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Research Article

Amino Acid Content of Cows' Milk when adding Biologically Active Substances

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ABSTRACT

The article provides the data on amino acid content of milk protein when using a new combination of biologically active substances for feeding cows. There are the results of amino acid score of milk protein. It is stated that the milk of the cows from the experimental group was more nutrient-enriched regarding the combination of amino acids. Adding a complex of biologically active substances in animals' diet resulted in increased amount of essential amino acids in milk protein's content of the cows from the experimental group after 14 days of the research by 4.2%, and after 28 days of the research by 5.5%, as compared with the results in the control group. At the same time during the period of the research, total content and mass of some nonessential amino acids in 100 grams of protein in the groups reduced, while their proportion changed, too. The content of glutamic and aspartic acids, glycine, arginin, alanine, and histidine increased,whereas the content of serine and tyrosine reduced, as compared with the content of these amino acids in milk protein content of the cows from the control group. The limiting amino acid in the control group was tryptophane, its amount in milk protein content was practically the same by the 28th day of the research. In the experimental group threonine had the lowest score. After 14 and 28 days of the research lysine and isoleucine had the highest score. Adding a complex of biologically active substances in cows' diet resulted in increasing of proportion of all the essential amino acids in milk protein content. Thus, the use of a complex of biologically active substances for feeding cows improved proportion of amino acid content of milk, as well as of its biological value and nutritive quality, that proves the necessity to add this feed supplement in animals' diet during the milk production.

Key words: cows, milk, protein, essential and nonessential amino acids, amino acid score, biological value.

1. INTRODUCTION

Milk proteins are high-molecular organic substances with the molecular made of amino acids. Proteins are structural and functional basis of life support, as they provide growth, development and proper metabolic process. Proteins can not be replaced with some other substances. In a human body proteins are degraded into amino and keto acids, which, in turn, influence the synthesis of new amino acids and proteins necessary for body. Native protein contains all the eight of essential amino acids and is almost 100 % digestive. Proper life support mostly depends on satisfying the needs in native protein.

Amino acid content of cows' milk protein is mostly determined by quantity, quality and proportion of feed blends in the diet. Despite of achievements in the sphere of rationing of highly productive cows, the issue of monitoring biological value and nutritive milk quality by means of rational supplementation of biologically active substances and their influence on milk content needs further research. To do the above-mentioned, it seems to be promising to add biologically active substances able to control body capacity in animals' diet. The use of low-cost and real natural sources of biologically active substances is considered to be efficient and scientifically grounded [1,2,3,4,5,6,78,9,10,11,12].

Thus, the research on efficiency of the use of a new combination of some biologically active substances in cows' diet, in order to produce milk with the expected quality and functional characteristics is considered to be an important task that has determined the aim of the research done [2,3].

2. MATERIAL AND METHODS OF RESEARCH

To achieve the aim, the research on influence of a complex of biologically active substances on the content and properties of cows' milk was done. A basic enterprise for the research was a farming unit with breed and age distribution of animals and average level of productivity typical for the Ural area. Genetic structure of the herd was presented with three types of stud bulls, most common in the region, such as Wes Back Ideal 1013415, Reflection Sovering 198998, Montwick Chieftain 95679. For milk production the method of tie-up housing is used, which is common for the most enterprises of the area. Methods of feed production and mixing, as well as nutritive and energy value are traditional for the area of the middle Urals.

In the course of the research, the cows from the control group had basic diet typical for the farm, whereas the animals from the experimental group, in addition to the basic diet had a complex of biologically active substances (mineral elements, vitamins, and carboxylic and amino acids) in the form of water slurry in the amount of 1 litre per head a day. A complex of biologically active substances to cows' diet had been added for 28 days, starting with the first day of the second phase of lactation.

In the course of the experiment the animals from the control and experimental groups were under the same conditions of feeding and welfare. The diet consisted of 21% stover, 72.70% succulent, and 25.09% concentrated feedstuff.

The analysis of amino acid content of milk was done on the aminoacid analyzer T-339 by the method of ion-exchange chromatography. The calculation of amino acid score was done by the method of comparing the actual content of amino acids in milk proteins with the FAO/WHO scale.

