TRAINING MATERIAL FOR PRACTICAL WORK

ANIMAL BIOTECHNOLOGY

Almaty, 2021

Practical work №1.
Basic methods of animal biotechnology.
Animal Breeding and Biotechnology.

Aim of the work: Acquaintance students with methods of animal biotechnology and animal breeding.

Animal biotechnology is a branch of biotechnology in which molecular biology techniques are used to genetically engineer (i.e. modify the genome of) animals in order to improve their suitability for pharmaceutical, agricultural or industrial applications. Animals provide a number of products we use in everyday life. Animals provide a number of products we use in everyday life: –Milk –Leather –Meat –Wool –Egg –Enzymes –And many more e-g medicine.

Major areas of animal biotechnology: Animal breeding; Animal vaccines; Animal nutrition; Embryo transfer; Transgenic animal; Xenotransplfntation.

Animal biotechnology is the use of science and engineering to modify living organisms. The goal is to make products, to improve animals and to develop microorganisms for specific agricultural uses. Examples of animal biotechnology include creating transgenic animals (animals with one or more genes introduced by human intervention), using gene knock out technology to make animals with a specific inactivated gene and producing nearly identical animals by somatic cell nuclear transfer (or cloning).

References:

1. R. Renaville and A. Burny (eds.), Biotechnology in Animal Husbandry, 2001. Kluwer Academic Publishers. Printed in the Netherlands. P. 209-223.
2. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.

Control questions:

1, Application of animal biotechnology.
2. Major areas of animal biotechnology.
3. Animal breeding and biotechnology.
4. The methods of animal biotechnology.

Internet resources:

https://www.youtube.com/watch?v=IiHEYtnKfF0
https://youtu.be/rneeZlxyl_Y

Practical work №2.
Reproductive technologies: Artificial insemination.
In vitro production of embryos.

Aim of the work: Acquaintance with animal reproductive technologies.

Animal breeding, nowadays, is a field that is influenced by a whole range of biotechnological applications and developments (Bazer and Spencer, 2005). Various biotechnology methods are used in improving the breeding stock of animals.

Artificial insemination (AI) is the deliberate introduction of sperm into a female's cervix or uterine cavity for the purpose of achieving a pregnancy through in vivo fertilization by means other than sexual intercourse. It is a fertility treatment for humans, and is common practice in animal breeding, including dairy cattle (see Frozen bovine semen) and pigs.

Artificial insemination may employ assisted reproductive technology, sperm donationand animal husbandry techniques. Artificial insemination techniques available include intracervical insemination and intrauterine insemination. The beneficiaries of artificial insemination are women who desire to give birth to their own child who may be single, women who are in a lesbian relationship or women who are in a heterosexual relationship but with a male partner who is

infertile or who has a physical impairment which prevents full intercourse from taking place. Intracervical insemination (ICI) is the easiest and most common insemination technique and can be used in the home for self-insemination without medical practitioner assistance.[1] Compared with natural insemination (i.e., insemination by sexual intercourse), artificial insemination can be more expensive and more invasive, and may require professional assistance.

In-vitro production of embryos. In case other artificial reproductive techniques fail due to difficulties such as blocked reproductive systems, non-responsive ovaries in the females, marginal semen quality and quantity in the male, and presence of disease, in vitro fertilization (IVF) is used. The fertilization of the sperm and the egg is conducted in vitro (outside the animal's body) at specific environmental and biochemical conditions.

Control questions:

- Animal breeding.
- Artificial insemination.
- In vitro fertilization.
- Embryo transfer in animals.

References:

1. R. Renaville and A. Burny (eds.), Biotechnology in Animal Husbandry, 2001. Kluwer Academic Publishers. Printed in the Netherlands. P. 209-223.
2. Lodish H, Berk A, Zipursky SL, et al. Molecular Cell Biology. 4th edition. New York: ed. by W. H. Freeman; 2000.
3. B.R. Glick & J.J. Pasternak. Molecular Biotechnology - Principles and Applications of Recombinant DNA. 3rd Edition). 2003
4. I.R. Gordon. Reproductive Technologies in Farm Animals. 2004. DOI 10.1079/9780851998626.0000
5. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.

