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INFLUENCE OF GENETIC FACTORS ON THE SPERM PRODUCTION OF BULLS PRODUCING MEAT BREEDS IN THE CONDITIONS OF THE NORTHERN REGION OF KAZAKHSTAN

ANNOTATION

The article presents the results of studies of the influence of genetic factors on the fertilizing ability and quality indicators of sperm production for beef sires of different breeds.

The main purpose of the work: to determine the influence of the breed and the country of origin on the quantitative and qualitative indicators of sperm production of beef sires with different genotypes and the relationship of the studied breeding traits.

Research work was carried out in the Akmola region. The object of the study are sires of the Kazakh whiteheaded, Aberdeen-Angus and Hereford breeds. The practical part of the work was carried out on the basis of AI Center named "Asyl-Tulik" JSC on a healthy livestock in compliance with all veterinary and sanitary requirements. To study the fertilizing ability of bull sperm, the indicators of 18 bulls were obtained: for the Kazakh white-headed breed - 6 bulls, Aberdeen Angus - 6 bulls, Hereford - 6 bulls. 5610 cows and heifers were inseminated: according to the Kazakh white-headed breed - 2190, Aberdeen Angus - 2160, Hereford - 1260.

According to the results of the study, it was found that the fertilizing ability of sires of the Kazakh white-headed breed ranges from 47-60%; Aberdeen - Angus - within 30-59%; Hereford breed - in the range of 45-60% and 38% of genetic factors affect the sperm production of sires. Of these, 22.0% by genotype, 14.0% by breed and 1.5% by country of origin.

Key words: *beef sires, sperm productivity, quantitative and qualitative indicators, fertility, genetic factors, genotype.*

Introduction. To date, the country has expanded the use of highly productive animal breeds, improving the system of feeding and keeping animals, beef production technology and forms of organization, where the meat balance occupies a leading place[1].

However, due to the successful development of the industry and the increase in its profitability in a given region, it depends on the timely implementation of measures for the reproduction of the herd, as well as correctly analyzed scientifically based breeds and genotypes of animals [2].

Manufactured products can be achieved not only by improving the existing gene pool and increasing the number of livestock, but also by increasing the productivity of livestock [2].

An important place in the field of breeding work is occupied by the issues of effective evaluation and selection of farm animals for productive and pedigree qualities. Sires are of great importance in improving the pedigree and productive qualities of animals [1,3].

To date, in this regard, in all developed countries, one of the main requirements for breeding work is the high quality of sperm from bulls - producers. Sperm quality is influenced by many factors and conditions. One of the main factors is the breed of bulls [4,16].

The reproductive function of bulls is always determined by their genotype. While there is speculation about this efficacy, there is little research on genetic potential.

Therefore, the reproductive ability of sires often depends on the interaction of the genotype with the environment. Changes in the volume of ejaculate during the year occur as a result of the reaction of the animal organism to changes in seasonal environmental environmental factors.

Among the genetic factors that affect the quality of sperm, the following can be distinguished: sire genotype, breed, paternity trace, origin, etc.

It is known that in the livestock industry the level of intensification consists of many factors. However, the main role in this process is played by the genetic potential, and if it is not high enough, other factors will not have an influence [4,5,6,7,20].

According to the studies of many scientists who refer that the individual feature of breeding sires is transmitted to their offspring by 30% by genetic factors, and by 70% by paratypic factors. Nevertheless, today the study of ways and means of predicting the influence of genetic factors on the meat productivity of the offspring of beef sires is becoming an urgent problem. That is, in breeding work with beef cattle, it can be carried out using forecasting of the index assessment of livestock productivity to improve breeding qualities and increase the production of high-quality beef [8,9,10].

Genetic factors are characterized by belonging to a particular breed, sire, pedigree, mother, herd of cattle.

Studies by many scientists show that genetic factors largely depend on the sire, even more so the connection of the breed.

