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Fatty acid composition of cow milk fat under the influence of humic acids

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Abstract. The fatty acid composition of milk from healthy animals is relatively stable and within the appropriate limits. Adding an organic feed mixture based on humic acids to the diet of dairy cows can affect the content of the main components of milk and change its fatty acid composition.

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The study was conducted to determine the effect of an organic feed mixture made on the basis of humic acids on the mass fraction of fat in cow milk and its fatty acid composition. An organic feed mixture made on the basis of humic acids was included in the diet of cows (dosage: 20 g/100 kg of body weight). Milk samples (volume 500 cm^3 each) were taken from cows of the experimental (n = 20) and control (n = 20) groups at the beginning of the experiment and on the 65^{th} day after the mixture was applied. 21 fatty acids were identified and quantified by gas chromatography. It was found that the mass fraction of fat in the milk of cows in the experimental group increased (at $p < 0.05$) 65 days after the modification of the diet, which may be the result of better assimilation of feed ingredients under the influence of humic acids. An increase in long-chain fatty acids was noted: myristic (C14:0) and palmitic (C16:0), but these changes were not statistically significant. An increase in heptadecanoic (C17:0) at $p < 0.01$ and stearic (C18:0) at $p < 0.05$ fatty acids was found. Long-chain fatty acids are synthesised by the absorption of circulating fatty acids, dietary fats absorbed from the digestive tract, and non-esterified fatty acids (NEFA) from mobilised fat stores. The synthesis of heptadecanoic acid (C17:0) is carried out by the bacterial microflora of the rumen, which indicates an increase in the number of bacteria under the influence of humic acids. The change in the isomeric composition of unsaturated fatty acids in milk occurred due to octadecene (elaidic) acid (C18:1) (trans-9), and a tendency to increase the intermediate products of rumen hydrogenation – linoleic acid C18:2 (cis-9:12) was also noted. The biological value of milk fat is characterised by the saturation coefficient, which is determined by the ratio of saturated fatty acids to unsaturated. The saturation coefficient of milk of the experimental and control groups did not significantly differ

Keywords: mass fraction of fat; saturated short-chain fatty acids; unsaturated long-chain fatty acids; humic acids

Introduction

In 2020-2025, more and more attention is paid to the study of the composition and properties of lipids in food products. Fats are the main source of energy, perform a structural function, and are also the main components of cell membranes, ensuring their flexibility and integrity. Fats are also factors in the absorption of vitamins E, A, K, and D, which provide the physiological needs of the body (Comerford *et al.*, 2021; Teter *et al.*, 2023). According to data from Y. Hou *et al.* (2023) and W. Lou *et al.* (2024), fats, including milk fat, play a role in thermoregulation, helping to maintain optimal body temperature in animals. In turn, V. Sadvari *et al.* (2024) and B. Paszczyk & E. Tońska (2025) argue that milk and dairy products, due to the balance of components necessary for the body, play an important role in a healthy daily diet of people. In addition to proteins, carbohydrates, vitamins and minerals, milk contains milk fat. The fat present in milk has a unique property, as it contains about 400 different fatty acids, which makes it the most complex of all natural fats (Sadvari *et al.*, 2025).

