The influence of feed quality from peat soils on the productivity of cattle

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Abstract. In the context of the implementation of environmental, resource-saving systems of agriculture, research in the system of biogeocenosis is very relevant: soil – plant-feed-animal-livestock products. Peatlands and developed peat soils are a kind of environment for human activity in this system. As a result of many years of research, it was found that perennial grasses grown on peat soils have differences in chemical composition compared to plants grown on mineral soils. They contain more organic matter and raw protein. However, their digestibility of nutrients is lower than in herbs grown on mineral soils. Therefore, for a full-fledged balanced feeding of cows, the realization of the genetic potential of animal productivity, and the preservation of their health, scientifically-based diets are necessary, developed on the basis of bulky feeds obtained from peat and developed soils, with the introduction of appropriate feed additives in them.

Keywords: peat soils, feed quality, feed digestibility, cattle productivity, nutrients, feed additives.

1. Introduction

The potential of peat soils is very high, especially against the background of a huge number of low-fertile podzolic soils, which have a number of specific features that affect the species diversity of plants, chemical composition, digestibility, feed quality and, as a result, assume the specifics of the organization of animal husbandry in this biogeocenosis [1, 2, 3]. Conducting comprehensive research allows us to improve detailed feeding standards for highly productive cattle, develop animal feeding rations based on the assessment of the quality of plant raw materials and feed obtained from peat and developed soils, which is relevant for improving the efficiency of the livestock industry. The realization of the genetic potential of dairy cows depends on providing them with metabolic energy by 50%, protein by 25 % and minerals and vitamins by 25 % [4, 5, 6]. Therefore, the most important condition for increasing the productivity of farm animals and increasing the production of livestock products is to create a solid feed base and provide animals with a sufficient amount of high-quality feed. One of the main ways to increase the milk productivity of cows is a full and balanced feeding, which allows you to fully unlock the genetic potential of the animal, increase productivity and reduce feed consumption per unit of production.
2. Methods and materials
The work was carried out in the farm "Kirovskaya lugobolotnaya experimental station", located on the drained low-lying peat mass "Gadovskoye" in the North-eastern part of Russia. To solve the tasks set, field, laboratory, physiological (according to the determination of digestibility by the invivo method), scientific and production experiments were conducted. Harvesting of all types of feed was carried out according to the existing methodological recommendations, the assessment of the green mass and feed from it was carried out according to the current GOST standards [7, 8]. The animals for the experiments were selected according to the principle of pairs of analogues, taking into account the breed, origin, age and live weight [9, 10]. Rations and balancing additives were made based on the need for nutrients of animals and the characteristics of their content in feeds grown on peat and developed soils. The chemical composition of feed and feces was determined according to generally accepted methods of zootechnical analysis [11]. The following parameters were determined: dry matter – by drying in a drying cabinet, ash – by dry salting, nitrogen – by the Kjeldahl method, fat – by the skimmed residue method, fiber – by Henneberg and Shtoman, BEV – by calculation, potassium, calcium and sodium – by a flame photometer, phosphorus – by the vanadomolybdate method, organic acids in silage and haylage according to Wagner, sugar according to Bertrand, trace elements – by atomic absorption. The amount of total nitrogen in the urine of animals was determined by Kjeldahl. The calculation of gross, digestible, exchange energy and energy-protein ratio was carried out according to existing recommendations [12, 13, 14] using the Excel program.

3. Results and discussion
The rations developed on the basis of feed assessment based on actual data of chemical composition and digestibility (invivo) allow us to detail the feeding norms of cattle, increase the productivity and resistance of animals, and ensure effective cattle breeding on peat soils. Of all the feeds, it is bulky feeds that have the most unstable chemical composition and nutritional value. A large number of factors affect the quality and nutritional value of bulky feeds – weather conditions, soil, the phase of vegetation of plants during harvesting, feed storage conditions, etc. Long-term studies have established that the productivity and nutritional value of forage crops are greatly influenced by the growing environment of these crops. Thus, on organogenic soils, the interphase periods of plant development, especially of perennial grasses, are 5-7 days longer compared to plants grown on mineral soils, due to the fact that peat soils are more "cold" and moisture-intensive. The content of crude protein in forage crops grown on peat soils is 7-8 % higher than in plants from podzolic soils, which is associated not only with the elongated interphase period of plants, but also with the use of soil nitrogen by plants, which peat soils are richer than mineral ones. These positions indicate that the harvesting of high-quality feed on peat soils can last for a longer period than on mineral soils. Compliance with the technologies of forage harvesting and harvesting of grasses in the optimal phases of their development (the beginning of earing-earing) allowed us to obtain high-quality silage and haylage. The fiber content in the feed harvested during this period was in the range of 25-28 %, protein 12-15 %, in 1 kg of dry matter (Table 1).

| Years | Crude ash, % | Crude fiber, % | Crude protein, % | Crude fat, % | BEV, % | Sugar, % | OE, MJ | Feed units |
|-------|---------------|----------------|------------------|--------------|--------|----------|--------|------------|
| 2015  | 5,7-7,5       | 26,7-31,7      | 9,6-16,2         | 3,5-4,2      | 40-55  | _        | 9,2-9,8 | 0,7-0,8    |
| 2016  | 6,0-9,8       | 22,7-29,1      | 11,4-17,3        | 3,2-4,7      | 39-57  | 0,2-1,8  | 9,4-10,2 | 0,7-0,8    |
| 2017  | 4,6-7,2       | 23,3-28,1      | 11,3-15,9        | 3,5-4,6      | 44-57  | 0,4-1,1  | 9,8-10,3 | 0,7-0,8    |
The amount of exchange energy (9-10 MJ) and feed units (0.7-0.8) per 1 kg of silage dry matter was also high, which in turn significantly affected the realization of the genetic potential of dairy productivity. Perennial grasses grown on peat soils contained more organic matter and crude protein, but the sugar content (0.2-2.0 %) in the harvested silage did not correspond to optimal values. Violation of the sugar-protein ratio affected the decrease in the digestibility of feed obtained from peat soils. The digestibility of the organic matter of the silage harvested from the boneless stalk, mown in the phase of entering the tube from peat soil was 2.9 %, in the phase of earing it was 3.9 % lower compared to mineral soil. When harvesting grass in the early stages of development for silage, there was a high digestibility of raw protein and raw fiber, but the difference compared to mineral soil was less significant (Table 2).

