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COMPREHENSIVE STUDY OF MILK PRODUCTIVITY OF FIRST-CALVING SIMMENTAL COWS OF CZECH SELECTION UNDER THE CONDITIONS OF LLP "AQTOGAI MILK"

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Annotation. The study presents the results of research on the influence of the lactation period and calving season on the milk productivity and milk quality of first-calving Simmental cows of Czech selection kept under the conditions of LLP "Aqtogai Milk" in the Pavlodar region. The aim of the study was to identify patterns of changes in milk yield, fat, and protein content during different phases of lactation and in various calving seasons, in order to ensure a stable supply of high-quality milk throughout the year. The research was conducted on 15 first-calving cows kept under identical feeding and housing conditions. Indicators such as milk yield, fat and protein content, as well as the total amount of milk fat and protein produced during lactation, were determined. The chemical composition of milk was analyzed using standard methods.It was found that the average milk yield per lactation was 4,995.4 kg, with an average fat content of 4.10% and protein content of 3.04 %, exceeding the breed standard by 2,845 kg. The highest milk productivity was observed in the third month of lactation (25.4 kg per day), while the highest fat content was recorded during the initial milking phase (4.24 %). The study of the influence of the calving season showed that the highest productivity and economic efficiency were achieved in cows with winter and autumn calving (milk yields of 4,943 and 4,683 kg, revenues of 593,160 and 561,960 tenge, respectively). The lowest results were observed in cows calving in summer (4,501 kg).

Keywords: Simmental breed, lactation, calving season, milk productivity, milk fat content, economic efficiency.

Introduction. In the leading countries of the world with developed dairy farming, breeding programs are primarily focused on increasing the protein content in milk, and one of the main trends in the industry is the production of high-tech and environmentally friendly food products [1].

Providing the population with high-quality dairy products is one of the most important and socially significant tasks, the solution of which largely depends on milk producers.

Scientific concepts and practical experience, both in our country and abroad, demonstrate that the efficient production of high-quality milk is possible only under certain conditions: purposeful breeding work, an effective feed production system, and balanced, nutritionally adequate feeding [2].

The genetic potential of dairy cattle productivity has now reached 10,000 kg or more. The dairy industry in Kazakhstan aims to achieve positive results both in increasing milk production and improving its quality [3]. The sustainable growth of livestock production, based on higher productivity and improved economic and hereditary traits, requires a combination of external management measures and systematic breeding work, provided that animal husbandry is conducted at a high technological level.

In recent years, LLP "Aqtogai Milk" has been carrying out work to develop a desirable type of dairy cattle characterized by a well-defined dairy conformation and high productivity. The productive and exterior traits of these animals have been studied to some extent, whereas the quality and technological properties of their milk remain less explored.

Understanding the influence of paratypic (environmental) factors on the quantitative and qualitative characteristics of milk production can significantly affect the profitability of dairy farming. Therefore, studies devoted to the comprehensive analysis of milk productivity, particularly the effects of lactation stage and calving season, are relevant both from a theoretical and practical standpoint.

Materials and Methods. The research was conducted at LLP "Aqtogai Milk" in the Pavlodar region. The object of the study was first-calving Simmental cows of Czech selection. The purpose of the study was a comprehensive assessment of the influence of the lactation period and calving season on the indicators of milk productivity and milk quality.

All experimental animals were kept under the same feeding, housing, and management conditions. The feeding rations were developed in accordance with the "Norms and Rations for Feeding Farm Animals" (Kalashnikov et al., 2018). The housing system was loose, using a "herringbone" type milking parlor. The cows had free access to drinking water and mineral supplements.

For the study, 15 first-calving cows were selected, with a live weight of 540–560 kg, in satisfactory body condition, and without signs of udder or reproductive system diseases.

Milk productivity was studied throughout one full lactation, from calving to the end of the lactation period. The following indicators were recorded:

- Milk yield (kg) – based on monthly control milking data;
- Milk composition – mass fraction of fat and protein (%);
- Amount of milk fat and protein (kg) – calculated values;
- Live weight of cows (kg) – measured at the beginning and end of lactation [4].

