IJAMB
INTERNATIONAL JOURNAL OF ADVANCES IN MEDICAL BIOTECHNOLOGY
(e-ISSN: 2595-3931)

II EPNAT

Encontro de Polímeros Naturais

Meeting on Natural Polymers

21 a 23 de outubro de 2020.

Organização: UNIARA · FZEA USP · unesp · UNIFESP · UNICAMP · UFPI

The 2nd Meeting on Natural Polymers – EPNAT brought together entrepreneurs, undergrad and graduate students, postdocs, and professors to discuss emerging research challenges and strategies for different applications of natural polymers. The II EPNAT was chaired by scholars from leading universities in Brazil: University of Araraquara (UNIARA), University of São Paulo USP–FZEA, Pirassununga, University of Campinas (UNICAMP), São Paulo State University (UNESP, Araraquara & Ilha Solteira campuses), Federal University of São Paulo (UNIFESP, Diadema campus), and Federal University of Piauí (UFPI).

The event took place virtually in 2020, gathering 1013 participants, 173 abstracts submitted and a strong international engagement, as the lectures given by top–notch speakers, which can you watch on–demand at https://www.youtube.com/watch?v=P5ylh2UrZpQ&t=4673s.

II EPNAT
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BIOFIBERS PRODUCTION - APPLIED IN MICROMOTORS ENGINEERING

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The manufacture of nano/micromotors based on biomaterials, has been the focus of researchers in the last decade. In the present work, it was developed and produced the structure that will serve as a platform for a micromotor capable of worked as drug delivery system. For the micromotor platform, biofibers composed of chitosan and alginate were produced by electrostatic interaction. The biofibers productions was optimized, varying parameters such as: concentration of biopolymers and formation speed. And to assign new functionalities to the biofibers, we added to it carbon nanotubes or quantum dots. The characterizations of the biofibers were carried out, using optical microscope coupled with ultraviolet light, ultraviolet-visible spectroscopy and Fourier transform infrared spectroscopy. Results suggest that the electrostatic formation of biofibers (chitosan/alginate) is directly linked to the concentration of the biopolymers solutions, the best results (less defects in the structure and longer biofibers) were obtained using a chitosan concentration of 2% (w/w) and alginate 1% (w/w). Obtaining a biocompatible and biodegradable platform, using a green synthesis, to produce micromotors is an important step towards the widespread use of these nano/micro machines.

Keywords: Chitosan; Alginate; Biofibers.

II EPNAT
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CHITOSAN/COLLAGEN BIOMEMBRANE LOADED WITH 2,3- DIHYDROBENZOFURAN FOR THE TREATMENT OF CUTANEOUS LEISHMANIASIS

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Leishmaniasis are diseases caused by protozoa belonging to the *Leishmania* genus, which have a wide global distribution and are part of the neglected infectious diseases group, since they occur in the poorest countries and affect the most vulnerable populations. The current pharmacological treatment of leishmaniasis consists of limited therapies, which cause serious side effects, and the majority of the drugs used are only effective when administered parenterally, requiring long periods of therapy. In this work, a chitosan/collagen-based membrane loaded with 2,3-dihydrobenzofuran was developed for use in the treatment of cutaneous Leishmaniasis. The new membrane was characterized by TG, DSC and hydrophilicity was analyzed. Thermogravimetric analysis (TG, DTG, and DSC) was performed on the TA Instruments SDT Q600 V20.9 Build 20 device using approximately 10.0 mg of sample with a heating rate of 10 °C min^{-1} in an Argon atmosphere with a flow of 100.0 mL min^{-1} in an alumina sample holder in the temperature range from 25 to 800 °C. The hydrophilicity of the samples was determined by the angle of contact with the water using the sessile drop method on the Theta instrument (Biolin Scientific) at 25.0 °C. The characterizations of the materials demonstrated that the new chitosan/collagen-based membrane with the use of 2,3- DHB was successfully carried out maintaining the collagen triple helix preserved without deformation. With the insertion of the 2,3-DHB structure, the new membrane had hydrophilicity increased. The antileishmanial activity tests against the promastigote form of *Leishmania amazonensis* exhibited inhibitory effects superior to those of Amphotericin B, which is used in the treatment of Leishmaniasis. These results evidence that the formulated membrane is a great candidate to be used in the treatment of cutaneous Leishmaniasis, being indicated for the advance studies *in vivo*.

Keywords: Antileishmania activity; Cutaneous wound; Membrane.

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CITRUS BY-PRODUCTS AS CARBON SOURCES FOR THE PRODUCTION OF POLYHYDROXYALKANOATES

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Polyhydroxyalkanoates (PHAs) are microbial polyesters. Biologically, PHAs act as carbon, energy, and reducing equivalents storage materials. Industrially, PHAs can be used as plastic materials and in noble applications in the biomedical field. The cost of the carbon source is still the major hurdle for PHAs' large-scale production. Brazilian citriculture occupies a prominent position in the production and international trade of orange juice. This industry generates abundant and cheap carbon-rich by-products. The present work evaluates the use of orange peel flour, pectin, and galacturonic acid as carbon sources for the production of PHAs. Out of the 52 bacteria previously isolated from sugar-cane soil, forest reserve soil, domestic sewage, and good PHAs producers from Bioproducts laboratory collection, 40 were selected by colony staining methods using both Sudan Black and Nile red A. Many of these bacteria grown and were positive for more than one carbon source derived from orange peel. Quantitative assays were performed to evaluate the production of PHAs in shaken flasks. Genetic engineered *E. coli* MG1655 was cultured in mineral medium with galacturonic acid as the sole carbon source (pH 6-7, 37°C, 150 rpm agitation rate). In 24h, *E. coli* accumulate 30% polyhydroxybutyrate (PHB) of the cell dry mass, 0.51±0.17g/L, a result comparable to essays using glucose. These results provide evidence for PHAs' production using citrus carbon sources where the by-product valorization strategy fits in a broader circular economy model.

Keywords: Polyhydroxyalkanoates; Galacturonic Acid; Agro-Industrial Wastes.

II EPNAT
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POLYMERIC PLATFORM FOR CELL GROWTH

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Tissue Engineering is an interdisciplinary field that uses the cultivation of cells in scaffolds which are placed on the damaged site, being degraded slowly as the cells begin to regenerate. Ideally, the material to be used as a platform for cell culture, as well as the scaffold in tissue engineering, should be biocompatible, biodegradable, and should allow mass transport and so adequate diffusion of oxygen and nutrients. Ideally, it should also present a three-dimensional architecture similar to the extracellular matrix through the presence of intertwined fibrils, promoting cell adhesion and allowing uniform cell distribution. In the context of platforms for cell culture, polymers are the most used biomaterials, as they can be associated with other molecules in order to have their properties improved. However, many of the materials produced from synthetic polymers may still present a risk of rejection due to their low bioactivity. In contrast, most natural polymers are biologically active and they have been widely used in the medical and biomedical fields. Lastly, the behavior of cells cultured in scaffolds mimic aspects of the native cell microenvironment, reflecting more appropriately the cell responses *in vivo*. The present work covers the current knowledge of the scientific community based on the most cited and most relevant articles in the considered context.

Keywords: Tissue Engineering; Polymers; Cell Growth.

II EPNAT
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Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ENERGY AND ENVIRONMENTAL APPLICATIONS USING QUANTUM DOTS FROM BIOPOLYMERS

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*Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (**x**) Multifunctional Applications*

The obtaining chitin and chitosan biopolymers is a great solution for the waste produced in the shrimp industry. The biopolymers were possible to perform the hydrothermal of carbonization synthesis, which is a low cost process, of two renewable precursors, which are materials derived from biomass (chitin and chitosan) and graphite as a third material used for obtain two solid phase and liquid. The application of the liquid phase was used for the formation of the carbon quantum dots (CQDs) with application on solar cells and photocatalysis (using zinc oxide via sonochemical method), and the application of the solid phase for the formation of the heterogeneous catalysts for reactions of the transesterification of the biodiesel. The results of the CQDs liquid phase obtained quantum yield of 17.1% with doping in ZnO / CQDs for the applications for photocatalytic activity, observed the degradation of the efficiency of pure ZnO and the included CQDs was efficient on the degradation of methylene blue with 70% of the efficiency. The solid phase a heterogeneous graphite-chitosan catalyst obtained process efficiency for by gas chromatography with 36% conversion used a promising application as a heterogeneous catalyst.

Keywords: Chitosan; Quantum Dots And Hydrothermal.

II EPNAT
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Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

HYALURONIC ACID AS A VEHICLE FOR INJECTABLE CELL THERAPY: CHARACTERIZATION BY COMPUTATIONAL SIMULATION

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Hyaluronic acid (HA) is a natural polymer widely used as a vehicle in injectable cell therapy for the treatment of arthropathies. However, there are no reports regarding the influence of its physical-chemical characteristics on cell viability and, consequently, the therapeutic efficacy of the referred procedure. This project aimed to estimate, through computer simulation, the influence of HA viscosity and administration speed on the shear stress generated in the syringe/needle set as well as the consequent risk to cell viability during administration. To create the virtual model, and perform the simulations, we used the software Rhinoceros® 5.0 and Ansys/CFX® 18.2, respectively. To establish the influence of viscosity, rheological parameters, corresponding to the HA concentrations of 6, 8, 10 12, and 15 mg/mL, were considered. For the determination of the speed influence, it was considered the values of 8.3x10-4, 1.6x10-3, 1.9x10-3, 3.8x10-3, 6.0x10-3, 1.3x10-2 m/s, corresponding to the speed spectrum used in clinical procedures of viscosupplementation with HA. From the simulations, it was possible to estimate the shear stress magnitude as a function of the speed of administration for each viscosity. The results showed a directly proportional relationship between the viscosity and speed of administration and the shear stress magnitude. It stands out that the formulation with the highest viscosity reached, at the highest administration speed, levels corresponding to the "critical values" associated with mechanical damage to the membrane and cell death (4KPa). The lower viscosity of HA showed reduced stress levels (below 1KPa) even when administered at the highest speed, representing the formulation potentially recommended for use in injectable cell therapy. We conclude that the administration of HA presents a viscosity and speed-dependent behavior concerning the shear stress and needs to be taken into account for use as a vehicle for injectable cell therapy. For this purpose, it is recommended to use formulations with reduced viscosities.

Keyword: Hyaluronic Acid; Natural polymer; Injectable cell therapy; Computer simulation.

II EPNAT
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Organização: UNIARA unesp UNIFESP UNICAMP

BIODEGRADABLE HYDROGELS BASED ON BACTERIAL CELLULOSE NANOFIBERS AS POTENTIAL ADDITIVE FOR CEMENT-PASTES

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The development and application of polymeric additives in cement materials have been widely studied in the civil construction area due to the improvement in durability, mechanical performance, and internal curing procedures. Thus, the hydrogels based on bacterial cellulose nanofibers (BCN) are attractive technological alternatives for these purposes, mainly due to the characteristics obtained with the presence of nanofibers in the polymeric matrix such as biodegradability, high crystallinity, excellent mechanical resistance, and improvements in water absorption and release kinetics. The objective of the study was to apply hydrogels based on polyacrylamide, carboxymethylcellulose, and BCN in cement paste (0.35 water/cement ratio), and to analyze their effect on fresh state properties such as consistency index, density, air content, and drying shrinkage in the hardened state. The hydrogels were synthesized by free radical polymerization with 5% BCN solution, extracted by oxidation reaction from curative residues. Cementitious pastes were produced from 0.5% swollen hydrogel (wt/wtcement). The results demonstrated that the density of the fresh paste produced with hydrogel was 0.25% higher than control sample. This indicated that the hydrogels remained swollen, avoiding an initial water loss by evaporation and pore formation in the cement matrix, which corroborates with the low air content of approximately 0.9% observed in the cement- hydrogel paste. The consistency index of the cement-paste with hydrogel was 5.1% lower when compared to the control. The drying shrinkage results were similar to all cement-pastes analyzed. The highest values observed for both pastes were at 21 days age, around 2.85 + 0.17 (mm/mm). Therefore, these hydrogels can improve the properties of cementitious materials, mainly in their fresh state.

Keywords: Hydrogel; Bacterial Cellulose Nanofiber; Construction Civil.

Acknowledgments: CNPq, Fapesp, CAPES, IFSP, UNESP, Seven Indústria de Produtos Biotecnológicos Ltda®.

USE OF THE RICE HUSK FOR THE PRODUCTION OF CELLULOSE ACETATE AND SILICA GEL

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The present study was developed by students from Escola Técnica Getúlio Vargas (ETEC GV) and evaluated the viability of the synthesis of cellulose acetate polymer with raw material from organic renewable sources; in this case, the cellulose present in the rice husk, taking into account its physical-chemical properties, production cost and the viability of the final product. Several washes and extractions were carried out using the reflux technique to remove the most diverse compounds present in the shell's composition, such as cellulose, lignin, silica, and others, to obtain cellulose with a high degree of purity and silica gel. Then, the Cellulose Acetate was synthesized through the acetylation of the cellulose obtained from the rice husk. After the polymerization of Cellulose Acetate, it was found that the proportion of yield concerning the total compounds was 4% of the initial mass converted to polymer. Based on the usual commercial price, this production method is economically viable since it adds value to a waste supplying it with a more noble destination. Among the secondary products obtained, silica gel stands out, which can be added to the polymer itself, giving it the capacity for ion exchange, making its use promising in the manufacture of wrappers for plant seedlings. The cellulose acetate obtained can have numerous applications, such as in the textile industry, cigarette filters, etc.

Keywords: The Rice Husk; Cellulose Acetate and Silica Gel.

