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DIGESTIBILITY AND ABSORPTION OF NUTRIENTS BY YOUNG CATTLE AT INCLUSION OF COMPLEX FEED ADDITIVES INTO THE DIETS IN THE CONDITIONS OF YAKUTIA

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It is known that cattle with a high genetic potential of productivity cannot fully realize it in the conditions of Yakutia. This is facilitated by many factors, especially it is necessary to highlight the basic feeds, which are poorly provided with nutrients and minerals. Therefore, the development of technologies and methods to increase productivity of cattle through inclusion of complex feed additives from natural resources in their diets is of scientific and practical importance for the conditions of risky agriculture. In this regard, the goal was to study effect of complex feed additives from local natural raw materials on the digestibility and metabolism of young cattle. The studies used methods generally accepted in zootechnical practice, setting up for the experiment was carried out according to the method (M.F. Tomme, 1969). Experiments were conducted on 3 groups of young cattle. Each group has 10 heads selected by the method of analogues. When analyzing the data on the digestibility and absorption of nutrients, it was found that the animals of the experimental groups digested nutrients better compared to the animals of the control group: dry matter by 1.44% and 0.1%, organic matter by 2.0% and 1.65%, crude protein by 1.68% and 1.16%, crude fat by 2.28% and 1.33%, crude fiber by 2.48% and 2.04%, and nitrogen-free extractives by 1.88% and 1.61%. At the same time, the animals of the experimental groups used nitrogen better compared to the control group by 2,28% and 1,05%. The study of the biochemical composition of animal blood showed that complex feed additives are harmless. Thus, the inclusion of complex feed additives in the diets of young cattle can improve the indicators of digestibility and the degree of use of nutrients in the conditions of Yakutia.

Keywords: *cattle; digestibility; feed; metabolism; efficiency*

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ПЕРЕВАРИМОСТЬ И УСВОЕНИЕ ПИТАТЕЛЬНЫХ ВЕЩЕСТВ МОЛОДНЯКОМ КРУПНОГО РОГАТОГО СКОТА ПРИ ВКЛЮЧЕНИИ В РАЦИОНЫ КОМПЛЕКСНЫХ КОРМОВЫХ ДОБАВОК В УСЛОВИЯХ ЯКУТИИ

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Известно, что крупный рогатый скот, имеющий высокий генетический потенциал продуктивности, не может реализовать его в полной мере в условиях Якутии. Этому способствует множество факторов, особенно нужно выделить основные корма, которые слабо обеспечены питательными и минеральными веществами. Поэтому разработка технологий и способов, позволяющих повысить продуктивность крупного рогатого скота, за счет включения комплексных кормовых добавок из природных ресурсов в состав их рационов, представляет научно-практическую значимость для условий рискованного ведения сельского хозяйства. В связи с этим поставлена цель: изучить влияние комплексных кормовых добавок из местного природного сырья на показатели переваримости и обмена веществ молодняка крупного рогатого скота. В исследованиях использованы общепринятые в зоотехнической практике методы, постановка на опыт была произведена по методике (М.Ф. Томмэ, 1969). Опыты проведены на 3 группах молодняка крупного рогатого скота. В каждой группе 10 голов подобранных методом аналогов. При анализе данных по переваримости и усвоению питательных веществ, установлено, что животные опытных групп лучше переваривали питательные вещества по сравнению с животными контрольной группой: сухое вещества на 1.44% и 0.1%, органическое вещество на 2.0% и 1.65%, сырой протеин на 1.68% и 1.16%, сырой жир на 2.28% и 1.33%, сырая клетчатка на 2.48% и 2.04 % и безазотистых экстрактивных веществ на 1.88% и 1.61%. При этом животные опытных групп лучше использовали азот по сравнению с контрольной группой на 2,28% и 1,05%. Изучение биохимического состава крови животных показало, что комплексные кормовые добавки безвредны. Таким образом, включение комплексных кормовых добавок в рационы молодняка

крупного рогатого скота позволяют улучшить показатели переваримости и степени использования питательных веществ в условиях Якутии.

