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Lifetime productivity of bulls depending on the similarity of their parents by antigens of the B blood group system

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Abstract. During the selection of parents of future bulls of meat breeds, the problem of improving the main signs of meat productivity is a priority. Search for techniques that would additionally influence the effectiveness of using future bulls using conventional breeding methods determines the relevance of this study. The purpose of the study was to determine the influence of the selection of parent pairs based on antigens of the B blood group system on the results of lifelong use of bulls of Ukrainian beef cattle, created by the method of the complex reproductive crossing of four different breeds. The study was conducted by comparing the performance of bulls assigned to different groups by the antigenic similarity index (r_{as}) of their parents. By r_{as} value over 0.150 formed a group of progenies from a homogeneous selection of parents ($n=5$). In the group from a heterogeneous selection of parents ($n=5$), the indicator r_{as} less than 0.150. The libido of bulls was tested in the arena by the time of manifestation of sexual reflexes when receiving sperm on an artificial vagina. Within the groups, the age of bulls at the time of first sperm collection, life and productive use, the number of ejaculates received and culled, and the quality and fertilising ability of sperm were determined. It was identified that in bulls obtained from the homogeneous selection of parents by r_{as} compared to peers from heterogeneous mating, there is a tendency to increase the age of initiation of sperm collection by 33.9%. They also have a longer productive use expectancy by 6.3% and a longer life expectancy by 21.5%. Bulls obtained from heterogeneous selection during use have more leads to the scarecrow by 13.6% and predominate in the number of ejaculates obtained. The percentage of ejaculate culled is twice as high. Bulls from homogeneous selection have a higher (by 15.3 points) share of active manifestation of sexual reflexes, a larger volume of ejaculate, better indicators of sperm motility and concentration, fewer culled ejaculates, and a higher fertilisation capacity of sperm by 18.2 points. The results obtained should be used in the selection of bulls for potential mothers of valuable bulls of the Ukrainian beef breed and in other livestock populations created by the method of complex reproductive crossing

Keywords: Ukrainian beef cattle breed, red blood cell antigens, duration of productive use, ejaculate, reproductive crossing, sexual activity

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Introduction

In meat cattle breeding, the use of artificial insemination of cows and heifers with the sperm of valuable bulls accelerates breeding progress compared to the use of natural mating. The effectiveness of using bulls largely depends on their productivity on the characteristics associated with the collection and accumulation of cryopreserved sperm. It is known that the genetic improvement of reproduction traits can be achieved by the optimal use of sperm from the best bulls in artificial insemination (Suprayogi *et al.*, 2020). Many bulls with genetically high productivity during use in the artificial insemination programme are culled for signs of growth, due to injuries and previous diseases, poor libido, unsatisfactory sperm quality, and its unsuitability to be frozen (Dangar *et al.*, 2021). The fertility of bulls is given less attention than that of cows (Fair & Lonergan, 2018) because it is complex and multi-factorial. Understanding the reasons for the variability of bull fecundity is a key prerequisite for achieving a reliable assessment of their sperm fertilisation capacity.

In the classical theory of selection, heterogeneous mating of parents is used to improve traits, which contributes to the manifestation of the effect of heterosis. In the Ukrainian beef breed of cattle, there is a need to justify effective selection methods, the use of which would contribute to improving the reproductive capacity of bulls. One of the strategies to improve the performance characteristics of cattle is to introduce methods for selecting pairs using polymorphic erythrocyte antigens of the system in blood groups. Their use has a certain effect on the signs of growth of bulls in the period from 8 to 18 months of age (Ugnivenko & Natalych, 2021). To date, there is a lack of published studies on the specific features of the use of bulls, meat breeds created in Ukraine, obtained from the selection of parents by blood group factors.

Signs of reproduction of bulls are divided (Savchuk, 1985) into indirect (testicular size, scrotum girth, age of puberty) and direct (sexual activity, sperm production, fertilisation capacity of sperm). The physiological maturity of bulls lasts from 2nd to 5th year of age (Naumenko *et al.*, 2009). They show five unconditional basic sexual reflexes: attraction, climbing, erection, mating, and ejaculation. Sexual desire and climbing reflex bulls show not only to the female but also to the artificial cow (an artificially created figure of a cow that reproduces the shape of their body). This ensures that sperm is collected on the artificial vagina. Not all bulls mount on an artificial vagina, which is manifested by conditioned reflexes. It is known that the sexual behaviour of sire is not affected by their sperm mass and physical and morphological aspects (De Oliveira *et al.*, 2007). It is affected by parameters (length, width, depth, thickness, circumference of scrotum, and total testicular volume (Gippolito *et al.*, 2019; Novotná *et al.*, 2022), body structure type, and expressiveness of the meat forms (Ugnivenko & Koropets, 2021).

