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CHEMICAL COMPOSITION AND FIBROUS STRUCTURAL COMPONENTS OF CELL WALLS OF DRY LEAF MASS OF SUGAR BEET, FODDER BEET AND TABLE BEET

ABSTRACT

In 2018, field experiments were conducted at the Agricultural Institute - Shumen, Bulgaria to assess the feed value of leaf mass of standard cultivars of beetroot (the institute's gene pool). For this purpose, the chemical composition of dry leaf mass of Bulgarian cultivars of sugar beet, fodder beet and table beet and their pollinators were analyzed.

Data indicated that the cultivars with the highest content of crude protein in dry matter were: Vesi (272.2 g kg^{-1}) - from fodder beet, Diex (271.0 g kg^{-1}) - from sugar beet and Radost 1 (247.5 g kg^{-1}) – from table beet.

In the sugar beet cultivars, the leaf mass has the lowest content of acid-detergent fibers (from 25.7 to 50.8%), acid-detergent lignin (from 25.7 to 50.8%) and cellulose (from 10.9 to 14.3%), but with a higher concentration of neutral-detergent fibers (with from 15.1 to 15.4%) and hemicellulose (with from 54.0 to 74.0%) compared to that of fodder and table beets.

Regression models have been developed through significant dependence between some quality indicators of the plant cell, which can be used for indicative prediction of the traits.

Keywords: sugar beet, fodder beet, table beet, leaves, chemical composition

INTRODUCTION

One of the ways to solve the problem of balanced feeding of animals is the inclusion of fodder, sugar and semi-sugar beets in the daily ration (Tanosiunier and Noskaitit, 2000). High yields and concentrations of nutrients and vitamins, and their good palatability determine the use of fodder and semi-sugar beets for fodder and their inclusion in ruminant rations in the autumn-winter period (Badawi et al., 2002; Kikindonov, 2011; Enchev and Bozhanska, 2022).

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Sugar beet (*Beta vulgaris* L.) is a technical crop that is grown for the production of granulated sugar and sweet syrups. The high content of amino acids in its biomass is a prerequisite for its use as a raw material for animal husbandry (Vladimirov, 1973). Of the root crops, sugar beet has the highest content of feed units, with digestibility of 75%. In the processing of root crops, valuable fodder for animal husbandry are the leaves, beetroot and beet slices, and molasses. For industrial purposes, alcohol, citric, lactic and glycolic acid, glycerin, betaine, baker's yeast, yeast, etc. are obtained from molasses. (Uchkunov, 2008; Kikindonov and Kikindonov, 2012).

Fodder beet (*Beta vulgaris* var. crassa) is grown for the production of succulent fodder. Its inclusion in the ration of animals improves their balanced nutrition. Root crops are an easily digestible forage and are readily accepted by cattle, pigs, sheep and horses (Todorov et al., 1995). The dry matter in the roots of fodder beet is composed of nitrogen-free extractive substances, 1.3% protein, 0.1% oils, 0.9% cellulose and 0.9% ash substances, crude protein, crude fats and fibers, methionine, cystine, tryptophan, calcium, phosphorus, etc. (DAF, 1998).

Table beet is a traditional and popular vegetable in many parts of the world. It is consumed regularly as part of the normal diet, fresh, after heat treatment or fermentation. In production, it is used as a food coloring - E162 (Clifford et al., 2015; Sawicki and Wiczkowski 2018). It contains large amounts of biologically active substances, including betalains, carotenoids, phenols, B-vitamins (B1, B2, B3, B6 and B12), folate minerals, fiber, as well as low-energy sugars (Kale et al., 2018) and inorganic nitrate (Clifford et al., 2015). All parts of this plant have various medicinal uses, such as antioxidant, antidepressant, antimicrobial, antifungal, anti-inflammatory, diuretic, expectorant and carminative (Jasmitha et al., 2018), and hepatoprotective agents (Olumese and Oboh, 2018).

