

**Kushumkhanov Zh.S.**, PhD, the main author, <https://orcid.org/0000-0002-5132-7359>  
NJSC "West Kazakhstan Agrarian and Technical University named after Zhangir Khan", Uralsk,  
st. Zhangir Khan 51, 090009, Kazakhstan, [Jenis.90@mail.ru](mailto:Jenis.90@mail.ru)  
**Zhumayeva A.K.**, PhD doctor, the main author <https://orcid.org/0000-0001-7637-8155>  
NJSC "West Kazakhstan Agrarian and Technical University named after Zhangir Khan", Uralsk,  
st. Zhangir Khan 51, 090009, Kazakhstan, [araikon\\_90@mail.ru](mailto:araikon_90@mail.ru)  
**Zhaksygalieva D.S.**, senior lecturer, master, <https://orcid.org/0009-0008-3646-0259>  
NJSC "West Kazakhstan Agrarian and Technical University named after Zhangir Khan", Uralsk,  
st. Zhangir Khan 51, 090009, Kazakhstan, [dariga\\_aidos@mail.ru](mailto:dariga_aidos@mail.ru)

## BREED CHARACTERISTICS OF THE INFLUENCE OF ANTIBIOTICS ON BIOCHEMICAL AND ORGANOLEPTIC PARAMETERS OF MARE'S MILK

### ANNOTATION

This paper examines the effect of antibiotic residues on the quality of mare's milk, including changes in enzymatic activity, microbiological composition and organoleptic characteristics. It was found that the presence of antibiotics, such as penicillins and tetracyclines, leads to inhibition of key milk enzymes, disruption of the microbiological balance and deterioration of the taste and aromatic properties of the product. Potential risks to consumer health, including the development of antibiotic resistance and allergic reactions, are considered. A review of modern methods for monitoring antibiotics, including biological, enzyme immunoassay and chromatographic tests, is provided. The data obtained indicate the need for strict control of antibiotic content in mare's milk to ensure consumer safety and maintain high quality characteristics of the product. The article presents a comparative study of the effect of antibiotics on the quality of mare's milk in Kazakh and Kushum horse breeds. Residual concentrations of antibiotics (penicillin and tetracycline), their effect on enzymatic activity (lactase, lipase), microbiological parameters (total microbial count, lactobacilli content), and organoleptic properties of milk were analyzed. It was found that milk of the Kazakh breed is characterized by lower antibiotic residues, high resistance of microflora and minimal sensory changes. While in the Kushum breed, more pronounced inhibition of enzymatic activity and disruption of organoleptic properties were found at the same dosages of drugs. The results emphasize the need to take into account breed characteristics in veterinary care of dairy mares and in product quality control. Methods for monitoring residual antibiotics using ELISA, HPLC and biotests are proposed.

*Key words: horse, milk, antibiotics, Kushum breed, organoleptic parameters.*

**Introduction.** Mare's milk is a traditional food product in the cultures of many peoples of Central Asia, including Kazakhstan. It has a high biological value, contains easily digestible proteins, vitamins, enzymes and essential amino acids. Particularly valued is the fermented product based on it - kumiss, which has probiotic, immunomodulatory and restorative properties. Mare's milk is increasingly considered not only a traditional drink, but also as a functional product in the system of preventive nutrition. The development of dairy horse breeding is accompanied by the need to use veterinary drugs, in particular antibiotics, in the treatment of infectious diseases in animals. However, the use of antibiotics is associated with the risk of their accumulation in milk, which can affect both the technological properties of the product and its safety for the consumer. Antibiotics in milk can suppress beneficial microflora, disrupt the processes of natural fermentation and maturation of the product, reduce enzymatic activity and cause organoleptic defects. In addition, consumption of milk with residual amounts of antibiotics is associated with the risks of developing allergic reactions, dysbiosis and the formation of antibiotic-resistant strains of bacteria in the human body.

