BPS 2022

21th International Workshop
for Young Scientists
„BioPhys Spring 2022"

SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA
FACULTY OF ENGINEERING

INSTITUTE OF ELECTRICAL ENGINEERING, AUTOMATION,
INFORMATICS AND PHYSICS

Tr. A. Hlinku 2, Nitra, Slovakia

21st International Workshop for Young Scientists BioPhys Spring 2022

BOOK OF ABSTRACTS

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Dear friends and colleagues,

It is our privilege and great pleasure to invite you on behalf of organising institutions – Institute of Electrical Engineering, Automation, Informatics and Physics of Slovak University of Agriculture in Nitra, together with Institute of Agrophysics Polish Academy of Sciences, Lublin, Poland, Czech University of Life Sciences, Prague, Czech Republic and Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary – to participate in the 21st International Workshop for Young Scientists BioPhys Spring 2022 (BPS 2022) to be held in Nitra on 30th – 31st May 2022 as the event with hybrid – personal and online participation.

The workshop is oriented on the deeper insight into the physical processes occurring in biological, agricultural and food systems. The workshop combines two basic tasks of international meeting: exchange of professional experience and integration of young people from different countries.

Let me cordially invite young scientists to participate in the BPS 2022 Workshop and to present results of your research in application of physical methods to agriculture, biology and/or life sciences.

The workshop is organised as an opened English spoken event. One-page abstracts of contributions will be published in the Book of Abstracts of the BPS 2022 Workshop.

Vlasta Vozárová

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EVALUATION OF *TRICHODERMA ATROVIRIDE* G79/11 METABOLIC POTENTIAL AND GROWTH INTENSITY UNDER DIFFERENT ADDITIVES

Ali M., Cybulska J., Frąc M.

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Keywords: Bioproducts, carbon sources, salt metals, Biolog

Bioproduct-based materials are gaining more attention overtime to ensure food safety and promote a sustainable agriculture system. Beneficial microbes are precious and robust candidates to protect the crops from plant pathogens and pest insects as well as enhance crop productivity without damaging our environment [1].

The aim of study was to evaluate the *Trichoderma atroviride* G79/11 metabolic potential and growth intensity through MT2 microplates (Biolog™) containing different compounds with the 0.5% of trehalose, starch, maltodextrin, maltose, mannitol, glucose, saccharose while sodium alginate with 0.3 %, and additionally 0.5 % of bacterial cellulose, and pectin fractions with 0.5% of water soluble pectin (P1), oxalate-soluble pectin (P3), whereas 0.3% of diluted alkali soluble pectin (P2), and four metal salts (MSs), each metal salt was used with 6 mM concentration ($CaCl_2$, $ZnCl_2$, $MgCl_2$, and $FeCl_2$) as well as their combination with each pectin fraction of varying percentage (E.g. 0.5 % of P1 with 6 mM of each MSs, 0.15 % of P2 with 6 mM of each MSs, 0.5 % of P3 with 6 mM of each MSs). The suspension of fungal mycelium in inoculating fluid (FF-IF, Biolog®) was adjusted to 75% of transmittance measured by a turbidimeter. The 50µl of the above-mentioned mycelial suspension and 100µl of each water-solution additive were added into each well of microplates (Biolog™). Microplates were incubated under dark conditions at 25 °C for 10 days. Finally, the fungal metabolic potential (490 nm) and growth intensity (750 nm) were determined using a Biolog microplate reader [2, 3].

Our study evaluated that water soluble pectin and its combinations with MSs improved the fungal growth compared to diluted alkali soluble pectin and oxalate-soluble pectin. The oxalate-soluble pectin combination with $FeCl_2$ significantly enhanced the fungal growth rather than other combinations. Moreover, $FeCl_2$ metal salt expressed more fungal growth compared to other metal salts. Most significant fungal growth was observed in bacterial cellulose additive. Starch was the second most prominent additive for fungal growth promotion compared to other carbon sources. Out of all additives, bacterial cellulose is the best additive for fungal growth promotion.

Fungal metabolic activity was assessed using MT2 microplates comprising the above-mentioned additives. The fungal strain showed high metabolic activity by utilizing the bacterial cellulose, maltodextrin, and maltose, and oxalate-soluble pectin combination with $MgCl_2$ as compared to other additives and their combinations. The diluted alkali soluble pectin highly utilized by fungal strain to produce high metabolic activity than other pectin fractions. Our study results highlighted the most prominent additives and their possible composite that might help to boost the *Trichoderma atroviride* G79/11 growth intensity and metabolic activity.

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THE IMPORTANCE OF THIN-FILM PV MODULES IN BUILDING INTEGRATED DESIGN

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Keywords: thin-film, PV technology, green building, solar energy

There is a worldwide movement toward alternate and sustainable energy sources, particularly solar energy, which is regarded as the greatest critical renewable energy sources for reducing harmful pollutants and noise. One of the most important sources of solar energy is PV cells.

Building integrated photovoltaics (BIPV) has a dual function: they serve as the structure's external layer while generating electricity for on-site usage or distribute to the grid. As a result, BIPV systems may save money on raw material and electricity, decrease pollution, and improve a building's modern appeal.

BIPV devices can also use thin-film and organic solar cells; however, organic solar cell technology is still being developed. BIPV devices replace traditional building roof, facade, and window shading systems (Shukla, Sudhakar and Baredar, 2016). The cost of building a BIPV system is somewhat greater than traditional construction, but it has a similar life expectancy as the classic PV rack version. This method also minimizes the amount of energy used by buildings' HVAC systems.

Different anisotropic models and optimization approaches, combined with shadow effects, can be used to determine the precise orientation of PV modules at various sites. Replacement facilities for BIPV products in building structures are also significant considerations, as BIPV products' efficiency is constantly improving due to continual research and development. BIPV

technology is a sustainable technology with a bright future since it provides zero-emission buildings (Tripathy, Sadhu and Panda, 2016).

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This work was supported by the Stipendium Hungaricum Program and by the Doctoral School of Mechanical Engineering, Hungarian University of Agricultural and Life Sciences, Gödöllő, Hungary.

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SCANNING ELECTRON MICROSCOPY (SEM) TECHNIQUE FOR DARK LOCK-IN THERMOGRAPHY (DLIT) FAILURE ANALYSIS PHOTOVOLTAIC MODULE IN SOLAR PANEL

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Keywords: potential induce degradation, PV module degradation, efficiency, lower cost

Photovoltaic (PV) technology is facing great challenge to prevent Potential Induce Degradation (PID) of PV modules, as many solutions proposed to compromise efficiency or increase cost. There is still a long way to go on the path towards developing completely PID-free PV technologies at low cost [1]. The most frequent photovoltaic module degradation modes are yellowing, delamination, bubbles, crack in the cell, defect in the anti-reflective coating and burnt cell [2]. But the cause and occurrence of shunts in solar cells are manifold and not fully understood yet. Because of that further shunt analysis and research must be performed to support and to enable technological solutions for reducing breakdown issues in solar cells. For this sophisticated analysis methods for investigating shunts on a module, cell and microscopic level must be provided [3]

Lock-in thermography (LIT) is an imaging method that depicts radiated heat and its diffusion in manifold samples. LIT offers versatile possibilities for the characterization of solar cells and modules since the radiated heat is proportional to the dissipation of electrical power. Thus, the potential of LIT in terms of the calculation of power generation and dissipation in thin film solar cells has not been exploited. This visualization and calculation of power flows leads to a better understanding of the influences of defects on the efficiency of solar modules. Furthermore, it enables the evaluation of potential improvements, which results in solar modules with higher efficiencies, produced to lower costs [4].

Bauer present a comprehensive strategy for shunt diagnostics ranging from cell level localization by means of dark Lock-in Thermography (DLIT) and mini-cell preparation up to advanced scanning electron microscopy (SEM) microstructure diagnostics [5].

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EFFECT OF MIXOTROPHIC GROWTH OF MICROALGAE ON EXTRACELLULAR POLYMERIS SUBSTANCES (EPS) PRODUCTION AND BIOCHEMICAL COMPOSITION

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Keywords: mixotrophism, exopolysaccharides, microalgae

Microalgae are photosynthetic microorganisms, but they are also able to utilize organic carbon sources. Mixotrophic growth conditions increase the efficiency of exopolysaccharide (EPS) synthesis. However, the effect of glucose supplementation on the chemical composition of EPS has been poorly explored [1].

The aim of the study was to assess the effect of mixotrophic growth conditions on the synthesis and biochemical composition of exopolysaccharides synthesized by microalgae.

Microalgae were cultivated on mineral medium (control) and mineral medium supplemented with glucose. EPS were isolated from post-harvest medium and dialyzed. Freeze-dried samples of EPS were analyzed for the content sugars and their derivatives, proteins, amino acids, and phenolic compounds using UV-Vis methods. The monosaccharide composition was determined with thin-layer chromatography (TLC) [2].

The results show that mixotrophic growth conditions increase the efficiency of EPS synthesis. Supplementation of microalgal cultures with glucose affects the chemical composition of EPS. The results showed higher contents of total and reducing sugars, proteins, amino sugars, and phenolic compounds in comparison with the control conditions. Glucose supplementation was found to modify microalgal metabolism and the EPS composition.

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GREENSEEKER AS A USEFUL TOOL TO IDENTIFY CROP VIGOR OF KABOT AND KAMUT SPRING WHEAT VARIETIES

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Keywords: sensors, spring wheat**,** vegetation index

The main aim of this study is to assess the usability of GreenSeeker sensor with comparison of multispectral camera (MicaSense RedEdge MX) mounted on unmanned aerial vehicle (UAV) eBeeX. GreenSeeker is a handheld optical sensor that is mainly used to quickly detect the current state of vegetation in selected places [1]. Normalized Difference Vegetation Index (NDVI, [2]), whose values can calculate both sensors, is derived from the ratio between RED and NIR bands and can be successfully used to monitor seasonal development, variability and to estimate the phenological phase of vegetation [3]. The sensors were used during the vegetation in four terms on 6 experimental plots (Fig. 1), which were sown with two varieties of spring wheat: variant 1-3 - Kamut wheat and variant 4-6 - Kabot spring wheat. Different cultivation was used for individual plots: 1 & 4 - Conventional Tillage; 2 & 5 plots Minimum Tillage; 3 & 6 plots Minimization Technique. Each plot was divided into 12 measuring sections, where measurements were performed using GreenSeeker, and UAV scanned the area.

The results showed that the spectral response expressed by NDVI clearly define the difference between both varieties. The values derived from GreenSeeker reached lower values than NDVI derived from UAV images in any of the measured dates. This can be caused by both the wavelengths used and the method of measurement. While GreenSeeker was measured 1 m above the canopy at selected points, the UAV images provided area information with a spatial resolution of 6 cm.px^{-1}, which was then averaged for each plot separately. However, GreenSeeker has proven to be a useful and inexpensive tool that can give a quick and relatively accurate view of the condition of monitored crops.

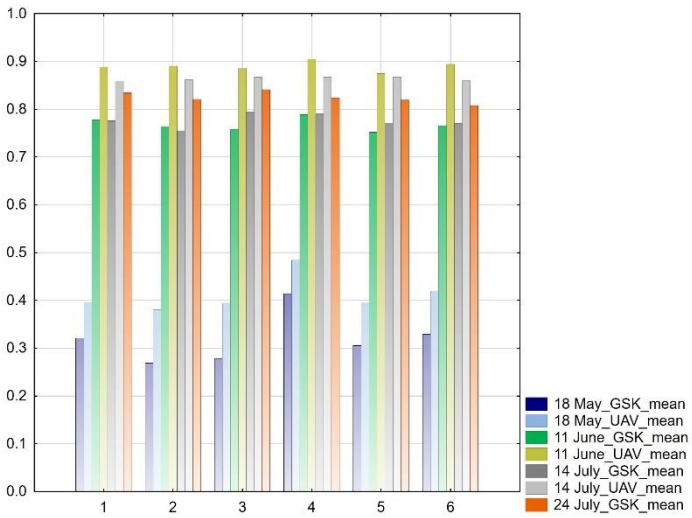

Fig. 1 Average values of NDVI index measured by GreenSeeker (GSK) and MicaSense RedEdge camera MX (UAV) on experimental plots.

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EFFECT OF MICROBIOLOGICAL BIOSTIMULANTS ON THE QUALITY PARAMETERS OF RASPBERRY (*RUBUS IDAEUS* L.)

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Keywords: biostimulants, raspberry, antioxidants content, antioxidant capacity, enzyme activity

Biostimulants are the basis in organic farming, and the use of beneficial microorganisms in their composition is becoming more and more common. Biostimulants ensure increased uptake and rational use of nutrients. It has been proven that microbial biostimulants improve yields by increasing resistance to biotic and abiotic stresses (Sangiorgio et al., 2021).

The paper presents the effect of four microbiological biostimulators (2-5) on the quality of raspberry cv. Delniwa, Poemat and Enrosadira. The results of these studies indicate that the fruits of *R. idaeus* L. are a valuable source of healthy compounds known as antioxidants. The increase in the content of antioxidants in the first season was noted in raspberry treated 2, 3, 4, and in the second season in raspberry grown in the presence of 2, 3, 4, 5. PCA analysis showed a correlation between the increase in the content of anthocyanins, vitamin C and the increase in the antioxidant capacity (DPPH) for three varieties of raspberries. The increase in the content of anthocyanins and polyphenols was correlated with the increase in ferric reducing power (FRAP). It is noteworthy that the activity of pectinolytic enzymes responsible, inter alia, for fruit rotting processes was reduced compared to the control and between seasons under the influence of selected microbiological biostimulators. A correlation was found between the increase in β-galactosidase (β-Gal) enzyme activity and the increase in FRAP. In the second season, a significant increase

in the activity of pectin methyl esterase (PME) and the degree of methylation (DM) was observed in the investigated raspberry cultivars.

Therefore, it was found that microbiological biostimulants allow to modify the content of antioxidants and the activity of pectinolytic enzymes, which affects the health-promoting properties and durability of raspberries. Further selection is needed to obtain a high spectrum formula that would be most suitable for all raspberry varieties.

