

# Economic and zoological rationale for using new bedding material for lactating cows

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**Abstract.** This article examines the influence of the studied bedding material, which is dust-free wood shavings, cleaned from metal impurities and processed by thermochemical and biotechnological methods on the productivity of cows, the sanitary and hygienic quality of milk and the profitability of the products obtained. The production experience was carried out in the conditions of one of the farms of the Republic of Tatarstan on cows of the Holstein-Friesian breed and lasted for 3 months. To assess the quality of milk, the following indicators were taken into account: the amount of fat, protein, lactose, dry matter, non-fat milk solids, urea, somatic cells, as well as acidity, freezing point, pH, analysis for ketone bodies. The milk production was calculated based on the results of the control milking. Our studies have shown that, from an economic point of view, the use of the investigated bedding material is most effective.

## 1 Introduction

Dairy farming is one of the leading livestock industries. The task of providing the population with milk and dairy products is an urgent issue of the country's food security. Before cattle breeding, tasks have been set that require a radical restructuring of the industry, its withdrawal from a difficult crisis state in order to increase the production of food for the population and raw materials for the food industry [8].

Agricultural enterprises, regardless of their form of ownership, independently decide on the development of organizational and economic conditions to improve the efficiency and profitability of their production.

Through in-depth analysis, possible trends in the further development of production are studied, the factors of changes in the results of activities are systematically investigated, and reserve ways of improving efficiency are identified. Applicable to dairy enterprises of the agro-industrial complex, the main task facing the heads of enterprises is to improve the quality and quantity of raw milk while reducing production costs.

Milk is not only one of the key production goods, but also a source of daily revenue for most cattle-breeding enterprises, which is why today the issue of reducing the cost of the resulting product, while increasing its quantity, is so urgent.

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It is important not only to increase the gross milk yield in the country, but also to improve its quality, for which it is necessary to introduce new technologies into dairy cattle breeding that are profitable from an economic point of view, helping to reduce the cost of production, they allow the efficient use of various resources, such as, for example, as energy, fodder and others [9; 3; 7].

Nowadays, the market economy dictates high requirements for the quality of milk, which should not only be cheap, but also have the highest grade, thereby determining consumer demand, sales volume, and the possibility of processing it into fermented milk products. One of the main factors influencing the quality of milk is the optimal conditions for keeping dairy cows [2; 4; 6].

Intensive industrial technology of livestock production presupposes a high concentration of livestock in limited areas, which causes a deterioration in the zoohygienic parameters of their maintenance. In such conditions, the body of animals is daily exposed to opportunistic and pathogenic microflora, one of the sources of which can be the bedding. Modern animal husbandry standards, focused on high productivity of farm animals and based on intensive cultivation of highly productive breeds, are effective only if high-quality consumables are used, one of which is bedding material.

The special zoohygienic value of bedding material in industrial technologies for keeping animals is due to the fact that the high productivity of the raised breeds, determined by the genotype, is implemented in practice only in a very narrow range of comfortable conditions in which the animals should be kept. Even minor deviations from optimal conditions lead to a sharp decrease in the productivity of animals, the level of natural resistance of animals falls, which ultimately can lead to the emergence of many diseases of non-infectious etiology, and in some cases to the emergence of outbreaks of infectious diseases and their spread.

Effective bedding materials contribute to the comfortable keeping of animals, make it possible to achieve the planned indicators of the productivity of reared animals, which guarantees the economic viability of livestock farms, reduce the risks of developing epizootics, and reduce the use of antibiotics [10].

Bedding materials are large consumables. Their total volumes, currently used only by poultry farms in our country, amount to at least 20 million tons per year. The production, use and disposal of used bedding materials is a significant expense item in animal husbandry, directly affecting not only the efficiency of farms, but also the ecological well-being of significant areas around them.

At present, various wastes of the agro-industrial and forestry complexes, physical and sanitary-hygienic characteristics, which do not always meet the requirements of modern animal husbandry, are used as bedding materials. The infectious hazard of bedding materials is not controlled, which negatively affects the epizootic situation in animal husbandry. In addition, poor bedding material can lead to various diseases of the respiratory system, to pathological changes in the trachea, lungs, kidneys and liver of animals [11].

The importance of traditional bedding materials cannot be underestimated, but with the increase in the rate of development of animal husbandry, with the advent of a large number of mega-farms, the requirements for bedding materials become higher.

Modern high-quality zoohygienic bedding material must have a unique set of physical, mechanical, thermal engineering and microbiological properties in order to provide comfortable conditions for keeping animals in farms using industrial technologies. Conventional bedding materials, such as peat, sawdust, straw and sunflower husks and others, which even showed themselves well in traditional animal husbandry technologies, do not possess such properties and require significant additional processing. Without additional processing, their use greatly increases the risks of farms associated with failure

to achieve the planned productivity of animals, outbreaks of epizootics and deterioration of the ecological situation.

