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EVALUATION OF THE BIOMASS QUALITY OF WHITE SWEETCLOVER, *Melilotus albus*, AND PROSPECTS OF ITS USE IN MOLDOVA

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Abstract

Legume plants play a major role in promoting sustainable agriculture, at global, regional and national levels. We investigated the biomass quality of the local ecotype of white sweetclover, Melilotus albus L., grown in an experimental field of the National Botanical Garden (Institute), Chişinău. That the green mass cut in the flowering period contained 27.9% dry matter. The dry matter of whole plants contained 132 g/kg CP, 82 g/kg ash, 381 g/kg CF, 386 g/kg ADF, 567 g/kg NDF, 64 g/kg ADL, 322 g/kg Cel, 181 g/kg HC, 86 g/kg TSS, with 58.8% DMD, RFV = 97, 11.66 MJ/kg DE, 9.57 MJ/kg ME, 5.59 MJ/kg NEl. The fermented fodder from Melilotus alba contained 127 g/kg CP, 414 g/kg CF, 99 g/kg ash, 407 g/kg ADF, 581 g/kg NDF, 58 g/kg ADL, 62 g/kg TSS, 348 g/kg Cel, 174g/kg HC, with nutritive and energy values: 57.2 % DMD, RFV = 92, 11.38 MJ/kg DE, 9.34 MJ/kg ME and 5.30 MJ/kg NEl. The biochemical methane potential of white sweetclover green mass substrate reached 267 L/kg organic matter and white sweetclover silage substrate - 278 L/kg organic matter. The local ecotype of white sweetclover can be used for the restoration of degraded lands, as a component of the mix of grasses and legumes for the creation of temporary grasslands. The harvested biomass can be used as alternative fodder for farm animals or as substrates in biogas generators for the production of renewable energy.

Key words: *biochemical composition, biochemical methane potential, forage quality, green mass, Melilotus albus, silage.*

INTRODUCTION

Population growth, economic development and awareness about healthy nutrition increase the demand for animal products day by day and require more efficient use of limited production resources such as water and soil. Selecting the right forages and suitable management practices are the most effective strategies for reasonable forage production under limited natural resources and under the conditions of climate change. The increasing need for animal feed and the insufficiency of production resources have caused a high interest in plants that can produce high yields under different climate and soil conditions and can be cultivated without great expense. *Fabaceae* plants play a major role in promoting sustainable agriculture, at global, regional and national levels. Legumes have a symbiotic relationship with atmospheric nitrogen fixing bacteria that live in root nodules and that make legumes independent of nitrogen fertilization. As a consequence, legume fodders commonly have higher concentrations of protein than other grasses. In this context, neglected and underutilized legume plants have gained a lot of attention recently.

Melilotus is a genus in the family *Fabaceae*, and its representatives occur commonly in grasslands or as weeds in fields. *The Plant List* includes 205 scientific plant names of species rank for the genus *Melilotus*, 22 of them are accepted species names, distributed in the Mediterranean countries, Asia and North America, Central and Eastern Europe. There are 6 species of the genus *Melilotus* in Romania and 4 species in the Republic of Moldova. The most known and common species are white sweet clover *Melilotus albus* Medik. and yellow sweet clover *Melilotus officinalis* L. (Stoian, 1987; Negru, 2007).