In this context, some authors state that the fertility of sperm obtained from beef bulls is determined by genetic factors, i.e., it is 14.24% of the genotype of the sire bull, 11.21% of its breed and 1.6% of its origin. Bulls-producers of domestic and foreign breeds are somewhat different – 64.29% and 60.26%, respectively [10,11,19].

According to some scientists, the sexual activity of bulls to a certain extent depends on their genotype, which is determined by a number of random reasons, the main of which are the activity of bulls. The volume of sperm, its mobility and concentration are largely determined by the genotype. According to scientists, the share of genetic variability reaches 60% [12,13,15].

In most studies, the heritability coefficient for sperm activity is 0.052; by ejaculate volume – 0.970; by sperm concentration – 0.200; by the amount of sperm in the ejaculate – 0.672; 0.176.

Differences in the genetic structure of cattle are evidently depending on their origin. Therefore, it is necessary to know the influence of this factor on the reproductive ability of animals.

In this regard, the creation of market relations in agricultural production on the basis of modern conditions for the development of animal husbandry and on the basis of artificial insemination of animals, the identification and effective use of sires of the highest class, taking into account their genetic influence and the relationship of breeding traits depending on the genotype, breed, origin of animal sperm producers is a pressing issue today.

The purpose of the research work: to determine the influence of the breed and country of origin on the quantitative and qualitative indicators of sperm production of beef sires with different genotypes and the relationship of the studied breeding traits.

Materials and methods. Research work was carried out in the Akmola region. The object of the study is bulls-producers belonging to the Kazakh white-headed, Aberdeen-Angus and Hereford breeds. The work on the practical part was carried out on the basis of JSC Asyl-TulikRepublican Center for Breeding in Livestock on healthy livestock in compliance with all veterinary and sanitary

requirements. Productive qualities of livestock were determined under the same conditions of feeding and keeping.

The following were taken as research materials: own experiments - laboratory studies to assess the quality of sperm of sires, documentation on production and on breed affiliation.

The analysis included data on the production and use of semen from 9 sires by country of origin and 3 breeds - Kazakh Whitehead, Aberdeen Angus and Hereford.

For research, we conducted immunogenetic testing of the semen of clinically healthy animals, in accordance with the instructions for use of bulls manufacturers.

Feeding and caring for the animals were the same for everyone, with no differences in the seasons of the year. The norms and diets of animals are compiled in accordance with the recommendations of JSC "Asyl tulik", taking into account age, live weight and modes of application.

The determination of the genetic influence on the productivity of sires with different genotypes is carried out according to the seasons of the year: in winter (December, January, February), spring (March, April, May), summer (June, July, August), autumn (September, October, November).

Sperm was obtained in the center for obtaining sperm from sires under standard conditions in compliance with all zootechnical and veterinary requirements. The mode of application is medium (twice a week, with a double cage of animals).

The resulting sperm was examined according to physiological parameters based on generally accepted methods:

- color, smell, texture - organoleptic analysis;
- semen volume - through a metered test tube;
- activity of spermatozoa on a 10-point scale, at a temperature of 35-38°C, through a microscope, magnified 180-200 times;
- the concentration of sperm in 1 ml was determined by the photoelectrocolorimetric method (F. I. Ostappso, G. S. Gaivoronsky), using the FEK-M photometer.
- resistance-resistance of sperm to 1% NaCl solution we determined by the Korotkov method;
- the intensity of the rest of the sperm - was determined on a 1% solution of methylene blue at a discoloration rate of 0.1;
- the concentration of hydrogen ions (pH) - by the electrometric method on the device electropotentiometer pH-340, determined by the electrometric method.

All semen was frozen in liquid nitrogen for long-term storage in a sperm bank.

We frozen the resulting sperm in straws, diluting it with a synthetic diluent (in terms of the number of spermatozoa at least 15 million per dose). The control of sperm resistance to deep freezing was carried out before dosage packaging after a month of storage.

One-way analysis of variance was defined by the following equation:

$$h_x^2 = C_x / C_{\Sigma} \quad ;$$

Where C_x – factors taken into account;

C_{Σ} - sum of all factors.

