Efficiency of Implementing a New System for Feeding Cows of Holstein Breed

T A Khoshaipo, V V Verkhoturov and Y A Kozub

1Kuban State Agrarian University named after I.T. Trubilin, 13, Kalinin street, Krasnodar, 350044, Russian Federation
2National Research Irkutsk State Technical University, 83, Lermontov street, Irkutsk, 664074, Russian Federation
3Irkutsk State Agricultural University named after A.A. Ezhevsky, Irkutsk, 664038, Russian Federation

E-mail: tatyana_zabai@mail.ru, biovervv@mail.ru, yulia_a72@mail.ru

Abstract. Feed makes up to 70% of the total cost of feeding livestock. Therefore, high-quality feeding, based on the satisfaction of animals with the necessary level of nutrients and nutrients, is the key to the quality and profitability of the final product. It is known that ruminants have fundamental differences in the physiology of digestion and metabolism, when, due to the enzymatic activity of microorganisms, not only quantitative, but also qualitative characteristics of almost all components of the feed change. In this regard, we conducted production experience in introducing a new feeding system for Holstein cows, first-calf cows. For this, two groups of cows were formed on the basis of analogues and placed in different sections. The cows of the first group were fed according to the old feeding system, i.e., the feed was prepared in SILOKING feeders. Cows of the second group were fed from KONGSKILDE feeders. At the end of the experiment, data were obtained on obtaining the greatest amount of milk productivity of cows of the second group, which were fed 628.0 kilograms according to the new feeding technology.

1. Introduction
Digestion in dairy cows is characterized by a higher tension than in growing or meat animals. For a day, a dairy cow should digest the feed of a diet containing 60-80 thousand kcal, while a meat animal of the same weight needs 30-35 thousand kcal. An animal can digest more feeds under favorable conditions [1].

Digestion in ruminants occurs partly in the rumen and partly in the intestine. The selection of feed in the diet can affect the distribution of digestion in parts of the digestive tract, for example, in ruminants. To accelerate the digestion of feed in animals with a simple stomach, they need to feed feeds that stimulate the secretion of digestive glands. Ruminants, in addition, must be given such feeds or nutrients that would stimulate the activity of the rumen micro flora [2].

Among the specific features of ensuring normal digestion in ruminants, in particular cows, are the requirements for the physical condition of the feed [3].
So, fiber, digesting in the rumen, should come in the form of large particles. If the feed containing fiber is finely ground, then it may not linger in the stomach, cannot be digested in the small intestine, and if it partially breaks down in the large intestine, then the effectiveness of its use will be low [4].

For the digestion of fiber and hemicelluloses, food must be retained in the rumen for a sufficient time. Conversely, protein substances, such as denatured casein, should not be retained for a long time in the rumen. If asked in large lumps, it will linger in the rumen, will be split to ammonia, and its use will be low, and finely ground quickly passes into the abomasum and intestines and is well used. The processes in the rumen are also affected by the fineness of grinding feed containing starch [5].

Ensuring accelerated and complete digestion in cows requires the selection of feeds that allow uniformly loading the tract, promoting the activation of micro flora and the secretory function of the digestive tract and delaying, or, conversely, the rapid passage through the rumen of substances that make up the food mass [4,6].

2. Materials and methods
In connection with the foregoing, we set a goal - to study the productive qualities of Holstein cows using a management program prepared for feeding fodder.

To achieve this goal, the following tasks were set and performed: to determine the technological processes of livestock production; analyze the conditions of feeding and keeping cows; to study the eating behavior of cows; analyze the milk production of cows; determine milk quality control.

The studies were conducted in a dairy farm on 100 heads of Holstein breed heifers feeding on different feeding systems.

The first group (control) included 50 heads of heifers receiving feed according to the old feeding system, that is, the preparation of feed for animals was carried out in a SILOKING mixer-feeder with a capacity of up to 8 m³.

The second group (experimental) was formed from analogous heifers in the same amount. Their feeding system was developed according to a new scheme, that is, the preparation of feed mixtures was carried out in a new KONGSKILDE mixer-feed distributor with a volume of 16 m³.

KONGSKILDE (JF) is the largest manufacturer of feed mixer in Northern Europe. To date, JF offers a wide range of feed mixer with vertical augers for farms with a livestock of cattle of 35-350 heads. The principle of mixing feed ingredients and feeding in accordance with the principle of “Complete mixed diet” is also gaining popularity in small farms [7].

KONGSKILDE is the first feed distributor to use predominantly fine grained steel S500 / 650 in production. The use of fine-grained steel is very important in the manufacture of the screw and the first 50 cm of the walls, since these details are subject to the greatest wear [8].

