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SECONDARY AGRICULTURAL PRODUCTS IN FUNCTION OF RAW MATERIALS FOR FURTHER INDUSTRIAL PROCESSING

Abstract

Secondary agricultural products are increasingly becoming interesting as a raw material in many branches of processing. Looking at the possible ways of using secondary agricultural products, it can be concluded that it would be rational every year using of 30-50% of dry harvest residues and residues after primary processing for energy purposes, and 50-70% for other purposes. By industrial processing from straw are separating carbohydrates, proteins, mineral salts and other chemical compounds from straw. The obtained substances are used in the paper industry, packaging, construction materials, alcohol, etc. Aromatic substances of various secondary products are using in cosmetic industry, fragrances and household disinfectants and disinfectants.

Key words: *biomass, secondary products, harvest residues, industries, straw,*

INTRODUCTION

By improving the crop production system, the attitude towards secondary agricultural products changes, so that they become more and more interesting as raw material in many other branches of processing. With the development of industrial processing, secondary agricultural products are becoming more and more interesting in paper production, then in construction, and further in the chemical, pharmaceutical and cosmetic industries. Every year, large amounts of waste are created in agricultural

production, representing organic biomass suitable for use in various industries. According to recent literary data, estimates are that in the total plant production of our country, over 15,000,000 tons of this biomass remain annually. It is estimated that the amount of biomass will increase from year to year depending on the raising of the level of agrotechnical measures, changes in the structure of sowing, as well as the way of using and further processing of agricultural products, as pointed out by Ikanović et al. (2019). When it comes to the further use of secondary products, it is very important to find the most rational way to use this biomass. Looking at possible ways of using secondary agricultural products, it can be concluded that it would be rational to use 30-50% of dry harvest residues and residues after primary processing for energy purposes, and 50-70% for other purposes. The most irrational way of using harvest residues would be to burn biomass in the fields, which is prohibited in many countries, including ours. By burning organic biomass in the fields, only small amounts of mineral salts will remain, while organic compounds will be decomposed with the consumption of large amounts of oxygen and the release of carbon dioxide and other aerosols, which has a negative effect on the ecosystem.

Secondary agricultural products, depending on the plant species, quantity and quality of these residues, can be used in different ways Janković et al. (2019). The same authors state that secondary agricultural products can be used as raw materials in many industrial branches because they contain significant amounts of mineral salts, carbohydrates (cellulose and lignin) and other compounds. These substances can be separated by a technological process and used as raw materials in many industrial branches.

Aromatic substances of various by-products (harvest residues, as well as residues after industrial processing of the main products) are used in the cosmetics industry for the production of personal hygiene products, fragrances, and home disinfection and disinfection products (Glamočlija et al. 2015).

Straw is an agricultural by-product, which represents dry stalks of cereal, after separating the grain and chaff. It accounts for half of the cereal yield such as wheat, barley, oats, triticale, rye and rice. It can be used in many ways, for example as biofuel, then as animal feed, a mat for domestic animals, to fill mattresses, to weave baskets, hats and other homemade items, to build and cover residential and commercial buildings, to protect against erosion, for the production of substrate for growing mushrooms, for the packaging of glass and other impact-sensitive goods, in pharmaceuticals and cosmetics, in the chemical industry, in art and so on, as pointed out by Janković et al. (2019). The same authors point out that the ways of using straw depend on the type of cereal and its quality at the time of harvest.

The main goal of this work was to study the methods by which these side products would be used in the best possible way, given that the share of crop residues in the total yield cannot be completely eliminated. At the same time, by perfecting the processing technology of primary and secondary agricultural products, the entire yield of biomass is taken from the fields. Seen from an economic point of view, this approach to the use of the produced biomass is justified because a greater profit is realized from the same area. It should be pointed out that with some agricultural plants, the share of the main product also depends on the production goal. Even so, it is not possible to completely

eliminate the share of harvest residues in the total yield, but it is necessary to opt for methods that would use these side products in the best possible way.

MATERIAL AND METHODS

Secondary agricultural products, depending on the plant type, quantity and quality of these residues, can be used in different ways. In this paper, the possibilities of using secondary agricultural products as raw materials for further industrial processing are analyzed. Ways of using straw depend on the type of cereal and its quality at the time of harvest. The use value of straw is determined after the end of the grain harvest, when the quality and health of the straw is assessed.

