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The Growth and Development of Replacement Heifers Using the Cold Housing Method During the Preweaning Period

*, Lyudmila Yuryevna Ovchinnikova, Olga Stanislavovna Safronova

Kostanay Research Institute of Agriculture, 111108, Zarechnyy, Yubileynaya Street, 12, Kazakhstan

Abstract | Productive qualities of dairy cows are attributed to the impact of both genetics and the environment. Among environmental factors, the leading role is played by the technology involved during the raising of animals. In the course of a scientific-economic experiment, a comparative analysis of growing replacement young animals according to the traditional method and the cold housing method was performed. Based on the results of the study, it has been established that at the age of six months, the weight of the replacement heifers grown using the cold housing method exceeded that of their peers grown using the traditional technology by 10.3kg, or 6.3% with the veracious difference of $P \leq 0.01$. The average daily live weight gains in the heifers grown using the traditional technology was lower by 59g or 8.8%; the relative growth rate was lower by 3.3%. It was established that the heifers, grown using the cold method, grew more intensively, had a higher live weight and its gain at the end of the preweaning period. Their production profitability was higher by 10.2%.

Keywords | Live weight, Heifers, Growth, Absolute gain, Average daily gain, Relative gain, Cold housing method, Economic efficiency

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***Correspondence** | Elena Anatolyevna Babich, Kostanay Research Institute of Agriculture, 111108, Kazakhstan, Zarechnyy, Yubileynaya Street, 12; **Email:** elena._76@mail.ru
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INTRODUCTION

Increasing the livestock and improving its productivity largely depend on how raising and breeding are organized and managed. In the conditions of dairy cattle breeding intensification, growing high-quality replacement young animals takes an important place in the system of herd reproduction. The technology of growing young stock involves a number of production processes that ensure obtaining normally developed, healthy offspring, their growth, and development in all age periods in accordance with the biological laws and the suggested business use, as well as funds-saving animal growing (Melnikova, 2013; Babich and Ovchinnikov, 2016). In the technology of calves' growing, the following periods are distinguished: the prophylactorium period – a newborn calf adapts to the living conditions outside the mother's organism, the preweaning period – the main food for the animals is milk, and gradual transition from milk to plant feed occurs, and the post-weaning period, or the period of intensive growth and reproduction (Shiriyev et al., 2013).

In the conditions of dairy cattle breeding intensification, growing replacement young stock takes an important place in the system of herd reproduction. The cold housing method of growing calves for example. keeping them outside, is one of the most relevant issues of dairy cattle breeding development. The basics of the cold housing method reside in the fact that immediately after birth, a calf is to be thoroughly dried and placed on dry bedding in a dry place; it can quite easy endure the temperature down to -30 °C, or even lower. This is explained by the fact that in the organism of calves, metabolism accelerates and heat production becomes more intensive, i.e. animals

acquire innate resistance to cold. A newborn calf is to be transferred quickly enough to an individual hut after the first colostrum feeding and complete drying of the skin covers. With that, the calf should not be exposed to direct rainfall and wind (Kibkalo et al., 2008).

The advantages of this technology of growing newborn calves are as follows. Firstly, the calf is easily adapted to the temperature conditions it is placed into in the first day of its life and gets clean air without the admixture of ammonia. Secondly, it has access to natural sunlight, which contributes to the vitamin D synthesis in the organism, as it is a free natural sterilizer. A calf always has a choice: depending on weather conditions, it may stay in an aviary, or in a hut (Kostomakhin, 2012; Babich and Ovchinnikov, 2016).

Calves' isolation from each other in individual huts guarantees non-dissemination of diseases to other healthy born calves. In the winter, cold air creates a sterile environment for the calf, since, at low temperatures, the growth of pathogenic microorganisms stops. Keeping calves in huts allows eliminating feed competition, which typically occurs in groups of calves. The huts are easy to clean and disinfect, they can be moved from one area to another. At many farms that successfully use the "cold" method of growing young stock, mortality of calves is usually reduced to 1 – 2 %, and at some farms, it has not been observed in recent years. For the staff, year-round placement of huts for outside calves is most complicated in the winter. However, the result pays off which means from the first day of life, calves are grown using this method, they are to remain in the same conditions further on, otherwise, the efficiency of the method will be limited (Ivanov and Melnikov, 2009).

This study was conducted to understand the growth and development of replacement heifers using the cold housing method during the pre-weaning period. Understanding the impact of these housing would guide the most production-efficient and cost-effective managemental regimens.

