

EFFICIENCY OF DIFFERENT MILKING SYSTEMS USAGE UNDER CONDITIONS OF RESOURCE-SAVING TECHNOLOGIES OF MILK PRODUCTION

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The article presents the efficiency evaluating results of easily build cowsheds in modern milk production technologies and the use of high-productive milking plants such as "Parallel" and "Carrousel" with 32 machines each and robotic milking systems. It has been established that the new type of premises not only provides comfortable conditions for keeping high-yielding cows, but also reduces labor costs for their maintenance and, most importantly, allows the use of modern high-productive milking plants such as "Parallel" and "Carrousel", as well as the usage of "motivational milking" technology. It has been established that the technology of preparing cows for milking and milking technology provides more complete realization of milk ejection reflex at the installation of the "Parallel" type and robotic milking system. The average intensity of cows' milk flows at these plants is 30% and 47% higher compared to those of the installation of "Carrousel" type, which is confirmed by the intensity of milk flow production at the first minute of milking.

The multiplicity of cows' milking of different lactations under conditions of "motivational milking" depending on their productivity and lactation period was also studied. It has been proved that the higher the daily yield, the more often the cow goes to milking. Thus, animals with a daily milk yield of 10 to 20 kg go to milking in average of 2.34 times a day, and with a daily milk yield of 40 and above - 3.39 times.

It has been deemed that milk obtained with the help of a milking parlor of the "Parallel" type and a robotic milking system has higher values of mass fraction of fat and protein, which is associated with the genetic potential of animals, their diet and quality of milking. According to physical, chemical and technological properties, milk obtained at the milking parlors "Parallel" and "Carrousel", as well as robotic milking systems meets current standards. Due to bacterial contamination, reductase test and milk clot characteristics, milk obtained with a Parallel milking parlor as well as the robotic milking system has higher quality indicators than with the use of the Carrousel type installation. But according to a set of indicators, the milk obtained by the studied milking systems belongs to the desired class of cheese.

Key words: *dairy farms, milking parlors, robotic milking systems, milk ejection process, milking multiplicity, quality and technological properties of milk, "motivational milking".*

Recent years in Ukraine have been characterized by the active introduction of the newest farms for 500 and 1,000 cows with resource-saving milk production technologies.

They are based on easy-assembly premises with free-stall housing for keeping of highly productive cattle and milking them in specialized halls with milking parlors of different types, the basic of which are "Parallel" and "Carrousel" with different number of machines. In addition, dairy farm projects for 500 cows with robotic milking systems have been developed and implemented [32, 34, 38, 40].

The application of the latest technologies in milk production makes it possible to implement in full new approaches to keeping and exploiting of livestock, especially highly

productive, and to provide a higher economic effect [3, 5, 25]

It is known that the technology of milk production is a complex biotechnical system in which the conditions of animals' maintenance, technical and technological links come into direct interaction with the biological object – the animal. Therefore, the productivity of animals is greatly influenced by the technology of their keeping [6, 15, 25, 26, 33].

Studies that were conducted in recent years have shown a significant advantage and prospects for keeping of high-yielding cows in easily build cowsheds with a width of 32.5 and 36 m (Figs. 1, 2) [11, 29, 32].

With such volumetric – planning and technological solutions, the volume of premises per

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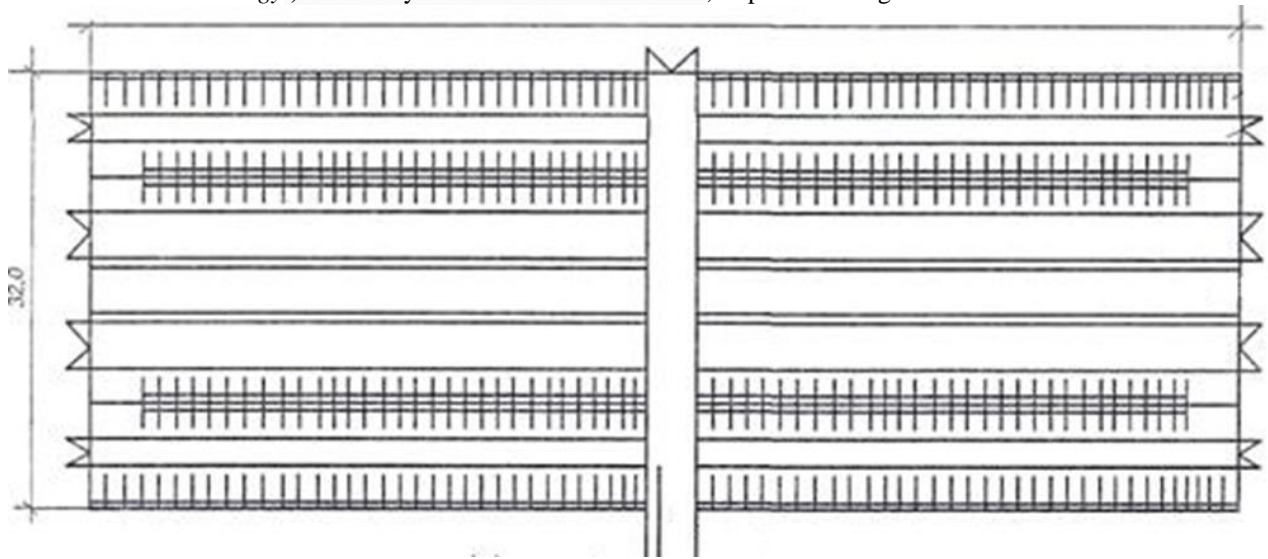


