



colloquium-journal

ISSN 2520-6990

Międzynarodowe czasopismo naukowe

**Medical sciences
Technical science
Economic sciences
Veterinary sciences
Biological sciences
Agricultural sciences**

**№7(94) 2021
Część 1**



colloquium-journal

ISSN 2520-6990

ISSN 2520-2480

Colloquium-journal №7 (94), 2021

Część 1

(Warszawa, Polska)

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Wydrukowano w Annapol 4, 03-236 Warszawa Poland, «Interdruk»

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BIOLOGICAL SCIENCES

УДК 574.58

*Денисенко О. С.**ООО «Азово-Черноморский научный центр
рыбохозяйственных исследований»*[DOI: 10.24412/2520-6990-2021-794-4-6](https://doi.org/10.24412/2520-6990-2021-794-4-6)**КАЧЕСТВЕННЫЕ И КОЛИЧЕСТВЕННЫЕ ПОКАЗАТЕЛИ ОРГАНИЗМОВ ЗООБЕНТОСА НА ПЕРИОДИЧЕСКИ ЗАТАПЛИВАЕМЫХ ПРИБРЕЖНЫХ УЧАСТКАХ АКВАТОРИИ КРАСНОДАРСКОГО ВОДОХРАНИЛИЩА***Denisenko O. S.**JSC «Azovo-Chernomorsk Scientific Center of Fishery Researches»***QUALITATIVE AND QUANTITATIVE INDICATORS OF ZOOBENTHOS ORGANISMS ON PERIODICALLY FLOODED COASTAL AREAS OF THE KRASNODAR RESERVOIR****Аннотация**

В рамках данной работы рассматриваются результаты мониторинговых исследований, проводимых специалистами ООО «Азово-Черноморский научный центр рыбохозяйственных исследований» в период января-декабря 2020 г. по изучению видового состава и численности организмов зообентоса на периодически затопляемых участках акватории Краснодарского края в пределах ст-цы Старокорсунская Краснодарского края

В результате исследований изучено видовое разнообразие, получены сезонные и годовые показатели численности и биомассы организмов зообентоса на периодически затопляемых участках акватории Краснодарского водохранилища. Проведена сравнительная характеристика данных характеристик с показателями, характерными для постоянно обводненных участков акватории Краснодарского водохранилища.

Abstract

Within the framework of this work, the results of monitoring studies carried out by specialists of the Azov-Chernomorsk Scientific Center for Fisheries Research in the period January-December 2020 to study the species composition and number of zoobenthos organisms in periodically flooded areas of the Krasnodar Territory water area within the Starokorsunskaya station are considered. Krasnodar Territory.

As a result of the research, the species diversity was studied, seasonal and annual indicators of the abundance and biomass of zoobenthos organisms were obtained in periodically flooded areas of the Krasnodar reservoir. A comparative characteristic of these characteristics with the indicators typical for constantly watered areas of the Krasnodar reservoir is carried out.

Ключевые слова: Краснодарское водохранилище, зообентос, численность, биомасса, сезонная динамика.

Key words: Krasnodar reservoir, zoobenthos, abundance, biomass, seasonal dynamics.

Материал и методы исследований

Отбор проб осуществлялся в 2020 году в период обводненности прибрежных участков акватории Краснодарского водохранилища на 10 станциях, расположенных на расстоянии 500 м друг от друга вдоль побережья акватории Краснодарского водохранилища в районе станицы Старокорсунская Краснодарского края. Для сбора и обработки проб, а также определения таксономической принадлежности организмов зообентоса использовались стандартные методики и общепризнанные определители [3,5,7,8].

Результаты исследований

Краснодарское русловое водохранилище расположено в среднем течении р. Кубани в 248 км от её устья, непосредственно выше г. Краснодара. Чаша водохранилища занимает территорию двух субъектов Российской Федерации – Республики Адыгея (87% площади зеркала водохранилища) и Краснодарского края (13% площади зеркала водо-

хранилища). На левом берегу водохранилища расположены Красногвардейский и Теучежский районы Республики Адыгея и Белореченский район Краснодарского края; на правом берегу – г. Краснодар, Динской и Усть-Лабинский районы Краснодарского края [6].

Водохранилища отличаются от естественных водоемов, прежде всего, площадью, уровнем режимом и регулированием водопусков, поэтому происходящие в них гидрологические, гидрохимические и гидробиологические процессы сильно отличаются от таковых в природных водоемах. Основные факторы, которые влияют на процессы, происходящие в водоеме – водообмен и уровень режим.

По характеру водообмена водохранилище относится к водоемам аккумулятивно-транзитного типа. В зависимости от водности года его водообмен происходит от 4 до 2 раз.

Уровненный режим Краснодарского водохранилища складывается как за счет атмосферных

осадков, так и за счет стока р. Кубани и левобережных притоков (Псекупс, Пшиш, Белая, Лаба и др.). Уровень воды и объем водохранилища зависят от поверхностного стока и сброса водных масс через плотину для нужд сельскохозяйственных предприятий, занимающихся выращиванием риса.

Ежегодно весной в период нереста фиитофильных видов рыб (конец апреля - начало мая) происходит интенсивный сброс воды из водохранилища на нужды мелиорации. Это приводит к оголению нерестилищ. Изменения объема и уровня водохранилища приводят к большим колебаниям площади водоема.

Так, в результате сработки водохранилища площадь в течение нерестового периода (апрель-первая декада июня) уменьшается на 10-15 %, затем наблюдается период накопления воды (вторая декада июня – июль), впоследствии (в период нагула рыб) происходит уменьшение объема и площади водохранилища до октября. С октября по апрель происходит аккумуляция воды в водохранилище.

Одним из наиболее подверженных постоянным колебаниям уровня воды в акватории Краснодарского водохранилища групп организмов является зообентос.

Ведущей группой в зообентосе как по встречаемости, так и по количеству видов являются личинки хирономид, представленные 19 формами. Основными биотопами в водохранилище являются илы и бывшие сельхозугодья. В первые годы его существования наблюдалась неравномерность в распределении донной фауны по этим биотопам, но в дальнейшем она была распределена почти равномерно. Как и в других водохранилищах, в Краснодарском резко выражены количественные изменения биомассы бентоса по сезонам.

Максимальная биомасса зообентоса на постоянно обводненных участках акватории наблюдается весной и осенью, минимальная летом. Летний минимум биомассы бентоса связан со степенью выедания его рыбами и хищными беспозвоночными, а также нестабильным гидрологическим режимом. Осенью наблюдается значительное развитие хирономид и олигохет. Наименьшие показатели численности и биомассы зообентоса отмечены в бывших руслах рек, глубоких участках вдоль плотины и в центральной зоне.

Наибольшая численность и биомасса донной фауны наблюдаются в течение всего вегетационного сезона на мелководных участках левобережья водохранилища со стороны республики Адыгея с разреженными кустарниковыми зарослями и прибрежной водной растительностью.

Учитывая бедность видового состава донных организмов и снижение в летний период биомассы кормовых объектов с первых лет существования водохранилища приступили к направленному формированию не только ихтиофауны, но и кормовых организмов путем интродукции ценных кормовых беспозвоночных - мизид и гаммарид. В настоящее время мизиды и гаммариды встречаются повсеместно в небольших количествах и в общем развитии бентофауны существенной роли не играют.

На значительных участках водоёма были отмечены большие скопления дрейссены (*Dreissena polymorpha*). Популяция дрейссены состоит из моллюсков, осевших весной, а также разновозрастных прошлогодних моллюсков. В популяции дрейссены доминируют особи более старшего возраста (двух- и трехлетки). В обрастаниях дрейссены отмечено наличие диатомовых и синезеленых водорослей, гидроидных полипов, гаммарид, личинок хирономид, нематоды и нитчатые водоросли (спирогира). Дрейссена распределена неравномерно по водоему. Наибольшее скопление её отмечено на насыпном грунте, бетонных сооружениях, сороудерживающих решетках. Общая площадь её распространения оценивается на уровне 650 га. Кроме дрейссены в составе зообентоса в незначительных количествах отмечена перловица (*Unio sp.*) и физа (пузырчатая улитка) - *Physa fontinalis*.

Среднегодовая величина биомассы зообентоса на постоянно обводненных участках акватории Краснодарского водохранилища составляет в настоящее время 2,8 г/м² при численности 244 экз./м² [1,2,4,6,9].

По результатам проведенных нами исследований зообентос на периодически затапливаемых участках акватории Краснодарского водохранилища представлен личинками хирономид, олигохетами, моллюсками и личинками насекомых. За период исследований водоемов были идентифицированы 4 вида хирономид (*Chironomus annularius*, *Chironomus balatonicus*, *Dicranota bimaculata*, *Tanytus monilis*), 3 вида олигохет (*Criodrilus lacuum*, *Limnodrilus profundicola*, *Tubifex tubifex*), 3 вида моллюсков (*Dreissena polymorpha*, *Physa fontinalis*, *Unio sp.*).

Высшие ракообразные - мизиды и гаммариды на периодически затапливаемых участках акватории Краснодарского водохранилища отсутствовали.

Численность и биомасса всех идентифицированных видов зообентосных организмов находилась на очень низком уровне, составляя в среднем за период исследований 0,12 г/м² при численности 24 экз./м². Доля мягкого бентоса превышает 62,3 %.

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VETERINARY SCIENCE

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[DOI: 10.24412/2520-6990-2021-794-7-12](https://doi.org/10.24412/2520-6990-2021-794-7-12)

PATHOMORPHOLOGICAL FEATURES OF THE PANCREAS IN MATURE CATS WITH ACUTE PANCREATITIS

Abstract.

The aim of the study was to investigate the pathomorphology of the pancreas of adult cats with acute pancreatitis. Histological examinations of the pancreas were performed in the laboratory at the Department of Anatomy and Histology of Polissya National University.

Histological sections were stained with hematoxylin and eosin and histomorphometric analysis of parts (exocrine and endocrine) of the pancreas was performed for examination microscopy to detect histological changes in cats with acute pancreatitis. The obtained morphometric data indicate an increase in sick animals in 1.12 times the parenchyma of the exocrine part of the gland, which was $48257.09 \pm 135.06 \mu\text{m}^2$ ($97.89 \pm 0.04\%$). The endocrine part, respectively, occupied $6771.88 \pm 274.06 \mu\text{m}^2$ area ($3.89 \pm 0.03\%$). In the control group of animals, the corresponding values were $42989.03 \pm 141.05 \mu\text{m}^2$ ($96.11 \pm 0.05\%$) and 6811.44 ± 312.04 ($3.89 \pm 0.03\%$).

Characteristic pathohistological changes in the gland were manifested by edema of the intercalary space and an increase ($p < 0.05$), 1.27 times the proportion of its stromal component, which was $22.47 \pm 0.25\%$, and in the control - $17.69 \pm 0.14\%$ respectively.

Keywords: *morphology, histostructure, islets of Langerhans, lysis of nuclei, proliferation of nuclei, volume of pancreaticocytes.*

Introduction.

The pancreas is one of the few organs that, due to the combination of external secretory and endocrine functions, participates in almost all physiological processes, from digestion to adaptation processes, including the maintenance of homeostasis of the whole organism [3, 4]. The activity of the body is extremely important for the regulation of carbohydrate, protein and fat metabolism in animal and human tissues [11].

It was found that diseases of the digestive system in animals are about 45% out of the total number of non-communicable diseases, among which in the first place is inflammation of the pancreas [12].

However, the data of morphological studies on the pathology of the pancreas in animals are ambiguous, and the results of histological studies in sick cats are given only superficially.

There is no doubt that pancreatitis in domestic animals, including cats, remains one of the most common diseases and insufficiently clarified causes of morbidity and mortality of animals of this species [6, 8].

Pancreatitis is an inflammatory-dystrophic disease of the glandular tissue of the pancreas that occurs due to premature activation of proenzymes in acinar cells and occurs with impaired patency of its ducts [7]. This pathology can be both acute and chronic, bacterial and nonbacterial in nature [10]. It depends on the degree of manifestation of its atrophic processes associated with fibrosis in the parenchyma of the pancreas [13]. However, there may be a severe form of the disease, which is accompanied by the development of pancreatic necrosis and systemic complications [1]. Any form of

pancreatitis can occur with mild symptoms or manifested by nonspecific clinical signs [10].

The acute form of pancreatitis is accompanied with edema and necrosis, with hypoperfusion and thrombosis, which in turn can exacerbate pancreatic necrosis [5].

At the same time acute pancreatitis can turn into chronic, which in turn may be accompanied by exocrine insufficiency of the pancreas.

The most common signs of pancreatitis in cats are low body temperature, anorexia, dehydration, jaundice is less common [9].

Therefore, given the importance of the function of the pancreas not only as an organ of the digestive system, but also one that determines the general condition of the whole organism, it is important to study the pathomorphological features of the gland in cats with acute pancreatitis.

Material and methods.

In conducting research, the basic rules of good laboratory practice GLP (1981), the provisions of the "General Ethical Principles of Animal Experiments", adopted by the First National Congress of Bioethics (Kyiv, 2001) and the requirements for the Rules of experimental use animals".

The material for the pathomorphological study was cats that died from pancreatitis diagnosed on the basis of clinical, biochemical studies and ultrasound ($n = 6$).

Histological examination of the pancreas in normal and in pathology was performed in the pathomorphological laboratory of the Department of Anatomy

and Histology, Faculty of Veterinary Medicine, Polissya National University.

To study the morphology of cells and tissues, and morphometric study used staining of histocuts with hematoxylin Ehrlich, Karats and eosin and the method of Van Gizon [2].

Microphotography of histological specimens was performed using a camcorder CAM V200 mounted in a microscope Micros MC-50.

Results.

The pancreas in cats is externally covered with a thin connective tissue capsule. The parenchyma of the gland is divided into lobes, between which are the septa (Fig. 1), which are connective tissue strands in which blood vessels, nerves and excretory ducts.

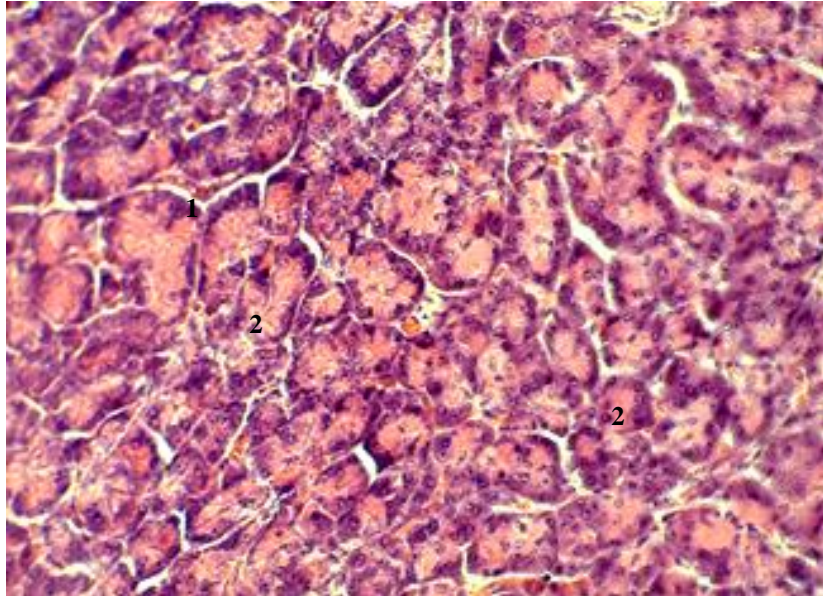


Fig. 1. A fragment of the microscopic structure of the exocrine part of the pancreas of the control group of cats: 1 - acinus; 2 - interparticle connective tissue. Hematoxylin Karatsi and eosin. $\times 120$.

Morphologically, it is noted that the largest part of the gland is the exocrine part (Fig. 3), which according to morphometric studies of the pancreas in clinically healthy adult cats is $42989.03 \pm 141.05 \mu\text{m}^2$ per unit area of the gland in optical examination (approx. 16, about 8) or $(96.11 \pm 0.05\%)$. It consists of terminal divisions - pancreatic acinuses with a diameter of $29.89 \pm 0.15 \mu\text{m}$ and excretory ducts.

The volume of pancreaticocytes and their nuclei in control animals is 425.05 ± 17.11 and $30.92 \pm 1.60 \mu\text{m}^3$, respectively. The nuclear-cytoplasmic ratio of pancreaticocytes is 0.12 ± 0.003 um. from

The acinus of the gland is formed by secretory (acinous) cells, which are known to produce digestive en-

zymes: lipase, amylase, trypsin, chymotrypsin, nucleases, etc. [11]. On histological examination, such cells are mostly triangular in shape, the nuclei are rounded, located almost in the center of the cells, the cytoplasm of acinar cells is stained unevenly. Thus, the basal part of such cells is stained basophilically blue, which is called a homogeneous zone. The apical part has an oxyphilic color, ie painted red - zymogenic zone. This color structure is due to the uneven distribution of organelles in the relevant parts of the pancreaticocytes. In addition to cells, the exocrine part contains plug-in and intraparticle excretory ducts, which are lined with a single layer of epithelium.

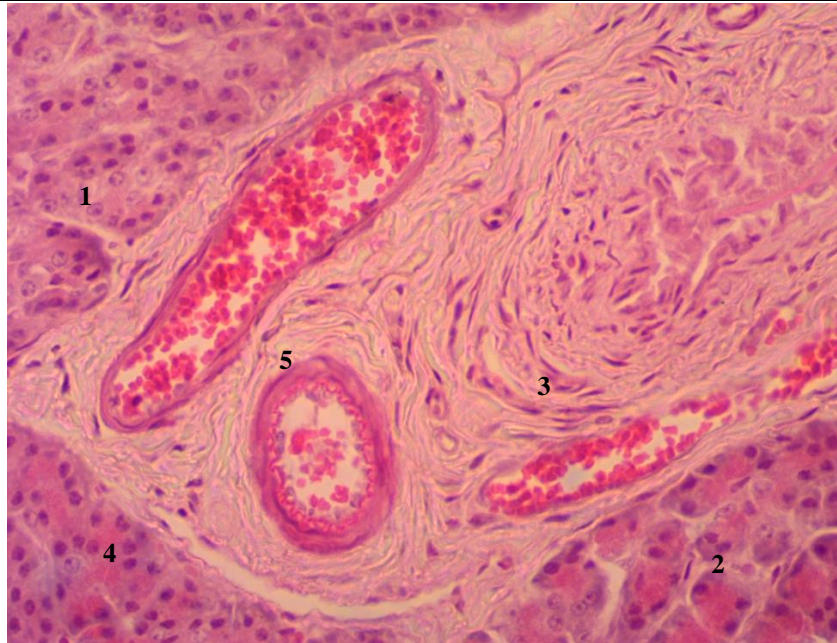


Fig. 3 Fragment of the microscopic structure of the pancreas of the control group of cats: 1 - exocrine part; 2 - nuclei of pancreaticocytes; 3 - interparticle connective tissue; 4 - interstitial connective tissue 5 - vessel. Hematoxylin Karatsi and eosin. $\times 400$.

The endocrine part of the gland, whose area is $6811.44 \pm 312.04 \mu\text{m}^2$ (3.89%) per conventional unit area in the field of view of the microscope (approx. 16, vol. 8) is formed by pancreatic islets (islets of Langerhans), which are located between the acinuses (Fig. 3). Such islets consist of insulocytes, around which are fenestrated capillaries with pericapillary space. Small cells - insulocytes had a light cytoplasm. It is known that there are the following cell types: acidophilic - A-

cells, basophilic - B-cells, dendritic - D-cells and PP-cells. Histologically, it is noted that in the center of the islets of Langerhans the largest mass is formed by B-cells containing a significant amount of heterochromatin.

Sectional macroscopic studies showed that in cats with acute pancreatitis at autopsy, the pancreas was dark red, hyperemic, enlarged, swollen, with localized hemorrhage.

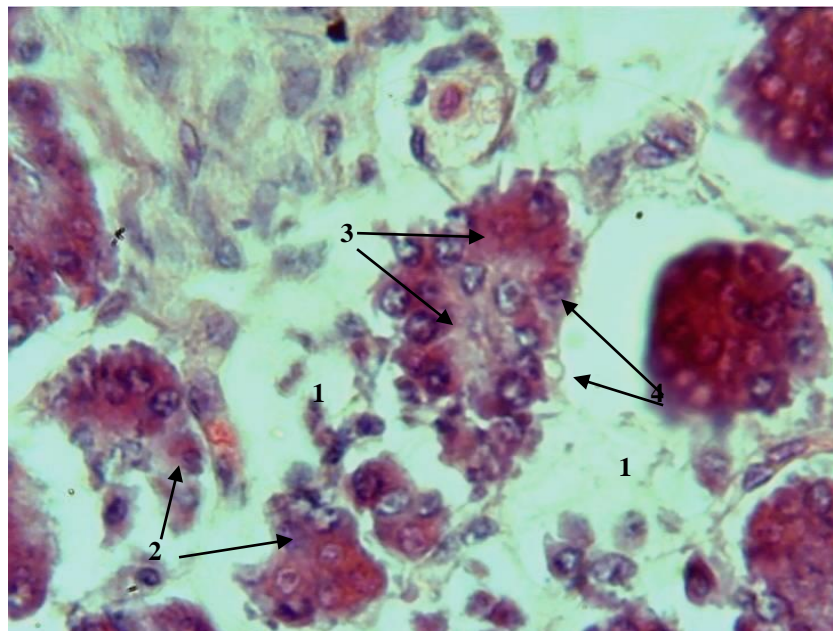


Fig. 4. Microscopic structure of the pancreas of cats with acute pancreatitis: 1 - interstitial edema; 2 - discomplexation of acinuses; 3 - pancreaticocytes; 4 - nuclei of pancreaticocytes. Hematoxylin Karatsi and eosin. $\times 400$.

Histological examination of the histostructure of the exocrine gland in acute pancreatitis in comparison with the control group of animals showed that the venous vessels and arteries were dilated, overflowing

with erythrocytes and single neutrophils. Isolated hemorrhages in loose fibrous connective tissue or in the lumen of the excretory ducts were noted. In addition, in addition to neutrophils, macrophages and lymphocytes were found in the gland stroma. In some cases, in the

field of view of the microscope there was an expansion of the intercalary space, which indicated the initial stage of acute inflammation. Morphometric studies showed an increase in the proportion of stromal component ($p < 0.05$) in 1.27 times, which was $22.47 \pm 0.25\%$ relative to animals in the control group - $17.69 \pm 0.14\%$, respectively.

At the same time, morphological examination of the pancreas in cats with acute pancreatitis showed an increase of 1.12 times ($p < 0.001$) in the exocrine parenchyma, which was $48257.09 \pm 135.06 \mu\text{m}^2$ or ($97.89 \pm 0.04\%$). Therefore, the morphometric parameters of the

endocrine part were reduced by $39.56 \mu\text{m}^2$ and amounted to $6771.88 \pm 274.06 \mu\text{m}^2$. Such morphological parameters in control animals were $42989.03 \pm 141.05 \mu\text{m}^2$ ($96.11 \pm 0.05\%$) and $6811.44 \pm 312.04 \mu\text{m}^2$ ($3.89 \pm 0.03\%$), respectively.

Disorganization of the structure of individual exocrinocytes was also noted. The latter were in a state of uneven swelling of the zymogenic zone, and a clear deformation of the homogeneous zone. The nuclei of such exocrinocytes moved to the basal part of the cell. Some exocrinocytes were in the stage of necrotic changes. There was a pronounced interstitial edema (Fig. 4).

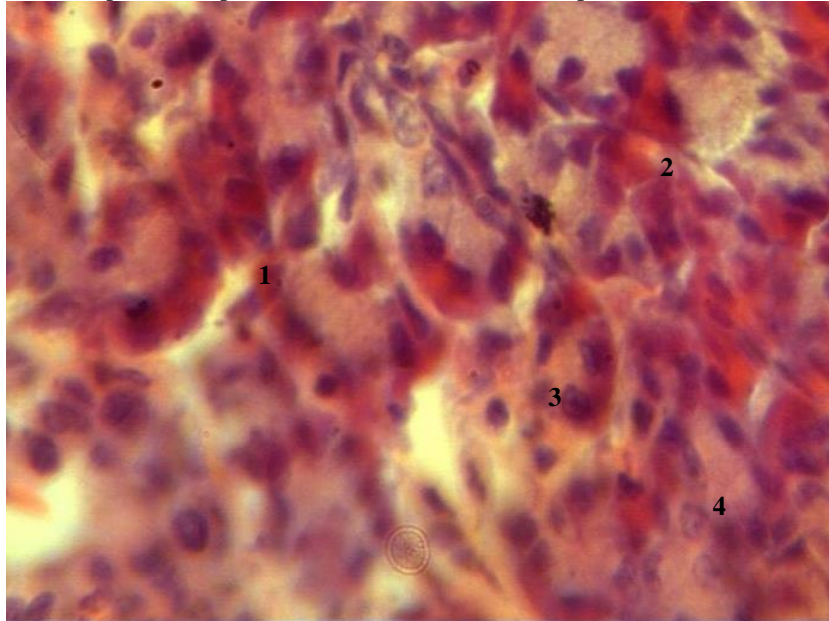


Fig. 5. Microscopic structure of the pancreas of cats with acute pancreatitis: 1 - plethora of the intercalary space; 2 - neutrophilic leukocytes; 3 - karyopyknosis of nuclei; 4 - smoothing the contours of the boundaries of exocrine cells. Hematoxylin Karatsi and eosin. $\times 400$.

In the analysis of the histrostructure of the acinus of the gland, found mostly destructive changes of various types. Thus, most noted a clear loss of eosinophilia of the cytoplasm, expansion of the perinuclear space, changes in the nuclei (compaction), the polarity of such cells was violated. Neutrophilic leukocytes were detected in such acinuses. In addition, the boundaries of exocrine cells lost their contours (Fig. 5). Focal hemorrhages were found in the parenchyma of the exocrine part. The vessels were dilated and filled with blood.

In addition, significant necrosis of the exocrine part of varying degrees was detected. In some parts of the parenchyma of the pancreas necrosis completely affects several lobes together with the connective tissue layer, in other parts of the parenchyma - only a small part of the lobes. Some acinuses lost their characteristic shape and did not have a clear structure (Fig. 6).

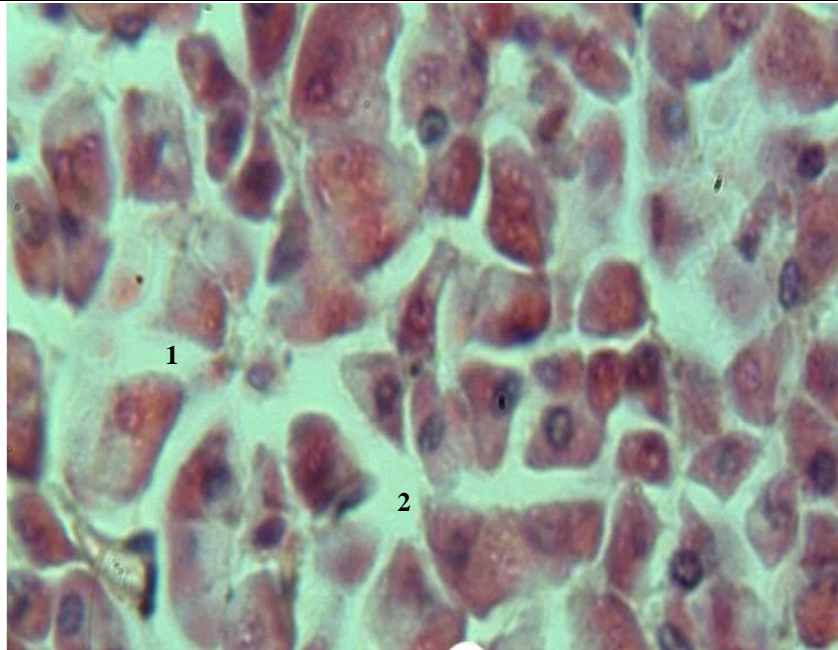


Fig. 6. Microscopic structure of the pancreas of cats with acute pancreatitis: 1 - necrosis of pancreaticocytes; 2 - karyolysis. Hematoxylin Karatsi and eosin. $\times 400$.

Microscopic examination of histological sections in the endocrine part showed that the contours of the islets of the pancreas were blurred, in a state of atrophy, in isolated cases, hyperplasia and sclerosis were observed in the area of histo sections. The number of islet cells in sick cats decreased significantly with the comparison of the control group. The walls of the vessels of

the islets were swollen, showed dilatation with intensive filling of the capillaries of the islets of Langerhans (Fig. 7), a slight stasis in the microcirculatory tract. Fragmentary necrosis of A-, D-, PP-, B-cells located on the periphery of the islets was noted.

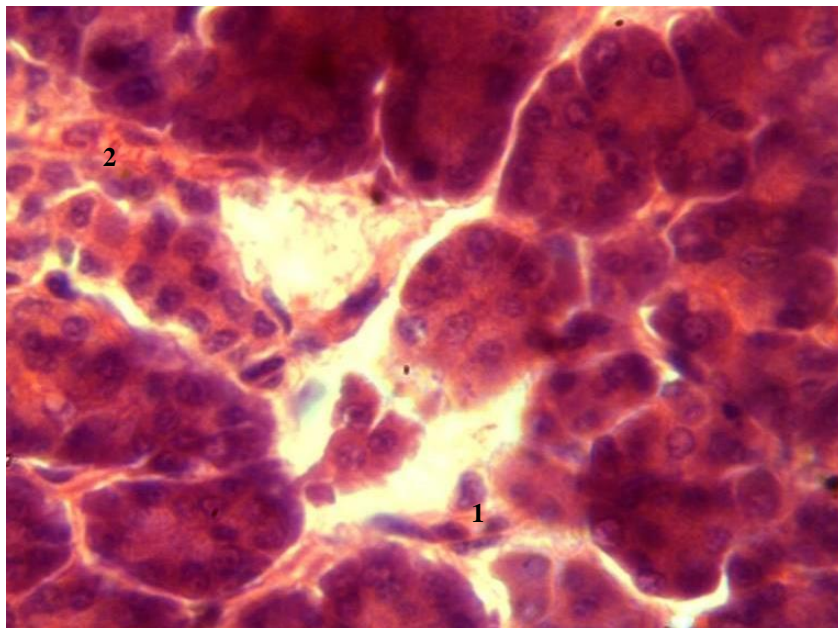


Fig. 7. Microscopic structure of the endocrine part of the pancreas of cats with acute pancreatitis: 1 - destruction of cells of the islets of Langerhans; 2 - focal hemorrhages in the endocrine parenchyma. Hematoxylin Karatsi and eosin. $\times 400$.

Morphometric examination of the diameter of the islets of Langerhans of the pancreas of sick cats of all studied groups revealed significant differences. Thus, the diameter of the acinuses and islets of Langerhans significantly ($p < 0.001$) increased by 1.14 and 1.15 times and was equal to 31.84 ± 0.04 and 71.82 ± 2.1

μm , respectively. The corresponding values in clinically healthy cats were 27.88 ± 0.14 and 62.15 ± 2.45 μm .

Conclusion.

1. Our histological morphometric and statistical methods of histoarchitectonics of pancreatic tissue of cats allows us to assess the degree of its morphological

structure in normal and in terms of pathology - acute pancreatitis.

2. The histological structure of pancreatic glands indicates cyto- and morphometric changes in the exocrine and endocrine parts. The results of morphometric studies of the exocrine part indicate a tendency to increase ($p < 0.001$) in 1.12 times the exocrine parenchyma of cats, equal to $48257.09 \pm 135.06 \mu\text{m}^2$ or $97.89 \pm 0.04\%$. The endocrine part of the gland, in contrast, was reduced by $39.56 \mu\text{m}^2$ times and amounted to $6771.88 \pm 274.06 \mu\text{m}^2$. Such morphological parameters in control animals were $42989.03 \pm 141.05 \mu\text{m}^2$ - $96.11 \pm 0.05\%$ and $6811.44 \pm 312.04 \mu\text{m}^2$ - $3.89 \pm 0.03\%$.

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UDC 619.09.636:678.048:615.916:631.842:636.4

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[DOI: 10.24412/2520-6990-2021-794-12-15](https://doi.org/10.24412/2520-6990-2021-794-12-15)

THE EFFECT OF METHIPHENE, METHIONINE, AND PHENARONE ON THE HUMORAL PART OF THE IMMUNE SYSTEM OF PIGLETS IN EXPERIMENTAL CHRONIC NITRATE-NITRITE TOXICOSIS

Abstract.

The article describes the dynamics of indicators of the state of humoral immunity of piglets in experimental nitrate-nitrite toxicosis. The subjects were 20 large white piglets three months old. The research was conducted at the Komarnivsky National Research Center of the Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies. According to the method of analog groups, one control and three experimental were formed. Feeding sodium nitrate to piglets at a dose of $0.3 \text{ g NO}_3^-/\text{kg. b.w.}$ contributes to the development of chronic nitrite-nitrate toxicosis. Nitrates in a toxic dose for 90 days reduce the protective properties of the body. Under nitrate load, feeding pigs phenarone, methyphene, and methionine had a positive effect on piglets' humoral immunity, manifested by the high antimicrobial activity of serum.

Keywords: *Methyphene, phenarone, methionine, humoral immunity, nitrate-nitrite toxicosis.*

Introduction. Many scientific works by domestic and foreign researchers are devoted to studying issues related to nitrate-nitrite toxicosis in animals and poultry. Among them in our country, the most fundamental researches are carried out by S.V. Bazhenov, Z.P. Skorodinsky, G.O. Khmelnytsky, A.Y. Mazurkevich, O.O. Malinin, D.F. Gufriy, O.I. Kanyuka, V.M. Hunchak and others. These scientists have identified the main links in the pathogenesis of nitrate-nitrite toxicosis with a different course in animals and birds, significantly identified features of metabolic processes and disorders of physiological functions of the body [1]. However, the mechanism of toxic effects of nitrates and nitrites on pigs has not been studied enough.

Still, an urgent problem in animals' chronic toxicosis is the development of veterinary drugs that can increase antioxidant activity and immune resistance of animals, normalize metabolic processes in tissues, restore the structure and function of organs and systems. Among them, various specific and nonspecific biologically active drugs have become widespread. One of them is phenarone, which delays lipid oxidation and reduces free radicals' content to preserve biologically active vitamin preparations and feed supplements. Phenarone is a complex compound containing 70% phenazanoic acid and 30% zeolite. In animals, phenarone stimulates the conversion of peroxides to inactive metabolites, which increases the nonspecific resistance of animals [6-8].

