UDC 636.084.1:636.22/28.053.2

DOI 10.29326/2304-196X-2018-1-26-28

INFLUENCE OF FEEDING NORMALIZED TRACE ELEMENTS IN MINERAL AND ORGANIC FORM ON GROWTH, DEVELOPMENT AND METABOLISM OF YOUNG CATTLE

Ye. Yu. Zalyubovskaya
Junior Researcher, FGBNU "DalZNIVI", Blagoveschensk, Russia, *e-mail: dalznivilabbiohim@mail.ru*

SUMMARY
The paper presents results of body weight and basic measurements of black-motley breed calves born at the OOO "Priamurye" dairy complex in the Tambov Rayon, the Amur Oblast in 2017. The animals were selected using the analogous pair method taking into account their age, body weight and health status. Three groups of six-month old animals were formed: one control group and two experimental groups with 10 animals in each. The housing conditions were similar in all the groups. Based on the obtained data on the amount of nutrients consumed and excreted with feces, the digestibility coefficients of crude protein, crude fat, nitrogen-free extracts and crude fiber – animal feeding nutrients used at the farm – were determined. The calves in the control group were fed the basic diet adopted in the farm, the animals in the first experimental group were fed the basic diet with addition of normalized trace elements (iodine, cobalt and selenium) in mineral form, the animals in the second experimental group were given the same trace elements in organic form. The experiment lasted for 180 days. The investigation revealed that the highest body weight and daily average growth values were observed in the second experimental group. Similar results were obtained with regard to increasing nutrient digestibility coefficients. Thus, the positive effect of trace elements in organic form on growth and development of calves was proved.

Key words: trace elements, calves, body weight, digestibility, measurement.

INTRODUCTION

Well-balanced mineral nutrition is a key factor of animal health maintenance. Amur Oblast belongs to a biogeochemical region with a dramatic deficiency of several trace elements, in particular iodine, selenium and cobalt, in the biosphere. Iodine and selenium deficiencies are over 80–90%, and cobalt deficiency is 70% [3, 7].

Vital trace elements influence the functions of hematopoietic organs and endocrine glands, gastrointestinal microbiota; they are involved in the formation of ferments and hormones; facilitate vitamin B_{12} and E synthesis, thereby regulating metabolism; have an indirect impact on protective response of the animal body [6, 8].

A chronic deficiency of trace elements results in low reproduction, birth of unviable young stock, premature culling of animals, decrease in animal performance and animal product quality [2, 4].

Nutrition, which is insufficient or not balanced with dietary need of animals for major nutrients, inflicts significant economic losses on animal industry and causes various diseases. Consequently, appropriate young stock feeding with high quality feeds and necessary feed additives helps to optimize all body processes, has a positive effect on growth, development, reproduction and performance as well as on the quality of products derived from animals [1, 9–11].

In connection therewith, the experiment goal was to study the effect of different forms of iodine, cobalt and selenium on growth, development and metabolism of young cattle.

MATERIALS AND METHODS

The experiment was conducted in black-motley calves at the OOO "Priamurye" dairy complex located in Tambovsky Rayon, Amur Oblast, in 2017. To carry out a scientific and economic experiment using the analogous pair method, taking into account age, body weight and health status,

Table 1
Changes in the calves' body weights within the experiment ($M \pm m$)

Group	Number of animals	Body weight, kg		Average daily growth, g	As % to control group
		at the beginning of the experiment	at the end of the experiment		
Control group	10	146.4 ± 0.42	243.3 ± 0.48	538.3	100
Experimental group 1	10	146.2 ± 0.46	247.6 ± 1.63*	563.3	104.6
Experimental group 2	10	146.0 ± 0.44	252.7 ± 0.75***	592.7	110.1

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

three groups of six-month-old animals were formed: one control group and two experimental groups, 10 animals per group. Control group calves were fed the basic diet used at the complex; iodine, cobalt and selenium in mineral form were added to the diet of experimental group 1; the calves of experimental group 2 were given the same trace elements in organic form. Other housing conditions were similar for all the groups of young cattle. The calves at the age of nine months were measured according to Ye. Ya. Borisenko (2012). The experiment lasted for 180 days. Upon completion of the experiment feed digestibility was determined using national standards, digestibility coefficients were calculated (A. P. Kalashnikov, 2003, N. G. Makartsev, 2012). Average daily growth was estimated (N. A. Kravchenko, 1963). Experimental findings were mathematically processed with Microsoft Excel programme, statistical significance of the results was determined with Student's test (*t*-criterion) [5].

