

# Improving haylage harvesting at enterprises

Marina Chaplygina<sup>1\*</sup>, Natalya Dolgopolova<sup>2</sup>, Ekaterina Malysheva<sup>2</sup>, and Galina Polskaya<sup>3</sup>

<sup>1</sup>Southwest State University, 94, 50 let Oktyabrya str., Kursk, 305004, Russia

<sup>2</sup>Kursk State Agrarian University, 70 Karl Marx House, Kursk, 305004, Russia

<sup>3</sup>Kursk Institute of Cooperation, 116 Radishchev str., Kursk, 305004, Russia

**Abstract.** Haylage harvesting in agricultural enterprises is crucial for ensuring high animal productivity, as high-quality forage is essential for optimal animal performance. However, weather conditions, particularly rainy summers, often hinder the harvesting process, leading to poor-quality haylage. The lack of proper isolation from air access during harvesting allows mold, putrefactive processes, and butyric acid bacteria to develop, resulting in a loss of useful properties and reduced animal performance. Modern technologies offer solutions to overcome these challenges. Haylage, which is chemically closest to green grass, has the highest energy and protein value among various forage types. Achieving good feed quality requires proper drying, silage, and haylage preparation, as well as conditions that prevent microflora reproduction. This study highlights the importance of efficient haylage harvesting and the benefits of adopting modern technologies to ensure high-quality forage production.

## 1 Introduction

The overall digestibility of bulky feed directly depends on the presence of easily digestible, effective fiber, which normalizes the processes of rumen digestion in cows with any level of productivity. To achieve this, forage procurement must be carried out during a favorable phase of development of forage plants. So, to prepare high-quality haylage, leguminous grasses should be mowed in the budding phase, cereals - in the booting phase before heading or sweeping, legume-cereal grass mixtures according to the predominant component. The optimal mowing time allows you to get the next cut. The recommended mowing height is 8-10 cm, with a good field levelness of 5-7 cm. Grass mowing is done together with flattening, which significantly reduces the wilting period. Proper preparation of feed makes it possible to achieve high nutritional value of the resulting feed. The high nutritional value of feed consists in particular: the preservation of sugar, protein, carotene, the original quality of feed, even during long-term storage. Natural preservation allows us to achieve the absence of chemical preservatives. Mowing grass at an earlier time allows for high feed value to be achieved. The implementation of these measures enables the enhancement of livestock productivity, including increased live weight gain and milk yield, while also promoting the long-term health and fertility of animals.

---

\* Corresponding author: [chaplyginam@mail.ru](mailto:chaplyginam@mail.ru)

## 2 Materials and methods

To ensure good preservation and good quality of feed, it is necessary to create conditions that are extremely unfavorable for the existence and reproduction of undesirable microflora. In feed production, these conditions are created in the form of hay drying, silage and haylage.

For alfalfa this is the beginning of budding. Then alfalfa has easily digestible fiber and, in addition, a protein content of about 18% of dry matter. The duration of the optimal phase of alfalfa is about a week, and in hot weather it is significantly reduced. It often happens that under production conditions the harvesting of alfalfa is very late; the feed is prepared with coarse, lignified fiber. This significantly reduces the overall digestibility and palatability of the finished feed. And the metabolic energy content often does not exceed 9.0 MJ/kg of dry matter. While ensuring high digestibility of fiber, we must not forget about the safety of the feed, with a minimum amount of losses during canning. The main goal of canning is to preserve food with the least possible loss of physiologically beneficial properties. Hay, as a type of feed obtained during the drying process, is today the most expensive in terms of cost among other bulk feeds, and as a component of the diet, it meets less and less the biological requirements of highly productive dairy cattle due to its low energy nutrition. The quality of hay is known to be highly dependent on weather conditions. In this regard, methods of canning by silage and haylage have become more widespread [1,2,3].

## 3 Results and discussion

To obtain high-quality haylage the following is necessary:

- 1) ensuring an oxygen-free environment and low temperature of the mass due to high-quality compaction, quick filling of the silo and hermetically sealed storage;
- 2) rapid acidification of the silage environment (pH level not higher than 4.2) at a humidity of 70% or more;
- 3) reducing the humidity of silage raw materials to 65% or less.

However, alfalfa, as a forage plant, is a difficult crop to ensile for two reasons:

- 1) low content of sugars, which are food for lactic acid microorganisms that provide acidity;
- 2) high mass buffering, when protein amino acids neutralize part of the lactic acid.

With increased humidity of the alfalfa mass, lactic acid fermentation proceeds sluggishly, the medium acidifies slowly and is not enough for good preservation of the feed, its spoilage is inevitable. Alfalfa requires separate harvesting with deep drying to a moisture content of 55-60% (for haylage). Of course, the arid climate of the Lipetsk region makes it possible to accomplish this task, but, as practice shows, this is not always possible.

Another problem identified during observations is the heavy contamination of alfalfa with wormwood. Then, the prepared food, even if it is well preserved and digestible, acquires a pungent odor of wormwood alkaloids and is poorly eaten by animals.

To date, the management of the farm has made a decision to replace alfalfa feed with haylage from grain crops, in particular spring barley.

