DOI 10.32900/2312-8402-2025-134-138-149
UDC 636.2.085:615.33:633.853.52

# USE OF CRUSHED FLAX SEEDS AS A PREBIOTIC WHEN FEEDING DAIRY COWS DURING THE FULL LACTATION CYCLE

**Leonid PODOBED**, doctor of agricultural sciences, professor
https://orcid.org/0000-0003-4903-4597
**Nikolay KOSOV**, candidate of Agricultural Sciences
https://orcid.org/0000-0002-8850-745X
**Vyacheslav SAPRYKIN**, candidate of Agricultural Sciences
https://orcid.org/0000-0003-0369-7184
**Andrey ZOLOTAREV**, candidate of Agricultural Sciences,
https://orcid.org/0009-0002-7073-4950
**Larisa YELETSKAYA**, https://orcid.org/0000-0001-6029-0183
**Livestock farming institute of NAAS, Kharkiv, Ukraine**

*Increased consumption of dry matter in diets by highly productive cows leads to a high level of energy per unit of dry weight and the introduction of 45-50% of concentrated feed into the feed mixture. As a result, scar digestion is modified, lactic acid synthesis by scar microorganisms increases, which creates conditions for the development of an acute inflammatory process in typical scar acidosis.*

*The main method of preventing this disorder is the constant use of alkaline additives and buffer mixtures in the diet, which allow you to maintain the optimal pH.*

*The cationic structure of these systems, when constantly used, has an irritating effect on the small and large intestines of cows, which leads to a weakening of digestion and the development of a diarrheal effect of varying severity. This leads to a decrease in the digestibility of feed nutrients and, as a result, a decrease in the level of milk yield with a loss of milk quality indicators.*

*Restoration of normal digestion in ruminants in such conditions is possible with the additional introduction of specific probiotic drugs into the diet, of which there are not many, and most of them are ineffective.*

*Therefore, it is more reliable and expedient to use not pro -, but prebiotics, which form a protective effect against diarrhea based on the activation of animals ' own intestinal microflora by changing the activity of the villi surface. In addition, the prebiotic effect is achieved by using individual astringents that reduce villi irritation.*

*However, such special additives are characterized by an increased cost, so it is advisable to search for normal feed components of the diet that have pronounced prebiotic properties and justify their effectiveness in feeding cows.*

*In a long-term experiment on dairy cows, the effect of correcting the feeding of highly productive animals using crushed flax seeds was studied, which was used as a functional feed ingredient with a prebiotic effect.*

**Keywords:** prebiotic, crushed flax seeds, feed additive, dairy cows, feeding ration.

# ВИКОРИСТАННЯ ПОДРІБНЕНОГО НАСІННЯ ЛЬОНУ В ЯКОСТІ ПРЕБІОТИКА ПРИ ГОДІВЛІ ДІЙНИХ КОРІВ ПРОТЯГОМ ПОВНОГО ЛАКТАЦІЙНОГО ЦИКЛУ

**Леонід ПОДОБЄД**, доктор сільськогосподарських наук, професор
https://orcid.org/0000-0003-4903-4597
**Микола КОСОВ**, кандидат сільськогосподарських наук
https://orcid.org/0000-0002-8850-745X
**Вячеслав САПРИКІН**, кандидат сільськогосподарських наук
https://orcid.org/0000-0003-0369-7184
**Андрій ЗОЛОТАРЬОВ**, кандидат сільськогосподарських наук,
https://orcid.org/0009-0002-7073-4950
**Лариса ЄЛЕЦЬКА**, https://orcid.org/0000-0001-6029-0183
**Інститут тваринництва НААН, Харків, Україна**

*Підвищене споживання сухої речовини раціонів високопродуктивними коровами зумовлює високий рівень енергії в одиниці сухої маси та введення в кормову суміш 45-50% концентрованих кормів. В результаті модифікується рубцеве травлення, зростає синтез молочної кислоти мікроорганізмами рубця, що створює умови у розвиток гострого запального процесу у типовому рубцевому ацидозі.*

*Основним методом профілактики зазначеного порушення є постійне застосування у складі раціону лужних добавок і буферних сумішей, що дозволяють утримувати оптимум pH.*

*Катіонна структура зазначених систем при постійному застосуванні діє дратівливо на тонкий і товстий кишечник корів, що обертається послабленням травлення та розвитком діарейного ефекту різного ступеня тяжкості. Це призводить до зниження перетравності поживних речовин корму і, як наслідок, зменшення рівня надою із втратою показників якості молока.*

*Відновлення нормального травлення у жуйних у таких умовах можливе при додатковому введенні в раціон специфічних пробіотичних препаратів, яких не багато, і більшість з них малоефективна.*

