NORWEGIAN JOURNAL OF DEVELOPMENT OF THE INTERNATIONAL SCIENCE

№58/2021

Norwegian Journal of development of the International Science

ISSN 3453-9875

VOL.2

It was established in November 2016 with support from the Norwegian Academy of Science.

DESCRIPTION

The Scientific journal "Norwegian Journal of development of the International Science" is issued 24 times a year and is a scientific publication on topical problems of science.

1000 copies

Norwegian Journal of development of the International Science

Iduns gate 4A, 0178, Oslo, Norway

email: publish@njd-iscience.com

site: http://www.njd-iscience.com

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UDC 636.27 «464» (477) (082)

EVALUATION OF MEAT PRODUCTIVITY OF REPAIRED BULL-CALVES OF UKRAINIAN BLACK-SPECKLED DAIRY BREED AND ITS ENERGY VALUE

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Abstract

The study found the impact of the ways of non-breed bull calves' keeping on the increase of their live weight gains: under the unleashed keeping the weight of bull calves of 18 months old was 328.9 kg, that is 612 g of average daily gain or 19.4% of relative gain, while their analogues had 454.3 kg, 877 g, 20.9%, respectively.

It is proved that the live weight at the age of 18 months is 372.6 kg under the leashed keeping, while it is 482.3 kg under the unleashed one. The average daily gains of live weight under the improved technology are higher by 31.6% (with 60% kept) and by 33.6% (with 50% kept) compared with the current one.

The energy value of 1 kg of edible carcasses in bull calves of the Ukrainian black-speckled dairy breed at the age of 18 months kept for the production of beef under the unleashed keeping is by 20% higher than under the leashed one ($P<0.001$), while their fatty tissue is on the contrary, but the qualitative indicator of the amount of protein is higher, which is a desirable factor for the production of beef.

Keywords: beef, cattle, bull calves, breed, value, production, energy, keeping, live weight

Introduction. The production of beef depends significantly on providing the calves and young cattle with appropriate standards of keeping and feeding. At the same time, in the conditions of the reformed agricultural milk production enterprises, there are organizational, technological, and hygienic problems in obtaining the high quality beef from non-breed young cattle [1].

The industrial technology often limits some of animals' natural needs. The intensive exploitation of animals leads to stressful situations, increases the animals' sensitivity to the worsening of microclimate, changes in feeding, the animals' constant rearrangements, etc. This is due to the fact that the industrial production technology expects cyclical processes and ongoing animal management (weighing, veterinary treatment, etc.), which is a precondition for the reproduction of microorganisms and the development of stress [5].

In order to improve the young cattle's feeding and keeping close to natural and in accordance with hygienic requirements, it is necessary to constantly change the conditions leading to stress. The environmental conditions affect the level of farm animals' viability in different ways [2, 7].

Setting the problem and its solution. According to the materials of literary sources, it was found that it is expedient to consider the conditions of keeping in the production of beef, taking into account young cattle's genetic inputs for meat productivity [2, 3, 4].

It is relevant to conduct the research in order to define the growth and development of non-breed young cattle under optimal conditions of keeping and feeding in accordance with genetic inputs. As a result of such research, new approaches to beef production will be identified, taking into account the use of modern technologies, conditions of keeping and the level of genetic inputs.

The relevance of the research. The use of a group cage for the unleashed keeping of calves and young cattle up to 18 months of age allows animals to be kept under comfortable conditions, which is important for small farms. Therefore, the search for the increase in meat productivity of calves and young cattle was constantly carried out in different age periods [2, 3].

The aim and tasks of the research. In the current conditions, under a small productivity of dairy farms, non-breed young cattle make up 30-40%.

From a scientific point of view, it is important to determine the expediency of leashed or unleashed keeping of bull calves of the Ukrainian black-speckled dairy breed and to define the energy value of the edible part of the carcass, as well as the energy value of bull calves of 6, 12, 18 months old kept for beef production. It is also important to forecast the market entry of veal and beef with the corresponding energy value having a consumer demand [6].