White sweetclover or honey clover *Melilotus albus* Medik. (syn. *Melilotus alba* L., *Melilotus leucanthus* W.D.J. Koch ex DC.) is annual or biennial herb, develops erect or ascending stems, robust, 30-180 cm tall, greenish-yellow, pubescent in the upper part. The leaves are bright green, trifoliate. The basal leaves have obovate leaflets, cuneate at the base and obtuse at the tip, the margins are slightly and irregularly serrated, the leaflets of the upper leaves are narrow, elongated-lanceolate, with slightly toothed margins, with scattered hairs on the adaxial side, the middle leaflet petiolate, the stipules are narrow, entire and slightly toothed at the base, subulate at the tip. The white flowers are arranged in a loose raceme, 5-8 cm long. It blooms from June to September. The fruit is a glabrous pod, obovate, rostrate and reticulated, blackish, 3-4 mm long, brown, indehiscent, with 1-2 yellowish, oval seeds that are 2.0-2.5 mm long and 1.5 mm wide. The weight of 1000 seeds is 2.0-2.5 g. The tap root is strongly branched, grows into the soil to a depth of 2.0 m. It forms a symbiotic relationship with the bacteria *Rhizobium meliloti.* The non-scarified seeds need high amounts of moisture in the germination bed, but the amount of water absorbed by the scarified seeds, for germination, decreases by 30-40%. The seeds germinate at a soil temperature of 2-4°C; in spring, the seedlings can withstand, temperatures as low as 3-6°C. In winter, the plants can withstand temperatures of -30°C, under the snow cover. In summer, it is more drought tolerant than alfalfa and sainfoin. White sweetclover cannot tolerate shade, thus, in mixted culture the foliage is sparse and the shoots are lignified. This species has relatively low requirements to the soil, due to the development of a strong root system, the high ability to solubilize phosphorus and other elements from combinations which are hard to dissolve for other plants. Strong and deep penetrating taproots make it a suitable candidate as a nurse crop in derelict land compacted soils. White sweetclover prefers neutral or moderately alkaline soils. It can grow on slightly sandy, solonchak, loamy, calcareous, stony and unstructured soils. It has shown some tolerance to saline soils with a salt concentration of 0.4-0.6%. Acidic and excessively moist soils should be avoided (Medvedev & Smetannikova, 1981; Guerrero-Rodríguez, 2006; Gucker, 2009; Anderson, 2013; Annaeva et al., 2020; Țîței & Roșca, 2021). *Melilotus albus* contains condensed tannins. The low level of tannins (2-3%) in ruminant feeding has a beneficial effect as it reduces protein degradation in the rumen while the high level of tannins negatively affects protein digestion, microbial and enzyme activities On the other hand, approximately 21-25% of anthropogenic CH_4 release worldwide is produced in the animal digestive system. In the rumen, this tannin protects proteins from degradation and ruminants excrete less urinary nitrogen (Kumar & Singh, 1984). White sweetclover is a promising honey plant, with a potential productivity of 200-500 kg/ha (Popa & Cîrnu, 1960; Glukhov, 1974). An important area of the foreign research is a breeding program with a biennial ecotype og *Melilotus albus* to on lengthening the duration of flowering and increasing the plant leaf coverage, to optimize the nutritional value of green mass by reducing the content of lignin and coumarin (Kosolapov et al., 2021) Due to the intensive growth of biomass during the growing season *Melilotus albus* has the prospect of being used for renewable energy production (Popp et al., 2015; Hunady et al., 2020; Kintl et al., 2020; 2021). In recent years, the interest in white sweetclover herba product in the official pharmacopoeia has been increasing, the antimicrobial, antibiofilm, and antioxidant potentials is being studied (Stefanovic et al., 2015).

The main objectives of this study were to evaluate the quality of green mass and silage from white sweetclover, *Melilotus albus* and the prospects of its use as fodder for farm animals or as substrates for renewable energy production

MATERIALS AND METHODS

The local biennial ecotype of white sweetclover - *Melilotus albus*, which was cultivated 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 traditional fodder crops - common sainfoin, *Onobrychis viciifolia* Scop. and Sudan grass, *Sorghum sudanense* (Piper) Stapf were used as control variants.