II EPNAT
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MORPHOLOGICAL AND PHYSICOCHEMICAL ANALYSIS OF WHITE AND BLACK HAIR WITHOUT CHEMICAL TREATMENT

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The hair keratin is the main compound in hair fiber. The hair fiber is a highly organized cylindrical structure, formed by inert cells and nanocomposites (mostly keratin). Its resistance, appearance, and chemistry composition are regulated by a variety of factors such as: ethnicity, cleanliness, chemical treatments and the environment. This protein forms a network of cross-links through disulfide bridges that gives hair chemical and mechanical resistance. The characterization of hair samples has been carried out considering different treatments and ethnicity of donors. The white hair does not have melanin granules, which avoid the oxidation reaction of the disulfide bridges. Therefore, white hair does not have a protective mechanism. This work aimed at the morphological and physicochemical characterization of white and black Caucasian hair from a single donor. The samples were characterized by mechanical and thermal analysis, atomic force microscopy (AFM) and scanning electron microscopy (SEM). The mechanical properties of the samples were similar, presenting Young modulus, maximal strength, and deformation around 12 GPa, 250 MPa and 27% respectively. The white hair (77.7 µm) was thicker than the black (72.2 µm) ($p = 0.0064$). SEM and AFM results showed that the scales of the white hair exocuticle were denser than those from black hair. White hair showed less scale, as well as less roughness. The thermal degradation profile of the samples was similar, however, in the study of the degradation kinetics, a lower activation energy was observed for the white hair sample, suggesting greater thermal stability for pigmented hair. In conclusion, despite white hair presenting several similar characteristics to black hair, the damage and irregular structure were mainly evidenced in white hair fiber.

Keywords: Thermal properties; Mechanical properties; Morphological analysis; Keratin.

II EPNAT
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21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ORALLY DISINTEGRATING FILMS MADE FROM BIOPOLYMERS: LITERATURE REVIEW

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Orally disintegrating films (ODFs) represent an alternative and advantageous way of administering drugs and other active compounds compared to conventional methods. ODFs may overcome limitations when there is no patient collaboration, especially for pediatric, geriatric, dysphagic patients, and even animals. They are thin polymeric films that can be applied in the mouth, where they will adhere to the oral mucosa and quickly disintegrate, releasing the active compound and enabling the oral absorption, with no need of water ingestion. The use of biopolymers in the composition of ODFs has gained space over synthetic and semi-synthetic polymers, once they present favorable properties for this application, such as biocompatibility and biodegradability, hydrophilicity, non-toxicity, mucoadhesiveness, film-forming ability, among others. Besides, biopolymers can be used in blends with other polymers to develop ODFs with better properties. In this review abstract, we focused on published studies in which ODFs were made by biopolymers used alone or in blends, to overview the literature and discuss how the biopolymers influence ODFs properties. We found 243 papers about ODFs, and we noticed that the trend for publications has grown over the years. By 2015, 58 papers were published, while in the last five years, 185 papers. We refined the search using main biopolymers, and we found approximately 115 papers, in which pullulan, maltodextrin, and starch were the most used, followed by gelatin, alginate, chitosan, collagen, and pectin. Most studies produced ODFs by casting, while the main characterizations were mechanical properties, surface pH, and disintegration time. The biopolymers ODFs presented suitable properties such as flexibility, adequate surface pH, and fast disintegration. Other biopolymers are still little explored, but recent studies have used new polymers extracted from natural sources and other production techniques such as printing technologies.

Keywords: Orodispersible Film; Fast Dissolving Film; Natural Polymer.

II EPNAT
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PROTECTING CULTURAL HERITAGE WITH NANOCELLULOSE AND NANOLIGNIN

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Cellulose-based cultural artifacts and works of art are sometimes treated with synthetic polymer coatings to provide mechanical protection and improved visual aspect. The traditional approaches used in this area are followed by some drawbacks such as the use of toxic organic solvents, yellowing with time, difficult removal, and lack of compatibility with the substrates. To overcome these issues, we proposed in this work the application of sustainable nanocomposites based on nanocelluloses (cellulose nanofibrils and nanocrystals) and nanolignin as waterborne transparent coatings for cellulosic substrates (wood, fabric, and paper). Nanocomposites films with high content of nanocelluloses (90-100%wt) and variable concentration of nanolignin (0-10%wt) were obtained from elephant grass as raw material and then analyzed in terms of UV shielding, resistance to color change, and substrate protection against color change during hydrothermal aging (80 °C and 75% RH for 168 h). When used as a shield, the nanocomposite with higher nanolignin content was able to successfully prevent the photo-oxidation of covered substrates; moreover, the color of all nanocomposite films did not significantly change after artificial aging ($\Delta E \leq 2.5$) and, when applied as coatings, films minimized the colorimetric changes of the coated cellulosic substrates - which are, in general, very prone to quickly deteriorate under harsh hydrothermal conditions, becoming darken and yellowish. Therefore, the combination of nanocelluloses and nanolignin is a very interesting and eco-friendly approach to protect cultural heritage objects. While cellulose is very compatible and provides good mechanical stability to wood, paper, and fabric, lignin protects against deterioration agents such as light and oxygen.

Keywords: Cellulose nanofibrils; cellulose nanocrystals; lignin nanoparticles.

TECHNOLOGICAL POTENTIAL OF HYDROGELS IN CEMENTIOUS PASTES: A POSSIBLE APPLICATION AS AN INTERNAL CURINGAGENT

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

For cement materials with good performance and durability throughout their useful life, it is necessary that these present good workability and satisfactory physical and mechanical properties. Thus, polymeric additives as a compound material of the dosage can improve the properties of these cementitious matrices. This study proposes the addition of polyacrylamide and carboxymethylcellulose polysaccharide hydrogels in cementitious pastes (0.35 water/cement ratio) to evaluate their effect on the density in the fresh state, exudation rate, capillarity coefficient, and drying shrinkage. They were synthesized by free radical polymerization and pastes produced with 0.50% hydrogel. The results demonstrated that the polymer in the cement matrix did not cause significant changes in apparent density values. The exudation rate for the polymeric cementitious composites was lower than the control samples for up to 60 minutes. After this time, the values were similar, which indicates a better capacity to maintain the free water in the mixture due to the hydrogel presence. The water absorption results showed a reduction of approximately 22% in the values of the capillarity coefficient. This indicates that the polymer may be retaining the available water to avoid the capillary rise of the water inside the samples. From the shrinkage test, it was observed that both samples reduced their volumes during the curing time. The samples containing hydrogel had shrinkage of approximately 17.8% concerning the control until the age of 10 days. Thus, it is concluded that cementitious composites produced with hydrogels presented a satisfactory performance in their properties compared to the control samples. Therefore, the hydrogel can contribute to the improvement in the performance and durability of these matrices.

Keywords: Civil Construction; Hydrogel; Composites.

Acknowledgement: The authors would like to thank IFSP, Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP (CEPID – CDMF 2013/07296-2 and 2018/13580-9 Grants), and CNPq (MRM 312530/2018-8; FAA 312414/2018-8 and 405680/2016-3). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – “Finance Code 001”.

II EPNAT
Encontro de Polímeros Naturais
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Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

OBTATION OF TANNIN-RICH EXTRACT FROM BARBATIMÃO (*Stryphnodendron adstringens*) BARK AND INCORPORATION IN SILK FIBROIN HYDROGEL

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Plants rich in phenolics compounds, including tannins, have become an interesting subject of research due to its potential applications, for instance as wound healing agents. These bioactive compounds can be incorporated in a natural polymer matrix to be used in biomedical and pharmaceutical areas. In this context, this study aimed to evaluate the extraction of bioactive compounds from barbatimão (*Stryphnodendron adstringens* (Mart.) Coville) and its incorporation in silk fibroin hydrogel. The barbatimão extracts were obtained by two optimized extraction methods, the first one using an ultrasonic bath with ethanol 65% (v/v) as solvent (Extract A) and the second one using a stirring bath and propylene glycol 50% (v/v) as solvent (Extract B). The antioxidant capacity was measured through FRAP and ORAC assays. The global yields of the Extracts A and B were 29.64% and 43.04% (w/w), respectively. The antioxidant capacity (ORAC and FRAP) of the Extracts A and B were 195.65 and 259.33 mg/g of dry raw material (drm.) and 199.56 and 291.26 mg/g drm., respectively. The total phenolic content present in the extracts was determined by the Folin– Ciocalteu method and resulted in 84.92 and 104.24 mg/g drm. for the Extracts A and B, respectively. These extracts were incorporated in the 1:10 proportion (v/v) of diluted extract in the concentration of 0.003 g/mL for the Extract A and 0.004 g/mL for the Extract B into silk fibroin solution and hydrogels were prepared in a thermostatic bath at 37°C. FTIR and DSC were used to verify the influence of barbatimão extracts in the physicochemical properties of silk hydrogels. To the best of our knowledge, there is no studies up to now addressing the incorporation of barbatimão extract in silk fibroin hydrogels, resulting in an innovative study to verify how this extract behaves in a biopolymer hydrogel.

Keywords: Barbatimão; Silk Fibroin; Hydrogels.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ANTIOXIDANT ACTIVE PACKAGING MATERIAL BASED ON CHITOSAN AND LEMONGRASS ESSENTIAL OIL

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Area: (*) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Chitosan is a natural, renewable, biodegradable, biocompatible and non-toxic biopolymer. Biopolymeric chitosan films have advantages such as resistance and flexibility, oxygen barrier and antimicrobial property. The incorporation of natural antioxidant agents in chitosan films can be an alternative to the use of synthetic antioxidants in foods susceptible to lipid oxidation. The objective of this project was to develop a new biopolymer material of chitosan and lemongrass essential oil and to evaluate the oxidative stability of a restructured chicken product. Factorial planning 22 was realized to select the formulation of the active films and the factors studied were: chitosan concentration (Cquit, 1.0%, 1.5%, 2.0%, w/w) and lemongrass oil concentration (Coil, 0.5 %, 1.5%, 2.5%, v/w). The highest antioxidant capacity (DPPH and ABTS) was verified in 1.0% chitosan and 2.5% lemongrass films that contained 5.94 mg AGE / g. The Chicken meat was subjected to four different treatments: 1) Control (without packaging), 2) PVC (packaged with polyvinyl chloride film),Q (packaged with 1% (w / w) chitosan film) and 4) Q + CL (packed with active film of 1% (m / m) of chitosan and 2.5% (v / w) of essential oil of lemongrass) and stored under refrigeration at 4 ° C. The TBARS content and peroxide index of chicken meat stored was evaluated periodically after 3, 7, 10 and 14 days. In parallel, pH and instrumental color were measured. The results indicated that the Q + CL treatment delayed the lipid oxidation of the restructured chicken meat.

Keywords: Chitosan Film; Active Packaging; Lemongrass Oil; Lipid Oxidation.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

A REVIEW ON NON-CLINICAL TESTS TO ASSESS THE GENOTOXICITY OF POLYMER FILMS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Polymer films are biodegradable structures formed of polysaccharides, lipids, and proteins. They can be used in the food industry (food films), biodegradable packaging, and biomaterials (substrates for drug delivery systems). So, as they are in direct contact with food or humans, they must be extensively studied. Genotoxicity refers to the ability of toxic agents to damage the genetic material in the cells. Under certain circumstances, this damage may result in cancer. Hence, genotoxicity is an important endpoint looked at in the studies assessing the toxicity. Thus, the objective of this review is to present the main techniques used to assess the genotoxic potential of polymeric films. Regarding the methodology, a search was made using the keywords polymeric films and mutagenicity. The results obtained from the analyzed articles showed that the most recommended tests are the Ames test and the micronucleus assay. The Ames test is globally known for efficiently spotting point mutations caused by different agents. This test employs indicative Salmonella Typhimurium strains that are sensitive to substances that induce distinct types of mutations. The micronucleus assay, detecting clastogenic and aneugenic agents, uses mammalian cells to assess chromosomal damage. In conclusion, the results of both assays complement each other and fulfill the basic requirements to cover the three genetic endpoints with the minimum number of tests: gene mutations and structural and numerical chromosome aberrations.

Keywords: Polymeric films; Ames test; Micronucleus assay.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.

Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

EFFECT OF THE MECHANICAL DEFIBRILLATION PROCESS ON THE DENSITY OF NANOSTRUCTURED COFFEE SHELL FILMS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

In view of the growing search for sustainable and renewable products, the use of cellulose nanofibrils is emerging as an alternative for the development of new ecologically correct products. This new material has sparked studies due to its high property of strength and stiffness associated with low density. Thus, the present work aims to produce and evaluate nanostructured films obtained from the coffee husk in different mechanical defibrillation processes (10 and 30 passes) using the defibrillator mill. For this, the coffee husk underwent chemical pre-treatments that consisted of: alkaline treatment (5% NaOH) and bleaching (24% H2O2 + 4% NaOH), to remove the amorphous constituents present in the fibers, in order to facilitate the process generation of nanostructures. Subsequently, this material remained for a period of 24 hours in a suspension of water and 1% urea to facilitate the defibrillation process. From the suspensions of the pre-treated fibers, cellulose nanofibrils were generated through a mechanical defibrillation process, using a Super Masscolloider Masuko mill, with different passages being evaluated (10 and 30). The films were formed using the Casting method. The effect of the different passages through the mill on the thickness and density of the films was evaluated. It was observed that the increase in the mechanical defibrillation process provided a decrease in the thickness of the films (from 125 µm for films in 10 passes, and 112 µm in 30 passes). For the density of the films, their increase was observed with the increase in the number of passes through the mechanical defibrillator (from 0.44 to 0.52 g/cm^3). Both results can be explained based on the more compact and less porous structure provided by the greater contact surface of the nanofibrils and the greater interaction between them, due to the decrease in the dimensions of the fibers after the mechanical defibrillation process.

Keywords: Coffee Husk; Nanostructured Films; Mechanical Defibrillation.