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INFLUENCE OF ORGANIC FERTILIZER INTENSITY ON SOIL PHYSICAL PROPERTIES

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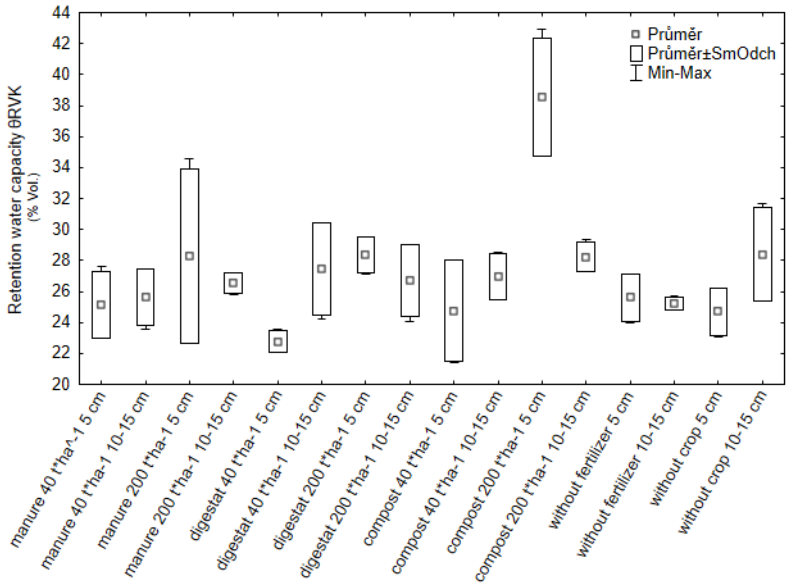
Keywords: organic fertilizer, soil, retention air capacity, absorbency

The aim of this paper was to compare the level of water retention capacity depending on the intensity and type of different organic fertilizers. According to the Czech Statistical Office [1], cattle production is falling and the number of biogas plants is rising. For organic fertilizers (digestate, compost, manure). The application took place in different intensities. The first value, which was chosen for all types of fertilizers, was 40 $t.ha^{-1}$ of organic fertilizer, the second value was chosen at the level of 200 $t.ha^{-1}$. To verify the experiment, the measurement was performed on the land without the use of organic fertilizer and subsequently on the land without the application of fertilizer and at the same time without the sown crop.

Undisturbed soil sampling in agriculture is performed using a Kopecky cylinder, a stainless-steel cylinder with diameter Dc = 54 mm and height Hc = 44 mm (100 cm^3) volume). The Kopecky cylinder is directly introduced into the soil by applying force to its upper rim [2]. The bottom rim of the Kopecky cylinder is designed to minimize physical disturbance of the sample, ensuring that its density will not differ from that found in the ground. If the sample were to be removed from the cylinder, especially in case of relatively low water content, it could crumble or fall apart, resulting in decreased density and, consequently, in changed permittivity [3]. The above method was also used to determine of water retention capacity.



The measured results show that the highest rate of retention capacity is evident when applying compost at an intensity of 200 $t \cdot ha^{-1}$.

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ENERGY PRODUCTION MODELLING OF 1000 WP SOLAR POWER PLANT USING NAÏVE BAYES

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Keywords: solar energy, root mean square error, mean absolute error, naïve bayes

One of the ways to convert solar energy into electrical energy is using Photovoltaic (PV) devices. This paper attempts to model the energy production of a 1000 Wp solar power plant (SPP) using the Naive Bayes algorithm (one of the machine learning algorithms). The specific objectives of this work are to try to find the best modeling through the assessments of accuracy, precision, recall/sensitivity, f-score as well as evaluation of Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE) by using Python program language.

The Naive Bayes algorithm model is a non-linear statistical model. In this stage, daily average temperature, daily total sunshine duration, daily total global solar radiation, and daily total photovoltaic energy generation parameters are utilized as the continuous-valued data. On the other hand, "Very Low", "Low", "Medium", "High" and "Very High" class labels are represented as the categorical-valued data. Later on, the Naive Bayes classifier is applied to the categorical valued data created in order to predict the photovoltaic energy generation [1]. The energy production model is performed, as an illustration of energy production for the future. The data used for testing were collected from June 2020 to December 2021. Fig. 1 shows an example of modeling using the Naive Bayes algorithm.

Further steps are carried out by compiling data sets, dividing class labels, encoding labels, dividing training data, and testing data with comparisons (80:20, 75:25, 90:10) with the application of the Naïve Bayes classification method. By applying this modeling, we observed there are improvements in accuracy and sensitivity, as well as explored how photovoltaic energy generation is affected by various solar parameters [2].

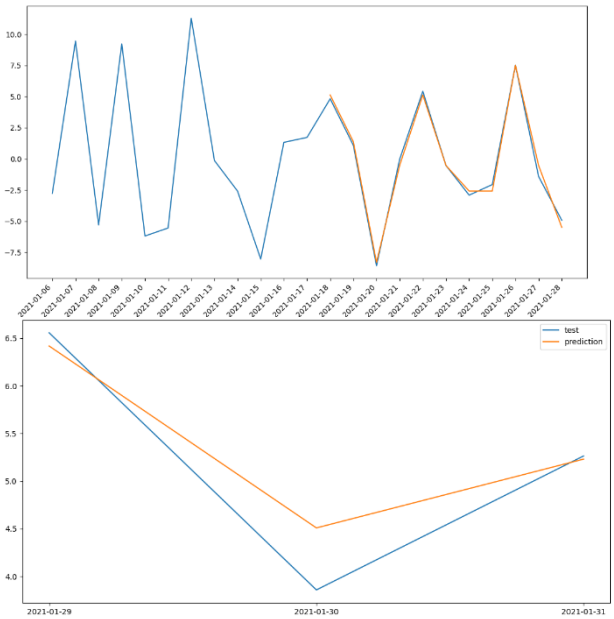

Fig. 1. The sample of forecasting resulted by Naive Bayes model

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FORECASTING OF PV ENERGY PRODUCTION USING SUPPORT VECTOR MACHINE AND MACHINE LEARNING MODELING

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Keywords: solar energy, root mean square error, mean absolute error, support vector machine

In line with the growth and increasing demand for new and renewable energy, photovoltaic (PV) solar power generation is increasing rapidly, and the Government of Indonesia is challenging the stakeholders to electrify through PV by 6.5 GW at 2025. Accurate forecasting of PV energy production is very important in the reliability of the system and promote its deployment on a large scale. This study proposes an energy production forecasting algorithm based on daily weather data using the support vector machines (SVM) algorithm.

SVM is a classification modeling method that was first introduced by Cortes and Vapnik in the late 1990s. The basic principle of SVM is a linear classifier, which was later developed to solve non-linear problems by integrating the concept of Kernel tricks and Gaussian models (Brereton and Lloyd 2009). SVM aims to find the best classification function and to distinguish between the members of the two classes in the training data. The matrix for the concept of the "best" classification function can be realized geometrically. For linearly separated datasets, the linear classification function corresponds to the f(x) separator hyperplane that passes through the middle of the two classes, separating them both.

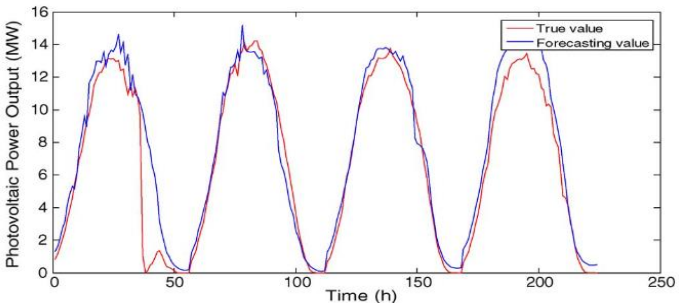

Figure 1. The sampel of forecasting result by SVM model

In the process, daily weather data, temperature, and radiation are independent variables that will be classified by a hyperplane in the form of energy production data [1]. To process the data and the SVM algorithm will use machine learning using Python language. The data to be analyzed is data recorded in January – December 2021. Fig. 1 shows an example of forecasting energy production using the SVM algorithm. Some critical issues such as data pre-processing, data selection, and performance evaluation will be discussed.

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STATUS AND PERSPECTIVES OF PHOTOVOLTAIC TECHNOLOGIES

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This paper is dealing with the status and future perspectives of the rapidly developing field of solar photovoltaic technologies. The worldwide situation is analysed based on the topic touched upon at the EuroSun 2020 Solar Conference organized online in Athens, Greece in 2020, and at the Solar World Congress (SWC 2021) organised online by the International Solar Energy Society in 2021. Additionally, the most recently published books in this topic serve information overviewing the recent statements. The most updated event was the COST Action PEARL PV's Conference on Enabling the PV Terawatt Transition, Enschede, The Netherlands during 14-16 March 2022.

In 2019, the solar PV market increased by about 21% reaching the global capacity of 916 GWpv along with the record of annual additions of 156 GWpv, which is equivalent to the energy production of about 64 thousand modules every hour (Renewables 2021; IEA PVPS, 2021).

Due to mainly photovoltaics technology, the distributed renewables for energy access becoming effective, and benefited about 150 million people around the world in 2019. The market for off-grid solar systems grew 13% in that year.

Concerning to the PV application development it is also a significant fact that the number of electric vehicles is getting increase. In 2019 around 7.2 million electric cars were on the world's roads. There are some countries having a national plan to reach the 100% electric vehicle target.

Putting into operation more solar plants is approaching to drive down the price of solar electricity. In case of large-scale ground-mounted plants there are concerns about the environmental impacts and agricultural lands. The floating PV projects continues their rapid expansion. Further new market segment is emerging such as agri-PV which is the combination of PV with agriculture.

In 2020 the modules' price dropped by around 9% to the world average of 0.33 USD per Watt. The new developments and innovations in PV technologies helped to get down the prices especially for polysilicon, wafers, cells and modules.

At the same time, strong research activities are conducted to reach more efficient cell technologies, for instance Perovskites, in tandem with crystalline silicon or thin-film base. There are projects focusing on the long-term stability of Perovskites. In the laboratory, the high concentration multi-junction solar cells achieved an efficiency of 47.1%, and modules with concentrator achieved 38.9% (Fraunhofer ISE, 2021). At module level it is intended to develop higher power ranging at 600 W-plus mainly for building applications.

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RARE EARTH ELEMENTS (REE) IN WASTE AND SOILS IN POLAND

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Keywords: rare earth elements, environment pollution, phytoremediation

The interest in rare earth elements (REE) is growing year by year. As a result of their use in medicine, industry, agriculture and electronics, more and more amounts are released into the environment. Accumulation of REE in soils, sediments and in water may have a detrimental effect on living organisms. Currently, there are many studies on the exposure of living organisms to REE to, emphasizing that the high content of REE in the soil has a negative effect on plants, as well as on humans, negatively affecting the circulatory and immune system. This leads to the need to assess the degree of enrichment of the environment with REE, and in case of their excessive amounts to develop methods of environmental rehabilitation. One of the methods of cleaning contaminated areas is phytoremediation. This strategy also allows REE to be recovered from waste or soil. It is a method that is safe for the environment. It has been suggested that potential sources of rare earth metals may be industrial waste disposal sites, urban areas, wastelands where metallurgical and coal waste are disposed, bottom sediments or sewage sludge. These sites are considered as alternative sources of REE. There are very small natural deposits of REE minerals in Poland.

The aim of the study was to assess the content and mobility of REE in selected wastes and soil (ash, post-mining wastes and soil with an increased content of REE) as potential substrates in controlled phytoextraction process The study also analyzed their physicochemical properties in terms of the content of macro and microelements, pH and organic matter content.

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TEXTURED VEGETABLE MEAT SUBSTITUTES BASED ON WHEAT-BASED RAW MATERIALS PRODUCED BY EXTRUSION COOKING TECHNIQUES

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Keywords: meat analogues, twin screw extruder

The population of our planet it may increase to 10 billion people by 2050. Thus, the demand for food will increase by several dozen percent. In the face of deepening climate crisis and loss of biodiversity, we should look for more sustainable food production methods. From a global perspective meat and dairy production consumes 83% of the arable land, and supplies only 18% of the global caloric supply. Increasingly scientists sees hope to reduce negative environmental effects and health benefits of our current food choices in more plant-based foods [16].

Currently, in the food market, there is a great deal of consumer interest in vegetable high-protein meat substitutes. These types of products are most often obtained by extrusion (texture). The raw materials used for the production of extruded meat substitutes are legumes, oilseeds and grains, including mushrooms [9, 15, 13]. After hydration, the products should not disintegrate in time like typical expanded products, but absorb water creating a fibrous-spongy texture. Textures should have appropriate granulation, bulk density, color and other organoleptic characteristics [4, 8].

For almost 80 years, the extrusion-cooking technology has been used in food manufacturing [5, 7, 14]. Mixing, shearing, kneading, heat and mass transfer, cooking, plasticizing, texturing, moulding and shaping food items from varied, primarily loose raw materials, during hydrothermal treatment at high pressure and in a short time are all part of extrusion technology [1, 2, 10]. The resulting goods are either meant for direct consumption or to be utilised in other ways. Extrusion technique is used in the cooking of cereal grains, grits,

and flours, resulting in a diverse range of innovative products.

Applying extrusion technology in the process of cooking cereal grains, grits or flours results in the wide range of novel products with a porous structure and crispy consistency with changed physical and chemical properties, such as breakfast cereals, snacks, pre-cooked flours and soups, crispy flatbread, instant pasta, supplementary food, breadcrumbs, cereal-based baby food, pet food or very popular nowadays meat alternatives [2, 3, 10, 14]. Extrusion technique, except for food segment, is used for developing biodegradable, eco-friendly packaging materials (using biopolymers) [10].

The purpose of the doctoral dissertation is to develop an innovative and cost-effective solution for the production of textured vegetable meat substitutes based on raw materials derived from wheat, such as gluten and starch.

A number of technological trials were carried out. A conditioner and a twin-screw extruder (screw diameter D = 42 mm, length (nominal) of the screws L = 1656 mm and parameter L/D=40, manufacturer: Buhler, Switzerland) will be used to carry out the technological test, which is provided by the Research and Development Center of the Lubella company.

The raw material base during the tests was wheat gluten and native wheat starch. During the experiment, additives were used to improve the quality, functional and organoleptic properties of the product. The additives used are: wheat bran, pectins, pea concentrates and isolates [6]. The production tests were carried out with different processing parameters of the conditioner and extruder, as well as the further drying process. The physical properties (humidity, bulk density, water absorption index-WAI) and organoleptic properties of the product were determined [11, 12].

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MECHANICAL PARAMETERS OF UREA-BASED FERTILIZERS MODIFIED WITH NBPT UREASE INHIBITOR AND BIODEGRADABLE COATINGS

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Keywords: urea fertilizer, physical properties, urease inhibitor.

