

"Biotsydin" (experimen). The level of ammonia in the control areas was increased compared with research in plant crates at 53,5 %, the rearing – by 52,7 % and fattening – by 33,3 %. Number of hydrogen sulfide in the experimental areas was also significantly lower at 53,4 %; 47,5 % and 46,3 % ($p \leq 0,05$). The shop farrowing rate of microbial air pollution was higher in the control room at 4,4 %, compared with research. Also the level of *E. coli* in Research indoors was less compared with the control by 14,7 %. The shop rearing and fattening plant level microbial contamination of the air was higher compared with controls at 6% and 4,2 %, the number of *E. coli* – 23 % and 22,7 %, respectively ($p \leq 0,05$). In research areas where disinfectants used complex "Biotsydin" mark D and "Bi-deztm" survival of livestock research groups was higher in piglets flukes and rearing to 5,0 %, fattening – 10 %.

Keywords: bacteria, disinfection, deodorization, pigs, micro-climate areas, the intensity of growth.

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BIOSAFETY AND BIOSECURITY EDUCATION IN UKRAINE: CURRENT SITUATION, GAPS AND NECESSITIES ANALYSIS

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A major challenge for today's the internationally scientific community is to find effective ways to raise awareness amongst Life scientists about their social responsibilities regarding the potential for the destructive use of the life sciences research in which they are engaged. The aim of the presented study is gathering information on the educational opportunities and the current level of awareness on Biosafety, Biosecurity and "Dual-use" in the Ukrainian universities. We have elaborated and used special questionnaire for interviewing of participants from various academic institutions. The interviewees have shown high level of awareness on Biosafety, Biosecurity and dual-use issues. The respondents noticed that the surveyed Ukrainian institutions almost always have courses that focus primarily on Biosecurity, Biosafety and the dual-use issues. The interviewees recognize necessity to implement some activities to improve the level of education on such topics in Ukraine.

Keywords: Biosafety, Biosecurity, bioethics, dual-use education.

Background. Life sciences research and biotechnology have offered great social benefits globally, for example in improvements to public health, agriculture and energy development. Alongside these benefits, however, the same advances also generate safety and security risks, which, while less obvious, are nonetheless real [1]. However, in addition to the risk addressed by Biosafety containment and engineering safety standards, life science research and engineering developments can also give rise to issues of dual-use, whereby peacefully developed scientific research and engineering projects can be misused for destructive purposes, such as biowarfare and bioterrorism [2]. But the lack of awareness of individual scientists across the globe has been clearly demonstrated [3, 4]. Thus, a major challenge for today's internationally scientific community is to find effective ways to raise awareness among scientists about their social responsibility regarding the potential for the destructive use of the life science research in which they are engaged [5]. In order to share resources and improve education on safe, secure and responsible biological science and technology in European countries, including Ukraine, Project "International Network of Universities and Research Institutes to Raise Awareness on Dual-Use in Biotechnology" was developed within the framework of the EU CBRN CoE program. The presented study is a part of this project and devoted to gathering information on the educational opportunities and the current level of awareness on Biosafety, Biosecurity and dual-use in the universities of Ukraine.

Methods. The "Questionnaire for Educators/Faculty members" was used for gathering information. Any personal information is used for the scope of the Project only and it will not be disclosed to third parties in circumstances other than those described above. 51 people participated in the survey. All the interviewees come from academic institutions, including 9 life science universities, 10 medical universities and 7 other institutions, such as the Institute of Cell Biology (NAS) or the National University of Food Technologies. 86,3 % of the interviewees have so far attended workshops or seminars focused on Biosafety, Biosecurity and dual use before current interviewing. The majority of participants are female (38), while male interviewees only amount to 1 fourth of the total. The age distribution of the sample is well diversified: almost three fourths of the participants are older than 40 (37 % between 40 and 50 and 35 % over 50), but there is also a component of younger professors (one fourth is under 40 years old). 23 professors (45 % of the total) come from medical universities, 19 (37 %) from life science universities, with the remaining 18 % of academics comes from different fields of study. About half of the interviewees teaches bachelor classes, 35 % teaches at master level, only 7 % of the total holds doctorate lectures.