3. RESULTS OF RESEARCH AND THEIR INTERPRETATION

Amino acids do not only fulfill structural function in body, but also take an active part in biosynthesis of a number of physiologically active substances and combinations, such as nucleinic acids, purine and pyrimidine bases, hormones, creatine, carnitine, vitamins and many others. Amino acids are needed for synthesis of protective agents – antibodies, and they also act as transport body systems and influence the activity of a number of ferments. Methionine takes part in synthesis of adrenalin and creatine as a provider of methyl groups and

it is also the source of sulfur for formation of thiamine, as well as it improves body protection from toxication with bacterial endotoxines. Phenylalanine is a precursor of a number of hormones; threonine is a precursor of vitamin B_{12}; valine takes part in synthesis of pantothenic acid. Asparlic acid increases the use of oxygen by heart muscle [13,14,15,16,17,18,19,20].

In the course of biochemical process, nonessential amino acids are affected by irreversible deamination, so it is very important to provide their constant delivery to body together with food.

In the course of the research, in order to evaluate full value of protein, the analysis on amino acid content of cows' milk was done. The results of the analysis are given below in Table 1.

The results of the research have shown that the milk of the cows from the experimental group had higher value regarding the proportion of amino acids. The use of a complex of biologically active substances in animals' diet resulted in increase of amount of essential amino acids in milk protein content of the cows from the experimental group after 14 days of the research by 4.2%, and after 28 days of the research – by 5.5%, as compared with the control group. At the same time total content and mass of some nonessential amino acids in 100 grams of protein in the groups reduced, and their proportion changed in the course of the research. The content of glutamic and asparlic acids, glycine, arginine, alanine and histidine increased, whereas the content of serine and tyrosine reduced, as compared with the amount of these amino acids in milk protein content of the cows from the control group. Such dynamics in changing proportion of nonessential and essential amino acids and some of its agents in the groups took place in the whole course of the research.

Table 1 – Amino acid content of milk proteins, g per 100 g of protein

(n=20, $\overline{X} \pm S\overline{x}$)

Amino acid	Group	
	Control	Experimental
After 14 days of research		
Nonessential, including:	56,63	54,83
Glutamic acid	14,98±0,07	14,57±0,03***
Serine	8,49±0,08	7,86±0,06***
Aspartic acid	6,70±0,05	6,65±0,01
Glycine	4,88±0,04	4,79±0,02
Arginin	6,69±0,05	6,57±0,02
Tyrosine	5,74±0,05	5,24±0,05***
Alanine	6,20±0,02	6,15±0,01
Histidine	2,95±0,01	3,00±0,01*
Essential, including:	43,37	45,17
Lysine	8,22±0,04	8,56±0,04***
Methionine +cystine	3,79±0,04	3,94±0,03*
Threonine	3,92±0,03	4,11±0,03**
Valine	5,76±0,02	5,97±0,03***
Leucine	8,58±0,05	8,84±0,05*
Isoleucine	5,72±0,04	5,89±0,02***

Phenylalanine +Tyrosine	6,61±0,03	6,81±0,03**
Tryptophan	0,77±0,02	1,05±0,02***
After 28 days of research		
Nonessential, including:	56,74	54,35
Glutamic acid	14,95±0,08	14,43±0,08**
Serine	8,48±0,07	7,79±0,10**
Aspartic acid	6,72±0,04	6,59±0,02*
Glycine	4,81±0,02	4,75±0,01*
Arginin	6,68±0,03	6,51±0,02***
Tyrosine	5,82±0,06	5,20±0,07***
Alanine	6,34±0,06	6,09±0,04*
Histidine	2,94±0,02	2,97±0,01
Essential, including:	43,26	45,65
Lysine	8,19±0,05	8,62±0,06***
Methionine +cystine	3,69±0,03	3,98±0,04***
Threonine	4,03±0,04	4,13±0,03
Valine	5,74±0,07	6,04±0,05*
Leucine	8,56±0,06	8,91±0,08
Isoleucine	5,70±0,05	5,96±0,04**
Phenylalanine +Tyrosine	6,59±0,06	6,89±0,07
Tryptophan	0,76±0,03	1,12±0,02***

During the whole period of research in all the groups of animals glutamic acid had the highest weight fraction among nonessential amino acids, whereas histidine had the lowest one. The highest figure of nonessential amino acids was in the control group, and by the 28th day of research their amount in the control group increased, while in the experimental group it reduced. It may be caused by the fact that the animals from the experimental group digest more essential aminoacids than nonessential ones from feeding stuff, because of the influence of added complex of biologically active substances.

