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COMPARATIVE ANALYSIS OF VISCUM *ALBUM* L. ANTIBACTERIAL, HEMAGGLUTINATING, CYTOSTATIC ACTIVITY DEPENDING ON THE HOST PLANTS

Actuality. *The search for new phytotherapeutic agents is an urgent problem of our time. Arguments in favor of transferring Viscum album to the rank of medicinal plants are, firstly, its medicinal properties, and, secondly, the wide distribution of the plant in the territory of Ukraine. A large number of publications have been devoted to the study of the medicinal properties of white mistletoe, among which there are works examining the influence of host plants on the antioxidant and cytotoxic properties of Viscum album.*

Aim. *The purpose of the presented research was to study the antibacterial, cytostatic and hemalutinative activity of white mistletoe shoots depending on the host plant. The work also studied the litholytic activity of a lectin-containing extract from white mistletoe, which was parasitic on rowan.*

Materials and methods. *The antibacterial activity of aqueous and lectin-containing extracts was studied by the disk-diffusion method. The test microorganisms were: Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa and Candida albicans. The lectin-containing extract was obtained by the Antonyuk method, by extraction in a physiological solution. Litholytic activity was studied by exposure of different chemical nature urinary calculi in lectin-containing solution in vitro. The chemical nature of calculi was determined by the infrared spectroscopy method at the Institute of Urology of AMNU. Cytostatic activity was studied by observing the intensity of mitotic division in cells of the seedlings Cucumis sativa lateral roots meristem. Hemagglutinating activity of the Viscum album shoots lectin-containing extract was evaluated as the titer of the highest dilution at which noticeable hemagglutination could be detected.*

Research results. *The results of the study indicate that the aqueous extract of white mistletoe showed little antibacterial activity with a lysis zone from 5.8 to 12.6 mm. Antibacterial properties of mistletoe depend on the type of host plant. The greatest antibacterial effect was demonstrated by mistletoe parasitizing rowan, and the least by apple and poplar mistletoe. Lectin-containing mistletoe extract from poplar and apple moderately inhibited the development of Pseudomonas aeruginosa and Staphylococcus aureus, remaining*

indifferent to other test microorganisms. The study of the antibacterial activity of water extracts from the branches host plant showed that rowan shoots have the highest antibacterial activity. So, there is a direct correlation between the properties of the host plant and the semi-parasitic plant. Analysis of the chemical composition of host plants of white mistletoe suggests that the antibacterial effect of Sorbus aucuparia may be related to the presence of sorbitol and phenolic compounds. The study of hemagglutinating activity allows us to conclude that the lectin-containing extracts of all the researched variants showed the ability to glue erythrocytes. Although the hemagglutination titer varies depending on the host plant species, all lectin-containing extracts showed a higher affinity for blood groups II and III. The results of studying the litholytic activity of lectin-containing extracts of mistletoe from rowan rowan carried out in vitro for 30 days show that white mistletoe has litholytic activity against urates and oxalates and does not affect phosphate urinary calculi. Cytostatic activity is characteristic of all studied mistletoe samples, which indicates its antitumor potential. Mistletoe that grew on a poplar and mistletoe that grew on a maple turned out to be the most active cytostatic agent among the studied samples.

Conclusions. *The antibacterial activity of Viscum album depends on the host plant. Among the studied types of raw materials, mistletoe from rowan showed the highest antibacterial activity. Lectin-containing extracts of all studied variants revealed hemagglutinating activity. The hemagglutination titer varies depending on the species of the host plant, but remains higher in relation to blood groups A and B. Cytostatic activity is typical for all studied samples. The extract from white mistletoe, which grew on poplar and maple, turned out to be the most active cytostatic agent. The lectin-containing extract of Viscum album showed litholytic activity against oxalates and urates in vitro.*

Key words: *antibacterial activity, cytostatic activity, litholytic activity hemagglutinating activity, lectin-containing extracts, Viscum album.*