Beetroot leaves are underutilized due to a lack of sufficient knowledge, especially of their nutritional value, both for animal husbandry and as human food. Beet leaves are rich in total phenolic compounds, vitamins and iron (Kaushik and Kavita, 2020, Lorizola et al., 2018). They are defined as secondary products (waste) in the harvest period (Fernandez et al., 2017). The byproduct in sugar beet constitutes almost half of the whole plant (Bengardino et al., 2019; Pellegrini and Ponce 2020; Ebrahimi et al., 2022). Beetroot leaves are a rich source of bioactive compounds such as fatty acids, minerals (Biondo et al. 2014), proteins (Akyüz and Ersus 2021) and polyphenols (Nutter et al., 2020). Among these compounds, polyphenols are powerful substances that improve human health through their antibacterial, antifungal, anti-inflammatory and anti-tumor properties. These compounds are a group of secondary metabolites synthesized in plants that possess one or more phenolic rings with attached hydroxyl groups. They are considered natural antioxidants, improving food quality by delaying lipid oxidation (Ebrahimi and Lante 2021; Kolev, 2022).

Since these food by-products can be major sources for the recovery of bioactive compounds, many studies have proposed a strategy to valorize them using extraction techniques (Tinello and Lante 2019; Cisneros-Yupanqui et al., 2021; Lante et al., 2020).

The aim of the present study was to determine the chemical composition and the content of the structural fibrous components of the cell walls in the dry matter of the leaf mass of sugar, fodder and table beet cultivars.

MATERIAL AND METHODS

In 2018, in the experimental field of the Agricultural Institute - Shumen, Bulgaria (43.315152/N43°18’54.547 27.029729/E27°1’47.022). field experiments were carried out to assess the feed value of leaves from standard cultivars and their pollinators sugar beet, fodder beet and table beet. Within the framework of the research, the developed technologies for beet cultivation are being optimized with an emphasis on the leaf mass as raw material for fodder. Pollinators and their hybrids from the comparative trials were studied to establish the genotypic response.

The experimental set-up was by the method of long plots in 4 replications, with a harvest plot size of 8.4 m^2. The soil type is medium-strength, heavy-sandy, carbonate chernozem with a slightly alkaline reaction of the soil solution. Sowing was done manually at 70 cm row spacing (10.000 plants/da). The leaf samples were realized together with the harvesting of the root crops on 23.10.2018.

The experiment included determination of the chemical composition and energy value of the leaf mass of sugar, fodder and table beet cultivars and their pollinators (Table 1).

Table 1. Standard cultivars sugar beet, fodder beet, table beet and pollinators

Type	Standard cultivars	Pollinators
Sugar beet	*Diex - diploid hybrid on monocot basis *KOM - triploid hybrid	*M 985 - tetraploid pollinator of Kom variety *MS 142 - maternal component of Hybrid 56 and KOM *RPK-multiseeded diploid pollinator of Diex variety
Fodder beet	*Sasha - multi-seeded tetrafruit variety *Preslav - diploid multiseed synthetic population *Hybrid 56 – triploid semi-sugar hybrid *Vesi – semi-sweet, diploid hybrid	Sg x 142 – Tetragold Semi-Sugar Yellow Pollinator
Table beet	Radost 1-diploid fertile multi-seeded variety *Radost 3- diploid fertile multifertile population	

The main chemical composition of the dried leaf mass was analyzed, including the following indicators:

• Crude fiber (CFr, g kg^{-1} DM) according to the Weende analysis - the sample was treated sequentially with solutions of 1.25% (w/v) H_2SO_4 and 1.25% (w/v) NaOH under special conditions. The residue was dried and incinerated;

• Crude protein (CP, g kg^{-1} DM) according to Kjeldahl (according to BDS - ISO-5983)

• Crude fats (CF, g kg^{-1} DM) by extraction in an extractor of Soxhlet type (according to BDS - ISO-6492). After extraction, the sample was dried at 95°C;

• Ash (g kg^{-1} DM) - decomposition of organic matter by gradual combustion of the sample in a muffle furnace at 550°C (according to BDS - ISO-5984);

• Dry matter (DM, g kg^{-1}) - empirically calculated from % of moisture;

• Calcium (Ca, g kg^{-1} DM) - according to Schottz (complexometric);

• Phosphorus (P, g kg^{-1} DM) - with vanadate-molybdate reagent by the method of Guericke and Curmis and spectophotometer (Agilent 8453 UV - visible Spectroscopy System), measuring in the range of 425 ηm.

