Василина Турсунай Қажымұратовна – PhD докторы, Қазақ ұлттық аграрлық зерттеу университеті Топырақтану және агрохимия кафедрасының доценті, Алматы қ., Абай даңғылы 8, 050010, тел: 87073363368; e-mail: v_tursunai@mail.ru.

Жаппарова Айгүл Абсултановна – ауылшаруашылығы ғылымдарының кандидаты, Қазақ ұлттық аграрлық зерттеу университетінің топырақтану және агрохимия кафедрасының профессоры, 050010 Алматы қ., Абай даңғылы 8, тел: 87078800060; e-mail: aigul7171@inbox.ru.

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CHEMICAL COMPOSITION OF COWS' MILK AS AN INDICATOR OF FEEDING VALUE

Papusha N.V. – candidate of agricultural sciences, associate professor of the department of technology for the production of livestock products, A. BaitursynovKostanay Regional University.

Bermagambetova N.N. – Ph.D., senior lecturer of the department of technology for the production of livestock products, A. BaitursynovKostanay Regional University.

Kubekova B.Zh. – master of agricultural sciences, senior lecturer of the department of technology for the production of livestock products, A. BaitursynovKostanay Regional University.

Smailova M.N. – Ph.D. student of the educational program 8D08201 - Technology for the production of livestock products, A. BaitursynovKostanay Regional University.

Feeding dairy cows with a diet with a crude protein content of 10.7% of dry matter led to an increase in the urea content in cows' milk up to 45.9 mg/ml, a change in the fat:the protein ratio in milk within 0.8:1, and a decrease in cow resistance and, as a result, an increase in somatic cells in milk up to 302.3 thousand / cm^3 .The adjusted diet of cows' feeding with a crude protein content of 9.9% of dry matter had a beneficial effect on the quantitative and qualitative indicators of the milk productivity of Black-and-White cows in the conditions of Zarya JSC. Thus, the concentration of the urea in the milk decreased up to 32.3 mg/ml, the ratio of fat: milk protein improved within 1.06: 1, the metabolism of cows \became normal, the resistance of animals increased and the number of somatic cells in milk decreased upto 164.2 thousand /cm^3. It was noted that cows in different stages of do not react equally to changes in the feeding diet. More responsive to diet changes were cows lactating for over 201 days, i.e. in the final stages of lactation. Groups of cows receiving 1821 grams of crude protein per day in thefeeding dietgot the best quantitative and qualitative indicators of milk productivity, in contrast to groups receiving 2163 grams of crude protein in the diet.

Key words: dairy cow diet, crude feed protein, milk urea, fat: protein ratio in milk, milk somatic cells

ХИМИЧЕСКИЙ СОСТАВ МОЛОКА КОРОВ, КАК ИНДИКАТОР ПОЛНОЦЕННОСТИ КОРМЛЕНИЯ

Папуша Н.В. – кандидат сельскохозяйственных наук, ассоциированный профессор кафедры технологии производства продуктов животноводства, Костанайский региональный университет им.А.Байтурсынова.

Бермагамбетова Н.Н. – доктор PhD, ст.преподаватель кафедры технологии производства продуктов животноводства, Костанайский региональный университет им.А.Байтурсынова.

Кубекова Б.Ж. – магистр с.-х.наук, ст.преподаватель кафедры технологии производства продуктов животноводства, Костанайский региональный университет им.А.Байтурсынова.

Смаилова М.Н. – обучающийся докторантуры образовательной программы 8D08201 – Технология производства продуктов животноводства, Костанайский региональный университет им.А.Байтурсынова.

Кормление дойных коров рационом с содержанием сырого протеина 10,7% от сухого вещества, привело к повышению содержания мочевины в молоке коров до 45,9 мг/мл., изменению соотношения жир: белок в молоке в пределах 0,8:1, снижению резистентности коров и как следствие увеличению соматических клеток в молоке до 302,3 тыс/$см^3$.Откорректированный рацион кормления коров с содержанием сырого протеина на уровне 9,9% от сухого вещества, благотворно отразился на количественных и качественных показателях молочной продуктивности коров черно-пестрой породы в условиях АО «Заря». Так, концентрация мочевины в молоке снизилась до 32,3 мг/мл, улучшилось соотношение жир: белок молока в пределах 1,06:1, метаболизм коров пришел в норму, повысилась резистентность животных и снизилось количество соматических клеток в молоке до 164,2 тыс/$см^3$.Отмечено, что коровы, находящиеся на разных стадиях лактации, неодинаково реагируют на изменения рациона кормления. Более отзывчивыми

на изменения рациона были коровы, лактирующие более 201 дня, т.е. в заключительной стадии лактации. Группы коров, получающие в рационе кормления 1821 грамм сырого протеина в сутки, имели лучшие количественные и качественные показатели молочной продуктивности в отличии от групп, получавших с рационом 2163 грамм сырого протеина.

Ключевые слова: рацион кормления дойных коров, сырой протеин корма, мочевина молока, соотношение жир: белок в молоке, соматические клетки молока.

ТОЛЫҚ ҚҰНДЫ АЗЫҚТАНДЫРУ КӨРСЕТКІШІ РЕТІНДЕ, СИЫР СҮТІНІҢ ХИМИЯЛЫҚ ҚҰРАМЫ

Папуша Н.В. – ауыл шаруашылығы ғылымдарының кандидаты, мал шаруашылығы өнімдерін өндіру технологиясы кафедрасының қауымдастырылған профессоры, А. Байтурсынов атындағы Қостанай өңірлік университеті.

