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Book of abstract

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Enzymatic hydrolysis for specific recovery of monomers from poly(lactic acid)-poly(1,5-pentanediol 2,5-furanoate) novel blends

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Half of the global produced plastics in 2010 was obtained through the blending of different polymers, benefitting from a cheaper and faster production process [1]. In the last decade, new formulations were continuously proposed, in order to fulfil the new biopolymer standards, such as a biobased production and good biodegradability.2,5 furandicarboxylic acid (FDCA) is the most promising alternative to the fossil-based Terephthalic acid for polymer production; it is in fact obtained only from renewable resources. It is currently applied in innovative formulations, especially for packaging: poly(ethylene 2,5-furandicarboxylate) (PEF), poly(butylene 2,5-furandicarboxylate) (PBF), or poly(pentamethylene 2,5-furandicarboxylate) (PPeF) [2]. Due to its versatility, PPeF was produced and characterize in its homopolymeric version, and blended with the biobased Poly(lactic acid) (PLA). The combination of the two polymers tunes the PLA brittleness and its poor biodegradability, while exploiting its environmentally friendly derivation. Enzymatic hydrolysis was chosen to achieve specific depolymerization and overcome a challenging aspect of polymer blending: the disposal. This work describes an application of *Thermobifida cellulositilytica* (Thc_Cut1) cutinase [3] for the hydrolysis of the mentioned blend. The substrate preferentiality of Thc_Cut1 proved to be focused on PPeF from PLA/PPeF blends, leaving PLA matrix intact. Moreover, it was possible to successfully recover FDCA monomer from the hydrolysate. Its high purity, assessed with ^{1}H-NMR and thermogravimetric assay, confirmed the possibility of resynthesis. These findings demonstrated the full circularity of new formulations based on FDCA, from their production to post-use processing.

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Revisiting the structure of fucoidan from Fucus vesiculosus

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Fucoidan is a sulphated marine polysaccharide, which is used as anticoagulant agent. It is isolated from *Fucus vesiculosus* (FV), an abundant brown alga grown in the Baltic Sea, Brittany, and Nova Scotia Ocean water. Fucoidan is a complex polysaccharide and a large diversity of structures was reported. Permethylation, hydrolysis, and conversion into partially methylated alditol acetates (PMAAs) for quantification by GC-FID/MS is a method for the structural analysis of polysaccharides, which is superior to either NMR or FTIR. Fucoidan of FV was first elucidated with GC-FID/MS in 1993, and this publication became the most cited reference on the structural elucidation of fucoidan. We encountered deficiencies in this protocol, for example due to co-elution of 2-fuc and 3-fuc and 2,3-fuc and 2,4-fuc on the most commonly used GC stationary phase. However, the complex structure of fucoidan requires the detection of all possible fucose PMAAs to elucidate the actual structure of fucoidan. We therefore revised the entire protocol and resolved any shortcomings. Fucoidan was methylated by using an excess of lithium dimsyl (15 e.q./OH) and methyl iodide (30 e.q./OH), which was followed by hydrolysis by TFA, reduction by $NaBH_4$, and acetylation by acetic anhydride. For GC, we replaced the DB-5 by an HP-88 column to resolve the co-elution. The improved protocol revealed that FV fucoidan consisted of 3-linked fuc and 4-linked fuc, where sulphate groups were mainly present as mono-sulphate at C-2, sometime di-sulphate at C-2 and C-4 or C-2 and C-3. The sulphate content was 23% w/w, which the value was equivalent to the result determined by elemental analysis. However, it was slightly overestimated against $BaCl_2$ gelatin method. We obtained a more complex structure than the previously reported structure.