RESULTS AND DISCUSSION

At the end of the experiment on effect of trace elements in mineral and organic forms on calves' bodies the highest average daily growth value was recorded in experimental group 2; it was 5.0–9.2% higher than similar values in the control group and experimental group 1.

The body weight of the calves in experimental group 1 was 4.6% and 10.1% higher than that of the calves in control group and experimental group 2, respectively (see Table 1). The analysis of body weight values in the experimental groups revealed that the mentioned value in experimental group 2 had statistically increased by 2.05% ($p < 0.05$) as compared to that of experimental group 1.

Nine-month-old calves of experimental group 2 demonstrated higher growth rates and better development as confirmed by the animals' measurements (see Table 2).

Measurements in experimental group 1 were higher than those in the control group. In particular, withers height was statistically 1.9% higher ($p < 0.01$), rump height – 1.6% ($p < 0.01$), diagonal body length – 1.3% ($p < 0.01$), chest width behind the shoulder blades – 13.5% ($p < 0.001$), chest depth – 2.4% ($p < 0.01$), chest girth – 2.5% ($p < 0.001$), hook bone width – 4.7% ($p < 0.05$), thurl width – 3.5% ($p < 0.05$). Such measurements as ischial tuberosity width and metacarpus circumference in experimental group 1 were 4.0% and 51.2% higher, respectively, as compared to the same measurements in the control group, but they were statistically insignificant.

All measurements made in experimental group 2 were statistically superior as compared to those made in the control group: withers height was 3.5% higher ($p < 0.001$), rump height – 2.8% ($p < 0.001$), diagonal body length – 3.3% ($p < 0.001$), chest width behind the shoulder blades – 15.4% ($p < 0.001$), chest depth – 3.9%

Table 2
Basic measurements of the calves at the age of 9 months ($M \pm m$)

Parameter, cm	Control group	Experimental group 1	Experimental group 2
Withers height	102.8 ± 0.45	104.8 ± 0.49**	106.4 ± 0.40***
Rump height	106.1 ± 0.30	107.9 ± 0.39**	109.1 ± 0.31***
Diagonal body length	116.5 ± 0.39	118.1 ± 0.35**	120.4 ± 0.36***
Chest width behind the shoulder blades	31.1 ± 0.32	35.3 ± 0.30***	35.9 ± 0.23***
Chest depth	45.2 ± 0.24	46.3 ± 0.32**	47.0 ± 0.28***
Chest girth	137.0 ± 0.28	140.4 ± 0.49***	141.4 ± 0.46***
Hook bone width	32.1 ± 0.44	33.6 ± 0.39*	35.0 ± 0.31***
Thurl width	34.0 ± 0.39	35.2 ± 0.31*	36.1 ± 0.32***
Ischial tuberosity width	22.0 ± 0.41	23.1 ± 0.27	24.3 ± 0.31***
Metacarpus circumference	16.0 ± 0.29	16.2 ± 0.31	16.8 ± 0.28*

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 3
Nutrient digestibility coefficients ($M \pm m$)

Coefficient, %	Control group	Experimental group 1	Experimental group 2
Crude protein	63.5 ± 0.33	65.7 ± 0.35***	66.9 ± 0.41***
Crude fat	56.3 ± 0.68	58.4 ± 0.74*	60.6 ± 0.72***
Crude fiber	34.1 ± 0.69	37.2 ± 0.84*	39.4 ± 0.71***
Nitrogen-free extractable substances	78.8 ± 0.97	81.1 ± 0.89	83.3 ± 1.11**

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

($p < 0.001$), chest girth – 3.2% ($p < 0.001$), hook bone width –5.7% ($p < 0.001$), thurl width – 6.2% ($p < 0.001$), ischial tuberosity width – 9.4% ($p < 0.001$), metacarpus circumference – 5% ($p < 0.05$).

Statistically significant increase in the following measurements was identified when the measurements of experimental group 2 were compared to those of experimental group 1: withers height – by 1.52% ($p < 0.05$), rump height – by 1.11% ($p < 0.05$), diagonal body length – by 1.94% ($p < 0.001$), hook bone width – by 4.16% ($p < 0.05$), ischial tuberosity width – by 5.19% ($p < 0.01$). Other measurements of experimental group 2 calves were also higher than those of experimental group 1 calves. In particular, chest width behind the shoulder blades increased by 1.69%, chest depth – by 1.51%, chest girth – by 0.71%, ischial tuberosity width – by 2.55%, metacarpus circumference – by 3.70%, but those measurements were statistically insignificant.

In order to determine the digestibility and utilization rate of nutrients included in the diet, a digestion trial was conducted.