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II EPNAT
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Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

FORMULATION OF CHITOSAN/GELATIN/PEQUI OIL EMULSIONS: THERMAL, RHEOLOGICAL AND ANTIMICROBIAL PROPERTIES

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The shelf-life of foods is affected by several aspects, mainly chemical and microbial events, resulting in a considerable decline in consumer's acceptance. There is an increasing interest to substitute synthetic preservatives by bioactive compounds without the use of complex chemical synthesis and toxic materials. However, this replacement is a challenge due to their low chemical stability, off-flavor, low solubility, and short-term effectiveness. Natural emulsions stabilized by chitosan/gelatin gel (CG) could overcome these limitations. In this study, chitosan/gelatin/pequi oil emulsions (CGPO) were developed in different oil concentrations. The samples were characterized according to their thermal stability by thermogravimetry, and the lowest levels of water absorbed in the emulsions containing pequi oil were an indicative of its interaction with the polymeric network. Rheological deformation tests of the emulsions determined their linear viscoelastic region (LVR). All emulsions were more elastic than viscous (G'> G'') and the increase of pequi oil concentration enhanced their elastic behavior. G' and G'' moduli were also studied as a function of temperature, and the presence of pequi oil in higher concentrations led to lower gelation temperatures. Flow tests indicated that all the samples showed pseudoplastic behavior and the addition of pequi oil increased their viscosity. Finally, minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were performed against Staphylococcus aureus and Salmonella enterica Enteritidis. CG gel inhibited the bacteria growth, showing MIC and MBC values of 31.2 for S. aureus and 62.5 µg mL−1 for S. Enteriditis. Pequi oil was not able to inhibit the bacteria at the tested concentrations. However, antimicrobial activity of CGPO emulsions against S. aureus surpassed that of chitosan/gelatin gel, suggesting synergism. These results offer a strategy for the development and application of emulsions containing natural compounds, allowing the conduction of new tests that disclosure their potential action as food coatings.

Keywords: Emulsions; Antimicrobial Activity; Food Coating.

II EPNAT
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Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

EX-SITU MODIFICATION OF BACTERIAL CELLULOSE: THE RELEVANT ROLE OF THE SILANE AGENT

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The ex-situ modification of bacterial cellulose (BC) was carried out by chemical methods, in which the cellulose matrix was impregnated with APTS silane reagent to modify its chemical composition. BC is a natural material that is mainly synthesized by the non- pathogenic bacteria *Komagataeibacter xylinus*, highly hydrated (up to 99% water), free of lignin and hemicellulose and has greater crystallinity than vegetable cellulose, in addition to its high purity with high potential for application in tissue engineering, wound healing, adsorption of contaminants. The experimental data were subjected to variance analysis, and significant differences between the means and were analyzed by the t test (STATISTICA 10). The XRD exhibited wide peaks at 14.4°; 16.8°; 22.6° and 34.9° (2θ) related to the planes (101), (101'), (002) and (040), respectively, which are attributed to the interplanar spacing of type I native cellulose. The modification was confirmed by the increase in the nitrogen content, which is probably due to the fact of the incorporation of the silane group in the modified samples, observed by elementary analysis (CHN). FTIR spectrum showed two new bands that can be attributed to the flexion of primary amine groups (NH_2) and lengthening the vibration of Si-O- Si, coming from APTS. For all samples, similar thermal behaviors were observed, in which two defined events were observed and with the maximum temperature of degradation it is possible to verify that as the amount of silane increases, with the temperature increases. The SEM images illustrated three-dimensional morphologies in fibrillar arrangements in the form of ribbon without preferential orientation and in the modified samples the morphologies became structures with highly ordered fibers after being grafted, indicating the success of the silane group incorporation process.

Keywords: Bacterial Cellulose; Silane; Modification.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

NATURAL POLYMERS USED AS HYDROGEL BIOINKS IN 3D BIOPRINTING

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

3D bioprinting has become one of the most promising technology of the 21st century whose main principle is to print materials with similar proprieties of the human body's tissue. In order to have a successful bioprinting, the choice of the bioink must be done carefully for obtaining a 3D construct that allows the exchange of substrate, oxygen and water for the living cells that are printed within the bioink. These polymers can be either natural or synthetic but the natural ones are the best option considering its bioactivity, providing optimistic results when it is used as an extracellular matrix. For each biomedical application, the polymers' chemical and physical properties must be suitable to the physiologic function required. Furthermore, biocompatibility is essential due to the fact that the material is placed in a biological environment. Then, the main goal of this work is to give an overall idea about which natural polymers are the most used and where they can be applied. We can cite as the main used polymers the alginate, collagen, hyaluronic acid and gelatin, being the alginate the more used natural polymer in 3D bioprinting. Also, we can highlight the polysaccharides of natural origin known as "Natural Gums" that are recently being used. Some examples of this type of polymer are: alginate, agar, cellulose, gellan gum and xanthan gum. All gums show water solubility, chemical inertness and nontoxic properties. The application of these hydrogels bioinks range from mimicking vascular networks and cartilage tissues to mimicking vital organs as heart, liver and pancreas. So, we can conclude that natural polymers bioinks have many applications in 3D bioprinting and their improvement promise to deliver as an outcome an entire vital organs manufacturing, possible turning this moment in the beginning of a new era for medicine.

Keywords: Hydrogel bioinks; 3D Bioprinting; Natural Polymers.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

USE OF ORANGE PEEL FOR CARBON QUANTUM DOTS PRODUCTION

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Carbon quantum dots (CQDs) are novel and promising nanomaterials thanks to its biocompatibility, no toxicity and fluorescence, that can be used in applications like environmental monitoring and treatment, food production, electronics and optoelectronics development among others. CQDs can be obtained from different methods and sources. Hydrothermal method is one of the most used and explored methods for its simplicity, low cost and the possibility to use great variety of sources like biomass, minerals and molecules. Agricultural biomass residues are a good tentative candidate for CQDs production, since their use can contribute to solid waste disposal, waste valorization and lower production costs. Nevertheless, complexity of biomass implies obtaining CQDs with heterogeneity in characteristics such as size, yield production and optical properties such as fluorescence intensity. In this sense, the objective of this work is to explain the main physicochemical mechanisms involved in CQDs formation from orange peel, a highly produced biomass residue, based on the compositional studies reported in the literature. In order to produce CQDs hydrothermal synthesis process of orange peel was carried out. The result synthesis products were studied with transmission electron microscopy and spectrometry. It was found that the main mechanisms for CQDs formation are hydrolysis, dehydration, decarboxylation, aromatization and re-condensation of polymers, in which monosaccharides aggregate form carbon structures and the more complex structures with longer carbon chains aggregate to form polysaccharides and become a co-product of the synthesis process. CQDs obtained from orange peel presented a size lower than 10 nm and a green fluorescence with a main peak intensity close to 550 nm. CQDs production from agricultural biomass could be achieved according to molecular composition and their link strength of the carbon source, in which operative conditions like temperature reaction plays a key role to ensure the carbonization process.

Keywords: Agricultural Residues; Nanotechnology; Nanomaterials.

II EPNAT
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Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

HIGH STRENGTH XYLAN/CHITOSAN BIOBASED FILMS PREPARED IN THE PRESENCE OF ETHANOL

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Xylan (Xyl), a natural polymer present in lignocellulosic biomass, was alkaline extracted (150 % NaOH/ wood) from Australian poplar wood and used to prepare films in combination with another natural polymer, chitosan (Ch). Films were prepared from colloidal suspensions of polyelectrolyte complexes (PECs) of Xyl and Ch (60/40 Xyl/Ch mass ratio) by the casting/solvent evaporation technique. The effects of different amounts of ethanol (0; 10; 25; 35 and 40% v/v) on the colloidal suspensions behavior as well as on unwashed and washed films mechanical properties, swelling and water vapor permeability (WVP) were studied. Dynamic light scattering results showed that the particle sizes of PECs decreased (from 1009 to 594 nm) and the opposite effect occurred with the zeta potential values (from +27 to +68 mV) when ethanol content was increased. All films showed higher stress-strain at break results than the ones reported in the literature using the same polyelectrolytes. Particularly, the stress at break of unwashed films increased from 22 to 34 MPa when they were prepared with 0 and 35% (v/v) ethanol, respectively, while the strain at break was similar (31%) for all films. When films were washed, the stress at break was increased even more (from 45 to 75 MPa when 35% (v/v) ethanol was used). The deformation was similar for all washed films (approx. 5%). Besides, the best wet tensile-strain properties were obtained (5.1 MPa-55%) when 35% (v/v) of ethanol was used. Not significance difference was observed in WVP values, but the swelling capacity slightly increase (11%) due to the presence of ethanol. Results suggest that the presence of ethanol favorably modified the interaction between polyelectrolytes. On the other hand, results show that it is not necessary to remove the residual ethanol used for Xyl precipitation and purification for preparing the films.

Keywords: Poplar Wood; Particle Size; Mechanical Properties; Swelling.

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Encontro de Polímeros Naturais
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21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

INFLUENCE OF CELLULOSE NANOCRYSTALS CONTENT ON RELEASE AND MOISTURE BARRIER PROPERTIES OF ALGINATE/CARBOXYMETHYLCELLULOSE MEMBRANES

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Natural polymers, such as alginate and carboxymethylcellulose (CMC) have been intensively studied for development of biomaterials due to its biodegradability and biocompatibility. Cellulose nanocrystals (CNC) can be originated from a wide variety of cellulosic materials and have attracted much attention for development of biocomposites with high mechanical strength and improved general properties. In this work, membranes based on alginate and CMC (1:1 in mass) containing the drugs tetracycline (TC) and sodium diclofenac (DS) were obtained by casting in order to enable applications as controlled release dressings for skin lesions. The effect of incorporating different proportions of CNC (1, 2.5 and 5 g/100 g biopolymer) obtained from cotton residue on membrane properties and drug release behavior was evaluated. The manufactured membranes presented a cohesive, uniform visual aspect, without heterogeneities and yellowish coloration due to TC presence. The fluid absorption capacity and the water vapor transmission rate of the membranes increased with the presence of CNC, while the mass loss was not altered significantly. The results of incorporation efficiency indicated that drug are partially removed in the membrane crosslinking stage, with the highest lost (~ 50%) observed for formulations containing 5 wt% NCC. Release studies in aqueous media indicate that the 2.5 wt% proportion of CNC was able to reduce the diffusion coefficient in comparison with membrane without CNC. The other proportions (1 and 5 wt%) resulted in higher diffusion coefficients. The evaluation of the release mechanism by the Power Law model indicated anomalous diffusion mechanisms for TC and pseudo-fickian for DS. In general, the presence of NCC, especially 2.5 wt%, improved important membrane properties to be considered for use as dressings for skin lesions.

Keywords: Cellulose Nanocrystals; Drug Release; Polysaccharides.

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Encontro de Polímeros Naturais
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21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

CARBOXIMETHYL SWEET POTATO STARCH (*Ipomoea batatas L.*) FOR FOOD USE

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The sweet potato is an unconventional tuberous source with high economic potential for starch extraction in tropical countries. The carboxymethylation of carbohydrates such as starch is a chemical modification that confers ionic properties to the structure and improves its functionality as a thickener. The functional properties of the carboxymethyl sweet potato starch (CMS) obtained by modification with chloroacetic acid in ethanolic medium were evaluated by analysis of the degree of substitution (DS), infrared spectroscopy (FTIR), X-ray diffraction (XDR), Scanning electron microscopy (SEM), amylose content, water absorption capacity (WAC), solubility (WSI), emulsifying capacity (EC), thawing stability (syneresis) and rheological behavior during gelatinization. The CMS showed low DS (0.05), as required in food applications, with the appearance of the new bands between 1416 and 1609 cm-1 in the infrared spectrum by incorporation of the carboxyl group. The micrographs reveal a heterogeneous morphology with alterations in granular integrity, but the crystallinity (36%) derived from the XRD pattern and the amylose content (20%) were maintained. The WAC (106%), the WSI (2.16), and the EC (8.1%) of the starch increased with the modification. The CMS did not presented syneresis (0%), which indicates that it is stable to thawing unlike native starch (28%). The maximum viscosity during gelatinization increased 44% in the CMS reaching 2095 Cp, being more susceptible to retrogradation during cooling. The results suggest that the carboxymethyl groups introduced favor the interaction with water and contribute negative charges to the structure, increasing electrostatic repulsion and therefore viscosity. Loss of granular structure favors solubility and produces greater retrogradation. In conclusion, the CMS of sweet potato has a favorable physicochemical behavior to provide viscosity in aqueous dispersions and maintain it during cooling, it is also stable to syneresis, which gives it potential for its application as a thickener and stabilizer in frozen foods.

Keywords: Carboxymethylation; Viscosity; Thickener.

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THERMAL DEGRADATION AND PIROLYSIS KINETICS ANALYSIS OF TAMARILLO AND PEACH PALM FRUIT PEELS

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Agricultural and food production is facing important challenges like waste management. Biomass residues represent a significant amount of volume in landfills, and unproper disposition leads to environment pollution. Nevertheless, these residues present an opportunity in bioenergy production. In which agricultural and food residues can be used by direct combustion, biochemical and thermochemical treatments. Pyrolysis is one of the primary thermochemical conversion methods to convert biomass residues into valuable products. However, pyrolysis efficiency depends on the biomass characteristics, what makes fundamental to know thermal and compositional behavior of biomass sources. By this means, this work studies and compares the main thermal characteristics of two tropical fruit residues, tamarillo (*Solanum betaceum*) peel (TP) and peach palm (*Bactris gasipaes*) peel (PP). In both fruit residues were performed proximate analysis, thermogravimetric analysis (TG), differential scanning calorimetry (DSC), and mass spectrometry (MS). The derivative mass of the pyrolysis process was deconvoluted and the kinetic behavior was identified with the isoconversional methodology of Friedman and KAS. TP and PP presented compositional differences that were evidenced in thermal degradation behavior, as well as degradation processes that were detected through deconvolution, which involved exothermic reactions. Activation energies calculated showed characteristic values for main processes detected in deconvolution, which ranged approximately from 150 to 450 kJ/mol for TP and from 150 to 350 kJ/mol for PP with the Friedmann method. The main thermal degradation characteristics of TP and PP were identified, finding that TP is more thermally complex than PP.

