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The biochemical composition of the biomass of the oat cultivar 'Sorin' grown under the conditions of the Republic of Moldova and its possible uses

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Abstract. We investigated the quality indices of the biomass from common oat *Avena sativa*, romanian cultivar 'Sorin' which was grown in the experimental plot of the "Alexandru Ciubotaru" National Botanical Garden (Institute), Chisinau, Republic of Moldova. The results revealed that the dry matter of whole oat plants contained 9.5% CP with forage value 598 g/kg DDM, RFV= 89, 11.84 MJ/kg DE, 9.72 MJ/kg ME and 5.37 MJ/kg NEl; prepared oat hay contained 10.5% CP, 574 g/kg DDM, 11.40 MJ/kg DE, 9.36 MJ/kg ME and 5.39 MJ/kg NEl. The oat haylage is characterized by pH = 3.77, 38.1 g/kg lactic acid, 5.9 g/kg acetic acid, 10.2% CP, 567-619 g/kg DDM, 11.28 MJ/kg DE, 9.26 MJ/kg ME and 5.29 MJ/kg NEl. The biochemical methane potential of the studied substrates from *Avena sativa* cv. 'Sorin' reaches 329-355 l/kg VS.

Keywords: *Avena sativa*, biochemical composition, biomethane potential, cultivar 'Sorin', fodder value, green mass, hay, haylage.

Compoziția biochimică a biomasei de ovăz a soiului 'Sorin' cultivat în condiţiile Republicii Moldova și posibilități de valorificare

Rezumat. Au fost investigaţi indicii de calitate ai biomasei de ovăz *Avena sativa*, soiul românesc „Sorin", cultivat pe lotul experimental al Grădinii Naţionale Botanice (Institutului) „Alexandru Ciubotaru", Chişinău, Republica Moldova. Rezultatele au evidenţiat că masa uscată a plantelor întregi de ovăz conţinea 9.5% PB cu o valoare furajeră de 598-603 g/kg MUD, VFR= 89, 11.84 MJ/kg ED, 9.72 MJ/kg EM şi 5.37 MJ/kg ENl; fânul preparat -10.5% PB, 574 g/kg MUD, 11.40 MJ/kg ED, 9.36 MJ/kg EM şi 5.39 MJ/kg ENl. Furajul însilozat (semifân) este caracterizat de pH = 3.77, 38.1 g/kg acid lactic, 5.9 g/kg acid acetic, 10.2% PB, 567-619 g/kg MUD, 11.28 MJ/kg ED, 9.26 MJ/kg EM şi 5.29 MJ/kg ENl. Potenţialul biochimic de producţie a biometanului al substraturilor studiate de *Avena sativa* ajunge la 329-355 l/kg VS.

Cuvinte-cheie: *Avena sativa*, compoziția biochimică, fân, fânaj, masa verde, potenţial de biometan, soiul 'Sorin', valoare furajeră.

1. Introduction

Because of the thermal regime with high temperatures and the lack of precipitation, droughts during the growing season occurred 2-3 times more often over the last 40 years, as compared to the entire period of observations made by the national meteorological services [3]. The cumulative action of high temperatures and the low amount of precipitation and its uneven distribution, soil erosion and salinization have a negative impact on the harvest and quality of traditional agricultural crops, and therefore, on the feed supply for livestock. The growth prospects of the agricultural-food market depend on solving the problem of providing a balanced diet for farm animals in accordance with their physiological and production requirements. In order to respond to these challenges, it is necessary to capitalize on the productive potential of traditional crops by identifying valuable forms, creating and implementing new cultivars and technologies, for a more efficient use of solar energy, soil and water resources, providing food for people and animals, and on the other hand, using these plants as a source of raw material for various industries (textiles, pharmaceuticals, cosmetics etc.) and last but not least, biomass for the production of renewable energy.

