ABSTRACT&REFERENCES

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BRAIN CORTEX ACTIVATION DURING THE EXECUTION OF THE MOTOR TASK IN SUBJECTS WITH ACUTE CEREBROVASCULAR ACCIDENT

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Oleksii Omelchenko, Postgraduate Student, Department of Physiology and Anatomy, Educational and Scientific Center "Institute of Biology and Medicine" of Taras Shevchenko National University of Kyiv, Volodymyrska str., 64/13, Kyiv, Ukraine, 01601
E-mail: ol.omelchenko@gmail.com
ORCID: *http://orcid.org/0000-0002-0089-3166*

Mykola Makarchuk, Doctor of Biological Sciences, Professor, Department of Physiology and Anatomy, Educational and Scientific Center "Institute of Biology and Medicine" of Taras Shevchenko National University of Kyiv, Volodymyrska str., 64/13, Kyiv, Ukraine, 01601
E-mail: mykola.makarchuk@gmail.com
ORCID: *http://orcid.org/0000-0002-0982-3463*

We propose the analysis of the peculiarities of the hemodynamic fMRI response in healthy subjects and in acute cerebrovascular accident patients under the movement execution for evaluation of fMRI brain cortex mapping applicability in acute stroke. Five groups of patients were studied with fMRI: first group consisted of 18 healthy subjects, second group consisted of 3 stroke patients with the left hemisphere central sulcus lesion location, third group consisted of 3 patients with the left hemisphere periventricular white matter lesion location, fourth group consisted of 3 patients with the right cerebellar hemisphere lesion location, fifth groups consisted of 2 stroke patients with the left hemisphere supramarginal gyrus lesion location. Right hand finger tapping task was used for the fMRI activation. Data was analyzed with the FSL software. Common regions of activation were located at the contralateral primary sensorimotor cortex, supplementary motor area and cerebellum. Additional regions of activation in stroke patients were located at the ipsilateral sensorimotor cortex, fronto-parietal and premotor cortex, bilateral cerebellum, and the subthalamic nuclei. Stroke-related migration of the activation regions in the supramarginal gyrus and ventral premotor cortex of the mirror neuron system was found during the audio-motor transformation. Regions of brain activation were found adjacent to the DWI hyper intense ischemic regions during the movement execution. But at the most DWI hyperintense focuses no fMRI activation was found. We have found out correlation of the maximal BOLD signal amplitude change and the total volume of brain activation. It was shown that fMRI allows visualization of the main cortical motor control regions in acute stroke. Additional regions of cortical motor control have to be involved in acute stroke. Adjacent to the DWI hyper intense regions of activation were found

Keywords: *brain, acute cerebrovascular accident, functional MRI, motor cortex*

References

1. Omel'chenko, A. N., Makarchuk, N. E. (2017). fMRI Visualization of Functional Patterns of Neural Networks during the Performance of Cyclic Finger Movements: Age-Related Peculiarities. Neurophysiology, 49 (5), 372–383. doi: http://doi.org/10.1007/s11062-018-9697-3

2. Purves, D., Augustine, G. J., Fitzpatrick, D., Hall, W. C., LaMantia, A.-S., White, L. E. (Eds.) (2012). Neuroscience. Sunderland: Sinauer Associates, 759.

3. Flanders, M. (2011). What is the biological basis of sensorimotor integration? Biological Cybernetics, 104 (1-2), 1–8. doi: http://doi.org/10.1007/s00422-011-0419-9

4. Iacoboni, M., Woods, R. P., Brass, M., Bekkering, H., Mazziotta, J. C., Rizzolatti, G. (1999). Cortical mechanisms of human imitation. Science, 286 (5449), 2526–2528. doi: http://doi.org/10.1126/science.286.5449.2526

5. Gazzola, V., Keysers, C. (2008). The Observation and Execution of Actions Share Motor and Somatosensory Voxels in all Tested Subjects: Single-Subject Analyses of Unsmoothed fMRI Data. Cerebral Cortex, 19 (6), 1239–1255. doi: http://doi.org/10.1093/cercor/bhn181

6. Warren, J. E., Wise, R. J. S., Warren, J. D. (2005). Sounds do-able: auditory–motor transformations and the posterior temporal plane. Trends in Neurosciences, 28 (12), 636–643. doi: http://doi.org/10.1016/j.tins.2005.09.010

7. Kuznetsova, S., Kuznetsov, V., Vorobey, M. (2005). Tiotsetam influence on CNS functional state of the patients undergone stroke. The news of medicine and pharmacy, 2, 6–7.

8. Zozulya, I., Zozulya, A. (2011). The epidemiology of cerebrovascular diseases in Ukraine. Annuals of Ukrainian medicine, 5. Available at: https://www.umj.com.ua/article/19153/epidemiologiya-cerebrovaskulyarnix-zaxvoryuvan-v-ukraini

9. Weimar, C., Kurth, T., Kraywinkel, K., Wagner, M., Busse, O., Haberl, R. L., Diener, H.-C. (2002). Assessment of Functioning and Disability After Ischemic Stroke. Stroke, 33 (8), 2053–2059. doi: http://doi.org/10.1161/01.str.0000022808.21776.bf

10. Lai, S.-M., Studenski, S., Duncan, P. W., Perera, S. (2002). Persisting Consequences of Stroke Measured by the Stroke Impact Scale. Stroke, 33 (7), 1840–1844. doi: http://doi.org/10.1161/01.str.0000019289.15440.f2

11. Gusev, E., Skvortsova, E., Martynov, M. (2003). Cerebral stroke: problems and solutions. Annals of RAMS, 11, 44–48.

12. Van Heerden, J., Desmond, P. M., Phal, P. M. (2014). Functional MRI in clinical practice: A pictorial essay. Journal of Medical Imaging and Radiation Oncology, 58 (3), 320–326. doi: http://doi.org/10.1111/1754-9485.12158

13. Srinivasan, A., Goyal, M., Azri, F. A., Lum, C. (2006). State-of-the-Art Imaging of Acute Stroke. RadioGraphics, 26, 75–95. doi: http://doi.org/10.1148/rg.26si065501

14. Altamura, C., Reinhard, M., Vry, M.-S., Kaller, C. P., Hamzei, F., Vernieri, F. et. al. (2009). The longitudinal changes of BOLD response and cerebral hemodynamics from acute to subacute stroke. A fMRI and TCD study. BMC Neuroscience, 10 (1), 151. doi: http://doi.org/10.1186/1471-2202-10-151

15. Jackman, K., Iadecola, C. (2015). Neurovascular Regulation in the Ischemic Brain. Antioxidants & Redox Signaling, 22 (2), 149–160. doi: http://doi.org/10.1089/ars.2013.5669

16. Schlaug, G., Siewert, B., Benfield, A., Edelman, R. R., Warach, S. (1997). Time course of the apparent diffusion coefficient (ADC) abnormality in human stroke. Neurology, 49 (1), 113–119. doi: http://doi.org/10.1212/wnl.49.1.113

17. Friston, K. J., Holmes, A. P., Worsley, K. J., Poline, J.-P., Frith, C. D., Frackowiak, R. S. J. (1994). Statistical parametric maps in functional imaging: A general linear approach. Human Brain Mapping, 2 (4), 189–210. doi: http://doi.org/10.1002/hbm.460020402

18. Logothetis, N. K. (2008). What we can do and what we cannot do with fMRI. Nature, 453 (7197), 869–878. doi: http://doi.org/10.1038/nature06976

19. Van Gelderen, P., Ramsey, N. F., Liu, G., Duyn, J. H., Frank, J. A., Weinberger, D. R., Moonen, C. T. (1995). Three-dimensional functional magnetic resonance imaging of human brain on a clinical 1.5-T scanner. Proceedings of the National Academy of Sciences, 92 (15), 6906–6910. doi: http://doi.org/10.1073/pnas.92.15.6906

20. Zarahn, E., Alon, L., Ryan, S. L., Lazar, R. M., Vry, M.-S., Weiller, C. et. al. (2011). Prediction of Motor Recovery Using Initial Impairment and fMRI 48 h Poststroke. Cerebral Cortex, 21 (12), 2712–2721. doi: http://doi.org/10.1093/cercor/bhr047

21. Jueptner, M., Weiller, C. (1995). Review: Does Measurement of Regional Cerebral Blood Flow Reflect Synaptic Activity?–Implications for PET and fMRI. NeuroImage, 2 (2), 148–156. doi: http://doi.org/10.1006/nimg.1995.1017

22. Moonen, C. T. W., Bandettini, P. A. (2000). Functional MRI. Medical radiology. New York: Springer, 575. doi: http://doi.org/10.1007/978-3-642-58716-0

23. Sibson, N. R., Dhankhar, A., Mason, G. F., Rothman, D. L., Behar, K. L., Shulman, R. G. (1998). Stoichiometric coupling of brain glucose metabolism and glutamatergic neuronal activity. Proceedings of the National Academy of Sciences, 95 (1), 316–321. doi: http://doi.org/10.1073/pnas.95.1.316

24. Rijntjes, M., Dettmers, C., Buchel, C., Kiebel, S., Frackowiak, R. S. J., Weiller, C. (1999). A Blueprint for Movement: Functional and Anatomical Representations in the Human Motor System. The Journal of Neuroscience, 19 (18), 8043–8048. doi: http://doi.org/10.1523/jneurosci.19-18-08043.1999

25. Mintzopoulos, D., Khanicheh, A., Konstas, A. A., Astrakas, L. G., Singhal, A. B., Moskowitz, M. A. et. al. (2008). Functional MRI of Rehabilitation in Chronic Stroke Patients Using Novel MR-Compatible Hand Robots. The Open Neuroimaging Journal, 2 (1), 94–101. doi: http://doi.org/10.2174/1874440000802010094

26. Nechypurenko, N., Pashkovskaya, I., Musiyenko, Yu. (2008). Main pathophysiological mechanisms of the brain ischemia. Medical news, 1, 7–13.