MATERIALS AND METHODS

The object of the research was replacement Holstein heifers and the research was performed at the breeding farm of LLC Turar in the Fedorovsky district of the Kostanay region in the Republic of Kazakhstan in 2018. For the scientific and economic experiments, two groups (n=14 animals each) were formed using the method of pairs of analogs: group I – heifers kept in the cages using the group method (7 animals), group II – heifers were kept in individual huts. Watering and feeding the animals was organized in accordance with the recommendations of the All-Russian Institute of Animal Breeding n.a. K. Ernst.

The dynamics of changes in the live weight of young stock were assessed by individual weighing at birth, and afterward at the age of one, two, three, four, five, and six months with the subsequent calculation of the absolute, mean daily, and relative live weight gain. The economic efficiency was calculated according to the methodology of the All-Union Academy of Agricultural Sciences (1980). The results of the research were processed by the variation statistics method using application Microsoft Excel. The degree of veracity of the obtained results was indicated by corresponding symbols: *- $P \leq 0.05$; * * $P \leq 0.01$; * * * $P \leq 0.001$.

RESULTS

In 2018, LLC «Turar» (a limited company engaged in the breeding of dairy cattle of the Holstein breed) introduced the cold type of housing calves during the preweaning period that had been adopted by the American livestock breeders, in which the animals developed from birth to the age of six months (Belkov, 1989). The technology of cold housing method during the preweaning period is organized at the farm in two periods: first period – from birth to the age of three months in individual huts outside and second period – from three months to six months of age using loose housing in a facility for 15 – 20 animals.

The huts are located in a row between calf-sheds; from one side, they are protected by bales of straw (4 meters high), and from the other two sides, there are walls of calf-sheds. This arrangement helps to protect the cages from the wind. The cages are located at a distance of 30 – 40 cm from each other. An individual cage consists of a hut and a backyard; the entire structure rests on metal legs with the height of 40 – 50 cm, of which 20 cm are dug into the ground to prevent cage blowout by the wind. The huts are made of plywood painted both inside and outside. The floor in the hut is made of solid hardwood. Straw bedding is placed on it. The presence of dry bedding is the main prerequisite for growing calves in such huts. The front wall of the hut has a hole for the calf to get out freely. The backyard is made of metal rods with a gate 1.8 m long for free walking and exposure to sunlight. In the winter, with the temperature outside of -25 to -30°C and strong wind, the front wall of the hut is closed with a canopy; however, it should not prevent the calf from getting in and out freely. In the spring and in the summer, this canopy is removed to avoid condensation inside the hut. On the side or front wall of the backyard, there are two buckets: for coarse forage, and for concentrates, and a device for a nipple bottle.

When calves reach the age of three months, they are transferred to the facilities for 10 – 15 animals for loose keeping until the age of six months, which are located in a calf-shed, also on deep permanent straw bedding. The calf-

Table 1: Age-related changes in the live weight of the calves during the preweaning period with different keeping technologies, kg (X±Sx).

Live weight	Traditional method	Cold housing method	Difference between cold and traditional methods±
- at birth	32.5±0.5	32.7±0.4	+0.2
- at the age of one month	55.2±0.8	56.8±0.8	+1.6
- at the age of two months	76.0±1.0	81.1±0.8***	+5.1
- at the age of three months	96.0±1.2	104.7±1.0***	+8.7
- at the age of four months	116.5±1.37	126.9±1.2	+10.4
- at the age of five months	135.8±2.1	149.1±1.9	+13.3
- at the age of six months	155.2±2.3	165.5±2.6**	+10.3

shed has four facilities; each facility has doors for the calves to freely get to the backyard. Unoccupied cages are cleaned and disinfected, and the bedding is removed. The backyard is dried and left to rest for 2 – 3 days.

Objective indicators that allow obtaining the most accurate information about the efficiency of keeping calves during the preweaning period using the cold housing method are calves' growth and development.

Studying the live weight gain in heifers from birth to six months of age has shown that in identical feeding conditions but with the use of different keeping technologies, the heifers grown with the use of the cold housing method grow more intensively than their peers grown with the use of the traditional technology, which is shown in Table 1.

Table 2: Growth and development of heifers grown using the traditional growing technology and the cold housing method.

Age period	Absolute gain, kg	Average daily gain, g	Relative gain, %
Traditional method			
0 – 3 months	63.5±2.3	690±23	98.8
3 – six months	59.2±3.1	643±29	47.1
For the entire period	122.7±4.3	667±31	130.7
Cold housing method			
0 – 3 months	72.0±1.8	782±18	104.8
3 – six months	60.8±2.8	661±25	45.0
For the entire period	132.8±3.4	726±28	134.0

Analysis of the data in Table 1 shows the superiority of the heifers kept using the cold housing method in terms of growth. At the age of one month, the difference was small and not veracious – 1.6 kg. However, the difference increased further, and reached 5.1 kg at the age of two months with $p \leq 0.001$, 8.7 kg at the age of three months with $p \leq 0.001$, and 10.3 kg at the end of the preweaning period with $P \leq 0.01$.

