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THE EFFECT OF INCREASED FEEDING ON HEIFERS AND THEIR SUBSEQUENT MILK PRODUCTION

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Abstract

As a result of the studies, the prematurity of cross-breed Simmental and Holstein animals in the early stages of growth was revealed. Hybrid heifers of the experimental groups reach a live weight of 380 - 390 kg at the age of 15 months and their control counterparts at 18 months age. Intensive raising of heifers allowed to accelerate the introduction of first-calf heifers into the herd. For milking during 305 days, experimental first-calf heifers, grown at a higher level of feeding, exceeded their analogue in control group by 9.2 -9.5%. The experimental first-calf heifers of 1/8 Simmental + 7/8 red-and-white Holstein genotype showed the highest productivity – 7590 kg. It is 757 kg and 1727 kg ($P \leq 0.001$) more than yields of heifers of 1/4 Simmental + 3/4 red-and-white Holstein genotype and 1/2 Simmental + 1/2 red-motley Holstein genotype respectively. Differences in milk productivity in animals of their control group are not so significant, but the pattern remains. So, in first-calf heifers of 1/8 Simmental + 7/8 red-and-white Holstein genotype milk yield was 6949 kg, which is 603 kg and 1595 kg ($P \leq 0.001$) more than in the same age cows of 1/4 Simmental + 3/4 red-and-white Holstein genotype and 1/2 Simmental + 1/2 red-and-white Holstein genotype respectively. The advantage in yield of milk fat and milk protein during the first lactation remains with the cows from the experimental groups. The first-calf heifers of the experimental groups showed higher values of the coefficient of lactation constancy (87, 3 - 97, 5%) than the cows of the same age in control groups (82, 8 - 95, 7%). Cows from the experimental groups are characterized by a high coefficient of milk yield (1079 - 1422) and as a result have a more prominent milking feature.

Key words: live weight, fat, protein, milk productivity, genotype, rearing, cow, breeding reproducer.

Introduction

Thanks to purposeful breeding, breeders and practitioners created hybrid Simmental-Holstein herds with high genetic potential for milk production. E.g., the average milk yield per feed cow was 6,700 kg and in the leading breeding reproducers it was 9 - 10 thousand kg of milk on the farms of Mordovia Republic.

It is known that the animal's genotype determines the directed development of all economically useful qualities, as well as the rate of the body's reaction to environmental factors. At the same time, the general biological purpose of young animals rearing is aimed at obtaining farm ones with optimal live weight. In this regard, it is important to obtain the desired genotypes by selecting parental types taking into account such qualities as pedigree and individual hereditary qualities, productivity, age, live weight (Golubkov *et al.,* 2019; Guryanov *et al.,* 2001; Guryanov *et al.,* 2010; Matros *et al.,* 1990). Growth and development during the rearing period of young animals determines feeding, which contributes in the best way to the reproductive ability of future heifers. Holstein youngsters have puberty, *i.e.* the first estrus time, occurs with a live weight of 270-300 kg at the age of 9-12 months (Taratorkin and Petrov, 2009; Gamko *et al.,* 2011). To achieve higher milk production rates (10-11 thousand kg of milk), to realize the created genetic potential for the productivity of Holstein hybrid cattle, it is necessary to develop technologies for intensive rearing of young animals for accelerated production of first-calf heifers. The available data (Kopaneva *et al*., 2017; Abushaev, 2014; Kleimenov *et al.*, 1989; Petrov and Taratorkin, 2007) indicate that the targeted rearing of heifers subsequently contributes to higher milk productivity, expanding the possibilities for livestock production use.

Meanwhile, such work with Holstein hybrid animals in industrial technology in Mordovia Republic was not carried out.

The aim of this work is to study the effect of increased feeding level of different genotypes heifers on growth and subsequent milk productivity.

Material and methods

The experiments included Holstein hybrid cattle. The breeding herd was created on the basis of Simmental cattle imported from Austria and red-and-white Holstein cattle. On the base of the industrial complex LLC Agrosoyuz in Mordovia Republic, 6 groups of heifers were formed with 30 animals each, three experimental and three control ones. Heifers in groups were selected by pair-analogues method taking into account their live weight and genotype.

Animals of the control groups received the diet, compiled to obtain an average daily gain in live weight of 650-700 grams. The nutritional value of the diet for the control group is balanced by the main indicators in accordance with the norms and diets of Russian Academy of Agricultural Sciences (Kalashnikov *et al.*, 2003). The diet for the same animals from the experimental groups was compiled to obtain an average daily gain in live weight of 750-800 grams.

