 *	42.20 ± 6.40 *	1.52 ± 0.23 *
	21	15.90 ± 3.80	33.90 ± 8.30	1.10 ± 0.19
K. tree-like	fourteen	5.27 ± 0.75 *	48.20 ± 4.80 *	2.21 ± 0.30 *
K. prickly	16	8.84 ± 3.20 *	36.70 ± 3.40	1.56 ± 0.20 *
Dealcoholized tincture of ginseng leaves 1.5 g / kg per day	16	5.49 ± 0.86 *	41.6 ± 7.70 *	1.98 ± 0.35 *
	25	9.80 ± 2.50 *	55.90 ± 14.6 *	2.47 ± 0.19 *
Intact Alloxan-diabetic 45 min. GTT: Intact Alloxan-diabetic	eight	4.40 ± 0.50 *	16.82 ± 5.76	1.32 ± 0.18 *
untreated (control)Treated with decoctions:	eight	6.70 ± 1.10 *	9.53 ± 6.60 *	1.12 ± 0.22 *
	16	5.54 ± 0.61 *	36.54 ± 6.07 *	1.53 ± 0.14 *
Altai Karagan	26	10.76 ± 1.57	17.77 ± 2.81	0.56 ± 0.12
K. white-haired	7	8.34 ± 2.30	18.50 ± 2.32	0.82 ± 0.33
K. frosty	6	8.05 ± 1.10 *	27.93 ± 4.69 *	1.22 ± 0.40 *
K. Kirgizov	6	8.25 ± 1.32 *	29.46 ± 4.70 *	1.28 ± 0.52 *
K. beautiful	6	7.96 ± 1.8 *	34.49 ± 5.08 *	1.07 ± 0.42 *
K. shrub (sample 1) K.	7	7.16 ± 1.6 *	18.80 ± 2.50	1.11 ± 0.48 *
undersized	twenty	7.45 ± 1.80 *	31.06 ± 4.18 *	0.97 ± 0.28 *
K. orange	7	7.75 ± 1.76 *	22.84 ± 7.35	0.75 ± 0.40
K. narrow-leaved	7	8.62 ± 2.05	19.87 ± 4.45	0.79 ± 0.48
	fourteen	7.75 ± 1.11 *	31.10 ± 4.5 *	1.09 ± 0.31 *

Notes: 1) the mean values ± confidence interval are given; 2) * - differences with control are statistically significant at $p \le 0.05$; 3) the number of animals treated with caragan broths is regulated by the availability of raw materials.

Table 4

Index of antidiabetic activity of decoctions of Karagana species in percent

Decoctions from plant species	GTT in rats			GTT in mice, hyperglycemia			Total index efficiency (E) (E / n)
	Hyper-glycemia	Insu-lin	WITH-peptide	Preven-tive introduction	Curative introduction		
					Series 1	Series 2	
Caragana maned	98.2 *	- 4.8	- 4.4	40.1 *	- 11.3	38.4	156.2 31.2
K. dwarf	64.9 *	19.5 *	86.7 *	27.4	44.9	25.1	268.5 53.7
K. shrub (sample 2) K.	70.9 *	46.2 *	71.1 *	54.9 *	38.0	41.9 *	323.0 64.8
small-leaved	102.6 *	15.6 *	111.1 *	40.8 *	97.4 *	43.0 *	410.5 82.1
K. Buryat	70.7 *	6,7	42.2 *	15.3	75.5 *	6,7	217.1 43.4
K. multifoliate	86.6 *	0.56	35.6 *	27.3	- 25.9	4.9	129.3 25.9
Common blueberry	67.3 *	17.8 *	95.6 *				180.7 60.2
Butamide	99.0 *	22.9 *	93.3 *				215.2 71.7
K. large-flowered	110.2 *	172.3 *	264.3 *	48.6 *	87.5 *	40.3 *	723.2 144.6
K. treelike	73.2 *	33.7	109.5 *	33.0 *	67.8 *	69.1 *	386.3 77.3
K. prickly	138.9 *	95.1 *	209.5 *	45.5 *	- 41.7	43.5 *	490.8 98.2
Ginseng leaf tincture	63.2 *	265.1 *	326.1 *				654.4 218.3
K. Altai	46.4	3.9	26.8	2.8	- 23.9	1.3	57.3 11.5
K. white-haired	51.9 *	54.3 *	68.0 *	25.9	53.5	6.2	259.8 52.0
K. frosty	48.1 *	62.2 *	74.2 *	42.4 *	5.8	25.1	257.8 51.6
K. Kirgizov	53.6 *	89.1 *	52.5 *	2.7	52.5 *	19.9	270.3 54.1
K. is beautiful	69.9 *	5.5	56.7 *	21.0	67.8 *	12.6	233.5 46.7
K. shrub (sample 1) K.	63.4 *	70.8 *	42.3 *	40.9 *	85.6 *	32.5 *	335.5 67.1
short	57.7 *	27.0 *	19.6	32.8 *	18.5	- 4.2	151.4 30.3
K. orange	41.0	11.2	23,7	24.8	44.0	23.0	167.7 33.5
K. narrow-leaved	57.7 *	71.0 *	54.6 *	46.6 *	34.3	37.0 *	301.2 60.2