Milk fatty acids are synthesised from two sources: feed and the result of microbial activity that occurs in the rumen of cows. Lipids in cow's milk are mainly present in globules in the form of an "oil-in-water" emulsion (Kholif *et al.*, 2021). The fatty acid content of milk is a reliable indicator of its quality. The change in this parameter depends on various factors that must be taken into account when implementing methods for adjusting the fatty acid composition of milk (Iakubchak *et al.*, 2024). I. Hryshchuk *et al.* (2022) studied the effect of different types of nervous activity on the content of saturated fatty acids. In the study of blood plasma, it was found that caproic acid in the normotonic group of cows (1.19 ± 0.01) was 0.15% lower compared to blood plasma taken from cows with a sympathotonic nervous system ($p \leqslant 0.01$) and 0.15% higher compared to vagotonic cows ($p \leqslant 0.001$). The content of caprylic acid was 0.28% higher in normotonics (1.19 ± 0.05) compared to sympathotonics ($p \leqslant 0.001$). The content of lauric acid in normotonics (0.54 ± 0.03) is higher than in vagotonics by 0.13% ($p \leqslant 0.01$), and the content of myristic acid is lower in normotonics (2.62 ± 0.08), compared to sympathotonics by 0.30% ($p \leqslant 0.001$). As for the content of palmitic acid, it is 2.95% lower in normotonics (17.59 ± 0.46), compared to vagotonics ($p \leqslant 0.001$). At the same time, the content of arachidic acid is lower in normotonic cows (0.21 ± 0.01), compared to sympathotonics by 0.08% ($p \leqslant 0.001$). Cows with a normotonic type of nervous system are characterised by the highest content of saturated fatty acids in blood plasma: capric (1.19 ± 0.05), lauric (0.54 ± 0.03), and the lowest – myristic (2.62 ± 0.08) and arachidic (0.21 ± 0.01). The blood plasma of sympathotonic cows is characterised by the highest content of the following saturated fatty acids: caproic (1.18 ± 0.04), myristic (2.92 ± 0.03) and arachidic (0.29 ± 0.01), and the blood plasma of vagotonic cows contains the lowest content of the following saturated fatty acids: caproic (0.88 ± 0.01), capric (0.82 ± 0.3) and lauric (0.41 ± 0.01). Therefore, the tone of the autonomic nervous system of cows is characterised by an indirect role in the metabolism of saturated fatty acids in blood plasma.

This study aimed to determine the fatty acid composition of cow milk fat under the influence of humic acids.

Literature Review

Fats in the body play an important role as an energy and plastic material, and therefore their research by many scientists has been relevant for the past decades. Deficiency of fats in the diet leads to complex pathological consequences, which are accompanied by nervous disorders, decreased immunity and, as a result, the quality of life deteriorates and the natural life expectancy is reduced. As M. Markiewicz-Kęszycka *et al.* (2013) noted, the mentioned processes are associated with lipid metabolism disorders. J. Miciński *et al.* (2012) found that short- and medium-chain fatty acids (C4:0, C6:0, C8:0, C10:0), which are present in milk, are oxidised in the liver to acetyl-CoA and do not affect the activity of low-density lipoprotein receptors. They do not increase the level of lipids in the blood, and therefore do not pose a threat to the development of obesity and cardiovascular diseases.

Milk from healthy cows is characterised by a relatively constant content of fatty acids, which are within natural physiological limits (Gómez-Cortés *et al.*, 2018). Although J. Ruiz *et al.* (2016) note that some fluctuations in the content of individual fatty acids may occur when the animal's diet changes. Thus, the concentration of lactate ($p < 0.05$) in cows that had protein feed (soybean) in the diet decreased by 18%. The mass fraction of butyric acid in the milk of cows increased when the buffer mixture was added to the diet, and the content of acids such as 18:1, 18:2, 18:3 and 20:4 ($p < 0.05$-0.01) decreased. When fat was added to the diet, the proportion of fatty acids such as linoleic (cis-9,12 18:2) ($p < 0.05$) and oleic (cis-9 18:1) increased in milk. When feeding both diets ($p < 0.05$), the buffer feed additive reduced the content of oleic and linoleic acids. In the case of feeding soybeans to cows instead of soybean meal, an increase in the content of the sum of trans-isomers of unsaturated fatty acids in milk ($p < 0.001$) was found by 1.7 times. Moreover, feeding cows additionally with a buffer mixture reduced the content of these acids ($p<0.05$) in milk (Hultyayeva *et al.*, 2017).