Бермагамбетова Н.Н. – PhD докторы, мал шаруашылығы өнімдерін өндіру технологиясы кафедрасының аға оқытушысы, А. Байтурсынов атындағы Қостанай өңірлік университеті.

Кубекова Б.Ж. – ауыл шаруашылығы ғылымдарының магистрі, мал шаруашылығы өнімдерін өндіру технологиясы кафедрасының аға оқытушысы, А. Байтурсынов атындағы Қостанай өңірлік университеті.

Смаилова М.Н. – 8D08201 - Мал шаруашылығы өнімдерін өндіру технологиясы мамандығының докторантура білім алушысы, А. Байтурсынов атындағы Қостанай өңірлік университеті.

Құрамында құрғақ зат 10,7% құрайтын шикі ақуызы бар сүтті сиырларды азықтандыру сиыр сүтіндегі мочевина мөлшерінің 45,9 мг/мл дейін артуына, сүттегі майдың: ақуыздың 0,8: 1 шегінде өзгеруіне, ал төзімді сиырлардың төмендеуі және соның салдарынан сүттегі соматикалық жасушалардың 302,3 мың/см^3 дейін артуына әкелді. «Заря» АҚ жағдайында қара-ала сиырлардың азықтандыруға арналған рацион түзетуне байланысты құрамында шикі ақуызы 9,9 % құрғақ зат құрайтын сүт өнімділігінің сандық және сапалық көрсеткіштеріне жақсы әсер етті. Осылайша, сүттегі мочевина концентрациясы 32,3 мг/мл дейін төмендеді, майдың қатынасы: сүт ақызына 1,06: 1 шегінде жақсарды, сиырлардың метаболизмі қалыпты жағдайға оралды, малдардың төзімділігі жоғарылады және сүттегі соматикалық жасушалардың саны 164,2 мың /см^3 дейін азайды. Лактацияның әртүрлі кезеңдеріндегі сиырлардың азықтандыруына өзгерістерге әртүрлі әрекет ететіні атап өтілген. Азықтандыру өзгеруіне көбірек шалдыққан сиырлар лактация 201 күннен астам, яғни лактацияның соңғы кезеңдерінде. Рационда күніне 1821 грамм шикі ақуыз алатын сиырлар топтары, 2163 грамм шикі ақуызды рационмен қабылдаған топтарға қарағанда сүт өндірудің сандық және сапалық көрсеткіштері жақсырақ болды.

Түйінді сөздер: сауын сиырларыныңазықтандыру рационы, шикі азықтық ақуыз, сүт мочевина, майдың қатынасы: сүттегі ақуыз, сүттің соматикалық жасушалары.

Introduction. In modern conditions of keeping highly productive dairy cows, the problem of violation of protein metabolism is quite common, which can cause a decrease in milk productivity, reproduction rates, the occurrence of various diseases, and, as a result, early retirement of the animal.

It is possible to diagnose metabolic disorders at an early stage only by biochemical parameters of blood, urine, milk, etc. Early diagnosis allows you to take timely measures aimed at eliminating the cause that caused the violation of metabolic processes in the body [1, p.3-4].

Even with detailed observance of feeding norms, an analysis of the biochemical parameters of the physiological fluids of cows is required. So, many farms in Kazakhstan still use the norms and feeding rations proposed by A.P. Kalashnikov, focusing on the overall nutritional value of the diet in-feed units. Although, the leading dairy enterprises of the CIS countries are already switching to NRC nutritional standards (**NationalResearchCouncil, 2001**), which are based on the dry matter intake of the diet, consider the content of neutral detergent fiber, etc.

Wecarried the studies out on the breeding farm of Zarya JSC, KostanayRegion. The farm is engaged in breeding black-motley breed of cattle. It balanced the diet for cows for the main nutrients, it used the feeding rate according to the reference book of Kalashnikov A.P. for cows with a live weight of 500 kg and an average daily milk yield of 18 kg [2, p.52-53]. During the stall period, animals, according to their belonging to physiological groups, received the same type of fully mixed diet. At the beginning of the study, dairy cows of Zarya JSC received a diet in the following composition: haylage – 20 kg, silage – 15 kg, sweet clover and wheatgrass hay – 800 gr., beer stillage – 2 kg, linseed cake – 2 kg, grain mixture (barley, corn) – 1 kg, bran (wheat, peas) – 1 kg, premix – 100 gr., salt and soda 100 gr., chalk is freely available.

We analyzed the diet of lactating cows at Zarya JSC with a simultaneous assessment of the chemical composition of milk in December 2021, which revealed an increase in the level of protein and urea in milk. The increase in protein levels reached critical levels, at which the ratio of fat to protein was 0.8:1, which was

a sign of approaching bovine acidosis. In this regard, the farm of JSC "Zarya" revised the diet of feeding cows with a decrease in the proportion of concentrated feed (Table 1).