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IN VITRO SCREENING OF THE SPRING WHEAT F_2 HYBRIDS FOR WATER DEFICIT RESISTANCE

p. 12-18

Serhii Pykalo, PhD, Senior Researcher, Department of Biotechnology, Genetics and Physiology, The V. M. Remeslo Myronivka Institute of Wheat National Academy of Agrarian Sciences of Ukraine, Tsentralna str., 68, Tsentralne, Myronivka district, Kyiv region, Ukraine, 08853
E-mail: pykserg@ukr.net
ORCID: *http://orcid.org/0000-0002-3158-3830*

Oleksandr Demydov, Doctor of Agricultural Sciences, Corresponding Member of NAAS of Ukraine, Director, The V. M. Remeslo Myronivka Institute of Wheat National Academy of Agrarian Sciences of Ukraine, Tsentralna str., 68, Tsentralne, Myronivka district, Kyiv region, Ukraine, 08853
E-mail: mwheats@ukr.net
ORCID: *http://orcid.org/0000-0002-5715-2908*

Nataliia Prokopik, Junior Researcher, Department of Biotechnology, Genetics and Physiology, The V. M. Remeslo Myronivka Institute of Wheat National Academy of Agrarian Sciences of Ukraine, Tsentralna str., 68, Tsentralne, Myronivka district, Kyiv region, Ukraine, 08853
E-mail: snatanata@ukr.net
ORCID: *http://orcid.org/0000-0003-3933-5054*

Serhii Voloshchuk, PhD, Leading Researcher, Department of Biotechnology, Genetics and Physiology, The V. M. Remeslo Myronivka Institute of Wheat National Academy of Agrarian Sciences of Ukraine, Tsentralna str., 68, Tsentralne, Myronivka district, Kyiv region, Ukraine, 08853
E-mail: volsi@ukr.net
ORCID: *http://orcid.org/0000-0002-9447-7525*

Tetiana Yurchenko, PhD, Head of Department, Department of Biotechnology, Genetics and Physiology, The V. M. Remeslo Myronivka Institute of Wheat National Academy of Agrarian Sciences of Ukraine, Tsentralna str., 68, Tsentralne, Myronivka district, Kyiv region, Ukraine, 08853
E-mail: T.Yurchenko978@gmail.com
ORCID: *http://orcid.org/0000-0003-0164-4003*

Svitlana Khomenko, PhD, Head of Laboratory, Laboratory of Spring Wheat Breeding, The V. M. Remeslo Myronivka Institute of Wheat National Academy of Agrarian Sciences of Ukraine, Tsentralna str., 68, Tsentralne, Myronivka district, Kyiv region, Ukraine, 08853
E-mail: homenko.mip@ukr.net
ORCID: *http://orcid.org/0000-0002-6047-7711*

In vitro screening of the spring durum and bread wheat F_2 hybrids for water deficit resistance by the direct selection using low molecular mannitol as a stressor was conducted. It is shown that with an increase in the concentration of mannitol from 0.2 to 0.8 M in all genotypes there was the inhibition of the growth of the callus culture that indicates the toxic effect of the stress factor. It was established that the concentration of 0.6 M mannitol allows to differentiate spring wheat genotypes for water deficit.

It was found that the F_2 hybrid Elehiia myronivska / Krasa Polissia was most resistant to osmotic stress because calli of this genotype under selective conditions are characterized by relatively high morphogenic potential, had the highest survival rate and regenerated plants were obtained only from explants of this hybrid after

cultivation on the medium containing mannitol concentration of 0.8 M. The F_2 hybrid Zhizel / Lan was most susceptible to osmotic stress because mass necrosis and lack of regenerative ability were observed in its calli, under selective conditions. The genotypic dependence of processes of shoot formation in in vitro culture was observed in the spring wheat forms of studied. The formation of regenerated plants from wheat calli took place through both gemmorizogenesis and somatic embryogenesis.

Plant regenerants were obtained from the induced calli and their rearing, rooting and transfer to in vivo conditions were optimized. Genotypic responses to osmotic stress in the callus culture of spring wheat were manifested by different survival rate and different regenerative ability under the action of a stress factor. The hybrid Elehiia myronivska / Krasa Polissia can be used as a valuable material for further breeding of spring wheat. The in vitro tissue culture can be used as a test system for the screening of wheat genotypes for resistance to osmotic stress. The optimized procedure of vigorous regenerated plants production of spring durum and bread wheat in in vitro callus cultures can be used in cell selection and genetic engineering experiments

Keywords: *spring wheat, water deficit, callus culture, mannitol, osmotic stress, resistance*

References

1. Yaremko, Z., Rudiak, O. (2016) Osnovni chynnyky formuvannia koniunktury svitovoho rynku pshenytsi [World wheat market economic situation formation factors]. Naukovyi visnyk Mykolaivskoho natsionalnoho universytetu imeni V. O. Sukhomlynskoho. Seriia: Ekonomichni nauky, 1, 103–109.

2. Mohammad, F., Ahmad, I. J. A. Z., Khan, N. U., Maqbool, K., Naz, A. Y. S. H. A., Shaheen, S. A. L. M. A., Ali, K. (2011). Comparative study of morphological traits in wheat and triticale. Pakistan Journal of Botany, 43 (1), 165–170.

3. Krasensky, J., Jonak, C. (2012). Drought, salt, and temperature stress-induced metabolic rearrangements and regulatory networks. Journal of Experimental Botany, 63 (4), 1593–1608. doi: http://doi.org/10.1093/jxb/err460

4. Bartels, D., Sunkar, R. (2005). Drought and salt tolerance in plants. Critical Reviews in Plant Sciences, 24 (1), 23–58. doi: http://doi.org/10.1080/07352680590910410

5. Kacem, N. S., Delporte, F., Muhovski, Y., Djekoun, A., Watillon, B. (2017). In vitro screening of durum wheat against water-stress mediated through polyethylene glycol. Journal of Genetic Engineering and Biotechnology, 15 (1), 239–247. doi: http://doi.org/10.1016/j.jgeb.2017.04.004

6. Morhun, V. V., Dubrovna, O. V., Morhun, B. V. (2016). Suchasni biotekhnolohii otrymannia stiikykh do stresiv roslyn pshenytsi [The modern biotechnologies of producing wheat plants resistant to stresses]. Fiziologiya rasteniy i genetika, 48 (3), 196–214.

7. Dubrovna, O. V., Chugunkova, T. V., Bavol, A. V., Lialko, I. I.; Morhun, V. V. (Ed.) (2012). Biotekhnologhichni ta cytoghenetychni osnovy stvorennja roslyn, stijkykh do stresiv [Biotechnological and cytogenetic bases for the creation of plants resistant to stresses]. Kyiv: Lohos, 428.

8. Soliman, H. I. A., Hendawy, M. H. (2013). Selection for drought tolerance genotypes in durum wheat (Triticum durum Desf.) under in vitro conditions. Middle-East Journal of Scientific Research, 14 (1), 69–78.

9. Dubrovnaya, O. V. (2017). In vitro selection of wheat for resistance to abiotic stress factors [Selektsiya in vitro pshenitsy na ustoychivost' k abioticheskim stressovym faktoram]. Fiziologiya rasteniy i genetika, 49 (4), 279–292.

10. Lestari, E. G. (2006). In vitro selection and somaclonal variation for biotic and abiotic stress tolerance. Biodiversitas, 7 (3), 297–301. doi: http://doi.org/10.13057/biodiv/d070320

11. Rai, M. K., Kalia, R. K., Singh, R., Gangola, M. P., Dhawan, A. K. (2011). Developing stress tolerant plants through in vitro selection – an overview of the recent progress. Environmental and Experimental Botany, 71 (1), 89–98. doi: http://doi.org/10.1016/j.envexpbot.2010.10.021

12. Generozova, I. P., Maevskaya, S. N., Shugaev, A. G. (2009). Ingibirovanie metabolicheskoy aktivnosti mitokhondriy etiolirovannykh prorostkov gorokha, podvergnutykh vodnomu stressu [Inhibition of the metabolic activity of mitochondria of etiolated pea seedlings subjected to water stress]. Fiziologiya rasteniy, 56 (1), 45–52.

13. Ahmad, A. A. (1999). Response of immature embryos in vitro regeneration of some wheat, Triticum aestivum genotypes under different osmotic stress of mannitol. Assiut Journal of Agricultural Sciences, 30 (3), 25–34.

14. Al-Kholani, H. A. (2010). Poluchenie stress-tolerantnykh rasteniy kukuruzy metodom kletochnoy selektsii [Obtaining stress-tolerant corn plants by the method of cell selection]. Moscow, 129.

15. Butt, A., Ahmed, N., Mubin, M., Khaliq, I., Lighfoot, D. A. (2015). Effect of PEG and mannitol induced water stress on regeneration in wheat (Triticum aestivum L.). Pakistan Journal of Agricultural Sciences, 52 (4), 1025–1033.