When selecting parents in meat breeds, special attention is paid to their heterogeneity. Using the system

B blood groups has been one of the methods of predicting the productivity of cattle for a long time. Analysis (Vagonis & Vinikas, 1981) of cow insemination showed that for an increase from 0.40 to 0.81 of the antigenic similarity index (r_{as}) between cows and mated bulls, the number of inseminations per fertilisation increases from 1.49 to 3.08. Fertilisation is substantially higher when mating heterogeneous cows and bulls than when combining homogeneous individuals (Shadmanov, 1981). When mating heterogeneous pairs from the first insemination, from 52.2 to 60.2% of cows are fertilised, and homogeneous pairs – from 37.2 to 41.5 %.

Analysis of studies on the livestock of the Ukrainian meat breed indicates ambiguous results of the relationship between blood group factors in males on the one hand and signs of their productivity on the other. Thus, under the conditions of heterogeneous selection of parents, the volume of ejaculate of the Cisdnieper type is 7.4% larger than that of peers from homogeneous selection (Koropets, 2003). Producers of the Chernihiv type of Ukrainian meat breed have an advantage of 9.1%. Bulls obtained from parents with a lower antigenic similarity index outperform their peers in terms of sperm motility and concentration. The opposite feature was obtained (Ugnivenko & Natalych, 2021) in males based on growth characteristics. By increasing the similarity of blood group antigens between parents with large differences in pedigrees, their sons show a tendency to increase the average daily weight gain, live weight, and improve in the expressiveness of meat forms. In the Ukrainian meat breed, the features of lifelong use of bulls obtained by considering the similarity of erythrocyte antigens of their parents are not sufficiently covered.

Thus, the purpose of the study is to determine the influence of the selection of parental pairs based on antigens of the B blood group system on the results of lifelong use of first- and second-generation bulls, which have a low degree of similarity in polymorphic proteins, of the Ukrainian beef breed created by complex reproductive crossing.

Materials and Methods

The analysis of the lifelong use of bulls of the Ukrainian beef breed, which were kept in the breeding plant “Volia” of the Zolotonosha District of Cherkasy region, was conducted in 2022. The raising of experimental bulls was conducted using the technology of beef cattle breeding. Until 6-7 months of age, bulls were kept with regulated suckling. After weaning, from 6-7 to 8 months, they were accustomed to a typical diet and conditions of being on a leash. Evaluation of bulls by their productivity was conducted from 8 to 15 months of age by growth rate, live weight, feed consumption per 1 kg of growth, and the expressiveness of meat forms. At the 14th month of life, bulls began to be used to collect sperm on an artificial vagina. After cryopreservation, it was sent for artificial insemination of breeding stock. The conditions of detention and use of bulls during the study met the requirements of the Order Ministry of Agrarian

Policy and Food of Ukraine No. 652 dated 25.10.2012, "On approval of the Procedure for using animals in agriculture".

The selection of bulls into groups was conducted based on the results of checking for the reliability of origin, considering the number of available antigens of the B blood group system of cattle, published in the catalogue "Blood types of bulls-producers and cows used in the breeding of dairy and meat breeds of cattle" (Podoba *et al.*, 1987). 10 animals were left to determine the lifetime productivity of bulls, which, according to the results of the assessment of their productivity, had a comprehensive breeding index "A" over 101. Bulls were distributed according to the value of the index of antigenic similarity of parents. The first group (n=5) included animals obtained with a relatively homogeneous selection of parents, in which the value of the antigenic similarity index is over 0.150. The second group (n=5) includes bulls who came from a heterogeneous selection of parents whose antigenic similarity index is less than 0.150.