According to the content of urea in milk, it is possible to determine the direction of the animal's metabolism. So if the level of urea is high, therefore, there is an excess of protein in the rumen, the micro-organisms that inhabit the rumen do not absorb fully the protein, and later the protein is broken down into ammonia. To avoid poisoning in the body, it converted ammonia into a safe form – urea. Itintroduced continuous monitoring of the level of urea in milk into the practice of animal husbandry, then, firstly, this will lead to a balanced diet in terms of energy -protein ratio, and secondly, to saving expensive concentrated feed.

According to Aitmukhanbetov D.K., AlentaevA.S., Shamshidin A.S. “The urea content in milk can serve as an indicator of the level of protein and energy in the diets of dairy cows, monitoring its content will make it possible to rationally use expensive protein feed, maintain animal health and, as a result, increase the efficiency of milk production. Deviation of the urea level from the norm may show various violations of animal feeding” [3, p.18-19].

In KamilSiatka's, Anna Sawa'sstudieset al., the adverse effect of increasing the level of urea in milk (from ≤150 to >300 mg/l) on the fertility of cows was especially noticeable in high-yielding herds (>9000 kg of milk) [4, p.44-46].

Material and research methodology. The purpose of the study is to show the effect of the proportion of concentrated feed in the diet of cows on changes in the chemical composition of milk of cows at different stages of lactation.

Research objectives:

- study the diet of lactating cows, conduct a chemical analysis of feed;
- conduct a chemical analysis of cows' milk at different stages of lactation, before and after adjusting the feeding ration;
- adjust the diet of cows based on the analysis of milk.

The object of the study was lactating cows of the black-motley breed JSC "Zarya" numbering 195 heads.

The subject of the study was individual samples of milk from cows and certain types of feed that are part of the diet of cows.

It carried individual milk sampling out using milk meters MM-04V, installed on the milk line during the milking of cows and allowed taking an average sample of milk from each head. It carried milk sampling out before and after adjusting the diet of cows.

The chemical parameters of milk and feed were determined in the laboratory "Assessment of the quality of feed and livestock products" of the Department of CCI of the NLC "A. BaitursynovKostanay Regional University". It carried out the analysis of milk samples on an infrared analyzer MilkoScanFT1 (FOSS), according to GOST 32255-2013; the number of somatic cells in milk was determined using a viscometric analyzer Ekomilk AMV-1-03, according to GOST 23453-2014 (p. 6). Analysis of feed for nutrient content was carried out on an infrared analyzer NIRSDS 2500 F (FOSS) according to GOST 32040-2012. And also with the help of classical methods of feed analysis: dry matter by drying according to GOST 27548-97, raw ash by burning in a muffle furnace according to GOST 26226-95, raw fat by extraction in the Soxtec8000 (FOSS) apparatus according to GOST 13496.15-2016. The content of feed units, exchange energy, BEV was determined by the calculation method according to the formulas specified in GOST 23637-90, GOST 4808-87, GOST 80-96, GOST R 53900-2010, and GOST 51038-97.

All digital research material (chemical and analysis of milk, feed) was subjected to biometric processing. It carried statistical processing of large data arrays out using the Statistica program Ultimate academic Bundle, version 13.3.

Research results. The type of feeding of dairy cows on the farm of Zarya JSC at the beginning of our study leaned closer to the concentrate type. So, the share of concentrated feed from the total nutritional value of the diet accounted for 35%, while the share of concentrates in physical weight was 6 kg or 14.6% of the total daily weight of the feed mixture (Table 1).

Table 1 - Feeding diet for black-and-white cows

Index	Daily provision, goal/ day		Deviations, ±
	before	after	
	dietary adjustments		
Mixedgrasshaylage, kg	20	20	
Corn silage, kg	15	15	
Sweet clover hay, kg	0,4	0,4	
Wheat hay , mixed herbs, kg	0,4	0,4	

Grain mix (barley, corn), kg	1	1	
Bran (wheat, peas), kg	1	1	
Flaxseed cake, kg	2	1	1
Beer stillage, kg	2	1	1
Contained in the diet:			
Feed units	21,9	18,9	3
Exchange energy, MJ	284,7	258,1	26,6
Dry matter, g	20108	18213	1895
Crude protein, g	2163	1821	342
Crudefiber, incl .	7860	7543	317
neutral detergent fiber, g	3732	3732	
acid - detergent fiber, g	3403	3403	
Crude fat, g	1108	896,1	211,9
Crude starch (BEV), g	6655	6186	469

It overloaded the feed ration used with concentrated feed. The probable reason was that according to the norms of Kalashnikov A.P. for cows with a daily milk yield of 18 kg, 2141 g of crude protein per day is required, and the use of 6 kg of the presented concentrates covered this need by 42% (i.e., the concentrates provided the need for crude protein (CP) at the level of 900 g of CP).

An analysis of the used diet showed that the proportion of crude protein from the dry matter of the diet is at the level of 10.7%, and crude fiber is within 39.1% of the dry matter. The concentration of the main nutrients in the diet exceeded the feeding rate: by 37.5% (5.96 feed units) in feed units, by 21.9% (3608 g) in dry matter, by 1% in crude protein (22.2 g), for crude fiber by 90.3% (3730 g) and starch by 213.1% (4530 g.) As can be seen from the analysis presented, to balance the diet for crude protein on the farm of Zarya, we had to go the overspending on other nutritional components. But such balancing could not affect the general level of metabolism of cows, as can be seen from the indicators of the chemical composition of milk (Table 2).