The newly developed urea-based fertilizers with ammonia reduction potential required by National Emission Ceilings (NEC) Directive [1] drafted by the European Commission shall possess physical and mechanical properties that comply with existing standards for 'base' granular urea [2]. It is equally important to ensure seamless usage of the new urea-based formulations at the phase of production, storage, transportation and spreading [3,4,5].

According to the literature, there is a variety of substances that may result in ammonia emmision reduction from granular urea-based fertilizes. However, high potential for rapid implementation at industrial scale presents urease inhibitors, such as NBPT, NPPT or 2 NPT [6] or biodegradable coatings [7].

The aspects related to mechanical parameters of newly developed urea based fertilizers, such as: particle strength, loss on drying, size distribution, hygroscopicity, tendency to cake, bulk parameters [8,9] will be raised and described. These features appear to play a crucial role in the development of novel urea-based formulations complying ammonia emission decrease regulations.

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EFFECT OF PLANT CELL WALL POLYSACCHARIDES ON MECHANICAL PROPERTIES OF BACTERIAL CELLULOSE-BASED COMPOSITES

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Keywords: bacterial cellulose, hemicellulose, mechanical properties, binary composite

Bacterial cellulose (BC) is a natural biopolymer metabolized by Gram-negative bacteria strains in carbon- and nitrogen-rich media. Due to its natural purity, biodegradability, biocompatibility and outstanding mechanical properties, it is considered to be an exceptional biomaterial with versatile scientific and commercial applications. Among many applications, BC composites with plant cell wall polysaccharides have gained particular importance in studies concerning the properties of plant cell walls (PCW). This has been attributed to the chemical similarity of BC to natural cellulose, which allows for the creation of polysaccharide assemblies which mimics those of PCW.

In this study, the effect of hemicellulose additives on mechanical properties of bacterial cellulose-based composites was evaluated. Bacterial cellulose-hemicellulose composites were grown in Hestrin-Schramm medium with four types of hemicellulose additives (xyloglucan, xylan, arabinoxylan and glucomannan) at three concentrations (0.25% wt., 0.5% wt. and 1.0% wt.). Uniaxial tensile tests were provided to evaluate elastic modulus, strain hardening modulus, stress at break, strain at break, stress at elastic limit and toughness.

Composites with glucomannan addition showed higher brittleness compared to other tested BC-hemicellulose films. It was confirmed by statistically significant decrease in Young's modulus (from 9.2 GPa to 2.4 GPa at concentrations of 0.25% and 1.0% wt., respectively), stress and strain at break (seven and three fold decrease at 1.0% wt. concentration, respectively,

compared with the control), and toughness, with no measurable value of the strain hardening modulus. The effect was stronger with increasing concentration of glucomannan. Similar response in terms of measured values of stress and strain at break, toughness and strain hardening modulus was observed for increasing concentration of xyloglucan additive. Contrary to glucomannan the addition of xyloglucan did not decreased values of Young's modulus of the composite (9.1 GPa at concentration of 1.0% wt.), compared to pure BC films (7.5 GPa). An increase in composites Young's modulus was observed for both, xylan and arabinoxylan increasing concentrations, with a stronger impact of the latter (with 10.2 and 14.1 GPa at 1.0% of concentration for arabinoxylan and xylan, respectively). A decrease in the values of the strain at break with increasing concentration of both hemicelluloses was followed with the increase in stress at break, which resulted in no overall change in toughness for BC-xylan and BC-arabinoxylan composites, compared to the pure BC films. There was also no observable decrease in the plastic properties of the xylan and arabinoxylan composites. The strain hardening modulus of BC-arabinoxylan composites remained at the level comparable to pure cellulose (3.7 GPa), while for xylan an increase in its values was observed at concentrations of 0.5 and 1.0% wt, up to 5.8 and 4.9 GPa, respectively. The observed differences indicated different roles of both the type and quantity of hemicelluloses in shaping the mechanical properties of bacterial cellulose composites.

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BPS 2022

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NUMERICAL MODELLING AND PREDICTION OF FLOW BEHAVIOUR INSIDE DRYING CHAMBER

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Keywords: ansys fluent software, computational fluid dynamics**,** prediction

Sometimes it very difficult to visualize, analyse or predict what is takes place inside drying chamber as a sense of flow and thermal behaviour. However, such kind of issues can be done using computational fluid dynamics (CFD) easily and in a smart way. CFD code can be used to predict the flow behaviour of air flow, temperature distribution and pressure profiles in different trays, degree of heating or temperature distribution, velocity contours characteristics and other parameters inside the drying chamber.

Computational fluid dynamics is the computer-based simulation of systems involving fluid movement, heat transport, and associated phenomena such as chemical reactions. The approach is extremely versatile and can be used in both industrial and non-industrial application areas. It can generate a digital simulation that depicts fluid flow and how it is influenced by objects. It's a powerful tool that predicts how temperature, pressure, and velocity will react in a given design (Versteeg and Malalasekera, 2007).

Babu et al. (2020) used CFD to evaluate several air flows drying chamber arrangements in the tray dryer. Four different optimum designs of drying chamber for drying leaves are built and theoretically assessed using ansys fluent software. The research tests, evaluates, and presents the limiting air-side pressure drops as well as the realized dried output from the four setups. The optimal arrangement and construction in details are also highlighted.

Within the ongoing project it is planned to study the effect of tray configurations and types of air flow paths on the performance of the solar drying chamber using CFD in the case of a modular solar dryer built at the in

the Solar Laboratory at the Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary (Al-Neama and Farkas, 2019).

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COMPARISON OF APPARENT VISCOSITIES AND DENSITIES OF SOME MUSTARDS

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Keywords: whole mustard, apparent viscosity, density, temperature, comparison

Mustard usually consists of mixed crushed mustard seeds, vinegar, black pepper, cloves and a mixture of spices. There are many types of mustards that differ in its composition, for example: whole mustard, whole grain mustard, honey mustard, spicy mustard, American mustard (from yellow mustard), horseradish mustard, Dijon mustard, English mustard, French mustard, hot pepper mustard, etc.

In our article we compared apparent viscosity and density of three types of whole mustards from different producers (Boneco, SNICO, COOP). Composition of mustards was similar, only small differences were in used ingredients like vinegar and sugar. We performed measurements of both parameters in the temperature range (5 – 25) °C. Apparent viscosity was measured on rotational viscometer Anton Paar DV-3P and density was determined according to definition (exact volume of sample was weighted on scales with precision 0,0001 g).

We have found that temperature affects the measured physical properties. Apparent viscosity is decreasing exponentially, while the density decreases linearly with increasing of temperature.

Highest apparent viscosity was obtained for the mustard Boneco and lowest for the mustard SNICO. Density of the mustard COOP was highest, while other two samples had similar densities. We had also investigated the effect of storing on apparent viscosity of mustards. For all three samples we obtained a bit lower values after storing. Changes of rheological properties with

temperature and storing time could be caused by internal structural changes and by destruction of bonds.

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DISCRETE ELEMENT METHOD MODELING OF PROPERTIES AND PROCESSES IMPORTANT FOR STORAGE, HANDLING AND PROCESSING OF AGRICULTURE AND FOOD MATERIALS

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Keywords: agricultural and food materials, discrete element method

Agriculture and food engineering harvests, stores, handles or processes an enormous amount of particulate material of biological origin. To predict behaviour of those materials researchers have developed several scientific methods of investigation: empirical, semi-empirical, analytical, and with the progressive development of numerical methods, the finite element modeling which is a continuum numerical method.

A new method that overcomes the shortcomings of empirical, analytical and continuum numerical methods is the discrete element method (DEM). DEM was developed by Cundall and Strack [1] and consists of an approximate solution of the equation of motion for each particle represented numerically and identified with its specific properties such as shape, size, material properties, and initial velocity. The last two decades brought new and advanced methods of modeling by introducing so called bounded particles model (BPM) [2]. The model based on the beam theory, introduces elastic bonds between particles which can transmit both force and moment up to the limiting values of the tension and bending strength.

DEM was successfully applied for modeling numerous operations of biosystems engineering: from soil tillage, through crop harvesting, to post-harvest processing of seeds, straw and other agricultural materials and products. Interactions in soil modeled at different scales (from micro- to mezo-) indicated impact of internal structure, soil composition, size of soil particles, and cohesive interactions between soil particles on behavior of soil aggregates and bulk behavior of soil in complex interactions with tools during plowing, fertilization, seeding, etc. Application of BPM to model interactions between

agricultural materials and machinery during operational processes allowed for better approximation of real processes. While modeling harvesting process, seeds or fruits are usually modeled with use of the multi-sphere method while deformable straw or branches (stems) are modeled as elastic beams with bending and tension thresholds. This approach appeared to be very useful in modeling particular unit operations of crop harvesting: material transfer, threshing, cleaning. Different contact models applied to contacts between spherical particles or clusters of spheres and were used to model accurately post-harvest processes: grain conveying, storage, discharge, and handling. BPM model appeared to be very useful in simulating interactions inside body of modeled objects subjected to external loads: bruise damage of fruits, grinding and milling of grain, testing strength of compacted biomaterials. This approach provided deeper insight into linkage between micro- and macro-properties of agricultural materials subjected to external loads during interactions with tools.

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OFFSHORE RISER SHIP COLLISION RISK ASSESSMENT

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Keywords: Offshore Riser Platform, Ship Collision, Risk Assessment

Pipeline in offshore oil and gas activity is used as a medium to transport hydrocarbon fluids across the sea [1]. The pipeline's riser is supported by a platform in the middle of the sea to conduct activities for the pipeline system. Ships and vessels mainly conduct activities in the platform surroundings and could occur ship collisions with the platform supporting the riser. Based on DNV-RP-F107, risks of ship collision to the platform are analyzed using the risk matrix, as shown in Fig.1, which its components are obtained from analyzing the Failure Frequency and Consequence of Failure of ship collisions [2][3].

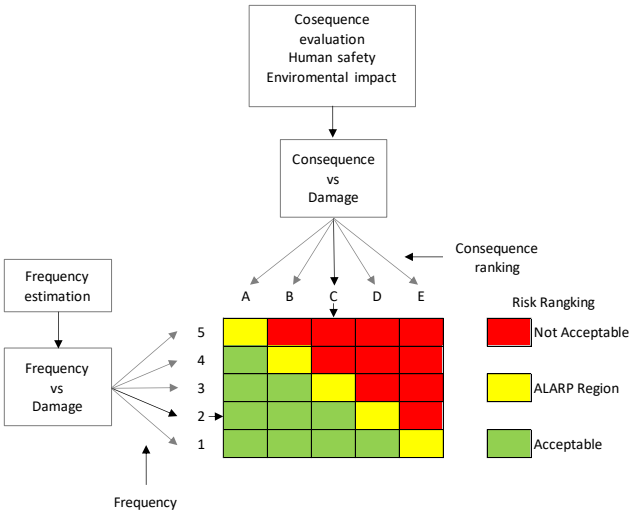

Fig. 1. Risk Matrix

Failure frequency analysis is conducted by applying the calculation of the probability of failure for ships to collide. The consequence of failure is analyzed from two perspectives; the economical of time and production losses, and the radius of fire explosion which is then defined as the value of consequence of failure (CoF). By defining the value of failure frequency and consequence of failure, data plotting into the risk matrix can be performed. The output of this study is a set of recommendations to decrease the risk of ship collisions.

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STUDIES ON CHANGES IN THE STRUCTURE OF ENZYMATICALLY TREATED RHAMNOGALACTURONAN-RICH PECTIN FROM APPLE AND CARROT

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Keywords: pectin, atomic force microscopy, enzymatic modification

Rhamnogalacturonan I (RG-I) belongs to the pectin family and is found in many plant cell wall types at different growth stages. It plays a significant role in cell wall and plant biomechanics and shows a gelling ability in solution. However, it has a significantly more complicated structure than smooth homogalacturonan (HG) and its variability due to plant source and physiological state contributes to the fact that RG-I's structure and function is still not so well known. Depending on the plant source, up to 90% of rhamnose units in pectic "hairy region" are decorated with neutral sugars. Major structural changes within pectin include neutral side chain loss and the rearrangement of their associations, which was shown to have an important influence over fruits firmness and textural properties [1].

Our previous studies of diluted alkali soluble fraction of pectin (DASP) deposited on mica showed characteristic kinked rods-resemble structures and regular network [2, 3]. It was hypothesized these structures originated from a single rhamnose residues or short sections of rhamnogalacturonan I interspersed within the homogalacturonan chains.

In these studies, an attempt has been made to investigate the role of rhamnose and arabinose units in building the structure of DASP fraction. Structural role of both saccharides was investigated by means of enzymatic modifications of pectin with different incubation durations. RG-I acetyl esterase, rhamnogalacturonan endolyase, arabinofuranosidase and their mixtures were applied to aqueous solutions of DASP extracted from apple (*Malus domestica Borkh*.) and carrot (*Daucus carota* subsp. *sativus*). The

effect of selective degradation of pectic polysaccharides after 5, 15, 30, 60, 120, 360 min and 24 h were observed using AFM. The AFM imaging was supported by chromatographic analyses of the DASP fraction. Effects of enzymatic treatment, described by differences in geometrical parameters of polysaccharides such skeleton length, branch number and their length, suggest possible role of rhamnose and arabinose in adopting characteristic structure on mica.

Acknowledgements:
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BIOFERTILIZATION POTENTIAL OF POST-BREEDING RESIDUE AFTER BIOCONVERSION OF ORGANIC WASTE BY *HERMETIA ILLUCENS* LARVAE

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Keywords: *Hermetia illucens*, black soldier fly, biofertilizer, breeding residues

The insect *Hermetia illucens* (black soldier fly, Diptera: Stratiomyidae) is often exploited in industry and agro-culture due to its ability to develop and gain weight on many organic substrates. *H. illucens* can be therefore used in production of feed for livestock and aquaculture animals. The substrate fed to the larvae during their breeding can consist of various agricultural wastes, e.g. plant biomass or manure, as well as food industry wastes, such as expired food, restaurant leftovers or fruit and vegetable peelings. The process of bioconversion of these substrates with the participation of *H. illucens* larvae, which simultaneously biorevalorize it to the form of insect proteins and fat, is a sustainable method of organic waste management [1]. Moreover, it is suggested that the residues of *H. illucens* breeding have biofertilizer potential and can be used as a substitute or additive for commercial fertilizers [2]. Such „insect fertilizer" due to its biological origin, introduces organic and humic components into the soil that improve soil fertility [3].