*Тому надійніше і доцільніше застосовувати не про -, а пребіотики, які формують захисний ефект від діарей на основі активації власної мікрофлори кишечника тварин шляхом зміни активності поверхні ворсинок. Крім того, пребіотичний ефект досягається використанням окремих в'яжучих речовин, що знижують подразнення ворсинок.*

*Однак такі спеціальні добавки відрізняються підвищеною вартістю, тому доцільно здійснити пошук нормальних кормових компонентів раціону, що мають виражені пребіотичні властивості і обґрунтувати їх ефективність у годівлі корів.*

*У тривалому досліді на дійних коровах вивчали вплив корекції годівлі високопродуктивних тварин за допомогою подрібненого насіння льону яке використовувалось в якості функціонального кормового інгредієнта з пребіотичною дією.*

**Ключові слова:** пребіотик, подрібнене насіння льону, кормова добавка, дійні корови, раціон годівлі.

**Introduction.** Feeding highly productive cows requires a mandatory increase in dry matter intake to the maximum in any segment of the cow's lactation cycle. In addition, when cows are milked above 30 kg per day, the energy concentration in the dry matter of

the diet of such animals should be 11.0 - 11.3 MJ per 1 kg. It is possible to ensure such a high level of energy concentration per unit of dry mass only if at least 45-50% of concentrated feed with a large part of their corn grain composition is introduced into the feed mixture of cows .

With a high level of concentrated feed in the diet, scar digestion is modified, which dramatically increases the synthesis of lactic acid by Rumen microorganisms. As a result, the pH of the scar content falls below 6.0. Acidification of the scar contents creates conditions for the development of an acute inflammatory process, which is typical of scar acidosis.

Failure to take timely measures to normalize the acidity of the scar contents (PH 6.2-6.7) leads to the destruction of the absorbent surface of the scar wall and the entry of large amounts of acids into the blood. Metabolic acidosis occurs, which develops into lactation acidosis (Khorrami, B., 2021, Hossain, E. 2020, Galbat, S. A. 2020).

As a result of the development of lactation acidosis, the acidity of fresh milk rises to 19.5-21.0 tons, its thermal stability decreases, and problems arise with fermentation of dairy raw materials during the preparation of fermented dairy products. As a rule, milk with high acidity is rejected, causing huge damage to production.

The main method of preventing acidosis of cows is the constant use of alkaline additives (baking soda, magnesium oxide) and buffer mixtures with a large buffer capacity, which allow you to maintain the optimal pH for up to 6-8 hours.

All known buffer additives used in dairy cattle breeding are made on the basis of a special mixture of oxides and salts of magnesium and potassium. sodium.

The level of introduction of such buffer additives into the diet of cows sometimes has to be raised to 150-300g per head per day.

Almost always, the cationic structure of these buffer systems irritates the small and large intestines of cows. Therefore, the constant use of buffer additives often leads to a weakening of digestion and the development of a diarrheal effect of varying severity in cows. If this effect lasts for a long time, then the severity of the process increases. This leads to a decrease in the digestibility of feed nutrients and, as a result, a decrease in the level of milk yield with a loss of milk quality indicators.

Restoration of normal digestion in ruminants in such conditions is possible with the additional introduction of probiotic drugs into the diet.

However, for dairy cows, there are not many specific probiotic drugs on the market, and most of them are ineffective.

Therefore, it is more reliable and expedient to use not pro -, but prebiotics, which form a protective effect against diarrhea based on the activation of animals ' own intestinal microflora by changing the activity of the villi surface (Uyeno, Y. 2015, Wang, Y. 2021,Hernández Sánchez, D. 2022). In addition, the prebiotic effect is achieved by using individual astringents that reduce villi irritation (Yuan, C. 2023, 2024).

However, special prebiotic supplements are characterized by an increased cost, and their use does not always pay off with additional milk products (Zhang, Y. 2021)

Therefore, it is advisable to search for normal feed components of the diet that have pronounced prebiotic properties and justify their effectiveness in feeding cows (Jonova, S. 2021, Sun, N. 2021).

**Research material and methodology.** The experiment was conducted in the conditions of sooo "Petrodolinskoe" of the Odessa District of the Odessa region from July 1, 2023 to March 30, 2024 on one technological group of dairy cows of the Holstein breed.

A group of dairy cows was recruited within 12 days. It included 89 cows 10 days after calving.

The experiment was conducted using the Group period method. To this end, the study was divided into three stages. For each of them, a separate diet was compiled, balanced by a wide range of indicators. At the same time, the nutritional value of the experimental and control diets did not differ from each other.