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Time vs drought: leaf age rather than drought drives osmotic adjustment in V. vinifera cv. Pinot Noir

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Global warming and the increasing occurrence of severe droughts due to climate change pose significant threats to agricultural crops. One common response to drought in plants is the leaf osmoregulation, leading to more negative leaf turgor loss point (TLP) and the ability to maintain gas exchange at lower water potentials[1]. This study explored how Pinot Noir grapevine leaves adapt their osmotic potential under three key factors: (i) time/ seasonal changes (seasonal osmoregulation), (ii) different growth temperatures, and (iii) exposure to drought events. The research was conducted in semi-controlled field conditions and in two different greenhouse chambers (maintained respectively at 20/15°C and 25/20°C day/night). Over two consecutive growing seasons, potted grapevines were subjected to either well-watered (WW) or water deficit (WD) conditions for at least 30 days. Leaf osmotic potential and TLP were measured using pressure-volume (PV) curves and osmometer readings, while plant gas exchange and water potential were continuously monitored during the growin season. Surprisingly, our results did not provide consistent evidence that temperature and water deficit stimulate osmotic adjustment in Pinot Noir, despite the experienced lower water potentials throughout the season. Conversely, seasonal osmoregulation[2] significantly decreased the osmotic potential at full turgor by an average of 0.46 MPa in 90 days.Lack of osmotic adjustment in response to drought observed in this cultivar suggests *Vitis* genotypes have a broad spectrum of responses to drought and the strategy adopted to cope with it is highly dependent on the cultivar under analysis.

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Synthesizing graphene doped by chemical vapor deposition

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The use of graphene as an additive in adhesives can significantly increase their strength and durability, enabling more effective bonding of materials due to its exceptional robustness. In this study, pristine graphene (G), nitrogen-doped graphene (N-G) and nitrogen-boron co-doped graphene (N,B-G) nanoporous materials as additives were synthesized via the chemical vapor deposition (CVD) method. The synthesis of graphene-doped nanoporous structures was carried out in a one-step growth process using waste materials such as melamine-impregnated paper, which is known for its cost-effectiveness and ease of handling as a solid feedstock. Boric acid was employed to facilitate the co-doping of boron into the graphene structure. These synthesis processes occurred under growth temperature of 1050^{o}C for G and 800^{o}C for N-G and N,B-G. To assess the quality of both pristine and doped graphene, a range of characterization techniques including Raman spectroscopy, elemental analysis and X-ray diffraction were applied. The high ratio of D (1350 cm^{-1}) to G (1580 cm^{-1}) peak observed in Raman spectra of all samples signifies high disorder, a favorable characteristic for multifunctional additive applications. Furthermore, SEM and FTIR analysis were conducted. In FTIR, the peak related to C-N and B-N bonds were observed at wave numbers 1638 cm^{-1} and 1574 cm^{-1}, respectively. This study stands as the pioneering effort in employing waste from melamine impregnated paper as carbon and nitrogen sources in a one-step synthesis of graphene doped nanoporous. The proposed CVD method, utilizing economical and readily available solid carbon and nitrogen sources, offers an efficient and practical approach for the growth and production of both graphene and doped graphene materials. These findings significantly contribute to the development of straightforward synthetic methods for nitrogen-doped graphene using solid precursors.

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Suitability Evaluation of Biobased Resins for HPL Production Based on Wetting Behaviour

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High-pressure laminates (HPL) are engineered materials used as decorative horizontal and vertical surfaces both indoors and outdoors. They are employed in a wide variety of uses, including furniture production, wall claddings for facades and balconies. HPL comprise multiple layers, including a core layer of sheets of Kraft paper impregnated with phenol-formaldehyde (PF) resins. This core provides the final product with resistance to chemicals, moisture, and fire, as well as excellent mechanical properties. However, increasing environmental concerns are fueling the search for a more sustainable alternative to fossil-based PF resins. A crucial factor for the suitability of an impregnation resin is its interaction with the paper substrate. In particular, the surface tension of the resin and the surface free energy of the paper determine their degree of compatibility. In this work, the surface free energy of paper and its polar and dispersive components were determined by contact angle measurement. Based on this knowledge, the wetting envelope of the substrate was ascertained. This crucial information was used to assess the wettability of the paper with different bio-based impregnation resins synthesized in this work, in order to investigate their suitability for HPL-production.