The coefficient of phenotypic correlation of the reproductive ability of productive bulls was determined by the equation:

$$r = C_x + C_y + C_d / 2 \sqrt{C_x \times C_y} \quad ;$$

where C_x - factors to consider

C_y - second selection characteristic taken into account

C_d - third selection characteristic taken into account

We determined the level of bull semen insemination in accordance with the approved method of statistical processing of bulls in regional farms on herds of beef cattle.

We have identified the influence of genetic factors on sperm production by factor analysis of variance.

The main quantitative materials obtained in the course of the study are processed by variational statistics by the method of N.A. Plokhinsky and by Student using the SPSS for Windows application program.

Research results. One important indicator of the reproductive function of bulls is the fertilizing ability of sperm [12]. Currently, there are no methods for assessing the fertility of bulls by sperm quality, so they are determined by the results of the first insemination. However, high quality sperm allows not only to increase the number of inseminated queens, but also to increase their efficiency. It has been scientifically proven that up to 15-18% of non-viable or very weak calves are born in bulls with reduced sperm fertility (less than 70%) [12,15].

The fertilizing ability of the sperm of stud bulls is an important indicator that determines the reproductive ability of stud bulls. The basis for comparing bulls in terms of fertility is the insemination of more females by each bull in the required measure, with more cows inseminated, the average fertility indicator shows the actual value.

This indicator directly depends on the conditions of feeding, the maintenance of queens and the genetic compatibility of fathers and breeding stock, the qualifications of a specialist engaged in artificial insemination of animals. The fertilizing ability of the sperm of the bulls of producers is assessed by repeated insemination. If during repeated insemination the number of cows exceeds 50%, then bulls are excluded from use [13,18].

Analysis of compliant indicators of productive ability: the quantity and quality of sperm, its fertilizing ability, safety, decrease, cases of stillbirth of young animals, the number of artificial abortions can give a reliable and complete assessment of the reproductive ability of sires [14,16].

The fertilizing ability of sperm directly depends on the age of puberty, feeding, the absence of infectious diseases, the hormonal background of the sire from which the sperm is obtained. If we take farms and farms, then in this case it is necessary to take into account the economic conditions, the level of zootechnical and veterinary work. Bulls-producers that have the same category in terms of sperm quality and are allowed for breeding use must necessarily be divided according to the fertilizing ability of sperm [15,17].

To study the fertilizing ability of bull sperm, indicators of 18 bulls were obtained: for the Kazakh white-headed breed - 6 bulls, Aberdeen Angus – 6 bulls, Hereford – 6 bulls. 5610 cows and heifers were inseminated: according to the Kazakh white-headed breed – 2190, Aberdeen Angus – 2160, Hereford - 1260. The genotype of breeding bulls also affects the quality of sperm and the number of ejaculates.

To this end, Asyl Tulik JSC managed to identify differences in breeds in terms of sperm production at all stages of the use of sires. (tab.1).

Table 1 – Indicators of sperm production of sires of various genotypes

Indicators	Breed		
	Kazakh white-headed	Aberdeen-Angus	Hereford
	The country of origin		
	Kazakhstan	Canada	Germany
Number of sires	11	7	10
Amount of ejaculate, pcs	430,1±52,7	223,4±30,3	369,1±51,5
Ejaculate volume, ml	3,38±0,15	4,01±0,25	3,86±0,26
Sperm concentration, billion/ml	0,78±0,03	0,70±0,04	0,78±0,05
Average amount of sperm to use, doses	24 497	12 200	32 348
Percentage of marriage, %	49	60	42

According to the results of the study, it was found that the average volume of ejaculate in bulls of the Aberdeen Angus breed of Canadian origin is 3.97 ml, which is 0.08 ml (2%) more than in bulls of the Hereford breed and 0.61 ml (16%) more than the Kazakh white-headed breed.

The amount of frozen semen depends on the concentration and amount of ejaculate, and this indicator corresponds to a given value for the concentration of sperm in the ejaculate.