16. Dubrovna, O. V., Bavol, A. V., Zinchenko, M. A., Lyalko, I. I., Kruglova, N. M. (2011). Vplyv osmotychnykh rechovyn na kaliusni linii miakoi pshenytsi, stiiki do kulturalnoho filtratu Gaeumannomyces graminis var. tritici [Effect of osmotic substances on the common wheat callus lines resistant to culture filtrate of Gaeumannomyces graminis var. tritici]. Visnyk Ukrainskoho tovarystva henetykiv i selektsioneriv, 9 (1), 10–16.

17. Murashige, T., Skoog, F. (1962). A revised medium for rapid growth and bio assays with tobacco tissue cultures. Plant Physiology, 15 (3), 473–497. doi: http://doi.org/10.1111/j.1399-3054.1962.tb08052.x

18. Lakin, G. F. (1990). Biometriya [Biometrics]. Moscow: Vysshaya shkola, 352.

19. Delporte, F., Mostadel, O., Jacquemin, J. (2001). Plant regeneration through callus initiation from thin mature embryo fragments of wheat. Plant Cell, Tissue and Organ Culture, 67 (1), 73–80. doi: http://doi.org/10.1007/s11240-004-9221-x

20. Khlebova, L. P., Nikitina, E. D., Matsyura, A. V., Bychkova, O. V. (2016). Vzaimosvyaz morfogeneticheskikh protsessov v kulture tkani pshenitsy [Relationship of morphogenetic processes in wheat tissue culture]. Biolohichnyi visnyk MDPU imeni Bohdana Khmelnytskoho, 6 (2), 311–320.

21. Sidor, L. S., Orlov, P. A. (2005). Regeneratsionnyy potentsial razlichnykh vidov pshenitsy, rzhi i yachmenya v kul'ture listovykh eksplantov [Regeneration potential of different types of wheat, rye and barley in culture of leaf explants], Tsitologiya i genetika, 39 (5), 28–34.

22. Komatsuda, T., Enomoto, S., Nekajima, K. (1989). Genetics of callus proliferation and shoot differentiation in barley.

Journal of Heredity, 80 (5), 345–350. doi: http://doi.org/10.1093/oxfordjournals.jhered.a110872

23. Henry, Y., Marcotte, J., De Buyser, J. (1994). Chromosomal location of genes controlling short-term and long-term somatic embryogenesis in wheat revealed by immature embryo culture of aneuploid lines. Theoretical and Applied Genetics, 89 (2-3), 344–350. doi: http://doi.org/10.1007/bf00225165

24. Pykalo, S. (2015). Biotekhnologiya polucheniya rasteniy-regenerantov tritikale v kulture razlichnykh tipov eksplantov [Biotechnology of plant regenerant production triticale in culture of various types of explants]. Austrian Journal of Technical and Natural Sciences, 5-6, 34–39.

25. Kaleikau, E. K., Sears, R. G., Gill, B. S. (1989). Control of tissue culture response in wheat (Triticum aestivum L.). Theoretical and Applied Genetics, 78 (6), 783–787. doi: http://doi.org/10.1007/bf00266658

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DIVERSITY AND VITALITY OF TREE SPECIES IN THE STREET PLANTATIONS OF KRYVYI RIH CITY

p. 18-23

Ivan Korshikov, Doctor in Biological Sciences, Professor, Kryviy Rih Botanical Garden of the National Academy of Sciences of Ukraine, Donetsk Botanical Garden of the National Academy of Sciences of Ukraine, Marshaka str., 50, Kryviy Rih, Ukraine, 50089
E-mail: ivivkor@gmail.com
ORCID: *http://orcid.org/0000-0002-1471-398X*

Lyudmyla Boyko, PhD, Senior Researcher, Department of Plant Introduction and Acclimatization, Kryviy Rih Botanical Garden of the National Academy of Sciences of Ukraine, Donetsk Botanical Garden of the National Academy of Sciences of Ukraine, Marshaka str., 50, Kryviy Rih, Ukraine, 50089
E-mail: ludmilaboyko@meta.ua
ORCID: *http://orcid.org/0000-0003-3699-6906*

Oleg Krasnoshtan, Researcher, Department of Plant Introduction and Acclimatization, Kryviy Rih Botanical Garden of the National Academy of Sciences of Ukraine, Donetsk Botanical Garden of the National Academy of Sciences of Ukraine, Marshaka str., 50, Kryviy Rih, Ukraine, 50089
E-mail: landscape.oleg@gmail.com
ORCID: *http://orcid.org/0000-0002-3489-4319*

Olena Suslova, PhD, Department Dendrology and Natural Flora, Donetsk Botanical Garden of the National Academy of Sciences of Ukraine, Marshaka str., 16 A, Kryviy Rih, Ukraine, 50089
E-mail: elenasuslova2901@gmail.com
ORCID: *http://orcid.org/0000-0002-6371-7514*

Antonina Mazur, PhD, Senior Researcher, Department of Plant Introduction and Acclimatization, Kryviy Rih Botanical Garden of the National Academy of Sciences of Ukraine, Donetsk Botanical Garden of the National Academy of Sciences of Ukraine, Marshaka str., 50, Kryviy Rih, Ukraine, 50089
E-mail: garden7@meta.ua
ORCID: *http://orcid.org/0000-0002-1819-3926*

The important factor of improving the ecological-esthetical role of green plantations in the city environment is a reasoned selection of tree species for greening city territories. That is why there is a necessity to study the state of green plantations in industrial cities. The ***aim*** *of the work was to study the diversity of dendroflora in city plantations in green plantations of Saksagansky district of Kryvyi Rih city and to reveal decorative species of tree plantations, most resistant to conditions of the urbanized environment. The studies were conducted by the* ***method*** *of inventory of green plantations with defining their type, forest valuation parameters and vitality level. It was established, that the studied territories contain 49 types of tree plants that include 17 families and present 23 genera. By the number of specimens there prevail Aesculus hippocastanum L.(13,4% of the whole number of trees), Populus bolleana Louche (7,8%), Populus nigra L. (6,6%), Ulmus laevis Pall. (6,4%), Tilia cordata Mill. (6,0 %), Robinia pseudoacacia L.(4,1%). The most number of types, characterized with 7-8 points of vitality originates from the Circumboreal floristic region (almost 39% of all species that received highest vitality indices). Fast-growing species prevail in plantations of the studied region, they are 67%. The share participation of middle-growing and slow-growing species is essentially less (23% and 10% respectively). The decrease of vitality of tree plants with age depends on their growth intensity. The decrease of vitality of tree plants is most fast in slow-growing species (in the age after 30 years), and in middle- and fast-growing species after 40–50 years. So, slow-growing tree plants must not be involved into the composition of linear street plantations of the Right-bank Pridneprovie, because they are less long-lived under these conditions. The highest vitality is typical for plants in age categories 21–30 and 31-40 years (27,4 % and 22,9 % respectively). The most number of trees with the lowest vitality level was revealed among young plants under 10 years old. Species of genera Fraxinus L., Acer L., Populus L., Robinia L., Ulmus L can be recommended as the most vital among street plantations*

Keywords: *urbanization, tree species, street plantations, diversity, vitality, age category*

References

1. Levon, F. M. (2008). Zeleni nasadzhennia v antropohennomu transformovanomu seredovyshchi [Green plantings in anthropogenic transformed environment]. Kyiv: NSC AEI, 364.

2. Adinolfi, C., Suarez-Caceres, G. P., Carinanos, P. (2014). Relation between visitors' behaviour and characteristics of green spaces in the city of Granada, south-eastern Spain. Urban Forestry & Urban Greening, 13 (3), 534–542. doi: http://doi.org/10.1016/j.ufug.2014.03.007

3. Jim, C. Y. (2012). Sustainable urban greening strategies for compact cities in developing and developed economies. Urban Ecosystems, 16 (4), 741–761. doi: http://doi.org/10.1007/s11252-012-0268-x

4. Avdeeva, E. V. (2008). Zelenyie nasazhdeniya v monitoring okruzhayuschey sredyi krupnogo promyishlennogo goroda: na primere g. Krasnoyarska [Green plantings within the large industrial city environment monitoring: case of Krasnoyarsk]. Krasnoyarsk, 390

5. Antonevich, O. A. (2013). Ekologicheskiy monitoring sostoyaniya zelenyih nasazhdeniy urbanizirovannyih territoriy: na primere g. Tomska [Ecological monitoring after state of green

plantings in urbanized territories: case of Tomsk city]. Krasnoyarsk, 152.

6. Bessonova, V. P., Ponomarova, O. A., Ivanchenko, O. Ie. (2014). Vydove riznomanittia ta zhyttievyi stan derevnykh nasadzhen vzdovzh avtotrasy pivdennoho napriamku m. Dnipropetrovsk [Specific diversity and vital state of tree plantings along the southward direction highway of Dnepropetrovsk city]. Bioindication and ecology issues, 19 (2), 64–84.

7. Kuznetsov, S. I., Levon, F. M. (2013). Introduktsiina ta ekoloho-landshaftna optymizatsiia miskykh zelenykh nasadzhen v Ukraini [Introductional and ecological-landscape optimization of urban green plantations in Ukraine]. Kyiv, 95–97.

8. Korshikov, I. I. (1996) Adaptatsiya rasteniy k usloviyam tehnogenno zagryaznennoy sredyi [Adaptation of plants to the technogenically polluted environment conditions]. Kyiv: Naukova dumka, 239.

9. Lysyi, A. E., Ryzhenko, S. A., Koziaryn, Y. P. et. al. (2009). Ekologicheskie i sotsial'no-gigienicheskie problemy i puti ozdorovleniya krupnogo promyshlennogo regiona [Ecological and social-hygienic problems and ways of sanitation in large industrial region]. Krivoy Rog, 428.