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Relationship between cure kinetics of formaldehyde-based wood adhesives by means of dynamic rheology and DSC

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During the complex curing process, formaldehyde-based wood adhesives undergo a transition from a liquid state into a highly crosslinked solid state. Rheometry and differential scanning calorimetry (DSC), are powerful techniques for analyzing the curing kinetics of formaldehyde-based adhesives. However, it is difficult to compare the results obtained from both techniques, as they are unavoidably performed under different conditions, which affects the resulting kinetic parameters. This study aims at finding a relationship between the kinetic parameters for curing selected formaldehyde-based adhesives based on analogous non-isothermal rheometry and DSC measurements. Rheometrically determined "complete" (100%) cure, at which maximum complex viscosity is reached, was lower than the complete conversion found by DSC, as the point at which no further enthalpy changes could be detected. The two techniques do not provide consistent information on the actual degree of conversion. For practical reasons, it is important to match the two methods and determine which method provides the most useful information up to which degree of curing, whereby the degree of curing is only defined on an operational basis. The results showed that the comparison between curing kinetics should not be just restricted to the comparison of activation energies.

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A biotechnological approach to upgrade wheat straw into high-performance binderless boards

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To transform our current fossil-based into a modern bio-based economy, new utilization concepts for the available biomaterials are required. Here, the material use of underutilized agricultural by-products like wheat straw offers considerable potential. Nature has optimized the structure of straw towards the ability to transfer the grain ear load and withstand external forces such as wind. This is accompanied by excellent strength properties, which the straw receives due to its fibrous structure. Due to the high-performance structure, the question arises whether it is more reasonable to utilize the structure of the straw in an engineering material than to disassemble the bio composite for biorefinery or to burn it directly without material utilization. In the scope of our research, a biotechnological approach was adopted to upgrade wheat straw to high-performance fibreboards without the use of binding agents. For this purpose, straw was first converted into fibres using a mild semi-chemical pulping process. The fibres were then exposed to natural water retting for various periods of time. The treated fibres were finally hot-pressed into fibreboards following a wet process. Detailed analysis and sequencing revealed the microorganisms involved and showed that generated xylanase interacted with the fibres. On the one hand, this improved the drainability of the fibres and thus the processability, bringing the process closer to industrial implementation. On the other hand, the biotreatment improved the self-bonding properties of the straw fibres, increasing both the mechanical properties and water resistance. Here, an 8-day biotreatment proved to be optimal and resulted in impressive flexural strengths of 64 MPa, flexural moduli of 6.8 GPa and internal bond of 1.1 MPa. While the properties partially reached the level of the top performers of binderless fibreboards made of straw, this approach offers above all the possibility of boards manufactured more efficiently and simply.

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Functionalised adhesive bondlines: evaluation of different conductive fillers to detect moisture in engineered wood

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Timber structures can decrease in performance in case of undetected moisture ingress. Nowadays, monitoring is frequently omitted, or performed while it may alter the structure's integrity. Therefore, there would be a need for an early detection of excessive moisture to ensure their durability. In this regard, adhesive bondlines modified with electrically conductive fillers could turn engineered wood into an embedded sensor system. However, a certain electrical percolation threshold needs to be reached in order to have an electrically conductive network. This threshold is influenced by different parameters such as the viscosity of the resin, filler type, and dispersion quality. In this research, the effect of different carbon fillers dispersed in melamine-urea formaldehyde resin on the electrical properties of the final composite and on the rheological properties of the adhesive was studied. Shear rheological measurements were performed to evaluate the modification of the resin's viscosity and a build-in setup was made to evaluate the electrical resistance of glued spruce *(Picea abies)* samples across the bondline. The interactions between the filler and the resin are of interest for understanding the electrically conductive network and further combination of rheo-electrical measurements could provide more information on the internal structure of the different modified adhesives.

