eISSN: 09748369

Evaluation of the influence of original conifer-energy feed additive on productivity and metabolism of young cattle

Biology and Medicine

Research Article

Volume 6, Issue 1, Article ID: BM-004-14, 2014
Indexed by Scopus (Elsevier)
Co-Publisher: OMICS Group, www.omicsonline.org

www.biolmedonline.com

Evaluation of the influence of original conifer-energy feed additive on productivity and metabolism of young cattle

Alexander Sergeyevich Zenkin[1], Valeryi Mihailovich Kirdyaev[1]*, Alexey Vasilievich Yedelkin[2], Vasily Pavlovich Korotky[3], Viktor Anatolievich Ryzhov[3], Victor Ivanovich Roschin[4]
[1]Ogarev Mordovia State University, 68 Bolshevistskaya Str., Saransk 430005, Republic of Mordovia, Russia.
[2]Veterinary Service of Mordovia Republic, 139 a Proletarskaya, ul., Saransk 430005, Republic of Mordovia, Russia.
[3]Science and Technology Center "Khiminvest" Ltd., 6/1 Nizhne-Volzhskaya Naberezhnaya, Nizhny Novgorod 603001, Russia.
[4]Saint-Petersburg Forestry University, Institutsky Pereulok, 5, Housing 2, St. Petersburg 194021, Russia.

***Corresponding author:** Ogarev Mordovia State University, 68 Bolshevistskaya Str., Saransk 430005, Republic of Mordovia, Russia.

Received: 25th Apr 2014; Accepted: 24th Jun 2014; Published: 1st Jul 2014

Abstract
Experiments have been performed in order to evaluate the influence of the original conifer-energy feed (CEF) additive manufactured by the Khiminvest Scientific-Technical Center, Limited Liability Company (LLC) on productivity and metabolism of calves. According to the principle of analogues, 3 experimental groups of calves were formed and received various doses of the feed additive for 30 days. Efficiency was assessed both by indicators of clinical and biochemical status and by average daily, absolute and relative growth. It has been found that the original CEF additive causes a considerable (by 10-23%) increase in meat production and normalization of metabolic processes in fattening calves.

Keywords: Calves; feed additive; clinical status; metabolism; meat productivity.

Introduction

The need of nutrients in young cattle is largely determined by its age, breed characteristics, living conditions, growing, and intensity of planned productivity [1-4]. It is impossible to increase efficiency of dairy breeding without proper balanced cattle feeding. The often used diets are unbalanced, which results in significant deviations occurring in metabolism. This hinders accomplishment of genetic potential, reduces productivity and product quality, and increases the cost of the product. In recent years, problems have arisen in growth and maintenance of high productivity, keeping productive health, preventing diseases, premature mortality, and culling of all animals [5-8].

In order to normalize metabolic processes in animals, a great attention is paid to feed additives of natural origin that feature high biological availability, digestibility, environment friendliness, absence of habituation, and side effects [9,10].

Insufficient attention is paid to studying changes in the intensity of metabolic processes when using by-products of food and processing industry in cattle diet, as well as wood processing. Such an approach cannot identify cause-and-effect relations between using alternative feed and efficiency of cattle production, and makes it impossible to predict changes in animal productivity after increasing their presence in diets [11].

Materials and Methods

Studies were performed on calves owned by Bolotnikovskoye, Limited Liability Company (LLC), Lyambirsk region of the Republic of Mordovia, Russia. Duration of the experiment was 5 months.

In order to perform the experiment under the principle of analogues, four experimental groups of calves were formed (one reference group and three (1, 2, and 3) experimental ones).

Male calves in experimental groups (1, 2, and 3) received original coniferous-energy feed additive (CEF) during 30 days on a daily basis at the dosage of 25, 50, and 100 ml, respectively.

Efficiency of the original CEF was determined by clinical observation of calves (considering their clinical condition, appetite, and signs of digestive disorders) and individual weighing.

Biochemical study of blood serum (aspartate transaminase (AST), alanine aminotransferase (ALT), α-amylase, alkaline phosphatase, creatinine, creatine phosphokinase, total bilirubin, total protein, glucose, phosphorus, calcium, Ca/P, cholesterol, and urea) in animals was performed using a semi-automatic biochemical analyzer Torus 1200 using proprietary techniques.

The obtained digital material was statistically analyzed using standard parametric methods, the level of confidence were determined by Student's *t*-test using Microsoft Excel (2000) software package and STAT 3 application.