The experimental design was a randomized complete block design with four replications, and the experimental plots measured 50 m^2. The *Melilotus albus* seeds were sown in late March, at a depth of 2.0 cm at a distance between rows of 15 cm, the sowing density was 120 scarified seeds/m^2. The plant growth, development and productivity were assessed according to methodical indications. The white sweetclover and Sudan grass green mass samples were collected in full flowering period, while the common sainfoin in budding - flowering stage. The leaf/stem ratio was determined by separating leaves and flowers from the stem, weighing them separately and establishing the ratios for these quantities. For this purpose, samples of 1.0 kg harvested plants were taken. The sweetclover and Sudan grass silages were prepared from harvested green mass, but common sainfoin haylage was produced from wilted green mass, cut into small pieces and compressed in glass containers. The containers were stored for 45 days, and after that, they were opened and the organoleptic assessment and the determination of the organic acids composition of the persevered forage were done in accordance with the Moldavian standard SM 108. The fresh mass and fermented fodder 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 quality of the biomass was evaluated by analyzing such indices as: crude protein (CP), crude fibre (CF), crude ash (CA), total soluble sugars (TSS), acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL), digestible dry matter (DDM), digestible organic matter (DOM) which have been determined by near infrared spectroscopy (NIRS) technique PERTEN DA 7200 of the Research and Development Institute for Grassland Braşov, Romania. The concentration of hemicellulose (HC) and cellulose (Cel), the digestible energy (DE), the metabolizable energy (ME), the net energy for lactation (NEl) and the relative feed value (RFV) were calculated according to standard procedures. The carbon content of the substrates was determined using an empirical equation according to Badger et al., (1979). The biochemical biogas potential (Yb) and the methane potential (Ym) were calculated according to Dandikas et al., 2014.

RESULTS AND DISCUSSIONS

Analyzing the results of the assessment of agro-biological peculiarities, it can be noted that in the first year of vegetation, the growth and development rates of *Melilotus albus* were low in comparison with *Onobrychis viciifolia,* it developed the rosette and 1-3 erect shoots about 57-78 cm long at the end of the growing season. In the second year, the growth and development of the local ecotype of white sweetclover plants began when the average temperature was above 5°C, in the first days of April. It was established that the revival of *Melilotus albus* plants from dormant buds was uniform, characterized by faster grow and development rates. In full flowering period, at the time when the green mass was harvested, the erect shoots of *Melilotus albus* reached 129.7 cm, the yield was 43.1 t/ha green mass or 12.58 t/ha dry matter, containing 70.2% leaves and flowers in the harvested mass (Table 1). The productivity of control crops, *Onobrychis viciifolia* plants reached 42.3 t/ha green mass or 10.1 t/ha matter with 53.7% leaves and 46.3% stems, but the yield of *Sorghum sudanense* was 27.9 t/ha or 7.2 t/ha dry matter with 51.6 % leaves and panicles.

The morphological structure of the whole plant has a significant impact on the nutrient content of the green mass. Analysing the results of the biochemical composition of dry matter, Table 2, we would like to mention that *Melilotus albus* fodder was characterised by reduced concentration of crude proteins as compared with *Onobrychis viciifolia* but higher content as compared with Sudan grass. The level of crude cellulose, acid detergent fibre, neutral detergent fibre, cellulose and hemicellulose in *Melilotus albus* fodder was low as compared with Sudan grass and higher as compared with *Onobrychis viciifolia*. The concentrations of acid detergent lignin in white sweetclover fodder were also high as compared with the control species, which negatively affected the digestibility of the organic matter. The dry matter in white sweetclover fodder contained a low amount of minerals and soluble sugars as compared with traditional fodder crops. The energy concentrations were optimal in white sweetclover fodder, but reduced as compared with sainfoin fodder.

Table 1. Some agrobiological peculiarities and the structure of the green mass of the studied crops

Plant species	Plant height, cm	Stem, g		Leaf + flower, g		Yield, t/ha	
		fresh mass	dry matter	fresh mass	dry matter	fresh mass	dry matter
Melilotus albus	129.7	10.2	3.0	30.6	8.4	43.1	12.0
Onobrychis viciifolia, first cut	99.2	10.1	2.5	12.5	2.9	42.3	10.1
Sorghum sudanense, first cut	212.0	33.1	3.0	12.5	3.2	27.9	7.2

Table 2. The biochemical composition and the fodder value of the green mass of the studied crops