Of particular interest is the study of the effect of antibiotics taking into account the breed characteristics of horses, since morphophysiological differences, milk yield, disease resistance and metabolic rate in different breeds can determine differences in the accumulation of antibiotic residues, as well as in the degree of their impact on the quality of milk. This paper examines the Kazakh and Kushum breeds - widely used in dairy horse breeding in Kazakhstan. The study is aimed at assessing the residual amounts of antibiotics in milk, their effect on enzymatic activity, microbiological composition and

organoleptic characteristics of milk in these breeds. The aim of the study is a comparative assessment of the effect of antibiotics on the composition and quality of mare's milk in horses of the Kazakh and Kushum breeds with an emphasis on biochemical and microbiological changes, as well as the development of recommendations for product safety control. Mare's milk is a unique food product, characterized by a high content of easily digestible proteins, vitamins, minerals and enzymes. Due to its composition and biological activity, it is widely used not only in nutrition, but also for medicinal purposes, especially in the production of the traditional drink kumys. However, the growing role of veterinary therapy of horses using antibiotics raises concerns about the possible entry of residues of these drugs into milk. The presence of antibiotics in mare's milk can have a negative impact on its quality, changing enzymatic activity, disrupting the microbiological balance and worsening organoleptic properties. Moreover, antibiotic residues pose a serious threat to consumer health, contributing to the development of allergies, disruption of intestinal microflora and the formation of antibiotic-resistant microorganisms.

In this regard, it is extremely important to study the effect of antibiotics on the quality of mare's milk and implement effective methods for monitoring drug residues. The purpose of this work is to review existing research on this issue and identify key areas for ensuring the safety and quality of mare's milk. Mare's milk occupies an important place among dairy products due to its unique composition and beneficial properties. It is rich in easily digestible proteins, vitamins, minerals and biologically active components, which makes it in demand both in the food industry and in medical practice. Traditionally, mare's milk is used to produce kumiss - a fermented drink with pronounced probiotic and medicinal properties. In recent decades, antibiotics have been widely used in animal husbandry, including horse breeding, to treat and prevent infectious diseases. However, the use of these drugs is associated with the risk of their residues getting into milk, which can significantly reduce the quality of the final product and entail serious consequences for the health of consumers. The presence of antibiotics in milk leads to inhibition of enzymatic processes, disruption of the balance of microflora, as well as deterioration of taste and aroma characteristics. Moreover, antibiotic residues pose a potential threat to humans, contributing to the development of allergies, disruption of microbiota and the formation of antibiotic-resistant bacterial strains, which exacerbates the problem of antibiotic resistance. The relevance of this topic is due to the need to ensure the safety of mare's milk and improve its quality. The introduction of effective methods for monitoring antibiotic residues is an important link in the quality control system for dairy products.

The purpose of this work is a comprehensive analysis of the effect of antibiotics on the quality of mare's milk, including enzymatic, microbiological and organoleptic indicators, as well as a review of modern methods for identifying and monitoring antibiotics in milk.

**Materials and methods.** The subjects of the study were mares of the Kazakh and Kushum breeds in the conditions of farms in the West Kazakhstan region. The study included 10 animals of each breed, in the lactation stage, without pronounced pathologies.

All animals with mild respiratory infections were prescribed standard doses of antibiotics approved for veterinary use:

Penicillin - intramuscularly, 20 thousand U / kg, 5 days,

Tetracycline - 10 mg / kg orally, 7 days.

Milk samples were collected before the start of therapy (control), on the 3rd day of treatment, and 3, 5 and 7 days after the end of the course.

Analysis of residual antibiotics

Determination of antibiotic residues in milk was carried out using the following methods:

ELISA — rapid assessment of residual penicillins and tetracyclines,

HPLC — quantitative determination of antibiotics with a detection limit of up to 0.5 ng/ml,

Biotest Delvotest SP — semi-qualification test for the presence of antibiotic substances.

Biochemical analysis

Enzymatic activity (lactase, lipase, protease) was determined according to GOST and photometry using the BiokhimAnalit reagent kit. The analysis was carried out in fresh milk samples.

Microbiological studies

To assess the state of microflora, the following were performed:

Counting the total microbial count (TMC) by seeding on the MPA nutrient medium,

Determining the number of lactobacilli on the MRS agar medium,

Detecting antibiotic-resistant strains — by the disk diffusion method (Kirby-Bauer) using standard antibiograms.

Assessment of organoleptic properties

Organoleptic analysis (taste, smell, color, consistency) was carried out by a tasting committee of 5 specialists on a 5-point scale. The assessment was carried out blindly, under the same conditions.

#### Processing of results

Statistical data processing was carried out using the Statistica 13.0 program. Average values are presented with a confidence interval ( $p \leq 0.05$ ). For comparison between groups, Student's t-test was used.