According to the table, the sperm production of sires of the Kazakh white-headed breed was in high demand, which is explained, first of all, by the priority of the livestock of this breed in the Republic of Kazakhstan.

The highest percentage at the 1st insemination among beef breeds falls on the Kazakh white-headed breed. In addition, it was found that the individual abilities of bulls have a significant impact on the fertilizing ability.

According to the table, the fertility of bulls of Kazakh white-headed breed ranged from 47 to 60%; in Aberdeen-Angus - from 30 to 59%; in the Hereford breed - from 45 to 60%.

Genetic factors influencing the formation of products obtained from animal breeds can be predicted in advance by a one-sided dispersion method.

Among the genetic factors that affect the quality of sperm, the following can be distinguished: sire genotype, breed, paternal trace, origin, etc.

The method of dispersion analysis can determine the influence on the formation of the considered products (feature), factors.

In this regard, the results of a one-way analysis of variance were identified to assess the degree of influence of the breed and origin of sires with different genotypes on sperm quality; ejaculate volume, amount of ejaculate and sperm concentration, unsuitability of sperm (Table 2).

Table 2 – Results of the analysis of variance between the degree of reliability of the influence of breed and origin on the index of sperm production

Factors	Indicators	Fisher Criterion		Accuracy
		Per table	fact	
Breed	ejaculatevolume	1	162,032	<0,001
	Amountofejaculate	1	142,356	<0,001
	semenconcentration	1	52,789	<0,001
Country oforigin	ejaculatevolume	3,32	483,106	<0,001
	Amountofejaculate	3,32	378,455	<0,001
	semenconcentration	3,32	122,130	<0,001

The table shows that there are significant differences between the breed and countries of origin of sires with different genotypes in terms of sperm productivity ($p < 0.001$).

The results of the fertility of beef bulls are presented in Table 3.

Table 3 – Fertilizing ability of bulls producing meat breeds

Factor	Genotype	Ejaculate volume. ml	Concentration, billion/ml	Dams inseminated	fertilizedfrom 1 insemination	
					n	%
Breed	Kazakh White-headed	3,28±0,14	0,77±0,03	219	137	62,5
	Aberdeen-Angus	4,04±0,34	0,97±0,23	3172	1403	44,2
	Hereford	4,06±0,28	0,79±0,05	841	463	55,1
Country of Origin	Kazakhstan	4,06±0,28	0,79±0,05	841	463	55,1
	Canada	3,96±0,45	0,76±0,02	837	423	50,5
	Germany	3,46±0,07	0,85±0,02	282	149	52,8

The low rate of fertility for Aberdeen-Angus bulls is based on its breed characteristics and adaptive properties. If we summarize these data, then for breeds in the Republic of Kazakhstan it reaches – 75–80%, for other breeds – 85–90%.

In terms of breeds, the highest rate among meat breeds belongs to the Kazakh whiteheaded breed. In addition, it was found that the individual qualities of bulls have a significant impact on fertility.

According to the list of sires presented in the table, the bulls with names Champion, Voron, Barnaul were distinguished from the Kazakh whiteheaded breed, the indicators of the volume and concentration of ejaculate were 3.67 ml and 0.80 ml/ml; 3.09 and 0.73; 3.30 and 1.01% make up 60%. Of the Aberdeen Angus bulls, the best insemination rate belongs to the Oris bulls – 59%, and the Yong Dale Zeptor 115z – 56%.

Among the Hereford bulls, the Vasco bull is in the lead. With the 1st insemination of 300 heads of cows with the sperm of the Vasco bull, the insemination rate reached 60%. This bull showed excellent results in all parameters of sperm production at all stages of its use on the farm, which, in turn, is an important factor affecting fertility.

Based on the study, bulls that have received the best and stable sperm production at all stages of use on the farm are characterized by high fertility.

It can be seen that between the beef bulls, the breed differences in fertilizing ability are not so noticeable. Based on the above data, it can be seen that the fertility of sperm is influenced by the individual characteristics of the bulls and the conditions of the farms that raise females.

