ABSTRACT&REFERENCES

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DEVELOPMENT OF HPLC METHOD FOR QUANTITATIVE DETERMINATION OF EPIMIDIN – NEW PERSPECTIVE APhI WITH ANTICONVULSIVE ACTIVITY

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The aim. *Development of optimal, high-precision and reproducible methods for quantitative determination of the main substance in the substance Epimidin – 1-(4-methoxyphenyl)-5-[2-[4-(4-methoxyphenyl)piperazin-1-yl]-2-oxo-ethyl]pyrazolo[3,4-d]pyrimidin-4-one by high performance liquid chromatography.*

Materials and methods*. High performance liquid chromatography (HPLC) was performed using a ShimadzuNexeraX2 LC-30AD system (Shimadzu, Japan) equipped with a SPD-M20A diode array detector (DAD). ACE C18 column, size 250×4.6 mm, YMC with pre-column, particle size 5 μm, filled with octylsilyl silica gel for chromatography P. During the work acetonitrile and trifluoroacetic acid of HPLC class (Sigma-AldrichGmbH, Switzerland) were used, other chemicals and solvents were of analytical grade. In the study an analytical ware class A were used that meet the requirements of SPhU.*

Results. *The following optimal conditions of chromatographic distribution are established: column C18 (250×4.6 mm); the speed of the mobile phase 1 ml / min; column thermostat temperature 35 °C; injection volume 10 μl; mobile phase A – 0.1 % trifluoroacetic acid; mobile phase B – acetonitrile P; the detection wavelength is 270 nm, the retention time of the test compound is 7.22 minutes. The performance of the column was determined for its main indicators, such as the number of theoretical plates (more than 25410) and the coefficient of symmetry (about 1.00). The technique was tested for the influence of various factors, such as flow rate, mobile phase composition and column thermostat temperature. It was established that the influence of these factors is insignificant and does not affect the results obtained by this method. The method was validated in accordance with the recommendations of SPhU on the parameters of specificity, linearity, correctness, precision, robustness (stability).*

Conclusions*. For the first time, a high-precision and reproducible method for quantitative determination of the main substance in the substance Epimidin with anticonvulsant activity by high-performance liquid chromatography was developed. Conditions for chromatographic analysis (HPLC) were standardized. The requirements for the test "System suitability test criteria for chromatographic methods" are set. Statistical processing of the experimental results shows that the relative uncertainty of the average result is within acceptable limits. The correctness of the method was confirmed by validation studies. The developed technique will be used for pharmaceutical development and standardization of dosage form*

Keywords*: Epimidin, pyrazolopyrimidine, anticonvulsant, quantitative determination, HPLC*

References

1. Vogt, V. L., Äikiä, M., del Barrio, A., Boon, P., Borbély, C., Bran, E. et. al. (2017). Current standards of neuropsychological assessment in epilepsy surgery centers across Europe. Epilepsia, 58 (3), 343–355. doi: http://doi.org/10.1111/epi.13646

2. Janmohamed, M., Brodie, M. J., Kwan, P. (2020). Pharmacoresistance – Epidemiology, mechanisms, and impact on epilepsy treatment. Neuropharmacology, 168, 107790. doi: http://doi.org/10.1016/j.neuropharm.2019.107790

3. Severina, A. I., Kavraiskyi, D. P., Shtrygol, S. Yu., Georgiyants, V. A. (2018). Pat. No. 103378 UA. 5-R-1-Aryl-1,5-dihydro-4H-pyrazolo[3,4-d]pyrimidin-4-one with anticonvulsant activity. MPK: A61K 31/50. No. u 2015 06663. declared: 06.07.2015; published: 26.02.2018, No. 4. Available at: http://uapatents.com/7-103378-5-r-1-aril-15-digidro-4n-pirazolo34-dpirimidin-4-oniv-shho-viyavlyayut-protisudomnu-aktivnist.html

4. Kavraiskyi, D. P., Shtrygol, S. Yu., Georgiyants, V. A., Severina, A. I. (2016). Screening study of novel pyrazolo[3,4-d] pyrimidine-4-one derivatives for anticonvulsant activity. Pharmacology and drug toxicology, 3 (49), 16–27.

5. Kavraiskyi, D. P., Shtrygol, S. Yu., Georgiyants, V. A., Severina, A. I. (2016). Experimental study of new pyrazolo[3,4-D]pyrimidine-4-one derivatives for anticonvulsant activity spectrum. ScienceRise: Pharmaceutical Science, 1 (1), 10–17. doi: http://doi.org/10.15587/2519-4852.2016.70528

6. O' Sullivan, J., Blake, K., Berntgen, M., Salmonson, T., Welink, J. (2018). Overview of the European Medicines Agency's Development of Product-Specific Bioequivalence Guidelines. Clinical Pharmacology & Therapeutics, 104 (3), 539–545. doi: http://doi.org/10.1002/cpt.957

7. Andrade, E. L., Bento, A. F., Cavalli, J., Oliveira, S. K., Schwanke, R. C., Siqueira, J. M. et. al. (2016). Non-clinical studies in the process of new drug development – Part II: Good laboratory practice, metabolism, pharmacokinetics, safety and dose translation to clinical studies. Brazilian Journal of Medical and Biological Research, 49 (12). doi: http://doi.org/10.1590/1414-431x20165646

8. Liu, L., Ouyang, J., Baeyens, W. R. G. (2008). Separation of purine and pyrimidine bases by ion chromatography

with direct conductivity detection. Journal of Chromatography A, 1193 (1-2), 104–108. doi: http://doi.org/10.1016/j.chroma.2008.04.011

9. Metwally, F. H., Abdelkawy, M., Abdelwahab, N. S. (2007). Application of spectrophotometric, densitometric, and HPLC techniques as stability indicating methods for determination of Zaleplon in pharmaceutical preparations. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 68 (5), 1220–1230. doi: http://doi.org/10.1016/j.saa.2007.01.024

10. Liu, M., Wang, J., Liu, P. (2016). HPLC method development, validation, and impurity characterization of a potent antitumor nucleoside, T-dCyd (NSC 764276). Journal of Pharmaceutical and Biomedical Analysis, 131, 429–435. doi: http://doi.org/10.1016/j.jpba.2016.08.034

11. Gunnar, T., Ariniemi, K., Lillsunde, P. (2006). Fast gas chromatography–negative-ion chemical ionization mass spectrometry with microscale volume sample preparation for the determination of benzodiazepines and α-hydroxy metabolites, zaleplon and zopiclone in whole blood. Journal of Mass Spectrometry, 41 (6), 741–754. doi: http://doi.org/10.1002/jms.1030