The aim of this study was to verify whether solid as well as liquid wastes from the breeding of *H. illucens* larvae on high-protein fed, i.e. post-production waste from pea and bean seeds, could be used as a fertilizer for plants. The pea variant included their husks and crushed seeds and the bean variant included crushed seeds. Both substrates were flooded with water to obtain a moisture content of about 75%. The study used 1000 larvae per replicate and the substrate dose was 1 g FW per 1 larvae. The breeding was carried out at about 25°C in boxes with air flow for 1 month.

In general, in solid residues, the nitrogen forms NO_3^- and NH_4^+ had higher concentration in bean than in peas. The NH_4^+ content of the liquid residue in both variants was high and at comparable levels, while the difference was in the content of NO_3^-, whose concentration was much higher in the beans variant. The larvae and pupae of *H. illucens* developed their biomasses to a similar extent as on other waste substrate reported in the literature, which indicated suitability of the used wastes for breeding of this fly.

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NEW FORMULATIONS OF LIQUID UREA-BASED FERTILIZERS CONTAINING ADDITIVES INFLUENCING THE LEVEL OF AMMONIA EMISSION

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The overarching goal of Green Deal for the European Union is to become the world's first "climate-neutral bloc" by 2050. The goals of Green Deal were extended to many different sectors, including biodiversity, energy, transport and food. Agriculture is the second largest emitter of greenhouse gases after the energy sector, the concentration of which in the atmosphere increases as a result of human activities. Nitrogen is the basic nutrient for plants, contributing to the growth of crops. Improving the efficiency of nitrogen fertilization is a key aspect in large-scale plant production, especially in the context of the lost value due to ammonia and nitrous oxide emissions. EU legislation also focuses on this issue. The recommendations contained in EU Directive on the reduction of domestic emissions of certain types of atmospheric pollutants were introduced. In accordance with the above-mentioned normative acts, after 2030, urea-based fertilizers with reduced NH_3 emissions by at least 30% will be allowed for use in the EU [1]. Those legal requirements leading to limit the possibility of using urea and urea-based fertilizers in the European Union in its present form. In Polish conditions, the Regulation sets a commitment to reduce ammonia emissions from the baseline level of 2005 by 1% each year in the years 2020-2029 inclusive and 17% from 2030.

Nitrogen gas losses from urea fertilizers in European agriculture reach up to approx. 50% [2] depending on climate and soil conditions. The use of

nitrogen in an appropriate form and dose is of key importance for the yield of agricultural production. The potential of ammonia emission from soil is influenced by several factors: the fertilizer application method, the type of cultivation, the type and pH of soil as well as thermal and moisture conditions. A solution that may improve the efficiency of fertilization through the reduction of nitrogen losses is to modify the composition of the fertilizers by the introduction of additives, such as inhibitors of urolysis or the ammonium ion nitrification process [3]. New formulations of urea-based fertilizers containing additives influencing the level of ammonia emission were developed - the ones limiting urolysis were selected on the basis of the available literature. The effectiveness of the components –N-(n-Butyl) thiophosphoric triamide (NBPT) and ATS (ammonium thiosulphate) in reducing ammonia emissions was verified during the incubation test. Soil enzymatic analyzes were also carried out and urease activity was determined by spectrophotometric method. The results of the enzymatic analyzes reflected the obtained results of the ammonia emission measurements.

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GLUTEN NETWORK AGGREGATION INDUCED BY SELECTED PHENOLIC ACIDS STUDIED BY FT-RAMAN SPECTROSCOPY

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Polyphenols are common in plant-based edible products and are characterized by antioxidant properties. Phenolics are secondary metabolites that include aromatic rings with one or more hydroxyl groups. The primary category of polyphenols is phenolic acids. The quantity and position of hydroxyl groups on the aromatic ring differ across phenolic acids. Hydroxycinnamic acid derivatives such as p-coumaric acids and hydroxybenzoic acid derivatives such as 4-hydroxybenzoic acid are examples of phenolic acid compounds used in the present studies [1].

The aim of this study was to determine the changes in gluten network structure induced by supplementation of model dough with two phenolic acids: p-coumaric acid and 4-hydroxybenzoic acid using FT-Raman spectroscopy. Gluten samples were prepared according to Nawrocka et al. (2020) [2]. Phenolic acids were added to the dough in amounts of 0.05%, 0.1% and 0.2% (w/w). The mixing of the supplemented dough was terminated shortly before the farinograph peak indicating the breakdown of the gluten network for "before breakdown" samples, or it was continued one hour for "overmixed" samples. The secondary and tertiary structures were determined by analysing the amide I band, the aromatic amino acid microenvironment, and the disulphide bridge conformations. The DTNB reagent was employed to determine the quantity of free SH groups and the content of SS groups. The gluten samples were analysed in the powder form.

Selected phenolic acids induced dough breakdown at different time depending on the type of phenolic acid used. Analysis of the amide I band revealed incorporation of the phenolic acids into gluten network and induced aggregation of gluten proteins. An increase in the free SH and SS groups, as well as an increase in the t-g-g conformation, additionally indicated gluten

protein aggregation. The findings suggest that dough mixing time and type of phenolic acid structure have a profound impact on changes in the structure of the gluten network.

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INFLUENCE OF THE FLAVONOIDS ADDITION ON THE STRUCTURE AND PROPERTIES OF MICROFIBRILLAR CELLULOSE AND NANOCELLULOSE-BASED COMPOSITES

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Flavonoids are a large group phenolic secondary metabolites. They can be found in higher plants, algae, and bryophytes. The basic skeleton structure of flavonoids is a heterocyclic ring with oxygen atom, like pyran, that contains two benzene rings [1]. This type of compounds are often used in pharmacy and cosmetics due to their antiallergic, antimicrobial, anti-inflammatory and vasodilating properties - most of these effects are due to their ability to reduce the formation and scavenging of free radicals [2]. However, these compounds outside the environment of plant structures are relatively unstable and prone to oxidation, which makes it difficult to widely use the properties of polyphenols in the food industry without a permanent carrier. A solution to this situation can be the production of composites based on nanocellulose and cellulose as a base material enabling the adsorption of this type of compounds. On the other hand, cellulose due to its naturalness, high mechanical strength and relatively low density provides the possibility to produce completely biodegradable, durable and safe food packaging, however with quite high hydrophilicity.

Polyphenols adsorbed on the surface of such composite allow to improve these packages with antioxidant properties and limit the development of microorganisms dangerous to food and thus to human health [3]. Four flavonoids (two pairs of flavonoids and their glycosides) quercetin and rutin, naringenin and naringin were emulsified in the water solution by the presence of phosphatidylcholine from sunflower lecithin. This emulsion was applied on the film made of cellulose or nanocellulose and filtered. The changes of

hydrophobicity, thermal properties as well as antioxidant an antimicrobial properties of film with addition of chosen flavonoids were determined. The examination of the composites showed antioxidant and antimicrobial properties, which were the greatest against *S. aureus* strain (composites with rutin and quercetin). Composites with naringenin were the most hydrophobic of all composites.

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PHYSICAL PROPERTIES OF EDIBLE OILS

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The physical properties of the edible oils are studied. Mainly viscosity, density, fluidity and color parameters of five bio-oils were studied: Pumpkin oil, Linseed oil, Nut oil, Poppy seed oil and Sesame oil. Color properties of all oils were measured at the room temperature 25°C. L*, a*, b* color coordinates of CIE LAB 3D color space were used to the characterization of the oil color. Samples were measured by a spectrophotometer (3NH YS3020, Shenzhen 3nh Technology CO., LTD, China) and computed as the mean of ten samples. Spectrophotometer was equipped with a D65 illumination source, a 2◦ observer angle, a diffused illumination and 10◦ viewing angle di:8◦ optical geometry. L*, a* and b* were used to define a three-dimensional color space and interpreted L*, the lightness, the values ranging from 0 to 100, a*, redness and greenness, b*, yellowness and blueness. The selected physical properties were statistically very similar.

THERMOGRAVIMETRIC ANALYSIS TO DESCRIBE THE ACTIVATION ENERGY IN PYROLYSIS PRODUCTS

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Keywords: products pyrolysis, thermogravimetric analysis, activation energy

There is growing interest in biomass fuels because of problems associated with climate change and energy dependence. The thermal decomposition reactions play a crucial role during several of the biomass utilization processes. One of these processes would be pyrolysis. The process of pyrolysis is evaluated via thermogravimetric analysis. Thermogravimetric analysis (TGA) is a high-precision method for the study of pyrolysis at low heating rates, under well-defined conditions in the kinetic regime. A simple kinetic thermal decomposition samples was investigation with isoconversional methods, such as Kisinger - Akahira - Sunose and Flyn - Ozawa - Wall model. The goal of this research is to description of the thermal behaviour of the straw versus Polypropylene during pyrolysis using TGA.

The sample was waste polymers materials as PP and straw from field in Zlaté Moravce. Each sample was analysed four times, at heating rates of 5, 10, 20 and 30 °C.min^{-1}. The output of these analyses were thermogram, from which we were able to determine the changes at what temperature were the largest weight losses and DTA curves. The largest mass losses sample occurred in the PP between 350 °C and 535 °C in one step. In the straw sample is evident 3 decreases of mass, the most decrease noted at lower temperatures, in the range of up 180 °C to 380 °C. This mass loss for follows that PP decomposes at higher temperature than straw. Capturing device for vapor hydrocarbons compounds should be placed under flue gas discharge pipe. Maximum efficiency should be within these temperatures. Calculated E_a the largest mass losses sample occurred in the PP between 350 °C and 535 °C in one step. In the straw sample is evident 3 decreases of mass, the most decrease happaned at lower temperatures, in the range of up 180 °C to 380 °C. This mass loss for

follows that PP decomposes at higher temperature than straw. Capturing device for vapor hydrocarbons compounds should be placed under flue gas discharge pipe. Maximum efficiency should be within these temperatures. Activation Energy for PP was calculated in the point of start decomposition, the inflection point, and for the ending point of decomposition. We calculated the activation energy for each conversion rate from 0.2 to 0.7 for biomass. Its value increased with the degree of conversion. The activation energy of PP for inflexion obtained from the KAS method was 104.89 $kJ.mol^{-1}$, from the FWO method 107,06 $kJ.mol^{-1}$. For biomass was maximally E_a in conversion 70 % in both cases KAS and FWO methods and acquires values 53,329 $kJ.mol^{-1}$ and 55,965 $kJ.mol^{-1}$, respectively. The results of our work show that values of activation energy were comparable than the valuesreported by authors Sorum et. Al (2001), Soudias et al. (2001) and Park et al. (2006), who analyzed plastic and cellulose samples.

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MOLECULAR STUDIES ON CHANGES OF ARABINOGALACTAN PROTEINS (AGPS) DURING TOMATO RIPENING PROCESS

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Keywords: arabinogalactan proteins, cell wall, fruit, ripening process

Introduction: Arabinogalactan-proteins (AGPs) are proteins in the plant extracellular matrix. AGPs are not classical proteins because glycan moiety makes up a significant part of the whole structure of molecule (which can account for 95% of the total mass). The protein is characterized by the presence of Ala-Pro, Pro-Ala, Thr-Pro, Ser-Pro, Val-Pro, and Gly-Pro peptide repeats and type II arabinogalactan (AG) chains. They have a glycosylphosphatidylinositol (GPI) anchor on their C-terminus, thus AGPs are described as GPI-anchored proteins, which are coupled to the outer leaflet of the plasma membrane. They are glycoproteins implicated in numerous, variable functions throughout plant growth and development. AGPs account for only a small portion of the cell wall, usually no more than 1% of the dry mass of the cell wall [1]. AGPs and other cell wall components make a proteoglycan complex called APAP1 (ARABINOXYLAN PECTIN ARABINOGALACTAN PROTEIN1), which enables the formation of continuity between polysaccharides and structural proteins of the cell wall [2].

Aim of the research: monitoring the role of AGPs in tomato during ripening process.
Research material: tomato fruits at following 5 stages of ripening process.
Methods: Total proteins content was determined by use typical extraction protocol (65mM Tris-HCl pH 6,8; 2% SDS; 2 mM EDTA; protease inhibitor; 1 mM PMSF; 700 mM β-mercaptoethanol). The protein concentration in supernatants obtained was checked by the Bradford method. Electrophoresis (SDS-PAGE) was performed to separate proteins and then stained with the Coomassie blue method. Yariv reagent was used for the AGP extraction. The

AGPs were checked by the method Dot Blot and Western Blotting, using specific monoclonal antibodies.

Results: The protein content is lower in fruit in comparison to other plant organs, as well as content is comparable at all examined stages of the ripening process. At the beginning of the ripening process ('Breaker stage'), there is a marked increase concentration of AGPs. Along with ongoing process, decrease of AGPs molecular weight is noticed, pointing at the degradation of carbohydrate chains with the progress of the ripening process.

Conclusions: In our research, we may assume that AGPs should not be consider like proteins but like proteoglycans. Their highest concentration of AGPs at 'Breaker stage' indicates that they are a marker of the ripening process.

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TEMPERATURE CHANGES OF PHOTOVOLTAIC CELL PARAMETERS

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The efficiency of the photovoltaic energy conversion depends on the temperature significantly. We monitored the behavior of important characteristics of the PV cell based on monocrystalline silicon in the wide temperature range. Changes of *I–V* and *P–V* characteristics were discussed in terms of the theory of solids. The open-circuit voltage dependence is approximately linear over a wide temperature range. The increase of the temperature causes a reduction in the instantaneous power of the photovoltaic cell at a constant radiation intensity and thus a reduction in the efficiency of the photovoltaic energy conversion.

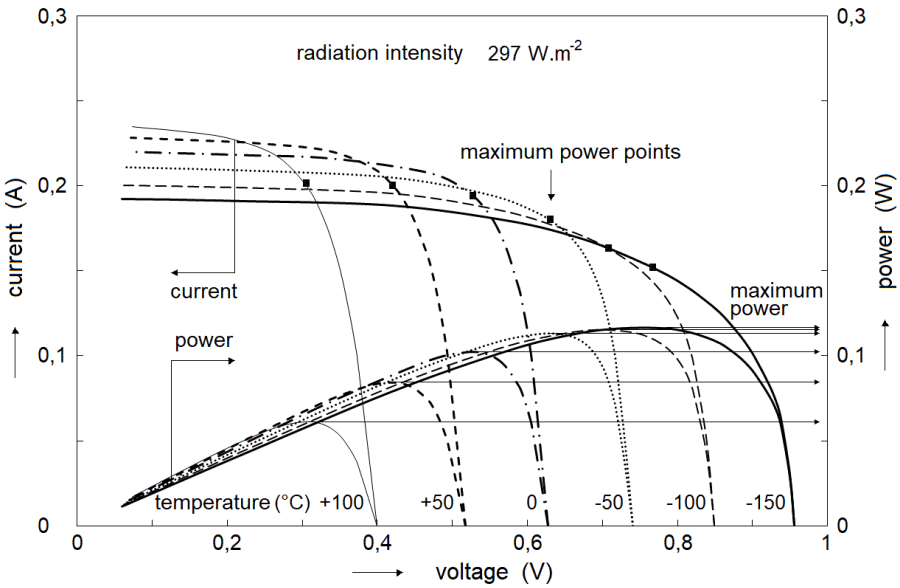

Fig. 1 *I–V* and *P-V* characteristics of the PV cell measured over a very wide temperature range from −150 °C to +100 °C.

