

UDC 615.272/451.16:641.561/563:582.893:612.397.2

GOUTWEED (*Aegopodium podagraria* L.) BIOLOGICAL ACTIVITY AND THE POSSIBILITIES OF ITS USE FOR THE CORRECTION OF THE LIPID METABOLISM DISORDERS

O. Tovchiga, Ph.D., Ass. Prof.*/***, E-mail: farmacol@nuph.edu.ua

O. Koyro, Ph.D.*, E-mail: farmacol@nuph.edu.ua

S. Stepanova, Ph.D., Ass. Prof.**, E-mail: bromatology@nuph.edu.ua

S. Shtrygol', Prof. Dr. of Medicine*/***, E-mail: farmacol@nuph.edu.ua

V. Evlash, Prof. Dr. of Technology****, E-mail: chem_mikro@hduht.edu.ua

V. Gorban', Ph.D., Ass.Prof.****, E-mail: chem_mikro@hduht.edu.ua

T. Yudkevich, researcher***, E-mail: cndl@nuph.edu.ua

*department of pharmacology, **department of nutriciology and pharmaceutical bromatology

***Central scientific-research laboratory

National University of Pharmacy, 53 Pushinskaya str., Kharkiv, 61002, Ukraine

****department of chemistry, microbiology and food hygiene

Kharkiv State University of Food Technology and Trade, 53 Klochkivska str., Kharkiv, 61051, Ukraine

Abstract. The article summarizes data concerning the biological activity of the promising herbal raw material: aerial part of goutweed (*Aegopodium podagraria* L., *Apiaceae*). This plant since time immemorial has been used as vegetable and fodder plant as well as in folk medicine including the treatment of the metabolic disorders. Nowadays the interest in this plant increases. The technology of obtaining the extract and the tincture from goutweed aerial part is described, the chemical composition of these preparations is elucidated. Pharmacological effects of the preparations obtained from goutweed are characterized with the special emphasis on the possibilities of the lipid metabolism disorders correction and prevention. The presented experimental results substantiate the efficacy of goutweed extract and the tincture under the conditions of alimentary lipemia together with their safety in the intact animals. Thus, the hypolipidemic activity of goutweed extract (1 g/kg intragastrically) and goutweed tincture (1 cm³/kg intragastrically) was shown in the test with olive oil loading in rats. The extract appeared to be able to decrease significantly the level of triglycerides in blood plasma, while the tincture reduced the content of plasma total lipids. In the intact rats, the extract at doses of 100 mg/kg and 1 g/kg as well as the tincture at doses of 1 and 5 cm³/kg did not influence on the values of the lipid metabolism after 12 days of administration. Total and HDL cholesterol as well as atherogenic index and plasma total lipids level remained unchanged. In contrast to the data previously obtained on the models of hyperuricemia, in the intact rats there were no changes in plasma uric acid concentration (which was determined proceeding from the role of the purine metabolism disorders in metabolic syndrome pathogenesis). Thus, goutweed preparations are characterized with the regulatory mode of action and sufficient level of safety. The development of drugs as well as functional foods containing goutweed herbal raw material is promising.

Keywords: goutweed (*Aegopodium podagraria* L.), herbal raw material, herbal drugs, lipid metabolism, functional foods.

БІОЛОГІЧНА АКТИВНІСТЬ ЯГЛИЦІ ЗВИЧАЙНОЇ (*Aegopodium podagraria* L.) ТА МОЖЛИВОСТІ ЇЇ ЗАСТОСУВАННЯ ДЛЯ КОРЕКЦІЇ ПОРУШЕНЬ ОБМІНУ ЛІПІДІВ

О.В. Товчига, к.фарм.н., доцент*/***, E-mail: farmacol@nuph.edu.ua

О.О. Койро, к.фарм.н.*, E-mail: farmacol@nuph.edu.ua

С.І. Степанова, к.фарм.н., доцент**, E-mail: bromatology@nuph.edu.ua

С.Ю. Штриголь, д.мед.н., професор*/***, E-mail: farmacol@nuph.edu.ua

В.В. Євлаш, д.тех.н., професор****, E-mail: chem_mikro@hduht.edu.ua

В.Г. Горбань, к.тех.н., доцент****, E-mail: chem_mikro@hduht.edu.ua

Т.К. Юдкевич, н.с.***, E-mail: cndl@nuph.edu.ua

*кафедра фармакології, **кафедра нутриціології та фармацевтичної броматології,

***Центральна науково-дослідна лабораторія

Національний фармацевтичний університет, вул. Пушкінська, 53, м. Харків, 61002

****кафедра хімії, мікробіології та гігієни харчування

Харківський державний університет харчування та торгівлі, вул. Ключківська, 333, м. Харків, 61051

Анотація. У статті узагальнено відомості щодо біологічної активності перспективної рослинної сировини: надземної частини яглиці звичайної (*Aegopodium podagraria* L., *Apiaceae*). Висвітлено технологію одержання препаратів із цієї рослинної сировини, охарактеризовано їхній хімічний склад та фармакологічні ефекти, особливу увагу приділено можливостям корекції порушень обміну ліпідів та їхньої профілактики. Наведено експериментальні дані, які підтверджують ефективність екстракту та настоянки яглиці звичайної в умовах аліментарної ліпемії поряд із їх безпечністю в інтактних тварин. Так, гіполіпідемічна активність екстракту яглиці (1 г/кг внутрішньошлунково) та настоянки яглиці (1 см³/кг внутрішньошлунково) була встановлена на щурах у тесті із навантаженням оливковою олією. У інтактних щурів екстракт у дозах 100 мг/кг та 1 г/кг, а також настоянка у дозах 1 та 5 см³/кг не впливають на показники обміну ліпідів після 12-денного введення. Створення лікарських препаратів, а також дієтичних добавок або функціональних харчових продуктів на основі сировини яглиці звичайної є перспективним.

Ключові слова: яглиця звичайна (*Aegopodium podagraria* L.), рослинна сировина, лікарські препарати рослинного походження, обмін ліпідів, дієтичні добавки, функціональні харчові продукти.



DOI: <http://dx.doi.org/10.15673/fst.v11i4.726>

Introduction. Formulation of the problem

There is a growing demand for herbal products nowadays, both in the field of drug development and in the region of functional foods and dietary supplements production for health promotion and disease risk reduction. The complex composition of a crude herbal raw material is a prerequisite of diverse biological activities including favourable metabolic effects. At the same time, the possible toxic influence or disadvantageous interactions with the drugs or food simultaneously taken are possible. These substantiates a need in a scientific verification of the effects of the medicinal herbs as well as the drugs of functional foods of plant origin.

Our efforts are focused on the pharmacological studies of the preparations obtained from the aerial part of goutweed (*Aegopodium podagraria* L., *Apiaceae*). It is a ubiquitous perennial plant widely used in traditional medicine and consumed as vegetable or fodder plant. Dry extract and tincture obtained from goutweed are standardized on hydroxycinnamic acids content, have a low toxicity level and are able to normalize metabolic processes and to protect the liver and the kidney under the different experimental conditions.

Analysis of recent research and publications

Biological activity of *Aegopodium podagraria* L. *Aegopodium podagraria* L since time immemorial has been used in traditional medicine for the treatment of rheumatism, kidney and bladder diseases, gastrointestinal and metabolic disorders including gout and related states [1–6]. The low toxicity level of goutweed preparations, which is expected considering its use as vegetable and fodder plant, has been confirmed experimentally for water extract and the tincture obtained from the aerial part of the plant [7].

The valuable pharmacological effects of goutweed preparations have been established recently. The extract and the tincture obtained from its aerial part exert nephro- and hepatoprotective effects [7–9]. Goutweed extract is especially effective in protection of the kidney against the different damaging factors, including ischemia, myoglobinemia, gentamicin, ethylene glycole, carbon tetrachloride. It prevents lethality and kidney histostructure changes, normalizes the kidney concentration function, reduces proteinuria and hyperazotemia. It restores the excretory renal function depending on the conditions of the kidney functioning (supporting urine-concentrating ability or normalizing the excretory capacities after water loading), and does not lead to hyperkalemia (even in the animals with the disturbed renal function) despite the high potassium content [10–11]. As to the active components of goutweed leaves extract, it has been shown that leaves protein-polysaccharide complex, and flavonoid trifolin exert significant nephroprotective

activity reducing lethality, hyperazotemia and proteinuria, eliminating anuria, counteracting glomerular filtration decrease, normalizing histopathological kidney structure [10].