If we do not have a more durable material (for example, silt fences or geotextile), straw bales can be used for coating construction sites on inclinations to prevent fine soil particles from being carried into nearby water bodies (rivers, lakes or seas).

Straw, as a building material, also poses a danger because it is easily flammable. On the other hand, there are also people who are allergic to straw dust.

RESULTS AND DISCUSSION

Every year, in agricultural production, but also in other activities, large amounts of waste are created, which represent organic biomass that can be used in various ways. One way is using in various industries. Secondary agricultural products can be used as raw material in many industrial branches because they contain significant amounts of mineral salts, carbohydrates (cellulose and lignin) and other compounds. These substances can be separated by a technological process and used as raw materials in many industrial branches.



Figure 1. Residues after starch separation

By industrial processing carbohydrates, proteins, mineral salts and other chemical compounds are separating from the straw. The obtained substances are used in the paper industry, packaging, construction materials, alcohol, as well as in other industries. Large amounts of cellulose and lignin are extracted from the glume and chaff, which remain after the husking of cereal grains, by the process of non-isothermal autohydrolysis, from which, through further processing, glucose can be obtained in the amount of 67 g L⁻¹ (Ares-Peón et al., 2010).



Figure 2. Bran in the pharmaceutical and cosmetic industry

An important raw material for the chemical industry is corn husks, which are used for the production of charcoal, xylan, furfural, acetic acid and other compounds that are important raw materials for further industrial processing.

The granules obtained by grinding the flakes are used for cleaning, polishing and drying metal products, for example gears, ball bearings, metal coins, chains and others.

Most of the solid harvest residues contain large amounts of cellulose, which is separated by a technological process and used for the production of paper packaging, from the finest paper (cereal straw) to coarser cardboard paper. By producing a paper from secondary agricultural products are significantly protect forest trees in which way extends their life cycle until the moment they are cut down for processing. In the pharmaceutical industry, substances are used that are separated from agricultural by-products through technological processing, such as sugars, vitamins, pollen powder (for example from corn, rye, buckwheat, and plants from the cabbage family), mineral salts, and the like. Most of these substances in medicines are inactive substances. These components are significant in medicines although they do not increase or affect the therapeutic effect of the active ingredient of the medicine. Inactive ingredients or excipients, are added during the manufacturing process of pharmaceutical products such as tablets, capsules, suppositories and injections. The role of the filler is in binding, coloring, conservation, aromatization and easier transfer of the active components of the drug in the body. In addition to official medicine, some secondary agricultural products are also used to make medicines that are used in folk medicine as auxiliary medicinal means or remedies.

Residues after the final processing of rice grains (hulls and sprouts) can be used in several ways. In Asian countries, which are large producers of rice, this residues are used for food and medicinal purposes, but also in further industrial processing to obtain oil.

In direct nutrition, rice oil is valued because it lowers high blood pressure and cholesterol in the blood, it is recommended for diabetics and people with digestive organ health problems, it helps in the treatment of alcohol addiction, against obesity and similar. In folk medicine, the oil is used to remove allergic rashes on the skin and the like.



Picture 3. Oat straw soap

Aromatic substances of various by-products (harvest residues, as well as residues after industrial processing of the main products) are used in the cosmetics industry for the production of personal hygiene products, fragrances, and household disinfectants and

disinfectants. Technical alcohol (methanol and ethanol) is obtained from carbohydrates obtained from secondary products through the distillation process, and it is an important raw material for further industrial processing. Preparations based on straw are recommended for strengthening the body of people recovering from long-term illnesses. The use of preparations made from oat straw to relieve nervous disorders began in the Middle Ages. An extract obtained from oat straw moderates the effect of two enzymes related to depression in the same way as some drugs of official medicine.

Today, preparations made from oat straw as well as from oats green parts and leaves are sold in the form of powder, juice, tincture or tea named wild oat extract. These preparations are used to calm anxiety, stress and nervous tension and improve mood. According to research in Germany, preparations based on oat straw have a very positive effect on cognitive functions, which provides opportunities for the individual to learn better and remember the learned material more easily. In some countries of Western Europe, the aphrodisiac effect of preparations made from oat straw is emphasized.