Additional processing, to give the original bedding materials the required properties, involves their transformation by mechanical, thermochemical, biotechnological and other methods. Considering the large tonnage of zoohygienic bedding materials, high requirements for the stability of their characteristics, the competitiveness of such materials is ensured only with a very high productivity of technological lines for their production, which is achievable only in high-tech innovative industries.

Modern industrial technologies of animal husbandry impose very high requirements on bedding materials in terms of moisture capacity, thermal conductivity and harmlessness for keeping animals. The carpet of bedding materials covering the floor of the farm must meet these requirements throughout the entire cycle of raising and keeping animals. The bedding carpet shall create favorable conditions for the growth of animals and retain its properties, despite the gradual filling with biological secretions, and prevent the occurrence of undesirable microbiological processes. Also, bedding materials are subject to requirements for their efficient disposal.

Therefore, zoological bedding material shall be a high-tech product with better consumer properties and meet all the requirements that are imposed on modern livestock enterprises.

Based on the foregoing, studies on the introduction of a new innovative technology for the processing of bedding material and its use in livestock breeding are relevant. In this regard, the aim of the paper is the economic and zoogygienic substantiation of use of a new hygienic bedding material when keeping lactating cows in production conditions.

## 2 Methods

The study was carried out in 2 stages: the first stage consisted in conducting a production experiment on the basis of the agricultural production complex named after Lenin, the second stage in the statistical analysis of the data obtained and took place at the department of animal husbandry technology and zoohygiene of the Kazan State Aviation Museum.

An industrial experience to study the effect of the tested bedding material on the body and productivity of dairy cows was carried out in the conditions of the agricultural production complex of the breeding plant named after Lenin, Atninsky district of the Republic of Tatarstan on 75 lactating cows of the Holstein-Friesian breed, which were divided into three groups of 25 animals each:

- the first group (control) - animals were kept on a straw bedding;
- the second group - the waste of the woodworking shop, which was delivered from the utility sawmill, was used as the bedding;
- the third group - the studied bedding material was used as the bedding.

The experiment lasted for three months.

Feeding of the cows used in the experiment was carried out considering the required norms [5].

The studies were carried out with a new hygienic bedding material, which is wood chips with a thickness of 0.1-0.6 mm, obtained by planing dry coniferous or deciduous wood, as well as recycled waste from the woodworking industry, with the removal of metal impurities, treated with thermochemical and biotechnological methods. In this case, the shavings themselves, in the direction across the fibers, are bent and have an arrow of deflection of at least 1 mm. The bedding material is dedusted from fine particles over 1 mm in size, and the number of particles less than 1 mm does not exceed 10 %. The treated bedding material is packed in a plastic wrap and then disinfected with ionizing radiation, which is a flux of gamma quanta from an appropriate source, directed evenly onto the

briquette from two sides (for example, from above and below). In this case, gamma radiation affects the electrons of the molecules of the bedding material, creating highly active radicals, thereby destroying the DNA of the pathogenic microflora. The wrapping film maintains sterility during transport and storage, preventing contamination of the bedding material. The studied material is a dust-free, disinfected bulk mass from light to dark brown color with a specific odor, the moisture capacity of the bedding is 480 % and the mass fraction of moisture is 3-10 %. The bedding is produced by the Omega LLC production complex and meets the requirements of TU 16.29.14-001-19235409-2018, is an agricultural product and is intended for farm animals and birds.

Accounting for milk production was carried out according to the results of control milking. The quality of milk of cows was determined according to the following indicators: the amount of fat, protein, lactose, dry matter, non-fat milk solids, urea, somatic cells, as well as acidity, freezing point, pH, analysis for ketone bodies .

The animals were kept in standard barns designed to house 200 animals. Watering of animals was carried out using automatic drinkers AP-1. A DeLaval feeder was used for mixing and dispensing feed. The animals were milked using the Delaval milk pipeline system.

The main sources of information for the analysis of the cost price, the volume of production were the data of the accounting reports of the enterprise, as well as the data obtained as a result of milk analyzes during the experiment. The paper used statistical, analytical methods, as well as structural-functional and abstract analysis.

In the course of the experiment, the influence of the new bedding material on the productivity, milk quality, and profitability of dairy production was studied.

### 3 Results

The experiment lasted for three months, and the main results for determining the quality and quantity of dairy products of experimental animals are presented in Table 1.

**Table 1.** Characteristics of individual indicators of the quality and quantity of milk of experimental cows, on average for three months of experience.

