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THE INFLUENCE OF TECHNOLOGICAL CHARACTERISTICS OF THE UDDER OF COWS ON SUITABILITY FOR MACHINE MILKING

Summary. The results of these studies allow to speak about the possibility of obtaining significant technological and economic effects by conducting breeding work aimed at developing a herd suitable for machine milking on udder morphology. The use of modern systems of automation of the process much easier and allows you to more efficiently perform the selection of animals.

In the study, it was found that the number of animals having udder with underdeveloped lobes, at the time of emptying is much larger than the number of animals with visually unevenly developed mammary gland and is recorded at 47.7%. While there are various combinations of immature shares. Of the total number of unequally developed lobes of the udder right front accounting for 27.2%; the left front – 34%; the left rear – 22,4%; right back to 16.4%.

Key words: agriculture, livestock, cow, milking, suitability, functional condition of the udder.

Formulation of the problem. The process of technical re-equipment of animal husbandry today acquires a completely new meaning. In recent years, there has been a fairly clear trend in the transition from the creation of technology to ensure existing technologies to the creation of new technological solutions based on fundamentally new machines and equipment. Significant reserves lie in the formation of an integrated approach that takes into account all the nuances and subtleties of mechanized technology. It is extremely important here to provide technological methods aimed at stimulating delicate natural biological processes, which are permeated with thin threads of interconnections of the elements of the triune system: «man-machine-animal». Any little thing here can become a factor determining the final effect of a long and multifaceted process [1,2].



Modern information technologies allow implementing production management taking into account human psychology, ergonomics, physiology and ethology of animals, features and capabilities of technology. It is necessary to provide technological methods aimed at stimulating natural biological processes, implemented by a peculiar catalytic mechanism, which involves a subtle, signaling effect on a complex deterministic system [3].

At the present stage of development of animal husbandry, among a large number of industries, dairy cattle breeding takes a leading place in ensuring food security in Ukraine. Milk, as an exceptionally valuable food product, is of key importance in human nutrition, as it contains the whole spectrum of nutrients, including essential ones, necessary for a person to live [1,4-6].

Despite the positive trends that have emerged in solving the problem of obtaining milk in herds remains a significant number of cows on the parameters of mammary gland development are not fully usable in a modern technological environment. The unsuitability of cows to machine milking results in low efficiency in the use of milking machines, leading to losses of 1,8–2,3 kg milk per cow per milking. The necessity of studying the problem of adaptation of an organism in industrial dairy cattle is mainly associated with new and largely unusual conditions of keeping and feeding animals. Change and transformation of historically developed techniques and practices of the livestock industry. Under the influence of a number of factors, the physiological status of animals can change, diseases can occur, since the body can not always adapt to certain environmental factors that can arbitrarily change without taking into account the characteristics of their body. And, first and foremost, this applies to machine milking of different technical systems [7–11].

Analysis of recent research. The leading domestic scientists Adamchuk V.V., Fenenko A.I., Zhukorsky A.N., Kostenko V.I., Kartashov L.P., Ushakov Yu.A., Kolpakov A.V., Korolev A.S., Vasilevsky G.P. are engaged in the creation of specialized dairy complexes for the production of milk, for the stable supply of dairy products to the population, where the technology of its production, machinery and equipment would correspond to the modern European level and ensure the production of high-quality milk. However, the technological suitability of cows for machine milking remains insufficiently studied and is relevant at the present stage of development of cattle breeding in Ukraine [12–16].

Formulation of the goals of the article. To determine the influence of technological features of udder development of cows on their suitability for machine milking and on milking efficiency.

Main part. Researches on studying of influence of technological parameters of development of the udder in cows when milking by hand and using milking machines showed unevenness of its functional development.



This is what caused the formation of different amounts of milk and the intensity of milk excretion in its shares and the so-called «idle milking». It often serves as a factor reducing the productivity of dairy cows, reducing their lifetime, the occurrence of mastitis and premature culling, reduced efficiency of selection-breeding work in herds and causes significant economic damage to farmers [17,18].