Results

During the period of feeding with CEF, the clinical status of animals in all groups remained stable with no signs of disorders of digestive system. In experimental groups that received the CEF in various dosages, an increase in appetite was observed; animals willingly ate the forage with the additive. In the following months, after feeding with CEF had been terminated, no deviations from the physiological norm in animals were reported, appetite remained high, and clinical status remained stable.

Indicators of average daily, absolute, and relative growth of calves after using the CEF are summarized and shown in Table 1.

Judging from the data in the table, a month after application of various dosages of the CEF additive in calves, there was no significant difference of growth and weight from those in reference animals.

The most expressed increase in the average monthly weight gain was observed after 2 months from the start of the experiment. So, for the calves in the group 1 (25 ml of CEF per animal per day), the average weight gain for the 2nd month exceeded the weight gain of the reference calves by 27%. For the calves that received CEF in the dosage of 50 ml per animal per day (group 2), the average monthly weight gain exceeded the weight gain of the reference calves by 79%, and for animals in group 3, the average monthly weight gain exceeded the weight gain of the reference animals by 43%.

Generalizing the data about the weight gain during 4 months, it can be noted that the highest weight gain was observed in the animals of group 2 that received the CEF at the dosage of 50 ml per animal. So, their weight gain for 4 months exceeded the weight gain of the reference calves by 23%. Stimulating effects on meat productivity was also noticed in case of using the CEF additive in the dosage of 100 ml per animal (10%), and no stimulating effect on meat productivity was noticed in case of using the CEF additive in dosage of 25 ml per animal.

Thus, using the CEF in dosages of 50 and 100 ml per animal per day causes expressed stimulation of meat productivity in calves. However, it is shown that only every day usage (during the entire fattening period) of the additive is most effective and increases meat productivity in feeding calves.

Results of biochemical study of blood serum, some indicators of which characterize the

Table 1: Indicators of daily average, absolute, and relative growth of calves after using the CEF additive.

Group	Time of observation after applying CEF (month)								
	1		2		3		4		For four months
	Average weight gain (kg)	Average daily weight gain (g)	Average weight gain (kg)	Average daily weight gain (g)	Average weight gain (kg)	Average daily weight gain (g)	Average weight gain (kg)	Average daily weight gain (g)	Average weight gain (kg)
Refer	32.8 ± 3.2	1.093 ± 106	22.2 ± 2.4	740 ± 81	37.8 ± 3.9	1027 ± 138	28.8 ± 1.0	980 ± 35.9	113 ± 7.1
1	30.8 ± 3.5	1.026 ± 88	28.2 ± 3.3	940 ± 110	30.8 ± 4.2	1093 ± 69	29.4 ± 1.1	953.4 ± 30.8	112 ± 7.1
2	30.75 ± 3.7	1.083 ± 100	39.8 ± 3.1*	1326 ± 103*	32.8 ± 2.1	1100 ± 160	31.6 ± 0.7	1053 ± 22.6	138.8 ± 2.9*
3	30.8 ± 2.6	1.024 ± 117	31.8 ± 2.4*	1059 ± 79*	33.0 ± 4.8	1159 ± 110	28.6 ± 0.9	960 ± 33.9	124.4 ± 1.7

*Indicates cases of veracious ($p \leq 0.05$) deviations of parameters in test animals compared to reference.

Table 2: Results of biochemical studies of blood serum in calves owned by Bolotnikovskoye, LLC, Lyambirsk region of the Republic of Mordovia, Russia.