Fig, 1 shows *I*–*V* and *P*-*V* characteristics of the PV cell measured over a very wide temperature range from −150 °C to +100 °C. If the PV system operates in locations with extreme climatic conditions, especially with extreme temperature changes during the year or even in space, the electrical voltage of the PV modules will change significantly as well as the instantaneous power. This must be taken into account in the design of the PV system, and the individual components must be carefully selected. Especially, electronic inverters tend to be sensitive to overvoltage or undervoltage. Our measurement and data evaluation was described in details in the article [1]. Our measurements show a good agreement between the theory and experiment.

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FORECASTING OF PHOTOVOLTAIC ENERGY PRODUCTION WITH TIME SERIES MODELING

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Keywords: Accuracy, FTS, SARIMA

Renewable energy technologies have been one of the best strategies in addressing sustainable energy development and climate change. The roles of renewable energy in developing countries are vital, which include the accessibility of modern energy services in rural areas, climate change mitigation, energy security, green job creation, and eventually improvement of quality of life. Solar energy is an important renewable energy, radiant light, and heat from the sun are converted into electricity, straight through the solar photovoltaic (PV) solar cells/module. In the context of electricity generation, solar energy doesn't emit harmful greenhouse gases, pollute groundwater or deplete any natural resources. The power generation from PV solar modules varies in nature due to irradiance, ambient temperatures, and other factors. The main issue of solar energy is its fluctuations in accordance with sudden weather change variables. Hence, forecasting energy generation is needed for solar electricity since it is required to ensure power continuity in order to store the energy. [1]

Refers to the preliminary discussion above, the studies of energy forecasting are necessary to be developed, in order to overcome the uncertainty of the fluctuations in the sudden weather changes. In this research, two forecasting time-series models, i.e., Seasonal Autoregressive Integrated Moving Average (SARIMA) and Fuzzy Time Series (FTS) models, are proposed.

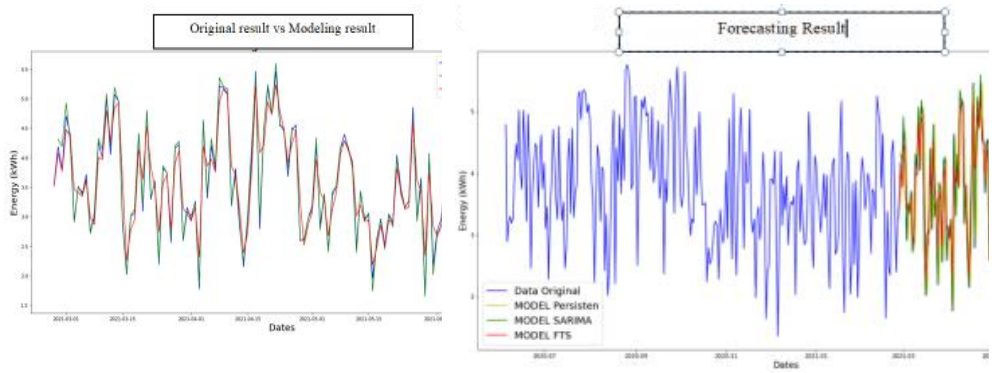

Fig. 1. a) Original vs Modeling Result, b) Forecasting Result

The basis of these two models is to utilize historical data and predict models from the data. The result of comparison performance is shown in accuracy with the best performance is achieved by SARIMA modeling which has 97.6 % in accuracy.

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THE INVESTIGATION OF ARCHAEAL GENETIC DIVERSITY IN THE DEGRADED SOIL AMENDED WITH PHOSPHORUS BIOFERTILIZER

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Keywords: phosphorus biofertilizer, archaea, genetic diversity, t-RFLP

Exploring the microbiome of agroecosystems is currently one of the key elements in the work towards the development of sustainable and organic agriculture. Soil archaeal communities are involved in the oxidation-reduction reactions of metals and modification of chemical conditions in the soil environment [1].

The aim of the study was to determine variations in the genetic diversity of archaea in the degraded soil (type BrunicArenosol) fertilized with microbiologically enriched phosphorus mineral fertilizer.

Two-year field experiment included the following treatments: FC-optimal dose of fertilizer without microorganisms, FA100-optimal dose of fertilizer containing beneficial microorganisms and FA60-40% reduced dose of fertilizer containing microorganisms. Soil samples were collected at autumn 2018 (A18), summer 2019 (S19) and autumn 2019 (A19). Genetic diversity of archaea was determined using terminal restriction fragment length polymorphism (t-RFLP), while identification of microorganisms, based on the size of selected terminal restriction fragments (T-RFs) was conducted using the TRiFLe tool [2].

Obtained results showed that not only fertilization treatment but also soil sampling time affected the composition of archaeal community. Identification with TRiFLe revealed the presence of *Ferroplasma* spp. (involved in iron cycling) and *Nitrososphaera* spp. (ammonia oxidizing archaea involved in nitrogen cycling). PCA analysis and tree clustering

(Ward's method, Euclidean distances) revealed a clear grouping of treatments with respect to the soil sampling time. Venn diagram demonstrated that "core microbiome" consisted of 45 T-RFs, while "satellite microbiome" included 2 characteristic T-RFs for each fertilization treatment.

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AMPLITUDE AND FREQUENCY CHARACTERISTICS OF ULTRASONIC SIGNAL ON REFLECTION FROM A TILTED PLANE

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Keywords: acoustic signal, frequency analysis, measurement, ultrasound, ultrasound reflection

The aim of the experiment is to determine the deviations of the frequency components of the ultrasonic signal in amplitude terms. A metal normal with dimensions 245 mm x 220 mm was used as a reflecting surface. The measurement was performed at a tilted plane at an angle of 45°. The results were compared with the plane case. The distribution of the ultrasonic transducers was in a semicircle. The distance of the ultrasound transmitter from the reflection normal was set to 260 mm. The distance of the ultrasonic sensors from the reflection normal was determined heuristically to a value of 1600 mm.

The experiment was performed with a number of four repetitions. The frequency of ultrasound was the standard with value 40 kHz. The signal from the ultrasonic sensors was logarithmically amplified by 25 dB.

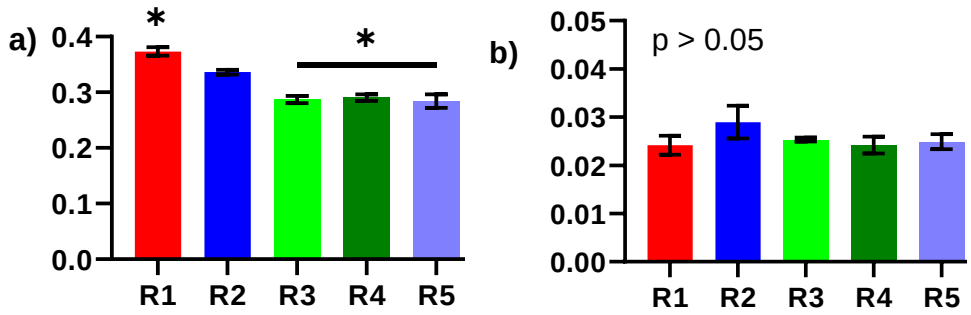

Fig. 1. Statistical evaluation of signal amplitudes on ultrasonic sensors. a) Non-tilted case. b) Tilted case.

The global maximum of frequency analysis of ultrasound signals in the planar case was observed with a frequency value of 39.79 kHz in the zero angle vector. The range of voltages in the angular vectors (± 4°; ± 14°) was in the interval 9.89 mV ÷ 16.89 mV. The percentage difference between the angular vectors at the same value was in the interval 8.88 % ÷ 9.16 %.

The measurement of the reflections from the tilted plane indicated a global maximum in the frequency analysis with a frequency value of 40.16 kHz. The range of voltages in the angular vectors (± 4°; ± 14°) was in the interval 0.20 mV ÷ 0.56 mV. The percentage difference between the angular vectors at the same value was in the interval 11.95 % ÷ 21.28 %.

The goodness of fit to the Normal probability distribution was verified by the Shapiro-Wilk test at a significance level of $\alpha = 0.05$ in favour of the Normal probability distribution for the non-tilted case and the tilted case. Statistically significant differences (* $p \leq 0.05$) were identified by Dunnett's test in a one-factor analysis of variance with respect to sensor R2 (vector of zero angle). Results are presented as arithmetic mean ± standard deviation.

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THERMAL PERFORMANCE MODELLING OF A SINGLE PASS SOLAR AIR COLLECTOR

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Keywords: solar air heaters, performance modelling, efficiency

Solar energy is trendy among alternative energy sources, particularly nowadays as the global energy demand increases, fossil fuel prices are rising, and ongoing conflicts over energy sources are experiencing severe. Solar air collectors are one of the most effective ways to harness solar energy because they convert the sun's energy into heat that can be used for space heating and crop drying (Machi et al., 2021).

However, the primary issue with solar air collectors is the low thermal efficiency; therefore, researchers look to enhance it by examining the factors affecting the efficiency and devising solutions. Several theoretical and experimental studies pointed out the parameters influencing the heat transfer and airflow process through the heaters to achieve reliable improvement in the overall efficiency (Fudholi et al., 2013).

This work introduces a numerical model describing the thermal process of a single pass solar air collector fabricated in the Solar Laboratory at the Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary (Al-Neama and Farkas, 2019). It has a single transparent cover with a flat copper plate absorber, and the air passes between the cover and the absorber. Several assumptions were introduced to simplify the modelling process, where the heat balance equations of the collector parts and the different heat transfer coefficients were calculated using MATLAB as simulation software.

The proposed model results showed a good agreement compared with the laboratory experiments conducted. Therefore, from the results, we can conclude that the airflow rate is considered the main factor affecting the performance of a single flat plate air heater as it increases the heat transfer rate,

reduces the plate temperature resulting reduces the heat loss and then increases the air temperature.

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THE EFFECT OF CONSERVATIVE SUBSTANCES ON A GROUP OF FUNGI BELONGING TO THE *NEOSARTORYA* GENUS

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Keywords: food chain, antifungal substances, inhibition test

There are many preservatives that are used in the food industry. However, there is only minimal knowledge about their effectiveness in the control of fungi that can be heat-resistant and cause food products contamination. Therefore, in our research, we are pursuing substances effective against *Neosartorya* spp., a genus of soil-borne fungi causing a threat to food quality as they are microbiological contaminants. Some of them generate losses in the agricultural field by secretion of dangerous mycotoxins such as veruculogen or fumitremorgins or deterioration of plant matter.

By studying the impact of different concentrations of several preservatives, reported to have antifungal properties [2,3], we were able to determine a few promising solutions potent against most *Neosartorya* spp. isolates. Tested preservatives were previously used in the food industry to conserve different products. Among tested substances, the most capable turned out to be sodium metabisulfite (75mg/ml) and sodium bisulfite (100mg/ml). However, there are numerous differences in the response to preservatives between subsequent isolates generating 5 main groups of sensitivity among tested fungi. It can be suspected that the cause of this is connected to different metabolic, morphological, and genetic properties of tested fungal isolates. This, therefore, requires a thorough analysis and comparison of morphological structures between the least and most resistant strains.

Further search for substances that have an effect even on the most resistant strains may deepen the knowledge about shaping the mechanisms of fungal resistance to environmental factors and also be beneficial for the development of agriculture and food production.

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THE POTENTIAL OF PLANT EXTRACTS AS UREASES INHIBITORS

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Keywords: urease, urease inhibitors, plant extracts

There are more and more reports in the scientific literature about natural substances which are inhibiting the processes of nitrogen transformation in soil. It is related to the fact that the activity of urease coming from soil microbiota can lead to losses of nitrogenous nutrients in fields supplemented with urea as fertilizer. Substances, that have urease-ihibiting properties can be divided into two groups. The first group are substances of synthetic origin. The second one, which is the object of our interest, are substances coming from nature.

In the natural environment there are many substances, that present urease-inhibiting properties. For example, they can be: plant extracts, processing residues, products of microorganism metabolism. With the information available in published scientific papers we can select the substances that have the properties we want.

There is a group of plant extracts that are inhibiting the activity of urease enzyme on the level of more than 80%. These include plants such as: acacia, eucalyptus, black tea, green tea, coffee, darek tree, bell paper or apricot [1]. The active substances occurring in black tea extract, which are responsible for such inactivation of enzyme are polyphenols. The effectiveness of polyphenols in inhibiting the activity of urease was widely described by Fernando and Roberts over 20 years ago [2]. An example of another substance, widely described in scientific literature is allicine. The effectiveness of garlic extract results from its chemical structure. The allicine contains thiosulphate groups which oxidize the thiol groups present in the active center of urease, causing its deactivation at the same time [3].

In this work we will show some examples of potential natural urease inhibitors. Substances that we have chosen were used in experiments on the basis of which we could assess the rightness of the choices made.

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POWER QUALITY ISSUES IN GRID-CONNECTED PV SYSTEMS

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Keywords: PV technology, power quality, harmonics, voltage fluctuation

For its inherent characteristics and modularity, solar photovoltaics technology is becoming the center of green-energy transformation. In recent years, grid-connected solar PV is becoming one of the most promising technologies to meet the growing energy demand of the globe. Grid-tied PV has plethora of technical and environmental benefits which makes it among the top-ranked sustainable energy options for future environmentally friendly energy supply alternatives. But, optimizing the technical benefits obtained from grid-connected PV technologies remains a critical challenge in power system. Moreover, the increased penetration of grid-connected PV systems is a concerning issue as it deteriorates the quality of power generated. When the penetration level increases it creates several challenges in the distribution network including reverse power flow, increase power losses, voltage unbalance, transformer and cable rating, and malfunction of protective equipment, and this ultimately affect the control, operation, and security of distribution feeders (Bajaj and Singh, 2020). Grid interfacing and power conditioning devices such as inverters also inject harmonics into the distribution network and cause undesirable effects on the quality of power generated.

