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CHEMICAL COMPOSITION ANALYSIS OF MISCANTHUS PLANT LEAVES AND STEMS

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Abstract: A comparative analysis of the chemical composition of the leaves and whole plant stems of the cellulose-containing miscanthus plant shows that the values of indicators such as the mass fraction of protein, fat, ash and acid-insoluble lignin in the plant components are similar to those of the whole Miscanthus plant. high in wire; therefore, it is recommended to use whole Miscanthus plants, including leaves and stems, for further research aimed at developing the scientific and technological basis of processing and using Miscanthus biomass in fuel and energy, cellulose, microbiology and other fields.

Keywords: Miscanthus, protein, oil, ash, fiber, cellulose, lignin, stem, leaves, polymers, plants, chemicals.

Introduction. Miscanthus or silvergrass is a type of perennial plant in the Poaceae family. At the moment, the areas for the cultivation of grass plants are constantly growing. This phenomenon can be explained by high growth rates and the prospects of its application in the national economy. All over the world, including Uzbekistan, comprehensive study of this plant and its use in the chemical and energy industry are being studied.

It should be noted that Miscanthus is a very valuable raw material due to its ability to collect a large amount of solar energy. The main advantage of this plant is its high yield. This plant can grow actively in nutrient-depleted soils while maintaining its quality and high lignin content.

Current fuel problems can be solved by using renewable energy sources, among which Miscanthus is a promising raw material for biofuel and bioethanol production. Planting crops for bioenergy on a large scale requires the study and implementation of new technologies for obtaining material.

In addition to biofuel production, several species of Miscanthus can be used to obtain biologically active substances. Miscanthus extracts are known to contain fatty acids, sterols and other aromatic compounds. The main structures of phenolic compounds and sterols of Miscanthus bark and core include vanillic acid, vanillin,

parahydroxybenzaldehyde, syringaldehyde, campesterol, stigmasterol, β-sitosterol, 5-sitosterol, stigmastadiene. 1-stigmast-4-ene-3-one, stigmast-6-ene-3,5-diol, 7-hydroxy-β-sitosterol and 7-oxo-β-siterol.

According to the studies of T.N. Goryachovskaya and K.G. Starostina, lignocellulosic biomass obtained from Miscanthus plants contains approximately 70% polysaccharides consisting of hexose (cellulose) and pentose (hemicellulose) residues. As a result of the complete hydrolysis of these polysaccharides, a mixture of hexoses (glucose, galactose, mannose) and pentoses (arabinose, xylose) is formed, which can then be used as a substrate for bacterial cultivation.

Simple carbohydrates such as glucose and fructose can be converted into products such as bioethyl alcohol, vitamins, enzymes, proteins, amino acids, lipids, organic acids, technical cellulose with the help of bacteria and fungi.

Miscanthus plant was hydrolyzed and found to contain large amounts of high and low molecular organic acids, alcohols, ketones, humic acids, and minerals in addition to peptose and hexoses. The qualitative and quantitative composition of substances depends on the method of obtaining Miscanthus hydrolysates.

This study aims to investigate the chemical composition of non-woody lignocellulosic raw materials. We used the following three different miscanthus for our research.

Figure 1. Miscanthus Chinese 'Flamingo' ('Flamingo').

Miscanthus Flamingo is an ornamental perennial that is perfect for creating beautiful compositions in the garden. Tall growth, unusual appearance and beautiful inflorescences make it an indispensable element of landscape design. This plant is fairly easy to care for, making it an excellent choice for those who want to add a pop of color to their garden.

Figure 2. Miscanthus Chinese 'Goldfeder' ('Goldfeder').

Ornamental grass with 0.75 in. wide lime green leaves with light yellow stripes which darken in warm climates to a yellow-green by late summer. It is similar to Silberfeder. Gold Feather is not readily available in nurseries because of the difficulty in propagation; this plant is a slower growing plant than most Miscanthus.

Figure 3. Chinese Miscanthus 'Gracillimus' ('Gratsilimus')

Gracillimus is a late-blooming variety (September - October) with copper-red ears and golden leaves in autumn. Miscanthus chinensis is a perennial herbaceous plant from the Poaceae family. Used in landscape design for park and coastal areas. More often, it is planted singly or at some distance from other miscanthus. Dried inflorescences are used in floristry.