Based on the data obtained, it can be seen that heredity directly depends on the fertilizing ability of sperm. Thus, bulls of the Kazakh white-headed breed are superior to the Aberdeen-Angus breed by 7.5% in the percentage of insemination at the 1st insemination.

There are no significant significant interbreed differences between the Hereford and Kazakh white-headed breeds and between the Hereford and Aberdeen-Angus breeds.

The harmonious development of many traits of livestock breeds goes through the variability of the conditions of environmental factors. And the development of traits in the body of animals taken into account in production depends on each other and is characterized by a correlation coefficient.

The sperm production of sires can be influenced by various factors: paratypic and genetic. Including the influence of genetic factors depends on the genotype, breed and country of origin. That is, when determining the reliability of the influence of the studied indicators of various factors on phenotypic variability, it is necessary to assess the strength of the influence of genetic factors. The classic method for determining the strength of a genetic effect is the intraclass correlation coefficient. In this regard, we determined the strength of the influence of the genotype, breed and country of origin on the quantitative and qualitative indicators of the sperm production of bulls of various genotypes obtained in the study using the correlation coefficient of the class (Table 4).

Table 4 – The strength of the influence of the genotype, breed and country of origin on the quantitative and qualitative indicators of the semen of bulls

Spermproductionindicators	Genetic Factors		
	Sire Genotype	Breed	Country of Origin
spermactivity	0,218	0,103	0,011
ejaculatevolume	0,267	0,124	0,020
semenconcentration	0,233	0,217	0,010
Amountofejaculate	0,245	0,143	0,021
Fertility	0,132	0,102	0,015
Averageofall	0,22	0,14	0,02

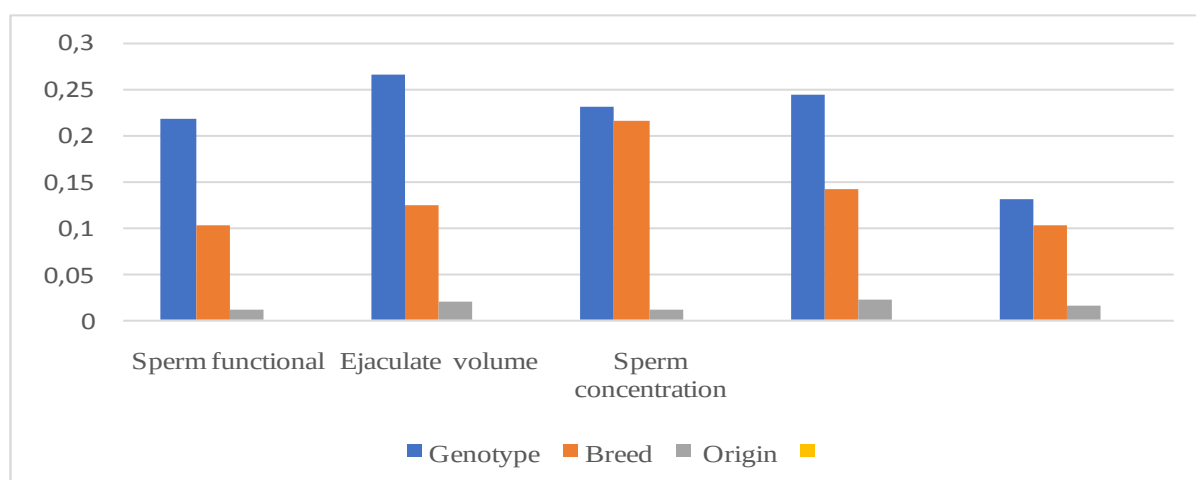


Figure 1 – The power of influence on the quantitative and qualitative indicators of the sperm of sires of the genotype, breed and country of origin

As a result of studies (Table 4), it was found that sperm activity is genetically transmitted 33.20%, which indicates the effect of 21.80% on the genotype, 10.30% on the breed and 1.1% on the country of origin, ejaculate volume, quantity ejaculate in it and the concentration of sperm, respectively, 41.1%, 40.9% and 46.0% for hereditary factors. Such an important indicator; the effectiveness of the use of bulls as a fertilizing ability is determined depending on genetic factors 24.90%: 13.20% of the genotype, 10.2% of its breed and 1.5% of the origin.