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ПОРІВНЯЛЬНИЙ АНАЛІЗ ГЕМАГЛЮТИНУЮЧОЇ, ЦИТОСТАТИЧНОЇ ТА АНТИБАКТЕРІАЛЬНОЇ АКТИВНОСТІ *VISCUM ALBUM* L. ЗАЛЕЖНО ВІД РОСЛИНИ-ЖИВИТЕЛЯ

Актуальність. *Актуальною проблемою сучасності є пошук нових фітотерапевтичних засобів. Аргументами на користь переводу Viscum album у ранг офіцінальних рослин є, по-перше, її лікарські властивості, а по-друге, велика розповсюдженість рослин на території України.*

Вивченню лікарських властивостей омели білої присвячена велика кількість публікацій, серед яких є роботи, які розглядають вплив рослин-живителів на антиоксидантні та цитотоксичні властивості Viscum album.

Мета дослідження. *Метою дослідження було вивчення антибактеріальної, цитостатичної та гемаглютинуючої активності пагонів омели білої залежно від рослини-господаря.*

Також у роботі вивчалася літична активність лектиновмісної витяжки з омели білої, яка паразитувала на горобині звичайній.

Матеріали та методи дослідження. *Антибактеріальна активність водних і лектиновмісних витяжок досліджувалися диско-дифузним методом. Тестовими мікроорганізмами були Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa, Candida albicans.*

Лектиновий екстракт отримували методом Антонюка шляхом екстракції у фізіологічному розчині. Літичну активність оцінювали після експозиції конкрементів різної природи в лектиновмісному розчині in vitro. Хімічну природу конкрементів визначали методом інфрачервоної спектроскопії в інституті урології АМНУ. Цитостатична активність оцінювалася шляхом спостереження за інтенсивністю мітотичного поділу в клітинах меристеми бічних коренів проростків Cucumis sativa. Гемаглютинуюча активність лектиновмісної витяжки з пагонів Viscum album оцінювалась як титр найбільшого розведення, за якого можна було виявити помітну аглютинацію.

Результати дослідження та їх обговорення. *Результати дослідження свідчать, що водний екстракт омели білої продемонстрував незначну антибактеріальну активність із зоною лізису від 5,8 до 12,6 мм. Антибактеріальні властивості омели залежать від виду рослини-живителя. Найбільший антибактеріальний ефект продемонструвала омела, яка паразитувала на горобині звичайній, а найменший – омела з яблуні та тополі. Лектиновий екстракт омели з тополі та яблуні помірно пригнічував розвиток синьогнійної палички та стафілокока золотистого, залишаючись індикатором до інших тест-мікроорганізмів. Вивчення антибактеріальної активності водних екстрактів з гілок рослин-господарів показало, що пагони мають найвищу антибактеріальну активність, тобто існує пряма кореляція між властивостями рослин і рослини напівпаразита. Аналіз хімічного складу рослини-живителя Viscum album дає підстави припустити, що антибактеріальна дія Sorbus aucuparia може бути пов'язана з наявністю спирту сорбітолу та фенольних сполук. Вивчення гемаглютинуючої активності дає змогу зробити висновок, що лектиновмісні екстракти всіх досліджуваних варіантів виявили здатність склеювати еритроцити. Хоча титр аглютинації варіює залежно від виду рослини господаря, усі лектинові витяжки продемонстрували більшу спорідненість до II та III груп крові. Результат вивчення літичної активності лектиновмісних екстрактів омели з горобини звичайної, проведений in vitro протягом 30 діб, свідчить, що омела біла має літичну активність щодо уратів та оксалатів і не впливає на фосфатні конкременти. Цитостатична активність характерна для всіх досліджуваних видів омели білої, що свідчить про її протипухлинний потенціал. Найбільша активність цитостатиком серед досліджуваних взірців виявилася омела з тополі й омела з клену.*