10. Tahtadzhyan, A. L. (1978) Floristicheskie oblasti Zemli [Floristic areas of Earth]. Leningrad: Nauka, 248.

11. Saveleva, L. S. (1975). Ustoychivost derevev i kustarnikov v zaschitnyih nasazhdeniyah [Stability of trees and bush es in protective plantings]. Moscow: Lesnaya promyshlennost, 271.

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RADIATION-INDUCED CHROMOSOME ABERRATIONS IN ONCOGYNECOLOGICAL PATIENTS AND PATIENTS WITH HEAD AND NECK CANCER UNDERGOING RADIOTHERAPY ON A LINEAR ACCELERATOR

p. 24-28

Nataliya Maznyk, Doctor of Biological Sciences, Head of Laboratory, Laboratory of Radiation Cytogenetics, State Institution «Grigoriev Institute for Medical Radiology of National Academy of Medical Science of Ukraine», Pushkinska str., 82, Kharkiv, Ukraine, 61024
ORCID: *http://orcid.org/0000-0002-3216-1330*

Tetiana Sypko, Researcher, Laboratory of Radiation Cytogenetics, State Institution «Grigoriev Institute for Medical Radiology of National Academy of Medical Science of Ukraine», Pushkinska str., 82, Kharkiv, Ukraine, 61024
ORCID: *http://orcid.org/0000-0002-1788-9235*

Nataliya Pshenichna, Junior Researcher, Laboratory of Radiation Cytogenetics, State Institution «Grigoriev Institute for Medical Radiology of National Academy of Medical Science of Ukraine», Pushkinska str., 82, Kharkiv, Ukraine, 61024
ORCID: *http://orcid.org/0000-0002-6119-1117*

Viktor Starenkiy, Doctor of Medical Sciences, Senior Researcher, Head of Department, Department of Radiation Therapy, State Institution «Grigoriev Institute for Medical Radiology of National Academy of Medical Science of Ukraine», Pushkinska str., 82, Kharkiv, Ukraine, 61024
ORCID: *http://orcid.org/0000-0002-6600-3381*

Iryna Krugova, PhD, Senior Researcher, Department of Oncogynecology, State Institution «Grigoriev Institute for Medical Radiology of National Academy of Medical Science of Ukraine», Pushkinska str., 82, Kharkiv, Ukraine, 61024
ORCID: *http://orcid.org/0000-0002-6676-3321*

Aims: *The assessment of radiation-induced chromosome aberrations in lymphocytes of oncogynecological and head and neck cancer patients during radiation therapy on linear accelerator depending on the tumor localization.*

Methods: *16 oncogynecological patients and 12 patients with head and neck tumors undergoing radiation treatment on linear accelerator were examined. Lymphocytes were cultivated by the conventional technique before treatment, in the middle and at the end of the radiotherapy course. Radiation doses exceeded 40–44 Gy.*

Results of research: *The yield and range of radiation-induced cytogenetic damage changes in lymphocytes during megavolt radiation therapy were demonstrated. The monotonic increase of chromosome type aberrations from start to the end of treatment was found. More pronounced changes in these parameters in oncogynecological patients than in patients with head and neck tumors were demonstrated. The range of cells with chromosome aberrations expanded during radiotherapy in both groups. In the middle of the radiotherapy cells with 1–4 aberrations per cell in head and neck cancer patients and 1–7 aberrations per cell in oncogynecological patients were observed. At the end of radiotherapy the number of damages per aberrant cell from 1 to 8 for both groups was observed. The distribution of the chromosome type aberrations among cells was found to be over-dispersed according to Poisson statistic both at the middle and at the end of radiotherapy course.*

Conclusion: *The study of the radiation-induced aberrations revealed the different character of cytogenetic damages accumulation in patients undergoing radiotherapy depending on tumor localizations and accordingly on the irradiated body fraction. The data obtained will expand the knowledge concerning effects of fractionated therapeutic megavolt radiation in non-tumor tissues of patients*

Keywords: *radiation-induced chromosome aberrations, lymphocytes, oncological patients, megavolt radiation therapy*

References

1. Gudkov, I. M. (2016). Radiobiologiya. Kyiv: NUBiP Ukrainy, 485.

2. Skladowski, K., Law, M. G., Maciejewski, B., Gordon Steel, G. (1994). Planned and unplanned gaps in radiotherapy: the importance of gap position and gap duration. Radiotherapy and Oncology, 30 (2), 109–120. doi: http://doi.org/10.1016/0167-8140(94)90039-6

3. Hille, A., Hofman-Hüther, H., Kühnle, E., Wilken, B., Rave-Frank, M., Schmidberger, H., Virsik, P. (2009). Spontaneous and radiation-induced chromosomal instability and persistence of chromosome aberrations after radiotherapy in lymphocytes from prostate cancer patients. Radiation and Environmental Biophysics, 49 (1), 27–37. doi: http://doi.org/10.1007/s00411-009-0244-x

4. Sreedevi, B., Rao, B. S., Nagaraj, H., Pal, N. K. (2001). Chromosome Aberration Analysis in Radiotherapy Patients and Simulated Partial Body Exposures: Biological Dosimetry for

Non-uniform Exposures. Radiation Protection Dosimetry, 94 (4), 317–322. doi: http://doi.org/10.1093/oxfordjournals.rpd.a006505

5. Gershkevitsh, E., Hildebrandt, G., Wolf, U., Kamprad, F., Realo, E., Trott, K.-R. (2002). Chromosomal Aberration in Peripheral Lymphocytes and Doses to the Active Bone Marrow in Radiotherapy of Prostate Cancer. Strahlentherapie Und Onkologie, 178 (1), 36–42. doi: http://doi.org/10.1007/s00066-002-0886-y

6. Roch-Lefevre, S., Pouzoulet, F., Giraudet, A. L., Voisin, P., Vaurijoux, A., Gruel, G. et. al. (2010). Cytogenetic assessment of heterogeneous radiation doses in cancer patients treated with fractionated radiotherapy. British Journal of Radiology, 83 (993), 759–766. doi: http://doi.org/10.1259/bjr/21022597

7. Cytogenetic Dosimetry: Applications in Preparedness for and Response to Radiation Emergencies (2011). Vienna: International Atomic Energy Agency, 229.

8. Cytogenetic analysis for radiation dose assessment (2001). IAEA Technical Reports Series. No. 405. Vienna: International Atomic Energy Agency, 127.

9. Zakharov, A. F., Benyush, V. A., Kuleshov, N. P., Baranovskaya, L. I. (1982). Khromosomy cheloveka. Atlas. AMN SSSR. Moscow: Meditsina, 264.

10. Sypko, T. S., Pshenichna, N. D., Maznyk, N. O. (2015). Mitotychna aktyvnist kultur limfotsytiv krovi onkolohichnykh khvorykh na riznykh etapakh promenevoi terapii na liniinomu pryskoriuvachi. Materialy VI zizdu radiobiolohichnoho tovarystva Ukrainy. Kyiv, 118–119.

11. Edwards, A. A., Lloyd, D. C., Purrott, R. J. (1979). Radiation induced chromosome aberrations and the poisson distribution. Radiation and Environmental Biophysics, 16 (2), 89–100. doi: http://doi.org/10.1007/bf01323216

12. Lakin, G. F. (1973). Biometriya. Moscow: Vysshaya shkola, 343.

13. Maznyk, N. O., Vinnikov, V. A., Mikhanovskyi, O. A., Sukhina, O. M., Tepla, V. O. (2002). Tsytohenetychni efekty v osib z onkohinekolohichnymy zakhvoriuvanniamy v protsesi promenevoho likuvannia. Ukrainskyi Radiolohichnyi Zhurnal, 10 (1), 32–36.

14. Arutyunyan, R., Martus, P., Neubauer, S., Birkenhake, S., Dunst, J., Sauer, R., Gebhart, E. (1998). Intercellular distribution of cytogenetic changes detected by chromosome painting in irradiated blood lymphocytes of cancer patients. Experimental Oncology, 20 (3), 223–228.

15. Cao, J., Liu, Y., Sun, H., Cheng, G., Pang, X., Zhou, Z. (2002). Chromosomal aberrations, DNA strand breaks and gene mutations in nasopharyngeal cancer patients undergoing radiation therapy. Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis, 504 (1-2), 85–90. doi: http://doi.org/10.1016/s0027-5107(02)00082-9

16. Lloyd, D. C., Edwards, A. A.; Ishihara, T., Sasaki, M. (Eds.) (1983). Chromosome aberrations in human lymphocytes: effect of radiation quality, dose, and dose rate. Radiation-induced chromosome damage in man. New York: A. R. Liss, 23–49.