The first experimental group included heifers with the genotype 1/2 Simental (S)+ 1/2 red-and-white Holstein (RWH); the second one included heifers with the genotype 1/4 (S) + 3/4 red-and-white Holstein; and the third one included heifers with the genotype 1/8 (S) + 7/8 red-and-white Holstein. Heifers with 1/2 (S) + 1/2 (RWH) genotype were selected in the fourth control group; the fifth one included heifers with a genotype of 1/4 (S) + 3/4 red-and-white Holstein; and the sixth group consisted of 1/8 (S) + 7/8 (RWH) genotype heifers.

To study the growth characteristics, all experimental animals in the groups were weighed individually at birth, then at 3, 6, 9, 12, 15, 18 months of age, and first-calf cows at the 2nd month of lactation. Milk productivity was checked by weekly control milking. The fat and protein content in milk was determined once a month. The lactation constancy coefficient was calculated by the method proposed by Furhner (1964) in the modification of A.A. Aksennikova (1963) and Kalashnikova *et al.,* (2012). Milk ratio was determined by the formula:

$\kappa M = Y/\chi M$

where κM is milk ratio

χ is milk yield for lactation

χM is live weight.

The data obtained within research were processed by the method of variation statistics proposed by E. K. Merkurieva, (1970) and N. A. Plokhinsky, (1963)

Results and Discussion

Intensive rearing of young animals contributes to the earlier introduction of animals into the dairy herd, higher productivity of first calving cows, expanding livestock production opportunities. It is clear that of all environmental factors, feeding conditions have the highest impact on livestock productivity. It is also known that in the structure of production of milk cost, the share of feed takes 50-60%, and beef does 65-70%. Therefore, in modern animal husbandry, the optimization of full-fledged animals' feeding is the basis for optimizing production cost, and an important component of production modernization, which will contribute to the accelerated introduction of intensive technologies that will realize the genetic potential of Holstein hybrid cattle and reduce feed consumption per production unit (Shishkin, 2004; Sirotinin, 2007).

As our studies have shown, a different amount of feed was consumed table 1 as a result of intensive growth of heifers until they reach a mass of 380 kg and, respectfully, different mating ages. Heifers up to 3 months of age in the experimental groups were fed more than 30

Table 1: Feed expenditure for young animals growing.

Index	Experimental groups (15 months)	Control groups (18 months)
Feed expenditure from birth to 15 months of age		
Milk, kg	290	260
Prestarter, kg	42	26
Starter, kg	189	162
Hay, kg	207	207
Haylage, kg	2610	2610
Silo, kg	990	990
Concentrates, kg	351	351
Sunflower meal, kg	54	30
Energetic feed unit (EFU)	2223	2015
Feed expenditure from 15 to 18 months of age		
Hay, kg		45
Haylage, kg		900
Silo, kg		450
Concentrates, kg		140
Nutrient costs for the growing period		
EFU	2223	2787
Digestible protein, kg	237,0	277,1
Digestible protein containing in 1 EFU	106,6	99,4

kg of whole milk and 16 kg of prestarter compared with heifers from the control groups. From 3 to 6 months of age, heifers of the experimental groups were additionally fed with rations of 27 kg of starter feed, compared with the control groups. From 6 to 12 months of age, animals of the same groups were additionally fed 24 kg more of sunflower meal, compared with the control ones. As the result, heifers from the experimental groups reached a live weight of 380 kg at the age of 15 months and were successfully inseminated. Heifers from the control groups reached this live weight for insemination at the age of 18 months.

Hence, in connection with longer growing period until reaching a live weight of 380 kg, feed costs in the control groups increased significantly. Heifers from the control groups consumed 90 kg more of hay, 900 kg more of haylage, 450 kg more of maize silage, and 140 kg more of concentrate.

During the growing period, the total nutritional value of the given feed for the heifers of the experimental groups was 2223 energetic feed unit (EFU) and 237 kg of digestible protein, and for the same animals in the control groups was 2787 EFU and 277.1 kg of digestible protein, respectively, which is 25.0% and 16.9% more.

One EFU in the control group accounted for 99.4 g of digestible protein and in the experimental groups it did 106.6 g.