In dairy cattle breeding one of the main technological parameters of cows is suitable for machine milking, which is determined by the following factors: the size and shape of the udder; the simultaneity of a share milking udder; development of udder glandular tissue; the size and shape of the nipples; the rate of excretion in milk [19].

Therefore, carrying out deep and comprehensive research on the functioning of the mammary gland and its separate share of a cow takes on a special scientific and practical importance in the improvement of their technological parameters (duration of milking, the udder and capacity of the particles, the intensity of excretion of milk, the duration of idle milking, duration of milking machine full and his volumes, complete milking machine, the index of symmetry) to created new and improving existing high-yielding dairy herds and the understanding of the problems of the theory of lactation. This will contribute to the development of theoretical foundations and the improvement of automated milking installations and practical approaches to milking cows, increasing the efficiency of milk production and selection and breeding in dairy cattle breeding.

The classification for assessing the condition of the nipples of the udder of highly productive cows when they are selected for machine milking is carried out as follows: category I (not suitable) – nipple diameter less than 18 mm, their length less than 60 mm; Category II (suitable) – the diameter and length of the nipples of the udder are in the range of 18-36 mm and 60-80 mm, respectively; Category III (not suitable) – nipple diameter of more than 36 mm, length – more than 80 mm. The interpretation of the data obtained is carried out according to Table. 1.

Table 1

Assessment of the suitability of highly productive cows for milking by the condition of the nipples of the udder.

Category	Dimensions of the nipples of the cow's udder, mm		Suitability of cows for milking
	nipple diameter	nipple length	
I	<18	<60	Not suitable
II	18–36	60–80	Suitable
III	>36	>80	Not suitable

The suitability of cows for milking is determined by the uniform development of the shares of the udder and the amount of milk received from

them. A quantitative indicator of the uniformity of development of the udder shares is the udder index. This is an objective indicator of the development and functional state of the udder lobes, which is important for reducing the duration of idle milking and maintaining the health of the animal during machine milking. The udder index is determined as a percentage and is equal to the ratio of milk yield from the front lobes to the total milk yield multiplied by 100 [20,21].

The optimal udder index corresponds to 45-50%. But animals that are kept in dairy complexes have an index below or above this indicator. In Fig. 1 shows the results of a change in the udder index of 133 first-born cows of the Ukrainian black-pocked dairy breed.

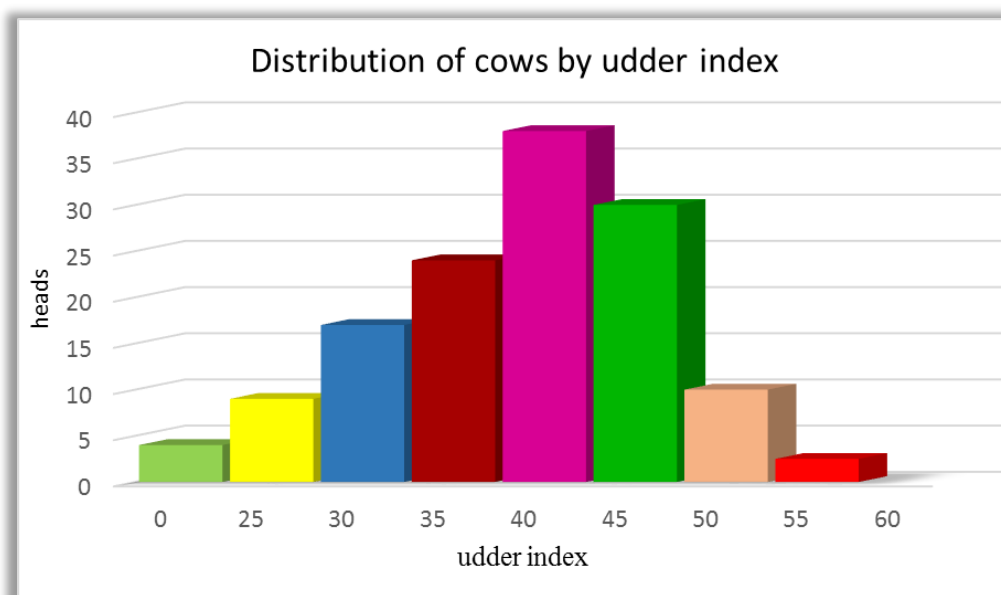


Fig. 1 The distribution of the number of cows for udder index

From the above chart it is evident that the index of the udder varies widely, with the greatest number of animals, the udder index corresponds to 40-45% and only 30 animals is in the range of 45-50%.