17. Fleckenstein, J., Kuhne, M., Seegmuller, K., Derschang, S., Melchior, P., Graber, S. et. al. (2011). The Impact of Individual In Vivo Repair of DNA Double-Strand Breaks on Oral Mucositis in Adjuvant Radiotherapy of Head-and-Neck Cancer. International Journal of Radiation Oncology Biology Physics, 81 (5), 1465–1472. doi: http://doi.org/10.1016/j.ijrobp.2010.08.004

18. Minicucci, E. M., Kowalski, L. P., Maia, M. A. C., Pereira, A., Ribeiro, L. R., de Camarco, J. L. V., Salvadori, D. M. F. (2005). Cytogenetic damage in circulating lymphocytes and buccal mucosa cells of head-and-neck cancer patients undergoing radiotherapy. Journal of Radiation Research, 46 (2), 135–142. doi: http://doi.org/10.1269/jrr.46.135

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ELECTRIC ACTIVITY OF THE HUMAN BRAIN IN INDIVIDUALS WITH DIFFERENT EGOISM-ALTRUISM LEVEL

p. 29-33

Oksana Rakovets, Lecturer, Lutsk Pedagogical College, Voli ave., 36, Lutsk, Ukraine, 43010
E-mail: oksana.fed88@gmail.com
ORCID: *http://orcid.org/0000-0002-1780-270X*

Illya Kuznetsov, PhD, Associate professor, Department of Human and Animal Physiology, Lesya Ukrainka Eastern European National University, Voli ave., 13, Lutsk, Ukraine, 43025
ORCID: *http://orcid.org/0000-0002-8780-8525*

Maria Osyp, Lecturer, Lutsk Pedagogical College, Voli ave., 36, Lutsk, Ukraine, 43010
ORCID: *http://orcid.org/0000-0002-3832-4276*

Igor Kotsan, Doctor of Biological Sciences, Professor, Rector, Department of Human and Animal Physiology, Lesya Ukrainka Eastern European National University, Voli ave., 13, Lutsk, Ukraine, 43025
ORCID: *http://orcid.org/0000-0001-8576-7398*

The formation of a human personality and the peculiarities of its social behavior are influenced by both biological characteristics and psychophysiological data. Therefore, in order to determine the prevailing socio-type of personality, it is necessary to take into account all aspects and features that may affect individual-psychological characteristics. In addition, neuromarkers that indicate altruistic and selfish social behavior will show the effective use of neurotrainings for their correction and explain the mechanisms of social adaptation.

The aim of the research: *to find differences in brain activity of individuals with different social type by registration of their electric activity.*

Methods: *psychological testing method, event-related synchronization/desynchronization method.*

Results: *Individuals with selfish type of social behavior chose selfish stimulus more often than individuals with altruistic type of social behavior. Individuals with selfish type of social behavior show higher indexes of spectrum power in alfa- and betha-range. Desynchronization reaction is typical for individuals with altruistic social behavior; synchronization reaction is typical for selfish-directed individuals. Synchronization in central and parietal areas in selfish-directed individuals is mostly shown as a reaction to altruistic stimulus; altruistic-directed individuals showed synchronization reaction to the altruistic stimulus in these areas.*

Conclusions: *EEG data in alpha-range suggest that mechanisms of attention are involved for longer time period in the individuals with altruistic social behavior type. The reaction to the opposite type of stimulus is characterized by the same behavioral effects, however, has different electroencephalographic characteristics. The results show the different nature of the subjective reaction to stimuli, which is opposite to the sociotype of the individuals. However, a more detailed analysis indicates a different neurophysiological and subjective component of these reactions*

Keywords: *electroencephalography, sociotype, selfishness, altruism, synchronization, desynchronization, cerebral cortex, social behavior*

References

1. Fox, N. A., Henderson, H. A., Marshall, P. J., Nichols, K. E., Ghera, M. M. (2005). Behavioral Inhibition: Linking Biology and Behavior within a Developmental Framework. Annual Review of Psychology, 56 (1), 235–262. doi: http://doi.org/10.1146/annurev.psych.55.090902.141532

2. Hari, R., Kujala, M. V. (2009). Brain Basis of Human Social Interaction: From Concepts to Brain Imaging. Physiological Reviews, 89 (2), 453–479. doi: http://doi.org/10.1152/physrev.00041.2007

3. Engemann, D. A., Bzdok, D., Eickhoff, S. B., Vogeley, K., Schilbach, L. (2012). Games people play – toward an enactive view of cooperation in social neuroscience. Frontiers in Human Neuroscience, 6. doi: http://doi.org/10.3389/fnhum.2012.00148

4. Liebrand, W. B. G., Jansen, R. W. T. L, Rijken, V. M., Suhre, C. J. M. (1986). Might over morality: Social values and the perception of other players in experimental games. Journal of Experimental Social Psychology, 22 (3), 203–215. doi: http://doi.org/10.1016/0022-1031(86)90024-7

5. Bhatt, M., Camerer, C. F. (2005). Self-referential thinking and equilibrium as states of mind in games: fMRI evidence. Games and Economic Behavior, 52 (2), 424–459. doi: http://doi.org/10.1016/j.geb.2005.03.007

6. Sanfey, A. G. (2007). Social Decision-Making: Insights from Game Theory and Neuroscience. Science, 318 (5850), 598–602. doi: http://doi.org/10.1126/science.1142996

7. Adolphs, R. (1999). Social cognition and the human brain. Trends in Cognitive Sciences, 3 (12), 469–479. doi: http://doi.org/10.1016/s1364-6613(99)01399-6

8. Declerck, C. H., Boone, C., Kiyonari, T. (2010). Oxytocin and cooperation under conditions of uncertainty: The modulating role of incentives and social information. Hormones and Behavior, 57 (3), 368–374. doi: http://doi.org/10.1016/j.yhbeh.2010.01.006

9. Kelso, J. A. S., Dumas, G., Tognoli, E. (2013). Outline of a general theory of behavior and brain coordination. Neural Networks, 37, 120–131. doi: http://doi.org/10.1016/j.neunet.2012.09.003

10. Leary, T. (1958). Interpersonal Diagnosis of Personality. American Journal of Physical Medicine & Rehabilitation, 37, 331.

11. Klimesch, W. (1999). EEG alpha and theta oscillations reflect cognitive and memory performance: a review and analysis. Brain Research Reviews, 29 (2-3), 169–195. doi: http://doi.org/10.1016/s0165-0173(98)00056-3

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HYGIENIC ASSESSMENT OF SANITARY AND CHEMICAL INDICATORS OF POTABLE TAP WATER QUALITY IN SHALLOW WATER REGIONS OF UKRAINE

p. 33-39

Olesya Zorina, PhD, Senior Researcher, Leading Researcher, Laboratory of Hygiene of Natural, Drinking Water, State Institution "O. M. Marzeiev Institute for Public Health National Academy of Medical Sciences of Ukraine", Popudrenka str., 50, Kyiv, Ukraine, 02094

E-mail: wateramnu@ukr.net

ORCID: *http://orcid.org/0000-0002-1557-8521*

The aim of current research was to make the hygienic assessment of sanitary and chemical indicators of potable tap water quality in Ukraine in regions with the shortage of potable water, where drinking water is used from underground low-quality sources or the big water pipelines. While conducting the research, the following methods were used: sanitary-chemical, hygienic monitoring, and mathematical statistics. It was determined, that the groundwater and hybrid water supply are used for provision of shallow water regions with potable tap water. In some regions of Ukraine, the water of centralized supply of drinking water from underground sources is of inadequate quality, which is due to the following indicators: nitrates, fluorine, dry residue, total hardness, chlorides, sulfates, iron, and manganese. Quantity of indicators for groundwater, which levels doesn't meet the hygienic requirements, can vary from 1–2 to 6-8, in average - 6 indicators. Detected exceedances of maximum permitted hygienic requirements reach up to 2–4,6 times. With the use of combined water supply in the drinking water of consumers of the Communal Enterprise "Berdyanskvodokanal" maximum content was detected: nickel-10MAC, selen-5MAC, permanganate demand – 1,2MAC (before transporting by the big water pipeline, dry residue – 3,5MAC, total hardness – 3,9 MAC, sulfates – 7,8MAC, colour – 2MAC, permanganate demand – 1,4 MAC (because of the water pollution in local surface water source). Reasonability of membrane technologies implementing for potable tap water purification has been proved. For the purpose of solving the crisis in the sphere of potable water supply considering the European legislation, the following actions need to be taken: to improve the national water legislation on water bodies protection from pollution and on assessment of potable water quality, as well as to implement the efficient modern technologies of water treatment and equip the measuring laboratories

Keywords*: potable tap water, quality that don't meet the standards, groundwater, shallow water regions*

References

1. Stavitskiy, E. A., Rudko, G. I., Yakovleva, E. O. et. al. (2011). Strategia vykoristania resursiv putnukh pidzemnykh vod dlia vodopostachania. Vol. 1 [Strategy for the development of resources for drinking water for water users. Vol. 1]. Chernivtsi: Bukrek, 348.

2. Palamarchuk, M. M., Zakorchevna, N. B. (2001). Vodnyi fond Ukrainy [Water fund of Ukraine]. Kyiv: Nika-Centr, 392.

3. Bardov, V. H., Fedorenko, V. I. (Eds.) (2013). O snovy ekologii [The Ecology basics]. Kyiv: New book, 424.

4. Prokopov, V. O. (2016). Pitna voda Ukraini: medico-ta sanitarno- ekologichni gigienechni aspekyi [Potable water in Ukraine: medical environmental, and hygiene issues]. Kiyv: Medicine, 400.

5. Markovskyi, Y. E. (2008). Ekologicheskoe sostoianie prirodnykh vod donbasa [Ecological state of natural waters of Donbas]. Science in information space. Available at: http://www.confcontact.com/2008oktInet_tezi/gg_markovsky.php

6. Vorohta, Y. M. (2007). Gigienichna otsinka vplyvu mineralnogo skladu pitnykh vod na zdorovia naselenia [Hygienic assessment of the mineral water content influence on public health]. Kyiv, 23.

7. Prokopov, V. O., Lypovetska, O. B. (2012). Vplyv mineralnogo skladu pitnoi vody na stan zdorovia naselenia (ogliad literatupy) [Influence of mineral composition of potable water on the health of population (literature review)]. Hygiene of settlements, 59, 63–74.