The most pressing power quality issues in grid-tied PV systems are harmonics and voltage fluctuation. Harmonics is the most critical power quality issue and the expected high penetration level of PV cannot be realized without properly addressing the issue of harmonics. PV systems being

dependent on changing environmental parameters such as irradiance and temperature is the main factor for various power quality issues. It is, therefore, imperative to find improved techniques to enhance the quality of power generated from grid-connected PV systems (Kow et al., 2016).

This paper reviews the major power quality issues in grid-connected PV systems and a MATLAB/Simulink-based simulation model is developed to demonstrate the impact of high PV penetration on the quality of power generated.

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PLANTS UNDER VARIABLE CONDITIONS

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Keywords: chlorophyll fluorescence, non-photochemical quenching, photosynthesis, high light

Generally crops are grown in highly variable conditions. Light, the most important factor driving plant productivity is highly variable due to changes in light spectrum, intensity at wide timescales (Murchie and Ruban, 2020, Steen et al., 2020). Photosynthetic apparatus of plants is able to utilize even small portion of light energy for photochemical reactions, however at full sunlight the light energy may be harmful due to generation of toxic reactive oxygen species. To cope with that threat plants evolved mechanisms dissipating excessive energy called non-photochemical quenching (NPQ). These photo protective mechanisms are based on complex biophysical, biochemical processes. All biochemical processes occurring in living organisms strongly depends on a temperature.

The aim of the study was to evaluate impact of temperature on processes related to utilization of light for photosynthesis processes with focus on dissipation of excessive energy.

Leaves of *Arabidopsis thaliana* wild type grown at optimum conditions were illuminated in the chamber of gas exchange system consisting of 3010-Dual cuvette, Dual PAM 100 and GFS 3000 (Walz GmbH, Germany). Specific pattern of light intensity changes ranging from low to high light intensities was applied to dark adapted leaves at low (10^{o}C), moderate (22^{o}C) and high (32^{o}C) temperatures.

Our results show importance of leaf temperature on the rate of relaxation of non-photochemical quenching after decrease in the light intensity and on so-called mechanism of plant light memory.

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REGULATED NON-PHOTOCHEMICAL QUENCHING UNDER DROUGHT AND FLUCTUATING LIGHT

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Keywords: variable light, water deficit, dissipation of excessive energy, xanthophyll cycle, PsbS, NPQ, RWC, *Arabidopsis thaliana*

Field grown crops are subjected to simultaneous action of many environmental constraints. Light intensity is one of the most variable factor of crop growth environment, while drought is considered as one of the most devastating for biomass production [1]. Light intensities that exceed plant's assimilating capabilities need to be dissipated in order to avoid photoinhibiton and reactive oxygen species formation [2]. However, energy dissipation can be disturbed by several environmental factors among which, drought and fluctuating light (FL) concern us the most.

The purpose of this study was to evaluate the impact of non-photochemichal quenching (NPQ) components depending on zaeaxanthin and light energy [3] on the photosynthetic performance of model plant *Arabidopsis thaliana* (*At*) under combined influence of drought and FL.

A laboratory experiment on *At* mutants (genotypes: npq1 – violaxanthin de-epoxidase deficient; npq4 – PsbS protein deficient) and wild type plants was conducted. Plants were divided into two groups: control group of optimal water availability and a drought-treated group. Intensity of drought was estimated by relative water content (RWC) measurements. Both groups, after required short period of dark adaptation, were illuminated with FL consisting of low and high intensity phases. Measuring light applied by Imaging PAM Maxi allowed to designate response of photosystem II by several parameters like quantum yield of PSII and regulated non-photochemical quenching, during illumination with FL. Separation of various components of non-photochemical quenching was carried out by monitoring

of chlorophyll fluorescence at period of darkness following illumination with FL.

The experiment revealed, that water deficit affect plants' response to FL. Lack of zeaxanthin in npq1 mutant and PsbS protein in npq4 reduced plant capability to dissipate excess of absorbed energy under rapid changes in light intensities.

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ADSORPTION IN INVESTIGATION OF CELLULOSE INTERACTION WITH OTHER POLYSACCHARIDES

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Keywords: adsorption, cellulose, polysaccharides, plant cell wall

Cellulose, hemicelluloses and pectins are the main components of the plant cell wall. The structure of these compounds is known, but it is worth noting that the group of hemicelluloses and pectins is broad and they can have a number of substituents and branchings that affect the conformation of the chains [1]. The functional group characteristic for cellulose and hemicelluloses is the hydroxyl group, while for pectins apart that is also the carboxyl group. Those groups are responsible for the interactions through hydrogen bonds between compounds and cellulose. The literature also reports that cellulose interacts with polysaccharides via van der Waals forces [2]. Research on the interactions between cell wall polysaccharides are mainly based on model adsorption studies [3].

Adsorption is a surface phenomenon of great importance to scientists, but also to industry while biosorbents that can be derived from agricultural wastes are of great ecological importance as they are environmentally neutral. The adsorption phenomenon is result of the accumulation of adsorbate on the surface of the adsorbent. By fitting an adsorption model to the experimentally obtained data, it is possible to characterise the system under study and, in particular, to determine the type of interactions (chemical or physical) between adsorbent and adsorbate [4].

The adsorption studies of selected commercially available non-cellulosic polysaccharides on microfibrillar cellulose isolated from apples was investigated under this study. The research was conducted using the indirect static method. The adsorptive concentrations were determined before and after contact with the adsorbent by UV-VIS spectrophotometry. Adsorption kinetics and equilibrium were carried out and the adsorption model was fitted. We have

shown that glucomannan, xyloglucan, ß-D-glucan and xylan interact with cellulose. In contrast, pectins, arabinan, galactan, arabinogalactan, polygalacturonic acid and rhamonglacturonan do not show these interactions.

The next stage of the study concerned the modification of the adsorption system, which consisted of cellulose and hemicellulose (1) with high affinity for the adsorbent and additionally hemicellulose (2)/pectin, which previously did not interact with cellulose. It has been shown that hemicelluloses such as xyloglucan, xylan, β-D-glucan that adsorb on cellulose are promoters that allow this adsorption complex to interact with selected pectins and other hemicelluloses. This occurs when the correct concentration ratio of these polysaccharides is chosen.

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A PRELIMINARY DESIGN AND MODELLING ANALYSIS OF SOLAR-ORGANIC RANKINE CYCLE WITH DIFFERENT TYPE OF SOLAR COLLECTORS

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Keywords: solar collector, organic Rankine cycle, turboexpander, evaporator, design analysis

Organic Rankine cycle (ORC) has been considered as most feasible cycle to generating electricity while recovering various heat sources, such as geothermal (Permana et al., 2021), biomass, waste heat recovery and solar thermal. Although, ORC generates a small amount of efficiency, but it can be effectively used in remote area, because its compactness and the most important thing is environmentally friendly (Orosz et al., 2009).

Many researchers and engineers have created and developed ORCs from solar thermal sources, so that ORCs combined with solar thermal sources can be used as an alternative for energy generation in disaster areas. In this case, the authors carry out preliminary design and modelling analysis involving solar-ORC using three types of solar collectors that are commonly marketed, including: parabolic compound collector, evacuated tube collector and parabolic tube collector.

This preliminary design and analysis is expected to provide a large amount of energy that can be produced in the Hungarian area, especially Budapest and its surroundings. After getting the amount of energy obtained, the author determines the type and rating of evaporator used by varying the pinch temperature at 5 °C and 10 °C. Determination of the type of expander is also carried out in this study, where for compact solar-ORC, switching the

function of the compressor to an expander is the best option due to the high cost and the lack of expander production for the ORC system.

Lastly, exergy and thermo-economic analysis will be provided in this study to see how much the feedback period costs generated by the manufacture of one unit of solar-ORC. So, that can be determined which solar collector is suitable and optimal in terms of energy produced and costs incurred.

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COMPARISON OF ANNUAL EMISSION ON ELECTRIC VEHICLE AND ON CONVENTIONAL VEHICLE

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Keywords: electric vehicle, emission, energetic mix

Electromobility is a very quickly developing industry. Therefore, it is necessary to compare and to know the different way of operating parameters of these vehicles. This article is thematically focused on the comparison of emission production between vehicles with the internal combustion engine and the electric vehicle one [1].

The tested vehicles were VW Golf 1.0 TSI 81 kW and VW e-Golf. Measurement of emission was performed using diagnostic instrument (Emission analyzer Bosch). In case of the electric vehicle, the data were obtained from the online website called: electricitymap.org. The electricity map is a live visualization of where your electricity comes from and how much CO_2 was emitted to produce it. Measured and gained data can be seen in table 1 [2].

Type of fuel	g CO_2/kWh energy	Consumption per 100 km	g CO_2 per 1 km	Annual emissions CO_2/t
Petrol	360	49,404 kWh	158	3,2
Electricity (mix)	285	13,85 kWh	35	0,7

Table 1 Measured and obtained data both of the vehicles

Carbon dioxide (CO_2) emissions are reported in grams per kilometer driven with combined consumption determined according to the new WLTP measurement cycle. To calculate the amount of carbon dioxide produced by burning 1 liter of fossil fuel, the calculation method of the American Environmental Protection Agency (EPA) was used but, moreover, 1.6 kWh of electricity needed for refining to fossil fuels had been added. At the time of

testing, the energy mix was 285 g CO_2 per kWh produced. However, if the car would be recharged only by solar energy, then one kWh emits about 65 g of CO_2 [2].

Comparing the two types of fuels, it can be concluded the VW e-Golf produces less emissions than the VW Golf. In the case of the ride which was actually measured, the gCO_2/kWh ratio was by165 higher. Comparing the consumption per 100 km and CO_2 production per km this value is substantially higher. This value is influenced by the fuel consumption of the car with combustion engine, where the calculated value per kWh is more than five times higher and due to the CO_2 production is reasonable higher.

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CHANGES IN THE MICROBIOME OF RASPBERRIES AS A RESULT OF THE BENEFICIAL BACTERIA APPLICATION

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Keywords: beneficial bacteria, raspberry microbiome, stress substrate index, phytopathogens

Biopreparations based on the plant beneficial bacteria inoculum are a valuable tool in helping the plants deal with the negative effect of fungal and fungal-like plant pathogens. Pathogens belonging to *Botrytis* sp., *Colletotrichum* sp., *Phytophthora* sp. and *Verticillium* sp. genera are one of the most important phytopathogens in organic farming of fruits, among others in raspberries cultivation. Plant beneficial bacteria have a multitude of action modes, including growth and yield increase, improving the plants' systemic resistance, directly inhibiting the growth of fungal and fungal-like pathogens, and increasing the amount of soil micro- and macro-nutrients available for plants [1,2]. In our research, we focused on the effect of beneficial bacteria inoculum on the rhizosphere and phyllosphere microbiome of raspberries in a pot experiment. Taxonomic composition and functional abilities were evaluated in terms of the microbiome.

The 4 isolates of beneficial bacteria belonging to genera *Arthrobacter*, *Pseudomonas* and *Rhodococcus* proved to be efficient in inhibiting the growth of fungal and fungal-like pathogens and were used in plants naturalization strategies including spreading over the roots of raspberry seedlings during planting, adding to watering 4 weeks after planting, or combining both treatments. The 4 pathosystems were applied including *Botrytis cinerea*, *Colletotrichum acutatum*, *Phytophthora* sp., *Verticillium* sp., and control without any pathogens. Following the pot experiment, the DNA was isolated from the rhizosphere and phyllosphere of raspberries and sequenced with the Illumina MiSeq platform (Illumina, San Diego, CA, US). Results were then analyzed with QIIME2 environment and with FUNGuild tool using UNITE or

SILVA databases and PICRUSt software package. Furthermore, rhizosphere and shoots samples were subjected to functional profiling analysis of their microbial communities with the use of Biolog® EcoPlates. The tests were carried out using two wavelengths of light. It allowed us to draw more specific conclusions because 750 nm stands for optical density, and 590 nm for substrate usage. Then the Stress Substrate Index was calculated.

The application of bacterial inoculum resulted in the decrease of stress substrate index of raspberry phyllosphere microbiota. Over 75% of bacterial phyla and 95% of fungal phyla consisted of 4 and 3 phyla respectively. The application of combined naturalization treatment resulted in the decrease of Shannon's diversity of fungal microbial communities which may be a sign of antifungal activity of beneficial bacteria inoculum. The inoculum application resulted in reducing the SST index value for microbial communities inhabiting the phyllosphere.

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TIANJING POSITIVE RHIZOSPHERE EFFECT ON SOIL CARBON IS DOMINANTLY CONTROLLED BY ABIOTIC RATHER THAN BIOTIC FACTORS ACROSS GLOBAL AGROECOSYSTEM

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Keywords: rhizosphere effect, carbon cycling, soil organic carbon, dissolved organic carbon, soil microbial biomass carbon, soil microorganism

The rhizospheric carbon (C), as the most sensitive terrestrial C to climate change, has been considered an essential link between atmosphere, plant, and soil material circulation. However, the spatial patterns and driving factors of rhizosphere effect on soil C in global agroecosystem were not systematically quantified. With 748, 294, and 695 paired data of soil organic carbon (SOC), dissolved organic carbon (DOC), and soil microbial biomass

carbon (SMBC) from 154 target literatures, together with 25 biotic and abiotic variables across global agroecosystem, the results showed that rhizosphere had higher SOC, DOC, and SMBC compared to bulk soil, with increased 7.0%, 34.6%, and 26.1%, respectively. The rhizosphere effect on SOC and DOC was significant different under climate zones, aridity index, and crop types, but this phenomenon did not occur in the rhizosphere effect on SMBC. Soil available nutrients dominantly regulated the rhizospheric SOC (relative influence of 37.0%), and SMBC played a small role in regulating the rhizospheric DOC besides the aridity index, crop types, initial soil C, and soil pH. Soil microbial structure, diversity, and function were not crucial for regulating the rhizospheric C. Path analysis showed a network of inter-correlation of climate, soil physicochemical properties, and SMBC in determining the rhizosphere effect on SOC and DOC. Our results reveal the relative importance of aridity index, crop type, soil property, and their complex interconnections in driving the rhizosphere effect on soil C in global agroecosystem. Ignorance of the size and driving factors of rhizosphere effect on soil C is likely one of the main reasons for the large variation of soil C predicted by Earth system models.

