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Methods Of Regulating Physiological And Biochemical Processes And Improving-Performance Of Dairy Cows Summer Period.

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ABSTRACT

The evidence-based livestock production experiment with the dairy cows divided into two groups (control and experimental) on the «AST-group» farm (Samara Region) has been performed in the summer period. The efficiency- of the used dietary additive based on the wood biomass consisting of glycerin, propylene glycol, activated carbon supplementation, sugar, linseed oil, and conifer extract is studied. The dietary additive used for cows with a dose of 150 mL contributed to improving the enzymatic processes in the rumen, which caused the increases in the concentrations of both the volatile fatty acids by 44% and the ammonium nitrogen concentration by 13.9% with an increase in ~~a~~ the acetic acid proportion and a decrease in the propionic and oil acid proportions. In the rumen of the experimental cows, a tendency to some increase in the total quantity of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAM) could be observed. The use of the analyzed dietary additive for the lactating cows indicated a 2.2% rise in the serum bactericidal activity and a 8.8% lysis increase. Improvement of the physiological and biochemical processes observed in the dairy cows of the experimntal group could contribute to a 10.9-% increase in the average daily yields of milk of natural fats with the reduction in costs per unit of output.

Keywords: dairy cows, digestion, milk production, resistance, complex additive

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INTRODUCTION

The modern livestock production demands the evidence-based and rational approaches to animal feeding. It is a necessary condition to realise the full potential of the -- intensive use of the animals. The dairy cattle high efficiency is influenced by the metabolic processes of all types in the different organ systems in an organism, which is inseparably linked with their intense functional activity.

During the summer period of the increased air temperature, the dairy cattle are affected by the heat stress, the reason for a significant decline in production. In addition, the economic losses are related with a decrease in the milk production, a decline in the milk quality, and a deterioration in the health of the animals.

The severity of a heat stress in cows depends on the air temperature and the humidity level. According to some literary data, the air temperature comfortable for the cattle ranges from -13 to + 26°C. The other scientists consider the optimum air temperature for the lactating cows may range from -0.5°C to +200 C° [9]. A decrease in the efficiency is related with the effects of the cortisol hormone, since its concentration increases ten times as much under the heat stress. Cortisol is the stress hormone acting as a protective agent for the stress response. Cortisol suppresses the activity of oxytocin, reducing the milk yield and increasing the amount of the residual milk remained in the udder after milking up to 15-17%. The milk fat content decreases. The risk of developing the mastitis increases.

Under the heat stress, a decrease in the intensity of the rumination g and the buffer capacity of saliva can be observed. Therefore, the acidosis can occur, when feeding the ruminants with the diets containing optimum level of cellulose. The lack of the dietary energy content due to less consumption of forages and the development of acidosis – may cause anestrus for a prolonged period; a high cortisol level causes the estrus cycle problems and the ovulation delays.

A heat stress in animals can cause the increasing breathlessness and sweating. The breathlessness sharply increases the carbon dioxide release through lungs, thereby reducing the concentration of carbonic acid in blood and resulting in the critical balance of carbonic acid and bicarbonate required to maintain the optimum hydrogen ion concentration (pH) in blood, which in turn causes a respiratory alkalosis [2].

Under the heat stress, breathing becomes rapid , which increases the development of the oxidizing agents in the animal tissues. Therefore, it is essential to increase the animal intake of dietary antioxidants, vitamins, and carotenoids.

Using the energy boosting feed supplements and the various complex additives including the processed woody biomass-based additives is one of methods of controlling the heat stresses [1, 3, 4, 5, 8]. In this case, the Complex additive on the basis of phytonutrients as a dietary supplement – containing glycerin, propylene glycol, carbon, linseed oil, sugar, conifer extract (of «Khiminvest» Science and Technology Center production) , is of practical science interest.

MATERIALS AND METHODS

The research and production experiment on the farm of the AST-group, LLC (village Verchnie Belozerki, Stavropol District, Samara Region) was carried out in the summer period. The experiment was performed with the Black-and-White cows selected according to their production volume and the lactation status, which were divided into two groups.

Design of experiment

Group	n	Experience Duration, days	Feedings characteristics
Control	10	85	Basal Diet (BD)
Experimental	10	85	BD+ Complex additive supplement

The research and production surveys were designed to provide the data on the items as follows: the rumen fermentation parameters, the cow milk production and quality, the serum biochemical and hematological parameters, and the non-specific immune parameters of the experimental animals.