Ключевые слова: *крупный рогатый скот; переваримость; корма; обмен веществ; эффективность*

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Introduction

Cattle breeding are one of the most important areas of animal husbandry in the Republic of Sakha (Yakutia). A significant share of livestock production is produced in the Central and Vilyuysk groups of districts. For the effective development of cattle breeding and providing the population with local safe meat and dairy products, the state target development program “Socio-economic development of the village of the Republic of Sakha (Yakutia) for 2012-2016” includes measures to improve breeding work, feeding and keeping of cattle for the entire region.

The analysis of 30 years of the dynamics of the cattle livestock showed that every year the number of animals decreased. This trend was also observed in other areas of animal husbandry. From 1999 to 2004, there was a positive trend in the growth of the total livestock by 10.16%, and the number of dairy cows increased by 4.54%. The analysis of these indicators in 2004-2008 showed that the reduction in the total number of livestock was 21.69% and cows decreased by 14.16%. From 2008 to 2009, there was a positive trend in the growth of the total number of livestock by 0.48%, including dairy cows increased by 0.1%. As of 2020, there were 183.3 thousand heads of the total number of cattle in the republic, of which 70.7 thousand heads were dairy cows, which is less than figures of last year for the total number by 0.11%, while the number of dairy cows increased slightly by 0.57% [7].

In the cattle breeding of Yakutia, the stable-pasture system of animal keeping is traditionally used. In farms, captive and yard cattle housing are used. In summer, the grazing method of keeping cattle is used for fattening and feeding. Winter is the most difficult period of cattle breeding in the republic due to the length of the period, the meager range of feed (coarse feed in the structure of the diet is from 75% to 100%) and the poor quality of feed, and we also note the insufficient coverage of artificial insemination of cows [13, 14].

Scientific novelty

The analysis of literature sources [4, 10, 12] showed that scientific research on increasing meat productivity, arrangement of cattle fattening was based solely on selection and breeding work, without paying attention to the issues of feeding, including mineral and vitamin nutrition of animals.

Consequently, the weak provision of basic and insurance feed in livestock farms, as well as the unbalanced diets of animals, the existing lack of macro- and microelements in plant feed has a negative impact on the realization of the genetic potential of cattle productivity in the conditions of Yakutia.

The data on the effectiveness of experiments are ambiguous and for individual feed additives there are different recommendations for their inclusion in the diets of animals and birds. At the same time, it is known that complex feed additives have different chemical composition, structure, adsorption and cation exchange abilities. It should be noted that until now, for many feed additives, there is no data on their impact on the physiology and productivity of animals, as well as on the economic indicators of production [1, 2, 5, 6, 8, 9, 11, 15 - 20].

The aim of research: to determine the effect of complex feed additives on the indicators of digestibility and absorption of nutrients in young cattle in the conditions of Yakutia.

The objectives of research:

- to study the digestibility and absorption of nutrients by animals;
- to study the absorption of nitrogen, calcium and phosphorus by animals.

Material and research methods

To conduct the scientific and economic experiment, 3 groups of Simmental young bulls of 10 heads each were formed. When forming identical groups, the indicators of age, live weight and physiological characteristics of the animals were taken into account. The duration of the scientific and economic experience is 300 days. Animals from the II and III experimental groups received 50 and 100 g of coniferous flour with the basic diet, respectively, by groups, hongurin at a dose of 0.7 g per kg of live weight and in addition to this 35 g of Kempdyask salt.

To study the detailed effect of complex feed additives on the productive parameters and physiological state of fattening young animals, we studied the morphological and biochemical composition of the blood, the digestibility of nutrients, as well as the exchange of nitrogen, calcium and phosphorus. Study of the morphological and biochemical composition of blood from 3 heads of each

group. The studies were conducted according to generally accepted methods. Blood was taken from animals from each group in the morning before feeding. In the blood of cattle, the content of total protein, reserve alkalinity, albumins and globulins was determined.

Feed additives consisted of coniferous flour, hongurin zeolite, and Kempendyask salt. Coniferous flour contains dry matter – 20.7%, crude protein – 6.9%, carbohydrates – 32.8%, crude fat – 9.6%, crude fiber – 10.5%, organic acids – 9.6%, other organic substances – 2.5%, crude ash – 7.4 mg%, calcium – 0.5%, phosphorus – 0.4%, potassium – 2.3%, magnesium – 0.3%, iron – 174 mg, copper – 12.6 mg, manganese – 197 mg, carotene – 168 mg, Vitamin E – 220 mg, Vitamin B – 8.0 mg%, Vitamin C – 127.3 mg, Vitamin P – 27.8 mg.

