при pH 2. Полученный табачный пектин обладает слабой гидролизирующей и повышенной комплексно-образующей способностями. Поэтому он может найти основное применение в медицине как комплексно-образующее средство для выведения тяжелых металлов из организма человека, а также для производства продукции, альтернативной курению, например, таблеток с пектатом никотина. Делается вывод о технологической возможности получения из табачных отходов таких технически ценных продуктов, как никотин, пектин, органические кислоты и микробиологический корм, т.е. о создании практически безотходного производства. Однако, по мнению многих авторов, этот процесс дорогостоящий и вследствие этого малоприменимый.

Кроме этого, табачная пыль является отходом табачного производства и подлежит утилизации, использование ее для защиты растений частично решает эту проблему. Недостатком способа является слабый защитный эффект, требуют многократной обработки, а также использования в качестве основы дорогостоящего табачного сырья (листьев).

Таким образом, можно сделать вывод, что наиболее экономически целесообразным является использование отходов сигаретного производства (табачная мелочь) без дополнительной обработки для изготовления табачных изделий: некурительных табаков и табака для кальяна [5].

Использование табачной мелочи (отделяемого табака от брака сигарет/штранга, табачной мелочи) для изготовления кальянной смеси и нюхательного табака является оптимальным решением, поскольку позволяет решить следующие задачи:

– получение табачного продукта с высокими дегустационными свойствами и постоянством потребительских характеристик;

– возможность получения изделий, обладающих естественным табачным ароматом;

– экономической эффективности, т. к. из технологического процесса изготовления исключены операции по подбору, обезжиливанию и измельчению табачного сырья.

Однако наиболее перспективным для Республики Беларусь является использование табачной пыли в качестве удобрения сельскохозяйственных растений, так как данный способ показывает хорошие результаты вследствие содержания в составе табачной пыли ряда ценных элементов.

ЛИТЕРАТУРА

1. Реестры объектов по использованию, обезвреживанию, захоронению и хранению отходов. [Электронный ресурс]. – Режим доступа: http://www.ecoinfo.by/content/2422.html .- Дата доступа: 010.02.2021

2. Современные технологии использования табачных отходов: пат. RU 2710727 C1 / Миргородская А.Г., Шкидюк М.В., Матюхина Н.Н., Дон Т.А. – Опубл. 27.06.2014

3. Способ получения биоорганического удобрения: пат. RU 2520730 C2 / авторы Филипчук О.Д., Тонконог М.Д.– Опубл. 27.06.2014

4. Способ приготовления инсектицидного водного экстракта из табачной пыли: пат. RU 2535496 C2 / Плотникова Т.В., Дон Т.А., Саломатин В.А., Миргородская А.Г. – Опубл. 10.12.2014

5. *Шкидюк М.В., Бедрицкая О.К., Глухов С.Д., Матюхина Н.Н.* К вопросу оценки качества кальянных смесеи // Инновационные исследования и разработки для научного обеспечения производства и хранения экологически безопасной сельскохозяйственной и пищевой продукции: матер. Междунар. науч.-практ. конф. Краснодар, 2015. С. 407–410.

CEREAL PRODUCT WASTES AND THEIR UTILIZATION IN VARIOUS INDUSTRIAL AREAS

ОТХОДЫ ЗЕРНОВОЙ ПРОМЫШЛЕННОСТИ И ИХ УТИЛИЗАЦИЯ В РАЗЛИЧНЫХ ПРОМЫШЛЕННЫХ ЗОНАХ

V. O. Lemiasheuski[1], M. M. Özcan[2]

В. О. Лемешевский[1], М. М. Озджан[2]

[1]Белорусский государственный университет, МГЭИ им. А.Д. Сахарова БГУ, Минск, Республика Беларусь

[1]Belarusian State University, ISEI BSU, Minsk, Republic of Belarus

[2]Department of Food Engineering, Faculty of Agriculture, Selcuk University, Konya, Turkey

lemeshonak@mail.ru

[2]Кафедра пищевой инженерии, сельскохозяйственный факультет, Сельчукский университет, Конья, Турция

In the food industry a large amount of solid and liquid waste is produced during production, preparation and consumption. When these wastes are given directly to the environment, they cause environmental pollution and

the loss of valuable biomass and nutrients. In food factories, large amounts of food wastes, called by-products, are formed as a result of the process, and many of these are immediately destroyed or used to produce products with low economic value (animal feed, fertilizer, etc.) using lower technologies.