8. Lypovetska, O. B. (2016). Vplyv dovgotrivalogo spojivania nekondytsiynoi za mineralnym skladom pitnoi vody na formuvania neinfectsiynoi zakhvopiunanosti naselenia ta rozrobka profilaktichnykh zakhodiv [Influence of long-term use of potable water with substandard mineral content on forming of the non-infectious morbidity of the population and development of preventive measures]. Kyiv, 177.

9. Golodovska, O. Ya., Kovalchuk, O. Z. (2009). Sposteredjenia za stanom poverkhnevykh vod osnovnykh richkovykh baseyniv Lvivskoi oblasti [Monitoring of the state of the main surface river basins of Lviv region]. Available at: http://ena.lp.edu.ua/bitstream/ntb/2580/1/50.pdf

10. Mokienko, A. V., Petrenko, N. F., Gozhenko, A. I. (2012). Obezzarazhivanie vogy. Gigienicheskie i medico-ekologicheskie aspekty. Chlorine Dioxide. Vol. 2 [Disinfection of water. Hygienic and medico-ecological aspects Vol. 2]. Odessa: TEC, 605.

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INFLUENCE OF AMMONIA OF WATERS FROM THE SURFACE SOURCES OF WATER SUPPLY ON THEIR TOXICITY FOR *RANA RIDIBUNDA* (PALLAS, 1771)

p. 39-43

E**lla Arystarkhova,** PhD, Associate Professor, Department of Environmental Safety and Economy of Natural Management, Zhytomyr National Agroecological University, Staryi blvd., 7, Zhytomyr, Ukraine, 10008
E-mail: ella.aryst@gmail.com
ORCID: *http://orcid.org/0000-0002-7523-4608*

Ludmila Romantschuk, Doctor of Agricultural Science, Professor, Department of Forest Ecology and Life Safety, Zhytomyr National Agroecological University, Staryi blvd., 7, Zhytomyr, Ukraine, 10008
E-mail: ludmilaromanchuck14@gmail.com
ORCID: *http://orcid.org/0000-0003-4790-8414*

Yevgen Dankevych, Doctor of Economic Science, Professor, Department of Environmental Safety and Economy of Natural Management, Zhytomyr National Agroecological University, Staryi blvd., 7, Zhytomyr, Ukraine, 10008
E-mail: dankevych2020@gmail.com
ORCID: *http://orcid.org/0000-0001-8337-5956*

Olena Zhytova, Doctor of Biological Science, Associate Professor, Department of Forest Ecology and Life Safety, Zhytomyr National Agroecological University, Staryi blvd., 7, Zhytomyr, Ukraine, 10008
E-mail: elmi1969@meta.ua
ORCID: *http://orcid.org/0000-0003-2572-4163*

Aim. *Revelation of the influence of ammonia from surface water supply sources on formation of their toxicity, determined by indices of motor activity of young lacustrine frogs (Rana ridibunda Pallas, 1771).*

Methods. *Biotesting was conducted by the method of «time sampling» with preliminary exposure of individuals for 12 hours (n=30) in test samples of water, taken from the Denishevsky water storage basin and Otsechne water intake of the river Teterev and also in samples of settled water from water pipe as a control. The indices of water toxicity were calculated by reactions of typical and non-typical activity of individuals. The ammonia content was determined by the photometric method with Nessler reagent. The correlation and regression analysis was realized by the standard computer program MO Excel 2003.*

Results. *There are established the effects of the ammonia influence on the toxicity of test waters that is proved by the values of determination coefficients, received for 3-year period (R^2 at level 0,3893 for the water storage basin and 0,2814 for water intake) and correlation (r of middle degree 0,6240 and 0,5305 respectively). There are constructed the graphs, expressed by the equations of rectilinear regression (y=52,535x+16,207 and y=50,917x+21,067), that gives a possibility to prognosticate toxicity levels of waters as to the ammonia content for the water storage basin and water intake.*

Conclusions. *There were revealed the correlations of the indices of toxicity of the testing waters with the ammonia content that in 2014 (0,6939 – in the Denishevsky water storage basin and 0,6803 – in the Otsechne water intake) reached more degree than in 2012 (0,6413 and 0,4281) and 2013 (0,6556 and 0,5083) years, respectively that is conditioned by increasing ammonification processes. There was fixed a tendency of increasing the force of the ammonia influence (from 41,12 to 48,15 % in waters of the water storage basin and from 18,33 to 46,28 % – water intake) on the toxicity of these waters. In the 3-years period of the studies, there was testified the presence of the reliable ammonia influence of the toxicity of waters in the water storage basin at level 38,93 % (F=3,0811; p ≤0,05,), and also its absence in the water intake 28,14 % (F=1,5663). There were given the equations of rectilinear regression and graphic images of the dependencies that allow to calculate the ammonia content (0,58 mg/dm³ and 0,64) at reaching 50 % level of water toxicity of lacustrine frogs*

Keywords: *toxicity of waters, ammonia, R. ridibunda, biotesting, non-typical motor activity, «time sampling»method*

References

1. Zapolskyi, A. K., Shumigay, I. V. (2015). Okhorona vod vid vysnazhennia i sabrudnennia. Agroecologichnyi zhurnal, 3, 6–15.

2. Malik, A., Grohmann, E., Akhtar, R. (Eds.) (2014). Environmental Deterioration and Human Health: Natural and anthropogenic determinants. Dordrecht; Heidelberg; London; New York: Springer, 8–16. doi: http://doi.org/10.1007/978-94-007-7890-0

3. Hriuk, I., Sukhodolska, I. (2012). Vmist spoluk nitrogenu e void malykh richok. Visnyk L'vivs'koho universitetu. Seria biologichna, 60, 227–238.

4. SanPiN 4630-88. (1988). Sanitarnyie pravila i normy okhrany poverkhnostnykh vod ot sagriasnenia, Moscow: Min. Sdravookhran SSSR, 70.

5. Dudnik, S. V. (2014). Vodna toksykolohiia. Part 2: Ichtiotoksykolohiia. Kyiv, 108.

6. Arystarkhova, E. O. (2017) Otsiniuvannia toksychnisti sabrudnenykh amoniakom vod Carassius auratus gibelio (Bloch, 1782) metodom «time sampling». Rybohospodars'ka nauka Ukrainy, 4, 33–41.

7. Schneeweiss, N., Schneeweiss, U. (1997). Amphibienverluste infolge mineralischer Düngung auf Agrarflächen. Salamandra, 33 (1), 1–8.

8. Schneeweiss, N., Schneeweiss, U. (1999). Gefährdung von Amphibien durch mineralische Düngung. Rana, 3, 59–66.

9. Melikhova, O. P., Egorova, E. I. (2007). Biologicheskii kontrol' okruzhaiushchei sredy: bioindycatsia i biotestuvannia. Moscow: Isd. zentr «Akademia», 288.

10. ASTM, Standard Guide for Conducting Acute Toxicity Tests on Aqueous Ambient Samples and Effluents with Fishes, Macroinvertebrates, and Amphibian (2008). ASTM International. URL: https://www.astm.org/DATABASE.CART/HISTORICAL/E1192-97R08.htm

11. Lur'ie, U. U. (Ed.) (1973). Unifizyrovannyie metody analisa vod. Moscow: Isdatiel'stvo Chimia, 376.

12. Biliavskiy, H. O., Butchenko, L. I. (2006). Osnovy ekolohii: teoria ta praktykum. Kyiv: Libra, 368.

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CORONAROGRAPHIC AND MAGNETIC-RESONANT STUDY OF THE MYOCARDIUM OF RATS FOR ARTIFICIAL HYPOBYOSIS

p. 44-47

Anna Umanska, Postgraduate student, Academician M. F. Guliy Department of Biochemistry, National University of Life and Environmental Sciences of Ukraine, Heroiv Oborony str., 15, Kyiv, Ukraine, 03041
E-mail: ann.umanska@ukr.net
ORCID: *http://orcid.org/0000-0001-7335-0851*

Dmytro Melnichuk, Doctor of Biological Sciences, Professor, Academician of NAS and NAAS of Ukraine, Head of Public Organization, Public Organization «The Council of Heroes of Ukraine in the agroindustrial complex», Solomianska str., 2a, Kyiv, Ukraine, 02000
E-mail: kalachnyuk_liliya@nubip.edu.ua
ORCID: *http://orcid.org/0000-0002-9013-4170*

Liliia Kalachniuk, Doctor of Biological Sciences, Professor, Academician of Academy of Sciences of Higher Education of Ukraine, Laureate of State Prize of Ukraine in the Field of Science and Technology, Academician M. F. Guliy Department of Biochemistry and physiology, National University of Life and Environmental Sciences of Ukraine, Heroiv Oborony str., 15, Kyiv, Ukraine, 03041
E-mail: kalachnyuk_liliya@nubip.edu.ua
ORCID: *http://orcid.org/0000-0002-5545-8495*