Materials and methods. We used the following species grown in the territory of the Tashkent State Technical University named after Islam Karimov and the Botanical Garden in the city of Tashkent to conduct research.Plant species selected for this study:

- Miscanthus "Flamingo" was selected;
- Miscanthus "Goldfeder" was selected;
- Miscanthus "Gracillimus" was selected.

Mature plants were selected to analyze the chemical composition of the samples. Plants that were tall and had the most flowering were selected for analysis. In the experiment, the chemical composition of individual parts of Miscanthus (leaves and stem) and the whole herbaceous plant was studied. As the leading indicators describing the chemical composition of cellulose-containing raw materials, we chose the mass fraction of protein, the mass fraction of fiber, the mass fraction of fat, the mass fraction of ash, lignin and cellulose.

The content of protein, mass fraction of fiber and crude fat was evaluated according to the requirements of GOST 32040-2012 "Forage, compound and animal feed raw materials". Spectroscopy was used to determine protein, cellulose, fat and moisture. Mass fraction of ash GOST 32933-2014 (ISO 5984: 2002). The mass fraction of lignin was evaluated according to GOST 11960-79 "one-year fibrous semi-products and raw materials for the pulp and paper industry". Method for determination of lignin content. To determine the mass fraction of cellulose, GOST 16932-93 (ISO 638-78) "Mass - determination of the amount of dry matter" was used. All samples were cut into 0.5-1.0 cm with scissors to study the chemical composition.

Results and analysis. The results of the study of the chemical composition of whole Miscanthus are presented in Table 1.

Table 1. The results of the study of the chemical composition of Miscanthus.

Indicators	Components of three types of Miscanthus plant		
	Miscanthus "Flamingo"	**Miscanthus "Goldfeder"**	**Miscanthus "Gracillimus"**
Humidity indicator	8.00±0.55	8.55±0.52	8.85±0.50
Mass fraction of ash, %	4,20±0,25	3,21±0,19	4,68±0,28
Mass fraction of lignin, %	12,00±0,72	10,00±0,65	18,00±1,08
Mass fraction of cellulose, %	55,00±3,45	60,00±3,75	62,00±3,87

The analysis of the results presented in Table 1 shows that the moisture content of all three studied Miscanthus samples does not exceed 8.85%, which does not contradict the literature data. Miscanthus was found to be rich in cellulose. The maximum amount of cellulose (62.0%) was found in Miscanthus "Gracillimus", the minimum - in Miscanthus "Flamingo" (55.0%). Miscanthus "Gracillimus" contains a record amount of lignin (18.0%), Miscanthus sinensis "Goldfeder" contains 1.8 times less lignin (10%).

We continued the research with Miscanthus "Gracillimus". Because the amount of cellulose in this type is more than others. In our further studies, the effect of NaOH concentration on the amount of cellulose during cooking of the plant was studied. The results are shown in Figure 4.

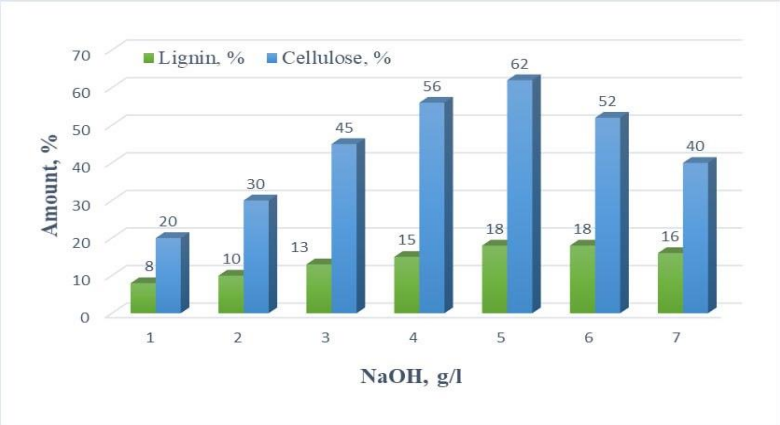

Figure 4. Effect of NaOH concentration on the amount of cellulose in cooking the plant.