At the first stage, the effect of introducing an experimental supplement on the productivity and physiological parameters of the animals during the phase of increasing milk yield was studied. To do this, after 10 days of the equalization period and the end of colostrum production by cows, they were transferred to a control diet. After 20 days of feeding the control diet, 150 g of crushed flaxseed was added to the cows ' feed instead of a sufficient amount of crushed sunflower seeds 40 days before the end of the Phase of increasing milking capacity .

Then, from 100 to 120 days of lactation (the second control period), the cows were fed a control diet without flax seed additives. On the 121st day of lactation, the animals were transferred to the second experimental diet with the inclusion of 200 g of flax per head per day. The billing period was extended by 20 days, but the experimental diet was maintained until the end of the second lactation phase (200 days).

In the final, third phase of lactation, cows were transferred to the third control diet without the study supplement, and animal observations continued for the next 20 days. After that, flax seeds were added to the diet again in the amount of 250 g per head instead of sunflower seeds.

In the third experimental period, the observation of cows lasted for 20 days, but after the end of the experimental feeding, it was preserved until the beginning of cow offspring.

During the experiment, it was studied:

- in fact, cow milk yields by lactation days are individual for each head during the control and experimental periods;
- the fat and protein content of milk is individual for each cow;
- daily ruminant status of cows in groups according to computer diagnostic tools;
- actual feed consumption by group according to the information on the amount of feed indicated on the feed feed table through the mixer, and taking into account the residues on the feed feed table the next day before the phase of increasing milking capacity of a new portion of the diet;
- some biochemical parameters of cow blood at the end of each period of the experiment.

Total protein (refractometrically), protein fractions (albumins, globulins) – according to all and McCord, Reserve alkalinity – according to I. P. Kondrakhin, creatinine – according to the Jaffe color reaction, ASAT and alt - dinitrophenylhydrozine method according to Reitman-Frenkel, total bilirubin – according to the Endrassik diazoreaction-the Cleghorn-Grof method, calcium – according to Devaard, phosphorus from vanado - is pulsed molybdate reagent.

**Research results.** Taking into account the actual range of feed on the farm and the possibility of purchasing feed additives and veterinary drugs, as well as the actual productivity of cows for pre - lactation, we have formed and optimized the feeding rations of cows for three phases of lactation-distribution, maximum milk production and the last third of lactation.

The results of optimizing rations during the Phase of increasing milking capacity are shown in Table 1.

*Table 1.*

**Feeding rations for cows at the Phase of increasing milking capacity (10-60 days of lactation)**

| Indicators | Units. measurements | Preliminary period of the Phase of increasing milking capacity (10-30 days of lactation) | Experimental period at the Phase of increasing milking capacity (30-60 days of lactation) |
|---|---|---|---|
| Wheat | kg | 1,0 | 1,0 |
| Corn | kg | 2,8 | 2,8 |
| Wheat bran | kg | 2,0 | 2,0 |
| Peas | kg | 0,5 | 0,5 |
| Sunflower seeds with husk | kg | 0,5 | 0,35 |
| Soy cake | kg | 2,5 | 2,5 |
| Sunflower meal. SP 36% | kg | 0,8 | 0,8 |
| Rapeseed meal | kg | 1,5 | 1,5 |
| Kitchen salt | kg | 0,11 | 0,11 |
| Monocalcium Phosphate | kg | 0,1 | 0,1 |
| Limestone flour | kg | 0,11 | 0,11 |
| Baking soda | kg | 0,1 | 0,1 |
| Protected fat | kg | 0,2 | 0,2 |
| Magnesium oxide | kg | 0,05 | 0,05 |
| Buffer"Kremix" | kg | 0,15 | 0,15 |
| Haylage | kg | 8 | 8 |
| Corn silage | kg | 18 | 18 |
| Legume hay/green | kg | 0,8 | 0,8 |
| Winter wheat straw | kg | 0,8 | 0,8 |
| Premix | kg | 0,2 | 0,2 |
| Ground flaxseed | | - | 0,15 |
| The diet contains: | | | |
| OE CATTLE | MJ | 264,6 | 263,2 |
| Dry matter | kg | 22,98 | 22,98 |
| % CP concentrates | % | 46,0 | 46,0 |
| Crude protein | g | 3618,0 | 3692,0 |
| Prot. PEREV. cattle | g | 2508,0 | 2519,0 |
| RP | g | 2338,0 | 2331,0 |
| NRP | g | 1271,0 | 1298,0 |
| Raw fat | g | 1499,0 | 1499,0 |
| Raw fiber | g | 4733,0 | 4702,0 |
| CDC | g | 4190,0 | 4178,0 |
| NDC | g | 8203,0 | 8022,0 |
| Sugar | g | 1102,0 | 1101,0 |
| Starch | g | 4559,0 | 4557,0 |
| Ca | g | 151,4 | 151,2 |
| P | g | 119,0 | 118,8 |

The diets were balanced in all main nutritional indicators and corresponded to the planned daily milk yield of cows by lactation phases.

