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THE EFFICIENCY OF DIHYDROQUERCETIN AND ORGANIC IODINE IN REDUCING THE ACTION OF SUMMER HIGH TEMPERATURES ON THE BODY OF DAIRY COWS ON THE BACKGROUND OF DIETARY INCLUSION OF FEED ENERGY

Research article

Abstract

In terms of spring-summer grazing period and high temperatures that exceed the comfort zone of 5-15 ° C, was used in the diet of dairy cows flued energetic feed (FEF), dihydroquercetin (DQC) and organic iodine (OJ) with the aim of increasing the capacities and adaptation of the organism to extreme factors of the environment. DQC and OJ had a normalizing effect on energy metabolism and, in general, on the metabolic health of cows, a specific effect on milk production. Carbohydrate-lipid metabolism in cows of the control group was characterized by low glucose, high content of NEFA and phospholipids in comparison with cows of the experimental groups, which tended to normalize by 3 months of lactation. Application of FEF separately and in combination with an antioxidant and organic iodine allowed to increase the content of glucose, cholesterol, to reduce the content of NEFA, phospholipids and triglycerides as a result of which the index NEFA/cholesterol decreased; reduced the content of bilirubin, TBA-AP and increased the content of ceruloplasmin, which indicates the normalizing effect of these biologically active substances. Serum levels of cortisol and thyroxine tended to increase in the experimental groups of cows in relation to control throughout the study period. Morpho-hematological parameters in all groups of cows were within the physiological norm and close. Milk productivity and milk quality in cows during the spring-summer period had differences between groups. In cows of the control group, the average daily yield for 5 months of lactation was 22.7 kg with a fat content of 3.79% and protein of 2.94%: in cows of the 1st experimental 21.6, 3.90, 3.02 and the second experimental group 20.8, 3.89 and 3.04, respectively.

Keywords: dairy cows, energy feed, antioxidant, organic iodine, metabolic health, productivity.

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ЭФФЕКТИВНОСТЬ ПРИМЕНЕНИЯ ДИГИДРОКВЕРЦЕТИНА И ОРГАНИЧЕСКОГО ЙОДА В СНИЖЕНИИ ДЕЙСТВИЯ ЛЕТНИХ ВЫСОКИХ ТЕМПЕРАТУР НА ОРГАНИЗМ МОЛОЧНЫХ КОРОВ НА ФОНЕ ВКЛЮЧЕНИЯ В РАЦИОН ЭНЕРГЕТИЧЕСКОГО КОРМА

Научная статья

Аннотация

В условиях весенне-летнего пастбищного периода и высоких температур, превышающих зону комфорта на 5-15 ºС, применяли в питании молочных коров жидкий энергетический корм (ЖЭК), дигидрокверцетин (ДКВ) и органический йод (ОЙ) с целью повышения энергообеспеченности и адаптации организма к экстремальным факторам среды. ДКВ и ОЙ оказали нормализующее действие на энергетический обмен и, в целом, на метаболическое здоровье коров, специфическое действие на молочную продуктивность. Углеводно-липидный обмен у коров контрольной группы характеризовался низким содержанием глюкозы, повышенным содержанием НЭЖК и фосфолипидов по сравнению с коровами опытных групп, которое имело тенденцию к нормализации к 3-у месяцу лактации. Применение ЖЭК отдельно и в сочетании с антиоксидантом и органическим йодом позволило повысить содержание глюкозы, холестерина, снизить содержание НЭЖК, фосфолипидов и триглицеридов в результате чего понизился индекс

НЭЖК/холестерин, снизило содержание билирубина, ТБК-АП и повысило содержание церулоплазмина, что свидетельствует о нормализующем действии данных биологически активных веществ. Содержание в сыворотке крови кортизола и тироксина имело тенденцию к повышению у коров опытных групп по отношению к контролю в течение всего периода исследования. Морфо-гематологические показатели у всех групп коров были в пределах физиологической нормы и близкими. Молочная продуктивность и качество молока у коров в течение весенне-летнего периода имели отличия между группами. У коров контрольной группы в среднем за 5 месяцев лактации среднесуточный удой составил 22,7 кг при содержании жира 3,79% и белка 2,94%: у коров 1-ой опытной 21,6, 3,90, 3,02 и второй опытной группы 20,8, 3,89 и 3,04, соответственно.

Ключевые слова: молочные коровы, энергетический корм, антиоксидант, органический йод, метаболическое здоровье, продуктивность.

