External and internal factors to improve the quality and environmental safety of milkian

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Abstract. During lactation, a significant amount of nutrients is excreted from the body of cows with milk. In addition, their significant costs for the functioning of the mammary gland. The quality of feed rations also has an effect on the taste and technological qualities of milk. The aim of this work was to identify and establish the degree of influence of some external, paratypical factors on the level of milk productivity of cows. The material for the study was a dairy herd of cows with milk production indices of at least three completed lactations. These data allow concluding that feeding cows is not enough both in terms of total energy nutrition and individual nutrients. In close connection with the level of feeding of rearing nutrition and individual animals is their body weight as an indicator of the growth and development of animals.

1. Introduction
During lactation, a significant amount of nutrients is excreted from the body of cows with milk. In addition, their significant costs for the functioning of the mammary gland. The quality of feed rations also has an effect on the taste and technological qualities of milk. Numerous studies show that milk yield depends on the level of energy supply by 40–50% and buttermilk by 25–30% [1;]. Particular attention should be paid to the level of protein, mineral and vitamin balance of diets [1; 3; 4].

Feeding cows of green fodder in the spring and summer and benign silage, haylage, hay and concentrated feed in the stall period (in scientifically sound proportions) allow ensuring a good level of milk productivity and obtaining benign milk.

In close connection with the level of feeding of rearing animals and young cows is their live weight as an indicator of the growth and development of animals.

Animals with a higher body weight have a greater milk production as a rule. But the body weight should not be due to significant deposition of adipose tissue because this leads to a decrease in the specific gravity of active (protein) tissues and a decrease in physiological processes. Therefore, there are scientifically based parameters for body weight for animals. So for full-aged cows of breeds of the milk direction of productivity this limit is 500-550 kg, for dairy meat 600-620 kg [5, 6].

The level of feeding along with other environmental factors determines the growth and development of rearing animals, which is controlled by growth in body weight during periods of ontogenesis. It is believed that heifers should be inseminated when they reach 65-70% of the body weight of adult cows. This can be achieved by 16-18 months of age with proper feeding. Many farms increase the age of the first insemination to 20 and even 22-24 months. This is due to an insufficient
level of feeding of pregnant cows (too low body weight of calves at birth) and maintenance of young animals. This leads to over-consumption of feed and, as a rule, to low milk productivity.

It is undesirable to obtain excessively high daily average growths because the growth is due to inactive tissues (mainly fat), which has a negative effect on reproductive functions and productivity [1; 3; 4].

The calving season also affects the level of milk productivity through the condition of the feed base and the usefulness of diets and environmental conditions (temperature, duration of solar insolation, humidity and daily routine).

Most farms plan calving for that period of the year when there is green food or still a sufficient amount of canned food - winter-spring and autumn-winter [1:]. This is not fully consistent with industrial technology, which provides for the uniform production of milk throughout the year.

In the summer cows must be kept in such a way as to avoid excessive exposure to sunlight and overheating of the body. Thus it is necessary to take time for pasturing lesser solar activity, to keep cows under awnings, to provide timely watering.

The next external factor affecting the productivity of dairy cows is the duration of the service period. The optimal duration is considered to be 45-70 days (i.e. it is recommended to inseminate cows no earlier than the second sexual cycle). Lengthening the service period leads to an extension of lactation and, consequently, to some increase in milk yield for the corresponding lactation. However the systematic lengthening of the service period leads to a decrease in the number of calving and life-long milk yields. Insemination in the first sexual cycle (20-22 days after calving) leads to a shortening of lactation and lower productivity [2; 3; 4; 5]. The length of the dry period also affects the milk yield of cows.

During this period renewal and development of the glandular tissue of the udder, and replenishment of nutrient, mineral and other biologically active substances in the body of animals takes place [2; 3; 4:]. In addition, the cessation of lactation contributes to a better completion of fetal development and the formation of complete colostrum at the beginning of lactation. The normal duration of the dry period is 60-70 days.