In this regard, the results of the study showed that 38% of genetic factors affect the sperm production of bulls. Of these, 22.0% by genotype, 14.0% by breed and 1.5% by country of origin. To determine the influence of genetic factors, such as the genotype, breed and country of origin of the bull, on the reproductive ability, we carried out a one-sided analysis of variance (Table 5).

A one-sided analysis of dispersion showed fairly significant differences between the breed and the origin, fertilizing ability of the sperm of sires of different genotypes.

Table 5 – The results of a univariate analysis of the variability of the influence of the genotype, breed and origin of the sire bull on the fertilizing ability

Factors	Fisher Criterion		Accuracy
	As per table	In fact	
Breed	2,32	4,032	<0,001
Country of origin	2,37	2,756	<0,05
Sire	1,00	1,730	<0,001

According to the Fisher criterion given in the table, it can be seen that the degree of authenticity of the breed and the sire prevails over the country of origin ($P_{0,001}$). That is, we can say that the influence of the genotype and breed of sires on the fertilizing ability is higher.

Conclusion. The results of the study showed that the fertility of bulls in the Kazakh white-headed breed was 47–60%; in Aberdeen - Angus – 30–59%; in the Hereford breed, 45–60%.

It was found that the activity of sperm is transmitted genetically 33.20%, of which 21.80% depends on the genotype, 10.30% on the breed and 1.1% on the country of origin, the volume of ejaculate, the amount of ejaculate in it and the concentration of sperm, respectively 41.1%, 40.9% and 46.0% depended on hereditary factors. An important indicator is the fertilizing ability as the efficiency of using bulls 24.90%, determined depending on genetic factors: 13.20% of the genotype, 10.2% of its breed and 1.5% of origin.

In this regard, the results of the study showed that 38% of genetic factors affect the sperm production of bulls. Of these, 22.0% by genotype, 14.0% by breed and 1.5% by country of origin. At

the same time, it can be said that the influence of the genotype and breed of bulls on reproductive ability is higher.

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РЕЗЮМЕ

В статье представлены результаты исследований влияния генетических факторов на оплодотворяющую способность и показатели качества спермопродукции быков-производителей мясных пород.

Основная цель работы: определение влияния породы и страны происхождения на количественные и качественные показатели спермапродукции быков-производителей мясных пород с различным генотипом и взаимосвязь исследуемых селекционных признаков.

Научно-исследовательские работы проводились в Акмолинской области. Объектом исследования являются быки-производители казахской белоголовой, абердин-ангусской и герефордской породы. Практическая часть работы осуществлялась на базе АО "Асыл түлік" на здоровом поголовье с соблюдением всех ветеринарно-санитарных требований. Для исследования оплодотворяющей способности спермы быков получены показатели 18 быков: по казахской белоголовой породе-6 быков, абердин-ангус-6 быков, герефорд - 6 быков. Осеменено 5610 коров и телок: по казахской белоголовой породе-2190, абердин-ангус-2160, герефорд - 1260.

По результатам исследования установлено, что оплодотворяющая способность быков казахской белоголовой породы колеблется в пределах 47-60%; абердин - ангусов – в пределах 30-59%; герефордской породы - в пределах 45-60% и на показатели спермопродукции быков-производителей влияет 38% генетических факторов. Из них 22,0% по генотипу, 14,0% по породе и 1,5% по стране происхождения.

ТҮЙІН

Бұл мақалада етті бағыттағы тұқымдық бұқалардың ұрықтандыру қабілетіне және ұрық өнімінің сапалық көрсеткіштеріне генетикалық факторлардың әсерін зерттеу нәтижелері көрсетілген.