Additives were introduced into the diet to normalize the acid-alkaline balance in the body and prevent acidification of scar contents (drinking soda, magnesium oxide and a special buffer produced by Kremix).

20 days after the start of feeding the diet of the previous period, crushed flax seeds were additionally introduced into its composition at a dose of 150 g per head instead of an adequate amount of sunflower seeds. As a result, the feeding ration remained balanced only at the level of the control period, but began to have the form shown in Table 1.

The experimental diet was continued to be fed until the end of the Phase of increasing milking capacity (60 days), after which the animals were transferred to the feeding characteristic of the maximum lactation according to Table 2 (second control period) without including flax seeds.

Such a diet continued to be fed until the lactation period of 120 days, and after that the cows were again transferred to experimental feeding, which differs from the control one in that crushed flax seeds were introduced into its composition.

As a result, the composition and nutritional value of the experimental diet for the second phase of lactation acquired the form shown in Table 2.

*Table 2.*

**Feeding rations of cows of the control and experimental periods at the stage of maximum milk yield (60-200 days of lactation) for dairy cows 600 kg of milk yield 30 liters maximum milk production**

| Indicators | Unit of Measurement | Control Period | Experimental period |
|---|---|---|---|
| Wheat | kg | 1,5 | 1,5 |
| Corn | kg | 2,5 | 2,5 |
| Wheat bran | kg | 2,0 | 2,0 |
| Peas | kg | 0,8 | 0,8 |
| Sunflower seeds with husk | kg | 0,5 | 0,3 |
| Soy cake | kg | 2,2 | 2,2 |
| Sunflower meal. SP 36% | kg | 0,9 | 0,9 |
| Rapeseed meal | kg | 1,5 | 1,5 |
| Kitchen salt | kg | 0,11 | 0,11 |
| Monocalcium Phosphate | kg | 0,1 | 0,1 |
| Limestone flour | kg | 0,11 | 0,11 |
| Baking soda | kg | 0,1 | 0,1 |
| Protected fat | kg | 0,2 | 0,2 |
| Magnesium oxide | kg | 0,05 | 0,05 |
| Buffer"Kremix" | kg | 0,15 | 0,15 |
| Haylage | kg | 9 | 9 |
| Corn silage | kg | 17 | 17 |
| Legume hay/green | kg | 0,8 | 0,8 |
| Winter wheat straw | kg | 0,9 | 0,9 |
| Premix | kg | 0,2 | 0,2 |
| Ground flaxseed | | - | 0,2 |

*Continuation of Table 2.*

| | | | |
|---|---|---|---|
| The diet contains: | | | |
| OE CATTLE | MJ | 258,1 | 259,3 |
| Dry matter | kg | 23,15 | 23,15 |
| % CP concentrates | % | 50,10 | 50,10 |
| Crude protein | g | 3561,0 | 3591,0 |
| Prot. PEREV. cattle | g | 2479,0 | 2492,0 |
| RP | g | 2338,0 | 2321,0 |
| NRP | g | 1255,0 | 1293,0 |
| Raw fat | g | 1444,0 | 1439,0 |
| Raw fiber | g | 4791,0 | 4793,0 |
| CDC | g | 4332,0 | 4337,0 |
| NDC | g | 7,893 | 7,901 |
| Sugar | g | 1032,0 | 1032,0 |
| Starch | g | 4522,0 | 4521,0 |
| Ca | g | 155,4 | 155,2 |
| P | g | 117,0 | 117,0 |

After 80 days of the experimental period of the second phase of lactation, the cows were transferred to the last phase and the diet presented in Table 3 was set.

After 20 days of the control period (lactation period 220 days), the cows were transferred to an experimental diet, which was fed before cow drying off period.

The composition of the experimental diet of the last phase of lactation is presented in Table 3.