Висновки. *Антибактеріальна активність Viscum album залежить від рослини-живителя. Серед досліджуваних видів сировини найбільшу антибактеріальну активність виявила омела з горобини звичайної. Лектиновмісні витяжки всіх досліджуваних варіантів виявили гемаглютинуючу активність. Титр аглютинації варіює залежно від виду рослини-живителя, але лишається більшим щодо до А та В крові. Цитостатична активність характерна для всіх досліджуваних взірців. Найбільш активними цитостатиками виявилися Viscum album з тополі та Viscum album з клену. Лектиновмісний екстракт Viscum album виявив літичну активність відносно уратів та оксалатів.*

Ключові слова: *антибактеріальна активність, цитостатична активність, гемаглютинуюча активність, літолітична активність, лектиновмісний екстракт, Viscum album.*

Actuality. In Ukraine, recently, the process of white mistletoe spreading in parks, gardens, along highways and railway tracks has become more noticeable (Rybalko, 2016).

In the previous article (Megalinska, 2020), we dedicated to the problem of pollution of park zones and forest areas by the plant - semi-parasite white mistletoe, we put forward the idea of transferring this plant to the rank of medicinal plants in Ukraine and introducing it into the spectrum of tasks for forest management during planned felling. Medicinal properties of white mistletoe raw materials are used in France, Germany, Spain, Paraguay, the Netherlands, Venezuela, where it is an medicinal herbs. White mistletoe preparations are used for diseases of the heart, blood vessels, digestive, urogenital, reproductive and endocrine systems. Extract from mistletoe leaves inhibits the growth and development of metastasizing tumors (Nazaruk, Orlikowski, 2016).

The studied properties of white mistletoe raw materials see below (Fig. 1)

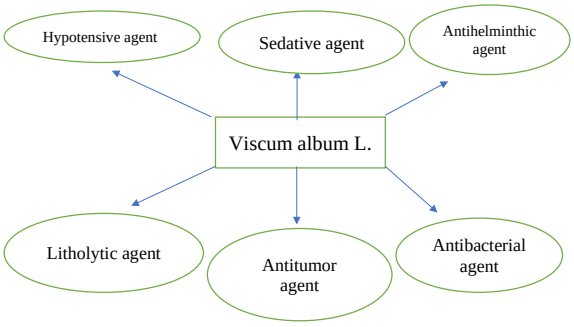

Fig. 1. White mistletoe studied properties (Nicoletti, 2023; Kleszken, 2022 Harna, 2016)

In previous works, a number of authors demonstrated that the physiological activity of raw materials from white mistletoe depends on the host plant.

For example, the influence of water extracts on cytostatic activity from mistletoe plants, which grown on different hosts (*Abies alba, Acer saccharinum, Malus domestica, Pyrus communis, Pinus sylvestris, Quercus petraea, Quercus robur, Pópulus alba, Robinia pseudoacacia*, *Crataegus monogyna*, *Salix alba, Prunus armeniaca, Prunus dulcis*) was investigated (Shah, 2017; Melo et al., 2022; Kleszken et al., 2023).

In the work of Bilonozko (Bilonozhko et al., 2023), it was demonstrated that the aqueous extract of mistletoe, which grew on a maple tree, has the highest cytostatic activity. Mistletoe extracts cause disruption of the cell cycle in the meristem of *Allium cepa.*

In the work of Melo (Melo et al., 2022), the seasonality effect on the mistletoe cytotoxicity was investigated. It has been proven that *V. album* summer extracts showed higher cytotoxic activity than winter extracts. The high antitumor bioactivity of mistletoe and its metabolite profile prove the prospects of its use for cancer treatment.

Mistletoe leaves and fruits have also shown significant antibacterial activity against some well-known pathogenic bacteria (Çiftci, 2024, pp. 1–4).

***The aim* of our work was** to study the antibacterial, cytostatic, litholytic, and hemagglutinating activity of extracts from white mistletoe, which had different hosts.