Keywords: Pyrolysis; Thermogravimetric Analysis; Agricultural Residues.

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Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

OXIDATIVE STABILITY OF FRESH BEEF PACKED WITH CHITOSAN FILMS INCORPORATED WITH CASHEW BARK

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The packaging of fresh beef in a modified atmosphere is a complex and dynamic system in which several factors interact to maintain product quality. The concentration of gases around the product and the storage conditions can decisively influence the color stability and the microbiological quality of the meat stored in a modified atmosphere. Therefore, the determination of a packaging system to maintain the quality of fresh meat involves the optimization of multiple variables: gaseous composition, ratio of gas volume to product mass, rate of permeability to packaging gases, storage time and temperature , among others. Commercially, the modified atmosphere packaging system most used with fresh meat employs high concentrations of oxygen (O_2) in combination with carbon dioxide (CO_2), usually 60-80% O_2 / 20-40% CO_2. Modified atmosphere with high oxygen concentration can be combined with other conservation techniques, such as the incorporation of natural antioxidant agents in an active biopolymeric film, such as chitosan film, in the packaging system or in absorbent pads inside the tray. *Anacardium occidentale L*. has good antioxidant and also antimicrobial properties. The bark of *Anacardium occidentale L*. is used for anti-inflammatory, healing, anti-glycemic purposes. In addition, the alkyl chain present in these compounds exerts a significant influence on biological activity, with the increase in the solubility of the phenolic moieties which is responsible for biological degradation or chemical oxidation. The liquid extracted from its shell is known as CNSL (cashew nutshell liquid), consisting of anacardic acids, cardan, cardanols and 2-methylcardols. To benefit from new processes and product development and to ensure that future changes do not compromise quality or safety, the meat industry must invest in research in science and technology.

Keywords: Beef; Active Packaging; Natural Antioxidant.

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21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

BACTERIAL CELLULOSE AS TOPICAL WOUND-DRESSING

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Bacterial cellulose (BC) is produced by bacteria such as those of the genus *Acetobacter*, *Aerobacter*, *Agrobacterium* and *Gluconacetobacter* in synthetic and non-synthetic media through oxidative fermentation. Due to its composition consisting of β-D-glycopyranose units joined by β- (1→ 4) glycosidic bonds, it exhibits numerous distinct properties compared to plant cellulose such as the unique nanostructure, high water holding capacity, high degree of polymerization, high mechanical resistance and high crystallinity. BC synthesized by *A. xylinum* has attracted more and more attention and interest in biomedicine because it can be used as a dressing to restore the biological and structural function of the skin. Thus, this abstract aimed to conduct a literature review of the main works published in the last 5 years in order to highlight the application of bacterial cellulose in topical dressings. This BC appears to be a suitable substitute for human skin to create a protective barrier, as well as to deliver therapeutic compounds during wound healing. BC is already industrially produced as a skin dressing and marketed to treat skin wounds, such as the Nexfill® dressing from Seven Biotecnologia and the Nanocell® dressing from Thai Nano Cellulose. Compared to traditional dressings, BC membranes have interesting characteristics in the treatment of skin lesions such as immediate pain relief, maintenance of local moisture, the action as a physical protection barrier, reducing the rate of external contamination, absorption of exudates, among others characteristics that accelerate the healing process. Despite the higher cost, its replacement is indicated only every seven days, allowing the treatment to be concluded with the use of a smaller number of inputs when compared to a standard dressing, indicated for daily changes. Therefore, it is concluded that in addition to the benefits associated with its use, the cost of treatment will be lower.

Keywords: Bacterial cellulose; Wound-dressing.

II EPNAT
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Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

CHITOSAN FILMS WITH LEMONGRASS (*Cymbopogon citratus*) ESSENTIAL OIL IN COSMETIC APPLICATION

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*Area: ( ) Food and Agriculture (**X**) Medical and Pharmaceutical ( ) Multifunctional Applications*

Chitosan films are characterized by biodegradability, low toxicity, flexibility, resistence and antimicrobial properties. Several researchs indicate the chitosan films application in cosmetic, food, medicines and other products. The objective of this work was to develop and characterize chitosan active films containing lemongrass essential oil (LO) with potential application as facial sheet masks. Different concentrations of LO (0, 0.5, 1.0, 1.5%, w/w) were incorporated into chitosan filmogenic matrix (1.0%, w/w), forming the active chitosan films. The films' antioxidant properties increased in function of LO concentration (8.16 µMol TE/g dry weight, for 1.5% of LO), measured by ABTS assay. The same ratio was observed in water vapor permeability and water solubility. Increasing LO concentration, higher water vapour barrier and less water solubility were observed. The citotoxicity analysis indicated the LO concentration control, limiting to less than 1.0% (w/w). Chitosan active films containing 0.5% (w/w) of LO presented cellular viability over than 70% antioxidant activity of 1.12 µMol TE/g dry weight. Chitosan films containing LO presented antimicrobian activity againist *Escherichia coli* and *Staphylococcus aureus*. The active chitosan films containing lemongrass essential oil 0.5% presented potential as cosmetic facial sheet masks with antioxidant capacity, seletive permeability, flexibility and celular safety.

Keywords: Chitosan; Lemongrass Oil; Sheet Mask; Antimicrobial; Antioxidant.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

DEVELOPMENT OF THE PECTIN FILMS REINFORCED BY BIOCELLULOSE NANOCRYSTALS

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The disposal of the plastic materials has been caused an environmental problem. For this reason, research has been concentrating on development of the new materials "ecological friendly". The present work consists in the development of films based on a natural polymer to be used as packaging material. Pectin is a biopolymer extensively used due the characteristics such us biodegradability, biocompatibility and low cost. Films were produced by solvent casting method. Colloidal dispersion BCN film-forming was obtained through the addiction of 78.5 g of the distilled water, 1.6 g of pectin and 0.16 g of Biocellulose Nanocrystals (BCN). BCN were obtained through acid hydrolysis using sulfuric acid solution. Films were analyzed by Tensile test through a Universal Mechanical Testing machine following ASTM 882/02 Method. Pectin film (control) exhibited tensile strength (MPa) of 76.63 ± 7.8 After BCN addition the values increased to 102.58 ± 6.8. The percent elongation at the break of the films change from 2.71 ± 0.8 to 2.31 ± 0.3 after BCN were added. The nanostructures addition contributed for increase of the film resistance due the interaction resultant between BCN and polymer matrice. This result is very important in this area and showed satisfactory properties of these films suggesting potential use as packaging material. Acknowledgment: FAPESP, CNPQ, CAPES and UNESP.

Keywords: Biopolymers; Biodegradable pack; Renewable resources.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

WATER VAPOR PERMEABILITY OF COMPOSITE FILMS BASED ON HYDROXYPROPYL METHYLCELLULOSE REINFORCED WITH BACTERIAL CELLULOSE NANOCRYSTALS

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The extensively use of the plastic has been caused serious environmental problem. In this sense, research has been concentrating on development of the biodegradable materials. The present work consists in the development of films based on Hydroxypropyl methylcellulose (HPMC) to be used as food packaging. HPMC is a cellulose eter, water soluble and good capacity for flexible film formation. However, HPMC films shown high solubility and high water vapor permeability (WVP), limiting its application, especially in the food area. For this reason, bacterial cellulose nanocrystals (BCN) were added in polymer matrice. The films were produced by solvent casting thought preparation of the colloidal dispersion containing 78.5 g of the distilled water, 1.6 g of HPMC and g of (BCN). WVP values were obtained according to the ASTM E96/80 method with some modifications. BCN were obtained through acid hydrolysis using sulfuric acid solution. HPMC film (control) exhibited 0.404 ± 0.02 g mm/kPa h m2. After BCN addition the values decreased to 0.342 ± 0.02. The nanostructures addition contributed for to decrease of the WVP films. This result contributed for major applicability of the films in the food packaging area. Acknowlegment: FAPESP, CNPq, CAPES and UNESP.

Keywords: Biopolymers; Biodegradable pack; Bacterial cellulose.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

POLYMERIC BLEND OF PANI AND MONOACYLGLYCERIDE POLYANHYDRIDE (FROM BABASSU OIL) WITH ANHYDROUS DICHLOROMALEIC AS A POTENTIAL ELECTRICAL CONDUCTOR

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Throughout history, the production of new devices, mainly electronics, promoted the development of new materials. PANI is the most researched intrinsically conductive polymer, including in the formation of polymeric blends. Therefore, the blend was made with monoacylglyceride polyanhydride from babassu oil and the electrical behavior of this material was evaluated. The polyanhydride was obtained by the polycondensation reaction of the anhydride dichloromaleic with monoacylglyceride, obtained by the glycerolysis reaction of babassu oil, an abundant fruit of Brazilian strivism. The blends were made in the proportions 90/10, 80/20 and 70/30 PANI / Poli by the casting method, with NMP solvent. Through the characterizations it was possible to observe indications of the change in the oxidative state of PANI, which left the emerald base state (EB) of electrical insulating character to the state of emerald salt (ES) of conductive character, because the real electrical impedance of pure PANI was determined around 1,4 x 10^8 Ω and the blend presented the lowest real impedance, around 2,4 x 10^3 Ω. Therefore, it is concluded that the material proves to be viable in the elaboration of films with a semiconductor character through a doping process of charge transfer between the polymer and the PANI.

Keywords: Babassu oil; Polyanhydride; Polyaniline; Polymeric blend.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização:

PHENOLIC COMPOUNDS EXTRACTED FROM RED MOMBIN (*Spondias Purpurea L.*), MICROENCAPSULATED, USING DIFFERENT WALL MATERIALS MALTODEXTRIN, ARABIC GUM AND WEY

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The red mombin (*Spondias purpúrea L.*), tropical fruit, native to Central America, presents considerable levels of phenolic compounds and the agroindustrial waste of this fruit still contains expressive amounts of this phytochemical. The objective of this study was to evaluate the feasibility of atomization encapsulation of the hydroethanolic extract using different wall materials (MP), [maltodextrin (MD), gum (GA) and whey (W)] and drying temperatures (120; 140 and 180ºC). Dispersions of wall material (27%) and extract (3%) were atomized and the powder resultant was evaluated for moisture content, water activity, phenolics encapsulation efficiency and efficiency. The microcapsules showed water and moisture activity that did not exceed 0.13 ± 0.02 and 5.45% ± 0.94, respectively, in all process conditions, considered, therefore, stable and safe products.. Regardless of the wall material, the microencapsulated at 180ºC exhibited lower yields, while the 140º C, using MD + GA and GA + W as wall material, we obtained the higher yields (55.56% and 46.78%, respectively). With the conditions 120ºC: MD + GA and MD + W; 140ºC: MD + GA + W and 180ºC: MD; GA and GA + W it was possible to obtain the highest values of encapsulation efficiency (88.99%; 71.81%; 77.45%; 84.95%; 98.48% and 72.98%, respectively). The highest total phenolic content (172.58 to 378.26 mg EAG / 100g) was obtained at 120ºC (MD + W); 140ºC (MD; GA; MD + GA and MD + GA + W) and at 180ºC (MD + GA and GA + W). Thus, the microencapsulated extract using MD + W; MD + GA + W and GA + W and, respectively, temperatures of 120; 140 and 180ºC showed good encapsulation efficiency and expressive total phenolic content.

Keywords: Encapsulation; Phenolic Compounds; Tropical fruit waste; Spray drying.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.

Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

DEVELOPMENT OF BIODEGRADABLE POLYMERS WITH MANIPUEIRA ADDED

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

There's a growing dependence on the use of synthetic polymeric materials in everyday life, as consequence, the disposal of these materials is also increasing. The scientific scenario has brought to light the development of biodegradable films to mitigate the effects generated by non- biodegradable polymers. But, the problem of waste also refers to the massive disposal of organic waste. Those discarded wastes have great potential for the production of new materials. The research establishes new techniques to enable the transformation of waste to developing products with less environmental impact. The manipueira is a liquid extracted from cassava in the pressing process for the production of flour, this residue when disposed of can contaminate the environment by the presence of hydrocyanic acid. Although toxic, the residue has components that can serve as nutrients for plants. The manipueira became harmless by treatment and the biodegradable polymer was then developed. The idea is to use it as seedling bags for the plants so that it can later turn into fertilizer. The chosen matrix for the polymer was starch because its properties are ideal for this type of product and are a polysaccharide available in several organic sources. Unfortunately, manipueira interferes in the film formation process, so there is a necessity to add a thickener to reach the desired texture, with that pectin added to the polymers. Both saccharides give good mechanical resistance to the film, yet, lack flexibility, so the use of a plasticizer is mandatory. The plastic has an opacity aspect due to the addition of manipueira, giving to the film a yellowish color. The final product decomposes in a shorter time when compared to synthetic polymers. Several tests will be carried out on the biodegradable film, such as determination of biodegradability time, tests of resistance, humidity and solvent solubility, besides others instrumental methods.

Keywords: Biodegradable Films; Biopolymers; Manipueira.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

A REVIEW ON THE USE OF NANOCELLULOSE IN BIOMATERIALS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The materials selection becomes the key to the success of tissue engineering in practical application. The use of conventional polymers may not satisfy these requirements, as a single biopolymer is often not able to provide all the properties required by biomedical scaffolds and tissues and for this reason the development of multi-component polymer systems is a positive strategy for the development of biomaterials with multifunction. In consideration of requirements, nanocellulose can be considered able to compose these polymeric systems are intended to at biomedical applications, due to the fact that cellulose has low toxicity, is biocompatible, and it shows good properties as flexibility, strength, and aspect ratio, which makes it a good candidate for load bearing components in biomedical applications. Therefore, a bibliographic survey of the possible uses of nanocellulose based biomaterials was carried out. The treatment of wounds with the nanocellulose biomaterial can be enhanced using this functionalized cellulose with other substances. Nanocelluloses have great potential to be used as reinforcement in applications where high quality in biocomposites is required. Authors state that nanocellulose is the best choice for preparing nanocomposites based on biomaterials, due to its unique properties. It was found that the nanocellulose disperses homogeneously in the natural rubber matrix without agglomerations when applied 5, 10 and 15% wt., there is an increase in thermal stability as the amount of nanocellulose increases. Collagen and nanocellulose films were studied by authors, verifying that the poor mechanical properties of collagen and the cellulose properties, led to an efficient film production that has characteristics very close to those of natural extracellular matrices. Nanocellulose can be applied in various polymeric matrices, which expands its use, in addition to the possibility of functionalization, serving as a vehicle for delivering medicines, which makes this material a great ally in the development of biomaterials.