The one of newest future methods of anesthesia is the state of artificial hypobiosis. For detail studying this method with a possibility of its further introduction in clinical practice, and before – in conducting clinical studies, it is necessary to have specified data of pre-clinical studies. Among important methods that characterize the completeness of pre-clinical data are magnetic resonance imaging procedure and coronography of key vessels of the myocardium of rats. Coronography – is the rontgenological method of research that demonstrates the structural deformation and speed of the bloodstream of key vessels of the heart. Its principle is based on introducing a contrast substance including iodine in the peripheral vein of a patient with the further rontgenological scanning during several full cycles of circuit. In its turn, the magnetic-resonance imaging procedure of the myocardium – non-invasive method of the structural-diagnostic study characterizes 3D-model using the three-dimensional reconstruction of the cardiac muscle, and also demonstrates the volume of cardiac chambers, characterizing the dynamics of changes of the wall thickness. That is why just these methods were chosen for the detail characteristics of structural-functional changes of the myocardium of rats at artificial hypobiosis. In experiments there were used white outbred male-rats with mass 180–200 g, kept in standard vivarium conditions. The animals were divided in groups: control (intact animals) and experimental (artificial hypobiosis). The number of animals in each group n=7. Experiments were conducted in correspondence of requirements of the "European convention about protection of vertebral animals, used for experimental and other scientific purpose" (Strasburg, France, 1985), According to general ethical principles of experiments, accepted by the first national congress of Ukraine on bioethics (2001). As a result of the conducted studies, it was demonstrated that the state of artificial hypobiosis favors the essential narrowing of the clearance of great vessels of the myocardium of rats, decrease of the frequency of heart contractions in six times comparing with the control one, and also decrease of the chambers of the cardiac muscle

Keywords: *hypobiosis, hypothermia, hypercapnia, hypoxia, myocardium, coronography, tomography, vessels, atriums, ventricles*

References

1. Morozova, V. I. (2013). Functional activity of mitochondria of hepatocytes and cardiomyocytes of rats for artificial gipobiosis. Kyiv, 21

2. Alukhin, Yu. S., Ivanov, K. P. (1998). A model of winter hibernation in a non-mammalian mammal upon cooling its brain to 1–4 °C. Adapt. organism to nature. and eco-sots. environmental conditions. Magadan, 6–7.

3. Schäfer, R., Wiskirchen, J., Guo, K., Neumann, B., Kehlbach, R., Pintaske, J. (2007). Aptamer-Based Isolation and Subsequent Imaging of Mesenchymal Stem Cells in Ischemic Myocard by Magnetic Resonance Imaging. RöFo– Fortschritte Auf Dem Gebiet Der Röntgenstrahlen Und Der Bildgebenden Verfahren, 179 (10), 1009–1015. doi: http://doi.org/10.1055/s-2007-963409

4. Vykhovanets, V. I., Melnychuk, S. D. (2008). History of the development of models of artificial suppression of living organisms. Scientific herald of NAU, 127, 65–68.

5. Kalabukhov, N. I. (1985). Hibernation of mammals. Moscow: Science, 168.

6. Melnichuk, S. D., Vakhovets, V. I. (2005). The Influence of the Conditions of the Artificial Hypobiosis on the Energy Exchange in Rats. Ukrainian Biochemical Journal, 77 (3), 131–135.

7. Melnichuk, S. D., Melnychuk, D. O. (2007). Animal hypobiosis (molecular mechanisms and practical values for agriculture and medicine). Kyiv: Publishing Center of NAU, 220.

8. Melnichuk, D. O., Melnichuk, S. D., Arnauta, O. V. (2004). Influence of the carbon dioxide medium on the preservation of erythrocytes in the canned blood of animals. Scientific Herald NAU, 75, 163–165.

9. Melnichuk, S. D. (2001). Basic indicators of acid-base blood and metabolic processes in the case of hypobiosis and general anesthesia for amputation of the limb. Ukrainian Biochemical Journal, 73 (6), 80–83.

10. Melnichuk, S. D., Rogovsky, S. P., Melnychuk, D. O. (1995). Features of acid-base equilibrium and nitrogen exchange in the body of rats under conditions of artificial gipobiosis. Ukrainian Biochemical Journal, 67 (4), 67–75.

11. Melnichuk, S. D., Vychanets, V. I. (2005). The Influence of Conditions of Artificial Hypobiosis on Energy Exchange in Rats. Ukrainian Biochemical Journal, 11 (3), 131–135.

12. Severina, E. S. (Ed.) (2004). Biochemistry. Moscow: GEOTAR-MED,784.

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BIOCHEMICAL CHARACTERISTICS OF ABOVEGROUND PHYTOMASS OF PLANT OF THE GENUS *ASTRAGALUS* L. IN THE RIGHT-BANK OF FOREST-STEPPE OF UKRAINE

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Dzhamal Rakhmetov, Doctor of Agricultural Sciences, Professor, Department of cultural flora, M. M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, Timiriazievska str., 1, Kyiv, Ukraine, 01014
E-mail: jamal_r@bigmir.net
ORCID: *http://orcid.org/0000-0001-7260-3263*

Oleksandr Bondarchuk, Leading Engineer, Department of cultural flora, M. M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, Timiriazievska str., 1, Kyiv, Ukraine, 01014
E-mail: bondbiolog@gmail.com
ORCID: *http://orcid.org/0000-0001-6367-9063*

Olena Vergun, Researcher, Department of cultural flora, M. M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, Timiriazievska str., 1, Kyiv, Ukraine, 01014
E-mail: en_vergun@ukr.net
ORCID: *http://orcid.org/0000-0003-2924-1580*

Valentyna Fishchenko, Leading Engineer, Department of cultural flora, M. M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, Timiriazievska str., 1, Kyiv, Ukraine, 01014
ORCID: *http://orcid.org/0000-0002-7714-1739*

Objective *– to find out the specific features of the biochemical composition of the representatives of the Astragalus genus as valuable phyto-raw materials for medicinal and energy purposes in the conditions of the Right-Bank of Forest-Steppe of Ukraine.*

Materials and methods. *The object of research is plants of the genus Astragalus species, in the collection fund of department cultural flora of M.M. Gryshko National Botanical Garden of the NAS of Ukraine.*

Phyto-raw materials were analyzed during the budding, flowering and fruiting phase in the biochemical laboratory of the department of cultural flora of the M.M. Gryshko National Botanical Garden of the NAS of Ukraine according to generally accepted methods. Processing of research results was performed by analysis of variance and statistical estimate of the average data using of program Microsoft Excel (2010).

Results. *The greatest amount of dry matter in all the investigated introducents accumulates in the fruiting phase (24,37–38,64 %) and the maximum value was in A. glycyphyllos.*

The total content of sugars significantly increases during the flowering phase. The highest was in A. glycyphyllos (20,00 %). Protein content in plants of the genus Astragalus in this period was 14,00–24,42 %, ascorbic acid respectively 102,44–398,45 %. A high level of ascorbic acid was released – A. ponticus. A high level of lipid content during the growing season (except for budding) was characterized by A. galegiformis.

Intensive accumulation of cellulose in plants of the genus Astragalus is fixed in the flowering phase (34,84–42,36 %). The highest content of cellulose was characterized in plants A. falcatus.

It was found that the most energy-producing plants were A. galegiformis and A. ponticus (more than 81 Gcal/ha), somewhat less valuable were A. falcatus plants (61–80 Gcal/ha). At an energy-productivity of 41–60 Gcal/ha, belong to the A. cicer and A. glycyphyllos plants.

Conclusions. *It was established that plants of the genus Astragalus species are characterized by a rich quantitative and qualitative composition of BAC in terms of dry matter. According to the biochemical composition, all accumulate sugars, vitamin C, carotene, lipids, protein, fiber and other valuable substances, which indicates the prospect of using them as valuable medicinal phytopreparations. The productivity of above-ground phytomass, the output of total energy and phyto-fuel per unit area gives grounds for considering data of introducts as valuable raw materials for the needs of bioenergy.*

Keywords: *Astragalus L. species, introduction, biochemical characteristic, productivity of plant, Right-Bank of Forest-Steppe of Ukraine.*

References

1. Stratehii udoskonalennia mekhanizmu upravlinnia v sferi vykorystannia ta okhorony zemel silskohospodarskoho pryznachennia derzhavnoi vlasnosti ta rozporiadzhennia nymy (2017). Postanova Kabinetu Ministriv Ukrainy No. 413. 7.06.2017. S.-Uriadovyi portal. Available at: https://www.kmu.gov.ua/ua/npas/250068882/

2. Voronov, I. V., Danilova, N. S., Poskachina, Ye. R., Semenova, V. V. (2017). Soderzhanie lyuteolin-7-glyukozida, rutina

i digidrokvertsetina v nadzemnoy chasti Astragalus angarensis (Fabaceae) v Tsentralnoy Yakutii [The content of luteolin-7-glucoside, rutin and dihydroquercetin in the aerial part of Astragalus angarensis (Fabaceae) in Central Yakutia]. Rastitelnye resursy, 3, 425–434.

3. Koshovyi, O. M. (2013). Suchasni pidhody do stvorennia likarskyh zasobiv na osnovi roslyn rodiv Evkalipt ta Shavliia [Modern approaches to the creation of medicines based on plants of the genera Eucalyptus and Shavliya]. Kharkiv, 39.

4. Rakhmetov, D. B., Vergun, O. M., Rahmetova, S. O. (2014). Panicum virgatum L. – perspektivniy introdutsent u natsionalnomu botanichnomu sadu im. M. M. Grishka NAN Ukraini [Panicum virgatum L. – Perspective introspection in the national botanical garden. M.M. Grishka NAS of Ukraine]. Plant introduction, 3, 3–14.

