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THE RELATION OF PRODUCTIVE LONGEVITY OF LITHUANIAN HEAVY DRAFT MARES WITH THE UDDER CAPACITY

Abstract. The intensity of mare's milk secretion is closely related to the accumulation and removal of it through the mammary glands. Studies of the udder capacity of the Lithuanian heavy draft mares were carried out at the breeding koumiss complex of ZAO Semenovskiy breeding plant. In mares of the Lithuanian breed, the udder capacity was the highest among the draft horse breeds: the average udder capacity was 3.01 ± 0.04 kg, and the maximum udder capacity was 4.75 kg of milk.

The udder capacity of mares of the Lithuanian heavy draft breed varied during the day, the lactation and the ontogenesis of mares, it was determined more by genetic factors - the coefficient of heritability of this trait was 0.60. The maximum duration of economic use of the Lithuanian draft mares was 23 years, during which the maximum lifelong milk yield reached 88138 kg, and the milk yield for the highest lactation was 8576 kg of milk.

It was found that the udder capacity is positively correlated with the milk yield of mares. The correlation coefficient between the udder capacity and the lifetime milk yield of mare of the Lithuanian heavy draft breed was positive and significant $r = +0.67$. Studies have been conducted to determine the possibility of using this indicator for the selection of animals with long-term economic use and a high lifetime milk yield. It was found that it is possible during the first lactation to select mares by the udder capacity, distinguishing by the period of economic use and high lifetime milk yield.

Keywords: dairy horse breeding, udder capacity, milk yield per lactation, correlation, period of economic use, lifetime milk yield.

Introduction. The most important feature of mares lactation is the continuous lactogenesis with periodic emptying of the udder during milking or sucking by foal. The intensity of mare's milk secretion is closely related to the accumulation and removal of it through the mammary glands since the udder capacity of mares is about ten times smaller than that of cows [1]. The dairy productivity of mares is directly related to the udder capacity and its milk-forming ability [2]. Mares with a larger udder have higher dairy productivity and, therefore, should be used for a longer period as productive animals [3].

Aim and objectives of the research. The aim of this study was to investigate the udder capacity of mares and the possibility to extend the period of economic use of mares of the Lithuanian heavy draft breed by selecting animals, including the morphological traits of the udder.

To achieve this aim, there were objectives of investigating the udder capacity of the Lithuanian heavy draft mares comparing with other heavy breeds, and the relation of the udder capacity with the duration of economic use and the lifetime dairy production of animals.

Materials and methods of research. The research was carried out on the breeding koumiss complex of ZAO Semenovskiy Breeding Plant of the Mari El Republic. The samples include data on 122 mares of the Lithuanian heavy draft breed, which were rejected from the broodstock of the complex from 2000 to

2013. Accounting for milk yields from dairy mares was carried out by the method of control milking, conducted twice a month, the daily milk yield was determined by Saigin formula [2]. The period of economic use (PEU) of mares was determined from the moment of the first foaling to rejection from the broodstock or forced slaughter of the animal. The age of the studied mares in lactation ranged from 1 to 21 lactation. The maximum udder capacity (MUC) and the physiological udder capacity (PUC) of mares were determined according to F.L. Garkavy [4] in the modification of E. Chirgin [5]. To determine the physiological udder capacity, the mares were milked out after skipping one milking, that is, the gap between the milkings was specially extended from two to four hours so that the udder was completely filled with milk [5]. The determination was carried out on the second or third month of lactation when the udder capacity of the mares was maximum.

Research results. The udder capacity, or the ability of animals to accumulate large amounts of milk in between milkings, is important for dairy productivity of mares. The fact is that the capacitive system of the mare's udder is relatively small compared to that of cows, but a milk production per day is about 20–40 kg, comparable to amount of milk in cow's udder [2, 5]. An objective criterion for assessing the development of glandular tissue and udder capacity are daily and one-time milk yields of mares. In cattle breeding, along with the concept of “maximum udder capacity”, which means “absolute maximum”, Azimov G.I. introduced the concept of “physiological udder capacity” (PUC), which meant the maximum udder capacity at a given time interval or, in a manner of speaking, the “relative maximum” of the udder capacity [6]. We determined the physiological udder capacity for mares of three heavy draft breeds that were milked at ZAO Semenovskiy breeding plant (table 1).