Red blood cell antigens of the B system of bovine blood groups were used to calculate the index of antigenic similarity of parents. It was determined by the formula (1) of Zhivotovsky-Mashurov, quoted from the paper (Ugnivenko & Natalych, 2021):

$$r_{as} = \frac{S}{n_1 + n_2 - S} \quad (1)$$

where: r_{as} – index of antigenic similarity of parents; S – the total number of identical antigens in the father and mother; n_1 – the number of red blood cell antigens detected in the mother; n_2 – the number of red blood cell antigens detected in the father.

Based on the results of testing and using bulls, their age at the time of first sperm collection, life expectancy, productive use in days, and the number of ejaculates received and culled were determined.

Evaluation of bull ejaculates was performed immediately after they were received. The assessment included an analysis of the presence of inclusions, sperm volume, and concentration. Sperm motility was evaluated before cryopreservation of sperm.

The use of sperm of the bulls under study was evaluated on the farm based on the results of artificial insemination of breeding stock. The analysis was conducted according to zootechnical accounting data. In particular, the number of

cows and heifers that were inseminated with the sperm of bulls of experimental groups was determined, including the percentage of those fertilised after the first insemination.

The degree of sexual activity (libido) of bulls was evaluated in the arena for obtaining bull sperm after bringing the animals to the artificial cow (an artificially created figure of a cow that recreates the shape of their body). According to the manifestation of libido, bulls were divided into three groups: active – ejaculation is conducted from 10 to 60 seconds; moderate – from 60 to 120 seconds, and calm – the time before ejaculation lasted over 120 seconds. The life expectancy of bulls (days) was determined by the period between the date of exclusion of the bulls from the herd and their birth date. The duration of productive use of bulls (days) was determined by the period between the dates of the first and last sperm collection from them.

Research data were processed to determine the average value for groups and its statistical error, and the relative indicators of individual traits as a percentage.

Results and Discussion

In breeds that were bred a long time ago and have a high degree of similarities by main traits, supporting the genetic diversity is attempted by using different variants of heterogeneous selection of parental pairs. In newly created breeds, stabilising selection is used, which allows obtaining animals of the desired type. This selection gradually reduces the level of genetic variation in the main breeding traits, while other traits can preserve genetic diversity and be used in breeding work. In the process of breeding the Ukrainian meat breed by complex reproductive crossing, the genes of the four original breeds were combined. This is caused a great genetic diversity of livestock. The effects of the heterogeneous and homogeneous selection of parents on the productivity of bulls of the newly created Ukrainian meat breed were investigated. The degree of similarity of parents by antigens of the B blood group system of cattle is one of the signs of genetic diversity of their offspring. The smaller the antigenic similarity of parents, the higher the theoretical degree of heterozygosity of their offspring for alleles that determine productivity, reproduction, immunity, and other traits. It was identified that bulls obtained from parents with varying degrees of antigenic similarity differ in the results of lifelong use (Table 1).

Table 1. Results of lifelong use of bulls obtained from different selection of parents according to the index of antigenic similarity of the B blood group system

Feature	Antigenic similarity index (r_{as})			
	over 0.150		less than 0.150	
	n	M±m	n	M±m
Age of first sperm collection, days	5	671±158.2	5	501±71.4
Duration of productive use, days	5	542±158.8	5	510±71.9
Life expectancy, days	5	1227±232.2	5	1010±64.6
Number of leads to the artificial cow, times	5	154±39.4	5	175±34.8
Number of ejaculates received, pcs.	5	124±29.5	5	147±36.8
-/-, %	5	82.3±2.8	5	82.8±8.3

In bulls from homogeneous selection of parents according to the index of antigenic similarity of the B blood group system (r_{as} over 0.150), the average age of receiving the first ejaculate using an artificial vagina was 671 days. In bulls obtained by heterogeneous mating of father and mother (r_{as} less than 0.150), there is a tendency to decrease the age of the first sperm collection by 33.9%. Within the groups, there was a large variability in the age of the beginning of reproductive use of bulls, which is due to the need for long-term rearing to assess meat productivity and other production factors associated with the accumulation of cryopreserved sperm and breeding work on the farm. In terms of life expectancy and productive use, bulls obtained from homogeneous selection had slightly better indicators, but no substantial difference in these characteristics between the groups was established.

