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THE GREEN MASS YIELD AND THE SILAGE QUALITY OF PERENNIAL SORGHUM, *Sorghum almum,* GROWING UNDER THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

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Abstract

Agricultural production plays an integral role in the regional economy, under the conditions of climate change with uneven distribution of rainfall and extreme heat, expansion of areas with degraded soils, affecting agricultural productivity. The identification of alternative crops that need less water and produce increased yield of organic matter per unit of water is important for agricultural sustainability. Adequate animal nutrition is one of the vital prerequisites to enhance the productivity and the performance of ruminants in terms of milk and meat production. Silage is one of the key components of the feed for herbivorous domestic animals. Sorghum species have recently gained popularity due to their numerous advantages, such as heat and drought tolerance and resistance to specific diseases and pests. Besides, they are well adapted to a wide range of soil types and recover easily after grazing or multiple harvests. The aim of this study was to determine the green mass yield, the silage quality, the nutrient content and the fodder value of the non-native, perennial, rhizomatous grass – Sorghum almum, grown in an experimental field of the National Botanical Garden (Institute), Chişinău. In the third growing season, the perennial sorghum was characterized by high growth rate and regenerative capacity after being cut. The annual productivity, from three harvests, was 6.1 kg/m^2 green mass or 1.4 kg/m^2 dry matter, surpassing the productivity of maize by 35 %. It was determined that the quality of the silage varied depending on the harvest time: pH 3.8-4.5, lactic acid 24.7-45.5 g/kg, acetic acid 6.3-9.1 g/kg, butyric acid 0.2g/kg, organic matter 892.4-922.8 g/kg, crude protein 50.7-95.2 g/kg, crude fats 20.6-36.8 g/kg, crude cellulose 402-428.9 g/kg, nitrogen free extract 330.5-407.2 g/kg, carotene 15.67-47.17 mg/kg, calcium 3.7-5.5 g/kg and phosphorus 1.8-2.7 g/kg. The fodder value of the prepared silage was 0.14-0.18 nutritive units/kg and 1.47-1.82 MJ/kg metabolizable energy. The potential methane yield of Sorghum almum silage substrates varied from 233 to 242 l/kg. The silage obtained from Sorghum almum, according to organoleptic characteristics (smell, colour and consistency) and biochemical indices (pH, content of organic acids and their correlation, chemical composition), largely meets the standards and can be used as alternative feedstuff.

Key words*: fodder value, green mass yield, methane yield, silage quality, Sorghum almum****.***

INTRODUCTION

Agricultural production plays an integral role in the regional economy, under the conditions of climate change with uneven distribution of rainfall and extreme heat, expansion of areas with degraded soils, affecting agricultural productivity. The identification of alternative crops that need less water and produce increased yield of organic matter per unit of water is important for agricultural sustainability. Forages and fodders have attained a special status as animal feed resource for being nutritious, economical and they have other associated advantages like the ease of growing and feeding. Adequate animal nutrition is one of the vital prerequisites to enhance the productivity and the performance of ruminants in terms of milk and meat production. Silage is one of the key components of the feed for herbivorous domestic animals and also feedstock for the production of a second-generation fuel – bio methane. Traditionally, in many parts of Europe, Northern and Southern America, maize silage is the major source of energy in animal feed and substrates in biogas plant, but frequent droughts, rising prices of seeds, agricultural equipment, fuel and fertilizers have a negative impact on its productivity and cost.

Sorghum species have recently gained popularity due to their numerous advantages, such as heat and drought tolerance, resistance to specific diseases and pests. Besides, they are well adapted to a wide range of soil types. Sorghum grains can be used to produce gluten-free foods, can be given to sheep, pigs and even poultry, but are usually ground for cattle. The whole plant can be used for the production of syrup, building material and fencing, animal feeds and feedstock for renewable energy (Cattani et al., 2017; Herrmann et al., 2016; Marin et al., 2016; Trulea et al., 2013).