Figure 1. Easily assembled premises 32,5 m wide.

one animal enlarges almost 2 times from 45.6 m³ up to 96.3 m³. At the same time, due to the increase of air velocity from 0.16 ... 0.27 m / s to 0.5 m / s, the ammonia content in the room

air reduces by 8-9 times, and bacterial contamination in comparison with the norms - by 18 , 7 times [3, 5, 27].

Studies also show that no machine or

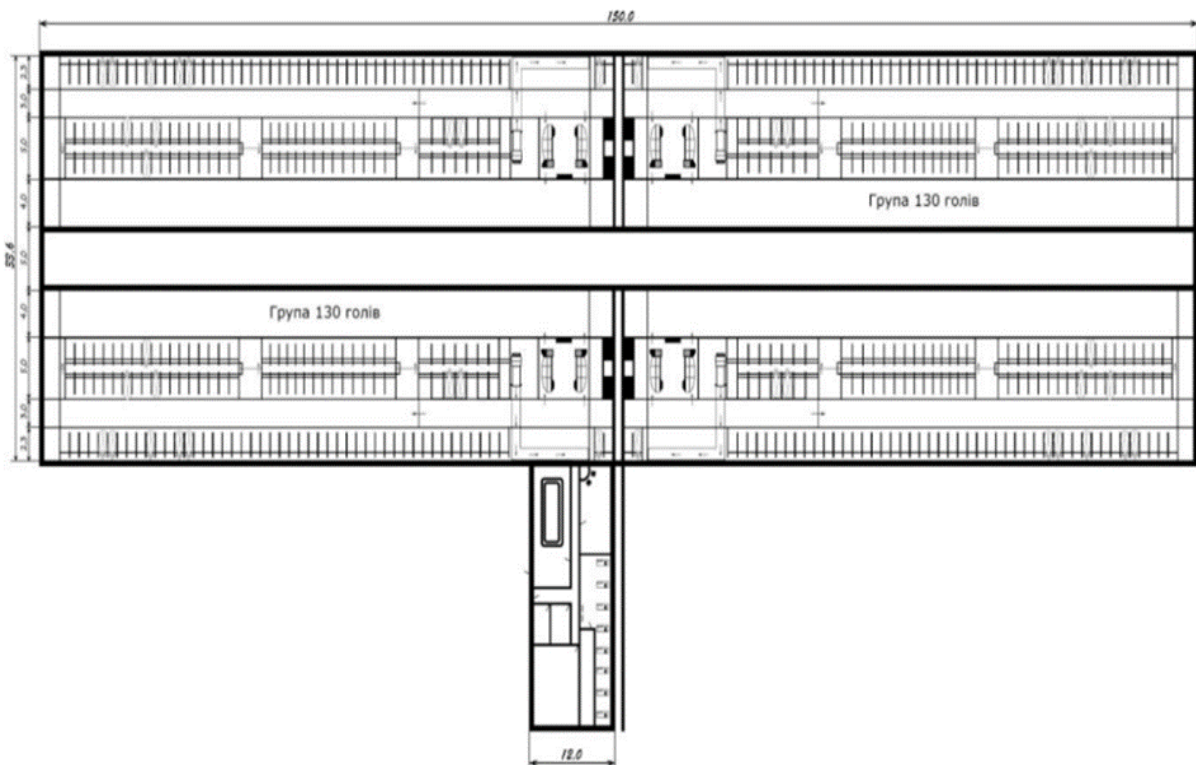


Figure 2. Easily assembled premises 36 m wide.

process equipment is in close contact with an animal as a milking parlor, in particular its main actuator, the milking machine [4, 14, 16, 36]. Therefore, the design of the milking parlor has a

decisive influence on the milking process, in particular on the implementation of the milk reflex in cows, and on the quality of milk and its

technological properties [17, 19, 23, 30, 31, 43, 45, 46].