				Time of study (days)			
No.	**Indicators**	**Initial data**	**Groups of animals**	**Before the experiment**	**30**	**60**	**90**
1	AST (units/l)	66.6 ± 4.5	Refer	62.7 ± 8.6	51.4 ± 9.4	72.6 ± 11.6	121.6 ± 17.7▲
			1	66.0 ± 6.7	57.6 ± 9.17	55.9 ± 10.1	107.1 ±17.1▲
			2	70.4 ± 14.9	58.4 ± 2.28	76.5 ± 22.4	144.5 ± 19.2▲
			3	67.3 ± 6.6	72.6 ± 5.9	66.8 ± 10.4	95.7 ± 17.06
2	ALT (units/l)	22.7 ± 0.0	Refer	22.4 ± 1.43	21.4 ± 1.5	25.4 ± 3.5	27.2 ± 2.3
			1	21.2 ± 1.77	32.4 ± 4.5	23.2 ± 1.9	28.2 ± 2.3
			2	23.8 ± 1.7	29.3 ± 9.0	22.2 ± 2.2	27.0 ± 2.8
			3	23.6 ± 3.1	22.4 ± 1.2	22.5 ± 0.9	30.0 ± 8.21
3	De ritis coefficient	3.03 ± 0.22	Refer	2.7 ± 0.3	2.4 ± 0.5	2.8 ± 0.2	4.4 ± 0.4
			1	3.1 ± 0.3	1.9 ± 0.4	2.3 ± 0.3	3.8 ± 0.5
			2	3.1 ± 0.7	2.4 ± 0.5	3.5 ± 1.2	5.4 ± 0.5
			3	3.1 ± 0.5	3.2 ± 0.1	3.0 ± 0.6	3.7 ± 1.0
4	α-amylase (units/l)	19.5 ± 5.2	Refer	16.2 ± 3.4	33.4 ± 9.1	31.8 ± 8.8	36.0 ± 11.3
			1	37.6 ± 19.4	94.2 ± 1.9*▲	31.05 ± 5.3	32.0 ± 3.3
			2	10.0 ± 3.4	303 ± 230	28.8 ± 6.8	17.5 ± 3.06
			3	14.2 ± 1.2	29.0 ± 2.8	57.2 ± 24.8	37.7 ± 13.82
5	Alkaline phos-phatase (units/l)	145.4 ± 17.7	Refer	72.0 ± 28.1	114 ± 15.3	155.0 ± 38.6	272.2 ± 62.2
			1	150 ± 19.5	146 ± 38.2	135.8 ± 23.4	199.4 ± 15.7▲
			2	84.8 ± 17.8	120 ± 5.3	154.6 ± 15.8	159 ± 18.5
			3	208.4 ± 47.6	185.2 ± 14.4*	153.5 ± 19.41	140.5 ± 32.2
6	Creatinine (μmol/l)	31.5 ± 8.3	Refer	16.0 ± 4.7	32.0 ± 2.2	43.2 ± 11.1	57.2 ± 7.8▲
			1	12.8 ± 5.0	22.4 ± 9.6	16.2 ± 4.5	62.6 ± 10.9▲
			2	46.0 ± 18.4	68.2 ± 7.7*▲	30.8 ± 4.4	53.5 ± 16.9
			3	51.4 ± 25.2	41.8 ± 13.9	36.0 ± 11.37	73.7 ± 12.4▲
7	Creatine phos-phokinase (units/l)	299.3 ± 41.9	Refer	421.4 ± 66.4	222.6 ± 50.5	283.0 ± 131.7	275.8 ± 94.7
			1	282.2 ± 72.3	160.2 ± 27.4	356.0 ± 70.9	364.2 ± 42.2
			2	281.4 ± 127.06	233.2 ± 49.7	343.2 ± 84.3	444.2 ± 76.3
			3	212.4 ± 42.4	184.4 ± 20.7	150.8 ± 30.7	267.0 ± 102.7
8	Total bilirubin (mol/l)	5.7 ± 0.5	Refer	7.2 ± 1.3	5.54 ± 0.7	6.3 ± 1.5	7.66 ± 1.06
			1	5.8 ± 1.2	6.9 ± 1.2	4.9 ± 0.8	7.8 ± 1.1
			2	4.02 ± 0.37	4.65 ± 1.8	6.36 ± 0.9	6.5 ± 1.4
			3	5.7 ± 0.73	4.86 ± 0.9	5.55 ±0.8	5.22 ± 0.73
9	Total protein (g/l)	101.5 ± 18.0	Refer	117.4 ± 34.5	112.6 ± 13.9	77.4 ± 13.4	80.2 ± 11.4
			1	146.0 ± 62.5	79.8 ± 6.7*	78.2 ± 13.7	89.4 ± 15.4
			2	70.2 ± 4.9	82.0 ± 18.6	97.4 ± 8.2	94.7 ± 14.8
			3	71.6 ± 3.04	72.8 ± 15.6*	103.3 ± 18.1	85.0 ± 10.46
10	Glucose (mol/l)	6.0 ± 1.3	Refer	4.23 ± 1.76	9.47 ±1.7	4.61 ±1.7	6.34 ± 1.9
			1	2.8 ± 0.96	6.34 ± 3.2	7.12 ± 0.6	5.82 ± 1.5
			2	10.5 ± 3.9	7.3 ± 3.7	4.42 ± 1.4	2.7 ± 1.02▲
			3	4.46 ± 1.76	4.44 ± 0.6	10.08 ± 2.62	5.9 ± 0.4
11	Phosphorus (mol/l)	3.75 ± 0.4	Refer	2.9 ± 0.9	4.65 ± 1.02	3.25 ± 0.7	5.2 ± 1.2
			1	3.84 ± 0.9	5.35 ± 1.67	1.82 ± 0.8	4.6 ± 0.8
			2	4.45 ± 0.8	5.22 ± 1.8	2.66 ± 0.6	4.83 ± 0.7
			3	3.72 ± 0.5	2.01 ± 0.16	3.09 ± 0.4	2.7 ± 1.0
12	Calcium (mol/l)	2.32 ± 0.4	Refer	2.5 ± 1.3	4.46 ± 0.3▲	2.42 ± 0.7	1.47 ± 0.3
			1	2.1 ± 0.7	3.23 ± 0.7	3.98 ± 0.9	1.36 ± 0.2
			2	2.73 ± 0.5	3.19 ± 0.3*	2.7 ± 0.9	1.09 ± 0.16
			3	1.9 ± 0.77	2.66 ± 0.4*	2.67 ± 0.5	1.74 ± 0.5