Methods of the research. The type of building of 12×72 m was chosen to conduct the research (non-breed bull calves of the Ukrainian black-speckled dairy breed were kept leashed in the first building, while they were kept unleashed in the second one).

The growth of experimental bull calves was determined by individual weighing each month. The dynamics of live weight was determined at birth and at the ages of 1, 3, 6, 12, 15 and 18 months. The daily average and relative gains of live weight (%) were determined by the indicators of live weight of bull calves.

In order to identify the impact on the efficiency of beef production, the keeping with the best genetic inputs (under the origin) was studied: 80%, 70%, 60%, 50% of experimental bull calves under the leashed and unleashed keeping.

Meat productivity was evaluated at the age of 6, 12 and 18 months. The slaughter of 4 heads from experimental and control groups was carried out under the technologies of meat processing enterprises, where the pre-slaughter live weight, kg, and the slaughter output, %, were determined.

The energy value of the edible part of the carcass in the bull calves kept for beef production was evaluated at the age of 6, 12 and 18 months. We determined the energy value of protein, fat, protein + fat, as well as of the whole meat carcass, the internal fat and the edible carcass per one kilogram of pulp (under the leashed and unleashed keeping).

The results of the research were processed by the methods of mathematical statistics using the MS Office Excel 2007 software. The average results were compared with the control group of animals, and the changes in the average results were considered statically probable at P<0.05*; P<0.01**; P<0.001***.

Results of the research. The results of meat productivity in the bull calves kept at the age of 6 months indicate that it is possible to produce veal from non-breed young cattle at the age of 12 months. The results of the slaughter of bull calves of 18 months old reveal the potential for the use of non-breed young cattle of the Ukrainian black-speckled dairy breed in the production of beef.

The bull calves of the control group were kept leashed from 1 to 18 months of age, and those of the experimental group were kept unleashed in the group cage. The assessment of meat productivity of four bull calves from each experimental group was determined at the age of 6, 12 and 18 months. The slaughter was carried out under the technology of meat processing enterprises. According to the results of the control slaughters, the weight of the pair carcass, the internal fat and the slaughter indicators were determined (Table 1).

Table 1

Slaughter indicators in bull calves of the Ukrainian black-speckled dairy breed at the age of 6 months, n=4, ($x\pm S_x$)

Indicator	Groups	
	control	experiment
Pre-slaughter live weight, kg	137,7±1,07	136,7±2,49
Weight of the pair carcass, kg	65,3±0,78	64,7±1,25
Carcass slaughter output, %	47,4±0,38	47,3±0,63
Internal fat, kg	6,4±0,33	4,7±0,27**
Slaughter weight, kg	71,7±0,95	69,4±1,18
Slaughter output,%	52,0±0,54	50,7±0,70*

From the data in Table 1 it can be seen that the weight of the pair carcass at the age of 6 months was 65.3 kg in the control group, while it was by 1% less in the experimental one (the difference is not probable).

At the same time significant differences were found as for the internal fat depending on the keeping conditions of bull calves. Thus, the bull calves, which were kept leashed for up to 6 months had 6.4 kg of internal fat, while the bull calves under the unleashed keeping – by 26.6% less (the difference is probable at P<0.01) .

Such an advantage as for the lower accumulation of adipose tissue is natural in the bull calves of the Ukrainian black-speckled dairy breed, which were kept unleashed in the group cage compared with the animals keeping leashed. The constant movement of calves within the group cage created a small motion, which allowed accelerating the oxidation-reducing processes. As a result, the bull calves under the unleashed keeping for up to 6 months lost less energy of feed for the accumulation of adipose tissue.

Then, it was found that such significant differences in the gains of internal fat in the bull calves between the experimental groups led to a difference in the slaughter weight and output. The slaughter output of bull calves (leashed keeping) was 52.0% at the age of 6 months, while it was 50.76% in the bull calves under the unleashed keeping (the difference is probable at P<0.05).

Thus, the keeping of bull calves under the genetic characteristics at the age of 6 months allows to get about 70 kg of veal (slaughter weight) from each head. The conditions of keeping (leashed or unleashed) to the age of 6 months do not have a significant effect on the calves. The factor of keeping conditions was not manifested in the bull calves that were kept for the production of beef.