The influence of the lactation phase was analyzed by dividing the lactation period into three stages:

- Early lactation (1st–3rd month),
- Peak lactation (4th–6th month),
- Late lactation (7th–10th month) [5].

The influence of the calving season was determined by dividing the cows into four groups according to calving time: winter, spring, summer, and autumn.

Control milkings were carried out once a month according to the standard method (GOST 13264-88 "Milk. Rules for Sampling"). The mass fraction of fat was determined by the Gerber method, and protein content – by the Kjeldahl method (GOST 23327-98).

Milk density, acidity, and organoleptic properties were evaluated using standard zootechnical methods.

All obtained data were processed biometrically, with determination of the arithmetic mean (M), its standard error (m), and the reliability of differences (td), according to the method of Plohinsky (1970). The results are presented in tables and graphs [6].

The economic efficiency of milk production was calculated based on the revenue from milk sales at an average price of 220 tenge per 1 kg of milk. Feed and maintenance costs per cow were taken into account.

Results of the Study. According to numerous researchers, milk productivity, as well as the composition and properties of milk, are significantly influenced by changes occurring throughout the lactation period [6,7]. It has been established that milk undergoes both quantitative and qualitative variations during this time. The nature of these changes depends not only on the physiological condition of the animal but also on the expression of its genetic potential under the influence of paratypic (environmental) factors.

The primary objective of studying the effect of the lactation period on milk productivity and quality indicators is to ensure a consistent supply of high-quality milk and to prevent the decline in milk quality associated with the progression of lactation. Investigating this factor allows for the more efficient utilization of the productive potential of Simmental cattle, taking into account the specific characteristics of the lactation process to assess the influence of lactation, such indicators as milk yield, milk composition, and milk properties were analyzed. The study was conducted on first-

calving Simmental cows of Czech selection. The chemical composition of milk was examined monthly throughout the entire lactation period.

Table 1 – Main indicators of milk productivity of first-calving Simmental cows of Czech selection, average per lactation

Indicator	M±m
Milk yield, kg	4995,40±13,62
Fat content, %	4,10±0,05
Milk fat yield per lactation, kg	204,8±1,3
Mass fraction of protein, %	3,04±0,001
Milk protein yield per lactation, kg	151,8±0,4

Analysis of the obtained data showed that the milk yield of first-calving cows was at a sufficiently high level. Compared to the breed standard requirements, the milk yield of the studied first-calving cows exceeded the standard by 2,845 kg, and by 1,995 kg on average compared to the productivity indicators of Simmental cows in the Pavlodar region. The study of milk composition revealed that this farm is characterized by high milk yield and fat production, but relatively low protein content in milk.

Table2 – Dynamics of lactation by months according to average daily milk yield data during control milkings (n = 15)

Indicator	Lactation period, months									
	1	2	3	4	5	6	7	8	9	10
Average daily milk yield, kg	22,9± 0,66	23,9± 0,63	25,4± 0,31	22,9 ±0,77	19,4 ±0,49	18,9±0 ,86	17,3 ±0,68	20,2 ±1,7	15,0 ±1,2	11,6 ± 1,5
Mass fraction of fat, %	4,54 ±0,09	4,59 ± 0,07	4,49 ± 0,09	3,77 ±0,14	4,12 ± 0,11	4,16± 0,09	4,34 ±0,09	3,92 ±0,1	4,28 ±0,1	4,52 ±0,2

The indicators characterizing the lactation performance of Simmental cows are presented in Figure 1.

According to the obtained data, the highest milk productivity was observed during the first four months of lactation. The maximum milk yield in first-calving cows occurred in the third month of lactation, amounting to 25.4 kg of milk per day. In the following months, milk productivity gradually decreased to 17.3 kg, but in the eighth month of lactation, it increased again to 20.2 kg of milk.