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n-Alkanes as Predictive Markers to Assess the Nutritional Contribution of Free-Range Systems for Laying

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Most plant species have a pattern n-alkanes concentration profile in their cuticular wax that remain undigested and can be used as markers in animal nutrition research. It is therefore possible to estimate diet composition by comparing these n-alkane profiles with those of feces corrected for their recovery rate. The aim of the present study was to investigate how n-alkanes are processed through the digestive tract of laying hens and their efficacy in predicting feed intake and diet composition. The experimental design was completely randomized with 2 pre-lay diets with or without 1% of a pre-dried lucerne (Medicago sativa) added on top of the diet. During the 4 days of adaptation, all hens received a common diet containing 2.75 Mcal AMEN/kg, 0.69% dig. Lys, and 2.50% Ca, with a restricted feeding system of 80 g/day per bird. There were 24 replicates for each treatment, with an individual caging as the experimental unit. Feed intake was estimated and total feces were collected during the last 2 days of the study. The mean values of the analyzed n-alkanes (mg/kg DM) were (1.59, 44.34, 2.20) for C27, (2.59, 289.52, 5.69) for C29, and (1.79, 357.88, 5.13) for C31 for the commercial diet, the pre-dried lucerne and the mixed feed with lucerne, respectively. A relatively low recovery rate of n-alkanes in feces was observed (37%), with high variability depending on the alkane carbon chain length and the diet consumed. The plants' contribution to DM intake was estimated to be biased by 0 to 1.5%, depending on the tested diet. In conclusion, the methodology showed that n-alkanes can be a valid alternative to reference markers for estimating the free-range farming contribution to the nutrition of laying hens. However, further researches are needed to improve its accuracy and assess the impact of different types of outdoor plants.

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SimTopN: an in silico tool to aid in optimizing data dependent acquisition settings for precursor ion selection

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Untargeted metabolomics approaches aim to detect and identify as many metabolites present in a sample as possible, and liquid chromatography paired with high-resolution mass spectrometry (LC-HRMS/MS) is often used towards this goal. For compound annotation and identification, ions must be fragmented, and the fragmentation patterns can be compared to known compounds. When attempting this in an untargeted manner, the most common method is data-dependent acquisition (DDA), which selects a predefined number of the most abundant (TopN) precursor ions per MS survey scan automatically in combination with simple rules, such as loop count, a dynamic exclusion window, isotopologue deconvolution, etc. As there are so many possible combinations for the DDA parameters, optimizing them for each sample is currently very tedious, and would take a lot of measurement time and sample volume. In order to streamline this process, we have developed SimTopN, a software tool that simulates precursor ion selection *in silico* using a previously-generated LC-HRMS full scan chromatogram of the sample. SimTopN covers all parameters provided for precursor ion selection with Orbitrap instruments. Depending on the sample and parameters, simulations can take less than a minute, saving time, and also provide the user with plots of precursor ion intensity, and if a peak table is provided as a ground truth, coverage and false positive rate plots, so the user can determine which settings are best suited for their DDA measurements. Additionally, .mzXML files are provided so the user can inspect the outcome of the simulation manually. SimTopN is written in the D programming language, and supports both Windows and Linux operating systems. The code will be provided in a free and open-source manner via github, and a pre-compiled executable will also be provided for both supported operating systems. SimTopN has been tested on an Q Exactive HF Orbitrap.

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Poster Presentation

1. Poster	Francesco	Flagiello	Unveiling a Hidden Link: Does Time Hold the Key to Altered Spectral Signatures of Grapevines under Drought?
2. Poster	Johanna	Kreuter	Hydrophilic ionic liquids for the rapid and simple release of nucleic acids from bacteria
3. Poster	Lalropuia	Lalropuia	Enrichment and adaptation of bioleaching consortia for the recovery of critical metals from spent Lithium-ion batteries
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Unveiling a Hidden Link: Does Time Hold the Key to Altered Spectral Signatures of Grapevines under Drought?