The genus *Avena* L. fam. Poaceae includes 29 species distributed in Europe, the Mediterranean Basin, North Africa, West Asia and East Asia, North and South America [17]. Most species and subspecies with a huge diversity of forms are found in Asia Minor, being considered the gene centre of the *Avena* genus [19]. The following species are widely cultivated: *Avena abyssinica* Hochst. (Ethiopian oat), *Avena byzantina* K.Koch (red oat), *Avena nuda* L. (hulless oat), *Avena sativa* L. (common oat), *Avena strigosa* Schreb. (black oat).

Oat *Avena sativa* was firstly cultivated approximately 3000 years ago, under the more favourable climatic conditions of Europe. It is an annual herbaceous plant with a stem (straw, culm) of 5-7 internodes, smooth, glabrous or hairy in the area of the nodes, hollow inside, 100-150 cm tall, forms a bush of 3-4 shoots and the main stem has one node more than the secondary stems. The leaves are flat, with 11-13 veins, up to 15 mm wide, glabrous or ciliate on margins, with glabrous sheaths, rarely hairy, leaf lobes absent, ligule white, limbed, medium or short, toothed at apex. The leaf blade is twisted from right to left, opposite to the other cereals. The inflorescence is a pyramidal panicle, 15–30 cm long, with ramifications arranged in 5-6 tiers on the main axis. Each ramification ends in a spikelet attached to a short peduncle. The spikelets have 2-3 flowers. The glumes are veined, 18–25 mm long, completely covering the flowers. The lower palea is elongated, convex, straight or geniculate on the dorsal side, yellowish-white or brown, obviously veined, glabrous or rarely with short hairs only at the base, with 2 teeth without awns. There are forms with compact panicle (standard) and with loose panicle. It blooms in June; pollination is autogamous, but not excluding allogamy. Fruit is a hairy caryopsis, with whitish-yellowish, sometimes grey-brown, adherent petals. The shape of the grain is fusiform, with a groove on the ventral side. The weight of 1000 seeds is 20-35 g. At germination, oats develop three embryonic roots, form a fibrous root system, which is stronger and deeper as compared with other grassy cereals, possesses a great capacity to absorb the nutritional elements from the poorly soluble compounds of the soil. Oat forms are identified as withstanding temperatures below -10 °C at the root collar. Winter hardiness also depends on the protective snow cover and temperature fluctuations. Oat plants are quite demanding in terms of moisture, thus, they need more water as compared to other cereals, especially in the stages of straw formation and budding-flowering. It does not have high requirements towards soil and can be grown on loamy and loamy-sandy soils, chernozem, forest red-brown soil, podzols, with pH between 5.5 and 7.0, while sandy soils and compacted loamy soils are less suitable. Oats make the best use of soils with nutrients left from heavily fertilized predecessor plants. Oats should never be planted on an area after sugar beet or another oat crop [27].

In the Catalog of Plant Varieties of the Republic of Moldova [29], 3 cultivars of common oat have been registered, while in the Official Catalog of the Varieties of Crop Plants in Romania [30] - 6 varieties of oat have been registered, of which 4 varieties were created at the Agricultural Research and Development Station Lovrin.

In recent years, special attention, both globally and locally, has been paid to the use of renewable energy sources. In our region, the focus is on the production and use of biomass to obtain second-generation fuels.

The goal of our research was to evaluate the quality of the harvested biomass of the romanian cultivar 'Sorin' of common oat *Avena sativa,* as natural fodder and haylage for feeding the livestock, as well as as a substrate for the production of biomethane by anaerobic digestion, as a renewable energy resource.

