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**INVESTIGATION OF CYTOTOXIC AND CYTOSTATIC ACTIVITY OF FLAVONOID-CONTAINING  
EXTRACT OF KIRKAZONE OF LOMONOSOVIDE (ARISTOLOCHIA CLEMATITIS L.) IN  
EXPERIMENTS IN VITRO AND IN VIVO**

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Extract of folia and flores Aristolochia clematitis contains flavonoids and non-toxic. The extract has cytotoxic and cytostatic activity in normal animal cells. At concentrations of 15 mg/ml and higher, the extract results in 100% cell death of the Spev line. The number of dead cells of the Spev line as a whole increases with increasing concentration of the extract. The LC50 of the Kirkazon extract was determined by the probit analysis method. LC50=7.24 mg/ ml. With an increase in the concentration of the extract, a marked decrease in the cell's polymeric activity was observed. After 48 hours, the inhibition of the proliferative activity of the Spev cells is more pronounced than 24 hours later. The percentage of the Spev cells killed by the Kirkzona extract becomes smaller with increasing exposure time. The mass of the transplanted tumor of rats practically did not differ from the control group without exposure. The extract showed no antitumor activity against transplantable liver cancer of rats PC-1 in an in vivo experiment.

**Key words:** Aristolochia clematitis, flavonoids, pig kidney kidney cell (Spev) culture, transplantable liver cancer of rats PC-1

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**REFERENCES**

Andreeva A. A., Gelevera N. I., Sharkova E. A., Polukonova A. V., Prilepsky A. Yu., Polukonova N. V. Comparison of the Activity of Extracts of Kirkazon lomonosovidny (Aristolochia clematitis) and Krapreya angustifolia (Chamerion angustifolium) on the Culture of Cells SPEV-2. Saratov Journal of Medical Scientific Research, 2016a, vol. 12, iss. 2, pp. 226. (in Russian)

Andreeva A. A., Sharkova E. A., Polukonova N. V. The Indices of the Functional Activity of the Chironomus Polytene Chromosomes for the Cyto- and Genotoxic Study of Plant Extracts. In: Week of Science – 2016: Materials of the All-Russian Youth Forum with International Participation. Stavropol; Izdatel'stvo StSMU, 2016 b. pp. 372 – 375. (in Russian)

Andreeva A. A., Sharkova E. A., Polukonova N. V. Comparative Toxicological Analysis of the Aqueous and Chloroform Fractions of Extracts of Kirkazon lomonosovidny. In: Medicinal Plants: fundamental and applied problems: Materials of the II International Scientific

Conference. Novosibirsk: Izdatel'stvo Novosibirskogo Gosudarstvennogo Agrarnogo Universiteta, 2015. pp. 179 – 181. (in Russian)

Arens L. E. Kirkazon lomonosovidny as the National Medicinal Plant. Priroda, 1949, № 2, pp. 61 – 62. (in Russian)

Baitman T. P., Polukonova A. V., Prilepsky A. Yu., Polukonova N. V. Comparison of the Biological Activity of Plant Extracts in Experiments in vitro According to LC50. In: Week of Science – 2016: Materials of the All-Russian Youth Forum with International Participation. Stavropol; Izdatel'stvo StSMU, 2016. pp. 378 – 381. (in Russian)

Baraboi V. A. Plant Phenols and Human Health. Moskow: Nauka Publ., 1984. 158 p. (in Russian)

Hoang M. L., Chen C. H., Sidorenko V. S., He J., Dickman K. G., Yun B. H., Moriya M., Niknafs N., Douville C., Karchin R., Turesky R. J., Pu Y. S., Vogelstein B., Papadopoulos N., Grollman A. P., Kinzler K. W., Rosenquist T. A. Mutational Signature of Aristolochic Acid Exposure as Revealed by Whole-Exome Sequencing. *Science Translational Medicine*. 2013 Aug 7; vol. 5 (197): 197 ra102. doi: 10.1126/scitranslmed.3006200

Korosov A. V., Kalinkina N. M. Quantitative Methods of Environmental Toxicology: a Teaching Aid. Petrozavodsk: Izdatel'stvo of PetrSU KSC. 2003. 56 p. (in Russian)

Kurchatova M. N., Durnova N. A., Polukonova N. A. The Effect of Extracts Containing Bioflavonoids on the Induction of Micronuclei with Dioxydin in Blood Erythrocytes of Nonbred White Mice. Proceedings of Voronezh State University. Series: Chemistry. Biology. Pharmacy, 2014, vol. 2, pp. 58 – 65. (in Russian)

Navolokin N. A., Polukonova N. V., Maslyakova G. N., Bucharskaya A. B., Durnova N. A. Effect of Extracts of Gratiola officinalis and Zea mays on the Tumor and the Morphology of the Internal Organs of Rats with Trasplanted Liver Cancer. *Russian Open Medical Journal*, 2012, vol. 1, iss. 2, P. 0203.