12. Larenas, G., Bollo, S., Rodriguez, M., Lemus, I., Nuñez-Vergara, L. J., Squella, J. A., Álvarez-Lueje, A. (2005). Voltammetric Behavior of Zaleplon and Its Differential Pulse Polarographic Determination in Capsules. Journal of AOAC International, 88 (4), 1135–1141. doi: http://doi.org/10.1093/jaoac/88.4.1135

13. Darwish, H. W., Bakheit, A. H., Darwish, I. A. (2016). Enhanced spectrofluorimetric determination of the multitargeted tyrosine kinase inhibitor, crizotinib, in human plasma via micelle-mediated approach. Tropical Journal of Pharmaceutical Research, 15 (10), 2209–2217. doi: http://doi.org/10.4314/tjpr.v15i10.20

14. Satyanarayana, L., Naidu, S. V., Narasimha Rao, M., Suma Latha, R. (2011). The estimation of Nilotinib in capsule dosage form by RP-HPLC. Asian Journal of Pharmaceutical Analysis, 1 (4), 100–102.

15. Swathi, P., Dutt, K. R., Rao, K. N. V., Raja, M. A. (2017). RP-HPLC Method Development and Validation for Estimation of Sofosbuvir in Pure and Tablet Dosage Form. Asian Journal of Pharmacy and Technology, 7 (3), 153–156. doi: http://doi.org/10.5958/2231-5713.2017.00025.3

16. Zhang, B., Zhang, Z., Tian, Y., Xu, F., Chen, Y. (2006). High-performance liquid chromatography–atmospheric pressure chemical ionisation-mass spectrometry determination of zaleplon in human plasma. Journal of Pharmaceutical and Biomedical Analysis, 40 (3), 707–714. doi: http://doi.org/10.1016/j.jpba.2005.06.031

17. Giroud, C., Augsburger, M., Menetrey, A., Mangin, P. (2003). Determination of zaleplon and zolpidem by liquid chromatography–turbo-ionspray mass spectrometry: application to forensic cases. Journal of Chromatography B, 789 (1), 131–138. doi: http://doi.org/10.1016/s1570-0232(03)00135-1

18. Kintz, P., Villain, M., Concheiro, M., Cirimele, V. (2005). Screening and confirmatory method for benzodiazepines and hypnotics in oral fluid by LC-MS/MS. Forensic Science International, 150 (2-3), 213–220. doi: http://doi.org/10.1016/j.forsciint.2004.12.040

19. Foda, N. H., Abd Elbary, A., El-Gazayerly, O. (2006). Reversed–Phase Liquid Chromatographic Determination of Zaleplon in Human Plasma and its Pharmacokinetic Application. Analytical Letters, 39 (9), 1891–1905. doi: http://doi.org/10.1080/00032710600721654

20. Derzhavna Pharmakopeya Ukrayini. Vol. 1. DP «Naukovo-ekspertniy farmakopeyniy tsentr» (2015). Kharkiv: DP «Ukrayinskiy naukoviy farmakopeyniy tsentr yakostI lIkarskih zasobIv», 1128.

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DEVELOPMENT AND VALIDATION OF THE METHOD FOR SIMULTANEOUS DETERMINATION OF BENZYDAMINE HYDROCHLORIDE AND METHYLPARABEN IN DOSAGE FORM BY HPLC

p. 12-19

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The aim. *The aim of the current work was to develop and validate HPLC method for simultaneous determination of Benzydamine hydrochloride (API) and methylparaben (preservative) in the dosage form containing Benzydamine hydrochloride as an active pharmaceutical ingredient.*

Methods. *The separation was performed on Grace Altima C18 column (250×4.6 mm, particle size 5 microns). The mobile phase consisted of 3.0 g of sodium perchlorate, 1 ml of trimethylamine and was adjusted to pH 3 with perchloric acid. The flow rate of mobile phase was 1 ml/min, detection wavelength was 320 nm for Benzydamine hydrochloride and 254 nm for Methylparaben.*

Results. *The method was validated according to ICH Q2 requirements and found to be robust, specific, linear in the range of 80–120 % for the analytes. The maximum RSD for each compound was less than 1.3 %. The accuracy of the method was within the acceptance criteria.*

Conclusions. *The method for simultaneous determination of Benzydamine hydrochloride and methylparaben was developed and validated according to the International Conference on Harmonization requirements. All validation parameters matched the acceptance criteria of the guideline.*

The developed method can be applied in routine control in QC laboratories for simultaneous determination of Benzydamine hydrochloride and Methylparaben in Benzydamine dosage forms.

Keywords*: HPLC, Benzydamine hydrochloride, Methylparaben, method validation, simultaneous determination.*

References

1. Turnbull, R. S. (1995). Benzydamine Hydrochloride (Tantum) in the management of oral inflammatory con-

ditions. Journal of the Canadian Dental Association, 61 (2), 127–134.

2. British pharmacopoeia. Vol. 1 (2018). London: Medicines and Healthcare products Regulatory Agency, 265.

3. British pharmacopoeia. Vol. 3 (2018). London: Medicines and Healthcare products Regulatory Agency, 181.

4. Dogan, A., E. Bascı, N. (2011). Development and Validation of RP-HPLC and Ultraviolet Spectrophotometric Methods of Analysis for the Quantitative Determination of Chlorhexidine Gluconate and Benzydamine Hydrochloride in Pharmaceutical Dosage Forms. Current Pharmaceutical Analysis, 7 (3), 167–175. doi: http://doi.org/10.2174/157341211796353228

5. Catanese, B., Lagana, A., Marino, A., Picollo, R., Rotatori, M. (1986). HPLC determination of benzydamine and its metabolite N-oxide in plasma following oral administration or topical application in man, using fluorimetric detection. Pharmacological Research Communications, 18 (4), 385–403. doi: http://doi.org/10.1016/0031-6989(86)90091-3

6. Benson, H. A. E., McElnay, J. C. (1987). High-performance liquid chromatography assay for the measurement of benzydamine hydrochloride in topical pharmaceutical preparations. Journal of Chromatography A, 394 (2), 394–399. doi: http://doi.org/10.1016/s0021-9673(01)94193-7

7. Shabir, G. (2010). A new validated HPLC method for the simultaneous determination of 2-phenoxyethanol, methylparaben, ethylparaben and propylparaben in a pharmaceutical gel. Indian Journal of Pharmaceutical Sciences, 72 (4), 421–425. doi: http://doi.org/10.4103/0250-474x.73906

8. M. Kashid, R., G. Singh, S., Singh, S. (2011). Simultaneous Determination of Preservatives (Methyl Paraben and Propyl Paraben) in Sucralfate Suspension Using High Performance Liquid Chromatography. E-Journal of Chemistry, 8 (1), 340–346. doi: http://doi.org/10.1155/2011/360431

9. Turabi, Z. M., Khatatbeh, O. A., Al-Abed, D. N. (2014). RP-HPLC Method Development and Validation for the Simultaneous Determination of Mebendazole and the Two Preservatives Methylparaben and Propylparaben in Pharmaceutical Oral Suspension Dosage Form. International Journal of Pharmaceutical Sciences and Drug Research, 6 (1), 70–74.