The slaughter indicators in the bull calves of the Ukrainian black-speckled dairy breed at the age of 12 months are given in Table 2.

Table 2

Slaughter indicators in bull calves of the Ukrainian black-speckled dairy breed at the age of 12 months, n=4, $x\pm S_x$

Indicator	Groups	
	control	experiment
Pre-slaughter live weight, kg	250,0±4,74	267,7±3,38*
Weight of the pair carcass, kg	126,1±4,30	142,30±1,99**
Carcass slaughter output, %	50,4±0,79	53,1±0,17
Internal fat, kg	7,8±0,44	5,4±0,28**
Slaughter weight, kg	133,9±4,12	147,7±1,71*
Slaughter output, %	53,5±0,61	55,2±0,15*

From the data in Table 2 it can be seen that the weight of the pair carcass was on average 142.3 kg in the experimental group that is by 12.8% more than that of the bull calves in the control. The pre-slaughter weight is by 7.08% and the weight of the pair carcass by 12.8% higher. As a result, the carcass slaughter output in the bull calves of the experimental group was 53.1% (the difference is probable at P<0.05 compared with the control).

The advantage in the accumulation of adipose tissue continued under the leashed keeping. We obtained 7.8 kg of internal fat from each leashed non-breed bull calve and 5.4 kg from each animal in the group cages (the difference is probable at P<0.01 compared with the control group).

The investigation of slaughtering results in the bull calves kept for beef production by the age of 12 months shows that 134-148 kg of slaughter weight can be obtained from each non-breed bull calve of the Ukrainian black-speckled dairy breed. But to increase the production of beef, it is desirable to choose an unleashed keeping, because the energy consumption of feed for the accumulation of internal fat is less desirable than the increase in the weight of the pair carcass.

When the bull calves reached the age of 18 months, the ones lagging behind in their growth were taken again and the slaughter was carried out (Table 3).

From Table 3 it is evident that under the leashed keeping the weight of the pair carcass in the bull calves of the Ukrainian black-speckled dairy breed up to 18 months was by 40.8 kg less than in those that were kept unleashed; the difference is probable at P≤0.001. As a result, the carcass slaughter output in the bull calves of the experimental group was by 5.3% higher (P<0.01).

Table 3

Slaughter indicators in bull calves of the Ukrainian black-speckled dairy breed at the age of 18 months, n=4, $x \pm S_x$

Показники	Groups	
	control	experiment
Pre-slaughter live weight, kg	374,7±4,51	412,2±4,36***
Weight of the pair carcass, kg	191,7±5,05	232,5±2,20***
Carcass slaughter output, %	51,1±1,00	56,4±0,70**
Internal fat, kg	18,1±0,75	11,4±0,74***
Slaughter weight, kg	209,8±4,63	243,9±2,34***
Slaughter output, %	56,0±0,85	59,2±0,52*

The advantage in the accumulation of internal fat in the bull calves under the leashed keeping was in the lack of movement leading to an increase in adipose tissue. So, on average, the internal fat was 18.1 kg. It is not only by 6.7 kg more compared with unleashed keeping, but also by 10.3 kg more than at the age of 12 months. At the same time, the difference between the internal fat in the bull calves of 12 and 18 months old, which were kept in the group cages, was only 6 kg.

Such differences in the internal fat between the bull calves of the control and experimental groups reduced the difference in the total slaughter weight (34.1 kg, P<0.001), while in the slaughter output – only 3.2%; the difference is probable at P<0.05.

The keeping of bull calves of the Ukrainian black-speckled dairy breed for the production of beef showed that at the age of 6 months, 1 kg of pulp contains 2.4 MJ or 2400 kJ or 2400000 J of protein, corresponding to 573.1 kcal.

1 kg of pulp contains 3.7 MJ of fat, which is equal to 883.6 kcal. Thus, 1 kg of pulp contains 6.1 MJ or 1456.7 kcal (control group). At the same time, 1 kg of pulp in the bull calves of the experimental group kept for beef production contained 2.93 MJ of protein and 1.79 MJ of fat (Table 4).

