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THE EVALUATION OF THE BIOMASS QUALITY OF *Spartina pectinata* AND PROSPECTS OF ITS USE IN MOLDOVA

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Abstract

Prairie cordgrass - Spartina pectinata Bosc ex Link, Poaceae family, is a warm-season, C_4 perennial rhizome grass native to North America. The main objective of this research was to evaluate the quality indices of green and ensiled mass substrate, solid dry biomass of the introduced taxa of Spartina pectinata, grown in monoculture in the collections of the National Botanical Garden (Institute), Chişinău. It was established that Spartina pectinata fresh mass substrate used for anaerobic digestion contained 43 g/kg CP, 66 g/kg ash, 437 g/kg Cel, 301g/kg HC, 59 g/kg ADL, 55 g/kg TSS, with C/N = 74 and biochemical methane potential 299 l/kg, but the ensiled substrate - 44 g/kg CP, 76 g/kg ash, 473 g/kg Cel, 323 g/kg HC, 57 g/kg ADL, with C/N = 72 and biochemical methane potential 303 l/kg, respectively. It has been determined that prairie cordgrass solid dry biomass harvested in winter period contained 453 g/kg Cel, 294 g/kg HC, 82 g/kg ADL, the estimated theoretical ethanol yield averaged 543 L/t. The prepared solid fuel, briquettes and pellets, had significantly higher net calorific value than perennial sorghum and corn stem fuel. The investigated introduced taxa of prairie cordgrass, may be used as multi-purpose feedstock for renewable energy production in Moldova.

***Key words**: biochemical composition, biomass, biomethane, cell wall components, solid fuel, Spartina pectinata, theoretical ethanol potential.*

INTRODUCTION

Energy availability is a crucial developmental factor for all areas of the economy. In recent decades there has been a considerable global increase in urban population, industrial productivity, energy demand, waste generation, and the emission of greenhouse gases from energy conversion.

Replacing fossil fuels with renewable energy alternatives has become a major global issue of the XXI century and a key to sustainable development. Lignocellulose is the most abundant and accessible renewable biomass in the world, it has great potential for being a source of energy and value-added products in circular economy.

In order to maintain biomass production on marginal land, developing energy crops with abiotic stress tolerances, it is necessary and will result in a reduction in competition for land with food crops, as well as improve sustainable cellulosic biomass feedstock and bioenergy production. *Poaceae* species with C_4 photosynthesis type are of great interest among non-traditional plant species, due to their high resilience to climate change effects: high temperature, water insufficiency and salinity stress. Therefore, it is necessary to study and develop perennial grass species having high biomass yields and stress tolerance that have been underutilized or unexploited.

Prairie cordgrass - *Spartina pectinata* Bosc ex Link, *Poaceae* family (syn. *Spartina michauxiana* Hitchc.; *Spartina pectinata* Bosc ex Link var. *suttiei* (Farw.) Fernald; *Sporobolus michauxianus* (Hitchc.) P.M. Peterson and Saarela) is a warm-season, C_4 perennial rhizome grass native to North America. The central culm is light green, terete, hollow, hard and sturdy that may reach 3 m in heights and 3-11 mm thick, during the growing season, the stems become woody and coarse. The glossy dark green leaves have sharp, serrated edges, are 5-15 mm wide and 20-96 cm long, with prominent linear veining and taper to a fine tip. The panicle may be up to 50 cm long and may have many branches, with 10 to 20 spikelets up to 2.5 cm in length. The seeds are flat, paper-like with barbed awns that attach firmly to fur or fabric. The root system is fibrous and strongly rhizomatous, and penetrates almost vertically downward to depths of 2.4-3.3 m. Clonal colonies of plants are often produced from the rhizomes. It is well adapted to both wet and dry soils and has a potential biomass yield of up to 21 t/ha in northern environments. The period of use of a plantation is 15-20 years. In Europe, it is grown primarily as an ornamental plant and, at the same time, it is used for strengthening sandy embankments, dams and dykes. Irrespective of the compactness of the soil, its strong and sharp-pointed roots permit its penetration. It should be noted that prairie cordgrass has a considerable anti-erosion function and, by growing on the banks of streams, it prevents flooding during periods of intensive rainfalls (Walkup, 1991; Fraser & Kindscher, 2005; Boe & Lee, 2007; Boe et al., 2009; Friesen et al., 2015; Kim et al., 2020).