Both experimental data and literature reviews published between 2013 and 2023 were used to study the effect of antibiotics on mare's milk quality. The main areas of study included:

#### Milk samples

Samples of mare's milk collected from different farms where antibiotics were used to treat horses were analyzed. Milk samples were collected in accordance with regulatory requirements and stored at  $4 \pm 2$  °C until analysis.

#### Determination of antibiotic residues

Several methods were used to detect and quantify antibiotic residues in milk:

Biological tests (Delvotest, BRT), which allow to detect the total level of antibiotic activity.

Enzyme-linked immunosorbent assays (ELISA), which are used to determine specific groups of antibiotics with high sensitivity.

Chromatographic methods — high-performance liquid chromatography (HPLC) and gas chromatography coupled with mass spectrometry (GC-MS), providing accurate quantitative determination and identification of antibiotics.

#### Enzyme activity analysis

The activity of key mare's milk enzymes (lactase, lipase, proteases) was assessed using spectrophotometric methods and standard enzymatic tests. Milk samples with different concentrations of antibiotics were compared.

#### Microbiological analysis

The total microbial count, the number of lactobacilli and pathogenic microorganisms were determined, and testing for the presence of antibiotic-resistant strains was carried out using standard bacteriological methods and antibiograms.

#### Organoleptic assessment

To assess the taste, smell and color of milk, an organoleptic examination was carried out by a qualified group of experts using a point scale and comparison with control samples.

#### Statistical data processing

Descriptive statistics methods, analysis of variance (ANOVA) and correlation analysis using SPSS and Excel software were used to analyze the obtained results.

This integrated approach allowed us to comprehensively assess the impact of antibiotics on the quality of mare's milk and identify key changes caused by the presence of drug residues.

**Results and discussion.** Table 5 presents comparative data on the effect of antibiotics on the composition and quality of mare's milk in Kazakh and Kushum horse breeds. These breeds are widely used in dairy horse breeding in Kazakhstan and differ in productivity, physiological characteristics and resistance to external influences, including the use of antibiotics.

Table 5 – (supplemented). Effect of antibiotics on milk quality in Kazakh and Kushum horse breeds

Indicator	Kazakh breed	Kushumskaya breed
1	2	3
Average milk yield (l/day)	1.8–2.5	3.0–4.0
Milk protein content (%)	2.0–2.3	2.2–2.5
Lactose content (%)	6.0–6.5	6.3–6.8
Residual concentrations of antibiotics	8–10 ng/ml (with typical treatment)	12–15 ng/ml (late excretion)
1	2	3
Lactase activity	85–90% of normal after antibiotic exposure	70–75% of the norm
Total microbial count (KUO/ml)	$1.5 \times 10^5$	$1.2 \times 10^5$

Number of lactobacilli (KUO/ml)	$4.0 \times 10^4$	$3.2 \times 10^4$
Antibiotic-resistant strains (%)	8–12%	16–20%
Organoleptic changes	Minor (slight sourness, odor not disturbed)	Bitter aftertaste, decreased transparency, sour smell
Antibiotic resistance	High (formed in extreme steppe conditions)	Average (with intensive feeding and veterinary load)
Veterinary use of antibiotics	It is recommended to strictly control the dosage and waiting periods	Requires an extended excretion period and laboratory monitoring
Suitability for kumiss	High (stable fermentation, good acidity)	Average (maturation may be delayed with antibiotic residues)

According to the data provided, the Kushum breed demonstrates a higher milk yield - up to 4 liters per day, which exceeds the indicators of the Kazakh breed (1.8-2.5 l / day). However, at the same time, Kushum mares have a higher residual concentration of antibiotics in milk (12-15 ng / ml), which may be associated with intensive maintenance, feeding and more frequent veterinary intervention. In terms of enzymatic activity, in particular lactase, the Kazakh breed retains up to 90% of the norm even in the presence of antibiotic residues, while in the Kushum breed, the activity drops to 70-75%, which negatively affects the biochemical processes during fermentation, especially in the production of kumiss. Comparison of the microbiological composition shows that the Kazakh breed retains a higher level of lactobacilli and the total microbial count, which indicates greater resistance of microflora to antibiotics. The Kushum breed also has a higher percentage of resistant bacterial strains - up to 20%, which potentially increases the problem of antibiotic resistance. As for organoleptic properties, milk from Kazakh mares practically does not lose its taste and aroma qualities during antibiotic therapy, while the Kushum breed often experiences negative changes: a bitter aftertaste, dull color, sour smell. In addition, it should be taken into account that the Kushum breed requires an extended period of antibiotic elimination before using milk for food, and laboratory control of residual substances is necessary. This makes products from Kazakh mares safer in terms of processing and consumption, especially in traditional kumis production conditions. Thus, breed characteristics have a significant impact on the resistance of mares to antibiotics and on the quality of milk, which must be taken into account when planning treatment regimens, timing of milk culling and selecting animals for dairy breeding.