Researchers A. Kholif *et al.* (2021) claim that adding a feed supplement containing humic acids to the diet of dairy cows affects the content of the main components of milk and changes the fatty acid profile. A. Teter *et al.* (2021) found that adding humic acids to the diet of cows in combination with mineral supplements increases the mass fraction of fat in milk and enhances its cheese-making properties. The ability of humic acids to change the composition of the intestinal microflora of cows has been scientifically proven, and this, in turn, improves the digestibility of feed nutrients. And as a result, the fat content increases, and the chemical composition of milk improves (Potůčková & Kouřimská, 2017).

It should be noted that humic compounds are formed as a result of the decomposition of plant and animal residues in the soil and are widely used in agronomy (Alsudays *et al.*, 2024). According to N. Strzałkowska *et al.* (2009), they are a source of fulvic and humic acids, as well as minerals. Humic acids have multidirectional properties, including anti-inflammatory, antibacterial, antiviral and immunomodulatory effects, and also reduce oxidative stress (Abo-Zeid *et al.*, 2017; Hassan *et al.*, 2020). Scientists Y. Kansagara *et al.* (2022) experimentally proved that humic acids stabilise the digestion of nutrients. N. El-Zaiat *et al.* (2018) also reported that the administration of humic acids resulted in an increase in both the fat and protein content of milk. In animals that received humic acids in the diet, the content of total protein, globulin and glucose in the blood increased.

Modern results of scientific research conducted by S. Malyugina & P. Horky (2024) indicate that humic acids, as a natural feed additive for ruminants, play an important role in nitrogen metabolism and stabilisation of protozoa without a negative impact on rumen fermentation. Feed additives of humic nature (potassium humate) are used in cow feeding rations. This activates metabolic processes in the animal body (Angeles *et al.*, 2022; Begma *et al.*, 2024). M. Potůčková & L. Kouřimská (2017) when feeding dairy cows humic substances revealed a significant increase in the content of crude protein, pure protein and casein in milk. In the studies conducted by A. Teter *et al.* (2021) note that adding a humic-mineral feed supplement to the diet of cows increased the fat content in milk and improved the properties of milk for cheese production. Thus, the current task is to conduct a study of the effect of the used supplement containing humic acids on the nutritional value of milk fat in raw milk.

Materials and Methods

The study was conducted during the autumn-winter period of 2022-2024 at the dairy farm “Kolosok” in the village of Kozhenyky, Bila Tserkva district, Kyiv region, Ukraine, on black-and-white cows, which were kept loose in a two-row cowshed that accommodates 100 cows (7.5 m^2 per 1 cow). All cows had free access to water, which they consumed ad libitum. The cows were fed a mixed diet. The main diet consisted of corn silage (63%), haylage (30%), rapeseed meal (1.8%), mixed feed (39% protein), soybean meal (2.1%), straw (0.6%) and tricalcium phosphate (0.2%). Forty cows were preliminarily selected from the herd between the 30th and 120th day of the I or II lactation (average 68 days). This period is characterised by the highest lactation. The average body weight of the cows was 554 ± 47 kg, and the daily milk yield was 25.68 ± 3.12 kg. Milking was carried out twice a day, at 6:00 am and 6:00 pm.

Cows were divided into two groups: experimental (n = 20) and control (n = 20) according to the principle of groups-analogues. Animals of the experimental and control groups were kept in different cowsheds on the same type of diet with ensuring their well-being. Cows of the experimental group were controlled to add an organic feed mixture containing 65% humic acids in terms of dry matter (based on 20 g/100 kg of body weight) to the main diet. The dosage was experimental; it was calculated taking into account the diet and productivity of cows. Organic feed additive is a complex of biologically active substances of natural origin, made from natural raw materials (peat, restructured water, leonardite). It is a liquid dark brown mixture with a weak specific odour, which contains 44.4 humic acids and 24.2% fulvic acids with other ingredients. The feed additive was stored in a sealed package at a temperature of 2°C to 16°C, avoiding freezing and direct sunlight. The manufacturer of the product is the company “Greenat Ecology”, Bila Tserkva. The duration of the experiment was 65 days.