2. Materials and Methods

The plants of common oat *Avena sativa* cv. 'Sorin' created at the Agricultural Research and Development Station Lovrin, Romania, and cultivated in the experimental sector of the "Alexandru Ciubotaru" National Botanical Garden (Institute) Chisinau, Republic of Moldova, served as research subjects. Alfalfa (*Medicago sativa*) and maize (*Zea mays*) plants served as control samples. The experiments started in autumn, at the end of September, were made in 4 repetitions, on non-irrigated land. Common oat plants were harvested during the panicle formation - flowering period (June). The haylage was prepared from pre-wilted in the field plant, shredded and then packed in airtight containers. The hay was dried directly in the field. The fresh and conserved mass samples were dehydrated in an oven with forced ventilation at a temperature of 60 °C; at the end of the fixation, the biological material was finely ground in a laboratory ball mill. The assessment of the content of crude protein (CP), crude ash (CA), acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL), total soluble sugars (TSS) was done by near infrared spectroscopy (NIRS) technique, using the PERTEN DA 7200 at the Research and Development Institute for Grasslands, Braşov, Romania, according to standard methods. The content of cellulose (Cel) and hemicellulose (HC), the digestible dry matter (DDM), the relative feed value (RFV), the digestible energy (DE), the metabolizable energy (ME) and the net energy for lactation (NEl) were calculated according to accepted equations.

The carbon content in the organic matter was calculated using the equation reported by Badger et al. [5]. The biochemical methane potential was calculated based on the basis the crude protein content and chemical compounds of the cell wall, acid detergent lignin (ADL) and hemicellulose (HC), according to Dandikas et al. [7].

3. Results and Discussions

The results regarding the biochemical composition of the dry matter and the nutritional value of the fresh mass and hay of the oat cultivar 'Sorin' are presented in Table 1. Oat plants were found to have higher crude protein content as compared with maize, but lower as compared with alfalfa. The content of structural carbohydrates was much higher, while that of soluble carbohydrates was lower, a fact that had a negative effect on the digestibility and energy supply of natural oat fodder as compared with that of maize. Oat plants have a lower content of ash and lignin, and contain a quite high amount of soluble sugars and hemicellulose as compared with alfalfa fodder. There are no essential differences in the digestibility of the dry matter and the energy supply of the oat and alfalfa fodder. In the process of making hay, the content of structural carbohydrates and acid detergent lignin increases and the digestibility of nutrients becomes lower. Oat hay has an optimal concentration of crude protein and hemicellulose.

In the specialized literature, there are different data regarding the quality of fresh mass and hay from *Avena* species. According to the data presented by Burlacu et al. [6] oat plants contained 170 g/kg dry matter, 90.1% organic matter, 10.3% crude protein, 3.1% fat, 26.5% crude cellulose, 50.2% nitrogen free extract, 9.9% ash, 14.2% sugars, 0.8% starch, 30.0% ADF, 6.6 % lignin and 17.8 MJ/kg gross energy, while hay was made up

Indices	*Avena sativa*		*Medicago sativa* fresh mass	*Zea mays* fresh mass
	Fresh mass	Hay		
Crude protein (CP), g/kg	95	105	170	84
Crude fibre (CF), g/kg	356	381	341	248
Crude ash (CA), g/kg	65	74	90	52
Acid detergent fibre (ADF), g/kg	374	404	365	271
Neutral detergent fibre (NDF), g/kg	627	660	558	474
Acid detergent lignin (ADL), g/kg	46	50	63	48
Total soluble sugars (TSS), g/kg	167	111	63	336
Cellulose (Cel), g/kg	328	354	302	223
Hemicellulose (HC), g/kg	258	256	193	203
Digestible dry matter (DDM), %	59.8	57.4	60.5	67.8
Digestible energy (DE), MJ/kg	11.84	11.4	11.96	13.28
Metabolizable energy (ME), MJ/kg	9.72	9.36	9.82	10.9
Net energy for lactation (NEl), MJ/kg	5.73	5.39	5.83	6.91
Relative feed value (RFV)	89	81	101	133

Table 1. The biochemical composition and nutritional value of oat fresh mass and hay.