Indices	*Melilotus albus*	*Onobrychis viciifolia*	*Sorghum sudanense*
Crude protein, g/kg DM	132	177	85
Crude fibre, g/kg DM	381	293	392
Minerals, g/kg DM	81	96	95
Acid detergent fibre, g/kg DM	386	309	413
Neutral detergent fibre, g/kg DM	567	447	656
Acid detergent lignin, g/kg DM	64	49	41
Total soluble sugars, g/kg DM	86	114	138
Cellulose, g/kg DM	322	260	372
Hemicellulose, g/kg DM	181	138	243
Digestible dry matter, g/kg DM	525	669	517
Digestible organic matter, g/kg DM	449	615	506
Relative feed value	97	135	80
Digestible energy, MJ/ kg	11.66	12.73	10.39
Metabolizable energy, MJ/ kg	9.57	10.45	8.52
Net energy for lactation, MJ/ kg	5.59	6.48	5.28

Different results regarding the productivity, biochemical composition and the nutritive value of the green mass from *Melilotus* species are given in the specialized literature. According to Medvedev & Smetannikova (1981), the green mass productivity of white sweetclover *Melilotus albus* was 42.3-50.0 t/ha, 21-23% dry matter, 16-22% CP, 2-4% EE, 24-34% CF, 30-45% NFE, 7-9% ash. Stoian (1987) found that, under the conditions of the Danube Delta, *Melilotus alba* yielded 32 t/ha fresh mass or 6.4 t/ha dry matter. Kshnikatkina et al. (2005) reported that the dry matter from *Melilotus officinalis* forage harvested in the flowering stage contained 8.19% CP, 2.62% EE, 23.47% CF, 50.62% NFE, 7-9% ash, 1.40%Ca, 0.8% P. Heuzé & Tran (2015) revealed that *Melilotus indicus* fresh aerial part contained 22.8% DM, 18.0% CP, 2.0% EE, 30.8% CF, 51.2% NDF, 36.3 % ADF, 9.2% lignin, 9.2% WSC, 11.5% ash, 21.5 g/kg Ca and 3.7 g/kg P, 70.3% ODM, 18.1 MJ/kg GE, 12.2 MJ/kg DE, 9.6 MJ/kg ME. Bozhanska et al., (2016), mentioned that the chemical composition and energy nutritional value of *Melilotus albus* was: 11.76% CP, 3.16% EE, 32.59% CF, 33.60% NDF, 24.15% ADF; 3.05% ADL, 9.45% HC, 21.10% Cel, 5.28% ash, 1.84% Ca, 0.25% P, 17.11 MJ/kg GE, 7.48 MJ/kg ME, 0.69 feed unit of milk and 0.63 feed unit of growth. Makarov & Andrusova (2016) compared the quality of several *Melilotus* species and mentioned that *Melilotus albus* contained 17.8% CP, 1.9% EE, 22% CF, 48% NFE, 10.6% ash., 1.73% Ca, 0.26% P, 113 g/kg DP, 0.76 feed unit/kg, but *Melilotus suaveolens* contained 20.7-22.1% CP, 2.1-2.4% EE, 15.2-16.8% CF, 49.9-50.5% NFE, 9.8-10.5% ash., 1.87-2.09% Ca, 0.20-0.22% P, 155-166 g/kg DP, 0.82-0.86 feed unit/kg DM. Dashkevich et al. (2018) found that the concentrations of nutrients and energy in the dry matter of the tested ecotypes of *Melilotus albus* were 13.33-19.56% CP, 1.90-2.26% EE, 14.60-23.94% CF, 46.19-56.80% NFE, 7.43-10.12% minerals, 0.46-0.90% coumarin and 9.81-10.83 MJ/kg ME, in *Melilotus officinalis* plants 16.20-20.73% CP, 2.02-2.28% EE, 13.18-18.66% CF, 49.57-57.80% NFE, 7.73-11.09% minerals, 0.28-1.13% coumarin and 10.57-11.29 MJ/kg ME, but in the *Melilotus wolgicus* plants: 16.93-21.17% CP, 2.00-2.29% EE, 15.64-20.52% CF, 48.90-54.41% NFE, 8.10-10.14% minerals, 0.79-1.13% coumarin and 10.40-10.95 MJ/kg ME, respectively. Ateş & Seren (2020) remarked that the *Melilotus caeruleus* forage harvested in different growth stages contained 17.98-20.67% CP, 39.09-42.33% NDF, 28.2430.83% ADF. Annaeva et al. (2020) found that, in saline areas of Uzbekistan, the productivity of *Melilotus albus* cv. Kibray ranged from 31.6 to 38.0 t/ha green mass at the first cut and 22.6-28.1 t/ha green mass at the second cut, but *Medicago sativa* cv. Tashkent yielded 17.5-22.5 t/ha and 17.4-20.9 t/ha respectively. Avetisyan et al. (2020) revealed that under the forest-steppe conditions of the Krasnoyarsk territory, Russia the productivity of *Melilotus albus* was 49.5 t/ha green mass, 11.3 t/ha dry matter, 122.0 GJ/ha metabolizable energy, 0.15 nutritive units/kg green mass and 35 g digestible protein /kg green mass, but *Sorghum sudanense* yielded 43.2 t/ha green mass, 9.9 t/ha dry matter, 97.0 GJ/ha metabolizable energy, 0.21 nutritive units/kg green mass and 23 g digestible protein /kg green mass. Hunady et al. (2021), evaluating of the biomass quality of 14 wild leguminous plant species collected in the budding stage, reported that *Melilotus alba* dry matter contained 87.23% OM, 16.68% CP, 4.43% EE, 19.89% CF, 35.16% NDF, 27.82% ADF; *Onobrychis viciifolia* - 92.18% OM, 12.47% CP, 2.77% EE, 26.08% CF, 46.97% NDF, 38.48% ADF; *Medicago sativa* - 94.98% OM, 15.33% CP, 2.75% EE, 25.30% CF, 47.83% NDF, 38.27% ADF. Kosolapov et al. (2021) reported that the tested *Melilotus albus* varieties were characterized, in first year of life, by a growing season of 106-110 days, 78.0-88.1 cm plant height, 14.48-16.39 t/ha green mass with 52.0-58.6% leaf coverage, 2.88-23.51 t/ha dry matter with 18.4-20.2% CP and 22.10-24.20% CF, but in the second year of life - growing season of 61-71 days, 145-182 cm plant height, 29.67-38.54 t/ha green mass with 53.9-66.9 % leaf coverage, 6.71-9.74 t/ha dry matter with 19.10-23.0% CP and 22.10-25.20% CF.