At the beginning of the experiment and after its completion, milk for the study was collected during morning milking in accordance with DSTU 3662:2018 (2019). An average sample of freshly milked milk was used for the study and was examined within 2 hours after milking. The fat content in milk was determined in accordance with DSTU ISO 488:2007 (2009). The determination of the fatty acid content in milk was carried out by gas chromatography after fat separation according to the method described in DSTU ISO 1211:2002 (2003). To determine the fatty acid composition of the obtained milk fat, its methylation was carried out according to DSTU ISO 5509-2002 (2003). The saturation coefficient of milk was also determined as the ratio of the sum of saturated fatty acids to the sum of unsaturated fatty acids.

Fatty acids were determined in the food laboratory of the State Enterprise "Kyivoblstandartmetrology" on a GC-2010 gas chromatograph (Shimadzu, Japan), equipped with a flame ionisation detector (FID) and a separate sample introduction system (ratio 1:30). Peak separation was performed on a capillary chromatographic column, 30 m long and 0.32 mm internal diameter, 0.25 µm film (Omegawax model – 320, Supelco Co., EUA). Chromatography temperature conditions: injector (280°C) and detector (260°C). At the beginning of the analysis, the thermostat temperature was 40°C for 3 min, followed by programming at 2.5°C/min (from 41 to 180°C), and subsequently at 2.0°C/min to 210°C, and the last temperature was maintained for 25 min. In this case, helium was used as a carrier gas. To achieve a helium velocity of 25.0 cm/sec, the appropriate pressure was set in the column. For identification and quantitative determination of fatty acid peaks of control and experimental milk samples, they were compared with similar indicators of analytical standards. Heptadecanoic acid (C17:0; Sigma Chemical Co.) was used as an internal standard, added for the purpose of quantitative calculation of fatty acid composition. Studies on the determination of fatty acid composition were carried out in 3 parallel tests. Xcalibur software (version 2.07) was used to read the chromatograms. Analysis of fatty acid content was performed according to DSTU ISO 5508-2001 (2003). Statistical data processing was performed using the Student's t-test. (at $p < 0.1$; $p < 0.05$; $p < 0.01$). The experimental studies were conducted in compliance with the requirements of the European Convention... (1986), as well as the Law of Ukraine No. 3447-IV (2006).

Results and Discussion

The mass fraction of milk fat of cows in the experimental group increased with the addition of an organic feed mixture made on the basis of humic acids to the diet (Table 1).

Table 1. *Milk fat content in cows following the administration of humic acids, %*

Animal groups	Experimental scheme			
	Beginning		End	
	[a]M ± m	[B]Lim	M ± m	Lim
Control	3.3 ± 0.05	2.98 - 4.22	3.5 ± 0.24	3.05 - 3.81
Experimental	3.27 ± 0.28	3.01 - 4.54	4.15 ± 0.21**	3.24 - 5.16

Note: ** – p<0.05; [a]M ± m (M – arithmetic mean, m – standard error of the mean); [B]Lim – limits of fluctuations of the indicator

Source: developed by the authors based on research

An increase in the mass fraction of fat in the milk of cows in the experimental group ($p < 0.05$) was noted 65 days after the modification of the diet, namely, the introduction of humic acids into the diet. The improvement in the synthesis of milk fat may be the result of better assimilation of feed ingredients under the influence of humic acids. The increase in the fat content in milk under the influence of humic acids occurs due to their ability to change the composition of the intestinal flora and, thus, improve the use of feed nutrients, which positively affects the chemical composition of milk (Mehmet & Songül, 2021). Furthermore, the addition of humic acids to the diet of dairy cows also affected the fatty acid profile and lipid composition of milk. Palmitic and palmitic acids predominated in the milk fat of cows in the experimental and control groups (16:0), stearic (C18:0) and myristic (C14:0) fatty acids (Table 2).