The characteristics of the zeolite feed additive are presented in the paper [3].

The results and discussion

The scientific and economic experiment was conducted to determine the effectiveness of complex feed additives consisting of local natural resources, such as coniferous flour, hongurin and Kempendyask salt in feeding fattening young animals of the Simmental breed of cattle on the basis of the Lonkur farm of the Suntarsk district of the Republic of Sakha (Yakutia). The research was carried out from January to October. Balance experience in March (11 months of age).

The average daily diet of experimental young bulls per head in the winter period of housing is presented in Table 1.

During the winter period of housing, there is a shortage of copper, zinc, cobalt, manganese, iodine, as well as carotene and vitamin D in the diet of animals. The inclusion of complex feed additives affected positively the provision of the diets of animals with all nutrients, minerals and biologically active substances.

Thus, for some elements of animal feeding, there is a correspondence in the level of energy and nutrients; there is a deficit in some minerals in the diet.

To determine the effectiveness of a complex feed additive from local resources, the indicators of feed digestibility were determined. The experiment to determine the digestibility of nutrients of the components of the diet of young bulls of the Simmental breed was carried out at the age of 11 months according to the generally accepted zoological and technical method by setting three heads from each experimental group for the experiment. The inclusion of complex feed additives affected the intensity of digestion of the nutritional components of the diet by the animals (Table 2).

Table 1.

Average daily diet of 12 months old young bulls

Indicators	Standard	Groups		
		I - control	II - experimental	III - experimental
Meadow hay, kg		5	5	5
Mixed feed, kg		1.5	1.5	1.5
Mixed grass haylage, kg		3	3	3
the diet contains:				
Exchange energy, MJ	46	52.75	52.75	52.75
Dry matter, kg	6.1	6.92	6.93	6.94
Digestible protein, g	550	573.32	584.45	592.5
Crude fiber, g	1155	1769.5	1789.78	1824.2
Starch, g	715	808.77	812.56	825.83
Sugars, g	495	236.1	237.83	238.93
Crude fat, g	230	268.66	275.34	289.1
Calcium, g	41	42.58	44.22	45.3
Phosphorus, g	23	23.9	24.86	25.97
Sulfur, g	22	29.46	30.95	32.56
Ferrum, g	330	482.89	488.76	496.89
Copper, g	45	43.82	46.45	48.5
Zinc, g	250	249.26	259.12	269.78
Cobalt, g	3.3	1.77	3.3	3.32
Manganese, g	220	247.74	259.53	267.77
Iodine, g	1.8	1.6	1.8	1.85
Carotene, mg	150	148.77	156.2	167.38
Vitamin D, thousand IU	3.4	2.15	3.42	3.49
Vitamin E, mg	195	209.89	216.25	229.6
Vitamin B ₁ , mg		13.8	14	14.98
Vitamin B ₂ , mg		43.77	44.85	45.79
Vitamin B ₃ , mg		67	68.78	69.65
Vitamin B ₄ , g		5.9	6.1	6.55
Vitamin B ₅ , mg		164.8	165.99	169.86

The experimental data indicate the high effectiveness of complex feed additives on the indicators of the intensity of digestion of nutrients in the diet by the young bulls of the experimental groups in comparison with the animals of the control group. Thus, the animals of the II and III experimental groups were better digested: dry matter by 1.44% and 0.1%, organic matter by 2.0% and 1.65%, crude protein by 1.68% and 1.16%, crude fat by 2.28% and 1.33%, crude fiber by 2.48% and 2.04%, and nitrogen-free extractives by 1.88% and 1.61%.

Table 2.