Results and discussion. The interviewees were asked several questions in order to assess their knowledge and level of awareness on a number of topics related to Biosafety, Biosecurity and dual use concerns.

The analysis of the questionnaires from Ukraine shows that there is a good knowledge of the topics and most of the interviewees had previously dealt with them in their professional career (Fig. 1).

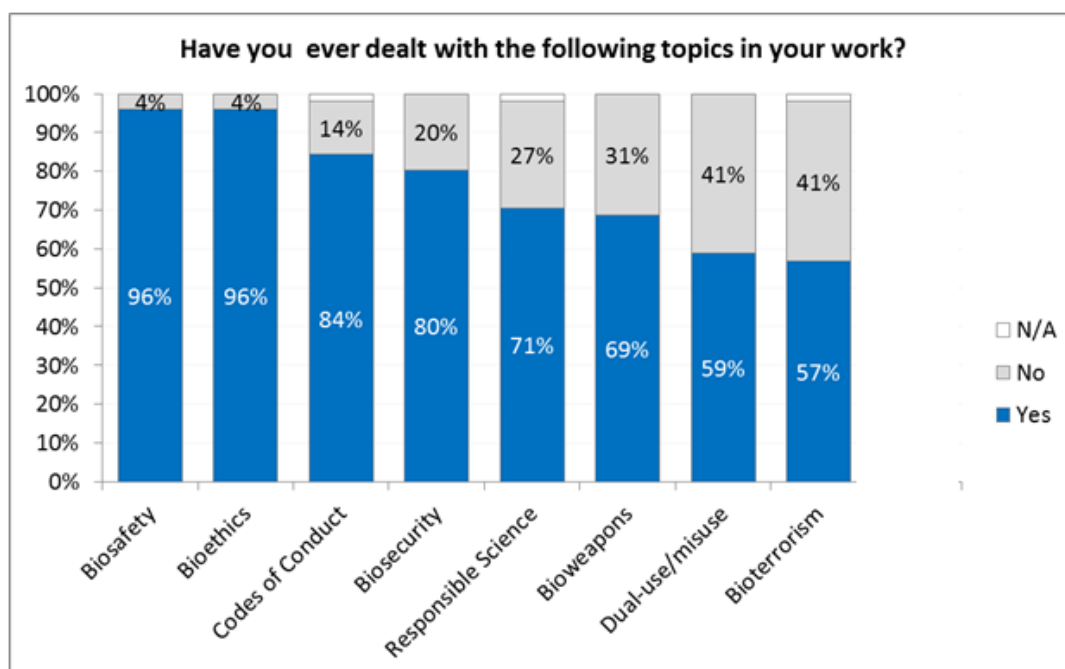


Fig. 1. Analysis of received answers on question “Have you ever dealt with the following topics in your work or in your courses?”

About half of the professors knows local or international organizations working on Biosecurity regulations (Fig. 2a), and more than 70% is aware of national or international rules prohibiting the non-peaceful use of life science research (Fig. 2b).

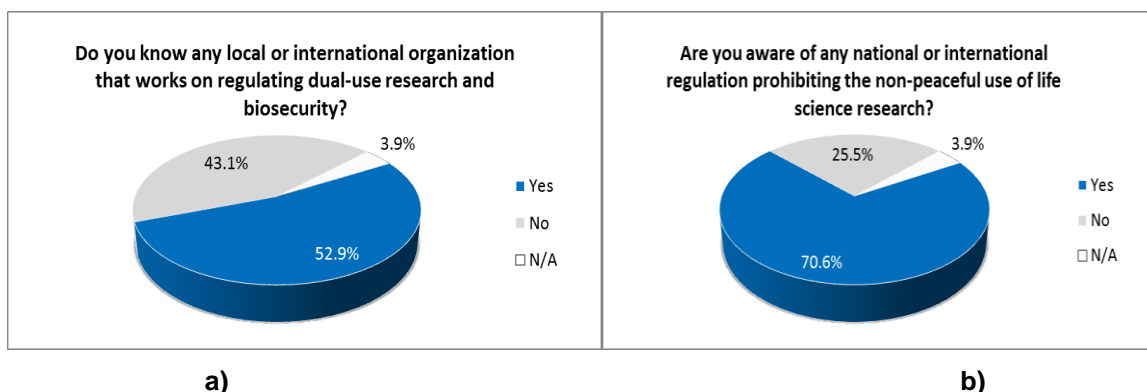


Fig. 2. Analysis of received answers on questions: a) “Do you know any local or international organization that works on regulating dual-use research and Biosecurity?”; b) “Are you aware of any national or international regulation prohibiting the non-peaceful use of life science research?”.

