

Productive and meat qualities of calves at use of Echinochloa frumentacea silage

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Goal. To determine the efficiency of using silage from *Echinochloa frumentacea* in comparison with silage from 4-component mixture of spring legumes and forage crops (oats + *pisum sativum* + narrow-leaved lupine + spring vetch) for fattening calves in Ukrainian Polissia. **Methods.** 2 groups of experimental calves were formed: Group I (control) — was fed with leguminous silage; Group II (experimental) — received silage from *Echinochloa frumentacea*. The live weight of calves was determined by individual weighing before morning feeding; the feed payment by live weight gain was determined by the calculation method (feed costs per unit of production in animals of the control and experimental groups), the slaughter quality was determined by technology adopted at meat processing plants. **Results.** The use of silage from *Echinochloa frumentacea* instead of the same amount by weight of 4-component leguminous silage (oats + dia- per + lupine + vetch) for fattening calves does not significantly reduce the productivity of animals, at the same time it has a positive effect on their slaughter quality and has no negative effect on chemical quality of meat and liver. **Conclusions.** Replacement in the diets of multicomponent silage from legumes (oats + *pisum sativum* + narrow-leaved lupine + spring vetch) to silage from *Echinochloa frumentacea* (45.4% of the nutritional value of the diet) for fattening calves has a negative effect on the average daily gain of live weight of animals (84 g, or 9.8% less than in the control). Metabolic energy consumption per 1 kg of live weight gain was lower by 7.6% in animals of group I compared to analogues of group II.

Key words: *dietary nutrition, fattening, legumes, average daily gain, slaughter yield.*

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Over the years, the range of feed for farm animals in Ukraine is expanding. According to studies by domestic scientists [1-3], corn silage is not a priority feed in terms of land use and saving material and energy resources. Due to the low content of digestible protein in it, there is often a problem of balancing the diets of cows and young cattle for this important element of animal nutrition. At the same time, foreign authors [4] note that the replacement of corn silage with corn silage from stalks or corn grain in highly concentrated diets of bull-calves can't increase their productivity and improve the economic performance of beef production. Studies by other authors [5, 6] have also shown a positive effect of feeding corn silage to cattle on cicatricial metabolism and productive and meat qualities of animals.

Comparing the productivity of spring and winter grass-legume mixtures with corn for silage, it can be noted that in terms of indicators such as dry matter and feed units, grass-legume mixtures are almost equivalent to the yield of corn silage, but they outperform corn by 24-80% of digestible protein and 10-23% of feed protein units per unit of sown area [7, 8].

Given the fact that the energy consumption of growing corn is much higher compared to spring and winter forage crops, it is reasonable to conclude that in conditions of limited use of fertilizers, grass-legume mixtures have the right to be widely used for the production of canned feed.

Currently, in the Polissya area, *Echinochloa frumentacea*, a millet grain-growing crop, has been grown en masse. Compared to other forage crops of the cereal family, *Echinochloa frumentacea* contains more digestible protein per 1 forage unit - 85 g, while in corn this figure does not exceed 70 g. Hay, green mass and *Echinochloa frumentacea* grain have good forage qualities. In hay weighing 100 kg contains 56 feed units and 8.1 kg digestible protein [9, 10].

Studies [11] in the western region of Ukraine found that the use of grain haylage from *Echinochloa frumentacea* for feeding dairy cows increased the average daily milk yield by 1,7 kg, or 9,2% and improved its quality. Other studies have also found that the use of silos from mixtures of *Echinochloa frumentacea* and vetch and *Echinochloa frumentacea* and soy had a positive effect on the milk productivity of cows [12].

In addition, paise is an environmentally friendly food. Studies conducted at the Mogilev branch of the RNIUP "Institute of Radiology" have shown that the replacement of corn on the *Echinochloa frumentacea* in areas contaminated with radionuclides contributes to a much smaller accumulation of ¹³⁷Cs in the feed [13].

The aim of the study is to determine the efficiency of using silage from *Echinochloa frumentacea* compared to silage from 4-component mixture of spring cereals and legumes (oats + *pisum sativum* + narrow-leaved lupin + *vicia sativa*) for fattening bull-calves in Polissya Ukraine.

Materials and methods of research. The study was conducted in the physiological yard of the Institute of Agriculture of Polissya NAAS (Grozyne village, Korosten district, Zhytomyr region). For the research and production experiment, young cattle (bull-calves) of the Ukrainian black-spotted dairy breed were selected, 2 groups were formed by the method of balanced groups in accordance with the methodological provisions of O.I. Ovsyannikov [14]. When forming groups took into account: live weight (201-205 kg), age (10,5-11,0 months), breed (50,0-62,5% for Holstein breed), growth intensity in the comparative period. The scheme of research is shown in table 1.