The protective multitargeted action of goutweed drugs was also confirmed in regard to the liver injury. The leaves extract, leaves protein-polysaccharide complex, and trifolin were the most effective hepatoprotective agents that improved survival rate, suppressed cytolysis and lipid peroxidation, activated antioxidative system, maintained liver glycogen and protein synthesis [10]. Besides, goutweed aerial part water-ethanol extract has been shown to exert a hepatoprotective effect in animals treated with the complex of antitumor drugs [12].

The preparations obtained from *Aegopodium podagraria* L. are also characterized by favourable metabolic effects including antidiabetic activity. In has been confirmed in alloxan-induced diabetic mice, in which goutweed tincture (1 and 5 cm³/kg) as well as the extract (1 g/kg) reduce glycemia after a course treatment and normalize blood uric acid level. The extract also demonstrates hypoazotemic effect, realized through extrarenal mechanisms, and counteracts body mass decrease [13].

Normalizing influence of goutweed tincture (1 cm³/kg) on glycemia level in rats is also evident when the metabolic disorders are induced by excess fructose combined with hydrochlorothiazide. The extract (1 g/kg) effect under these conditions exerts a hypouricemic. When further elevation of uricemia is induced in such animals by potassium oxonate, goutweed preparations contribute to diuresis maintenance. Both the extract and the tincture (5 ml/kg) tend to increase sodium reabsorption (spontaneous diuresis method) reduced by fructose excess (per se or combined with hydrochlorothiazide). The extract and the tincture (1 cm³/kg) demonstrate antiproteinuric effect in water-loading test [14,15].

Aegopodium podagraria L. tincture appeared to be especially effective for the correction of the disturbances in carbohydrate metabolism. Recently we have substantiated the expediency of its combining with metformin as the widely prescribed first line agent of the peroral normoglycemic drugs. In dexamethasone-treated rats (high dose of 5 mg/kg inducing severe disorders of metabolism was used) the tincture (1 ml/kg) partially increases the efficacy of metformin (50 mg/kg). Goutweed tincture demonstrates a permissive effect on the action of metformin in regard to glucose and lipid metabolism normalization, the reduction in plasma ALT activity and increment in urea clearance as well as normalization of plasma ALP activity [16,17]. On the model of the primary disorders of the lipid metabolism in rats (administration of protamine sulfate against the background of atherogenic diet) the tincture also shows an ability to increase metformin efficacy: these drugs in combination, but not *per se*, completely normalize area under glucose curve in the glucose tolerance test [18].

It is notable that the hypoglycemic effect of *Aegopodium podagraria L.* tincture in intact rats is moderate with glycemia values staying within the normal physiological range. Goutweed tincture exerts hypoglycemic action in intact rats after the administration of single doses of 0.5; 1.0; 5.0 cm³/kg under the conditions of glucose load. Basal glycemia tends toward the reduction in animals receiving the tincture at doses of 0.50 and 2.5 cm³/kg and is significantly decreased after its administration at a dose of 1 cm³/kg [19]. After course administration of this preparation, a statistically significant decrease in basal glycemia and area under the glycemic curve is seen at a dose of 5 cm³/kg [8].

The safety of combined use of *Aegopodium podagraria L.* tincture with metformin was verified in the intact rat and it was shown that the tincture at doses of 0.5 and 1.0 cm³/kg does not block the effects of metformin, and does not enhance its effect with the excessive decrease of blood glucose concentration (at low doses of metformin some indices of synergoantagonism are seen). In the glucose tolerance test, the tincture at a dose of 1.0 ml/kg (but not 0.5 ml/kg) co-administered with metformin allows decreasing its effective dose [19].

Goutweed preparations do not increase risk of ethanol-induced hypoglycemia. In rats receiving a single dose of ethanol (9 g/kg intragastrically), in which hypoglycemia was not manifested, but the tendency to the exhaustion of liver glycogen was seen, the tincture, on the contrary, increased glycemia, while glycogen reserves did not undergo exhaustion (the changes in same direction were registered in rats receiving fenofibrate) [20]. Thus, the tincture may be characterised as a preparation possessing the sufficient level of safety and not inducing hypoglycemia.

Other favourable metabolic effects of goutweed drugs are also manifested in ethanol intoxication, additionally confirming their ability to decrease xenobiotics toxicity described above. It has been shown that the extract (1 g/kg but not 100 mg/kg) significantly reduces the duration of ethanol-induced narcosis in mice [21,22]. In rats receiving a single dose of ethanol the extract (100 mg/kg and 1 g/kg) and the tincture (5 cm³/kg) normalize the lipid composition of the liver, surpassing fenofibrate (100 mg/kg) or being comparable with it. The extract (1 g/kg) reduces ALT activity, the tincture shows a dose-dependent influence on γ -glutamyl transferase activity. These do not induce unfavourable shifts in total protein, albumin, uric acid, and creatinine content [20,23].

Together with the favourable influence on the visceral systems, central effects of *Aegopodium podagraria L.* are of significant interest taking into account its planned prolonged usage for the treatment of chronic diseases of as the component of the functional foods. Sedative effect is among the properties of this plant mentioned in traditional medicine [1,3]. The study of its aerial part extract and tincture in the intact mouse

have shown that they do not induce suppression of the locomotor activity and exploratory behaviour in the combined open field test. The extract is able to decrease the levels of depression under certain conditions (at a dose of 100 mg/kg but not at a dose of 1 g/kg in female mice that is accompanied with the worsening of the results of the passive avoidance test). Against the background of this dose, another useful effect is evident, such as the reduction of the anxiety signs in the animals of both sexes, in male mice this reduction is also seen under the influence of the extract at a dose of 1 g/kg and the tincture at doses of 1 and 5 cm³/kg [24]. Besides, the same dose of goutweed extract of 100 mg/kg significantly increases the exhaustive swimming time (10 % and 20 % load) in male mice. In female mice such effect is registered with 20 % load against a background of the extract at both doses. The extract exerts a moderate positive influence on cognitive functions in mice (but not in rats) in the extrapolation escape test without any significant changes in level of depression in reserpine-treated rats. The central effects of goutweed tincture are less pronounced [25]. The expected prolonged usage of goutweed make it necessary to verify the possible interactions with psychotropic drugs. In addition to the above-mentioned ability of the extract to decrease the duration of ethanol-induced narcosis as the non specific CNS suppressive agent, there are data concerning goutweed preparations interaction with the well known drug with higher specificity of the inhibitory action— thiopental sodium. Namely, goutweed tincture, in contrast to the extract, significantly reduces the duration of sleep caused by thiopental sodium in male mice (at a dose of 1 cm³/kg, but not 5 cm³/kg), being comparable by this effect with *Hypericum perforatum L.* extract (100 mg/kg) [26]. Thus, goutweed extract and the tincture after course administration do not lead to the undesirable shifts in CNS functioning and do not potentiate the action of CNS depressants.

Another important aspect of herbal drugs pharmacology is their interaction with microorganisms. Serbian scientists have studied the antibacterial activity of water, ethanol and ethyl acetate extracts from *Aegopodium podagraria L.* and showed that ethanol extract was the most effective [27], it also exhibited synergistic and additive effects with streptomycin and chloramphenicol [28]. Moderate antibacterial and antifungal properties were reported for methanol extract [29].

The data available on goutweed aerial part preparations influence on the lipid metabolism. Lipid metabolism disorders are involved in the pathogenesis of diseases of the cardiovascular system, metabolic syndrome and diabetes mellitus, they can also arise as a side effect of drugs [30]. The role of healthy diet in prevention of such disorders is generally accepted and certain drugs of herbal origin may become the effective supplementation of their complex therapy. In this context, flavonoids and hydroxycinnamic acids attract much attention as the

possible active components of the functional foods and herbal drugs [31–32]. As described above, these substances are present in goutweed raw material.

Table 1 summarizes data of the experimental studies, which addressed the influence of goutweed aerial part preparations on the lipid metabolism.