Keywords: Biomaterials; Curative Membrane; Nanocellulose.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

IMMUNOHISTOCHEMICAL EVALUATION OF IL-1B, IL-10 AND TGF-B1 STIMULATION ON SKIN WOUNDS TREATED WITH BACTERIAL CELLULOSE MEMBRANE INCORPORATED WITH SILVER NANOPARTICLES IN ANIMAL MODEL

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Bacterial cellulose (BC) has been shown to be a promising biomaterial for the treatment of lesions, providing a moisten environment to the affected region, which might favor the healing process. Nanoscale silver compounds have been synthesized and incorporated into BC membranes in order to provide antimicrobial activity. The objective of the study was to evaluate the inflammatory, angiogenic profile and tissue formation from the expression of antibodies by immunohistochemistry technique on skin lesions treated with bacterial cellulose membranes incorporated with silver nanoparticles. The in vivo protocol was previously approved (CEUA_019/2018). Seventy-two Wistar rats (300g) were anesthetized by intraperitoneal administration of ketamine and xylazine. Two circular full-thickness wounds were created on the dorsum region of each rat by using a histological punch. The animals were distributed into three groups: Untreated (control), MC (cellulose membrane) and MCP (cellulose-silver membrane). The animals were followed for 2,7,14 and 21 days and the harvested skin tissue was used for immunohistochemistry evaluation of IL-1β, IL-10 and TGF-β1. On the 14th day, the UNTREATED group presented higher IL-1β levels than the other groups. However, on the 21st day, the MC group presented higher than the others. On the 2nd and 14th days, the MCP group presented higher levels of IL-10, but reduced levels on the 7thday. The expression of TGF-β1 was not different between groups at all experimental times. Bacterial cellulose membrane incorporated with silver nanoparticles modulated IL-1β and IL-10 profile, which in association with other results related to the inflammatory and tissue formation phases already reported by the research group, presents to be a promising alternative treatment to chronic wounds.

Keywords: IL-1β; IL-10; TGF-β1.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

BIOPOLYMER COMPOSITE AND NANOSTRUCTURED ZINC OXIDE FOR APPLICATION AS A SKIN SUBSTITUTE

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Application

Chitosan additive with nanostructured zinc oxide (nanoZnO) to obtain films as a skin substitute. Chitosan is a bioactive, non-toxic, and biodegradable biopolymer capable of forming films with good chemical-physical characteristics. Under environmental conditions, ZnO is a crystalline material with a wurtzite (hexagonal) structure, is a white powder, bioactive that affects microorganisms. The nanostructuring of the surface gives a high relationship between surface area and volume. The films prepared by casting method, where chitosan (1%) and glycerol (1%) pinned 100 mL of glacial acetic acid (0.5%), added with nanoZnO (0.2; 0.3; 0.5 and 0.7%). The films with and without nanoZnO was characterized by: chemically (EDS), sensorially (plate removal, handling, and continuity) and (thickness, opacity, moisture content, solubility (24 h), maximum absorption capacity, and mass loss (14 d), the solubility, absorption and mass loss tests performed in water and saline solutions (NaCl, Ringer and PBS) (pH 7.4). The results indicate an increase in thickness when adding nanoZnO, with significant differences $p < 0.05$; opacity (0.273 - 0.789) increased significantly in films with 0.5 and 0.7% ($p < 0.5$). The moisture content was 42.72% to 47.31%, and the nanoZnO affected the parameter increasing when compared with control (without nanoZnO), with $p < 0.05$. Solubility was higher in water (17.35- 20.53%) and lower in NaCl (15.19 - 19.55%) and Ringer's solution (12.62 - 15.56%). Absorption was higher in water (257.9 - 350.2%) and lower in PBS (90.5 to 108.7%). The mass loss varied from 20.66 - 56.63%. The results of moisture and absorption indicate a high affinity for water. By the aqueous medium influenced by solubility, good stability was observed in this test. The mass loss, corroborated with that of humidity, moisture in films tends to destabilize them. Based on the results obtained, observed that the investigated composite has potential for use as a temporary skinsubstitute.

Keywords: Chitosan; NanoZnO; Skin substitute.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

SHELF LIFE OF WHOLE WHEAT BREAD WITH ACTIVE CHITOSAN FILMS APPLICATION

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Healthier foods and more sustainable foods systems is gaining more and more importance by consumers. On the other hand, diversifying and the extension of shelf life of bread, such as whole wheat breads, is one of the biggest challenges facing the bakery industries. An alternative is the use of chitosan, which is a natural polysaccharide derived from N-deacetylation of chitin (β-1,4N- acetylglucosamine) found in the exoskeleton of crustaceans that are abundant and rejected by the fishing industry, it is soluble in weak organic acids and it has great scientific and industrial interest due to its capacity for antimicrobial and antioxidant action, in addition to being biodegradable. The objective of this study was to evaluate the shelf life of the whole wheat bread using active chitosan films (1%), with the purpose of increasing their microbiological stability and extending their shelf life for a period equal to or greater than that obtained with the addition of synthetic preservatives (anti- mold), such as calcium propionate. A pre-test was carried out to evaluate the efficiency of chitosan in delaying the development of filamentous fungi in bread. Slices of whole wheat bread approximately 1 cm thick were packaged without film (control) and in 1% chitosan films and exposed to room temperature. Bread packed with chitosan film showed no signs of fungal deterioration, while bread from the control treatment already showed visible signs of fungal deterioration, after 8 days of storage at room temperature. From these preliminary results, an experimental design will be carried out to assess the physical-chemical quality (pH, centesimal composition, instrumental color), texture profile (TPA), identification of filamentous fungi and the sensory acceptance of whole wheat bread stored in active packaging.

Keywords: Chitosan; Whole Grain Bread; Antimicrobial.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

PRELIMINARY EVALUATION OF DIFFERENT PROCESSES FOR THE INCORPORATION OF URUCUM GLYCOLIC EXTRACT IN BACTERIAL CELLULOSE MEMBRANES

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Bacterial cellulose (BC) is a desirable natural polymer for medical and pharmaceutical applications due to its biocompatibility, non-toxicity, non-allergenic, and biodegradability. However, BC has no antimicrobial properties, limiting its use in specific applications such as contaminated wounds. However, due to the characteristics of high porosity and high hydrophilicity, it forms adequate macromolecular support that allows the insertion of loading liquids and biofunctional materials to improve this BC property. As antimicrobial agents, the use of plant extracts has been highlighted in scientific research as an alternative to decrease microbial resistance in the face of various drugs. Some works reported in the literature have reported that the incorporation of glycolic extracts in BC occurs superficially. Thus, seeking better results in terms of incorporation and taking into account the oily/viscous characteristics of glycolic extracts, the present work consisted of evaluating and characterizing the BC membranes incorporated with annatto glycolic extract under different forms of incorporation (M1, M2, M3, M4, and M5). The samples were characterized by thermogravimetry (TGA) and Fourier transform infrared spectroscopy (FTIR). The incorporation of the extract in the membranes was confirmed by the presence of chemical bonds of aromatic compounds, which were not found in the membrane's pure structure, emphasizing the incorporation methods 1, 2, and TGA analyzes demonstrated other stages of degradation that were related to extracting degradation. The incorporation reduced the biocomposite's thermal stability by 33, 29, 49, 34, and 25 °C for M1, M2, M3, M4, and M5, respectively. However, this reduction does not interfere with its use as a dressing, since this application will not expose the polymer to high temperatures, therefore contributing and competing in the field of wound healing in thermal terms.

Keywords: Bacterial Cellulose; Herbal Extracts; Incorporation.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

ANALYSIS OF PARTIALLY VEGETABLE PU COMPOSITES DOPED WITH GLASS RESIDUES

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Seeking the sustainable development of the planet and environmental preservation, many scientific works are analyzing the high volume of recyclable waste in landfills. Among the waste, long neck glass bottles discarded in the environment are currently considered one of the most problematic waste generated in the world. In addition to being considered a thermal insulator, glass is also a non-crystalline, non-porous and fragile material. Because of this, research seeks an utilization of such vitreous residue by applying it as reinforcement in materials. In this work we study the morphological and mechanical properties of a polyurethane (PU) composite of vegetable origin and ground glass bottles that were discarded in the environment. The synthesis of the PU/glass specimens was carried out by adding 0%, 5%, 10% and 15% of the residues to 20g of a certain amount of polyol. After total homogenization, 20g of diisocyanate were added. The mixture was inserted in molds that were left in a vacuum chamber for 48 hrs at room temperature and external pressure of 5 atm. The morphologies of the samples were verified by SEM. Tensile tests were done according to ASTM D638-14. Digital image correlation (DIC) was performed by GOM Correlate software. The morphology of the fractured surfaces of the samples, obtained by SEM measurements, showed that all samples doped with glass presented the presence of agglomerates indicating the presence of glass in the material. Results for tensile properties showed an increase in the stiffness when the particle ratio increases from 5% to 10%. However, it was a small increase and, when the percentage became 15% the stiffness reduced dramatically. It happens because more particles represent more stress raisers, allowing increased crack growth and premature fractures. The use of bottle waste in the vegetable PU matrix represented an economically and environmentally viable alternative.

Keywords: Polyurethane; Glass; Composite

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

EFFECTS OF NON-THERMAL PLASMA SURFACE TREATMENT ON CELLULAR BEHAVIOR: A REVIEW

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The plasma state consists of a mixture of charged and neutral particles including atoms, ions, molecules, electrons, and radicals. It's often referred to as the fourth state of matter, and its uses on biomedical surfaces has been shown to be a promising technique, leading to increased biocompatibility of it by the insertion of chemical groups derived from the gas used, without causing damage to the surface. The exposure by plasma makes the new topography more attractive for cells adhesion. This affinity with the substrate is crucial for adhesion to occur and it is of fundamental importance for the development of a biomaterial that will be incorporated *in vivo* by tissue engineering. The aim of this work was to perform a systematic review on cell adhesion on plasma treated surfaces in order to understand the mechanisms by which this occurs. Relevant databases including *Medline*, *SciELO*, and *Google Scholar* were searched up to January 2020. Studies with controls and comparative studies from well-defined registries/databases were included. The main outcomes were effects of plasma treatment and surface modification. The studies analyzed showed that the exposure reduced the surface contact angle, hence improving the hydrophilicity of the material. The roughness was also altered, with an increase observed for all plasma-treated specimens. These effects may have been responsible for the better adhesion and growth of cells, related on treated samples. It can be concluded that the topographic polarity exerts a major influence on the growth and development of cells on it, since it alters the presentation of binding proteins that contribute to cell anchoring. Alteration of the surface hydrophobicity or hydrophilicity, by means of topographic treatments, can be a way to depress or increase cell adhesion, as required for a specific purpose.

Keywords: Cell; Plasma; Surface.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

INFLUENCE OF THE EXTRACTION PROCESS IN THE PROPERTIES OF SILK PROTEIN SERICIN FROM *BOMBYX MORI*

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Sericin is a natural silk protein which is removed from silk in a process called degumming. The silk fibers are composed of a fibrous core protein fibroin with sericin surrounding it. Sericin is a highly hydrophilic macromolecular protein comprising of 18 amino acids, many of which contain strong polar groups such as hydroxyl, carboxyl and amino. The molecular weight of sericin has a wide distribution and possible applications of sericin are somewhat related to the sizes of its molecules. Sericin protein in most silk manufacturing process is discarded as waste. Therefore, many researchers are looking for alternative uses to develop value-added products in the biomedical, pharmaceutical, cosmetic and food industries. Sericin samples were extracted with Na_2CO_3 solution and other samples with distilled water. After extraction, the samples were precipitated by freezing and then lyophilized. The Na_2CO_3 solution extracts almost 100% of the sericin present in the cocoon, however, the sericin extracted by this technique (the process used in the silk industry) is totally hydrolyzed. When the protein is extracted in the presence of Na_2CO_3, the bonds break causing a decrease in the molecular weight of the protein. Analyzing the scanning electron micrographs (SEM) of powdered sericin samples extracted with Na_2CO_3 solution, it appears that the material is all broken and without a defined shape. The micrographs of sericin extracted only with water were notably different, the sample has characteristics of sheets which is attributed to the significant amount of β-sheet structure that is present in the material forming a more stable structure, as verified in the Fourier-transform infrared spectroscopy analysis (FTIR). The properties of sericin change easily with temperature or in the presence of solvents. This promotes changes in the structure of the sericin protein, showing the complex behavior of this protein.

