

# Proposals

for cooperation

*of Department of biotechnology, biophysics  
and analytical chemistry*

of National Technical University «Kharkiv  
Polytechnical Institute»

# *Department of biotechnology, biophysics and analytical chemistry*

of National Technical University «Kharkiv Polytechnical Institute»

Head of the Department

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Department provide full-time training and learning [Bachelor (BA); Master's (MA); Doctor of Philosophy (PhD)] by speciality

«Biotechnologies and Bioengineering»

with two specializations:

1. Pharmaceutical Biotechnology
2. Industrial Biotechnology

PROJECT MANAGER: **Prof. Dr. Yuri Krasnopolsky**,

Doctor of Science (Pharmacy), Professor of Department of Biotechnology, Biophysics and Analytical Chemistry, awarded with USSR State Prize.

Previous studies contain priority results on development of liposomal drugs and in general match the scientific approach developed under the auspices of Project Manager.

**Prof. Yuri Krasnopolsky** within the period 1991 to 2016 participated in technology development of more than 10 liposomal drugs.

### **List of patents:**

1. Stefanov A.V., Temirov Y.P., **Krasnopolsky Y.M.** Methods of obtaining liposomal drug (Lipin). Patent of Ukraine № 5654. Patentpending 14.03. **1993**. A61K9/127; Issued. 28.12. 1994. Bull. № 7-1. 4 p. ((licensed in Ukraine)

2. Grygorieva A.S., Kohanovich N.F., Stefanov A.V., **Krasnopolsky Y.M.**, Temirov Y.P., Ryabushev M.B., Technology of obtaining liposomal hepatoprotective drug. Patent of Ukraine № 46528. Patentpending 07.08. **2001**. A61K9/127; AK61 33/06. Issued. 15.05.2005. Bull. № 5. 10 p. (licensed in Ukraine)

3. Dudnichenko A.S., Temirov Y.P., Shvets V.I., **Krasnopolsky Y.M.**, Sennikova I.G. Methods of obtaining liposomal form anticancer drug Patent of Ukraine № 64591. Patentpending 03.07. **2003**. A61K9/127; A61K61 47/44. A61K47/36 Issued. 16.01. 2006. Bull. № 1. 5 p. (licensed in Ukraine)

4. Dudnichenko A.S., Temirov Y.P., Shvets V.I., **Krasnopolsky Y.M.**, Sennikova I.G. Methods of obtaining liposomal form anticancer drug (platine) Patent of Ukraine № 66633. Patentpending 13.08. **2003**. A61K 9/127; A61K 47/26. A61K 31/282 Issued. 15.02. 2006. Bull. № 2. 5 p.

5. Stefanov A.V., Grygorieva A.S., Soloviev A.I., Pasechnikova N.V., Khromov A.S., Kohanovich N.F., [Krasnopolsky Y.M.](#) Methods of obtaining liposomal agent that contains quercetin. Patent of Ukraine № 76393 Pending Patent 27.04. 2006. A61K 9/127; A61K31/353. A61K47/44, A61P31/00 A61K35/00, A61P39/06 Issued. 17.07.2006. Bull. №7. 10 p. (licensed in Ukraine)

6. Shakhmaiev AE., GorbachTV. , [Krasnopolsky Yu.M.](#) Methods of obtaining cardioprotective agent on the basis of liposomal nanoparticles. Patent of Ukraine for the utility model № 91702, patent pending 26.02.2014, BO1F 3|00, BO1F 3|08, BO1F 3|20, BO1F 3|22, Published 10.07.2014. Bull. №. 13., 14 p.