The ensiling process has substantial effects on the nutritive value of the prepared feed and animal performance. During the sensorial assessment, it was found that, in terms of colour, the silage from white sweetclover had olive stems with dark green leaves and smell specific to pickled apples, the haylages prepared from *Onobrychis arenaria* consists of yellowish-green leaves and yellow-green stems; it has a pleasant smell of pickled vegetables; while the silage made from Sudan grass was homogeneous, green-yellow, with pleasant smell, specific to pickled vegetables. The texture of the plants stored as silage and haylage was preserved well, without mold and mucus. The results regarding the quality of the prepared fermented fodder are shown in Table 3. It has been determined that the pH values of the fermented fodder depended on the species, thus, *Melilotus albus* silage had higher pH than *Sorghum sudanense,* but lower than *Onobrychis viciifolia* haylage. The content of organic acids in the fermented fodder from the studied leguminous crops did not vary essentially, but was lower than in *Sorghum sudanense.* Most organic acids were in fixed form, butyric acid was detected only in Sudan grass silage. According to the Moldavian standard SM 108, the ration of acetic acid and lactic acid of the studied fermented fodder corresponds to the 1st class quality. It was found that during the process of ensiling, the concentrations of crude protein and acid detergent lignin decreased, but the level of minerals, neutral detergent fibre increased in comparison with the green mass. In white sweetclover silage, the amount of crude protein was high as compared with Sudan grass silage, but lower as compared with sainfoin haylage. The energy concentrations in the prepared silage were at the same level, but reduced compared with sainfoin haylage.