• NFE (%) = 100 - (CP, % + CFr, % + CF, % + Ash, % + Moisture, %) in g kg^{-1} DM.

The fibrous structural elements in the plant cell are analyzed in laboratory: Neutral Detergent Fibers (NDF, g kg^{-1} DM); Acid detergent fiber (ADF, g kg^{-1} DM) and Acid detergent lignin (ADL, g kg^{-1} DM) by the Van Soest and Robertson (1979) detergent assay and in vitro dry matter digestibility (IVDMD, g kg^{-1}) according to a two-way pepsin-cellulase method of Aufrere (1982). The polyosides are empirically calculated: Hemicellulose (g kg^{-1} DM) = NDF-ADF and Cellulose (g kg^{-1} DM) = ADF-ADL. The lignification degree is expressed as the percentage of ADL and NDF.

The experimental data were statistically processed by analysis of variance (ANOVA) and the program Statistica for Windows 10.

RESULTS AND DISCUSSION

Main chemical composition of dry matter of sugar beet, fodder beet and table beet cultivars

The nutritive value of *Beta vulgaris* L. result mainly from its high content of protein gathered both in leaf blades and in petioles, and from high content of mineral salts, mainly iron and calcium, as well as vitamins C, A, B1, B2 (Dzida et al., 2011). Dehydrated beet leaves contain high crude protein (26.4–31.0%) and carbohydrate (30.7–41.0%) (Biondo et al., 2014; Glencross, 2009). The chemical analysis of the dry leaf mass of fodder, sugar and table beets indicates that the cultivars with the highest crude protein content are: Vesi (272.2 g kg^{-1}) – from fodder beet, Diex (271.0 g kg^{-1}) – from sugar beet and Radost 1 (247.5 g kg^{-1}) - from table beet - Table 2.

Table 2. Main chemical composition of dry matter of sugar beet, fodder beet and table beet cultivars (g kg-1 DM)

Cultivars	CP	CFr	CF	Ash	БЕВ	Ca	P	N
Sugar beet								
M 985	251.9	110.8	24.8	178.0	324.2	21.6	5.9	35.9
РПК	250.1	118.4	28.1	194.6	306.2	19.2	5.6	35.9
КОМ	265.1	138.1	25.5	174.1	298.3	19.1	5.6	38.2
Diex	271.0	115.9	25.2	185.0	302.3	32.5	6.1	39.0
MC 142	226.0	102.5	29.2	185.7	351.6	23.7	6.3	32.4
Average	***252.8***	***117.1***	***26.6***	***183.5***	***316.5***	***23.2***	***5.9***	***36.3***
CV	***6.9***	***11.3***	***7.4***	***4.3***	***6.9***	***23.8***	***5.2***	***7.1***
SD	***17.4***	***13.2***	***2.0***	***7.9***	***22.0***	***5.5***	***0.3***	***2.6***
Fodder beet								
Preslav	271.3	106.2	25.2	181.8	313.6	23.6	6.0	39.0
Vesi	272.2	95.3	30.5	194.8	302.7	21.4	5.9	39.0
Tetragold	260.0	124.3	24.2	185.7	287.5	21.8	10.0	36.7
Sasha	239.3	123.0	23.2	222.6	283.1	21.5	6.6	34.1
Sg x 142	271.4	109.9	25.1	178.7	307.9	10.3	8.7	38.8
Hybrid 56	233.9	120.9	27.4	220.7	296.6	10.2	7.6	33.7
Average	***258.0***	***113.3***	***25.9***	***197.4***	***298.6***	***18.1***	***7.5***	***31.4***
CV	***6.7***	***10.1***	***10.2***	***9.9***	***4.0***	***34.0***	***21.9***	***44.0***
SD	***17.3***	***11.5***	***2.6***	***19.6***	***11.8***	***6.2***	***1.6***	***13.8***
Table beet								
Radost 1	247.5	128.1	25.6	223.5	283.3	18.9	8.4	36.0
Radost 3	216.5	132.7	22.2	209.7	323.5	14.6	7.5	31.3
Average	***232.0***	***130.4***	***23.9***	***216.6***	***303.4***	***16.8***	***8.0***	***33.7***
CV	***9.4***	***2.5***	***10.1***	***4.5***	***9.4***	***18.2***	***8.0***	***9.9***
SD	***21.9***	***3.3***	***2.4***	***9.8***	***28.4***	***3.0***	***0.6***	***3.3***