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Remote sensing technology captures spectral data beyond the visible range, making it useful for monitoring plant stress. Vis-NIR (Visible-Near Infrared) spectroscopy (400-1000 nm) is commonly used to indirectly assess plant status during drought. One example is the widespread use of normalized difference vegetation index (NDVI) that is strongly linked to green biomass. However, a knowledge gap exists regarding the applicability of this method to all the drought conditions and if it is a direct correlation to the water status of the plant. This study focused on the spectral behavior and physiological changes in leaves of different grapevine cultivars, that were subjected to different dehydration conditions. The goal was to determine the potential role of time influencing the consistency of responses across different water dehydration conditions, and if drought stress symptoms could be detected through Vis-NIR analysis. The experimental design included four dehydration treatments: leaf dehydration by (i) cutting the stem from the roots, (ii) removing the soil from the root zone, and (iii) natural dehydration by irrigation withholding. By monitoring the spectral and physiological changes, the study aimed to assess the impact of different dehydration timings and the detectability of associated symptoms. Our results suggest that the timing of dehydration strongly influences the spectral signature changes. In instances under comparable water potentials, plants subjected to fast dehydration (e.g., stem cutting or detached leaves) displayed spectral patterns not significantly different as compared to the ones from adequately hydrated control plants. In contrast, plants undergoing gradual dehydration over several days (e.g., via irrigation withholding) exhibited spectral modifications consistent with previously documented findings.

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Hydrophilic ionic liquids for the rapid and simple release of nucleic acids from bacteria

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The diagnostics of health-relevant microorganisms and viruses increasingly relies on the detection and quantification of their nucleic acids, DNA and RNA. The extraction of nucleic acids from the respective, often very diverse samples requires complex protocols, a considerable amount of time and effort as well as special equipment, making sample processing one of the main bottlenecks of molecular diagnostics. On the path to simple and efficient DNA/RNA extraction procedures, we have previously demonstrated that hydrophilic ionic liquids (organic salts that are liquid below 100°C) are able to effectively lyse Gram-negative and Gram-positive bacteria in a matter of minutes and release DNA for subsequent analysis by qPCR. We have recently adapted the protocol for the lysis of periopathogenic bacteria for point-of-care diagnostics. Periodontal diseases, such as gingivitis and periodontitis, are among the most common diseases worldwide. Early and targeted therapy can prevent not only the impending loss of teeth, but also possible systemic secondary diseases. We could show that hydrophilic ionic liquids are capable of lysing periopathogenic bacterial cells at room temperature, within 5 minutes. In a next step, we are investigating the effect of ionic liquids on the stability and detectability of RNA. In contrast to DNA-based detection methods, tests for rRNA allow insight into metabolic activity and can improve the detection limit, while analysis of mRNA indicates activity of a specific metabolic pathway. Furthermore, RNA-based detection methods are essential for diagnostics of RNA-viruses. Lastly, we have established a molecular diagnostic workflow for the detection of Legionella spp. in water that is suitable for on-site use. It consists of a combination of membrane filtration, cell lysis using hydrophilic ionic liquids followed by loop-mediated isothermal amplification-based analysis for on-site testing of water quality. In conclusion ionic liquids allow rapid, simple cell lysis protocols with little equipment and hands-on time.

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Enrichment and adaptation of bioleaching consortia for the recovery of critical metals from spent Lithium-ion batteries