The conceptual basis of our research is a transdisciplinary approach. We see the application of this approach in the versatile research of plant raw materials and the systematization of the acquired knowledge (Strizhak, Dovgy, 2019).

Materials and methods. The antibacterial activity of aqueous and lectin-containing extracts was studied using the paper disk method (diameter 5 mm) (Valgas, 2007). The test microorganisms were: *Escherichia coli* Migula 1985, *Staphylococcus aureus* Castellani and Chalmers 1919, ATCC 25922, *Proteus vulgaris* Hauser 1885, ATCC 6896, *Pseudomonas aeruginosa* Schroeter 1872, ATCC 9027 and yeast *Candida albicans* C.P. Robin, Berkhout 1923, ATCC 885-653. All microorganisms were obtained from the Ukrainian Collection of Microorganisms of the Institute of Microbiology and Virology named after D.K. Zabolotny of the National Academy of Sciences of Ukraine.

The lectin-containing extract was obtained according to Antonyuk's method (Antonyuk, 2015, pp. 20–21). Litholytic activity was studied by the method (Zheltovskaya, 2018). One volume of plant material was mixed with 9 volumes of 0.9% NaCl. Then it was vigorously stirred for 2 hours. The obtained extract was filtered, thus obtaining a lectin-containing extract. Stones that were surgically removed from the human urinary system were exposed in lectin-containing extract *in vitro.* Every 10 days, the stones were dried and weighed. The stones were kept from DU "Institute of Urology named after academic O.F. Vozianov".

In order to determine the chemical composition of renal concrements spectroscopy method was used on the UR-20 device ("Carl Zeiss", Germany), which allows determining the composition and quantitative ratios of complex renal concrement components by the quantity, position, and intensity of absorption bands in the spectrogram of the sample in the range of 4000–400 cm^{-1}.

Concrements weighing no less than 50 mg were ground in a ball mill with 600 mg of potassium bromide monocrystal, transferred to a press-form, formed into a tablet for subsequent spectrometry in the above-mentioned range. The extinction coefficients were calculated using the Bouger-Lambert-Beer equation and compared with those of standard samples. The relative ratio of the content of individual stone-forming components in concrements of mixed composition was determined by the ratio of intensities of analytical bands based on extinction coefficients.

Cytostatic activity was studied using the method of Ivanov V.B. modified by Megalinskaya G.P. (Megalinskaya, 2020, pp. 20–21). The essence of this method lies in the inhibition of mitosis during lateral root formation, while the growth of the main root is inhibited, and cell differentiation continues. In pumpkin roots, the formation of lateral roots occurs in the basal part of the meristem, and in roots of other plants – in the zone of cell differentiation after stretching. The length of the main root serves as an indicator of heteroauxin activity, and the length hipocotile as an indicator of cytokinins activity. Since lateral cucumber roots arise as a result of mitotic divisions, their number can be an indicator of mitosis activity. The initial aqueous extract was prepared at the rate of 5 g per 100 ml of water, then diluted from 50 to 450 mg/ml. 10 seeds were germinated in each variant of breeding. Each experiment was performed in triplicate.

The hemagglutination test was performed as described in Jefferson Muniz de Lima (Jefferson Muniz de Lima et al., 2015, pp. 1–6). Four healthy subjects, without blood diseases were recruited. The capillaries blood samples were centrifuged to 1200–1500 rpm, during 15 minutes. A 2% solution of erythrocytes in a phosphate buffer was added to all wells of the microplate. Next, 50 µl of lectin-containing extract was added to the first well and mixed. Then, from the first well, 50 µl was transferred to the second, from the second to the third, and the solution was drained from the last well. In this way, a series of dilutions of the extract in 2, 4, 16, 32, etc. are obtained. times Experiment performed in three times. The results of the experiments are calculated by

looking at the holes from above. The titer is expressed as the maximally diluted extract at which agglutination is observed. Drops of blood, together with lectin-containing extracts, were examined under a light microscope.