For a more complete analysis, the absolute, the relative and the average daily live weight gain was calculated over the growing periods for the two groups of heifers (Table 2).

Table 3: Economic efficiency of the calves keeping methods.

Indicator	Traditional method	Cold housing method
Number of animals at the beginning of the experiment	14	14
Number of animals at the end of the experiment	12	14
Absolute gain per animal, kg	122.7	132.8
Average daily gain, g	667	726
The cost of 1 kg of live weight gain, tenge	705.16	657.92
The sales price per 1 kg of live weight, tenge	1,000.0	1,000.0
The total cost of the weight gain, tenge	86,523.13	87,371.78
The total cost of sales, tenge	122,700.0	132,800.0
Profit, tenge	36,176.87	45,428.22
Profit margin, %	41.8	52.0

Comparing the weight gain of heifers grown using different technologies during the preweaning period, it should be noted that the absolute and the average daily live weight gain is higher in the heifers grown using the cold housing method. The average daily gain in this group over the entire period of growth was higher by 59 g, or 8.8 %, and amounted to 726 g, whereas in the group grown using the traditional technology, it was 667 g. The heifers grown using the cold housing method were superior to their peers grown using the traditional technology in terms of growing intensity over the entire period. Their relative growth rate was higher by 3.3 % than that in the first group.

Calculation of the economic efficiency of the calves keeping technology was performed with regard to the cost per 1 kg of live weight gain at the farm and sales prices from the data in the annual report, Table 3. The calculation was made for one animal and with regard to the live weight gain.

The data in Table 3 show that the heifers grown using the cold housing method grew more intensively, had higher live weight, and weight gain at the end of the preweaning period; their profitability was higher by 10.2 %.

DISCUSSION

To increase the production of livestock products and improve their quality, it is necessary to preserve as many newborn calves as possible. In the "Turar" farm, the method of year-round growing of calves in individual houses in open areas was introduced to the production.

The method of cold growing of calves is widely used in the Orenburg region. According to G.I. Belkov (Belkov, 1989), in this region, up to 300 thousand calves are raised annually using this technology in the winter and summer periods.

These results from the scientific and economic experiments indicate that the heifers using the cold housing method grow faster, and are less prone to gastrointestinal and respiratory infections (Klyuev and Karelin, 1987; Babich and Ovchinnikov, 2017). In our research, comparing the weight gain of the heifers kept in different conditions, it should be noted that during the growing period from birth to three months of age, the absolute and the average daily live weight gain was greater in the animals grown using the cold housing method by 8.5 kg and by 92 g, respectively, which is consistent with the data about growing replacement young stock at low temperatures in the Tyumen region (Ivanova and Volynkina, 2017; Richard et al., 1988; Bates and Anderson, 1984).

Similar results were obtained in Eastern Siberia, where the average daily gain in live weight of calves grown using the cold method was higher at the age of 60 days by 20.4% and at the age of 60-180 days by 10.8%, as compared to the traditional technology (Kashin and Kolesnikova, 2017). At the collective farm named after the Petrovs in the Kabardino-Balkar Republic, it was also noted that by the end of the preweaning period, the heifers grown by the cold method outperformed their peers grown in premises in terms of live weight by 12.6 kg, or 8.0%. They also demonstrated the formation of high immunity to diseases (Ulimbashev and Tarchokova, 2017).

In Hungary, the specialists of the Research Institute for Animal Breeding, Nutrition and Meat Science in Herceghalom conducted a comparative experiment on growing calves in the open air and indoors during the summer and winter periods. The results of the experiment allowed the researchers to recommend the method of growing young stock in the open air for widespread introduction to production (Kleimenov and Kleimenov, 1989; Daenicke, 1985).

Thus, the results obtained in the course of the research indicate that heifers, grown using the cold mwthod, grow more intensively and suffer less gastrointestinal and respiratory diseases.

CONCLUSIONS

The disadvantage of the cold housing method of keeping calves during the preweaning period is an increased consumption of bedding and forage. However, the advantages are significant including absence of high expenses for building recreation facilities, natural ventilation and ultraviolet irradiation, ease of cleaning and disinfection, possibility of fast relocation of individual huts, calves quickly adapt after relocation and are more resistant to respiratory and gastrointestinal diseases.

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The ethical permission

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CONFLICT OF INTERESTS

There is no conflict of interest.

AUTHORS CONTRIBUTION

E.A. Babich: Development of research ideas, obtaining data for analysis, writing manuscript text; L.Yu. Ovchinnikova: analysis of the data; O.S. Safronova: review of publications on the topic of the article.

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