Another significant advantage of the KONGSKILDE feeder is its optimum comfort. There is no need to leave the tractor cab and come back in order to rotate the display. All functions are controlled directly from the terminal [7].

The diet composition of the cows of both groups was the same. The difference was only in the particle size of the feed fed. According to the set goal, we studied the nutritional behavior of the first heifers of the experimental groups, which was studied by the method of V.I. Velikzhanin. After the observations, the time spent by the animals on feeding, drinking water, rest, chewing gum and movement was calculated. The materials of primary veterinarian accounting were used in the work; information coming from the sensors of the company DeLaval program «DelPro».

Milk productivity of cows was determined for 4 months (60-180 days after calving) of the second lactation according to the following indicators: gross yield, milk fat, milk protein according to State standard 25966-83 (ST SEV 3459-81) «Agricultural breeding animals. Methods for determining the productivity parameters of dairy and combined cattle».

The amount of milk of basic fat content was determined by the formula:

\[ M_{b.f.} = \frac{M_{a.f.} \times F_{a.f.}}{3.4}, \]
where $M_{b.f.}$ – amount of milk of basic fat content, 
$M_{a.f.}$ – amount of milk of actual fat content, 
$F_{a.f.}$ – the actual fat content of milk in the household, 
3,4 – Russian basic fat content.

The results were processed by methods of variation statistics in the Statistical 12.5 software product. The reliability of the intergroup difference was determined by the Student $t$-test method.

3. Research results

In order for animals to show genetically determined productivity, they must receive a certain amount of nutrients with feed. Accurate determination of nutrient requirements is critical to achieving expected productivity with the economical use of feed [9].

The lack of certain nutrients causes a violation of the physiological state of animals and a decrease in their productivity, an excess of nutrients leads to irrational consumption. Similar negative phenomena occur with the wrong ratio of nutrients coming from the feed in the body [3,10]. Table 1 presents the diets used in feeding experimental cows.

| Ingredient  | Lactation phase 0-19 | Lactation phase 20-180 | Lactation phase 181 и ≥ |
|-------------|----------------------|------------------------|-------------------------|
| Syrup       | 0.9                  | 1.0                    | -                       |
| Haylage     | 7.0                  | 8.9                    | 22.0                    |
| Silage      | 18.0                 | 18.0                   | 19.0                    |
| Compound feed | 9.3               | 12.3                   | 2.3                     |
| Straw       | 0.4                  | 0.5                    | 2.0                     |
| Beer grains | 6.0                  | 7.87                   | 7.0                     |
| Total       | 41.5                 | 48.6                   | 52.3                    |

As the data in table 1 show, the entire lactation period is divided into 3 parts (phases). The first part of lactation lasts from calving to 19 days. At this time, the amount of molasses in the diet was 0.9 kg; silage - 7.0; silo 18.0; compound feed 9.3; straw - 0.4; grains of beer 6.0 kilograms per day.

In the second period of lactation, and it lasts from 20 to 180 days after calving, the amount of feed in the diet varies. So there is a slight increase in molasses - by 0.1 kg. The amount of haulage also increases by almost 2.0 kg. The volume of feed silo remains at the same level during all periods of lactation. A noticeable increase in feed - 12.3 kg, which is 3.0 kg more than in the first phase. During the dawning period, farm specialists increased the yield of beer grains - by 7.87 kg.

Beer pellet, thanks to its valuable nutrients and special action, is a good help in feeding. Its advantages: a lot of high-quality protein; low cleavage of protein in the rumen; contains as much energy as concentrated feed; high content of natural active substances; increases consumption of basic feed; is a balancing feed; diet food; healthy food [11].

In the third period of lactation (181 days before launch), it is characterized by the same presence of feed with the exception of molasses. Beet molasses (beet molasses) is a waste of sugar beet production, feed for farm animals and a food product. The amount of molasses after processing beets for sugar is 3.5-5% by weight of the feedstock [11]. But the amount of assigned haulage has noticeably increased by more than 2 times and amounted to 22.0 kg. The feed mass was reduced to 2.3 kg per day, and straw was added to 2.0 kg. The number of given grains has not changed. In general, in the first period of lactation, first calf received 41.5 kg of feed, in the second - 48.58 kg and in the third period - 52.3 kg of feed.