10. Koel, M., Kaljurand, M. (2006). Application of the principles of green chemistry in analytical chemistry. Pure and Applied Chemistry, 78 (11), 1993–2002. doi: http://doi.org/10.1351/pac200678111993

11. He, Y., Tang, L., Wu, X., Hou, X., Lee, Y. (2007). Spectroscopy: The Best Way Toward Green Analytical Chemistry? Applied Spectroscopy Reviews, 42 (2), 119–138. doi: http://doi.org/10.1080/05704920601184259

12. Płotka-Wasylka, J., Gałuszka, A., Namieśnik, J.; Płotka-Wasylka, J., Namieśnik, J. (Eds.) (2019). Green Analytical Chemistry: Summary of Existing Knowledge and Future Trends. Green Analytical Chemistry. Green Chemistry and Sustainable Technology. Singapore: Springer, 431–449. doi: http://doi.org/10.1007/978-981-13-9105-7_15

13. Bhandari, M., Raj, S. (2017). Practical approach to green chemistry. International Journal of Pharmacy and Pharmaceutical Sciences, 9 (4), 10–26. doi: http://doi.org/10.22159/ijpps.2017v9i4.15640

14. Validation of analytical procedures Q2 R1 (2005). International Conference on Harmonization. Available at: https://database.ich.org/sites/default/files/Q2_R1__Guideline.pdf

15. Eldin, A., Ismaiel, O., Hassan, W., Shalaby, A. (2015). Development and validation of stability indicating green HPLC-UV method for determination of Cephalexin in pharmaceutical dosage forms and human urine using micellar mobile phase. International Journal of Pharmacy and Pharmaceutical Sciences, 7 (9), 122–127. Available at: https://innovareacademics.in/journals/index.php/ijpps/article/view/5950

16. United States Pharmacopeial Convention. General chapter: Validation of compendial procedures. Rockville: United States Pharmacopeial Convention.

17. Kozakevich, Y., Lobrutto, R. (2007). HPLC for pharmaceutical scientists. New Jersey: John Wiley and Sons. doi: http://doi.org/10.1002/0470087951

18. Grossman, R. B., Finkel, R. (2017). ACE and JChem acidity and basicity calculator, ACE UKY-4.2 & Marvin JS by ChemAxon: Perfluorononane-sulfonic acid. Lexington: University of Kentucky & Pearson Education.

19. Weast, R. C. (1985–1986). Handbook of Chemistry and Physics. Florida: CRC Press Inc.

20. LoBrutto, R. (2000). Retention of Ionizable Compounds in HPLC. Available at: https://scholarship.shu.edu/dissertations/1240

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COMPARATIVE ANALYSIS OF THE DYNAMICS OF HEALTHCARE EXPENDITURES FROM COUNTRY GDP AND CASH PAYMENTS OF FAMILIES TO MEDICAL AND PHARMACEUTICAL SUPPORT IN UKRAINE, CIS COUNTRIES AND EU

p. 20-27

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The aim*: conducting a comparative analysis of the dynamics of changes in health expenditures (%) from GDP and cash payments of families for medical and pharmaceutical support from total health expenditures in Ukraine, CIS countries and the EU (members since 2004).*

Materials and methods. *The data of the WHO Regional Office for Europe and such analysis methods as historical, analytical,*

comparative, systemic, logical, graphic, mathematical and statistical, etc. were used.

Results. *According to the results of the analysis, it was found that the expenditures (%) on health care from the GDP of countries and the cash payments (%) made by families on medical and pharmaceutical support from the total expenditures on health care in 1990–2014 steadily increasing. At the same time, it was proved that the growth rate (%) of these indicators in Ukraine, the CIS countries and the EU differed both in numerical values and in years of research. The largest and smallest growth values of these indicators were characteristic of Ukraine. In addition, it was internal indicators that were zigzag in their changes, for example, expenditures (%) on health care of the country's GDP in 1995 increased to 7.0 % from 3.3 % (1994). It is proved that in Ukraine during 1990-2014 against the background of an increase in expenditures (%) on healthcare from the country's GDP by 2.14 times. Cash (%) payments to the population of total health spending increased 1.9 times. In the CIS countries, over the same period, the above expenses increased 1.7 times, and family cash payments 1.8 times, and in the EU 1.4 times and 1.04 times respectively. Thus, it can be argued that the population of European countries against the background of a systematic increase in health care costs (%) of the country's GDP invariably spends in the form of cash payments for medical and pharmaceutical support no more than 25.0 % of the total health care costs in national health systems.*

Conclusions. *The presence of unstable dynamics of changes in these macroeconomic indicators in Ukraine and the CIS countries compared with similar data that are presented for the EU countries is the result of a lack of a systematic vision of the reform processes of national health systems, as well as a lack of a consistent state policy to provide effective financial support to the population in the process of providing medical and pharmaceutical care*

Keywords: *medical care, health care costs, cash payments made by families for medical and pharmaceutical support, healthcare, pharmaceutical care*

References

1. Darvas Z., Moës, N., Myachenkova, Y., Pichler, D. (2018). The macroeconomic implications of healthcare. Policy Contribution, 11. Available at: https://www.bruegel.org/wp-content/uploads/2018/08/PC-11_2018_cover.pdf

2. Pakdaman, M., Geravandi, S., Askari, R., Askarishahi, M., Reza Afzali, H. (2019). The effect of macroeconomic indicators on health-care expenditure in Iran. Journal of Education and Health Promotion, 8 (1), 123.