The mechanism of action of phenarone in chronic nitrate-nitrite toxicosis is associated with the direct effect of its components on the inhibition of the absorption of metabolites that have a toxic effect on cell membranes caused by nitrites. As a result of the adsorbing action of zeolite in the digestive tract, there is a decrease in the concentration of substances formed by nitrates and nitrites, which can be toxic to the body and enhance the processes of lipid peroxidation. This cause occurs by osmosis and diffusion of these substances through the capillaries of the small intestine's microvilli and their subsequent fixation on the sorbent granules [5]. By preventing the entry of toxic substances from the digestive tract into the blood and developing inflammatory reactions in the intestine, enterosorption indirectly contributes to the functional unloading of the liver, thus ensuring more efficient functioning of the antioxidant defense system. Phenosan acid is a direct-acting antioxidant that interacts directly with lipid peroxidation products and free radicals.

However, many authors [2] found that when nitrates enter animals' bodies in large quantities, phenarone did not have a proper corrective effect on the antioxidant defense system and neutralization of lipid peroxidation products. That prompted the development of a new drug that could perform a proper corrective function.

At the Department of Pharmacology and Toxicology of Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv, the antioxidant Methyphene was developed, which contains the drug phenarone and the amino acid methionine [3].

The methionine combines enzymatic and non-enzymatic systems of antiradical protection of biological cell membranes. It converts neutral fats into phospholipids, which stabilize subcellular membranes, thus providing antioxidant protection and increasing hepatocytes' resistance against the toxic effects of harmful substances, including nitrites. Methionine also maintains calcium homeostasis and prevents the development of the fatty liver disease.

Therefore, it is known from the literature that nitrate-nitrite toxicosis in animals uses drugs that have antioxidant properties because nitrate-nitrite toxicosis is the depletion of the antioxidant system and the growth of lipid peroxidation products. The proposed methods of treatment of animals in this intoxication apply only to poultry and cattle. Still, this toxicosis also affects pigs, so the urgent problem is to study the pathogenesis of nitrate-nitrite toxicosis in swine and develop an effective method of treatment and prevention of nitrate-nitrite intoxication [4]. The use of known remedies is insufficiently studied in pigs. That is why the research of phenarone, methyphene, and methionine in nitrate-nitrite toxicosis in swine is relevant.

The aim of the study. To investigate the effect of phenarone, methyphen, and methionine on the humoral part of the immune system of pigs in experimental nitrate-nitrite toxicosis.

Materials and methods of research. The subjects were 20 large white piglets three months old. The study was conducted at the Komarnivskyi National Research Center of the Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies. According to the method of analog groups, one control and three experimental were formed. The scheme of the experiment is given in table 1.

Table 1

Groups of animals	The dose of the drug
C	Piglets were fed sodium nitrate at a dose of 0.3 gNO ₃ ⁻ /kg body weight once a day during the studies
E ₁	Piglets were fed methionine at a dose of 4 mg/kg + sodium nitrate at a dose of 0.3 gNO ₃ ⁻ /kg body weight once a day during the studies
E ₂	Piglets were fed phenarone at a dose of 1.20 mg/kg + sodium nitrate at a dose of 0.3 gNO ₃ ⁻ /kg body weight once a day during the studies
E ₃	Piglets were fed methyphen at a dose of 0.9 mg/kg + sodium nitrate at a dose of 0.3 gNO ₃ ⁻ /kg body weight once a day during the studies.

Blood for investigation was taken from the cranial vena cava at the beginning of the experiment and 10, 30, 60, 90 days. From humoral indicators of resistance bactericidal activity of blood serum (BABS) was investigated by the method of O.V. Smirnova, T.A. Kuzmina (1966), lysozyme activity of blood serum (LABS) - photo electro colorimetric method, and titer of normal antibodies of blood serum (TNABS) in agglutination reaction (Chumachenko V.E., etc., 1990).

Research results.

The investigation of the effects of phenarone, methiphen, and methionine on humoral immunity in nitrate-nitrite toxicosis in pigs is shown in table 2.

It is known that specific macromolecules provide humoral immunity that functions in the internal fluids of animals. Blood plasma contains particular proteins that can neutralize microorganisms and toxic products of their activities that enter body fluids. The function of the immune system is to recognize genetically foreign

antigens and specifically respond to them. Its primary purpose is to neutralize and destroy those antigens that stimulate the immune response.

As shown in Table 2, in chronic nitrate-nitrite toxicosis in piglets, serum antimicrobial activity in the first days of the study increased, as indicated by grew up of the bactericidal and lysozyme activity of serum in sick animals. Thus, on the 10th day, BABS increased by 11%, while the LABS in this period grew up by 4%. Subsequently, the antimicrobial activity of the serum of piglets fed sodium nitrate in a toxic dose began to decline gradually, indicating the suppression of the physiological state of the humoral immune system. On the 30th day, the C group's BABS reached $25.13 \pm 0.65\%$, and the LABS - $39.41 \pm 0.60\%$. The lowest antimicrobial activity was found on the 60th day, compared with the initial values, BABS decreased by 9% and LABS - by 6.8%.

Table 2

The indicators of humoral immunity of piglets feeding methionine, phenarone, and methyphene under conditions of chronic nitrate-nitrite toxicosis ($M \pm m$, $n=5$)

Indicators	Groups of animals					
		Start day	10th day	30th day	60th day	90th day
Bactericidal activity (BABS) %	C	26.44±0.49	29.41±0.60	25.13±0.65	24.04±0.54	24.83±0.50
	E1	25.79±0.49	28.79±0.50	25.20±0.49	24.91±0.50*	25.05±0.56
	E2	25.91±0.48	28.64±0.65	25.26±0.50	25.53±0.52**	25.42±0.49
	E3	26.28±0.50	28.55±0.63	26.06±0.61	26.41±0.55**	26.35±0.61
Lysozyme Activity (LABS) %	C	41.12±0.61	42.89±0.63	39.41±0.60	38.31±0.72	40.21±0.70
	E1	41.33±0.70	41.64±0.60	39.86±0.65	39.92±0.54***	39.99±0.70
	E2	41.24±0.61	41.60±0.75	40.15±0.63	40.22±0.60***	40.76±0.65
	E3	41.08±0.60	41.55±0.64	41.28±0.60	41.12±0.75***	41.20±0.60
CIC, mM / ml	C	79.28±3.13	79.85±3.10	80.91±3.11	84.32±3.13	80.86±3.11
	E1	79.31±3.10	79.34±3.13	79.74±3.13	82.86±3.10	79.91±3.10
	E2	79.39±3.10	79.41±3.11	79.68±3.12	80.75±3.13**	79.42±3.10
	E3	79.15±3.11	79.19±3.10	79.42±3.12	79.27±3.11	79.20±3.12

The degree of probability, compared with the control group: * - $p \leq 0,05$; ** - $p \leq 0,02$; *** - $p \leq 0,001$

On the 90th day of the research in the C group was found an increase in BABS and LABS, as indicated by the adaptation of piglets to long-term sodium nitrate intake, but comparing the values with blood taken at the beginning of the experiment, antimicrobial activity of serum was lower.

Under physiological conditions, the formation and presence of circulating immune complexes (CIC) in fluids manifest the body's immune response to antigen and an essential factor in ensuring immunity. The formed immune complexes under these conditions circulate in lymph and blood for some time; then, there is their detection. Simultaneously, the CIC can trigger chains of pathological changes because their prolonged circulation, even with a slight increase in body fluids, leads to accumulation in tissues. This, in turn, causes increased aggregation and adhesion of platelets, which leads to disruption of microcirculation and obliteration of blood vessels of the hemomicrocirculatory tract, tissue damage and necrosis. Formed CIC interacts with almost all blood cells, with complement, and receptors of many cells of organs and tissues. The interaction of

the CIC with immunocompetent cells leads to the modulation of the immune response.

In studying the values of humoral immunity in sick piglets in the blood, the level of circulating immune complexes (CIC) on the 30th day of the experiment is 80.91 ± 3.11 mM/ml against 79.28 ± 3.13 mM/ml in clinically healthy. On the 60th day, the highest CIC level was established, where, according to the initial values, it increased by 6%. High levels of CIC in the serum indicate the suppression of the body's immune system due to the attachment of specific antibodies to the products of metabolism in chronic nitrate-nitrite toxicosis.

Therefore, the simple detection of high CIC levels without clinical signs, anamnesis data indicates only the stimulation of piglets' immune response, which is aimed at removing from the body genetically foreign antigens.

In studying the values of humoral immunity of piglets fed methionine, phenarone, and methyphene for three months, high antimicrobial activity of blood serum was found.

The bactericidal activity of serum of piglets fed methionine and sodium nitrate was $28.79 \pm 0.50\%$ on the 10th day of the experiment and $25.20 \pm 0.49\%$ on the 30th day, respectively. On the 60th day, BABS in this experimental group decreased slightly but, compared with the C group, risen by 4%. On the 90th day, this figure reached the limits of the physiological norm.

Feeding phenarone and methiphen contributed to a better normalization of serum bactericidal activity than the use of methionine. Thus, on the tenth day of the experiment, we note an increase in the studied indicator, respectively, by 10 and 9% compared to the initial values. Still, relative to the C group of animals, this figure was slightly lower. On the 30th day, serum bactericidal activity in both experimental groups was in the range of 25.26 ± 0.50 - $26.06 \pm 0.61\%$. On the 60th day, the BABS was the highest in the experimental group of animals fed methiphen. According to the C group, it raised by 10%. On the 90th day, BABS reached the initial values' limits.

Lysozyme activity of blood serum of piglets on the 10th day in all experimental groups was slightly lower than the control group of animals. The E₁ group was $41.64 \pm 0.60\%$, in the E₂ group - $40 \pm 0.75\%$, in the E₃ group - $41.55 \pm 0.64\%$, while in the C group it was $42.89 \pm 0.63\%$.

In subsequent periods of the study, LASC in the experimental groups of piglets continued to decline, but compared with the control group of animals, it increased slightly, respectively, in piglets fed methionine - by 1.1%, in piglets fed phenarone - by 2%, in piglets fed methiphen - by 5%. On the 60th day, the most probable changes in the above indicator of the experimental groups of animals compared with the control group were found. Thus, in the E₁ group, LABS grew by 4%, in the E₂ group - by 5%, and in the E₃ group, respectively, by 7%. On the 90th day, LASK continued to grow, but it reached the initial values only in the experimental group of animals treated with methiphen, where, respectively, it was $41.20 \pm 0.60\%$.

In general, the results indicate a specific stimulating effect of methionine, phenarone, and methiphen on humoral immunity activity in blood, namely BABS and LABS, when added to compound feed to piglets that were nitrated for three months

Having established that the CIC increases significantly in chronic nitrate-nitrite toxicosis, we tested antioxidant drugs with hepatoprotective and detoxifying effects. In piglets treated with these remedies before nitrate and nitrite poisoning, the CIC content did not change compared to intact animals. The absence of changes in CIC content in the body of poisoned piglets

treated with phenarone and methiphen may indicate the intensity of detoxification processes and thus reduce antigens' formation, which leads to stabilization of the content of CIC in the blood.

Conclusions

1. Feeding sodium nitrate to piglets at a dose of $0.3 \text{ g NO}_3^-/\text{kg. b.w.}$ contributes to the development of chronic nitrite-nitrate toxicosis. Nitrates reduce the body's protective properties in a toxic dose; when they enter the animal's body for 90 days

2. Under nitrate load, feeding pigs phenarone, methiphen, and methionine had a positive effect on piglets' humoral immunity, manifested by the high antimicrobial activity of serum.

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DOI: [10.24412/2520-6990-2021-794-16-18](https://doi.org/10.24412/2520-6990-2021-794-16-18)

THE EFFECT OF METHYPHEN AND VITAMIX SE ON THE LEVEL OF PRODUCTS OF BULL LIPID PEROXIDE OXIDATION UNDER NITRATE-CADMIUM LOAD

Abstract.

The study aimed to investigate methyphene and Vitamix Se's antioxidant properties under the nitrate-cadmium loading in young cattle. The experiments were performed on 20 bulls of six months of age, black-spotted breed, from which four groups of 5 animals in each were formed: control and three experimental groups. The control group's bulls (C) were fed with feed for a month sodium nitrate at a dose of 0.15 g NO_3^- /kg body weight together with cadmium chloride at a dose of 0.02 mg/kg animal. The first experimental group (E_1) bulls were fed sodium nitrate and cadmium chloride in the above doses for a month, and methyphene was given to the diet at a dose of 0.28 g/kg of feed. The second experimental group (E_2) was fed sodium nitrate and cadmium chloride in the above doses for a month, and Vitamix Se was added to the diet at a dose of 0.03 g/kg body weight. The third experimental group (E_3) bulls were fed sodium nitrate and cadmium chloride in the above doses for a month and fed with methyphene and Vitamix Se. The level of intermediate and final products of lipid peroxidation under conditions of chronic nitrate-nitrite toxicosis with cadmium loading was studied. Antioxidant properties of methyphene and Vitamix Se preparations in young cattle under conditions of nitrate-cadmium loading were installed. The use of methyphene and Vitamix Se in developing chronic nitrate-nitrite toxicosis of bulls with cadmium load contributed to reducing intermediate and final products of lipid peroxidation diene conjugates and malonic dialdehyde. At nitrate-cadmium loading, the best effect on inhibition of processes of peroxidation of lipids of an organism of animals was shown by the combined use of methyphene and Vitamix Se.

Keywords: cadmium nitrate intoxication, antioxidant, nitrates, cadmium, lipids, malonic dialdehyde, diene conjugates.

Introduction

Lipids and their natural complexes are the basis for the construction of biological membranes, in which they perform essential functions. Double bonds accompany lipid oxidation in the diene conjugate system [2, 4]. Lipid peroxidation reactions reflect the cell's functional state and subcellular membranes, which are important for the body's viability.

The development of a pathological process is preceded by damage to cell membranes, which is manifested primarily by a violation of the lipid layer's functional state. Numerous toxicosis is known, characterized by disturbances of oxidative-antioxidant balance, including nitrate-nitrite and cadmium toxicosis [1, 3, 5-7]. Previous studies have shown that under conditions of nitrate-cadmium loading in young cattle, the balance between the processes of lipid peroxidation and the antioxidant system's activity, resulting in the body accumulating a large number of free radicals, reactive oxygen species, products of lipid peroxidation that are harmful to the body as a whole and reduce the activity of both enzymatic and non-enzymatic systems of the body's antioxidant defense. Therefore, to correct this balance, we used drugs that have antioxidant properties [8, 9].

As antioxidants, we took the drugs methyphene and Vitamix Se, which are permitted in clinical veterinary practice, mainly in sick animals with nitrate-nitrite toxicosis. However, there is no data on the use of these drugs under nitrate-cadmium loading in the literature.

Therefore, **our work aimed** to investigate methyphene and vitamin Se's antioxidant properties during nitrate-cadmium loading in young cattle.

Materials and methods. The experiments were performed on 20 bulls of six months of age, black-spotted breed, from which four groups of 5 animals in each were formed: control and three experimental groups. The C group's bulls were fed with feed for a month sodium nitrate at a dose of 0.15 g NO_3^- /kg body weight together with cadmium chloride at a dose of 0.02 mg/kg animal. The E_1 group's bulls were fed sodium nitrate and cadmium chloride in the above doses for a month and methyphene was given to the diet at a dose of 0.28 g/kg of feed. The E_2 group's bulls were fed sodium nitrate and cadmium chloride in the above doses for a month, and Vitamix Se was added to the diet at a dose of 0.03 g/kg body weight. The E_3 group's bulls were fed sodium nitrate and cadmium chloride in the above doses for a month and fed with methyphen and Vitamix Se.

The level of malonic dialdehyde was determined (MDA) by the method of E.N. Korobeynikov (1989), the level of diene conjugates (DC) was determined by the method of I.D. Steel (1977)

Research results.

The effect of methyphen on the level of intermediates of lipid peroxidation in cadmium nitrate toxicosis is shown in table 1.

Table 1

The level of diene conjugates in the serum of bulls after the introduction of methyphene and Vitamix Se in chronic nitrate-nitrite toxicosis with cadmium load (M±m, n=5)

The blood test time (days)	Diene conjugates (µmol/l)			
	Groups of animals			
	Control (nitrates + cadmium)	Experimental 1 (nitrates + cadmium) methyphen	Experimental 2 (nitrates + cadmium) Vitamix Se	Experimental 3 (nitrates + cadmium) methyphene + Vitamix Se
The initial values	5.80±0.17	5.78±0.21	5.81±0.19	5.75±0.23
The first day	6.81±0.25	6.67±0.22	6.60±0.23	6.59±0.21
The fifth day	6.96±0.30	6.69±0.23	6.62±0.21	6.43±0.22 *
The tenth day	7.25±0.35	6.63±0.25 *	6.57±0.22 *	6.05±0.20 *
The fifteenth day	7.52±0.30	6.61±0.23 *	6.51±0.20 *	5.98±0.20 *
The twentieth day	7.67±0.34	6.34±0.22 *	6.19±0.19 *	5.86±0.21 *
The thirtieth day	7.81±0.38	6.16±0.20 *	6.05±0.19*	5.80±0.23 *

As can be seen from this table, the level of DC in the blood of bulls, which were given methyphen on the first day of the experiment, was 6.67±0.22 µmol/l, which is 15% higher than the initial values and 2% lower than the control values-groups of animals. On the fifth day, the level of DC in the blood of the E₁ group decreased by 4% relative to the C group's values. On the tenth day, this indicator decreased by 9%. On the fifteenth day, the level of DC felt by 12%. On the twentieth day, the intermediate peroxidation products' level was 6.34±0.22 µmol/l. On the thirtieth day, the diene conjugates' level felt by 21% relative to the C group.

The use of Vitamix Se in the E₂ group contributed to a more likely reduction in the level of diene conjugates than the use of methyphene. In the blood of animals, it was lower than in the E₁ group throughout the experiment. Thus, compared with the C group, the level of the studied indicator on the fifth day decreased by 5%, on the tenth day - by 9%, on the fifteenth day - by 13%, on the twentieth day - by 19% respectively.

However, the use of the above drugs did not reduce the level of intermediates to the limits of physiological norms, so the combined use of these drugs contributed to better neutralization of lipid peroxidation products. The level of DC in the blood of the E₃ group compared to other groups was the lowest, where it ranged from 6.59±0.21 to 5.80±0.23 µmol/l, respectively. The diene conjugates' level in experimental bulls' blood fluctuated within the physiological norm from the twentieth day. It was lower than the C group of animals by 24 and 26%, respectively.

Therefore, the combined use of methyphene and Vitamix Se in animals under conditions of nitrate-cadmium loading prevents the formation of intermediate products of lipid peroxidation in animals' blood.

The second important factor is the study of the final products of lipid peroxidation - malonic dialdehyde. Table 2 shows the changes in this indicator in the blood of bulls under conditions of chronic nitrate-nitrite toxicosis with cadmium load and the effect of antioxidant drugs: methyphene and Vitamix Se.

Table 2

The level of malonic dialdehyde in the serum of bulls after the introduction of methyphene and Vitamix Se in chronic nitrate-nitrite toxicosis with cadmium load (M±m, n=5)

Blood test time (days)	Malonic dialdehyde (µmol/l)			
	Groups of animals			
	Control (nitrates + cadmium)	Experimental 1 (nitrates + cadmium) methyphen	Experimental 2 (nitrates + cadmium) Vitamix Se	Experimental 3 (nitrates + cadmium) methyphene + Vitamix Se
The initial values	0.233±0.010	0.235±0.010	0.240±0.009	0.239±0.011
The first day	0.264±0.011	0.262±0.011	0.263±0.012	0.260±0.010
The fifth day	0.277±0.012	0.260±0.010 *	0.259±0.010 *	0.256±0.011 *
The tenth day	0.286±0.011	0.263±0.011*	0.261±0.010*	0.251±0.011*
The fifteenth day	0.292±0.012	0.258±0.010*	0.254±0.011*	0.248±0.009*
The twentieth day	0.299±0.011	0.251±0.009*	0.249±0.010*	0.244±0.011*
The thirtieth day	0.310±0.013	0.252±0.011*	0.250±0.009*	0.244±0.010*

When feeding animals sodium nitrate at a dose of 0.15 g NO₃⁻/kg body weight and cadmium chloride at a 3.0 mg/kg dose, was found an increase in MD from the first day of the experiment, where it raised by 13%

compared to baseline. On the fifth day, the malonic dialdehyde level was 0.277±0.012 µmol/l. On the tenth day, the level of lipid peroxidation products continued to increase. On the twentieth day, it grew by 28%, on the thirtieth day - by 33% relative to the initial data.

The use of methyphene and Vitamix Se in bulls of the E₃ group helped reduce lipid peroxidation's final product. When comparing experimental groups with the control, it was found that on the fifth day of the experiment, the MD level decreased by 6, 6.5, and 7.6%, respectively. On the tenth day in the blood of the E₁ group, the level was 0.263±0.011 μmol/l, in the E₂ group, the level was 0.261±0.010 μmol/l, in the E₃ group, the level of MD was 0.251±0.011 μmol/l. On the fifteenth day of the experiment, the level of malonic dialdehyde continued to decrease relative to the values of the C group. This figure felt in animals treated with methyphene - by 12%, in animals treated with Vitamix Se - by 13%, and in bulls treated with methyphene. Together with Vitamix Se reduced by 15%. On the twentieth and thirtieth days in the blood of bulls of all experimental groups again noted a decrease in the level of MD and reached the physiological values.

It should be noted that the combined use of methyphene and Vitamix Se in animals with chronic nitrate-nitrite toxicosis with cadmium loading contributed to a better reduction of the final products of lipid peroxidation.

Summing up the results of the research, we came to the following **conclusions**:

- the use of methyphene and Vitamix Se in the development of chronic nitrate-nitrite toxicosis of bulls with cadmium load contributed to the reduction of intermediate and final products of lipid peroxidation, namely diene conjugates and malonic dialdehyde;

- at nitrate-cadmium loading of bulls, the best effect on inhibition of processes of peroxidation of lipids of an organism of animals was shown by the combined use of metifen and Vitaminx Se.

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[DOI: 10.24412/2520-6990-2021-794-18-21](https://doi.org/10.24412/2520-6990-2021-794-18-21)

THE EFFECT OF BENDAMINE ON ANTIOXIDANT PROTECTION OF RATS' MYOCARDIUM IN DOXORUBICIN INTOXICATION

Abstract.

The study aimed to investigate the effect of the remedy "Bendamine" on rats' antioxidant status in experimental doxorubicin-induced cardiomyopathy. The research was performed on white sexually mature young male Wistar rats weighing 180-200 g. Animals were divided into three groups of six rats each: control group - intact; experimental group E₁ - doxorubicin was applied intraperitoneally at a dose of 2.5 mg/kg 3 times a week for two weeks; experimental group E₂ - in case of doxorubicin intoxication, the drug "Bendamine" was administered intragastrically at a dose of 20 mg/kg. The action of doxorubicin and the development of the hypoxic state in rats are accompanied by activation of oxidative stress and enhancement of free radical processes. It was indicated by

increased levels of intermediate and end products of lipid peroxidation and inhibition of antioxidant defense. There was a 32.7% increase in diene conjugates and a 37.6% increase in TBA-active product in rats' control groups. After application to rats, it was also found that doxorubicin causes inhibition of the glutathione system of antioxidant protection of animals. The use of the remedy "Bendamine" in the E₂ group contributed to the strengthening of the enzymatic and non-enzymatic parts of the antioxidant system, protecting the structural and functional integrity of cell biomembranes. The medicine "Bendamine" inhibits the excessive formation of LPO products in pathologically altered tissues of rats' hearts. In the E₂ group, the level of intermediate and final products is probably reduced. In the E₂ group, the myocardial homogenate, the level of diene conjugates decreased by 16.8% also the level of TBA-active products - by 20.8% compared to the E₁ group-had characteristic clinical signs of cardiomyopathy caused by doxorubicin.

Keywords: pharmacology, drug "Bendamine," doxorubicin, rats, cardiovascular insufficiency.

Introduction

Cardiovascular pathologies in dogs and cats are incredibly diverse and common in daily practice in Ukraine and abroad. According to the classification of Professor G.V. Domracheva, in domestic animals, cardiovascular pathology is divided into myocardial, pericardial, endocardial, and vascular diseases. There is a close relationship between the above pathologies, age, and animal breeds [4, 6, 10, 11].

Heart failure in dogs can be both a congenital disability and acquired as a result of infection. This pathology occurs mainly in elderly dogs. With heart failure in dogs, the heart cannot fully perform its physiological functions and provide the body with normal blood circulation. Accordingly, it leads to stagnation and deterioration of blood supply to organs, leading to pathological myocardium changes. [2, 3]. Analyzing domestic and foreign researchers' data, the development of the easy-to-use and safe complex cardiac drug, the use of which will increase the effectiveness of treatment of animals and a wide range of cardiovascular pathologies, is timely and relevant to research for veterinary medicine [5, 7, 8].

The study aimed to investigate the effect of the drug "Bendamine" on the antioxidant protection of rats' myocardium in experimental modeling of heart failure.

Material and methods of research

The study was performed on white sexually mature young male Wistar rats weighing 180-200 g, which were kept on the standard diet of the institute vivarium of the State Scientific-Research Control Institute of Veterinary Medicinal Products and Feed Additives. Throughout the research, the rats were kept on a balanced diet containing all the necessary components; the animal's drinking water was obtained without restrictions from glass drinking bowls with a volume of 0.2 liters.

Experimental studies were conducted by the drug-biological experiment requirements to select analogs, control, compliance with the same conditions of feeding and maintenance during the research, and accounting for the results.

Twenty-four male rats were selected to create a model of doxorubicin-induced cardiomyopathy. Animals were divided into three groups of 6 rats each: control group - intact; experimental group E₁, in which rats

were simulated doxorubicin-induced cardiomyopathy by intraperitoneal administration of doxorubicin at a dose of 2.5 mg/kg 3 times a week for two weeks; experimental group E₂, in which animals after injection of doxorubicin were intragastrically applied the drug "Bendamine" at a dose of 20 mg/kg.

The content of LPO products - diene conjugates and TBA-active products, the activity of antioxidant enzymes - glutathione peroxidase and glutathione reductase, and the level of reduced glutathione, were determined by methods [9].

All animal manipulations were performed under the European Convention for the Protection of Vertebrate Animals Used for Experimental and Scientific Purposes (Strasbourg, 1986).

The analysis of research results was carried out using the software package Statistica 6.0. The student's t-test assessed the probability of differences. The results were considered plausible at $P \leq 0.05$.

Results and discussion

The obtained data indicate that doxorubicin's administration to the experimental groups is accompanied by an intensification of free radical oxidation processes in the myocardium. Thus, based on the conducted researches, the growth of intermediate and final products of LPO was established, namely the increase of diene conjugates by 32.7% and TBA-active products - by 37.6% compared with the control group of rats (Table 1). Oxidative damage to proteins leads to disruption of cardiomyocyte metabolism. Thus, under conditions of intensification of free radical oxidation, was suppress the antioxidant system's enzymatic link, thus intensifying oxidative stress in the myocardium [1]. The negative effect of oxidative-modified proteins in the cell is apparently because oxidized proteins act as a source of free radicals that deplete cellular antioxidants' supply.

An increase in the amount of TBA-active products in the myocardium of rats under the influence of doxorubicin indicates myocardial depletion of polyunsaturated fatty acids, which are the main substrate for lipid peroxidation. The myocardium loses the primary source of prostaglandin synthesis necessary for its normal functioning and plays an essential role in myocardial adaptation processes to stress.

Table 1

Indicators of lipid peroxidation intensity in rat myocardial homogenate in experimental modeling of heart failure and action of the drug "Bendamine" (M ± m, n = 6)

Indicators	Groups of animals		
	Control	Experimental 1	Experimental 2
Diene conjugates, μmol/g	6.45 ± 0.13	8.56 ± 0.39*	7.12 ± 0.22*
TBA-active products, mmol/g	30.79 ± 4.50	42.36 ± 2.11*	33.57 ± 2.47

After applying the drug "Bendamine" to rats of the E₂ group, inhibition of lipid peroxidation processes under doxorubicin intoxication conditions was found. In the E₂ group, the level of intermediate and final products is probably reduced. In the myocardial homogenate, the diene conjugates' level decreased by 16.8%. The level of TBA-active products - by 20.8% compared to the E₁ group-had characteristic clinical signs of cardiomyopathy caused by doxorubicin.

Thus, the remedy "Bendamine" inhibits the excessive formation of LPO products in pathologically altered tissues of the heart of rats, has an inducing effect

on the antioxidant defense system, thus protecting the structural and functional integrity of cell biomembranes.

Studies have shown that doxorubicin causes inhibition of the glutathione system of rats' antioxidant defense in the E₁ group. Thus, the level of reduced glutathione in the animals' myocardial homogenate of the E₁ group probably decreased by 45.3%. In comparison, glutathione reoxidase and glutathione reductase activity decreased by 26.1 and 33.3%, respectively, compared with the rats' control group (Table 2).

Table 2

Indicators of the antioxidant defense system in rats' myocardial homogenate in experimental modeling of heart failure and the action of the drug "Bendamine" (M ± m, n = 6)

Indicators	Groups of animals		
	Control	Experimental 1	Experimental 2
Reduced glutathione, μmol/g	0.53 ± 0.08	0.29 ± 0.05*	0.39 ± 0.05*
Glutathione peroxidase, nmol/min × mg protein	6.81 ± 0.79	5.03 ± 0.54*	6.37 ± 0.37
Glutathione reductase, μmol/min × mg protein	0.57 ± 0.11	0.38 ± 0.12*	0.51 ± 0.10

The use of the remedy "Bendamine" in rats of the E₂ group under doxorubicin cardiomyopathy conditions contributed to the activation of the glutathione link of the myocardium antioxidant system. The level of reduced glutathione in the myocardial homogenate of the E₂ group ranged from 0.39 ± 0.05 μmol/g.

After studying glutathione peroxidase activity in the experimental groups in the myocardium, it was highest in the E₂ group. This enzyme activity was correspondingly higher by 26.6% relative to intoxicated rats not treated by the remedy "Bendamine".

Glutathione reductase activity was also higher in the E₂ group, where it was 0.51 ± 0.10 μmol/min × mg of protein. In contrast, this figure was 0.38 ± 0.12 μmol/min × mg of protein in the E₁ group.

Thus, based on studies of the effect of the drug "Bendamine" on the antioxidant system of the myocardium of experimental rats under doxorubicin intoxication, it was found that the newly developed remedy has a corrective effect under oxidative stress inherent in doxorubicin-induced cardiomyopathy. The studies' results enrich the pharmacological characteristics of the drug "Bendamine," indicate its rather pronounced protective effect on the myocardium in experimental doxorubicin cardiomyopathy, and is a convincing proof of the feasibility of the drug in veterinary practice.

Conclusions

The action of doxorubicin and the development of the hypoxic state in rats are accompanied by activation of oxidative stress and enhancement of free radical processes, as indicated by increased levels of intermediate

and end products of lipid peroxidation, as well as inhibition of antioxidant defense.

The use of the drug "Bendamine" in rats of the E₂ group contributed to the strengthening of the enzymatic and non-enzymatic parts of the antioxidant system, protecting the structural and functional integrity of cell biomembranes.

The remedy "Bendamine" inhibits the excessive formation of LPO products in pathologically altered tissues of rats' hearts.

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AGRICULTURAL SCIENCES

УДК 332.142.6

*Кравчуненко А.Р., Воронцова Е.А.**Кубанский Государственный Аграрный Университет ИМ. И. Т. Трубилина***ШЕЛУХА ПОДСОЛНЕЧНИКА, КАК СРЕДСТВО ПОДДЕРЖАНИЯ ИСКУССТВЕННОГО ВОДОЕМА***Kravchunenko A.R., Vorontsova E.A.**Kuban State Agrarian University named after I. T. Trubilina***SUNFLOWER HUSK AS A MEANS OF MAINTAINING ARTIFICIAL WATER****Аннотация**

Возможность использования целлюлозных каркасов, как средство поддержания формы искусственного водоема и его внутреннего единства. Технология внедрения таких укреплений требует тщательного изучения изменения свойств и качества воды в водоеме, а также его трофности. Самым простым и быстрым методом для определения трофности является биотический индекс Майэра. При помощи этого индекса проводился «легкий мониторинг» состояния водоема..

Abstract

The possibility of using cellulose frames as a means of maintaining the shape of an artificial reservoir and its internal unity. The technology of introducing such fortifications requires a thorough study of changes in the properties and quality of water in a reservoir, as well as its trophicity. The simplest and fastest method for determining trophicity is the Mayer's biotic index. This index was used to "lightly monitor" the state of the reservoir.

Ключевые слова: искусственный водоем, укрепление, поддержание, мониторинг, биотический индекс, целлюлоза, лигнин, сельское хозяйство.

Key words: . artificial reservoir, strengthening, maintenance, monitoring, biotic index, cellulose, lignin, agriculture

Шелуха от семян подсолнечника является ценным ресурсом. Она используется в основном для улучшения минерального состава почв на огородных участках и на больших фермерских угодьях. В связи с обилием минеральных компонентов в своем составе является хорошим удобрением, значительно увеличивающим урожаи сельскохозяйственных культур. Основная ценность ее свойств заключается в наличии целлюлозы. Основным действующим компонентом целлюлозы является лигнин, который благодаря своей структуре образует прочный каркас, такой каркас называется ультроструктурой. Свойства каркаса из шелухи можно сравнить со свойствами каркаса из железобетона. Место структурной составляющей каркаса занимает целлюлоза, а лигнин, расположенный на ней обладает высокой прочностью на сжатие.

Такой каркас, предполагается, будет положительно влиять на живое сообщество водоема. В качестве действующего вещества лигнин является хорошим адсорбентом вредных веществ и одновременно может помочь восстановить недостаток растительного вещества в относительно молодых водных сооружениях. Которые еще не восстановили регулирующие свойства.

Было проведено исследование на одном из водных объектов. Опытный объект - пруд, созданной на основе балки древовидной системы. Расположен в условия степной зоны Краснодарского края с умеренным климатом. Максимум осадков

здесь наблюдается в середине лета, а максимальный уровень воды приходится на весенний период паводков. Водный объект имеет две подпруженные части, отделенные между собой дамбой. Максимальная глубина обеих частей около 3 м, наиболее широкая часть – у дамбы, 6 м. В течение года пруд подвергался технической очистке от донных отложений. За весь процесс очистки сократили зарастание пруда тростником практически к 15% (ранее зарастание насчитывало около 38% от общей площади пруда).

Такой технический процесс, как механическая очистка является достаточно резким для естественной системы, что в свою очередь становится естественным препятствием на пути поддержания водоемом его внутренней устойчивости. Процессы восстановления в водном объекте, по сравнению с наземными системами, происходят гораздо быстрее, благодаря чему нам и удалось пронаблюдать все необходимые тенденции за достаточно небольшой срок. На внешнюю дамбу, вниз по течению, была вывезена насыпь из шелухи подсолнечника, когда же, верхняя часть водного объекта никакого внешнего воздействия после технической очистки не было. В течение последующих нескольких лет проводились регулярные сезонные и внутри сезонные исследования по оценке трофности водоема. Внутрисезонные исследования требуются для усреднения и подтверждения единого показателя. Трофность оценивали по биотическому индексу Майэра. Данный индекс позволяет быстро оценить

трофность водоема, не прибегая к лабораторным анализам. Однако он имеет высокую погрешность, поэтому выводился средний показатель из 5 проб.