7. Shobolov D.L., [Krasnopolsky Yu.M.](#), Ulianov A.M., Notekan A.A., Tarasov V.V., Balabanian V.Y., Shvets V.I., Katsay A.G. Method of obtaining liposomal form of Cytochrome C. Application № 201201592 dd. 24.12.2012. Bull. 6. 2014. Eurasian Patent Organization. Patent № 022183 date of entry to the register 16.09.2015. Bull. 11. dd. 30.11.2015 (clinical study)

8. Shobolov D.L., [Krasnopolsky Yu.M.](#), Ulianov A.M., Notekan A.A., Tarasov V.V., Balabanian V.Y., Shvets V.I., Prochorov V.V. Method of obtaining liposomal form of docetaxel. Application № 201201591 dd. 24.12.2012. Bull. 6. 2014. Eurasian Patent Organization. Patent № 022182 date of entry to the register 16.09.2015. Bull. 11. dd. 30.11.2015 (clinical study)

9. Shobolov D.L., [Krasnopolsky Yu.M.](#), Ulianov A.M., Notekan A.A., Tarasov V.V., Balabanian V.Y., Shvets V.I., Stadnichenko A.V. Method of obtaining liposomal form of irinotecan. Application № 201201594 dd. 24.12.2012. Bull. 6. 2014. Eurasian Patent Organization. Patent № 023179 date of entry to the register 29.04.2016. (clinical study)

**Prof. Yuri Krasnopolsky publications** listed below are devoted to process engineering aspects of manufacture of liposomes and their components:

1. Klyashchitsky B.A., Mezhova I.V., [Krasnopolsky Yu.M.](#), Shvets V.I. Preparative isolation of Polyphosphoinositides and other Anionic phospholipids from Natural Sources Using Chromatography on Adsorbents Containing Primery AminoGroups. **Biotechnology and applied Biochemistry**. 1991. 14. P. 180-192.
2. Menzeleev R.F., [Krasnopolsky Yu.M.](#), Zvonkova E.N., Svetz V.I. Preparative separations of ganglioside GM<sub>3</sub> by high-performance liquid chromatography. **J. of Chromatography**. 1994. 678. P. 183-187.
3. Kaplun A.P., Ivanova N.N., [Krasnopolsky Yu.M.](#), Shvets V.I., Slon H.M., Kim K., Park I.P. Hard charged liposomes inhibit complement induced haemolysis. **The 24-th International Symposium on Controlled Release of Bioactive Materials proceedings**. Stockholm. 1997. P. 757-758.
4. Dudnichenko A., [Krasnopolsky Yu.](#) The efficacy of liposomal form of cytostatics. **Fourth International conference liposome advances. Progress in drug and vaccine delivery**. London. 1999. P. 95.
5. Grigoryeva G.S., Stefanov A.V., Konakhoych N.F., [Krasnopolsky Yu.M.](#), Pasechnikova N.V. Physical-chemical grounds of the membrane tropic factors in mechanism of the liposomal medicines action. **International liposome society "Progress in drug and vaccine delivery" 2005**. London. P. 50-54.
6. Grigoryeva G.S., Stefanov A.V., Konakhoych N.F., [Krasnopolsky Yu.M.](#), Pasechnikova N.V. Liposomal formulation for application on ophthalmology. **International liposome society "Progress in drug and vaccine delivery" 2006**. London. P. 38-39.

7. Shvets V.I., [Krasnopolsky Yu.M.](#), Stepanov A.E. and Chekhonin V.P. From Liposomes of the 1970s to 21st Century Nanobiotechnology. [Nanotechnologies in Russia](#). 2008. v.3. No. 11-12. p. 643-655.

8. Grygorieva A.S., Konakhovych N.F., [Krasnopolsky Yu.M.](#) Real Nanopharmacology: Liposomic medicines in clinic. [International Liposome Society](#). 2009. MEETING. Liposome Advances: Progress in drug and Vaccine Delivery 12-15 December 2009. London. P. 70-71.

9. [Krasnopolsky YM](#), Stepanov AE, Shvets VI. Technological aspects of obtaining liposomal drugs under GMP. [Biopharm. Journal](#). 2009; 1(3):18-29.