Table 1 – Average udder capacity for mares of some heavy draft breeds

Horse breed	n, animals	Average udder capacity, kg	Limit: min-max	σ , kg	C_v , %
Russian heavy draft	150	2.54±0.04	1.35-4.00	0.45	17.72
Lithuanian heavy draft	169	3.01±0.04	1.90-4.75	0.45	14.95
Soviet heavy draft	101	2.87±0.16	1.90-4.50	0.75	26.13

In our studies, the average udder capacity of the Lithuanian mare was 3.01±0.04 kg of milk, which is 18.5% higher than the figures of the Russian heavy draft breed and by 4.88% higher than the same indicator in Soviet heavy draft mares [7]. The variability of the udder capacity in Lithuanian draft mares was lower than that of Russian and Soviet heavy draft mares and was equal to 14.95%, indicating a greater stabilization of this trait in Lithuanian mares. The maximum udder capacity (MUC) taken into account in Lithuanian draft mares reached 4.75 kg of milk, which is an absolute record among mares of all breeds used for milk production. In terms of the maximum udder capacity, the Lithuanian mares exceeded Russian mares (4.00 kg) and Soviet ones (4.50 kg), despite the fact that the latter had significantly larger udder and nipple measurements [8]. The correlation coefficient between the physiological udder capacity and the maximum udder capacity was significant and amounted to +0.70 for the Lithuanian mare.

In our studies, the capacity of the udder of mares varied during the day, the lactation and the ontogenesis of animals [9]. During the day, the largest udder capacity of a mare of the Lithuanian breed was observed in between 5 and 8 am of local time.

After foaling during three weeks, the udder capacity of the mares enlarged rapidly due to hypertrophy of the milk alveoli and the disappearance of puffiness and reached a maximum during this lactation. Then, over the course of five to six months of lactation, the udder capacity changed little, and towards the end of lactation, it began to decrease quickly, about 1.5-2.0 months before the takeoff due to the restructuring of the mammary glands.

In the process of ontogenesis, the physiological udder capacity of a mare of the Lithuanian breed increased by the fifth lactation. The udder capacity of Lithuanian mares from the first to the second lactation increased intensively - by 17% at once. Then it increased with each lactation by 6-8% on average, up to the fifth lactation. From the fifth to the 10-12 lactations, the udder capacity remained approximately at the same level, and then gradually began to decline. The udder capacity of mares decreased by about 15–20% by the 16–18 lactations.

The high correlation calculated by us ($+0.79 \pm 0.03$) of the physiological udder capacity of mares with the calculated daily milk yield indicates that the udder capacity largely determines the amount of milk produced by animals. Between the physiological udder capacity and the average one-time milk yield of mares, the correlation coefficient was $+0.80 \pm 0.02$. These data confirmed the close relation between milk yield and udder capacity. Mares' milk yields reflect the capacity of their udder and the amount of glandular tissue in the udder.

The relation between the maximum udder capacity of the mares, the calculated daily milk yield and the calculated milk yield per lactation was determined using big data of factual material (table 2).

Table 2 – Relation between the maximum udder capacity of the Lithuanian heavy draft mares and their calculated milk yield per day and per lactation

Indicators	Udder capacity of mares, kg						
	1.50-1.99	2.00-2.49	2.50-2.99	3.00-3.49	3.50-3.99	4.00-4.49	4.50-5.00
Calculated milk yield per day, kg	15-19	20-24	25-29	30-34	35-39	40-44	45-50
Calculated milk yield per lactation, kg	2800-3500	3700-4400	4500-5400	5500-6400	6500-7300	7400-8200	8300-9200

In our opinion, knowing the maximum udder capacity of mares, using the data in this table, it is possible to predict what amount of yield per lactation a particular animal or group of mares can have according to their average udder capacity. We believe that the functional udder capacity is a relative value since it depends on environmental conditions and the physiological state of the animal.

The maximum udder capacity is predicated mainly upon the genotype of the animal. In mares of the Lithuanian breed, the heritability coefficient of the maximum udder capacity averaged 0.60, while in individual families of the Lithuanian heavy draft breed it varied from 0.70 to 0.95. The frequency of occurrence of this feature in the Lithuanian mare of the heavy breed was also high equaled 0.88. Therefore, we believe that the maximum udder capacity of mares can be a remarkable breeding indicator in dairy horse breeding. A simplicity of determining the udder capacity makes this indicator a universal selection tool in the industry. [10].

Horses like late-ripening and infertile animals have a rather high individual value. Therefore, economically valuable animals in terms of breeding and production should be used as long as possible. It can be assumed that mares with a more capacious udder have a higher milk yield, and, consequently, a higher level of metabolism and higher viability. These animals, therefore, should have a higher lifetime yield.