***Table 2.** Fatty acid composition of cow's milk under the influence of humic acids, %*

Name indicators	Fatty acid code	Research results	
		research group	control group
Saturated fatty acids			
Butyric acid	C4:0	3.96±0.68	4.22±0.02
Caproic acid	C6:0	2.21±0.13	2.35±0.1
Caprylic acid	C8:0	1.19±0.01	1.28±0.15
Capric acid	C10:0	2.41±0.32	2.78±0.39
Lauric acid	C12:0	2.86±0.45	3.20±0.54
Myristic acid	C14:0	11.02±1.31	10.50±0.91
Pentadecanoic acid	C15:0	1.05±0.12	1.37±0.35
Palmitic acid	C16:0	31.12±2.5	30.69±1.57
Heptadecanoic acid	C17:0	0.46±0.02*	0.22±0.01
Stearic acid	C18:0	11.02±0.66*	9.39±0.059
Arachidic acid	C20:0	0.03±0.02	0.08±0.02
Behenic acid saturated	C22:0	0.08±0.02	0.58±0.002
Monounsaturated fatty acids			
Undecanoic acid	C11:0	0.21±0.02	0.36±0.04
Myristoleic acid	C14:1	1.34±0.06	1.68±0.1
Palmitoleic acid	C16:1	1.95±0.53	2.02±0.59
Heptadecenoic acid	C17:1	1.02±0.59	0.93±0.04
Elaidic acid	C18:1 (trans-9)	1.80±0.06*	1.61±0.05
Oleic acid	C18:1n9c	23.17±3.39	23.79±3.13
Polyunsaturated fatty acids			
Linoleic acid	C18:2 (cis-9:12)	2.36±0.06*	2.20±0.02
Linolenic acid	C18:3 (cis-9.12.15)	0.35±0.02	0.43±0.03
Linoelaidic acid	C18:2 (trans-9:12)	0.36±0.02*	0.32±0.01

Note: * – p<0.1; ** – p<0.05; *** – p<0.01

Source: developed by the authors based on research

Milk fat is characterised by a significant mass fraction of saturated fatty acids. Short-chain saturated fatty acids from C4:0 to C10:0 in the milk of cows of the experimental and control groups, respectively, on average amounted to 9.8 and 10.6% of the total saturated fatty acids. A characteristic feature of milk fat is the presence of butyric acid in milk. This fatty acid is formed in milk by synthesis in the epithelial cells of the udder from the products of microbial fermentation of feed carbohydrates. According to the studies conducted, the mass fraction of butyric acid (C4:0) in the milk of cows of the experimental group ranged from 3.29 to 4.66%, and in the milk of the control group – 3.95-4.05%. Long-chain fatty acids are synthesised by the absorption of circulating fatty acids from dietary fats absorbed from the digestive tract and non-esterified fatty acids (NEFA) from mobilised fat stores (Vašková *et* *al.*, 2011). In the milk of cows of the experimental group, an increase in long-chain fatty acids was noted: myristic (C14:0) and palmitic (C16:0), but these changes were not statistically significant. Along with this, the percentage of heptadecanoic acid C17:0 ($p < 0.01$) and stearic acid C18:0 ($p < 0.05$) increased.

The change in the isomeric composition of unsaturated fatty acids in milk occurred due to octadecenoic (elaidic) acid (C18:1), trans-9. In addition, a tendency to increase the intermediate products of rumen hydrogenation – linoleic acids C18:2 (cis-9:12). The saturation coefficient of milk of the experimental and control groups did not differ significantly (Table 3). The biological value of milk fat is characterised by the saturation coefficient, which is determined by the ratio of saturated fatty acids to unsaturated ones.