Research results. The results of the study of antibacterial activity are presented in (Table 1, 2).

The highest antibacterial activity is exhibited by the aqueous extract of mistletoe parasitizing on rowan. Of all the test microorganisms presented, *Staphylococcus aureus* and *Pseudomonas aeruginosa* were the most sensitive to the aqueous extract of *Viscum album*.

The study of antibacterial properties of the lectin extract of white mistletoe indicates that the lectin-containing fraction has greater antibacterial activity than the aqueous one. The greatest bacteriostatic effect belongs to mistletoe parasitizing on common rowan, and the least – to mistletoe from Black locust. All lysis zones in this case are 40–60% larger than the lysis zones from mistletoe on Norway maple, black locust, and domestic apple. Mistletoe lectin extract which was parasite on apple and poplar moderately inhibited the development of *Pseudomonas aeruginosa* and *Staphylococcus aureus*, while remaining indifferent to other test microorganisms. According to Bilonozko's work (Bilonozhko et al., 2023), the lysis zone of *Staphylococcus aureus* treated with mistletoe water extract was 11.0 ± 0.1 mm, which corresponds to our research.

To explain the mechanism of differences in studied types of *Viscum album* raw materials antibacterial properties, a study of the antibacterial activity of aqueous and lectin extracts from branches of *Sorbus aucuparia, Populus nigra and Robinia pseudoacacia* was conducted (Table 3, 4).

Comparison of mistletoe host plants antibacterial properties shows that rowan shoots have the highest antibacterial activity, while black locust shoots have the lowest.

Comparison of the data presented in (Table 3, 4) indicates a direct correlation between the antibacterial properties of the host plant and the semi-parasite plant *Viscum album*.

Analysis of the chemical composition of the studied host plants, presented in Table 5, gives grounds to assume that the antibacterial effect of *Sorbus aucuparia* may be associated with the presence of sorbitol alcohol and phenolic compounds. Also, Korcan's work proves that mistletoe raw materials have a large amount of phenolic compounds (Korcan, 2023).

So, all other chemical substances in the composition of host plants with antimicrobial activity (flavonoids,

Table 1

Antibacterial activity of white mistletoe depending on the host plant species (aqueous extract)

Test microorganisms	Lysis zone (in mm)				
	Host plant				
	Apple tree (*Malus domestica*)	Rowan (*Sorbus aucuparia*)	Maple (*Acer platanoides*)	Black locust (*Robinia pseudoacacia*)	Poplar (*Populus nigra*)
Escherichia coli	5.8 ± 0.4	9.3 ± 0.6*	6.8 ± 0.7	8.1 ± 0.7*	6.2 ± 0.4
Pseudomonas aeruginosa	9.6 ± 0.7*	12.1 ± 0.3*	7.2 ± 0.5	7.4 ± 1.2	6.8 ± 0.4
Proteus vulgaris	7.8 ± 0.5	7.2 ± 0.7	6.8 ± 0.5	6.8 ± 0.9	6.5 ± 0.5
Staphylococcus aureus	6.4 ± 0.1	12.6 ± 1.1*	8.2 ± 0.2	10.4 ± 1.5*	8.4 ± 0.4
Candida albicans	6.6 ± 0.3	8.3 ± 0.2	6.6 ± 0.1	6.6 ± 0.7	7.6 ± 1.3

* Mean values ± standard error of three independent experiments (n = 15).

* $p \leq 0.05$ compared with control (disk with physiological solution), significantly by Student's Test.