3. Reeves, A., McKee, M., Basu, S., Stuckler, D. (2014). The political economy of austerity and healthcare: Cross-national analysis of expenditure changes in 27 European nations 1995–2011. Health Policy, 115 (1), 1–8. doi: http://doi.org/10.1016/j.healthpol.2013.11.008

4. Braithwaite, J., Hibbert, P., Blakely, B., Plumb, J., Hannaford, N., Long, J. C., Marks, D. (2017). Health system frameworks and performance indicators in eight countries: A comparative international analysis. SAGE Open Medicine, 5. doi: http://doi.org/10.1177/2050312116686516

5. Kutzin, J. (2012). Anything goes on the path to universal coverage? No. Bulletin of the World Health Organization, 90 (11), 867–868. doi: http://doi.org/10.2471/blt.12.113654

6. Rechel, B. (2019). Funding for public health in Europe in decline? Health Policy, 123 (1), 21–26. doi: http://doi.org/10.1016/j.healthpol.2018.11.014

7. Loughnane, C., Murphy, A., Mulcahy, M., McInerney, C., Walshe, V. (2018). Have bailouts shifted the burden of paying for healthcare from the state onto individuals? Irish Journal of Medical Science, 188 (1), 5–12. doi: http://doi.org/10.1007/s11845-018-1798-x

8. Brousselle, A., Benmarhnia, T., Benhadj, L. (2016). What are the benefits and risks of using return on investment to defend public health programs? Preventive Medicine Reports, 3, 135–138. doi: http://doi.org/10.1016/j.pmedr.2015.11.015

9. Nichols, L. M., Taylor, L. A. (2018). Social Determinants As Public Goods: A New Approach To Financing Key Investments In Healthy Communities. Health Affairs, 37 (8), 1223–1230. doi: http://doi.org/10.1377/hlthaff.2018.0039

10. Stuckler, D., Reeves, A., Mckee, M. (2017). Social and economic multipliers: What they are and why they are important for health policy in Europe. Scandinavian Journal of Public Health, 45 (18), 17–21. doi: http://doi.org/10.1177/1403494817707124

11. Lee, J. T., Majeed, A., Millett, C. (2012). User fees in universal health systems. The Lancet, 380 (9854), 1643–1644. doi: http://doi.org/10.1016/s0140-6736(12)61941-2

12. Towards actionable international comparisons of health system performance: expert revision of the OECD framework and quality indicators. (2015). International Journal for Quality in Health Care, 27 (2), 137–146. doi: http://doi.org/10.1093/intqhc/mzv004

13. Perić, N., Hofmarcher-Holzhacker, M. M., Simon, J. (2017). Health system performance assessment landscape at the EU level: a structured synthesis of actors and actions. Archives of Public Health, 75 (1). doi: http://doi.org/10.1186/s13690-016-0173-5

14. Tanza Loudenback The average cost of healthcare in 21 different countries (2019). Business insider Australia. Available at: https://www.businessinsider.com.au/cost-of-healthcare-countries-ranked-2019-3

15. Burbela, A. L. (2017). Derzhavni vytraty na okhoronu zdorovia v Ukraini. Naukovyi visnyk Uzhhorodskoho natsionalnoho universytetu vypusk, 14 (1), 37–40.

16. Carrera, P. M. (2018). Social Determinants Of Health As Public Goods. Health Affairs, 37 (10), 1710. doi: http://doi.org/10.1377/hlthaff.2018.1115

17. Sachs, J. D. (2012). Achieving universal health coverage in low-income settings. The Lancet, 380 (9845), 944–947. doi: http://doi.org/10.1016/s0140-6736(12)61149-0

18. Jowett, M., Brunal, M. P., Flores, G., Cylus, J. (2016). Spending targets for health: no magic number. Geneva: World Health Organization; 2016 (WHO/HIS/HGF/HFWorkingPaper/16.1; Health Financing Working Paper No. 1). Available at: http://apps.who.int/iris/bitstream/10665/250048/1/WHO-HIS-HGFHFWork¬ingPaper-16.1-eng.pdf

19. White, J. (2013). Budget-makers and health care systems. Health Policy, 112 (3), 163–171. doi: http://doi.org/10.1016/j.healthpol.2013.07.024

20. WHO. European Health Information Gateway. Available at: https://gateway.euro.who.int/en/

21. Wilson, K. (2016). Innovation and sustainability of European healthcare systems. Bruegel Blog. Available

at: https://www.bruegel.org/2016/01/innovation-and-sustainability-of-european-healthcare-systems/?utm_content=buffer1ba87&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer+(bruegel)

22. Tsurikova, O. V. (2019). A comparative analysis of the dynamics of cash payments of families for medical and pharmaceutical services among the total health spending in Ukraine, Azerbaijan, Armenia, Georgia. Social Pharmacy in Health Care, 5 (4), 31–39. doi: http://doi.org/10.24959/sphhcj.19.171

23. Tereshchenko, L., Zhirova, I. (2019). Analysis of the dynamics of expenditures on pharmaceutical support of population in Ukraine, Belarus republic and in European Union. ScienceRise: Pharmaceutical Science, 4 (20), 10–14. doi: http://doi.org/10.15587/2519-4852.2019.177193

24. National strategy for reforming the health care system in Ukraine for the period 2015-2020. Ministry of Health of Ukraine. International Renaissance Foundation. 2015. Available at: https://moz.gov.ua/uploads/0/691-strategiya.pdf

25. McDaid, D., Quaglio, G., Correia de Campos, A., Dario, C., Van Woensel, L., Karapiperis, T., Reeves, A. (2013). Health protection in times of economic crisis: Challenges and opportunities for Europe. Journal of Public Health Policy, 34 (4), 489–501. doi: http://doi.org/10.1057/jphp.2013.35

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PREPARATION AND STUDY OF THE SUBSTANCE OF MULTICOMPONENT DRY EXTRACT OF BELISA AS A STAGE OF PHARMACEUTICAL DEVELOPMENT OF SEDATIVE CAPSULES

p. 28-32

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The aim. *Scientifically and experimentally substantiate the production and study of the properties of the multicomponent dry extract of Belisa in order to formulate a capsule mixture based on it, taking into account the requirements of ICQ 8 "Pharmaceutical Development".*

Methods. *Physico-chemical and pharmaco-technological research methods were used to determine moisture, bulk density and bulk density after shrinkage, fractional composition of the obtained multicomponent dry extract of Belisa and model mixtures with excipients based on it.*