Due to the intensive growth of biomass during the growing season *Spartina pectinate* has the prospect of being used for renewable energy production and feedstock for particleboard manufacture (Kowalczyk-Juśko, 2013; Maj & Piekarski, 2013; Helios et al., 2014; Kim et al., 2015; Guo, 2017; Janiszewska et al., 2022; Steinhoff-Wrzesniewska et al., 2022).

The main objective of this research was to evaluate the quality indices of green mass, ensiled mass, and solid dry biomass of the introduced taxa of *Spartina pectinate* in the third year of vegetation, and the prospects of its use as feedstock for renewable energy production.

MATERIALS AND METHODS

The introduced taxa of prairie cordgrass, *Spartina pectinata*, which was grown in monoculture in the experimental plot of the National Botanical Garden (Institute) Chişinău, N 46°58′25.7″ latitude and E 28°52′57.8″ longitude, served as subject of the research, and the cv. *Argentina* of perennial sorghum, *Sorghum almum*, and the hybrid *Porumbeni* 458 of corn, *Zea mays*, were used as control variants.

The green mass was harvested manually, *Spartina pectinate* and *Sorghum almum* in the flowering stage, but *Zea mays* - in the milk-wax kernel stage. The harvested green mass was chopped with a stationary forage chopping unit. The dry matter content was detected by drying samples up to constant weight at 105°C. For ensiling, the chopped green mass was shredded and compressed in well-sealed glass containers. After 45 days, the containers were opened, and the sensorial and fermentation indices of the conserved forage were determined in accordance with standard laboratory procedures – the Moldavian standard SM 108 for forage quality analysis. For chemical analyses, the green mass and silage samples were dried in a forced air oven at 60°C, milled in a beater mill equipped with a sieve with diameter of holes of 1 mm and some assessments of the main parameters, such as crude protein (CP), crude fibre (CF), ash, acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL) and total soluble sugars (TSS), have been made by near infrared spectroscopy (NIRS) technique using PERTEN DA 7200 of the Research-Development Institute for Grassland Brasov, Romania. The concentrations of hemicellulose (HC) and cellulose (Cel) were calculated according to standard procedures. The carbon content of the substrates was obtained using an empirical equation according to Badger et al. (1979). The biochemical methane potential was calculated according to the equations of Dandikas et al. (2015). The solid dry biomass was collected in winter. The total carbon (C), hydrogen (H), nitrogen (N) and sulphur (S) amounts were determined by dry combustion in a Vario Macro CHNS analyser, according to standard protocols. The some physical and mechanical properties of dry biomass, briquettes and pellets were determined according to the standards: SM EN ISO 18134, SM EN ISO 18122; SM EN ISO 18125. The acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL) in solid biomass have been determined using PERTEN DA 7200, the concentrations of hemicellulose (HC) and cellulose (Cel) were calculated according to standard procedures. The Theoretical Ethanol Potential (TEP) was calculated according to the equations of Goff et al. (2010) based on conversion of cellulose and hemicellulose into hexose (H) and pentose (P) sugars:

$$H = [\%Cel+(\%HC \times 0.07)] \times 172.82$$
$$P = [\%HC \times 0.93] \times 176.87$$
$$TEP = [H + P] \times 4.17$$

RESULTS AND DISCUSSIONS

Under the conditions of the Republic of Moldova, in the 3rd year of life, *Spartina pectinata* plants come out of dormancy in mid-April, while *Sorghum almum* plants - in the first days of May. The most intense growth was recorded during June and July. *Sorghum almum* plants bloom at the end of June and *Spartina pectinata* plants - in the first days of August. At the harvest time, the *Spartina pectinata* plants were 150-155 cm tall and the weight of a shoot was on average 23 g green mass or 9.1 g dry matter, consisting of 56.0% leaves and panicle.