The shortening of the dry period, while lengthening the current lactation, has a negative effect on the milk production of the next lactation and the development of offspring.

The genotype implies that in the first two to three months of lactation (cow milking), the milk yield gradually increases and if during this period a set of measures is taken to increase productivity, then the decrease in milk yield will not be significant and, therefore, milk productivity in general for lactation will be higher. The organization of milking (timely launch of cows, full advance feeding, increasing the multiplicity of milking, massage of the udder, etc.) contributes to an increase in milk yield for lactation by 15-20% as a numerous studies shown [7; 8:].

Numerous studies show that every farm should constantly carry an analysis of the state of milk production out with the identification of the impact of the above factors on the level of milk productivity of cows and the efficiency of milk production. Measures are developed and implemented to improve the efficiency of the industry based on this.

It is necessary to constantly monitor the impact of these factors and take timely measures to eliminate their negative impact in every farm which produces milk. Therefore, the present work is devoted to studying the effect of certain genetic factors on the level of milk production of cows.

2. Material and research methods

The aim of this work was to identify and establish the degree of influence of some external, paratypical factors on the level of milk productivity of cows.

The material for the study was a dairy herd of cows with milk production indices of at least three completed lactations.

The observation was chosen as a method of scientific research and, in particular, a chronological comparison.
For this purpose, we used data from zoo-technical and economic records for the last 3-5 years: a diary of artificial insemination and calving, a diary of rearing of young animals, books of brood stocks, acts of weighing animals and conducting control milk yields, summary statements of scoring of the reproducing part of the herd, production and financial plans and reports.

The main indicator of milk productivity was selected milk yield.

The analysis of the impact of factors was carried out by studying the influence of the level of feeding by calculating the average feed consumption according to the feed balance for the last three years and comparing it with scientifically based norms of feeding.

A dairy cattle breeding is a leading livestock industry, providing the population with such valuable food products as milk, meat and gives leather raw materials for light industry.

The current state of cattle breeding is characterized by an insufficient level of productivity and insufficient milk production. This is due to a number of objective reasons (price disparity, a slight decrease in consumer demand, etc.) and insufficiently clear work of the producers themselves.

Therefore, the managers and specialists of the household must constantly analyze the reasons for the low productivity of animals, identify factors that reduce production efficiency and take measures to create favorable conditions for the cultivation of highly productive animals, their operation on the basis of scientifically based recommendations.

However, the genetic potential of crossbreeds of cows of black-motley breed with bulls of Holstein black-motley breed is higher.

Therefore, one of the objectives of this work was to study the main internal factors determining the milk productivity of cows on the farm and to develop proposals for improving the state of dairy cattle breeding.

According to the literature analysis, the milk production of cows varies in a very wide range (from 1000 to 30 000 kg of milk or more). Even in the same climatic zone for the same calendar period the average milk yield of cows in individual farms varies significantly. These differences are due to the complex interaction of the pedigree and individual characteristics of animals (genetic factors) and the physiological state, the conditions of their feeding, maintenance and use (environmental factors). The most important and first factor that affects most milk production, determined by the three main features - milk yield, milk fat and milk yield is the development of a milk-forming organ - the udder of cows. The udder consists of four lobes (quarters): two front and two rear. The outside part of udder is covered with thin smooth skin with sparse hairs that grow on the back of the gland from the bottom up and to the side, forming a milk mirror: the larger it is, the less the hair cover on it and the better the udder is developed. Significant changes occur in the structure of the udder of cows during lactation. In the first half of lactation glandular tissue reaches its greatest development. Its mass, like the mass of the udder is much larger than in the second half. In the second half of lactation the mass of the udder decreases by 20-40%, the area of the glandular tissue by 10%, the diameter of the milk alveoli by 30%. At the same time, the area of the connective tissue is increased by 50%, and the thickness of the connective tissue cords is up to 10%.

