

INFLUENCE OF FEEDING LEVEL ON THE REPRODUCTIVE CAPACITY OF HEIFERS OF THE ZNAMIANSKY TYPE OF POLISSYA BEEF BREED

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Abstract

The influence of different intensities of rearing heifers of the Znamenskaya type of Polissya beef cattle breed on their growth, development, and reproductive capacity was studied. The coefficients for determining the level of heifer feeding were developed and used: 1.75 - high; 1.57 - normal. It has been experimentally established that intensively reared heifers, compared to animals in the control group, reached the optimal live weight for mating of 384 kg much earlier. From birth to mating age, they consumed 17.2% less feed units and 15.7% less digestible protein. They had better reproductive performance, the age of fertile mating was 146 days shorter and fertility rates were 6% higher than in the control group. Intensively reared heifers were 4-5 months younger at fertile mating than animals in the control group, indicating their higher early maturity. Intensive heifer rearing shortens the period from birth to calving, reduces labour and rearing costs, and increases the reproductive capacity of animals.

Key words: early maturity, intensive growing, Polissya beef breed, repair heifers, reproductive capacity.

INTRODUCTION

On the world food market "grass-fed" and "marble" beef is highly valued (Kryvoruchko et al., 2023; Wu et al., 2020; Dorotiuk et al., 2003). Grazing system of livestock contributes to an optimal balance of nutrients, which gives the effect of "marbling" meat. "Grass-fed" beef contains much more Omega-3 fatty acids, beta-carotene, vitamin E and antioxidant enzymes, which have anti-carcinogenic properties in comparison with beef that keep tethered and fed concentrate (Ponnampalam et al., 2021). In Ukraine, meat cattle breeding is a specialized independent branch of animal husbandry. It is most expedient to organize it in a large natural land areas (Honcharova, 2022; Dorotiuk et al., 2003). Beef cattle are used for beef production. These animals are well adapted to different climatic conditions, undemanding to feed, resistant to diseases, with consolidated heredity, early maturing, with high paying feed products and high slaughter yield (Suprun & Dovha, 2021). The Znamyansky type of Polissya meat breed of cattle with high productivity potential was bred and officially registered in Ukraine, in 2009 (Honcharova, 2022; Pochukalin et al., 2016; Savranchuk et

al., 2011). This type of cattle was created by complex reproductive crossing of the following breeds: Red Steppe, Aberdeen-Angus, Simmental and Charolais (Vdovychenko & Shpak, 2012; Podriezko, 2007). This cattle is light brown in color, has a compact type of constitution, deep and wide chest, even topline, well-developed rear third of the body, strong and not very voluminous bones (Tsukanova, 2011). In general, the Znamyansky type of Polissya meat breed animals are characterized by a calm disposition and workability, good use of pastures, rough and juicy fodder (Honcharova, 2010; Dorotiuk et al., 2003). Cows of this type, in particular, are characterized by high reproductive capacity, ease of calving and fertility (Romaniak et al., 1993). The live weight of adult cows is 500–580 kg, the intensity of growth of young animals in fattening is 1000-1250 g; males at the age of 18-24 months reach 265-290 kg, the slaughter yield is 60-64%. The milk yield of cows during 8 months of lactation is 1200 kg (Podriezko & Kernasiuk, 2011). However, the population of the Znamyansky type of Polissya meat cattle breed is very small due to the low level of reproduction of the herd and the extensive breeding of repair heifers. At the

same time, the conclusions of experts regarding the expediency of using different methods of raising heifers are contradictory. Researchers point out that high level of heifer feeding has a negative effect on the formation of future milk yield of cows (Foksha et al. 2021; Liu et al., 2015; Chumachenko et al., 2014; Abeni et al., 2012).

Small livestock farms are the most optimal in terms of the ability to ensure profit (Dabija et al., 2021). Using of the beef cattle breeding system involves intensive growth of animals during the milk period with a slowdown in growth after weaning from the mother cows (Poghosyan, 2021; Saenko & Kaznacheeva, 2018; Rodríguez-Sánchez et al., 2017).

The analysis of research materials accumulated up to now shows that the above provision needs to be revised and clarified. One of the main elements of intensification in the complex of measures regarding breeding work with beef cattle, is scientifically based breeding of heifers for reproduction of the herd. In meat cattle breeding the problem of reproduction is extremely important in comparison with dairy cattle breeding. After all, the only product of a beef cow is a calf that is raised before weaning (up to 6-8 months of age) (Boyer et al., 2020; Vdovychenko & Shpak, 2012).