Navolokin N. A., Mudrak D. A., Matveeva O. V., Tychina S. A., Bucharskaya A. B., Polukonova N. V., Maslyakova G. N. Effect of Plant Extracts Containing Flavonoids on the Leukocyte Formula and Red Bone Marrow of Laboratory Rats with Transfused Sarcoma 45. *The Successes of Modern Natural Science*, 2015, vol. 4, pp. 134 – 140. (In Russian)

Navolokin N. A., Mudrak D. A., Polukonova N. V., Tychina S. A., Korchakov N. V., Bucharskaya A. B., Maslyakova G. N. Evaluation of the Antitumor and Anti-acetic Activity of the Medicinal Drug Avrana Extract (Gratiola officinalis L.) in Rats with Transfused Sarcoma. *Siberian Journal of Oncology*, 2016a, vol. 15, iss. 1., pp. 37 – 43. (in Russian)

Navolokin N. A., Mudrak D. A., Polukonova N. V., Tychina S. A., Kanaeva T. V., Bucharskaya A. B., Maslyakova G. N. Antioxidic and Antitumor Activity of the Flavonoid-containing Extract of the Immortelle Sand (*Helichrysum arenarium*) with Oral Administration to Rats with Interleaved Sarcoma-45. *Malignant Tumors*, 2016b, vol. 4 (20), pp. 329 – 330. (in Russian)

Navolokin N. A., Polukonova N. V., Bucharskaya A. B., Maslyakova G. N. Morphofunctional changes in laboratory rats with interleaved liver cancer PC-1 with prolonged

oral administration of flavonoid-containing extracts. Bulletin of the Russian State Medical University, 2012, iss. S1, pp. 277 – 278. (in Russian)

*Navolokin N. A., Polukonova N. V., Maslyakova G. N., Skvortsova V. V., Baitman T. P., Bucharskaya A. B., Durnova N. A.* Antitumor activity of plant extracts containing bioflavonoids. Russian Journal of Biotherapy, 2013, vol. 12, iss. 2, pp. 59 – 59a. (in Russian)

*Navolokin N. A., Polukonova A. V., Bibikova O. A., Polukonova N. V., Maslyakova G. N., Bucharskaya A. B.* Cytomorphological Changes in the Culture of Kidney Cells of a Pig Embryo under the Influence of an Extract of Avran medicinal (*Gratiola officinalis L.*). Basic Research, 2014, vol. 10 – 7, pp. 1369 – 1374.

Plant Resources of the USSR. Vol. 1: Angiosperms, their Chemical Composition, Use. Leningrad: Nauka Publ., 1984. 464 p.

Plant Resources of Russia and Neighboring Countries. Saint-Peterburg: Mir i Semya Publ., 1996. 571 p.

*Polukonova N. V., Navolokin N. A., Durnova N. A., Maslyakova G. N., Bucharskaya A. B.* A method for obtaining a dry extract from a plant material having a biological activity. RU 2482863 dated February 15, 2012. Polukonova N. V., Navolokin N. A., Raikova S. V., Maslyakova G. N., Bucharskaya A. B., Durnova N. A., Shub G. M. Anti-Inflammatory, Antipyretic and Antimicrobial Activity of Flavonoid-Containing Extract of *Gratiola officinalis L.* Experimental and Clinical Pharmacology, 2015, vol. 78, iss. 1, pp. 34 – 38.

*Polukonova N. V., Navolokin N. A., Baitman T. P., Sharkova E. A., Avramets O. A., Polukonova A. V., Mudrak D. A.* Comparison of the Dynamics of Tumor Growth of Rats PC-1 under the Action of Extracts of Tagolga, Cyprus and Kirkazone. In: Innovative Technologies in Fundamental, Clinical and Preventive Medicine: Collection of Scientific Papers. Saratov: Izdatel'stvo SSMU, 2018. pp. 90 – 92.

*Polukonova N. V., Baitman T. P., Polukonova A. V., Navolokin N. A., Avramets O. A., Prilepsky A. Yu., Gelevera N. I., Bucharskaya A. B.* Investigation of the activity of the flavonoid-containing *Chamerion angustifolium* extract in the experiments *in vitro* and *in vivo*. Bulletin of Botanic Garden of Saratov State University, 2017, vol. 15, iss. 4, pp. 3 – 15.

*Polukonova N. V., Andreeva A. A., Sharkova E. A.* Investigation of the *Aristolochia clematitis* Extract by Analyzing the Activity of the Balbiani Rings and the Nuclear Organizer in Polytene Chromosomes. Bulletin of Botanic Garden of Saratov State University, 2017, vol. 15, iss. 3, pp. 33 – 40.

*Polukonova N. V., Kurchatova M. N., Navolokin N. A., Bucharskaya A. B., Durnova N. A., Maslyakova G. N.* A New Extraction Method of Bioflavanoids from Poisonous Plant (*Gratiola officinalis L.*). Russian Open Medical Journal, 2014, vol. 3, iss. 3, P. 304.

*Poon S. L., Pang S. T., McPherson J. R., Yu W., Huang K. K., Guan P., Weng W. H., Siew E. Y., Liu Y., Heng H. L., Chong S. C., Gan A., Tay S. T., Lim W. K., Cutcutache I., Huang D., Ler L. D., Nairismägi M. L., Lee M. H., Chang Y. H., Yu K. J., Chan-On W., Li B. K., Yuan Y. F., Qian C. N., Ng K. F., Wu C. F., Hsu C. L., Bunte R.M., Stratton M. R., Futreal P. A., Sung W. K., Chuang C. K., Ong C. K., Rozen S. G., Tan P., Teh B. T.* Genome-Wide Mutational Signatures of Aristolochic Acid and

Its Application as a Screening Tool. Science Translational Medicine. 2013 Aug 7; vol. 5 (197): 197  
ra101. doi: 10.1126/scitranslmed.3006086

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