В пищевой промышленности при производстве, приготовлении и потреблении продуктов образуется большое количество твердых и жидких отходов. Когда эти отходы попадают непосредственно в окружающую среду, они являются причиной ее загрязнения, потери ценной биомассы и питательных веществ. На пищевых предприятиях в результате технологического процесса образуются большие количества пищевых отходов, называемых побочными продуктами, многие из которых немедленно уничтожаются или используются для производства продуктов с низкой экономической ценностью (кормов для животных, удобрения и т. д.) с использованием простых технологий.

Key words: grain wastes, usefulindustrial using, rice husk, wheat bran, wheat embryo, composite production, biopellet production, raw material grinding stage waste, food products for humans.

Key words: зерновые отходы, полезные для промышленности, рисовая шелуха, пшеничные отруби, зародыши пшеницы, композитное производство, производство биопеллет, отходы стадии измельчения сырья, продукты питания для человека.

https://doi.org/10.46646/SAKH-2021-2-191-195

Introduction. Effective evaluation of waste generated during food processing is important not only in terms of preventing environmental pollution, but also in terms of creating added value and diversifying products. Considering that the number of factories processing food will continue to increase with the increasing population in the coming periods, it can be said that the amount of food waste and waste problems will increase in parallel. The utilization of food wastes will provide additional benefits in terms of health and nutrition, as well as providing added value in terms of economy and preventing environmental pollution, as well as enrichment of foods and the entry of valuable ingredients into human metabolism. Studies on this subject will shed light on industrial applications and contribute to the development of the food sector [4].Cereal waste is generated as a result of agricultural practices and industrial processes. They are in the class of wastes with the highest biomass worldwide and contain rich nutritional elements [3]. In order to determine the grain processing industry wastes and alternative evaluation methods, it is necessary to know the grain products, the structure of the grain grains, the chemical composition of the grains and the wastes that occur in the production technology.

The Importance of Cereals in Human Nutrition. Most of its grains are made of starch, and flour and bran are obtained when milled; It also constitutes the product group cereals that require a certain temperature requirement for growing containing protein, oil and mineral substances. The development level of the countries, their socioeconomic structures and the nutritional habits of individuals are changing day by day, and cereal products constitute the most important food source of societies in the world and in our country. Almost all of its cereals are used in both human and animal nutrition. Grains are widely used in human nutrition because they are cheap, easy to supply, easy to store and transport, do not spoil prematurely, are a source of energy, have a satisfying feature, contain high protein with high biological values, and have a boring neutral taste and aroma. Cereal and cereal products, which have a large place in our diet, undoubtedly have important effects on our health. Cereal and cereal products are important foods for health, as they contain water, carbohydrates, proteins, lipids, minerals, vitamins and other nutrients. Their carbohydrate content is high. Therefore, grains are the main energy source of the body. Carbohydrates have a probiotic effect and give a feeling of satiety. Proteins have partially full biological value. Although the quality of grain proteins is low, they contain some. When consumed with foods such as meat, milk and eggs, protein quality can be increased. Lipids are a rich source of energy. Grain lipids are particularly rich in monounsaturated oleic and polyunsaturated linoleic acids. They show cholesterol dissolving effects and are essential for the usefulness of fat-soluble vitamins (A, D, E, K). They are rich in phosphorus (P), calcium (Ca), potassium (K) minerals. Vitamins are vital compounds for life. Cereals contain B group, A and E vitamins. Vitamins A and E show antioxidant properties. Vitamin E strengthens the immune system [2].