Internet resources:

https://en.wikibooks.org/wiki/Anatomy_and_Physiology_of_Animals/Reproductive_System
http://people.ucalgary.ca/~browder/transgenic.html
https://www.ncbi.nlm.nih.gov/books/NBK207576/

Additional visual material for study:

https://www.uaex.edu/publications/pdf/fsa-3119.pdf
http://www.fao.org/3/X6500E03.htm#:~:text=Embryo%20transfer%20is%20an%20artificial,where%20they%20develop%20to%20term.

Practical work №3.
The features of the organization of biotechnological laboratory in animal husbandry.

Aim of the work: Acquaintance with features of the organization of biotechnological laboratory.

Animal biotechnology is the use of science and engineering to modify living organisms. The goal is to make products, to improve animals and to develop microorganisms for specific agricultural uses.

Examples of animal biotechnology include creating transgenic animals (animals with one or more genes introduced by human intervention), using gene knock out technology to make animals with a specific inactivated gene and producing nearly identical animals by somatic cell nuclear transfer (or cloning).

While predicting the future is inherently risky, some things can be said with certainty about the future of animal biotechnology. The government agencies involved in the regulation of animal biotechnology, mainly the Food and Drug Administration (FDA), likely will rule on pending policies and establish processes for the commercial uses of products created through the technology. In January 2008, the U.S. Food and Drug Administration (FDA) approved the sale of cloned animals and their offspring for food, despite fierce opposition from animal welfare and consumer advocacy groups, environmental organizations, some members of Congress, and many

consumers. It also is expected that technologies will continue to be developed in the field, with much hope for advances in the use of animal organs in human transplant operations.

Control questions:

1. The future of animal biotechnology.
2. The technology involved in animal biotechnology.
3. Animal biotechnology applications.
4. Food safety and animal biotechnology.
5. Animal biotechnology and their potential impact to the environment.

References:

1. R. Renaville and A. Burny (eds.), Biotechnology in Animal Husbandry, 2001. Kluwer Academic Publishers. Printed in the Netherlands. P. 209-223.
2. Lodish H, Berk A, Zipursky SL, et al. Molecular Cell Biology. 4th edition. New York: ed. by W. H. Freeman; 2000.
3. B.R. Glick & J.J. Pasternak. Molecular Biotechnology - Principles and Applications of Recombinant DNA. 3rd Edition). 2003
4. I.R. Gordon. Reproductive Technologies in Farm Animals. 2004. DOI 10.1079/9780851998626.0000
5. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.

Internet resources:

https://en.wikibooks.org/wiki/Anatomy_and_Physiology_of_Animals/Reproductive_System

Practical work №4.
Transgenic Animals.

Aim of the work: Acquaintance with application transgenic Animals.

Genetic engineering technology has numerous applications involving companion, wild,and farm animals, and animal models used in scientific research. The majority of genetically engineered animals are still in the research phase, rather than actually in use for their intended applications, or commercially available.

Farm animals.

As reviewed by Laible (9), there is ‑an assorted range of agricultural livestock applications [for genetic engineering] aimed at improving animal productivity; food quality and disease resistance; and environmental sustainability.‖ Productivity of farm animal species can be increased using genetic engineering. Examples include transgenic pigs and sheep that have been genetically altered to express higher levels of growth hormone (9).

Genetically engineered farm animals can be created to enhance food quality (9). For example, pigs have been genetically engineered to express the Δ12 fatty acid desaturase gene (from spinach) for higher levels of omega-3, and goats have been genetically engineered to express human lysozyme in their milk. Such advances may add to the nutritional value of animal-based products. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3078015/

Control questions:

1. What is genetic engineering?
2. The principles of genetic engineering in Animal biotechnology.
3. Animal genetically modified food products.
4. The assess of risk GMO to environment,.
5. Methods of obtaining of GM animals.

References:

1. R. Renaville and A. Burny (eds.), Biotechnology in Animal Husbandry, 2001. Kluwer Academic Publishers. Printed in the Netherlands. P. 209-223.
2. Lodish H, Berk A, Zipursky SL, et al. Molecular Cell Biology. 4th edition. New York: ed. by W. H. Freeman; 2000.
6. B.R. Glick & J.J. Pasternak. Molecular Biotechnology - Principles and Applications of Recombinant DNA. 3rd Edition). 2003

7. I.R. Gordon. Reproductive Technologies in Farm Animals. 2004. DOI 10.1079/9780851998626.0000
8. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.