Жұмыстың негізгі мақсаты – әртүрлі генотипті етті бағыттағы тұқымдық өндіруші бұқалардың шәует өнімділігінің сандық және сапалық көрсеткіштеріне мал тұқымы мен шыққан елінің әсерін және зерттелетін селекциялық белгілердің байланысын анықтау.

Ғылыми-зерттеу жұмыстары Ақмола облысында жүргізілді. Зерттеу нысаны ретінде қазақтың ақбасы, абердин-ангус және герефорд тұқымдарының асыл тұқымды бұқалары алынды. Жұмыстың тәжірибелік бөлігі «Асыл Түлік» АҚ базасында барлық ветеринариялық-санитариялық талаптарды сақтай отырып, сау мал басы бойынша жүргізілді. Бұқа шәуетінің ұрықтандыру қабілетін зерттеу үшін 18 бас бұқаның көрсеткіштері алынды: қазақтың ақбас тұқымы үшін – 6 бұқа, абердин ангус – 6 бұқа, герефорд – 6 бұқа. 5610 сиыр мен құнажын ұрықтандырылды: қазақтың ақбас тұқымы бойынша – 2190, абердин-ангус – 2160, герефорд – 1260.

Зерттеу нәтижелері бойынша қазақтың ақбас тұқымының бұқаларының ұрықтандыру қабілеті 47–60% аралығында; Абердин-ангус бұқаларында – 30–59% арасында; Герефорд тұқымында – 45–60% және 38% диапазоны аралығында аталықтардың сперматозоидтарының түзілуіне генетикалық факторлар әсер еткен. Оның 22,0%-ы генотипі бойынша, 14,0%-ы тұқымдылығы бойынша және 1,5%-ы шыққан елінетіесілі болды.

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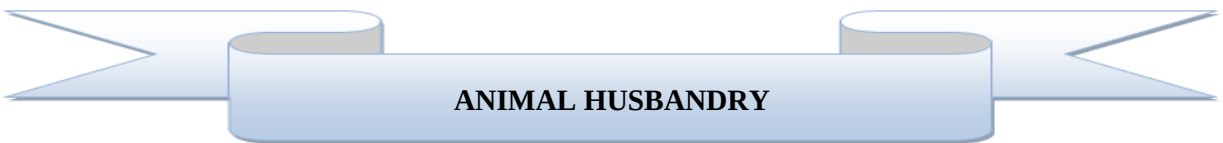
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CONTENT



ANIMAL HUSBANDRY

Makhanbetova A.B., Kazhgaliev N.Zh., Shamshidin A.S., Ateykhan B., Zhamurova V. S. INFLUENCE OF GENETIC FACTORS ON THE SPERM PRODUCTION OF BULLS PRODUCING MEAT BREEDS IN THE CONDITIONS OF THE NORTHERN REGION OF KAZAKHSTAN.....	3
Ateikhan B., Abeldinov R.B., Burambayeva N.B., Temirzhanova A.A., Makhanbetova A. B. THE QUALITY OF BIOLOGICAL MATERIAL IN EMBRYO TRANSPLANTATION.....	12
Bednyagin D., Davletova A.M., Iskakov K.A., Kulataev B.T., Doshanov D. A. FEATURES OF GENETIC POTENTIAL AND DEFINITION QUANTITATIVE CONTENT OF IMMUNOGLOBULINS IN LAMBS AND SHEEP MEAT-FAT KAZAKH FAT-TAILED ROUGH-HAIRED BREED.....	20
Baimishev Kh.B., Yessengaliyev K.G., Zakirova F.B, Kassimova G. V. MORPHOLOGICAL AND BIOCHEMICAL BLOOD PARAMETERS OF THE STUDIED ANIMAL GROUPS.....	29

Rules for authors on the design of an article for publication

Scientific and practical journal «Ğylym jáne bilim» is a periodical of the West Kazakhstan Agrarian and Technical University named after Zhangir Khan K. The journal is published quarterly and articles are published in Kazakh, Russian and English languages. The journal publishes scientific works on actual problems of fundamental and applied researches in the field of agricultural, veterinary, biological, technical, economic and socio-humanitarian sciences.

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