Результаты первого семестра наблюдений показали, что по биотическому индексу Майэра обе части водоема относятся к классу загрязненных вод, однако, значение в конце семестра в 10 баллов по индексу свидетельствует о том, что состояние водоема стремительно приближается к бета-мезосапробной зоне. Второй и третий семестр наблюдений показал, что состояние нижней части пруда имеет большую скорость изменения. Баллы в конце семестра составили 11 и 14 баллов у верхней части и нижней части пруда по течению соответственно.

Особое внимание следует обратить на то, в каком темпе идет нарастание количество живого вещества водоема. Насыщенность кислородом в нижней части водоема с насыпью шелухи составляет около 85%, что почти на 20% превышает показатель второй части объекта. Третий семестр выводит верхнюю часть водного объекта к бета-мезосапробной зоне (13 баллов по шкале Майэра). Эта часть водоема только начинает насыщать свои воды кислородом и наращивать биомассу. Когда в другой части спадает нарастание и начинает прорисовываться некоторое подобие баланса, четвертому семестру наблюдений эти процессы окончательно стабилизировались.

Таким образом наблюдения показали, что использование шелухи подсолнечника в качестве средства поддержания искусственного водоема вполне реально. Как и было предположено ранее шелуха не только может стать заменой железобетонному каркасу для укрепления берегов и дамб

водного объекта, но и быть источником органического вещества, необходимого водоему для восстановления баланса после технического вмешательства. Несомненно, на процессы восстановления в пруду влияет огромное множество факторов и исследования проведенные при помощи биотического индекса в реальных условиях не являются на 100% указывающими на причинно-следственные связи. Однако даже столь простой и короткий мониторинг позволил доказать предложенную гипотезу.

Однако при внесении избыточного количества шелухи при промывном водном режиме может возникнуть опасность чрезмерного накопления органики и сукцессии водоема. Это может в конце поменять не только внешний вид водного объекта, но и привести к гибели его обитателей и смене видовых сообществ территории. В таком случае имеет место быть опытное использование укрепления шелухой, с постоянным контролем ее влияния на водоем.

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THE INFLUENCE OF PLANT COLLECTION OF SARASM ON SOME BIOCHEMICAL INDICATORS OF THE LIVER IN A CHRONIC EXPERIMENT.

Since the second half of the twentieth century, various types of interferon obtained from the composition of human leukocytes or by genetic engineering from distinct strains of microorganisms are widely used in world hepatology and oncology as an immunostimulating, hepatoprotective, antiviral and anti-cancer agent [1-4].

The disadvantages of interferon-containing drugs are that they are expensive, capable, similar to the same antibiotics, or obtained synthetic drugs, to cause a lot of side effects from the liver, kidneys, hematopoietic and other internal organs [5]. It has been proven that many medicinal plants, including *Rhodiola rosea* and other plant adaptogens, have an interferon-stimulating effect [6].

The advantage of these natural remedies is that they are cheap, available to a wide range of patients, and safer.

The creation of safe interferon-stimulating phytopreparations capable of replacing expensive lymphocytic and bacterial interferons is considered a promising and urgent direction for the pharmacology of the 21st century [7]. The search for interferon-stimulating medicinal plants and the creation of natural stimulants of interferon on their basis requires extremely energetic and coordinated searches with the participation of experienced botanists, biologists, phytochemists, and especially pharmacologists.

Since the second half of the twentieth century, active searches have been carried out in Tajikistan to develop new hepatoprotective phytopreparations based on local medicinal plants [8]. increasing the liver's resistance to pathological influences - enhancing its detoxifying function by increasing the activity of its defense mechanisms, as well as helping to restore its functions in case of various injuries.

Herbal remedies due to the content of a complex of biologically active substances, i.e. complexes of such compounds as phenolic compounds, flavonoids, essential oils, vitamins, organic acids, macro and microelements and dozens of other compounds exhibit active hepatoprotective, antioxidant, membrane stabilizing, anti-inflammatory, choleric, antispasmodic and hypoglycemic properties.

Flavonoids, due to their chemical structure, have broad medicinal properties. They have an active anti-

inflammatory, antioxidant, antitoxic capillary stabilizing, antitumor, diuretic, hypoglycemic effect, play an important role in the prevention of violations of the structure and function of the liver in various pathological conditions. Other authors have established that some flavonoids strengthen the walls of blood vessels and reduce their permeability. Some of them have a tonic effect and accelerate the body's adaptation to heavy physical activity.

Currently, on the basis of individual flavonoid-containing medicinal plants, such hepatoprotective drugs as legalon, carsil, silibor and others have been created, which are widely used in modern hepatology.

Based on the relevance of modern herbal hepatoprotective drugs and their importance for modern hepatology and medicine in general, we were faced with the task of studying the hepatoprotective effect of Sarazm tincture.

Material and research methods. Subacute liver damage was chosen as a model of hepatitis. With the help of carbon tetrachloride (CCl₄), which is considered a potent hepatotoxin and is widely used to obtain an experimental model of hepatitis. To compare the therapeutic effect, the drug Carsil was chosen. Carsil largely protects the liver from pathological changes in the structure and enzymatic activity, has a detoxifying effect, has properties similar to a routine, which has a specific hepatoprotective effect.

The experiments were carried out on 75 sexually mature outbred white rats of both sexes, with an average weight of 190-220 g. The animals were divided into the following 5 series: 1 - intact, receiving intragastric saline under vivarium conditions daily for 30 days at a rate of 2 ml / kg masses; 2 - control, untreated rats that received CCl₄ subcutaneously at the rate of 2 ml / kg of weight mixed with cottonseed oil (1: 1) 3 times a week subcutaneously for 1 month; 3 and 4 - experimental animals that received for 1 month according to the same scheme CCl₄ and daily intragastrically dealcoholized tincture "Sarazma", respectively, in doses of 2 and 5 ml / kg of weight; 5 - rats that received CCl₄ according to the same scheme and were treated for 1 month with Carsil administered daily intragastrically at the rate of 50 mg / kg of weight.

Table 1.

Survival of animals treated with tincture, Pamiro-Alai (SARASM) (1: 5) with subacute hepatitis CCl₄

Series of experiments and doses per kg mass Initial number of rats Survived	Initial number of rats	Survived Number in%		Killed Number in%	
Intact fiziol. rast. 2 ml	12	14	93,3%	1	6,7%
Control CCl ₄ 2 ml s / c every other day		6	40%	9	60%
CCl ₄ 2 ml s.c. according to the scheme SARASM 2 ml daily for 1 month.		9	60%	6	40%
CCl ₄ 2 ml s.c. according to the SARASM scheme 5 ml daily for 1 month.		9	60%	6	40%
CCl ₄ 2 ml s / c according to the scheme Karsil 50 mg / kg daily for 1 month.		8	53,3%	7	46,7%

In the process of subacute intoxication of the organism with CCl₄, severe disturbances in the enzyme-forming function of the liver occurred (Table 2). In untreated animals, the activity of ALT increased by 35.5%

(P <0.001), AsAT by 35.3% (P <0.001), silk phosphatase by 49.4% (P <0.001), and the activity of 5-HT by 62.7% (P <0.001).

table 2

Influence of tincture (SARASM) (1: 5) on enzymatic activity in subacute CCl₄ hepatitis. An average of 6 to 14 rats per batch.

Series of experiments and doses per kg of mass	P r o c a t e M m P<			
	АлАТ Е/Л	АсАТ Е/Л	Щелочная Е/Л	ЛДГ нмоль/л
Intact fiziol. rast. 2 ml	40,0±0,04	22,3±0,07	353,6±0,03	220,1±0,05
Control CCl ₄ 2 ml s / c every other day	<u>153,1±0,03</u> 0,001* 35,5%**	<u>134,3±0,02</u> 0,001 95,3%	<u>528,5±0,04</u> 0,001 49,4%	<u>358,2±0,03</u> 0,001 62,7%
CCl ₄ 2 ml s.c. according to the scheme SARASM 2 ml daily for 1 month.	<u>86,9±0,5</u> 0,01 33,6%***	<u>83,5±0,05</u> 0,05 22,4%	<u>410,1±0,04</u> 0,05 -22,4%	<u>274, ±00,05</u> 0,05 -23,5%
CCl ₄ 2 ml s.c. according to the SARASM scheme 5 ml daily for 1 month.	<u>58,6±0,5</u> 0,01 - 35,1%	<u>53,8±0,08</u> 0,01 -30,0%	<u>403,0±0,07</u> 0,01 -23,6%	<u>254,1±0,06</u> 0,05 -29%
CCl ₄ 2 ml s / c according to the scheme Karsil 50 mg / kg daily for 1 month.	<u>62,5 ±0,03</u> 0,02 - 36,2%	<u>60,0±0,03</u> 0,02 -26,3%	<u>407,2±0,04</u> 0,01 -22,9%	<u>254,1±0,04</u> 0,01 -20,6%

Note: * - the P value for the control batch is given in comparison with the intact batch, for the experimental batch it is given in comparison with the indicators of the control batch; ** - as a percentage in relation to the intact series; *** - as a percentage in relation to the indicators of the control series

Tincture Sarazm administered intragastrically at doses of 2 and 5 ml / kg body weight for 1 month markedly prevented the consequences of the hepatotoxic effect of CCl₄.

Tincture Sarazm administered intragastrically at doses of 2 and 5 ml / kg for 1 month significantly prevented the consequences of the hepatotoxic effect of CCl₄.

As a result of the course of treatment carried out with the help of Sarazm (at a dose of 5 ml / kg of body weight) in the blood serum of experimental animals, the level of the studied enzymes increased under the influence of CCl₄ decreased: ALT by 35.1% (P <0.001), AST by 30.0 % (P <0.001), WF by 23.6% (P <0.05), 5 NT by 29.0% (P <0.05). Under the influence of SARASM, administered according to the same scheme at a dose of 2 ml / kg of body weight, statistically significant positive results were also obtained for all studied parameters. The ALT level decreased by an average of 33.6%, AST by 22.4%, ALP decreased by an average of 22.4%, and LDH by 23.5%.

Carsil administered according to the same scheme at a dose of 50 mg / kg body weight for 30 days also caused a noticeable decrease in the level of the studied enzymes. ALT level decreased on average by 36.2% (P <0.02), ALT level by 26.3% (P <0.02), ALP level by 22.9% (P <0.01) and 5 NT by 20 , 6% (P <0.01).

Subacute intoxication of CCl₄ animals caused an increase in the content of bilirubin and cholesterol in the blood serum of control rats (Table 3)

In experimental rats treated with Sarazm tincture at doses of 2 and 5 ml / kg body weight for 30 days, the bilirubin content, respectively, averaged 5.6 ± 0.03 and 5.8 ± 0.05 nmol / L versus $7.6 \pm 0, 03$ nmol / l in the control series, which on average this difference was 26.3%. The cholesterol content in the experimental animals increased only by 21.4%, while the content of B-lipoproteins decreased by 18.0%. The total protein in serum in all series did not differ from the control series.

Sarazm tincture, administered intragastrically for 30 days, contributed to a significant decrease in the increased concentration of bilirubin under the influence of CCl₄, the activity of transaminase enzymes (ALT

and ASAT), alkaline phosphatase, LDH in blood serum. Did not have any effect on protein-nitrogen metabolism in subacute hepatitis (CCI).

Flavonoids are capable not only of neutralizing free radicals, but at the same time can interact with other inhibitors and restore the activity of a stronger inhibitor. As a result, the "consumption" of endogenous antioxidants in the body decreases, which contributes to a more rational use of the internal reserve of antioxidants (Kudrin A.N., Skakun N.P., 1996).

Sarazm's tincture has an active hepatoprotective effect, the mechanism of which is associated with a high content of selenium in its composition, and possibly with the manifestation of interferon stimulating properties.

The results obtained allow Sarazm to be recommended as an auxiliary hepatoprotective agent in combination with other hepatoprotective drugs.

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ANTIOXIDANT SYSTEM OF RATS BY THE INFLUENCE OF COMPOSITION OF BACTERIA ISOLATED FROM TRADITIONAL CARPATHIAN CHEESE BRYNDZA**Abstract.**

The article presents data on the study of the effect of the composition of probiotic strains of *L. lactis*, *Lb. plantarum* and *E. durans* SB18 in a ratio 50:40:10 on some indicators of the antioxidant defense system of white rats. In particular, the use of the tested composition caused an inhibitory effect on the intensity of lipid peroxidation processes, which in turn led to decrease of TBA-active products and lipid hydroperoxides. It was found that on the 14th day of the experiment the content of TBA-active products and lipid hydroperoxides decreased by – 6.1 and 4.1% respectively and on the 21st day of the experiment – by 14.9 and 22.1% ($p < 0.01$).

In determining the content of products of oxidative modification of proteins (OMP), which characterize the oxidative damage of various components of the cell, a slight decrease in the concentration of OMP₄₃₀ and OMP₃₇₀ was noted throughout the experiment. Under these conditions, was established the activation of metabolic processes, which indicated by an increase in superoxide dismutase activity (SOD) on 14 and 21 day of the experiment by 6.3 and 9.6% respectively ($p < 0.05$).

In addition, an increase of humoral defense factors of laboratory animal was found, in particular on the 21st day of the experiment the serum lysozyme activity increased by 9.1%, and the level of circulating immune complexes (CICs) decreased by 14%.

Keywords: antioxidant defense system, *E. durans*, *L. lactis*, *Lb. plantarum*, lipid peroxidation processes, TBA-active products

Introduction

Contravention of the balance between endogenous and pathogenic microflora causes functional disorders of the digestive system, which can be the reason of disorders of psycho-emotional state and an increased sensitivity to the stress [1]. Given this, dysbacteriosis and stress conditions mutually reinforce each other, which generally causes a violation of homeostasis of the macroorganism. In this case, in the body occurs excessive immunoreactivity, and in the tissues activation of lipid peroxidation and also when the functional interaction between the immune and hypothalamic-pituitary systems is disrupted [2, 3]. It is confirmed, that under stress conditions the processes of peroxide oxidation in the body intensify [4].

It was found, that one of the mechanisms of the action of probiotics is their restoration of pro- and antioxidant balance. The obtained results indicated on the effectiveness of combined probiotics in the prevention of stress-induced lesions [5-7]. The therapeutic effect of lactic acid bacteria is also provided with their rapid colonization of the gastric mucosa [8].

Considering the literature data about the antioxidant properties of probiotics [9], the studies were conducted to determine their effect on the lipoperoxidation processes, in particular were found decrease in the concentration of DC after 14 days of administration of combination of lactic acid bacteria, and also was observed decrease of TBA-active products and catalase activity in comparison to the control group of rats [5, 10].

For more detailed study of the effectiveness of new probiotic strains of microorganisms a topical issue is research directed on studying the antioxidant protection of the macroorganism. So the aim of this work was

to study the effect of the developed composition of lactic acid bacteria [11] which were isolated from traditional Carpathian cheese bryndza [12] on some indicators of the antioxidant protection system of white rats.

Materials and methods.

Determination of the influence of the studied composition of the consortium of lactic acid bacteria on the antioxidant defense system was performed on white rats, Wistar line, body weight 160–180 g. For this purpose, was formed control and experimental group of animals, with six animals in each group. Animals of the first (control) group were administered isotonic sodium chloride solution, animals of the second group – a composition of probiotic strains of *L. lactis*, *Lb. plantarum* and *E. durans* SB18 in a ratio of 50:40:10 at a dose of 1 cm³ ($1 \cdot 10^7$ CFU/cm³) per animal. The tested compositions were administered intragastrically by using a metal probe for 21 days. After that, under light ether anesthesia, the animals were decapitated and blood and tissues were taken for research. The level of intensity of oxidative destruction of proteins was evaluated by the reaction of the obtained carbonyl derivatives of the amino acid reaction with dinitrophenylhydrazine, as described in Levine et al. [13]. Lysozyme activity of blood serum was determined by nephelometric method [14]. Determination of the content of circulating immune complexes (CICs) in the serum was performed according to the method of Grinevych Yu. A. et al. [15]. The concentration of TBA-active products in blood plasma was determined by the method of Korobeinykov E. N. [16].

Determination of superoxide dismutase activity was performed according to the method of Dubynyna E. E. et al. [17]. The content of lipid hydroperoxides in

plasma blood was determined by the method described by Myronchik V. V. [18].

Results and discussion.

The use of a composition of lactic acid bacteria *L. lactis*, *Lb. plantarum* and *E. durans SB18* throughout the experiment caused an inhibitory effect on the intensity of lipid peroxidation processes, which led to the decrease of the content of TBA-active products and lipid hydroperoxides (Table 1). In particular, on the 14th day of the administration of consortium of lactic acid bacteria the content of TBA-active products and lipid

hydroperoxides decreased by 6.1 and 4.1%, respectively, and on the 21st day – by 14,9 and 22.1% ($p < 0.01$). Because lipid peroxidation is a physiological process and represent the degree of influence of molecular oxygen on mitochondrial lipids under normal physiological conditions and is determined by the ability to regulate the structural and functional state of membranes [19], the detected changes may indicate on enhanced antioxidant and detoxification properties of lactic acid bacteria.

Table 1

Indicators of lipids peroxidation in plasma blood of rats

Parameters	14 day		21 day	
	Control	Experiment	Control	Experiment
TBA-active products, nmol/ml	4.459±0.29	4.184±0.32	3.966±0.40	3.374±0.09
Lipid hydroperoxides, OdE/ml	2.18±0.08	2.09±0.12	2.26±0.06	1.76±0.012**

Note: ** - $p < 0.01$

An extremely important enzyme of antioxidant protection of the body is superoxide dismutase (SOD), which is the primary line of defense against oxidative damage and provides interruption of chains in oxygen-dependent of free-radical reactions [20].

In the determining the activity of SOD (Table 2) it was found out, that the use of the studied composition of lactic acid microorganisms for 14 days caused its increased by 6.3%, and on the 21st day of the experiment this figure was probably higher by 9.6% ($p < 0.05$). Therefore, an increase of SOD activity may indicate on the activation of metabolic processes, in particular, an increased demand for O₂, and an increased generation of active form of oxygen.

The evaluation of oxidative damage of various components of the cell was carried out on the content of products of oxidative modification of proteins (OMP). It should be noted that OMP is one of the earliest and most reliable indicators of tissue damage, as OMP derivatives are stable [21, 22, 23]. That is why we studied the effect of the studied composition of lactic acid bacteria on OMP. As can be seen from the data in Table 2, long-term administration of a consortium of lactic acid bacteria caused a slight decrease in OMP₄₃₀ and OMP₃₇₀, which is likely to indicate an inhibitory effect of the test composition on the processes of OMP.

Table 2

SOD activity and content of products of oxidative modification of proteins

Parameters	14 day		21 day	
	Control	Experiment	Control	Experiment
SOD (U/ml)	4.13±0.26	4.39±0.13	4.18±0.11	4.58±0.03*
OMP ₄₃₀ (µM/ml)	3.68±0.13	3.36±0.10	3.57±0.11	3.51±0.09
OMP ₃₇₀ (µM/ml)	0.78±0.021	0.75±0.029	0.79±0.025	0.75±0.017

Note: ** - $p < 0.05$

In determining the influence of the studied composition on humoral defense factors (Table 3), it was found, that on the 14th day of the experiment, the lysozyme activity of blood serum increased only by 0.8%. At the same time, there was a decrease the level of CICs by 4.9% compared to the values of the control group.

Whereas, on the 21st day of the experiment, the Lysozyme activity an increased by 9.1%, and the level of the CICs decreased by 14%. The detected changes may indicated about an increase in humoral defense factors and normalization of homeostasis.

Table 3

Humoral defense factors in blood serum of rats

Parameters	14 day		21 day	
	Control	Experiment	Control	Experiment
Lysozyme activity, %	35.7±2.33	36.0±1.15	28.7±0.88	31.3±1.45
CICs, mmol/L	41.0±1.0	39.0±3.46	45.0±3.51	38.7±1.86

Conclusions.

1. The use of a consortium of lactic acid bacteria *L. lactis*, *Lb.plantarum* and *E. durans SB18* in a ratio 50:40:10 caused decrease in the content of lipid peroxidation products, TBA-active products, the content of OMP products, which indicated to the an increase in antioxidant properties of the body.

2. Lactic acid bacteria of the formed composition had a positive effect on humoral defens factors of the organism of laboratory animals, in particular on the 21st day of its use lysozyme activity of blood serum increased by 9.1%.

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УДК: 502/504: 631.6.02

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ОРГАНИЗАЦИЯ СИСТЕМЫ АВТОМАТИЗИРОВАННОГО МОНИТОРИНГА РАСХОДОВ ВОДЫ В ОТКРЫТОМ ВОДОТОКЕ

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ORGANIZATION OF THE AUTOMATED MONITORING SYSTEM OF WATER FLOWS IN THE OPEN WATER

Аннотация

С течением времени всё больше и больше процессов производства, контроля состояния доверяют автоматизированным системам. Для мониторинга расходов воды в открытом водотоке также возможна организация системы сбора и обработки фиксируемых значений. Создание такой системы возможно на базе компонентов Arduino.

Abstract

Over time, more and more production processes, condition monitoring rely on automated systems. To monitor water discharge in an open watercourse, it is also possible to organize a system for collecting and processing recorded values. The creation of such a system is possible based on Arduino components.

Ключевые слова: автоматизация, датчики, расход воды, мониторинг.

Key words: automation, sensors, water flow, monitoring.

Методы и способы автоматизации простых или сложных процессов всё больше находят своё место в различных областях производства, контроля состояния, а также регулирования этих процессов. Такая тенденция возникла с развитием научной и технической базы, когда один человек может с помощью пульта управления вживую наблюдать и контролировать ход выполняемой деятельности. В данной статье речь пойдёт о датчиках контроля и мониторинга состояния изучаемого объекта, а также об автоматизированных системах, частью и даже основным звеном которых предстают эти датчики. В частности рассмотрим современные достижения и возможную организацию мониторинга расходов воды в малых водотоках.

Датчики измерения расходов воды (расходомеры) подразделяются на следующие типы:

1. Тахометрические.
2. Электромагнитные полнопроходные.
3. Штанговые электромагнитные.
4. Ультразвуковые.
5. Радарные и лазерные.
6. Счётчики на основе уровнемера.

Так как не все типы расходомеров подходят для измерений в открытых водотоках, выделим лишь те, кто сможет справиться с поставленной задачей. Речь о тахометрических и лазерных типах расходомеров.

Применение радарных и лазерных расходомеров даст наиболее точные результаты при замерах таких гидрологических характеристик, как скорость и расход потока реки, канала или иного водотока. Такие технологии активно применяются в странах Европы и США, они дорогостоящие и зачастую являются секретными, поэтому их тяжело найти в свободной продаже[4].

Тахометрические типы расходомеров применяются повсеместно, в различных производственных системах. Принцип действия датчика прост. Вода, поступающая во входное отверстие известного сечения, вращает установленную внутри вертушку, которая в свою очередь передаёт на устройство мониторинга количество совершённых оборотов. На самом же устройстве, отображающем информацию, количество совершённых оборотов переводится в общепринятые значения - литры или м³. Данный тип датчиков прост в использовании и производстве, а также общедоступен в продаже.

При организации автоматизированной системы мониторинга на открытом водотоке (малой реки) опишем возможность применения тахометрических расходомеров. Система мониторинга состоит из следующих компонентов: датчик расхода воды, процессор, модуль для передачи данных через мобильную сеть, компьютер или монитор для отображения и обработки принятых данных, расчётная программа для автоматизированной обработки и сортировке данных, а также элементы установки и монтажа системы в подготовленном месте или створе. Простым и доступным, как в плане цены так и установки, способом организации описываемой системы может выступить сборная система Arduino. В состав будет входить плата (цена от 500 до 1000руб.), непосредственно сам датчик расхода воды (около 400руб.) и связующие компоненты (провода, модуль связи, защитная капсула и тд.). Готовая система на базе Arduino способна справиться с поставленной задачей[3].

При монтаже системы, для её корректной работы, необходимо выполнить следующие условия:

1. Обеспечить полную гидроизоляцию датчика, платы и соединяющих компонентов (в защитной капсуле, пьезометре и пр.);

2. Надёжно установить датчик в открытом потоке, прикрепив его к штанге или любой твёрдой поверхности (опоры моста, балки и тд.), строго по направлению течения, для получения точных значений.

Наиболее простым способом гидроизоляции датчика может выступить заранее подготовленная капсула, сделанная из неразлагаемого пластика, либо иных материалов. С лобовой стороны располагается входное отверстие для потока воды диаметром равным рабочему диаметру взятого датчика. С тыльной стороны располагается выходное отверстие. Для уменьшения риска сноса капсулы потоком, её нужно выполнить в обтекаемой форме. Выполнение данных условий позволит долго-

срочно и без рисков поломки оборудования своевременно и постоянно получать значения расходов воды, проходящей через датчик. Так как один датчик не сможет измерять весь расход воды в открытом русле, рекомендуется установка сети таких датчиков по всему исследуемому створу. Полученные при этом данные приводятся в общую базу данных и по средним арифметическим значениям на глубинах можно определить расход воды всего створа за короткое время.[1,2]

Для определения расхода воды датчики Arduino уже запрограммированы, т.е. исходный код для них находится в открытом доступе. Например, на рис.1 изображен код счетчика воды на базе сенсора Water flow sensor SEN-HZ21WA.

```

1  volatile int flow_frequency;           // Water flow
2  unsigned int l_hour,f_val;            // Water flow
3  unsigned long ctTime,flow_val,cloopTime; // Water flow
4
5
6  void flow () // Water flow Interrupt function
7  {
8      flow_frequency++; f_val++;
9  }
10 void setup()
11 {
12     Serial.begin(9600);
13     attachInterrupt(1, flow, RISING); sei(); ctTime = millis(); cloopTi
14 }
15 void loop ()
16 {
17     ctTime = millis();
18     if(ctTime >= (cloopTime + 1000))
19     {
20         cloopTime = ctTime;
21         l_hour = (flow_frequency * 60 / 7.5);
22         flow_frequency = 0; // Сброс счётчика
23         Serial.print(l_hour, DEC); Serial.print(" L/hour"); // Литров
24     }
25
26     if(f_val>=450){flow_val++;f_val=0;}
27     Serial.println(flow_val);Serial.println("L"); // Всего литров
28
29 }

```

Рис.1 - Код счетчика воды на базе сенсора Water flow sensor SEN-HZ21WA

Как видим на рисунке, итоговое значение подсчитывается в л/с, но при дополнительном кодировании этого значения расчётная программа может переводить в м³/с.

Система автоматизированного мониторинга расхода воды в открытом водотоке, созданная на основе Arduino, может стать эффективным инструментом в руках гидрологов, прогнозистов, а также собственников объектов ГТС. Непрерывное получение данных о потоке позволит собрать обширную базу данных по объёмам стока на створе, своевременно предупреждать опасные ситуации, связанные с большими расходами воды, и вести грамотную политику в области распределения водных ресурсов.

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[DOI: 10.24412/2520-6990-2021-794-32-36](https://doi.org/10.24412/2520-6990-2021-794-32-36)

CONTROL OF WEEDS IN AGROPHYTOCENOSES OF SOWING PEAS

Summary.

The article contains the results of research of the impact of measures to regulate the number and weight of weeds in agrophytocenoses of sowing peas. It was determined that the quality control of weeds in pea crops was ensured by consistent treatment with the soil preparation Dual Gold (0.8 l/ha) and the insurance one MaxiMox (0.5 l/ha). The destruction of weeds was 91.6% of the natural weed background and reduced the above-ground air-dry mass by 88.9%. In the paper it is scientifically substantiated and proved, that such protection of crops from the harmful effects of weeds provides the level of pea yield for an average of three years at the level of 3.3 t/ha.

Keywords. Pea, weeds, harrowing, herbicides, crop capacity.

Formulation of the problem. In 2020, 582.6 thousand tons of peas were harvested in Ukraine from an area of 251.5 thousand hectares, with an average yield of 2.32 t/ha. And in 2019, 573 thousand tons of peas were harvested, from an area of 254.3 thousand hectares with a yield of 2.26 t/ha. It has great prospects in Ukraine for strengthening the economic indicators of the agricultural sector. For agriculture it is important the solving the issue of increasing the growth rate of pea yields and reducing the impact of unfavorable growing conditions, due to which it is possible to achieve a significant increase in the level of stability of grain production over the years.

In Vinnytsia region, 14.09 thousand tons of peas were threshed in 2020 with a yield of 29.97 quintal per hectare.

Sowing peas are sensitive to weediness of crops. Due to the harmful effect of weeds, its productivity can be reduced by 30% or more. Because in weedy fields yields are significantly reduced due to shading, reduction of soil moisture available to cultivated plants, difficulty of tillage and harvesting, deterioration of fertilizer efficiency, etc. One of the reserves of increasing the pea grain yield is to reduce the weediness of its crops.

As the weediness of the agrophytocenosis increases, the negative effects of weeds increase, causing large crop losses. Considering the high level of weed infestation, the use of herbicides remains an important element of integrated weed control. But for their highly effective use, it is necessary to know the actual species composition of weeds in each field, which makes it necessary to survey the territories.

As weeds compete with crops for moisture, photosynthetic radiation, and nutrients, limiting their harmful effects has been and remains one of the main problems in the crop industry. Timely intervention in the phytocenosis and measures, taken by man, will result in a good harvest.

Analysis of recent research and publications. Peas are an important legume. One of the reserves of increasing the yield of pea grain is to reduce the weediness of its crops. The level of presence of annual weeds in agrophytocenoses is determined by growing conditions and biological characteristics of cultivated plants. And the presence of perennial weeds is determined by

the content of their vegetative reproductive organs in the soil. The level of weed component in agrophytocenoses by species, number and weight is a dynamic phenomenon during the growing season.

High weed infestation is a risk factor in agriculture. In Ukraine, this problem has become more acute in recent years for a number of reasons, which makes it important to find measures to improve weed control in agrocenoses. Monitoring of weed seed stocks in the arable soil layer (0-30 cm) in different soil and climatic zones of Ukraine shows, that in the zone of sufficient moisture there are 1.47 billion pcs/ha, in the zone of excessive moisture 1.71 billion pcs/ha, in the zone of insufficient moisture 1.14 billion pcs/ha [5].

The demanding nature of peas to the temperature regime limits the area of its cultivation in the Southern Forest-Steppe and Steppe Zones of Ukraine. In Polissya and in the Forest-Steppe the yield of peas is 1-5 dt/ha higher than when growing it in the conditions of the Steppe and the Southern Forest-Steppe Zones [3, 9].

The practice of many countries shows, that overcoming the existing shortage of high-quality protein for food and feed needs is possible only by increasing their production. The positive qualities of these crops contribute to the constant growth of sown areas and gross fees, second only to these indicators of grain crops [10].

In Ukraine, there is a similar trend to increase the use of herbicides, and reduce agrotechnical methods of weed control [11].

Due to the significant level of littering of most agricultural lands, agrotechnical measures cannot always achieve the desired result of weed control, which necessitates the use of highly effective herbicides [4, 13].

In pea crops, weeds, with insufficient protective measures, can be the main reason for reduced crop yields, they strongly shade and suppress pea crops, dry and deplete the soil, complicate crop care and harvesting, promote the reproduction and spread of pests and pathogens, etc. [2, 15].

Extermination measures should be carried out in the presence of 10 pcs/m² of weeds. Decreased pea yields are observed, when weeds have been in pea crops for 20 days after emergence of pea seedlings. Later, weed control measures no longer compensate for the losses, that were inflicted on peas during this period [14].

Obtaining high and stable yields of pea varieties significantly depends on the timely passage of stages of growth and development, which are determined by both varietal characteristics of the culture, weather and climatic conditions of the years. Growth and development is one of the most important agrobiological features of peas, which reflect a certain interaction of the plant genotype with a set of technological techniques and agroclimatic resources of the growing region [6, 7].

The development of the most effective control system of the weed component cenosis with the use of chemical plant protection products in the cultivation of peas is an extremely important element of technology [8].

The purpose of the study is to determine the effect of harrowing and herbicides on the weed component in the agrocenosis and to identify the peculiarities of the formation of grain productivity of peas, depending on the options of controlling its weediness.

Presenting main material. During 2018-2020, the experiments were based on the experimental field,

where the soil has the following parameters: gray forest soil of medium-loamy mechanical composition; humus content - 3.0%; pH of the salt is 5.4. The weather characteristics of the three years of the study were typical for the Forest-Steppe zone and suitable for growing peas.

The technology of growing peas of the Magnat variety was generally accepted for the Forest-Steppe zone. The sown area of the plot was 22.5 m²; the accounting area was 20 m². The experiment was repeated four times with a randomized placement of variants. The working solution was applied with a knapsack sprayer with a liquid consumption rate of 250 l/ha. Weed counts were performed according to generally accepted methods. The first record was performed quantitatively, using a framework in 30 days after sowing, and the second - quantitative weight method-before harvesting. Recording for pea yield was performed in sections. Statistical processing of the obtained data was performed by analysis of variance.

The scheme of the experiment

Options
1. Natural background of weediness (control)
2. Pre-emergence and post-emergence harrowing
3. Before the emergence of pea seedlings - Dual Gold emulsion ratio, 1.6 l/ha
4. In the phase of 2-3 true leaves of MaxiMox crop, soluble ratio, 1.0 l/ha
5. Before the appearance of pea seedlings - Dual Gold emulsion ratio, 0.8 l/ha + in the phase of 2-3 true leaves of MaxiMox crop soluble ratio, 0.5 l/ha

Peas are less demanding of temperature than other legumes. The minimum germination temperature of its seeds is 2-3°C. But under such conditions, early spring and winter weeds can also grow in agrophytocenoses. Our research has shown, that in agrophytocenoses of peas a mixed type of weeding was formed, where monocotyledonous species had the largest share: *Echinochloa crus-galli* L.Pal. Beauv., *Setaria glauca* L. Pal. Beauv.), *Agropyrum repens* L. Dicotyledonous perennial weeds are present in the experimental plots: *Chenopodium album* L., *Thlaspi arvensis* L., *Stellaria media* L., *Sinapis arvensis* L., and perennial - *Sonchus arvensis* L. [1, 12].

Unlike early cereals, peas have certain weed species. In particular, its agrophytocenosis is dominated by annual cereals and spring dicotyledonous weeds. Due to the symbiosis with nodule bacteria, in the rhizospheric zone peas have excretions, that are enriched with nitrogen and other elements. And this creates favorable conditions for the germination and vegetation of weeds in its crops.