The effect of antibiotics on the enzymatic activity of mare's milk

Studies have shown that the presence of antibiotic residues in mare's milk leads to a significant decrease in the activity of enzymes - lactase, lipase and proteases. For example, penicillin concentrations above 10 ng / ml caused a decrease in lipase activity by up to 28%, and lactase - up to 20% compared to control samples without antibiotics. Such inhibition of enzymatic processes negatively affects the technological processing of milk, especially fermentation and coagulation in the production of fermented milk products such as kumiss. Such results are consistent with the data of Ivanov et al. (2019), who noted a similar decrease in enzymatic activity when exposed to antibiotics.

Microbiological composition and resistance of bacteria

Table 2 – Microbiological parameters, residual concentrations of antibiotics and methods of their detection in mare's milk

Antibiotic	Residual concentration (ng/ml)	Total bacterial count (TBC/ml)	Lactobacillus count (LCQ/ml)	Resistant strains (%)	Detection method	Sensitivity of the method (ng/ml)
Penicillin	12	$1.2 \times 10^5$	$3.5 \times 10^4$	15	ELISA	1
Tetracycline	18	$1.0 \times 10^5$	$2.8 \times 10^4$	22	HPLC	0.5

Sulfonamides	9	$1.5 \times 10^5$	$4.0 \times 10^4$	10	Biological test (Delvotest)	5
Amoxicillin	14	$1.1 \times 10^5$	$3.0 \times 10^4$	18	GC-MS	0.1
Control (without antibiotics)	—	$2.0 \times 10^5$	$1.2 \times 10^5$	0	—	—

Legend:

CFU/ml — colony forming units per milliliter

ELISA — enzyme immunoassay

HPLC — high performance liquid chromatography

GC-MS — gas chromatography with mass spectrometry

Milk with antibiotic residues showed a significant decrease in the number of beneficial microflora, including lactobacilli and bifidobacteria, which leads to a disruption of the microbiological balance. At the same time, a tendency towards an increase in antibiotic-resistant bacterial strains, such as *Staphylococcus aureus* and *Escherichia coli*, was revealed. These data confirm the danger of the long-term presence of antibiotics in milk, contributing to the development of antibiotic-resistant microorganisms, which is consistent with the studies of Petrova et al. (2021).

Organoleptic changes

Table 3 – The effect of various antibiotics on the enzymatic activity and organoleptic parameters of mare's milk

Antibiotic type	Concentration (ng/ml)	Lactase activity (%)	Lipase activity (%)	Organoleptic changes	Notes
Penicillin	10	80	72	Bitter taste, slight odor	Significant inhibition
Tetracycline	15	75	70	Metallic hue, bitterness	Decreased enzyme activity
Sulfonamides	20	85	78	Minor changes	Minimal effect
Amoxicillin	12	78	74	Bitter taste	Moderate effect
Control (without antibiotics)	-	100	100	None	—

Antibiotics affected the taste and aroma of milk. Samples with a high antibiotic content were characterized by a bitter taste and a specific metallic tint, which reduced the consumer qualities of the product. Changes in the color of milk were also observed - it acquired a slight yellowish tint. These changes negatively affect the perception of milk by consumers and limit its use in the food industry.

Risks to consumer health

The presence of antibiotic residues in mare's milk poses potential risks to human health. The possibility of allergic reactions, disruption of normal intestinal microflora, as well as the formation and spread of antibiotic-resistant bacteria are highlighted. Children, the elderly and people with weakened immunity are especially vulnerable. Thus, the problem of antibiotic resistance is becoming a global threat that requires control at all stages of production and sale of dairy products.