Several studies have evaluated the potential of white sweetclover *Melilotus albus* as silage. Medvedev & Smetannikova (1981) mentioned that white sweetclover silage contained 23.1% DM, including 3.4% CP, 1.6% EE, 9.4% CF, 7.2% NFE, 1.6% ash, 2.2 g/kg Ca, 0.64 g/kg P and 84 mg/kg carotene. Popp et al. (2015) reported that sweet clover silage was characterized by 22.2% DM, pH 4.5, lactic acid 0.1 g/kg fresh mass, acetic acid 1.3 g/kg fresh mass, butyric acid 0.32 g/kg fresh mass, 8.6% CP, 0.9% EE, 38.0% NFE, 41.0 % Cel, 31.0% HC and 15.0% lignin. Kintl et al. (2020) remarked that the quality of silage from pure white sweetclover was 316.4 g/kg DM, 96.75% OM, 11.62% CP, 3.83%EE, 4.51% starch, 28.16% CF, 31.62% ADF, 48.67% NDF, 14.32% ADL, 17.51 mg/kg coumarin, the maize silage contained 333.8 g/kg DM, 96.04%

OM, 8.13% CP, 4.26% EE, 20.66% starch, 16.73% CF, 20.35% ADF, 42.14% NDF, 6.16% ADL, 1.84 mg/kg coumarin, but silages from different weight shares of these two crops 321.0-341.3 g/kg DM, 94.89-96.69% OM, 8.10-11.34% CP, 2.59-4.03% EE, 11.13-4.03% starch, 17.59-25.49% CF, 29.49-38.84% ADF, 37.21-57.10% NDF, 3.90-16.33% ADL, 4.35-14.25 mg/kg coumarin, respectively.

Table 3. The biochemical composition and the nutritive value of the fermented fodder from studied crops

Indices	*Melilotus albus* silage	*Onobrychis viciifolia* haylage	*Sorghum sudanense* silage
pH index	4.42	4.68	3.82
Organic acids, g/kg DM	24.0	23.4	30.0
Free acetic acid, g/kg DM	0.3	1.1	2.3
Free butyric acid, g/kg DM	0	0	0.0
Free lactic acid, g/kg DM	2.3	4.4	10.2
Fixed acetic acid, g/kg DM	3.1	2.2	2.1
Fixed butyric acid, g/kg DM	0	0	0.2
Fixed lactic acid, g/kg DM	18.3	15.7	15.2
Total acetic acid, g/kg DM	3.4	3.3	4.4
Total butyric acid, g/kg DM	0	0	0.2
Total lactic acid, g/kg DM	20.6	20.1	28.4
Acetic acid, % of organic acids	14.20	14.10	14.67
Butyric acid, % of organic acids	0	0	0.66
Lactic acid, % of organic acids	85.8	85.90	84.67
Crude protein, g/kg DM	127	142	57
Crude fibre, g/kg DM	414	312	392
Minerals, g/kg DM	99	118	109
Acid detergent fibre, g/kg DM	407	317	402
Neutral detergent fibre, g/kg DM	581	470	652
Acid detergent lignin, g/kg DM	58	40	39
Total soluble sugars, g/kg DM	62	135	108
Cellulose, g/kg DM	349	277	363
Hemicellulose, g/kg DM	174	153	250
Digestible dry matter, g/kg DM	509	653	57.5
Digestible organic matter, g/kg DM	416	582	53.8
Relative feed value	92	127	82
Digestible energy, MJ/ kg	11.38	12.63	11.43
Metabolizable energy, MJ/ kg	9.34	10.37	9.38
Net energy for lactation, MJ/ kg	5.30	6.38	5.54

Table 4. Biochemical composition and biomethane production potential of substrates from studied species

Indices	*Melilotus albus*		*Onobrychis viciifolia*		*Sorghum sudanense*	
	fresh mass	silage	fresh mass	haylage	fresh mass	silage
Minerals, g/kg DM	81.0	99.0	96.0	118.0	95.0	109
Nitrogen, g/kg DM	21.1	20.3	28.3	22.7	13.6	9.1
Carbon, g/kg DM	510.6	500.6	502.2	490.0	502.8	495
Ratio carbon/nitrogen	24.2	24.6	17.7	21.6	37.0	54.3
Hemicellulose, g/kg DM	181.0	174.0	138.0	153.0	243.0	250.0
Acid detergent lignin, g/kg DM	64.0	58.0	49.0	40.0	41.0	39.0
Bio gas potential, L/kg VS	518	543	569	608	627	636
Biomethane potential, L/kg VS	267	278	291	311	321	326