To verify this hypothesis, we selected 122 mares of the Lithuanian heavy draft breed, rejected from the broodstock from 2000 to 2013. The following indicators were determined in these animals: the period of economic use (PEU), number of lactations, lifetime milk yield, average milk yield per lactation and milk yield for the highest lactation (table 3). The number of lactations in mares turned out to be less than the average years of PEU, about 20%, which in this case is understandable since the mare is removed from the milking in case of illness or death of the foal. In highly productive mares of the Lithuanian heavy draft breed, on average, about 5% of foals die every year, according to our data, and from 12 to 18% of offspring are susceptible to various diseases. In the average sample, the average milk yield per lactation

Table 3 – Period of economic use, lifetime milk yield and other indicators of mares of the Lithuanian heavy draft breed

Indicators	n, animals	M \pm m	Limit min-max	σ	C _v , %
PEU, years	122	6.50 \pm 0.37	1-23	4.83	74.25
Lactations, n	122	5.38 \pm 0.32	1-21	4.10	76.14
Lifetime milk yield, kg	122	21200.08 \pm 1390.70	940-88138	18025.59	85.03
Average milk yield per lactation, kg	122	3727.72 \pm 76.18	940.00-5839.67	987.42	26.49
Milk yield for the highest lactation, kg	122	4611.71 \pm 106.28	940-8576	1377.54	29.87

was 3,727.72 kg and the milk yield for the highest lactation was 4,611.71 kg, while the best milk yield for the highest lactation was 8576 kg of milk. To achieve this result, there was an extreme rejection of low-productive mares, after the first lactation 18.67% of mares were rejected, after the second lactation - 15.05% of mares and after the third lactation - 10.24% of all mares. But dairy productivity does not directly affect the period of economic use of mares [11]. On the contrary, it is usually more productive animals that leave the herd for various reasons. Therefore, the variability of such traits as the period of economic use of mares, the number of lactations and the lifetime milk yield of mares were very high 74.25-85.03%.

To determine how the udder capacity of mares affected the period of economic use (PEU) and their lifetime productivity, all animals were divided into six groups depending on the value of their udder capacity: in the first group with a capacity below 2.0 kg, in the second group - from 2.0 to 2.49 kg, in the third group - from 2.50 to 2.99 kg, in the fourth group - from 3.00 to 3.49 kg, in the fifth group - from 3.50 to 3.99 kg, in the sixth group with the udder capacity of more than 4.00 kg of milk. The results of the investigation are presented in table 4.

Table 4 – Relation between the udder capacity of the Lithuanian draft mares, their lifelong milk yield and period of economic use

Groups	n, animals.	PEU, years	Lactations, n	Lifetime milk yield, kg	Average highest yield, kg	Average milk yield per lactation, kg
1	7	2.57	1.86	5162.57	2370.00	2775.58
2	44	6.16	5.02	18087.60	4335.09	3603.11
3	27	7.48	6.07	23497.11	5102.33	3871.02
4	30	10.63	8.70	37042.53	5672.03	4257.76
5	9	11.67	10.22	46271.89	5728.67	4527.58
6	5	13.80	11.80	49115.40	5858.80	4162.32

The table shows a clear trend that with enlarging the udder capacity, the period of economic use of mares increased from 2.57 years to 13.8 and the lifetime milk yield increased from 5162.57 to 49115.40 kg of milk. A particularly noticeable increase in both investigated traits was observed in mares with the udder capacity of more than 2.50 kg. The correlation coefficient between the udder capacity and the lifetime milk yield for the Lithuanian heavy draft mares was +0.67. The highest yield also rose as the udder capacity of the mares of the Lithuanian breed increased. The average milk yield per lactation in mares with the udder capacity of more than 4.00 kg even decreased by 8.78% compared with the previous group of animals. In the last group of mares, lifetime milk yield increased due to growth in the number of lactations.

The Lithuanian heavy draft mares with the udder capacity from 2.50 kg to 4.75 kg were distinguished by a longer period of economic use, the highest lifetime milk yield and higher average milk yield per lactation. A clear relation has been established between the udder capacity, the period of economic use and the lifetime milk yield of mares [12]. Consequently, it is already possible during the first lactation to select mares according to the udder capacity, which are distinguished by long-term economic use and high lifetime milk yield.

Conclusions.

1. In mares of the Lithuanian heavy draft breed, the udder capacity was the highest among the draft horse breeds: the average udder capacity was 3.01 ± 0.04 kg, and the maximum udder capacity was 4.75 kg of milk.

2. In mare of the Lithuanian breed, a close positive relation was found between the udder capacity and daily milk yield ($r=+0.79 \pm 0.03$), between the udder capacity and one-time milk yield ($r=+0.80 \pm 0.02$), therefore, milk yield of mares was mainly determined by the udder capacity.

3. The udder capacity of the Lithuanian mares varied during the day, the lactation and the ontogenesis and it was determined more by genetic factors - the heritability coefficient of this trait was 0.60.

4. The maximum duration of economic use of the mares of the Lithuanian heavy draft breed was 23 years, during which time the maximum lifetime milk yield reached 88138 kg, and the milk yield for the highest lactation was 8576 kg.