Milking parlors such as "Parallel" and "Carrousel" implemented in Ukraine, (Figs. 3, 4) differ significantly from each other in design

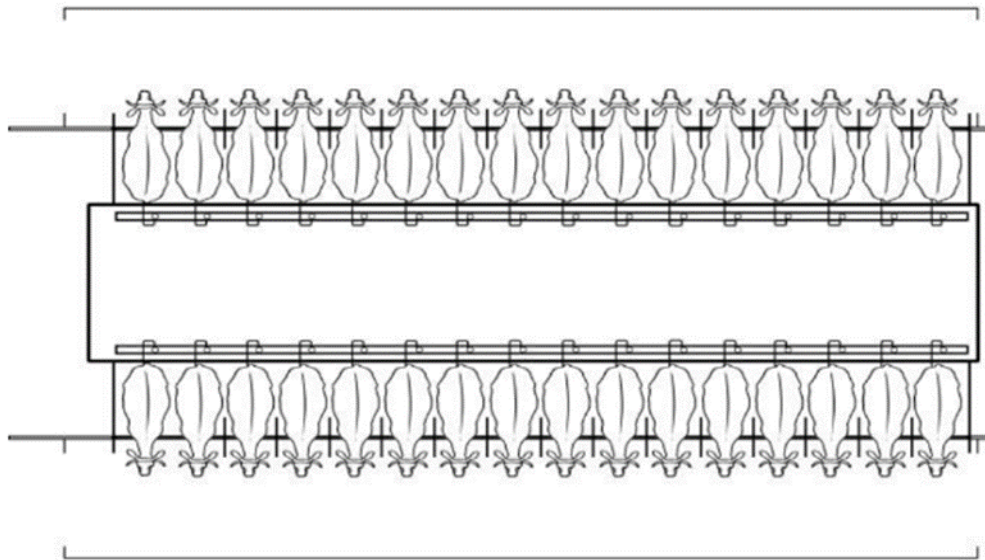


Figure 3. The milking parlor "Parallel".

and technology of milking, in particular, the placement of cows in machines, their preparation for milking and control of the milking process.

The milking unit "Parallel", which is serviced by two operators, 16 cows visit by the same time, after that the udder is washed mechanically with warm water and wiped with a disposable napkin, milking of the first streams of milk and connection with milking machines takes place. Each operator simultaneously serves 8 cows.

The Carrousel milking plant has 32 machines, which are placed according to the "Herringbone" scheme and are serviced by three milking machine operators according to the following scheme: the first operator wipes the udder first with wet and then dry wipes, milks the first streams of milk and disinfects the teats with a special solution; the second one connects the milking machine and controls the milking process, and the third operator performs the final milking operations and regulates the speed of the moving platform.

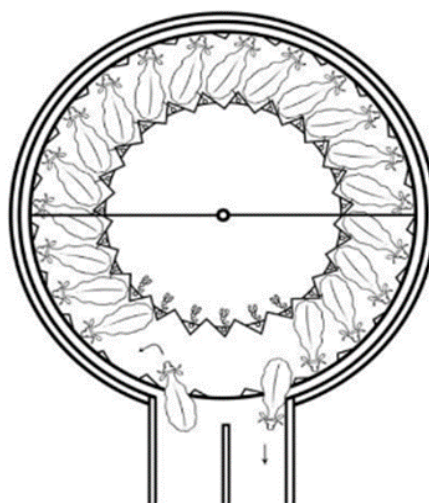


Figure 4. The milking parlor "Carrousel".

Unlike traditional milking parlors, the use of robotic milking systems (Fig. 5) ensures the

execution of all operations automatically without human intervention. Their functioning

is based on the so-called "motivational milking" or "voluntary milking", when animals are milked not according to the daily routine, but according to their own desire, which appears only when all their functions related to milking

reach the maximum level. Therefore, in the process of research the need to determine the frequency of cows' milking at different stages of lactation appeared.

Despite such differences in the design of



Figure 5. The Voluntary Milking System (photo from the Internet).

these milking parlors and the technology of cows' milking at them, researches, in comparative terms, the assessment of the milking process quality was not conducted, which greatly complicates the process of selecting milking equipment for new farms.

Therefore, the aim of our research was to study the keeping of high-yielding cows in new premises, as well as to assess the effectiveness of the use of milking parlors such as "Parallel", "Carrousel" and robotic milking systems.