Replacing fossil fuels with renewable energy alternatives has become a major global issue of the XXI century and a key to sustainable development. Biogas plants for anaerobic digestion utilize different substrates organic materials like residual waste from livestock, food production, effluents from industry or sludge from wastewater treatment plants, energy crops. However, in order to consolidate the role of biogas production via anaerobic digestion as a renewable energy production technology, it is important to ensure the availability of sustainable biomass sources. Installations do not only produce energy but also digestate and fugate are believed to be good fertilizers, which are rich in plant available nutrients such as nitrogen, phosphate and potash, and could serve as a replacement for fossil based mineral fertilizers. The results regarding the quality of substrates and their biochemical methane potential are illustrated in Table 4. We found that the investigated substrates from *Melilotus albus,* according to the carbon nitrogen ratio, which constituted 24, met the established standards, but the high concentrations of acid detergent lignin negatively influenced the activity of bacteria and decomposition processes, as compared with the other investigated substrates. The biochemical biogas and biomethane potential of white sweetclover green mass substrate reached 518 L/kg and 267 L/kg organic matter, but white sweetclover silage substrate - 543 L/kg and 278 L/kg organic matter, respectively, being lower as compared with the potential of the substrates of Sudan grass and sainfoin.

According to Popp et al. (2015) the cumulative methane yield of substrate codigestion of sweet clover silage and cow manure was almost equal: 266 L/kg VS for the 2.5% coumarin content substrate and 259 L/kg VS for the 5.0% coumarin substrate, respectively, and 265 L/kg VS for the coumarin-free control substrate. Kintl et al. (2020) found that the average methane yield, after 21 days of the experiment, of ensiled sweetclover was 0.161 m^3/kgVS, of maize silage - 0.271 m^3/kg VS and of silage mixture of these two crops - 0.199-264 m^3/kg VS. Hunady et al. (2021) calculated the theoretical methane yield and revealed that the values of biomass from *Galega orientalis*, *Lathyrus pratensis*, *Trigonella foenum-graecum* and *Melilotus alba* ranged from 0.161 to 0.172 m^3/kg VS, the methane yield of biomass from *Onobrychis viciifolia*, *Astragalus cicer*, *Dorycnium germanicum, Vicia sylvatica* ranged from 0.141 to 0.160 m^3/kg VS and the absolutely lowest value – 0.12-0.14 m^3/kg VS – was calculated for *Medicago sativa.*.

CONCLUSIONS

The productivity of the local ecotype of white sweetclover in the first year reached 1.74 kg/m^2 green mass or 0.4 kg/m^2 dry matter, but in the second year 4.31 kg/m^2 green mass or 1.2 kg/m^2 dry matter. The dry matter of harvested mass, in the second year, contained 132 g/kg CP, 82 g/kg ash, 381 g/kg CF, 386 g/kg ADF, 567 g/kg NDF, 64 g/kg ADL, 322 g/kg Cel, 181 g/kg HC, 86 g/kg TSS, with 58.8 % DMD, RFV= 97, 11.66 MJ/kg DE, 9.57 MJ/kg ME, 5.59 MJ/kg NEl.

The silage prepared from *Melilotus albus* is characterized by pH = 4.72, 3.4 g/kg acetic acid, 20.6 g/kg lactic acid, contained 127 g/kg CP, 414 g/kg CF, 99 g/kg ash, 407 g/kg ADF, 581 g/kg NDF, 58 g/kg ADL, 62 g/kg TSS, 348 g/kg Cel, 174g/kg HC, with nutritive and energy values: 57.2 % DMD, RFV= 92, 11.38 MJ/kg DE, 9.34 MJ/kg ME and 5.30 MJ/kg NEl.

The biochemical methane potential of white sweetclover green mass substrate reaches 267 L/kg organic matter and white sweetclover silage substrate - 278 L/kg organic matter.

The local ecotype of white sweetclover can be used for the restoration of degraded lands, as a component of the mix of grasses and legumes for the creation of temporary grasslands. The harvested biomass can be used as alternative fodder for farm animals or as substrates in biogas generators for the production of renewable energy.

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