Table 1. Summarised data of the experimental studies elucidating the influence of *Aegopodium podagraria* L. aerial part preparations on the lipid metabolism

Model	Preparation, dose, course	Effects	Reference
Rats receiving excess fructose combined with hydrochlorothiazide	Aerial part water extract, 1 g/kg, tincture (1 and 5 cm ³ /kg), course administration for 10 weeks	Decrease in LDL cholesterol (elevated under the influence of fructose excess) and normalization of the atherogenic index (the extract and the tincture at both doses, as well as hydrochlorothiazide), increment in HDL cholesterol (the tincture at both doses and hydrochlorothiazide)	[33]
Rats receiving a single dose of ethanol (9 g/kg intragastrically)	Aerial part water extract, 100 mg/kg and 1 g/kg, prophylactic administration for 7 days	Significant reduction of triglycerides and cholesterol, increment in the content of phospholipids in the liver, lipid metabolism values of blood plasma do not differ from that of intact rats	[23]
	Aerial part tincture, 1 and 5 cm ³ /kg, prophylactic administration for 7 days	Decrease in the level of triglycerides and cholesterol (only at high dose) and increment in the content of phospholipids in the liver (at both doses), reduction of the HDL cholesterol (that is similar to the effect of the reference drug fenofibrate under the conditions of the study)	[23]
Rats receiving dexamethasone (5 mg/kg subcutaneously for 5 days)	Aerial part tincture, 1 cm ³ /kg for 5 days (per se or combined with metformin, 50 mg/kg)	Reduction of triglycerides level in blood plasma and increment of HDL cholesterol content, the tendency towards the decrease in total lipids level (the tincture per se or combined with metformin), decline in LDL cholesterol content (the tincture per se)	[16]
Rats receiving protamine sulfate against the background of atherogenic diet and cholesterol administration	Aerial part water extract (1 g/kg), tincture (1 cm ³ /kg), course administration for 16 days (per se or combined with metformin, 50 mg/kg)	Decrease in the level of triglycerides and cholesterol and increment in the content of phospholipids in the liver (both preparations and their combinations with metformin), lipid spectrum of the blood plasma is not changed significantly by all drugs	[18]

Phytochemical composition of the preparations obtained from *Aegopodium podagraria* L. By the commonly used methods of phytochemical analysis (qualitative reactions, paper and thin-layer chromatography), phenolic compounds such as flavonoids and hydroxycinnamic acids were identified in both goutweed preparations, while coumarins were detected in the tincture. Among phenolic compounds hydroxycinnamic acids prevail. Chlorogenic acid and caffeic acid were identified through comparison with authentic samples.

The procedure of hydroxycinnamic acids and flavonoids quantitative assay by direct spectrophotometry was successfully applied to goutweed aerial part [34,35] and to the preparations obtained from it, the content of hydroxycinnamic acids (chlorogenic acid equivalent) equalled 5.33±0.07 % in the extract and 0,36±0,01 % in the tincture 1:5 (if the plant material and solvent were taken in 1:10 ratio, this value equalled 0.26±0.03 %), while the content of flavonoids equalled 0.47±0.02% and <0.02 % respectively [10,36].

The protein polysaccharide complex of the aerial part of the plant partially mediates its nephro-

hepatoprotective and hypoureemic activity. Its content was determined [10,37], and it equalled 28.5±3.0%. The monomer composition of the protein polysaccharide complex carbohydrates was studied using paper chromatography after hydrolysis, which allowed identifying glucose, galactose, fructose, arabinose, xylose, rhamnose. The amino acid composition of the protein polysaccharide complex was investigated using the methods [38,39]. Aspartic acid (0.88 %), glutamine (0.70 %), tyrosine (0.55 %), histidine (0.48 %), methionine (0.45 %), serine (0.43 %), glycine (0.43 %), isoleucine (0.3 %) predominate in the protein part of the protein polysaccharide complex. The content of the basic amino acids obtained by hydrolysis was also determined in the goutweed extract. Tyrosine (0.69 %), methionine (0.5 %), glutamine (0.47 %), aspartic acid (0.36 %), arginine (0.35 %) histidine (0.34 %) were predominant among them [10].

In addition, the aerial part of goutweed contains a significant amount of mineral elements such as silicon (500–1140 mg/100 g), phosphorus (190–300 mg/100 g), magnesium (420–1020 mg/100 g), calcium (1040–2050 mg/100 g), iron (15–

95 mg/100 g), copper (0.7 – 4 mg/100 g), zinc (0.05 – 10 mg/100 g) et al. Potassium (3810–8300 mg/100 g) is the predominant among the macroelements in the raw material. Its content reaches 60% of the ash weight. Potassium in a significant amount is transferred to the extract (from 6000 mg/100 g to 16000 mg/100 g), while its content in the tincture is much lower and equals 350 mg/100 g. Potassium supplementation is of high importance, since the modern population suffer from its deficiency, and its high content in goutweed raw material contributes to the activity of the preparations obtained from it (besides, these preparation are characterized by high K^+/Na^+ ratio that, according to the data in the literature, is specific for herbal drugs able to enhance the excretory renal function) [10,11,40,41]. At the same time, it is important that heavy metals concentration (plumbum, molybdenum, nickel) in goutweed raw material is low and they are not accumulated [40,41].

The data discussed above confirm the promising phytochemical composition of goutweed preparations as well as their high level of safety and significant efficacy in the disorders of lipid as well as uric acid metabolism. At the same time, the study of the promising substances for functional foods and drugs development presupposes the determination of their effects in the intact animals. Besides, the changes of the lipid metabolism in the intact rat receiving goutweed preparations under the conditions of alimentary lipemia, which is of special interest from the point of view of nutriціology, are still not described.

The **purpose** of the experimental part of this study was to establish the basis for functional foods and drugs development through the evaluation the efficacy of goutweed extract and the tincture under the conditions of alimentary lipemia as well as their safety in the intact animals.

The following **tasks** were formulated to achieve this aim:

1. to determine the influence of the prophylactic course administration of goutweed extract (100 mg/kg and 1 g/kg intragastrically) and goutweed tincture (1 and 5 cm³¹/kg intragastrically) on the blood plasma values of the lipid metabolism in the test with olive oil loading in rats (the conditions of the alimentary lipemia);
2. to study the possible shifts in the lipid metabolism in the intact rats after the course administration of goutweed extract (100 mg/kg and 1 g/kg intragastrically) and goutweed tincture (1 and 5 cm³/kg intragastrically).

Research Materials and Methods

Plant material and extraction. The aerial parts of *A. podagraria* were collected from the natural population in Kharkiv region (Ukraine) in June. The herbal raw material was dried at room temperature and powdered using a standard grinding mill to obtain the

powder with the mean particle size of approximately 2 mm. The powder was twice extracted with water at 90°C. The plant material and solvent were taken in 1:10 ratio, the solvent volume was increased according to the swelling index. The extract was filtered under vacuum conditions and concentrated using a rotary evaporator, and a dry solid was obtained (residual water content equalled 5%), corresponding to an average yield of 25%. Goutweed dry extract is a brown powder with a characteristic pleasant odour, sour-bitter to taste.

Goutweed tincture was prepared by double extraction with 70% ethyl alcohol. The plant material and solvent were taken in 1:5 ratio, the solvent volume was increased according to the swelling index. The solvent was divided into two parts. The plant material was macerated in 2/3 solvent at room temperature for five days being periodically shaken and stirred. The mixture was filtered under vacuum conditions and maceration process was repeated under the same conditions with the rest of the solvent. The obtained liquids were combined into one, kept for two days at 4°C, filtered and brought to the calculated volume with the solvent. Goutweed tincture is dark green liquid with a characteristic odour. The standard technology of *A. podagraria* dry extract and tincture obtaining was in accordance with the requirements of State Pharmacopoeia of Ukraine and was described previously [7–9].

The content of the active components, namely the hydroxycinnamic acids, was measured in the extract and in the tincture by the direct spectrophotometry, the data obtained were within the limits described above.

Noninbred albino rats bred in the Central Scientific-Research Laboratory of National University of Pharmacy (Ukraine) were used. Male rats were housed in a well-ventilated animal room at a controlled temperature and relative humidity, on a natural light-dark cycle. Food and water were supplied ad libitum. All the experimental protocols were in accordance with “Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes.”

The doses of goutweed preparations were chosen on the basis of previous experiments confirming their positive metabolic and organoprotective activity. Herbal preparations were administered intragastrically once a day. Ethanol was removed from the tincture before administration. Rats of the intact control groups received intragastrically tap water by the similar scheme.

At the first stage of the experiment the values of the lipid metabolism were determined under the conditions of alimentary lipemia as described in [33]. The rats (with 200 to 250 g body weight) were randomised into six groups: intact control (n=7); hyperlipidemic control (n=8) and the animals receiving the extract at doses of 100 mg/kg (n=6) and 1

g/kg (n=6); the tincture at doses of 1 ml/kg (n=7) and 5 ml/kg (n=8). On day 7 after the administration of the last dose of the herbal preparations (or water) the rats received olive oil (qualified “for food purposes”) load-loading at a dose of 10 g/kg. 8 hours after the blood samples were obtained from a cut at the tip tail [42] and blood plasma was separated immediately by centrifugation (the anticoagulant heparin in vitro). Total cholesterol content in plasma was determined using enzymatic methods, plasma total lipids level – by the reaction with phospho-vanillin reagent with commercially-available kits (Spine-Lab, Ukraine).