The presence of bioethics committees in the surveyed institutes is quite high (almost 70 %) (Fig. 3a); on the contrary very few institutions have internal Biosafety committees (even if about 30 % of the interviewees did not answer) (Fig. 3b).

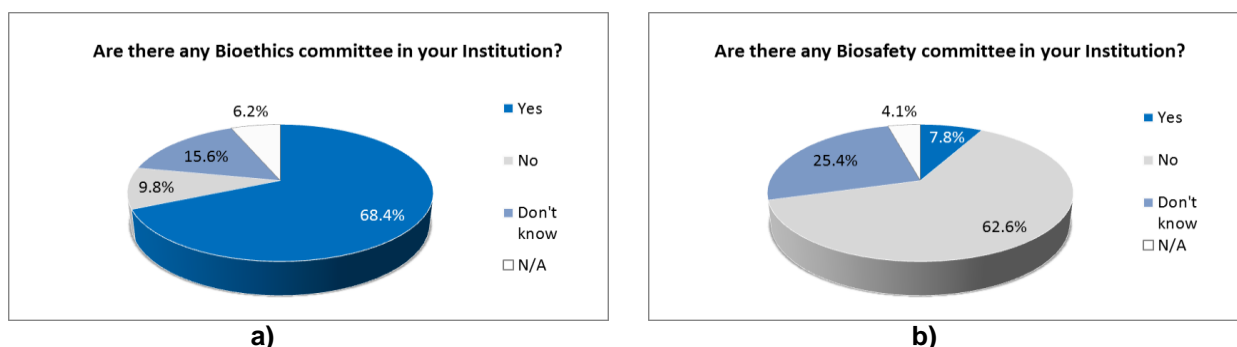


Fig. 3. Analysis of received answers on questions: a) “Are there any Bioethics committee in your Institution?”; b) “Are there any Biosafety committee in your Institution?”.

Furthermore, the participants were asked more specific questions regarding the contents of the modules/courses they teach (Fig. 4 a-c).

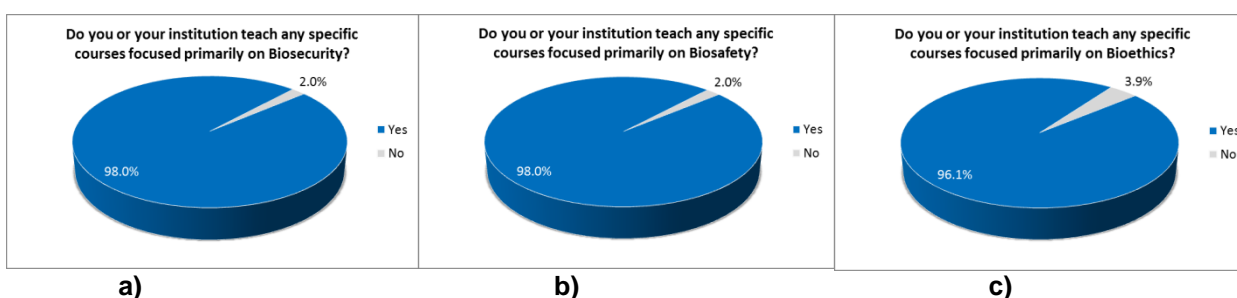


Fig. 4. Analysis of received answers on questions: a) “Do you or your institution teach any specific courses focused primarily on Biosecurity?”; b) “Do you or your institution teach any specific courses focused primarily on Biosafety?”; c) “Do you or your institution teach any specific courses focused primarily on Bioethics?”

As shown in the previous graphs, the surveyed Ukrainian academic institutions almost always have courses that focus primarily on Biosecurity, Biosafety or Bioethics.

When asked more detailed questions regarding the availability of resources and infrastructures used for education on Biosafety (Fig. 5), most of the participants were able to rate their country’s situation with a good grade of precision, and with encouraging results. Ukraine certainly shows an above average level of availability of resources and infrastructures.