Indicator	Groups		
	First	Second	Third
Average daily milk yield, kg	33.41±1.69	33.48±1.74	35.44±1.77
Mass fraction of fat, %	3.73±0.19	3.75±0.18	4.00±0.21
Protein mass fraction, %	2.84±0.15	2.85±0.16	2.94±0.15
Mass fraction of lactose, %	4.10±0.21	4.11±0.21	4.23±0.21
SOMO, %	7.96±0.38	7.98±0.39	8.12±0.41
Dry matter, %	14.42±0.72	14.48±0.74	15.08±0.75
Urea, mg/l	301.7±21.4	298.4±24.5	278.5±23.8
pH	6.54±0.05	6.57±0.04	6.61±0.04
VNV, mmol/l	0.07±0.02	0.07±0.04	0.06±0.01
Acetone, mmol/l	0	0	0
Freezing Point	-0.528.3±0.01	-0.528.7±0.01	-0.529.2±0.01
Somatic cells, thousand/cm <sup>3</sup>	501.21±30.8	497.85±30.1	297.85±15.1**

\*\* P<0.01

Analyzing the data given in Table 1, we can conclude that the use of the studied bedding material contributed to the improvement of certain indicators characterizing the

quality of milk, compared with the control. So, by the end of the study, the fat content in the third experimental group was higher than in the control (first group) by 0.17 %, protein - 0.10 %, lactose - 0.13 %, SOMO, which is the dry residue of milk without fat, - 0.16 %, dry matter - 0.66 %, and the number of somatic cells, on the contrary, decreased by 40.6 %, which indicates the high quality of milk in experienced cows, which in all respects meets the requirements of premium raw materials.

The content of BHB-beta-hydroxybutyrate was much lower than the critical level of 1.5 mmol/L, which indicates the absence of ketone bodies in milk, and, consequently, no energy imbalance in experimental animals of all groups. The urea content in cows in three groups was at the upper limit of the optimal level, which can be explained by the increased content of concentrates in the diet of cows, due to their high productivity. The studied parameters in lactating cows in the second group, where untreated wood waste was used, were approximately at the same level as the animals of the control group.

Therefore, it can be concluded that the use of the studied bedding material contributes to an increase in the quantity and quality of milk in experienced dairy cows, allowing it to be sold at the price of premium milk.

**Table 2.** Calculation of economic efficiency on average per lactating cow.

Indicator	Group		
	First	Second	Third
Average daily milk yield, kg	33.41±1.69	33.46±1.74	35.44±1.77
Gross milk yield, kg	3006.9	3013.2	3189.6
Unit cost, rub.	16.79	16.81	16.99
Additional costs for the purchase of bedding material per unit of production, rub.	0.11	0.11	0.18
Unit sales price, rub.	24.04	24.05	27.44
Sales proceeds, rub.	803.18	804.71	972.47
Profit, rub.	242.23	242.25	370.34
Profitability, %	30.16	30.10	38.08
Economic efficiency per 1 ruble of additional costs, rub.	-	-	2.52

Analyzing the data given in Table 2, it can be concluded that the use of the studied hygienic bedding material contributed to an increase in the selling price of dairy products: the milk of animals from the experimental group met the requirements for premium products in all respects, which ultimately resulted in an increase in profit on average per cow per day by 128.11 rubles and an increase in profitability by 7.92 % compared to the control. Economic efficiency per 1 ruble of costs when using the studied hygienic bedding material was 2.52 rubles.

## 4 Discussion

In this study, we compared several different types of bedding materials and their impact on the quality of raw milk and the profitability of the resulting product.

In the course of our study, a positive effect of the studied bedding material on the sanitary and hygienic indicators of milk in the experimental group was established: there was a slight increase in the content of fat, protein, lactose, while the number of somatic cells, on the contrary, decreased by 40.6 %. This, in turn, led to an increase in profits and an increase in the profitability of production, due to an improvement in the grade of milk. At the same time, the studied parameters in lactating cows in the second group, where

untreated wood waste was used, were approximately at the same level with animals of the control group, where straw was used as bedding material.

Our results indicate that, under the same feeding conditions, the conditions of keeping, in particular the type of bedding material used, play a decisive role in the quality of the product, and sometimes in its quantity, therefore, it is necessary to take a more responsible approach to its choice.

## 5 Conclusion

Therefore, our calculations showed that from an economic point of view, it is most effective to use the studied hygienic bedding material, which is wood chips processed by thermochemical and biotechnological methods, as a bedding material when keeping lactating cows. Its use significantly improves the quality of the raw milk obtained, and, consequently, increases the profitability of production in general.

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