In cows with udder index is less than this range, sufficiently developed posterior lobe of the udder, and the udder index is range - developed front lobe. All cows with udders that are unsuitable for machine milking, because they have a significant disparity in the shares of the udder.

To ensure effective selection of cattle to machine milking in modern dairy complexes experimental the cow is sent to be milked to a milking robot where, in the process of milking, total milk yield and milk yield of the front lobes of the udder is fixed automatically. In the next step calculate the index of the udder.

The interpretation of the obtained data is carried out according to Table. 2. The evaluation of cows whose index of the udder was <45% should be



considered unsuitable for machine milking. Cows assigned to the index of the udder in the range of 45 – 50% is referred to the suitable for machine milking, and if the index of the udder of the cow > 50% – it is considered to be unsuitable for machine milking.

Table 2

Determining the suitability of cows for industrial use

The udder index,%	The Suitability of cows for machine milking
<45	Not suitable
45-50	Suitable
>50	Not suitable

To assess compliance of cattle to machine milking conducting follow-milking cows total herds using a four-channel float is a pneumatic device that allows you to graphically record the dynamics of the excretion of milk for each share of the udder of the cow and having automatic torque signal its end. Then determine the average value of one-time milk yield, intensity of excretion of milk, the duration of the latent period, the actual and idle milking, with the calculation of the standard deviation. In the next stage, a cow, which is estimated, subjected to the same control milking with the same performance and compare them with the average value the herd. The interpretation of the data obtained is carried out according to Table. 3.

Table 3

The values of the main indicators in determining the conformity of cattle to machine milking

Cow productivity indices	Deviation
Latent milking period, min	0,2
The intensity of milk yield, kg / min	0,4
The size of a single milk yield, kg	0,9
Milking time, min	0,7
Single milking, min	0,2

If the productivity indices of the cow, which is estimated by the latent period of milking, deviate by more than 0.2 min, the intensity of milk yield is more than 0.4 kg / min, the value of a single milk yield is more than 0.9 kg, the duration of milking is longer than 0.7 min, idle milking - 0.2 min from similar average herd cow is considered unsuitable for the applied technology of machine milking.

The construction of new and the modernization of existing dairy farms and complexes is aimed at increasing the productivity of animals and improving the quality of milk produced. Under the current conditions, the most important factor is machine milking of cows, which is of great importance for maintaining the health of animals throughout the entire period



of economic use. At the same time, milking machine parameters significantly affect milk productivity, milk flow rate and milk quality.

At milking installations located in special milking parlors, automatic control systems with programmable settings for milking process parameters are used. In the absence of automated milking control, the parameters are regulated by the vacuum level, nipple rubber and the pulsator operating mode. At the dairy complex, the cow immediately after calving is milked at the milking unit in the maternity ward, which, as a rule, does not have automatic control, and after being transferred to the production group and continues to be milked at the automated installation. The problem of mismatch of the milking parameters at the milking unit in the maternity ward and at the main milking unit in the milking parlor is very common in the livestock farms of Ukraine and is one of the main causes of mastitis in cows in the first weeks of lactation.

Consequently, the high efficiency of the use of highly productive cows, an increase in their productivity and milk quality can be achieved only if the animals are clearly aligned with machine milking, which provides for the introduction of innovative technological solutions based on the latest animal care technologies and the rational organization of production processes.

On the domestic farms and complexes used quite a large percentage of cows with udder unevenly developed. The main problem of milking cows that quickly vydelenie share for a long time subjected to the "dry milking" which is the main reason for "kroutoi", irritation of udder, mastitis and atrophy nipples. "Dry milking" causes pain, which leads to the formation of conditioned reflexes, inadequate process and hinder the normal hormonal stimulation of galactopoiesis. Cows are for milking reluctantly, in the audience were restive, and sometimes react aggressively to operator action. In practice the uneven development of the lobes is one of the main reasons for the retirement of the most productive cows and the formation of thodologie herd, unsuitable for machine milking.