Results. *As a result of experimental studies, a multicomponent dry extract of Belisa was obtained. Humidity, bulk density and bulk density after shrinkage, fluidity of the obtained extract and seven model mixtures with it were determined and microscopic analysis was performed. According to the results of the experiment, the dry extract without the addition of excipients for 2 days lost its flowability, which prompted the use of excipients in its subsequent technology. To improve the technological properties of the dry extract of Belisa, model samples were made with different excipients (Aerosil in the amount of 1, 2 and 3 % and maltodextrin in the amount of 2, 3 and 4 %) and with a different technology.*

Conclusions. *Physico-chemical and pharmaco-technological properties of multicomponent dry extract of Belisa and its model samples with a number of excipients were studied. Humidity, bulk density and bulk density after shrinkage, fractional composition were studied. According to the results of experimental researches the technology is developed and the technological scheme of obtaining the multicomponent dry extract of Belisa is made and critical parameters of its production are defined*

Keywords: *composition, technology, multicomponent dry extract, excipients, ICQ 8 "Pharmaceutical development"*

References

1. Liapunov, M., Bezuhla, O., Pidpruzhnykov, Yu. et. al. (2012). Nastanova ST-N MOZ Ukrainy 42-3.0:2011. – Likarski zasoby. Farmatsevtychna rozrobka (ICH Q8). Standartyzatsiia farmatsevtychnoi produktsii. Kyiv, MOZ Ukrainy, 6–11.

2. Korotkov, V. A., Kukhtenko, O. S., Hladukh, Ye. V. (2013). Vybir optymalnoi tekhnolohii oderzhannia oliinoho ekstraktu plodiv makliury. Farmatsevtychnyi zhurnal, 6, 36–41. Available at: http://nbuv.gov.ua/UJRN/pharmazh_2013_6_6

3. Ponomarev, V. D. (1982). Ekstragirovanie lekarstvennogo syria. Moscow, 204.

4. Ruban, O. A., Kolisnyk, T. Ye., Slipchenko, H. D., Kovalevska, I. V. (2015). Vyvchennia tekhnolohichnykh vlastyvostei sukhoho ekstraktu dlia rozrobky novoho protydiabetychnoho preparatu. Zbirnyk naukovykh prats spivrobitnykiv NMAPO im. P. L. Shupyka, 24 (5), 218–223. Available at: http://nbuv.gov.ua/UJRN/Znpsnmapo_2015_24(5)__44

5. Vyshnevska, L. I., Shmalko, O. O., Soldatov, D. P. (2019). Study on the development of multicomponent dry uroholum extract and its pharmaco-technological indicators. Management, Economics and Quality Assurance in Pharmacy, 2 (58), 16–21. doi: http://doi.org/10.24959/uekj.19.19

6. Derzhavna Farmakopeia Ukrainy. T. 1 (2015). Kharkiv: Derzhavne pidpryiemstvo «Ukrainskyi naukovyi farmakopeinyi tsentr yakosti likarskykh zasobiv», 1128.

7. Swarbrick, J. (Ed.) (2007). Encyclopedia of pharmaceutical technology. New York: Informa Healthcare USA, Inc., 4372.

8. European Pharmacopoeia 9.0. European Directorate for the Quality of Medicines & HealthCare (EDQM) (2017). Strasbourg: Council of Europe. Available at: http://online6.edqm.eu/ep900 Last accessed: 17.10.2017

9. United States Pharmaacopeia (2000). Rockville, 2569.

10. Pertsev, I. M., Dmytriievskyi, D. I., Rybachuk, V. D. et. al.; Pertsev, I. M. (Ed.) (2010). Dopomizhni rechovyny v tekhnolohii likiv: vplyv na tekhnolohichni, spozhyvchi, ekonomichni kharakterystyky i terapevtychnu efektyvnist. Kharkiv: Zoloti storinky, 600.

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STUDY OF THE MONOSACCHARIDE COMPOSITION OF WATER-SOLUBLE POLYSACCHARIDE COMPLEXES AND PECTIC SUBSTANCES OF PIMPINELLA ANISUM HERBS

p. 33-38

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In the study of the pharmacological activity of WSPC and pectin substances isolated from the Pimpinella anisum herbs, it was found that pectin substances are practically non-toxic and exhibit a pronounced laxative effect, not inferior to the comparison drug «Senadex».

The aim of the work. *The study of the monosaccharide composition of water-soluble polysaccharide complexes and pectin substances isolated from Pimpinella anisum herbs.*

Materials and methods. *For analysis, we used Pimpinella anisum herbs, harvested in the summer of 2019 in Kharkov. The study was carried out by liquid chromatography on an Agilent 1290 liquid chromatograph, detection was refractometric.*

Results and discussion. *WSPC isolated from the Pimpinella anisum herbs contain two monosaccharides – glucose and ramnose. Rhamnose with a content of 215.5 mg/g is the dominant sugar, glucose is present in a much smaller amount – 17.5 mg/g. The glucose content in PS is approximately the same – 12.3 mg/g. Moreover, in pectins in the absence of ramnose, the presence of galactose and arabinose in the amount of 59.8 mg/g and 69.5 mg/g, respectively, was established.*

Conclusions. *Using liquid chromatography, the presence of two monosaccharides in WSPC and three monosaccharides in pectin isolated from Pimpinella anisum herbs was established*

Keywords: *biopolymers, WSPC, PS, Pimpinella anisum, laxative effect, drug "Senadex", herb, monosaccharides, quantitative determination, thin-layer chromatography, liquid chromatography*

References

1. Olennikov, D. N. (2014). Polysaccharides. Current state of knowledge: an experimental and scientometric investigation. Chemistry of Plant Raw Material, 1, 5–26. doi: http://doi.org/10.14258/jcprm.1401005

2. Zorikova, O. V., Manyahin, A. Yu., Borovaya, S. A., Railko, S. P. (2018). Seasonal dynamics of polysaccharid content in raw materials reynoutria japonica. Chemistry of Plant Raw Material, 3, 33–39. doi: http://doi.org/10.14258/jcprm.2018033777

3. Trigui, I., Yaich, H., Sila, A., Cheikh-Rouhou, S., Bougatef, A., Blecker, C. et. al. (2018). Physicochemical properties of water-soluble polysaccharides from black cumin seeds. International Journal of Biological Macromolecules, 117, 937–946. doi: http://doi.org/10.1016/j.ijbiomac.2018.05.202

4. Harholt, J., Suttangkakul, A., Vibe Scheller, H. (2010). Biosynthesis of Pectin. Plant Physiology, 153 (2), 384–395. doi: http://doi.org/10.1104/pp.110.156588

5. Rascón-Chu, A., Martínez-López, A. L., Carvajal-Millán, E., Ponce de León-Renova, N. E., Márquez-Escalante, J. A., Romo-Chacón, A. (2009). Pectin from low quality "Golden Delicious" apples: Composition and gelling capability. Food Chemistry, 116 (1), 101–103. doi: http://doi.org/10.1016/j.foodchem.2009.02.016

6. Masmoudi, M., Besbes, S., Abbes, F., Robert, C., Paquot, M., Blecker, C., Attia, H. (2010). Pectin Extraction from Lemon By-Product with Acidified Date Juice: Effect of Extraction Conditions on Chemical Composition of Pectins. Food and Bioprocess Technology, 5 (2), 687–695. doi: http://doi.org/10.1007/s11947-010-0344-2

7. Ovodov, Yu. S., Golovchenko, V. V., Gyunter, E. A., Popov, S. V. (2009). Pektinovyie veschestva rasteniy evropeyskogo Severa Rossii. Yekaterinburg, 111.