The biogas production as renewable energy has recently become of major interest in Europe. Biomethane is a sustainable and renewable alternative to fossil fuels, can be used as vehicle fuel, as fuel in combined heat and power systems, or to produce electricity and heat, and the digested effluent (digestate) can be utilized as fertilizer. Plant biomass - phytomass substrates may be used in biogas generators as fresh mass and as ensiled mass. Analysing the results of the assessment of the biochemical composition of the studied *Poaceae* species, it can be noted that the harvested whole plants of prairie cordgrass were characterized by lower content of crude protein and total soluble sugars, optimal amount of minerals and higher cell wall fractions (NDF, ADF, ADL). The green mass substrate of perennial sorghum contained higher content of crude protein and minerals, optimal total soluble sugars and a much lower amount of cell wall fractions than prairie cordgrass substrate. The very high level of total soluble sugars, optimal levels of crude protein and reduced levels of minerals and cell wall fractions were found in corn green mass substrate. It is a commonly known fact that methanogenic bacteria need a suitable ratio of carbon to nitrogen for their metabolic processes, ratios higher than 30: 1 were found to be unsuitable for optimal digestion, and ratios lower than 10: 1 were found to be inhibitory, because of low pH, poor buffering capacity and high concentrations of ammonia in the substrate. The nitrogen content in the studied green mass substrates ranged from 6.90 to 17.00 g/kg, the estimated content of carbon - from 502.00 to 527.00 g/kg, the C/N ratio varied from 30 to 74. The C/N ratio in the prairie cordgrass mass substrate was very high and had a negative influence on the activity of bacteria and methanogenesis processes. The estimated biochemical methane potential of the studied green mass substrates varied from 299 l/kg VS to 332 l/kg VS (Table 1). The *Spartina pectinata* green mass substrate contained high level of acid detergent lignin (59 g/kg) and reduced biochemical methane potential - 299 l/kg VS. According to Nicholson & Langille (1965), unfertilized prairie cordgrass harvested in 10% head stage contained 388 g/kg DM, 1.32% N and 4.2% ash, but nitrogen-fertilized prairie cordgrass - 264 g/kg DM, 1.78 % N and 4.9% ash. Pabón-Pereira (2009) remarked that *Spartina anglica* substrate contained 320 g/kg DM, 89% OM, 77% total fibre, 5% lignin, 26% Cel, 46% HC, 0% starch, 12% protein, with biochemical methane potential 290 l/kg, but *Hordeum vulgare* substrate contained 380 g/kg DM, 95% OM, 65% total fibre, 2% lignin, 23% Cel, 40% HC, 22% starch, 9% protein with biochemical methane potential 300 l/kg. Kupryś-Caruk & Kołodziejski (2016) revealed that the yield and chemical composition of fresh biomass of *Spartina pectinata* was 32.5 t/ha, 329 g/kg DM, 96.2% OM, 39.8% CF and C/N = 35.5, but - of *Festuca arundinacea* - 25.0 t/ha, 296 g/kg DM, 89.3% OM, 29.7%CF and C/N = 22.9. Kupryś-Caruk et al. (2023) reported that the chemical composition of the cordgrass fresh mass was 307 g/g DM. 95.1% ODM, 7.1% CP, 36.7% Cel. 22.5% HC, 6.3% LIG, 2.5% WSC, 55.4% DDM, but *Miscanthus* fresh mass - 172 g/g DM. 92.4% ODM, 9.3%CP, 37.1% Cel. 23.7% HC, 6.3% LIG, 3.5% WSC and 55.4% DDM. The quality of silage depends on the plant species, the harvesting period, on the bio-morphological peculiarities of the harvested herbage, on techniques and technology of preparation, on conditions of its storage and on many other factors. As a result of the performed sensorial analysis, the investigated *Spartina pectinata* silage was distinguished by homogeneous olive colour, pleasant smell specific of pickled vegetables, and the consistency was maintained in comparison with the initial green mass, without mould and mucus. The biochemical composition and the biomethane potential of silage substrate from the studied Poaceae species are shown in Table 2. It was determined that the pH index of the ensiled prairie cordgrass was 4.57, but in the control variants pH = 3.77-3.87. The concentration of total organic acids in *Spartina pectinata* silage was lower (36.90 g/kg), predominantly in fixed form; a higher content of butyric acid was detected (15.75% of organic acids). We would like to mention that the dry matter of *Spartina pectinata* silage had lower concentration of crude protein, optimal mineral content and higher cell wall fractions content, with a minor decrease in the acid detergent lignin content, but total soluble sugars were detected as compared with the initial green mass. The corn and perennial sorghum silages were characterized by high content of total soluble sugars, optimal level of crude protein and minerals, low level of hemicellulose and acid detergent lignin as compared with prairie cordgrass silage. The nitrogen concentration in the tested ensiled substrates ranged from 7.10 g/kg to 15.40 g/kg, the estimated content of carbon - from 503 g/kg to 523 g/kg, the C/N ratio varied from 33 to 72. The biochemical methane potential varied from 303 l/kg VS in prairie cordgrass silage substrate to 338 l/kg VS in corn silage substrate.