Keywords: Sericin; Extraction; Structure.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ANALYSIS OF METHODOLOGY OBTAINING CHITOSANA / *ALOE VERA* MEMBRANES FOR TREATING BURNS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Polymer innovation has become something very important for many areas, especially the health one, which is always looking for new materials that reduces costs and get more effectiveness on treatments. Inside this universe, biopolymers have gaining expressiveness in many studies for the most diverse applications. In this context, the present study seeks to test scientifically the use combined of a biopolymer easily found in crustaceans, the Chitosan with *Aloe Vera*, both natural products, which have good properties for skin regeneration, by analyzing the interaction of the polymer with the plant extract. Two different methodologies were performed, in the first one 1 g of chitosan was added to 100 mL of a 1% v/v glacial acetic acid solution, under stirring at 45 ° C for 2h. In the second, 5 g of Chitosan and 1.5 g of polyethylene glycol were added to 100 ml of 5% acetic acid solution under magnetic stirring at 45 ° C for 2 h. The membranes developed were those with only chitosan, without the addition of Aloe Vera. These membranes served as a comparison to verify the healing properties of the membranes with Aloe Vera as proposed at the reference article. Good results were not obtained with the formulations used, the membranes were found fragile and brittle. Then, the results obtained in the reference article were analyzed to verify the behavior that the membrane would present. It was found that the results of the characterizations of the reference article validates the use of the membrane for burns treatment. There is a need to develop an adequate methodology to obtain the membranes.

Keywords: Biomaterials; Regeneration; Polymeric Membrane.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

EVALUATION OF CELLULOSE OCTANOATE PRODUCTION FROM CELLULOSE MATERIALS PURIFIED FROM MORINGA OLEIFERA RESIDUES FOR MEMBRANE PRODUCTION

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The *Moringa oleifera* is a multipurpose tree of growing use and basically all its parts meet some use in the industry, from feed to food, except the cellulosic portion of its fruits, that are mainly treated as residues. In this work, on a biorrefinery context, we evaluated the production of cellulose octanoate by heterogeneous acylation of cellulosic fractions purified from *Moringa oleifera* pods, residues from biodiesel production. For this, the cellulosic materials dispersed in dimethylacetamide were modified by reaction with octanoyl chloride using pyridine as catalyst. After reaction, the material was thoroughly washed, until a fine white powder remained. The modified cellulose and holocellulose were identified as Modif.C-x and Modif.H-x, respectively, with x being the number of times the material was modified (1 or 2). The products were analyzed by Thermogravimetric Analysis (TGA), and by Attenuated Total Reflectance-Infrared Spectroscopy (FTIR-ATR). The 5% (w/w) toluene solution of cellulose derivatives modified twice (Modif.C-2 and Modif.H-2) formed plastic, transparent films, whereas those modified once returned to a powdery appearance after solvent evaporation. The infrared spectra reveal a decrease in intensity of the OH band (3400 cm-1) along with the appearance of a stretching at 1740 cm-1 (–C=O), and at 720 cm-1 (at least four -CH2- on a linear chain). These changes confirm that the ester chains were linked to the cellulosic backbone and were more intense for the twice-acylated materials, indicating a greater degree of modification. TGA evaluations showed that all cellulosic materials produced maintained their thermal stability, even those acylated twice, decomposing only above 250 °C. Therefore, the results showed that cellulose octanoate can be successfully produced from cellulose of M. oleifera and molded into films, signaling the possibility of using this neglected part of the plant as a source of cellulose and derivatives of higher added value.

Keywords: Acylation; Cellulose Modification.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

COPPER NANOPARTICLES SUPPORTED ON CELLULOSE BEADS AS CATALYSTS FOR EMERGENT CONTAMINANTS ABATEMENT.

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Drugs, hormones, industrial chemicals, among other emergent contaminants (ECs), are continuously thrown into the environment. These organic compounds, even at small concentrations, produce adverse effects in water. A wide range of advanced treatment methods has been investigated for the removal of ECs from wastewater. Nowadays, catalytic oxidation processes are playing a prominent role in the field. These processes aim to design catalysts which result active for the decomposition of ECs with a low-cost production. Our objective is to synthetize copper nanoparticles (CuNPs) based catalysts supported on regenerated cellulose (RC) beds using green method principles. Cellulose is the most abundant biopolymer and it is optimal for several applications like packaging, adsorbents or as catalysts support. Cellulose processing is difficult as it is a non meltable material, and it cannot be dissolved in usual solvents. This limits its potential applications and arouse great interest in regenerated cellulose in the form of fibers, films, membranes and beads. The synthesis of RC beads was performed dissolving cellulose (i) by direct dissolution in simple solvents and (ii) from carbamate solution methods, instead of viscose method. CuNps were obtained on the beads by reduction of copper acetate with L-ascorbic acid. The catalytic activity was analyzed for the decomposition of phenol with H_2O_2(aq) as an oxidant agent. Phenol conversion was calculated by taking samples every 10 minutes. To determine the selectivity towards mineralization, total organic composition (TOC) was measured after 120 minutes reaction time. In all samples the conversion resulted over 90% at final reaction time, whereas TOC was around 30%. The results obtained are very promising and show that it is possible to produce CuNps supported on cellulose beads catalysts by green methods and apply them for the elimination of ECs from wastewater.

Keywords: Cellulose Regenerated Beads; Copper Nanoparticles; Emergent Contaminants.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

REVIEW OF POLYMERS IN BONE REGENERATION

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Bone tissue engineering is a science that has been innovating and developing new techniques and materials that can restore the structure and functionality of bone tissue in situations of bone loss. Thus, the search for new polymers and pharmacological compounds capable of increasing the expression of autogenous growth factors to stimulate tissue regeneration, at a lower cost, has increased in the field of scientific research. Natural polymers include modified polysaccharides (eg, chitosan) and polypeptides (collagen and gelatin). Synthetic polymers, for example, poly (glycolic acid) (PGA), poly (L-lactic acid) (PLLA), PLGA (co-glycolic polylactic acid) provide a platform to display the biomechanical properties of scaffolding in tissue engineering. The materials normally function as osteogenic, osteoconductive and osteoinductive scaffolding. In this context, bibliographic searches were carried out in the Pubmed and Google academic, using the following search terms related to “polymers in bone regeneration”. The articles were compared and we obtained as a result the effectiveness of using polymers as a barrier material in tissue regeneration (GTR), thus being able to influence cell proliferation in the periodontal tissue / bone regeneration process. More research needs to be done and focused on in vivo systems to improve the outcome of delivery systems based on biomaterials, with a greater approach in this field, new therapies may be developed in order to minimize bone loss.

Keywords: Periodontal Regeneration; Polymers; Bone Regeneration.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

XANTHAN GUM-AMINO ACID-BASED COATINGS WITH COVALENTLY AND PHYSICALLY CROSS-LINKED NETWORKS VIA CARBODIIMIDE AND ESTERIFICATION

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

One most of the major issues in tissue engineering is the lack of specific interaction between the scaffold surface and cells. Thus, surface modification is required to improve biocompatibility and to stimulate cell adhesion. In this work, coatings of xanthan gum (XG) were prepared with four different amino acids (AA), namely, tryptophan (TRYP), glutamic acid (GLU), histidine (HIS), and cysteine (CYS) using *N*-(3-dimethylaminopropyl)-N′-ethylcarbodiimide hydrochloride (EDC)/*N*- hydroxysuccinimide (NHS) or citric acid/sodium hypophosphite (CA/SHP) as cross-linker agents. The Si/SiO_2 wafers were used as model substrates. They were kept in contact with the aqueous solutions containing XG (0.1 wt%) and the AA (0.1 wt%) in the presence or absence of cross-linker at 60 ^oC for 20 h. After that, the samples were extensively rinsed with distilled water and dried under a stream of N_2. The thickness, wettability, and morphology were determined using ellipsometry, contact angle measurements, and atomic force microscopy (AFM), respectively. The results indicated the physically crosslinked layers of XG and CYS, HIS, or TRYP was thicker than their chemically crosslinked counterparts with cross-linker. For instance, the mean thickness values of XG-CYS, XG-CYS-CA/SHP, and XG-CYS-EDC/NHS coatings amounted to 24.3 nm, 11.8 nm, and 1.4 nm, respectively. The coatings presented contact angle values for water droplets ranging from 17^o to 73^o. AFM topography images showed well-interconnected pores formation for XG-AA coatings and a tendency to flatten after cross-linking. AFM images for XG-HIS-EDC and XG-HIS coatings formed well-defined networks with nanometric pores. The preliminary results revealed XG-AA coatings as tunable systems to be applied for cell culture.

Keywords: Coatings; Biomaterials; Tissue Engineering.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

STUDY OF THE ANTIBACTERIAL ACTIVITY AND THE RELEASE PROCESS IN LATEX INTRA-ORAL ORTHODONTIC ELASTICS IMPREGNED WITH CHLOREXIDINE

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Latex intra-oral orthodontic elastics are composed by the natural latex rubber, which is an Cis-1,4-polyisoprene polymer. They are used in the brackets to improve the fit between the teeth and the arches. This orthodontic treatment contributes to the development of bacterial plaque accumulation that can creates some problems in the mouth. One suggested strategy is the incorporation of antibacterial agents, such as chlorhexidine (CHX) that is a chemical antiseptic with antifungal, bactericidal and bacteriostatic actions. Thus, the objective of this work was the study of the antibacterial activity and the release process in commercial latex intra-oral orthodontic elastics impregned with chlorhexidine. The antibacterial activity, using the E. Coli bacteria, was tested in elastics with immersion in 2% and 4% of CHX solutions by times of 24h and 48h. The results showed that elastics impregned with 2% of CHX exhibited a higher percentage of E. Coli inhibition, that increased with the immersion time. Also, no differences were founded for the elastics with 4% of CHX. Consequently, the chlorhexidine release was just tested in elastics with 2% of CHX, showing a greater release in the elastics with 48 hours of immersion, with an initial burst release in both cases. Finally, we can conclude that the impregnation of latex intra-oral orthodontic elastics in 2% of chlorhexidine by 48h has potential use in orthodontia in order to decrease the plaque accumulation, although other modifications will be studied for the better control of the chlorhexidine release.

Keywords: Latex orthodontic elastics, antibacterial activity, chlorhexidine release.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

SCIENTIFIC PROSPECTION OF THE USE OF POLYMERIC BLENDS BASED ON COLLAGEN AND CHITOSAN APPLIED TO TISSUE ENGINEERING

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Polymeric blends are formed by mixing at least two polymers or copolymers, making it possible to combine the individual characteristics in one material, giving it superior properties. Collagen and chitosan have excellent biocompatibility and can be used to obtain polymeric blends for application in tissue engineering. In this sense, the present work aimed to conduct a search on the Scopus and Web of Science bases, relating results of studies on the use of polymeric blends based on collagen and chitosan applied to tissue engineering. The results were collected and classified in September 2020, by combining the following keywords: collagen and chitosan and blend and tissue and engineering. The SCOPUS database showed a total of 84 results, while the Web of Science database returned 150 results. The first documents were published in 1998, so that in all the following years there was at least one new publication. There was also a considerable increase in the production of articles until 2020, whose volume of publications follows an increasing trend. Of the countries that publish in this area, China, the United States and India are the most prominent, respectively. The main areas of publication are Materials Science, Engineering, Polymer Science, and Biochemistry, genetics and molecular biology. Regarding the impact, the published documents carry great relevance, as can be evidenced by the belief citation indexes since the first publication, having seen the high volume of written and published documents, proving greater interest from researchers, giving greater impact to these publications. It can be concluded that the theme raised has great relevance, and for this reason the volume of publications has been increasing, instigating researchers, and promising important scientific and technological advances.

Keywords: Blend; Collagen; Chitosan.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

PHYSICOCHEMICAL PROPERTIES OF PROPOLIS-LOADED STARCH NANOPARTICLES PRODUCED BY ANTI-SOLVENT PRECIPITATION

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Propolis is consider a bioactive compound due to the presence of phenolic acids, flavonoids, and terpenes. This raw material has antimicrobial, anti-inflammatory, and antioxidant activity. The use of propolis as a food ingredient is still limited due to its low solubility in water, strong flavor and aroma which may alter organoleptic properties of foods. The anti-solvent precipitation technique using starches appears as an alternative to preserve the bioactive properties and increase the water-solubility of propolis. Hence, this work aims to stabilized propolis using potato starch (PS) and to study the effect of the organic phase concentration on the physiochemical properties of propolis/starch particles produced by anti-solvent precipitation. Propolis extracts (PE) were prepared in different ethanol/water concentrations (50:50, 60:40 70:30, 80:20, and 96:04, v/v). The nanoparticles (NP) were analyzed by scanning electronic microscopy (SEM), DLS, polarized light microscopy (PLM), X-ray diffraction (XRD), and color. The NP showed a color change with the increase of the organic phase concentration, thus, the control NP showed a white color, while the NP containing the propolis showed a brown color, indicating that color can be correlated with the concentration of ethanol used, as well as with the encapsulation efficiency. A change in the morphology of the PS granules was observed, associated with a destruction of the granular structure of the starch. Furthermore, with the increase of ethanol concentration, there was a greater formation of agglomerates. X-ray diffractograms and PLM images showed that the modified starches were transformed in amorphous materials during anti-solvent precipitation. This behavior was not modified by the presence of propolis extract with different ethanolic concentrations. In addition, the modified starches did not have the Maltese cross, confirming their amorphous structure. These NP rich in bioactive compounds can be used as functional component in formulations of new food.

Keywords: Encapsulation; Potato starch; Nanotechnology.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização:

BIOPOLIMERIC FILMS OF CASSAVA RESIDUE INCORPORATED WITH WICKERHAMOMYCES ANOMALUS: ANTIMICROBIAL POTENTIAL

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Biopolymers have emerged associated with the environmental concern as an option of materials capable of carrying compounds of interest to food. It can be produced from agro- industrial residues, such as cassava residue, that is generally used for animal feed. Besides that, some yeasts, such as *Wickerhamomyces anomalus*, can inhibit undesirable microbial growth, characterizing them as potential for application in active films. This project aimed to develop cassava residue films to incorporate the yeast *W. anomalus* and evaluate their antimicrobial potential. This research used cassava residue flour consisting of bark and bagasse residues in equal proportions. The cassava residue was dried, ground, and sieved at 100 mesh. The filmogenic solutions were obtained mixing 2.5 or 5.0% of flour in water at 90ºC. After the initial 10 minutes, 0.5% (v/v) of glycerol was added, and then the mixtures were sterilized in an autoclave for the inoculation of microorganisms with 5% cell suspension. The films were produced using the casting method, pouring the mixtures into Petri dishes and drying them in an oven for 24h at 40ºC. With the films, after six days at room temperature, filamentous fungi grew, forming visible cottony colonies, only on the control plate, in which there was no addition of yeast suspensions. These results provide evidence of the in vitro inhibitory activity of films with *W. anomalus*. Despite this, experiments are necessary to optimize the film´s production, evaluate their mechanical properties and confirm the yeast inhibitory activity against pathogenic and deteriorating microorganisms of interest.