Table 2

White mistletoe antibacterial activity depending on the host plant species (lectin-containing extract)

Test microorganisms	Lysis zone (in mm)				
	Host plant				
	Apple tree (*Malus domestica*)	Rowan (*Sorbus aucupa-ria*)	Maple (*Acer platanoi-des*)	Black locust (*Robinia pseudoacacia*)	Poplar (*Populus nigra*)
Escherichia coli	8.2 ± 0.8	13.8 ± 1.2	6.8 ± 0.7	6.1 ± 0.6	7.0 ± 0.4
Pseudomonas aeruginosa	13.2 ± 1.0*	15.7 ± 1.3*	7.2 ± 0.5	6.7 ± 0.1	11.2 ± 1.4*
Proteus vulgaris	6.5 ± 0.5	10.0 ± 0.7	6.8 ± 0.6	7.0 ± 0.4	9.4 ± 0.9
Staphylococcus aureus	6.2 ± 0.4	12.6 ± 1.1*	13.2 ± 1.7*	7.2 ± 0.7	8.2 ± 0.8*
Candida albicans	8.4 ± 0.8*	8.3 ± 0.2*	7.4 ± 1.1	7.1 ± 0.8	7.6 ± 1.3

* Mean values ± standard error of three independent experiments (n = 15).

* $p \leq 0.05$ compared with control (disk with physiological solution), significantly by Student's Test.

Table 3

Antibacterial activity of host plants branches *Viscum album* (lectin-containing extract)

Test microorganisms	Poplar *(Populus nigra)*	Rowan *(Sorbus aucuparia)*	Black locust *(Robinia pseudoacacia)*
Escherichia coli	7.5 ± 0.7	7.9 ± 0.9*	6.8 ± 0.1
Pseudomonas aeruginosa	9.3 ± 0.7*	13 ± 1.8*	6.6 ± 0.9
Proteus vulgaris	7.1 ± 0.7	9.0 ± 0.2*	6.6 ± 0.2
Staphylococcus aureus	11.3 ± 0.4*	13.4 ± 0.5*	8.3 ± 1.1*
Candida albicans	11.4 ± 0.6*	13.1 ± 1.1*	6.8 ± 0.7

* Mean values ± standard error of three independent experiments (n = 3).
* $p \leq 0.05$ compared with control (disk with physiological solution), significantly by Student's Test.

Table 4

Antibacterial activity of host plants branches *Viscum album* (aqueous extract)

Test microorganisms	Poplar *(Populus nigra)*	Rowan *(Sorbus aucuparia)*	Black locust *(Robinia pseudoacacia)*
Escherichia coli	7.4 ± 0.6	9.4 ± 0.7	7.8 ± 0.6
Pseudomonas aeruginosa	7.4 ± 0.8	12.3 ± 1.1*	7.1 ± 0.1
Proteus vulgaris	6.9 ± 0.5	7.1 ± 0.8	6.9 ± 0.2
Staphylococcus aureus	10.3 ± 0.9*	12.4 ± 1.2*	10.6 ± 0.8*
Candida albicans	7.0 ± 0.4	7.5 ± 0.6	7.1 ± 0.7

* Mean values ± standard error of three independent experiments (n = 15).
* $p \leq 0.05$ compared with control (disk with physiological solution), significantly by Student's Test.

Table 5

Comparison of the host plants *Viscum album* chemical compositions (Harna, 2016)

Plant	Main chemical components
Apple (*Malus domestica*)	Carbohydrates (1.66%), organic acids (1.9%), carotenoids, vitamin C (up to 64.2 mg / %), tannins, catechins (20–25%)
Maple (*Acer platanoides*)	Sugars (1.4%), in leaves - tannins, rubber, alkaloids, ascorbic acid (268 mg/%)
Poplar (*Populus nigra*)	Glycosides, flavonoids, organic acids, essential oils (0.7%)
Rowan (*Sorbus aucuparia*)	Phenolic compounds, organic acids, alcohol - sorbitol, pectin substances
Black locust (*Robinia pseudoacacia*):	Flavonoids, essential oils, organic acids, tannins, toxalbumin – robin

essential oils, tannins, alkaloids) are found in the raw materials of all plants that feed mistletoe. Although in the work of Pietrza (Pietrza W., Nowak R., 2021) it is experimentally established that the chemical composition of mistletoe depends on the time of its collection and the host plant.