The data in Table 4 show that the pulp for its protein energy value in the experimental group exceeded by 22.1% that one in the control group (the difference is probable at P<0.001).

Table 4

Energy value of the edible carcass in the bull calves of 6 months old kept for the production of beef, MJ, n=4, $x \pm S_x$

Indicator	Groups		On average
	control	experimental	
Energy value in 1 kg of pulp:			
Protein	2,40±0,06	2,93±0,06***	2,65
Fat	3,70±0,32	1,79±0,32***	2,75
Protein and fat together	6,10±0,26	4,72±0,10***	5,41
Energy value of the whole carcass pulp	276,3±17,28	217,1±17,11*	246,7
Energy value of internal fat	66,2±5,51	46,7±3,68*	56,4
Energy value of the edible carcass	342,5±17,71	263,8±17,32*	303,1

The energy value of the bull calves' carcasses in the experimental group as for the fatty pulp was by 51.6% lower than that of the bull calves at the age of 6 months in the control group (the difference is probable at P<0.001).

The total amount of the protein and fatty pulp energy value at the age of 6 months was by 22.7% higher than in those bull calves, which were kept leashed in comparison with unleashed.

The total amount of energy in the carcass pulp in bull calves of the control group at the age of 6 months

reached 276.3 MJ, and it was 217.1 MJ in those of the experimental one. The difference is probable at P≤0.05 in favor of leashed keeping.

Similar data are obtained as for the total amount of energy in 1 kg of carcass pulp in the bull calves under leashed and unleashed keeping, where the advantage was minimal in the bull calves of 12 months old kept for the production of beef, so the probable difference was at the level P<0.05 (Table 5).

At the same time, the significant difference as for the output of protein and fat energy in the bull calves of 12 months old kept for the production of beef under different ways of keeping is not determined.

The bull calves of the control group accumulated 416.6 MJ of internal fat, while their analogues by age and breed of the experimental group – by 29% less (P<0.001).

As a result, at the age of 12 months there was no energy value of the edible carcass in the bull calves of the Ukrainian black-speckled dairy breed.

At the age of 18 months the slaughter of bull calves of the Ukrainian black-speckled dairy breed showed that the protein energy value in 1 kg of carcass pulp was by 20% higher in the bull calves of the experimental group.

Table 5

Energy value of the edible carcass in the bull calves of 12 months old kept for the production of beef, MJ, n=4, $X \pm S_x$

Indicator	Groups		On average
	control	experimental	
Energy value in 1 kg of pulp:			
Protein	2,6±0,12	3,1±0,10*	2,85
Fat	4,7±0,33	3,0±0,47*	3,85
Protein and fat together	7,3±0,35	6,1±0,11*	6,70
Energy value of the whole carcass pulp	611,7±38,67	616,1±51,37	613,9
Energy value of internal fat	416,6±14,29	295,9±12,36***	356,2
Energy value of the edible carcass	1028,3±47,31	912,0±53,9	970,1

Thus, the accumulation of energy in the form of a protein was significantly higher under the unleashed keeping of the bull calves than under the leashed one. The difference is probable at P≤0.001.

The second component of the edible carcass is fat. The pulp of beef with an appropriate amount of fat is always valued by meat buyers (Table 6).

Table 6

Energy value of the edible carcass in the bull calves of 18 months old kept for the production of beef, MJ, n=4, $X \pm S_x$

Indicator	Groups		On average
	control	experimental	
Energy value in 1 kg of pulp:			
Protein	3,0±0,10	3,6±0,22***	3,3
Fat	7,4±0,86	4,2±0,64*	5,8
Protein and fat together	10,4±0,77	7,8±0,76*	9,1
Energy value of the whole carcass pulp	1307±96,4	1311±88,0	1309
Energy value of internal fat	849±46,9	627±80,2*	738
Energy value of the edible carcass	2156±128,1	1938±136,7	2047

Therefore, the presence of adipose tissue in 1 kg of pulp in the control group of bull calves in the amount of 7.4 MJ not only has the energy value, but also forms the nutritional quality of beef. The pulp of 18-month-old bull calves of the Ukrainian black-speckled dairy breed under the unleashed keeping contains a slightly less fat (4.2 MJ/kg), which is probably less at P<0.05, than of those under the leashed keeping.