Sorghum almum Parodi, family *Poaceae,* native to Argentina, is a C_4 type photosynthesis plant, robust, erect, tussocky perennial grass with numerous tillers and thick short rhizomes, which curve upwards to produce new shoots near the parental stool, sometimes reaching a height of 300 cm. It is more tolerant to drought than maize, Sudan grass and Johnson grass and survived in areas receiving 200 mm of annual rainfall. This species has been cultivated in the United States of America since 1943, in Romania it has been researched since 1962, in several scientific centres: Fudulea, Caracal, Lovrin (Popescu and Albu, 1970). Depending on the variety, age and the manner of exploitation, the productivity of *Sorghum almum*, under the conditions of the Ukraine, was 20 t/ha dry matter (Rakhmetov and Rakhmetova, 2008), but in Uzbekistan, under irrigation conditions, the green mass productivity reached 211 t/ha (Avutkhonov et al., 2016).

The aim of this study was to determine the green mass yield, the silage quality, the nutrient content and the fodder value of perennial sorghum, *Sorghum almum*, as well as its potential as substrate for the production of biogas.

MATERIALS AND METHODS

The cv. 'Argentina' of perennial sorghum, *Sorghum almum*, created in the National Botanical Garden (Institute) Chişinău, which was cultivated in the experimental plot of the Plant Resources Laboratory of the National Botanical Garden (Institute), N 46°58′25.7″ latitude and E 28°52′57.8″ longitude, served as subject of the research.

The green mass of three-year-old plants of *Sorghum almum* was cut manually for the first time in the middle of June, the second cut – at the end of July and the third cut – at the end of the September. The harvested green mass was weighed.

The preparation of silage and the evaluation of its quality were carried out in the Laboratory of Nutrition and Forage Technology of the Scientific and Practical Institute of Biotechnologies in Animal Husbandry and Veterinary Medicine, in accordance with the methodological indications and the requirements of the Moldavian standard SM 108.

The harvested green mass was chopped to 1.5-2.0 cm with a forage chopper and compressed in well sealed glass containers, stored at ambient temperature (18–20^{o}C) for 45 days, to allow complete fermentation to occur. Following the 45 days fermentation period, each glass container was opened and the content was visually examined, the colour and the aroma were recorded.

The pH of the samples of silage was measured immediately after removal from the containers. At the same time, samples were taken to determine the content of organic acids (lactic, acetic and butyric) in free and fixed state.

The dry matter content was detected by drying samples up to constant weight at 105 C; crude protein – by Kjeldahl method; crude fat – by Soxhlet method; crude cellulose – by Van Soest method; ash – in muffle furnace at 550^{o}C; nitrogen-free extract (NFE) was mathematically appreciated, as the difference between organic matter values and analytically assessed organic compounds; organic dry matter was calculated through differentiation, the crude ash being subtracted from dry matter. The calcium concentration of the samples was determined by using atomic absorption spectrometry method, phosphorus concentration – by spectrophotometric method.

The biogas and the biomethane, litre per kg of organic dry matter, were calculated using the gas forming potential of nutrients according to Baserga (1998), corrected by the nutrient digestibility.

RESULTS AND DISCUSSIONS

The results of our previous study concerned the agro biological features, the green mass yield and its structure, depending on the harvesting period of the *Sorghum almum* plants (Ţîţei et al., 2015). In the third year of growth, when the plants were cut for the first time, in mid-June 2018 y., they were 196 cm tall, with a moderate proportion of leaves – of 30 %, and the productivity reached 2.85 kg/m^2 of green mass or 0.67 kg/m^2 dry matter. In spite of the favourable weather conditions in June-July 2018, with considerable amount of rainfall and moderate temperatures 22-25^{o}C, the plants recovered well after the harvest, thus, several new shoots developed and, at the end of July, the height of the plants was 160-165 cm and 1.72 kg/m^2 natural fodder was harvested, with reduced dry matter content (18.6%), but higher proportion of leaves (49%). After the second cut, the growth and the development of plants were slower in the August, but then they intensified and, until the end of September, the shoots reached a height of about 153 cm and 30% of the plants were in the stage of panicle development. The yield at the third cut was 1.53 kg/m^2 green mass or 0.41 kg/m^2 dry matter. The annual productivity from three harvests was 6.1 kg/m^2 green mass or 1.4 kg/m^2 dry matter, surpassing the productivity of maize by 35%.