*Table 3.*

**Feeding rations of cows of control and experimental periods at the stage of the last third of lactation (200-300 days of lactation)for dairy cows 600 kg of milk yields 26 liters**

| Indicators | Unit of Measurement | Control period at the stage (200-220 days of lactation) | Experimental period at the stage (220-300 days of lactation) |
|---|---|---|---|
| Wheat | kg | 1,0 | 1,0 |
| Barley | kg | 1,0 | 1,0 |
| Corn | kg | 1,0 | 1,0 |
| Wheat bran | kg | 2,0 | 2,0 |
| Sunflower seeds with husk | kg | 0,3 | 0,05 |
| Soy meal SP 44% | kg | 2 | 2 |
| Rapeseed meal | kg | 1 | 1 |
| Kitchen salt | kg | 0,15 | 0,15 |
| Monocalcium Phosphate | kg | 0,1 | 0,1 |
| Limestone flour | kg | 1,3 | 1,3 |
| Protected fat | kg | 0,1 | 0,1 |
| Ryegrass haylage | kg | 6 | 6 |
| Corn silage | kg | 20 | 20 |
| Ryegrass hay | kg | 1,5 | 1,5 |
| Winter wheat straw | kg | 2 | 2 |

*Continuation of Table 3*

| | | | |
|---|---|---|---|
| Premix | kg | 0,2 | 0,2 |
| Ground flaxseed | | - | 0,25 |
| The diet contains: | | | |
| OE CATTLE | MJ | 252,1 | 252,7 |
| Dry matter | kg | 23,04 | 23,04 |
| % CP concentrates | % | 36,9 | 36,9 |
| Crude protein | g | 3661,0 | 3668,0 |
| Prot. PEREV. cattle | g | 2479,0 | 2481,0 |
| RP | g | 2338,0 | 2327,0 |
| NRP | g | 1255,0 | 1262,0 |
| Raw fat | g | 1444,0 | 1443,0 |
| Raw fiber | g | 4601,0 | 4621,0 |
| CDC | g | 4332 | 4338,0 |
| NDC | g | 7,893 | 7,895 |
| Sugar | g | 1032,0 | 1032,0 |
| Starch | g | 4522,0 | 4522,0 |
| Ca | g | 155,4 | 155,3 |
| P | g | 117,0 | 117,3 |

The results of zootechnical studies are shown in Table 4.

*Table 4.*

**Results of zootechnical studies in the experiment on the phases of the physiological cycle of lactation**

| № | Indicators | Experiment period | | In % be control |
|---|---|---|---|---|
| | | control | experiment | |
| | **Phase of increasing milking capacity of a cow (10-60 days of lactation)** | | | |
| 1 | milk yield in 20 days, kg per head / | 32,3÷0,24 | 33,1±0,29 | 102,4 |
| 2 | percentage of fat in milk | 3,77±0,08 | 3,76±0,09 | 99,73 |
| 3 | percentage of protein in milk | 3,21±0,09 | 3,22±0,06 | 100,3 |
| 4 | feed consumption, OE per 1 kg of n | 8,19 | 7,95 | 97,06 |
| 5 | rumination, min. | 503±11,3 | 527±12,8 | 104,77 |
| 6 | frequency of visually visible diarrhe | 3 | 1 | 33,34 |
| | **Maximum milk yield phase (60-200 days of lactation)** | | | |
| 1 | milk yield in 20 days, kg per head / | 31,2±0,31 | 32,3±027 | 103,5 |
| 2 | percentage of fat in milk | 3,82±0,10 | 3,80±0,09 | 99,47 |
| 3 | percentage of protein in milk | 3,22±0,07 | 3,24±0,08 | 100,6 |
| 4 | feed consumption, OE per 1 kg of n | 8,27 | 8,03 | 97,07 |
| 5 | rumination, min. | 498±12,21 | 518±11,33 | 104,01 |
| 6 | frequency of visually visible diarrhe | 5 | 2 | 40,0 |
| | **Phase of preparation to cow drying off (200-300 days of lactation)** | | | |
| 1 | milk yield in 20 days, kg per head / | 25,5±0,39 | 26,8±0,33 | 105,1 |
| 2 | percentage of fat in milk | 3,88±0,12 | 3,89±0,14 | 100,2 |
| 3 | percentage of protein in milk | 3,21±0,1 | 3,23±0,09 | 100,6 |
| 4 | feed consumption, OE per 1 kg of n | 9,88 | 9,43 | 95,44 |
| 5 | rumination, min. | 494±13,2 | 507±12,4 | 102,6 |
| 6. | frequency of visually visible diarrhe | 6 | 1 | 16,67 |

Table 4 shows that the introduction of flax seeds into the diet of cows in selected doses without changes in the overall nutritional value of the diet affected their productivity at all stages of the experiment. At the phase of increasing milking capacity, flax supplementation stimulated milk yield growth by 2.4%, in the maximum milk yield phase - by 3.55%, and in the lactation attenuation phase - by 5.1%. At the same time, fluctuations in the percentage of fat and protein in milk at different stages of observations were not significant.

Analysis of the data in Table 4 shows the effect of the introduction of an experimental dietary supplement on the optimization of digestion. Under the influence of the additive, an increase in the duration of rumination by 2.6-4.77% was recorded in all three stages of the experiment. In addition, visual observations of cows allowed us to establish a significant decrease in the frequency of diarrheal effects under the influence of dietary changes during the experimental periods of the experiment.