At the end of experiment, the levels of the serum non-specific immune parameters of the experimental animals (n=5) were determined at Microbiology Laboratory for Serum Bactericidal Activity (SBA) Assays. The rumen content samples via esophageal tubing were taken three hours after feeding in the middle of the experiment to characterize the ruminal digestion of the animals (n=5) and to measure the rumen fermentation parameters. The pH values, the total volatile fatty acid concentrations, the molar ratio between the acids essential for fermentation, the ammonia nitrogen concentration, and the total count of mesophilic aerobic and facultative anaerobic microorganisms in the rumen content were determined.

The analyses were carried out in the Ernst VIZh Federal Science Center for Animal Husbandry.

The (total and average daily) milk yields are estimated based on the values obtained from the control milking procedure performed on all the experimental animals (n=10). The changes in the quality of milk of the experimental animals (n=10) were evaluated with the average milk samples . They were analyzed in the Testing Research Laboratory, Samara State Agricultural Academy, Federal State Budgetary Educational Institution of Higher Education to determine the fat and protein contents expressed by weight and the somatic cell count.

RESULTS AND DISCUSSION

The animals of the control and experimental d groups were kept under the same conditions. Their feeding was performed according to the common management practices on the farm [7]. The diets fed to the animals were formulated according to their live weight and performance. The average diet fed to cows during the experiment is present in Table 1. The animal basal diet consisted of hay, fresh green forages, and grain mixes (barley, oats, and sunflower meal). The "Yogurt for cows" additive was supplemented at a dose of 150 g per diet for the cows from the experimental group. Therefore, the energy content of the enriched diet was 1.2 MJ higher than that for the standard diet of cows from the control group. . In addition, the experimental cow diet compared to the standard diet of cows in the control group had some excess of the other nutrients.

Table 1. Diets for experimental group dairy cows

Fodders and Indicators	Group	
	Control	Experimental
Hay, kg	4.000	4.000
Green forage, kg	15.000	15.000
Mixed grains, kg	6.0	6.0
Complex additive, g	-	150

The efficiency of the energy and feed nutrient utilization in the ruminants directly depends on the characteristics of the rumen metabolic pathways and the microbial processes in the pre-gastric chambers. In order to study the test additive effects on the rumen fermentation processes, the rumen content samples were taken via the esophageal probe at the end of the experiment. The samples were analyzed for the pH, the total volatile fatty acids (VFA), the certain fermentation molar proportions, the ammonia nitrogen concentration, and the contents of the total number of microorganisms and their certain species.

In case of feeding the animals with the Complex additive, an increase in the overall acidity of the rumen contents in the test cows is recorded, which can be caused by the intensification of rumen processes of fermentation and formation of sour metabolites in the form of the volatile fatty acids.. The total content of VFA, the end of carbohydrate splitting in pregastric fermentation chambers was 44% higher in the experimental group cows than in the cows of the control group. This fact can prove the more intensive course of hydrolysis of carbohydrates in the animals of the experimental group. Considering the molar proportions of the certain short-chain fatty acids, an increase in the acetic acid concentration and a decrease in the propionic and oil acid concentration in the cows of the experimental group should be reported, which present a positive factor. The concentration of ammonia nitrogen was slightly higher in the experimental group animals compared to the control group animals (by 13.9%), which can indicate the higher proteolytic activity of the ruminal microflora.

Table 2. Dynamics of parameters for rumen metabolism in experimental group animals

Indicators	Groups of animals		Norm
	Control	Experimental	
pH	7.26±0.07	6.94±0.01*	6.0-7.3
Ammonia, mg%	13.99±0.6	15.93±0.6	6.5-30
Total content of VFA, Mmol/g	53.3±1.86	76.81±6.2	
Acetate, %	64.5±0.8	65.3±3.8	55-75
Propionate, %	18.4±0.3	16.8±1.7	15-25
Butirat, %	11.7±0.7	11.5±0.8	10-17

Variences are statisitcally scinificant at * P<0.05

The Complex additive supplemented the animal diets at a dose of 150 g each had a positive effect on the rumen microflora (Table 3). During the test period within the survey, a tendency to increasing the total quantity of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAM) in the rumen of the cows of the experimental group could be observed. In addition, the same tendency was observed with respect to the lactose-positive and negative colonies.