Several studies have evaluated the biochemical composition and biogas potential of *Spartina* ensiled substrates. According to Kupryś-Caruk & Kołodziejski (2016), the *Spartina pectinata* silage substrate was characterized by pH 5.2, 0.5 g/kg lactic acid, 17 g/kg acetic acid, 267 g/kg DM, 4.7% ash, 8.8% CP, 1.9% EE, 5.8% monosaccharides, 33.2% Cel, 6.6% HC, 3.8% lignin, 60.6% DDM and the maximum biogas yield measured after 21 days of incubation was 722.7 m^3/t, but the silage substrate from *Festuca arundinacea* had pH 5.2, 89.7 g/kg lactic acid, 2.3 g/kg acetic acid, 214 g/kg DM, 11.7% ash, 10.0% CP, 2.2% EE, 5.5% monosaccharides, 30.4% Cel, 5.7% HC, 3.0% lignin, 62.9% DDM and biogas yield 734.1 m^3/t. Piątek et. al. (2016) revealed that the biogas yield from *Spartina pectinata* reached 404.5 m^3/t ODM, from *Miscanthus × giganteus* 487.9 m^3/t ODM and from *Andropogon gerardii* 546.6 m^3/t ODM. Kupryś-Caruk & Podlaski (2019) found that the chemical composition of silage from perennial grass *Spartina pectinata* was the following: pH 5.2, 2.5 g/kg lactic acid, 2.5 g/kg acetic acid, 357 g/kg DM, 10.1% CP, 29.4% CF, 2.7% monosaccharides, 6.2% ash, 404.5 m^3/t ODM biogas yield with 55% content of methane in biogas, but maize silage substrate had pH 3.9, 11.6 g/kg lactic acid, 1.9 g/kg acetic acid, 284 g/kg DM, 9.9% CP, 23.8% CF, 6.7% monosaccharides, 5.5% ash, 737.8 m^3/t ODM with 55% methane content. Kupryś-Caruk et al. (2021) remarked that the silage prepared from *Spartina pectinata* without silage additive had pH 4.7, 12 g/kg lactic acid, 3.5 g/kg acetic acid, 3.5 g/kg butyric acid, 346 g/kg DM, 4.5% CP, 37.9% Cel, 34.6% HC, 0.65% WSC, 1.21% EE, 54.2% DDM with observed biogas production 592.7 l/kg, but the ensiled mass with silage additives: pH 4.4-4.6, 8.5-24.7 g/kg lactic acid, 3.4-10.7 g/kg acetic acid, 1.2 g/kg butyric acid, 341-348 g/kg DM, 4.5-4.6% CP, 37.8-38.0% Cel, 32.0-32.5% HC, 0.65-0.77% WSC, 1.19-1.20% EE, 54.3-54.8% DDM with observed biogas production 533.8-653.0 l/kg. Kupryś-Caruk et al. (2023) reported that the chemical composition and methane yield of the cordgrass silage substrate was: 306 g/g DM, pH 5.2, 26.8 g/kg lactic acid, 42.5 g/kg acetic acid, 0 g/kg butyric acid, 94.5% ODM, 6.6% CP, 36.3% Cel. 22.6% HC, 6.6% LIG, 0% WSC, 56.3 % DDM and 267.7 l/kg VS, but the cordgrass silage prepared with the inoculant: 299 g/g DM, pH 5.1, 69.5 g/kg lactic acid, 109.3 g/kg acetic acid, 0 g/kg butyric acid, 94.6% ODM, 6.7% CP, 36.9% Cel, 21.9% HC, 6.0% LIG, 0% WSC, 55.0 % DDM and 329.3 l/kg VS.