8. Suvakanta, D., Narsimha, M. P., Pulak, D., Joshabir, C., Biswajit, D. (2014). Optimization and characterization of purified polysaccharide from Musa sapientum L. as a pharmaceutical excipient. Food Chemistry, 149, 76–83. doi: http://doi.org/10.1016/j.foodchem.2013.10.068

9. Sun, Y. (2011). Structure and biological activities of the polysaccharides from the leaves, roots and fruits of Panax ginseng C.A. Meyer: An overview. Carbohydrate Polymers, 85 (3), 490–499. doi: http://doi.org/10.1016/j.carbpol.2011.03.033

10. Shibata, H., Kimura-Takagi, I., Nagaoka, M., Hashimoto, S., Aiyama, R., Iha, M. et. al. (2000). Properties of fucoidan fromCladosiphon okamuranustokida in gastric mucosal protection. BioFactors, 11 (4), 235–245. doi: http://doi.org/10.1002/biof.5520110402

11. Sun, Y. (2014). Biological activities and potential health benefits of polysaccharides from Poria cocos and their derivatives. International Journal of Biological Macromolecules, 68, 131–134. doi: http://doi.org/10.1016/j.ijbiomac.2014.04.010

12. Tyagi, V., Sharma, P., Malviya, R. (2015). Pectins and Their Role in Food and Pharmaceutical Industry: A Review. Journal of Chronotherapy and Drug Delivery, 6 (3), 65–77.

13. Kushi, L. H., Doyle, C., McCullough, M., Rock, C.L., Demark-Wahnefried, W., Bandera, E. V. et. al. (2012). American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention: Reducing the Risk of Cancer With Healthy Food Choices and Physical Activity. CA: A Cancer Journal for Clinicians, 62 (1), 30–67. doi: http://doi.org/10.3322/caac.20140

14. Pietrzyk, L., Torres, A., Maciejewski, R., Torres, K. (2015). Obesity and Obese-related Chronic Low-grade Inflammation in Promotion of Colorectal Cancer Development. Asian

Pacific Journal of Cancer Prevention, 16 (10), 4161–4168. doi: http://doi.org/10.7314/apjcp.2015.16.10.4161

15. Kaczmarczyk, M. M., Miller, M. J., Freund, G. G. (2012). The health benefits of dietary fiber: Beyond the usual suspects of type 2 diabetes mellitus, cardiovascular disease and colon cancer. Metabolism, 61 (8), 1058–1066. doi: http://doi.org/10.1016/j.metabol.2012.01.017

16. Brownlee, I. A. (2011). The physiological roles of dietary fibre. Food Hydrocolloids, 25 (2), 238–250. doi: http://doi.org/10.1016/j.foodhyd.2009.11.013

17. Torralbo, D. F., Batista, K. A., Di-Medeiros, M. C. B., Fernandes, K. F. (2012). Extraction and partial characterization of Solanum lycocarpum pectin. Food Hydrocolloids, 27 (2), 378–383. doi: http://doi.org/10.1016/j.foodhyd.2011.10.012

18. Baluja, Z., Kaur, S. (2013). Antihypertensive aroperties of an apple peel – can apple a day keep a doctor away? Bulletin of Pharmaceutical and Medical Sciences, 1, 9–16.

19. Yang, X., Zhao, Y., Lv, Y. (2007). Chemical Composition and Antioxidant Activity of an Acidic Polysaccharide Extracted fromCucurbita moschataDuchesne ex Poiret. Journal of Agricultural and Food Chemistry, 55 (12), 4684–4690. doi: http://doi.org/10.1021/jf070241r

20. Kratchanova, M., Nikolova, M., Pavlova, E., Yanakieva, I., Kussovski, V. (2010). Composition and properties of biologically active pectic polysaccharides from leek (Allium porrum). Journal of the Science of Food and Agriculture, 90 (12), 2046–2051. doi: http://doi.org/10.1002/jsfa.4050

21. Holck, J., Hotchkiss, A. T., Meyer, A. S., Mikkelsen, J. D., Rastall, R. A. (2014). Production and Bioactivity of Pectic Oligosaccharides from Fruit and Vegetable Biomass. Food Oligosaccharides. Wiley-Blackwell, 76–87. doi: http://doi.org/10.1002/9781118817360.ch5

22. Wicker, L., Kim, Y., Kim, M.-J., Thirkield, B., Lin, Z., Jung, J. (2014). Pectin as a bioactive polysaccharide – Extracting tailored function from less. Food Hydrocolloids, 42, 251–259. doi: http://doi.org/10.1016/j.foodhyd.2014.01.002

23. El-Gamal, S., Ahmed, H. (2017). Influence of Different Maturity Stages on Fruit Yield and Essential Oil Content of Some Apiaceae Family Plants A: Anise (Pimpinella anisum, L.). Journal of Plant Production, 8 (1), 119–125. doi: http://doi.org/10.21608/jpp.2017.37824

24. Gülçın, İ., Oktay, M., Kıreçcı, E., Küfrevıoğlu, Ö. İ. (2003). Screening of antioxidant and antimicrobial activities of anise (Pimpinella anisum L.) seed extracts. Food Chemistry, 83 (3), 371–382. doi: http://doi.org/10.1016/s0308-8146(03)00098-0

25. Lee, J. B., Yamagishi, C., Hayashi, K., Hayashi, T. (2011). Antiviral and Immunostimulating Effects of Lignin-Carbohydrate-Protein Complexes fromPimpinella anisum. Bioscience, Biotechnology, and Biochemistry, 75 (3), 459–465. doi: http://doi.org/10.1271/bbb.100645

26. Karimzadeh, F., Hosseini, M., Mangeng, D., Alavi, H., Hassanzadeh, G. R., Bayat, M. et. al. (2012). Anticonvulsant and neuroprotective effects of Pimpinella anisum in rat brain. BMC Complementary and Alternative Medicine, 12 (1). doi: http://doi.org/10.1186/1472-6882-12-76

27. Jamshidzadeh, A., Heidari, R., Razmjou, M., Karimi, F., Moein, M. R., Farshad, O. et. al. (2015). An in vivo and in vitro investigation on hepatoprotective effects of Pimpinella anisum seed essential oil and extracts against carbon tetrachloride-induced toxicity. Iranian journal of basic medical sciences, 18 (2), 205–211.