5. A clear relation was established between the udder capacity on the one hand and the period of economic use and the lifetime milk yield of mares on the other hand. The correlation coefficient between the udder capacity and the lifetime milk yield for a mare of the Lithuanian breed was positive and significant $r=+0.67$.

6. The Lithuanian heavy draft mares with larger udder capacity have high dairy productivity and longer economic use. Consequently, during the first lactation, it is possible to select such mares according to the udder capacity, which will differ by a long period of economic use and high lifetime milk yield.

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ЛИТВА АУЫР ЖҮК ТАРТАТЫН ЖЫЛҚЫ ТҰҚЫМЫНЫҢ ЕМШЕГІ СЫЙЫМДЫЛЫҒЫНЫҢ ӨНІМДІЛІК ҰЗАҚТЫҒЫМЕН БАЙЛАНЫСЫ

Аннотация. Жылқы сүтінің секрециясының қарқындылығы сүт бездерінде жиналуымен және оны шығарумен тығыз байланысты. Литвалық ауыржүк тартатын тұқымды жылқылардың желін сыйымдылығын зерттеу бойынша зерттеулер З.А. Семеновскийдің асыл тұқымды қымызды кешенінде өткізілді. Литвалық ауыр жүк тартатын жылқыларының желін сыйымдылығы басқа ауыр жүк тартатын жылқылар арасында ең жоғары: орташа сыйымдылық $3,01 \pm 0,04$ кг, ал жоғарғы көрсеткіш 4,75 кг. Литва тұқымының желін сыйымдылығы тәулік ішінде өзгерді, лактация және онтогенез генетикалық факторлармен анықталды - осы ерекшеліктің мұрагерлік коэффициенті 0,60 болды. Шаруашылықта ең ұзақ қолданысы 23 жыл, сол аралықта өмірлік сауын 88138 кг құрды, ал ең жоғарғы лактация 8576 кг құрады. Желін сыйымдылығы жылқының сауынымен тікелей байланыста екенін байқадық. Корреляция коэффициент желін сыйымдылығы мен өмірлік сауынмен байланысы оң көрсеткіш көрсетті $r = +0,67$. Бұл көрсеткішті ұзақ уақыт шаруашылық пайдалануда және өмірлік сүт өнімділігі бар жануарларды таңдау үшін пайдалану мүмкіндігін анықтау үшін зерттеулер жүргізілді. Алғашқы лактация кезінде ұзақ уақыт бойы шаруашылықта пайдалану және сүттің жоғары өмірлік деңгейімен ерекшеленетін жылқыларды таңдау мүмкіндігі бар екені анықталды.

Түйін сөздер: жылқы сүт шаруашылығы, емшек сыйым вымени, лактация кезінде сауын, корреляция, шаруашылық қолдана ұзақтығы, өмірлік сауын.

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ВЗАИМОСВЯЗЬ ПРОДУКТИВНОГО ДОЛГОЛЕТИЯ КОБЫЛ ЛИТОВСКОЙ ТЯЖЕЛОВОЗНОЙ ПОРОДЫ С ЕМКОСТЬЮ ИХ ВЫМЕНИ

Аннотация. Интенсивность секреции кобыльего молока тесно связана с накоплением и выведением его из молочных желез. На племенном кумысном комплексе ЗАО ПЗ «Семеновский» были проведены исследования по изучению емкости вымени кобыл литовской тяжеловозной породы. У кобыл литовской тяжеловозной породы емкость вымени была самой высокой среди тяжеловозных пород лошадей: средняя емкость вымени составляла $3,01 \pm 0,04$ кг, а максимальная емкость вымени равнялась 4,75 кг молока. Емкость вымени кобыл литовской тяжеловозной породы изменялась в течение суток, лактации и онтогенеза кобыл и детерминировалась в большей степени генетическими факторами – коэффициент наследуемости этого признака

составлял 0,60. Максимальная продолжительность хозяйственного использования кобыл литовской тяжело-возной породы составляла 23 года, за это время максимальный пожизненный удой достигал 88138 кг, а удой за наивысшую лактацию составлял 8576 кг молока. Выяснили, что емкость вымени положительно коррелирует с удоем кобыл. Коэффициент корреляции между емкостью вымени и пожизненным удоем у кобыл литовской тяжело-возной породы был положительным и значительным $r = +0,67$. Были проведены исследования по определению возможности использования этого показателя для отбора животных с длительным периодом хозяйственного использования и высоким пожизненным удоем. Было установлено, что можно уже во время первой лактации отбирать по емкости вымени кобыл, отличающихся продолжительным периодом хозяйственного использования и высоким пожизненным удоем.

Ключевые слова: молочное коневодство, емкость вымени, удой за лактацию, корреляция, продолжительность хозяйственного использования, пожизненный удой.

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