TOWARDS IMPLEMENTATION OF VISEGRÁD FOUR+ CONSORTIUM IN ACADEMIC AND SCIENTIFIC ACTIVITIES

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Keywords: The new paradigm, key drivers, internationalization, collaboration, mobility

The new paradigm about the employees has opened mostly the universities (as human capital resource producers) in the world. The key drivers related to this issue are: Industry 4.0, emancipated learning, internationalization, and COVID-19. In view of the internationalization matter, learn not only the academics but also the cultures and customs in the host country. Meanwhile, in simple form, the evolution of employee is shown in Table 1 [1].

Table 1. The evolution of employee

Past	Future
Work 09 – 17	Work anytime
Work in an office	Work anywhere
Use company equipment	Use any device
Focused on inputs	Focused on outputs
Climb the company ladder	Create your own ladder
Pre-defined work	Customized work
Stores information	Shares information
No voice	Can become a leader
Relies on email	Relies on collaboration technologies
Focused on knowledge	Focused on adaptive learning
Company learning and teaching	Democratized learning and teaching

Nowadays, support each other to make further collaboration between universities worldwide is needed, in the education and scientific field, especially to enhance education quality. The new policy in Indonesia about "freedom to learn (independent learning) – independent campus" is a challenge for ITENAS Bandung, and with establish of the Visegrad Four+ consortium, it is hoped will enhance various collaboration and mobility, significantly, particularly in support excellent education, in responding to the new paradigm about the employee, for a better world [2].

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IMPACT OF UREA-BASED FERTILIZER MODIFIED WITH NBPT UREASE INHIBITOR ON GROWTH OF SPRING WHEAT IN POT EXPERIMENT

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Keywords: urea fertilizer, urease inhibitor, ammonia emissions, N loss.

The European Commission, through Directive NEC [1], clearly expressed its position referring to the reduction of urea-based fertilizers in agriculture. According to Directive NEC, after 2030 use of pure solid urea as a fertilizer must be limited due to high ammonia emissions. Therefore, urea fertilizers must be gradually replaced by ammonia nitrate fertilizers or by urea fertilizers with reduced ammonia emissions at the level of 30 % in order to reduce ammonia emission. Only such fertilizers will be allowed to remain on the market and still in use. The review of the literature shows a plenty of substances, which decrease ammonia emission from the soil fertilized with urea. In commerce sense, urease inhibitors such as: NBPT and NPPT [2] or 2NPT [3] have a great potential to limit NH_3 volatilization. The efforts of the Commission to limit use of nitrogen fertilizers, are also included in the climate Package "Fit for 55" widely discussed nowadays. In this context, on 20 October 2021 the EU Parliament approved Resolution on "a farm to fork" strategy for a fair food [4].

The Resolution implies inter alia 20 % limitation in use of fertilizers in EU to force GHG reduction until 2030. The specialists of Centre for Climate and Energy Analyses predicted that the assumptions to "a farm to folk" strategy may shrink food market in significant way. Forcing GHG reduction by 20 %

may lead to decline in value of produced market commodities by ca. 9.5 % in Poland [5].

We conducted the laboratory experiment of growing of spring wheat (cv. Rusalka) fertilized with urea-based fertilizer modified with NBPT and pure urea as a control. Beside ammonia emission measurement, leaf chlorophyll content, photosynthesis rate, shoot biomass were conducted among the measurements during plant growth. These factors seem to be as well important as reducing of ammonia emissions shown in EU's legislations due to a specific reply on how model plant is able to assimilate nitrogen from the soil solution, especially in presence of NBPT and under lower loss of nitrogen via less NH3 waste. Our results shows a positive impact of addition of urease inhibitor on reduction of N loss.

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METATAXONOMY IN ORGANIC STRAWBERRY CULTIVATION - WHAT'S THE BIG DEAL?

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Keywords: mycobiome, microbiome, metataxonomy

Classical, plate-based methods to determine the composition of microorganisms present in a particular environment are time-consuming and often inaccurate [1]. Molecular methods of microorganisms detection, such as optimized by us triplex real-time PCR and LAMP, in contrast, are more precise and rapid [2,3], but unfortunately they do not offer characterization of whole microbiome present in the sample. State-of-the-art metataxonomic methods are able to analyze bacterial and fungal taxonomic composition and diversity present in the sample, allowing throughput and deeper characterization of microbial communities.

The aim of the research was to characterize mycobiome and microbiome composition of organic strawberry plantations. We collected samples of bulk soil, rhizosphere, roots and shoots from organic strawberry plantations located in Poland. Then, we isolated the DNA with FastDNA Spin Kit for Feces (MP Biomedicals, Solon, OH, USA) and sequenced fungal (ITS1) and bacterial (16S) markers with Illumina MiSeq platform (2x300 paired-end). Then, we processed and analyzed the bacterial and fungal data in QIIME2 (Quantitative Insights Into Microbial Ecology) environment (version 2020.11) [4] and R language (v. 4.0.3) in RStudio (v.1.4.1103) (R Studio Team).

We have identified bacterial and fungal phyla most frequently occurring in the samples of bulk soil, rhizosphere, roots and shoots. We also calculated statistical differences between abundances in fungal and bacterial phyla between sample types. We did not detect statistical differences in abundances of top 7 bacterial and top 3 fungal phyla between rhizosphere and bulk soil samples. Rhizosphere and roots differed significantly in abundances of all 7 top fungal phyla.

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THE WONDERS OF LIQUID - PHYSICAL EXPERIMENTS

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Keywords: hydrostatics, air pressure, flow, Bernoulli law, experiments

Among the mainly theoretical presentations we should like to show the interesting side of the Physics, as well, that is the reason, why we started several years ago to have experimental presentations. We would go on with this tradition this year, as well, with the Physics of liquids which is very essential for the Engineering, and for the biological systems as well.

At the beginning, some experiments about the Hydrostatics are planned to present. With the pressure of the liquids, which changes much faster as the air pressure with the height because of their higher density, the effect of the increased a d decreased pressure can be shown. However, there are some special equipment for the pressure decrease (e.g. vacuum pumps), similar results can be achieved by other tricky ways as well, as it will be demonstrated.

If the medium starts moving, it can cause pressure change as well, as it is described by the Bernoulli law. This law gives the background for numerous surprising experiments, which will be demonstrated mainly with air stream, instead of liquid, as the realization is much simpler.

In biological systems the viscosity determines the flow, on this field the most interesting materials are the so called Non-Newtonian mediums, where the viscosity of the medium is depending on the speed of the deformation. During our experiments we will demonstrate this behavior with starch, or to be more exact, with starch solution. In the very end (if our time schedule makes it possible yet) some experiments about the surface tension is planned to show.

We hope that after the Covid period, when we had to have online conferences, these experiments with personal presence will give an enjoyable way to meet with the physics.

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INFLUENCE OF NOD FACTORS (LCOS) ON MORPHOLOGICAL TRAITS AND YIELDING OF PEA

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Keywords: field pea, symbiotic N fixation, Nod factors, yield

Bacterial Nod factors (lipochitooligosaccharides - LCOs), considered as signal particles involved in the exchange of information between the bacteria and the plant in the process of biological reduction of atmospheric nitrogen, contribute, among other things, to the deformation of root hairs, the formation of new meristems [1,3] and root nodules [2].

The aim of the study was to evaluate the possibility of increasing the yield of pea by improving the symbiotic nitrogen fixation process as a result of the application of a preparation containing Nod factors. The study also determined the effect of stress conditions (soil water deficiency) on the course of pea-rhizobia symbiosis.

The preparation of Nod factors was applied before sowing in the form of seed dressing, at a dose of 1 dm^3 per 100 kg seeds. The experiment was set up and conducted in Mitscherlich pots containing a mixture of garden soil and sand, in a ratio of 5:2. The preparation of Nod factors was obtained from the strain of *Rhizobium leguminosarum* bv. *viciae* GR09 (Rlv GR09) at Maria Curie Skłodowska University in Lublin, Poland. In a one-year experiment conducted in a two-year cycle, the pea cultivar Batuta was included. The first experimental factor was the type of preparation used (H_2O, LCOs), and the second factor was soil moisture (30 and 60% of field water capacity).

The applied preparation of Nod factors had a favorable effect on the formation of morphological features and on pea yielding, especially under conditions of water deficit in the soil. Pea plants grown from seeds treated with the above mentioned preparation were higher and produced a larger leaf area

than plants grown from control seeds (treated with demineralized water). An increase in the yield of pea seeds as a result of the application of this preparation was a consequence of an increased number of pods per plant and the number of seeds per plant, while the other features of the yield structure (number of seeds per pod and 1000 seed weight) did not change significantly.

On the basis of the conducted research, it can be concluded that the application of a preparation containing LCOs signal particles can be an important factor for improving the efficiency of symbiotic nitrogen fixation, and thus better nutrition of plants with this nutrient and consequently - increasing the seed yield of pea.

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WASTE CLASSIFICATION SYSTEM FOR ORGANIC AND NON-ORGANIC WASTE BASED ON REAL TIME ARTIFICIAL INTELLIGENCE

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Keywords: ResNet-18, real-time, waste, classification

Garbage is an inextricable part of human life because every human being creates and produces waste. In Indonesia, waste is generally classified into two types based on its composition: organic waste and non-organic waste. In this study, Artificial Intelligence was used to create a design for classifying different types of organic and non-organic waste images (AI). It can distinguish between organic and non-organic waste with some accuracy by directing the object at the camera.

In this study, the main hardware such as the Jetson Nano and Camera were used. The ResNet-18 (Residual Network) model is then used with the Python programming language. The ResNet model produces better input data but has a more stable change in the training error gradient [1]. The training process in this study was carried out over 30 epochs. Figure 1 depicts the accuracy and loss graph during the training process.

The measurement for classifying of organic and non-organic waste in real-time in the morning, day, afternoon, and night, based on the condition of the waste object. The accuracy of the classification test in the morning was 88.46 %, 100 % during the day, 92.31 % in the afternoon, and 88.46 % at night. As a result, the average accuracy in the classification of organic and non-organic waste in real-time using the ResNet-18 model is 92.30 %.

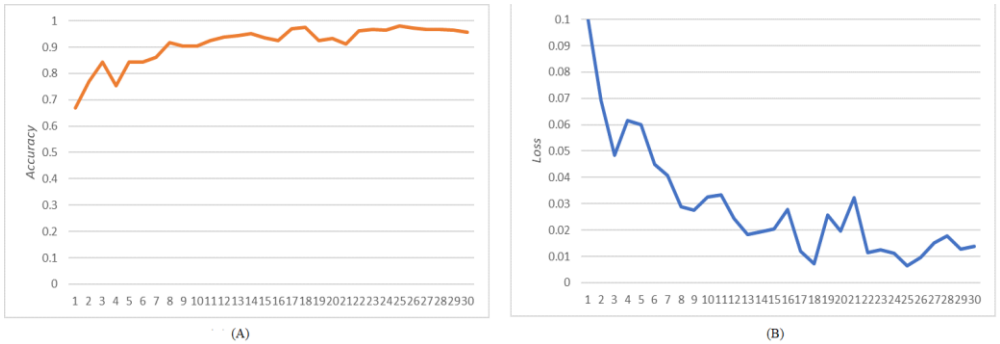

Fig. 1. (A) Accuracy Training for Graphics, (B) Loss Training for Graphics

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ONSHORE PIPELINE MECHANICAL DAMAGE ANALYSIS

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Keywords: oil industry, impact, crack assessment, lifetime, maintenance strategy

The onshore oil industry uses the pipeline as transport media to deliver the product hydrocarbon fluids [1]. The pipeline is designed to operate safely, and the installation is subject to any requirements and activities around could impact or defect the pipeline. Pipelines onshore can be impacted by excavating machines and causes mechanical damage. Dent is one mechanical damage due to those activities which give a force to the pipeline. To evaluate pipeline damage can be assessed by some equations using several parameters such as factors of sigma facture, the diameter of the pipeline, etc. The type of the crack assessment methodology can be seen in Fig. 1 [2].

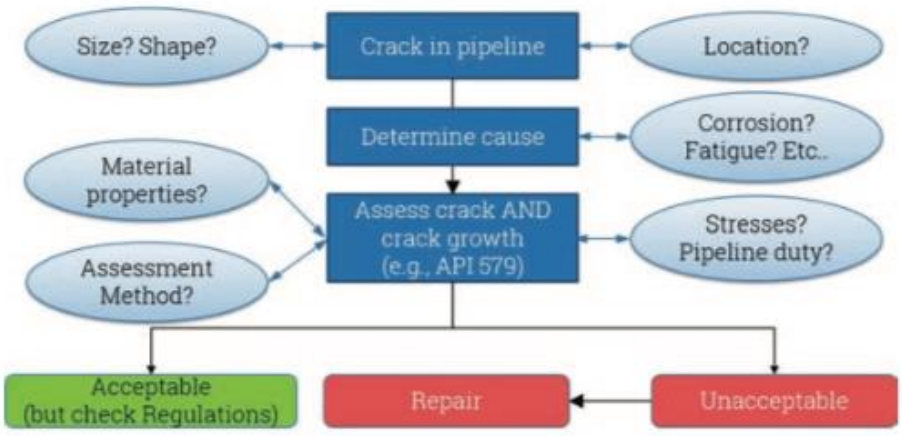

Fig. 1. Crack Assessment Methodology

In this work, an assessment of dent as one of mechanical damage will be performed. A dent phenomenon is principally describing the condition of the pipeline after the impact. The output of dent assessment can be used to predict the pipeline lifetime or as a comparative basis to the criteria of pipeline standards. Based on the evaluation, it might be that further treatment is needed, as a maintenance strategy.

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WATER DROPS' OPTICS AT THIN HYDROPHOBIC LAYER

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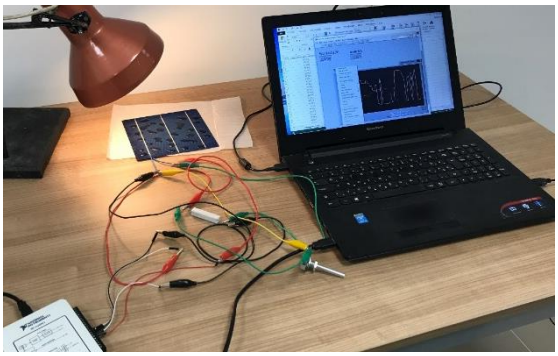
Keywords: measurement, thin layer, refraction, reflection, solar module

The thin hydrophobic layer that often covers the leaves contributes greatly to the self-cleaning of the leaves and thus helps the plants to breathe. When precipitation occurs, the drop-down water droplets carry away the dirt on the leaves. However, in addition to their cleaning effect, the droplets that appear also have surface cooling and optical effects. The present work examines the optical effects. When water droplets appear, the illumination becomes uneven, so the distribution of energy reaching the surface also changes, and the reflection and refraction conditions change. To study the optical effects model was developed by Víg and Tóth (2021), and with the help of this model the simulations were performed.