At the second stage of the experiment the values of the lipid metabolism were determined in the intact rats (with 160 to 210 g body weight) after 12 day of goutweed preparations administration. Uric acid concentration in plasma was also measured in these animals samples because this value is among the targets of goutweed influence, and hyperuricemia is commonly registered in the patients with metabolic syndrome, hyperlipidemia and other “diseases of civilization,” thus it is important to verify the possibilities of the simultaneous shifts of the values of the lipid and purine metabolism. In the previous studies [11] the influence of goutweed preparations on uric acid exchange in rats was limited to the short course of administration – up to 3–6 days – and mainly addressed renal excretion of this metabolite.

Rats were randomly assigned to 5 groups: intact control (n=9) and the animals receiving the extract at doses of 100 mg/kg (n=8) and 1 g/kg (n=9); the tincture at doses of 1 ml/kg (n=7) and 5 cm³/kg (n=8). On day 12 after the administration of the last dose of the herbal preparations (or water), blood samples were

obtained and plasma was obtained as described above. Total cholesterol content in plasma was determined using enzymatic methods, HDL cholesterol – using phosphotungstate-Mg²⁺ precipitation and enzymatic cholesterol assay, plasma total lipids level– by the reaction with phospho-vanillin reagent, uric acid concentration – by the uricase method with commercially-available kits (Spine-Lab, Ukraine).

Atherogenic index was calculated by using the following formula: atherogenic index=(total cholesterol – HDL-C)/HDL-C

Medians, 25% and 75% percentiles (upper and lower quartiles) were calculated as recommended for biomedical research. The traditionally used arithmetic means and their standard errors (M±m) are also given. The comparison of the central tendencies of independent samples was performed by the criterion of Mann-Whitney U.

Results of the research and their discussion

The results of the first stage of the experiments confirmed a hypolipidemic effect of *Aegopodium podagraria L.* that was also partially reported in [33]. As can be seen in Figure 1, the extract at a dose of 1 g/kg (but not 100 mg/kg) significantly reduced triglycerides content which was noticeably increased after lipid loading. This value in the animals receiving the tincture did not differ significantly from hyperlipidemia control group, still the increment in the dose was not beneficial. The absence of the advantages of the dose increase was also shown in regard to the carbohydrate metabolism [13,14].

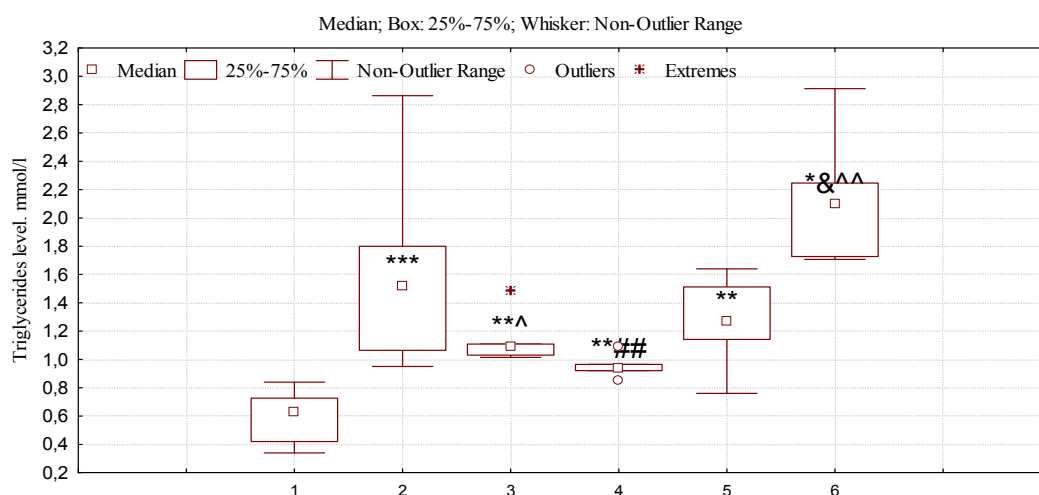


Fig. 1. The changes in plasma triglycerides level in rats receiving goutweed drugs under the conditions of olive oil loading, mmol/dm³

Notes. 1. Intact control; 2. Hyperlipidemia control; 3. Hyperlipidemia + goutweed extract, 100 mg/kg; 4. Hyperlipidemia + goutweed extract, 1 g/kg; 5. Hyperlipidemia + goutweed tincture, 1 cm³/kg; 6. Hyperlipidemia + goutweed tincture, 5 cm³/kg; * – p<0.05 compared to intact control; ** – p<0.01 compared to intact control; *** – p<0.001 compared to intact control; ## – p<0.02 compared to the hyperlipidemia control group; ^ – p<0.05 compared to the group receiving the extract at a dose of 1 g/kg; ^^ – p<0.02 compared to the group receiving the extract at a dose of 1 g/kg; & – p<0.05 compared to the group receiving the tincture at a dose of 1 ml/kg.

A similar pattern was seen in the influence of goutweed tincture on the total lipids level (Figure 2) – hypolipidemic effect was eliminated after the increment in the dose. The influence of goutweed

extract on this value was dose-dependent with the opposite relationship “dose-effect,” still there were no statistically significant differences with hyperlipemia control group value.

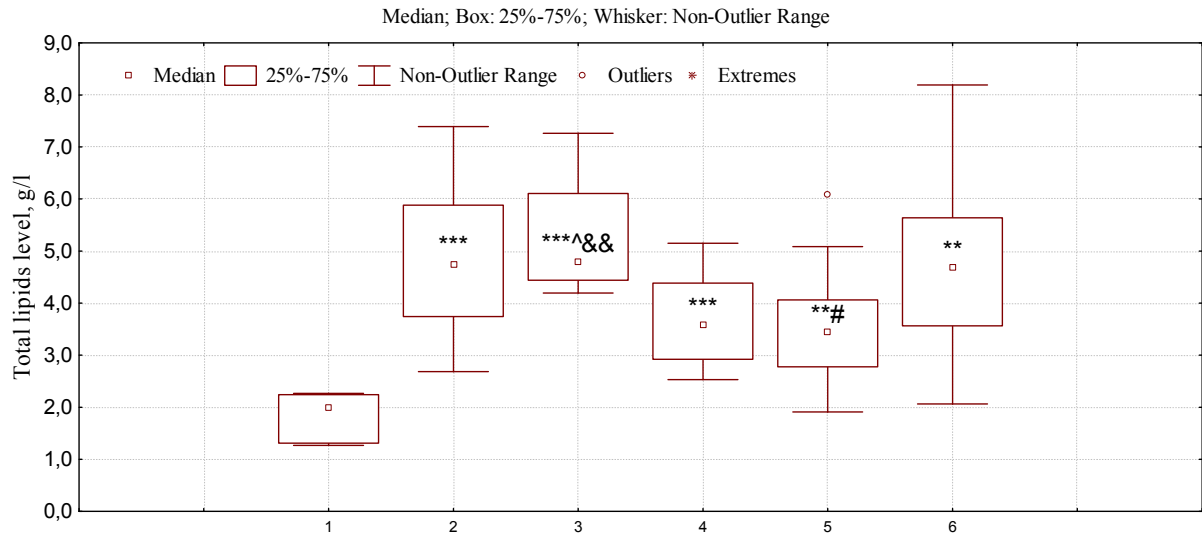


Fig. 2. The changes in plasma total lipids level in rats receiving goutweed drugs under the conditions of olive oil loading, g/dm³

Notes. 1) Intact control; 2) Hyperlipidemia control; 3) Hyperlipidemia + goutweed extract, 100 mg/kg; 4) Hyperlipidemia + goutweed extract, 1 g/kg; 5) Hyperlipidemia + goutweed tincture, 1 cm³/kg; 6) Hyperlipidemia + goutweed tincture, 5 cm³/kg; ** – p<0.01 compared to intact control; *** – p<0.001 compared to intact control; # – p<0.05 compared to the hyperlipemia control group; ^ – p<0.05 compared to the group receiving the extract at a dose of 1 g/kg; && – p<0.02 compared to the group receiving the tincture at a dose of 1 cm³/kg.

Total cholesterol level (Figure 3) tended towards decrease in rats receiving the extract at a high dose and demonstrated inter-individual differences in

animals treated with the tincture at a low dose, so there were no statistically significant differences with hyperlipemia control group value.