The number of attempts to collect sperm (leads to the mount) and ejaculates obtained during life was less in bulls obtained from homogeneous selection of parents by 13.6% and 18.5%, respectively, and the proportion of successful attempts to obtain ejaculate did not differ between animals of both groups. In general, according to the results of lifelong use, slightly better indicators can be noted in bulls obtained from heterogeneous parents for erythrocyte antigens, which is reflected in the earlier beginning of reproductive use and a larger number of ejaculates obtained. However, the increased intensity of use may be associated with the need for additional sperm production from heterogeneous bulls, so other signs of their reproductive ability were analysed.

The results of sexual activity assessment were analysed in bulls of experimental groups (Table 2).

Table 2. Sexual activity of bulls obtained from different selection of parents according to the index of antigenic similarity of the B blood group system

Feature		Antigenic similarity index (r_{as})			
		over 0.150		less than 0.150	
		manifestations	indicator by group	manifestations	indicator by group
Sexual activity on the mount	Active libido, %	53	76.8	88	61.5
	Moderate libido, %	11	15.9	33	23.1
	Calm libido, %	5	7.3	22	15.4
Time of libido manifestation	With active libido, seconds	53	8.9±1.23	88	12.8±1.37
	For moderate libido, seconds	11	73.6±23.29	33	81.8±14.46
	For a calm libido, seconds	5	720.0±360.0	22	649.1±141.64

It was identified that bulls from homogeneous selection (r_{as} over 0.150) were characterised by higher sexual activity. Active manifestations of libido in their group were 15.3 points more. In the group of bulls from heterogeneous selection (r_{as} less than 0.150), the proportion of moderate and calm libido manifestations was higher by 7.2 and 8.1 points, respectively. The time of manifestation of sexual reflexes within the classes for sexual activity also differed. Bulls obtained from a homogeneous selection of parents with libido rated as active gave ejaculate to an artificial

vagina 4 seconds earlier than heterogeneous ones. In the class with moderate libido, homogeneous bulls also prevailed in terms of the speed of mounting and ejaculation by 8 seconds.

The data obtained indicate higher sexual activity of bulls from the homogeneous selection of parents by red blood cell antigens, but it does not explain why more ejaculates were obtained from heterogeneous bulls during their lifetime. This becomes clear after analysing the quality of native bull sperm and the results of its use (Table 3).

Table 3. Quality of sperm production of bulls obtained from the heterogeneous selection of parents according to the index of antigenic similarity of the B blood group system

Feature	Antigenic similarity index (r_{as})			
	over 0.150		less than 0.150	
	n	M±m	n	M±m
Ejaculate volume, cm ³	4	5.02±2.9	5	4.77±2.39
Sperm motility, points	4	7.52±4.34	5	6.98±3.49
Sperm concentration, billion/cm ³	4	1.40±0.81	5	1.24±0.62
Culled ejaculates, pcs.	5	11.5±6.2	5	18.9±6.5
-/-, %	5	7.5±4.0	5	15.0±7.4
Total inseminated cows and heifers, heads	3	582	3	299
Fertilised after the first insemination, %	3	51.0	3	32.8

Bulls from parents with a higher antigenic similarity index, against the background of better sexual activity, had a slightly larger ejaculate volume and prevailed over bulls obtained from heterogeneous selection for sperm motility by 0.54 points and sperm concentration by 0.16 billion/cm³. These are the signs that determine the number of standard sperm doses that can be obtained from a single ejaculate. In addition to better sperm quality, bulls from a homogeneous selection of parents had a 7.5-point (2-fold) lower proportion of culled ejaculates after their analysis for inclusions and sperm quality. Thus, more sperm doses were obtained from each bull that descended from parents with higher similarity in red blood cell antigens, and therefore the need to receive additional ejaculates from them was reduced.

Costs of bull sperm obtained from the mating of heterogeneous parents (r_{as} less than 0.150) were higher. In particular, the fertilisation rate of breeding stock after the first insemination with their sperm was only 32.8%, which is 18.2 points less than the indicators of bulls obtained from the homogeneous selection of parents.

Thus, for most signs of reproduction, the best results were obtained in bulls descended from parents with a high index of similarity in erythrocytic antigens of the B blood group system. More ejaculates received from bulls whose parents had r_{as} less than 0.150 is due only to the need to replenish the reserves of standard sperm doses, which were received less from the ejaculate, and the costs due to low fertilisation capacity were higher.