Table 1 – Approximate chemical components of cereal grains [2]

Components	Hard wheat	Rye	Corn	Hordeum	Rice	Oat
Moisture (%)	10.0	10.5	15.0	10.6	11.4	9.8
Protein (%)	14.3	13.4	10.2	13.0	9.2	12,0
Oil (%)	1.9	1.8	4.3	2.1	1.3	5.1
Sellulose (%)	3.4	2.2	2.3	5.6	2.2	12.4
Ash (%)	1.8	1.9	1.2	2.7	1.6	3.6
Tiamin (mg/kg)	5.5	4.4	4.6	5.7	3.2	7.0
Niacin (mg/kg)	63.6	1.3	26.6	64.5	40.0	17.8
Riboflavin (mg/kg)	1.3	1.8	1.3	2.2	0.7	1.8
Pentotenic acid (mg/kg)	13.6	7.7	5.9	7.3	7.0	14.5

Ceral Product Wastes. *Addition of wheat embryo to chicken sausages.* In recent years, consumers have turned to skimmed dairy products, low-fat red meat, low-fat fish and poultry meat, and various meat products with reduced fat in order to limit the amount of fat they consume in their diets. In order to improve the functional and sensory properties of foods, it will be possible to obtain products with high sensory quality and efficiency by using different additives such as lupine, tofu and wheat germ and applying various technological processes. In this way, it was aimed to increase the functionality of sausages, to improve their emulsion properties and to contribute to nutrition with higher fiber content. Since the protein content is determined higher than the unadulterated sausages, it can be recommended to add germ and tofu additives to the formulations of emulsion-type meat products, especially in order to increase the nutritional value and sensory quality.

The use of paddy husk as a base for poultry. Chicken farming as well as in the world meat production in Turkey is mostly done in order to set the litter. The litter material used in production is usually wood chips and paddy husk. Coarse wood shavings, straw, sawdust shavings, paper scraps, sunflower husk, paddy hull, fresh hazelnut slag, corn silage, sand, pine bark, crushed corn cob, diatomite and pumice can be used as litter material in the ground system.

Inclusion of wheat bran in biscuits. The most common source of dietary fiber in bakery products is wheat bran. The mechanism of action of dietary fiber is explained as reducing the absorption of triglycerides and cholesterol in the digestive system and lowering the glycemic index of food. Most of the fiber found in wheat bran is water-insoluble fiber. While water-soluble fibers are fermented in the large intestine, wheat bran can be partially degraded by colon bacteria, thus increasing stool volume and shortening the transit time through the intestine. In a study conducted by Leelavathi and Rao, it was determined that the biscuits obtained as a result of replacing flour with wheat bran at the rate of 30 % were of acceptable quality.

Pigment from wheat bran. Pigments are one of the most commonly used food additives in food products. The natural and healthy food consumption habit, which has been formed with the increasing awareness of food consumption in recent years, emphasizes the importance of natural pigments. A scientific field open to development is created by using pigments such as carotenes, anthocyanins, melanin and caramel from agricultural and industrial wastes such as oil seeds and wheat bran. Monascus pigment was produced from wheat bran by the microorganism Monascus purpureus.

Razmol. Razmol is actually a type of wheat bran. However, the main reason for giving the name razmol is that it contains more flour than wheat bran. At the point of nourishment, razmol has a more nourishing and strengthening structure than normal bran. Razmol flour is healthy, economical and has a high protein value. If wholegrain flour is desired, it can be mixed into white flour. It can also be given to razmol animals. It is a very popular product in the field of animal husbandry. It is used in feeding milk and livestock.

Wheat germ oil. The germ is separated as a by-product in the flour milling process to eliminate oxidation problems in the storage in the flour. Wheat germ is embryo and constitutes 2-3 % of germ. They contain high amounts of oil and vitamin E. The oil extraction process depends on the raw material quality, chemical composition and production technique. Wheat germ oil is obtained by various techniques [2].