1. Introduction

In the pasture season during summer, temperature and humidity of the environment play a very important role on the state of the homeostasis of the cow's organism along with the state of pastures, composition, nutritional and energy values of the diet. Deviation of the values of these parameters from the "comfort zone" leads to the change in intensity and direction of redox processes, as well as change in the biochemical status and state of resistance of the body of cows [1], [2],.[3]. As for temperature, the comfort zone for dairy cows depends on productivity, which, in its turn, is due to genetics and the level of feeding. It is established that during starvation, critical temperature for cows is +13 ºC. If the level of feeding corresponds to the maintenance requirement, then critical temperature drops to -5 °C. [4]. For domestic cattle breeds, the neutral zone is within the temperature range from +4 to +20 ºC, for highly productive cows – from +9 to +16 ºC [5]. Other authors believe that at air temperatures of +10 – 22 ºC, fluctuations in relative humidity are in the range of 50-90% and do not affect animal productivity directly [6]. The reaction of dairy cows to high summer temperatures can be aggravated in the transit period after calving, when additional energy feed is added to the diet to replenish energy costs [7], [8], [9].

The aim of the study was to increase adaptive abilities of dairy cows to elevated ambient temperatures during the transit period and to give new functional properties to liquid energy feed (LEF) by introducing the antioxidant dihydroquercetin (DHQ) and organic iodine (OI).

2. Material and methods

The studies were conducted on Zybino Farm of the Federal State Unitary Enterprise Experimental Household "Klenovo-Chegodaevo" Federal State Budgetary Institution named after L.K. Ernst on three groups of black-and-white cows with 9 animals each. One of which was a control one, two others – experimental. During the transit period, energy feed and biologically active substances were added to the main diet of cows in the experimental groups according to the experimental scheme (Table 1).

Table 1 – Experimental Scheme

Groups	Options	
	Interlactation period	Lactation
Control	Main diet (MD)	Main diet (MD)
Experimental 1	MD + LEF 150 ml animal/day	MD +LEF 300 ml/animal/day
Experimental 2	MD + LEF 150 ml animal/day 0.5 g SF "Prost" animal/day + 1.0 g SF "Ecostimulus-2" animal/day	MD + LEF 300 ml/animal/day 1.5 g SF "Prost" animal/day + 1.0 g SF "Ecostimulus -2" animal/day.

LEF – "Milkanizer" liquid feed of the following composition: glycerin 36.8%, water 9.6%, propylene glycol 25%, propionic acid 2%, acetic acid 2%, sorbitol 3.8%, fructose 5%, lactose 5% , sucrose 5%, glucose 5%, a complex of vitamins and minerals 0.8%, 1 kg of product contains 23 mJ. The product also contains: - α-tocopherol (vitamin E) 250 mg/kg; - L-carnitine - 2000 mg/kg; - choline chloride (vitamin B4) - 8000 mg/kg; - Biotin (vitamin B_7) - 100 mg/kg. 1 g of SF "Prost" contains 7 mg of iodine

SF "Ecostimulus-2" contains 80% of dihydroquercetin.

3. Results

The research period that lasted 2/3 days of the summer was characterized by high air temperatures that exceeded the zone of comfort temperature for dairy cows +17 ºC reaching + 32ºC on some days, which affected the nature of the metabolic and adaptation processes in the cow's body (Fig. 1, 2). An increase in air temperature causes heat stress in cows with all the ensuing consequences in the biochemical and physiological status of their body.

The biochemical status of the organism of cows of all groups during the experiment was within the reference values of the physiological norm, but characteristic changes were observed in connection with the action of energy feed, biologically active substances and ambient temperature.

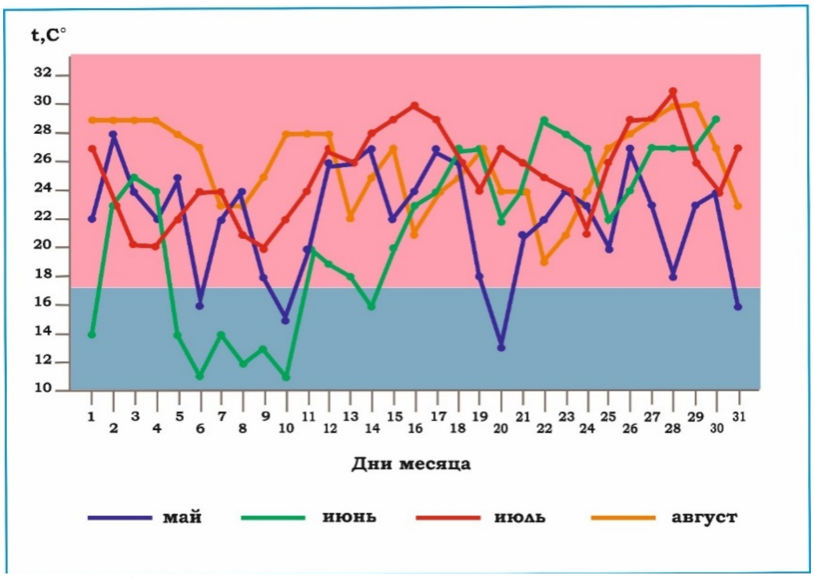

Figure 1 – Charts of average daily air temperatures in May-August 2018 (Moscow region)