According to literature data, white mistletoe has litholytic activity and is used in urology and nephrolog (Harna, 2016). So the next stage of our research was the study of the litholytic effect of a lectin-containing extract from the shoots of white mistletoe, which was parasitic on rowan. In our study, concretions with the following chemical composition were used: oxalate – wedelite ($CaC_2O_4x2H_2O$), phosphate – struvite ($MgNH_4PO_4x6H_2O$), urate – uric acid ($C_5H_4N_4O_3$). 5% of any consumed lectin enters the human blood, which is filtered through the kidneys, at this moment the stones are washed with the lectin fraction of plant raw materials, so the experiment can be extrapolated to the level of the human body.

The results presented in Fig. 2, indicate that the lectin-containing extract of white mistletoe has lytolitic activity against urates and oxalates and does not affect phosphate concrements.

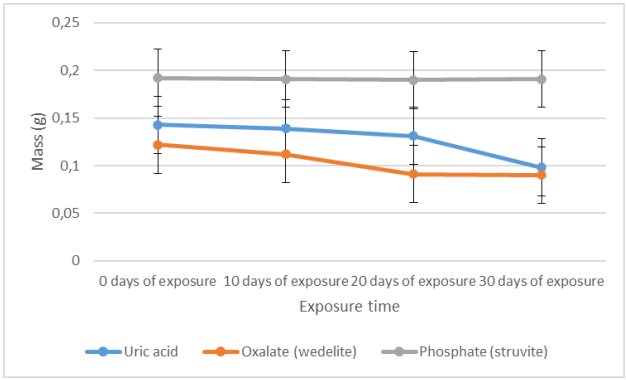

Fig. 2. Dynamics of changes in the mass of concrements depending on the exposure time in the lectin-containing extract of *Viscum album* (host - common rowan)

* the results are reliable at $p \leq 0.05$, control is physiological solution.

The mass of urates decreased by 31.4%, and oxalates by 26.2% over 30 days of exposure. Our data are correlated with the work of Yachi (Yachi et al., 2018), which demonstrated a decrease in the mass of cystine-calculi concrements by approximately 20% under the action of a lectin-containing extract from *Trigonella foenum-graecum.* It is also experimentally proven that the use of infusions of herbs, which cause the dissolution of kidney stones *in vitro*, have a similar effect *in vivo* (Papalia, Greco, 2020).

One of the questions of our experiment was the comparison of hemagglutinating activity of mistletoe lectins from different hosts.

The results of the study of hemagglutinating active activity are shown in Table 6.

Table 6

Hemagglutinating activity of *Viscum album* lectin-containing extract, which has different host relative to erythrocytes of four blood groups

Blood groups	Hemagglutination titer		
	Mistletoe (poplar is host)	Mistletoe (apple is host)	Mistletoe (maple is host)
0	16	32	16
A	128	64	16
B	128	64	32
AB	64	64	128

According to the research results, mistletoe lectins cause a hemagglutination reaction with erythrocytes of all blood groups. Erythrocytes of blood groups A, B, AB have a stronger agglutinating activity relative to lectin-containing extracts of mistletoe, compare with erythrocytes 0. See hemagglutination with light microscopy bellow (Singeta, 10 x 100) (Fig. 3)