In animals that have already grown, during normal provision with fodder resources, food excitement occurs rhythmically, although if a well-fed animal is given a certain feed, then natural reflexes will cause a motivational state [6]. At the end of our studies, we observed the behavior of animal experimental groups.
Table 2. Timing of the main acts of behavior of experimental animals, М±m.

| Element conduct       | Group          | control minutes | %       | experienced minutes | %       | experienced to control, ± minutes |
|-----------------------|----------------|-----------------|---------|---------------------|---------|----------------------------------|
| Standing              |                | 266.9±2.81*     | 18.7    | 251.3±3.33          | 17.5    | -15.6                            |
| Lying                 |                | 507.6±1.32      | 35.2    | 569.8±2.54***       | 39.6    | 62.6                             |
| Eating feed           |                | 244.3±2.59**    | 17.0    | 217.1±1.98          | 15.1    | -27.2                            |
| Water intake          |                | 28.3±3.87       | 2.0     | 22.1±2.88           | 1.5     | -6.2                             |
| Milking               |                | 21.6±1.14       | 1.5     | 25.1±1.16           | 1.7     | 3.5                              |
| Gum                   |                | 371.7±4.43*     | 25.8    | 354.6±1.22          | 24.6    | -17.1                            |
| incl. lying down      |                | 247.1±1.75**    | 17.2    | 226.0±0.49          | 15.7    | -21.1                            |
| standing up           |                | 124.6±4.24      | 8.6     | 128.6±1.71          | 8.9     | 4.0                              |

Note: *Р≥0.95; **Р≥0.99; ***Р≥0.999

Analysis of table 2 shows that the difference in the timing of the eating behavior of experimental cows varies greatly. So, the biggest difference in behavioral acts is observed when resting lying down, the difference is deeply reliable at the third threshold (Р≥0.999) and is 62.6 minutes. This is probably due to the fact that the cows of the experimental group ate their feed faster, as a result of which they had more time to rest.

This indicator is reflected in the line «Eating feed». The cows of the experimental group consumed food by 27.2 minutes, which amounted to 217.1±1.98 minutes. When receiving water, cows grown according to the new feeding system were also faster than their peers who received food according to the old technology. The difference was 6.2 minutes.

Naturally, the cows of the experimental group milked longer, as they gave more milk, as will be discussed below. In the control group, the cows were milked 21.6±1.14 minutes, and in the experimental group, 25.1±1.16 minutes in total per day.

Of particular interest is the chewing gum indicator. According to observations of eating behavior, it is clear that the cud in the cows of the experimental group lasted 354.6±1.22 minutes, and in the cows of the control group - 371.1±4.43 minutes. The difference in favor of the cows of the experimental group by 17.1 minutes (Р≥0.95) on the first threshold of reliability. This can probably be explained by the fact that cows consumed the feed specified by them faster, and accordingly, its digestion passed faster, since the feed particles were smaller than in the given feed of the control group.

Signs by which the level of cow productivity is judged are the amount of milk yield and the content of nutrients in the milk. Of the latter, the highest importance is given to the content of fat and protein in milk. Currently, different methods are used to assess the milk production of cows, but the most common of them is milk yield for 305 days, or for full lactation [1].

In each cow, the level of milk productivity is more dependent on individual characteristics, due to the genotype. Within the limits of one herd with rational feeding, part of the highly productive cows is 3-4 times or more superior in the yield of low-producing cows. In this case, the variability in milk yield in the herd is 20-23% [9].

Analysis of the productive qualities of experimental first-calf cows indicates that the live weight of the first-calf heifers of the experimental group was higher than that of the first-calf heifers. The difference was 22.0 kg.

The indicator of the second completed lactation in the first group was 7600.0 kg, in the second - 8225.0 kg of milk. The superiority in favor of the first-calves of the experimental group is 628.0 kg or 8.2 percent.

The first-calf heifers grown in different feeding systems also differed in butterfat milk production. The amount of fat in the experimental group was 3.5%, in the experimental group - 3.3%, the
difference is only 0.2 absolute percent. The amount of milk fat was also obtained more from the experience group cows. The protein content in the milk of both groups was almost at the same level of - 3.1-3.21 percent.

Technological input control at the enterprise is carried out upon receipt of raw materials (milk - raw materials, cream - raw materials or other food products used as raw materials) according to accompanying quality documents, in which the supplier must provide information on the availability of veterinary certificates (certificates), hygiene certificates, certificates of conformity (test protocols of technological predecessors) and others.

The hygiene indicators of raw milk are influenced by many factors, and above all, the sanitary condition of milking machines. It should be borne in mind that in most first-calf heifers during the first lactation the udder is not infected yet, but if the milking machine allows milk to reverse the milk flow during milking, the nipple is washed with milk and bacteria enter the udder through the milk channel [5,6].