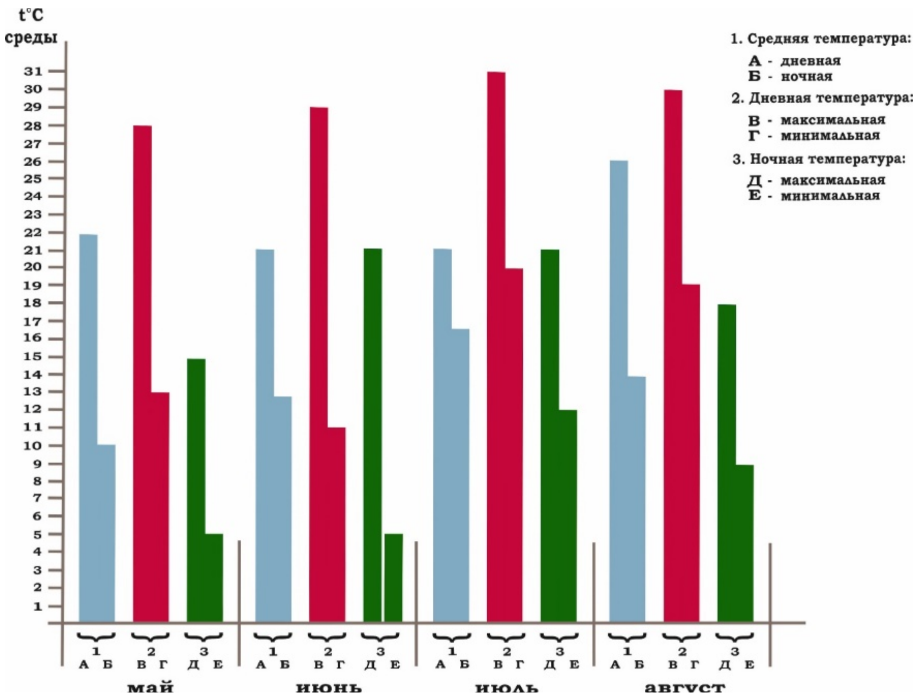

Figure 2 – Chart of average, maximum and minimum day and night air temperatures (Moscow region)

An increase in air temperature causes heat stress in cows with all the ensuing consequences in the biochemical and physiological status of the body.

The biochemical status of the body of cows of all groups during the experiment was within the reference values of the physiological norm, but at the same time, characteristic changes were observed due to the effect of energy feed, biologically active substances and ambient temperature. Carbohydrate and lipid metabolism in cows of the control group was characterized by low glucose content, increased content of unesterified fatty acid and phospholipids in comparison with the cows of the experimental groups, which tended to get normalized by the 3rd month of lactation. The use of LEF separately and in combination with antioxidant and organic iodine enabled the increase of the content of glucose, cholesterol, reduction of unesterified fatty acid, phospholipids and triglycerides, as a result of which the unesterified fatty acid/cholesterol index, which characterizes the flow of unesterified fatty acid in the liver, decreased, which, in turn, indicates the normalizing effect of these biologically active substances (table 2).