Thus, it can be concluded that the lactation curve of the cows is moderate, without sharp declines or fluctuations in productivity. A noticeable decrease in milk yield was observed between the fifth and seventh months of lactation, while the peaks in milk production occurred in the third and eighth months (December and June, respectively).

The peak observed in the third month of lactation corresponds to the natural increase in productivity during the early lactation phase, whereas the secondary rise in the eighth month can be explained by the inclusion of fresh green forage in the cows' diets during that period (June) [8].

As noted by many researchers, not only the changes in milk productivity during the entire lactation period are of significant economic and production interest, but also the data characterizing the individual phases of lactation [9,10].

According to Tikhomirov T. V. and Butina V. S., when analyzing the influence of the lactation phase on milk composition and properties, a decrease in milk fat content during the winter–spring period is mainly the result of the early months of lactation, as well as unbalanced or inadequate feeding and seasonal molting of animals [11].

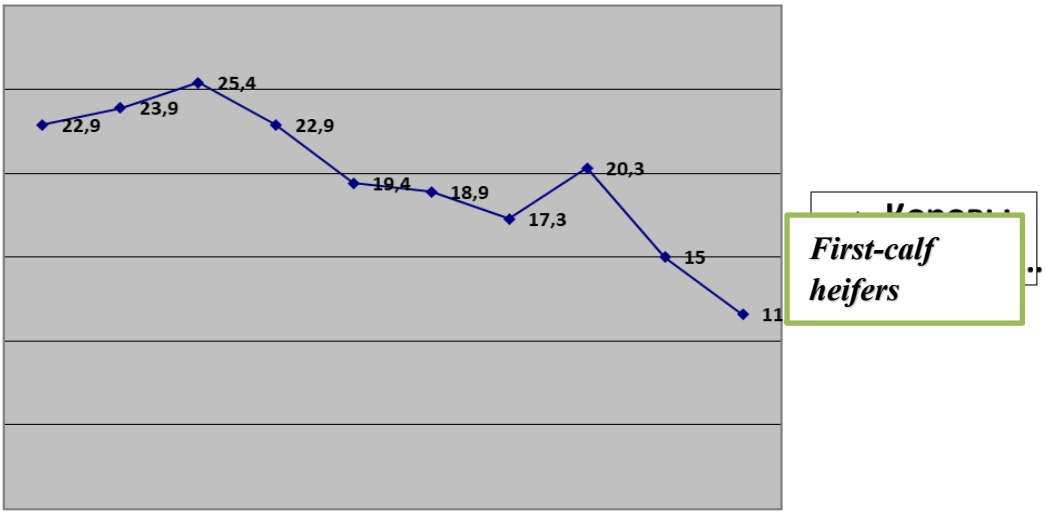

Figure 1 – Lactation curve of first-calving Simmental cows of Czech selection

The first-calving cows of LLP "Aqtogai Milk" are characterized by high milk yield, exceeding the Simmental breed standard by 2,845 kg, and by very high milk fat content (4.10%), with a protein content of 3.04%.

Table 3 – Influence of the lactation phase on the main indicators of milk productivity of first-calving Simmental cows of Czech selection

Indicator	Lactation stage		
	Early lactation	Peak lactation	Late lactation
Milk yield, kg	1817,1±10,35	1503,36±19,47	1675,95±17,54
Mass fraction of fat,	4,24±0,05	4,02±0,07	4,19±0,07
Milk fat yield, kg	77,0±0,20	60,42±0,30	70,18±0,20

The highest milk yield of 1,817.1 kg from first-calving cows was obtained during the early lactation (initiation) period, which exceeded the yield during the peak and late lactation periods by 314 kg and 141.1 kg, respectively. This early lactation period also corresponded to the highest fat content in milk (4.24 %) and the greatest amount of milk fat produced – 77.0 kg for the period.