The aim of this study was to study the suitability of cows for machine milking, using the capabilities of the automated control system of milking equipment and herd management, to determine the effectiveness of using the milking system udder quarters, providing preservation of health of cows with asymmetrically developed udder.

In the study, 281 cows was conducted visual assessment of the morphology of the mammary gland, which found that about 15% of the herd has unevenly developed udder. In most cases, animals with unevenly developed udder togadiya, with negative reflexes to machine milking, it is not only genetically determined characteristics, but also the reflexes resulting from pain from "dry milking" and treatment of mastitis [23-25].

It should be noted that visually it is impossible to establish the amount of milk contained in each of the lobes, and from the point of view of machine



milking, the importance is not so much the shape of the udder and the amount of milk in fractions, how much time difference the end of their milking milking machine. Therefore, the uniformity of development of the udder in the herd of animals was estimated by milking the udder quarters Milpro P4C [26,27]. This system has indicator lights at each milking post that light up the early disconnection of any shares. The essence of this system is that the process is managed separately for each share of udder and disable one or more teat cups in case of cessation of milk flow. All remaining shares continue to be milked. Technically the problem is solved by fixing the glass in the compression stroke, when the annular space is supplied atmospheric pressure. And the walls of the liner are compressed and close access of the vacuum to the sphincter of the nipple from the manifold, which in turn prevents "dry milking" on milked nipple. The glass is held on the nipple by periodically (every 10 seconds) short-time transition in time to the sucking by the vacuum supply in listennow the camera. Table. 4 presents data on the number of cows with unequally developed lobes of the udder.

Table 4

Structure of the herd on the uniformity of development of the udder

Indicator	Number, Goals	Structure, %
Total animals	281	100
With an uneven udder	134	47,7
With one unevenly developed share	57	20,3
including with: right front	16	5,7
left front	15	5,3
left rear	13	4,6
right rear	13	4,6
With two unevenly developed shares	56	19,9
including with: front lobes	22	7,8
right front and rear left lobes	11	3,9
right lobes	10	3,6
left lobes	3	1,1
left front and right rear lobes	8	2,8
back lobes	2	0,7
With three underdeveloped stakes	21	7,5
including with: front and rear right	12	4,3
front and rear left lobes	2	0,7
rear and left front lobes	1	0,4
rear and right front lobes	6	2,1
With an evenly developed udder	147	52,3

From the data presented in the table shows that almost half of the herd is to some extent unevenly developed udder. Cows often with outwardly evenly developed udder had no interest leaving milked before the others. This is due to the fact that outwardly it is difficult to establish the structure of the udder, and the speed of emptying depends not only on the amount of milk, but also on the speed of the milk output of a particular share.

Most often found hypoplasia of one or two lobes at the same time a part of the herd has completely unevenly developed udder. The uneven development of the udder does not have certain regularities and, although a significant part of the animals share the front stop milked before, underdevelopment occurs in all segments in all combinations. Consequently, uneven development of the udder – the problem is much more extensive than the known hypoplasia of the anterior lobes of the udder [28]. It was found that the more pronounced the uneven development of the udder in the herd, the more animals suffer from mastitis.

For a more general idea of the problem in Fig. 2 shows the structure of underdeveloped shares in the animals of the herd.