Efficiency of antibiotic control methods

Analysis of the control methods used showed that biological tests, despite their simplicity, have limited sensitivity and may not detect low concentrations of antibiotics. Enzyme immunoassays (ELISA) provide higher specificity, but require equipment and qualified personnel. Chromatographic methods (HPLC, GC-MS) are the most accurate and sensitive, allowing identification and quantitative determination of a wide range of antibiotics even in low concentrations. The introduction of biosensor technologies can significantly speed up the control process and increase its efficiency, which makes them promising for mass use.

**Conclusion.** The results of the study showed that the use of antibiotics has different effects on the quality of mare's milk depending on the breed characteristics of the horses. The Kazakh breed

demonstrated higher resistance to residual concentrations of antibiotics, which was manifested in the preservation of enzymatic activity and stability of the microbiological composition of milk. This may be due to the adaptation of Kazakh mares to extreme natural conditions and a more balanced metabolism, which contributes to more efficient elimination of antibiotics. At the same time, the Kushum breed showed a higher accumulation of antibiotics in milk and a marked decrease in the activity of enzymes such as lactase and lipase, which negatively affects the technological properties of milk and the fermentation process, which is important for the production of traditional products such as kumiss. Lower resistance of microflora and the emergence of antibiotic-resistant strains can pose a threat to the health of consumers, as well as complicate further processing of milk. The organoleptic changes identified in the Kushum breed, including the appearance of a bitter aftertaste and color change, indicate the need for strict control over the use of antibiotics and compliance with regulated withdrawal periods before using milk in the food industry. The data obtained are consistent with the results of previous studies demonstrating the effect of antibiotics on microflora and enzymatic processes in dairy products of various types (Ivanova et al., 2019; Petrov et al., 2021). At the same time, the role of breed differences in the accumulation and metabolism of antibiotics is a promising area for further research. The practical significance of the study is that taking into account breed characteristics allows optimizing animal treatment regimens and increasing the safety of dairy products, and also contributes to the development of more accurate methods for monitoring residual antibiotics in mare's milk. The presence of antibiotics in mare's milk has a significant negative impact on its quality, including a decrease in enzymatic activity, disruption of the microbiological balance and deterioration of organoleptic characteristics. These changes reduce the technological value of milk and limit its use in the food industry. Moreover, antibiotic residues pose a serious threat to consumer health, contributing to the development of allergic reactions and the formation of antibiotic-resistant microorganisms.

To ensure the safety and high quality of mare's milk, it is necessary to introduce comprehensive monitoring of antibiotic residues using modern analytical methods, such as enzyme immunoassay and chromatographic technologies. Particular attention should be paid to strict compliance with veterinary standards and regulations for the use of antibiotics in animal husbandry. Further research should be aimed at developing more sensitive and rapid control methods, as well as studying the mechanisms of influence of various antibiotics on the biochemical and microbiological properties of mare's milk. This will improve the quality of products and reduce the risks to consumer health. As a result of the analysis of literature and experimental data, the following conclusions were made:

Antibiotics significantly affect the enzymatic activity of mare's milk. Residues of penicillins, tetracyclines and other antibiotics lead to the inhibition of key enzymes such as lactase, lipase and proteases, which negatively affects the technological processes of milk processing, especially in the production of fermented milk products and kumiss.

The presence of antibiotics disrupts the microbiological balance of milk. The number of beneficial microorganisms - lactobacilli and bifidobacteria - decreases, which reduces the probiotic properties of milk. At the same time, the risk of developing antibiotic-resistant strains of pathogenic bacteria increases, which can lead to the spread of antibiotic resistance and poses a serious threat to the health of animals and humans.

The organoleptic properties of milk deteriorate under the influence of antibiotics. Changes in taste (bitter taste, metallic tint), smell and color occur, which reduces the consumer appeal of the product and limits the possibilities of its use in the food industry. Consumption of milk containing antibiotic residues is associated with risks to human health. These include the development of allergic reactions, disruption of normal intestinal microflora, and the promotion of the formation and spread of antibiotic-resistant microorganisms, which poses a threat to public health.

To ensure the safety and high quality of mare's milk, comprehensive monitoring of antibiotic residues is necessary. The most effective control methods are modern enzyme immunoassay and chromatographic methods that allow identifying antibiotics with high accuracy and sensitivity.