According to Dahiya *et al.*, (2013), obtaining sperm from producers at a relatively early age is economically beneficial and reduces the time for evaluating the quality of the offspring. Of the genetic factors, the age of the bull during the first sperm collection is affected by the breed (Naha *et al.*, 2019), different types of crossbreeding (Vijetha *et al.*, 2014). A comparative analysis of results obtained with the conclusions of studies by other authors on the effect on the age of taking sperm from bulls from different types of parental selection shows that their heterogeneous mating leads to a decrease in the age of the beginning of sires using. Thus, in mixed bulls, the age of the first sperm collection is less than in purebred animals (Mukhopadhyay *et al.*, 2010).

In addition to genetic factors, the age of puberty, and the first sperm collection from bulls are affected by the concentration of the hormone testosterone in the blood serum (Lunstra *et al.*, 1978), the season of their birth (Abdullah *et al.*, 2018), scrotum circumference (Suprayogi *et al.*, 2020). Testing shows (Waite *et al.*, 2019) that 98% of young bulls are suitable for use with a scrotum circumference ≥ 27 cm and they have $\geq 70\%$ of normal sperm. The age of first sperm collection is lower in bulls that have higher average testosterone concentrations (Lunstra *et al.*, 1978), live mass of as newborns (Abdullah *et al.*, 2018), and are born in the fall, compared to their spring peers (Rendel, 2002). The effect of the birth season of bulls on their sexual development is a consequence of the photoperiod, which may be involved in the regulation of testicular function immediately after puberty (Tatman *et al.*, 2003).

Due to the complexity of the longevity trait in cattle, Zhang *et al.*, (2021) recommend making extensive use of two groups of its definitions, which either cover the entire life span or represent only part of it. According to the data of this study, the duration of productive use and life of bulls obtained from the homogeneous selection of parents according to the antigenic similarity index is 6.3 and 21.5% longer, respectively, than in peers born from heterogeneous mating. Consequently, the high heterogeneity of parents by erythrocyte antigens tends to negatively affect these traits in the offspring.

Bulls from homogeneous selection tend to reduce the number of leads to the mount and the total number of ejaculates received on the artificial vagina. The tendency to increase these signs of productivity in bulls obtained from parents with a lower index of antigenic similarity may be associated with an earlier start of their use, or a violation of signs of sperm productivity, which causes the need for more intensive use of bulls. The intensity and effectiveness of ejaculate selection from bulls are related to their sexual activity. In this study, a trend regarding the superiority of bulls obtained from a homogeneous selection of parents over peers from heterogeneous mating by the active manifestation of sexual reflexes was established. Bulls obtained from heterogeneous parents spent more time showing active and moderate types of sexual activity. Sexual behaviour is an indicator of hormonal activity, in particular, it was noted that exposure to certain factors that increase testosterone levels can simultaneously improve the sexual activity of bulls and sperm quality (Srivastava *et al.*, 2022). In our study, the concentrations of sex hormones were not investigated, but the results obtained indicate that the indicators of features that they affect are better in bulls obtained from a homogeneous selection of parents. In addition to a decrease in libido activity, bulls often completely refuse to mount and ejaculate on the artificial vagina. Refusal to ejaculate in bulls may be associated with seasonal stress, especially in summer (Bhakat *et al.*, 2009), their sexual lethargy or weak temperament (Singh, 2014). Most of the above reasons for the refusal of bulls to show sexual reflexes are due to natural conditions or technological factors. Since the proportion of refusals of bulls to mount in both groups was the same, this indicates the same impact on them of the conditions of keep and use. While the level of their sexual activity is determined by individual characteristics and, in the opinion of this study, was defined by the method of selecting parents.

The characteristics of the signs of sperm productivity of bulls are very different and depend on the type of selection of their parents by the antigenic similarity index. Sires originating from a homogeneous selection of parents compared to peers from heterogeneous mating are characterised by a larger ejaculate volume and sperm motility and concentration. There is a lot of data in the literature on the sperm productivity of bulls. In particular, it was noted that the sperm characteristics presented in this study are not similar to those given in the literature

(Koropets, 2003). They differ due to differences in the genotypes of the used bulls of the created Ukrainian meat breed of the third and fourth generations.