The possibility of converting lignocellulosic biomass in bioethanol fuel is currently an area of great interest around the world. The bioethanol yields are influenced by tissue composition, ratios of cellulose, hemicellulose and lignin. Analysing the cell wall composition of straw substrates (Table 3), we would like to mention that the concentration of neutral detergent fibre in *Spartina pectinata* straw substrate was 829 g/kg, including 453 g/kg cellulose, 294 g/kg hemicellulose and 82 g/kg lignin, but *Sorghum almum* substrate contained

490 g/kg cellulose, 291 g/kg hemicellulose and 62 g/kg lignin; in *Zea mays* substrate, there were 423 g/kg cellulose, 244 g/kg hemicellulose and 83 g/kg lignin, respectively.

The estimated theoretical ethanol yield averaged 543 L/t in *Spartina pectinata*, compared to 485 L/t in *Zea mays* substrate and 567 L/t in *Sorghum almum* substrate.

Table 1. The biochemical composition and the biomethane potential of the studied green mass substrate

Indices	*Spartina pectinata*	*Sorghum almum*	*Zea mays*
Crude protein, g/kg DM	43.00	106.00	84.00
Crude fibre, g/kg DM	487.00	392.00	248.00
Minerals, g/kg DM	66.00	96.00	52.00
Acid detergent fibre, g/kg DM	496.00	421.00	271.00
Neutral detergent fibre, g/kg DM	797.00	670.00	474.00
Acid detergent lignin, g/kg DM	59.00	45.00	48.00
Total soluble sugars, g/kg DM	55.00	110.00	336.00
Cellulose, g/kg DM	437.00	376.00	223.00
Hemicellulose, g/kg DM	301.00	249.00	203.00
Carbon, g/kg DM	508.00	502.00	527.00
Nitrogen, g/kg DM	6.90	17.00	13.44
Ratio carbon/nitrogen	74	30	39
Biomethane potential, l/kg VS	299	332	321

Table 2. The biochemical composition and the biomethane potential of studied silage substrate

Indices	*Spartina pectinata*	*Sorghum almum*	*Zea mays*
pH index	4.57	3.87	3.77
Content of organic acids, g/kg DM	36.90	48.00	48.60
Free acetic acid, g/kg DM	2.00	3.30	5.10
Free butyric acid, g/kg DM	1.80	0	0
Free lactic acid, g/kg DM	7.50	12.70	17.00
Fixed acetic acid, g/kg DM	1.90	3.80	5.20
Fixed butyric acid, g/kg DM	3.90	0	0.20
Fixed lactic acid, g/kg DM	19.80	28.20	21.10
Total acetic acid, g/kg DM	3.90	6.10	10.30
Total butyric acid, g/kg DM	5.70	0	0.20
Total lactic acid, g/kg DM	27.30	40.90	38.10
Acetic acid, % of organic acids	10.57	12.71	21.19
Butyric acid, % of organic acids	15.45	0	0.41
Lactic acid, % of organic acids	73.98	77.29	78.40
Crude protein, g/kg DM	44.00	93.00	80.00
Crude fibre, g/kg DM	523.00	405.00	245.00
Minerals, g/kg DM	76.00	94.00	59.00
Acid detergent fibre, g/kg DM	530.00	405.00	258.00
Neutral detergent fibre, g/kg DM	853.00	630.00	469.00
Acid detergent lignin, g/kg DM	57.00	40.00	37.00
Total soluble sugars, g/kg DM	0	52.00	326.00
Cellulose, g/kg DM	473.00	365.00	221.00
Hemicellulose, g/kg DM	323.00	225.00	211.00
Carbon, g/kg DM	513.00	503.00	522.78
Nitrogen, g/kg DM	7.10	15.40	12.80
Ratio carbon/nitrogen	72	33	41
Biomethane potential, l/kg VS	303	338	338