(Continued)

13	Ca/P	0.59 ± 0.07	Refer	0.6 ± 0.1	0.6 ± 0.1	1.4 ± 0.9	0.3 ± 0.05▲
			1	0.5 ± 0.1	3.4 ± 2.9	13.8 ± 9.6	0.3 ± 0.03▲
			2	0.6 ± 0.1	0.8 ± 0.2	1.4 ± 0.6	0.2 ± 0.03▲
			3	0.5 ± 0.2	1.4 ± 0.3	2.6 ± 0.5	1.1 ± 0.4
14	Cholesterol (mol/l)	3.51 ± 1.09	Refer	1.7 ± 0.45	3.7 ± 0.3	4.3 ± 0.7	6.6 ± 1.5
			1	5.6 ± 4.1	3.4 ± 0.9	5.8 ± 2.5	4.0 ± 0.9
			2	5.1 ± 1.3	3.1 ± 1.0	2.7 ± 0.4	2.7 ± 0.3
			3	1.7 ± 0.6	5.9 ± 2.9	4.8 ± 0.7	4.6 ± 0.9
15	Urea (mol/l)	1.92 ± 0.16	Refer	2.2 ± 0.2	2.0 ± 0.44	6.8 ±1.3▲	2.4 ± 0.4
			1	2.0 ± 0.5	2.4 ± 0.4	5.4 ±1.0▲	2.4 ± 0.24
			2	1.6 ± 0.2	3.75 ± 0.8	5.0 ± 0.9▲	2.25 ± 0.25
			3	1.9 ± 0.2	2.4 ± 0.24	8.25 ± 2.6	1.75 ± 0.25

*Indicates cases veracious ($p \leq 0.05$) deviations of parameters in test calves compared to reference.
▲Deviations of parameters in test calves compared to initial data.

functional state of liver and kidneys obtained from calves, are summarized and shown in Table 2. Analysis of the table showed the following. Before using the additive, the AST values in all animals were within the average limits of the norm, with no significant difference between the groups. Three months after using the CEF, AST levels in animals in all groups increased considerably in the calves of the reference group and in the animals that received the CEF additive at the dosage of 25 and 50 ml (groups 1 and 2), with a considerable difference in comparison to the baseline.

ALT levels in experimental calves during all periods of the study ranged between the middle and upper limits of the norm. Three months after the start of the experiment, there was a trend to an increase in this index in all animals, if compared to the baseline.

Level of α-amylase in calves before the experiment was below the norm fluctuations (19.5 ± 5.2 units/l, with the norm fluctuating between 41 and 98 units/l); 1 month after using the additive at the dosage of 25 and 50 ml, it increased when compared to the baseline and the reference animals; after 2 and 3 months of the experiment, a considerable difference in α-amylase levels between groups was not noted, but they were higher than the initial values. Thus, the use of the CEF modifies the level of α-amylase in calves within the fluctuation norm.