The structure of sown peas agrocenosis weediness was determined: in total during the 3 years of research there were in average 93 weeds/ m², among them monocotyledons - 70% and dicotyledons - 30% (Table 1).

Table 1

Weediness structure of pea agrocenosis (average 2018-2020), pcs/m²

Name of weeds	Number of weeds
Total	93
<i>Echinochloa crus-galli</i> L.	37
<i>Setaria glauca</i> L.	19
<i>Poa annua</i> L.	3
<i>Agropyrum repens</i> L.	6
Total monocotyledons	65
<i>Chenopodium album</i> L.	6
<i>Stellaria media</i> L.	5
<i>Thlaspi arvensis</i> L.	3
<i>Sinapis arvensis</i> L.	2
<i>Matricaria perforate</i> Merat L.	2
<i>Polygonum convolvulus</i> L.	1
<i>Sonchus arvensis</i> L.	3
Other species	6
Total dicotyledons	28

Control of segetal vegetation and its harmful effects in agrophytocenosis of peas to economically insignificant level is a very important condition in the technology of its cultivation.

In peas' agrocenosis, the issue of weed protection is given a special place. Practical experience shows, that it is almost impossible to reduce the weediness of pea crops to an economically insignificant level only with the help of agronomic measures. The system of peas protection from weeds should combine a set of agrotechnical and chemical measures, that are carried out consistently and are mutually agreed.

Peas had a mixed type of weediness, where annual cereal species predominated - about 65 pcs/m² ac-

ording to research years. The most common weed species were *Echinochloa crus-galli* L., *Setaria glauca* L., *Agropyrum repens* L., *Chenopodium album* L., *Stellaria media* L., *Sonchus arvensis* L., *Thlaspi arvensis* L., *Sinapis arvensis* L., *Perforated matrix* Merat.

When caring for crops, measures to limit the number and harmful effects of weeds are important to obtain the planned harvest. During the pea growing season in the control variant, the number of weeds decreased by an average of 10 pcs/m² over three years of research. This is the result of suppression of weeds, which were in the lower tier of the coenosis, by cultivated plants (Table 2).

Table 2

Influence of harrowing and herbicides on weediness of peas agrocenosis (average for 2018-2020)

Experiment options	Record	Number of weeds, pcs/m ²			Weed destruction, %		
		Total	Mono cotyledons	Dicotyledons	Total	Mono cotyledons	Dicotyledons
Natural background of weediness (control)	1	93	65	28	-	-	-
	2	83	64	19	-	-	-
Pre-emergence and post-emergence harrowing	1	16	7	9	82,8	89,2	67,9
	2	19	7	12	77,1	89,1	36,8
Dual Gold e.c, 1.6 l/ha	1	11	5	6	88,2	92,3	78,6
	2	12	4	8	85,5	94,2	57,9
MaxiMox, s.l., 1.0 l/ha	1	8	4	4	91,4	93,8	85,7
	2	7	3	4	91,6	94,2	78,9
Dual Gold e.c., 0.8 l/ha + MaxiMox s.l., 0.5 l/ha	1	7	3	3	93,5	95,3	89,3
	2	7	3	4	91,6	95,3	78,9

During the experiment an agrotechnical method of weed control in agrophytocenoses of peas – pre-emergence and post-emergence harrowing was used. Before harvesting, 19 pcs/m² of weeds were counted on this variant. Harrowing in agrophytocenoses of peas reduced the level of their numbers by 77.1% and their air-dry mass by 49.5%.

In our studies, the degree of weediness in agrophytocenoses was on a high scale, so herbicides had to be used to reduce their presence.

The application of the dual Gold herbicide at the rate of 1.6 l/ha before pea emergence ensured the reduction of weeds in one month after application by 88.2%, compared to control areas, where weed protection measures were not carried out. The active substance S-metolachlor has a negative effect on cell division, which slows down the growth process and subsequently causes death of weeds.

The protective effect of soil herbicide was manifested in the reduction of the number and ability of weeds to accumulate vegetative mass. It was especially effective against monocotyledonous weeds. During the recording in a month after the application of the preparation, it was noted, that the number of monocotyledonous weeds was 5 pcs/m², and dicotyledonous - 6 pcs/m². The level of weediness by cereal weeds decreased by 92.3%, and dicotyledons - by 78.6%, compared to control. However, the herbicide did not show any toxic effect on perennial weeds in the pea crops, so they were able to grow freely, develop and accumulate their weight. The number of weeds before harvesting peas in the areas, where the soil herbicide Dual Gold

was applied at a rate of 1.6 l/ha was 12 pcs/m², the level of weeds decreased by 85.5%, compared to control areas.

Pea plants are highly sensitive to the action of herbicides in the periods before the phase of 2 leaves and after 5 leaves. And when its plants have from 2 to 5 leaves, the wax layer best protects against negative chemical influence. So, the insurance herbicides to protect peas from weeds are recommended to be applied at this stage of crop development. Spraying crops at an earlier or later date can negatively affect cultivated plants: their development is delayed, leaves are deformed, stems are distorted.

Analysis of the insurance herbicide MaxiMox action at the rate of 1.0 l/ha showed, that it effectively destroyed perennial weeds. Its active substance imazamox inhibits protein synthesis in weeds, which leads to chlorosis of young leaves, the death of growth points, the suspension of growth processes and the weeds death. After chemical treatment with MaxiMox, weed growth stops within a few hours, although visible signs of toxicity of the herbicide may not appear for several days after application. Complete weeds death occurs after 3-6 weeks after application.

During the second weed record, it was found that the herbicide MaxiMox had the effectiveness of 91.6%. The number of perennial monocotyledonous species decreased compared to the control by 94.2%. The reduction in the number of dicotyledonous weeds on the options for its application was 78.9%. MaxiMox herbicide destroyed perennial weeds, so the total weediness of crops decreased by 91.6% compared to control plots.

It was recorded, that negative effects of herbicides on cultivated plants were not detected during studies. Dual Gold and MaxiMox herbicides decompose quickly in the soil and in the recommended application rates do not have a negative effect on those crops that will be sown after peas.

In the experimental variants, in the second half of the pea growing season, due to the detoxification of herbicides and precipitation, we observed a weakening of their effect on weeds. This has led to an increase in the number of certain species. There was an increase in the level of pea weediness in the variants, where the

Dual Gold herbicide was applied. A new wave of dicotyledonous weeds appeared in the areas after precipitation: *Chenopodium album L.*, *Stellaria media L.* and from monocotyledons – *Echinochloa crus-galli L.*

Consecutive application of herbicides: Dual Gold at the rate of 0.8 l/ha and Maxi Moks at the rate of 0.5 l/ha allowed to regulate qualitatively the presence of weeds in agrophytocenoses during the growing season of sowing peas. At the time of crop harvesting, weed death in this variant averaged 91.6% over three years of research, and the above-ground air-dry mass was 105 g/m².

Table 3

Influence of harrowing and herbicides on weeds in the pea agrocenosis (average for 2018-2020)

Experiment options	Number of weeds, pcs/m ²	Aboveground mass of weeds (air-dry)	
	total	g/m ²	reduction to control,%
Natural background of weediness (control)	84	948	-
Pre-emergence and post-emergence harrowing	20	479	49,5
Dual Gold e.c., 1.6 l/ha	12	211	77,7
MaxiMox s.l., 1.0 l/ha	8	136	85,7
Dual Gold e.c., 0.8 l/ha + MaxiMox s.l., 0.5 l/ha	7	105	88,9

The process of growing stable yields of peas is highly dependent on the ability of the agronomic service to provide favorable conditions for cultivated plants for their formation. The decrease in the number and weight of weeds in agrophytocenoses contributed the increasing in the density of standing pea plants, their better growth and development, and increasing crop yields.

One of the set of measures to obtain high yields of pea grain is high-quality protection of its coenoses from the negative effects of weeds. After all, the yield is an integral indicator of the productivity of cultivated plants, which determines the relationship of a set of quantitative signs with growing conditions.

Table 4

Pea yields depending on weed control (average for 2018-2020), t/ha

Experiment options	Seed yield, t/ha				Increase to control	
	2018	2019	2020	average	t/ha	%
Natural background of weediness (control)	1,6	1,4	1,4	1,5	-	-
Pre-emergence and post-emergence harrowing	2,1	1,9	1,8	1,9	+0,4	26,7
Dual Gold e.c., 1.6 l/ha	2,7	2,3	2,2	2,4	+ 0,9	60,0
MaxiMox s.l., 1.0 l/ha	3,2	2,7	2,6	2,8	+ 1,3	86,7
Dual Gold e.c., 0.8 l/ha + MaxiMox s.l., 0.5 l/ha	3,5	3,2	3,3	3,3	+ 1,8	120,0
LSD ₀₅	0,17 0,16 0,16					

The protection of pea plants from the negative effects of weeds contributed to the quality realization of the productive potential of the crop. On average over three years of research, the yield of pea grain on the variants with the introduction of herbicides was 2.4-3.3 t/ha, which was higher, than in the control areas by 60-120%. The largest increase in pea seed yield was obtained in the variants with the application of Dual Gold (0.8 l/ha) and the subsequent use of MaxiMox (0.5 l/ha). On the average for three years of researches it was 1,8 t/ha.

Over three years of research high herbicidal activity was characteristic of the sequential variant of herbicides application: soil Dual Gold with consumption rate of 0.8 l/ha and insurance MaxiMox with a consumption rate of 0.5 l/ha. Qualitative control of crop

weeding made it possible to obtain the yield of pea grain on average at the level of 3.3 t/ha.

Conclusions.

1. In agrophytocenoses of peas a mixed type of weediness was formed. The ratio of groups was dominated by monocotyledonous weed species - 72.0%.

2. During the first record, the presence of weeds in the control was 93 pcs/m². And during the pea growing season, due to interspecific competition, their presence decreased by 10 pcs/m².

3. As a result of harrowing pea crops, the number of weeds decreased by 77.1% and by 49.5% above-ground air-dries mass.

4. Treatment with soil herbicide Dual Gold at a rate of 1.6 l/ha killed 85.5% of weeds and reduced their weight by 77.7%, compared to the control option.

5. Spraying of peas with the insurance herbicide MaxiMox at the rate of 1.0 l/ha ensured the death of 96.1% of weeds and reduction of their weight by 85.7% before control.

6. On options of consecutive application of Dual Gold (0.8 l/ha) and MaxiMox (0.5 l/ha) there was the best control of pea weediness: in relation to the control, the death of weeds was 91.6% and the reducing of their weight by 88.9%.

7. The largest increase in pea yield (1.8 t/ha on average over three years of research) was obtained in the variants with application of Dual Gold (0.8 l/ha) and subsequent use of MaxiMox (0.5 l/ha). Reducing the number and weight of weeds allowed to get a pea harvest at the level of 3.3 t/ha.

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UDC: 633.635:638.19

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[DOI: 10.24412/2520-6990-2021-794-36-40](https://doi.org/10.24412/2520-6990-2021-794-36-40)

ECOLOGICAL EFFICIENCY OF INCREASING YIELD OF AGRICULTURAL CROPS BY BEE POLLINATION

Abstract

The ecological efficiency of increasing the yield of agricultural crops due to bee pollination has been studied. It was found that in the period from 2000 to 2016, 175.6 mg of lead and 56.2 mg of cadmium per 1 hectare of agricultural land in the territory of Vinnytsia region; of them with nitrogen fertilizers – 47.4 % and 3.7 %; with phosphorus – 29.2 % and 16.5 %; with potassium – 23.3 % and 80 %. During the cultivation of winter rape and sunflower on the area of 405370 ha with mineral fertilization in order to increase their yield, 908.2 kg of lead and 214.5 kg of cadmium got into the soil. The increase in yields of these crops due to bee pollination against the

background of reduced use of mineral fertilizers led to a reduction of up to 30% of soil contamination with lead and up to 25 % of costs.

Key words: *heavy metals, lead, cadmium, concentration, bee pollination, nitrogen fertilizers, phosphorus fertilizers, potassium fertilizers.*

I. Literature review

The intensification of modern agriculture in the conditions of Vinnytsia and Ukraine as a whole leads to intensive pollution of natural ecosystems with various toxicants, in particular, and heavy metals, the concentration of which in some cases exceeds acceptable levels. At the same time, there is a tendency to reduce the content of humus in soils, which over the past 25 years has decreased by an average of 5.3 percentage points, primarily due to crop failure by a sharp decrease in crops and low levels of organic fertilizers. At the same time, there is a need to restore soil nutrients, which is solved mainly by applying mineral fertilizers to the soil [1, 4].

Significant sources of heavy metals entering the environment in Ukraine are enterprises of the metallurgical and mining industries, which have led to man-made soil contamination with heavy metals. It is known that the scale of environmental pollution by heavy metals over the past few decades is growing rapidly. According to the Institute of Soil Science and Agrochemistry. O.N. Sokolovsky currently heavy metals contaminate about 20% of agricultural land in Ukraine.

A large amount of heavy metals enters the soil with precipitation, especially in areas near industrial centers. In the soils around these enterprises, a significant excess of permissible concentrations of such metals was found. The environment is also polluted by non-ferrous and ferrous metallurgy enterprises, the production of mineral fertilizers, and the machine-building industry, and the application of organic fertilizers.

Intense pollution of the environment with such metals has created serious problems for the safe agricultural use of soils, especially near highways, large industrial cities and metallurgical enterprises. After all, it is known that the soil is of great sanitary and hygienic importance for animals, whose existence is closely linked to this object of the natural environment. It is important for the functioning of the agroecosystem and human life.

Once in the soil, these metals together with organic components form slowly moving complexes. It is known that the organic matter of the soil binds such metals more strongly, nor its mineral components. At the same time, it should be noted that lead and copper are more strongly fixed in organic matter, while cadmium is weaker. Fixation of such metals in the soil to some extent depends on the amount of oxides, calcium and phosphorus [5].

From the soil part of the lead and cadmium passes into plants through the root system. It has been proven that plants can accumulate heavy soil metals in large quantities. The intensity of migration of these elements in plants largely depends on their botanical origin [2, 3, 6].

Due to migration and transformation, such metals affect the components of almost all ecological systems. The intensity of migration and transformation of heavy metals in plants is significantly affected by lead and cadmium.

The use of mineral fertilizers promotes the constant entry of heavy metals into the soil and their inclusion in the soil cycle crop food. Under conditions of high inflow of heavy metals into the soil with the use of food products made from food raw materials grown in these conditions, leads to their accumulation in tissues and organs of living organisms, causing a number of disorders at the cellular, organ and body levels in general.

Heavy metals, getting into the tissues of living organisms interact with thiol groups of various macromolecules of the body, blocking them, which subsequently leads to the loss of proteins of many reactions and metabolic disorders.

The entry of heavy metals into the body for a long period of time has a negative effect on its hematopoietic organs, and also enhances the formation of free radicals, which leads to lipid oxidation.

It is established that cadmium poisoning causes a violation of protein synthesis and enzymatic processes. At the same time, it should be noted that cadmium causes a violation of nucleic acid metabolism and disrupts DNA synthesis.

Some of the lead circulates in the blood plasma in the form of albuminates, is found in the liver, kidneys, but mainly accumulates in bone and cartilage.

Lead lactate, which penetrates nerve and muscle cells easily, plays a key role in the mechanism of lead toxicity. Fast-growing tissues have been shown to be most sensitive to lead. Lead intoxication in childhood prevents the peak of bone mass, which can provoke osteoporosis in the future.

It is proved that heavy metal poisoning leads to increased morbidity and reduced life expectancy, there is an increased stillbirth rate. The consequence of environmental pollution is a reduced level of immunity, increased morbidity and mortality. The constant supply of heavy metals to the body leads to stress, as well as to hidden changes in metabolism.

Under such conditions, there is a need to limit the use of mineral fertilizers in modern conditions of intensive agriculture and to develop measures to increase the yield of agricultural plants through environmentally friendly technologies.

The purpose of research study of the effectiveness of reducing soil contamination with heavy metals through the use of bee pollination of crops.

II. Methodology

The ecological efficiency of bee pollination research was determined by establishing the level of heavy metals entering the soil due to the increase in

crop yields with mineral fertilizers and bee pollination.

Accumulation of lead and cadmium in bee nests (honey, perga, honeycomb) was determined by atomic absorption method.

Chemical methods of increasing crop yields included the use of mineral fertilizers, and biological pollination of these crops by honey bees.

Research on this topic was conducted in the

conditions of agricultural production of Vinnytsia region, Ukraine.

III. Analysis and results

Analysis of the use of mineral fertilizers (Table 1) in the Vinnytsia region over the years showed that the amount of nitrogen fertilizers per 1 ha ranged from 14 kg to 72 kg, phosphorus – from 2 to 20 kg and potassium fertilizers – from 3 to 20 kg.

Table 1

Use of mineral fertilizers during 2000 - 2016

Years of research	Mineral fertilizers, kg/ha in current weight			
	Nitrogen	Phosphorus	Potassium	Total by years
2000	14	2	3	19
2005	27	3	9	39
2009	44	7	12	67
2010	39	20	21	80
2015	54	20	17	91
2016	72	18	20	110
Total for years of research	250	70	82	406
On the average on 1 hectare for the investigated period	41.6	11.6	13.6	67.6

On average, 41.6 kg of nitrogen fertilizers were applied to the soil per 1 ha during the accounting period; phosphorus – 11.6 kg and potassium fertilizers – 13.6 kg. At the same time, it is necessary to note the tendency to increase the level of use of mineral fertilizers.

Analysis of the supply of lead with mineral fertilizers (Table 2) shows that in 2000 in agricultural soils per 1 hectare got 45,8 mg of lead, in particular, with nitrogen fertilizers – 61.1 %, phosphorus fertilizers – 19.2 % and potassium – 19.6 %. In 2005, 94.2 mg/ha of lead entered the soil with mineral fertilizers, of which 57.3 % with nitrogen fertilizers, 14.0 % with phosphorus fertilizers and 28.6 % with

potassium fertilizers. In 2009, 154.8 mg/ha of lead was received, with nitrogen fertilizers – 56.8 %, with phosphorus – 19.9 % and potassium – 23.2 %. In 2010, 229 mg of lead per 1 ha fell into the soil, of which 34.0 % with nitrogen – 38.4 % with phosphorus - and 43.9 % with potassium. In 2015, 247 mg of them entered the soil: nitrogen – 43.7 %, phosphorus – 35.6 % and potassium – 20.6 %. In 2016, 283.2 mg of lead, 50.8% – nitrogen fertilizers, 27.9 % – with phosphorus and 21.2 % – with potassium fertilizers got into the soil.

That is, there is a clear trend to increase the intensity of lead with mineral fertilizers in recent years. The highest amount of lead in the soil came with nitrogen fertilizers.

Table 2

Receipt of heavy metals with mineral fertilizers in agricultural soils appointment, mg/ha

Years of research	Receipt of heavy metals with mineral fertilizers							
	Nitrogen fertilizers (ammonium nitrate)		Phosphorus fertilizers (simple superphosphate)		Potassium fertilizers (potassium chloride)		Together	
	Pb	Cd	Pb	Cd	Pb	Cd	Pb	Cd
2000	28	0.7	8.8	1.6	9	9	45.8	11.3
2005	54	1.35	13.2	2.4	27	36	94.2	39.7
2009	88	2.2	30.8	5.6	36	63	154.8	70.8
2010	78	1.95	88	16.0	63	51	229	68.9
2015	108	2.7	88	16.0	51	51	247	69.7
2016	144	3.6	79.2	14.4	60	60	283	78
On the average on 1 hectare for the investigated period	88.3	21	51.3	9.3	41	45	175.6	56.2

In 2000, 11.3 mg of cadmium got into the soil per 1 ha (Table 2), of which 6.2 % with nitrogen fertilizers; phosphorus – 14.2 % and potassium – 79.7 %. In 2005, the soil received 39.7 mg, of which 3.45 % – with nitrogen fertilizers; 6.5 % – with phosphorus and 91 % – with potassium fertilizers. In 2009, the soil received 70.8 mg/ha of cadmium, in particular, 3.1 % – with nitrogen; 7.9 % – with phosphorus and 90 % – with potassium fertilizers. In 2010, 68.9 mg of cadmium per soil per

hectare; 2.8 % – with nitrogen fertilizers; 23.3 % – with phosphorus fertilizers and 2.8 % – with potassium. In 2015, the soil with mineral fertilizers received 69.7 mg, of which 3.8 % – with nitrogen fertilizers; 22.9 % – with phosphorus fertilizers and 73.1 % – with potassium fertilizers. In 2016, the soil received 78 mg/ha of cadmium; with nitrogen fertilizers – 4.6 %; phosphorus – 18.5 % and potassium – 76.9 %.

Table 3

Intensity of accumulation of heavy metals in the soil during the cultivation of winter rape and sunflower

The main honey-bearing agricultural crops	Amount of fertilizers, kg/ha		Total sown area, ha	Gross input into the soils of heavy metals, kg	
	active substance	physical weight		Pb	Cd
Nitrogen fertilizers (ammonium nitrate)					
Winter rape	80	222	159420	70.7	3.5
Sunflower	45	125	245950	61.5	1.54
Phosphorus fertilizers (double superphosphate)					
Winter rape	60	300	159420	411	38.2
Sunflower	45	225	245950	238	44.3
Potassium fertilizers (potassium chloride)					
Winter rape	90	150	159420	71.7	71.7
Sunflower	45	75	245950	55.3	55.3
Together			405370	908.2	214.5

Analysis of the intensity of soil contamination by heavy metals (Table 3) showed that when growing winter oilseed rape and sunflower with an area of 405,370 ha in the soil in 2018 with mineral fertilizers got up to 8.2 kg of lead and 214.5 kg of cadmium.

During the cultivation of winter rape, 50.9 % of lead and 52.8 % of cadmium got into the soil, while during the cultivation of sunflower these indicators

were in the range of 39.1 % and 47.2 %.

During the cultivation of winter rape (Fig. 1,2) 553.4 kg of lead and 113.4 kg of cadmium got into the soil, of which 12.7 % and 3.1 % – with ammonium nitrate, 74.3 % and 33.7 % – with double superphosphate and 13.0 % and 63.2 % – with potassium chloride.

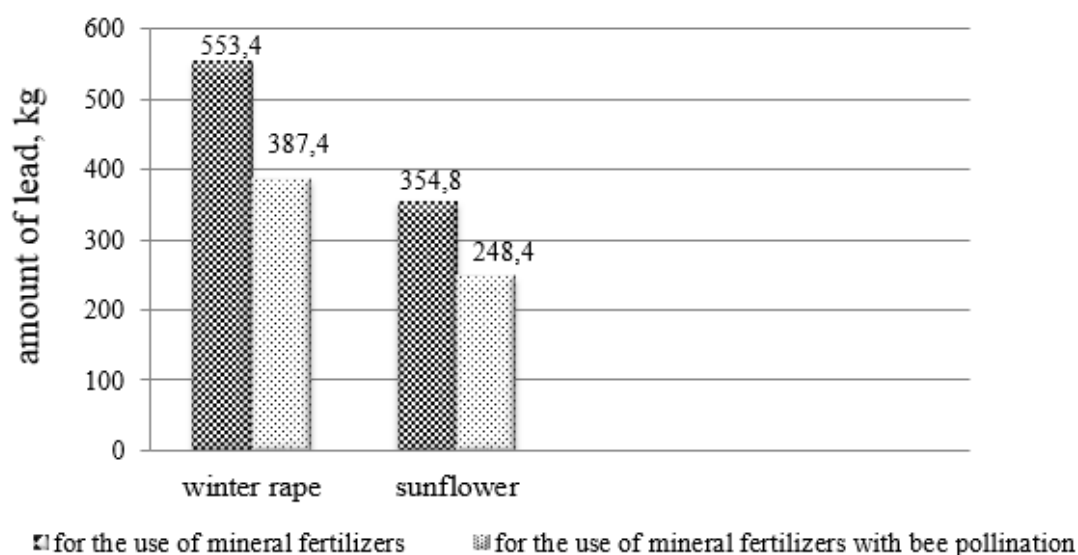


Fig. 1. Efficiency of reduction of soil pollution by lead by bee pollination of winter rape and sunflower

During the cultivation of sunflower in the soil got 354.8 kg of lead and 101.1 kg of cadmium, of which 17.3 % and 1.52 % – with ammonium nitrate, 67.1%

and 43.8% – with double superphosphate and 15.6 % and 54.7 % – with potassium chloride.

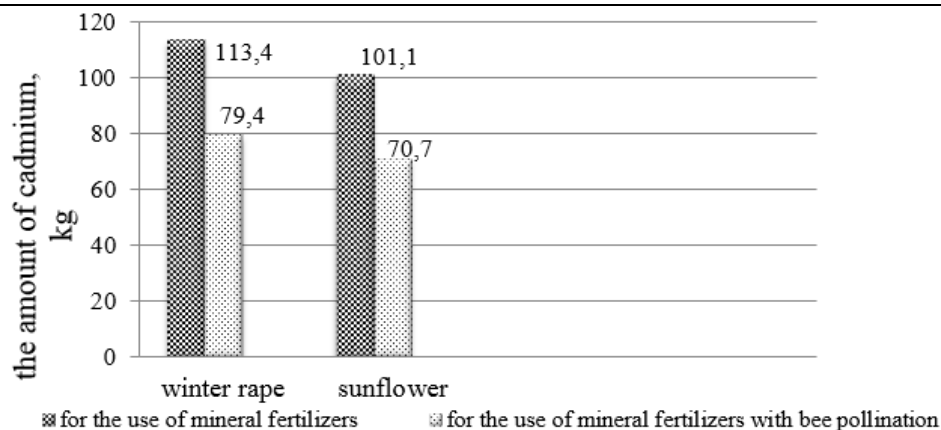


Fig. 2. The effectiveness of reducing soil contamination with cadmium

Increasing the yield of agricultural plants due to bee pollination against the background of reducing the use of mineral fertilizers makes it possible to reduce the supply of lead and cadmium in the soils of Vinnytsia region when growing winter rape by 166 kg and 106.4 kg, sunflower – by 34.0 kg and 30.3 kg, respectively.

The analysis of economic efficiency showed that increasing the yield of winter rape and sunflower for bee pollination, reduces the cost of using mineral fertilizers by 25 %.

IV. Conclusion and discussion

Analysis of the use of mineral fertilizers in the Vinnytsia region over the years of research (2000-2016) showed that the amount of nitrogen fertilizers per 1 ha in the active raw material ranged from 14 kg to 72 kg, phosphorus - from 2 to 20 kg and potassium fertilizers – from 3 to 20 kg, as a result of which 908.2 mg of lead and 214.5 mg of cadmium per 1 ha.

When growing winter rape and sunflower, 0.006 kg of lead and 0.001 kg of cadmium are added to the soil per 1 ha.

Increasing the yield of winter rape and sunflower by bee pollination makes it possible to reduce the use of mineral fertilizers by up to 30 %, which limits the inflow of lead to soil to 30 % and cadmium to 30 % and reduce costs to 25 %.

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[DOI: 10.24412/2520-6990-2021-794-41-42](https://doi.org/10.24412/2520-6990-2021-794-41-42)

INFLUENCE OF GROWTH STIMULANTS ON THE ONTOGENESIS OF SPRING BARLEY (*HORDEUM VULGARE* L.)

Abstract.

An investigation of the importance of growth factors for accumulation of solids in spring barley (*Hordeum vulgare* L.) plants at different stages of organogenesis is established, the influence of growth factors on the elements of structure and productivity of spring barley is specified. The use of growth regulators in crop production along with other agricultural practices of intensive and biologized tillage technologies is one of the most advantageous and promising methods of improving crop yields. Spring barley plants were treated with the stimulants Epin-extra, Zircon and 1 % bischofite in the tillering phase. As a result of the research, it was found out that spraying of crops in the tillering phase with the growth regulators Epin-extra, Zircon and 1 % bischofite reduces the growing season by 2–4 days when treating spring barley on sod-podzolic soil; the growth regulator Epin-Extra and 1 % bischofite increase the assimilation leaf surface of plants by 8.5 and 11.1% respectively, the photosynthetic potential by 5.7 % and the net productivity of photosynthesis by 3 and 10 %; the growth regulator Zircon does not have a positive effect on the photosynthetic activity of spring barley plants under soil and climatic conditions.

Keywords: plant growth regulators, leaf surface area, photosynthetic activity, photosynthetic potential, net productivity of photosynthesis

In the modern technologies of spring barley (*Hordeum vulgare* L.) treatment great importance is attached to various methods of treatment of both seeds and plants with environmentally friendly new preparations in order to improve yields. One of the most promising directions of the modern technology for crop production is the use of plant growth stimulants [1]. Growth stimulants activate the immune system of the plant (spring barley), enable to 'smooth' the limiting factors of obtaining potential yields, improve resistance to drought or excess moisture at high or low ambient temperatures, as well as accelerate or slow down the maturation of plants, increase the number of seeds in the ear, contribute to the redistribution of nutrients in economically important plant organs. These conditions cannot be provided by the traditional elements of the technology [2, 3, 4].

Thus, our research is relevant and deals with the study of growth stimulants influence on the ontogenesis of spring barley (*Hordeum vulgare* L.).

Field experiment was carried out during 2017–2019 on the experimental field of the Poltava State Agrarian Academy (Ukraine) and barley Helios, Vakula and Parnassus cultivars were used as test crops. All cultivars are Ukrainian breeding and recommended for grown in the Forest-Step zone of Ukraine. Institute of Plant Breeding named after V. Ya. Yuriev of National Academy of Agrarian Sciences of Ukraine is originator of the barley cultivars.

Characterizing the results of seedlings and full maturity of the studied cultivars of spring barley (*Hordeum vulgare* L.) in 2019, it should be said that for

the cultivar 'Helios', treatment with Zircon led to the emergence of seedlings on 11.05.19, which is 3 days faster than the control. And the full maturity was on 3.07.19, which is 2 days faster than the control. The best stimulant was Zircon. For 'Parnassus' cultivar the seedlings appeared on 12.05.19, and the full maturity was on 12.07.19 under the action of Zircon as well. 'Vakula' cultivar in 2019 had seedlings on 14.05.19, and the full maturity – on 6.07.19. Such indicators did not show a significant advantage of the stimulants used for growing this cultivar of barley.

Thus, the use of Zircon and 1 % bischofite solution (for 'Helios' and 'Parnassus' cultivars) accelerated the earing phase by 2–4 days, Epin-extra – only by 1–2 days. The effect of stimulants on the growth rate of spring barley plants was observed in the maturity phase of barley grain, as a result of which the barley grain treated with stimulants matured 2–4 days earlier than in the control, this is due to the fact that stimulants accelerated processes of metabolism in plants, thereby promoting maturation. Therefore, 1 % bischofite solution and Zircon most actively promoted the approach of subsequent phases of plant development in the control field. In the control variant, the phenological phases came later, so on average, for 3 years of the experiment, the duration of the growing season in this variant was 92 days.

When treating with different stimulants, the duration of the phases (stem elongation – earing, earing – full maturity) differ greatly, which is due to specific weather conditions in the period of the experiment

(2017–2019). Thanks to the use of stimulants, the duration of the growing season of spring barley plants was reduced by 2–5 days in 2017 compared to the control. It was the shortest when using Zircon and 1 % bischofite solution, while the growing season in both cases was 86 days. It should be noted that the effect of Zircon and 1 % bischofite solution was especially evident in the following periods: tillering – stem elongation and earing – full maturity, because each of these periods was reduced by 2 days relative to the control (for the cultivars ‘Helios’ and ‘Parnassus’). The use of Epin-Extra was manifested in the reduction of these periods by only 1–2 days.

In 2018, when using Zircon and 1 % bischofite solution, the duration of each subsequent phase of the development of spring barley plants was the shortest, and these stages were reduced by 1–3 days relative to the development phases, and the growing season was 6 days shorter than the control. The use of Epin-extra on crops also accelerated the development of spring barley (*Hordeum vulgare* L.), and the growing season was reduced by only 3 days and amounted to 87 days.

In 2019, the duration of development phases of spring barley plants differed slightly from previous years of the research (2017–2018). In variants through the use of stimulators the period of tillering – stem elongation was reduced by 1 day. The next period: stem

elongation – earing differed greatly from previous years, as under the action of Zircon the period was reduced by only 1 day, and under the action of 1 % bischofite solution the reduction in maturity of spring barley ‘Vakula’ was not detected. The stimulant Epin-extra increased this period by 3 days, but reduced the stage of earing – full maturity by 3 days. In general, under our experimental conditions, the regularity of reduction of the growing season under the influence of stimulants was kept. It was most pronounced when treating spring barley crops (cultivars ‘Helios’ and ‘Parnassus’) with stimulants such as Zircon and 1 % bischofite solution.

The use of Epin-extra promoted increasing the period of stem elongation – earing by 1–3 days (table 1). The growing season was reduced by 2–4 days. Thus, through the use of Epin-extra the maturity was on the 90th day after emergence of seedlings, when using Zircon and 1 % bischofite solution – on the 88th, and in the control variant – on the 92nd day [5].

Optimally oriented in space photosynthetic system of spring barley crops, mainly leaf surface, ensures the most complete use of soil and climatic resources of the region and enables to get a maximum effect from the methods of agroretechnical influence (table).

Table

Leaf surface area in the earing phase of the spring barley cultivars under study for 2017–2019, thousand m²/ha

Variant of stimulant	Average for 3 years ‘Helios’	Deviation from the control (±)		Average for 3 years ‘Vakula’	Deviation from the control (±)		Average for 3 years ‘Parnassus’	Deviation from the control (±)	
		thousand m ² /ha	%		thousand m ² /ha	%		thousand m ² /ha	%
Control	35.1	–	–	36.5	–	–	36.2	–	–
Epin-extra	36.8	3.3	6.7	36.7	4.2	8.8	37.1	4.7	8.2
Zircon	35.4	1.2	5.3	36.9	1.8	1.2	37.5	2.1	1.4
1% bischofite solution	39.4	2.8	6.5	39.1	2.3	11.8	38.3	1.8	11.4
HCP ₀₅	0.8	–	–	0.9	–	–	0.8	–	–

During the research it was found out that at the time of treating the crops in the tillering phase with the growth stimulants Epin-extra, Zircon and 1 % bischofite solution the growing season reduces by 2–4 days when growing spring barley on sod-podzolic soils; the stimulant Epin-extra and 1 % bischofite solution increase the assimilation leaf surface of spring barley (*Hordeum vulgare* L.) plants by 8.5 and 11.1 % respectively, the potential of a photosynthetic process by 5.7 % and the net productivity of photosynthesis by 3 and 10 %.

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ECONOMIC SCIENCES

УДК 338.22

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ЭКОНОМИКА ТУРИСТИЧЕСКОЙ ОТРАСЛИ ТУРЦИИ В УСЛОВИЯХ COVID-19

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THE ECONOMY OF THE TOURISM INDUSTRY IN TURKEY IN THE CONTEXT OF COVID-19

Аннотация.