It was found that the nutrient digestibility coefficients in the experimental groups were higher as compared to the control group. The following coefficients were statistically different in experimental group 1: crude protein digestibility increased by 3.46%, crude fat digestibility – by 3.73%, crude fiber digestibility – by 9.09%. The digestibility coefficient of nitrogen-free extractable substances was 2.91% higher (statistically insignificant). The digestibility coefficients in experimental group 2 increased as compared to those in experimental group 1: the digestibility coefficient of crude protein– by 1.82%, of crude fat – by 3.76%, of crude fiber – by 5.91%, of nitrogen-free extractable substances – by 2.71%. Due to the changes in the development of group 1 and group 2 calves those coefficients were statistically insignificant.

At the same time, all the coefficients in experimental group 2 calves fed with trace elements in organic form were higher as compared to those in the control group. The difference in protein digestibility was 5.35% ($p < 0.001$), in fat digestibility – 7.63% ($p < 0.001$), in crude fiber digestibility – 15.54% ($p < 0.001$), in nitrogen-free extractable substance digestibility – 5.71% ($p < 0.01$).

CONCLUSION

Thus, feeding young black-motley cattle with normalized trace elements, namely iodine, selenium and cobalt, in mineral and organic forms was found to have a positive effect on growth and development of calves. The diets supplemented with trace elements in organic form were found to facilitate calves' daily weight and growth gains to a greater extent than those supplemented with trace elements in mineral form. The digestibility of feed nutrients also improved.

REFERENCES

1. Vlijanie skarmlivanija mineral'no-vitaminnoj kormovoj dobavki na molochnuju produktivnost' pervotelok / E. S. Dubkova, T. A. Krasnoshhekova, E. V. Tuaeva [i dr.] // Zootehnija. – 2011. – № 12. – pp. 10–11. (In Russ.)

2. Donnik I. M. Vlijanie jekologicheskih faktorov na organizm zhivotnyh [The influence of ecological factors on animals organism] // Veterinarija. – 2007. – № 6. – pp. 38–42. (In Russ.)

3. Zaljubovskaja E. Ju., Gerasimovich A. I. Optimizacija mikromineral'nogo pitanija molodnjaka krupnogo rogatogo skota i svinej putem ispol'zovanija sapropelevyh gumatov [Optimization of the micromineral food of young cattle and pigs by the use of sapropelic humates] // Dal'nevostochnyj agrarnyj vestnik. – 2016. – № 4 (40). – pp. 102–106. (In Russ.)

4. Isaeva E. Mikrojelementy v organicheskoj forme – zalog zdorovogo pitanija korov // Kombikorma. – 2016. – № 4. – pp. 53–56. (In Russ.)

5. Koksharova T. E., Cydypov C. C. Metodicheskie ukazanija po matematicheskoj obrabotke rezul'tatov issledovanija s ispol'zovaniem tablichnogo processora Excel. – Ulan-Udje: VSGTU, 2002. – 40 p. (In Russ.)

6. Kuznecov S. G. Mikrojelementy v kormlenii zhivotnyh // Zhivotnovodstvo Rossii. – 2003. – № 3. – pp. 16–18. (In Russ.)

7. Plavinskij S. Ju., Pustovoj S. A. Dejstvie razlichnyh form I, Fe i Se na rost i razvitie molodnjaka krupnogo rogatogo skota [Action of various forms of iodine, ferrum and selenium on growth and development of young cattle] // Zootehnija. – 2009. – № 5. – pp. 10–11. (In Russ.)

8. Primenenie helatov v zhivotnovodstve / Z. Dunkel', H. Kluge, J. Shpil'ke, K. Jeder // Kombikorma. – 2008. – № 1. – pp. 77–78. (In Russ.)

9. Fiziologicheskie podhody k optimizacii mikromineral'nogo pitanija molodnjaka krupnogo rogatogo skota [Physiological-and-ecological approaches to improvement the micro-mineral feeding of cattle youngsters] / S. N. Kochegarov, T. A. Krasnoshhekova, R. L. Sharvadze [i dr.] // Zootehnija. – 2012. – № 5. – pp. 13–14. (In Russ.)

10. Harlamov I. S., Chepelev N. A. Vlijanie helatnyh mikrojelementov na protekanie obmennyh processov v organizme novotel'nyh vysokoproduktivnyh korov // Vestnik Kurskoj gos. s.-h. akademii. – 2013. – № 7. – pp. 45–46. (In Russ.)

11. Harlamov I. S., Chepelev N. A. Mineral'nyj obmen u korov pri ispol'zovanii helatnyh soedinenij mikrojelementov // Vestnik Kurskoj gos. s.-h. akademii. – 2013. – № 9. – pp. 64–66. (In Russ.)