Table 3. Microbiological indices s of rumen contents (n=3, M±m)

Indicators	Groups of animals	
	Control-	Experimental
QMAFAM, CFU/g	4400000000±450000000	7300000000±420000000
Lactose Positive, CFU/g	860±22.9	2800±1126
Lactose Negative, CFU/g	300±25	410±125

In order to study the effect of the Complex additive feed on performance of dairy cows, the milk production of cows from each group was recorded.. The diet suppleented with the conifer-energy additive could increase the milk production.

Table 4 shows that the Complex additive feed could ensure the increase the milk production.

On day 30 within the experiment, the average daily milk yields with the natural fat content decreased by 2.2L and 1 L in the cow of the control and experimental groups, respectively, when compared with their initial milk yields. In addition, the average daytime temperature was 330° C at the relative air humidity of 63%. On day 45 within the experiment, the milk yields decreased by 1.2 L and 0.9 L in cows of the control and experimental groups, respectively.. On day 60 within the experiment, these decreases comprised 0.9 L and 0.3L, respectively for the above mentioned groups.

Within the experiment, the average daily yields of milk with thenatural fat content and the 3.4% fat-corrected milk of the were 10.9% and 11.2% higher, respectively, in the experimental group cows compared to the control group animals.

Table 4. Milk production of ~~in~~ experimental group animals, milk quality (n=10, M±m)

Indicator	Groups of animals	
	Control	Experimental
At the beginning of the experiment		
Average daily milk yield, kg	18.3±0.4	18.2±1.4
Percentage to control	100.0	99.4
On day 30 of the experiment (Average daily temperature within three days was 33^0 C, humidity of 63%)		
Average daily milk yield, kg	16.1±0.6	17.2±1.1
Percentage of control	100.0	106.8
On day 45 of the experiment (Average daily temperature within three days was 25^0 C, humidity of 67%)		
Average daily milk yield, kg	14.9±0.4	16.3±0.9
Percentage of control	100.0	109.4
On the 60th day of the experiment (Average daily temperature within three days was 24^0 C, humidity of 66%)		
Average daily milk yield, kg	14.0±0.3	16.0±0.9
Percentage of control	100.0	114.3
On day 75 of the experiment		
Average daily milk yield, kg	14.3±0.4	16.0±1.3
Percentage of control	100.0	111.9
On day 85 of the experiment		
Average daily milk yield, kg	14.0±0.4	15.8±1.0
Percentage of control	100.0	112.8
Averages over the experiment		
Average daily milk yield, kg	14.66±0.2	16.26±0.4*
Percentage to control	100.0	110.9
Percentage of fat	3.82±0.2	3.83±0.04
Percentage of protein	2.99±0.02	3.01±0.02
Number of somatic cells, thousand/cm^3	277±38	261±5.2
Gross yield over-period of experiment	1246.1	1382.1
Milk fat yield, kg	47.60	52.93
Gross milk yield of 3.4% milk, kg	1400.0	1557.0
Average daily yield of 3.4% milk, kg	16.47	18.32
Feed cost per 1 kg milk of 3.4-% fat Concentrates, g	364.3	327.5

Variences are statistically scinificant at *- P<0.05

The milk fat and protein content was rather higher in the cows assigned to the experimental group. The udder health status is evaluated by the somatic cell count in the milk. A decrease in somatic cell count in the milk of the cows fed with the Complex additive was observed, which might be ensured by the bacteriostatic effect of the conifer extract contained in the additive. The feeding costs per kilogram of milk produced at 3.4% fat were lowest for the cows fed with the dietary test additive. Thus, the expenditures on the energy concentrates were 10.1% lower for the experimental group cows compared to the control group animals.

Therefore, the data collected from the research and production experiment with the fresh cows can prove the effectiveness of the dietary complex additive.

The analysis of data in table *6* shows an 8.8-% increase in the percentage of lysis for cows in the experimental group, when compared to that for the cows in the control group. In addition, a 2.2-% increase in the values for the bactericidal activity in the cows fed the diet supplemented with the complex additive should be reported.

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Table 5. Indicators for non-specific blood serum resistance in cows from experimental group (M±m, n=5)

Indicator	Groups of animals	
	Reference	Experimental
BABS, %	81.4±4.5	83.2±2.5
lysis, %	19.4±3.7	21.1±1.3

CONCLUSIONS

The survey data can prove that the dietary Complex additive improving the digestion even at the level of the rumen fermentation has a positive effect on the natural resistance and the lactation yields. It allows us to recommend this product to increase the milk production of animals, to maintain their health and performance, and to limit the heat stress factor.

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