Features of harvesting grain haylage from grain crops. The idea of harvesting grain haylage is far from new and has deep roots. Many scientific works have been published about its features and advantages. First of all, these are high parameters of fiber digestibility, energy nutrition due to starch and sugars, low humidity and organic acid content, and consistency of composition, regardless of the weather. In particular, the results of feed analysis in the Sverdlovsk region over several years (Table 1) showed that grain haylage, due to the biological characteristics of grains, has easily digestible fiber, which, together with the high starch content in the feed (20-25% dry matter), provides metabolic energy not less than 10.0 MJ/kg of dry matter.

**Table 1.** Results of zootechnical analysis of batches of grain haylage in the Sverdlovsk region from 2019 to 2022.

Lots of haylage grain	Dry matter content, %	Dry matter content		
		Crude protein,%	Crude fiber,%	Metabolic energy, MJ/kg
#1 (2019)	38.6	13.1	20.7	10.6
#2 (2019)	40.9	9.1	24.0	10.5
#3 (2020)	33.1	10.6	28.7	9.5
#4 (2021)	44.0	13.0	23.6	10.5
#5 (2022)	39.2	11.3	20.5	10.7
#6 (2022)	53.3	14.0	27.0	9.5

At the same time, until recently, the production of grain haylage was not widespread. Producers inevitably had to deal with the main problems associated with low humidity of grain haylage mass - lack of aerobic stability, tendency to self-heating and molding of feed, especially during the period of opening the storage facility, during loading and delivery.

Thanks to the drug “BiotolHolcropGold”, grain haylage received a second life in Russia. The *Lactobacillus buchneri* strain contained in the preparation (number in the collection of the L. Pasteur Institute NCIMB 40788) produces in an oxygen-free environment, in addition to a small amount of lactic and acetic acids, propionic acid and its derivatives (1-propanol). These substances have a strong fungicidal effect on aerobic microflora. In 2014, at the Federal State Institution “North-Western State Zonal Machine Testing Station “Kalitino”, using the technology of OOO “Lallemand”, a small batch of barley haylage was laid. Despite the unfavorable weather conditions during the harvesting period, the results obtained were very encouraging, which was reflected in the test report of the feed harvesting technology No. 10-13-05.

Since then, the spread of this method of feed procurement has continued continuously. Numerous positive results from feeding grain haylage have been obtained in the Leningrad, Sverdlovsk, Yaroslavl, Kursk, Kostroma regions, the Republic of Karelia and other regions. Such food can partially replace concentrates from grain grinding and reduce the cost of the diet. In addition, grain haylage provides good rumination and can be successfully fed together with corn silage instead of hay. These feed qualities greatly contribute to the activity of rumen digestion in cows. When mixed with wet silage, grain haylage provides optimal moisture content of the diet of 50-55% and its good digestibility. The only significant drawback of grain haylage, like corn silage, is the low crude protein content. It is necessary to carefully balance the protein diet.

In the production of grain haylage, it is recommended to use a highly effective microbial-enzyme preparation of complex action, which ensures good preservation of feed and aerobic stability in conditions of low humidity of the mass. This is a specialized drug of the Biotol brand - HolcropGold.

Due to the presence of a powerful enzyme complex (a mixture of  $\beta$ -glucanase and xylanase), partial breakdown of fiber occurs in the haylage mass. Enzymes break down hemicellulose molecules contained in fiber into simple sugars, thereby loosening the fiber fibers and making it more accessible to rumen microflora. The digestibility of fiber improves (by 15%), which significantly increases the digestibility and palatability of feed.

## 4 Conclusion

Understanding of the seriousness of the issue of increasing the share of bulky feed in feeding rations and the need for an urgent solution is finding an increasingly wider response from managers and specialists of Russian agricultural enterprises. The successes achieved in a number of farms in the Leningrad, Moscow, Sverdlovsk, Kursk, Lipetsk, Nizhny Novgorod regions, the Republic of Karelia and other regions are clear confirmation of this.

Bulk feeds can partially replace concentrates from grain grinding and reduce the cost of the diet. In addition, grain haylage provides good rumination and can be successfully fed together with corn silage instead of hay. These feed qualities greatly contribute to the activity of rumen digestion in cows. When mixed with wet silage, grain haylage provides optimal moisture content of the diet of 50-55% and its good digestibility. The only significant drawback of grain haylage, like corn silage, is the low crude protein content. It is necessary to carefully balance the protein diet.

## References

1. T. H. Amaral Corrêa, J. N. França Holanda, *Materials Research*, **22**, 1–5 (2019). <https://doi.org/10.1590/1980-5373-MR-2019-0486>.
2. L.G. Gorkovenko, A.E. Chikov, N.A. Omelchenko, N.A. Pyshmantseva, *Zootekhnika* **3** 13-14 (2011).
3. S. Jafarzadeh, A. K. Alias, F. Ariffin, S. Mahmud, *International Journal of Food Properties*, **21(1)**, 983–995 (2018). <https://doi.org/10.1080/10942912.2018.1474056>.
4. A.A. Barymov, I.V. Glebova, O.P. Barymova, S.P. Bugayev, *Vestnik of Kursk state agricultural academy* **3** (2021).
5. N.V. Dolgopolova, Yu.N. Furman, Ye.Ya. Lebedko, *IOP Conference Series Earth and Environmental Science* **548** 022059 (2020).
6. E. Malysheva, O. Nikitina, M. Chaplygina, N. Dolgopolova, L. Fomicheva, *E3S Web of Conferences* **443** 03003 (2023).
7. J. Shlisky, R. Mandlik, et al. *Annals of the New York Academy of Sciences* **1512(1)**, 10–28 (2022). <https://doi.org/10.1111/nyas.14758>.