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The demand for Lithium-ion batteries (LIB) dramatically increases in recent years due to its application in different electronic devices but mainly due to its use in electric vehicles (EVs) and is projected to further increase in the near future[1]. This results in generation of large amounts of LIB wastes most of which will end up on landfills, posing potential environmental threats and may further lead to insufficient supply of the required raw materials for Li-batteries production like Co, Ni, Li etc. [2]. The LIB wastes contain substantial amounts of critical metals and can therefore act as a good secondary source for these metals. Additionally, efficient recycling of LIB could help to mitigate the environmental impacts as well as reduce the mining of virgin minerals [3].Recovery of critical metals such as Li, Co, Ni, Mn, Cu, etc. from the black mass of spent LIB can be carried out using bioleaching, a process which uses microorganisms to solubilize metals mainly from sulphidic ores but also from other secondary sources such as ashes and slags, etc.[4] Bioleaching is a viable option due to its economic advantage and environmental friendliness as compared to the conventional method of recycling which is mainly done by pyro or hydrometallurgical processes [5]. During this study, environmental samples from a highly acidic lake were enriched in three different universal media with iron, sulphur or a mixture of iron/sulphur as the sole energy source. One promising culture was selected and used for adaptation experiments with elevated concentrations of Li^{+}, Co^{2+}, Ni^{2+}, Mn^{2+}, and Cu^{2+}. 16S rRNA metagenomic analysis of the enriched culture showed that the dominant genera included *Acidithiobacillus, Alicyclobacillus*, and *Sulfobacillus*. Finally, up to 100% recovery of Li, Co, Ni, and Mn was achieved by direct bioleaching using the adapted enriched culture.

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Challenges in Austrian winemaking: shifts in ROS metabolism and harvest quality in climate change scenarios

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Grapevine (*Vitis vinifera*) is an economically important crop in Austria, where approximately 45,000 hectares are dedicated to viticulture. Future climate change scenarios, with increasing frequency of drought spells and heat waves, are predicted to impact harvest quality not only in terms of yield but also key secondary metabolites necessary for aroma and mouthfeel of wine. Drought and heat are known to alter various biochemical processes in developing grape berries, and one feature that these two stressors have in common is that they increase production of cytotoxic reactive oxygen species (ROS) in cells. Despite their toxic nature, ROS also play a role in berry development throughout the growing season, such as during the veraison-associated oxidative burst. It is therefore important to understand how drought- and heat-induced changes in ROS metabolism may be correlated with the final makeup of important secondary grape metabolites upon harvest, and how stress-induced ROS production can be influenced by development-related ROS signalling. Our project focuses on drought and heat stress imposed in different stages of berry development. Drought is imposed through the use of lysimeter scales, which also measure whole-plant evapotranspiration, and plant water status is monitored through measurements of stomatal conductance (g_{sw}) and stem water potential (Ψ_{stem}). Heat is imposed through the use of infrared lamps aimed at the grape bunches and monitored through infrared thermometers and canopy temperature sensors. Biochemical analyses are focused on quantification of secondary metabolites through chromatographic techniques (HPLC, GC/MS) whereas measurements of ROS metabolism will focus on ROS-scavenging enzyme activity and gene expression.

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Nitrogen forms and Iron deficiency: how do Grapevine rootstocks responses change?

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Grapevine rootstocks provide protection against environmental biotic and abiotic stresses. Iron (Fe) and nitrogen (N) are key nutrients, as they involved in many functions, such as chlorophyll synthesis and photosynthesis [1]. The application of nitrogen forms, nitrate (NO3-), and ammonium (NH4+) and in which ratio can influence plant growth, nutrient uptake, and physiological processes [2]. Iron nutrition of plants can be significantly affected by different nitrogen forms through altering the uptake ratio of cations and anions and changing rhizosphere pH. The aim of this study was to better understand how nitrogen forms and iron uptake interact to affect the physiological, biochemical, and molecular response mechanisms of grapevine rootstocks. Rooted woody cuttings of the rootstocks Fercal (V. berlandieri x V. vinifera) and Couderc 3309 (V. riparia x V. rupestris) were grown within a hydroponic system (Kick-Brauckmann, 7.5 L pots) filled with modified half-strength Hoagland solution under semi-controlled climatic glasshouse conditions in 2021. Plants were grown with or without FeNa(III)- EDTA, and with two NO3-/NH4+ ratios (100:0; 50:50). The results showed variations in the degree of induced iron chlorosis. The nitrate plants suffered from iron absence which reflected in severe chlorosis symptoms as a result of high chlorophyll loss, especially in 3309C. Both rootstocks showed a reduction in the root biomass when only NO3- supplied. whereas, the application of both nitrogen forms associated with an increase in root growth, observed only in Fercal. Fercal also showed a high increase in FCR activity with both nitrogen forms combinations, while 3309C showed an increase in FCR activity just with NO3-/NH4+ (50:50). These results indicate that rootstocks differ in their tolerance to Fe chlorosis and have different abilities to modify their growth and physiology to adapt to Fe absence. On the other hand, nitrogen form appeared to have a great impact on iron uptake and reutilization.