For the sugar beet cultivars, the difference in crude protein values was from 5.9 g kg^{-1} (KOM) to 45.0 g kg^{-1} (MC 142) relative to the maximum. Only the cultivars KOM and Diex registered a higher concentration of the indicator by 4.9% and 7.2%, respectively, compared to the average (252.8 g kg^{-1}). Cultivar KOM has the highest crude fiber content (138.1 g kg^{-1}) and the least amount of nitrogen-free extractives (298.3 g kg^{-1}). The values of these indicators are completely opposite for variety MC 142, where the fiber content (102.5 g kg^{-1}) in the composition of the dry leaf mass is the lowest, and the amount of BEV (351.6 g kg^{-1}) is the highest. In the sugar beet cultivars, the content of mineral substances and crude fat varied from 174.1 g kg^{-1} (KOM) to 194.6 g kg^{-1} (RPK) and from 24.8 g kg^{-1} (M 985) to 28.1 g kg^{-1} (RPK). The dry leaf mass of sugar beet cultivars is rich in the macroelement calcium. With the highest values of the indicator is the Diex cultivar (32.5 g kg^{-1}), and with the lowest - the KOM cultivar (19.1 g kg^{-1}). The amount of phosphorus and nitrogen varies from 5.6 g kg^{-1} (RPK and KOM) to 6.3 g kg^{-1} (MC 142) and from 32.4 g kg^{-1} (MC 142) to 39.0 g kg^{-1} (Diex).

The beetroot leaves showed significant levels of protein and lipids in all developmental stages (Biondo et al., 2014). In fodder beet cultivars, the difference in crude protein values was from 0.8 g kg^{-1} (Sg x 142) to 38.3 g kg^{-1} (Hybrid 56) compared to the maximum. The cultivars Vesi (by 5.5%), Sg x 142 (by 5.2%), Preslav (5.1%) and Tetragold (by 0.8%) have a higher content than the average value of the indicator (258.0 g kg^{-1}).

Carbohydrate is an important non-protein and energy source (Bansemer et al., 2016; Lee et al., 2017). The leaf mass of the cultivar with the highest protein content (Vesi) has the lowest crude fiber values (95.3 g kg^{-1}). For fodder beet cultivars, the content of non-nitrogen extractive and mineral substances in dry matter varies from 283.1 g kg^{-1} (Sasha) to 313.6 g kg^{-1} (Preslav) and from 178.7 g kg^{-1} (Sg x 142) to 222.6 g kg^{-1}(Sasha), respectively.

Mineral substances are of great importance for the nutrition of farm animals. The leaf mass of the Preslav cultivar has the highest concentration of calcium (23.6 g kg^{-1}). Nitrogen is a very important structural element in plants, which contain between 1 and 6% of nitrogen in dry mass (Dzida et al., 2012). In the Vesi and Preslav cultivars, the amount of nitrogen prevails by 24.2% compared to the average value of the indicator (31.4 g kg^{-1}). The dry matter of the cultivars: Tetragold (33.3%), Sg x 142 (16.0%) and Hybrid 56 (1.3%) has a higher phosphorus content than the average value (7.5 g kg^{-1}).

Beetroot leaves are underused due to lack of proper knowledge, specially of their nutritive value (Vilhena and Silva, 2007).

In table beets, the amount of the protein fraction in the composition of Radost 1 is higher by 6.7% compared to the average value of the indicator (323.0 g kg^{-1}) and by 14.3% compared to that of Radost 3 (216.5 g kg^{-1}). The leaf mass of the Radost has a higher crude fat content (by 15.3% compared to the Radost 3 cultivar and by 7.1% compared to the average value of the indicator), ash (by 6.6% compared to the Radost 3 cultivar and by 3.2% compared to the average value of indicator), calcium (by 29.5% compared to the Radost 3 cultivar and by 12.5% compared to the average value of the indicator), phosphorus (by 12.0% compared to the Radost 3 cultivar and by 5.0% compared to the average value of the indicator) and nitrogen (by 15.0% compared to cultivar Radost 3) and by 6.8% compared to the average value of the indicator), but with a lower content of raw fibers (by 3.6% compared to cultivar Radost 3 and by 1.8% compared to the average value of the indicator) and nitrogen-free extractive substances (by 14.2 % compared to cultivar Radost 3 and by 7.1% compared to the average value of the indicator).