Research materials and methods. The study has been performed at dairy farms "Terezine" DLC and "Ostriykyvske" DLC of Bila Tserkva district in Kyiv region, in which new types of premises with a width of 32.5 and 36 m with a yard housing system have been built. Conditions for keeping of highly productive cows in easily assembled premises of a new type were assessed by microclimate indicators: temperature, relative humidity, gas content, bacterial air pollution and behavior of cows of different physiological groups [1].

Daily and weekly thermographs were used for direct registration of temperature and relative humidity: model M-16 AN ("Hydrometpribor", Russia); model M-16 AS ("Hydrometpribor", Russia), model M-21 AS ("Hydrometpribor", Russia) and psychrometer - model MV-4M ("Hydrometpribor", Russia).

The speed of indoor air was determined with a cup anemometer model MS-13 ("Hydrometpribor", Russia), the concentration of ammonia and hydrogen sulfide - gas analyzer model UG-2 ("Analitpribor", Ukraine), carbon dioxide content - by chemical method [7]. Bacterial air pollution was determined using a bacterial analysis device "Typhoon" model R-40 ("Thermolab", Ukraine).

Indicators of milk ejection and milk flow at cows were researched in two groups of cows-analogues that were in the 2-4 months of lactation, suitable for machine milking and had the same productivity and daily hopes. Registration of indicators was carried out by means of ASUTP of farms.

The intensity of milk flow in cows was determined by formula 1:

$$Q = \frac{\sum^n (g_1 + g_2)}{\sum^n (t_1 + t_2)} \quad (1)$$

Where q_1 is the value of machine milking, kg;
 q_2 is the value of machine dry milking, kg;
 t_1 is the duration of machine milking, min;
 t_2 is the duration of machine dry milking, min.

The assessment of the quality of milk indicators was carried out using the device "Bentley 150 Combi" ("BentleyInstrumentsInc.", USA).

Evaluation of the chemical composition of milk was performed by determining the percentage of fat mass, true protein, protein, lactose and solids skimmed milk residue by infrared spectroscopy at the device "Bentley 150 Combi" ("BentleyInstrumentsInc", USA).

Total bacterial contamination of milk was studied by a method based on the properties of mesophilic aerobic and facultatively anaerobic microorganisms to multiply on dense nutrient agar ("ALFARUS", Ukraine) at a temperature of 30 ± 1 °C for 72 hours (DSTU IDF 100B: 2003).

The number of growing bacterial clumps was counted in each Petri dish.

The total number of bacteria in 1 cm³ or 1 g of milk (X) was evaluated by formula 2:

$$X = n \cdot 10^m, \quad (2)$$

Where *n* is the quantity of clumps, counted in Petri dish; *m* is the quantity of tenfold dilutions.

The coli titer of milk was determined by a method based on the properties of Escherichia coli bacteria to ferment lactose in Kessler's medium, which leads to the formation of acids and gases (GOST 9225).

Somatic cells in milk were examined using a viscometer "Somatos" model AMV-1-0, 2

(Agroservice, Ukraine). 5 cm³ of Mastoprim solution and 10 cm³ of experimental milk were collected into the vessel of the device. The number of somatic cells in milk was determined by the time of expiration of the mixture of test milk with the drug (GOST 23453).

The thermal stability of milk was evaluated by a method based on the ability of ethyl alcohol to completely or partially denature milk proteins and thereby disrupt the stability of the colloidal system (DSTU 5073: 2008).

Research results. Influence of new volumetric-planning and technological solutions of premises under conditions for the maintenance of highly productive cows was estimated by the indicators of the microclimate and ethological indicators and compared with the traditional cows in Ukraine (Table 1, 2, 3)

It was established that new volumetric-planning and technological solutions of the premises provide comfortable conditions for the maintenance of highly productive cows during the year.

Table 1. Indicators of microclimate in different types of premises in winter

Indicator	Meaning of the indicator			
	Normative parameters for VNTP-APK	Traditional cow house with tie-up housing	New type of a cow house of 32,5 м	New type of cow house of 36 м
Speed of air movement m/s	0,3–0,4	0,16...0,27±0,05	0,5±0,09***	0,55±0,09***
Lighting in the feeding area, lux	52,0	31,0±2,70	49,0±3,2**	51,0±3,6**
Air gas pollution: Ammonia, mg/m ³	20,0	10,5±0,50	1,3±0,25**	1,3±0,25**
Carbon dioxide, %	0,25	0,75±0,05	0,05±0,01***	0,03±0,01***
Bacterial air pollution, thousands/m ³	Up to 70	493,6 ± 0,57	26,4 ± 2,5 ***	25,4 ± 2,3 ***

Note: **P>0,99; ***P>0,999.