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Mechanical treatment and characterisation of plant proteins for their utilisation as wood adhesives

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The vast majority of all wood (building) products are glued as part of their production. Almost all adhesives currently used are based on fossil raw materials. Many systems also contain substances that are hazardous to health or the environment – such as formaldehyde, which is classified as a carcinogen. Despite considerable research efforts, large-scale industrial use of alternative adhesives in Europe has not yet been achieved. Among the potential bio-based alternatives, plant proteins show promising properties. However, their use is currently limited by insufficient processability (high viscosity despite high water content) and low moisture resistance of the products. Using mechanical methods to improve the rheological properties together with the solid content of the protein dispersions. Homogenisation of the protein dispersions and alteration of the protein structures can be utilised to make them suitable for use as bio-based adhesives for wood building products. Compared to the alkaline treatments currently used, mechanical methods for protein denaturation allow savings in process time and chemicals. The primary structure of the proteins remains largely unchanged, thus preventing an undesired, excessive reduction of the molecular mass. In addition, mechanical methods offer the significant advantage of a high degree of freedom for the subsequent cross-linking process, which can be carried out both purely physically and chemically.

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AN INVESTIGATION OF WOOD BARK AS A PROMISING OF CNF's raw material

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The abundant amount of bark from pulp and paper industries is becoming an environmental issue because current methods of bark utilization can not significantly decrease the volume of bark waste. To address this, converting to cellulose nanofibrils (CNF) may be more effective in minimizing the bark and increasing the added value of the bark. In this study, four different raw materials, i.e., spruce wood, poplar wood, spruce bark, and poplar bark, were repeatedly treated with hydrogen peroxide, acetic acid, and sulfuric acid followed by a reaction with a mild concentration of sodium hydroxide solution. The cellulose pulp product was sequential mechanical fibrillated to yield CNF. Characterisation revealed that CNF from bark exhibited comparable results to those derived from wood-based CNF. Therefore, it indicates that bark can be a potential candidate for CNF raw material.

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Selective recovery of metals from spent lithium-ion batteries using metal-binding peptides

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In December 2022, the EU agreed on a new law on more sustainable and circular batteries based on the Commission's proposal in 2020. In the proposal, higher recycling targets for lithium-ion batteries (LIBs) of 65% in 2025 and 70% in 2030, respectively were introduced. Moreover, material recovery rates of 95% in 2030 for Co, Ni and Cu and 70% of Li were required [1]. After mechanical LIB processing, the fine-grained active material contains critical raw materials such as lithium, phosphorous, cobalt, silicon, and graphite as well as nickel, copper, and manganese. Successful bioleaching of the active material results in polymetallic solutions with a high acidity (pH <3). By adjusting the pH of the leachate, target metals can be precipitated selectively but there is a high risk of co-precipitation of Ni2+, Co2+, Mn2+, and Cu2+ due to similar solubility of their hydroxides [2]. Peptides show a high sensitivity and selectivity towards binding of metals. Therefore, peptides with metal-binding properties present a novel technique for metal separation from aqueous solutions via biosorption. A powerful tool for the identification of those peptides with strongest affinities to the desired metals from a large variety of candidates is phage surface display (PSD), where short peptides are presented on the surface of bacteriophages which can then be separated based on their metal binding affinities [3]. In initial PSD experiments, a plethora of peptides were screened and promising nickel binding peptides have been identified. First characterization results indicate that these peptides can be used to selectively separate nickel from cobalt and other metal ions in aqueous solutions. Attaching the peptides to a suitable carrier material will make it possible to extract the specific metals from complex solutions like the spent lithium-ion batteries and therefore support the European recycling goals.

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