**Table 2.** The chemical composition and digestibility of silage from the boneless stalk, depending on the phase of plant development and growing conditions.

| Indicators         | Dry matter | Organic matter | Crude protein | Crude fiber | Crude fat | BEV  |
|--------------------|------------|----------------|---------------|-------------|-----------|------|
|                    | 1          | 2              | 1             | 2           | 1         | 2    |
| Exit to the tube   |            |                |               |             |           |      |
| Chemical composition| 17.8       | 17.0           | 91.1          | 91.8        | 15.9      | 16.8 |
| Digestibility, %   | 74.0       | 71.1           | 76.1          | 73.2        | 74.0      | 71.5 |
|                    |            |                |               |             | 75.2      | 74.2 |
|                    |            |                |               |             | 75.2      | 72.1 |
|                    |            |                |               |             | 77.2      | 74.4 |
| Earing             |            |                |               |             |           |      |
| Chemical composition| 26.3       | 25.4           | 92.5          | 92.8        | 11.5      | 12.6 |
| Digestibility, %   | 66.2       | 65.3           | 70.8          | 66.9        | 67.3      | 64.2 |
|                    |            |                |               |             | 68.5      | 66.1 |
|                    |            |                |               |             | 68.5      | 62.3 |
|                    |            |                |               |             | 72.2      | 70.1 |

Note: 1-mineral soil; 2-peat soil

The digestibility of the raw protein of the haylage from the seedless seedling, mown in the exit phase into the tube, was 72.6 %, in the earing phase – 65.4 %. The haylage from the seedless seedling, mown in the exit phase into the tube and earing, was characterized by high digestibility of raw fiber – 74.0% and 66.9%, respectively, against 49.2% in the flowering phase. The digestibility of raw fat in the haylage was at the level of 52.0-59.3 %. The digestibility of the BEV of haylage from the boneless stalk, depending on the phase of culture development during the harvesting period, changed and amounted to 76.5 % when mowing grass in the phase of entering the tube, 72.1 % in the phase of earing, 55.2% in flowering. Increasing the usefulness of such feed due to the inclusion in the diet of biologically active additives "Rumimaster", "Rumistart", which contribute to increasing the digestibility of feed, made it possible to significantly increase the productivity of cattle and improve the efficiency of their feeding. The economic assessment of the research results showed that the addition of feed additives "Rumimaster", "Rumistart" to the diet of highly productive cows, consisting of feed obtained from peat and worked-out soils, allows to increase the productivity of animals by, receive additional profit from one head in the amount of 12-15 rubles and increase the profitability of livestock production by 2.1-2.5 absolute percent.

4. Conclusion

Due to the fact that feed production on peat soils has its own pronounced features, primarily due to completely specific soil and climatic conditions, increasing the usefulness of feeding by including feed
additives in the diet allows you to maintain the productivity of animals at a high level, 9,000 kg of milk or more from one cow.

Perennial grasses grown on peat soils have differences in chemical composition compared to plants grown on mineral soils. They contain more organic matter and crude protein, while their digestibility is lower. Improving the usefulness of feed due to the inclusion of biologically active additives can significantly increase the productivity of animals and the quality of beef.

The use of a feed additive significantly increased the digestibility of crude protein by 3.3, crude fiber-by 3 absolute percent, respectively (P≤0.05). Nitrogen assimilation for productive purposes in the experimental group was 160.9 g, which is 12.4% higher than similar indicators in the control group.

The introduction of scientific developments in the production herd of cattle contributed to an increase in the productivity of animals up to 9,000 kg of milk or more (Table 3).

Table 3. Changes in the productivity of the production herd of cattle in the application of scientific developments

| Indicators                                      | 2015  | 2016  | 2017  | 2018  | 2019  |
|------------------------------------------------|-------|-------|-------|-------|-------|
| The number of cows – only at the beginning of the year | 400   | 400   | 400   | 400   | 400   |
| Average milk yield from one cow (according to the production report), kg | 8300  | 8529  | 8847  | 9099  | 9100  |
| Fat content in milk (according to the production report),% | 3.67  | 3.67  | 3.75  | 3.81  | 4.01  |
| Protein content in milk (according to the production report),% | 3.09  | 3.08  | 3.17  | 3.12  | 3.14  |
| Milk yield of cows for 305 days of the first lactation, kg | 7200  | 7435  | 8146  | 8104  | 8542  |
| Fat content in milk, % | 4.77  | 4.59  | 4.68  | 4.54  | 4.29  |
| Protein content in milk, % | 2.89  | 3.00  | 3.01  | 2.93  | 3.08  |
| The number of cows with a milk yield of 7000 kg and above, heads | 268   | 267   | 301   | 294   | 321   |

The fat content in milk over the past 5 years (2015 – 2019) has increased from 3.67 to 4.01 %, the protein content from 3.09 to 3.14 %. Cows had good indicators for the first lactation. The milk yield of cows for 305 days of the first lactation was 8542 in 2019 against 7200 kg in 2015. The protein content in milk also increased at the same time. The number of cows with a milk yield of 7000 kg of milk and above increased from 268 heads in 2015 to 321 heads in 2019.

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