In order to assess the effect of the level of concentrated feed on milk quality indicators more objectively, we divided the groups of lactating cows by stages of lactation. Thus, the study was conducted on three groups of cows: lactating for the first hundred days, the second group –the middle of lactation, from 101 to 200 days of lactation, and the third group - the last hundred days of lactation. At the beginning of the study, milk sampling was carried out on 168 cows. After adjusting the diet, it took milk samples from 195 cows.

Table 2 - Daily milk yield and chemical composition of milk of cows by stages of lactation

Milkcompo-nents		Days of lactation					
		1-100		101-200		201 and more	
		before	after	before	after	before	after
		dietary adjustments		dietary adjustments		dietary adjustments	
Number of cows, head		103	53	16	102	45	40
Daily milk yield, kg	X±m	17,29±0,55	18,14±0,75	13,82±1,75	16,75±0,42	7,49±0,57	17,49±0,92
	δ	5,60	5,43	6,33	4,24	3,82	5,84
	C v	32,37	29,92	45,81	25,30	50,94	33,41
Mass fraction of fat, %	X±m	3,75±0,10	3,93±0,1	3,41±0.07	3,91±0,06	3,94±0,21	4,01±0,18
	δ	0,61	0,73	0,27	0,58	1,38	1,16
	C v	16,18	18,57	7,8	14,87	35,0	28,94
Mass fraction of protein, %	X±m	3,79±0,11	3,64±0,04	4,14±0,02	3,8±0,03	4,41±0,08	3,73±0,07
	δ	0,67	0,3	0,08	0,32	0,52	0,46
	C v	17,78	8,33	2,02	8,37	11,7	12,43
SOMO, %	X±m	9,79±0,10	9,67±0,04	9,92±0,07	9,9±0,03	9,5±0,22	9,78±0,07
	δ	0,62	0,3	0,24	0,32	1,47	0,46
	C v	6,34	3,14	2,44	3,26	15,7	4,73

Lactose, %	X±m	5,31±0,09	5,14±0,05	5,07±0,08	5,12±0,03	4,17±0,16	4,96±0,09
	δ	0,57	0,37	0,29	0,32	1,07	0,56
	C v	10,83	7,24	5,71	6,27	25,6	11,27
Casein, %	X±m	2,81±0,07	2,72±0,03	3,04±0,01	2,86±0,02	3,21±0,07	2,77±0,05
	δ	0,45	0,21	0,04	0,21	0,48	0,31
	C v	15,83	7,62	1,41	7,47	15,0	11,13
Lactic acid, %	X±m	0,178±0,003	0,174±0,01	0,187±0,002	0,181±0,01	0,172±0,004	0,175±0,01
	δ	0,02	0,01	0,01	0,01	0,03	0,02
	C v	12,68	7,15	2,92	6,02	17,2	10,69
Lemon acid, %	X±m	0,187±0,007	0,225±0,01	0,191±0,002	0,226±0,01	0,162±0,005	0,236±0,01
	δ	0,04	0,03	0,01	0,03	0,03	0,05
	C v	22,75	12,66	4,57	15,12	18,9	19,92
Galactose, %	X±m	0,05±0,017	0,01±0,01	0,02±0,009	0,02±0,01	-0,01±0,023	0,03±0,01
	δ	0,11	0,04	0,03	0,04	0,15	0,07
	C v	226,5	499,31	183,4	169,9	-254,4	266,41
Glucose,%	X±m	-0,04±0,029	-0,05±0,01	0,01±0,012	0,03±0,01	-0,15±0,17	-0,05±0,02
	δ	0,18	0,08	0,04	0,07	0,17	0,12
	C v	433	165,2	425,4	198,9	110	-262,11
Urea, mg/ml	X±m	44±1,08	31,69±0,66	45,6±0,24	34,17±0,59	48,15±0,97	30,93±0,99
	δ	6,67	4,73	0,88	5,99	6,51	6,25
	C v	15,15	14,93	1,93	17,54	14	20,21
Somatic. cells, thousand / cm^3	X±m	205,76±21,95	183,96±25,4	279,8±24,16	166,7±11,5	421,2±63,4	141,98±8,78
	δ	135,39	183,33	87,12	116,2	425,3	55,52
	C v	64,51	99,66	31,14	69,7	101,0	39,10

Analysis of the chemical composition of milk before adjusting the diet showed that the fat content in milk is much less than the protein content. Thus, in the group of cows lactating for the first 3 months, the ratio of fat to protein was 0.98:1, in the second group – 0.82:1, and in the group of cows lactating for the last 100 days, the ratio was 0.89:1. Cows in the second stage of lactation (which have already been inseminated and the fetus is forming, but lactation activity is still high) respond more strongly to an increase in the proportion of concentrated feed in the diet. In cows of the third group, the protein supplied with feed is evenly distributed to the growth of the fetus and the formation of dairy products.

But we noted such a ratio of fat and protein in the milk of cows at Zarya JSC only at the end of 2021 when the specialists of the enterprise made an additional inclusion of concentrated feed in the diet. Thus, our analysis of milk in 2020 showed that “in the analyzed groups of cows for all lactation periods, the average fat: protein ratio was 1.34:1, which is the absolute norm” [5, p.50-55].