In the chemical industry, rye straw is used as a raw material for obtaining lignin, organic acids and furfural. During the long history of the construction of residential and commercial buildings, numerous secondary plant products played an important role as building materials. In East Asia, for thatching roofs it is common to use miscanthus trees tied in bundles. For this purpose, the use of miscanthus trees has recently been encouraged in Europe as well (Fowler et al., 2003).

Harvest residues (straw, trees and leaves) are still used today to cover residential and commercial buildings, especially in areas with hot climates (Africa and Asia) because they do not leak water and are excellent heat insulators. This building material has been used for this purpose since the very beginnings of human civilization. Cereal straw, especially the type with a longer stem (rye, oats and old varieties of wheat) was most often used to cover these buildings (Lakić et al. 2018).

Today, in the world, especially in highly developed countries, there is a very developed movement that propagates the use of natural materials for the construction of construction facilities, such as eco-houses, resorts, restaurants. According to the results obtained by Acikel (2011), using ground miscanthus as an additive to concrete increases the compressive strength of concrete (by 4-28%), compression (by 9-25%) and bending (by 4-9%). When ground miscanthus is incorporated into the joist mix as reinforcement, the flexural strength increases by 2-6%.

During the 19th century in England, the production of various knitted straw items for household purposes was very widespread. The making of art objects from wheat straw originates from the Far East and in Europe these materials were first used for similar production in the 17th century. Instead of veneers people have begun to use wheat and oat straws which they first were soaking by hot and cold water to obtain various colors and ironed after (Fowler et al., 2003). It should be noted that farmers made scarecrows out of straw and corn stalks to scare the birds in their fields. Using this tradition of protecting crops from birds with scarecrows in England, at the end of the 20th century, a May Day scarecrow festival was established, which is visited by about 10,000 guests. Similar festivals are organized in other places, which is an interesting way of attracting tourists. Various dolls, made from plant parts of the most commonly grown crops, had a pagan religious significance among the pre-Christian peoples of Europe. They were

symbols of the fertility of crops and the fertility of domestic animals, as pointed out by Acikel (2011).

The above-ground biomass of most alternative grains is used to obtain biofuels. Biogas is extracted from the fresh above-ground biomass (green stems and leaves) of miscanthus, prairie millet, Spanish reed and elephant grass through the biological process of anaerobic digestion. After the process of obtaining biogas, large amounts of biomass remain, which are used in several ways. The most common way is scattering it on fields and plowing it together with harvest residuals and other organic residues for increasing soil fertility. This biomass can be used to make compost or vermicompost, but also as mulch to cover the inter-row space in wide-row crops. In a similar way, plant residues are used after obtaining bioethanol. If above-ground biomass is used for the preparation of solid fuels, briquettes or pellets, after combustion in boiler plants, ash rich in potassium and calcium remains. It is most expedient to scatter this mass on the surface and plow it into the soil (Ares-Peón et al., 2010).

Straw bales can be used to cover construction sites on slopes to prevent fine soil particles from being carried into nearby bodies of water (rivers, lakes or seas). Straw, as a building material, also represents a danger because it is easily flammable (Glamočlija 2012).

Buckwheat fruit casings (husks) are used in the production of ecological sleeping aids (pillows, mattresses, blankets, etc.). Pillows filled with buckwheat these husks do not compress under pressure, so that the head and the whole body provide an ideal position during sleep. After a long period of sleeping on mattresses and pillows filled with husks, pain in the neck and upper back is reduced. Husks are also good thermal insulators and maintain an optimal temperature throughout the night. Air circulates freely through the flakes, which prevents the head from sweating. The increased content of silicic acid in the flakes reduces the possibility of the appearance of bacteria. This bedding can be rated as an ecological product and is recommended for people with back problems, neck and shoulder pain, as well as people with asthma symptoms and allergies to house dust and dust mites. Sleeping on this bedding is more comfortable because there is no excessive sweating (Glamočlija et al., 2015). Industrial processing separates carbohydrates, proteins, mineral salts and other chemical compounds from straw. The obtained substances are used in the paper industry, packaging, construction materials, alcohol, as well as in other industries.