In order to reproduce such a herd, maximum attention should be paid to the search for optimal parameters of the breeding system of repair heifers and their mating age. As a rule, heifers of meat breeds are mated at the age of two years and older, and therefore the costs of their keeping and maintenance begin to be reimbursed only at the age of three years (at the expense of obtaining offspring) (Tucho et al., 2021; Pochukalin et al., 2019; Shevkhuzhev & Smakuev, 2015). To some extent, this reduces the number and growth of the cattle population and slows down the pace of selection. Lack of an optimal system for raising young animals is a significant problem in meat cattle breeding in Ukraine. In particular, reproductive capacity of the Znamansky type of Polissya meat cattle breed is insufficiently researched. First of all, the issue of purposeful breeding of breeding heifers after weaning needs to be investigated. Therefore, the scientific and practical substantiation of the intensity of rearing heifers of the Znamyansky type of meat breed, the

timing and age of their mating, the study of the influence of these factors on reproductive capacity is an actual issue.

MATERIALS AND METHODS

Experimental part of the research was carried out in the conditions of the family farm of Znamyansky type of Polissya meat breed cattle. At the beginning of monitoring, the number of livestock here was 25 heads. The researched farm and agricultural land are located in the Kropyvnytskyi region of Ukraine. The research was made in two stages. The first stage of the research consisted in studying the conditions of keeping, feeding and exploitation of cows and heifers. Two groups of repair heifers of the Znamyansky type of Polissya beef breed cattles, 5 heads each, were selected to carry out the second stage of research.

Metabolizable energy requirement for maintenance (M_{Em}) and metabolizable energy intake (M_{Ei}) were determined according to recommendations (Honcharova, 2010; Tsiupko & Pronyna, 1989). The amount of feed energy required for maintenance metabolism was calculated based on these indicators (M_{Ef}). Hereinafter, M_{Ef} is understood as the intensity level.

$$(ME_f) = ME_i + ME_m$$

The heifers of the experimental groups, after weaning from the mother cows, were reared according to the intensity level: I (control) - 1.57; II - 1.75. The feeding diet of the heifers in all groups, both in terms of the set of forages and their quality, was identical and balanced in terms of all necessary nutrients. At the same time, the norms for feeding young animals were observed. The estimated average daily gain of live weight from weaning to mating in heifers of the I group was 400 g, in heifers of the II group - 700 g.

Different intensities of growing heifers from birth to breeding age were achieved by introducing different amounts of wheat grain of their own harvest into feeding rations: 1.5 kg in the ration of the control (I) group; 2.0 kg in the rations of the experimental (II) group.

The reproductive capacity of heifers was assessed by the rate of fertile insemination. Those heifers that did not come into desire after

mating during the last two months were considered to be inseminated.

Heifers were weighed monthly (before feeding) during the experiment. Based on this, the live weight of animals and the calculation of average daily, absolute gains were determined. The digital material of the experiments was processed by the method of variational statistics (Baranovskiy et al., 2017) using the MS Excel 2003 spreadsheet processor.

RESULTS AND DISCUSSIONS

According to the data obtained from the study of the conditions of keeping, feeding and exploitation of cows and heifers in the studied farm, it was determined that the animals are raised according to the technology that provides for their free grazing and untethered keeping. In the farm, the natural mating of repair heifers and cows with breeding bulls lasts for three calendar months (from April 1 to August 1). This technology of pairing beef cows and heifers ensures their calving in the period from January to April. Accordingly, the newborn calves have time to grow up and get stronger before going out to the pasture. Calves on pasture develop well and achieve high live weight before weaning.

After birth, the calves are kept with the cow on suckers, and at the age of 8 months they are weaned. A similar technological scheme for keeping calves of meat breeds is described by researchers (Honcharova & Khokhlov, 2022; Ugnivenko, 2013; Vdovychenko & Shpak, 2012). Experts indicate that in beef cattle breeding, the main principle of raising a calf in the milk period (up to 6-8 months of age) is its stay together with the cow (Gutierrez et al., 2014; Alvarez-Rodriguez et al., 2010; Grings et al., 2007).

Based on this, during the experiment we tried to create relatively favorable feeding and housing conditions for the animals. Without this, it is impossible to identify potential opportunities for the reproductive capacity of heifers.

In the research farm, the system of keeping beef cows during the stall period is unattached (on deep litter in light-type premises, with the organization of feeding and drinking on walking and feeding grounds).