The influence of the stage of lactation on the increase in the level of concentrates in the diet was noted, so the cows in the group from 1 to 100 days of lactation responded less to the increase in concentrates in the diet, compared with the other two groups. In cows of the first group, the concentration of total protein (and casein in particular) in milk was 0.35-0.62% less compared to the groups lactating during the second and third hundred days of lactation, respectively.

We recorded the maximum value of the protein level in milk in the group of cows that were milked for over 201 days, so for this group, the protein concentration was 4.41%, which is 1.21% higher than the breed standard.

With an increased supply of concentrates, for all groups of cows, an increase in the amount of urea in milk was noted, higher than the standards by 14-18.2 mg/ml, or 46.6-60.7%, at a rate of 30 mg/ml. At the same time, with an increase in the duration of lactation, the concentration of urea in milk increases from 44 to 48.2 mg/ml.

Monitoring the level of urea in milk allows you to determine the protein component of the feed ration. After all, it is known that nitrogen-containing feeds are essential sources of nutrition, the lack or excess of which leads to adverse consequences for animals, aggravating the health of dairy cows.

Naturally, the stages of lactation showed an increase in the number of somatic cells in the milk of cows. So, a minimum somatic characterized cows lactating for the first hundred days at the level of 205.8 thousand/cm ^{3}, which is 74-215.4 thousand cells/cm^3 less than in the second and third groups.

A detailed analysis of milk without considering the stage of lactation of cows showed that in the herd of Zarya JSC, only one cow had a reduced amount of protein in milk at the level of 2.89% (this is a cow with the number KZP158710280, at 2 years – apparently increased giving of concentrates, compensated by the continued growth of the animal).

61 analyzed samples of milk, or 36.3% of cows, are characterized by protein content of 2.89 to 3.8%, which is considered normal and indicates an adequate metabolism (metabolism process) in the animal's body. For the remaining livestock, i.e. 107 heads revealed an increased protein content in milk, above 3.8%. A protein index above 3.8% indicates a significant decrease in productivity. This development is closely related to the accumulation of fat.

The observed increase in protein content in milk occurs on a par with the decrease in fat content in milk. So out of 168 analyzed samples in 90 samples or 53.6%, we detected a lower fat content compared to the protein content. In general, the ratio of fat to protein in the herd of Zarya JSC was 0.95:1. According to literary sources, the ratio of fat to protein below 1.0 may be evidence of acidosis. Therefore, 90 heads might be found to have acidosis.

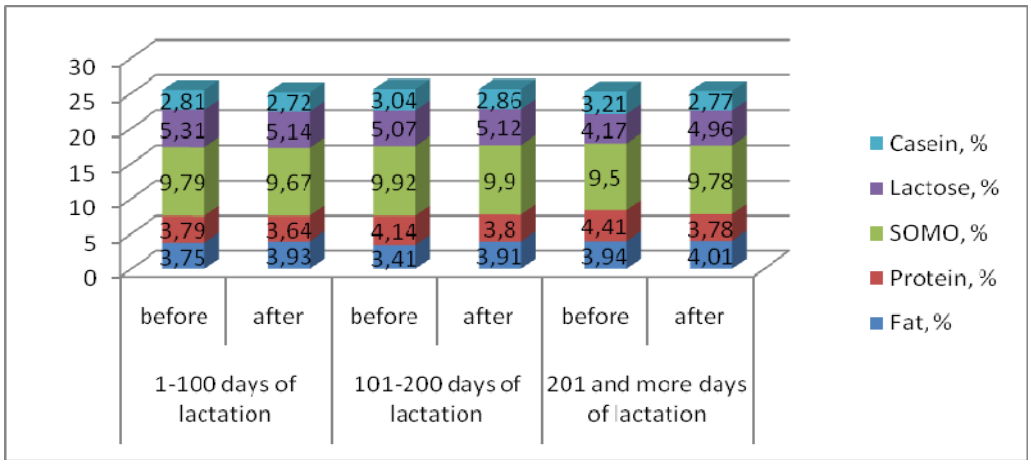
In 132 heads, increased protein content in milk and a simultaneous increase in the urea content were revealed, which can lead to the development of metritis, udder edema, cysts, stagnation, liver damage, and loss of appetite. Ofthetotalanalyzed livestock, this amounted to 78.6%.

In connection with the above, it was revised to the diet of cows and reduce the proportion of concentrated feed by reducing the supply of linseed cake by 1 kg and beer stillage by 1 kg.

After the diet change (in January 2022), the total nutritional value of the diet decreased by 3 feed units, or 26.6 MJ of metabolizable energy, the decrease in crude protein was 342 g, while the share of crude protein on dry matter the diet also decreased to 9.9% SP from DM (or 0.8% compared to the first diet). Recalculation of the corrected diet according to the feeding norms of A.P. Kalashnikov revealed a lack of crude protein at the level of 319.8 g.

However, milk sampling followed by milk analysis (in March 2022) showed that the use of a diet with a content of 9.9% of crude protein in the dry matter the diet had a positive effect not only on the quality indicators of milk but also on the quantitative indicator. Thus, the daily milk yield naturally increased in all analyzed groups of cows: in the first group, the increase in daily milk yield was 0.85 kg ($P<0.01$), in the second group – 2.93 kg ($P<0.01$), and the highest value noted in the third group – 10 kg ($P<0.001$). Since cows with similar genetics are lactating in the herd, it is advisable to associate the differences in the level of milk productivity that occurred over 3 months only with a change in the feeding ration. The observed situation can be explained if we consider that in the herd with a reduction in the proportion of concentrates, the metabolism in the body of cows normalized, acidification of the rumen caused by increased giving of concentrates decreased, health improved and the level of productivity of cows naturally increased.