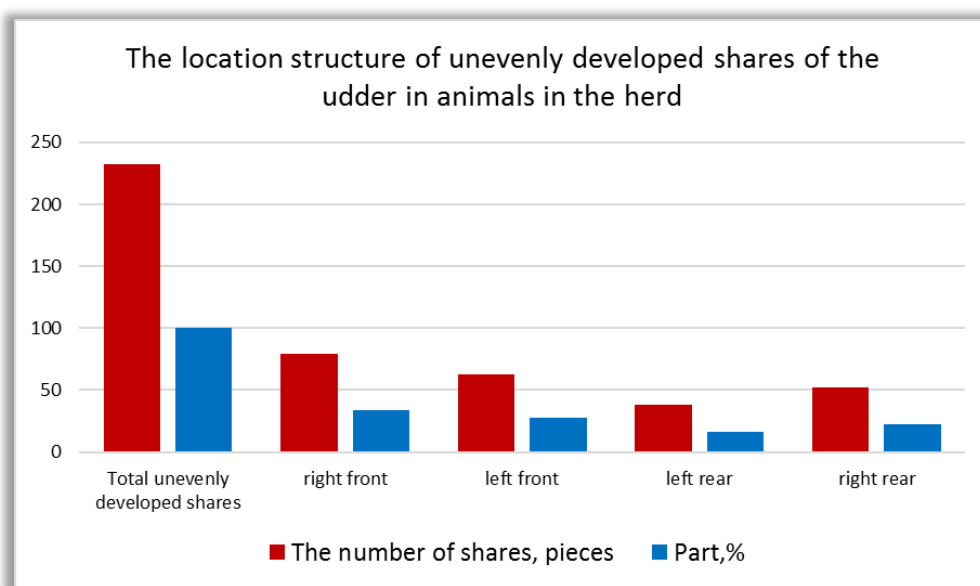


Fig. 2 The location structure of unevenly developed shares of the udder in animals in the herd

This is due to the multifactorial nature of the formation of a uniform development of the mammary gland, which is both genetic and paratypical quality. More clearly, the data on the structure of unevenly developed udder shares in animals in the herd are presented in Fig. 3.

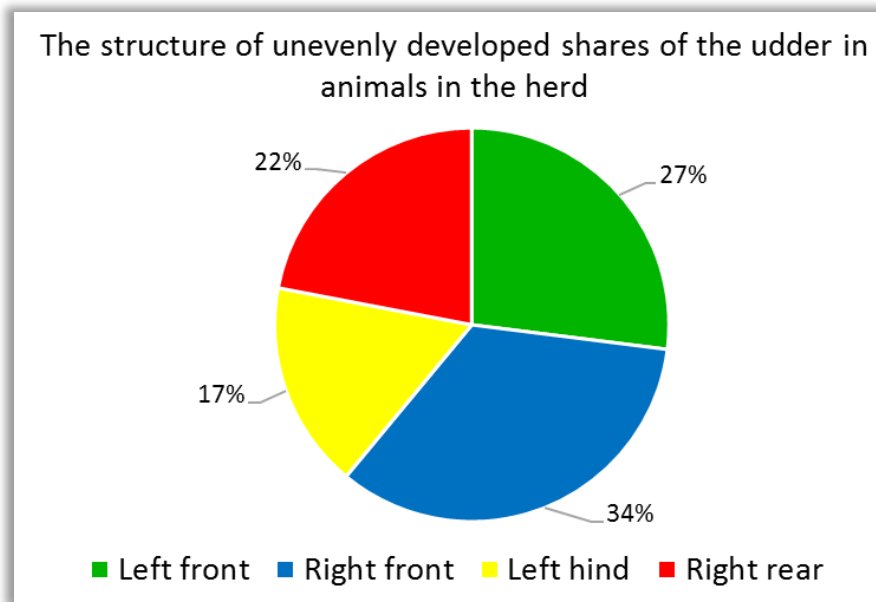


Fig. 3 The structure of unevenly developed shares of the udder in animals in the herd

From the presented data it is seen that a significant number of unevenly developed shares (almost 40%) are in the posterior lobes. In general, the location of the underdeveloped shares is evenly distributed, despite the greater number of front ones, this indicates the need for a broader understanding of the problem than the presence of a “goat udder” in part of the herd. The above data indicate that almost half of the herd is at risk of «dry milking» and therefore all its negative consequences [29,30].

The results of these studies allow to speak about the possibility of obtaining significant technological and economic effects by conducting breeding work aimed at developing a herd suitable for machine milking on udder morphology. The use of modern systems of automation of the process much easier and allows you to more efficiently perform the selection of animals.

Conclusions. In the study, it was found that the number of animals having udder with underdeveloped lobes, at the time of emptying is much larger than the number of animals with visually unevenly developed mammary gland and is recorded at 47.7%. While there are various combinations of immature shares. Of the total number of unequally developed lobes of the udder right front accounting for 27.2%; the left front – 34%; the left rear – 22.4%; right back to 16.4%.