Table 3. The composition of cell walls and the theoretical ethanol potential of the studied dry biomass substrates

Indices	*Spartina pectinata*	*Sorghum almum*	*Zea mays*
Acid detergent fibre, g/kg DM	535	552	506
Neutral detergent fibre, g/kg DM	829	843	750
Acid detergent lignin, g/kg DM	82	62	83
Cellulose, g/kg DM	453	490	423
Hemicellulose, g/kg DM	294	291	244
Hexose sugars, g/kg	81.84	88.20	76.05
Pentose sugars, g/kg	48.44	47.87	40.14
Theoretical ethanol potential, L/t	543	567	485

Several literature sources describe the composition of cell walls in *Spartina pectinata* straw and ethanol yield. Kim et al. (2015) reported that in *Spartina pectinata* substrate glucan concentrations ranged from 301.8 to 373.5 g/kg biomass, xylan concentrations were in the range of 181.5-214.6 g/kg biomass, total lignin ranged from 155.3 to 188.7 g/kg biomass, the ethanol yields produced by *Saccharomyces cerevisiae* SR8 varied from 205.0 to 275.6 g/kg biomass, these ethanol yields are comparable with those of switchgrass, corn stover and bagasse. Guo (2017) mentioned that the feedstock quality of prairie cordgrass was characterized by 292.9-316.3 g/kg HC, 399.8-421.4 g/kg Cel, 63.3-73.8 g/kg lignin. Thapa et al. (2022) found that *Spartina pectinata* contained 30.07-31.75% HC, 37.20-38.66% Cel, 4.99-5.67% lignin, 4.97-5.47 % ash, *Andropogon gerardii* 30.61% HC, 39.91% Cel, 5.47% lignin, 4.80% ash; *Miscanthus* × *giganteus* 29.11 % HC, 40.00% Cel, 6.31% lignin, 3.63 % ash; *Panicum virgatum* 31.04 % HC, 38.88% Cel, 5.09% lignin, 4.51 % ash.

From the perspective of the direct combustion of solid biomass, knowing its properties is essential. The moisture content, ash content, elemental composition of biomass are significant assets that define dry biomass and are key factors that affect the calorific value, technologies for the production of solid biofuels that are clean and efficient in energy conversion systems The higher carbon and hydrogen contents, the higher the calorific value. In contrast, high oxygen and nitrogen values decrease the calorific value, decreasing the energy potential of the sold biofuel. Chlorine, nitrogen and sulphur have an effect on ash formation as well as significant impact on the formation of harmful emissions, mainly mono-nitrogen oxides and sulphur oxide and highly corrosive hydrochloric acid. The gas produced by combustion of sulphide and chloride is the main substance of acid rain, which have huge environmental impact. The elemental composition, ash content and calorific value of biomass and solid fuel from studied *Poaceae* species are illustrated in Table 4. We would like to mention that the dry matter of the studied biomass contained 44.35-45.87% C, 5.31-5.75% H, 0.30-0.83% N, 0.06-0.12% S, 0.04-0.05% Cl, 3.56-4.48% ash, 18.64-19.51 MJ/kg GCV. and 17.69-18.46 MJ/kg NCV. The higher content of carbon and the lower content of nitrogen and ash in *Spartina pectinata* biomass have positive impact on the calorific value as compared with *Zea mays* and *Sorghum almum.* The nett calorific value of pellets varied from 17.59 MJ/kg to 18.50 MJ/kg and - of briquettes from 17.24 MJ/kg to 18.20 MJ/kg. The *Spartina pectinata* densified solid fuel, namely, pellets and briquettes, is characterized by excellent nett calorific value (18.20-18.50 MJ/kg).