В статье были рассмотрены особенности развития туризма Турецкой Республики. Роль туристической сферы как основного фактора развития Турецкой экономики, в период активной фазы распространения коронавирусной инфекции COVID-19.

Abstract.

The article discusses the features of the development of the tourism of the Republic of Turkey. The role of the tourism sector as the main factor in the development of the Turkish economy, during the active phase of the spread of the coronavirus infection COVID-19.

Ключевые слова: Турция, туристическая отрасль, туризм, туристов, COVID-19.

Keywords: Turkey, tourism industry, tourism, tourists, COVID-19.

Сегодня Турция является одной из наиболее быстро развивающихся стран мира.

Следует отметить выгодное географическое положение Турции играет значительную роль в экономике развития по отрасли туризма страны.

Турция занимает 16-е место в рейтинге стран по вкладу туризма в ВВП.

В 2019 году туристическая отрасль показала рост на 10,1%, увеличив удельный вес в структуре ВВП до 11,3%. Инвестиции в туристическую отрасль в 2019 году увеличились на 3,8% и составили 16,2 млрд. долл. США [1].

Турцию называют перекрестком количеством архитектурных памятников великих древних цивилизаций и культур, обладает превосходным средиземноморским климатом.

Согласно результатам проведенного исследования, самыми популярными являются туры с целью отдыха на побережьях Эгейского, Мраморного и Средиземного морей, экскурсионному, лечебному и спортивному туризму [2].

Таковыми известными *дестинациями* выступают средиземноморского побережья, Анталья, Аланья, Белек, Сиде, Кемер, эгейского побережья, Бодрум, Памуккале, Кушадасы, Мармарис, Фетхие а также исторические города Турции такие как: Стамбул – древняя столица, крупный мегаполис, Эдирне, Измир, Эфес, Демре, Бурса, Каппадокия, Анкара, Кonya, Мардин, Антакья, Амася, Карс и Эрзурум.

Черноморское побережье Турции, не так развито, как средиземноморское и эгейское, но для отдыха здесь также имеются все условия. К тому же,

в последнее время, этому региону уделяется повышенное внимание со стороны правительства Турции. К главным достопримечательностям региона относят Сафранболу – исторический османский город, Трабзон, Самсун, Орду, Кастамону, Амасра, Синоп, Гиресун Артвин и Ризе.

В Турции находятся термальные источники, и источники минеральных вод Кангал, Ялова, Балчова, Афьон, а также горнолыжных курортов Улудаг, Картаккая, Сарыкамыш, Паландокен и Эрджияс [3].

Национальной стратегии развития туризма в Турции прогнозируется, что в стране развитие туризма будет происходить за счет открытия новых направлений туризма на базе значительного ресурсного потенциала страны, в частности, курортов, а также быстрого репрофилирования туристической отрасли под запросы новых клиентов, которые, как ожидается, будут прибывать из новых стран. Несмотря на сложные геополитические обстоятельства, Турция проводит политику демократизации к туристам, стараясь обеспечить свои курорты достаточным количеством отдыхающих, ориентируясь как на исламских, так и на европейских туристов.

К 2023 году туристическая отрасль страны ставит перед собой задачу войти в пятерку мировых лидеров по числу туристов и доходов от туризма.

Успешно планируя деятельность туризма, обращается внимание и на строительство различного уровня гостиниц, проведение дорог, широкую подготовку гостиничных кадров.

В 2020 году в Турции побывало 12,7 млн иностранных туристов, это на 71,7% меньше по сравнению с 2019 годом (45 млн) [6].

Самым посещаемым регионом Турции стала Анталья, принявшая 3,2 млн иностранных туристов. На втором месте Стамбул (более 5 млн), на третьем – провинция Эдирне (1,8 млн), расположенная у границы с Болгарией на северо-западе страны, на четвертом – Мугла (670 тыс.), где располагаются курорты Эгейского побережья Турции.

По данным Министерства культуры и туризма Турции опубликовано статистику топ-5 государств по количеству туристов, посетивших Турцию в 2020 г. Первое место по количеству туристов в Турции, заняли туристы из России (2 128 758 чел.) оказав благоприятный эффект на турецкую экономику, испытывающую кризис из-за пандемии COVID-19.

Второе и третье места заняли Болгария (1 242 961 чел.) и Германия (1 118 932 чел.). (Рис. 1)



Рис. 1. ТОП-5 государств по количеству туристов, посетивших Турцию в 2020 г. [4].

Доля российских туристов составила 16,7%, болгарских – 9,7%, немецких – 8,8%. (Рис.2).

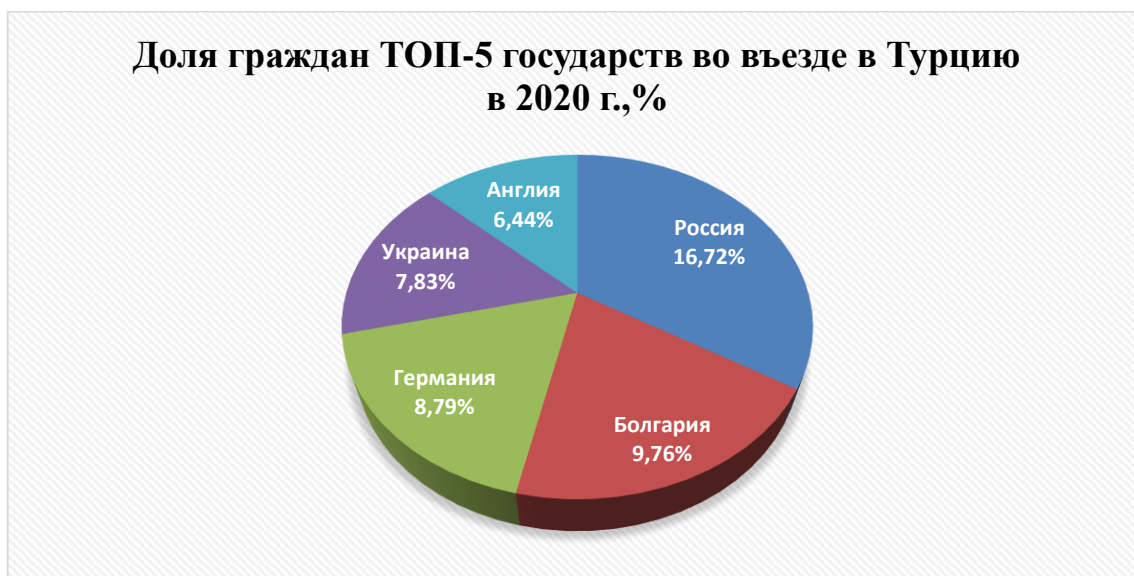


Рис. 2. Доля граждан ТОП-5 стран во въезде в Турцию в 2020 г. [4].

По данным Института статистики Турции доходы Турции от туризма в 2020 году во время пандемии COVID-19 сократились на 65,1% – до 12 млрд 59 млн 420 тыс. долларов, по сравнению с 2019 годом (\$34,5 млрд). Практически 10 млрд долларов из поступлений от туризма в 2020 году составили личные расходы туристов, а 2,6 млрд долларов – расходы на турпакеты [5].

Средние расходы одного туриста на проживание в сутки составили 61 доллар, средние расходы

иностранцев – 70 долларов, а средние расходы турецких граждан, прибывших из-за границы на отдых в Турцию – 44 доллара.

Сжатие туристической отрасли Турции в 2020 году обусловлено тем, что вся цепочка предоставления туристических услуг, а также деятельность смежных экономических отраслей были затронуты социальными, экономическими ограничениями, закрытием международного авиасообщения между странами в связи с пандемией COVID-19.

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UDC 338

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[DOI: 10.24412/2520-6990-2021-794-45-48](https://doi.org/10.24412/2520-6990-2021-794-45-48)

THE VALUE OF THE NATIONAL CURRENCY IN THE STATE ECONOMY**Abstract.**

The article deals with the issues on the current economic status of the Russian Federation and the USA. The analysis of factors that can speed up the development of the Russian economy in a number of areas, including the financial system, is carried out.

Keywords: *exchange rate, national currency, national economy, international economy, foreign currency, commercial banks, inflation.*

As most analysts predicted, the exchange rate of the Russian national currency has significantly weakened. This decline is explained by another decline in the price of oil on the international market. The direct dependence of the ruble exchange rate on the cost of "black gold" is still obvious and natural. The systematic currency interventions carried out by the Central Bank of the Russian Federation once again show that the strategy for the development of the Russian economy has a clear link to the US economy, namely, lending to the US government debt and the development of the US economy. The categorical reluctance to develop the real sector of their national economy is becoming more obvious every year. In the modern Russian economy, every "major player" plays his own so-called "game". The industrial sector is mainly represented by commodity corporations: oil companies, metal and steel companies. The largest oil vertically integrated corporations make huge profits from oil exports and are more than interested in making all payments to them in US dollars, taking into account the exchange rate ratio. The financial sector of the Russian economy, which is mostly represented by commercial banks, is also primarily interested in getting extra income and during the crisis, instead of lending to the real sector of the economy, is engaged in active speculation on the foreign exchange market.

Over the past 10 years, the US dollar has grown by more than 2 times. Despite the fact that during this

period of time, there was sharp punctuation of currencies, and the exchange rate was approaching a record high of 80 rubles per dollar in early 2016.

A similar situation was observed in March the year 2020 when the dollar broke the mark of 80 rubles. This trend, observed from year to year, significantly undermines confidence in the Russian ruble on the international market, which, of course, negatively affects the investment attractiveness of the Russian market.

However, in our opinion, despite the globalization of the international economy and the openness of the economies of all developed countries, the erosion of confidence in the national currency within the country is much more significant and significant.

From a financial point of view, a very large share of savings among Russians is in foreign currency. The Russians are not afraid of even the meager interest rates on dollar deposits and Euro. The high level of inflation, low level of economic growth (and sometimes its reverse indicator), as in the 90s of the last century, are an unspoken call to invest in foreign currency, both from the point of view of saving their capital, and from the point of view of their capitalization.

Domestic investment in the national economy gives any country economic growth. This was clearly presented during the Soviet era. Despite the fact that the Soviet economy was "closed", being under the "iron curtain", about 80% of GDP was focused exclusively on the military-industrial complex. Nevertheless, the

savings of all Russian citizens in the Soviet era were exclusively in the national currency.

And this was quite obvious in the "closed" administrative-command economy. However, the essence of the economic breakthrough was explained, in my opinion, not only by the type of economic system. The reason for the demonstration of economic growth, in our opinion, is the financial and economic plan. In other words, the commodity and money turnover has moved and has given income to the national economy, because the country's citizens keep all their savings in the national currency, thereby lending to the national economy and enabling it to develop and demonstrate economic growth. The issue of inflation is also resolved under this condition. It is very easy for the state to control the correspondence of the money supply to the mass of goods, since all savings are in the national currency and the financial regulator (in our time - the Central Bank) can easily and effectively regulate the balance of the national economy through the issue function. At the same time, the national currency is full-fledged, in the absence of alternative sources of savings and investment within the country's market.

However, in the modern world, with the massive globalization of the economies of all countries, such an economic model is utopian. All developed countries have open economies. Accordingly, all developed countries have well-developed financial markets and currency markets, including.

What is the problem with the lack of economic growth and the fall in the national currency? The answer probably lies in a number of factors that artificially slow down the development of the Russian economy in a number of areas, including the financial system. It is not a secret that the financial system of any state, like the circulatory system of a living organism, is designed to supply the economy with investments for its development and growth.

The ideal model of the economic balance of any country is that the issue of money should correspond to the mass of goods. This is the principle that Central Banks in all developed countries adhere to. The issue of funds is determined by the ratio to GDP, GNP, gold reserves, etc.. And if there is an increase in proportion in the direction of increasing the mass of commodities, i.e. higher GDP, it leads to a rise in a country's currency, i.e. increase the rate of a certain currency on the foreign exchange market. For the most part, these economic indicators allow us to set the exchange rate of one currency against the currencies of other countries. As mentioned earlier, the country's economic balance will be stable if there is a clear link between the money supply in circulation and the commodity mass within the country. If alternative savings funds appear within the state, expressed in the currency of other countries, the principle of matching the money supply to the commodity mass is violated. It turns out that all the total income produced by one country during the reporting period is not expressed in the national currency, but the savings of citizens, the value of the country's produced income, are sent to the currency of another country. In this situation, there is inflation in the country where a foreign

currency appears as a way to save and increase the capital of citizens, and the automatic increase in the price of foreign currency, since this foreign currency is used as a means of saving and capitalization. Theoretically, a country whose currency is used as a means of saving and turnover does not need to produce anything! Its currency becomes more expensive only on the basis that it is accepted for payment and used as a means of saving, actually lending free of charge to the economy of this country, crediting its public debt, crediting the military-industrial complex of this country (which is already strategically dangerous for the economies of all countries). But the most important thing is that by investing in foreign currency, Russian citizens stimulate economic growth of the USA, not Russia. If a foreign currency in a certain country is perceived as a means of circulation and accumulation, then the issuing country appropriates the income produced in another country, where the foreign currency is perceived as a means of saving. This immediately raises a reasonable question. And why are Russian citizens so inclined to spend their savings in a foreign currency – the US dollar and Euro? It is very difficult to answer this question unambiguously. There are many reasons for this. One of the most significant reasons, of course, is that the political and economic situation observed in Russia for several decades does not meet the criteria of stability, which is why Russian citizens – domestic investors in the economy, do not have sufficient confidence in the state and, consequently, in the national currency. After serious crises, defaults, that were observed during the 90-ies, formed a certain attitude of citizens to the foreign exchange market in Russia and the country's financial system as a whole.

For these reasons, Russian citizens have a significant part of their savings in foreign currency. And the purpose of saving in foreign currency is significant fluctuations and punctuation in the world currency market, which is why the foreign exchange rate may increase sharply relative to the ruble. The currencies of many developed countries are tied to the world price of oil, and as soon as a country, a major oil exporter, such as Saudi Arabia or Iran, "opens the tap" and begins to sell oil in huge volumes at reduced prices, that's when the price of oil on the world market decreases...and with it the depreciation of the Russian ruble! So the change in the exchange rate is not caused by short – term growth of foreign economies-the level of US GDP as it was, as a rule, and remains at a certain level. This sharply reduces the price of the Russian currency-the ruble, which is directly dependent on the world price of oil. In addition, if you delve into the very concept of a monetary unit – the currency of a particular country, then in fact it is a paper with a certain denomination and a certain issuer. But using a foreign currency as a means of saving means direct exchange only of banknotes of different countries. In fact, using the US dollar as a means of saving, for example, means that we pay for the purchase of banknotes issued by the US Federal reserve with real goods, or rather raw materials: oil, metals, wood, coal and other natural resources. With rare

exceptions, ready-made knowledge-intensive and capital-intensive products are exported from Russia. Raw materials are mainly exported to Russia.

Indeed, we can go to a commercial bank and exchange Russian rubles for US dollars in the proportion of 80 to 1 according to the exchange rate. Given that the Russian Federation has a two-tier banking system, commercial banks are lent by the Central Bank of the Russian Federation. But the "independent" Central Bank of the Russian Federation, taking into account the current policy of the Ministry of Finance, purchases currency on the international currency market... Here in principle everything is clear... There is only one question. What does the Central Bank of Russia buy US dollars for? The Central Bank of the Russian Federation buys US dollars for our oil, steel and other raw materials that Russia exports abroad.

It turns out that for real raw materials, Russia receives a foreign currency – a paper that shows the nominal value and the issuing country. In fact, the cost of expensive US resources costs the cost of paper and paint to print dollars, just because its currency is accepted for payment. The main lobbyists for selling raw materials abroad in US dollars in Russia are, of course, oil exporters. Moreover, these companies-vertically integrated oil producing and refining companies that sell oil abroad, are very interested in devaluing the national currency, because if the value of the Russian ruble decreases, having huge foreign exchange reserves when the national currency is devalued, they will get super profits when exchanging US dollars for rubles. And the talk that when the ruble exchange rate falls, the value of shares of major companies decreases and they suffer losses is not true. On the contrary, often at times of sharp punctuation in the international currency market and a sharp decline in the value of the ruble, holders of large reserves of foreign currency win significantly on the currency difference, since it automatically becomes more expensive in the ruble equivalent. And this is primarily the largest companies that export raw materials abroad, as well as the banking sector, which is also actively buying up currency. Moreover, the devaluation of the ruble and subsequent inflation can also be achieved by commercial banks engaged in speculation on the domestic currency market.

Commercial banks, analyzing the financial and economic situation in the world and the country, can unite in so-called cartels and begin to actively buy foreign currency from the Central Bank and economic entities within the country. As soon as the foreign exchange reserves are exhausted and a huge part of the foreign exchange reserves is concentrated in commercial banks, a sharp jump in the foreign exchange rate will automatically occur, since the value of the currency will be set by commercial banks. In this case, we must pay tribute to the fact that the policy pursued by the Central Bank of the Russian Federation is quite effective in such a development. In such situations, the Central Bank of the Russian Federation stops selling currency inside the market, releases the ruble exchange rate, thereby saving the country's foreign exchange reserves.

An interesting phenomenon is the prosperity of the American economy. Since the Bretton Woods agreement, the US dollar has been recognized as the world's reserve currency because the US suffered the least from World War II and because the US had the largest gold reserve at that time. The US dollar was recognized as the world currency and the rule was adopted that the value of the currency should be secured by gold, and later the IMF accepted the condition that no state has the right to issue its currency more than the amount that it has in reserves in dollar equivalent, that is, in US dollars. Lobbyists for these bills were the wealthiest families in the US and co-owners of the fed. Thus, since the mid-50s of the last century, the US dollar has taken the role of the reserve currency of the world and the role of the world currency. Since then, many developed countries have held huge reserves of US dollars, such as Russia and China, thus providing free loans to the US economy, stimulating its active growth, and covering the US trillion-dollar national debt. Oil is the greatest discovery of all time. And in the modern world, oil is not only the number one energy raw material in the world, but also a component that is contained in the production process of almost any product. The fact is that Americans sell their "printed paper dollars" in exchange for real resources and raw materials – primarily oil. This is why, taking advantage of the fact that the US dollar is the world's reserve currency, the whole world actually credits the US economy, actually giving away such a basic energy raw material – oil! America just needs to turn on the printing press. The fed prints as many US dollars as necessary, and credits its real sector of the economy – absolutely all industries, production, processing, education, etc. and then collects financial resources through taxes. Thus, uncontrolled emission (the volume of emission is classified) the US is spinning its economy, which under such conditions demonstrates phenomenal growth rates. It would seem that with a large issue of money supply, hyperinflation should begin...but it is not in the US. What is the secret? Why is it that with a colossal money supply, which is clearly more than the mass of goods, prices do not rise in the United States and store shelves are not empty? Why doesn't the US devalue the dollar? This is because the excess money supply, which is no longer such, is transferred by the US to other countries in exchange for the income generated by the country that accepted US dollars for payment for its goods. Simply put, the United States buys raw materials and goods for its printed US dollars, which are no longer really a currency, but only printed paper. This explains economic growth and the absence of hyperinflation in the US. And as soon as over-printed paper dollars come back from abroad to the homeland, they are immediately withdrawn from circulation. This explains most of the world's crises in recent decades. Those countries that accept US dollars for exchange for their raw materials and goods, and put the US currency into circulation, immediately undermine their economy and financial system. And the US economy is thriving.

The US economy gets a boost to the development of the economy, and it is successfully developing without any effort on the part of the state itself because the

whole world, being the holder of huge reserves of US dollars, credits the American economy.

Russia is the world's largest exporter of oil and other raw materials. The terms of international settlements in the Russian national currency are an obvious advantage for the Russian economy. Buying Russian raw materials from foreign countries for Russian rubles would dramatically increase the exchange rate of the

Russian national currency. And along with the increase in the ruble exchange rate, Russia's investment attractiveness increased, both in financial and real terms, and the Russian economy showed high growth rates. For the development and growth of the national economy, the state must create favorable conditions for investment of the economy by citizens of this state.

UDK 332.2 (477)

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[DOI: 10.24412/2520-6990-2021-794-48-56](https://doi.org/10.24412/2520-6990-2021-794-48-56)

FEATURES OF LAND RELATIONS REFORM IN UKRAINE

Abstract.

Agricultural production, in contrast to industry and other areas of economic activity, is characterized by specific, unique properties associated with the biological basis of production processes. The obligatory need for agriculture is also the availability of land resources as the main means of production. The role and place of land in the agricultural economy is now defined quite significantly. From an economic point of view, land is the object of economic activity, the material base of production, the source of meeting human needs.

Involvement of land in economic relations has defined a special type of relationship – land relations. The content of this concept makes private land ownership one of the most important elements of protection of the system of civil rights, state guarantees of business and investment activities. These phenomena are a consequence of Ukraine's transition to a market economy. This, in turn, was inevitably accompanied by the transformation of the economic mechanism, changes in forms and methods of management. In agriculture, such transformations were marked by reform. It is the process of land reform in Ukraine that focuses on providing a legal basis for implementing the requirements of international law of economic freedom and independence. According to scholars, economic freedom is the basis and component of the freedoms of civil society. The guarantee of personal freedom of a citizen is private property [1], [3]. Given that man is a social being, property allows him to feel independent and be more confident within society. Private property is the product of a mature self-consciousness of the individual. It is effective when the owner and the owner are combined in one person, due to which there is a greater material interest in working better and more efficiently for their own good. Such goals are envisaged by the completion of land reform in Ukraine. The article describes the chronology of land reform and highlights key legislation that had a significant impact on its progress. The key problems of completing land reform and prospects for land market development in Ukraine have also been identified.

Keywords: *land, private property, regulation, land reform, agricultural land, land market, farms.*

Results. In Ukraine, the category of private property has come a long way from evolution, from the monopoly of public property under socialism in the early twentieth century, when collective and state enterprises were created, to a market economy in a multifaceted environment. The country's agriculture underwent a process of forced collectivization, and the land was nationalized. This provided for the creation on the basis of private property of peasants agricultural cooperatives, and on the basis of large landed estates – state farms (state farms). The disadvantage of this model of state and collective forms of ownership in agriculture, as Azizov, S. emphasizes, should be considered that the workers were separated from the ownership of the means of production and economic results. This state did not encourage them to highly productive work, efficient use, accumulation and economic storage of means of production, manufactured products, and the private interest of the peasant was lost [1].

After the collapse of the USSR and the disbandment of the command-and-control conditions of the planned economy, the introduction of market economy principles in the sphere of domestic agricultural policy took place in a period characterized by political uncertainty, economic instability and stagnation of agricultural production. The inconsistency of the regulatory framework for the completion of land reform had a negative impact on the process of agrarian reform. The problem was exacerbated by the conservative views of officials with conservative communist ideological views [2].

The reform of the development of the Ukrainian system of land relations began with the proclamation by the Verkhovna Rada of the Ukrainian SSR on July 16, 1990, of the Declaration on the State Sovereignty of Ukraine. This document confirmed the fact that Ukraine withdrew from the Soviet Union and gained independence. The fundamental motive of land reform

was the text of the Constitution: «land, its subsoil, air-space, water and other natural resources located within the territory of the Ukrainian SSR, natural resources of its continental shelf and exclusive (marine) economic zone, all economic and scientific-technical the potential created on the territory of Ukraine is the property of its people, the material basis of the sovereignty of the Republic and is used to meet the material and spiritual needs of its citizens» [5]. The result of the land reform was the transfer of ownership of state-owned agricultural land to the peasants. This political step became the basis for the formation of market land relations. Citizens have been granted a full range of rights in relation to land resources in the form of possession, use and disposal of it [22].

Land reform began with the basic ideology ... the land should belong to those who cultivate it [24]. On October 1, 1990, the Verkhovna Rada of the Ukrainian SSR adopted the Concept of the Transition of the Ukrainian PCP to a Market Economy. The fifth section of this document states: The transition to market relations implies a radical transformation of agrarian relations, which requires land reform. However, as the content analysis showed, this document did not contain specific ways to achieve the stated goal. On December 18, 1990, the Verkhovna Rada of the Ukrainian SSR adopted the Resolution «On Land Reform». This document initiated the reform of land ownership and the formation of market relations in the countryside. Based on the above Concept, the Verkhovna Rada of the Ukrainian PCP adopted the Land Code of the Republic of Ukraine. The Code declared the land the property of the people and stipulated the procedure for granting it to citizens for life inherited possession. The restraining factor of such a transfer should be considered that according to Article 11 of the Constitution of the USSR (in force on the date of adoption of the Code), the land was still in the exclusive ownership of the state. Therefore, the real transition to market relations in the agro-industrial complex was not possible without resolving the issue of transfer of land to private ownership [1, 2].

The implementation of this obstacle was planned to be solved by unbundling the lands of collective agricultural enterprises. Citizens received the right to receive a land share (share) according to the 1992 Land Code. Article five stated that each member of a cooperative or collective farm, provided he left its structure, could receive a land share in the amount of the average land share of the region. The same Code provided that this right could be inherited or subject to sale. The Decree of the President of Ukraine of October 10, 1994 № 666/94 «On Urgent Measures to Accelerate Land Reform in the Sphere of Agricultural Production» [24] was of great importance in regulating these norms of the Land Code. This document specified that each member of the sold economy was issued a certificate. This document confirmed his right to privatize the land share. The certificate recorded the actual area of the land share in conventional hectares and in monetary terms. In addition, the Decree provided that a citizen-shareholder could dispose of the certificate by donation, sale, exchange, inheritance, pledge, and if desired, could receive land for cultivation.

On August 8, 1995, the President of Ukraine issued Decree № 720/95 «On the Procedure for Sharing Lands Transferred to Collective Ownership by Agricultural Enterprises and Organizations» [25]. The decree stipulates that the right to a land share is also granted to formerly working pensioners who remain members of these enterprises and have a share in the collective ownership of land. It should be noted that within the time period when the above regulations were adopted, citizens actively privatized land plots provided by the Land Code for personal farming, gardening, housing, cottage and garage construction or horticulture.

The expediency of dividing the land of collective farms was motivated by the fact that the peasant becomes economically independent. This was to ensure the equal development of various forms of management in Ukraine and to promote land protection. Acceleration of these events was facilitated by the issuance by the President of the Decree On Land Lease on April 23, 1997 and the adoption of the Law of Ukraine On Land Lease on October 6, 1998 [7]. As a result, it became possible to lease whole plots of land to anyone. The adoption of the Resolution of the Cabinet of Ministers of Ukraine of January 24, 2000 № 119 contributed to the regulation of lease relations. The resolution determined the procedure for registration of land share lease agreements (shares). And by the order of the State Land Committee of Ukraine dated January 17, 2000 № 5 the form of the Standard contract of lease of the land share (share) was established. The conclusion of such an agreement has strengthened the legal protection of landowners and land users [7].

Despite the created institutional conditions for market transformations, the process of development of private farms was slow. This phenomenon can be explained by the lack of experience of the peasants in doing business, the lack of the necessary theoretical and methodological materials and the lack of the necessary means of production. In addition, the peasants had no idea of land as a family value. This was facilitated by the absence of cases of inheritance of family farms and private land ownership.

At the time of the reform, the Soviet collective and state farms concentrated considerable material and technical potential for agricultural production — land, machinery, buildings, and resources. However, the limited financial capacity of Ukrainian peasants limited the prospects for investment development of small farms. This is confirmed by the fact that at the end of 1999 in Ukraine less than 10% of collective enterprises were reorganized [2].

The reform of land relations was intensified after the President of Ukraine signed the Decree «On urgent measures to accelerate the reform of the agricultural sector of the economy» on December 3, 1999 [24]. According to this document, land shares were transferred to private land holdings with clear boundaries. For this purpose, the Law of Ukraine of June 5, 2003 № 899-IV «On the procedure for allocating land plots in kind (on the ground) to owners of land shares (units)» [8] was adopted and a resolution of the Cabinet of Ministers of Ukraine of April 4, 2004 was issued № 122 «On the organization of works and methods of distribution of

land plots between owners of land shares (units)» [24]. That is, only eight years after the beginning of land division, its legislative regulation took place. As a result of this legislative activity, the process of citizens' exchange of certificates for the right of ownership of land shares (units) to state acts intensified.

On October 25, 2001, the new Land Code of Ukraine was adopted. It entered into force on January 1, 2002. This legal act has become a conceptual bill governing the reform of land relations and the formation of the land market. Private, state and communal forms of land ownership have become equal [10].

Part three of Article 22 of the new Land Code of Ukraine defines the following categories of targeted use of agricultural land: for personal farming; for gardening and horticulture; for cattle grazing and haymaking; for conducting commodity agricultural production; and for the organization of farms [10].

The new version of the Land Code of Ukraine also supported the following Constitutional norms:

- «Land is the main national wealth under special state protection» (Article 14);
- «Ensuring ecological safety and maintaining ecological balance on the territory of Ukraine is the duty of the state» (Article 16)
- «No one may be unlawfully deprived of property rights. The right to private property is inviolable».
- «Everyone has the right to engage in entrepreneurial activity, which is not prohibited by law» (Article 42) [10].

Analyzing the Ukrainian legislation and taking into account the research of Tretyak, A [23] we note sixteen elements of land ownership in Ukraine: the right to own land, the right to use, the right to dispose, the right to lease, the right to manage, the right to income from land, the right to security of property, the right to rent, the right to transfer property rights to inheritance, the right to capital value, the right to contribute to the statutory fund, the right to transfer rights to land easements, the right to emphyteusis, the right to superficies, the right to pledge, the right to prohibit benefits in a harmful manner, the right to compensation. Disclosure of these elements of land ownership in terms of its market circulation is of particular importance. We believe that the more of these rights are assigned to the land, the greater will be its value and market value.

It will be recalled that together with the adoption of the Land Code in 2001, a moratorium on the sale of agricultural land was introduced. According to paragraph 15 of section X of the Land Code, the date of lifting the moratorium has been repeatedly postponed. Article 15 of the Transitional Provisions of the new Land Code of Ukraine provided that until January 1, 2005, citizens and non-state legal entities could not sell or otherwise alienate property rights. This norm applied to two categories of land they owned: plots allocated for farming or other commodity agricultural production and land shares (shares). The prohibition did not apply to the right to exchange, inherit and seize land for public use. The government planned to establish this ban to provide additional time for the formation of legislation necessary to create a land market [18]. But this process

took quite a long time. The moratorium was systematically extended:

1. Until January 1, 2007 with a ban on land exchange. During this period, the legislation was aimed at banning shadow mechanisms to circumvent the moratorium. Such illegal mechanisms provided for the conclusion of agreements for the future. But by law they were declared invalid from the moment of signing [10].

2. Until January 1, 2008, except for the lands intended for conducting commodity agricultural production. The moratorium was extended to lands intended for personal farming and any change in the purpose of the land covered by the moratorium was prohibited. But it was allowed to conclude agreements to exchange one plot for another.

3. According to the wording of the Land Code of Ukraine of January 1, 2008, paragraph 15 of the Transitional Provisions establishes the following conditions for lifting the moratorium «... until the entry into force of the laws of Ukraine «On State Land Cadastre» and «On Land Market» ...». On January 19, 2010, this item was supplemented with a new date – January 1, 2012. During this period, of these conditions, on July 7, 2011, only the Law of Ukraine «On the State Land Cadastre» was adopted. And on December 9, 2011, the Verkhovna Rada of Ukraine adopted the draft Law of Ukraine «On the Land Market» in the first reading. During the sitting of the Verkhovna Rada of Ukraine it was proposed to rename the Law of Ukraine «On Land Market» to the Law of Ukraine «On Circulation of Agricultural Land» [10].

4. In the following wording of the Land Code of Ukraine dated of December 30, 2011, item 15 of Section X was rewritten as follows: «Purchase or sale or other alienation of land plots and land shares (units) is prohibited until the entry into force of the Law of Ukraine «On Land Market», but not earlier than January 1, 2013...» [10].

5. On November 20, 2012, the parliament adopted in the second reading amendments to the Land Code, according to which the moratorium was extended for the period until the adoption of the law On the circulation of agricultural land, but not earlier than January 1, 2016. [10]. The law, which extended the moratorium, instructed the Cabinet of Ministers of Ukraine to draft a Law of Ukraine «On the Circulation of Agricultural Land» within six months. Despite the fact that the draft Law of Ukraine «On Land Market» was approved in the first reading on December 9, 2011, it has not been adopted yet. It was envisaged to change the concept of this bill with the change of its name to the Law of Ukraine On the circulation of agricultural land. Another extension of the moratorium was necessary to develop an effective mechanism for selling land and preventing possible abuses.

6. In November 2015, the Verkhovna Rada again extended the moratorium on the sale of agricultural land until January 1, 2017. Lifting the moratorium in the context of military conflict and economic crisis would be a threat to national and food security. It could also threaten the loss of land as an important national

resource. It was necessary to develop a plan for the introduction of agricultural land, which will be clear and safe for citizens.

On June 7, 2016, the Verkhovna Rada of Ukraine adopted another law «On Amendments to Section X «Transitional Provisions» of the Land Code of Ukraine to extend the ban on the alienation of agricultural land». According to this Law: «In paragraphs 14 and 15 of Section X «Transitional Provisions» of the Land Code of Ukraine, the figures «2017» shall be replaced by the figures «2018» [6]. Thus, the time period for banning the market circulation of agricultural land was extended until January 1, 2018. Given that the creation of a land market was a necessary component of the development of a market economy, the market had to be transparent and fair. Thus, the extension of the moratorium was necessary to develop legislation that would regulate the land market.

8. On December 31, 2017, another law «On Amendments to Section X «Transitional Provisions» of the Land Code of Ukraine» came into force. This once again extended the moratorium on sale or alienation until January 1, 2019. The lifting of the moratorium in the context of Russia's military aggression and economic crisis in the absence of legislation governing the circulation of agricultural land threatened national and food security [18].

9. February 07, 2019, the law on the extension of the moratorium on the sale of agricultural land for another year – until January 1, 2020.

10. March 31, 2020 can be considered a significant date in the completion of land reform. On this day, the law On Amendments to Certain Legislative Acts of Ukraine Concerning the Conditions of Circulation of Agricultural Lands was adopted [9]. This act already offers clearer positions in the introduction of market circulation of agricultural land. This bill enters into force on July 01, 2021, and is characterized by the following innovations:

1. The introduction of the circulation of agricultural land will take place in stages:

- from July 01, 2021 to 01. 01. 2024 buyers will be able to be individuals (only citizens of Ukraine);
- from January 1, 2024 the buyers will be able to be legal entities owned by citizens of Ukraine.

2. Restrictions on the acquisition of ownership of agricultural land with a total area of up to one hundred hectares will apply to citizens until January 1, 2024. From January 1, 2024, the purchase of 10 thousand hectares will be allowed for citizens and legal entities.

3. State lands will be made available to communities and they will only be able to lease them, but not sell them. It will be similar with state and communal lands.