28. Al Mofleh, I. A., Alhaider, A. A., Mossa, J. S., Al-Soohaibani, M. O., Rafatullah, S. (2007). Aqueous suspension of anise "Pimpinella anisum" protects rats against chemically induced gastric ulcers. World journal of gastroenterology, 13 (7), 1112. doi: http://doi.org/10.3748/wjg.v13.i7.1112

29. Tirapelli, C. R., de Andrade, C. R., Cassano, A. O., De Souza, F. A., Ambrosio, S. R., da Costa, F. B., de Oliveira, A. M. (2007). Antispasmodic and relaxant effects of the hidroalcoholic extract of Pimpinella anisum (Apiaceae) on rat anococcygeus smooth muscle. Journal of Ethnopharmacology, 110 (1), 23–29. doi: http://doi.org/10.1016/j.jep.2006.08.031

30. Kolisnyk, S. V., Umarov, U. A., Dynnyk, K. V., Fathullaeva, M., Shabilalov, A. A., Gazieva, A. S. (2020). The study of the acute toxicity and the laxative effect of pectins from Pimpinella anisum herb. Clinical Pharmacy, 24 (2), 52–55. doi: http://doi.org/10.24959/cphj.20.1528

31. Drozdova, I. L., Denisova, N. N. (2011). Analiz polisakharidnogo sostava travy korostavnika polevogo flory Centralnogo Chernozemia. Nauchnye vedomosti BelGU. Seriia. Medicina. Farmaciia, 4 (99), 161–164.

32. Derzhavna Farmakopeya Ukrayini. Vol. 1 (2015). Kharkiv: DP «Ukrayinskiy naukoviy farmakopeyniy tsentr yakosti likarskih zasobiv», 1128.

33. Ghlissi, Z., Kallel, R., Krichen, F., Hakim, A., Zeghal, K., Boudawara, T. et. al. (2020). Polysaccharide from Pimpinella anisum seeds: Structural characterization, anti-inflammatory and laser burn wound healing in mice. International Journal of Biological Macromolecules, 156, 1530–1538. doi: http://doi.org/10.1016/j.ijbiomac.2019.11.201

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ESTIMATION OF THE POSSIBILITY OF EXPANDING THE INSTRUMENT BASE FOR THE RAPID DETECTION OF FALSIFIED MEDICINAL PRODUCTS IN THE RIVNE REGION

p. 39-43

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*The **aim** of the research was assessment of ways to expand the instrument base of photometric equipment for quality control of medicines, substantiation of prospects for their implementation and application in the activities of the territorial service for medicines and drug control in Rivne region.*

***Materials and methods.** Literature data, scientific publications on the application of photometric methods in drug quality control and own research on drug quality control were used. The methods of system analysis, bibliosemantic, data generalization was used in the work, the method of absorption spectrophotometry in the infrared region is used in the experimental research.*

***Results.** It is analyzed the effectiveness of IR spectroscopy for quality control of drugs and detection of their counterfeits in the framework of improving modern approaches to counteracting and combating the turnover of drugs in Ukraine. The prospect of using portable Raman spectrometers for drug quality control is established, based on their advantages over IR spectrophotometry. It was analyzed a list of drugs containing (azithromycin, erythromycin, ibuprofen, paracetamol, clarithromycin, cefuroxime sodium), including antipyretics and antibiotics that can be used to treat complications of COVID-19, in the field of involvement of the instrument base of the National University of Water Management and Nature Management and Rivne State University for the Humanities of Rivne.*

***Novelty of the obtained results.** For the first time, the paper suggests the involvement of the instrument base of higher education institutions for routine quality control of drugs and detection of their counterfeits by territorial laboratories for quality control of medicines on the example of Rivne region. The necessity of introduction and equipping of territorial bodies of the state quality control of medicines with portable devices of Raman spectrometry for carrying out express, non-destructive quality control of medicines is substantiated.*

***Conclusions.** The method of Raman spectroscopy is relevant for the implementation of the State Service for Medicines and Drug Control. The introduction of this method and equipment will increase the efficiency of inspections, as well as significantly reduce the time of analysis. According to the results of experimental research on the basis of the National University of Water Management of Rivne and Rivne State University for the Humanities, it is expedient and possible to involve the equipment of regional educational institutions and laboratories to detect counterfeits and prevent their use by the health care system*

***Keywords:** infrared spectroscopy, Raman spectroscopy, quality control of drugs*

References

1. Arzamascev, A. P., Pechennikov, V. M., Rodionova, G. M. et. al. (2000). Analiz lekarstvennykh smesei. Moscow: Kompaniia Sputnik, 275.

2. Pogodina, L. I. (1985). Analiz mnogokomponentnykh lekarstvennykh form. Minsk: Vysshaia shkola, 240.

3. Baranova, N. V., Feofanova, M. A. (2011). Primenenie metoda infrakrasnoi spektroskopii v analize lekarstvennykh sredstv. Vestnik Tverskogo gosudarstvennogo universiteta. Seriia Khimiia, 12, 49–56.

4. Aleksandrova, T. V., Kriuchkova, L. K., Budanova, N. A., Grigoreva, I. V. (2016). Aktualnost primeneniia metoda IK-spektrometrii pri opredelenii podlinnosti lekarstvennykh sredstv v usloviiakh ispytatelnoi laboratorii po kontroliu kachestva lekarstvennykh sredstv. Mezhdunarodnii zhurnal prikladnykh i fundamentalnykh issledovanii, 10 (4), 609–613.

5. Stepanova, E. V., Dorofeev, V. L., Arzamascev, A. P. (2008). Ispolzovanie metoda IK- spektrofotometrii bez vydeleniia deistvuiuschego veschestva dlia identifikacii lekarstvennykh sredstv ranitidina gidrokhlorida. Vestnik VGU. Seriia: Khimiia, Biologiia, Farmaciia, 2, 153–158.