Table 2 – State of Lipid and Carbohydrate Metabolism in Cows

Groups of cows	Values					
	Glucose, ml mol/l	Cholesterol, mmol/l	Unesterified fatty acid, mmol/l	Phospholipids, mmol/L	Triglicereads Mmol/L	Index, unesterified fatty acid/cholesterol
1st month of lactation						
Control	2,16±0,12	4,27±0,28	0,53±0,04	1,77±0,18	0,22±0,02	0,097±0,02
Experimental 1	2,84±0,10	4,57±0,56	0,44±0,02	1,76±0,22	0,22±0,02	0,10±0,012
Experimental 2	2,58±0,22	3,55±0,38	0,45±0,03	1,37±0,16	0,31±0,01	0,137±0,018
Ratio of experimental groups to control						
Experimental 1,±	+0,68	+0,3	-0,09	-0,01	±	+0,003
%	131,5	107,0	83,0	99,4	100,0	103,1
Experimental 2, ±	+0,42	-0,72	-0,08	-0,4	+0,09	+0,04
%	119,4	83,1	84,9	77,4	140,9	141,2
Ratio of experimental group 2 to experimental group 1:						
±	-0,26	-1,02	+0,01	-0,39	+0,09	+0,037
%	90,8	77,7	102,3	77,8	140,9	137,0
3rd month of lactation						
Control	3,02±0,14	4,76±0,20	0,40±0,01	2,11±0,12	0,23±0,02	0,085±0,006
Experimental 1	3,03±0,14	5,64±0,27	0,41±0,04	1,49±0,17	0,21±0,02	0,070±0,009
Experimental 2	2,87±0,15	4,88±0,12	0,33±0,03	0,90±0,04	0,25±0,02	0,066±0,007
Ratio of experimental groups to control						
Experimental 1, ±	+0,01	+0,88	+0,01	-0,62	-0,02	-0,015
%	100,3	118,5	102,5	70,6	91,3	82,3
Experimental 2, ±	-0,15	+0,12	-0,07	-1,21	+0,02	-0,019
%	94,7	102,5	82,5	42,6	108,6	77,6
Ratio of experimental group 2 to experimental group 1:						
±	-0,16	-0,76	-0,08	-0,59	+0,04	-0,04
%	94,7	86,5	80,5	60,4	119,0	94,3

Unlike triglycerides and fatty acids, phospholipids are not an essential energy material. Phospholipids play an important role in the structure and function of cell membranes, activation of membrane and lysosomal enzymes, in conducting nerve impulses, blood coagulation, immunological reactions, cell proliferation and tissue regeneration processes, electron transfer in the chain of “respiratory” enzymes. They are also indispensable for the formation of lipoprotein complexes. The biosynthesis of phospholipids occurs intensively in the liver, intestinal wall, testes, ovaries, mammary gland and other tissues. The content of phospholipids in the blood serum during the 1^{st} month of lactation in the cows of the control group comprised 1.77 mmol/L, and by the 3^{rd} month their number increased to 2.11 mmol/L. The inclusion of LEF in the diet of cows during the 1st month of lactation did not affect their content in the blood serum. However, during the 3^{rd} month their content had decreased by 0.62 mmol/L in comparison with the control group, and amounted to 70.6% in relation to the latter. The inclusion of LEF in the diet together with antioxidant and organic iodine influenced their concentration in the blood serum significantly. Therefore, during the 1^{st} month of lactation, their content in relation to the control group was lower by 32.6%, and during the 3^{rd} month it had decreased by 57.4%, and in relation to the 1^{st} experimental group – by 32.2 and by 39.6%, respectively (Table 2).

A study of the state of lipid peroxidation by the content of TBC AP in the blood serum and the antioxidant defense of the body by the content of ceruloplasmin showed the effectiveness of the influence of LEF and biologically active substances on these processes. During the 1st month of lactation, the content of TBC AP in the blood serum of the cows of the control group was 4.61 μmol/L, while in the cows of the experimental groups it comprised 2.85 and 3.05 μmol/L, which was less by 38.2 and 33.8% than in the control group in cows of the 1^{st} and 2^{nd} experimental groups, respectively. By the 3^{rd} month of lactation, the content of TBC AP decreased to 3.56 μmol/L, while it increased to 3.17 and 3.35 μmol/L in experimental group, as a result of which the difference was only 89.0 and 94.1% respectively, with cows of the 1^{st} and 2^{nd} experimental groups (Table 3). These changes are reflected in the TBC/AOD index, which shows that at the beginning of lactation, the use of energy feed separately and together with biologically active substances was more effective than during the 3rd month of lactation (Table 3).

Table 3 – Lipid Peroxidation and Antioxidant Defense of the Body

Groups of cows	Values		
	TBC AP, µmol/L	Ceruloplasmin, mg/l	Index, TBC/AOD
1st month of lactation			
Control	4,61±0,94	136,2±23,34	0,034
Experimental 1	2,85±0,46	154,3±20,94	0,018
Experimental 2	3,05±0,28	144,5±12,62	0,021
Ratio of experimental groups to the control			
Experimental 1, ±	- 1,76	+ 18,1	-0,016
%	61,8	113,2	-
Experimental 2, ±	- 1,56	+ 8,3	-0,011
%	66,2	106,1	-
Ratio of experimental group 2 to experimental group 1			
±	+ 0,2	- 9,8	+0,003
%	107,0	93,6	-
3rd month of lactation			
Control	3,56±0,28	150,9±8,34	0,023
Experimental 1	3,17±0,15	149,3±14,19	0,021
Experimental 2	3,35±0,11	173,5±16,53	0,019
Ratio of experimental groups to the control			
Experimental 1, ±	- 0,39	- 1,6	-0,002
%	89,0	98,0	-
Experimental 2. ±	- 0,21	+ 22,6	-0,004
%	94,1	114,9	-
Ratio of experimental group 2 to experimental group 1			
±	+0,18	+24,2	-0,002
%	105,6	116,2	-