According to the results of young animals' growth, it can be noted that before reaching the live weight of 380 kg, 6.49 EFU per 1 kg of growth was spent in the 1st group. For the second one this indicator was 6.36, for the third group it was 6.42 EFU. For the 4th, the 5th, and the 6th this indicator was 8,02, 7,70, and 7,66 respectively. At the same time, the cost of digestible protein per 1 kg of growth in the 1st group amounted to 691 g and 677 g, 684 g, 798 g, 766, and 762 g in the 2nd, the 3d, the 4th, the 5th and the 6th group respectively. Hence, due to the more intensive growth of young animals at a young age, it is possible to save feed and reduce the cost of energy feed units and digestible protein per 1 kg of live weight gain.

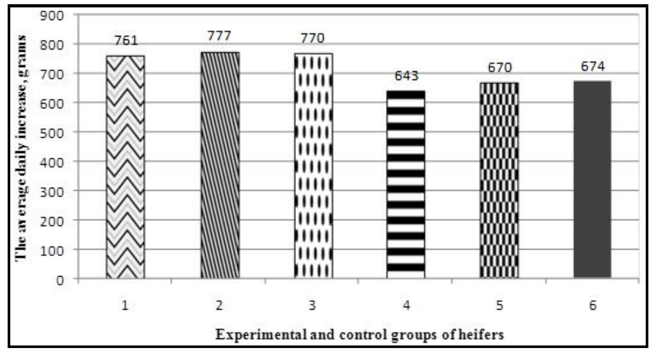

Fig. 1: The average daily increase in heifers, grams.

The change in live weight of different genotypes heifers grown at different feeding levels was significant. During the experiment, the heifers of all groups, due to different feeding levels and genotype, grew with different intensities. The heifers of the experimental groups with 75.0 % of Holstein blood in the genotype differed in more intensive growth table 2.

The results of table 2 show that at three months of age, the heifers of the 1st experimental group with a genotype of 1/2 (S) + 1/2 (RWH) exceeded their homogenous counterparts in live weight by 8.8 kg. At 6 months of age they advantage was significantly 22.2 kg. An 9, 12, and 15 months of age these indicators were 31.9 kg, 46.6 kg, and 51.8 kg respectively (P≤0,001).

The heifers of the second experimental group with a genotype of 1/4 (S) + 3/4 (RWH) exceeded the counterparts from the control one, respectively, in similar age periods by 7.3 kg; 18.6 kg; 27.3 kg; 37.6 kg and 49.0 kg (P≤0.001).

The heifers of the third experimental group with a genotype of 1/8 (S) + 7/8 (RWH) had an advantage over the control same animals in the same age periods by 7.4 kg; 22.9 kg; 27.0 kg; 39.9 kg; 47.6 kg respectively (P≤0.01; 0.001).

-As a result of the studies, it was found that the average daily gain in heifers of the first experimental group for 15 months of growth was 761 grams; for the second and the third ones it was 777 grams and 770 grams respectively Fig. 1. The heifers of all experimental groups, upon reaching a live weight of 379-387 kg at the age of 15 months, were successfully inseminated.

The heifers of the control group being fed by ordinary ratio, had daily average growths of 643-674 grams and reached

Table 2: Dynamics of heifers' live weight.

Index	Group of animals					
	Experimental			Control		
	1	2	3	4	5	6
At birth	36,5±0,79	37,5±0,88	37,0±1,21	36,9±0,99	37,1±1,10	37,0±1,19
3	100,1±2,36	98,2±2,03	90,4±2,21	91,3±2,73	90,9±2,65	83,0±2,26
6	170,5±3,17	173,7±3,85	168,4±4,61	148,3±3,54	155,1±3,57	145,5±3,93
9	247,4±4,32	250,8±4,54	241,0±5,47	215,5±4,16	223,5±3,79	214,1±5,81
12	314,4±4,52	322,8±5,57	317,3±5,37	267,8±5,62	285,2±5,44	277,4±6,43
15	379,0±5,52	387,0±6,03	383,4±5,28	327,2±6,12	338,0±5,89	335,8±7,38
18				384,1±8,11	398,8±6,14	400,8±8,35

a weight of 384-400 kg at the age of 18 months. Hence, the intensive raising of heifers will speed up the introduction of first-calf heifers into the herd.

Numerous data of domestic researchers show that the milk productivity of cows directly depends on their live weight in the growing process (Moroz, 2006; Borovsky, 1991; Kozankov *et al.*, 2002). Our studies show that different levels of young animals feeding during their rearing subsequently reflected on the level of milk productivity. Thus, in 305 days milk yield, experimental first-calf heifers grown at a higher level of feeding exceeded their peers by 9.2 - 9.5% table 3.