Table 3. *Ratio of fatty acid groups in cow's milk with the use of humic acids ($M \pm m$, $n = 20$, in %)*

No.	Fatty acid groups	Research group	Control group
1	Saturated fatty acids	67.41 ± 6.33	66.66 ± 4.04
2	Unsaturated fatty acids	32.59 ± 4.85	33.34 ± 4.78
3	Saturation factor	2.07	1.99
4	Monounsaturated fatty acids	29.49 ± 4.65	30.39 ± 3.97
5	Polyunsaturated fatty acids	3.1 ± 0.1	2.95 ± 0.06

Source: developed by the authors based on research

R. Golubets *et al.* (2011) point out the regularity that with a decrease in the saturation index, the proportion of unsaturated fatty acids in milk increases. This is manifested in a more pronounced taste and smell, a softer consistency of butter, and milk fat is more stable during storage. In previous studies, O. Yakubchak *et al.* (2023) found that when feeding dairy cows a feed mixture containing 45% humic and 22% fulvic acids, an increase in the cows' milk productivity (an increase in average daily milk yield) and an increase in the mass fraction of fat and protein in their milk were observed. At the same time, R. Mylostyvyi *et al.* (2023) noted that the fatty acid composition of milk can be influenced by various factors, and the study by O. Yakubchak *et al.* (2021) showed that the organoleptic and physicochemical parameters of raw milk change depending on the season. In particular, in winter, the content of saturated fatty acids in milk increases, while in summer and autumn, the content of unsaturated fatty acids increases, which is associated with the presence of green mass and corn silage in the diet of cows. This confirms the need for a comprehensive approach to assessing factors affecting the fatty acid composition of milk. The authors also indicate that the ratio of fatty acids in the milk of cows characterises the level of their feeding, and this confirms the feasibility of using feed additives to improve the quality of dairy products.

The diverse fatty acid composition of cow's milk is also due to the rumen biohydrogenation of C18 unsaturated fatty acids of feed lipids and the synthesis of fatty acids *de novo* in breast tissue (Markiewicz-Kęszycka *et al.*, 2013). The addition of humic acids to the diet of dairy cows affected the change in the fatty acid profile, namely, the increase in saturated fatty acids: stearic acid (C18:0) at $p < 0.05$ and heptadecanoic acid (C17:0) at $p < 0.001$. Taking into account the fact that the synthesis of heptadecanoic acid (C17:0) is carried out by the bacterial microflora of the rumen, it can be assumed that the number of bacteria increases under the influence of humic acids. Stearic acid, which belongs to long-chain fatty acids, can be desaturated in the mammary gland with the formation of the corresponding monounsaturated acids. Part of the saturated fatty acids absorbed from the blood is converted into monounsaturated by Δ9-desaturase of the mammary gland. The main substrates of this enzyme are stearic (18:0) acid, which is converted into the trans-9 isomer of C18:1 monounsaturated fatty acids.

Trans fatty acids are negatively perceived by consumers, but it is necessary to distinguish between trans fatty acids of natural origin and those obtained industrially. In the milk of cows in the experimental group, an increase in essential polyunsaturated long-chain fatty acids (linoleic and linoleic acid), which is important for milk as a biologically complete food product. Therefore, feeding dairy cows a feed additive based on humic acids contributes to the change not only of the main components of milk, but also improves its fatty acid composition.

Conclusions

The conducted studies have shown a significant effect of enriching the diet of dairy cows with an organic feed additive based on humic acids on milk quality indicators and its fatty acid profile. It was experimentally established that the use of this additive leads to a statistically significant increase in the mass fraction of fat in the milk of cows of the experimental group ($p < 0.05$) 65 days after diet modification. This phenomenon is explained by the improvement of the assimilation of feed ingredients under the influence of humic acids, which are able to change the composition of the intestinal microflora and optimise metabolic processes in the animal body. Chromatographic analysis of milk of dairy cows that received a feed additive based on humic acids allowed the identification of 21 fatty acids of different classes: 12 saturated, 6 monounsaturated and 3 polyunsaturated fatty acids. Particularly significant were the changes in the profile of long-chain fatty acids, namely a statistically significant increase in the concentration of heptadecanoic acid C17:0 ($p<0.01$) and stearic acid C18:0 ($p<0.05$). At the same time, there was a tendency to increase the content of myristic acid C14:0 and palmitic (C16:0) acids, although these changes did not reach statistical significance. Analysis of the ratio of different groups of fatty acids showed that the saturation coefficient of milk between the experimental and control groups did not differ significantly, being 2.07 and 1.99, respectively. This indicates the preservation of the biological value of milk fat when using the studied supplement.