Ceruloplasmin belongs to α-globulins (glycoproteins), which consists of 80% protein, 16% carbohydrates and 0.32% copper and causes its active state. One of the main functions of ceruloplasmin is the transfer of copper from the liver, where it is synthesized, to organs and tissues where copper functions as part of redox enzymes, primarily cytochrome C reductase and superoxide dismutase (SOD). Being a ferrooxidase, cerulorulazmin promotes saturation with iron ($Fe3+$) of apotransferrin, which binds oxide iron selectively turning into mono- and di-iron transferrin. Thus, ceruloplasmin is involved in hematopoiesis. Analysis of changes in serum ceruloplasmin in cows of the 1st and 2nd experimental groups during the 1st month of lactation was higher by 13.2 and 6.1%, respectively than in the control group; during the 3rd month of lactation, the cows of the first experimental group were by 2.0% less, while in the second experimental group it was higher than 14.9%. In this case, an increase in ceruloplasmin content by the 3rd month was observed in cows of the control group from 136.2 to 150.9 mg/l while in the cows of the second experimental group, it comprised from 144.5 to 173.5 mg/l, whereas there was a slight decrease from 154.3 to 149.3 mg/L in the cows of the first experimental group. Thus, the use of LEF in the nutrition of dairy cows separately and in combination with antioxidant and organic iodine had a positive effect on lipid peroxidation and antioxidant defense of the body.

Serum bilirubin content in cows of all groups during the entire experiment was at the level of the upper boundary of the reference value (1.16–8.15 µmol/L), and in two cases exceeded it; in cows of the control group during the 3rd month of lactation, and in cows of the 2nd experimental group during the 1st month of lactation, its content comprised 9.22 and 9.93 µmol/L, respectively, which can be caused by environmental factors and biologically active substances used in LEF. The serum ALT activity in the cows of the control group during the 1st month of lactation was significantly lower than in the experimental ones, but it doubled by the 3rd month and exceeded the analogues of the experimental groups, where the activity of ALT remained practically unchanged during the entire experimental period, which may reflect the involvement of amino acids in the energy metabolism in cows of the control group. The serum AOD activity in cows of all experimental groups had increased by the 3rd month of lactation and was higher in the cows of the 2nd experimental group, which can reflect the effect of organic iodine on the cardiovascular system (Table 4).

Table 4 – Functional Status of Cows' Liver

Groups of cows	Values			
	Total bilirubin, μmol/l	ALT, IU/L	AST, IU/L	De Ritis Ratio
1st month of lactation				
Control	6,24±1,59	14,31±1,96	72,92±4,92	5,09
Experimental 1	5,66±0,71	21,66±1,95	73,45±4,04	3,39
Experimental 2	9,93±1,40	21,37±2,81	80,62±5,32	3,77
Ratio of experimental groups to the control				
Experimental 1, ±	-0,58	+7,35	+0,53	-1,7
%	105,7	151,3	100,7	66,6
Experimental 2, ±	+3,69	+7,06	+7,7	-132
%	159,1	149,3	110,5	74,0
Ratio of experimental group 2 to experimental group 1				
±	+4,27	-0,29	+7,17	+0,38
%	175,4	98,6	109,7	111,2
3rd month of lactation				
Control	9,22±1,47	28,75±2,13	78,70±2,20	2,73
Experimental 1	7,23±0,97	22,17±3,37	81,01±1,45	3,65
Experimental 2	7,96±0,88	22,00±3,20	82,76±2,63	3,76
Ratio of experimental groups to the control				
Experimental 1, ±	-1,99	-6,58	+2,31	+0,92
%	78,4	77,1	102,9	133,7
Experimental 2, ±	-1,26	-6,75	+4,06	-1,03
%	86,3	76,5	105,1	137,7
Ratio of experimental group 2 to experimental group 1				
±	+0,73	-0,17	+1,75	+0,11
%	110,1	99,2	102,1	103,0