The production of well-preserved, high-quality silages depends mainly on the composition of the forage used for ensiling and the application of appropriate silage-making practices. When opening the glass vessels with silage made from green mass of *Sorghum almum* obtained after the first and third harvests, there was no gas or juice leakage from the preserved mass, but from the vessels with silage made from green mass obtained after the second harvest, carbon dioxide – a by-product of fermentation – was moderately eliminated. The forage materials obtained after all the harvests resulted in silages with agreeable colour and aroma, the consistency was retained, in comparison with the initial green mass, without mould and mucus. During the organoleptic assessment, it was found that the colour of the silage obtained after the first cut was homogeneous green-yellow with pleasant smell, specific to pickled vegetables, but the silage made from green mass obtained after the second cut – green-olive leaves and yellow-green stems with pleasant smell like fresh grass. In the silage obtained after the third cut, the stems were yellow and the leaves – yellow-green with specific smell of pickled vegetables. The materials consolidated well and the fermentation was complete, with pH values 3.77-4.50, the silage obtained after the first cut had the lowest pH, the silages harvested later had higher pH 4.0-4.50. It has been determined that the amounts of organic acids, in the prepared silages, differed essentially depending on the period of harvesting (Table 1). The content of fixed lactic acid decreased from 33.8 g/kg to 17.6 g/kg DM and free lactic acid from 11.7 to 7.1 g/kg DM; total acetic acid increased from 6.3 to 9.1 g/kg DM and free acetic acid from 3.4 to 3.5 g/kg DM, respectively, in the silage obtained after the second cut. The butyric acid content was below the detected level in fixed form (0.2 g/kg DM) in the silage obtained after the first cut. The concentrations of lactic acid varied from 73.1 to 87.5 % of organic acids.

Table 1. The fermentation quality of the investigated *Sorghum almum* silages

Indices	First cut	Second cut
pH index	3.77	4.50
content of organic acids, g/kg DM	52.0	33.8
free acetic acid, g/kg DM	3.4	3.5
free butyric acid, g/kg DM	0	0
free lactic acid, g/kg DM	11.7	7.1
fixed acetic acid, g/kg DM	2.9	6.6
fixed butyric acid, g/kg DM	0.2	0
fixed lactic acid, g/kg DM	33.8	17.6
total acetic acid, g/kg DM	6.3	9.1
total butyric acid, g/kg DM	0.2	0
total lactic acid, g/kg DM	45.5	24.7
acetic acid, % of organic acids	12.12	26.93
butyric acid, % of organic acids	0.38	0
lactic acid, % of organic acids	87.50	73.07

The dry matter content in the investigated *Sorghum almum* silages and its biochemical composition significantly varied depending on the harvest time of green mass (Table 2). The dry matter content in the silage obtained from green mass after the first cut was 21.07%, the lowest, 18.07%, was in the silage obtained after the second cut and the highest, 25.85%, was in the silage obtained after the third cut. It was determined that the biochemical composition of the silage varied depending on the harvest time: crude protein 50.7-95.2 g/kg, crude fats 20.6-36.8 g/kg, crude cellulose 402-428.9 g/kg, nitrogen free extract 330.5-407.2 g/kg and ash 77.2-107.6 g/kg. The amount of protein and fats was high in the silage obtained after the second cut, and low – in the silage obtained after the third cut. The crude cellulose concentration in all the silages was significantly higher. The amount of nitrogen free extract was very low in the silage obtained after the second cut.

Table 2. Dry matter content, biochemical composition, nutritive and energy value of the investigated silages

Indices	First cut	Second cut	Third cut
Dry matter, g/kg	210.70	180.70	258.50
Crude protein, %	7.58	9.52	5.07
Crude fats, %	3.20	3.68	2.06
Crude cellulose, %	41.00	42.99	42.89
Nitrogen free extract, %	40.50	33.05	40.72
Ash,%	7.72	10.76	8.67
Nutritive units/ kg silage	0.17	0.14	0.22
Metabolic energy, MJ/kg silage	1.80	1.47	2.18
Calcium, %	0.48	0.55	0.37
Phosphorus, %	0.19	0.27	0.18
Carotene mg/ kg silage	35.70	47.17	15.67