During the peak lactation phase, the lowest milk yield was observed – 1,503.36 kg, with a fat content of 4.02 %, and the smallest amounts of pure milk fat and protein for the period (60.42 kg, respectively). In general, during the early lactation stage, first-calving cows produced more milk with the highest fat concentration, which indicates good physiological adaptation and efficient use of the feed ration [12].

Thus, the first-calving Simmental cows of LLP "Aqtogai Milk" demonstrated high productivity overall. However, the course of lactation in these cows was not constant throughout the lactation period. Changes in average daily milk yield and milk fat content showed a wave-like pattern.

Milk is one of the most valuable food products, serving as a complete source of essential nutrients necessary for vital activity [13].

Currently, much attention is paid to the qualitative composition of milk, particularly to the content of fat and protein [14]. The quality of milk is influenced by both genotypic and paratypic (environmental) factors, one of which is the season of calving.

The objective of the next stage of our study was to determine the influence of calving season on milk productivity in order to assess the possibility of ensuring a stable supply of high-quality milk throughout the year.

Table 4 – Milk productivity of cows depending on the calving season (n = 15), M ± m

Calving season	Indicator			
	Milk yield per lactation, kg	Fat content of milk, %	Milk fat yield, kg	Body weight, kg
Winter	4943±22,0	4,41±0,02	217,8±1,6	560±8,46
Spring	4659±21,9	3,98±0,03	185,4±2,13	556±8,63
Summer	4501±22,6	3,94±0,02	177,3±1,46	560±6,64
Autumn	4683±23,0	3,88±0,01	181,7±1,60	562±6,91

As a result of studying the course of lactation depending on the calving season, it was found that the highest milk-yielding cows were those calving in winter and autumn, with milk yields of 4,943 kg and 4,683 kg, respectively.

Figure 2 presents the milk productivity data of the experimental cows depending on the calving season. The highest productivity was observed in cows calving in winter compared to all other seasons, and in cows calving in autumn compared only to the summer calving group.

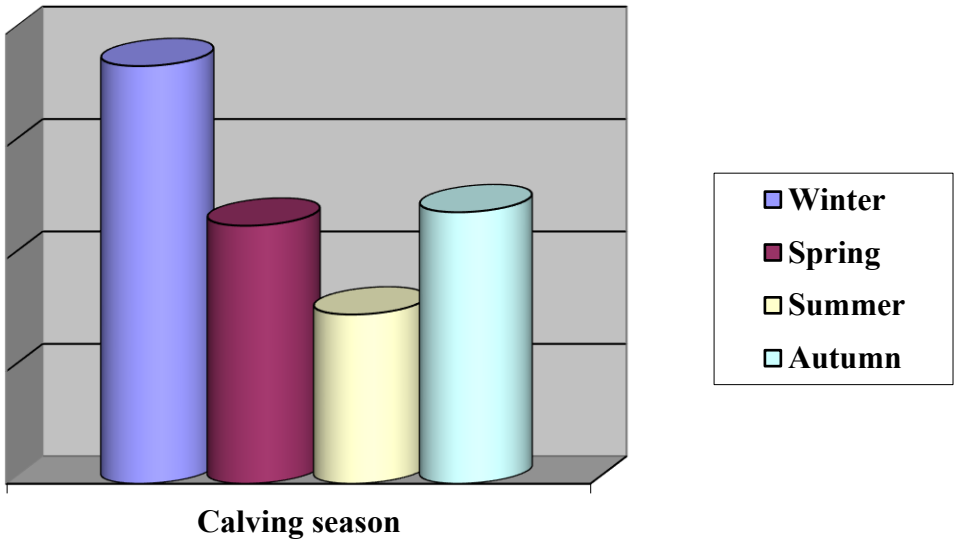

Figure 2 – Milk yields of cows depending on the calving season

The differences in milk yield among cows calving in different seasons are explained by the fact that, after reaching the maximum monthly yield, cows calving in the spring-summer period enter the hot summer months, during which the use of pasture grass is significantly reduced due to its drying out. The lack of sufficient green feed negatively affects the normal course of lactation, resulting in a reduced total milk yield over the entire lactation [15].