4. Banks will also be able to acquire the right of ownership of agricultural land plots, but only in case of their confiscation as collateral for non-payment of the loan. However, such land plots must be sold by them at a land auction within two years from the date of acquisition of ownership.

5. Citizens of Ukraine who have the right of permanent use, the right of lifelong inherited ownership of land plots of state and communal property intended for peasant (farming) economy, as well as tenants of land

plots who have acquired the right to lease land by re-issuing the right of permanent use plots until 2010, have the right to purchase such land in the property with installments of up to ten years at a price equal to the normative monetary value of such land, without land auction.

6. Until January 1, 2030, the sale price of agricultural land plots allocated on the ground to owners of land shares (units) may not be less than their normative monetary value.

7. Permission to grant property rights to agricultural land to foreigners will be adopted in an all-Ukrainian referendum.

8. It is strictly forbidden to grant ownership of land:

- legal entities, participants or beneficiaries of which are foreigners – on state and communal lands. It is also prohibited to sell land located closer than 50 km from the state border of Ukraine (except for the state border, which passes by sea);

- legal entities, participants or final beneficiaries of which are citizens of Russia;

- persons who belonged or belong to terrorist organizations;

- legal entities, participants or beneficiaries of which are foreign states;

- legal entities where it is impossible to identify the final beneficiary;

- legal entities whose beneficiaries are registered in offshore zones;

- individuals and legal entities subject to sanctions;

- legal entities registered in the states included in the list of those who do not cooperate in the field of combating money laundering.

Summarizing the chronology of the described events, taking into account the results of our own research [13], we highlight the following stages of land reform in Ukraine:

- the first stage (1990-1992). The beginning of land reform. Adoption of the Resolution of the Verkhovna Rada «On Land Reform» of December 18, 1990;

- the second stage (1992-1996). The lands were denationalized and transferred to collective farms. The Law of Ukraine «On Forms of Land Ownership» of January 30, 1992 was adopted;

- the third stage (1997-1999). Formation of private land ownership as a result of shares through the issuance of land certificates;

- the fourth stage (2000-2019). Development of land lease relations. The beginning of the formation of the legal field for the land market. Establishing a ban on the sale of agricultural land;

- the fifth stage (2020 – present). Adoption of the new Law of Ukraine «On Amendments to Certain Legislative Acts of Ukraine Concerning the Conditions of Circulation of Agricultural Lands» № 552-IX. The law ensured the beginning of the formation of a full-fledged legislative field for the introduction of market circulation of agricultural land. At this stage, the implementation of a set of measures to ensure the mechanism of practical implementation of the constitutional rights

of citizens to freely dispose of their property is envisaged. Creating conditions for the acquisition of agricultural land by citizens of Ukraine.

It is worth noting the main feature of modern land relations in Ukraine. It is that most peasants do not have the physical ability to cultivate their own land, so they rent them out on the basis of contracts. In 2019, 4.9 million such lease agreements were concluded for 17.6 million hectares of total land area, of which 0.75 million were agreements with farms. According to our own research, we can conclude that rents in Ukraine are quite low. When conducting their own research among landowners-landlords, dissatisfaction of 98% of respondents with the amount of rent was recorded [13]. In addition, it was noticed that low rents underestimate the value of land for its owners, and accordingly – its potential market value. As defined in Part 2 of Art. 21 of the Law of Ukraine On Land Lease [7] the amount of rent for land is set by agreement of the parties in the lease agreement. However, in accordance with item 1 of the Presidential Decree of February 2, 2002, № 92/2002 «On additional measures for social protection of peasants – owners of land plots and land shares (units)», not less than 3% of the normative-monetary assessment of the land plot [26], which is defined in the certificate of receipt of land.

Given the large number of landlords (almost 5 million people), it should be noted that the ideology of land reform was violated, according to which the land should belong to those who will work on it. We agree with the opinion of Martin, O [17] that the land should pass from a person who is not interested in its use, to the owner, who has a desire to cultivate it and make a profit. We motivate this by the fact that the owner of the resource on a conscious level will be more careful about their property. It is in the interest of the landowner to attract innovative techniques and technologies to maximize the return on investment. For a start, this will be possible for Ukraine only if the state controls the market for agricultural land.

Let's pay attention to the importance of small farms. As Lutsyak, V says: «small business due to its unique characteristics (freedom of decision-making, focus on rationality, risk sharing, innovation, initiative, activity) is the basis for economic security of the state» [15]. In accordance with paragraph 3 of Art. 55 of the Commercial Code of Ukraine, business entities are divided into micro-enterprises, small, medium and large enterprises according to the criteria of the number of employees and income from any activity for the year. The subjects of micro-entrepreneurship are: natural persons registered in the manner prescribed by law as

natural persons – entrepreneurs, and legal entities – business entities of any organizational and legal form and form of ownership. They have an average number of employees for the reporting period should not exceed ten people. Their annual income from any activity does not exceed the amount equivalent to two million Euro, determined at the average annual rate of the National Bank of Ukraine.

Ukrainian statistics authorities distinguish the following types of agricultural producers:

1. Agricultural enterprises – economically independent economic units with the right of legal entity. They are engaged in the production of agricultural products for sale and operate on a business basis. Agricultural enterprises also include farms.

2. Farming – a form of entrepreneurial activity of citizens with the creation of a legal entity who have expressed a desire to produce marketable agricultural products. They are engaged in processing and sale of products in order to make a profit on land provided to them for farming.

3. Households – households engaged in agricultural activities. The purpose of such activities is self-sufficiency in food and production of marketable agricultural products. This category of producers also includes natural persons – entrepreneurs who carry out their activities in the field of agriculture.

In Ukraine, the most common small businesses in the agricultural sector are farms, personal farms (prototype family farms), individuals – entrepreneurs who operate in the field of agriculture and personal farms.

Summarizing the above analyzed research, it is safe to say that the fact of private ownership of land is the main criterion for the efficiency of agricultural production. As a generalization, we give the judgment of Luzan, Ya. [14], who summarized the system and complexity of, in our opinion, the most promising model of farming in the following:

1. farmer – the owner of land capital and property;
2. new principles of production relations based on the principles of sole ownership of land, ownership of production resources and own labor;
3. implementation of production on the ideology of market conditions;
4. providing a controlled land market with a developed infrastructure.

As a result of land reform in Ukraine, a specific structure of the land fund was formed. As of January 1, 2019, the land area of Ukraine was 60.3 million hectares (about 6 percent of Europe). Let us illustrate the comparative characteristics of the state of land use in European countries (Table 1).

Table 1.

Comparative characteristics of the state of land use in European countries and Ukraine in 2019

Indicator	Ukraine	Europe	Countries EU
Total area, million hectares	60,4	1017	438
Area of black soil, million hectares	28	85	20
The area of agricultural lands destination, million hectares	42,7	475	178
Area of arable land, million hectares	32,5	278	116
Share of leased land in agricultural land use,%	97	65	55
Area of agricultural land certified as organic, million hectares	0,3	12,8	8,5
Area of irrigated land, million hectares	0,5	22,8	15,1
Amount of investments, US dollars / ha	1450	4260	6860
Grain exports, million tons	41,8	130	38,5
Area of agricultural land per capita, ha / 1 person	0,9	0,6	0,4
Price per 1 hectare of agricultural land, thousand US dollars	–	4,7	8,2

Source: compiled by the authors based on the data from official website of the State Service of Ukraine for Geodesy, Cartography and Cadastre [19] and Eurostat [20]

In the further analysis of land relations of Ukraine it is necessary to pay attention to the value of land resources in ensuring food security. The main part of food in the XXI century is obtained only on 9% of the Earth's surface (arable land, gardens, plantations, meadows, pastures). According to the Food and Agriculture Organization (FAO), up to 3.2–3.5 billion hectares (20%) can be used in world agriculture. Of this area, only 0.45 billion hectares after development can become highly productive agricultural land. At the same time, of all arable land, only 1.1 billion hectares can be irrigated. The destabilizing factor is that only part of the land used for agricultural production uses intensive land use technologies [4]. Ukraine's agricultural land accounts for almost 19% of Europe's reserves. At the same time, the high level of soil fertility in Ukraine is able to provide food for 140 to 180 million people a year [3]. The area of black soil on the territory of Ukraine is, according to various estimates, from 15.6 to 17.4 million hectares (8% of the world level).

As of January 1, 2019, the area of state-owned land in Ukraine was 47.9%, private – 52.0%, non-state agricultural enterprises – only 0.1%. A significant part of the land area (70.9%, or 42,776.9 thousand hectares) is agricultural land, in the structure of which agricultural land – 68.9%. Arable land accounts for 53.8%, pastures occupy 9.1%; 4.0% – hayfields; 1.5% – perennial plantings; 0.5% – fallows. These figures confirm the highest provision of Ukraine with agricultural land – 0.9 hectares and 0.7 hectares of arable land per capita. This is the highest figure among EU countries. For example, in Poland – 0.38 hectares of arable land, and in France – 0.30 hectares [20].

At the present stage, the result of land reform has been the elimination of the state monopoly on land [24]. Gradually there are changes in the composition and structure of the land fund of Ukraine. Let's compare its structure from the beginning of independence till today (tab. 2).

Table 2.

Change in the structure of the land fund of Ukraine for 1991-2019, thousand hectares

Type of land	Years		2019 till 1991 +/-
	1991	2019	
Agricultural land	42030,3	41407,9	–622,4
Forested areas	10221,3	10433,1	211,8
Built-up land	2161,2	2552,9	391,7
Wetlands	884	982,3	–98,3
Open lands without vegetation or with little vegetation	1314,5	1020,6	–293,9
Reservoirs	2435	2426,4	–8,6
Other lands	1308	1231,7	–76,3
Total	60354,9	60354,9	0

Source: compiled by the authors based on the data from official website of the State Service of Ukraine for Geodesy, Cartography and Cadastre [19]

Since January 1, 1992, 6.9 million citizens have acquired the right to a land share. As a result, almost 27 million agricultural lands (74.8%) were transferred to private ownership for commercial agricultural production. After that, 25.1% remained in state ownership, and 0.1% in communal ownership. Of the arable land, 84.3% is privately owned, 15.6% is state-owned and 0.1% is communal. According to the State Service of Ukraine for Geodesy, Cartography and Cadastre as of January 1, 2019, the average regulatory monetary value

of arable land is 27499 UAH / ha (about 986 Euro or 1093 US dollars) The most expensive arable land is estimated in Cherkasy region 646 UAH / ha or 1207 EUR, 1337 USD). The cheapest land in the Zhytomyr region (21,411 UAH / ha or 768 Euro, 851 US dollars). According to our estimates, the total regulatory assessment of Ukraine's land assets is about UAH 1,138.67 billion. (34.505 billion Euro, 40.667 billion US dollars) [19].

Analyzing the change in the structure of the land fund of Ukraine, it should be noted that by 622.4 thousand hectares there was a decrease in the area of agricultural land. The area decreased from 42030.3 thousand hectares in 1991 to 41407.9 thousand hectares in 2019. The total area of forested land increased from 10,221.3 thousand hectares to 10,433.1 thousand hectares, ie by 211.8 thousand hectares. The area of built-

up land also increased by 391.7 thousand hectares. This is due to the intensification of agglomeration. The distribution of land by the main landowners and land users indicates the predominance of land of agricultural enterprises, which account for 28.7% of the territory (Fig. 2.1).

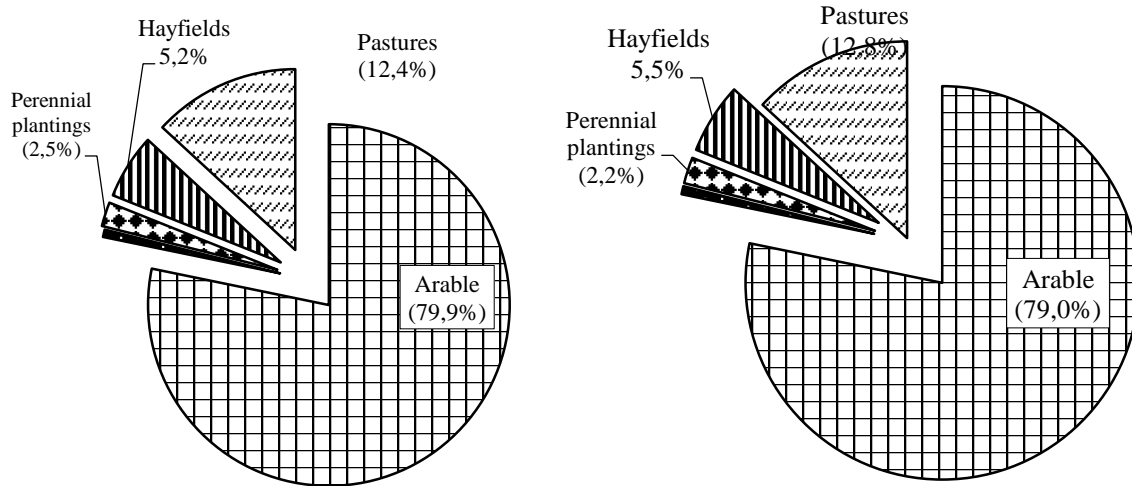


Fig. 2.1. Change in the structure of agricultural lands for the period from 1991 to 2019 in Ukraine
Source: compiled by the authors based on the data from official website of the State Service of Ukraine for Geodesy, Cartography and Cadastre [19]

Considering the changes in the structure of agricultural land, we can say that no significant changes have taken place. The area of arable land decreased by 0.9%, and under perennial plantings by 0.3%. At the same time, the area under pastures increased by 0.3%, fallow lands by 0.7% and hayfields by 0.3%

Reforming land relations in Ukraine as a whole has gone through a number of stages:

1. The destruction of the state monopoly on land and its transformation into a collective and private form of ownership.
2. Renunciation of collective property and its replacement by communal property.
3. Unbundling of lands of former state-owned agricultural enterprises with issuance of certificates of ownership.
4. Allocation of land shares in the area and replacement of certificates for full private ownership of them.

The end of a political and scientific discourse that has lasted more than a decade should be a carefully calculated and implemented institutional system that would ensure the transfer of land from passive landowners to active land users. It is necessary to form a system of effective institutions that would provide a set of market mechanisms of institutional regulation, which will develop the class of farming and ensure the rational and gentle conduct of agricultural business. Institutionalization of market turnover of land in the agricultural sector of Ukraine provides for the modification of domestic elements of its functioning through borrowing and transplantation of certain categories of the institutional system to the conditions of the national agricultural sector. However, this process has only just begun, and despite the duration of land reform, only the

basic institutional skeleton of the domestic model of the agricultural land market has been formed.

An important issue of further reform of land relations in Ukraine in terms of the organization of land relations is to ensure their sustainability, which is associated with the ecological and economic use of land resources, based on rational land use and land protection. Organizational and legal principles of rational use of agricultural land is a set of mandatory legal means aimed at the implementation of the subjects of land relations measures to ensure targeted, economic, environmentally safe use of land, reproduction and increase their fertility [11]. Therefore, based on the achievements of institutional theory, world experience of sustainable land use and our own research, we will try to outline the necessary conditions for basic social and economic measures that would ensure approximation to the goals of sustainable development:

- greening of agricultural production;
- improving public welfare;
- balancing ecological, economic and technological conditions of agro-industrial complex development with social values;
- meeting the growing material and spiritual needs of the population;
- prudence and mercantilism in the use of natural resources;
- providing favorable for human health recreational natural conditions.

Based on the above postulates, sustainable development should be understood as a process of increasing economic and technological exponents of agro-industrial production without devastating consequences for the environment and in terms of promoting the solution of urgent dilemmas of social welfare [12].

Summarizing the views of scientists, we can say that sustainable land use as a component of sustainable development of Ukrainian society is a system of resource use, which is characterized by harmonization and balancing of processes of use of the whole array of communications with the most effective options for specific space and time principles of the relationship man-earth-ecosystem.

The main factor in the compliance of land reform in Ukraine with the requirements of the concept of sustainable development is private ownership of land, so the direction of research was aimed at identifying problems in this area. Among them are the following:

1. Absence of the subject of ownership for certain categories of lands (lands of unaccepted inheritance, unclaimed shares, collective lands), which does not allow them to be fully and legally used;

2. State bodies regulating land relations, nature management and environmental protection do not support proper control over compliance with current legislation in terms of mandatory monitoring of agrochemical conditions of agricultural land, do not effectively implement land ownership rights, do not define environmental and legal aspects of realization of land ownership;

3. The legislation does not define a clear mechanism for punishing legal entities and individuals who receive for temporary use (lease, emphyteusis, land easement, superficies) an agricultural land plot for deterioration of its agrochemical indicators;

4. Restrictive norms of legislation (moratorium) do not allow to fully implement the legal content of ownership of land resources;

5. The long and protracted process of land reform has given rise to a number of illegal shadow schemes for the transfer of ownership of agricultural land;

6. Uncertainty with the subsequent fate of collective ownership of land, as the legislation of Ukraine eliminates this form of ownership, but informally it still exists and is accounted for by the State Service of Ukraine for Geodesy, Cartography and Cadastre;

7. Unresolved problem of distribution of agricultural lands of former collective agricultural enterprises that did not fall under the process of unbundling: non-agricultural lands, economic field roads and access roads, protective plantings, girders, lands under farmyards;

8. Unresolved problem with the existence of unclaimed certificates for the right to receive land shares;

9. Uncertainty of the process of recognizing the inheritance not inherited and the acquisition of rights to it by the territorial community.

The institutionalism of the rules of the market environment for agricultural land should be accompanied by the development of control mechanisms, which in the EU include price regulation, tax regulation and quantitative restrictions on sales. The analysis of world experience indicates the existence of different market models of land turnover, the analysis of which can be useful if we take into account and design the specific features of a country and domestic national interests. It is necessary to develop a unique Ukrainian model of the land market. Its basis has already been determined by

the adoption of the new Law «On Amendments to Certain Legislative Acts of Ukraine Concerning the Conditions of Circulation of Agricultural Lands» № 552–IX [9], which was adopted by the Verkhovna Rada on March 31, 2020 and provides for a number of planned changes:

– from July, 2021 – agricultural land can be purchased only by individuals who are citizens of Ukraine, within the limits of the maximum size of the land plot – 100 hectares per person;

– from January 1, 2024 – in addition to individuals, the right of ownership of agricultural land will also be able to acquire legal entities (participants of which are exclusively citizens of Ukraine), territorial communities and the state. The maximum size of the land plot increases to 10 thousand hectares.

– until January 1, 2030, the legislation of Ukraine sets the lower limit of the price, which for agricultural land allocated in kind (on the ground) to the owners of land shares (units), cannot be less than their regulatory monetary value.

According to the new law, a moratorium on the sale of agricultural land of state and communal ownership is established. Analyzing the prospects of this scenario, it should be noted that it contains certain inaccuracies and gaps. First, the law does not provide for a single procedure for the alienation of agricultural land and does not directly regulate the procedure for buying and selling land, but only states that the transfer of ownership of land is the conclusion of civil law agreements, which determines a fairly wide list. Secondly, the buyer must be checked for compliance with the criteria for acquiring the right to purchase land in certain amounts. The procedure for such verification must be approved by the Cabinet of Ministers of Ukraine and carried out using information from the State Register of Real Estate Rights, the State Land Cadastre and the Unified State Register of Legal Entities, Individual Entrepreneurs and Public Associations.

Conclusions. The analysis of structural changes of agricultural lands, as a result of the land reform in Ukraine, allowed stating the elimination of the state monopoly of land rights as a result of their transfer to citizens by unbundling. A positive consequence of this was the development of various organizational and legal forms of management, among which farms predominate. It is determined that modern land relations in Ukraine between farms and landowners are built on lease terms. An in-depth analysis noted that modern land use in Ukraine does not meet the conditions of sustainable development.

Prospects for the completion of land reform in Ukraine are proposed to be considered in the form of a state-controlled land market. An important step in this direction was the adoption of the Law On Amendments to Certain Legislative Acts of Ukraine on the Conditions of Circulation of Agricultural Land of 31.03.2020. It should be noted that the integration of this law into the regulatory system will provide innovative changes in the process of completing land reform and the development of sustainable land use. The most important measure will be the lifting of the moratorium, which, with its systematic extension, has caused the deepening

of existing problems, namely: landlord of land relations; predominance of lease terms of land use with minimum rental rates; deterioration of the situation with the structure of crops and non-compliance with crop rotations.

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СОСТОЯНИЕ ВАЛЮТНОГО РЫНКА И ВЛИЯНИЕ НА ЭКОНОМИКУ РОССИИ.

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STATE OF THE FOREIGN EXCHANGE MARKET AND INFLUENCE ON THE RUSSIAN ECONOMY.

Аннотация:

В статье рассматриваются особенности современного валютного рынка России и его перспективы развития в будущем. Проведен анализ основных внутренних и внешних факторов, оказывающих влияние на конъюнктуру отечественного валютного рынка. Рассмотрели динамику ключевой ставки ЦБ РФ и динамику курсов евро и доллара к рублю.

Abstract:

The article examines the features of the modern Russian foreign exchange market and its development prospects in the future. The analysis of the main internal and external factors influencing the situation on the domestic foreign exchange market is carried out. We examined the dynamics of the key rate of the Central Bank of the Russian Federation and the dynamics of the rates of the euro and dollar against the ruble.

Ключевые слова: валютный рынок, котировка, интервенции, денежно-кредитная политика Банка России.

Key words: foreign exchange market, quotation, interventions, monetary policy of the Bank of Russia.

Валютный рынок — это рынок, на котором покупатель и продавец участвуют в покупке и продаже иностранных валют.

Роль валютного рынка в экономике проявляется через его функции:

1. Функция перевода. Основной и наиболее заметной функцией валютного рынка является перевод средств (иностранной валюты) из одной страны в другую для урегулирования платежей. В основном это включает конвертацию одной валюты в другую, где роль валютного рынка заключается в передаче покупательной способности из одной страны в другую. Например, если экспортер Индии импортирует товары из США, и оплата должна быть произведена в долларах, то конвертация рупии в доллар будет осуществляться валютным рынком. Передаточная функция выполняется с использованием кредитных инструментов, таких как банковские чеки, векселя и телефонные переводы.

2. Функция кредитования. Валютный рынок предоставляет краткосрочные кредиты импортерам, чтобы облегчить беспрепятственный поток товаров и услуг из страны в страну. Импортер может использовать кредит для финансирования зарубежных закупок. Например, индийская компания, желающая приобрести технику из США, может оплатить покупку, выпустив вексель на валютном рынке, по сути, с трехмесячным сроком погашения.

3. Функция хеджирования. Участники валютного обмена часто боятся колебаний обменных курсов. Изменение обменного курса может привести к

выигрышу или убытку для заинтересованной стороны.

2020 год стал максимально необычным для валютного рынка.

Коронавирус заставил инвесторов уходить из рискованных активов, к которым относится рубль, и переходить в защитные, например доллар и евро. Давление на российскую валюту также оказали резкое падение цен на нефть и осложнение геополитической ситуации — президентом США был избран Джо Байден, известный жесткой риторикой в адрес России. Все эти факторы, естественно отражаются на формировании валютного курса российского рубля на рынке.

За 2020 год курс доллара к российскому рублю вырос на 11,9700 руб. за \$1. **Максимальная стоимость доллара** за год была зафиксирована во второй половине марта и равнялась 80,8815 руб., а минимальная — в середине января и составляла 60,9474 руб. Курс рос 8 месяцев из 12, а самое серьезное изменение произошло в марте, когда за месяц доллар прибавил 11,4051 руб.

Стоимость доллара сильнее всего менялась в марте, когда колебания курса достигали почти 15 рублей, а слабее всего — в июне. Больше всего доллар прибавил в марте, по итогам которого вырос на 17%, а потерял — в ноябре, когда его цена уменьшилась на 5,9%.

В таблице показаны изменения курса доллара в 2020 году по месяцам:

Динамика изменения курса доллара

Месяц	Средний курс	Курс в начале	Курс в конце	Минимум	Максимум
Январь	61,8121	61,9057	63,0359	60,9474	63,0359
Февраль	63,9897	63,1385	66,9909	62,7977	66,9909
Март	73,7194	66,3274	77,7325	66,0784	80,8815
Апрель	74,7376	76,4074	73,6894	73,3150	77,0416
Май	72,5003	72,7263	70,7520	70,7520	74,1169
Июнь	69,1967	69,7114	69,9513	68,3123	70,3950
Июль	71,2941	70,4413	73,3633	70,4413	73,3633
Август	73,7981	73,4261	74,6382	72,9676	75,5379
Сентябрь	75,7280	73,8039	79,6845	73,5849	79,6845
Октябрь	77,6635	78,7847	79,3323	76,4443	79,3323
Ноябрь	76,8359	80,5749	75,8599	75,4518	80,5749
Декабрь	74,2167	76,1999	73,8757	72,9272	76,3203

Крайне негативное влияние на экономику РФ играет как цена на нефть, так и курсовая политика Банка России, а именно: в кризисный период с 2014г., в связи с возросшим девальвационным и инфляционным риском, Центральный Банк Российской Федерации (Банк России) резко увеличил ключевую ставку с отметки 5,5% до 17% годовых, т.е. на 11,5 процентных пунктов. [2, 5]

В результате это привело к постепенному укреплению российского рубля и повышению курса доллара. Последнее заседание Совета директоров Банка России датируется 18 декабря 2020 года. На нем принято решение сохранить ключевую

ставку. Таким образом, **ключевая ставка ЦБ РФ на сегодня 2020 год установлена на уровне 4,25%.**

На сегодняшний день особое внимание уделяется защите стабильности российской экономики от колебаний курсов иностранных валют по отношению к российскому рублю. В связи с чем далее рассмотрим динамику курсов евро и доллара по отношению к рублю в период за 2020г. (Таблица 2.)

Как видно из таблицы 2, за исследуемый период 2020г. наблюдалась тенденция увеличения стоимости курса евро и доллара по отношению к рублю.

Таблица 2.

Динамика курсов евро и доллара к рублю за 2020г. [2]

Дата	Евро	Доллар
01.01.20г	68,72	61,78
01.02.20г	69,70	63,88
01.03.20г	81,05	63,88
01.04.20г	81,94	75,23
01.05.20г	79,07	72,68
01.06.20г	77,96	69,22
01.07.20г	81,38	71,28
01.08.20г	87,34	73,79
01.09.20г	89,28	75,66
01.10.20г	91,29	77,59
01.11.20г	91,08	77,04
01.12.20г	90,07	74,05

Между тем на дальнейшее развитие валютных пар (евро, долл./руб.) оказывает влияние такой фактор, как объем торгового внешнего оборота Российской Федерации с зарубежными странами. В основном торговую деятельность Россия вела со странами Евросоюза, чья доля во внешнеторговом обороте страны составила 42,7%, странами АТЭС - 31%, СНГ - 11,7% и ЕАЭС - 8,1%. Среди стран основными торговыми партнерами в 2018 году были: Китай - 15,7%, Германия - 8,7%, Нидерланды - 6,9%, Беларусь - 4,9%, Италия - 3,9%, Турция - 3,7%, Республика Корея - 3,6%, Соединенные Штаты - 3,6%, Польша - 3,2% и Япония - 3,1%. В результате проведенных исследований можно сказать, что состояние валютного рынка России зависит от следующих факторов: динамики мировых цен на нефть (именно цены на нефть оказывают фундаментальное влияние на уровень жизни многих россиян), регулирующей направленности де-

нежно-кредитной политики ЦБ РФ, объема внешнеторгового оборота РФ с зарубежными партнерами и геополитической ситуации в мире. Но несмотря на наличие как отрицательных, так и положительных тенденций, валютный рынок России можно считать относительно устойчивым. В следующем году экономический рост России должен укрепиться, главным образом благодаря просроченным налоговым стимулам и более благоприятным условиям денежно-кредитной политики, которые, как видно, способствуют росту внутреннего спроса.

Проведение результативной валютной и денежно-кредитной политики позволит стабилизировать валютный курс рубля и устойчивость национальной валюты, снизить инфляцию, что даст возможность нашей стране занять устойчивую позицию на мировом валютном рынке.

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БЕЗРАБОТИЦА РОССИИ: ПРИЧИНЫ И СОЦИАЛЬНО-ЭКОНОМИЧЕСКИЕ ПОСЛЕДСТВИЯ.

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UNEMPLOYMENT IN RUSSIA: CAUSES AND SOCIO-ECONOMIC CONSEQUENCES.**Аннотация:**

Статья посвящена анализу одной из важнейших социально-экономических проблем Российской Федерации – безработицы. В работе рассматриваются основные виды безработицы. Указываются причины и негативные последствия, порождаемые безработицей и основные методы борьбы с ней. Также приводится статистика безработных по некоторым республикам Северного Кавказа.

Resume:

The article is devoted to the analysis of one of the most important socio-economic problems of the Russian Federation - unemployment. The paper deals with the main types of unemployment. The reasons and negative consequences generated by unemployment and the main methods of combating it are indicated. It also provides statistics on unemployed people in some republics of the North Caucasus.

Ключевые слова: безработица, виды безработицы, факторы безработицы, статистика.

Key words: unemployment, types of unemployment, factors of unemployment, statistics.

Главной экономической проблемой в современном мире является безработица. Безработица - положение в экономике, при котором часть экономически активного населения, которое желает трудиться, не может найти работу. К экономически активному населению не относятся дети, пенсионеры, женщины в декретном отпуске и инвалиды.

Причины безработицы могут быть разными. Но чаще всего безработицу связывают с увеличением численности экономически активного населения относительно уровня национального производства. Если уровень экономики низок, а население постоянно прирастает – то, естественно, они не смогут реализоваться в нужной им сфере деятельности. Также на уровень занятости населения влияет и продление пенсионного возраста. Люди старшего возраста, не имея возможности уйти на пенсию, препятствуют работе молодых специалистов, в связи с этим, уровень безработицы также увеличивается.

Изменение потребительского спроса на товары и услуги влечёт за собой изменения в производстве: применение новых технологий, совершенствование

рабочих мест и т.д. Многие виды товаров исчезают, снижается или увеличивается спрос на тот или иной вид профессиональной деятельности. Если профессия, квалификация или опыт работника не соответствует новой технике производства, то человек вынужден уйти с работы, в большинстве случаев. В современном мире жертвой такого явления стала профессия бухгалтера, с внедрением в производство и других сфер жизни компьютерной технологии. Также уместно связывать безработицу с сезонными работами. Она так и называется, сезонная безработица. В зависимости от времени года, люди вынуждены оставаться без работы. Например, в сельском хозяйстве, в связи с сезонным характером деятельности.

Немаловажной причиной безработицы является и низкая заработная плата. Того же мнения придерживается и академик Д.С. Львов[2]. Действительно, с этим трудно не согласиться, ведь это оказывает разрушающее воздействие на стимулы работника. Человек перестает видеть перспективы, считает, что его труд обесценен и в итоге увольняется с работы.

После ухода с одной работы человек может приступить к новой работе или начать её поиски. Краткие периоды между этими действиями, периоды незанятости человека, вытекают во фракционный вид безработицы. Если человек в течение длительного времени не может найти работу, то такая безработица именуется структурной. Невозможно, чтобы безработица полностью исчезла, она будет существовать всегда, по крайней мере 2 ее вида: структурная и фракционная. Эти два вида безработицы формируют естественный уровень, с которым совместима полная занятость населения страны. Направление персонала в принудительный отпуск, сокращая заработную плату, в связи со спадом производства или другими экономическими проблемами в сфере деятельности приводит к циклической безработице. Циклическая безработица определяется разностью между существующей нормой безработицы и естественной нормой [1].

На 2020 год численность экономически активного населения России составила 75,3 млн. человек, из 4,8 млн. человек являются безработными. Особенностью безработицы России является её более высокий уровень в сельской местности, чем в городе. На данный момент самый высокий уровень безработицы зафиксирован в Северо-Кавказском федеральном округе (14,9%):

Республика Ингушетия - 30,7%

Чеченская Республика - 21,7%

Республика Северная Осетия-Алания 16,3%

Республика Дагестан - 16,1%

Как бы мы не говорили о безработице, её высокий уровень влечёт за собой серьезные экономические и социальные проблемы: во-первых, снижается доход населения и повышается уровень государственных расходов, ведь несмотря ни на что, безработным выплачиваются пособия, что своеобразно давит на экономику, особенно если она и так в плохом состоянии. А во-вторых, из-за отсутствия работы и постоянного дохода в семьях, особенно где есть дети, постоянно происходят скандалы, нередко приводящие к разводам. А с разводом людей требуется больше ресурсов, жилья и т.п., что также влияет на экономику. Связь между разводами и экономикой установил в своих исследованиях также и Институт брака и религии.

Но самым важным последствием безработицы, по нашему мнению, является рост преступности и ухудшение психического здоровья людей. Люди, не имея достаточных средств на жизнь и возможности работать, пытаются добиться всего этого преступным путем. А именно, увеличиваются воровство, убийства, мошенничество и т.п. В этой ситуации одни становятся преступниками, а другие жертвами, у которых это происшествие не проходит без следов, портит их психическое здоровье. Чаще всего вовлечена в эту сферу молодежь. И нередко люди, чувствуя себя бесполезными, теряют смысл жизни и решаются на самоубийство. И самым важным вопросом на сегодняшний день является вопрос борьбы с безработицей. Опыт стран с развитой рыночной экономикой подтверждает, что сам по себе рынок не способен справиться с безработицей, необходима помощь со стороны государства. Примером борьбы государства с безработицей может служить политика СССР. Людей, которые

даже не хотели работать, заставляли, применяя силу, а низкая заработная плата компенсировалась бесплатным образованием, бесплатной медицинской помощью и обеспечением жилья для не имеющих.

Поскольку одного "лекарства" для решения проблемы безработицы недостаточно, применяют несколько методов. Для борьбы с безработицей государство может выдавать пособия и организовать центры занятости, в которые человек сможет обратиться за помощью. И такие центры в России уже давно существуют.

На современном этапе экономического развития государству выгодно стимулировать самостоятельную, активную деятельность граждан по обеспечению собственной занятости. С этой целью создана Федеральная государственная служба занятости населения. Её главная задача - создать условия для реализации личностью своей инициативы и творческих способностей. В частности, задача организации - снять препятствия, мешающие людям сохранить или приобрести рабочее место: отсутствие информации о наличии свободных мест, нехватка квалификации и т.д.

Для создания условий самозанятости приняты меры для поддержки малого предпринимательства, которая помогает открыть свое дело. Для поддержания достойного уровня жизни в стране, государству необходимо принять всевозможные меры.

Усложняет устранение безработицы ее разновидности и, соответственно, для каждого вида необходим свой метод решения. Так, для решения проблем безработицы структурного вида можно создать программы по перекавалификации и постоянно информировать о востребованных квалификациях. Циклическая безработица самая сложная и требует системного подхода. Главный способ - стимуляция потребительского спроса, также поддержку оказывает рост экспорта и инвестирование в обновление предприятий.