Minerals have a disproportionate effect on animal production relative to their low concentration in total diets. The macro-minerals calcium and phosphorus are especially important in milk production. They are also vital for the skeleton and the function of nerve impulses. Phosphorus is the mineral included in the body's energy metabolism, ATP system, affects acid-base balance and plays a role in the detoxification process. The concentrations of minerals, calcium (3.7-5.5 g/kg) and phosphorus (1.8-2.7 g/kg), in the Sorghum silages were acceptable. The concentrations of calcium were higher in the silage made from green mass obtained after the first and second cuts, but phosphorus – in the silage prepared after the second cut.

Vitamins are essential for total body function. In ruminants, as in other animals, carotenes are precursors of Vitamin A –retinol. A deficiency in retinol may reduce reproductive efficiency in dairy cows, especially through impaired ovarian function and increased incidence of abortion. Together with Vitamin E and polyphenols, carotenoids are natural antioxidants in the diet of ruminants. They play a role in cell communication and immune function by protecting cells against free radicals. Plant carotenoids affect the colour of milk and dairy products, particularly of butter, some cheeses, and also body fat. It was determined that the carotene content in silage varied significantly in dependence of the time of harvesting green mass: 35.70 mg/kg in silage from the first cut, 47.17 mg/kg in the silage from the second cut and 15.67 mg/kg – from the third cut.

Some authors mentioned various findings about the quality of *Sorghum* silage. Aminah et al. (2001) determined that *Sorghum bicolor* and *Sorghum almum* produced silage with pH 4.0-4.4 and lactic acid amounts of 3.75%, and also 8.7% protein, 2.6% fats, 33.4% cellulose, 51.0% nitrogen free extract and 4.2% ash, 0.47% Ca and 0.17% P. According to Kallah et al. (1997) the forage, at ensiling, declined in moisture content (85.0 to 56.0%) and leafiness (46.0 to 26.0%) with advancing stage of maturity of *Sorghum almum*, and the chemical composition of the silage changed: 6.4-14.7% protein, 5.3-7.7% fats, 5.3-8.5% ash, 72.6-78.8% NDF, 38.8-49.5% ADF, 0.23-0.58% Ca, 0.12-0.21%. Alpizar et al. (2014) mentioned, that *Sorghum almum* plants produced silage with pH 3.8, 7.92% protein, 60.70% NDF, 36.49% ADF, 24.21% hemicellulose, 9.01% ash. Muhammad et al. (2008) determined that silage from pure *Sorghum almum* plants had pH level 5.5, 11.0% protein, 17.5% fats, 40% cellulose, 6.1% ash, 25.1% nitrogen free extract. Under the climatic conditions of Poland, Ksiezak et al. (2012), reported that the silage from *Sorghum saccharatum* cv. *Sucrosorgo* 506 was characterized by 6.32-6.82% crude protein, 2.80-3.06% crude fats, 31.60-31.82% fibre, 5.48-5.93% ash, 0.34-0.39% calcium, 0.14-0.21% phosphorus, 55.50-56.90% digestibility of dry matter, but maize silage contained 6.57-6.63% crude protein, 2.91-3.16% crude fats, 17.26-17.62% fibre, 5.89-6.70% ash, 0.23-0.26% calcium, 0.13-0.22% phosphorus, 66.35-68.18% digestibility of dry mass. The results obtained in Romania, by Voicu et al. (2013), for the silage prepared from sorghum cultivars *F 436* and *F 465*, ensiled in the milk-dough stage, were 6.39-6.74% crude protein, 1.23-1.38% crude fats, 36.8-39.3% crude fibre, 45.1-48.4% nitrogen free extract, 7.03-7.58% ash, 0.34-0.39% calcium, 0.14-0.21% phosphorus, 55.50-56.90% digestibility of dry mass, for maize silage – 6.57-6.63% crude protein, 2.91-3.16% crude fats, 17.26-17.62% fibre, 5.89-6.70% ash, 0.23-0.26% calcium, 0.13-0.22% phosphorus, 66.35-68.18% digestibility of dry matter.