The source of microorganisms in milk can be sick quarters of the same cow or an infected udder of other cows, as well as towels, hands of milkmaids, contaminated glasses of the milking machine. The latter can injure the nipple canal and the skin of the nipple, causing the possibility of infection of the udder and the development of mastitis. Therefore, when using milking machines, the correct installation of cups, the reliable operation of vacuum machines, maintaining the established vacuum during the entire time of milking the cows, timely cleaning and disinfection of the milking machine, replacing the nipple rubber after 1500-2500 milks [5].

The research results indicate that all indicators of the planned production control of milk carried out in the Argus test center meet acceptable levels. So, for all categories of indicators: physic-chemical, microbiological, antibiotic groups, toxic elements, pesticides, mycotoxins, they were all within the limit.

The importance of animal husbandry as a branch of agriculture cannot be overestimated. The development of animal husbandry determines the degree of saturation of the market with high-calorie food products - meat, eggs, dairy and other products, which, due to their importance in human development, are called intellectual products [1].

However, a decrease in the productivity of cows, often cows, is often associated not only with age, but also with other factors that cannot be ignored when assessing a herd of cattle [1,3].

Opportunities for fundamental changes in the economy are available in all farms and divisions. Many of them, having the same amount of resources as the lagging farms, overfulfilling the planned targets, achieve low milk costs, high labor productivity and payback [8].

4. Conclusion

In terms of basic fat content, we received an average of 7376.5 kg of milk from the cows of the control group, in the experimental group - 8466.9 kg. The difference was 1090.4 kg of milk in favor of the cows of the experimental group.

Considering all the costs incurred to maintain one cow in a given farm, we see that more funds were spent on keeping cows fed under the new feeding system. The difference was 2.0 thousand rubles. The selling price of one kg of milk in the farm under consideration as of 01.01.2019 was 23.7 rubles.

The proceeds from the sale of products in the experimental group amounted to 200.6 thousand rubles, in the control - 174.8 thousand rubles, which is less by 25.8 thousand rubles.

Hence, the level of profitability in the production of milk by different feeding systems in the farm in the control group amounted to 20.8%, in the experimental group - 36.7%, the difference is 15.9 percent.

Thus, the studies conducted on the testing of the new feeding system for Holstein cows give evidence that the use of KONGSKILDE feed mixer-feed mixers increase the profitability of production with a loose system of milk content in an industrial environment.
5. References

[1] Chinarov V I 2018 Assessment of the competitiveness of dairy breeds of cattle *Achievements of science and technology of the agro-industrial complex* 10

[2] Ulimbashev M B, Alagirova Zh T 2016 Adaptive abilities of Holstein cattle during introduction into new habitat conditions *S.-kh. biol., Agricultural biology, S-h biol, Sel-hoz biol, Sel'skokoziyaistvennaya biologiya* *Agricultural Biology* 2

[3] Vlasov V, Kareлина L, Kozub Y 2012 Metabolic aspects of cows productivity when feeding “FELUCEENE” *Dairy and beef cattle breeding* 5 pp 19-20

[4] Kozub Y A 2009 Dynamics of productivity of cows different genotypes during lactation in the region *Siberian Bulletin of Agricultural Science* 6(198) pp 61-64

[5] Tagirov Kh Kh, Ganieva E S, Galieva Z A 2019 INFLUENCE OF FEED ADDITIVE "BIODARIN" ON DAIRY PRODUCTIVITY AND CHEMICAL COMPOSITION OF MILK *Current Problems of Intensive Development of Animal Husbandry* 22-1 pp 193-199

[6] Komlatsky V I et al 2020 Technological process intensification trends in livestock *J. Phys.: Conf. Ser.* 1515 022009

[7] Komlatsky V I, Tahoe-Godi A Z, Podoinitsyna T A 2017 To the problem of automation of technological processes of milk processing and production of dairy products *Transactions of the Kuban State Agrarian University* 69 pp 236-242

[8] Takho-Godi A Z, Takho-Godi G A, Podoinitsyna T A 2018 Robots in the production of meat, dairy and fish products In the collection: Problems in animal husbandry Materials of the international scientific and practical conference pp 81-89

[9] Podoinitsyna T A, Kozub Y A 2019 Regular changes in hematological and biochemical indicators and immunogenetic certification of yak blood introduced in new conditions IOP Conference Series: Earth and Environmental Science Vol 315 152072 042007

[10] Komlatsky V I, Al Azaawi U A T, Podoinitsyna T A 2017 Behavior and productivity of dairy calves when kept in huts *Bulletin of agricultural science of Taurida* 10(173) pp 84-90

[11] Kolmogorova E A, Kolmogorov D A, Ivanova O V 2014 The use of brewer’s grain in feeding lactating cows *Agricultural journal* 7