Fibrous structural components of cell walls and in vitro digestibility of dry matter in sugar, fodder and table beet cultivars Beet leaves containing high fiber content (Fernandez et al., 2020). Research indicates that sugar beet leaf mass has the lowest content of acid-detergent fiber, acid-detergent lignin and cellulose, which positively affects dry matter digestibility (Table 3). The average values of these indicators are lower than those of fodder and table beets by 26.0-38.7% (for

ADF), 25.7-50.8% (for ADL) and 10.9-14.3% (for Cellulose), respectively and are similar to those found by Alhan and Can (2017).

Table 3. Fibrous structural components of cell walls and in vitro dry matter digestibility of sugar, fodder and table beet cultivars (g kg^{-1} DM)

Cultivars	NDF	ADF	ADL	Hemicellulose	Cellulose	IVDMD of Aufrere
Sugar beet						
M 985	406.0	142.2	97.5	263.9	44.6	783.8
РПК	348.4	111.5	80.7	236.9	30.8	810.6
KOM	414.4	157.4	102.3	257.0	55.1	774.6
Diex	412.9	173.2	121.4	239.8	51.8	761.4
MC 142	400.4	126.9	72.3	273.6	54.5	799.8
Average	***396.4***	***142.2***	***94.8***	***254.2***	***47.4***	***786.0***
CV	***6.9***	***17.1***	***20.3***	***6.2***	***21.4***	***2.5***
SD	***27.4***	***24.3***	***19.2***	***15.7***	***10.2***	***19.6***
Fodder beet						
Preslav	337.2	204.1	95.2	133.1	108.8	741.4
Vesi	318.6	193.3	138.8	125.3	54.5	744.8
Tetragold	360.9	201.0	155.2	159.9	45.8	745.2
Sasha	335.7	171.4	136.4	164.3	35.0	764.5
Sg x 142	332.2	204.2	151.1	128.1	53.0	731.9
Hybrid 56	375.5	209.4	181.3	166.1	28.0	730.7
Average	***343.4***	***197.2***	***143.0***	***146.1***	***54.2***	***743.1***
CV	***6.1***	***7.0***	***19.8***	***13.2***	***52.9***	***1.6***
SD	***20.9***	***13.7***	***28.4***	***19.2***	***28.7***	***12.2***
Table beet						
Radost 1	385.4	148.6	81.5	236.8	67.1	782.3
Radost 3	303.1	209.8	156.9	93.3	53.0	731.6
Average	***344.3***	***179.2***	***119.2***	***165.1***	***60.1***	***757.0***
CV	***16.9***	***24.1***	***44.7***	***61.5***	***16.6***	***4.7***
SD	***58.2***	***43.3***	***53.3***	***101.5***	***10.0***	***35.9***

The results obtained regarding the average amount of neutral detergent fibers and hemicellulose are completely opposite. The values of these indicators are higher (by 15.1-15.4% for NDF and by 54.0-74.0% for Hemicellulose) in the dry mass composition of sugar beet cultivars compared to fodder and table beet cultivars.

In the sugar beet cultivars, the excess in the values of neutral-detergent fibers compared to the average for the species (396.4 g kg^{-1}) is from 1.0% (MS 142 - line) to 4.5% (KOM).

The sugar beet leaves which are rich in WSC can lead to a reduction in cell wall constituents, particularly cellulose and hemicellulose and to a lower degree lignin (Larsena et al., 2017). The amount of ligno-cellulose complex (ADF) is a determining factor for dry matter digestibility. This amount is lower compared to the average value of the indicator (142.2 g kg^{-1}) for the cultivars MS 142 - line and RPK (by 12.1-27.5%) and higher for the cultivars KOM and Diex (by 10.7-21.8%). Similar are the results regarding the concentration of acid-detergent lignin. In the composition of the sugar beet cultivars, the values of hemicellulose and cellulose polyosides range from 236.9 g kg^{-1} (RPK) to 273.6 g kg^{-1} (MS 142) and from 30.8 g kg^{-1} (RPK) to 55.1 g kg^{-1} (KOM), respectively. With the highest in vitro digestibility of dry matter is the RPK cultivar (810.6 g kg^{-1}) followed by the MC 142 cultivar (799.8 g kg^{-1}). The values of the indicator exceed the average for the species by 3.1% and 1.4%, respectively.