Bulls obtained from the homogeneous selection of parents by the antigenic similarity index have a 2-fold lower percentage of ejaculate culling. The quality of sperm in the ejaculate and the signs by which it can be culled are affected by various factors. The worst indicators of quantitative and qualitative signs of sperm are observed during puberty (Nugraha *et al.*, 2019). Young bulls secrete less sperm in their ejaculate than adults (Fair & Lonergan, 2018). At the age of 1 year, they have worse indicators of sperm production and sperm motility compared to older ones, although there is no difference in sperm motility after unfreezing cryopreserved sperm doses between younger and older bulls (Murphy *et al.*, 2018). One-year-olds selected for breeding have not only reduced sperm production but also an increased inflammatory response, leading to poor reproduction if used intensively in breeding (Snider *et al.*, 2022). Sexually mature bulls have better-quality sperm than young ones (Bhakat *et al.*, 2011). They have better libido. Spermatozoa are formed in the seminal tubules located inside the testes. Sperm production increases with age due to a positive correlation between sperm and testicular size (Asenabor *et al.*, 2015), which are 90% seminal tubules (Nugraha *et al.*, 2019). In this study, the use of bulls was conducted after the onset of puberty, so the negative impact of the early age of animals can be discarded, and the reasons for intergroup differences are considered to be the individual characteristics of the animals included in them, due to the origin from parents with different similarities in erythrocyte antigens.

Evaluation of sperm quality indicators is conducted to ensure effective fertilisation of cows and heifers. There is a very close genetic correlation between the percentage of live sperm and sperm motility before and after cryopreservation (Berry *et al.*, 2019). In bulls descended from parents with different antigenic similarity indices, a substantial difference was identified in the fertilisation capacity of sperm after the first insemination. The number of breeding stock fertilised from the first time was dominated by bulls obtained from a homogeneous selection of parents. The volume of ejaculate, the concentration and motility of sperm were higher in bulls of this group, so quantitative and qualitative indicators of their sperm productivity should be considered a likely reason for the better fertilisation capacity of sperm. The effectiveness of fertilisation of breeding stock is one of the most important characteristics of bulls and their sperm, as it affects the economy of beef production. The use of bulls with satisfactory fertility has the greatest impact on farm profits (Barth, 2018), so producers prefer older bulls (Brimlow & Doyle, 2014), which, due to physiological characteristics, have a better development of the reproductive system and reproduction indicators. For example, among farmers raising cattle and calves in the United States, in seventy-four per cent of cases, mature bulls are used, while only

six are one-year-olds (USDA, 2020). Forty-seven per cent of farmers buy 18-month-old bulls, fourteen – 12-month-olds, and eight – two-year-olds (Banwarth *et al.*, 2021). The purchase of older bulls is justified by the need to ensure effective reproduction, although they have higher prices at the time of sale (Bacon *et al.*, 2017). One-year-old bulls, due to the worst development of the reproduction function, are not allowed to breed more than twenty-five cows (Engelken, 2008). These data highlight the economic importance of bull breeding traits.

Regarding the need to improve the productivity characteristics of meat cattle by breeding methods, one of the most common techniques is the use of a heterogeneous selection of parents. In commercial meat cattle breeding, crossbreeding is used, and during purebred breeding, animals that are remote in origin are selected to avoid inbreeding. According to Karoui *et al.* (2011), inbreeding does not lead to a deterioration in the signs of sperm production (ejaculate volume, motility, and sperm concentration), but previous attempts to use the selection of parents based on the index of antigenic similarity of erythrocyte antigens of the system in blood groups (Vagonis & Vinikas, 1981) identified that an increase in r_{as} it leads to a deterioration in fertility based on the characteristics of cows and bulls. Since then, heterogeneous selection by erythrocyte antigens has been thought to improve the productivity of livestock. Notably, these studies were conducted for purebred breeding on animals with high similarity of erythrocyte antigens and a negative result was obtained for r_{as} from 0.40 to 0.81. This study used data from bulls obtained at the stage of breeding and consolidation of the Ukrainian meat breed with substantially lower similarity of parents in terms of erythrocyte antigens. There is presumably an optimal level of parental similarity for r_{as} , which can affect the manifestation of various signs of livestock productivity. It is advisable to select parents with an antigenic similarity index greater than 0.150 to improve the signs of sperm productivity of bulls of the Ukrainian meat breed, such as the volume of ejaculate, the concentration and motility of sperm, and the fertilising ability of sperm after the first insemination. Excessive parental differences in red blood cell antigens will have a negative result.