The intensity and direction of metabolism in the body is closely related to the action of thyroid hormones and adrenal cortex, in particular, cortisol, which qualifies as a stress hormone. Thyroid hormones optimize metabolism, regulate basic, lipid and carbohydrate metabolism i.e. energy metabolism as a whole. It is known that cortisol and thyroid hormones are in close interaction. A decrease in thyroid function always leads to the decrease in adrenal function. At the same time, normal level of cortisol in blood also determines normal functioning of the thyroid gland. With its deficiency, hypothyroidism develops regardless of the level of thyroid gland hormones in blood (T3, T4, TSH, etc.). In turn, hypothyroidism increases the production of corticosteroid-binding globulin (transcortin), which binds cortisol and converts it into an inactive form, thereby further reducing its amount.

Analysis of data on the content of cortisol and thyroxin in blood serum during spring and summer showed differences in their content and similar dynamics of its change. In the 1st month of lactation, the lowest (115.3 nmol/L) serum cortisol content was observed in the cows of the control group, and the highest (321.9 nmol/L) – in the cows of the 2nd experimental group. In the cows of the first experimental, it was equal to 180.5 nmol/L and occupied an intermediate place. By the 3rd month of lactation there was a significant increase in its content in cows of all groups: by 4.6 times in the cows of the control group, by 2.9 times and by 1.9 times in the first and the second experimental groups, respectively. As a result, the serum cortisol content in the cows of the control and the 1st experimental group was equal, but remained higher in the cows of the 2nd experimental group, which may indicate a stronger state of stress during high summer ambient temperatures and the adaptive action of energy feed, antioxidant and organic iodine (Table 5). Unlike cortisol, the content of thyroxin in the blood serum of cows of all groups was close and equal to 56.7, 48.6, and 68.1 nmol/L in the 1st month of lactation. By the 3rd month of lactation, it had not change in the cows of the control group, while in the cows of the 1st experimental group it increased to 52.3, whereas in the cows of the 2nd experimental group it decreased to 63.9 nmol/L. In this regard, it is interesting to note the change in the cortisol/thyroxin index. In the 1st month of lactation, it differed between groups of cows significantly; its lowest value (2.11) was in the cows of the control group, and its highest (4.33) – in the cows of the second experimental group. The cows of the first experimental group took an intermediate place concerning this indicator. By the 3rd month of lactation, as a result of a different increase in the serum cortisol content, the cortisol/thyroxin index in groups of cows had leveled up to 9.47, 10.4 and 9.76 in the cows of the control group, 1st and 2nd experimental groups, respectively. These changes in the serum thyroxin content in cows in the experiment are associated with the functional activity of the thyroid gland and with the normalizing effect on energy metabolism (Table 5).

Table 5 – Hormonal Status of Cows

Groups of cows	Values		
	Cortisol, nmol/L	Thyroxin, nmol/L	Index, Cortisol/thyroxine
1st month of lactation			
Control	115,3±24,73	56,7±2,98	2,11
Experimental 1	180,5±49,68	48,6±8,97	3,71
Experimental 2	321,9±103,4	68,1±6,76	4,33
Ratio of experimental groups to the control			
Experimental 1,±	+65,2	- 8,1	+1,59
%	156,5	85,7	-
Experimental 2, ±	+206,6	+11,4	+2,22
%	279,2	120,	-
Ratio of experimental group 2 to experimental group 1			
±	+141,4	+19,5	+0,63
%	178,3	140,2	-
3rd month of lactation			
Control	537,4±121,5	56,71±4,43	9,47
Experimental 1	538,8±147,2	52,33±4,60	10,4
Experimental 2	613,9±101,8	63,9±4,44	9,76
Ratio of experimental groups to the control			
Experimental 1,±	+1,4	-4,38	+0,83
%	100,2	92,3	-
Experimental 2, ±	+76,5	+7,19	+0,29
%	114,2	112,6	-
Ratio of experimental group 2 to experimental group 1			
±	+73,1	11,57	-0,54
%	113,9	122,1	-

In connection with the subject of the study, interesting data were obtained on cows and heifers, which, during the summer due to the temperature of 28 ºC and higher, were separately and intramuscularly administered with the preparation of selenium (Gabivit-Se) together with DHQ twice with an interval of 7 days [11]. When cows and heifers were twice treated with the Gabivit-Se preparation in combination with the DHQ antioxidant, functional state of the animals improved significantly: Blood pressure, pulse, as well as respiration rate decreased. Temperature of the cows of the second experimental group was 1.60 °C lower than in the control group. The best results were obtained for all indicators in the 2nd experimental group, where, in addition to the drug Gabivit-Se, 500 mg of DHQ antioxidant was injected. Functional state of animals improved significantly: Blood pressure, pulse, and respiration rate decreased (Table 6).