In fodder beet, the leaf mass of the cultivars Tetragold and Hybrid 56 has a higher content of neutral-detergent fibers by 5.1% and 9.3%, respectively, compared to the average for the species (343.4 g kg^{-1}). The values are close to those established by Özkan et al., (2017). Acid-detergent fibers prevail in the dry matter of the cultivars Tetragold, Preslav, Sg x 142 and Hybrid 56 with from 1.9% to 6.2% compared to the average value (197.2 g kg^{-1}) of the indicator. The Preslav cultivar has the lowest concentration of acid-detergent lignin (95.2 g kg^{-1} with an average value of 143.0 g kg^{-1}) and the highest (almost twice compared to the other cultivars of the species) of the cellulose that is not completely digestible by animals (108.8 g kg^{-1}). The differences in ADF end NDF contents of leaves are likely associated with harvesting stage of plant. The ADF content increased with advancing maturity (Kaplan et al., 2014). The hemicellulose values of fodder beet cultivars ranged from 125.3 g kg^{-1} (Vesi) to 166.1 g kg^{-1} (Hybrid 56) with an average of 146.1 g kg^{-1}. With the highest in vitro digestibility of dry matter is the cultivar Sasha (764.5 g kg^{-1}) followed by the cultivar Tetragold (745.2 g kg^{-1}) and the cultivar Vesi (744.8 g kg^{-1}).

The neutral-detergent fiber content of the table beet cultivars varied from 303.1 to 385.4 g kg^{-1}. A significant difference in the values of acid-detergent fiber, acid-detergent lignin and hemicellulose was observed in the species. In the dry matter of the cultivar Radost 1, the concentration of KDF and KDL is respectively 41.1% and 92.5% lower compared to Radost 3, and the content of hemicellulose (a polyoside fully digestible by ruminants) is 153.8% higher. The digestibility of the leaf mass in the cultivar Radost 1 is higher by 3.3% and 6.9%, respectively, compared to the average value of the species and compared to the digestibility of Radost 3.

The leaf mass of fodder beet has the highest degree of lignification (average value of the indicator – 41.54) compared to that of sugar (average value of the indicator – 23.87) and table (average value of the indicator – 36.46) beet – Fig. 1.

Only the leaf mass of the cultivars Preslav (coefficient – 28.25) and Sasha (coefficient – 40.63) registered a lower degree of lignification compared to the average for the species. In sugar beet cultivars, the degree of lignification is characterized by coefficients from 18.07 (MS 142 - line) to 29.39 (Diex), and in table beet with a coefficient of 21.16 - for the Radost 1 cultivar and a coefficient of 51.75 - Radost 3.

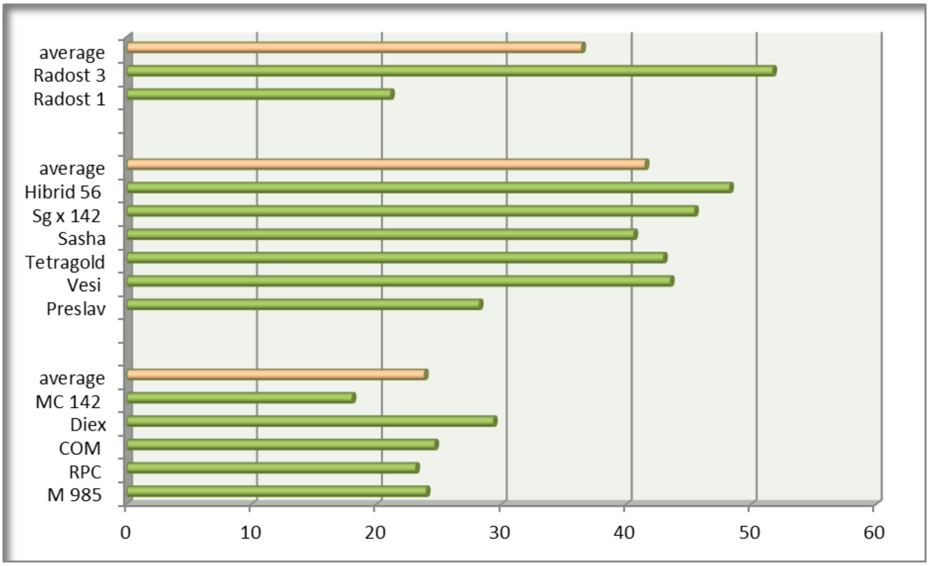

Figure 1. Degree of lignification of dry leaf mass of sugar, fodder and table beet cultivars (coefficient)