Coefficients of digestibility of nutrients in the diet of young bulls, % (M±m)

Groups	Dry matter	Organic matter	Crude protein	Crude fat	Crude fiber	Nitrogen-free extractives
I - control	56.42 ±1.44	60.34 ±1.2	65.39 ±1.77	58.13 ±1.8	58.26 ±1.03	60.31 ±2.38
II - experimental	57.86 ±1.42	62.34 ±1.14	67.07 ±1.14	60.41 ±1.3	60.74 ±0.76	62.19 ±1.87
III - experimental	56.52 ±1.58	61.99 ±0.89	66.55 ±1.39	59.46 ±2.2	60.30 ±0.85	61.92 ±1.4

There is also a difference at comparing the coefficients of digestibility of nutrients between the young bulls of the experimental groups. The young bulls of the experimental group II digested the components of the diet better than the animals of the experimental group III: dry matter by 1.34%, organic matter by 0.35%, crude protein by 0.52%, crude fat by 0.95%, crude fiber by 0.44% and nitrogen-free extractives by 0.27%. The conducted experiment showed that in the diet of young bulls, the optimal standard is the proportion of feed additives consisting of coniferous flour (50 g), hongurin (0.7 g per kg of live weight) and 35 g of Kemendyaysk salt. The intensity of digestion of the nutritional components of the feed in the young bulls of the experimental groups was affected by the insertion of complex feed additives into their basic diet.

The data of the balance experiment showed that the nitrogen balance in all groups of experimental fattening young bulls was positive, while the indicator of nitrogen retention in the body was different, the data are presented in Table 3.

Table 3.

Use of nitrogen by animals, g (M±m)

Indicators	Groups		
	I - control	II - experimental	III - experimental
Taken with food, g	139.73±1.72	143.32±1.42	141.88±1.52
Excreted with feces, g	37.54±1.67	36.57±1.38	37.96±1.45
Digested, g	102.19±1.59	106.55±0.88	103.92±1.26
Excreted with urine, g	73.36±2.27	73.77±0.82	73.18±1.68
Balance (+/-), g	28.83±0.87	32.78±0.99*	30.75±1.07
Used:			
from the absorbed, %	20.64±0.6	22.92±0.84	21.69±0.96
from digested, %	28.25±1.18	30.76±0.8	29.60±1.1

Note: *P>0.95

Nitrogen intake in all groups was almost the same, but the indicators of nitrogen use in individual groups were different. The young bulls from the II and III experimental groups compared to the control group used nitrogen better from the taken by 2,28% and 1,05%, and from the digested by 2,51% and 1,35%. At the same time, in the control group of animals, nitrogen retention in the body was 28.83 g, while in the animals of the II and III experimental groups, this indicator was at the levels of 32.78 and 30.75 g. Consequently, the use of complex feed additives from local raw materials as part of the basic diet of young bulls affected positively the indicators of nitrogen use and retention in the body, which explains the intensive increase in live weight of animals from the experimental groups. According to the use of nitrogen, the best animals from the III experimental group received a feed additive including coniferous flour (50 g), hongurin (0.7 g per kg of live weight) and Kemendyask salt (35 g).

Along with the determination of nitrogen, it is also important to determine the level of use of such biogenic macronutrients as calcium and phosphorus. Data on the use of calcium by experimental fattening young bulls are given in Table 4.

Table 4.

Use of calcium by animals, g (M±m)

Indicators	Groups		
	I - control	II - experimental	III - experimental
Taken with food, g	58.36±1.18	59.26±1.12	58.75±1.16
Excreted with feces, g	38.94±2.33	33.71±2.23	36.75±2.26
Digested, g	1.46±0.09	1.22±0.06	1.41±0.07
Excreted with urine, g	40.4±2.35	34.93±2.28	38.16±2.31
Balance (+/-), g	17.96±3.52	24.33±3.02	20.59±2.83
Used from absorbed, %	30.55±5.48	40.94±4.46	34.96±4.35

The intake of calcium from feed varied in the range of 58.36-59.26 g. But there were differences between the groups by its use. At the same time, the calcium balance in all groups was positive, which indicates a normal metabolism of the animals. The retention of calcium in the groups was the control group – 17.96 g, the II experimental group – 24.33 g, the III experimental group – 20.59 g. There was also a difference in phosphorus uptake between different groups of young bulls (Table 5).