1. The scheme of the experiment

Groups	Number of animals in the group, h.	Experimental periods	
		comparative (45 days)	pilot (187 days)
I – control	8	BR - basic ration (clover hay, oat straw, grain mixture, table salt) + cereal-bean silage	BR + cereal-bean silage
II – research	8	BR + cereal-bean silage	BR + silo from echinocloa frumentacea

According to the scheme of the experiment, bull-calves of the I (control) group received a basic ration, which consisted of 4-component cereal-bean silage, clover hay, oat straw, grain mixture and table salt. Animals of the II (experimental) group, in addition to feed of basic ration, were fed instead of silage from cereal-bean mixture silage echinocloa frumentacea.

Grain concentrates of own production grown in the III zone of radioactive contamination as a result of the Chernobyl accident (% by weight) were introduced into the composition of grain mixtures for feeding experimental young cattle: wheat - 55, lupine - 30, oats - 15. Concentrated a mixture of crushed grains of cereals and legumes, which were made directly on the farm and distributed during the morning feeding of bull-calves. Feed residues were selected from the feeders after each feeding, taking into account their actual consumption once a decade for two consecutive days. Samples were taken from the average daily residues for zoochemical analysis.

The rations of animals according to the composition of basic feeds differed between groups, at the same time they were balanced by basic nutrients, they were adjusted monthly according to live weight and average daily gain according to modern detailed feeding norms and taking into account the actual chemical composition and nutritional value of feeds [15]. Type of animal feeding - silage-concentrate. In the structure of the feed ration of bulls in terms of energy nutrition, concentrated feed was 34,6-35,4%, roughage – 18,7-19,2 and succulent feed – 45,4-46,7% (Table 2).

During the experiment, the nutritional value of feed per 1 kg of dry matter of feed was 0.89-0.96 EFU, the concentration of metabolic energy – 8,86-9,60 MJ, and the amount of crude and digestible protein was at the level of 122-127 g and 86-96 g, respectively. Each energy feed unit had 97-100 g of digestible protein. The content of crude fiber in 1 kg of DM rations was 272-279 g, and crude fat - 31-41 g. The ratio of sugar to digestible protein in the proposed rations ranged from 0,24 to 0,26: 1, Ca: P - 2, 47-3,11: 1. The concentration of trace elements in 1 kg of DM feed of the main diet of young cattle was: for Cu – 7,1-7,9 mg, Zn – 30,2 -30,5, Co – 0,21-0,22, Mn – 29,8 -31,1 mg.

2. The composition and nutritional value of the average daily rations of experimental bull-calves

Feed and nutrients	Groups			
	I – control		II – research	
	kg	by nutritional value, %	kg	by nutritional value, %
Cereal-bean silage	19,5	46,7	-	-
Silo from echinocloa frumentacea	-	-	19,5	45,4
Clover hay	1,5	12,0	1,5	12,3
Oat straw	1,0	6,7	1,0	6,9
Grain mixture	2,65	34,6	2,65	35,4
Table salt	0,06	-	0,06	-
The ration contains:				
EFU	8,35		8,15	
metabolic energy, MJ	83,5		81,5	
dry matter, kg	8,7		9,2	
crude protein, g	1102		1121	

digestible protein, g	833		794	
crude fat, g	360		282	
crude fibre, g	2426		2504	
sugars, g	197		207	
starch, g	926		868	
lignin, g	29,5		33,4	
methionine +sistine, g	21,0		23,0	
Ca, g	60,1		81,6	
P, g	24,3		26,2	
Cu, mg	62,0		72,4	
Zn, mg	263,0		280,5	
Co, mg	1,83		2,03	
Mn, mg	259		286	
Fe, mg	1681		1837	
carotene, mg	381		303	
vitamin E, mg	934		875	

Summarizing the results of feeding experimental bull-calves, it should be noted that the experimental animals during the study period consumed the same amount of roughage, succulent and concentrated feed, and their diets were balanced for basic nutrients, excluding deficiency of sugar and trace elements Cu, Co, Zn, Cu, Zn.

Results. The results of the research showed that under the same conditions of feeding and keeping animals, depending on the type of silage in the diet, bull-calves had different live weight at the end of the experiment (Table 3).

3. Live weight gain of bull-calves for fattening and nutrient consumption per 1 kg of gain (n = 8; M ± m)

Indicators	Groups	
	I – control	II – research
Live weight for the period of the experiment, kg: - the beginning - end	205,5 ± 19,6 366,1 ± 24,0	201,1 ± 16,3 346,1 ± 18,8
Absolute weight gain, kg	160,6 ± 8,3	145,0 ± 5,0
Average daily gain, g	859 ± 44	775 ± 27
+ or - to control: g %	- -	-84 -9,8
Costs per 1 kg of live weight gain: - metabolic energy, MJ - digestible protein, g	97,2 970	105,2 1024
+ or - to control: MJ g	- -	+8,0 +54

Young cattle of the I (control) group by live weight at the end of the study exceeded the analogues of the II (experimental) group by 20,0 kg, or 5,8%. Therefore, the absolute increase in live weight of animals was: Group I – 160,6 kg, Group II – 145,0 kg. The average daily gain of live weight of bull-calves in the control group was also higher compared to the analogues of the experimental group by 84 g, or 10,8% with an incredible difference (P <0,95).