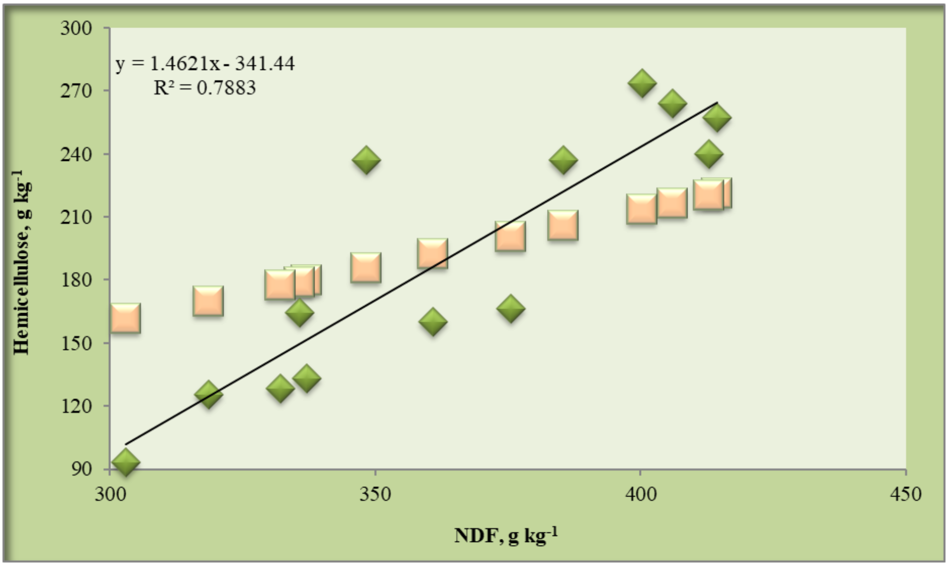

Figure 2. Regression relationship between the content of neutral detergent fibers and the amount of hemicellulose in the dry matter of sugar, fodder and table beet cultivars

Given the chemical and biochemical analyses, and the graphic regression models developed on this basis, it is possible to determine with relatively high accuracy, the variation of some indicators determining the quality and nutritional value of the dry leaf mass of the studied beet types.

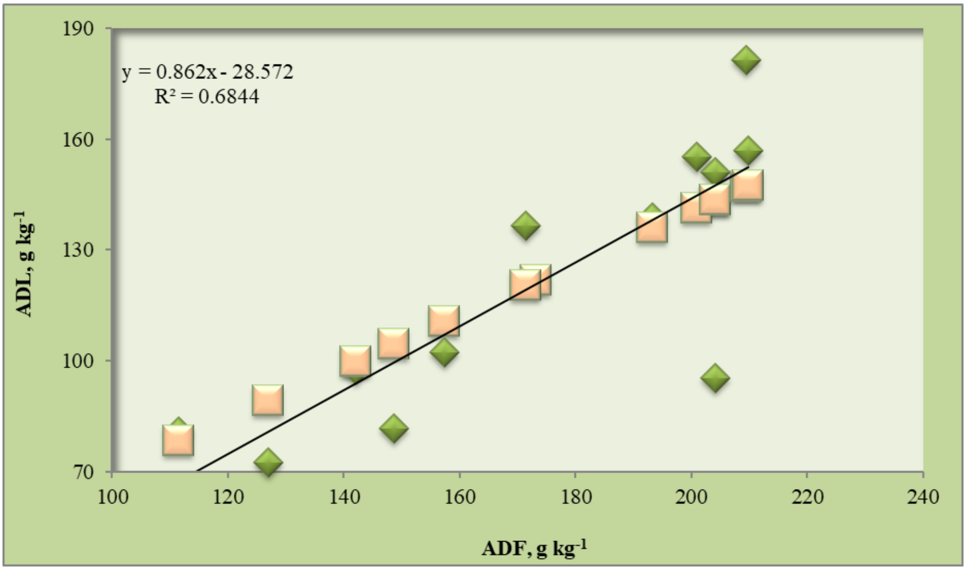

Figure 3. Regression relationship between the content of acid-detergent fibers and acid-detergent lignin in the dry matter of sugar, fodder and table beet cultivars