The essence of the present work is to investigate experimentally the modifying optical effect of water droplets on the light reaching the surface. For the measurement a solar module coated with a nanotechnology thin layer was used, as the performance of the solar module is very sensitive to the lighting conditions and at the same time it can be well measured. The measuring layout is shown in the figure.



To determine the power, values of voltage and current different load resistors are required. For the current measurement the internal resistance was used inserting into the loop as a shunt. A small, but finely variable resistor was a potentiometer with 0-50 Ohm resistance. During the data gathering a myDAQAD converter unit was used, and a computer with LabVIEW program collected the data. Using artificial lighting, the I-V characteristics of the solar module covered with water droplets in different ways were recorded at a constant temperature. Based on these, the maximum power under the given conditions were determined from the comparison of which conclusions can be drawn for the optical effect. Measurements were performed to determine the dependence on the number, size and shape of the water droplets, and to examine the dependence on the angle of illumination.

Measurement results, presented in detail in the presentation, are in good accordance with the results obtained by the model and can be used in addition to solar modules to study the optical effect of water droplets at plant leaves or human skin.

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IOT AND IMPROVING THE FERMENTATION PROCESS OF RICE WINE

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Key words: automation, industry, 4.0, IoT, fermentation, rice wine

Abstract: The article deals with the issue of automation of the rice wine fermentation process in the field of industry 4.0. Fermentation is the process of converting D-glucose into ethanol along with oxidation of reduced coenzymes (fermentation). This is known as ethanol fermentation, which takes place anaerobically in the presence of yeast. The fermentation is being improved by automation (sensors, etc.). The main aim is to develop an experimental automation environment in industry 4.0 for the process of rice wine fermentation.[1] During the rice wine fermentation process, variety of measurable attributes are created which affect the quality of the resulting product. They can be monitored with the help of automation elements (pH, temperature, humidity etc.). In case of an experimental environment development, it is therefore important to select appropriately the sensory that can record the measurable attributes. At the same time, the sensory must be at a level of reliability that guarantee their sufficient use in the mentioned experimental environment for the rice wine fermentation. The result is that, if the right environment is chosen, the quality of the fermented wine will improve. [1]

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BPS 2022

30th – 31st May 2022, Nitra, Slovakia

DETERMINATION OF STRENGTH OF TIME-CONSOLIDATED POTATO STARCH USING A NEW PULLED-BASED CAKING TESTER

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Keywords: caking, powder strength, potato starch

In powder processing, flowability and degree of strength are extremely important parameters. Therefore, there is a need to develop and determine new methods of measuring the strength of bulk materials [1,2]. In the experiment, a new designed pulled-based caking tester was used. Potato starch was placed in perforated vessels with a centrally placed measuring rod. The material was stored at 75% humidity and consolidated with 5 kPa and 10 kPa loading for 2, 4, and 24 hours. The new method is based on measuring the force through a sensor when pulling out measuring rods made of plastic and steel from the powder sample.

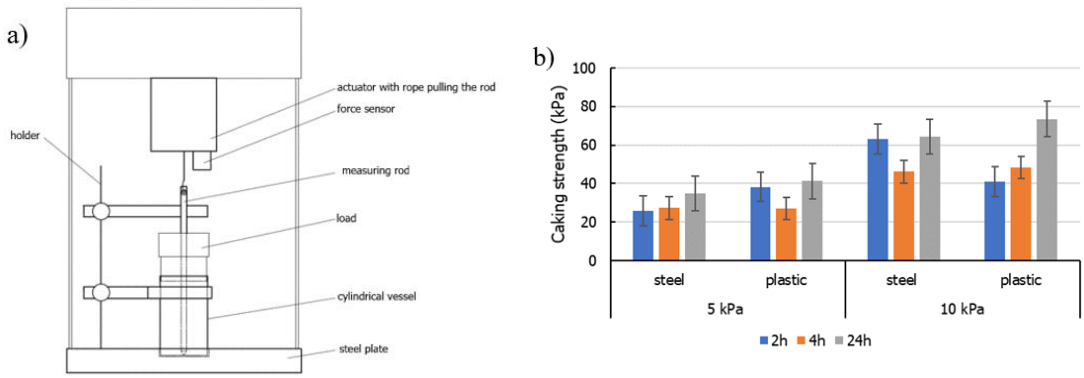

Fig. 1. a) The new pulled-based caking tester, b) The material caking strength values.

It was shown that higher strength values were obtained for powders loaded with 10 kPa. As the consolidation time increased, the strength of the material changed. The increase of starch strength between 2 hours and 24 hours of consolidation was observed. The experimental graphs were characterized by the occurrence of oscillations. Based on their analysis it was shown that their number decreases with a time of starch consolidation. In addition, higher oscillations were observed when the starch was consolidated with a lower load of 5 kPa. It was also shown that the frequency of oscillations slightly increases with the time of consolidation and also slightly higher frequency was characteristic for the samples subjected to 10 kPa load.

Based on the experiment, it was shown that time consolidation affects the changes in potato starch strength. The occurrence of oscillations was also observed in similar studies and was associated with the slip-stick phenomenon [3], which is characteristic of potato starch. Thus, the new pulled-back caking tester can be used not only to study the strength and degree of caking but also to study the slip-stick phenomenon in powders.

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AMMONIA EMISSIONS AFTER UREA-BASED FERTILIZERS APPLICATION

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Keywords: SRF, NH_3 emissions, emissions measurement

The emission of ammonia after nitrogen fertilizers application mainly depend on soil properties (moisture, density, pH) and climatic conditions. Average losses form urea is reported at level c.a. 18% of applied nitrogen [Skorupka M., 2021]. Due to the high diversity of soil properties, ammonia emissions from the soil after fertilization are characterized by considerable spatial and temporal variability. Depending on data sources (and tests conditions), N loses can be at a level of 2–43% for arable land and 10–58% for grassland [Wesołowska M, 2021].

The research was focused on ammonia emission measurements after the application of different type of urea-based fertilizers. Two types of soil and different soil conditions (humidity, compaction) were tested. The results of the incubation tests for chosen prepared fertilizers enabled to distinguish the differences in their efficiencies in regard to reducing the ammonia emissions, and losses of applied nitrogen. To measure ammonia emission levels, the static chamber method (non-flow-through-non-steady-state chamber) with portable FTIR analyzer of gases - Gasmet DX 4040 was used. It is one of the most commonly used method to measure gasses emissions from soils [Livingston and Hutchinson, 1995]. The basic principle of this technique is to cover a known area of soil with a closed chamber that allows the gas exchange between the soil below the chamber and the chamber headspace. The gas concentration change over time inside the chamber headspace is quantified and translated into a flux rate, representing the flux into or out of the soil.

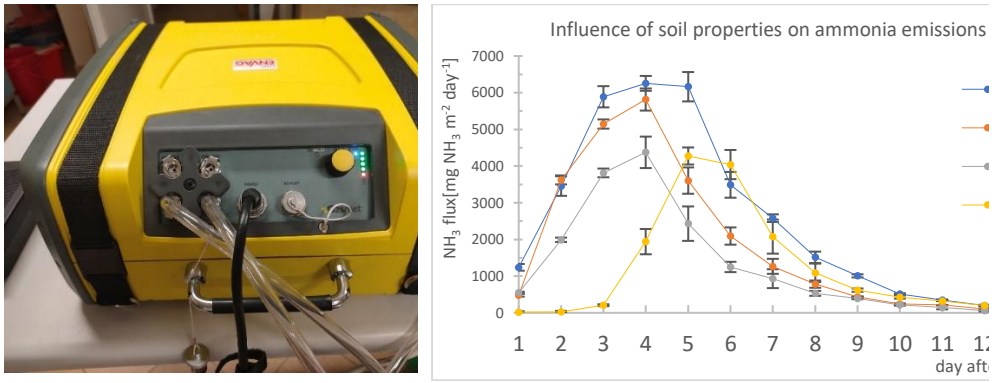

Fig. 1. a) Gasmet DX4040 analyzer b) Daily ammonia fluxes after N fertilizers application

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INFLUENCE OF ORGANIC FERTILIZERS ON PHYSICAL PARAMETERS OF SOIL

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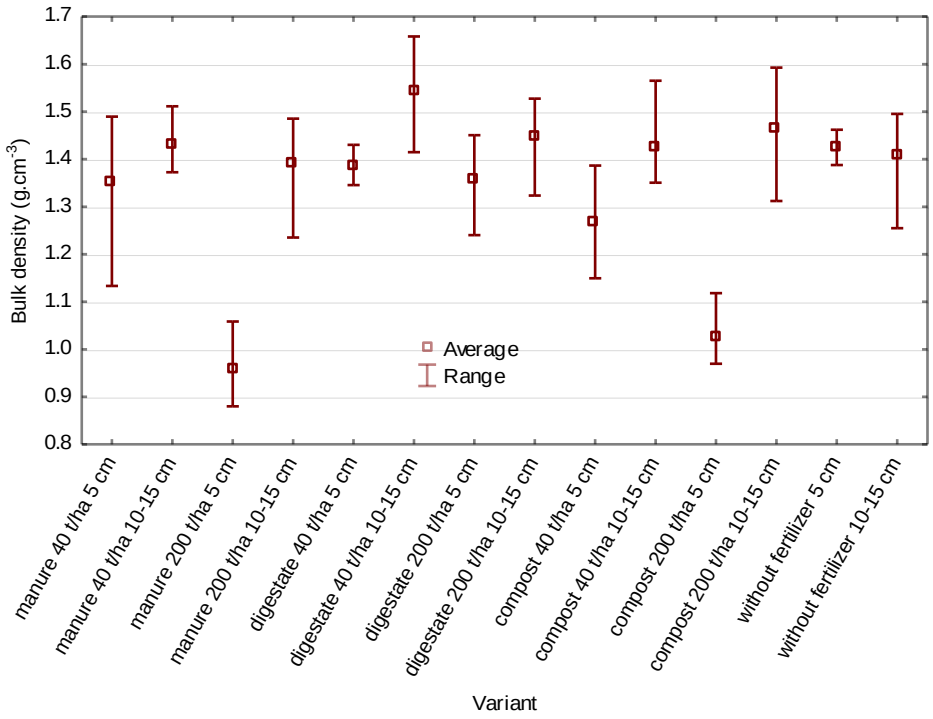
The paper focuses on the effect of organic fertilizers on soil bulk density. For the purpose of measurement, a field experiment was established in the locality Nesperská Lhota in Central Bohemia Region. Experiment included variants with compost, manure and digestate. The rates were 40 and 200 tons per hectare. The experiment also had a variant without fertilization for control. The experiment was based on a sloping plot with a light sandy loam cambisoil. In the experiment, the effects on soil properties, hydraulic conductivity and the effect on crop yield (in this case maize) were evaluated. The Kopecký cylinders method was used [1] . The samples were processed in CULS laboratories. The data show a significant effect of especially high doses of fertilizers on the physical properties of the soil. The data confirm the need to use organic fertilizers in practice. No significant effect was observed for digestate fertilization, when no positive effect of fertilization was recorded. However, this phenomenon can be found in other studies [2].



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CHANGES IN THE SECONDARY AND TERTIARY STRUCTURE OF GLUTEN PROTEINS DUE TO THE ADDITION OF SELECTED FLAVONOIDS AND THEIR GLYCOSIDES

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Keywords: gluten, flavonoids, glycosides, FT-IR

Wheat gluten is a continuous and viscoelastic network that form during dough mixing process and is responsible for dough as well as bread quality. Gluten consists of two types of proteins: gliadins - proteins with a low molecular weight of about 30-75 kDa and glutenins - polymer proteins of molecular weight 80-120 kDa. In the process of the dough mixing, glutenins combine with each other in the presence of water by disulfide bridges. Gliadins, on the other hand, attach to glutenins through hydrogen bonds and hydrophobic interactions. This is how a gluten network is formed in the dough. The network is able to trap fermentation gases during the baking process [1].

Flavonoids constitute a large group of phenolic, plant secondary metabolites. In plants, these compounds are often in the form of glycosides. Due to their structure, they show many beneficial properties for the human body. Therefore, supplementing bread with polyphenols can be a good way to enrich the human diet. However, these compounds can disrupt the proper structure of the gluten network and, at the same time, deteriorate the quality of bread [2].

The aim of the research is to determine the effect of selected polyphenols from the group of flavonoids (quercetin, naringenin, hesperetin) and their glycosides (rutin, naringin, hesperidin) on the structure of gluten proteins in the model wheat dough. Polyphenolic components were added in three concentrations 0.05%, 0.1% and 0.2%. The dough samples were mixed in the farinograph. Then, the gluten was washed out from the dough. Next,

gluten was frozen, lyophilized and pulverized. The samples were tested using FT-Raman spectroscopy [3].

Analysis of the FT-Raman difference spectra in the amide I band showed that flavonoids and their glycosides induce changes in the structure of gluten proteins. The type of these changes depends on the type of functional groups present in the structure of these compounds and the point of attachment of the glycosidic part.

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DETERMINATION OF MECHANICAL PROPERTIES OF WASTE BIOMASS PELLETS

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Keywords: pellets; force; loading; modulus of elasticity; biomass

The work presented deals with the assessment of pellet mechanical properties. Waste biomass in a form of oak sawdust and spruce sawdust, and waste in a form of ground sunflower straw were utilized for the pellet production. Mechanical properties were observed by an experimental device Micro-epsilon UMZ 3K, using a quasi-static test – compressive loading test between two pistons in the pellet axial direction. On the basis of measured values, loading curves between compress force and $F(\varepsilon)$ and compressive strain $\sigma(\varepsilon)$ were plotted, and moduli of elasticity were calculated for each of materials. During the compressive loading test, the maximum compressive force was 120.13 N for oak sawdust pellets; 184.117 N for spruce sawdust pellets; 160.204 N for sunflower straw pellets. The modulus of elasticity showed values of 74.727 MPa for oak sawdust pellets, 45.805 MPa for spruce sawdust pellets and 5.522 MPa for sunflower straw pellets.

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