It can be seen from this figure that the cellulose separation increases with the increase of NaOH concentration, but we can observe that the cellulose content decreases when the alkali concentration is further increased. This is because the increase in the concentration of alkali during cooking causes chemical destruction. Therefore, when the alkali concentration reached 6 g/l, the amount of cellulose began to decrease. From the figure, we can conclude that the alkali concentration of 5 g/l was selected as the optimal condition in our study.

A comparative analysis of the chemical composition of the plant stem and the whole plant shows that the values of the parameters such as the mass fraction of protein, fat, ash and acid-insoluble lignin are higher in the whole plant.

Summary. Thus, it is recommended to use whole Miscanthus plants, including leaves and stems, for further research to develop the scientific and technological basis of processing and use of Miscanthus biomass in fuel and energy, cellulose, microbiology and other fields.

References

1. Hontarenko S.N. Method of propagation, stimulation of rhizome growth in vitro culture and adaptation in the open ground for the genus Miscanthus representatives / Hontarenko S.N.,Lashuk S.A. / Plant Varieties Studying and Protection. – 2017. – V. 13. – No. 3. – P. 230-238.

2. Ilyasov S.G. Depolymerization of acetone lignin in ethanol / Ilyasov S.G., Cherkashin V.A. / South-Siberian Scientific Bulletin. – 2014. – No. 4 (8). – P. 18-20.

3. Korchagina A.A. Non-traditional sources of raw materials for the production of nitric acid ethers of cellulose (review) / Korchagina A.A. / South-Siberian Scientific Bulletin. – 2018. –No. 1 (21). – P. 68-74.

4. 4. Veshnyakov, V.A. Comparison of methods for the determination of reducing substances: Bertrand's method, ebuliostatic and photometric methods / V.A. Veshnyakov, Yu.G.Khabarov, N. D. Kamakina // Khimija Rastitel'nogo Syr'ja. – 2008. – No. 4. – P.47-50.

5. Radiation capture and conversion efficiencies of Miscanthus sacchariflorus M. sinensis and their naturally occurring hybrid M.xgiganteus / Davey C.L., Jones L.E., Squance M. al. // Global change biology bioenergy. – 2017. – Vol. 9. – №2. – P. 385-399.

6. Anisimov A.A. Miscanthus (Miscanthus spp.) In Russia: Opportunities and Prospects /Anisimov A.A., Khokhlov N.F., Tarakanov I.G. / New and unconventional plants and prospects for their use. – 2016. – No. 12. – P. 3-5.

7. Features of formation of Miscanthus giganteus planting material depending on cultivation technology element / Doronin V.A., Dryga V.V., Kravchenko Yu.A., Doronin VV./ Plant Varieties Studying and Protection. – 2017. – V. 13. – No. 4. – P. 351-360.

8. Lanzerstorfer C. Combustion of Miscanthus: Composition of the Ash by Particle Size /Lanzerstorfer C. // Energies. – 2019. – Vol. 12. – №1. – No. 178.

9. Technology of miscanthus biomass saccharificationwith commercially available enzymes / Goryachkovskaya T.N., Starostin K.G., Meshcheryakova I.A. et al. / Vavilov journal of genetics and breeding. – 2014. – V. 18. – No. 4-2. – P. 983-988.

10. Baibakova O.V. Study of the dependence of the bioethanol yield on the stages of chemical pretreatment of miscanthus / Baibakova O.V. / Polzunovsky Bulletin. – 2014. – No. 3. – P.156-160.

11. Redcay S. Effects of roll and flail conditioning systems on mowing and baling of Miscanthus x giganteus feedstock / Redcay S., Koirala A., Liu J. // Biosystems engineering. – 2018. – Vol. 172. – P. 134-143.