The content of nutrients and their digestibility influence the fodder and energy value of the *Sorghum almum* silages. So, 100 kg of silage obtained at the first cut contained 17.3 nutritive units and 180 MJ metabolizable energy, at the second cut- 14.2 nutritive units and 147 MJ metabolizable energy; the silage at the third cut was characterized by the highest dry matter content which had a beneficial impact – 22.2 nutritive units and 218 MJ metabolizable energy for cattle.

The rapid increase in population and the substantial burning of fossil fuels have contributed to an increase in global warming because of greenhouse gas (GHG) emissions. Hence, renewable sources of energy can be a key option as a potential substitute for fossil fuels. Energy production from biomass at a large scale without affecting environment and human activity has been encouraged. Anaerobic digestion process is a promising method of volatile solid conversion to gaseous fuel and manure as degraded by-product, thereby solving ecological and agrochemical issues.

The stability and the productivity of anaerobic digestion are mostly influenced by the content of organic matter, its biochemical composition, biodegradability and ratio of carbon and nitrogen (Herrmann et al., 2016).

The content of organic digestible substances in the studied *Sorghum almum* silages ranged from 563.2 to 575.2 g/kg, the gas forming potential varied from 399 to 461 l/kg, the methane yield 232-242 l/kg, respectively (Table 3).

Table 3. The gas forming potential of the fermentable organic matter from *Sorghum almum* silage substrates

Indices	First cut	Second cut	Third cut
Organic digestible matter, g/kg	575.2	563.2	569.1
Digestible proteins, g/kg	33.4	41.9	22.3
Digestible fats, g/kg	20.5	23.6	13.2
Digestible carbohydrates, g/kg	521.3	497.7	533.6
Carbon and nitrogen ratio	42	33	63
Biogas, l/kg ODM	461	399	454
Biomethane, l/kg ODM	242	237	232
Methane, %	52.6	59.4	51.1

In Cadriano Italy, Barbanti et al. (2014) found that, in the substrate from perennial inter-specific hybrid Sorghum Silk, the carbon and nitrogen ratio (C/H) was 108 and the methane yield was 271 l/kg, in the substrate from annual Sorghum varieties, they were 49-54 C/H and 251-268 l/kg, but in maize substrate – 40 C/H and 316 l/kg, respectively.

In Germany, Herrmann et al. (2016) determined that the silage substrate from a Sudan grass hybrid was characterized by 7.5% crude protein, 1.8% crude fats, 53.5% nitrogen free extract, 58.7% NDF, 36.6% ADF, 4.7% ADL, carbon and nitrogen ratio 39 and methane production was 288.9 l/kg, for comparison, the methane production potential of winter barley silage was 320.1 l/kg.

Under the climatic conditions of Poland, Ksiezak et al., (2012), determined that the methane production potential of sorghum substrate was 232-268 l/kg, but of maize substrate 280-285 l/kg dry matter.

CONCLUSIONS

In the third growing season, the cv. 'Argentina' of *Sorghum almum*, was characterized by high growth rate and regenerative capacity, the productivity from three cuts was 6.1 kg/m^2 green mass or 1.4 kg/m^2 dry matter, surpassing the productivity of maize by 35%.

The results of this study indicate that satisfactory silages were obtained: pH 3.8-4.5, lactic acid 24.7-45.5 g/kg, acetic acid 6.3-9.1 g/kg, organic matter 892.4-922.8 g/kg, crude protein 50.7-95.2 g/kg, crude fats 20.6-36.8 g/kg, crude cellulose 402-428.9 g/kg, nitrogen free extract 330.5-407.2 g/kg, carotene 15.67-47.17 mg/kg, calcium 3.7-5.5 g/kg and phosphorus 1.8-2.7 g/kg.

The fodder value of the prepared silage was 0.14-0.22 nutritive units/kg and 1.47-2.18 MJ/kg metabolizable energy.

The gas forming potential of the digestible organic dry matter from *Sorghum almum* silage substrates varied from to 399 to 461 l/kg with 51.3-59.9% methane content.

The silage obtained from *Sorghum almum* largely meets the standards and can be used as alternative feedstuff for cattle and as feedstock for the production of biogas.