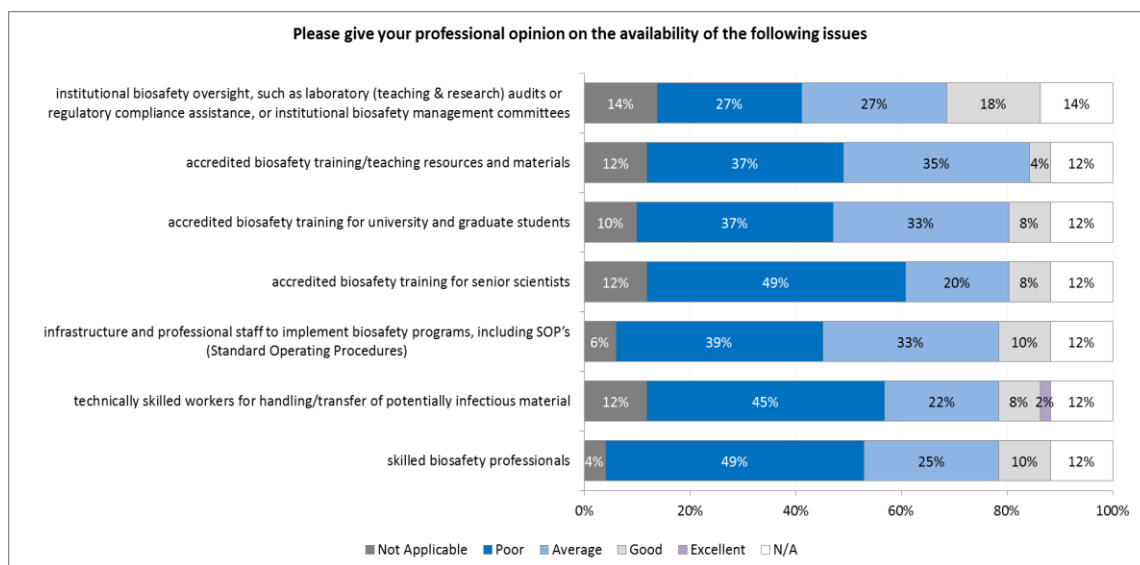


Fig. 5. Analysis of received answers on question “Please give your professional opinion on the following issues using the scale provided below?”

On the other hand, most of the participants recognize the seriousness of the topics discussed and consequently the importance of implementing a series of activities to better inform and educate the students and the new generation of scientists (Fig. 6 a-c).

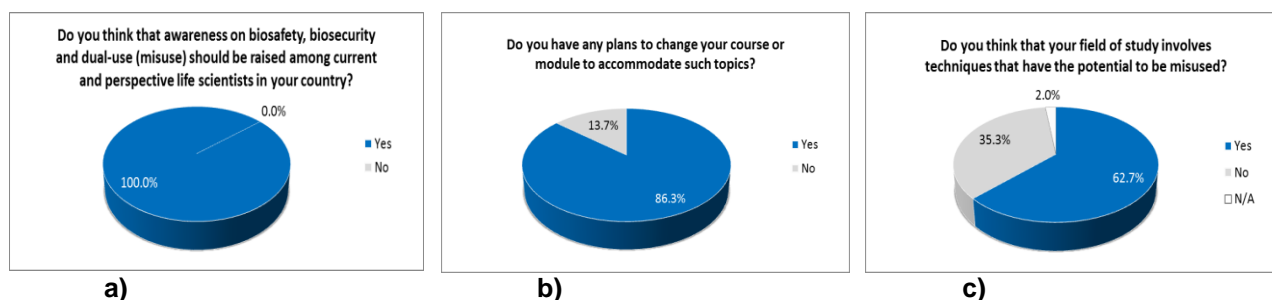


Fig. 6. Analysis of received answers on questions: **a)** “Do you think that awareness on Biosafety, Biosecurity and dual-use (misuse) should be raised among current and perspective life scientists in your country?”; **b)** “Do you have any plans to change your course or module to accommodate such topics?”; **c)** “Do you think that your field of study involves techniques that have the potential to be misused?”.

Almost every participant confirmed its interest in being involved in activities aimed at raising awareness on these topics (Fig. 7).