Conversely, cows calving in the autumn-winter period, being in climatically favorable conditions (with winter characterized by a moderate climate), utilize spring and early summer pastures during mid-lactation, which are rich in good-quality forage, thereby promoting a normal lactation process [16].

Based on the above, it can be concluded that cows kept under the same feeding conditions demonstrate higher milk yields and produce more milk fat (185.4–217.8 kg) when calving occurs in autumn and winter. For spring-summer calving, the peak milk production in the first months of lactation coincides with the hot summer period, which directly reduces milk yields.

In contrast, for cows calving in autumn-winter, the first months of lactation occur under moderate temperatures, which positively affects milk productivity throughout lactation. The higher milk fat yield in autumn-winter calving cows compared to spring-summer cows is associated with their overall higher milk productivity.

The higher yields of cows calving in winter and autumn during the first months of lactation

are supported by natural postpartum intensive activity of the mammary gland, which is maintained at a high level due to spring-summer pasture feeding [17,18].

Therefore, at LLP "Aqtogai Milk," to achieve high productivity, it is advisable to schedule calving of Simmental cows of Czech selection during the autumn-winter period.

Creating herds with stable and uniform productivity, adapted to the requirements of modern advanced technology, as well as the most complete and cost-effective use of technical resources, forms the basis for further progress in dairy farming [19].

The economic evaluation of milk production efficiency from first-calving cows, calving in different seasons, was determined based on the research results, taking into account the selling price of milk and the total production costs [20].

Table 5 – Economic efficiency of milk production depending on cow calving season (average per cow)

Indicator	Calving season			
	Winter	Spring	Summer	Autumn
Raw milk yield, kg	4943	4659	4501	4683
Revenue from milk sales at a price of 220 tenge/kg, tenge	1087460	1024980	990220	1030260

According to our calculations, the highest revenue from milk sales was obtained from cows calving in the winter period, amounting to 1,087,460 tenge. Therefore, from an economic standpoint, winter calving is the most profitable under the conditions of LLP "Aqtogai Milk." In this case, maximum cow productivity is achieved with lower feed costs per unit of milk produced.

Conclusion. A comprehensive analysis of the milk productivity of first-calving Simmental cows demonstrated a high level of performance. Compared to the breed standard, the milk yield of the studied cows exceeded it by 2,845 kg, and was 1,995 kg higher than the average productivity of Simmental cows in the Pavlodar region. The highest milk productivity was recorded during the first four months of lactation, with the peak yield occurring in the third month, reaching 25.4 kg of milk per day. The lactation curve of the cows was moderate and stable, without abrupt fluctuations in productivity.

First-calving Simmental cows at LLP "Aqtogai Milk" exhibited consistently high overall productivity. The course of lactation, however, was not uniform, showing variations in average daily milk yield and fat content throughout the lactation period.

An analysis of lactation dynamics by calving season revealed that the most productive cows were those calving in winter and autumn, with milk yields of 4,943 kg and 4,683 kg, respectively.

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КОМПЛЕКСНОЕ ИЗУЧЕНИЕ МОЛОЧНОЙ ПРОДУКТИВНОСТИ КОРОВ-КОМПЛЕКСНОЕ ИЗУЧЕНИЕ МОЛОЧНОЙ ПРОДУКТИВНОСТИ КОРОВ-ПЕРВОТЕЛОК СИММЕНТАЛЬСКОЙ ПОРОДЫ ЧЕШСКОЙ СЕЛЕКЦИИ В УСЛОВИЯХ ТОО "AQTOGAI MILK"