REFERENCES

Alpizar, A., Camacho, M.I, Saenz, C., Campos. M.E., Arece, J., Esperance, M. (2014). Efecto de la inclusión de diferentes niveles de morera (*Morus alba*) en la calidad nutricional de ensilajes de sorgo (*Sorghum almum*). *Pastos y Forrajes*, 37 (1), 55-60.

Aminah, A., Abu Bakar, C., Izham, A. (2001). Silages from tropical forages: nutritional quality and milk production. *FAO Electronic Conference on Tropical Silage* www.fao.org/DOCREP/005/X8486E/x8486e0d.htm.

Avutkhonov, B. S., Safarov, A. K., Safarov, K. S. (2016). Physiological peculiarities of Columbus grass (*Sorghum almum* Parodi) in Samarkand region conditions of Uzbekistan. *European science review*, 7-8, 5-7.

Barbanti, L., Di Girolamo, G., Grigatti, M., Bertin, L., Ciavatta, C. (2014). Anaerobic digestion of annual and multi-annual biomass crops. *Industrial Crops and Products,* 56, 137-144.

Baserga, U. (1998). Landwirtschaftliche Co-Vergärungs-Biogasanlagen – Biogas aus organischen Reststoffen und Energiegras. *FAT-Berichte*, 512, 1-11.

Cattani, M., Guzzo N., Mantovani, Bailoni L.R. (2017). Effects of total replacement of corn silage with sorghum silage on milk yield, composition, and quality. *Journal of Animal Science and Biotechnology,* 8, 1-15.

Herrmann, C., Idler, C., Heiermann, M. (2016). Biogas crops grown in energy crop rotations: Linking chemical composition and methane production characteristics. *Bioresource Technology,* 206, 23–35.

Kallah, M.S., Baba, M., Alawa, J.P., Muhammad, I.R., Tanko, R.J. (1997). Ensiling quality of columbus grass (*Sorghum almum*) grown in northern Nigeria. *Animal Feed Science and Technology*, 68 (1-2), 153-163.

Ksiezak, J., Matyka, M., Bojarszczuk, J., Kacprzak, A. (2012). Evaluation of productivity of maize and sorghum to be used for energy purposes as influenced by nitrogen fertilization. *Zemdirbyste-Agriculture*, 99(4), 363–370.

Marin, M., Hodoşan, C., Nicolae, C., Diniţă, G., Drăgotoiu, T., Nistor, L. (2016). Researches regarding the chemical composition and gross energy of sorghum in comparison to other forages for feeding cattle and pigs. *Scientific Papers: Series D, Animal Science*, 59, 95-98.

Muhammad, I.R., Baba, M., Mustapha, A., Ahmad, M.Y., Abdurrahman, L.S. (2008). Use of Legume in the Improvement of Silage Quality of Columbus Grass *(Sorghum almum* Parodi). *Research Journal of Animal Sciences,* 2, 109-112.

Popescu, V., Albu, M. (1970). Date biometrice a speciei *Sorghum almum* Parodi. *Notulae botanicae horti agrobotani Clujensis*, 101-106. www.notulaebotanicae.ro/index.php

Rakhmetov, D., Rakhmetova. C. (2008). Columbus grass promising multifunctional use culture in Ukraine. *Propozitsiya,* 6, 148-154. [in Ukrainian]

SM 108:1995 (1996). Siloz din plante verzi/ Green plant ensilage. Condiţii tehnice. *Moldovastandart*, 10.

Ţîţei, V., Muntean, A., Coşman, V. (2015). Introduction and agro economical value of *Sorghum almum* in the Republic of Moldova. *Research Journal of Agricultural Science*, 47(2), 232-237.

Trulea, A., Vintilă, T., Pop, G., Şumălan, R., Gaşpar, S. (2013). Ensiling sweet sorghum and maize stalks as feedstock for renewable energy production. *Research Journal of Agricultural Science,* 45(3), 193-199.

Voicu, I., Mircea, E., Voicu, D., Vasilachi, A. (2013). Evaluation of the energy and protein potential of some drought-resistant plant hybrids (ensiled sweet sorghum). *Analele IBNA,* 29, 23-28.