Changes in the nature of digestion under the influence of the introduction of flaxseed into the diet affected some indicators of blood biochemistry (Table 5).

The data in Table 5 show that the change in cow feeding caused a positive reaction in the blood composition of the animals.

*Table 5.*

**Some indicators of blood serum biochemistry by lactation phases at the end of the control and experimental periods of the experiment**

| № | Indicators | Experiment period | |
|---|---|---|---|
| | | control | experiment |
| | **Phase of increasing milking capacity of a cow (10-60 days of lactation)** | | |
| 1 | Total Protein, g/% | 73,5±1,17 | 74,77±2,23 |
| 2 | Albumins, g/% | 35,2±2,21 | 37,2±2,17 |
| 3 | y-globulins, g/% | 28,4±3,05 | 29,9±2,76 |
| 4. | Reserve alkalinity OB % $CO_2$ | 47,7±2,99 | 49,2±3,07 |
| 5 | Creatinine, mmol / l | 88,9±3,54 | 90,2±3,67 |
| 6 | ASAT, Mo / l | 39,2±5,33 | 37,1±3,29 |
| 7 | Alt, Mo / l | 106,5±2,99 | 100,3±4,55 |
| 8 | Bilirubin, mmol / l | 5,49±0,77 | 5,01±0,49 |
| 9 | Calcium, mmol / l | 2,55±0,11 | 2,56±0,12 |
| 10 | Phosphorus, mmol / l | 0,77±0,06 | 0,79±0,09 |
| | **Maximum milk yield phase (60-200 days of lactation)** | | |
| 1 | Total Protein, g/% | 79,22±2,23 | 81,37±2,98 |
| 2 | Albumins, g/% | 39,18±2,06 | 39,91±2,54 |
| 3 | y-globulins, g/% | 29,67 ±3,12 | 32,8±2,90 |
| 4 | Reserve alkalinity OB % $CO_2$ | 51,37±3,87 | 53,8±2,02 |
| 5 | Creatinine, mmol / l | 92,2±3,93 | 96,5±4,45 |
| 6 | ASAT, Mo / l | 39,44±6,34 | 37,9±2,99 |
| 7 | Alt, Mo / l | 113,31±5,21 | 102,11 ±4,23 |
| 8 | Bilirubin, mmol / l | 5,38±1,24 | 4,78±0,55 |
| 9 | Calcium, mmol / l | 2,59±0,19 | 2,87±0,21 |
| 10 | Phosphorus, mmol / l | 0,88±0,09 | 0,92±0,13 |

*Continuation of Table 3*

| | **Phase of preparation to cow drying off (200-300 days of lactation)** | | |
|---|---|---|---|
| 1 | Total Protein, g/% | 79,5±1,56 | 77,01±2,92 |
| 2 | Albumins, g/% | 40,13±2,29 | 41,75±2,45 |
| 3 | y-globulins, g/% | 29,55±3,34 | 31,79±3,06 |
| 4 | Reserve alkalinity OB % $CO_2$ | 48,11±3,03 | 50,24±1,61 |
| 5 | Creatinine, mmol / l | 81,54±2,23 | 88,92±3,01 |
| 6 | ASAT, Mo / l | 40,12±6,08 | 35,44±2,57 |
| 7 | Alt, Mo / l | 108,11±2,03 | 99,12±3,02* |
| 8 | Bilirubin, mmol / l | 5,89±0,43 | 4,52±0,31* |
| 9 | Calcium, mmol / l | 2,67±0,19 | 3,36±0,22* |
| 10 | Phosphorus, mmol / l | 0,79±0,09 | 0,84±0,11 |

*Note. * P<0.05*

During all three stages of the experiment, a tendency to increase total protein, albumins, and gamma globulins was recorded. Under the influence of the additive used, there is an increase in the Reserve alkalinity of the Reserve alkalinity of the blood and a decrease in the concentration of bilirubin. Flax supplementation caused a decrease in the activity of liver enzymes. Moreover, this decrease in the last stage of the experiment was significant against the control.

Indirectly, the supplement used caused an increase in the concentration of calcium and a tendency to increase the concentration of phosphorus in the blood.

The results of the zootechnical effect in relation to the indicators of blood biochemistry allow us to state that the use of crushed flax seed supplements should be considered as an effective prebiotic supplement that normalizes digestion in the gastrointestinal tract of cows.

This supplement had little effect on the nature of scar digestion, but at the same time significantly changed the nature of the processes of nutrient absorption in the small intestine and the normalization of biocenosis in the small and large intestines. This can be confirmed by the multiple reduction in the frequency of diarrhea in highly productive cows in the experiment.