Adding bulgur bran and bulgur flour to tarhana. Bulgur bran is the product obtained by boiling and drying the wheat in the production of bulgur and then grinding it in peeling machines. Bulgur flour is the product that is separated by passing through a 0.25 mm sieve in the classification process applied to the wheat after shelling and crushing. Tarhana samples were produced by adding bulgur factory wastes to the tarhana formulation. The produced tarhana samples were evaluated in terms of chemical properties, sensory properties and total nutritional fiber content, color properties of each sample were determined and the results were evaluated statistically. Wheat bran samples were the samples with the lowest scores for sensory properties, despite having the highest total nutritional fiber content. Wheat flour was determined to be a better source of fiber than wheat bran in the enrichment of tarhanas, as the samples containing wheat flour had the highest total nutritional fiber content after wheat bran and got the highest score by the panelists in terms of sensory properties and general acceptability.

The use of paddy husk as a cucumber seedling growing medium. In this study, the use of unmilled and ground rice husk and peat combinations of these media in the production of cucumber seedlings were investigated. As a seedling growing medium in the trial, 100 % unminded rice husk, 100 % ground rice husk, 50 % unminded rice hull + 50 % peat, 25 % unminded rice hull + 75 % peat, 25 % ground rice hull + 75 % peat, 50 % ground paddy husk + 50 % peat and 25 % super coarse perlite + 75 % peat were used. Paddy husk is an organic waste that can be found easily in our country, does not cause pollution in the environment, is light, easy to transport, clean and cheap. Frequent irrigation and a more regular fertilization is required only because of its low water holding capacity. This negativity can be prevented by grinding the particle size to ideal and standard sizes. In many countries, it is used alone as a rooting medium in ornamental plant cultivation, and by mixing with peat instead of perlite in potted ornamental plants. It is mixed with peat and sold by commercial companies. In addition to these, considering the results obtained from the research, it can be said that it would be appropriate to consider rice hull as an organic waste that can be used in the composition of production environments for the future.

The effect of paddy husk on erosion and dehydrogenase enzyme. In this study, firstly, it was determined that soils were sensitive to erosion and had low enzyme activity values before the study. It was determined that if appropriate doses of tobacco processing waste, garbage compost and paddy husk compost were added to these soils, the soil properties improved, resistance to erosion and enzyme activity increased. By reducing the erosion rate values of the regulators added to the soils of Tepecik and Kampus regions below the limit value, the soils have been made resistant to erosion. But; It has been observed that the soil belonging to Tepecik region with alkaline reaction is not sufficient in this respect. While an increase in activity was observed in acid soil parallel to the regulator doses used; It was observed that a decrease in enzyme activity occurred in the third application doses of litter compost and paddy husk compost in neutral soil, and in the

third application doses in 27 soils with alkaline reaction. As a result of these findings, it is necessary to take into account the properties and quantities of the soils and the regulator used when choosing the regulator and dose in applications to be made to improve soil properties and increase enzyme activity.

Evaluation of paddy husks in chipboard production. The development of particle board production depends on various factors. Raw material costs have been reduced by utilizing various wastes. Different gluing methods were developed, saving glue, which is one of the most important costs. Paddy husk can be used in chipboard production by increasing the amount of glue or by not exceeding 10 % of the usage amount. Paddy stalk and husks contain a high percentage of silica. This makes the panels made of paddy and husk naturally fire-proof. Due to silica, it is necessary to use it as an alternative raw material in the production of fire-resistant boards with different glue and chemicals, to use appropriate supply ways and to pay attention to R & D studies.

Production of insulation material from corn cob. Buildings and settlements are responsible for 40 % of CO_2 emission, which is the main greenhouse gas that causes global warming. For this reason, various insulation systems and insulation materials are used to minimize the energy required for heating buildings. It is aimed to produce thermal insulation material with ground corn cobs and epoxy as a binder. The unit weight, water absorption, sound permeability and heat conduction coefficient of the produced insulation material were found. The thermal conductivity coefficient of corn cob-based insulation material has decreased to 0.075. In addition, insulation material was produced by using different proportions of gypsum and cement as binders. In these examples, insulation values are within acceptable limits.