Безработица - это не какое-то сверхъестественное явление. С ней можно бороться и нужно. Ведь если уровень её будет слишком высоким, она может серьезно подорвать экономику любого государства и привести к развалу страны. Конечно, государство старается снизить безработицу, предпринимает меры, но эти меры, как "маленькая капля в огромном море".

К сожалению, в России этому препятствуют бюрократия и коррупция на местах. Меры по борьбе с произволом чиновников проводятся, но для того, чтобы ситуация изменилась к лучшему, требуется значительное время.

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TECHNICAL SCIENCE

УДК: 004.942

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ИССЛЕДОВАНИЕ АНАЛИЗА КЛЮЧЕВЫХ НАПРАВЛЕНИЙ ОПТИМИЗАЦИИ ИТ-БЮДЖЕТА КОМПАНИИ

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RESEARCH ANALYSIS OF KEY AREAS TO THE COMPANY'S IT-BUDGET OPTIMIZATION

Аннотация

Данная статья посвящена вопросам оптимизации бюджета на ИТ-продукты и услуги предприятий. Рассмотрены виды ИТ-затрат, ключевые компоненты ИТ-бюджета, а также предлагается выделение средств из ИТ-бюджета на развитие ИТ-технологий предприятия, которая может способствовать его дальнейшей модернизации. Приведены все необходимые выводы.

Abstract

This article is devoted to the issues of budget optimization for enterprises IT products and services. There are considered the IT costs types, the IT budget key components, and it is also proposed to allocate funds from the IT budget for enterprise's IT technologies development, which can contribute to its further modernization. All the necessary conclusions are given.

Ключевые слова: ИТ-бюджет, ИТ-затраты, ИТ-продукты и услуги, измерение эффективности ИТ, оптимизация ИТ-бюджета, ИТ-служба.

Keywords: IT budget, IT costs, IT products and services, IT performance measurement, IT budget optimization, IT service.

Расходы на информационные технологии являются важным фактором, определяющим актуальность подходов к планированию бюджета предприятий и формирование ИТ-бюджета – одна из ключевых и не всегда простых задач ИТ-отдела. От эффективности планирования бюджета во многом зависит как работа сотрудников, так и эксплуатации всей аппаратно-программной ИТ-инфраструктуры предприятия.

Изменение динамика расходов ИТ-затрат не является постоянным ни во времени, ни в региональном разрезе, ни в индустрии. Темпы роста на спрос ИТ-продуктов и услуг могут значительно отличаться как между отраслями промышленности, так и между регионами. За последний год максимальные темпы роста на спрос ИТ-продуктов и услуг по миру произошло в здравоохранении, на втором месте находится сегмент образования, а на третьем – государственный сектор электронного правительства. Но, несмотря на это основные инвестиции в ИТ сосредоточены в промышленности (дискретное и непрерывное производства), телекоммуникационном и финансовом секторах [1].

ИТ-затраты предприятия включают в себя:

- оперативные затраты, стоимость ежедневной работы ИТ;
- капитальные затраты, стоимость приобретения новых основных средств производства ИТ и стоимость оборудования в ИТ-проектах;
- затраты на внешние ИТ-услуги (консалтинг, аналитика) и аутсорсинг;

- затраты на внедрение новых ИТ-продуктов и технологий, а также на внешние технические консультации;

- затраты на унаследованные приложения, стоимость поддержки и усовершенствования устаревших приложений, которые поддерживают существующие бизнес-процессы;

- затраты на R&D (Research & Development), разработку собственных ИТ-систем, испытание новых ИТ-технологий и т. д.;

- зарплаты и бонусы ИТ-персонала;

- затраты на управление и администрирование, стоимость управления ИТ-отделом и стоимость затрат топ-менеджмента.

В целом ИТ-бюджет состоит из шести ключевых компонентов:

- аппаратное обеспечение;

- программное обеспечение;

- затраты на оплату труда;

- внешние поставщики услуг;

- передача данных и коммуникации (в зависимости от компании сюда может входить или не входить стоимость голосовых коммуникаций);

- все прочие расходы, например на обучение, услуги HR-агентств или на юридические услуги [2].

Так как предприятия отличаются по своим размерам и объемам на несколько порядков, то более показательным на практике является величина расходов на ИТ, приведенная к масштабу предприятия. Для этой цели используется величина годовых расходов на ИТ, выраженная в процентах от годового

дохода (или бюджета для государственных структур). В составе суммарных ИТ-затрат обычно выделяют операционные ИТ-затраты и капитальные ИТ-затраты.

Рисунок 1 отражает примерное соотношение между этими категориями расходов на ИТ-технологии.

Операционный бюджет на предприятии включает расходы на приобретение комплектующих и запасных частей, платежи за аренду оборудования и амортизационные отчисления в случае приобретения оборудования. Капитальный бюджет представляет собой редко возникающие расходы, которые амортизируются с течением лет на протяжении

жизненного цикла ИТ-активов. К таким расходам относятся – приобретение нового сервера масштаба предприятия или строительство резервного вычислительного центра. Размер капитального бюджета сильно зависит от вида деятельности предприятия и отрасли и может значительно отличаться от года к году. Поэтому более показательным является сравнение операционного бюджета, в состав которого включаются амортизационные отчисления, связанные с капитальными инвестициями в ИТ за ряд предыдущих лет.

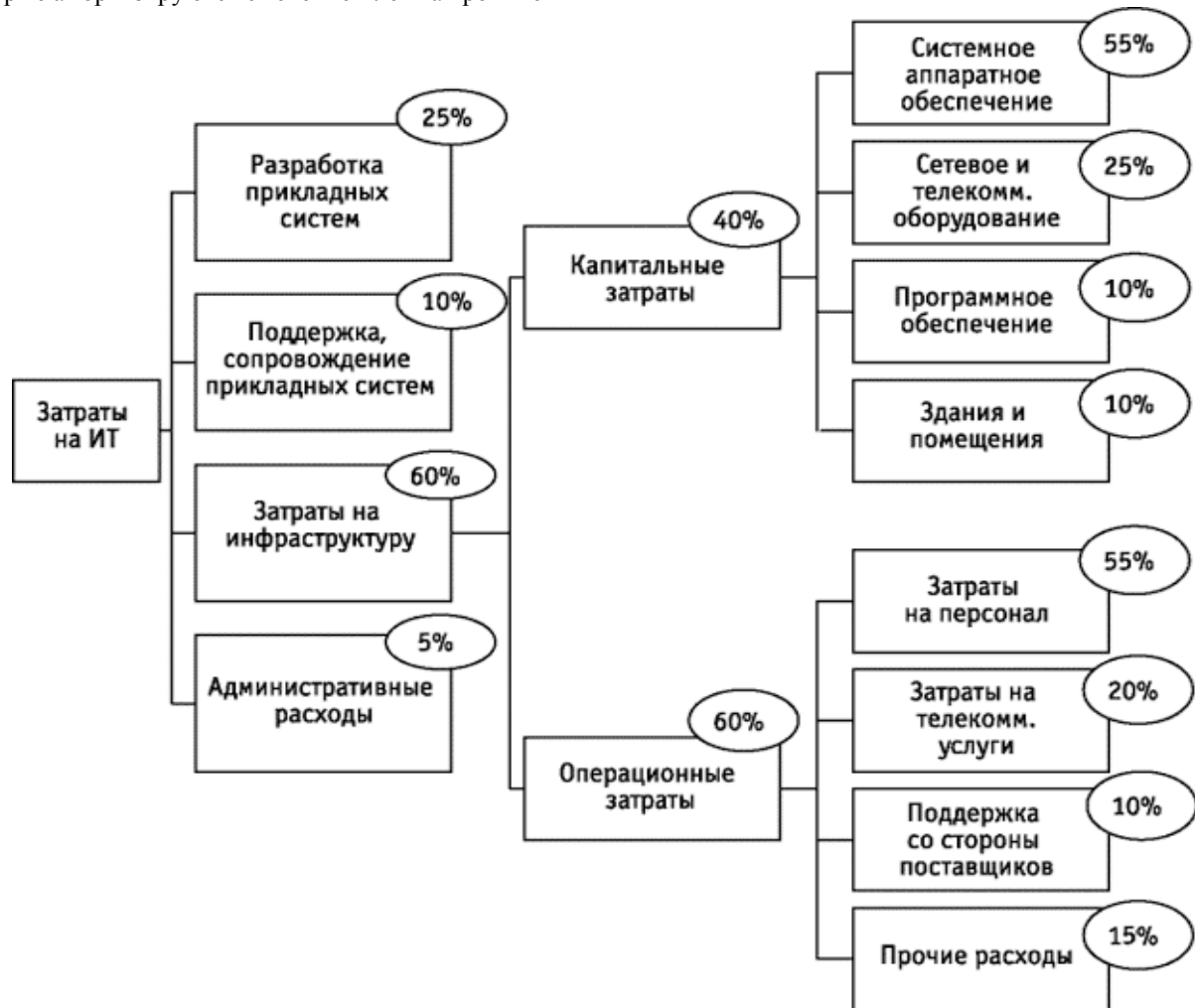


Рисунок 1 – Распределение между различными статьями расходов на ИТ-технологии

Также существует еще одна важная компонента ИТ-затрат, которая обычно не включается в ИТ-бюджет – это так называемые "скрытые ИТ-затраты". Эти затраты могут быть сравнимы с самим ИТ-бюджетом – средняя относительная их величина составляет порядка 0,3% от дохода компании. Скрытые ИТ-затраты представляют собой расходы на закупки, произведенные бизнес-подразделениями, не учтенными ИТ-службой. К этой же статье могут относиться затраты на проведение исследований и разработок (R&D), связанных с информационными технологиями.

Средняя заработная плата ИТ-специалистов с примерно одинаковой квалификацией в суммарном

ИТ-бюджете не столь существенна по двум причинам:

- с одной стороны, доля расходов на внутренний персонал в общем операционном ИТ-бюджете составляет порядка 25-30%;

- с другой стороны, величина удельных затрат как процента от дохода обратно пропорциональна размеру предприятия и абсолютной величине этого дохода – т.е. у мелких предприятий величина удельных затрат выше.

Отсюда следует, что размер предприятия (численность персонала, годовой доход) достаточно сильно влияет на относительную величину затрат на информационные технологии.

Однако, такие данные являются только индикативными и не могут идентифицировать адекватность информационных систем предприятия. Статистический расчет по ИТ-затратам не позволяет измерить эффективность ИТ: соответствие удельных затрат отдельной компании средним значениям не означает обязательного соответствия ИТ-систем задачам предприятия.

Тем не менее, существенные отличия суммарных ИТ-затрат компании от среднеотраслевых значений могут свидетельствовать либо о неэффективности инвестиций в ИТ, либо о значительном недофинансировании ИТ и, тем самым, об угрозе для поддержки и развития ИТ-инфраструктуры предприятия. Увеличение расходов на ИТ в каком-то периоде может быть вполне обосновано, например, существенным расширением бизнеса, новой рыночной политикой или необходимостью кардинальной смены критических приложений, таких, как автоматизированная банковская система для финансовых организаций. Обратная попытка определить ИТ-бюджет организации, исходя из соответствия относительных значений, и подогнать под этот бюджет набор ИТ-проектов, может привести к серьезным затруднениям в работе ИТ-службы как с бизнес-подразделениями, например, из-за навязывания возможно ненужных им проектов, так и с финансовыми службами из-за раздувания операционных расходов.

В то же время сами абсолютные величины ИТ-бюджетов свидетельствуют о том, что совокупность информационных систем и инфраструктуры ИТ компании – весьма дорогостоящее приобретение, так что ее создание и эксплуатация требуют заблаговременного планирования и конструирования – то есть формирования архитектуры и разработки стратегии [3].

Для понимания практики затрат различных компаний на ИТ важно отличать два типа затрат на информационные технологии [4]:

- обязательные затраты (non-discretionary);
- затраты, связанные с развитием (discretionary).

Это достаточно важные понятия, поскольку организация бюджетного процесса исключительно

вокруг таких понятий как бюджет на капитальные и операционные затраты, не полностью отражает реальную практику деятельности ИТ-служб и использования ИТ-технологий на предприятии.

Обязательные затраты – это те затраты, которые организация просто обязана производить для того, чтобы обеспечить функционирование текущей ИТ-инфраструктуры и приложений, выполнять их обслуживание, а также обеспечивать текущие операции. Примерами таких затрат являются затраты на поддержку компьютеров пользователей и серверов, обслуживание имеющихся прикладных систем и их эксплуатацию (например, системы электронной почты), административные расходы, связанные с ИТ. Это аналог затрат на автомобиль после его покупки: кроме трат на бензин, необходимо периодически менять масло, тормозные колодки и т.д.

Бюджет развития – это оставшаяся от обязательных затрат часть ИТ-бюджета. Это та часть ИТ-бюджета, которая может быть инвестирована на развитие функциональных возможностей систем, замену существующих систем на новые, обновление инфраструктуры и в улучшение деятельности ИТ-службы. Примерами таких затрат являются новые проекты в области управления отношениями с клиентами, электронной коммерции, управления знаниями, миграции с одной версии корпоративной системы управления ресурсами на новую и т.д.

Практика показывает, что составляющая, связанная с обязательными затратами, доминирует в ИТ-бюджетах компаний и составляет в среднем около 70% (а по некоторым – 80%). И только оставшаяся часть ИТ-бюджета может быть направлена на развитие, связанное с возможностями получения новых преимуществ от использования ИТ (рисунок 2). В то же время анализ, проведенный, в частности, компанией Accenture, показал, что для компаний-лидеров рынка в своей индустрии доля затрат на ИТ, направляемая на развитие, составляет большую, чем в среднем по рынку величину, а именно, 35-45%. Между тем обязательные затраты составляют всего 55-65%.

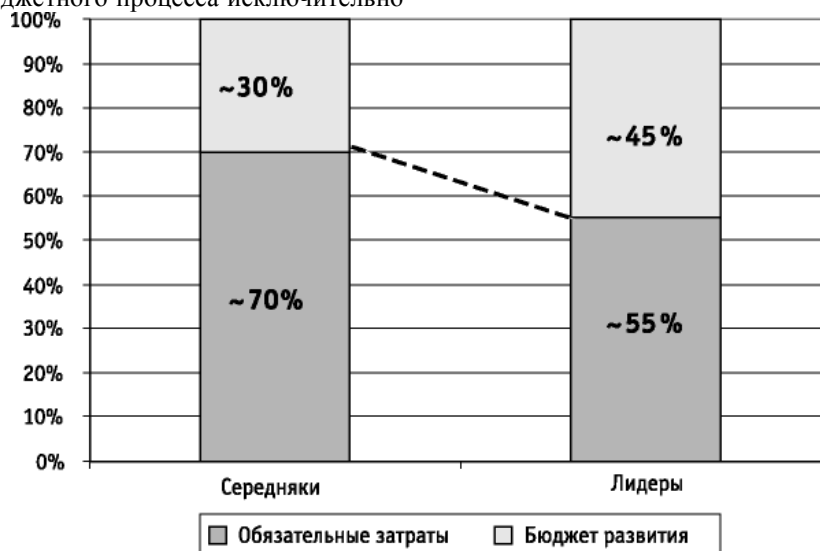


Рисунок 2 – Соотношение обязательных затрат и бюджета развития ИТ

Именно проекты, финансируемые бюджетом развития, позволяют компаниям получить новые финансовые преимущества или уменьшить затраты. Преимущества таких проектов, как правило, оцениваются по критерию возврата от инвестиций. Эта же категория проектов позволяет получать и не измеримые напрямую в денежном выражении преимущества, такие, как увеличение качества обслуживания.

Именно руководители ИТ-служб несут прямую ответственность за обоснование и минимизацию той части ИТ-бюджета, которая связана с обязательными затратами. Обоснование требует сравнения с характерными для индустрии нормами, рассчитываемыми, например, на основе количества персональных компьютеров в организации или количестве обращений в службу поддержки. Если затраты меньше, чем в среднем для индустрии, то это достаточно сильное обоснование для защиты заявки на эту часть бюджета.

Уменьшение обязательных затрат дает организации эффект постоянной экономии, поскольку это расходы на текущие процессы и операции. Такая экономия создает основу для постоянных улучшений, связанных с использованием ИТ. Примерно две трети средств, получаемых в результате данной экономии можно направить на бюджет развития ИТ.

Ситуация по обоснованию ИТ-бюджета, направляемая на развитие и соответствующие проекты должна меняться. Это должна стать областью совместной ответственности первых руководителей, заинтересованных в получении новых преимуществ, и руководителей ИТ-служб, которые должны достаточно точно оценивать затраты на реализацию проектов.

Из этого анализа можно сделать следующие выводы.

Первый вывод состоит в использовании ИТ-технологий в организации, имеющей две составля-

ющих: предоставление услуг и продуктов со стороны службы ИТ и спрос на эти услуги и продукты со стороны подразделений. В данном случае ИТ-службам необходимо уделять большее внимание той составляющей, которая связана с управлением запросами на ИТ-услуги со стороны подразделений, т.е. нужен постоянный поиск вместе с руководством подразделений максимальной отдачи от ИТ в основной деятельности организации. Для его осуществления, необходимо предварительное обеспечение должного уровня эффективности текущих операций, связанных с работой и эксплуатацией существующей инфраструктуры и систем. Это означает и уменьшение обязательных текущих затрат на ИТ за счет эффективности операций. Если в организации существуют проблемы в этой области, то в таком случае следует обратить внимание на возможность говорить о стратегии и заниматься стратегическими проектами.

Второй вывод состоит в необходимости создания постоянных организационных и управленческих механизмов, обеспечивающих поиск перспективных областей инвестиций в новые возможности, связанные с ИТ.

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УДК 631.31

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[DOI: 10.24412/2520-6990-2021-794-65-70](https://doi.org/10.24412/2520-6990-2021-794-65-70)**ВИЗНАЧЕННЯ ОСНОВНИХ ПАРАМЕТРІВ РІЗАЛЬНОГО АПАРАТА РОТАЦІЙНОЇ КОСАРКИ**

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DETERMINATION OF THE MAIN PARAMETERS OF THE ROTARY MOWER CUTTING APPARATUS**Анотація.**

В статті встановлено, що ефективна довжина ріжучої кромки ножа прямо пропорційна швидкості агрегування косарки та обернено пропорційній кутовій швидкості ротора та кількості встановлених на ньому ножів. Перекриття шляхів руху ножів сусідніх роторів залежить від радіуса ротора; кількість встановлених на ньому ножів і кінематичний режим роботи ріжучого апарату. Більше того, збільшення радіуса ротора вимагає збільшення перекриття, а збільшення кінематичного режиму та кількості ножів призводить до зменшення перекриття між шляхами ножів.

Abstract.

It was found that the effective length of the cutting edge of the knife is in direct proportion to the aggregation speed of the mower and in inverse proportion to the angular velocity of the rotor and the number of knives mounted on it. The overlap of the paths of the knives of adjacent rotors depends on the radius of the rotor; the number of knives mounted on it and the kinematic mode of operation of the cutting apparatus. Moreover, an increase in the radius of the rotor requires an increase in the overlap, and an increase in the kinematic mode and the number of knives leads to a decrease in the overlap between the paths of the knives.

Ключові слова: ротаційна косарка, ротор, ніж, скошена площа, перекриття, швидкість різання.

Keywords: rotary mower, rotor, knife, mown area, overlap, cutting speed.

1. Introduction

For mowing grass during harvesting of hay or haylage, support-free mowers with rotary movement of knives are used mainly, the productivity of which is much greater than segment-finger mowers. Free-cutting apparatuses with rotational movement of knives can be the ones with rotation around the vertical (rotational) and horizontal (rotary) axes. Mowers that are equipped with rotary cutting devices grind grass significantly, so they are used in mower-grinders and lawn mowers. The purpose of the work is to substantiate the methodology for calculating the structural and kinematic parameters of rotary cutting devices that should correspond to the conditions of their use. The main parameters characterizing the operation of rotary cutting devices are: area, mown within one disk rotation cycle; knife effective length; overlap of adjacent rotors' knives; cutting speed. The following assumptions were

made while determining the basic parameters of the rotary cutting apparatus of the mower. It was assumed that the angular speed of the rotor and the ground speed of the mower are unchanged, with the movement of the unit being straightforward. In addition, the cutting apparatus performs mowing in a plane parallel to the soil surface, which is perpendicular plane to most plant stems.

2. Target setting

Grass mowing is an integral part of any haymaking technology. It must be carried out with optimal timing and in compliance with agronomic requirements. Support free mowers with rotary knives movement are the most frequently used for this technique. They proved substantially more productive than segment finger mowers. Cutting apparatuses are among the major parts of mowers. They are updated in two directions: the first is to improve the cutting process due to optimization of the apparatus parameters and search for new

ways of cutting and new types of cutting apparatus; the second one aims at improving the knife driver.

Support free cutting apparatuses with rotational movement of knives can have vertical (rotational) and horizontal (rotary) axes [1]. Mowers that are equipped with rotary cutting devices grind grass significantly, so they are used in mower-grinders and lawn mowers [2].

The differences in construction of the rotary mowers are most frequently based on the cutting apparatus design and the type of its drive. In terms of the tool drive location the rotary mowers can have upper, lower and combined drive. It must be noted that the drive defines the design of the cutting apparatus. The lower drive mowers have their cutting apparatus rotors disk shaped with articulated knives attachment, the cutting edges being located in the rotation plane. These apparatuses are cost effective, have simple design, are reliable and easy to maintain. The disks are the pressed structures, circle or oval shaped and equipped with strengthening ribs.

Cutting apparatus rotors of the upper drive mowers are made as cylinders with articulated attachment of knives.

The main parameters that describe the operations of rotary cutting apparatuses are: the area mown for one disk cycle; effective length of the knife, overlapping knives of adjacent rotors; cutting speed. The studies [3-8, 14, 15] substantiate the above parameters. It should be noted however, that the studies do not provide sufficient analysis of the rotor kinematics while the findings on correlation, enabling to calculate kinematic and geometrical indicators of cutting apparatus performance, have contradictions.

3. The analysis of the most recent research

Knife is the main functional element of the cutting apparatus of a mower and performs the function of mowing plants. It is equipped with a cutting edge, which is set at an angle ψ to the radial direction and has a sharpness angle β (Fig. 1). The following are the rational values of the angles: $\psi = 0,44 \dots 0,53$ rad, $\beta = 0,35 \dots 0,70$ rad [3].

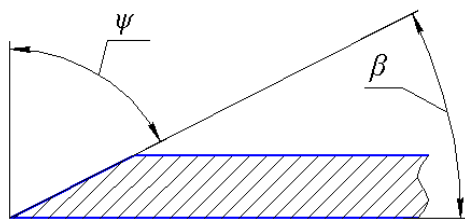


Fig. 1. Cutting edge angles of the knife

Edge sharpness is an important parameter of the knife. In order to secure high quality grass mowing at the speed of 40 m/sec the edge sharpness should be within 100...200 microns [4]. However, the width of the edge stops influencing the cutting apparatus performance when the cutting speed is increased to 80 m/s [5, 6, 7].

According to the findings, the critical support free grass cutting speed is within 20 m/s while the speed at which the stubble height is almost the same as the set height of cutting stays within the range of 45...60 m/s [7].

The work [8] defines the optimal cutting speed for sharp knives as 60 and for blunt ones 80 m/s.

The rational cutting speed depends on the grass in-feed to the cutting apparatus and, thus, on the mower's load speed and the grass yield. The in-feed increase requires relevant increase in cutting speed. With the in-feed of 4.2 kg per second the rational cutting speed is 50...60 m/s [9].

Rotary cutting apparatuses have a number of weaknesses, one of which is grinding grass during the mowing process, which results in bigger yield loss. The explanation is the incoherence of the knives' circular speed and the mower's load speed. The above effect is also observed when the number and the length of knives is bigger than the optimal. The attempts to reverse the parameters may result in fail patches, i.e. unmown segments of the field [10].

Thus, a fundamental task is to identify the coherence of constructive and kinematic parameters of rotary cutting apparatuses and their use conditions.

4. Basic research

The main factors of rotary mower performance are the shear area of one knife for one rotation cycle, the effective length of the knife and the speed of support free cutting. These factors define the workload on the knife by the cutting power and the energy spent on the grass mowing.

In order to identify the main parameters of the rotary cutting apparatus we refer to the figure 2, which provides the scheme of one of the mower rotors, that moves translationally with the speed of V and rotates with the circular speed of ω .

To define the main parameter of the rotary cutting apparatus of the mower the assumptions are as follows. We shall assume that the angular speed of the rotor and the translational speed of the mower are unchanged, while the unit movement is straightforward. The cutting apparatus also mows in the plane parallel to the ground surface, i.e. across the most stalks of plants.

The origin of coordinates is placed according to the picture. Y -axis is directed towards the translational movement (the load) of the mower.

Mowing with support free rotational apparatuses is the result of the impact interaction between the knife and the grass stalks. One of the main factors of this mode of mowing is the cutting speed. For comparison purposes among different apparatuses the speed is normally defined for extreme outer points of the knives' cutting edges.

Since the travel speed of the mower V is much lower than the circular speed of the knives, all the points thereof trace out cycloidal trajectories in the absolute motion. The equation of the trajectory of the point of the knife 1 (point a) in parametric form is written as:

$$x_a = R \cos \omega t \quad (1)$$

$$y_a = Vt + R \sin \omega t, \quad (2)$$

where x_a and y_a – are movement projections of the point a on coordinate axis, m;

R – the radius of the circle made by point a during the circular movement, m;

t – time, s.

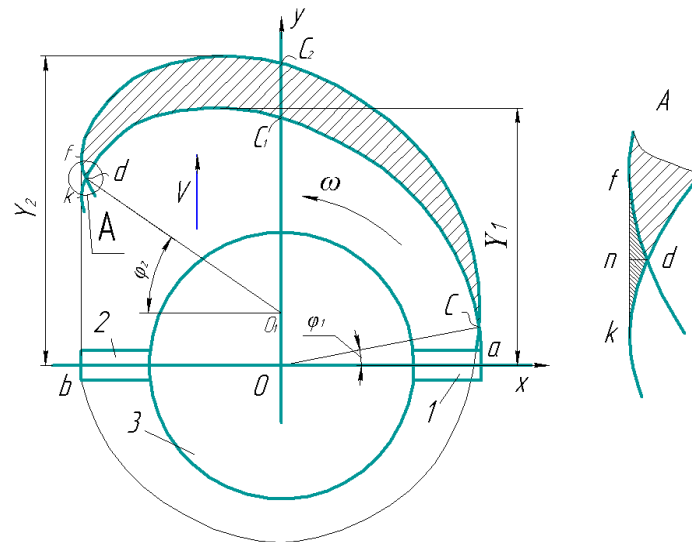


Fig. 2. The scheme of defining the main parameters of rotary cutting apparatus:
1, 2 – knife, 3 – disk

After differentiating between 1 and 2 in time, we obtain:

$$\frac{dx_a}{dt} = -R\omega \sin \omega t, \quad (3)$$

$$\frac{dy_a}{dt} = V + \omega R \cos \omega t. \quad (4)$$

Absolute speed of the point *a* at any moment of time

$$V_{abs} = \sqrt{\left(\frac{dx_a}{dt}\right)^2 + \left(\frac{dy_a}{dt}\right)^2}. \quad (5)$$

When we apply the figures of the speed projection from (3) and (4) to (5), we obtain

$$V_{abs} = \sqrt{R^2 \omega^2 + 2VR\omega \cos \omega t + V^2}. \quad (6)$$

The absolute speed will reach the maximum value at $\omega t = 2\pi k$, where $k = 0; 1; 2 \dots$, i.e. $V_{abs} = R\omega + V$. V_{abs} will have the minimum value at $\omega t = \pi + 2\pi k$, i.e. $V_{abs} = R\omega - V$.

Therefore, the absolute speed of any point of knife varies from the maximum value, equal to the sum of the circular speed of this point and the mower's aggregation speed, to the minimum, which is the difference of the above speeds.

Point of knife trajectory equation 2 (point *b*) in parametric form is written as:

$$x_b = R \cos\left(\omega t - \frac{2\pi}{z}\right), \quad (7)$$

$$y_b = V + R \cos\left(\omega t - \frac{2\pi}{z}\right), \quad (8)$$

where x_b, y_b – are movement projections of the point *b* on coordinate axis *b*;

$$F_{cc_1dc_2c} = \int_{-R\cos\phi_2}^{R\cos\phi_1} \left[\frac{V}{\omega} \left(\frac{2\pi}{z} + \arccos \frac{x}{R} \right) + \sqrt{R^2 - x^2} - \frac{V}{\omega} \arccos \frac{x}{R} + \sqrt{R^2 - x^2} \right] dx =$$

z – the number of knives mounted on the rotor.

One of the main parameters of the rotary mower performance is the area mown with a knife for one rotation cycle. As we can see on picture 2, the area mown by a knife for one cycle of the rotor is limited with absolute movement trajectories (cycloids) of point *a* and *b* of the knives 1 and 2, graph cc_1dc_2c . Therefore, the blade of each knife cuts plants from the field segment that is limited by two trochoids shifted towards the mower's aggregation speed.

The coordinates of the points *c* and *d* (the cycloid cross points) are defined by the angles ϕ_1 and ϕ_2 . According to the data [12]:

$$\phi_{1,2} = \frac{\pi}{z(\lambda \pm 1)}, \quad (9)$$

where λ is kinematic parameter, $\lambda = \omega R/V$.

The sign (+) in this formula corresponds to the point *c*, while the sign (-) corresponds to the point *d*.

We use well known Fundamental theorem of calculus [11] to identify the area of the figure cc_1dc_2c

$$S_{cc_1dc_2c} = \int_{-R\cos\phi_2}^{R\cos\phi_1} [u(x) - f(x)] dx, \quad (10)$$

where $u(x)$ and $f(x)$ – are the function that describes the curves cc_2d and cc_1d respectively.

To identify the formula for the function $u(x)$ and $f(x)$ we exclude the parameter t from the equations (1) and (7) and apply the obtained values of time to (2) and (8) respectively. As a result, we obtain:

$$f(x) = \frac{V}{\omega} \arccos \frac{x}{R} + \sqrt{R^2 - x^2}, \quad (11)$$

$$u(x) = \frac{V}{\omega} \left(\frac{2\pi}{z} + \arccos \frac{x}{R} \right) + \sqrt{R^2 - x^2}. \quad (12)$$

Applying (11) and (12) to (10), we obtain:

$$= \frac{2\pi VR}{\omega z} (\cos \varphi_1 + \cos \varphi_2).$$

Then, with consideration of (9) the knife mows the following area for one rotation

$$F_{cc_1dc_2c} = \frac{2\pi R^2}{\lambda z} \left(\cos \frac{\pi}{z(\lambda+1)} + \cos \frac{\pi}{z(\lambda-1)} \right). \quad (13)$$

The effective length of the cutting edge of the knife should be bigger or equal to the difference between the maximum ordinates of the absolute movement of the points of adjacent knives (Fig. 2), i.e.:

$$h_p \geq Y_2 - Y_1, \quad (14)$$

where h_p – effective length of the cutting edge of the knife, m;

Y_1, Y_2 – maximum ordinates of the absolute shifts of the points of the first and the second knife respectively, m.

After we differentiate (7) from (8) in time, we obtain:

$$\frac{dx_b}{dt} = -R\omega \sin \left(\omega t - \frac{2\pi}{z} \right), \quad (15)$$

$$\frac{dy_b}{dt} = V + R\omega + \cos \left(\omega t - \frac{2\pi}{z} \right). \quad (16)$$

In the points of the trajectories of the points of knives,

that have maximum ordinates, the derivatives $\frac{dy_a}{dx_a}$ and

$\frac{dy_b}{dx_b}$ are equal to zero, i.e.:

$$\frac{V + R\omega \cos \omega t}{-R\omega \sin \omega t} = 0,$$

$$\frac{V + R\omega \cos \left(\omega t - \frac{2\pi}{z} \right)}{-R\omega \sin \left(\omega t - \frac{2\pi}{z} \right)} = 0.$$

As long as the denominators of these fractions cannot be equal to zero, and having set the numerators of the obtained fractions to zero and solved them for time, we obtain:

$$t_a = \frac{1}{\omega} \left(\pi - \arccos \frac{V}{R\omega} \right), \quad (17)$$

$$t_b = \frac{1}{\omega} \left[\pi - \arccos \left(\frac{V}{R\omega} + \frac{2\pi}{z} \right) \right], \quad (18)$$

where t_a, t_b – the time, needed for the points a and b to reach the maximum ordinates.

We apply the values of time t_a and t_b from (17) and (18) to (2) and (8) and obtain:

$$Y_1 = \frac{V}{\omega} \left[\pi - \arccos \left(\frac{V}{\omega R} \right) \right] + R \sqrt{1 - \left(\frac{V}{\omega R} \right)^2}, \quad (19)$$

$$Y_2 = \frac{V}{\omega} \left[\pi - \arccos \left(\frac{V}{\omega R} + \frac{2\pi}{z} \right) \right] + R \sqrt{1 - \left(\frac{V}{\omega R} \right)^2}. \quad (20)$$

We apply (19) and (20) to (14) and, after transformation, we obtain:

$$h_p \geq \frac{2\pi V}{\omega z}. \quad (21)$$

Thus, the effective length of the edge of the knife is in direct proportion to the aggregation speed of the mower and is in reverse proportion to the angular speed of the rotor and the number of knives mounted on it.

If we switch from the angular speed of the rotor to the circular frequency, we obtain:

$$h_p \geq \frac{60V}{nz}, \quad (22)$$

where n – the circular frequency of the cutting apparatus' rotor, rotations per minute.

The path points of the adjacent knives, which have the maximum ordinates should have equal abscisses. Let us verify this. We apply the found values of time from (17) and (18) respectively to (1) and (7) and make sure that the abscisses of both points are equal to each other.

$$x_a = x_b = -V/\omega. \quad (23)$$

The Figure 3 shows the graphic correlations between the changes of minimal effective length of the cutting edge of the knife and the change in rotation speed of the mower's rotor, built according to (22).

The graphs assume that two knives are mounted on the rotor, i.e. $z = 2$. As we can see according to the presented data, the effective length of the cutting edge of the knife decreases as the circular frequency of the rotor increases.

During the operations of the rotary mower the knives' trajectories of the adjacent rotors must overlap by the value Δ . If they don't, there will be fail patches on the field, i.e. the unmown areas. As we can see on the fig. 2 after the mower passes over the unmown areas there will be curvilinear triangles kfd left on the field.