The presence in the design of these rooms of the side curtains and the light-aeration crest increases the speed of air more than three times (0.5 m/s vs. 0.16 m/s), that positively affects the gas content of the premises and bacterial air pollution. The presence of ammonia in new cows

houses is 8–9 times less in comparison with traditional premises, and bacterial contamination, due to volume increase of the premises up to 129.6 m³ per head, decreases to a minimum level and is 2,8 thousand / m³ (P> 0,999) in winter

period Studies of the behavior of cows in

new types of premises have shown that the animals have been at rest for a long time. They lie without activity 52.1–51.7 % of the time of day, and at low temperatures this figure increases to 54 %, while in a traditional cowshed the rest reaches only 46.34 % (Table

3). Also a positive fact is that cows in easily assembled cowsheds have the opportunity to move freely, which they spend 8.6–10.24 % of the time, and thanks to feeding from the feed

Table 2. Indicators of microclimate in different types of premises in summer

Indicator	Meaning of the indicator			
	Normative parameters for VNTP-APK	Traditional cow house with tie-up housing	New type of a cow house of 32,5 m	New type of cow house of 36 m
Speed of air movement m/s	0,3–0,4	0,26±0,02	0,6±0,04***	0,7±0,05***
Lighting in the feeding area, lux	52,0	53,4±1,13	63,1±4,60**	65,5±3,50**
Air gas pollution: Ammonia, mg/m ³	20,0	8,2±0,70	0,9±0,25**	0,7±0,30**
Carbon dioxide, %	0,25	0,85±0,07	0,08±0,01***	0,07±0,01***
Bacterial air pollution, thousands/m ³	Up to 70	523,4±1,21	38,6±0,09***	34,6±0,11***

Note: **P>0,99; ***P>0,999.

Table 3. Behavior of cows in different types of premises (n = 80)

Indicator	Type of cow house					
	New easy assembled with the width				Traditional with the width	
	32,5 m		36,0 m		24,0 m	
	Duration of the behavior act					
	min.	%	min.	%	min.	%
Method of maintenance	Free-stall housing				Tie-up housing	
Lie without activity,	750,0	52,1	731,8	50,8	667,2	46,34
Some of them chewing cud	174,7	23,3	170,2	22,8	149,6	22,43
Stand without activity,	262,2	18,20	270,1	18,78	431,6	29,98
Some of them chewing cud	37,2	14,2	36,1	13,36	66,2	13,29
Move	123,0	8,6	135,0	9,3	-	-
Consume food	252,0	17,4	250,0	17,3	320,2	22,23
Consume water	19,8	1,4	20,1	1,52	13,8	0,95
Milking	33,0	2,3	33,0	2,3	7,2	0,5

table reduced feed time to 17.4–18.9 %.

It has been established that the new type of premises provides not only comfortable conditions for keeping high-yielding cows, but also reduces labor costs for their maintenance and, most importantly, allows the use of modern high-performance milking machines such as "Parallel", "Carrousel" and robotic milking systems.

Since the use of robotic milking systems, the animal is not milked according to the daily

routine, as on farms with traditional milking, but at its own request, there is an urgent need to investigate the frequency of different lactations cows' milking depending on their productivity and lactation period (Tables 4, 5).

It has been proved that the higher the yield in 24 hours, the more often the cow goes for milking. Thus, animals with a daily milk yield of 10 to 20 kg go to milking in average of 2.34 times a day, and with a daily milk yield of 40 and above – 3.39 times.

Today, it is undeniable fact that the average daily productivity of cows varies in different periods of lactation and is highest in the first third of lactation, and the lowest - in the last. Exactly during these periods the largest and smallest number of milking, which constitutes in average 2.38 and 1.88 times per 24 hours, respectively takes place (Table 5).

It was found that the lowest frequency of milking during lactation the first-born cows had (2.17 times), which peaked in the second lactation (2.24 times) and gradually decreased in the third one (2.21 times) and the fourth one (2.18 times).

Table 4. Frequency of different lactations cows' milking depending on their productivity, $M \pm m$, $n = 32$

Yield per lactation	3550-6500 kg	6550-9500 kg	9550-12500 kg	12550-15500 kg
Milk yields in 24 hours	10 - 20 kg	21 - 30 kg	31 - 40 kg	41-50 kg
1 lactation	2,12 ± 0,17	2,22 ± 0,12	2,57 ± 0,15	3,00 ± 0,18**
2 lactation	2,64 ± 0,18	2,74 ± 0,11	3,12 ± 0,14	4,10 ± 0,17**
3 lactation	2,38 ± 0,17	2,57 ± 0,15	2,82 ± 0,11	3,34 ± 0,13**
4 lactation	2,22 ± 0,16	2,42 ± 0,12	2,60 ± 0,14	3,10 ± 0,19**
Average at groups	2,34 ± 0,09	2,49 ± 0,07	2,78 ± 0,18	3,39 ± 0,29

Note**- $P > 0,99$ in comparison with the group with productivity 10 – 20 kg.