10. [Krasnopolsky YM](#), Shvets VI. The lipid technology platform to create new formulations and transport of pharmaceutical substances. [Biopharm. Journal](#). 2011; 3(2):10-18.

11. [Krasnopolsky YM](#), Dudnichenko AC, Shvets VI. Pharmaceutical biotechnology: Bionanotechnology in pharmacy and medicine. [Publishing Center NTU "KPI", Kharkov](#), 2011, 227

12. [Krasnopolsky Y.M.](#), Shvets V.I. Lipid process engineering platform for development of new drug forms and transportation of pharmacological substances. [Biofarmatsevtichekiy Zhurnal](#). 2001. Vol. 3. No 2. Pp.10-18.

13. [Krasnopolskii Y.M.](#), Balabanyan V.Y., Shobolov D.L., Shvets V.I. Prospective clinical Applications of Nanosized Drugs. [Russian J. of General Chemistry](#). 2013. v. 83. N. 12. P. 2524-2540.

14. [Krasnopolsky YM](#), Shvets VI. Technological principles of obtaining liposomal medicinal drugs and their application in clinic. [Nanotechnologies and health protection](#). 2013; 5 №2(15):10-18.

15. Shakhmaiev A.E., Corbach T.V., Bobritskaya L.A., [Krasnopolsky Yu.M.](#) Preparation and cardioprotective effect analysis of liposomal coenzyme Q10. [The Pharma Innovation Journal](#). 2015. V. 4. N. 9. P. 22-26.

## **PROJECT TITLE**

Development of complex liposome (injection, inhalation or eye drops) drug preparations to reduce toxicity and improve selectivity of their action, possessing antioxidant (anti-inflammatory, regenerating) activity, on the basis of natural hydrophobic antioxidants

### **BRIEF PROJECT DESCRIPTION**

The purpose of project is development and study of highly efficient complex (injection, inhalation or eye drops) drug preparations containing hydrophobic antioxidants that reduce drug toxicity and are used in treatment of oncology, ophthalmology and cardiology patients.

The importance of item is connected with the fact that at contemporary level of pharmacy and medicine development oncology patients are treated with a broad range of chemotherapeutical drugs having strong cytostatic action. In this process not only tumor tissues are damaged but normal tissues as well, which causes side effects of chemotherapy, namely cardiac, renal and stomach toxicity. Contemporary studies in human organism pathological processes have convincingly proved that many diseases (such as cardiac, ophthalmic and oncologic) are concomitant with lipid peroxidation in human body and biomembrane destruction. Hydrophobic antioxidants possess high antioxidant activity. But their application in the form of injection solutions is difficult due to their hydrophobicity. We propose application of artificial liposomic membranes in development of drugs; their bilayer may contain antioxidants, such as quercetin and ubidecarenone, which possess antioxidant, anti-inflammatory and membrane-protecting activity.

## **BASIC TASKS OF THE PROJECT**

- development of composition and industrial process manufacturing platform of a complex liposome preparation containing quercetin and ubidecarenone in liposome lipid bilayer;
- determination of obtained preparation pharmacological activity range in model experiments;
- determination of optimal drug commercial form on the basis of pharmacological research;
- study of developed product physico-chemical and biological properties;
- study of developed preparation stability;
- application of DMF project for the developed drug.

## **EXPECTED RESULTS**

1. Development of a unique pharmaceutical drug on the basis of hydrophobic antioxidant liposomal form, model study of its pharmacological activity (ophthalmology, oncology, cardiology). Expected scientific and social-economic effect lies in further application of developed drug in prophylaxis and treatment of cardiovascular, ophthalmic and oncologic patients.

2. Expected result shall be theoretically substantiated development of liposomal drug on the basis of a binary complex of hydrophobic pharmacologically active compounds possessing antioxidant, membrane protecting and anti-inflammatory action in treatment of cardiovascular, ophthalmic and oncologic patients.