A positive correlation (correspondence) between adipose tissue and fat content in milk was also revealed.

A certain relationship between the mass of the udder of cows and their milk productivity has been clarified: with an increase in high milk yield, the amount of milk per 1 kg of live weight of a cow is constantly increasing, while the amount of milk per 1 kg of udder weight does not increase significantly.

Under the normal conditions of feeding, keeping and leaving the cow in the first half of lactation (up to 5 months) inclusive it usually produces 60-70% of all milk, and in the second - 30-40%. Moreover, the total amount of milk fat (kg), as well as milk yield, is higher in the first period of lactation, the average percentage of milk fat is much higher in the second period of lactation (by 0.5-0.8%).

There is 40-45% of milk for the first 100 days of lactation, 30-35% for the second and 20-25% for the third.
In a practical terms it is important the intravital determination of the mass and volume of the udder. There was established the following approximate relationship between the mass of the udder and the milk production of cows: milk yield up to 2000 kg — the mass of the udder as a percentage of the live weight of 0.5%; 2 - 3 thousand kg of milk yield - 1%; 3 - 4 thousand - 1.5%; 4 - 5 thousand - 2.5%; 6 - 7 thousand - 3%; 15 - 20 thousand kg of milk and more, the weight of the udder is 5% of the live weight of the cow.

The milk productivity of cows is primarily determined by the genotype: breed, individual characteristics, age and lactation phase.

Creating breeds and working on their improvement, people specialized in each of them to obtain one or another product. Therefore, cattle breeds vary significantly in terms of milk production. By the level of milk and meat productivity and their compatibility all breeds are subdivided into breeds of milk, meat and combined directions of productivity.

Breeds of the dairy direction differ in that for every 100 kg of live weight for lactation from 640 to 900 kg of milk are obtained. In combined breeds this indicator ranges from 540 to 600 kg per lactation. The increase from the first lactation to the maximum milk yield is approximately 40 - 50%. Moreover, this increase is much faster than a subsequent decline. However, in the literature there are a lot of reports that the maximum milk yield was observed in individual animals and at an older age.

It also has a great influence on the milk production level of cows during the lactation phase. The pattern is that in most breeds’ milk yield increases up to 2 - 3 months of lactation and then gradually decreases. The task of livestock workers is to ensure the maximum manifestation of milk productivity in the first months of lactation and a gradual decrease (not more than 5 - 7% per month) by the end of it [8].

The duration of lactation is also a breeding trait in terms of milk production. The current valuation instruction [7] provides for normal lactation duration of 305 days. However, there are animals that spontaneously start earlier than this time. Among highly productive cows it is often observed that animals do not stop lactating until calving. Such extremes are not desirable since they have a negative effect on the health and reproductive abilities of animals and on the lifelong level of milk productivity.

In the second part of this work the influence of external factors on the level of milk production of cows was investigated.

The analysis of the impact of internal factors was carried out by studying the influence of:
1. Species and breeds by calculating the arithmetic average of genotypes and their variability.  
2. Analysis of the influence of the age of cows on the level of milk productivity by calculating average indicators and comparing them.

One of the objectives of this work was to identify and establish the degree of influence of some external, paratypical factors on the level of milk productivity of cows. We studied the level of feeding and maintenance, the calving season and others.

The obtained data were processed by biometric methods with calculation of the arithmetic mean (M), its error (m), variability indices (σ - standard deviation and Cv - coefficient of variation), and correlation coefficients (r) between milk yields by lactation.

3. The results of research
In the first place, hereditary factors influence the milk productivity of cows: breed, age of cows, lactation phase, and individual characteristics. If animals are kept in favorable conditions of feeding and keeping, then these factors are crucial.