Table 5. Frequency of different lactations cows' milking depending on the Period of lactation, $M \pm m$, $n = 32$

Descriptors	0-100 days	101-200 days	201-305 days	Average per lactation
1 lactation	2,28 ± 0,07	2,37 ± 0,07	1,87 ± 0,18	2,17 ± 0,24
2 lactation	2,45 ± 0,11	2,36 ± 0,09	1,92 ± 0,10	2,24 ± 0,22
3 lactation	2,41 ± 0,06	2,34 ± 0,08	1,89 ± 0,21	2,21 ± 0,21
4 lactation	2,36 ± 0,09	2,30 ± 0,05	1,87 ± 0,20	2,18 ± 0,32
Average at groups	2,38 ± 0,08	2,34 ± 0,07	1,88 ± 0,17	2,20 ± 0,06

This decrease in the frequency of milking with increasing productivity for the third and fourth lactation is explained by the fact that with increasing of age in lactations, the udder of cows reaches its maximum parameters, ensuring its optimal functioning, positively affecting the

processes of milk production.

The effectiveness of these installations usage was estimated by the indicators of the milk ejection reflex realization of the intensity of milk flow per minutes of milking, total milk yield and quality of milk (Table 6).

Table 6. Indicators of milk flow at cows with different types of milking installations $M \pm m$, $n=20$

Indicators	Types of milking installations		
	"Parallel"	"Carrousel"	«VMS»
Average intensity of the milk flow, kg/min	1,93±0,25	1,47±0,12**	2,17± 0,27***
Intensity of the milk flow, kg/min:			
Per the first minute of milking	2,97±0,10	1,85±0,02***	2,85 ± 1,01***
Per the second minute of milking	2,49±0,15	2,35±0,20**	2,76 ± 1,00**
Per the third minute of milking	2,05±0,05	1,85±0,03**	2,61 ± 0,98**
Average milk yield, kg	12,10±0,17	11,5±0,15*	12,5 ± 0,94*
Total milking time, min.	6,30±0,15	7,08±0,10**	7,3 ± 0,56**

Note: *** $P > 0,999$, ** $P > 0,99$.

Studies have shown that the milking reflex in cows is more fully manifested in the milking machine of the "Parallel" type and robotic

milking system than in the installation of the "Carrousel" type.

Thus, the average intensity of milk production in cows at the milking parlor "Parallel" is 30 %, and when using a robotic system is 47 % higher compared to the installation such as "Carrousel". The full realization of the milk reflex with the "Parallel" type installation and the robotic milking system "VMS" is evidenced by the maximum intensity of milk production at the first minute of milking, which is at the level

of 2.97 kg / min and 2.85 kg / min, respectively, against 1,85 kg / min ($P > 0.999$) at the installation of the "Carrousel" type. At the same time, the maximum rate of milk let-down at the Carrousel type machine is observed at the second minute of milking, which indicates the inhibition of the lactation reflex (Fig. 6). The investigations have established that the milk flow reflex in cows is on full display at the milking machine of the "Parallel" type