Alkaline phosphatase in calves in all groups before the experiment was at the upper normal limits (145.4 ± 17.7 units/l, with norm fluctuation between 18 and 153 units/l). A month after using the CEF in the dosage of 100 ml per animal, an increased level of this indicator was noticed, if compared to reference calves. After 3 months of the experiment, a sharp increase in alkaline phosphatase was noted in calves of reference and group 1 (25 ml per animal per day), while in calves of groups 2 and 3, its level was in the upper limit of the norm. Thus, use of the CEF additive for 2-3 months resulted in stabilization of alkaline phosphatase level in blood serum of calves.

Total protein concentration in blood serum of all experimental calves before the experiment was above the norm (101.05 + 18.0 g/l, with fluctuation of the norm between 62 and 82 g/l). One month after using the CEF, this figure in all experimental animals decreased to the norm limits, while remaining significantly higher than the norm fluctuation in the reference calves. The difference in indicators of protein in calves that had been treated with the additive, and calves in the reference group, was veracious. After 2 and 3 months from the start of the experiment, higher concentrations of protein in blood serum were observed in the calves that were receiving the additive. So, 1 month after the use of different dosages of the additive, normalization of protein concentration in the experimental calves was observed. During the experiment, in majority of animals, concentration of protein in blood serum in the majority of animals was higher than normal, or within the upper limits of the norm.

Glucose level in calves before the experiment was considerably higher than norm fluctuations (6.0 ± 1.3 mol/l, with norm fluctuation between 2.3 and 4.1 mol/l). After 1 month of using the additive at the dosage of 100 ml per animal (group 3), serum glucose level decreased to normal values, while in the calves in the reference group it was more than 2 times higher than the upper limit of the norm. Three months after using the additive at the dosage of 50 ml per animal (group 2), glucose concentration was within the norm fluctuations, being considerably different from the baseline level. It was found that changes in concentration of glucose in blood serum of experimental calves had a wavy nature, and often exceeded the level of norm. Thus, the use of the CEF, especially at the dosage of 50 ml per animal leads to stabilization of glucose concentration in blood serum of calves.

Concentration of phosphorus in blood serum of experimental calves before the experiment was high (3.75 + 0.4 mol/l, with norm fluctuating between 1.4 and 2.5 mol/l). After 1 month of using the additive at the dosage of 100 ml per animal per day, phosphorus concentration was within the normal range, while in the calves of reference and the groups 1 and 2 it remained high. After 2 and 3 months from the start of the experiment, in most of experimental calves this figure was within the upper limit of the norm, and remained high in reference calves. Thus, the use of the CEF, especially in the dosage of 100 ml per animal leads to stabilization of phosphorus concentration in blood serum of calves.

Calcium level in blood serum of experimental calves before the experiment was within the norm fluctuations (2.3 + 0.4 mol/l, norm fluctuation between 2.1 and 2.84 mol/l). After 1 month of the experiment this indicator in reference calves was veraciously high, if compared to the baseline level. In calves of groups 2 and 3 (50 and 100 ml of CEF per animal), calcium level was within normal range (group 3), or within the upper limits of the norm (group 2). After 2 months of the experiment, calcium level in blood serum of all experimental calves was below norm fluctuations. After 3 months of the experiment, calcium concentration in most of experimental calves was within norm fluctuations. Thus, after 1 month of using the CEF, concentration of calcium in blood serum of calves was stabilized.

Discussion

Before the research, we initially evaluated biochemical state of the animals. It was found that in the farm selected for the research, animals were overfed with carbohydrate and protein; and calcium and phosphorus balance was disrupted. In order to achieve our goal (improving meat productivity and correcting biochemical status of animals), a unique technology has been developed for processing wood foliage, based on extraction of biologically active substances with the new selective extractant. The preparation obtained using this technology has commercial name Conifer-Energy Feed Additive, and a certificate of conformity has been obtained for it.

The feed additive increases appetite, improves digestibility of forage, and leads to expressed (10-23%) increase in meat production. The use of the feed additive leads to normalization of metabolic processes in fattening calves and does not cause deterioration of liver and kidneys functions (anti-toxic, excretory, etc.). The data obtained as a result of this work made it possible to determine the most effective dose, namely, 50 and 100 ml per animal per day.