of – 8.0 % crude protein, 3.1% fat, 36.4% crude cellulose, 44.6% nitrogen free extract, 39.7% ADF, 3.9 % lignin, 7.9% ash and 19.3 MJ/ kg gross energy. Kamble et al. [13] reported that oat green mass had a concentration of 121 g/kg dry matter, 13.5% protein, 3.1% fat, 50.8% NDF, 1.7% ADL, 32.9% ADF, 17.9% HC and 22.5% Cel. Kocer & Albayrak [14] determined that the concentration of nutrients in *Avena sativa* plants was 10.87% protein, 59.12% NDF, 34.4% ADF, 566.7 g/kg total digestible nutrients, RFV=97.45. Heuze et al. [11] reported that the nutritional value of *Avena sativa* plants was 263 g/kg dry matter, 10.5% protein, 4.9% fat, 30.2% crude cellulose, 54.2% NDF, 31.0% ADF, 4.5% lignin, 7.1% soluble sugars, 10.1% ash, 3.8 g/kg Ca and 2.2 g/kg P, 67.0% digestible matter, 18.0 MJ/kg gross energy, 11.5 MJ/kg digestible energy and 9.3 MJ/kg metabolizable energy, while that of hay was, respectively, 9.1% protein, 2.2% fat, 34.0% crude cellulose, 61.7% NDF, 38.1% ADF, 8.3% ash, 17.7% starch, 4.7 g/kg Ca and 2.0 g/kg P, 60.1% digestible matter, 18.0 MJ/kg gross energy, 10.2 MJ/kg digestible energy and 8.3 MJ/kg metabolizable energy. Kumar et al. [15] mentioned that the biochemical composition and nutritive value of oat fresh mass was 8.80% protein, 2.74%

fat, 53.25% NDF, 27.41% ADF, 3.73% ADL, 25.84% HC, 20.22% Cel, 11.97% ash, 8.34 MJ/kg metabolizable energy and 567.2 g/kg total digestible nutrients. Tambara et al. [25] determined that the biochemical composition of the dry matter of *Avena sativa* plants was 24.11% protein, 40.50% NDF and 18.86% ADF, while that from *Avena strigosa* plants was – 24.38% protein, 43.53% NDF and 19.83% ADF. Horst et al. [12] mention that the oat green mass harvested until flowering period contained 185.1-243.4 g/kg dry matter, 8.85-9.96% protein, 68.85-70.97% NDF, 38.69-44.89% ADF, 26.08-28.16% HC, 5.57-5.62% ash, 564.4-607.6 g/kg total digestible nutrients, RFV=74.09-84.59 and 0.664-1.029 Mcal/kg net energy for lactation. Abdelraheem et al. [1] mentioned that oat hay was characterized by 7.50-7.86 % protein, 1.80-2.12 % fat, 54.13-54.20 % NDF, 28.72-31.17% ADF, 4.60-5.50 % ash, 61.96-63.82% digestible organic matter and 17.71-17.92 MJ/kg gross energy. Bacchi et al. [4], evaluating forage quality indices of annual forage crops, determined that when it is harvested in the inflorescence emergence period, *Avena sativa* plants contain 201.4 g/kg dry matter with 10.56 % protein, and *Lolium multiflorum* plants contain 217.2 g/kg dry matter and 8.67% protein, while, when it is harvested during the ripening period of the grains, *Avena sativa* plants contain 358.4 dry matter with 6.63 % protein and *Lolium multiflorum* plants contain 322.9 g/kg dry matter with 6.41 % protein. Ma et al. [18] reported that the nutrient content of *Avena nuda* forage was 5.94% protein, 63.83% NDF, 38.28% ADF, 7.99% ash, 3.81% starch, 53.61% total digestible nutrients, 59.08% digestible dry matter, RFV=86.11 and RFQ=81.95. Patidar et al. [21] indicated that the nutritional value of oat plants was 87.68% organic matter, 10.80% protein, 2.10% fat, 10.84% starch, 53.50% NDF, 47.86% ADF, 10.80% lignin, 55.06% total digestible nutrients, 16.62 MJ /kg gross energy, 10.23 MJ/kg digestible energy and 8.44 MJ/kg metabolizable energy; while that of hay was 88.91% organic matter, 9.48% protein, 1.80% fat, 7.86% starch, 73.24% NDF, 48.24% ADF, 11.48% lignin, 55.40% total digestible nutrients, 16.64 MJ/kg gross energy, 8.81 MJ/kg digestible energy and 7.31 MJ/kg metabolizable energy. Rady et al. [22] mentioned that the nutritional value of oat plants was 901.9 g/kg organic matter, 8.30% protein, 2.58% fat, 169.16% NDF, 64.67% ADF, 4.48%HC, 55.39% Cel, 11.29% lignin, 533.1 g/ kg total digestible nutrients. Shekara et al. [24] reported that quality parameters of fodder oats genotypes were170-212 g/kg dry matter, 9.0-11.1% crude protein and 25.99-27.36% crude cellulose.