The effect of breed. Since the end of the last century work on Holsteinization has been started in livestock farms of the country. The breeding stock of the Simmental breed was seeded by bulls of the red-motley Holstein breed to obtain crossbreeds ¾ and 5/8 of blood content in the Holstein breed. According to numerous studies, this work gives positive results only on the condition that the level of productivity of the original breeding stock is at the level of 3000 kg of milk per lactation. The analysis of the level of milk yield depending on the genotype of cows (Table 1) showed
Table 1. Milk productivity of cows of various genotypes, in kg

| Breed                  | The number of cows | The 1st lactation | The 2nd lactation | The 3rd lactation |
|------------------------|--------------------|-------------------|-------------------|-------------------|
|                        |                    | M±m              | C, %              | M±m              | C, %              | M±m              | C, %              |
| Purebred and IV generation | 70                | 3265±64          | 16,5              | 3478±73          | 17,6              | 3395±85          | 21,0              |
| III generation         | 58                | 3198±73          | 17,6              | 3525±82          | 17,8              | 3510±96          | 20,9              |
| II generation          | 40                | 3325±136         | 25,9              | 3624±141         | 24,6              | 3630±152         | 26,6              |

That in hybrids of the second generation milk productivity is higher, but the observed difference is not statistically significant. The higher variability in cows of the second generation is noteworthy.

It is well known that milk production in cows varies significantly with age. According to most researchers, the maximum milk yield of cows of breeds bred in our country is observed for 4 - 6 lactations. The increase from the first lactation to the maximum milk yield is approximately 40 - 50%. Moreover, the increase in milk yield with the age of the animal from the first to the highest lactation is much faster than a decrease in the subsequent.

In the analyzed herd, there is a slight increase in cow productivity with age (Table 2).

Table 2. Dependence of the average milk yield of cows on age

| Breed                  | The number of cows | The 1st lactation | The 2nd lactation | The 3rd lactation |
|------------------------|--------------------|-------------------|-------------------|-------------------|
|                        |                    | 1      | %      | 1      | %      | 1      | %      |
| Purebred and IV generation | 45                | 213    | 9,4    | 130    | 5,7    | -83    | -3,4    |
| III generation         | 58                | 327    | 14,8   | 312    | 14,2   | -15    | -0,6    |
| II generation          | 40                | 299    | 8,9    | 305    | 9,1    | 6      | 0,1      |

In the group of cows of black and motley breed of the fourth generation, the growth compared to the first lactation was 6.5 to 2 and 3.9%, for cows of the third generation 10.2 and 9.7, for cows of the second generation 8.9 and 9.1% respectively. This difference is statistically significant (P> 0.95). Comparing the productivity of lactation 2 and 3 a slight decrease should be noted by 0.4 - 2.3%, but this difference is not statistically significant.

The calculations of the correlation coefficients between milk yields for different lactations did not reveal statistically significant regularities. Repeatability was expressed by correlation coefficients from 0.04 to 0.12.

The genetic potential of productivity of farm animals is possible only if optimal, scientifically sound environmental conditions are created for them, and, first of all, feeding conditions, keeping and operating conditions.

The proper organization of the level and usefulness of feeding cows has a decisive influence on the level of milk productivity, the uniformity of milk production during lactation and, ultimately, on the efficiency of milk production.

Cows’ rations lack such valuable feeds as hay and root crops, and the demand is mainly covered by corn silage - 48.6% of the total energy nutrition of the diet. This food is fed even in the summer.
The total energy supply is 85.7%. Moreover, the structure of the diet is far from optimal. Due to straw 1.6% of the diet is covered (2% recommended), haylage - 3.5% (8%), corn silage - 48.6% (21%), green fodder - 29.2% (35%) and due to concentrated feed - 17% (21%). As a result, digestible protein in cows is provided only by 68.8%, easily digestible carbohydrates by 60%, and phosphorus by 44.5%.

Only 78.6 g of digestible protein and the sugar-protein ratio of 0.74:1 are accounted for 1 feed unit.

4. Discussion

These data allow concluding that feeding cows is not enough both in terms of total energy nutrition and individual nutrients.