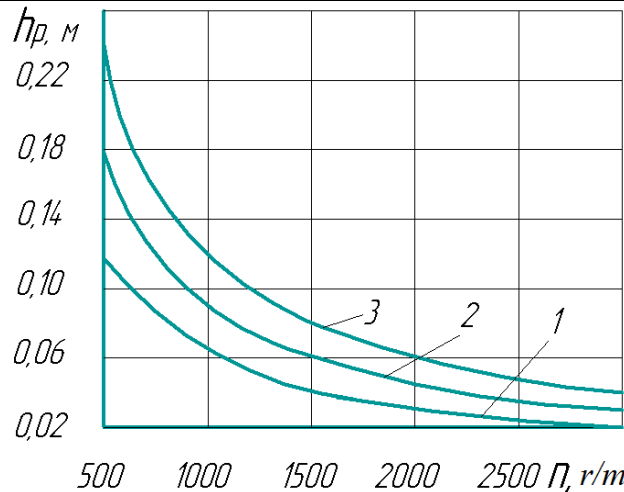


Fig. 3. The graphs of variance between the minimal effective length of the cutting edge of the rotary cutting apparatus h_p and the circular frequency of the rotor n : 1 – $V = 2$ m/s, 2 – $V = 3$ m/s, 3 – $V = 4$ m/s

That same picture makes it evident that the knives' overlap Δ must be bigger than the double projection of the interval nd on the absciss [13]:

$$\Delta \geq 2|x_n - x_d|,$$

where $|x_n| = R$ – the absciss of the farthestmost trajectory point from the axis OY ;

$|x_d|$ – the absciss of the two adjacent knives' trajectories cross point.

From the fig. 2 we have:

$$|x_d| = R \cos \varphi_2.$$

Then

$$\Delta \geq 2R \left(1 - \cos \frac{\pi}{z(\lambda - 1)} \right). \tag{24}$$

From (24) we conclude that the path overlap of the adjacent rotors' knives depends on the rotor radius; the number of the knives, installed thereon and the kinematic operation mode of the cutting apparatus. Besides, the increase in the rotor radius requires the increase in the overlap while the growth of the kinematic mode rate and the number of knives results in reduction of the knives' path overlap. This is described in graphs on the fig. 4.

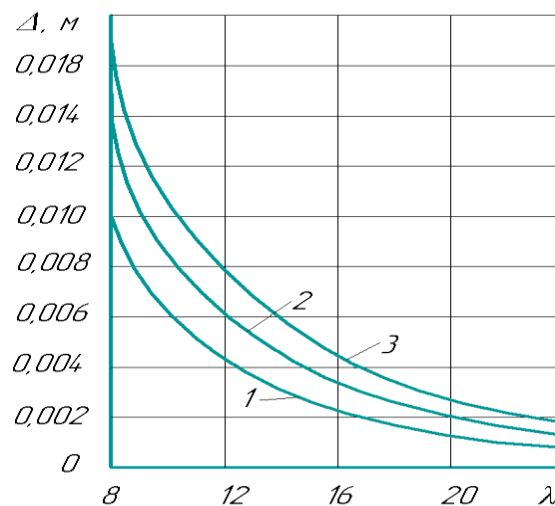


Fig. 4. The variance of the path overlap of the adjacent rotors knives Δ in correlation with kinematic mode λ and rotor radius R ($z = 2$): 1- $R = 0,2$, 2- $R = 0,3$, 3- $R = 0,4$ m

5. Conclusions

1. The main parameters that describe the operations of rotary cutting apparatuses are the area mown by a knife for one disk cycle, knife's effective length, adjacent rotors knives overlap, cutting speed.

2. The cutting speed of any point of knife varies from the maximum value, which is equal to the sum of the circular speed of this point and the mower's aggregation speed, to the minimal one, which is the difference between the above speeds.

3. The effective length of the cutting edge of the knife is in direct ratio to the mower's aggregation speed and in reverse ratio to the angular speed of the rotor and the number of knives, installed thereon.

4. The adjacent rotors knives overlap depends on the rotor's radius, the number of the knives, installed thereon and the kinematic mode of operation of the cutting apparatus. The increase in the rotor radius requires the increase in the overlap while the increase in the kinematic mode

rate and the number of knives results in the reduction of the overlap of the knives' trajectories.

5. We obtained the correlation that allows to identify the area mown by one knife for one cycle of the rotor.

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[DOI: 10.24412/2520-6990-2021-794-22-26](https://doi.org/10.24412/2520-6990-2021-794-22-26)

"PRESERVING FERTILITY IN MALIGNANT PATIENTS"

Abstract

Fertility preservation is becoming increasingly important to improve the quality of life in cancer survivors. Despite guidelines suggesting that discussion of fertility preservation should be done prior to starting cancer therapies, there is a lack of implementation in this area. Several techniques are available for fertility preservation, and they can be used individually or together in the same patient to maximize efficiency. Oocyte and embryo cryopreservation are now established techniques but have their limitations. Ovarian tissue cryopreservation though considered experimental at present, has a wider clinical application and the advantage of keeping the fertility window open for a longer time. Both chemotherapy and radiotherapy have a major impact on reproductive potential and fertility preservation procedures should be carried out prior to these treatments. The need for fertility preservation has to be weighed against morbidity and mortality associated with cancer. There is thus a need for a multidisciplinary collaboration between oncologists and reproductive specialists to improve awareness and availability.

Keywords: Cancer, counseling, cryopreservation, fertility preservation

Introduction

Fertility is a precious concern in human life. Unfortunately, several factors and conditions can jeopardize female patients' fertility prior the completion of their family planning such as the use of chemotherapy and radiotherapy for cancer treatment. When aggressive chemotherapy and radiotherapy are used, gonadotoxicity may occur as a side-effect leading to impairment of reproductive functions and even fertility loss in severe cases⁽¹⁾. Oncofertility is a relatively new interdisciplinary field at the intersection of oncology and reproductive medicine that expands fertility options for young cancer patients. The term 'oncofertility' was coined for the first time in 2006 by our coauthor Prof. Teresa Woodruff, the founder and the director of Oncofertility Consortium, Northwestern University, Chicago, Illinois, USA⁽²⁾. In women, hematological malignancies are not rare and account for 7%–9% of estimated new cancer cases and deaths. The most common forms of hematological malignancies that occur in girls and young women and therefore necessitate oncofertility care are acute lymphocytic leukemia (ALL), acute myeloid leukemia (AML), non-Hodgkin's lymphoma (NHL), and Hodgkin's lymphoma (HL). The other forms of hematological malignancies such as chronic lymphocytic leukemia, chronic myeloid leukemia, and myeloma occur usually at an older age after menopause (age >50) and hence do not raise such serious concerns about fertility⁽³⁾.

We focus on the current multidisciplinary challenges and future trends of fertility preservation and restoration in girls and young women with ALL, AML, NHL, and HL.

Fertility preservation can be defined as the application of medical, surgical, or laboratory techniques to preserve gametes or reproductive tissue to achieve future genetic parenthood.^{19,20} Women who have not

preserved their gametes by cryopreserving oocytes, embryos, or ovarian tissue and who defer parenthood until the completion of gonadotoxic cancer treatment may find themselves with a reduced reproductive window and may jeopardize their chances of conception, even with assisted reproductive treatments⁽⁴⁾. Although several strategies of interdigitating fertility preservation options with cancer therapy have been described in the medical literature, these strategies have to be individualized according to a patient's pubertal status, cancer diagnosis, prognosis, and—most important—desire to preserve future childbearing potential.⁽⁵⁾

Aggressive chemotherapy and radiotherapy in young patients with cancer have greatly enhanced the life expectancy of these patients, but these treatments often cause infertility because of the massive destruction of the ovarian reserve resulting in premature ovarian failure (POF). This review focuses on the effect of cancer treatments on fertility and on the various surgical and assisted-reproduction innovations that are available to provide the patient with the option of future pregnancies⁽⁶⁾. As the emerging discipline of fertility preservation is steadily attracting increasing interest, developments shortly promise to be very exciting. However, in everyday routine work, better interdisciplinary cooperation between gynecological and pediatric oncologists, surgeons, immunologists and endocrinologists is necessary so that individualized options for fertility preservation can be offered in advance of surgical procedures or cancer treatments. GnRH analog treatment can preserve fertility in some patients, but not in all. At present, cryopreservation of ovarian tissue appears as a very promising method of providing the cancer patient with a realistic chance of preserving fertility—a prospect that is also extremely important to patients for psychological reasons.

Oncofertility is a new interdisciplinary field at the intersection of oncology and reproductive medicine that expands fertility options for young cancer patients. The most common forms of hematological malignancies that occur in girls and young women and therefore necessitate oncofertility care are acute lymphocytic leukemia, acute myeloid leukemia, non-Hodgkin's lymphoma, and Hodgkin's lymphoma. Aggressive genotoxic anticancer regimens including alkylating chemotherapy and total body irradiation are used often in treating girls and young women with hematological malignancies ⁽⁷⁾. The risks of gonadotoxicity and subsequent iatrogenic premature ovarian insufficiency and fertility loss depend mainly on the type and stage of the disease, dose of anticancer therapy as well as the age of the patient at the beginning of treatment. To avoid or at least mitigate the devastating complications of anticancer therapy-induced gonadotoxicity, effective and comprehensive strategies that integrate different options for preserving and restoring fertility ranging from established to experimental strategies should be offered before, during, and after chemotherapy or radiotherapy ⁽⁸⁾. A multidisciplinary approach that involves strong coordination and collaboration between hemato-oncologists, gynecologists, reproductive biologists, research scientists, and patient navigators is essential to guarantee a high standard of care.

Methodology

A systematic search of bibliographic and grey literature for clinical practice guidelines regarding fertility preservation in TYAs with cancer was undertaken, in addition to expert consultation. The literature search combined demographic-specific terms and the relevant disease—((teenage OR adolesce* OR young adults) with fertility and its preservation (fertility and (preservation or conservation))). The search was limited to clinical practice guidelines. A thorough internet search was undertaken to ensure that eligible clinical practice guidelines not cataloged within bibliographic databases were included. Experts in the field of TYA oncology were also approached. A similar search strategy was used to identify fertility preservation guidelines for children and adults to ensure that no guidance relevant to TYAs was missed. In cases where multiple versions of a guideline were available, the latest version was appraised ⁽⁹⁾.

All identified clinical practice guidelines were reviewed according to the Appraisal of Guidelines for Research and Evaluation (AGREE-II) criteria by two researchers (a TYA oncology consultant and an academic oncology trainee). The AGREE-II is an online appraisal tool used to assess the methodological rigor and transparency by which a guideline is developed.

The AGREE-II tool is comprised of 23 individual elements categorized into six groups: scope and purpose, stakeholder involvement, the rigor of development, clarity of presentation, applicability, and editorial independence. The rigor of the development category is split into eight statements ⁽¹⁰⁾:

- Systematic methods were used to search for evidence .
- The criteria for selecting the evidence are clearly described .
- The strengths and limitations of the body of evidence are clearly described .
- The methods for formulating the recommendations are clearly described .
- The health benefits, side effects, and risks have been considered in formulating the recommendations .
- There is an explicit link between the recommendations and the supporting evidence .
- The guideline has been externally reviewed by experts before its publication .
- A procedure for updating the guideline is provided.

Guidelines with a score of 75% (42/56) or better in the “rigor of development” section were then further assessed and narratively synthesized. Prior to commencing the study, the investigators agreed that this score was an acceptable cut-off, as no score breakdown is provided within the AGREE-II. If there was disagreement between the two researchers, a third independent researcher (a TYA oncology consultant) was consulted. Content, scope, and consistencies between recommendations were examined. Key elements of inconsistency were further explored, relating these areas to the quality of the guideline (overall AGREE-II score), the rigor of its development (AGREE-II subgroup score), the healthcare system within which the guideline was developed, and the evidence from which the recommendation was derived.

Organ-preserving surgery

There are several S3 guidelines on the treatment of patients with malignant ovarian tumors, cervical cancer, and endometrial cancer. To prevent discrepancies between guidelines, the guideline coordinators of the S3 guidelines and the coordinators of the S2k guideline on fertility preservation unanimously agreed to incorporate the relevant Statements, Recommendations and background texts from the S3 guidelines into the S2k guideline. The relevant Recommendations and Statements are available in the long version of the guideline ⁽¹¹⁾.

Ovariopexy and gonadal protection for radiotherapy

Consensus-based Statement 4.S25

Expert consensus	Strength of consensus +++
------------------	---------------------------

Transposition of the ovaries out of the area which will be irradiated may reduce the risk of radiogenic ovarian insufficiency.

Cryopreservation of unfertilized oocytes

Outcomes for unfertilized oocytes after slow freezing or vitrification.

	Slow freezing	Vitrification
Survival rate per unfertilized oocyte after cryopreservation/thawing	45–67%	80–90%
Fertilization rate per unfertilized oocyte after cryopreservation/thawing	54–68%	76–83%
Clinical pregnancy rate/transfers	11.6%	44.9% (p = 0.002)
Congenital malformation rate	0.5%	1.3%

Stem cell transplantation**Consensus-based Recommendation 6.R80**

Expert consensus	Strength of consensus
	+++

Women treated with a conditioning protocol to prepare them for stem cell transplantation have a high risk of infertility. These patients must be informed and receive counseling about methods to protect their fertility.

One major concern raised by the use of ovarian cortical fragments in cancer patients is the potential risk that the frozen-thawed ovarian tissue might harbor malignant cells that could induce a recurrence of the disease after reimplantation. In the case of Hodgkin and non-Hodgkin lymphoma, the risk is minimal, if not non-existent. In the case of leukemia, malignant cells may be present in the bloodstream and at risk of being transferred ⁽¹²⁾.

Ethical Consideration

Gamete or gonads storage for long periods generates ethical and moral questions without answers so far, but they deserve attention, reflection and discussion before one opts for a fertility preservation protocol. One reason for such discussion is the existence of uncertainties curtailing the processes that involve routine and experimental strategies, as well as the future use of the preserved tissues and cells in the face of the possibility of the death of their biological owner .

For how long cryopreserved biological material will be feasible? Although cryopreserved sperm can remain viable for many years ⁽¹³⁾ and ovarian tissue may resist freezing, at least in the short term ⁽¹⁴⁾, experience with these and other techniques is too recent to ensure its security and its routine use. Will the freezing and thawing processes affect the quality and function of cells and tissues? Is it safe to use them? These are questions that only time will answer .

While recognizing the merits of the cause, questions arise from the indication of fertility preservation protocols for individuals with cancer. This is so because, from a technical point of view, those are treatments primarily linked to the diagnosis of infertility, and cancer patients are not necessarily infertile at the time of treatment or will be infertile after its completion, challenging the existence of a true medical indication ⁽¹⁵⁾. On the other hand, the provision of strategies to preserve fertility in the presence of any disease or treatment that may affect it reaches a moral obligation level, respecting the autonomy of choice, which is an essential foundation of a free society ⁽¹⁶⁾

Thus, it is understood that fertility preservation preceding antineoplastic treatment lays between medical indication - based on the intention of prevention, humanization and a social statement - based on biopsychosocial impact of procreating disability. In the case of cancer patients with the potential risk of fertility loss, real ethics is to furnish the best information about the potential risks and the currently available techniques for the preservation of their gametes. This will allow wellinformed patients and their families to make the right decisions with the necessary clarity, based on personal interest concerning the possibility of future fertility .

Disquieting questions need to be raised to a profound and sensible approach to fertility preservation of anyone. In a very real sense for feminist authors, the observation that some medical procedures are considered as solutions to social problems is seen often with pejorative eyes. One of the questions is related to the possible inappropriate social pressure on women with cancer or parents of girls and adolescents with cancer, because of the obligation of future motherhood as a requirement of society ⁽¹⁷⁾

Finally, the universal right to procreate gives ethical, legal, and moral support for the development of oncofertility. Similarly, the principles of autonomy, beneficence and non-maleficence should chart the course of the chosen strategy with respect and attention, including children and adolescents' opinion, when they can understand the circumstances ⁽¹⁸⁾.

The expected outcome of the study

Only a few studies have been conducted on the reproductive outcomes after FSS in early and advanced stage MOGCTs and evidence concerning fertility potential remains unclear ⁽¹⁹⁾. This is because MOGCTs are rare tumors and only about 30 years have passed since the dramatic improvement in prognosis with BEP therapy. However, among significant BEP-related toxicities, fertility impairment due to follicle destruction, ovarian stromal fibrosis, and reduction of primordial follicles is one of the most relevant ⁽²⁰⁾. These effects seem to be strictly correlated to the type of drugs used,

schedule, total dose, and treatment duration. In an attempt to diminish toxicity, JEB (carboplatin, etoposide, and bleomycin) has replaced BEP in children⁽²¹⁾, given that among chemotherapeutic agents, cisplatin has the highest risk of causing ovarian failure. Available data have shown that menstrual function is maintained after platinum-based regimens in over 85–95% of patients with MOGCTs

Brewer et al. reported that 71% of patients who underwent FSS and BEP chemotherapy maintained their normal menstrual function during and after treatment, the remaining patients regained normal menses within 6 months of completing chemotherapy. However, resumption of cyclic menses after oncologic treatment does not necessarily imply normal fertility. The rate of premature menopause reported in the literature ranges between 3% and 7.4% (23).

According to the literature available on the possible dangerous effects of cancer treatments on pregnancy, no evidence of an increased risk of genetic or other defects in new-born from MOGCTs survivors exists. Data are currently scant, and further and long-term studies should be conducted to confirm this. However, the available evidence is reassuring, reporting an infertility rate of about 20%. Therefore, a young woman with MOGCTs at any stage must be reassured about the promising oncologic and fertility outcomes after treatment.⁽²⁴⁾

Problems anticipated

The increasing number of young survivors of cancer with favorable outcomes is defining the need for a more comprehensive approach that will improve the quality of life after cancer, including the preservation of fertility. This new paradigm of treatment raises several complex questions. If a risk factor for infertility can be assessed, what does the patient or parent of a young child do with this information? What if an insurance carrier declines to cover fertility treatment, exacerbating economic disparities in patient care and society as a whole? How can the ethical and legal issues surrounding consent and assent be addressed? Ten years ago, many of these issues were irrelevant, given the status of research in the field of follicle biology at that time. Now, these questions are being addressed with the use of an interdisciplinary approach to medical progress and patient care. The opportunity to provide accurate information as well as generational hope is invaluable. Clinicians must break through old practice patterns and understand that young patients will no longer be concerned only with preserving their lives in the present but will want to preserve the fullness of their future as well. Questions to ask the health care team before treatment:

What is the risk of infertility from the recommended treatments?

Would potential infertility be temporary or permanent?

Are there other effective treatments that do not pose a high risk?

Conclusion

Aggressive genotoxic anticancer regimens, including alkylating chemotherapy and TBI, are often

used in treating girls and young women with hematological malignancies, and they can lead to subsequent iatrogenic POI and fertility loss. To avoid, or at least mitigate, such devastating gonadotoxicity risks and complications, effective and comprehensive oncofertility strategies that integrate different options for preserving and restoring fertility ranging from established to experimental should be offered before, during, and after anticancer therapy. A multidisciplinary approach that involves strong coordination and collaboration between hemato-oncologists, gynecologists, reproductive biologists, research scientists, and patient navigators is essential to guarantee a high standard of care.

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УДК 616.311.2-0002.2-06:616.322-002.2]-053.2-092-085

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[DOI: 10.24412/2520-6990-2021-794-75-78](https://doi.org/10.24412/2520-6990-2021-794-75-78)

**МИКРОФЛОРА ЛИНГВАЛЬНОЙ ПОВЕРХНОСТИ У ДЕТЕЙ С ХРОНИЧЕСКИМ
ГЕНЕРАЛИЗОВАННЫМ КАТАРАЛЬНЫМ ГИНГИВИТОМ (ХГКГ), ИМЕЮЩИХ
ЗАБОЛЕВАНИЯ ОРГАНОВ ПИЩЕВАРИТЕЛЬНОЙ СИСТЕМЫ И ЛОР-ПАТОЛОГИЮ**

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**LINGUAL SURFACE MICROFLORA IN CHILDREN WITH CHRONIC GENERALIZED
CATARRHAL GINGIVITIS (CGCG) WITH DISEASES OF THE DIGESTIVE SYSTEM AND ENT
PATHOLOGY**

Аннотация

В статье показаны результаты проведенных цитологических и бактериологических исследований соскобов с языка на выявление и подсчет количества колоний резидентной флоры у детей с хроническим генерализованным катаральным гингивитом и имеющих заболевания верхних отделов пищеварительного тракта в сочетании с ЛОР-патологией. Выявлен дисбаланс роста резидентной флоры на поверхности языка у этих детей как в остром периоде, так и в период угасания симптомов основных заболеваний.

Abstract

The article shows the results of cytological and bacteriological studies of scrapings from the tongue to identify and count the number of colonies of the resident flora in children with chronic generalized catarrhal gingivitis

and those with diseases of the upper digestive tract in combination with an ENT pathology. An imbalance in the growth of the resident flora on the surface of the tongue was revealed in these children both in the acute period and in the period of decrement of the symptoms of the main diseases.

Ключевые слова: дети, хронический генерализованный катаральный гингивит, заболевания пищеварительной системы, ЛОР-патология, обсемененность языка, гипертрофия сосочков языка.

Key words: children, chronic generalized catarrhal gingivitis, diseases of the digestive system, ENT pathology, contamination of the tongue, hypertrophy of the papillae of the tongue.

На границе ротовой полости, эзофагогастроудоденальной зоны и тонзил-лофарингиальной области находится язык и он подвержен воздействиям стрессорных факторов, обусловленных патологическими процессами в этих трех отделах. Поверхность корня языка является не только местом обитания большого количества микрофлоры, но и первичным звеном полости рта, которое испытывает кислотный стресс при попадании на нее рефлюксного содержимого и изменений pH ротовой жидкости [1, 2, 3], что не может не раздражать тонзилло-фарингиальную область. Проводимая терапия с использованием антибиотиков при заболеваниях пищеварительной системы и ЛОР-патологии также может оказать влияние на микробиоценоз полости рта [4,5].

Материал и методы.

Проведены цитологические и микробиологические исследования соскобов с корня языка у детей практически здоровых и с санированной полостью рта, с воспалительными заболеваниями тканей пародонта, не отягощенных сопутствующими заболеваниями и у детей с заболеваниями верхних отделов пищеварительного тракта и имеющих патологию ЛОР-органов.

В проведенных нами исследованиях приняли участие 176 детей в возрасте от 9 до 15 лет. 1-ю группу (контрольную) сформировали из здоровых и санированных детей, обратившихся к нам с целью профилактического осмотра и санации полости рта, которым была оказана стоматологическая помощь (10 детей).

Количество детей в остальных группах было примерно одинаковым, что позволило нам провести сравнение полученных результатов. Во 2-ю группу вошли дети, имеющие патологию тканей пародонта – ХГКГ, и без заболеваний желудочно-кишечного тракта (ЖКТ) и ЛОР-патологии. В 3-ю группу – дети, обратившиеся к гастроэнтерологу и оториноларингологу на контрольный осмотр, имеющие заболевания верхних отделов ЖКТ и

ЛОР-патологию (хронический тонзиллит, хронический фарингит) в стадии ремиссии, которым ранее было проведено лечение основных заболеваний. В 4-ю группу включили детей с неэрозивной рефлюксной болезнью (НЭРБ) и хроническим тонзиллитом (ХТ), в 5-ю группу – детей с гастроэзофагеальной рефлюксной болезнью (ГЭРБ) и хроническим фарингитом (ХФ). В 6-ю группу – детей с хроническими гастродуоденитами (ГД) и гастродуоденальными язвами (ГДЯ) с сопутствующим ХТ, в 8-ю группу – детей с хроническим панкреатитом и ХФ.

Результаты и обсуждения. В результате полученных данных при осмотре языка детей с заболеваниями верхних отделов пищеварительной системы и ЛОР-патологией, атрофия сосочков языка выявлена у 1/3 детей с ГЭРБ и ХФ. У детей с ГД и ГДЯ, заболеваниями холецистопанкреатической зоны с сопутствующим ХТ или ХФ атрофия сосочков обнаруживается несколько реже – у 1/5 детей. Следует отметить, что в группе детей с патологией тканей пародонта –ХГКГ, без выраженной фоновой патологии этот симптом не был выявлен ни в одном случае. Гипертрофия сосочков языка имела место у 56,4 % детей с заболеваниями ЖКТ и ЛОР-патологией, очаги десквамации – у 15,7 %. Из этого следует, что очевидно воспалительные заболевания эзофагогастроудоденальной и холецистопанкреатической зон пищеварительного тракта в сочетании с ЛОР-патологией оказывают влияние на состояние сосочкового аппарата языка.

Цитологические исследования у 156 детей, выявили смешанную микрофлору у 26,1 % обследованных. Смешанная флора реже (10,7 %) присутствовала у детей с ГЭРБ и ХФ, несколько чаще она обнаруживалась у детей 3-й группы. В остальных группах частота выявления была следующей: в 6-й – у 20 %, в 4-й – у 23,8%, в 8-й – у 27,3%, в 7-й – у 29,2%, что не явилось статистически значимой разницей.

Грибы рода *Candida* обнаружены у детей 1-6-й групп. Причем у детей 3-й группы (с вялой симптоматикой заболеваний) этот процент был самым высоким – 42,9 %. Проведенная ранее терапия с использованием антибиотиков у этих детей способствовала росту данного вида грибов. В группе детей с воспалительными заболеваниями тканей пародонта-ХГКГ, грибы *Candida* обнаружены у 38,9 %, и совсем редко они выявились у детей с заболеваниями органов холецистопанкреатической зоны и ХТ – 8,3 % в 7-й группе, у 4,5 % в 8-й группе у детей с хроническим панкреатитом и ХФ.

Лептотрихии не выявлены в контрольной группе детей. В группе детей с ГЭРБ и ХФ они обнаружались с частотой 82,1 %, в группе детей с НЭРБ и ХТ с частотой 66,7 %. При заболеваниях желчного пузыря и ХТ лептотрихии выявлены у 75% детей, при ГД, ГДЯ в сочетании с ХТ и ХФ – у 60 %, при заболеваниях поджелудочной железы и ХФ у 36,4%. В группе с воспалительными заболеваниями тканей пародонта – ХГКГ, лептотрихии в соскобе с языка выявляются у каждого второго ребенка. Данный вид микрофлоры реже всего обнаруживался у детей 3-й группы.

Фузобактерии наиболее часто выявлялись в 3-й группе (85,7 %) и в группе с ГЭРБ и ХФ (64,3 %). У детей с НЭРП и ХТ этот показатель находился на более низкой отметке – 47,6 %. В остальных группах получены следующие данные: в 8-й группе – у 36,4 %, в 6-й – у 35 %, в 7-й – у 16,7 %.

У 1/5 части детей с заболеваниями органов эзофагогастроуденальной и холецистопанкреатической зон и ЛОР-патологией наблюдались ассоциации отдельных видов микробной флоры, которые были выявлены в препаратах в большом количестве.

Бактериологические исследования соскобов с языка проведены у 122 детей. При подсчете учитывалось количество, превышающее норму. Среди выявленных видов резидентной флоры, имеющих тенденцию к росту, можно выделить: *Streptococcus* spp., *Enterococcus* spp., *Fusobacterium* spp., *Leptotrichia* spp., *Candida* spp. У 3 детей 6-й группы в соскобах с языка высевались лактобактерии. Стрептококки преобладали (87,5 %) у детей с панкреатитами и ХФ. Меньше всего (56,2 %) их было обнаружено в группе с НЭРБ и ХТ. В контрольной группе ни у одного ребенка стрептококки не выявлялись. Энтерококки обнаружены также у детей с панкреатитами (31,3 %) и ХФ, в 1-й

и 3-й группах они отсутствовали. Фузобактерии чаще (83,3 %) обнаруживались в 5-й группе, а в контрольной группе это был единственный случай. Количественные показатели колоний лептотрихий выше нормы выявили у большинства детей с выраженной симптоматикой заболеваний ЖКТ и ЛОР-патологией. Грибы рода *Candida* чаще высевались в группах детей с НЭРБ и ХТ и ГЭРБ и ХФ. У 1 (4,3 %) ребенка 3-й группы в препаратах были выявлены почкующиеся формы бластоспор и мицелии грибов рода *Candida*, у части детей 4-6 групп обнаружено увеличение количества грибов, что послужило основанием для диагностики хронического кандидоза у этих детей. В 3-й группе у таких детей отмечался в анамнезе кроме ХТ или ХФ еще и хронический гастрит. У остальных обследуемых детей была выявлена обычная микрофлора полости рта.

При сопоставлении данных бактериологических и цитологических исследований выявлена корреляция по отдельным видам микрофлоры. Данные по фузобактериям расположились симметрично в группах детей с заболеваниями ЖКТ и ЛОР-патологией, протекающими в активной фазе (рис. 1).

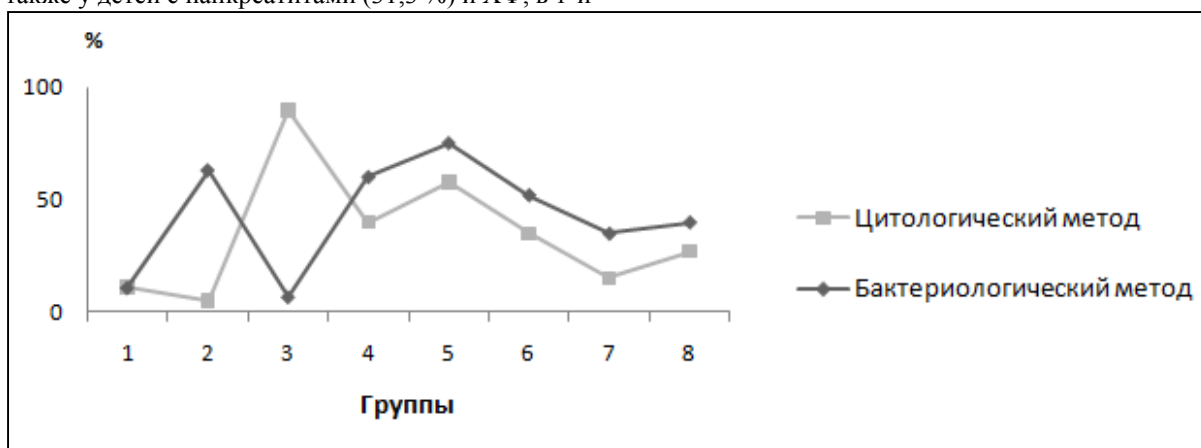


Рис. 1. Обсеменённость поверхности корня языка *Fusobacterium* spp.

Показатели высеваемости лептотрихий по результатам бактериологического и цитологического исследования имели заметную разницу в 8-й группе (62,5 и 36,4 % соответственно), а в 5-й и 2-й

группах цитологический метод дал большой процент детей с высоким ростом колоний (рис. 2).

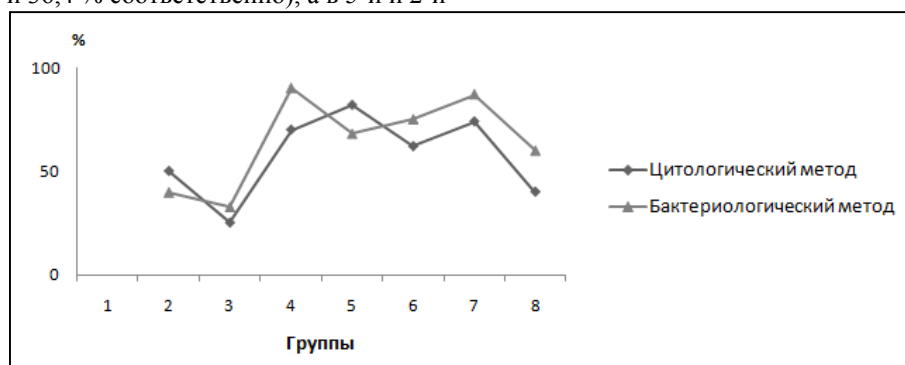


Рис. 2. Обсеменённость поверхности корня языка *Leptotrichia* spp.

Грибы рода *Candida* намного чаще высевались при бактериологических исследованиях в 4-й

и 5-й группах (соответственно 56,3 и 50% против 33,3 и 32,1%), при цитологических исследованиях (рис. 3).

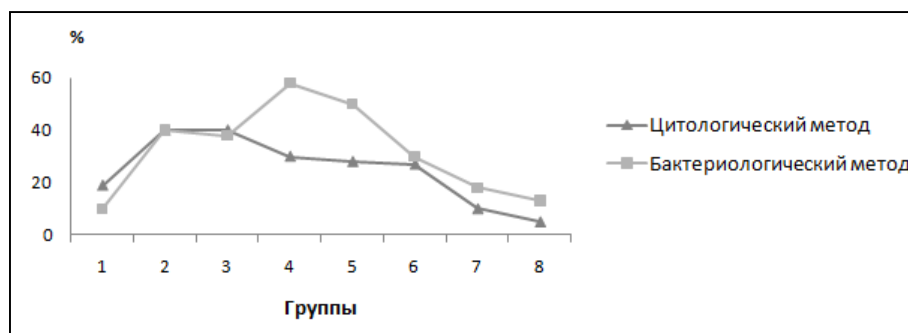


Рис. 3. Обсеменённость поверхности корня языка *Candida spp.*

Заключение. По результатам, полученным при проведении цитологических и бактериологических исследований, можно сделать вывод, что на поверхности языка у большинства детей с ХГКГ больных заболеваниями верхних отделов ЖКТ в сочетании с ЛОР-патологией, наблюдалось увеличение роста резидентной микрофлоры: лептотрихий, фузобактерий, грибов рода *Candida* и стрептококков. Особенно это было выражено при ГЭРБ и ХФ и у детей, ранее леченных по поводу заболеваний верхних отделов ЖКТ и ЛОР-патологии. Хотя тенденция была неоднозначной, в различных группах и у 1/3 обследованных были выявлены ассоциации микробной флоры в различных вариантах количественного увеличения.

У детей с патологией тканей пародонта – ХГКГ, по данным бактериологических исследований, условия для размножения *Candida spp.* (42,1 %) и лептотрихий (36,8 %) были также достаточно благоприятны. Реже (10,5%) высевались фузобактерии.

В большинстве случаев у детей с ХГКГ больных сочетанной патологией верхних отделов пищеварительной системы и ЛОР-органов цитологический экспресс-метод исследования соскобов с языка может использоваться без дополнительного дорогостоящего бактериологического исследования для выявления дисбаланса резидентной флоры

полости рта и назначения корректирующего парадонтологического и оториноларингологического лечения [6,7].

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Colloquium-journal №7(94), 2021

Część 1

(Warszawa, Polska)

ISSN 2520-6990

ISSN 2520-2480

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Redaktor naczelny - **Paweł Nowak, Ewa Kowalczyk**

«Colloquium-journal»
Wydrukowano w Annopol 4, 03-236 Warszawa Poland, «Interdruk»
Format 60 × 90/8. Nakład 500 egzemplarzy.

E-mail: info@colloquium-journal.org

<http://www.colloquium-journal.org/>