Fermented forage is the key element for productive and efficient livestock farms, providing an even amount of high-quality nutrients, especially during the autumn – mid-spring period, but also, for some farms, throughout the year.When opening the glass containers with oat haylage, there was no gas or juice leakage, the preserved mass retained its consistency in comparison with the initial green mass, without mould or fungi. The oat haylage had dark green-olive colour, with a pleasant, specific smell of pickled apples, and the maize silage was homogeneous yellow, with a pleasant smell like pickled fruits. Following the analyses carried out (Table 2), it was determined that the fermentation profile of the fermented fodders was pH=3.77-4.10, 38.1-38.8 g/kg lactic acid, 5.9-10.3 g/kg acetic acid, which corresponded to the standard in force SM 108, quality 1. In oat haylage, the concentration of acetic acid was lower than in maize silage, and there was no butyric acid. The dry matter of the researched pickled fodder contained 8.0-10.2% protein, 5.9-7.8% ash, 24.5-39.3% crude fiber, 25.8-41.3% ADF, 46.9-69.9% NDF, 3.7-4.0 % ADL, 2.6-32.6% soluble sugars, 56.7-68.8% g/kg digestible dry matter, RFV= 76-136, 9.26-11.04 MJ/kg metabolizable energy and 5.29-7.06 MJ/kg net energy for lactation. Oat haylage had a higher content of crude protein and structural carbohydrates as compared with maize silage. The dry matter digestibility and energy supply of oat haylage was than that of maize silage.

The quality of fermented forage from oat plant has been presented in several sources. Burlacu et al. [6] reported that the silage from oat plants contained 185 g/kg dry matter, 91.2% organic matter, 11.1% protein, 3.7% fat, 31.5% crude cellulose, 44.9% nitrogen-free extract, 5.7% sugars, 4.1% starch, 33.1% ADF, 4.7% lignin and 18.3 MJ/kg gross energy. Geren et al. [9] mentioned that *Avena sativa* silage was characterized by pH 3.91-4.64, 9.2-12.2% protein, 51.3-54.9% NDF and 34.2-39.7% ADF. Herrmann et al. [10] stated that *Avena sativa* silage contained 379 g/kg dry matter, 92.4% organic matter, pH 4.3, 5.6% lactic acid, 1.1% acetic acid, 9.2% protein, 3.1% fat, 51.5% NDF, 34.3% ADF and 5.5 % ADL, while that – of *Zea mays* contained – 302 g/kg dry matter, 95.8% organic matter, pH 3.7, 5.1% lactic acid, 1.6% acetic acid, 7.8% protein, 2.6% fat, 41.2% NDF, 24.0% ADF and 2.9% ADL. Heuze et al. [11] reported that the nutritional value of *Avena sativa* silage was 305 g/kg dry matter, 9.5% protein, 5.8% fat, 37.4% crude cellulose, 53.4% NDF, 35.9% ADF, 4.1% lignin, 9.7% starch, 10.1% ash, 4.6 g/kg Ca and 3.1 g/kg P, 17.6 MJ/kg gross energy, 10.7 MJ/kg digestible energy and 8.7 MJ/kg metabolizable energy. Leão et al. [16] indicated that *Avena sativa* silage contained 54-78 g/kg protein, 50-54 g/kg ash, 660-711 g/kg NDF, 417-459 g/kg ADF, 243-253 g/kg HC, 485-509 g/kg total digestible nutrients, while *Avena strigosa* silage contained 43-60 g/kg protein, 55-58 g/kg ash, 709-799 g/kg NDF, 443-520 g/kg ADF, 265-279 g/kg HC, 451-494 g/kg total digestible nutrients. Teixeira & Fontaneli [26] determined that the nutrient concentration in oat silage was 6.57-10.72% protein, 37.23-39.02% ADF, 59.45-62.46% NDF and 58.53-60.66 DMD. Horst et al. [12] mentioned that fermented oat feed contained 538.1-613.4 g/kg dry matter, 8.29-10.1% protein, 69.62-72.03% NDF, 42.05-47.22% ADF, 24.81-27.57% hemicellulose, 4.91-5.41% ash, 54.79- 58.41% total