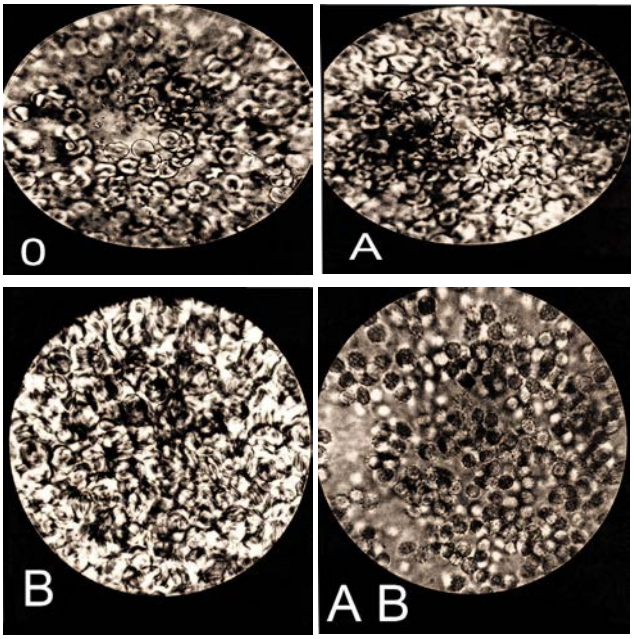

Fig. 3. Hemagglutinating activity under light microscopy: 0 – Mistletoe lectins (poplar is host) + 0 blood; A – Mistletoe lectins (poplar is host) + A blood; B – Mistletoe lectins (poplar is host) + B blood; AB – Mistletoe lectins (poplar is host) + AB blood

Viscum album from poplar lectin-containing extract generally shows higher hemagglutination titers.

Cytostatic activity of aqueous extract white mistletoe, wich has different host is presented below (Table 7).

As the research results show, the cytostatic activity of mistletoe depends on the host plant species. Cytostatic activity mistletoe from poplar and maple showed the highest activity.

Bilonozhko (Bilonozhko et al., 2023, pp. 432–438) studied the cytostatic activity of water extracts from mistletoe, the hosts of which were Scots pine, apple tree,

Table 7

Cytostatic activity of mistletoe from different host plants (aqueous extract)

Extract concentration (mg/ml)	Number of lateral roots					
	Mistletoe (poplar is host)	% in relation to the control	Mistletoe (apple tree is host)	% in relation to the control	Mistletoe (maple is host)	% in relation to the control
0	28 ± 1.9	100%	22 ± 2.4	100%	17 ± 2.6	100%
50	25 ± 2.1*	89.3%	19 ± 1.6*	86.4%	15 ± 1.4*	88.2%
100	25 ± 2.8*	89.3%	15 ± 1.9*	68.2%	19 ± 2.1*	111.8%
150	19 ± 3.6	67.9%	17 ± 2.1	77.3%	16 ± 1.7	94.1%
200	18 ± 2.3*	64.3%	10 ± 3.1	45.5%	12 ± 2.4	70.6%
250	18 ± 1.7	64.3%	14 ± 2.7	63.6%	18 ± 1.9	105.9%
300	13 ± 1.3*	46.4%	15 ± 1.6*	68.2%	8 ± 2.1	47.1%
350	12 ± 3.1	42.9%	19 ± 2.9*	86.4%	7 ± 1.6	41.2%
400	15 ± 1.1*	25%	9 ± 3.7	40.9%	10 ± 3.1	11.8%
450	9 ± 2.6	14.3%	13 ± 1.4	59.1%	16 ± 2.8	5.9%

* Mean values ± standard error of three independent experiments (n = 3).

* $p \leq 0.05$ compared with control (water), significantly by Student's Test.

white fir, and maple. According to their experiment, the water extract of mistletoe obtained from *Acer saccharinum* has the highest cytostatic.

Conclusions

1. The antibacterial activity of Viscum album depends on the host plant. Among the studied types of raw materials, mistletoe from rowan showed the highest antibacterial activity.

2. Lectin-containing extracts of all studied variants revealed hemagglutinating activity. The hemagglutination titer varies depending on the species of the host plant, but remains higher in relation to blood groups A and B.

3. Cytostatic activity is typical for all studied samples. The extract from white mistletoe, which grew on poplar and maple, turned out to be the most active cytostatic agent.

4. The lectin-containing extract of Viscum album showed litholytic activity against oxalates and urates in vitro.

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