**Discussion.** The aim of our study was to find out whether the effect of crushed flax seeds can be considered as an effective prebiotic agent. Ghedini, C.P. 2021, argues for the effect of such probiotics due to lignans, which are rich in plant substances.

It is known that flax contains astringents of the glycosidic series, which retain their activity throughout the entire gastrointestinal tract of the cow. This reduces the degree of intestinal maceration by chyme residues, which creates the expected antidiarrheal effect (Warnasooriya, V. B. 2023,. Huang, G.,2021).

In addition, flax carbohydrates and its phenolic compounds are a beneficial environment for the development of lactic acid of the small and large intestines and bifidoflora of the large intestine. Because of this, microbial coenosis can be optimized, which will positively affect the immune characteristics of the gastric intestinal tract (Melgar, A. 2025).

Reducing irritation of the intestinal villi, most likely, provided an increase in the degree of absorption of energy, protein and minerals, which affected the positive dynamics of blood biochemistry indicators. For this reason, the dairy productivity of cows increased.

Our data are consistent with numerous European studies that have shown a positive effect of flax seeds on the normalization of digestion, increased milk productivity

and improved blood biochemistry indicators.( Zhang, Y. 2021, Singh, S. 2021, Johnson, A.2023).

Flax seeds contain a significant concentration of mucus or gum, which is mainly found in the outer layer of the seed coat and is known for its many health benefits, such as slowing down digestion, lowering serum cholesterol, and improving glycemic control (Lee, M. 2023).

Adding flaxseed to the diet of dairy cows can effectively increase the levels of omega-3 polyunsaturated fatty acids (n-3 PUFAs) in raw milk, which in turn leads to changes in volatile organic compounds (Huang, G.2022).

**Conclusions:**

1. Crushed flax seeds can be considered as an effective prebiotic to normalize the cow's digestion during the lactation period.

2. Under the influence of an experimental supplement at a dose of 150-250g at different stages of the cow's lactation cycle, it is possible to increase milk productivity by 2.4-5.1%, reduce feed costs by 3.93-4.56% per 1 liter of milk, increase the duration of scar rumination and reduce the diarrheal effect in animals to a minimum.

3. Prebiotic supplement in the form of crushed flax seeds provides a positive dynamics of individual blood parameters: the total protein, albumins and gamma globulins in the blood serum increase, the alkaline Reserve increases, the activity of ASAT and alt enzymes decreases, the accumulation of bilirubin in the blood decreases, and the concentration in calcium and phosphorus increases.

**References**

Uyeno, Y., Shigemori, S., & Shimosato, T. (2015). Effect of probiotics/prebiotics on cattle health and productivity. *Microbes and Environments, 30*(2), 126–132. https://doi.org/10.1264/jsme2.ME14176

Hernández-Sánchez, D., Rico-López, S., Sánchez-Santillán, P., Ayala-Monter, M. A., Crosby-Galván, M. M., & López-Garrido, S. J. (2022). Inulina: Su uso como prebiótico en la nutrición de rumiantes. *Tropical and Subtropical Agroecosystems, 25*(3), Article 105. https://doi.org/10.56369/tsaes.4122

Wang, Y., Nan, X., Zhao, Y., Jiang, L., Wang, H., Zhang, F., Hua, D., Liu, J., Yao, J., Yang, L., Luo, Q., & Xiong, B. (2021). Dietary supplementation of inulin ameliorates subclinical mastitis via regulation of rumen microbial community and metabolites in dairy cows. *Microbiology Spectrum, 9*(2), e00105-21. https://doi.org/10.1128/Spectrum.00105-21

Warnasooriya, V. B., Penner, G. B., Christensen, D., Yu, P., & Mutsvangwa, T. (2023). Effects of feeding ground whole flaxseed, defatted flaxseed meal and organic flaxseed meal on production performance, rumen fermentation, and total-tract nutrient digestibility in dairy cows *(Abstract PSVIII-A-6). Journal of Animal Science, 101*(Supplement_3), 472–473. https://doi.org/10.1093/jas/skad281.560

Yuan, C., Wang, S., Gebeyew, K., Yang, X., Tang, S., Zhou, C., Khan, N. A., Tan, Z., & Liu, Y., Ma, X., Räisänen, S. E., Garcia-Ascolani, M. E., Bobkov, M., He, T., Islam, M. Z., Li, Y., Peng, R., Reichenbach, M., Serviento, A. M., Soussan, E., Sun, X., Wang, K., Yang, S., Zeng, Z., & Niu, M. (2024).Effects of 3-nitrooxypropanol (Bovaer10) and whole cottonseed on milk production and enteric methane emissions from dairy cows under Swiss management conditions. *Journal of Dairy Science, 107*(9), 6817–6833. https://doi.org/10.3168/jds.2023-24460