CONCLUSION

By improving the crop production system, the attitude towards secondary agricultural products changes, so that they become more and more interesting as raw material in many other branches of processing. Secondary agricultural products can be used as raw material in many industrial branches because they contain significant amounts of mineral salts, carbohydrates (cellulose and lignin) and other compounds. With the development of industrial processing, secondary agricultural products are becoming more and more interesting in the production of paper. An important raw material for the chemical industry are residual corn parts, which are used for the production of charcoal, xylan, furfural, acetic acid and other compounds that are

important raw materials in further industrial processing. In the pharmaceutical industry, are used substances which are used that are separated from agricultural by-products through technological processing, such as sugars, vitamins, pollen powder. disinfection and disinfection.

By perfecting the technology of processing primary and secondary agricultural products, the entire yield of biomass is taken from the fields. Seen from an economic point of view, this approach to the use of the produced biomass is justified because a greater profit is realized from the same area.

REFERENCES

1. Acikel, H. (2011): The use of *Miscanthus x giganteus* as a plant fiber in concrete production. Scientific Research and Essays, Vol. 6, No. 13, pp. 2660-2667.
2. Anonymous (2017): *Flax straw and fibre*. Flax council of Canada.
3. Anonumous (2018): Composting for the homeowner. University of Illinois Extension.
4. Ares-Peón, I. A., C. Vila, G. Garrote and J. C. Parajó (2010): Enzymatic hydrolysis of autohydrolyzed barley husks. <https://doi.org/10.1002/jctb.2511>.
5. Fowler, P. A., A. R. McLauchlin, and L. M. Hall (2003): The potential industrial uses of forage grasses including *Miscanthus*. Bio-Composites Centre, Univ. of Wales, Bangor, pp. 40.
6. Glamočlija, Đ., S. Janković i R. Pivić (2012): Alternativna žita, monografija. Izdavač Institut za zemljište, Beograd.
7. Glamočlija, Đ., S. Janković, V. Popović, V. Filipović, V. Ugrenović i J. Kuzevski (2015): Alternativne ratarske biljke u konvencionalnom i organskom sistemu gajenja. Monografija, Izdavač, IPN, Beograd.
8. Horne, M. R. L., D. Waldron, J. L. Harwood and R. Harwood (2010): The production and extraction of flax-fibre for textile fibres. Journal of Biobased Materials and Bioenergy 4 (2), rr. 98-105.
9. Ikanović J., Popović V., Janković S., Živanović Lj., Kolarić Lj., Lončar M., Kulić G., Dražić N. (2019). Sekundarni proizvodi žita kao energenti. XXXIII Savetovanje agronoma, veterinara, tehnologa i agroekonomista. Zbornik naučnih radova 2019. Instituta PKB Agroekonomik. ISSN: 0354-1320; 25, 1-2: 99-110.
10. Ikanović J., Rakašćan N., Živanović Lj., Popović V., Dončić D., Milanović T., Kolarić Lj. (2019): Značaj proizvodnje biomase iz sekundarnih proizvoda ratarske proizvodnje u funkciji integralne zaštite bilja, 16. Simpozijum o zaštiti bilja u Bosni i Hercegovini Mostar, 05-07.11.2019, pp. 81-83
11. Janković, S., Đ. Glamočlija, J. Ikanović, S. Rakić (2019): Sekundarni ratarski proizvodi. Monografija, Institut za primenu nauke u poljoprivredi, Beograd. ISBN 978-86-81689-41-7pp 385.
12. Lakić, Ž., Glamočlija, Đ., Kondić, D., Popović, V., Pavlović, S. (2018). Forage plants and cereals for the protection of soil from degradation. Monograph. In Serbian: Krmne biljke i žita u funkciji zaštite zemljišta od degradacije. Banja Luka, 1-405.

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СЕКУНДАРНИ РАТАРСКИ ПРОИЗВОДИ У ФУНКЦИЈИ СИРОВИНА ЗА ДАЉУ ИНДУСТРИЈСКУ ПРЕРАДУ

Извод

Секундарни ратарски производи постају све више интересантни као сировина у многим гранама прераде. Сагледавајући могуће начине коришћења секундарних производа ратарства може се закључити да би било рационално сваке године искористити 30-50% сувих жетвених остатака и остатака после примарне дораде за енергетске сврхе, а 50-70% за остале намене. Индустијском прерадом из сламе издвајају угљене хидрате, протеине, минералне соли и остала хемијска једињења. Добијене супстанце се користе у индустрији папира, амбалаже, грађевинског материјала, алкохола, итд. Ароматичне супстанце споредних производа користе се: у козметичкој индустрији, за израду мириса и средстава за кућну дезинфекцију и дезинсекцију.