Uniform development of the udder is one of the most important indicators of suitability for machine milking. However, the finish time of the milking of the lobes is more important than the amount of milk contained in them, as evenly developed udder is a quality that ensures the absence of «dry



milking». These data indicate that almost half of the herd is at risk of «dry milking», and therefore all its negative consequences.

Given the fact that in the herd there is a fairly large number of cows with the irregular shape of the udder and asymmetric breast development, it is advisable to use the milking system udder quarters, protecting the gland from the negative factors of the «dry milking».

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ВПЛИВ ТЕХНОЛОГІЧНИХ ОЗНАК ВИМЕНІ КОРІВ НА ПРИДАТНІСТЬ ДО МАШИННОГО ДОЇННЯ

Анотація

Результати проведених досліджень дозволяють говорити про можливість отримання значного технологічного та економічного ефекту за рахунок проведення селекційної роботи, спрямованої на формування стада придатного до машинного доїння по морфології вимені. При цьому використання сучасних систем автоматизації процесу істотно полегшує і дозволяє більш якісно проводити відбір тварин.

Індекс вимені є кількісним показником рівномірності розвитку долей вимені. Це об'єктивний показник розвитку і функціонального стану долей вимені, важливий для скорочення тривалості холостого доїння і збереження здоров'я тварини при машинному доїнні. В ході дослідження було встановлено, що кількість тварин, що мають вим'я з недорозвиненими частками, по часу видоювання значно перевищує кількість тварин з візуально нерівномірно розвинутою молочною залозою і становить 47,7%. При цьому зустрічаються найрізноманітніші комбінації



недорозвинених часткою. Із загальної кількості нерівномірно розвинених часткою вимені праві передні складають 27,2%; ліві передні – 34%; ліві задні – 22,4%; праві задні – 16,4%.

Рівномірність розвитку вимені - один з найважливіших показників придатності до машинного доїння. Разом з тим, час закінчення доїння часткою важливіше, ніж кількість молока, що міститься в них, тому що рівномірно розвинене вим'я – це якість, що забезпечує відсутність «сухого доїння». Наведені дані свідчать про те, що практично половина стада знаходиться в зоні ризику «сухого доїння», а значить і всіх його негативних наслідків. Наведено структуру недорозвинених долей у тварин, яка свідчить про те, що значна кількість нерівномірно розвинених долей (майже 40 %) знаходиться у задніх долях.

З урахуванням того, що в стаді є досить велика кількість корів з неправильною формою вимені і асиметричним розвитком молочної залози, доцільно використовувати систему доїння вимені по чвертях, що забезпечує захист залози від негативних чинників «сухого доїння».

Ключові слова: тваринництво, корова, машинне доїння, ефективність, придатність до доїння, функціональний стан часток вимені.

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ВЛИЯНИЕ ТЕХНОЛОГИЧЕСКИХ ПРИЗНАКОВ ВЫМЕНИ КОРОВ НА ПРИГОДНОСТЬ К МАШИННОМУ ДОЕНИЮ

Аннотация

Результаты проведенных исследований позволяют говорить о возможности получения значительного технологического и экономического эффекта за счет проведения селекционной работы, направленной на формирование стада пригодного к машинному доению по морфологии вымени. При этом использование современных систем автоматизации процесса существенно облегчает и позволяет более качественно проводить отбор животных.

Индекс вымени является количественным показателем равномерности развития долей вымени. Это объективный показатель развития и функционального состояния долей вымени, важный для сокращения продолжительности холостого доения и сохранения здоровья животного при машинном доении. В ходе исследования было установлено, что количество животных, имеющих вымя с недоразвитыми долями, по времени видоювания значительно превышает количество животных с визуально неравномерно развитой молочной железой и составляет 47,7%. При этом встречаются самые разнообразные комбинации недоразвитых долей. Из общего количества неравномерно развитых долей вымени правая передняя составляют 27,2%; левые передние - 34%; левые задние - 22,4%; правая задняя - 16,4%.

Ключевые слова: животноводство, корова, машинное доение, эффективность, пригодность к доению, функциональное состояние долей вымени.