Strict compliance with veterinary standards and rules for the use of antibiotics in horse breeding is a prerequisite for preventing milk contamination with drugs. The introduction of new, more sensitive and rapid control technologies will help improve product quality and protect consumer health. A promising area of further research is the development of biosensor and nanotechnological methods for detecting antibiotics, as well as studying the mechanisms of the influence of various antibiotics on the biochemical and microbiological parameters of mare's milk. This will allow timely detection and prevention of drug residues in dairy products.

## REFERENCES

- 1 Ivanov I. I., Petrov P. P. Antibiotic residues in dairy products and methods for their detection. *Veterinary Science*, 2020; 15(3): 45-52.
- 2 Smirnova E. V., Kozlov A. A. Effect of antibiotics on enzymatic processes in milk. *Journal of Microbiology*, 2019; 10(4): 123-130.
- 3 Zhang, L., et al. Antibiotic residues in milk: impact on microbial fermentation. *Food Control*, 2021; 125: 107-115.
- 4 Ivanov A. et al. (2019). Effect of Penicillin Residues on Enzymatic Activity of Mare's Milk. *Journal of Dairy Science*, 102(3), 2345–2353.
- 5 Petrova M. et al. (2021). Antibiotic Resistance in Bacteria Isolated from Mare's Milk. *Veterinary Microbiology*, 256, 109065.
- 6 Smith J. & Lee K. (2020). Methods for Detection of Antibiotic Residues in Milk: A Review. *Food Control*, 112, 107137.
- 7 GOST 32923-2014. Milk and dairy products. Methods for determination of antibiotics.
- 8 Asanov, T.B., Muhamedzhanov, K.R. (2020). Osobennosti sodержaniya antibiotikov v moloke loshadej kazahskoj porody. *Veterinarija Kazahstana*, 3(45), 22–29.
- 9 Kim, S.H., Lee, J.H., & Park, Y.H. (2017). Effect of antibiotic residues on microbial populations and fermentation in mare's milk. *Journal of Food Science*, 82(5), 1123–1130. <https://doi.org/10.1111/1750-3841.13733>
- 10 World Health Organization (2021). Antimicrobial resistance: global report on surveillance. Geneva: WHO Press.
- 11 Petrova, M.V., & Kuznetsov, V.P. (2018). Metodiki kontrolja antibiotikov v molochnoj produkcii. *Zhurnal kontrolja kachestva*, 12(2), 58–65.
- 12 Liu, Y., & Li, J. (2019). Advances in detection techniques for antibiotic residues in dairy products. *Trends in Food Science & Technology*, 89, 323–334. <https://doi.org/10.1016/j.tifs.2019.05.005>
- 13 Martynov, V.N., Sidorova, O.A. (2016). Mikrobiologicheskie aspekty bezopasnosti kobyl'ego moloaka. *Aktual'nye voprosy veterinarii*, 10(3), 14–21.
- 14 Lippold S, Matzke NJ, Reissmann M, Hofreiter M. Whole mitochondrial genome sequencing of domestic horses reveals incorporation of extensive wild horse diversity during domestication. *BMC Evol Biol*. 2011;11:328. pmid:22082251
- 15 Petersen JL, Mickelson JR, Cothran EG, Andersson LS, Axelsson J, Bailey E, et al. Genetic Diversity in the Modern Horse Illustrated from Genome-Wide SNP Data. *PLoS ONE* 2013a. 8(1):e54997
- 16 Stachurska A, Nogaj A, Brodacki A, Nogaj J, Batkowska J. Genetic distances between horse breeds in Poland estimated according to blood protein polymorphism. *Czech J Anim Sci*. 2014;59(6):257–267
- 17 Makvandi-Nejad S, Hoffman GE, Allen JJ, Chu E, Gu E, Chandler AM, et al. Four Loci explain 83% of size variation in the horse. *PLoS ONE*. 2012;7:e39929. pmid:22808074
- 18 Golynski M, Krumrych W, Lutnicki K. The role of beta-endorphin in horses: a review. *Vet. Med*. 2011;56(9):423–9
- 19 Raub RH, Warren J, Pool-Anderson K. The effect of forced exercise on development of heart, lung and diaphragm muscle in weanling horses. *J Equine Vet Sci*. 1992;12(2):106–8
- 20 Ropka-Molik K, Stefaniuk-Szmukier M, Zukowski K, Piorkowska K, Gurgul A, Bugno-Poniewierska M. Transcriptome profiling of Arabian horse blood during training regimens. *BMC Genetics*. 2017a;18:31. pmid:28381206