Notes: 1) * - the indicator according to the previous tables significantly differed from the control of untreated alloxan-diabetic animals; 2) E - the sum of all test indices; 3) E / n - the sum of all indices divided by the number of tests, an integration indicator of the effectiveness of antidiabetic action.

Analysis of the total indices of the antidiabetic activity of decoctions of the Caragana species (Table 4) makes it possible to single out those of them that are comparable and superior to the activity of butamide and the official antidiabetic plant Bilberry vulgaris. In decreasing activity, they are arranged in the following order: K. large-flowered ≥ K. prickly ≥ K. small-leaved ≥ K. treelike ≥ butamide ≥ K. shrub, samples 1 and 2 ≥ Common bilberry = K. narrow-leaved ≥ K. Kirghiz ≥ K. dwarf ≥ K. white-brown ≥ K. frosty.

Thus, 11 out of 18 samples of Karagana are most worthy of further, more in-depth study and, possibly, introduction into the practice of diabetologists. Considering the background vasoprotective, antidestructive activity manifested by decoctions of Karagana species [6, 7], they can also be a means of preventing angiopathies and associated retino-, nephro-, neuropathies. Combinations of these properties do not show synthetic antidiabetic drugs. Unlike plants, which contain hundreds of natural compounds, synthetic substances have no biologically determined interest in maintaining the health of their distributors. Manifestation of antidestructive, preventive activity with decoctions of Karagana species on models of damage to various organs: vessels - xylene, hepatocytes - carbon tetrachloride, gastric mucosa
- reserpine and other influences is a confirmation of the consistency and high significance developed by N.V. Lazarev and his school of the theory of the state of nonspecifically increased adaptability (SNPS) of the organism, achieved with the help of medicinal plants [2, 14]. Classical phytoadaptogens are leaders in the mobilization of SNPS, which is confirmed by the above results for the reference drug - dealcoholized tincture of ginseng leaves. A number of our studies have repeatedly confirmed its high antidiabetic activity, comparable to that of ginseng root [2, 4, 8, 9]. It is obvious that the increase in the resistance of organs and tissues against the background of the course administration of phytopreparations is not organotropic, but systemic.

organismic character and manifests itself in relation to various damaging influences. Thus, the obstacle to the diabetogenic effect of alloxan during preventive administration, the acceleration of reparative, insulin-producing processes during treatment with Karagan decoctions are particular manifestations of the SNPS caused by them. Mobilization of other mechanisms correcting carbohydrate metabolism is not excluded and worthy of study: non-suppressed insulin-like substance, cholecystokinin, gastrin, secretin, vasoactive intestinal polypeptide, other insulin liberators and antihyperglycemic proteins, peptides [18]. The combination of antihyperglycemic and antidyslipidemic properties in many plants confirms the mobilization of endogenous correctors of metabolism in SNPS caused by medicinal plants, which is achieved not only by classical phytoadaptogens,

CONCLUSIONS

1. With the course of preventive administration, 9 of 17 decoctions showed antihyperglycemic activity in glucose-tolerance test in alloxan-diabetic mice and 9 decoctions in alloxan-diabetic rats. Decoctions of 6 types were effective in both types of animals. Dealcoholized alcoholic tinctures did not show antihyperglycemic properties.

2. Decoctions of most types of Caragana in the treatment of alloxan-diabetic rats reduce the level of hyperglycemia in the glucose-tolerance test, increase the content of insulin and C-peptide in the blood and are comparable in these indicators with the control drugs: butamide, decoction of blueberry shoots, dealcoholized tincture of ginseng leaves.

3. Calculation of the total index of antidiabetic activity for all indicators carried out experiments made it possible to identify 11 out of 18 samples worthy of more in-depth study in order to be able to be introduced into the practice of diabetologists.

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