Indices	Avena sativa haylage	Zea mays silage
pH	4.10	3.77
Organic acids, g/kg DM	44.7	48.6
Free acetic acid, g/kg DM	2.5	5.1
Free butyric acid, g/kg DM	0	0
Free lactic acid, g/kg DM	10.7	17
Fixed acetic acid, g/kg DM	3.4	5.2
Fixed butyric acid, g/kg DM	0	0.2
Fixed lactic acid, g/kg DM	28.1	21.1
Total acetic acid, g/kg DM	5.9	10.3
Total butyric acid, g/kg DM	0	0.2
Total lactic acid, g/kg DM	38.8	38.1
Lactic acid, % organic acids	86.8	78.4
Crude protein (CP), g/kg DM	102	80
Crude fiber (CF), g/kg DM	393	245
Crude ash (CA), g/kg DM	78	59
Acid detergent fiber (ADF), g/kg DM	413	258
Neutral detergent fiber (NDF), g/kg DM	699	469
Acid detergent lignin (ADL), g/kg DM	40	37
Total soluble sugars (TSS), g/kg DM	26	326
Cellulose (Cel), g/kg DM	373	221
Hemicellulose (HC), g/kg DM	286	211
Digestible dry matter (DDM), %	56.7	68.8
Digestible energy (DE), MJ/kg	11.28	13.45
Metabolizable energy (ME), MJ/kg	9.26	11.04
Net energy for lactation (NEl), MJ/kg	5.29	7.06
Relative feed value (RFV)	76	136

Table 2. Fermentation profile, biochemical composition and nutritional value of ensiled fodder.

digestible nutrients, RFV=70.78-78.10 and 0.527-0.832 Mcal/kg net energy for lactation. Ruckaya et al. [23] determined that the oat haylages contained 474-526 g/kg dry matter, 6.9% protein, 4.9-5.8 % ash and 9.0-9.1 MJ/kg metabolizable energy. Özyazıcı et al. [20]

reported that the nutritional value of *Avena sativa*oat silage is 170 g/kg organic matter,pH =5.50, 6.01% protein, 64.83% NDF, 40.27% ADF and RFV=82.55.