In close connection with the level of feeding of rearing animals and young cows is their body weight as an indicator of the growth and development of animals.

Animals with a higher body weight have a greater milk production. However body weight should not be due to significant deposition of adipose tissue, because this leads to a decrease in the specific gravity of active (protein) tissues and a decrease in physiological processes. Therefore there are scientifically based limits on body weight for breeds. So this limit is 500-550 kg for full-aged cows of breeds of the milk direction of productivity and 600-620 kg for dairy meat.

The level of feeding, along with other environmental factors, determines the growth and development of rearing animals which is controlled by growth in body weight during periods of ontogenesis. It is believed that heifers should be inseminated when they reach 65-70% of the body weight of adult cows. With proper feeding, this can be achieved by 16-18 months of age. Many farms increase the age of the first insemination to 20 and even 22-24 months. This is due to an insufficient level of feeding of pregnant cows (too low body weight of calves at birth) and maintenance of young animals. This leads to cost overruns and as a rule to low milk production of animals.

It is undesirable to obtain excessively high daily average growths because the growth is due to inactive tissues (mainly fat), which has a negative effect on reproductive functions and productivity [1; 3; 4]. The calving season also affects the level of milk productivity through the condition of the feed base and the usefulness of diets and environmental conditions (temperature, duration of solar insolation, humidity and daily routine).

Most farms plan calving for that period of the year when there is green food or still a sufficient amount of canned food - winter-spring and autumn-winter. This is not fully consistent with industrial technology, which provides for the uniform production of milk throughout the year.

In the summer cows must be kept in such a way as to avoid excessive exposure to sunlight and overheating of the body. So it is necessary to take time for pasturing lesser solar activity, to keep cows under awnings, to provide timely watering.

The time interval from calving to fruitful insemination is called a service period. The optimal duration is considered to be 45-70 days (i.e. it is recommended to inseminate cows no earlier than the second sexual cycle). Lengthening the service period leads to an extension of lactation and, consequently, to some increase in milk yield for the corresponding lactation. But the systematic lengthening of the service period leads to a decrease in the number of calving and life-long milk yields. Insemination in the first sexual cycle (20-22 days after calving) leads to a shortening of lactation and lower productivity.

The great importance of the dry period for the milk productivity of cows and heifers (obtained from them) has been established by many years of practice and numerous studies. During this period, renewal and development of the glandular tissue of the udder, and replenishment of nutrient, mineral, and other biologically active substances in the animal’s body occurs [1; 3; 4]. In addition, the cessation of lactation contributes to a better completion of fetal development and the formation of complete colostrum at the beginning of lactation. The normal duration of the dry period is 60-70 days.

The shortening of the dry period, while lengthening the current lactation, has a negative effect on the milk production of the next lactation and the development of offspring.
The genotype implies that in the first two to three months of lactation (cow milking), the milk yield gradually increases and if during this period a set of measures is taken to increase productivity, then the decrease in milk yield will not be significant and, therefore, milk productivity in general for lactation will be higher. The organization of milking (timely launch of cows, full advance feeding, increasing the multiplicity of milking, massage of the udder, etc.) contributes to an increase in milk yield for lactation by 15-20% as a numerous studies shown [9].

5. Conclusion

• Cows show a slight increase in milk yield compared to the first lactation with age. A more significant increase was in crossbreeds with black-motley breed, especially 3 generations. Productivity growth between the 2nd and 3rd lactations was not observed, even a downward trend is observed.
• A decisive influence on the level of milk productivity of cows is provided by the level and usefulness of feeding.
• The specific weight of cows in the herd has a great influence on milk productivity 40 - 42%.
• Cows show a slight increase in milk yield compared to the first lactation with age.
• A more significant increase is observed in crossbreeds of black-motley breed, especially 3 generations.
• No increase in productivity between the 2nd and 3rd lactations was observed, even a downward trend was observed.

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