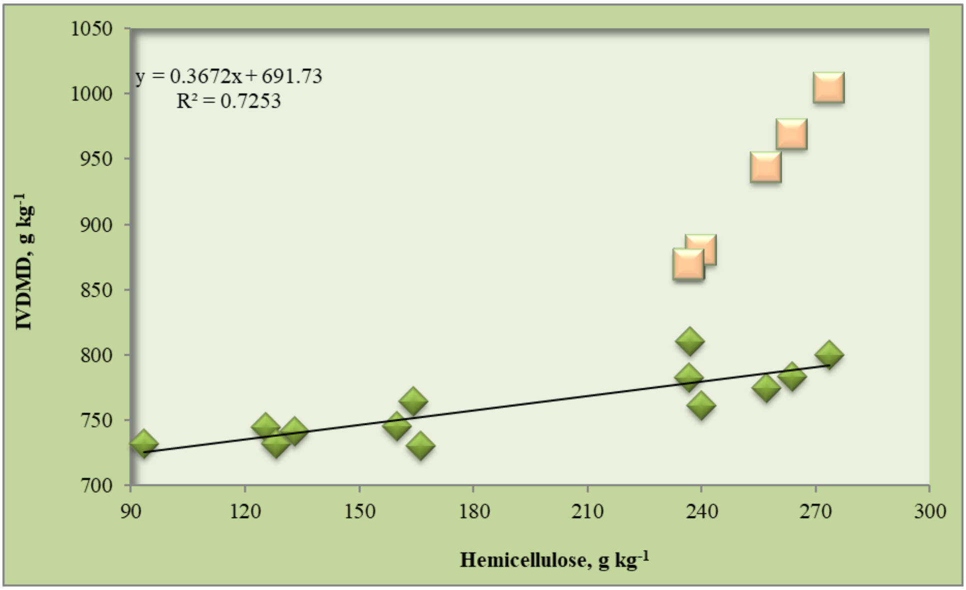

Figure 4. Regression relationship between hemicellulose content in dry matter and in vitro dry leaf mass in sugar, fodder and table beet cultivars

A regression relationship was established between the content of neutral-detergent fibers and the amount of hemicellulose in the sugar, fodder and table beet cultivars. The resulting equation has a high coefficient of determination $R^2 = 0.7883$ proven statistically at $P < 0.05$ – Figure 2.

The equation by which it is possible to predict the amount of acid-detergent lignin by acid-detergent fibers is: y = 0.862x – 28.572 with a coefficient of determination – R^2 = 0.6844 (with significance level P <0.05) - Figure 3.

Hemicellulose as a structural component of the plant cell is found in a significant relationship with the in vitro digestibility of the dry leaf mass (Figure 4). The established regression equation (y = 0.3672x + 691.73 with a high coefficient of determination R^2 = 0.7253) can be used to tentatively predict the digestibility of the investigated sugar, fodder and table beet cultivars.

CONCLUSIONS

- It was found that the cultivars with the highest content of crude protein in the dry matter are: Vesi (272.2 g kg^{-1}) - from fodder beet, Diex (271.0 g kg^{-1}) - from sugar beet and Radost 1 (247.5 g kg^{-1}) – from table beets.
- The leaf mass of the sugar beet cultivars has the lowest content of acid-detergent fibers (from 25.7 to 50.8%), acid-detergent lignin (from 25.7 to 50.8%) and cellulose (from 10.9 to 14.3%), but with a higher concentration of neutral-detergent fibers (with from 15.1 to 15.4%) and hemicellulose (with from 54.0 to 74.0%) compared to that of fodder and table beets.
- Regression equations have been developed as an expression of the regression dependence between the fibrous structural components in the plant cell and can be used for indicative prediction of the traits.

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