Internet resources:

https://en.wikibooks.org/wiki/Anatomy_and_Physiology_of_Animals/Reproductive_System
http://people.ucalgary.ca/~browder/transgenic.html
https://www.ncbi.nlm.nih.gov/books/NBK207576/

Practical work №5.
Animal biotechnology. Regulation of the reproduction of farm animals. Biotechnology economic implications.

Aim of the work: Acquaintance with regulation of the reproduction of farm animals and economic implications of animal biotechnology.

Regulations. The regulation of animal biotechnology currently is performed under existing government agencies. To date, no new regulations or laws have been enacted to deal with animal biotechnology and related issues. The main governing body for animal biotechnology and their products is the FDA. Specifically, these products fall under the new animal drug provisions of the Food, Drug, and Cosmetic Act (FDCA). In this use, the introduced genetic construct is considered the "drug." This lack of concrete regulatory guidance has produced many questions, especially because the process for bringing genetically engineered animals to market remains unknown.

In 2015, the FDA determined that AquAdvantage Salmon meets the statutory requirements for safety and effectiveness under the Federal Food, Drug, and Cosmetic Act.

Many people question the use of an agency that was designed specifically for drugs to regulate live animals. The agency's strict confidentiality provisions and lack of an environmental mandate in the FDCA also are concerns. It still is unclear how the agency's provisions will be interpreted for animals and how multiple agencies will work together in the regulatory system.

When animals are genetically engineered for biomedical research purposes (as pigs are, for example, in organ transplantation studies), their care and use is carefully regulated by the Department of Agriculture. In addition, if federal funds are used to support the research, the work further is regulated by the Public Health Service Policy on Humane Care and Use of Laboratory Animals.

Livestock is becoming increasingly important in the growth of agriculture in developing economies. The contributions made by livestock to both agriculture and gross domestic product (GDP) have risen, at a time when the contribution of agriculture to GDP has fallen. The demand for livestock products is a function of income, and sustained growth in per capita income, rising urban populations and changes in diet and lifestyle are fuelling growth in livestock production.

Livestock production contributes to socioeconomic development in many ways, by augmenting income and employment and reducing the incidence of rural poverty. Though the role of livestock in ensuring nutritional security is recognised in mixed crop-livestock systems, the importance of livestock goes beyond direct food production.

Livestock supply draught power and organic manure to the crop sector, and hides, skins, bones, blood and fibre are used in many industries. Thus, livestock are an important source of income and employment, helping to alleviate poverty and smooth the income distribution among small landholders and the landless, who constitute the bulk of the rural population and the majority of livestock owners. In addition, livestock can easily be converted into cash and thus act as a cushion against crop failure, particularly in less favoured environments. By enabling crop residues and by-products to be used as fodder, livestock production contributes positively to the environment.

Control questions:

1. The regulation of animal biotechnology.
2. Labeling genetically engineered foods.
3. Livestock production.
4. Requirements for safety and effectiveness of GMO.

5. Biotechnology economic implications.

References:

1. R. Renaville and A. Burny (eds.), Biotechnology in Animal Husbandry, 2001. Kluwer Academic Publishers. Printed in the Netherlands. P. 209-223.
2. Lodish H, Berk A, Zipursky SL, et al. Molecular Cell Biology. 4th edition. New York: ed. by W. H. Freeman; 2000.
9. B.R. Glick & J.J. Pasternak. Molecular Biotechnology - Principles and Applications of Recombinant DNA. 3rd Edition). 2003
10. I.R. Gordon. Reproductive Technologies in Farm Animals. 2004. DOI 10.1079/9780851998626.0000
11. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.

Internet resources:

https://en.wikibooks.org/wiki/Anatomy_and_Physiology_of_Animals/Reproductive_System
http://people.ucalgary.ca/~browder/transgenic.html
https://www.ncbi.nlm.nih.gov/books/NBK207576/

Additional visual material for study:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3078015/