Кључне речи: биомаса, секундарни производи, жетвени остаци, индустрије, слама

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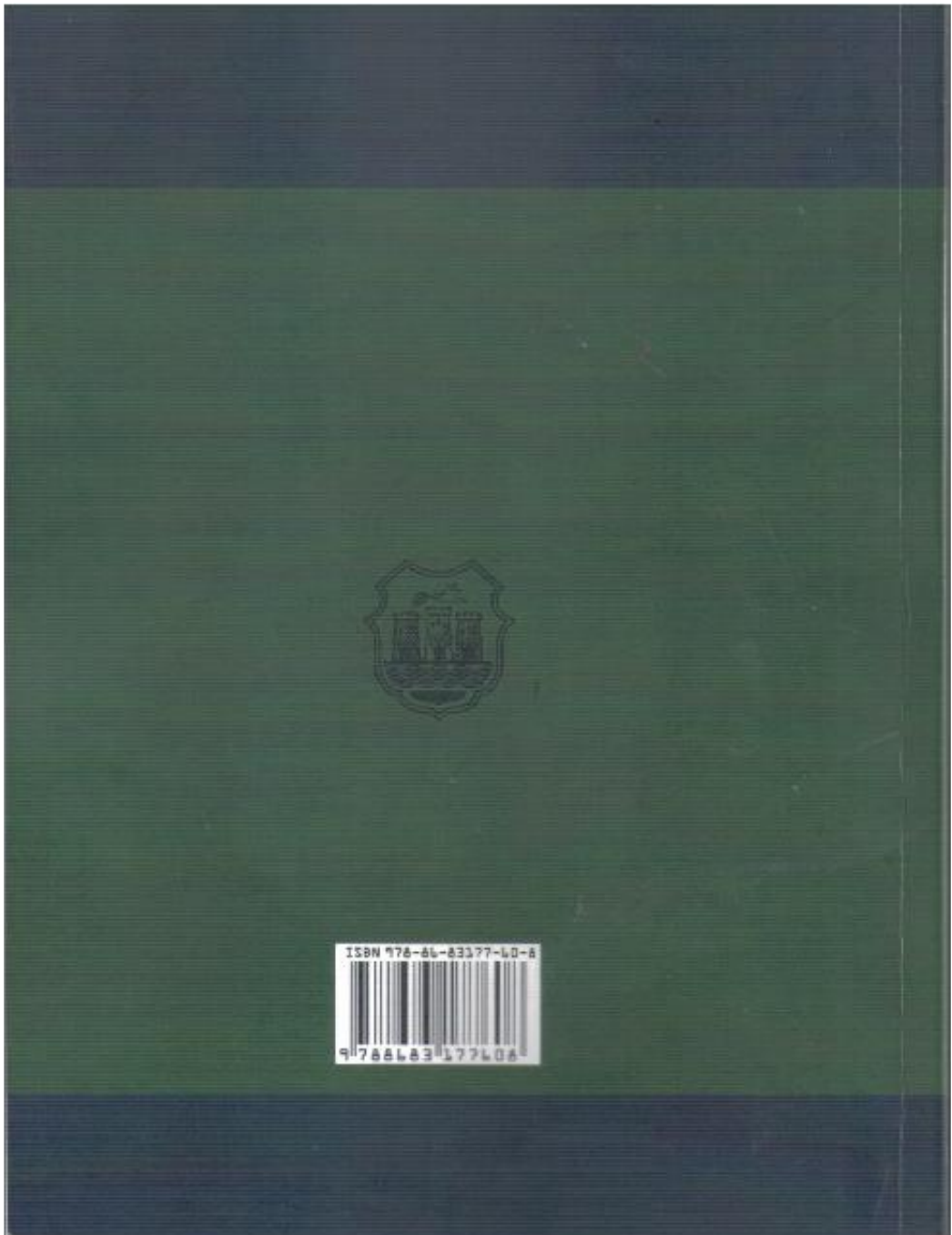
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