The level of calcium intake from feed averaged 26.53-27.29 g. At the same time, there was a difference in its use. So in the control group of animals, this indicator was equal to 21.75% and the young bulls of the II and III experimental groups exceeded this indicator by 18.12% and 9.61%. The retention of calcium in the body of animals was: control group – 5.96 g, II experimental group –

10.99 g, III experimental group – 8.77 g. Based on the presented data, the animals of the II and III experimental groups used calcium and phosphorus better compared to their peers of the control group that received only a household diet.

Table 5.

Use of phosphorus by animals, g (M±m)

Indicators	Groups		
	I - control	II - experimental	III - experimental
Taken with food, g	26.53±2.35	27.29±2.21	27.27±2.33
Excreted with feces, g	16.64±0.56	12.57±0.44**	14.66±0.5
Digested, g	3.94±0.24	3.72±0.25	3.84±0.21
Excreted with urine, g	20.57±0.79	16.3±0.69*	18.51±0.52
Balance (+/-), g	5.96±1.64	10.99±1.56	8.77±2.04
Used from absorbed, %	21.75±4.11	39.87±2.67*	31.36±4.71

Note: *P>0.95; **P>0.99

In order to determine the effect of complex feed additives from local raw materials (coniferous flour, hongurin and Kempendyaysk salt), the biochemical composition of the blood of experimental animals was studied (Table 6).

Table 6.

Biochemical composition of the blood of experimental animals (M±m)

Groups	Total protein, g/%	Reserve alkalinity, vol. % CO ₂	Albumins %	Globulins %			Protein ratio
				α	β	γ	
at the beginning of accounting							
Standard	7.2-8.6	46-66	30-50	12-20	10-16	25-40	0.9-1.2
I - control	7.23±0.17	47.33±0.62	43.47±0.32	12.3±0.35	10.3±0.2	25.2±0.21	0.91±0.02
II - experimental	7.3±0.31	47.73±0.68	43.7±0.25	12.37±0.49	10.37±0.3	25.2±0.31	0.91±0.02
III - experimental	7.2±0.25	47.2±0.53	43.33±0.24	12.23±0.37	10.23±0.27	25.1±0.3	0.91±0.02
at the end of the accounting							
I - control	7.43±0.27	48.1±0.6	46.1±0.12	13.57±0.34	11.33±0.37	26.33±0.27	0.90±0.02
II - experimental	7.83±0.33	48.87±0.55	47.5±0.15*	13.87±0.43	11.5±0.35	26.7±0.44	0.91±0.02
III - experimental	7.57±0.33	48.40±0.7	46.73±0.19*	13.7±0.45	11.47±0.38	26.6±0.46	0.90±0.02

Note: *P>0.95

Analysis of the biochemical composition of the blood of experimental animals showed that all the studied blood parameters did not go beyond the established norms. At the same time, there was a slight difference in the total protein content in the blood. The control group of young bulls on this indicator was inferior to the animals of the experimental groups by 0.4% and 0.14%.

Thus, it is established that experimental complex feed additives do not negatively affect the animal body.

Conclusions

The inclusion of complex feed additives in the diets of young cattle helped to improve the indicators of nutrient digestibility. At comparing the data of the control group and the II and III experimental groups, it was found that the animals that received the additives used better dry matter by 1.44% and 0.1%, organic matter by 2.0% and 1.65%, crude protein by 1.68% and 1.16%, crude fat by 2.28% and 1.33%, crude fiber by 2.48% and 2.04%, and nitrogen-free extractives by 1.88% and 1.61%.

These changes also affected the ability to retain nitrogen, calcium and phosphorus in the body of animals. The animals of the experimental groups compared to the control group used nitrogen better from the absorbed one by 2,28% and 1,05%. In terms of calcium absorption, the experimental groups exceed the control group by 10.39% and 4.41%.

The study of the biochemical composition of the blood of animals found that all the studied indicators did not go beyond the limits of the standards.

Thus, the inclusion of complex feed additives in the diets of young cattle contributes to the improvement of digestibility and nutrient metabolism in the conditions of Yakutia.

Practical significance and prospects for further research. According to results of research, we recommend including in the composition of rations young cattle: 50 g of coniferous flour, hongurin at a dose of 0.7 g per kg of live weight and 35 g of Kempendyask salt.

Further research will be aimed at studying optimal norms for the inclusion of complex feed additives in rations of cows.

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