After adjusting the feeding ration, the qualitative composition of milk has changed significantly (Figure 1). Thus, the ratio of fat: protein was normalized, and in the first group it was 1.07:1, in the second group – 1.03:1, and in the third group – 1.08:1. And although this is not yet the optimal indicator, indicating a balanced feeding (the norm is 1.2-1.5: 1), compared with the first diet, we can conclude that the metabolism of cows comes to an appropriate state.



Picture 1 - The content of the major components of milk before and after adjusting the diet of cows

In similar studies Aitmukhanbetova D.K., Bostanova S.K. and others, an increase in crude protein by over 17% of the dry matter of the diet led to a decrease in the fat: protein ratio from 1.14:1 to 1.07:1 in the milk of Holstein cows [6, p.9-10].

The reduction of concentrated feed in the diet significantly affected the content of urea in milk (Fig. 2). Thus, in cows lactating for the first 100 days, the urea content decreased by 12.31 mg/ml (P<0.001), in cows of the second group by 11.43 mg/ml (P<0.001), and in cows of the third group – by 17.22 mg/mL (P<0.001) compared with the first diet.

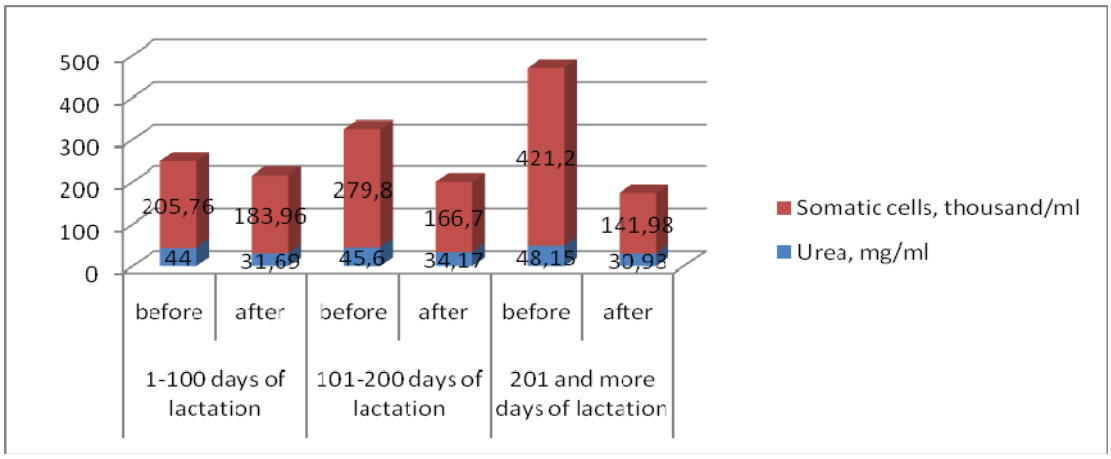


Figure 2 - Milk components characterizing the level of resistance of cows (before and after adjusting the diet)

Also, cows have improved udder health as a result of a decrease in the number of somatic cells in the milk of cows receiving an adjusted diet. The obtained reduced results of the level of somatic cells in milk confirm that the increased supply of concentrates leads to a deterioration in the metabolism of cows, and, accordingly, a decrease in resistance.

The number of somatic cells in the milk of cows of the first group decreased by 21.8 thousand/cm^3 (P <0.01), in the second group – by 113.1 thousand/cm^3 (P <0.001), in the third group – by 279.2 thousand/cm^3 (P<0.001). Thus, the total somatic in the herd was 164.2 thousand/cm^3, which is 138.1 thousand/cm^3 or 54.3% less than before adjusting the feeding ration.

It should be noted that cows at the last stage of lactation reacted most strongly to the change in diet, i.e. after 201 days of lactation.

Conclusion. The analysis of the cows' diets in JSC "Zarya" showed that it is necessary to use the feeding norms consciously, carefully approaching the selection of feeds, consider the level of animal productivity, and analyze the feeding norms offered not only in the CIS countries but also abroad.

After any change in the diet of cows, an analysis of the physiological fluids of animals (milk, blood, urine) should be carried out. In our study, the chemical analysis of milk made it possible to identify problems with the level of metabolism of cows at an early stage. Changes in the diet of feeding rather quickly affect the quality of milk, in our study, the chemical analysis of milk carried out 2 months after adjusting the diet, showed a significant improvement in the chemical composition of milk.

Using a diet for feeding cows with a crude protein content of 10.7% of dry matter led to an increase in the urea content in cows' milk up to 45.9 mg/ml, a change in the fat:protein ratio in milk within 0.8:1, and a decrease in resistance cows and, as a result, an increase in somatic cells in milk up to 302.3 thousand/cm^3 .