5. Bondarchuk, O. P., Rys M. V., Fishchenko, V. V., Korablova, O. A., Rakhmetov, D. B. (2016). Biohimichnyi sklad roslyn vydiv rodu Astragalus L. ta Elsholtzia Willd. v umovach introdukcii v NBS im. M.M. Hryshka NAN Ukrainy [Biochemical composition plants of species of Astragalus L. and Elsholtzia Willd. genus under conditions of introduction into M.M. Gryshko NBG National Academy of Sciences of Ukraine]. Khimiia pryrodnykh spoluk. Ternopil, 73–74.

6. Lobanova, I. Ye. (2010). Dinamika soderzhaniya askorbinovoy kisloty v organakh astragala sladkolistnogo i chiny vesenney [Dynamics of ascorbic acid in the organs and astragalus glycyphyllos spring ranks]. Siberian Herald of Agricultural Science, 4, 19–23.

7. El-Hawiet, A. M., Toaima, S. M., Asaad, A. M., Radwan, M. M., El-Sebakhy, N. A. (2010). Chemical constituents from Astragalus annularis Forssk. and A. trimestris L., Fabaceae. Revista Brasileira de Farmacognosia, 20 (6), 860–865. doi: http://doi.org/10.1590/s0102-695x2010005000047

8. Zhang, Z. Y., Wu, B., Tang, Y. H., Li, Z. X., Sun, Z. L., Chen, L. Y. et al. (2013). Characterization of major flavonoids, triterpenoid, dipeptide and their metabolites in rat urine after oral administration of Radix Astragali decoction. Journal of Analytical Chemistry, 68 (8), 716–721. doi: http://doi.org/10.1134/s1061934813080145

9. Borchardt, J. R., Wyse, D. L., Sheaffer, C. C. et. al. (2008). Antioxidant and antimicrobial activity of seed from plants of the Mississippi river basin. Journal of Medicinal Plants Research, 2 (4), 81–93.

10. Gao, J., Zheng, M., Meng, P., Zhang, J-S. (2008). Effects of Armeniaca sibirica-Astragalus system on soil physi-chemical properties of the hill and gully area on the Loess Plateau. Journal of Forest Research, 719–723.

11. Rios, J. L., Waterman, P. G. (1997). A review of the pharmacology and toxicology of Astragalus. Phytotherapy Research, 11 (6), 411–418. doi: http://doi.org/10.1002/(sici)1099-1573(199709)11:6<411::aid-ptr132>3.0.co;2-6

12. Malitskaya, N. V. (2015). Vozdelyvanie i ispolzovanie netraditsionnykh kormovykh kultur v umerenno zasushlivoy stepi Severnogo Kazakhstana [Cultivation and use of non-traditional fodder crops in the moderately arid steppe of Northern Kazakhstan]. Bulletin of KrasGAU, 7, 148–153.

13. Xiang-Yong, Z., Zhong-Fu, L., Yong, S. (2006). The dynamical studies on biomass and interspecific competition of limpograss and red clover mixture. Journal of Sichuan Agricultural University, 367–370.

14. Lysiuk, R. M., Yanovich, D. O., Zaritska, E. G., Bondarchuk, O. P., Rakhmetov, D. B. (2016). Doslidzhennya makro- i mikroelementnogo skladu nadzemnih organiv introdukovanih vidiv rodu Astragalus L. [Investigation of macro- and microelements contents in aerial portions of introduced Astragalus species]. Agrobiodiversity for improving nutrition, health and life quality. Nitra, 148–152.

15. Belous, V. N. (2005). Vidyi roda Astragalus L. i ih rol v rastitelnom pokrove Predkavkazya [Role of the genus Astragalus L. species in the plant cover of Ciscaucasia]. Stavropol, 174.

16. Davis, A. M. (1973). Protein, crude fiber, tannin and oxalate concentrations of some introduced Astragalus species. Agronomy Journal Abstract, 65 (4), 613–615. doi: http://doi.org/10.2134/agronj1973.00021962006500040025x

17. Altantsetseg, E., Kalashnikova, E. A. (2013). Razmnozhenie astragala mongolskogo (Astragalus mongholicus Bunge) v usloviyah in vitro [Reproduction of Mongolian Astragalus (Astragalus mongholicus Bunge) in vitro]. Izvestiya of Timiryazev Agricultural Academy, 6, 40–48.

18. Razzhivina, T. V. (2008). Astragal nutovyy – perspektivnaya kormovaya kultura v Penzenskoy oblasti [Astragalus cicer – promising fodder crop in the Penza region]. Fodder Production, 1, 26–27.

19. Erisen, S., Atalay, E., Yorgancilar, M. (2011). The effect of thidiazuron on the in vitro shoot development of endemic Astragalus cariensis in Turkey. Turkish Journal of Botany, 35 (5), 521–526. doi: https://doi.org/10.3906/bot-1009-74

20. Lee, C. H., Park, K. D., Jung, K. Y., Ali, M. A., Lee, D., Gutierrez, J., Kim, P. J. (2010). Effect of Chinese milk vetch (Astragalus sinicus L.) as a green manure on rice productivity and methane emission in paddy soil. Agriculture, Ecosystems and Environment, 138, 343–347. doi: http://doi.org/10.1016/j.agee.2010.05.011

21. Townsend, C. E. (1993). Breeding, physiology, culture, and utilization of Cicer milkvetch (Astragalus cicer L.). Advances in Agronomy, 49, 253–308. doi: http://doi.org/10.1016/s0065-2113(08)60796-8

22. Safronova, V. I., Chizhevskaya, Ye. P., Belimov, A. A. et. al. (2011). Opredelenie taksonomicheskogo polozheniya mikrosimbiontov kopeechnika (Hedysarum) i astragala (Astragalus) na osnove analiza genov ribosomalnykh RNK [Determination of the taxonomic position of the microsymbionts of the penny (Hedysarum) and astragalus (Astragalus) on the basis of the analysis of ribosomal RNA genes]. Agricultural Biology: The Plant Biology, 3, 61–64.

23. Peregrim, Yu. S. (2014). Introduktsiya ridkisnih i znikayuchih vidiv rodu Astragalus L. (Fabaceae) prirodnoi flori Ukraini: uspihi ta perspektivi [Introduction of rare and endangered of the genus Astragalus L. species (Fabaceae) of Ukraine natural flora: successes and perspectives]. Scientific Herald of Chernivtsy University. Biology (Biological Systems), 6 (1), 64–71.

24. Lysiuk, R., Darmohray, R., Rakhmetov, D., Bondarchuk, O. (2015). Current trends and prospects for application of Astragalus spp. Agrobiodiversity for improving nutrition, health and life quality. Nitra, 442–444.

25. Gubaniov, O. G. (2013). Astragal sherstystokvitkovyi – cinna likarska kultura. «Trava zyttia kremlivskykh vozdiv» [Astragalus sherstistotsvetkovy – a valuable medicinal crop. «The

Grass of the Life of the Kremlin Chiefs»]. Modern agrarian technologies, 6 (334), 55–59.

26. Kolosovych, M. P. (2003). Osoblyvosti biolohii cvitinnia Astrahalu sherstystokvitkovoho (Astragalus dasianthus Pall.) ta sholomnyci baikalskoi (Scutellaria bacalensis Geoggi) i pidvyshchennia ix nasinnevoi produktyvnosti v umovax Lisostepu Ukrainy [Peculiarities of the flowering biology of Astragalus dastianthus Pall. and Schelellaria bacalensis Geoggi flour and increasing their seed productivity in the conditions of the forest-steppe Ukraine]. Kyiv, 20.

27. Bondarchuk, O. P., Rakhmetov, D. B. (2017). Produktyvnist roslyn vydiv rodu Astragalus L. v umovax introdukcii v Pravobereznomu Lisostepu Ukrainy [Productivity of plants of the genus Astragalus L. species in conditions of introduction into Right-Bank of Forest-Steppe of Ukraine]. Plant introduction, 4, 11–19.

28. Yermakov, A. I., Arasimovich, V. V., Smirnova-Ikonnikova, M. I. (1985). Metody biokhimicheskogo issledovaniya rasteniy [Methods of biochemical research of plants]. Leningrad: Kolos, 455.

29. Pochinok, Kh. N. (1976). Metody biokhimicheskogo analiza rasteniy [Methods of biochemical analysis of plants]. Kiev: Naukova dumka, 336.

30. GOST 24027.2-80. Syre lekarstvennoe rastitelnoe. Metody opredeleniya vlazhnosti, soderzhaniya zoly, ekstraktivnykh i dubilnykh veshchestv, efirnogo masla [GOST 24027.2-80. Raw materials medicinal vegetative. Methods for determination of moisture content, ash content, extractive and tanning agents, essential oil] (1988). Moscow, 120.

31. Hrycaenko, Z. M., Hrycaenko, A. O., Karpenko, V. P. (2003). Metody biolohichnyh ta ahrohimichnyx doslidzen roslyn i hruntiv [Methods of biological and agrochemical studies of plants and soils]. Kyiv: Nichlava, 320.

32. Pleshkov, B. P. (1985). Praktikum po biokhimii rasteniy [Workshop on Plant Biochemistry]. Moscow: Kolos, 256.

33. Krishchenko, V. P. (1983). Metody otsenki kachestva rastitelnoy produktsii [Methods for assessing the quality of plant products]. Moscow: Kolos, 192.

34. Rakhmetov, D. B. (2017). Naukovo-innovatsiyniy potentsial mobilizatsii ta vikoristannya novih roslinnih resursiv (za materialami naukovoi dopovidi na zasidanni Prezidii NAN Ukraini) [Scientific and innovative potential of mobilization and use of new plant resources]. Visnyk of the National Academy of Sciences of Ukraine, 1, 73–81.