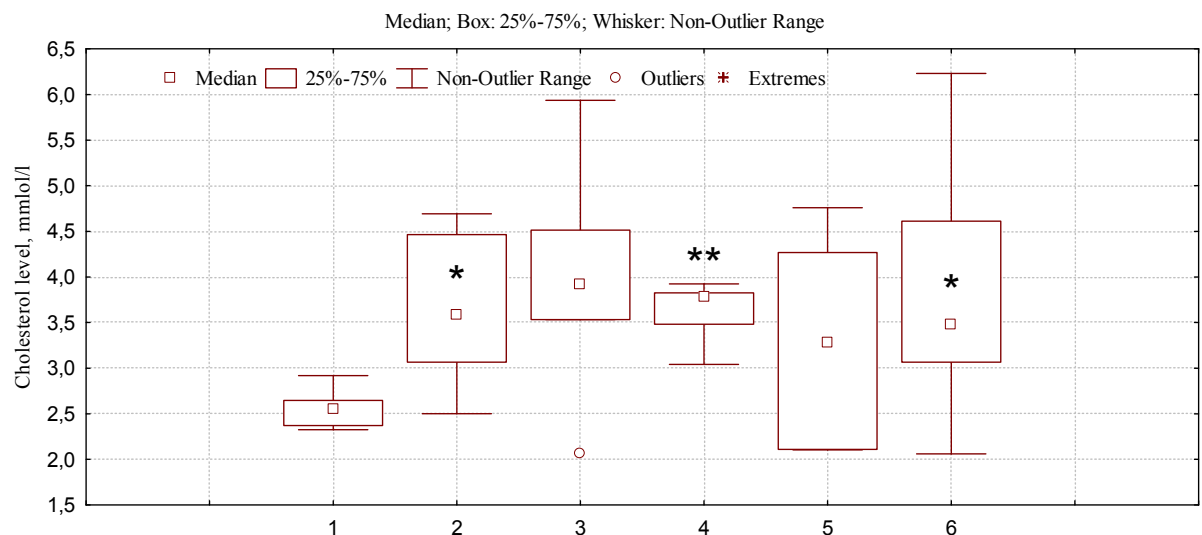


Fig. 3. The changes in plasma total cholesterol level in rats receiving goutweed drugs under the conditions of olive oil loading, mmol/l

Notes. 1. Intact control; 2. Hyperlipidemia control; 3. Hyperlipidemia + goutweed extract, 100 mg/kg; 4. Hyperlipidemia + goutweed extract, 1 g/kg; 5. Hyperlipidemia + goutweed tincture, 1 cm³/kg; 6. Hyperlipidemia + goutweed tincture, 5 cm³/kg; * – p<0.05 compared to intact control; ** – p<0.01 compared to intact control

As shown in Table 2, all investigated preparations did not considerably change the values of the lipid and uric acid metabolism after 12 days of administration to the intact rat. This

confirms their high level of safety which is necessary for the substances planned to be used as the components of functional foods or drugs used in chronic diseases.

Table 2 – Influence of *Aegopodium podagraria* L. preparations (course administration) on plasma values of lipid and uric acid metabolism in the intact rats;
Mean ± S.E.M; Q₅₀ (Q₂₅–Q₇₅), n=6–9

Indicators	Intact control	Goutweed extract, 100 mg/kg	Goutweed extract, 1 g/kg	Goutweed tincture, 1 cm ³ /kg	Goutweed tincture, 5 cm ³ /kg
Total cholesterol, mmol/dm ³	1.75±0.16 1.84 (1.34–2.01)	1.90±0.21 1.94 (1.59–2.31)	1.85±0.15 1.85 (1.76–2.08)	2.01±0.13 2.10 (1.86–2.22)	1.99±0.21 1.89 (1.67–2.54)
HDL cholesterol, mmol/dm ³	0.92±0.10 0.92 (0.90–1.09)	0.99±0.08 1.03 (0.86–1.10)	0.94±0.12 0.92 (0.71–1.18)	1.04±0.07 1.09 (0.94–1.11)	0.99±0.15 1.09 (0.70–1.28)
Atherogenic index	0.99±0.15 1.00 (0.79–1.18)	0.94±0.18 0.99 (0.62–1.36)	1.13±0.18 0.91 (0.75–1.59)	0.95±0.17 0.74 (0.68–1.01)	1.17±0.20 1.03 (0.73–1.42)
Total lipids, g/dm ³	2.02±0.24 2.04 (1.30–2.75)	2.15±0.16 2.14 (1.97–2.51)	1.99±0.23 2.10 (1.33–2.48)	2.28±0.24 2.18 (1.99–2.70)	2.07±0.17 2.22 (1.52–2.43)
Uric acid, mmol/dm ³	0.054±0.008 0.050 (0.033–0.072)	0.056±0.010 0.052 (0.041–0.078)	0.068±0.006 0.072 (0.057–0.081)	0.060±0.007 0.060 (0.051–0.070)	0.068±0.005 0.071 (0.061–0.077)

Aegopodium podagraria L. extract is characterised by the high content of potassium [10,12,40]. In certain cases this may lead to the disadvantageous effect, for example, the rats receiving excess fructose combined with hydrochlorothiazide and a diet relatively low in sodium, an unfavourable hyperaldosteronism with extensive renal excretion of potassium and unfavourable shifts in glucose metabolism [14]. Lipid exchange is also known to be exacerbated by aldosterone [43]. Evidently, in the intact rat these effects were not manifested and all the studied values of the lipid metabolism did not differ significantly from the intact animals data.

Also there were no changes in uricemia. This result is in good agreement with the data previously obtained on mice in which uricemia remained unchanged after a shorter course of administration [24] (this study addressed mostly behavioral reactions and uricemia was determined in the context of the possible impact of purine metabolism changes on CNS [44] that is poorly understood in relation to the herbal drugs effects).

Uric acid renal excretion in rats after a similar course, as reported in [19] showed a tendency to the increase against the background of the both doses of the extract, no changes were registered in the animals receiving the tincture at a low dose (that is consistent with our previous data [11]), while at a high dose the tincture slightly decreased this value. Thus, under physiological conditions, goutweed preparations do not induce any shifts in purine metabolism, while in

pathological states they are able to induce a selective normalising action.

The tincture causes restoration of uricemia, decreased in alloxan-induced diabetic mice [13], while in oxonate-induced hyperuricemic mice and rats the tincture as well as the extract significantly reduce uric acid blood level [10,11], the extract also exerts a hypouricemic effect in rats receiving excess fructose combined with hydrochlorothiazide. At the same time, in other models of the metabolic disorders not causally related to the purine metabolism, such as induced by high doses of ethanol or dexamethasone, goutweed preparations do not lead to the unwanted changes in uric acid exchange (in dexamethasone-induced model there is also favourable influence on the renal excretion of this metabolite) [17,20].

Taking into account the possible disadvantageous effects of hypouricemia [44,45], this metabolic neutrality is a positive characteristic of the preparations supposed to be used during long periods (as drugs or as components of the functional foods).

Conclusions

1. The hypolipidemic effect of the extract and the tincture obtained from the aerial part of goutweed (*Aegopodium podagraria* L.) has been confirmed under the conditions of alimentary lipemia. In the test with olive oil loading, goutweed extract (1 g/kg) significantly reduces the level of triglycerides in blood plasma, goutweed tincture

(1 cm³/kg) significantly decreases the level of plasma total lipids.

- In the intact rats after 12 days of administration goutweed extract at doses of 100 mg/kg and 1 g/kg; goutweed tincture at doses of 1 and 5 cm³/kg do not influence on the values of the lipid metabolism and do not induce any changes in uricemia.

The metabolic neutrality of goutweed active components, together with their influence on the lipid metabolism values under the conditions of the alimentary lipemia, substantiate the possibility of use of this herbal raw material for functional foods development.