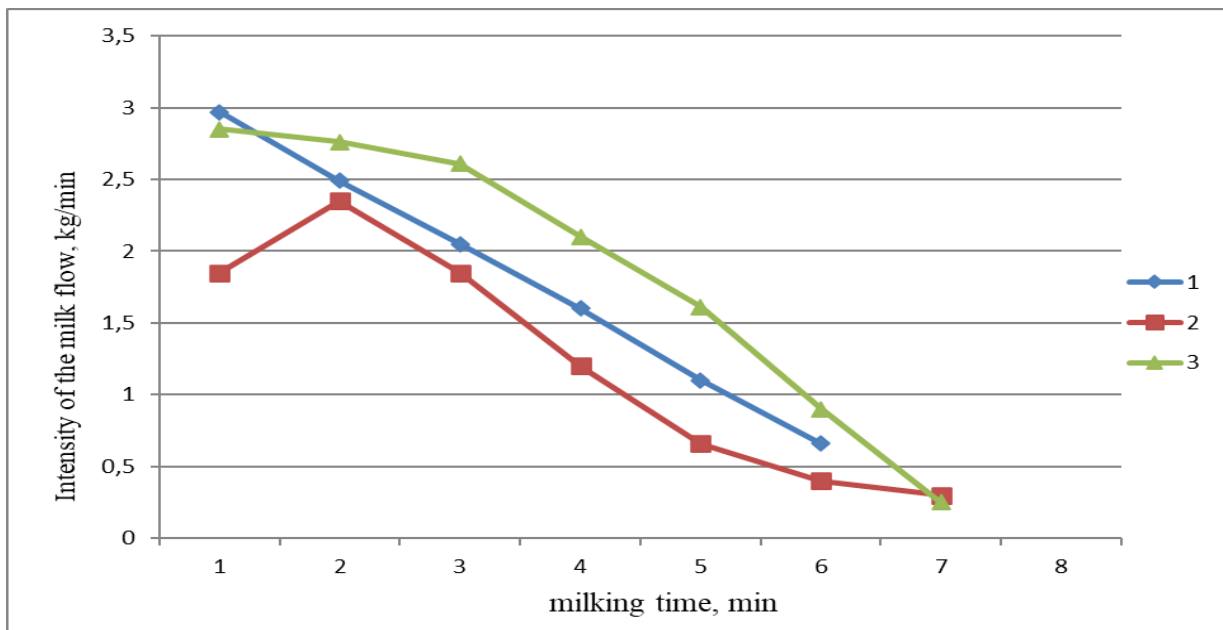


Figure 6. Intensity of the milk flow in cows on different types of milking parlors: 1- "Parallel", 2- "Carrousel", 3- "VMS".

and robotic milking system than in the installation of the "Carrousel" type. Thus, the average intensity of milk production in cows at the milking installation "Parallel" is per 30 %, and when using a robotic system is per 47 % higher compared to the installation such as "Carrousel". The full realization of the milk flow reflex at the "Parallel" type installation and the robotic milking system "VMS" is evidenced by the maximum intensity of milk production at the first minute of milking, which is at the level of 2.97 kg/min and 2.85 kg/min, respectively, against 1, 85 kg/ min ($P > 0.999$) at the installation of the "Carrousel» type. At the same time, the maximum rate of milk flow at the Carrousel type installation is observed at the second minute of milking, which indicates the inhibition of the milk ejection reflex (Fig. 5). The obtained results are corresponding with the research of Izmailova N. O. [16] and other scientists [21].

Simultaneously with the physiological evaluation of the milking process, the quality of milk and its technological properties were investigated using these types of milking parlors (Table 7).

According to the results of the study it has been established that while using robotic milking systems milk has a slightly higher mass fraction of fat and protein than at milking installations such as "Parallel" and "Carrousel", which is obviously connected with milking technology and with the fact that at these farms cows have a high productivity at the level of 9-10 thousand kg per lactation and in their diets there is a high percentage of concentrated feed, feeding which provides a high level of fat and protein in milk.

It is known that in the process of dairy production among the physicochemical properties of milk titrated acidity, active acidity,

density, heat resistance and so on are the most important. Titrated acidity is a criterion for assessing the quality of the primary components of milk, namely its freshness and naturalness, and depends on a combination of factors (period of the year, lactation stage, animals' health, physiological condition, diet, etc.).

At the same time, in the production of dairy products, the active acidity index is more important than the titrated acidity, as a number of process indicators depend on the pH value.

Table 7. Quality and technological indicators of milk, obtained at different types of milking installations $M \pm m$, $n=12$

Indicator	Type of milking installation		
	"Parallel"	"Carrousel"	«VMS»
Mass fraction of fat, %	4,15±0,02	4,1±0,01	4,2 ± 0,12
Mass fraction of protein, %	3,12±0,04	3,07±0,03	3,4 ± 0,05
Mass fraction of dry matters, %	12,83±0,11	12,35±0,07	12,88±0,08
SNF, %	8,68±0,05	8,55±0,03	8,71±0,03
Density, kg/m ³	1027, 5±0,02	1028,1±0,01	1027,0±0,01
Titrated acidity, °T	18,5±0,4	18,0±0,3	17,0±0,5
Active acidity, pH	6,67±0,01	6,68±0,01	6,69±0,01
Level of purity by the sample, group	I	I	I
Thermal stability according to the alcohol test, group	II (alcohol 75%)	III (alcohol 72%)	II (alcohol 75%)
Freezing point ° C	-0,56 ± 0,01	-0,57 ± 0,01	-0,56 ± 0,01
Bacterial contamination, thousands. KUO/cm ³	205,5±9,67	314,0 ± 10,05	51,0 ± 2,60
Quantity of somatic cells thousands./cm ³	285,6±17,2	375,4±27,4	105,0±1,8
Reductase test, class	The highest (more than 3,5 hours)	I (3,5 hours)	The highest (more than 3,5 hours)
Fermentation test, class	I	II	I
Rennet fermentation test, class	I	II	I

The cryoscopic freezing point of milk ranges from -0.57 ° C to -0.55 ° C is within normal limits. The active acidity of milk obtained from the use of milking installations such as "Parallel", "Carrousel" and robotic milking systems is also within normal limits, while the titrated acidity of milk obtained from the milking parlor "Carrousel" is the lowest. In our opinion, this may be due to the fact that the milk obtained at this plant has an increased content of somatic cells that indicates a higher incidence of mastitis in cows.