Keywords: Biopolymers; Active films; *Wickerhamomyces anomalus.*

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

PLA/β-CHITIN WHISKERS/SILVER NANOPARTICLES ASYMMETRIC MEMBRANES AS WOUND DRESSING MATERIALS

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Asymmetric nanofibrous nonwovens have emerged as promising materials for wound dressing application due to their inherent high porosity and surface area to volume ratio, which enable a proper control of moisture balance at the wound site and favor the gas permeation, transport of nutrients as well as the metabolic waste elimination. Here, we report on the application of solution blow spinning (SB-Spinning) and electrospinning to prepare PLA-based nonwovens, whose surfaces were functionalized by combining the filtration of beta-chitin whiskers aqueous suspension followed by dispersion of silver nanoparticles (AgNPs) via SB-Spinning, thus yielding to an asymmetric structure. SEM images clearly revealed the asymmetric character of such material consisting of a nanofiber matrix coated by a homogeneous thin layer of beta-chitin whiskers and AgNPs. The diameter of SB-spun and electrospun PLA fibers were determined as 1,600 ± 500 nm and 346 ± 81 nm, respectively, and both surfaces displayed a pronounced hydrophobic character according to water contact angle experiments (above 90º). However, the deposition of β-chitin whiskers/AgNPs strongly decreased the water contact angle (≈55°) revealing that the surface became hydrophilic. In vitro experiments showed that such bio-based asymmetric material has outstanding antimicrobial activity toward Staphylococcus aureus and Escherichia coli. Overall, although further physicochemical and biological assays are required, these preliminary results indicate that such materials are promising candidates for wound dressing applications.

Keywords: Chitin Whiskers; Spun Fibers; Wound Dressing.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

EVALUATION OF THE INFLUENCE OF THE CONCENTRATION OF CHITOSAN AND ANTIOXIDANT ON THE PROPERTIES OF BIOACTIVE FILMS: EXPERIMENTAL DESIGN DCCR

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The change in consumer profile, as food safety and concern for the environment have been key to the development of new packaging materials and active packaging seek to meet these new market trends. Within this context, this study aimed to determine the concentrations of chitosan and hydroethanolic extract the residue of acerola (EHRA) to obtain films with flexibility and differentiated rigidity, with retention of phenolic compounds and antioxidant potential, applying the technique the CCRD experimental design (Compound Center Delineation Rotational). Seventeen trials were conducted, among which the Trial 3 (RCF = 4.4 ± 0.08 mg / g PA = 25.2 ± 0.11%); Test 4 (RCF = 1.5 ± 0,21mg / g PA = 15.8 ± 0.21%) and test 12 (RCF = 4.1 ± 0,66mg / g PA = 22.4 ± %) showed the best results regarding the retention of phenolic compounds and the antioxidant potential parameters considered most important for characterization of the films obtained in this work. Thus, the technique employed experimental design in this study made it possible to obtain films with antioxidant properties, enabling new packaging formulations with potential assets, in order to provide greater protection and ensure the quality and safety of food in order to meet the expectations of an increasingly demanding consumer.

Keywords: Acerola Residue; Antioxidant Activity; Chitosan Film.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

ANTIMICROBIAL ACTIVE EDIBLE COATING OF ALGINATE AND CHITOSAN ADD ZNO NANOPARTICLES APPLIED IN GUAVAS (*PSIDIUM GUAJAVA* L.)

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Nanostructured coatings made with chitosan (100%Q), alginate (100%A) and blends of 50%Q–50%A; 90% Q–10%A and 90%A–10%Q, were added with (1%v/vgel) of nanoZnO and applied to guavas (*Psidium guajava* L.). After coating application, fruits were stored for 15 days at 21 ± 1 °C and 80 ± 2% RH. To determine the effect on ripening process, fruits were submitted to water loss, texture, color, rot index, and physic-chemical assays. The results showed that coatings made with 90%A did not delay the maturation process, however, chitosan matrices (100%Q or 90%Q) protected fruits against excessive mass loss and retarded physic-chemical changes related to maturation. The experiment showed that it is possible to extend guava shelf life with ZnO nanostructured coatings with 100%Q or 90%Q–10%A up to twenty days *vs* seven days of uncoated fruits.

Keywords: Bioactive packaging; Nanoparticles (NPs); NanoZnO.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

ANTIMICROBIAL ACTIVITY OF AG/ZEOLITE-LOADED CHITOSANFILMS

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The antimicrobial properties of chitosan films for the treatment of burns can be induced and/or enhanced by incorporating devices for the controlled release of active agents, such as zeolites (NaA or NaY) containing silver as the antimicrobial agent. In this work, films of pure chitosan, films with zeolite without silver (NaY/chitosan or NaA/chitosan), and films with silver and zeolite (Ag/NaA/chitosan or Ag/NaY/chitosan) were evaluated against antimicrobial activity in a liquid medium. The experiment was carried out by inoculating 106 CFU/mL of each tested microorganism (E. coli, C. albicans, S. aureus or P. aeruginosa), previously standardized, in individual test tubes containing 30 mL of TSB or SDB medium. The films were previously sterilized with UV light. All samples were incubated in the test tubes. The evaluation of microbial growth was determined by optical density using the automatic microplate reader (Biotek model Synergy HT). The 5% Ag/NaA/chitosan film, compared to the Ag/NaY/chitosan, presented the highest antimicrobial activity against all pathogens tested. This occurred due to the high silver content contained in the zeolite NaA, not only on the surface in the form of clusters but also within the channels and zeolitic cavities, indicating a controlled release of silver ions into the culture medium, which, consequently, inhibited higher growth rates of pathogenic microorganisms. As expected, the films containing pure chitosan and NaY/chitosan or NaA/chitosan did not show antimicrobial activity against any tested microorganism, reinforcing that silver is the component responsible for the biocidal activity of the wound dressing for burns.

Keywords: Chitosan; Zeolite; Silver.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

DEVELOPMENT AND CHARACTERIZATION OF SELF-SUSTAINED FILMS BASED ON AMBURANA *CEARENSIS* GUM AS ALTERNATIVE FOR BIODEGRADABLE PACKAGING

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The development of self-sustained films based on polysaccharides or natural polymers is one of the important aspects of science and current technology as they have low production costs, are renewable and biodegradable under different conditions. Films based on natural polymers have been replacing those made from synthetic materials, mainly in packaging, in order to minimize the harmful effects of non-biodegradable synthetic polymers residues on the environment. Thus, an interesting polysaccharide to be used in the formation of self-sustained films, is found in the exudate of the species Amburana *cearensis* (A. *cearensis*), also called Amburana cearensis gum (GAmb), which has substances with antioxidant, antibacterial and anti-inflammatory properties. The by-products of its degradation are non-toxic, since it is a natural polymer, and can be incorporated into nature without contaminating the environment, in addition, this natural polymer has low cost and differentiated properties due to the presence of several constituents, also, seeks add value to this species, as it is a regional material still little studied, besides generating information for the scientific community and providing opportunities for the development of films with this new polysaccharide. In this work, GAmb films were obtained by the casting technique using glycerol as a plasticizer in order to improve the visual aspect of the films obtained. In the results, the DRX showed that the films have an amorphous characteristic, with only a wide peak observed at 2θ=20°, in addition, GAmb films containing 10%, 15%, 20%, 25% and 30% glycerol showed are similar to those observed for the GAmb film without glycerol, but a slight increase in intensity was observed at peak 2θ=20°, which confirms the presence of glycerol in the GAmb polymer chain. The FTIR spectrum of the gum indicated the presence of the main groups corresponding to the elements Chalcone (OH in 3450 cm-1), Dilmin (CH in 2943 cm-1), Quinone (C-O in 1628 cm-1) and Isoflavone (C=C in 1422 cm-1 and C-O-C in 1022 cm-1), proving that GAmb is composed of different elements. Finally, films containing 15%, 20% and 25% glycerol presented an excellent visual aspect with a smooth and homogeneous surface, and average thickness values in the range of 0.0800 to 0.0863 mm.

Keywords: Exsudate; Amburana Cearensis; Casting Films.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ANTIOXIDANT POTENTIAL OF THE POLYSACCHARIDE EXTRACTED FROM *ULVAS* ALGAE FROM THE PIAUI COAST

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The algae of the genus *Ulva* can be found easily around the shores of the seas across the planet. They have a very relevant chemical composition, which makes them a commercial attraction. The work aims to evaluate the antioxidant potential of polysaccharides extracted from marine algae of the genus *Ulva*. To obtain the polysaccharide, aqueous extraction was performed. The characterization of the polysaccharide was carried out by means of FTIR with Fourier transform and phytochemical analysis performed by qualitative methods to identify the main classes of secondary metabolites: phenols and tannins, alkaloids content, reducing sugar flavonoid content and organic acids. The test for the antioxidant potential of polysaccharides obtained from algae was carried out by sequestering ABTS • + in a 96-well microplate. For the extraction the yield of the polysaccharide extracted from the algae of the genus *Ulva*, was approximately 13%. The infrared results show that the spectrum shows the presence of the groups providing characteristics of the ulvana polysaccharide. In the phytochemical analysis there was no presence of any of the secondary metabolites investigated, demonstrating that the isolation of the polysaccharides was successful. The antioxidant activity of the polymers extracted from the algae against the radical ABTS was 60% at a concentration of 83.33 µg / mL. In view of the above, it is possible to state that the algae presented a good yield, in addition, the phytochemical tests are within the same range of values as the results that are present in the literature and despite the absence of secondary metabolites that generally assist in the anti-toxicity activity, the polysaccharide presented satisfactory antioxidant potential. From the FTIR analyzes it was also possible to verify that the polysaccharide isolation was effective. Finally, the importance of developing research is clear in order to investigate possible applications in the pharmaceutical, cosmetic and nutritional sectors.

Keywords: Olysaccharide; Algae; Ulva; Antioxidant

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

SILVER NANOPARTICLES IN THE TREATMENT OF TRAUMATIC ORAL LESIONS IN RATS

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Ulcerative lesions in the oral mucosa are a common finding in the dental clinic and are caused by mechanical trauma due to poorly adapted dentures, orthodontic appliances and teeth with fractured crowns or restorations. Local dentists with few resources to prevent or relieve lesions of the oral mucosa. In this context, interest in compounds that have less adverse effects and that stimulate healing is growing. Therefore, it becomes relevant to evaluate the effects of different formulations of silver nanoparticles in the treatment of traumatic or induced injuries in rats. Eighty male Wistar rats were used, injured by a 4.0 mm diameter dermatological punch for the excision of two circular fragments in the oral mucosa. After making the lesions, the animals were treated twice a week according to the following groups: without injury, control, vehicle, solid Ag, soluble Ag, and diluted Ag. On the 2nd, 7th and 14th days post-injury, biopsies were collected for immunohistochemistry; dosage of Myeloperoxidase and N-Acetylglycosaminidase. As a result, the amount of neutrophils and macrophages in the groups did not obtain significant differences, however the greatest production of neutrophils was on 2nd day and of macrophages on 14th day in all groups. Regarding the IL-1β and IL-10, the diluted Ag and soluble Ag groups did not obtain control of the inflammatory phase, whereas the solid Ag group has greater expression of pro-inflammatory cytokine after injury, and on the other days studied, increased IL-10. We conclude that solid Ag was the more adequate formulation because of its inflammatory control, favoring the next phases of healing oral lesions.

Keywords: Silver Nanoparticle; Oral Ulcers; Formulations.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

KINETIC AND ADSORPTION ISOTHERM STUDY APPLIED TO NANOCOMPOSITE HYDROGELS HERBICIDE PARAQUAT SYSTEMS

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The controlled release of actives, especially from hydrogels, has attracted great attention in recent years since they can maintain the concentrations of these actives in the environment at desirable levels. Thus, the objective of this work was to develop composite and nanocomposite hydrogels and to investigate the adsorption type that occurs between the adsorbent and the adsorbate by using sorption isotherm mathematical models. The hydrogels were prepared from the immersion of alginate/starch solutions or alginate/starch/nanostructure in containers containing different crosslinking agents (MnCl2, ZnCl2, CaCl2). The adsorption study was performed by immersing a certain mass of hydrogel in a solution containing paraquat. The concentration of the herbicide in the solution was determined using a UV-Vis spectroscopy. Considering the linear regression coefficient (R2) as the main evaluation parameter, it is noted that the adsorption process of paraquat by the both composite and nanocomposite hydrogels is better fitted by Freundlich model. On the other hand, the interaction between the adsorbent and adsorbate was chemical sorption by the adsorption kinetic study. In this case, the best-fitted model was the pseudosecond-order, assuming that the chemisorption of paraquat molecules occurs through electron transfer or complexation. Based on the results obtained, the authors concluded that the mathematical models studied are important keys to understand how occurs the desorption or release process of these actives from hydrogels. Furthermore, the results presented serve for researchers to develop new strategies to control and extend the release of different actives.

Keywords: Hydrogels; Natural Polymer; Nanostructure Inorganic.