Table 6 – Clinical Indicators of Cows and Heifers after 2-fold Treatment with an Interval of 7 days with Gabivit-Se-DHQ Drug in Hot Season

Values	Groups		
	control	I experimental	II experimental
Arterial pressure - systolytic (Mx)	190 184	182 180^{xx}	176^{xx} 170
- diastolytic (Mn)	70 72	65^{x} 69	66^{xx} 65^{xx}
Pulse (PD)	120 112	117 111	110^{xx} 105^{xx}
Pulse, beats/min.	118 110	96 89^{xx}	90^{xx} 85^{xx}
Respiratory rate, in 1 min.	32 31	25^{x} 24^{x}	23^{xx} 21^{xx}
Temperature, 0C	39,5 39,3	38,2 $38{,}2^{x}$	$37{,}8^{xx}$ $37{,}7^{xx}$

*Note *x - P<0.5;**-P<0.01. In the numerator, indicators are for cows, in the denominator – for heifers.*

Morphological and hematological parameters in cows of all groups were within the physiological norm and have improved by the 3rd month of lactation with a slightly higher value in cows of the control group with the exception of leukocytes content, which were lower in the experimental blood (Table 7).

Table 7 – Blood Morphological and Hematological Parameters

Groups of cows	Values				
	White blood cells, 109/l	Red blood cells, 1012/l	Hemoglobin, g/l	Hematocrit, %	Colour indicator
1st month of lactation					
Control	9,98±0,89	6,85±0,35	86,93±2,21	34,56±0,77	0,38±0,012
Experimental 1	8,82±1,17	7,06±0,28	85,2±3,91	34,87±1,40	0,36±0,011
Experimental 2	7,97±0,67	7,09±0,29	83,7±4,49	34,53±1,75	0,35±0,008
Ratio: to control of experimental 1, ±	-1,16	+0,21	-1,72	+0,31	-0,02
%	88,4	103,1	98,0	-	94,7
Experimental 2, ±	-2,01	+0,24	-3,23	-0,03	-0,03
%	79,8	103,5	96,3	-	92,1
Experimental 2 to experimental 1: ±	-0,85	+0,03	-1,5	-0,34	-0,01
%	90,4	100,4,	98,2	-	97,2
3rd month of lactation					
Control	8,46±0,32	7,57±0,15	86,55±2,68	36,14±1,12	0,34±0,003
Experimental 1	8,50±0,61	7,20±0,30	84,9±2,20	34,95±0,84	0,35±0,008
Experimental 2	7,89±0,51	7,39±0,19	86,9±1,46	36,2±0,79	0,35±0,007
Ratio: to control of experimental 1, ±	+0,04	-0,37	-1,65	-1,19	+0,01
%	100,4	95,1	98,1	96,7	102,9
Experimental 2, ±	-0,57	-0,18	+0,35	+0,06	+0,01
%	93,3	97,6	100,4	-	102,9
Experimental 2 to experimantal 1: ±	-0,61	+0,19	+2,0	+1,3	+-
%	92,8	102,6	102,3		100,0

There were differences in milk productivity and milk quality between the groups of cows during the spring-summer period. In the cows of the control group, the average daily milk yield for 5 months of lactation comprised 22.7 kg with fat content of 3.79% and protein of 2.94%: In the cows of the first experimental it comprised 21.6, 3.90, 3.02 and 20.8, 3.89 and 3.04 for the second experimental group, respectively (Table 8).

Table 8 – Productivity and Quality of Cow's Milk

Values	Lactation, months					On average
	1	2	3	4	5	
Control group						
Milk yield, kg	21,2±2,43	27,1±2,15	23,7±1,45	23,2±1,28	18,5±1,60	22,7
Fat%	4,81±0,20	3,76±0,35	3,32±0,21	3,48±0,21	3,620,22	3,79
Protein %	3,37±0,11	2,95±0,13	2,78±0.03	2,76±0.04	2,83±0.06	2,94
Lactose %	-	5,06±0.06	5,05±0,04	4,26±0.06	4,71±0,07	4,77
Dry matter %		12,69 ±0.18	12,05 ±0,13	11,46 ±0.06	12,41 ±0.42	12,15
Somatic cells, thousand/cm3	462±185 (1)	-	742±558 (1)	495±207 (1)	616±205 (2)	506 (2)
Acidity ºT		16,3±0,17	17,0±0,20	16,4±0,20	16,4±0,26	16,5
Thermostability, alk.probe		76,3±0.87	78,0±1.20	75,1±1.30	74,2±0.90	75,9
Experimental 1						
Milk yield, kg	26,4±2,38	25,8±2.46	23,4±2,61	20,4±1.24	12,1±1,20	21,6