A study of the sanitary and hygienic parameters of milk showed that in terms of bacterial contamination and reductase testing, milk obtained at the "Parallel" milking plant and robotic milking system also has higher quality indicators than when using the "Carrousel" plant). This is obviously due to the better

Also the cryoscopic freezing point of milk is of great importance, which allows, as an indicator of falsification, to determine the degree of dilution of milk with water [20, 39].

A comparative assessment of the physicochemical and technological properties of milk shows that the milk when using the studied types of milking installations fully meets the requirements of the current standard (DSTU 3662: 2018), that indicates the absence of falsifications.

execution of preparatory operations and better milking of cows at the "Parallel" installation and robotic milking system.

The suitability of milk for cheese making was evaluated by the rate of milk clot formation under the action of rennet and fermentation test. Thus, according to the fermentation test, the milk obtained at the "Parallel" milking plant and the robotic milking system was assigned class I, because the clot had a smooth surface, elastic to the touch, no voids in the longitudinal section and floated in whey that does not stretch. And the milk obtained at the "Carrousel" installation was assigned class II, because the clot was soft to the touch, with isolated voids (1-10), torn, but not swollen.

But according to a set of indicators, the milk obtained at the studied milking plants belongs to the desired class of cheese making.

Conclusions

1. New types of livestock premises with a width of 32.5 m and 36 m provide comfortable conditions for keeping of high-yielding cows and provide the opportunity to use highly productive milking installations "Parallel" and "Carrousel", as well as robotic milking systems

2. The milking technology of cows at the installation of the "Parallel" type and robotic milking systems is more physiological in relation to the animal, as it provides high quality preparation of cows for milking and the intensity of milk flow during the first milking minute is at the level of 2.97 and 2.85 kg / min

against 1.85 kg / min at the installation of the "Carrousel" type.

3. The robotic milking system and milking installation of the "Parallel" type provide higher indicators of milk quality and its technological properties in comparison with the "Carrousel" type installation.

4. The growing trends dealing with the quality of milk cause the need to improve the processes of its production and revision of a number of scientific standards for the production of high quality products with a simultaneous transition to stricter standards for determining its quality indicators.

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Луценко М. М., Ластовська І. О. Ефективність різних молочних систем за умов ресурсощадних технологій молочної продуктивності

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У статті представлено результати оцінки ефективності легкозбірних корівників за сучасних технологій виробництва молока та використання високопродуктивних доїльних установок типу «Паралель» та «Карусель» та роботизованими доїльними системами. Встановлено, що новий тип приміщень знижує витрати праці на утримання, а головне, дозволяє використовувати сучасні високопродуктивні доїльні установки, а також технології «мотиваційного доїння». Встановлено, що технологія підготовки корів до доїння та технологія доїння забезпечує більш повну реалізацію рефлексу викиду молока при установці системи доїння типу «Паралель» та роботизованої системи доїння. Середня інтенсивність потоків молока корів на цих підприємствах на 30% та 47% вище в порівнянні з установками типу «Карусель», що підтверджується інтенсивністю виділення молока на першій хвилині доїння.

Досліджено також кратність доїння корів різної лактації в умовах «мотиваційного доїння» залежно від їх продуктивності та періоду лактації. Доведено, що чим вище добовий надій, тим частіше корова йде на доїння. Так, тварини з добовим надоєм від 10 до 20 кг виходять на доїння в

середньому 2,34 рази на добу, а з добовим надоєм 40 і вище – 3,39 рази. Молоко, одержане за допомогою доїльної установки типу «Паралель» та роботизованої доїльної системи, має вищі значення масової частки жиру та білка, що пов'язано з генетичним потенціалом тварин, їх раціоном та якістю доїння. Завдяки бактеріальному забрудненню, редуцтазному тесту та характеристикам згустку молока молоко, отримане за допомогою паралельної доїльної зали, а також роботизованої системи доїння має вищі показники якості, ніж при використанні установки типу «Карусель». Але за сукупністю показників молоко, отримане досліджуваними системами доїння, відноситься до бажаного класу.

Ключові слова: молочні ферми, доїльні зали, роботизовані доїльні системи, процес молоковіддачі, кратність доїння, якість та технологічні властивості молока, «мотиваційне доїння».