The consumption of metabolic energy and digestible protein per unit of growth varied in the range of 97,2-105,2 MJ and 970-1024 g, respectively. For 1 kg of live weight gain, group I bull-calves consumed 97,2 MJ of metabolic energy and 970 g of digestible protein, which is .6% and 5,3% less than the group II analogues, respectively.

Based on the above analysis, we can conclude that the use in the diets of young cattle for growing and fattening silage from *echinochloa frumentacea* compared with 4-component silage from cereals-legumes mixture of spring forage crops (oats + diaper + lupine + spring vetch) on indicators of productivity and feed conversion.

In order to study the meat productivity and quality of beef at the end of the experiment, a control slaughter of bull-calves with 3 heads from each group was performed (Table 4).

4. Slaughter qualities of experimental bull-calves (n = 3; M ± m)

Indicators	Groups	
	I – control	II – research
Pre-slaughter live weight, kg	373,3 ± 7,3	360,3 ± 26,4
Weight of steam carcass, kg	196,1 ± 6,9	193,2 ± 18,6
Carcass yield, %	52,53	53,62
Weight of internal crude fat, kg	2,53 ± 0,18	2,33 ± 0,12
The yield of crude fat, %	0,68	0,65
Slaughter weight, kg	198,6 ± 7,1	195,5 ± 18,6
Slaughter yield, %	53,2 ± 1,0	54,3 ± 1,2

The obtained results testify to good slaughter qualities of young cattle of Ukrainian black-spotted dairy breed of both experimental groups. However, some indicators show an insignificant intergroup difference.

The most characteristic indicator of the quality of meat productivity of fattening animals is the weight of steamed carcass. Against the background of increasing pre-slaughter live weight of bull-calves of the control group compared with experimental analogues (by 13,0 kg, or 3,6%), the yield of carcass in young cattle of group II was higher by 1,09% abs.

Slaughter yield objectively characterizes the state of meat productivity of animals. This figure was also 1,1% higher in the experimental group than in the control counterparts (54,3% vs. 53,2%).

The most important morphological indicators of meat quality are muscle and adipose tissue, which consist of water, protein, fat, ash and other substances. Their composition and quantitative ratio determine the biological value and taste of meat. It is known that the water content in meat gives it the appropriate tenderness and taste. There is more water in the meat of young animals than in the meat of adult animals. The fatter the meat, the less water in it and the higher its caloric content.

In bull-calves of the control group, which were fed cereal-legume silage, the content of dry matter, protein and ash in the longest muscle of the back was lower by 0,23% abs., 0,64 and 0,12% abs. respectively compared with analogues of the experimental group, and fat, on the contrary, greater by 0,53% abs. (Table 5). This resulted in a higher energy value of 1 kg of the longest back muscle of young animals of group I – 4,39 vs. 4,30 MJ.

5. Chemical composition of bull-calves slaughter products (n = 3; M ± m)

Bull-calves groups	Indicators				Energy value, MJ / kg
	dry matter	protein	fat	ash	
The longest back muscle					
I – control	24,04±0,78	21,18±0,65	1,94±0,40	0,92±0,07	4,39
II – research	24,27±0,35	21,82±0,37	1,41±0,07	1,04±0,03	4,30
Liver					
I – control	28,83±0,55	25,42±0,39	1,81±0,07	1,60±0,16	5,07
II – research	28,13±0,52	24,17±0,30	2,39±0,23	1,57±0,01	5,08

Currently, animals of group I (control) outperformed analogues of group II (experimental) in terms of dry matter content in the liver by 0,70% abs., protein – 1,25 and ash - by 0,03% abs. Despite the slightly different chemical composition, the energy value of 1 kg of liver in bull-calves of both experimental groups is almost the same – 5,07-5,08 MJ / kg.

According to the obtained data, the use of silage from *Echinochloa frumentacea* instead of the same amount by weight of 4-component cereal-legume silage (oats + diaper + lupine + vetch) for fattening young cattle has a positive effect on their slaughter qualities and has no negative effect on the chemical composition of beef and liver.

Conclusions

The use of Echinochloa frumentacea silage for fattening bull-calves compared to cereal-leguminous silage of spring forage crops (oats + diaper + lupine + vetch) had a negative effect on the average daily gain of live weight of animals - they were 84 g, or 9.8% incredibly smaller than in control. At the same time, young cattle of the I (control) group spent on 1 kg of live weight gain by 7.6% less metabolic energy than their counterparts from the II (experimental) group.

Fattening bull-calves in an experimental silo from a Echinochloa frumentacea had a negative effect on their slaughter qualities, the chemical composition of the longest muscle of the back and liver did not have at almost the same energy value of the product.

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