Fat%	4,35±0,26	3,54±0,20	3,81±0.33	3,80±0.21	4,0±0,17	3,90
Protein %	3,58±0,31	2,85±0.09	2,71±0.07	2,85±0.08	3,1±0.07	3,02
Lactose %	4,70±0,14	4,81±0,12	4,54±0,17	4,51±0,15	4,8±0.08	4,67
Dry matter %	13,6 ±0,63	12.28 ±0,25	12,08 ±0,38	12,86 ±0,79	12,7 ±0,30	12,70
Somatic cells, thousand/cm3	1412±958 (2)	624±340 (1)	451±178 (1)	526±177 (1)	581±168 (1)	718 (2)
Acidity ºT	16,6±0.57	16,9±0.37	16,7±0.31	16,5±0.24	16,0±1.41	16,5
Thermostability, alk.probe	77,0±1.37	76,7±1,33	77,1±1.09	74,3±1.40	75.0±1.40	76,0
Experimental 2						
Milk yield, kg	22,8±1.29	24,3±1.52	22,0±1.83	18,5±1.83	16,4±0,84	20,8
Fat%	4,29±0.27	4,04±0.29	3,70±0.22	3,50±0.24	3,91±0.27	3,89
Protein %	3,29±0,17	3,09±0.13	2,92±0,06	2,98±0.06	2,93±0.11	3,04
Lactose %	5,01±0.09	4,76±0.18	4,60±0.12	4,92±0.09	4,23±0.47	4,70
Dry matter %	13,10 ±0,34	12,50 ±0.43	12,27 ±0.29	12,28 ±17.18	12,55 ±0.90	12,54
Somatic cells, thousand/cm3	349±127 (1)	297±89 (1)	672±252 (1)	857±325 (3)	297±327	494 (3)
Acidity ºT	16,3±0.23	16,7±0.21	16,0±0.24	16,1±0.28	16,7±0.41	16,4
Thermostability, alk.probe	76,2±1.43	76,2±1.30	76,0±0.86	74,6±0.46	74,0±1.22	75,4

The maximum average daily milk yield in cows of the control group was observed in the second month of lactation, while in cows of the 1st experimental group it was observed in the first month, which was characteristic during the use of energy feed. However, in cows of the 2nd experimental group, as well as in cows of the control group, the highest average daily milk yield occurred in the second month of lactation, which may be associated with the development of the adaptive reaction to elevated ambient temperatures under the effect of organic iodine and antioxidant when used together with liquid energy feed. The average daily milk yield in the cows of the control group was slightly higher by 1.1 and 1.4 kg compared with the cows of the first and second experimental groups, their fat and protein content in milk was less than 0.11 and 0.08 % in relation to the cows of the first experimental group and 0.10 and 0.10%, respectively, to the cows of the second experimental group. As a result, the milk content of total dry solids was higher in the cows of the experimental groups, which amounted to 12.70 and 12.54% compared with 12.15% in the control group. In terms of acidity and thermal stability, milk did not differ for all groups of cows during five months of lactation, while there was a general tendency to decrease concerning these values in July and August for months of lactation, when the highest ambient temperatures were observed. Cow’s milk, both on average and by months of lactation, differed in the content of somatic cells. Their greatest amount, equal to 718 thousand/cm^3, was observed in the milk of cows of the 2nd experimental group, and the smallest – 494 thousand/cm^3 of cows of the 1st experimental group. As for cow’s milk of the control group, their content was 506 thousand/cm^3. The increased content of somatic cells in cow’s milk is mainly associated with their mastitis. Among the cows of the control and the 1st experimental group, two of them had it, as for the cows of the 2nd group — three of them had it, but it differed in degrees of severity (Table 8).

4. Conclusion

The effectiveness of the use of LEF in feeding cows in the summer pasture period largely depends on the state of the ambient temperature. High air temperatures exceeding the temperature of the comfort zone for cows lead to aggravation of adaptation processes in the body associated with energy metabolism. The inclusion of DHQ antioxidant and organic iodine in the energy feed had an adequate effect on adaptive processes in the body to elevated ambient temperatures and contributed to the normalization of the metabolic and clinical health of cows in accordance with their biological properties.

Conflict of Interest

None declared.

Конфликт интересов

Не указан.

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