Calving of cows and heifers was organized in a room equipped with individual sections (size 5.0 x 3.0 m), a feeder and a drinker. The floor here is covered with straw (the thickness of the layer is 30-40 cm). After birth, the calf stays with the mother cow and sucks her often and little by little.

Keeping a cow with a calf in a separate section helps to strengthen the maternal instinct and sucking reflex in the calf, which is especially important during the colostrum period.

Cows were kept in individual cages for 3-5 days before calving and 7-10 days after, so that the calf and cow got used to it and later easily found each other. Then the calves and cows were transferred to a group section for 5 cows. Fences were made in these sections, where the calves could pass freely. Feeders for feeding calves with concentrates and a container for water are equipped here. A place made of dry straw is equipped along the perimeter of the section, a place for keeping a cow with a calf.

In the summer and in the warm periods of the year (practically from April to December), the heifers and their mother cows graze on the pasture (Figure 1).



Figure 1. A cow of the Znamyansky type of Polissya beef breed with a calf in the pasture (original photo)

In the resting places of cows with calves on the pasture, small fenced pens with canopies for calves are arranged, where they freely passed for rest, especially in the hot season or during rain, and were fed with concentrates, green mass, hay and mineral supplements.

Calves were trained to eat fodder prepared for the stall period - 3-4 weeks before stall keeping. At the same time (from the end of October to the beginning of November), calves were separated from their mothers.

In winter, the heifers were kept untethered in an adapted room with free access to the walking area, where feeders for concentrated, rough and

juicy fodder were installed. Control over metered grain feeding was carried out by keeping heifers in spacious isolated machines with feeders. The feeding ration of heifers aged 1 to 3 months consisted of mother's milk 6.1-6.6 kg/head and concentrated fodder (accustomed to them starting with a dose of 0.2-0.4 kg/head). From the age of three months, the heifers of the two groups were grazed on pastures of equivalent grass quality and were fed with concentrates (up to 1 kg/head). Animal feed was sufficiently complete: in terms of nutrients, the amount of digestible protein, the content of minerals and vitamins in the diet. (Figures 2 and 3).

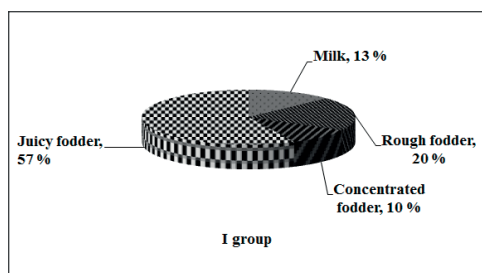


Figure 2. Fodder consumption during rearing of heifers I group from birth to breeding age per head, kg

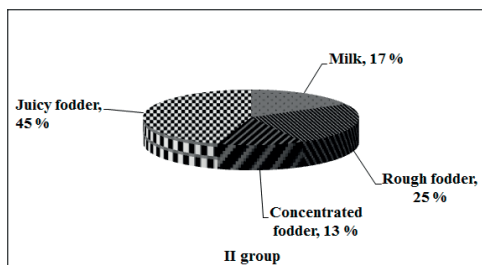


Figure 3. Fodder consumption during rearing of heifers II group from birth to breeding age per head, kg

The structure of the ration of feeding heifers of the I group from birth to mating age was as follows: milk - 13%, rough fodder - 20%, concentrated fodder - 10%, juicy fodder - 57%. In the heifers of the II group, the structure of the feeding ration, respectively, was as follows: milk - 17%, rough fodder - 25%, concentrated fodder - 13%, juicy fodder - 45%. The total consumption of feed, taking into account the consumed milk of the mother cow, was 3232.0 feed units and 316.7 kg of digestible protein in the first control group

(from birth to 20 months); and 2677.0 feed units, 267.0 kg of digestible protein in the II experimental group (from birth to 15 months), respectively.

Heifers of the II experimental group consumed less feed units and digestible protein by 555 (17.2%) and 49.7 kg (15.7%) from birth to weaning age than their peers of the I control group.

However, a higher consumption of metabolized energy was noted in the first control group of heifers from birth to mating age, - 36710.0 MJ, which is - 8093.0 MJ (22.0%) more than in the second group, and is explained by the late mating of fertile heifers in the first group.

Thus, the heifers of the second group consumed less feed daily than the animals from the first group. The total feed costs in the first group during the entire period of growing heifers until the first mating of the growing period were higher due to the extension of the growing period.