E.g., the first-calf heifers of the genotype 1/2 (S) + 1/2 red-and-white Holstein, fed by plentiful ratio, subsequently exceeded their analogues from the control group by 509 kg. The heifers of the genotype 1/4 (S) + 3/4 (RWH) exceeded the same animals from the control group by 603 kg and heifers of the genotype 1/8 (S) + 7/8 (RWH) exceeded their peers by 641 kg.

If we consider the obtained data on milk productivity in the context of genotypes, then the highest productivity (7590 kg) was obtained from experimental first-calf heifers with a genotype of 1/8 (S) + 7/8 red-and-white Holstein. This is 757 kg and 1727 kg ($P \leq 0.001$) more than from heifers of the genotype 1/4 (S) + 3/4 (RWH) and 1/2 (S) + 1/2 red-and-white Holstein. Differences in milk productivity in animals of their control group are not so significant, but the pattern remains. For example, in first-calf heifers of the genotype 1/8 (S) + 7/8 red-and-white Holstein, the milk yield was 6949 kg, which is 603 kg and 1595 kg ($P \leq 0.001$) more than in the animals of the same age of the genotype 1/4 (S) + 3/4 (RWH) and 1/2 (S) + 1/2 red-and-white Holstein.

It should be noted that the feeding conditions during the growth of heifers did not have a significant effect on the content of fat and protein in milk. However, the advantage in yield of milk fat was observed in animals from the experimental groups.

According to the yield of milk fat during the first lactation, the advantage of the cows of the first experimental group is 20.2 kg, the second one is 24.5 kg and the third group is 26.7 kg. Among the genotypes, high-blood Holstein cows of 1/8 (S) + 7/8 (RWH) from the experimental groups with 307.4 kg of milk fat obtained, are distinguished. This is more than 30.0 kg and 68.8 kg ($P \leq 0.001$) in group of cows of the genotype 1/4 (S) + 3/4 (RWH) and in cows with the genotype 1/2 (S) + 1/2 (RWH) respectively.

Cows with a genotype of 1/8 (S) + 7/8 (RWH) differ in protein content in milk. They are superior to animals of the same age with a genotype of 1/2 (S) + 1/2 (RWH) and 1/4 (S) + 3/4 (RWH) by 0.07 - 0.08% (P d" 0.001). According to the yield of milk protein, the differences between these genotypes were 29.4 - 63.8 kg ($P \leq 0.001$).

First-calf heifers raised at a higher level of feeding were characterized by a higher live weight, although they were inseminated at a younger age (15 months). The differences were 1.0 - 1.3%. At the same time, the highest values of the lactation constancy coefficient of 87.3 - 97.5% were noted in individuals of the experimental groups, whereas in animals of control group these indicators were 82.8 - 95.7%. Experimental cows are distinguished by a high coefficient of milk yield (1079-1422), which indicates a more prominent milking feature of animals table 3.

It should be specially noted that animals with high-blood of Holstein have higher milk production rates, in comparison with other genotypes.

Conclusion

Holstein hybrid animals in the dairy complex are able to intensively increase live weight at a young age, which

Table 3: Milk productivity of cows in 305 days of the first lactation.

Index	Group of animals					
	Experimental			Control		
	1	2	3	4	5	6
Milk yield, kg	5863±378	6833±259	7590±286	5354±414	6230±228	6949±321
Fat, %	4,07±0,01	4,09±0,02	4,12±0,01	4,08±0,01	4,08±0,02	4,13±0,01
Protein, %	3,34±0,02	3,37±0,01	3,42±0,02	3,35±0,02	3,35±0,02	3,42±0,02
Milk fat, kg	238,6±15,4	277,4±14,2	307,4±14,4	218,4±16,1	252,9±13,2	280,7±14,7
Milk protein, kg	195,8±14,4	230,2±14,9	259,6±15,5	179,3±15,1	208,7±16,1	237,6±15,9
Live weight, kg	543,0±5,6	532,8±7,68	533,8±8,61	536,1±6,62	527,2±12,9	528,9±17,6
LCC (1)	87,3±3,0	91,6±2,08	97,5±2,53	82,8±2,79	92,9±3,11	95,7±2,56
MR (2)	1079	1282	1422	998	1181	1313

1- lactation constancy coefficient
2 - milk ratio

indicates the early maturity of animals. Heifers inseminated at the age of 15 months, having reached live weight by the time of insemination of 380 kg, had the highest milk yield. High-blooded Holstein heifers respond better to increasing the nutritional value of ratio during raising and milk production process.

Therefore, directed rearing of heifers is an important factor in obtaining more productive cows in industrial complexes.

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