Table 4. The elemental composition, ash content and calorific value of studied dry biomass

Indices	*Spartina pectinate*	*Sorghum almum*	*Zea mays*
Carbon	45.87	44.35	45.17
Hydrogen	5.31	5.60	5.75
Nitrogen	0.30	0.41	0.83
Sulphur	0.08	0.06	0.12
Chlorine	0.04	0.05	0.04
Ash content of biomass, %	3.56	4.42	4.48
Gross calorific value, MJ/kg	19.51	18.64	18.78
Nett calorific value of pellets, MJ/kg	18.50	17.59	17.77
Nett calorific value of briquettes, MJ/kg	18.20	17.24	17.54

Some authors mentioned various findings about the elemental composition, calorific value of biomass and quality of solid fuel from *Spartina* species. Kowalczyk-Juśko (2010) found that the elemental composition and energy parameters of *Spartina pectinata* biomass were 4.3-5.4% ash, 41.92-42.73% C, 0.31-0.72% N, 0.08-0.14% S, 14.90-15.38 MJ/kg calorific value, as compared with hard coal: 4.3-5.4% ash, 66.57 % C, 1.16% N, 0.46% S, 26.1 MJ/kg calorific value. Stolarski et al. (2014) mentioned that the energy biomass harvested in April from *Spartina pectinata* contained 49.17% C, 5.79% H, 0.054% S, 2.58% ash, 19.09 MJ/kg HHV and 14.48 MJ/kg LHV, but *Miscanthus x giganteus* biomass contained

50.43% C, 5.84% H, 0.028% S, 1.90% ash, 19.18 MJ/kg HHV and 14.16 MJ/kg LHV. Uchman et al. (2016) remarked that *Spartina pectinata* contained 8.0% moisture, 3.24% ash, 77.5% volatile materials, 45.8 % C, 7.28% H, 0.26% N, 1.45% S, 19.29 MJ/kg LHV, but *Sida hermaphrodita* 9.0% moisture, 2.6% ash, 78.8% volatile materials, 44.8 % C, 7.4% H, 0.37% N, 1.40% S, 19.0 MJ/kg LHV, *Miscanthus x giganteus* 7.6% moisture, 1.36% ash, 75.4% volatile materials, 46.6 % C, 7.16% H, 0.16% N, 1.35% S, 19.45 MJ/kg LHV, *Panicum virgatum* 8.5% moisture, 3.23% ash, 78.1% volatile materials, 46.0 % C, 6.9 % H, 0.55% N, 1.43% S, 18.35 MJ/kg LHV. Maj& Piekarski (2013) reported that the pellets made from prairie cordgrass contained 7.55% moisture, 4.86 % ash, the heat of combustion reached the value of 18.31 MJ/kg and the calorific value was 16.93 MJ/ kg. Guo (2017) remarked that the prairie cordgrass feedstock contained 43.7-50.7 g/kg ash, 6.1-7.5 g/kg N, 0.9-1.0 g/kg S. Urbanovičová et al. (2017) remarked that the briquettes from *Spartina pectinata* reached a density of 800 kg/m^3 and 95% durability with calorific value 14-17 MJ/kg, but the briquettes from *Sida hermaprodita* - 820 kg/m^3 and 95% durability with calorific value 15 MJ/kg, respectively.

CONCLUSIONS

The introduced ecotype of prairie cordgrass, *Spartina pectinata*, under the climatic conditions of the Republic of Moldova, was characterized by optimal growth rates and productivity.

The *Spartina pectinata* fresh mass substrate used for anaerobic digestion contained 43 g/kg CP, 66 g/kg ash, 437 g/kg Cel, 301g/kg HC, 59g/kg ADL, 55 g/kg TSS, with C/N = 74 and biochemical methane potential 299 l/kg, but the ensiled substrate - 44 g/kg CP, 76 g/kg ash, 473 g/kg Cel, 323 g/kg HC, 57 g/kg ADL, with C/N = 72 and biochemical methane potential 303 l/kg.

The prairie cordgrass solid dry biomass harvested in winter period contained 453 g/kg Cel, 294 g/kg HC, 82 g/kg ADL, the estimated theoretical ethanol yield averaged 543 L/t.

The prepared solid fuel, briquettes and pellets, had significantly higher net calorific value than perennial sorghum and corn stem fuel. The investigated introduced taxa of prairie cordgrass, may be used as multi-purpose feedstock for renewable energy production in Moldova.

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