The results obtained are of important practical importance for dairy farming, as they demonstrate the possibility of targeted modification of the fatty acid composition of milk by using natural biologically active substances. This opens up prospects for the production of dairy products with improved functional properties and increased biological value. In the context of further research, it seems appropriate to comprehensively study the dynamics of changes not only in the fatty acid composition, but also in the amino acid composition of milk with long-term use of feed additives based on humic acids. Promising directions also include the study of the effect of different concentrations and compositions of humic compounds on the metabolism of the mammary gland, the study of seasonal variability in the effectiveness of the additive, as well as the assessment of the economic feasibility of its use in different systems of keeping and feeding dairy cows. Additionally, it is relevant to study the effect of such additives on the organoleptic properties of milk and its technological suitability for processing into various types of dairy products.

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Conflict of Interest

None.

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Жирнокислотний склад молочного жиру корів за впливу гумінових кислот

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Анотація. Жирнокислотний склад молока здорових тварин є відносно сталим і знаходиться у відповідних межах. Збагачення раціону дійних корів сумішшю на основі органічних компонентів з додаванням гумінових кислот може впливати на вміст основних компонентів молока та змінювати його жирнокислотний склад. Дослідження проведено з метою визначення впливу органічної кормової суміші, виготовленої на основі гумінових кислот, на масову частку жиру в молоці корів та його жирнокислотний склад. До раціону корів було включено органічну кормову суміш, виготовлену на основі гумінових кислот (дозування: 20 г/100 кг маси тіла). Зразки молока (об'ємом по 500 см^3) відбирали від корів дослідної ($n = 20$) та контрольної ($n = 20$) груп на початку досліду та на 65-й день після застосування суміші. Методом газової хроматографії ідентифіковано та кількісно визначено 21 жирну кислоту. Встановлено, що масова частка жиру в молоці корів дослідної групи підвищилася (за $p < 0,05$) через 65 днів після модифікації раціону, що може бути результатом кращого засвоєння кормових інгредієнтів під впливом гумінових кислот. Відзначали підвищення довголанцюгових жирних кислот: міристинової (С14:0) та пальмітинової (С16:0), проте ці зміни не були статистично достовірними. Виявили підвищення гептадеканової (С17:0) за $p < 0,01$ та стеаринової (С18:0) за $p < 0,05$ жирних кислот. Довголанцюгові жирні кислоти синтезуються шляхом поглинання циркулюючих жирних кислот, харчових жирів, що всмоктуються із травного тракту, і неестерифікованих жирних кислот (НЕЖК) з мобілізованих запасів жиру. Синтез гептадеканової кислоти (С17:0) здійснюється бактеріальною мікрофлорою рубця, що вказує на зростання кількості бактерій під впливом гумінових кислот. Зміна ізомерного складу ненасичених жирних кислот молока відбувалася за рахунок октадеценової (елаїдинової) кислоти (С18:1) (транс-9), а також відзначали тенденцію до збільшення проміжних продуктів рубцевої гідрогенізації – лінолевої кислоти С18:2 (цис-9:12). Біологічна повноцінність молочного жиру характеризується коефіцієнтом насиченості, який визначається відношенням насичених жирних кислот до ненасичених. Під час досліджень не виявлено вірогідної різниці коефіцієнту насиченості молока у корів дослідної та контрольної груп

Ключові слова: масова частка жиру; насичені коротколанцюгові жирні кислоти; ненасичені довголанцюгові жирні кислоти; коефіцієнт насиченості