The energy requirement of animals is the amount of substances or energy that healthy animals need under optimal conditions of maintenance and balanced feeding to maintain life, obtain a set level of productivity and display reproductive function. The modern science of feeding animals provides an objective view of their need for energy and individual nutrients according to the main elements of the body's expenditure. In particular, in relation to maintaining life, development of reproductive organs during pregnancy, reproductive function in males, productivity (Freetly et al., 2023; Kharitonov & Agafonov, 2015; Gunn et al., 2015; Cardoso et al., 2014; Roberts et al., 2009).

This methodical approach to determining the energy needs of animals, combined with the results of experimental studies on the study of the characteristics of metabolism and the efficiency of the use of nutrients, makes it possible to accurately predict their productivity depending on feeding conditions and physiological state.

According to the results of our research, the highest indicators of the available metabolisable energy requirement for maintenance (M_{Em}) were established in the heifers of the II group (43.0 MJ), and the lowest in the heifers of the I group (42.4 MJ).

Metabolizable energy intake (M_{Ei}) was 66.5 MJ in the first control group, 75.7 MJ in the second experimental group. The largest amount of feed energy was observed in heifers of the II group - 1.75. In heifers of the I group, this indicator was 1.57. Animals of group I consumed less metabolisable energy requirement for maintenance per day. At the same time, the intensity of growing in animals of this group was correspondingly lower.

Thus, the analysis of spent feed testifies to the effectiveness of the proposed system of intensive rearing of heifers of the Znamyansky type of Polissya meat breed. At the same time, feed consumption is significantly reduced and the genetic capabilities of animals are used more fully.

The growth, development and reproductive capacity of animals depend, first of all, on the conditions of their feeding, maintenance and breed. The development of animals is the result of the interaction of the hereditary basis received from the parents and the specific conditions of the external environment in which it occurs. As a result, there is not only an increase in the mass of organs and tissues, but also their significant qualitative changes. In cattle breeding, great attention is paid to live weight. According to many researchers, the live weight of animals is not only a breed and constitutional feature, but also an indicator of growth and development. Of the numerous methods of directional calf rearing, the most important is the regulation of feeding level and planning of live weight gain by periods of growth and development of animals (Reis et al., 2015; Diskin & Kenny, 2014; Martin et al., 2008). Of the many methods of targeted calf rearing, the most important is the regulation of feeding levels and planning of live weight gain according to the periods of growth and development of animals (Reis et al., 2015; Diskin & Kenny, 2014; Martin et al., 2008).

The live weight of the studied heifers of the two groups at birth did not differ, but feeding during the period of suckling and their subsequent intensive rearing caused a high live weight in the animals of the II group (Figure 4). In heifers of the II group at the age of 15 months an advantage was observed in terms of live weight by 50 kg (14.9%, $P \geq 0.999$) in comparison with animals of the control (I)

group. These heifers were at a higher intensity of growing, had a live weight of 385.0 kg and were successfully mated at the age of 15 months (Figure 5). Heifers from I group reached a live weight of 384.0 kg, which is sufficient for mating only at the age of 20 months.

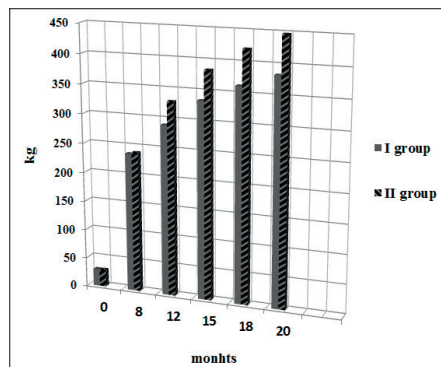


Figure 4. Live weight dynamics of heifers, kg



Figure 5. A 15-month-old experimental heifer of the Znamyansky type of the Polissya beef breed (original photo)

Thus, the relatively high live weight of intensively grown heifers of the Znamyansky type of the Polissya meat breed indicates their prematurity, a large genetic reserve, and the possibility of increasing size and stature (in terms of appropriate selection).

The heifers of the II experimental group, in terms of absolute gains, exceeded the analogue heifers of the I (control) group in all age periods. The maximum increase in absolute gains in heifers was observed up to 8 months of age. Heifers of the II group gained 356.1 kg during the period from weaning to mating (8-15 months) and exceeded the heifers of the control group by 49.9 kg (13.1%).

High average daily gains of heifers in both experimental groups were observed in the dairy

growing period (from birth to weaning) and were, respectively: 853.3-865 g. During this period, the calves were kept with their mothers, they were raised according to the technology of meat cattle breeding. Weaning calves from their mothers led to a decrease in average daily gains. However, in the heifers of the II group a certain advantage was observed. Thus, they exceeded the analogs of the first control group by 300.2 g during the growing period from 8 to 12 months ($68.6\% P \geq 0.999$). The same tendency took place in subsequent growing periods. It is worth noting that the growth of heifers decreased in the period of 15-18 months in individuals of both experimental groups, which coincides with the manifestation of their sexual activity (Figure 6).