12. M.Umarova, E.Egamberdiyev, O.Maksumova. Study of resource-saving viscosity modifiers of used oils. V International Scientific Conference “Construction Mechanics, Hydraulics and Water Resources Engineering” (CONMECHYDRO - 2023) E3S Web of Conferences 401, 05087 (2023) https://doi.org/10.1051/e3sconf/202340105087

13. D.Azimov, S.Turabdjanov, E.Egamberdiyev, Sh.Azimova, R.Nazirova, B.Dautov, Sh.Arslanov, O.Muratkulov. Investigation of the water of Aydarkul Lake into components and the scope of their application. International Conference on Sustainable Management of Earth Resources and Biodiversity (SERBEMA-2023) E3S Web of Conferences 421, 05004 (2023) https://doi.org/10.1051/e3sconf/202342105004

14. S.Aliev, E.Egamberdiev, S.Turabdjanov, Sh.Rashidov, A.Juraev. Role of fillers in the production of wood-polymer composites. 4th International Conference on Energetics, Civil and Agricultural Engineering (ICECAE 2023) E3S Web of Conferences 434, 02030 (2023) https://doi.org/10.1051/e3sconf/202343402030

15. E.Egamberdiyev, Y.Ergashev, G.Akmalova, G.Rahmonberdiyev. Effects and Analysis of Chytazone in the Process of Processing Paper from Natural polymeres. International Conference on Smart Technologies and Applied Research (STAR'2023) E3S Web of Conferences 477, 00053 (2024) https://doi.org/10.1051/e3sconf/202447700053

16. E.Egamberdiev, Kh.Khaydullaev, S.Abdurazakova, Q.Khoshimov, O.Muratkulov, Kh.Tilovov, B.Rakhimjonov, M.Alieva. Composite papers based on natural polymers. 5th International Conference on Energetics, Civil and Agricultural Engineering (ICECAE 2024) E3S Web of Conferences 497, 03031 (2024) https://doi.org/10.1051/e3sconf/202449703031

17. E.Egamberdiev, Kh.Khaydullaev, D.Shomurodov, A.Atakhodjaev, Sh.Mengliev, N.Igamkulova, M.Mukhamedjanov, S.Turabdjanov. Application of waste paper in composite materials based on mineral fibers. 5th International Conference on Energetics, Civil and Agricultural Engineering (ICECAE 2024) E3S Web of Conferences 497, 02026 (2024) https://doi.org/10.1051/e3sconf/202449702026

18. N.Lutfullaeva, E.Egamberdiev, Y.Ergashev, U.Alamov, Sh.Shamuratova, I.Usmanxadjaeva, A.Tukhtamushova, B.Saparov. Physico-chemical research of the processes of hydration of cements. 5th International Conference on Energetics, Civil and Agricultural Engineering (ICECAE 2024) E3S Web of Conferences 497, 02034 (2024) https://doi.org/10.1051/e3sconf/202449702034

19. Y.Ergashev, E.Egamberdiev, G.Akmalova, M.Umarova, I.Ayubova, S.Kholiqova, M.Mirzakhmedova, S.Turabdjanov. Production of filter material from various natural fibers. 5th International Conference on Energetics, Civil and Agricultural Engineering (ICECAE 2024) E3S Web of Conferences 497, 03052 (2024) https://doi.org/10.1051/e3sconf/202449703052

20. G.Djakhangirova, A.Miralimova, D.Maxmudova, E.Egamberdiev, U.Sharipova, M.Ziyaeva, Y.Ergashev. Control of microbiological contamination and content of cations in wastewater of grain processing enterprises in Uzbekistan. 5th International Conference on Energetics, Civil and Agricultural Engineering (ICECAE 2024) E3S Web of Conferences 497, 03032 (2024) https://doi.org/10.1051/e3sconf/202449703032

21. N.Ibragimov, Sh.Mirkomilov, M.Mukhamedjanov, E.Egamberdiev, N.Igamkulova, A.Agzamkulov, Yo.Ergashev. Decontamination of aeration station wastewater using ultraviolet radiation. 5th International Conference on Energetics, Civil and Agricultural Engineering (ICECAE 2024) E3S Web of Conferences 497, 03033 (2024) https://doi.org/10.1051/e3sconf/202449703033

22. Rakhmatullaeva N.T., Giyasov A.Sh., Egamberdiev E.A., Shokhakimova A.A., Sharipova U.I., Rakhmatov U.N. Selective extraction of copper (II) ions from complex industrial samples and photometric determination of it with 1-(2-pyridylazo)-2-naphthol (PAN). JMEA Journal of Modern Educational Achievements Volume 3, 2024 https://scopusacademia.org/

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