Biogas extraction from grain stalks. Biomass is an environmentally friendly, renewable and local energy source that can meet economic needs. Many fuel types such as bioethanol, biogas and biodiesel are obtained from biomass. Biogas is basically producing usable gas from organic wastes. In other words, it is the conversion of organic matter into carbon dioxide and methane gas under the influence of microbiological flora in an oxygen-free environment. Although there is organic waste that can be utilized, biogas cannot be properly utilized. If the subject is evaluated, an economic input will be provided in terms of energy, and a sustainable quality environment will be created by reducing harmful wastes in terms of environment. In Turkey, which can be obtained from cereal straw waste methane value of about 1372.104 million m^3 of biogas, biogas energy value is 49.396 PJ/year [1].

Table 2 – Usable waste quantities of grain stalks [1]

Cereals	Kullanılabilir atık miktarı (kg/da)
Buğday	37
Arpa	36
Rye	37
Oat	32
Mısır	527
Pirinç	38

Paper production from grain stalks. Since agricultural wastes are fibrous like forest resources, they can be used in paper production. In our country, there is not enough wood raw material for paper production and therefore the utilization of agricultural wastes, especially wheat stalks, which are an important source of cellulose, in the pulp industry will play an important role in solving the raw material problem. Limited forest resources have made pulp production from agricultural wastes more important. The high potential of agricultural waste and its inadequate utilization are another factor that makes the use of agricultural waste attractive in paper production.

The use of sap waste as organic matter in the soil. It can also be utilized by spreading the grain stalks over the soil surface. It is important that the grain stalks are properly crushed and distributed over the field surface. The main purpose of this system is to prevent soil erosion and water loss by creating a mulch layer on the soil surface.

Making straw from straw waste. After the grain harvest, straw wastes on the field surface are collected by straw making machines and used to meet the feed need in animal production.

Making panels from sap waste. Panels were made from sunflower, crop and corn stalks, styrofoam, palm leaves and textile waste. The heat and sound insulation properties of these panels have been tested. According to the tested heat transfer coefficient values; It has been determined that the heat conduction coefficient of the grain stalk filled panels is lower than the panels made of other materials. Panels filled with wastes give better results in terms of thermal insulation than many materials used in wall construction. It is thought that the standard value will be achieved by squeezing the stems. It has been determined that the indoor spaces built with these panels absorb a significant amount of noise. Made works; It has shown that natural and artificial waste fiber materials will provide significant advantages especially if they are used in the production of wall panels. In rural settlements, with the support of public institutions, panel walls and floors made of waste fiber materials should be built and the public should be informed about this issue.

Composite production from sap waste. In this study, polymer composites were produced using corn stalk flour and recycled high density polyethylene. Mechanical properties of produced polymer composite materials such as tensile, bending and impact resistance were determined. Considering these properties, it has been determined that increasing the amount of corn stalk flour reduces the tensile, bending and impact resistance of the polymer composites produced, but increases the elasticity modulus. It has been determined that corn stalk flour and recycled high density polyethylene can be used in the production of polymer composites. In line with the results obtained; It is important to evaluate the potential

of agricultural wastes to be used as alternative raw materials for the forest industry. The burning of agricultural wastes that can be used in the production of polymer composites in the fields will be prevented from forest fires and environmental pollution caused by 2019. If composite is produced from agricultural wastes, the need for wood material used for the production of similar materials will decrease, so the reduction of our forest resources can be prevented to some extent.

Bio-pellet production from sap waste. It is of great importance to use agricultural wastes in the form of solid fuel as an energy source in the world and in our country. One of the easiest and most effective methods to generate energy from agricultural wastes is to use these wastes as solid fuel. The most important problem in the utilization of plant wastes as solid fuels is that these wastes have low density and high moisture content. Low density and high moisture content cause transportation and storage problems. For this reason, in order to be able to use plant wastes effectively and easily to generate energy, we need to turn these wastes into pellets after drying, grinding, pressing. Since it is easier to transport pelleted biomass (it reduces the transportation cost by compression), it becomes efficient to use it as a fuel.