The corrected diet for feeding cows with a crude protein content of 9.9% of dry matter, in contrast to the diet with a crude protein content of 10.7% of the DM, had a beneficial effect on the quantitative and qualitative indicators of the milk productivity of Black-and-White breed cows in the conditions of the AO "Dawn". Thus, the concentration of urea in milk decreased to 32.3 mg / ml, the ratio of fat: milk protein improved within 1.06: 1, the metabolism of cows returned to normal, the resistance of animals increased and the number of somatic cells in milk decreased to 164.2 thousand/cm ^{3}.

This work was carried out within the framework of the PCF project of the Ministry of Agriculture of the Republic of Kazakhstan - "Development of technologies for keeping, feeding, growing and reproduction in dairy cattle breeding based on the use of adapted resource-energy-saving and digital technologies for various natural and climatic zones of Kazakhstan", BR10764965.

REFERENCES:

1. **Tanifa , V.V. Causes of metabolic disorders in cattle and normative biochemical parameters of blood** [Text] / Tanifa V.V., Kravaine R.S., Muratova N.S. etc. – Recommendations. – Yaroslavl. – YANIIZhK. – 2008. – 30 p.

2. **Kalashnikov A.P. Norms and diets for feeding farm animals** . [Text] Reference manual. 3rd edition revised and enlarged. / Ed. A.P. Kalashnikov, V.I. Fisinina, V.V. Shcheglova, N.I. Kleimenova. – Moscow. 2003. – 456 p.

3. **Aitmukhanbetov D.K. The content of urea in the milk of dairy herds of the Akmola region of the Republic of Kazakhstan** [Text] / Aitmukhanbetov D.K., Alentaev A.S., Shamshidin A.S. // Mat. intl .scientific and practical . Conf ., dedicated to the 100th anniversary of the birth of A.P. Kalashnikov. "Fundamental and Applied Aspects of Farm Animal Feeding". – nos. Dubrovitsy: L.K. Ernst VNIIZH. – 2018. – p.18-19.

4. **Kamil Siatka.The effect of milk urea level on fertility parameters in Holstein–Friesian dairy cows** [Text] / KamilSiatka, Anna Sawa, MariuszBogucki, SylwiaKrężel-Czopek// Turk J Vet AnimSci. -2020. – No. 44. – R. 42-46.

5. **Papusha N.V. Milk productivity of black-motley cows depending on the genotype** [Text] Papusha N.V., Gulyaeva E.V. // 3i: intellect , idea , innovation - intelligence, idea, innovation. – 2020. – №3 – p.50-55.

6. **Aitmukhanbetov D.K. / Influence of dairy cows feeding on the content of urea in milk** [Text] / D.K. Aitmukhanbetov, SK Bostanova, MF Valieva, G. Sharipova // Bulletin of Science of the Kazakh Agrotechnical University. S. Seifullina (interdisciplinary). – 2021. – No. 3 (110). – P.4-10.

Information about the author

Papusha Natalya Vladimirovna – candidate of agricultural sciences, associate professor of the department of technology for the production of livestock products,,A. BaytursynovKostanayRegional university. 110000,Kostanay, Mayakovsky St. 99/1.ph. 8-705-411-51-71, E-mail:natali.p82@inbox.ru.

Bermagambetova Nurgul Nurmukhanbetovna – Ph.D., senior lecturer of the department of technology for the production of livestock products, A. BaytursynovKostanayRegionaluniversity. 110000,Kostanay, 99/1 Mayakovskystr. tel.8-777-166-95-84 E-mail: u-nurgul@mail.ru.

Kubekova Bakhyt Zhanaidarovna – master of agricultural sciences, senior lecturer of the department of technology for the production of livestock products, Kostanay Regional University named after A.Baitursynov. 110000, s.Kostanay, 99/1 Mayakovsky str. tel.8-777-693-35-27 E-mail: baha11.09@mail.ru.

Smailova Madina Nurbekovna – Ph.D. student of the educational program 8D08201 - Technology for the production of livestock productsof A. BaitursynovKostanay Regional University, 110000,Kostanay, Mayakovsky str. 99/1, tel 8-747-734-06-92, e-mail: smailova-madina@inbox.ru.

Папуша Наталья Владимировна – кандидат сельскохозяйственных наук, доцент кафедры «Технология производства продуктов животноводства», Костанайского регионального университета им. А.Байтурсынова. 110000, г.Костанай, ул.Маяковского 99/1. тел. 8-705-411-51-71 E-mail:natali.p82@inbox.ru.

Бермагамбетова Нургуль Нурмуханбетовна – доктор PhD, старший преподаватель доцент кафедры «Технология производства продуктов животноводства», Костанайского регионального университета им.А.Байтурсынова. 110000, г.Костанай, ул.Маяковского 99/1. тел.8-777-166-95-84 E-mail: u-nurgul@mail.ru.

Кубекова Бахыт Жанайдаровна – магистр сельскохозяйственных наук, старший преподаватель доцент кафедры «Технология производства продуктов животноводства», Костанайского регионального университета им.А.Байтурсынова. 110000, г.Костанай, ул.Маяковского 99/1. тел.8-777-693-35-27 E-mail:baha11.09@mail.ru.

Смаилова Мадина Нурбековна – обучающийся докторантуры образовательной программы 8D08201 – Технология производства продуктов животноводства, Костанайский региональный университет имени А. Байтурсынова, 110000, г. Костанайул. Маяковского 99/1, тел 8-747-734-06-92, e-mail: smailova-madina@inbox.ru.