Energy production from biomass is considered an important component in the transformation of the current energy system in order to reduce greenhouse gas emissions and decrease the dependency on fossil energy sources. Biogas has become important as a renewable source of energy due to of its decentralized approach, and it can be used to obtain heat and electrical power in special installations, as well also as fuel in internal combustion engines. The anaerobic digestion process of biomass consists in the conversion of organic matter, by anaerobic bacteria, into biogas, mixture of methane, carbon dioxide and other substances, and also the fermentation residue – digestate rich in nutrients that may be used as fertilizer in organic farming systems. The results regarding the quality indices of the substrates for anaerobic digestion and the biomethane production potential are presented in Table 3. Oat substrate is characterized by a higher content of hemicellulose and optimal content of proteins, a fact that had a positive effect on the reduction of the carbon/nitrogen ratio as compared with maize substrates. The biochemical methane potential reached 355 l/kg in the oat haylage substrate, as compared with 338 l/kg in the maize silage substrate.

Dubrovskis et al. [8] mentioned that the methane yields of oat-barley silage were 288.3-299.2 l/kg those of maize silage were 293.4-296.8 l/kg, respectively. Heiermann et al. [10] noted that the carbon/nitrogen ratio and the specific methane yield of oat silage substrate were C/N = 33 and 277 l/kg, while those of maize silage substrate were C/N = 37 and 329 l/kg organic matter.Allen et al. [2] established that oat silage substrates were characterized by a content of 43.39% C, 6.38% H, 0.55% N, C/N= 80.70 with a biogas potential of 450 l/kg and methane of 281.26 l/kg. Zhang et al. [28] reported that the biomethane potential of oat substrates ranged from 203 to 402 l/kg organic matter.

4. Conclusions

Oat plants of the cultivar 'Sorin' harvested before flowering have a dry matter nutrient content of 9.5% crude protein, 35.6% crude fiber, 6.5% crude ash, 4.6% acid detergent lignin, 16.7% soluble carbohydrates, 32.8 % cellulose and 25.8% hemicellulose, with a feed value of 59.8% dry matter digestibility, 11.84 MJ/kg digestible energy, 9.72 MJ/kg metabolizable energy, and 5.73 MJ/kg net energy for lactation. The natural oat fodder is richer in protein as compared with maize, and as compared with alfalfa, the fresh mass oat fodder has a lower content of lignin.

The hay from oat plants has a nutrient content in dry matter of 10.5% crude protein, 38.1% crude fiber, 7.4% crude ash, 5.0% acid detergent lignin, 11.1% soluble sugars, 35.4% cellulose and 25.6% hemicellulose with a forage value of 57.4% digestible dry

Indices	*Avena sativa*			*Zea mays*	
	fresh mass	hay	haylage	fresh mass	silage
Crude protein (CP), g/kg	95	105	102	84	80
Crud ash (CA), g/kg	65	74	78	52	59
Nitrogen (N), g/kg DM	15.2	16.8	16.3	13.44	12.8
Carbon (C), g/kg DM	519	514.44	512.2	527	511.1
Carbon/nitrogen ratio (C/N)	34	33.5	31.38	39	39.93
Hemicellulose (HC), g/kg	258	256	286	203	211
Acid detergent lignin (ADL), g/kg	46	50	40	48	37
Biomethane potential, L/kg O.M.	329	324	355	321	338

Table 3. The biochemical methane production potential of the investigated substrates.

matter, 11.4 MJ/kg digestible energy, 9.36 MJ/kg metabolizable energy, and 5.39 MJ/kg net energy for lactation.

Oat haylage is characterized by pH = 3.77, 38.1 g/kg lactic acid, 5.9 g/kg acetic acid, no butyric acid, 10.2% crude protein, 567 g/kg dry matter digestibility, 9.26 MJ/kg metabolizable energy and 5.29 MJ/kg net energy for lactation.

The biochemical methane production potential in the studied substrates of *Avena sativa* reaches values of 329-355 l/kg organic matter, while in the substrates of *Zea mays* the values are of 321-338 l/kg organic matter.

In the Republic of Moldova the Romanian cultivar 'Sorin' of *Avena sativa* can be cultivated in pure culture or mixed with leguminous plants, and used as fresh mass fodder, hay and haylage for feeding farm animals, as well as a substrate at biogas stations for the production of biomethane.

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