Conclusions

A unique technology has been developed for processing wood foliage, based on extraction of biologically active substances. The feed additive has commercial name Conifer-Energy Feed Additive, technical specifications have been developed for it, and a certificate of conformity has been obtained. An application for the invention “Method of obtaining extruded conifer-energy additive” has been filed.

The original CEF additive during the feeding period and after feeding does not disturb the clinical status of animals, increases their appetite and improves digestibility of forage.

The use of the original CEF additive in dosages of 50 and 100 ml per animal per day leads to expressed stimulation of meat productivity in calves. However, it is shown that only every day usage (during the entire fattening period) of the additive is most effective.

It has been found that the use of the original CEF additive:

1. Increases the level of aspartate aminotransferase in blood, does not change the level of alanine aminotransferase, and after 2 to 3 months of its use increases the de Ritis coefficient;

2. Modifies the α-amylase level in calves within the fluctuation norms, stabilizes the level of alkaline phosphatase in blood serum of calves;

3. After 1 month of using various dosages, normalization of protein concentration in experimental calves, and stabilization of calcium,

phosphorus, and glucose concentration in blood serum of calves was noted;

4. Disbalance of calcium to phosphorus rate was noted in blood serum of calves owned by Bolotnikovskoye, LLC, which had evidently been caused by an unbalanced diet for these elements. The use of the CEF additive only during the period of its application stabilizes this indicator and when the use of the additive is terminated, the disbalance comes back.

The most effective dosage of the original CEF is 50 and 100 ml per animal per day. When this dosage was introduced into the diet, a veracious (by 10-23%) increase in meat productivity and improvement of metabolism were noted. It is recommended to use the feed additive during the entire fattening period.

References

1. Chabaev MG, Nekrasov RV, Anisova NI, Hajiyev AM, Klementeva YI, *et al.* (2013) Productivity and metabolism of dairy calves in case of enriching rations with probiotic preparation “A2”, Dairy and Beef Cattle: Research and Production Journal/ JSC Agroplemsoyuz. Moscow, Kolos N4: 22-24.

2. Podhorský A, Pechová A, Dvořák R, Pavlata L (2007) Metabolic disorders in dairy calves in postpartum period. Acta Veterinaria Brno 76: 45-53.

3. Tao S, Monteiro APA, Thompson IM, Hayen MJ, Dahl GE (2012) Effect of late-gestation maternal heat stress on growth and immune function of dairy calves. Journal of Dairy Science 95: 7128-7136.

4. Tao S, Monteiro APA, Hayen MJ, Dahl GE (2014) Short communication: Maternal heat stress during the dry period alters postnatal whole-body insulin response of calves. Journal of Dairy Science 97: 897-901.

5. Samohin VT (2000) Micronutrient elements deficiency in organism is the most important environmental factor. Agrarian Russia 5: 69-72.

6. Shakhov AG (2003) Actual problems of diseases in young cattle in modern conditions. Veterinary Pathology 2: 6-7.

7. Maciel SM, *et al.* (2001) Dexamethasone influences endocrine and ovarian function in dairy cattle. Journal of Dairy Science 84: 1998-2009.

8. Ford S, *et al*. (2005) Effects of early gestational undernutrition in the cow on fetal growth and placentomal composition. Journal of Animal Science 83(1): 297.

9. Zenkin AS, Kirdyaev VM, Chinyaeva AY, Ryazanov NA, Korotky VP, *et al.* (2012) In the proceedings of the I International Internet Conference: modern trends in agriculture. Kazan, Editing House of Kazan University, pp. 72-74.

10. Korotky VP, Ryzhov VA, Marisov SS, Zenkin AS, Esipovich AL (2013) Technologies of processing wood foliage–new approaches, part 2. In the proceedings of the III International Scientific and Practical Conference: Innovations and Technologies in Forestry–2013. St. Petersburg, Federal State–Funded Institution “St. Petersburg Forestry Research Institute (SPFRI)”, pp. 24-36.

11. Shaposhnikov AA, Afanasiev PI, Altukhov AA, Martynova IA, Ilyushchenko SV (2012) Some metabolic parameters in calves when used in rations of malt. Magazine Scientific bulletin of the Belgorod State University. Series, Natural Sciences 21: 123-126.

Citation: Zenkin AS, Kirdyaev VM, Yedelkin AV, Korotky VP, Ryzhov VA, *et al.* (2014) Evaluation of the influence of original conifer-energy feed additive on productivity and metabolism of young cattle. Biol Med 6(1): BM-004-14.