Папуша Наталья Владимировна – А.Байтұрсынов атындағы Қостанай өңірлік университеті, мал шаруашылығы өнімдерін өндіру технологиясы кафедрасының доценті, ауыл шаруашылығы ғылымдарының кандидаты, 110000 Костанай қ. Маяковский көшесі 99/1 тел: 8-705-411-51-71 e-mail: natali.p82@inbox.ru.

Бермағамбетова Нұргүл Нұрмұханбетқызы – PhD докторы, аға оқытушы, Қостанай Өңірлік университеті "мал шаруашылығы өнімдерін өндіру технологиясы" кафедрасының доценті. А. Байтұрсынов. 110000 Қостанай қ., Маяковский көш., 99/1. тел. 8-777-166-95-84 E-mail: u-nurgul@mail.ru.

Кубекова Бахыт Жанайдаровна – Ауыл шаруашылығы ғылымдарының магистрі, аға оқытушы, Қостанай аймақтық университеті, "мал шаруашылығы өнімдерін өндіру технологиясы" кафедрасының доценті.А. Байтұрсынов. 110000 Қостанай қ., Маяковский көш., 99/1. тел. 8-777-693-35-27 E-mail: baha11.09@mail.ru.

Смаилова Мадина Нұрбекқызы – А. Байтұрсынов атындағы Қостанай өңірлік университетінің 8D08201 – мал өнімдерін өндіру технологиясы мамандығының докторанты, 110000, Қостанай қ., Маяковский көшесі 99/1, тел 8-747-734-06-92, e-mail: smailova-madina@inbox.ru.

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THEORETICAL STUDIES OF THE EXPANDER WORKFLOW FOR THE PRODUCTION OF FARM ANIMAL FEED

Sapa V.Yu. – Candidate of Technical Sciences, Associate Professor, Kostanay Regional University named after A. Baitursynov.

The article runs about the issues of improving the design and operating parameters of the machine for the production of expanded animal forage. Based on the analysis of the research and classification of design solutions, a promising model of a single-screw press was substantiated and the direction of improving its design was determined. The main four compaction zones of the forage mixture in the expander are presented. The modes of operation of the installation without a damping spring on the output head and with a spring were presented. Mathematical expressions of the capacity of the output head of the expander with and without a damping spring are also presented. The main adjustable design parameter of the expander is determined – the width of the annular channel depending on the maximum pressure in the third sealing zone. The productivity of the machine screw at the end of the third pressure zone is presented. The main condition of the material flow sustainability ensuring the stable operation of the expander was determined.

Key words: expansion, compression, auger, energy intensity, research, temperature, humidity.

ТЕОРЕТИЧЕСКИЕ ИССЛЕДОВАНИЯ РАБОЧЕГО ПРОЦЕССА ЭКСПАНДЕРА ДЛЯ ПРОИЗВОДСТВА КОРМОВ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ЖИВОТНЫХ

Сапа В.Ю. – к.т.н., ассоциированный профессор, Костанайский региональный университет имени А. Байтурсынова.

В статье рассмотрены вопросы совершенствования конструктивно-режимных параметров машины для производства экспандированых кормов сельскохозяйственных животных. На основании анализа исследований и классификации конструктивных решений была обоснована перспективная модель одношнекового винтового пресса и определено направление совершенствования его конструкции. Представлены основные четыре зоны уплотнения кормовой смеси в экспандере. Рассмотрены режимы работы установки без демпферной пружины на выходной головке и с пружиной. Также представлены математические выражения пропускной способности выходной головки экспандера с демпфирующей пружиной и без нее. Определен основной регулируемый конструктивный параметр экспандера – ширина кольцевого канала в зависимости от максимального давления в третьей зоне уплотнения. Представлена производительность шнека машины в конце третьей зоны давления. Определено основное условие непрерывности потока материала, обеспечивающую устойчивую работу экспандера.

Ключевые слова: экспандирование, сжатие, шнек, энергоемкость, исследование, температура, влажность.

АУЫЛ ШАРУАШЫЛЫҒЫ ЖАНУАРЛАРЫНЫҢ АЗЫҒЫН ӨНДІРУГЕ АРНАЛҒАН ЭКСПАНДЕРДІҢ ЖҰМЫС ПРОЦЕСІН ТЕОРИЯЛЫҚ ЗЕРТТЕУ

Сапа В.Ю. – т. ғ. к., қауымдастырылған профессор, А. Байтұрсынов атындағы Қостанай өңірлік университеті.

Мақалада ауылшаруашылық жануарларының экспандерленген жемін өндіруге арналған Машинаның құрылымдық және режимдік параметрлерін жетілдіру мәселелері қарастырылған. Зерттеулерді талдау және құрылымдық шешімдерді жіктеу негізінде бір бұрандалы бұрандалы пресстің перспективті моделі негізделді және оның дизайнын жақсарту бағыты анықталды. Экспандерде Жем қоспасын тығыздаудың негізгі төрт аймағы ұсынылған. Шығу басына және серіппеге демпферлік серіппесіз қондырғының жұмыс режимдері қарастырылады. Сондай-ақ, демпферлік серіппесі бар және онсыз экспандердің шығу басының өткізу қабілеттілігінің математикалық