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Аннотация. В работе представлены результаты исследований по изучению влияния лактационного периода и сезона отела на молочную продуктивность и качество молока коров-первотелок симментальской породы чешской селекции, содержащихся в условиях ТОО «Aqtogai Milk» Павлодарской области. Целью исследований являлось выявление закономерностей изменения удоев, массовой доли жира и белка в молоке в различные фазы лактации и при разных сезонах отела с целью обеспечения равномерного поступления молока высокого качества на протяжении всего года. Исследования проводились на 15 коровах-первотелках, находившихся в одинаковых условиях кормления и содержания. Определялись показатели удоя, содержания жира и белка в молоке, количество молочного жира и белка за лактацию. Химический состав молока определяли по стандартным методикам. Установлено, что удой коров-первотелок за лактацию составил в среднем 4995,4 кг при массовой доле жира 4,10 % и белка 3,04 %, что превышает породный стандарт на 2845 кг. Наибольшая молочная продуктивность наблюдалась на третьем месяце лактации (25,4 кг в сутки), а наибольшее содержание жира в фазу раздоя (4,24 %). Исследование влияния сезона отела показало, что наиболее высокие показатели продуктивности и экономической эффективности отмечены у коров зимнего и осеннего отелов (удой 4943 и 4683 кг соответственно, выручка 593160 и 561960 тенге).

Наименьшие показатели были у коров летнего отела (удой 4501 кг).

Ключевые слова: симментальская порода, лактация, сезон отела, молочная продуктивность, жирность молока, экономическая эффективность.

“AQTOGAI MILK” ЖШС ЖАҒДАЙЫНДА ЧЕХ СЕЛЕКЦИЯСЫНЫҢ СИММЕНТАЛ ТҰҚЫМДЫ БІРІНШІ БҰЗАУЛАҒАН СИЫРЛАРЫНЫҢ СҮТ ӨНІМДІЛІГІН КЕШЕНДІ ЗЕРТТЕУ

Джанзакова А.С., 7М08201 – «Мал шаруашылығы өнімдерін өндіру технологиясы» білім беру бағдарламасының 2-курс магистранты
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Аннотация. Зерттеу жұмысында Павлодар облысындағы «Aqtogai Milk» ЖШС жағдайындағы чех селекциясының симментал тұқымды бірінші бұзаулаған сиырларының сүт өнімділігі мен сүт сапасының лактациялық кезеңі мен төлдеу маусымының әсерін зерттеу нәтижелері келтірілген. Зерттеудің мақсаты – жыл бойы жоғары сапалы сүттің тұрақты әрі біркелкі өндірісін қамтамасыз ету мақсатында лактацияның түрлі кезеңдерінде және әртүрлі төлдеу маусымдарында сауын мөлшерінің, сүттегі май мен ақуыздың массалық үлесінің өзгеру заңдылықтарын анықтау. Зерттеулер бірдей азықтандыру және күтіп-бағу жағдайларындағы 15 бас бірінші бұзаулаған сиырда жүргізілді. Сауын мөлшері, сүттегі май мен ақуыздың мөлшері, сондай-ақ лактация кезеңіндегі жалпы сүт майы мен ақуызының саны анықталды. Сүттің химиялық құрамы стандартты әдістемелер бойынша зерттелді. Орта есеппен бір лактациядағы сауын мөлшері 4995,4 кг құрап, майдың массалық үлесі 4,10 %, ақуыз 3,04 % болды, бұл көрсеткіштер тұқым стандартынан 2845 кг-ға жоғары. Ең жоғары сүт өнімділігі лактацияның үшінші айында (тәулігіне 25,4 кг), ал майдың ең жоғары мөлшері – лактацияның бастапқы кезеңінде (4,24 %) байқалды. Төлдеу маусымының әсерін зерттеу нәтижесінде қысқы және күзгі төлдеулерде ең жоғары өнімділік пен экономикалық тиімділік тіркелді (сауын мөлшері тиісінше 4943 және 4683 кг, табыс 593 160 және 561 960 теңге). Ең төмен көрсеткіштер жазғы төлдеу кезінде байқалды (сауын мөлшері 4501 кг).

Тірек сөздер: симментал тұқымы, лактация, төлдеу маусымы, сүт өнімділігі, сүт майлылығы, экономикалық тиімділік.