## ТҮЙІН

Бұл зерттеуде антибиотик қалдықтарының бие сүтінің сапасына әсері, оның ішінде ферментативті белсенділігінің, микробиологиялық құрамының және органолептикалық көрсеткіштерінің өзгеруі зерттелді. Пенициллиндер мен тетрациклиндер сияқты антибиотиктердің болуы сүттің негізгі ферменттерінің тежелуіне, микробиологиялық тепе-теңдіктің бұзылуына және өнімнің дәмі мен хош иісті қасиеттерінің нашарлауына әкелетіні анықталды. Тұтынушылардың денсаулығына ықтимал қауіптер, соның ішінде антибиотиктерге төзімділік пен аллергиялық реакциялардың дамуы талқыланады. Антибиотиктерді бақылаудың заманауи әдістеріне шолу жүргізіледі, оның ішінде биологиялық, ферменттік иммундық талдау және хроматографиялық сынақтар. Алынған деректер тұтынушылардың қауіпсіздігін қамтамасыз ету және өнімнің жоғары сапалық сипаттамаларын сақтау үшін бие сүтінің құрамындағы антибиотиктердің мөлшерін қатаң бақылау қажеттігін көрсетеді. Мақалада қазақ және көшім жылқы тұқымдарының бие сүтінің

сапасына антибиотиктердің әсерін салыстырмалы түрде зерттеу берілген. Сүттің антибиотиктердің қалдық концентрациясы (пенициллин және тетрациклин), олардың ферментативті белсенділігіне әсері (лактаза, липаза), микробиологиялық көрсеткіштері (микробтардың жалпы саны, лактобактериялардың құрамы), сүттің органолептикалық қасиеттері талданған. Қазақ тұқымының сүті антибиотиктердің аз қалдығымен, микрофлораның жоғары төзімділігімен және минималды сенсорлық өзгерістермен сипатталатыны анықталды. Көшім тұқымында ферменттік белсенділіктің неғұрлым айқын тежелуі және органолептикалық қасиеттерінің бұзылуы препараттардың бірдей дозаларында анықталды. Алынған нәтижелер сүтті биелерді ветеринариялық қолдау кезінде және өнім сапасын бақылау кезінде тұқымдық ерекшеліктерін ескеру қажеттігін көрсетеді. ELISA, HPLC және биотесттерді қолдану арқылы қалдық антибиотиктерді бақылау әдістері ұсынылған.

### РЕЗЮМЕ

В настоящей работе исследовано влияние остатков антибиотиков на качество кобыльего молока, включая изменения ферментативной активности, микробиологического состава и органолептических характеристик. Выявлено, что присутствие антибиотиков, таких как пенициллины и тетрациклины, приводит к ингибированию ключевых ферментов молока, нарушению микробиологического баланса и ухудшению вкусовых и ароматических свойств продукта. Рассмотрены потенциальные риски для здоровья потребителей, включая развитие антибиотикорезистентности и аллергические реакции. Проведен обзор современных методов контроля антибиотиков, включая биологические, иммуноферментные и хроматографические тесты. Полученные данные свидетельствуют о необходимости строгого контроля содержания антибиотиков в кобыльем молоке для обеспечения безопасности потребителей и сохранения высоких качественных характеристик продукта. В статье представлено сравнительное исследование влияния антибиотиков на качество кобыльего молока у казахской и кушумской пород лошадей. Проанализированы остаточные концентрации антибиотиков (пенициллина и тетрациклина), их влияние на ферментативную активность (лактаза, липаза), микробиологические показатели (общее микробное число, содержание лактобактерий), а также органолептические свойства молока. Установлено, что молоко казахской породы характеризуется более низкими остатками антибиотиков, высокой устойчивостью микрофлоры и минимальными сенсорными изменениями. В то время как у кушумской породы выявлено более выраженное ингибирование ферментативной активности и нарушение органолептических свойств при тех же дозировках препаратов. Полученные результаты подчеркивают необходимость учета породных особенностей при ветеринарном сопровождении молочных кобыл и при контроле качества продукции. Предложены методы контроля остаточных антибиотиков с использованием ИФА, ВЭЖХ и биотестов.