According to modern conceptions, biological value of proteins is determined by efficiency of transformation of food proteins into proteins of human body, or maintenance of nitrogen balance in it. It depends on balanceness of amino acid content regarding essential amino acids. Synthesis of most proteins of human body does not only require sufficient quantity of every amino acid, but also their proper balance that in ideal should be close to the one in proteins of human body. Imbalance in amino acid content of food proteins results in improper synthesis of self-proteins and dominating apolexis of body self-proteins. Insufficiency of some essential amino acid limits the use of other amino acids for biosynthesis of protein, whereas significant excess of it results in formation of highly toxic byproducts from amino acids not used for synthesis [2, 12] .

Biological value of proteins is determined by calculation of amino acid score. As an “ideal”, protein of a hen’s egg, or hypothetic protein offered by FAO/WHO, is used. On the practical side, calculation of score for the most deficient amino acids (tryptophan, lysine and total sulphur-containing methionine and cystine) is considered to be sufficient. The amino acid defining biological value of protein (limiting) is considered to be the one with the least score.

According to the results of the research, a limiting amino acid in the control group was tryptophan. Besides, its quantity in the content of milk protein by the 28th day of research stayed practically the same. In the experimental group it was threonine that had the least score, so it was a limiting amino acid. It is worth to note that in the control group its score was also

low as compared with other amino acids (Table 2).

Table 2 – Amino acid score of cows' milk protein, %

Amino acid	FAO/WHO standard, g/100 g of protein	Group	
		Control	Experimental
After 14 days of research			
Lysine	5,5	149	155
Methionine +cystine	3,5	108	112
Threonine	4,0	98	102
Valine	5,0	115	119
Leucine	7,0	122	126
Isoleucine	4,0	143	147
Phenylalanine +Tyrosine	6,0	110	113
Tryptophan	1,0	77	105
After 28 days of research			
Lysine	5,5	148	156
Methionine +cystine	3,5	105	113
Threonine	4,0	100	103
Valine	5,0	114	120
Leucine	7,0	122	127
Isoleucine	4,0	142	149
Phenylalanine +Tyrosine	6,0	109	114
Tryptophan	1,0	76	112

After 14 and 28 days of research lysine and isoleucine had the highest score in all the groups. However, by the 28th day of research the quantity of both lysine and isoleucine in the control group reduced insignificantly, whereas it increased a little in the experimental group. In the experimental group the score of lysine was higher than in the control group: after 14 days of research – by 4%; after 28 days of research – by 4.9 %.

By the 28th day of research score of sulphur-containing methionine and cystine reduced by 2.8% in the control group, and increased by 0.9% in the experimental group. Already after 14 days of research relative content of methionine and cystine in the group of the animals given a complex of biologically active substances in addition to their basic diet, was 3.7 % higher, as compared to the control figures. By the 28th day of research the animals of the experimental group had shown the score of those amino acids 7.6 % better than the one in the control group.

Score of threonine, valine, leucine, and total phenylalanine and tyrosine in the milk of the cows from the experimental group was respectively 4.1; 3.5; 3.3; 2.7% higher by the 14th day of research; 3.0; 5.3; 4.1; 4.6% higher by the 28th day of research, as compared with the control group.

After 14 days of research score of tryptophan in the control group was 77 % and reduced to 76 % by the 28th day of research. Adding a complex of biologically active substances in cows' diet

resulted in increasing relative content of tryptophan in the content of milk protein already at the first stage of the research. This parameter was 36.4 % higher than in the control group, and by the 28th day of research it was even better in the experimental group and was 47.4%.

4. CONCLUSION. Thus, the use of a complex of biologically active substances for feeding cows resulted in improved proportion of amino acid content and biological and nutritive value of milk that proves the necessity to add this feed supplement in animals' diet, during the milk production.

5. CONFLICT OF INTEREST

The authors confirm that the data presented here have no conflict of interest.

CREDITS

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