As a result, even with different pulp output, the energy value of the whole carcass pulp in the bull calves of 18 months of age, under the leashed and unleashed keeping, was practically the same – 1307 and 1311 MJ.

Even taking into account the energy of internal fat, where the bull calves, which were kept leashed, had the fat energy by 35.4% more than those kept unleashed, a probable difference in the energy value of the edible carcass in the bull calves under the unleashed keeping was not determined. It is due to more protein, which is a more desirable factor for beef market.

Conclusions. 1. The effect of zoo-hygienic conditions under the unleashed keeping of non-breed young cattle of the Ukrainian black-speckled dairy breed, taking into account their genetic inputs, on meat productivity and its energy value is the confirmation of high economic efficiency.

2. It is proved that it is advisable to keep the best genotypes in order to extent the period of growth and fattening of young cattle by the age of 18 months, while the keeping of bull calves is 50%. As a result, the live weight at the age of 18 months under the leashed keeping is 372.6 kg, while it is 482.3 kg under the unleashed one. The average daily gains of live weight under the advanced technology compared with the current one are by 31.6% (with 60% kept) and by 33.6% (with 50% kept) higher.

3. The energy value of 1 kg of the edible carcass

in the bull calves kept for the production of beef showed that at the age of 18 months the protein energy value in the slaughtered animals of the Ukrainian black-speckled dairy breed under the unleashed keeping will be by 20% higher than under the leashed one ($P<0.001$), while their fatty tissue will be on the contrary higher under the leashed keeping, but under the unleashed one the quality of beef is better due to the higher amount of protein, which is a desirable factor for beef market.

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DENSITY DYNAMICS AND BIOPRODUCTIVENESS OF LEGUMINAL HERBS GROWN ON SOILS CONTAMINATED WITH HEAVY METALS

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Abstract

In conditions of moderate soil contamination with heavy metals lead, cadmium, copper and zinc, the highest field germination of seeds at sowing is observed in alfalfa (*Medicago sativa L.*) - 58.9%. The lowest falling out of grasses of the second-fourth years of the growing season is found in the crops of Eastern goatweed (*Galega orientalis Lam.*) and bird's-foot trefoil (*Lotus corniculatus L.*). The highest average yield of green mass for all years of vegetation is provided by sowing of white clover (*Melilotus albus L.*) - 56.9 t / ha, but it grows only for two years. Among leguminous perennial grasses that grow for four years, the highest yield of green mass is provided by sowing of sand sainfoin (*Onobrychis arenaria Kit.*) - 44.6 t / ha.

Keywords: leguminous perennial grasses, heavy metals, soil, pollution, productivity, density.

Formulation of the problem

Due to the intensification of agricultural production in Ukraine, permanent and irreversible processes occurring in agroecosystems are soil degradation. Of the total arable land in Ukraine, 32.4 million hectares, dehumidification and trophic depletion are observed by 43.0%, agrophysical properties are disturbed by 39.0%, water erosion is developed by 32.1%, and soil acidification is observed by 17.7% [1].

In recent decades, due to the growing use of mineral fertilizers and pesticides, their contamination with heavy metals may be a potential threat to Ukraine's soils. This problem is especially relevant on gray podzolic soils, which cover an area of 1.99 million hectares of arable land, distributed mainly in the Central Forest-Steppe of Ukraine and are characterized by lower fertility and higher natural acidity, much worse buffering properties compared to black soil.

Forage production, in particular the cultivation of perennial legumes for green mass, is one of the factors that can stabilize the negative degradation processes occurring in soils, in particular the normalization of heavy metals. The great phytomeliorative role of perennial legumes is due to the formation of a large vegetative mass, which is able to absorb heavy metals from the soil and accumulate them in the aboveground mass. Also, perennial legumes are able due to symbiotic nitrogen fixation to increase soil fertility, neutralize its acidity, due to the strong root mass to increase the humus content, improve agrophysical properties [2].