THE BIOMASS PRODUCTIVITY AND QUALITY INDICES OF SOME PERMANENT GRASSLANDS

Adrian-Ilie NAZARE[1], Victor ŢÎŢEI[2], Ana GUŢU [2], Costel SAMUIL[1], Vasile VÎNTU[1]

[1] "Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania

[2] " Alexandru Ciubotaru" National Botanical Garden (Institute) of Moldova State University, Chişinău, Republic of Moldova

Introduction

Grasslands hold significant ecological importance, as they comprise a substantial portion of terrestrial habitats. In Europe, grasslands cover approximately 1.8 million hectares, accounting for about 40% of the land surface. Natural grasslands play a crucial role in conserving European phytodiversity. They also provide essential ecosystem services, including carbon sequestration, erosion control, and habitat for a wide range of plant and animal species (Dengler et al., 2014). The sustainable management of grassland biomass has become a growing challenge across Europe. While the primary function of grasslands remains the production of forage for livestock, recent studies have shown that grassland biomass also serves as a valuable substrate for biofuel production and biorefining processes (Dindová et al. 2019; Von Cossel et al. 2019; Carni et al. 2021; Schaub et al. 2025).

The goal of this study was to evaluate the productivity and quality indices of biomass from permanent grasslands dominated by *Festuca valesiaca* and dominated by *Elytrigia repens* used as fodder for livestock, also as feedstock for biofuels production as renewable energy.

MATERIALS AND METHODS

The research was conducted on an permanent grassland dominated by *Festuca valesiaca* and dominated by *Elytrigia repens*, Central Zone, Republic of Moldova. Samples were collected from the first cut. Mowing was performed at the inflorescence emergence stage of the dominant species. Biomass productivity was determined by weighing the total dry phytomass from plots measuring 10 m² (5 × 2 m), with five replications. The harvested phytomass was dried directly in the field. The dry matter content was assessed by oven-drying samples at 105 ° C until a constant weight was achieved. For chemical analysis, biomass samples were chopped into pieces 1.5–2.0 cm in length, dried in a forced-air oven at 60 ° C, and then milled using a beater mill equipped with a 1 mm sieve. The primary biochemical parameters – crude protein (CP), ash, acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL), and total soluble sugars (TSS) – were determined using near-infrared spectroscopy. The concentrations of hemicellulose (HC), cellulose (Cel), digestible dry matter (DDM) digestible energy (DE), metabolizable energy (ME), net energy for lactation (NEl) and relative feed value (RFV) were calculated following standard procedures.

The carbon content of the substrates was determined 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 Theoretical Ethanol Potential (TEP) was calculated based on the equations proposed by *Goff et al.* (2010), considering the conversion of cellulose and hemicellulose into hexose (H) and pentose (P) sugars. The energy value of the dry biomass was measured according to standardized protocols at the Scientific Laboratory of Biosolid Fuel, Technical University of Moldova.

Biomass from grassland dominated by *Festuca valesiaca*

Biomass from grassland dominated by *Elytrigia repens*

RESULTS AND DISCUSSIONS

Table 1. **Productivity, biochemical composition and the nutritive value of biomass from studied grasslands**

Indices	*Festuca valesiaca* grassland	*Elytrigia repens* grassland
Dry biomass productivity, t/ha	1.59	7.93
Biochemical composition		
Crude protein, g/kg DM	91	85
Minerals, g/kg DM	89	86
Crude fibre, g/kg DM	382	424
Acid detergent fibre, g/kg DM ,	415	450
Neutral detergent fibre, g/kg DM	658	753
Acid detergent lignin, g/kg DM	60	44
Total soluble sugars, g/kg DM	27	19
Cellulose, g/kg DM	355	416
Hemicellulose, g/kg DM	243	303
Nutritive value		
Digestible dry matter, g/kg DM	566	538
Relative feed value	80	66
Digestible energy, MJ/ kg	11.28	10.76
Metabolizable energy, MJ/ kg	9.26	8.84
Net energy for lactation, MJ/ kg	5.26	4.86

Financially supported by the subprograms no. 010101*"Identification of valuable forms of plant resources with multiple uses for the circular economy"*.

Contact: adrian.nazare@iuls.ro; vic.titei@gmail.com

Table 2 **The quality indices of energy biomass from the studied grasslands**

Indices	*Festuca valesiaca* grassland	*Elytrigia repens* grassland
Biomass for solid fuels		
Ash content of biomass, %	8.9	8.6
Gross calorific value of biomass, MJ/kg	18.0	17.8
Net calorific value of biomass, MJ/kg	16.0	15.9
Biomass for gaseous fuels		
Crude protein, g/kg DM	91.00	85.00
Nitrogen, g/kg DM	14.56	13.60
Minerals, g/kg DM	89.00	86.00
Organic matter, g/kg	911.00	914.00
Carbon, g/kg DM	506.11	507.78
Ratio carbon/nitrogen	34.76	37.34
Acid detergent lignin, g/kg DM	60.00	44.00
Hemicellulose, g/kg DM	243.00	303.00
Biomethane potential, L/kg VS	304.00	333.00
Biomethane potential, L/kg DM	276.90	304.00
Biomass for liquid fuels		
Cellulose, g/kg DM	355	416
Hemicellulose, g/kg DM	243	303
Theoretical ethanol potential from hexose sugars, L/t ODM	268.00	315.07
Theoretical ethanol potential from pentose sugars, L/t ODM	166.68	207.82
Theoretical ethanol potential, L/tODM	434.68	522.89

CONCLUSIONS

The dry matter productivity of the studied grasslands varied from 1.59 t/ha *Festuca valesiaca* grassland to 7.93 t/ha *Elytrigia repens* grassland.

A lower content of structural carbohydrates, higher concentration of crude protein, digestible dry matter and energy value was found in the biomass from *Festuca valesiaca* grassland.

The biomass from the studied grasslands can be used as feedstock for biofuels production as renewable energy.