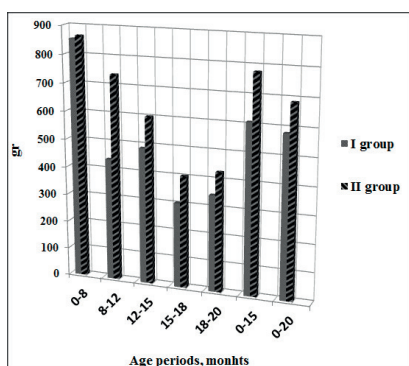


Figure 6. Average daily gains of heifers of the I and II experimental groups

During the period from birth to mating, intensively grown heifers of the II group had an average daily weight gain of 780.0 g, which is 197 g (34%, $P \geq 0.999$) more than the weight gain of the heifers of the same age from I control group.

It is known that the level of reproduction of the herd and the age of the heifers at the first insemination have a decisive influence on the economy of beef cattle breeding. In beef cattle breeding, the only product obtained from a cow is a calf for breeding or for meat. Therefore, reproductive capacity and maternal qualities of cows considered the main ones (Boyer et al., 2020; Moorey & Biase, 2020; Honcharova, 2010; Gutierrez et al., 2014; Bormann et al., 2006). In many farms heifers of meat breeds are inseminated at the age of two years and older, that is the main inhibiting factor in the

development of meat cattle breeding and a certain problem in increasing the number of meat cattle. As a result, feed costs and financial costs for their growth increase. At the same time, the reproduction rate of the herd slows down significantly (Kostenko, 2012; Wathes et al., 2014; Honcharenko & Izvekov, 1998). Numerous studies: Freetly et al., 2011, Hughes, 2013, Ugnivenko, 2013, Patterson et al., 2013 have established that intensively raised heifers of meat breeds, mated at a young age (15-20 months), grow better, develop normally and fertile well. Research shows that for determining the optimal age of the first mating, it is not the age that is important, but the live weight and general development of the animals. Also, one of important factors in this aspect is the level and completeness of animal feeding and the conditions of their keeping. By balancing the use of these factors, it is possible to accelerate or restrain the growth and development of an animal at any age. Intensive feeding of heifers contributes to their earlier physiological and economic precociousness and, accordingly, faster reproduction of the herd.

We conducted a comparative study of the reproductive function of Znamyansky heifers at different intensities of growing. At fertile mating, the heifers of the II group were almost 122-152 days younger than the animals of the control group. In the heifers of the II experimental group, sexual precociousness and their ability to give the first normally developed offspring in 24-25 months are revealed. Therefore, despite the fact that heifers were mated at an early age, they had 2-3 sexual cycles. The results of the study showed that there was a difference in reproductive capacity between heifers of different groups. Live weight of heifers of all experimental groups at fertile mating was practically the same. But the heifers of the II group, with more intensive growing, reached it earlier and, accordingly, offspring were obtained from them much earlier. It was established that heifers of the II group had the largest live weight at fertile mating, which reached 385.0 ± 3.25 kg in 15 months. Heifers of the I (control) group reached the same live weight and were mated at 20 months. Heifers of intensively reared group II had a high average daily gain in the period

from weaning to mating: 683.0 ± 11.20 , which is 282.0 g (70.1%, $P \geq 0.99$) more than heifers of the control group. Fertilization from the first mating was higher in animals of the II group by 6 % in comparison with the control group (I). Heifers of the II experimental group had a significantly better index according to the number of inseminations. Thus, intensively grown heifers had a significant advantage according to all indicators of reproductive capacity in comparison with the group of heifers that were on standardized systems of keeping.

CONCLUSIONS

Intensive breeding of the Znamyansky type of Polissya meat breed heifers with an estimated coefficient of 1.75 provides an average daily gain of 700 g, a live weight of 385 kg at the age of 15-16 months. Under the condition of the intensity of raising heifers with an estimated coefficient of 1.57, animals have such a live weight at the age of 20 months. Intensively reared heifers of the II group were noted for their better reproductive capacity: the age of fertile mating was 146 days ($P \geq 0.99$) shorter in them, and the fertility rates were 6 % higher than those of the control group. Intensively grown heifers were younger by 4-5 months than animals of the I (control) group at fertile mating, which indicates their higher prematurity.

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