List of references:

- Adams M. Medicinal herbs for the treatment of rheumatic disorders – a survey of European herbals from the 16th and 17th century / M. Adams, C. Berset, M. Kessler, M. Hamburger // *J Ethnopharmacol.* – 2009. – Vol. 121. – P. 343–359. doi: 10.1016/j.jep.2008.11.010.
- Łuczaj Ł. Changes in the utilization of wild green vegetables in Poland since the 19th century: A comparison of four ethnobotanical surveys // *J. Ethnopharm.* – 2010. – Vol. 128. – P. 395–400. doi: 10.1016/j.jep.2010.01.038.
- Handbook of Medicinal Herbs / J.A. Duke, M.J. Bogenschutz-Godwin, P. duCellier, P.A. Duke. – 2nd Ed. – Boca Raton: CRC Press, 2002. – P. 346.
- Буданцев А.Л. Дикорастущие полезные растения России / А.Л. Буданцев, Е.Е. Лесиовская. – СПб.: СПХФА, 2001. – С. 17–18.
- Лікарські рослини: Енциклопед. довід. / Відп. ред. А.М. Гродзинський. – К.: Голов. ред. УРЕ, 1990. – С. 487.
- Kunstman P. Podagrycznik pospolity (*Aegopodium podagraria* L.) / P. Kunstman, M. Wojcińska, P. Popławska // *Postępy Fitoterapii.* – 2012. – №4. – P. – 244–249.
- Патент UA 76891 на винахід, МПК А61К 36/23 (2006.01), 13/02 (2006.01), 19/06 (2006.01). Лікувально-профілактичний засіб з урикозуричною дією / О. В. Товчига, С. Ю. Штриголь, С. І. Степанова; заявник і патентовласник Національний фармацевтичний ун-т. — № а 2005 00108; заявл. 04.01.2005; опубл. 15.09.2006, Бюл. № 9.
- Патент UA 104448 на винахід, МПК А61К 36/23 (2006.01), А61К 135/00, А61Р 3/10 (2006.01) / Застосування 20% настоянки яглиці звичайної на 70% спирті етиловому як засобу з гіпоглікемічною дією / О.В. Товчига, С.Ю. Штриголь, С.І. Степанова. – № а 2011 09246; Заявл. 25.07.11; Надрук. 10.02.2014. – Бюл. № 3/2014.
- Патент UA 85892 на винахід, МПК А61К 36/23 (2006.01), А61К 135/00 (2008.04) / Лікувально-профілактичний засіб з нефропротекторною дією / О.В. Товчига, С.Ю. Штриголь, С.І. Степанова. – № а 2007 01563 заявл.14.02.2007, надрук. 10.03.2009, Бюл. № 5.
- Койро О.О. Роль біологічно активних речовин яглиці звичайної (*Aegopodium podagraria* L.) у нефропротекторній, гепатопротекторній та гіпоурикемічній дії / О.О. Койро. – Автореф. дис. ... к. фарм. наук. – Х., 2014. – 20 с.
- Товчига О.В. Дослідження сечогінної, нефропротекторної, гіпоурикемічної дії яглиці звичайної (*Aegopodium podagraria* L.) як основа для створення лікарських засобів / О.В. Товчига. – Автореф. дис. ... к. фарм. наук. – Х., 2009. – 21 с.
- Агеев В.А. Фармакогностическое исследование сънги обыкновенной (*Aegopodium podagraria* L.) / В.А. Агеев. – Автореф. дис. ... к. фарм. наук. – Самара, 2013. – 26 с.
- Товчига О.В. Вплив препаратів яглиці звичайної (*Aegopodium podagraria* L.) на метаболічні процеси в мишей із алоксановим цукровим діабетом / О.В. Товчига // *Фармакологія та лікарська токсикологія.* – 2012. – №5. – С. 73–78.
- Tovchiga O. Effects of *Aegopodium podagraria* preparations on the metabolic disorders induced in rats by excess fructose combined with hydrochlorothiazide: the relationship between influence on electrolyte and carbohydrate metabolism / O. Tovchiga // *Int. J. Biochem. Res. Rev.* – 2014. – Vol.4. – №4. – P. 80–98.
- Товчига О.В. Ренальні ефекти препаратів яглиці звичайної (*Aegopodium podagraria* L.) у щурів із порушеннями метаболізму, спричиненими фруктозою та гідрохлоротіазидом / О.В. Товчига // *Український біофармацевтичний журнал.* – 2014. – №4 (33). – С. 60–66.
- Tovchiga O.V. The influence of goutweed (*Aegopodium podagraria* L.) tincture and metformin on the carbohydrate and lipid metabolism in dexamethasone-treated rats / O.V. Tovchiga // *BMC Complementary and Alternative Medicine.* – 2016. – Vol. 16. – Art. 235. doi: 10.1186/s12906-016-1221-y
- Tovchiga O.V. Metabolic effects of goutweed (*Aegopodium podagraria* L.) tincture and metformin in dexamethasone-treated rats / O.V. Tovchiga // *Pharmaceutical Sciences and Technology.* – 2016. – Vol.1. – №4. – P. 11–20. doi: 10.11648/j.jdmp.20160206.17
- Эффекты препаратов сънги обыкновенной (*Aegopodium podagraria* L.) и их комбинаций с метформином у крыс с нарушениями липидного и углеводного обмена, вызванными протамином сульфатом / О.В. Товчига, Т.В. Горбач, С.Ю. Штриголь и др. // *Обзоры по клинической фармакологии и лекарственной терапии.* – 2017. – Т. 15. – №2. – С. 31–41. doi: 10.17816/RCF15231-41
- Tovchiga O.V. Effects of goutweed (*Aegopodium podagraria* L.) preparations on glycemia in the intact rats and against the background of metformin / O.V. Tovchiga // *Вісник фармації.* – 2017. – №2 (90). – С. 54–62.
- Tovchiga O.V. Metabolic effects of goutweed (*Aegopodium podagraria* L.) preparations in rats treated with a single dose of ethanol // O.V. Tovchiga, S.Yu. Shtrygol' // *Український журнал клінічної та лабораторної медицини.* – 2016. – Т. 11, №4. – С. 52–59.
- Tovchiga O.V. Interaction of *Aegopodium podagraria* L. (goutweed) preparations with central nervous system depressants / O.V. Tovchiga // *Український біофармацевтичний журнал.* – 2016. – №1 (42). – С. 31–36.
- Патент UA 111644 на винахід, МПК А61Р 25/32 (2006.01) / А61К 36/23 (2006.01) Застосування екстракту яглиці звичайної як засобу з антиалкогольною дією / О.В. Товчига, С.Ю. Штриголь, В.А. Товчига. – а 2014 07345; Заявл. 01.07.2014; Надрук. 25.05.2016, Бюл. № 10. – 7 с.
- Вплив препаратів яглиці звичайної (*Aegopodium podagraria* L.) на показники ліпідного обміну у щурів на тлі одноразового введення етанолу / О.В. Товчига, Т.В. Горбач, С.Ю. Штриголь, С.І. Степанова // *Фармакологія та лікарська токсикологія.* – 2015. – № 4–5 (45). – С. 87–96.
- Tovchiga O. The influence of *Aegopodium podagraria* L. extract and tincture on behavioural reactions of random-bred mice / O. Tovchiga, S. Shtrygol' // *Journal of Chemical and Pharmaceutical Research.* – 2015. – Vol.7. – №7. – P. 370–384.
- Tovchiga O.V. The effect of medicines with goutweed (*Aegopodium podagraria* L.) on the physical endurance, cognitive functions and the level of depression in animals / O.V. Tovchiga, S.Yu. Shtrygol' // *Вісник фармації.* – 2016. – №1 (85). – С. 71–76.
- Tovchiga O.V. Interaction of *Aegopodium podagraria* L. (goutweed) preparations with central nervous system depressants / O.V. Tovchiga // *Український біофармацевтичний журнал.* – 2016. – №1 (42). – С. 31–36.
- Antibacterial activity of naturally occurring compounds from selected plants / O. Stefanović, I. Radojević, S. Vasić, L. Čomić // *In: Antimicrobial agents / Ed. Varaprasad Bobbarala.* – InTech, 2012. – P. 1–24. doi: 10.5772/33059