6. Trineeva, O. V., Rudaia, M. A., Gudkova, A. A., Slivkin, A. I. (2018). Primenenie IK-spektroskopii v analize lekarstvennogo rastitelnogo syria. Vestnik VGU. Seriia: Khimiia, Biologiia, Farmaciia, 4, 187–194.

7. Ofitsiinyi Sait Derzhavnoi sluzhby Ukrainy z likarskykh zasobiv ta kontroliu za narkotykamy. Available at: https://www.dls.gov.ua/

8. Korostashova, I. M. (2012). Borotba proty kontrafaktsii likarskykh zasobiv v Ukraini (pytannia normatyvno-pravovoho zabezpechennia: kryminalne zakonodavstvo ta zakonodavstvo z pytan intelektualnoi vlasnosti). Visnyk Akademii mytnoi sluzhby Ukrainy. Seriia: «Pravo», 2 (9), 65–71.

9. Derzhavna Farmakopeia Ukrainy. Vol. 1. Kharkiv: Derzhavne pidpryiemstvo «Ukrainskyi naukovyi farmakopeinyi tsentr yakosti likarskykh zasobiv», 1128.

10. Wilson, B. K., Kaur, H., Allan, E. L., Lozama, A., Bell, D. (2017). A New Handheld Device for the Detection of Falsified Medicines: Demonstration on Falsified Artemisinin-Based Therapies from the Field. The American Journal of Tropical Medicine and Hygiene, 96 (5), 1117–1123. doi: http://doi.org/10.4269/ajtmh.16-0904

11. Arzamascev, A. P., Senov, P. L. (1978). Standartnye obrazcy lekarstvennykh veschestv. Moscow: Medicina, 248.

12. Zhiliaeva, M. A., Trofimov, A. R., Ramenskaia, G. V. et. al. (1996). Identifikaciia lekarstvennykh sredstv gruppy 1,4-benzodiazepina po elektronnym i kolebatelnym spektram pogloscheniia. Farmaciia, 45 (5), 35–36.

13. Kozlov, N. E., Sbezhneva, V. G. (1980). Ispolzovanie IK-spektroskopii dlia ocenki kachestva preparatov – proizvodnykh khloretilamina. Farmaciia, 29 (1), 33–34.

14. Lazarian, D. S. (1980). IK spectroscopia v analyse necotoryh proizvodnyh benzosulfonamida. Farmaciia, 29 (2), 36–38.

15. Mynka, A. F., Liuta, M. L. (1985). Vykorystannia IK-spektroskopii dlia identifikacii nikotynovoi kysloty ta ii pohidnyh. Farmacevt, 4, 40–43.

16. Belikov, V. G. (2000). Identifikaciia preparatov v lekarstvennykh formakh metodom proizvodnoi spektrofotometrii. Farmaciia, 49 (1), 23–25.

17. Lanzarotta, A., Lorenz, L., Batson, J. S., Flurer, C. (2017). Development and implementation of a pass/fail field-friendly method for detecting sildenafil in suspect pharmaceutical tablets using a handheld Raman spectrometer and silver colloids. Journal of Pharmaceutical and Biomedical Analysis, 146, 420–425. doi: http://doi.org/10.1016/j.jpba.2017.09.005

18. Ma, B., Wang, L. (2015). An application of rapid detection technologies in a national regulatory laboratory setting: Differentiating imported and domestic drug products of oxcarbazepine using handheld Raman, near infrared, and portable FTIR analyzers. American Pharmaceutical Review, 18 (2).

19. Nesterov, V. V., Titova, A. I., Evtushenko, I. S. (1991). Ispolzovanie UF spektrofotometrii v kontrole kachestva azidoti-midina. Farmaciia, 40 (3), 30–32.

20. Kashirin, D. M., Sibilev, A. V., Beloborodov, V. L. et. al. (2000). Primeneniie IK-spektroskopii dlia identifikaciii syntertisheskih peptydnyh preparatov timogena, tymodepressina i neogena. Khimiko-farmacevticheskii zhurnal, 34 (11), 48–51.

21. Volgram, E. N. (1988). Primenenije IES-spectrofotometrii dlia ustanovlenija kordanuma v trupnom materiale. Sudeb.-med. Ekspertiza, 31 (2), 34–35.

22. Derzhavna Farmakopeia Ukrainy. T. 2. Kharkiv: Derzhavne pidpryiemstvo «Ukrainskyi naukovyi farmakopeinyi tsentr yakosti likarskykh zasobiv», 52–55.

23. The State Pharmacopoeia of the Russian Federation. Vol. 1–3 (2015). Moscow. Available at: http://femb.ru/feml

24. Vickers, S., Bernier, M., Zambrzycki, S., Fernandez, F. M., Newton, P. N., Caillet, C. (2018). Field detection devices for screening the quality of medicines: a systematic review. BMJ Global Health, 3 (4), e000725. doi: http://doi.org/10.1136/bmjgh-2018-000725

25. Frosch, T., Wyrwich, E., Yan, D., Domes, C., Domes, R., Popp, J., Frosch, T. (2019). Counterfeit and Substandard Test of the Antimalarial Tablet Riamet® by Means of Raman Hyperspectral Multicomponent Analysis. Molecules, 24 (18), 3229. doi: http://doi.org/10.3390/molecules24183229

26. Dégardin, K., Guillemain, A., Roggo, Y. (2017). Comprehensive Study of a Handheld Raman Spectrometer for the Analysis of Counterfeits of Solid-Dosage Form Medicines. Journal of Spectroscopy, 2017, 1–13. doi: http://doi.org/10.1155/2017/3154035

27. Arzamascev, A. P., Lutceva, T. Iu., Sadchikova, N. P. (2001). Metody analiza i standartizaciji lekarstvennyh sredstv proizvodnyh barbiturovoi kisloty(obzor). Khimiko-farmacevticheskii zhurnal, 35 (8), 47–51.

28. Lutceva, A. I., Maslov, L. G. (1999). Metody kontrolia i standartizacii lekarstvennykh preparatov, soderzhaschikh vodorastvorimye vitaminy (obzor). Khimiko-farmacevticheskii zhurnal, 33 (9), 30–37.

29. Lutceva, A. I., Maslov, L. G., Seredenko, V. I. (2001). Metody kontrolia i standartizacii lekarstvennykh preparatov, soderzhaschikh zhirorastvorimye vitaminy. Khimiko-farmacevticheskii zhurnal, 35 (10), 41–46.