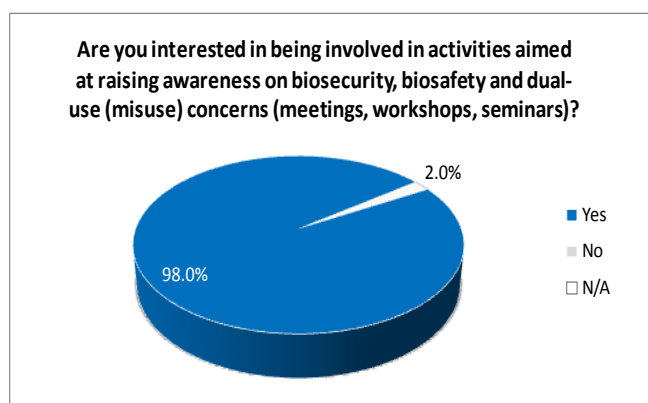


Fig. 7. Analysis of received answers on question: “Are you interested in being involved in activities aimed at raising awareness on Biosecurity, Biosafety and dual-use (misuse) concerns (meetings, workshops, seminars)?”

The interviewees have shown high level of awareness on Biosafety, Biosecurity and dual-use issues. That can be explained by previous activities of participants in seminars and conferences on studying issues before interviewing. In additional, interviewees indicated presence of Bioethics committees and absence of Biosafety committees in their institutions. In spite of absence any approved separate curriculum on Biosafety and Biosecurity, the respondents noticed that the surveyed Ukrainian institutions almost always have courses that focus primarily on Biosecurity and Biosafety. The dual-use issues often are covered in framework of the separated bioethics course which is obligatory for students in the field of life sciences in Ukraine. However, participants noted an above average level of availability of resources and infrastructures used for teaching on Biosafety. Thus interviewees recognize necessity of implementing a series of activities to educate the students and have some plans to change their courses or modules to accommodate such topics. For this purpose it will be very beneficial to develop and implementation of training materials and guidelines on Biosafety, Biosecurity and dual-use issues.

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**ОСВІТА З БІОБЕЗПЕКИ ТА БІОЗАХИСТУ В УКРАЇНІ: АНАЛІЗ СУЧАСНОГО СТАНУ,
НЕДОЛІКІВ І ПОТРЕБ**

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Одним з основних викликів для міжнародної наукової спільноти є пошук шляхів підвищення рівня усвідомлення науковцями, які працюють у сфері біологічних наук, соціальної відповідальності за потенційно небезпечне використання результатів їх досліджень.

Метою даної роботи був збір інформації про стан освіти та нинішній рівень обізнаності викладачів університетів України з питань біобезпеки та біозахисту. Для отримання даних проводилося анкетування з використанням спеціально розробленого опитувальника. Було опитано 51 представника 26 вищих навчальних закладів та академічних установ України. Результати опитування свідчать про відносно високий рівень обізнаності респондентів у сфері біобезпеки та біозахисту, зокрема про поінформованість щодо національних та міжнародних нормативних документів, що забороняють можливе небезпечне використання результатів наукових досліджень, та про міжнародні й національні організації, діяльність яких присвячена біобезпеці. Таку обізнаність опитаних можна пояснити тим, що більшість з них попередньо брала участь у роботі наукових семінарів, проведених в Україні і присвячених біобезпеці та біозахисту. Більшість респондентів зазначили, що в їх навчальних закладах викладаються навчальні модулі, що присвячені питанням біобезпеки та біозахисту, а проблеми «подвійного використання» часто висвітлюються в межах нормативного курсу з біоетики, що є обов'язковим для студентів біологічних та медичних напрямів підготовки. У той же час, респонденти вважають, що в Україні рівень наявних ресурсів, які використовуються для навчання в сфері біобезпеки, є недостатнім. Викладачі, які брали участь в опитуванні, зазначили необхідність вдосконалення існуючих навчальних програм в даній сфері. Одним із шляхів подолання даної проблеми є розробка методичних рекомендацій з біобезпеки, біозахисту та проблем «подвійного використання» та ефективне і широке їх впровадження у навчальний процес.

Ключові слова: біобезпека, біозахисту, біоетика, «подвійне використання»