Raw material grinding stage waste. The cleaned and tempered wheat is first fed to the crushing system and coarse bran from wheat in this first stage with the grooved rollers and sieve arrangements. Apart from this, the semolina obtained as the main product is cleansed from the shell particles remaining on them with auxiliary semolina cleaning devices, classified and sent to the reduction system. While the reduction system reduces the semolina that reaches it to flour, it also separates the obtained main flour from bran with sieve arrangements. The sieves work together with roller pairs in both crushing and reduction systems, forming the grinding units together. The job of the screens is to separate and classify the material crushed by the rolls. Sieves; They are made with fabrics woven from wire, synthetic, silk fiber. The sieving surface of the sieves is used to estimate the sieving capacity and is calculated as a percentage. The ground wheat coming to the sieves turns into four separate by-products, razmol, bonkalite, embryo and bran.

REFERENCES

1. Aybek, A., Üçok, S., İspir, M. A., Bilgili, M. E., 2015, Türkiye'de Kullanılabilir Hayvansal Gübre ve Tahıl Sap Atıklarının Biyogaz ve Enerji Potansiyelinin Belirlenerek Sayısal Haritalarının Oluşturulması, *Tekirdağ Ziraat Fakültesi Dergisi*, 12 (03), 109-113.

2. Elgün, A., 2017, Tahıl İşleme Teknolojisi. Konya, 2-50.

3. Özlü, S., Shiranjang, R., Elibol, O., Karaca, A., Türkoğlu, M., 2017, Kâğıt Sanayi Atıklarının Altlık Materyali Olarak Kullanılmasının Etlik Piliç Performansı Üzerine Etkisi, *Tavukçuluk Araştırma Dergisi*, 14 (2), 12-17.

4. Yaman, K., 2012, Bitkisel Atıkların Değerlendirilmesi ve Ekonomik Önemi, *Kastamonu Üniversitesi Orman Fakültesi Dergisi,* 12 (2), 342.

МЕТОДИКА ПРЕДВАРИТЕЛЬНОГО АНАЛИЗА КАЧЕСТВА И ОТБОРА ДАННЫХ ИЗМЕРЕНИЙ СИСТЕМОЙ МОНИТОРИНГА АТМОСФЕРНОГО ВОЗДУХА ДЛЯ ПОСЛЕДУЮЩЕЙ ОБРАБОТКИ

METHOD OF PRELIMINARY QUALITY ANALYSIS AND SELECTION OF MEASUREMENT DATA BY ATMOSPHERIC AIR MONITORING SYSTEM FOR FURTHER TREATMENT

П. Н. Павленко[1], Е. А. Мельник[2], А. М. Людчик[3]

P. N. Paulenka, E. A. Melnik, A. M. Liudchik

[1]Белорусский национальный технический университет,
г. Минск, Республика Беларусь
pavlenko_pn@mail.ru
[2]Республиканский центр по гидрометеорологии, контролю радиоактивного загрязнения и мониторингу окружающей среды, г. Минск, Республика Беларусь
kbb@rad.org.by
[3]Национальный научно-исследовательский центр мониторинга озоносферы Белорусского государственного университета,
г. Минск, Республика Беларусь
liudchikam@tut.by

Belarusian National Technical University, Minsk, Republic of Belarus
Republican Center for Hydrometeorology, Control of Radioactive Contamination and Environmental Monitoring, Minsk, Republic of Belarus
National Ozone Monitoring Research Centre of the Belarusian State University, Minsk, Republic of Belarus

Разработана методика и компьютерная программа для предварительного анализа и отбора качественных данных наблюдений системы мониторинга атмосферного воздуха с целью формирования унифицированной