Conclusions

In the bulls of the Ukrainian meat breed, obtained at the first stages of complex reproductive crossing from a heterogeneous selection of parents, according to the index of similarity of antigens of the system in blood groups, compared with peers from homogeneous mating, there is a tendency to reduce the age of sperm collection by 33.9%, lengthening productive use by – 6.3 and life expectancy – by 21.5%. However, they have a higher number of leads to the mount – by 13.6, received ejaculates – by 18.5%, and a lower percentage of sperm culling by 2 times.

There is a tendency of 15.3 points advantage of bulls obtained from the homogeneous selection of parents over peers from heterogeneous mating for the active

manifestation of sexual reflexes and a decrease in time by 44.6 and 11.1%, respectively, for the manifestation of active and moderate libido. Sires originating from the homogeneous selection of parents compared to their peers from heterogeneous mating are characterised by a 5.2% increase in ejaculate volume, 7.7% sperm motility, and 12.9% sperm concentration.

In the Ukrainian meat breed, the selection of parents should be conducted with the similarity index for erythrocyte antigens of the B blood group system (r_{as}) over 0.150, which will positively affect the most important signs of bull fertility.

The results obtained should be considered when selecting sires for cows that are potential mothers of valuable bulls. There is a need for further research to determine the optimal difference between father and mother in the similarity of antigens of the B blood group system in a larger r_{as} range to substantiate the methods of selecting parental pairs aimed at improving the efficiency of using future sires. It is also advisable to check the results obtained in the study in other cross-breeding populations of cattle, which are bred according to the principle of the Ukrainian beef breed by a combination of remote source breeds.

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Довічна продуктивність бугаїв залежно від подібності їхніх батьків за антигенами системи В груп крові

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Анотація. Під час підбору батьків майбутніх бугаїв м'ясних порід, у першу чергу вирішують завдання з поліпшення основних ознак м'ясної продуктивності. Пошук прийомів, які за умов застосування традиційних методів селекції додатково впливали б на ефективність використання майбутніх бугаїв визначають актуальність цієї статті. Метою дослідження було визначити вплив підбору батьківських пар за антигенами системи В груп крові на результати довічного використання бугаїв української м'ясної худоби, створеної методом складного відтворювального схрещування чотирьох різних порід. Дослідження провели методом порівняння продуктивності бугаїв, віднесених до різних груп за індексом антигенної подібності (r_{as}) їхніх батьків. За величиною r_{as} понад 0,150 сформували групу плідників від гомогенного підбору батьків ($n=5$). У групі від гетерогенного підбору батьків ($n=5$) показник r_{as} менший за 0,150. Лібідо бугайців тестували у манежі за часом прояву статевих рефлексів під час отримання сперми на штучну вагіну. У межах груп визначали вік бугайців під час першого взяття сперми, тривалість життя та продуктивного використання, кількість отриманих та вибракуваних еякулятів, якість і запліднюючу здатність сперми. Виявлено, що у бугаїв, отриманих від гомогенного підбору батьків за r_{as} , порівняно з ровесниками від гетерогенного спаровування, проявляється тенденція до збільшення віку початку взяття сперми на 33,9 %. У них також більша тривалість продуктивного використання на 6,3 % та тривалість життя на 21,5 %. Бугаї, отримані від гетерогенного підбору за час використання мають більше підведень до опудала на 13,6 % і переважають за кількістю одержаних еякулятів. Відсоток вибракуваних еякулятів у них вдвічі вищий. У бугаїв від гомогенного підбору більша (на 15,3 пункти) частка активного прояву статевих рефлексів, більший об'єм еякуляту, кращі показники рухливості і концентрації спермій, менше вибракуваних еякулятів та вища на 18,2 пункти запліднююча здатність сперми. Отримані результати доцільно використовувати під час підбору бугаїв до потенційних матерів ремонтних бугайців української м'ясної породи та в інших популяціях худоби створених методом складного відтворювального схрещування

Ключові слова: українська м'ясна порода великої рогатої худоби, еритроцитарні антигени, тривалість продуктивного використання, еякулят, відтворювальне схрещування, статеві активність