28. Antibacterial activity of *Aegopodium podagraria* L. extracts and interaction between extracts and antibiotics / O. Stefanović, L. Čomić, D. Stanojević, S. Solujic-Sukdolak // *Turk J. Biol.* – 2009. – Vol. 33. – P. 145–150. doi:10.3906/biy-0810-21
29. Antimicrobial activity of some coumarin containing herbal plants growing in Finland / T. Ojala, S. Remes, P. Haansuu et al. // *J. Ethnopharm.* – 2000. – Vol. 73, №1-2. – P. – 299–305.
30. Ginsberg H.N. The obesity, metabolic syndrome, and type 2 diabetes mellitus pandemic: II. Therapeutic management of atherogenic dyslipidemia / H.N. Ginsberg, P.R. Maccallum // *J. Clin. Hypertens (Greenwich).* – 2009. – Vol. 11, №9. – P. 520–527. doi: 10.1111/j.1559-4572.2009.00060.x.
31. Bone K. Principles and practice of phytotherapy. Modern herbal medicine / K. Bone, S. Mills. – Edinburgh ; New York : Churchill Livingstone/Elsevier, 2013. – 1056 p.
32. Вопросы создания, качества и безопасности диетических добавок, опыт мировых производителей и перспективы развития на отечественном рынке / Попова Н.В., Казаков Г.П., Ковалев С.В., Степанова С.И. // Повноцінне харчування: інноваційні аспекти технологій, енергоефективного виробництва, зберігання та маркетингу: колективна монографія / за ред. проф. В. В. Євлаш, проф. В. О. Потапова, проф. М.І. Радченко, проф. Н. Л. Савицької. – Х.: Світ книг, 2016. – С 16–40.
33. Товчига О.В. Влияние препаратов съноти обыкновенной (*Aegopodium podagraria* L.) на липидный обмен у крыс / О.В. Товчига // *Вестник ВГУ.* – 2017. – №3.
34. Койро О.О. Кількісне визначення суми гідроксикоричних кислот у сировині яглиці звичайної / О.О. Койро, С.І. Степанова, С.Ю. Штрыголь // *Журнал клінічної та лабораторної медицини.* – 2009. – № 2. – С. 12–15.
35. *European Pharmacopoeia.* – 4-th ed. – Strasbourg : Council of Europe, 2001. – 3469 p. L.) / О.В. Товчига, С.Ю. Штрыголь, С.И. Степанова, Л.В. Яковлева, А.А. Самохин // *Запорожский мед. журнал.* – 2005. – № 1. – С. 121–124.
36. Камышников В.С. Справочник по клинико-биохимическим исследованиям и лабораторной диагностике / В.С. Камышников. – 3-е изд. – М.: МЕДпрессинформ, 2009. – 896 с.
37. Волочай В. І. Вивчення амінокислотного складу трави галінсоги дрібноквіткової та галінсоги в'ійчастої / В. І. Волочай, В. М. Ковальов // *Запорожский мед. журн.* – 2012. – № 3. – С. 44–46.
38. Вивчення водорозчинного полісахаридного комплексу трави галінсоги дрібноквіткової / В.І. Волочай, В.М. Чушенко, В.М. Ковальов, Т.О. Краснікова // *Фармацевтичний часопис.* – 2012. – № 1. – С. 16–19.
39. Койро О.О. Вивчення мінерального складу листя та екстракту яглиці звичайної / О.О. Койро, С.І. Степанова, С.Ю. Штрыголь // *Мед. хімія.* – 2009. – № 2. – С. 116–119.
40. Товчига О.В. Вклад мінеральних речовин в фармакологічну активність настойки съноти обыкновенной (*Aegopodium podagraria* L.) / О.В. Товчига, С.Ю. Штрыголь, С.И. Степанова // «Биологические особенности лекарственных и ароматических растений и их роль в медицине»: сборник научных трудов Международной научно-практической конференции, посвященной 85-летию ВИЛАР (23–25 июня 2016). – М.: Щербинская типография, 2016. – С. 618–619.
41. Prasanna G.S. Pharmacological investigations on the role of *Trichilia connaroides* (Wight. et Arn.) Benth. on oxidant status and vascular functions in animal models / G.S. Prasanna. – Diss ... Ph. D.: pharmacy. – Bangalore. – 2011. – 152 p.
42. Essential role of ICAM-1 in aldosterone-induced atherosclerosis / V. Marzolla, A. Armani, C. Mammi et al. // *Int. J. Cardiol.* – 2017. – Vol. 232. – P. 233–242. doi: 10.1016/j.ijcard.2017.01.013.
43. Álvarez-Lario B. Uric acid and evolution / B. Álvarez-Lario, J. Macarrón-Vicente // *Rheumatology (Oxford).* – 2010. – Vol. 49, №11. – P. 2010–2015. doi: 10.1093/rheumatology/keq204.
44. Kutzling M.K. Altered uric acid levels and disease states / M.K. Kutzling, B.L. Firestein // *J. Pharmacol. Exp. Ther.* – 2008. – Vol. 324, №1. – P. 1–7. doi: 10.1124/jpet.107.129031

БИОЛОГИЧЕСКАЯ АКТИВНОСТЬ СНЫТИ ОБЫКНОВЕННОЙ (*Aegopodium podagraria* L.) И ВОЗМОЖНОСТИ ЕЕ ПРИМЕНЕНИЯ ДЛЯ КОРРЕКЦИИ НАРУШЕНИЙ ОБМЕНА ЛИПИДОВ

О.В. Товчига, к.фарм.н., доцент*/***, E-mail: farmacol@nuph.edu.ua

О.О. Койро, к.фарм.н. *, E-mail: farmacol@nuph.edu.ua

С.И. Степанова, к.фарм.н., доцент**, E-mail: bromatology@nuph.edu.ua

С.Ю. Штрыголь, д.мед.н., профессор*/***, E-mail: farmacol@nuph.edu.ua

В.В. Євлаш, д.техн.н., профессор****, E-mail: chem_mikro@hduht.edu.ua

В.Г. Горбань, к.техн.н., доцент****, E-mail: chem_mikro@hduht.edu.ua

Т.К. Юдкевич, н.с.***, E-mail: cndl@nuph.edu.ua

*кафедра фармакологии

**кафедра нутрициологии и фармацевтической броматологии

***Центральная научно-исследовательская лаборатория

Национальный фармацевтический университет, ул. Пушкинская, 53, г. Харьков, 61002

****кафедра химии, микробиологии и гигиены питания

Харьковский государственный университет питания и торговли, ул. Клочковская, 333, г. Харьков, 61051

Аннотация. В статье обобщены сведения о биологической активности перспективного растительного сырья: наземной части съноти обыкновенной (*Aegopodium podagraria* L., *Apiaceae*). Освещена технология получения препаратов из этого растительного сырья, охарактеризован их химический состав и фармакологические эффекты, внимание акцентировано на возможностях коррекции нарушений обмена липидов и их профилактики. Приведены экспериментальные данные, подтверждающие эффективность экстракта и настойки съноти обыкновенной в условиях алиментарной липемии, наряду с их безопасностью у интактных животных. Так, гиполипидемическая активность экстракта съноти (1 г/кг внутривенно) и настойки съноти (1 см³/кг внутривенно) была установлена на крысах в тесте с нагрузкой оливковым маслом. У интактных крыс экстракт в дозах 100 мг/кг и 1 г/кг, а также настойка в дозах

1 и 5 см³/кг не изменяют показатели обмена липидов после 12-дневного введения. Создание лекарственных препара-препаратов, а также диетических добавок или функциональных пищевых продуктов на основе сырья сняти обыкновенной является перспективным.

Ключевые слова: снять обыкновенная (*Aegopodium podagraria L.*), растительное сырье, лекарственные препараты растительного происхождения, обмен липидов, диетические добавки, функциональные пищевые продукты.

References:

1. Adams M, Berset C, Kessler M, Hamburger M. Medicinal herbs for the treatment of rheumatic disorders – a survey of European herbals from the 16th and 17th century. *J. Ethnopharmacol.* 2009; 121: 343–359. doi: 10.1016/j.jep.2008.11.010.
2. Łuczaj Ł. Changes in the utilization of wild green vegetables in Poland since the 19th century: A comparison of four ethnobotanical surveys. *J. Ethnopharm.* 2010; 128: 395–400. doi: 10.1016/j.jep.2010.01.038.
3. Duke JA, Bogenschutz-Godwin MJ, duCellier P, Duke PA. *Handbook of Medicinal Herbs.* 2nd Ed. Boca Raton: CRC Press; 2002.
4. Budancev AL, Lesiovskaia EE. *Dikorastushhie poleznye rasteniia Rossii.* SPb.: SPChPhA, 2001.
5. Hrodzyn's'kyi AM. editor. *Likars'ki roslyny: Entsykloped. dovid.* Kyiv.: Holov. red. URE; 1990.
6. Kunstman P, Wojcińska M, Popławska P, Kunstman P. Podagrycznik pospolity (*Aegopodium podagraria L.*). *Postępy Fitoterapii.* 2012;4:244–249.
7. Tovchiga OV, Shtrygol' SYu, Stepanova SI. Agent possessing uricocuric activity. Ukraine patent 76891, Sept 15, 2006.
8. Tovchiga OV, Shtrygol' SYu, Stepanova SI. Use of 20% tincture of bishop'sweed with 70% ethyl alcohol as means of hypoglycemic action. Ukraine patent 104448, February 10, 2014.
9. Tovchiga OV, Shtrygol' SYu, Stepanova SI. Therapeutic and prevention composition possessing nephroprotecting activity. Ukraine patent 85892, Mar 10, 2009.
10. Koyro OO. [Role of goutweed (*Aegopodium podagraria L.*) biologically active substances in nephroprotective, hepatoprotective and hypouricemic activity]. Kharkiv: NUPh; 2014.
11. Tovchiga OV. [The investigation of the goutweed (*Aegopodium podagraria L.*) diuretic, nephroprotective and hypouricemic action as the basis for the drug development]. Kharkiv: NUPh; 2009.
12. Ageev VA. [Pharmacognostic study of goutweed (*Aegopodium podagraria L.*)]. Samara. Novosibirsk State Medical University; 2013.].
13. Tovchiga OV. [The influence of goutweed(*Aegopodium podagraria L.*) preparations on the metabolic processes in alloxan-induced diabetic mice]. *Pharmacol Med Toxicol. (Farmakolohiia ta likarska toksykolohiia).* 2012;5:73–78.
14. Tovchiga O. Effects of *Aegopodium podagraria* preparations on the metabolic disorders induced in rats by excess fructose combined with hydrochlorothiazide: the relationship between influence on electrolyte and carbohydrate metabolism. *Int J Biochem Res Rev.* 2014;4(4): 80–98.
15. Tovchiga OV. [Renal effects of goutweed (*Aegopodium podagraria L.*) preparations in rats with the metabolic disorders induced by fructose and hydrochlorothiazide]. *Ukr Biopharm J.* 2014; 4 (33): 60–66.
16. Tovchiga OV. The influence of goutweed (*Aegopodium podagraria L.*) tincture and metformin on the carbohydrate and lipid metabolism in dexamethasone-treated rats. *BMC Complement Altern Med.* 2016 Jul 22;16:235. doi: 10.1186/s12906-016-1221-y
17. Tovchiga OV. Metabolic effects of goutweed (*Aegopodium podagraria L.*) tincture and metformin in dexamethasone-treated rats. *J Dis Med Plants.* 2016;2(6):117–126. doi: 10.11648/j.jdmp.20160206.17
18. Tovchiga OV, Gorbach TV, Shtrygol' SYu, Mishchenko MV, Stepanova SI, Taran AV. [The effects of goutweed (*Aegopodium podagraria L.*) preparations and their combinations with metformin in rats with the disorders of the lipid and carbohydrate metabolism induced by protamine sulphate]. *Reviews Clin. Pharm. Drug Ther.* 2017;15(2):31–41. [In Russian]. doi: 10.17816/RCF15231-41
19. Tovchiga OV. Effects of goutweed (*Aegopodium podagraria L.*) preparations on glycemia in the intact rats and against the background of metformin. *Visnik farmacii.* 2017;2(90):54–62.
20. Tovchiga OV, Shtrygol' SYu. Metabolic effects of goutweed (*Aegopodium podagraria L.*) preparations in rats treated with a single dose of ethanol *Ukr J Clin Lab Med.* 2016;11(4):52–59.
21. Tovchiga OV. Interaction of *Aegopodium podagraria L.* (goutweed) with central nervous system depressants. *Ukr Biopharm J.* 2016;1(42):31–36.
22. Tovchiga OV, Shtrygol' SYu, Tovchiga VA. Use of goutweed extract as a preparation with antialcohol effect. Ukraine patent 111644, May 25, 2016.
23. Tovchiga OV, Gorbach TV, Shtrygol' SYu, Stepanova SI. [The influence of gout weed (*Aegopodium podagraria L.*) preparations on the lipid metabolism in rats treated with a single dose of ethanol]. *Pharmacol Med Toxicol. (Farmakolohiia ta likarska toksykolohiia).* 2015;4–5(45):87–96.
24. Tovchiga O, Shtrygol' S. The influence of *Aegopodium podagraria L.* extract and tincture on behavioural reactions of random-bred mice. *J Chem Pharm Res.* 2015;7(7):370–384.
25. Tovchiga OV, Shtrygol' SYu. The effect of medicines with goutweed (*Aegopodium podagraria L.*) on the physical endurance, cognitive functions and the level of depression in animals. *Visnik farmacii.* 2016;1(85):71–76.
26. Tovchiga OV. Interaction of *Aegopodium podagraria L.* (goutweed) with central nervous system depressants. *Ukr Biopharm J.* 2016;1(42):31–36.
27. Stefanović O, Radojević I, Vasić S, Čomić L. Antibacterial activity of naturally occurring compounds from selected plants. In: *Antimicrobial agents.* Ed. Varaprasad Bobbarala. InTech, 2012. doi: 10.5772/33059
28. Stefanović O, Čomić L, Stanojević D, Solujic-Sukdolac S. Antibacterial activity of *Aegopodium podagraria L.* extracts and interaction between extracts and antibiotics. *Turk J. Biol.* 2009;33:145–150. doi:10.3906/biy-0810-21
29. Ojala T, Remes S, Haansuu P et al. Antimicrobial activity of some coumarin containing herbal plants growing in Finland *J Ethnopharm.* 2000;73(1-2):299–305.
30. Ginsberg HN, MacCallum PR. The obesity, metabolic syndrome, and type 2 diabetes mellitus pandemic: II. Therapeutic management of atherogenic dyslipidemia *J Clin Hypertens (Greenwich).* 2009;11(9):520–527. doi: 10.1111/j.1559-4572.2009.00060.x.
31. Bone K, Mills S. *Principles and practice of phytotherapy. Modern herbal medicine.* Edinburgh; New York: Churchill Livingstone/Elsevier, 2013.
32. Popova NV, Kazakov GP, Kovalev SV, Stepanova SI. Full-value nutrition as constitutent part of self-supporting evolutions and completed approach to health. In: *Nutrition innovation aspects of technologies, energy efficient production, storage and marketing.* Ed. Prof. V. Evlash, Prof. V. Potapov, Prof. M. Radchenko, Prof. N. Savytska. Kharkiv: Svit knyh, 2016.
33. Tovchiga OV. [The influence of goutweed (*Aegopodium podagraria L.*) preparations on the lipid metabolism in rats]. *Vestnik VGU.* 2017;3.

34. Koyro OO, Stepanova SI, Shtrygol' SYu. [Quantitative determination of hydroxycinnamic acids in goutweed raw material]. *Journal of Clinical and Laboratory Medicine*. 2009;2:12–15.
35. *European Pharmacopoeia*. – 4-th ed. – Strasbourg : Council of Europe, 2001.
36. Tovchiga OV, Shtrygol' SYu, Stepanova SI, , Yakovleva LV, Samokhin AA. Obtaining, analysis and study of acute toxicity and renal effects of the gout weed (*Aegopodium podagraria* L.) tincture // *Zaporozhye medical journal*. 2005;1:121–124.
37. Kamyshnikov V.S. *Manual on Clinical Biochemical Research and Laboratory Diagnostics: MEDpress–inform*; 2000
38. Volochay VI, Kovalyov VM. [The study of amino acids of herb of *Galinsoga parviflora* Cav and *Galinsoga ciliata* (Rafin) Blake.]. *Zaporozhye medical journal*. 2012;3:44–46.
39. Volochay VI, Chushenko VM, Kovalyov VM, Krasnikova TO. Study of water-soluble polysaccharide complex of the herb of *Galinsoga parviflora*. *Pharmaceutical review*. 2012;1:16–19.
40. Koyro OO, Stepanova SI, Shtrygol' SYu. [Mineral composition of goutweed (*Aegopodium podagraria* L.) leaves and extract]. *Medical chemistry*. 2009;2:116–119.
41. Tovchiga OV, Shtrygol' SYu, Stepanova SI. [Contribution of mineral substances to the mechanism of action of goutweed (*Aegopodium podagraria* L.) tincture]. *Proceeding from Biological features of medicinal and aromatic plants and their role in medicine: International scientific conference dedicated to the 85th anniversary of VILAR. Moscow, 2016*. [in Russian].
42. Prasanna G.S. *Pharmacological investigations on the role of Trichilia connaroides* (Wight. et Arn.) Benth. on oxidant status and vascular functions in animal models. Bangalore, 2011.
43. Marzolla V, Armani A, Mammi C et al. Essential role of ICAM-1 in aldosterone-induced atherosclerosis. *Int J Cardiol*. 2017;232:233–242. doi: 10.1016/j.ijcard.2017.01.013.
44. Álvarez-Lario B, Macarrón-Vicente J. Uric acid and evolution. *Rheumatology (Oxford)*. 2010; 49(11):2010–2015. doi: 10.1093/rheumatology/keq204.

Отримано в редакцію 19.09.2017
Прийнято до друку 22.10.2017

Received 19.09.2017
Approved 22.10.2017