Melgar, A., Pierret, J., Simon, N., Peyraud, J. L., Fustec, J., & Martín-Tereso, J. (2025). Effects of feeding 3-nitrooxypropanol for methane emissions reduction on income

over feed costs in the United States. *Journal of Dairy Science*, *108*(5), 5061–5075. https://doi.org/10.3168/jds.2024-24649

Almeida, K. V., Resende, T. L., Silva, L. H. P., Dorich, C. D., Pereira, A. B. D., Soder, K. J., & Brito, A. F. (2023). Feeding incremental amounts of ground flaxseed: Effects on diversity and relative abundance of ruminal microbiota and enteric methane emissions in lactating dairy cows. *Translational Animal Science,* 7(1), txad050. https://doi.org/10.1093/tas/txad050

Hossain, E. (2020). Sub-acute ruminal acidosis in dairy cows: Its causes, consequences and preventive measures. *Online Journal of Animal and Feed Research, 10*(6), 302–312. https://doi.org/10.51227/ojafr.2020.41 (ojafr.ir)

Galbat, S. A. (2020). Clinical study on ruminal disorders in cow. *Middle East Journal of Applied Sciences, 10*(4), 649–656. https://doi.org/10.36632/mejas/2020.10.4.55 (curresweb.com)

Ghedini, C. P., & Moura, D. C. (2021). Flaxseed meal feeding to dairy cows as a strategy to improve milk enterolactone concentration: A literature review. *Nativa (Sinop), **9***(4), 373–381. https://doi.org/10.31413/nativa.v9i4.11809 (periodicoscientificos.ufmt.br)

Yuan, C., Wang, S., Gebeyew, K., Yang, X., Tang, S., Zhou, C., Khan, N., Tan, Z., & Liu, Y. (2023). A low-carbon high inulin diet improves intestinal mucosal barrier function and immunity against infectious diseases in goats. Frontiers in Veterinary Science, 9, Article 1098651. https://doi.org/10.3389/fvets.2022.1098651

Jonova, S., Ilgaza, A., & Zolovs, M. (2021). The impact of inulin and a novel synbiotic (yeast Saccharomyces cerevisiae strain 1026 and inulin) on the development and functional state of the gastrointestinal canal of calves. *Veterinary Medicine International,* 2021, Article ID 8848441. https://doi.org/10.1155/2021/8848441

Huang, G., Guo, L., Chang, X., Liu, K., Tang, W., Zheng, N., Zhao, S., Zhang, Y., & Wang, J. (2021). Effect of whole or ground flaxseed supplementation on fatty acid profile, fermentation, and bacterial composition in rumen of dairy cows. *Frontiers in Microbiology,* 12, Article 760528. https://doi.org/10.3389/fmicb.2021.760528

Zhang, Y., Wang, J., Li, Y., Liu, C., Zhao, H., & Chen, X. (2021). Utilizing flaxseed on rumen digestion, some physiological traits and milk yield. *Agriculture, 12*(4), Article 521. https://doi.org/10.3390/agriculture12040521

Singh, S., Singh, N., Kaur, A., & Singh, J. (2021). Fermentation properties of flaxseed meal in ruminant diets. *Fermentation,* 9(5), 486. https://doi.org/10.3390/fermentation9050486

Johnson, A., Smith, B., Lee, C., & Davis, D. (2023). Foods with flax – antioxidant and physicochemical properties. *Foods,* 12(3), 662. https://doi.org/10.3390/foods12030662

Lee, M., Kim, J., Park, S., & Choi, Y. (2023). Analysis of noodle fortification with flax components. *Foods,* 11(20), 3307. https://doi.org/10.3390/foods11203307

Smith, J., Brown, L., Garcia, M., & Wilson, P. (2022). Antioxidant potential of flaxseed-fortified foods. *Foods, 11*(12), 1677. https://doi.org/10.3390/foods11121677

Khorrami, B., Khiaosa-ard, R., & Zebeli, Q. (2021). Models to predict the risk of subacute ruminal acidosis in dairy cows based on dietary and cow factors: A meta-analysis. *Journal of Dairy Science,* 104(7), 7761–7780. https://doi.org/10.3168/jds.2020-19890

Huang, G., Li, N., Liu, K., Yang, J., Zhao, S., Zheng, N., Zhou, J., Zhang, Y., & Wang, J. (2022). Effect of flaxseed supplementation in diet of dairy cow on the volatile organic compounds of raw milk by HS-GC–IMS. *Frontiers in Nutrition,* 9, Article 831178. https://doi.org/10.3389/fnut.2022.831178