Acknowledgement: The authors would like to Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP (CEPID – CDMF 2013/07296-2), and CNPq (MRM 312530/2018-8; FAA 312414/2018-8 and 405680/2016-3). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – “Finance Code 001”.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

DEVELOPMENT OF THE FILM-FORMING DISPERSION CONTAINING CMC, ARABIC GUM AND *FOENICULUM VULGARE* ESSENTIAL OIL FOR FOOD PACKAGING

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The concern about consuming products environmentally friendly has motivated research in the development of new packaging materials. In sense, films based on natural polymers have been used to replace the use of traditional petroleum-based. This work consists of an elaboration of new edible films based on carboxymethylcellulose (CMC), arabic gum, and Foeniculum vulgare essential oil. The films were analyzed for water vapor permeability (WVP) and solubility. Film pieces were weighed and then immersed in 50 mL distilled water for 6 h under continuous agitation at room temperature. The remaining film pieces were oven-dried at 105 °C to constant weight. The water solubility of the films were calculated as the difference between weight before and after the water immersion. The thermal processing at 105 °C was used to obtain the initial dry weight of the films. For the measurement of WVP, firstly, the samples were cut in circles and fixed in a standard cell containing 6 mL of distilled water and stored in at 25 °C with moisture control. Measurements weigh of the cells were realized during 25 h for WVP determination. The WVP value for CMC films were 0.259 ± 0.01 g mm / kPa h m2. After Arabic gum addiction, the permeability increased for 0.584 ± 0.02 g mm / kPa h m2. When essential oil was present, the WVP were 0.629 ± 0.02 g mm / kPa h m2. The CMC control films shown solubility equal to 100%. The CMC + GA films showed a lower solubility (63.67% ± 3.4), however, with the incorporation of essential oil, the solubility of the films was 73.99% ± 4.8. This result corroborates with what was observed in the water vapor permeability test, in which the addition of these components increased the passage of water vapor. These results are very interesting because the films were designed to be applied as water-soluble packaging material.

Keywords: Biopolymers; Edible films; Natural polymers.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

POLYMERIC FILMS WITH THE ADDITION OF CATUABA EXTRACT AS A NATURAL ANTIOXIDANT

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Interest in developing new products from renewable raw materials is growing in all sectors, including the pharmaceutical and cosmetic industry. Biopolymer films can be considered a promising alternative pharmaceutical form that has been used for the distribution of active compounds in medicines or cosmetics. The objectives this study were the production of starch- gelatin biopolymeric films with the incorporation of catuaba extract, a natural antioxidant. The films were produced from the mixture of starch and gelatin (1:1), using the casting technique, with different concentrations of the catuaba extract (0.5, 1.0 and 1.5 g/100 g polymer, labeled as CEF0.5, CEF1.0, and CEF1.5, respectively). The films were characterized according to the release of the total polyphenols content, which was determined after immersion of samples in distilled water for different times (5, 15, 30, and 60 min). All formulations showed an increased release of total polyphenols over time, and as the higher the concentration of catuaba extract in the films, the greater the release. The sample CEF1.5 (prepared with the addition of 1.5 g catuaba extract/ 100 g polymer) presented the highest total polyphenol release (73.55%). While the CEF0.5 sample had the lowest release in 60 min (39.35%). As higher the release of total polyphenols, greater its antioxidant capacity. The films produced presented good appearance and homogeneity, and the films loaded with 1.5 g catuaba extract/100 g polymers are promising alternatives for use as a topical drug delivery system.

Keywords: Catuaba; Biopolimeric films; Polyphenol.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

PRODUCTION AND APPLICATION OF COMPOSITES BASED ON NANOCELLULOSE AND LAYERED CLAYS: A BIBLIOGRAPHICAL REVIEW OF THE LAST 5 YEARS.

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The nanocelluloses are parts of cellulose in nanometric scale (1 - 100 nm) and according to their properties, composition, mode of production, can be classified into three types: nanocrystals (CNC), cellulose nanofibers (CNF) and bacterial cellulose (BC). The nanocelluloses have attracted the interest of industry and researchers in the production of new materials, since they can produce materials with well-defined structures and at various scales (Nano-Micro), being investigated primarily as reinforcement in the production of composites and nanocomposites. Layered clays, on the other hand, are used in the preparation of composites by combining them with polymers in nanometric scale. The composites obtained, in general, present improvements in the mechanical, thermal, optical, water and gas barrier, flame resistance properties, compared to isolated polymers. Thus, the production of composites using nanocellulose and layered clays can produce materials with different structures and specific properties of interest. Thus, this abstract had the goal of conducting a literature review with the objective of demonstrating the main works published in the recent period (2015 - 2020), on nanocellulose composites and lamellar matrices and the possible applications of these materials. During the study, a total of 23 articles were evaluated, of which several composites were presented using CNF, BC and CNC, together with the layered clays Montmorillonite, Bentonite, Laponite, Saponite, Cloysite and Haloisite. The works demonstrate applications for composites such as: flame retardants, luminescent materials, adsorption of dyes, metal-potentially toxic and antibiotic, curatives, catalysis, among other applications. Therefore, it is concluded that composites using nanocellulose and layered clays are diverse in composition and can be developed for several applications. Thus, it is demonstrated that this is an important field for the production of new materials of interest.

Keywords: Layered Clays, Nanocellulose, Composites.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

CARNAUBA WAX MICRO- OR NANOEMULSIONS MODIFY THE WATER BARRIER PROPERTIES AND MICROSTRUCTURE OF ARROWROOT STARCH FILMS

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Starch-based films can have their poor technological properties improved by lipid supplementation. Our aim was to evaluate the incorporation of carnauba wax (0-15 wt%) using emulsion technology ─ micro- (ME) and nanoemulsion (NE) ─ in the water barrier properties and microstructure of arrowroot starch films. The water vapor permeability (WVP) was determined from the gravimetric method and the ultrastructure of the films was analyzed in a scanning electron microscope JEOL- JSM 6510. The WVP was significantly reduced by carnauba wax presence, mainly at the 15% concentration, due to the hydrophobic character of the wax. At the 15% concentration, the NE film presented lower WVP than the corresponding ME film, which may be due to smaller droplets resulting in lower discontinuity of the film. The microstructure of the films was altered by the addition of carnauba wax. Films with carnauba wax ME presented a rough surface with aggregates of wax particles, which were more noticeable with increasing ME concentration. Differently from the films with ME, those with NE were smoother, with fewer aggregates and more homogeneous distribution of carnauba wax, demonstrating that the decreased carnauba wax droplet size resulted in better dispersion of the hydrophobic phase on the starch matrix. The addition of either ME or NE enhanced the water barrier properties which results in films that may be used as environmentally friendly food packaging materials. In addition, nanoemulsification seems to be a good strategy for incorporating hydrophilic compounds in starch-based films.

Keywords: Polysaccharides; Biopolymers; Emulsion Films.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

INFLUENCE OF MORPHOLOGY AND PH ON THE SWELLING DEGREE AND DIQUAT RELEASED PROPERTIES FROM METHYLCELLULOSE BASED NANOCOMPOSITE HYDROGELS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

This work aimed to obtain hydrogel nanocomposites based on methylcellulose (MC) and zeolite ZK406H, supported on poly(methacrylic acid)-co-polyacrylamide (PMAA-co-PAAm) networks, for possible application in agriculture. The swelling analyses were determined in aqueous NaCl 0.1 mol/L solutions with different pH values (from 1 to 9). The results showed an increase in the swelling capacity caused by the increment in the pH. This effect is related to the ionization of the carboxyl groups (pKa ≈ 4.9), provoking a repulsion between them, increasing thus the chain elasticity and water absorption. The scanning electron microscopy technique investigated the influence of polysaccharide and zeolite in the porosity and structure of the nanocomposites. From this technique, it was possible to see that the nanocomposites have a porous surface similar to those presented by the hydrogel matrix. A formation of several microporous in their porous wall of the nanocomposites were also observed. Probably, they were formed by the zeolite presence, and this morphology provoked a decrease in water uptake. Lastly, the amount of diquat released in NaCl solution (0.1 mol/L) at pH's 4, 7, and 10 was investigated by UV-VIS spectroscopy. The presence of zeolite increased the velocity and amount of the herbicide released, reaching the equilibrium after 24 hours for PMAA and PMAA-MC hydrogels and 8 hours for nanocomposites. Probably, the increase in the interaction between negative surface of the zeolite and Na+ present in the release medium facilitated the pesticide desorption. These results indicated that the intrinsic factors related to the nanocomposites, such as chain elasticity, the volume of hydrophilic groups, and extrinsic factors, such as pH of the release medium, influenced the herbicide desorption.

Keywords: Nanocomposite; Zeolite; Herbicide desorption.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

EFFECT OF CHITOSAN AND CITRIC ACID LEVEL ONTHE PHYSICAL PROPERTIES OF STARCH BASED EDIBLE FILMS CONTAINING OREGANO ESSENTIAL OIL

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The use of edible films and coatings containing antimicrobials has proven to be a useful tool to protect food against flora spoilage and decrease the risk of pathogen growth. The most commonly used antimicrobials are organic acids, chitosan, some plant extracts, and their essential oils. In turn, the use of starch films for food packaging has been restricted due to its hydrophilic characteristic, a poor barrier against moisture, and its high sensitivity to water. Hence, mixtures of starch with other bio-based polymers (cellulose acetate, chitosan, etc.) have been developed to form composite materials with improved physical properties. According to this, starch based edible films containing oregano essential oil were developed by casting method. Films formulation included citric acid and chitosan at different concentrations (0.07 – 0.47 and 0.19 – 0.41 % w/w, respectively) were investigated in order to study the effect of such compounds on their mechanical properties, solubility in water and color parameters. Results showed that films with the lower amounts of citric acid (0.07 and 0.13 % w/w) generate higher values of stress at break and Young's modulus, and percentages of elongation at break less than 6%. Solubility in water tends to increase as citric acid concentration was higher. The films were transparent and slightly yellow but with high L* values (84-87) and b* (9.8-16.9). The optimized formulation results 0.13 % w/w of citric acid and 0.38 % w/w of chitosan which show adequate stress at break and lowest solubility in water. Therefore, this formulation could be considered as a polysaccharide-based materials with improved properties, which have potential as bioactive packaging material for food application.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

CHITOSAN DRESSING DEVELOPMENT: THE IMPORTANCE OF BATCHES HOMOGENEITY TO PERFORMER THE PHYSICAL-CHEMICAL AND BIOLOGICAL TESTS

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The development of dressings made from biodegradable materials is a point of great interest for the industry. Chitosan is a biomaterial with several biological properties in addition to being biocompatible and biodegradable. In this context, a biomaterial was developed, using a 2% (w/v) chitosan solution in acetic acid, followed by freezing and lyophilization, keeping some samples chemically unchanged to be used as a control (QUI R), while others were cross-linked with 0.01 mol/L epichlorohydrin for 24 hours (EPI R) and others were neutralized with NaHCO3 (QUI NR). One unit of each sample was selected as the desirable standard and the entire batch was evaluated. The criteria used were: cracks, variation in size and thickness, degree of undulation, and degree of heterogeneity. The observations were cataloged and a comparative analysis regarding the batch constancy was performed. The samples were categorized into grades 0, 1, 2 and 3, the first two being highly satisfactory, grade 2, reasonable and Grade 3 not satisfactory. The criteria of homogeneity of the samples is a relevant factor in reproduction. A more homogeneous batch ensures best use of reagents, therefore, less waste, and greater yield. QUI R showed “grade 3” heterogeneity for the entire batch, corroborating the impossibility of confidence in the results of this sample in some tests and the need for cross-linking of the samples. Treatment with NaHCO3 results in a batch with greater amounts of “satisfactory” samples, since QUI NR obtained the highest batch constancy, and EPI NR the second one, inferring that the ionic crosslinking occurs more uniformly in the extension of the material. These results are relevant to the decision of the technique used, as well as to guarantee the quality of the developed batches and the confidentiality in the physic-chemical and biological assays.

Keywords: Quality Control; Cost Reduction; High Results Confidence.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

HYBRID MATERIALS FROM BACTERIAL CELLULOSE NANOCRYSTALS MODIFIED WITH SILOXANES

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

In recent years the biopolymers have increased the researchers interest in the biomedical field because they are an alternative for the production of biodegradable and/or biocompatible materials for several applications, including controlled drug release and tissue engineering as the polymeric scaffolds. Bacterial cellulose nanocrystals (BCN) stand out as a biomedical material due to outstanding characteristics such as excellent crystallinity structure, high rigidity and low density, as well as excellent biological properties such as biocompatibility, biodegradability and low toxicity. Polysiloxanes are elastomers considered to be good modifying agents due to their interesting properties such as very low surface energy, excellent gas and moisture permeability, good thermal stability, low temperature flexibility, biocompatibility and low toxicity. In this work, BCN were extracted from acid hydrolysis and the surface was modified with 3-aminopropyltriethoxysilane (APTES) and 3-glycidyloxypropyltrimethoxysilane (GPTMS), respectively, originating organic- inorganic hybrid films. Thermogravimetric Analysis (TGA) showed higher thermal stability for APTES hybrids. Zeta Potential measurements confirmed negative surface charge to BCN, which may justify the best interaction with this siloxane. Fourier Transform Infrared Spectroscopy (FTIR) showed slight change in some bands only for this same hybrid. Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM) images confirmed the needle-shaped structure for nanocrystals and revealed good incorporation of APTES with BCN. Cytotoxicity assays have shown that the films at certain concentrations have cell viability greater than 70%, ensuring that they are not toxic in contact with human fibroblast.

Keywords: Hybrids; Bacterial Cellulose Nanocrystals; Siloxanes.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

EVALUATION OF XYLAN/POLYETHYLENIMINE FILMS WITH DIFFERENT MASS RATIOS

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Films with interesting mechanical properties were obtained using xylan (xyl) as a main component and Polyethylenimine (PEI). Hemicellulose, the second vegetable polysaccharides more abundant in earth, is present as a polymer in lignocellulosic biomass. PEI is a branched synthetic polyamine that is admitted in certain packaging materials. Arabino-glucurono-xylan, the main hemicellulose in sugar cane bagasse, was alkali extracted at 50°C during 180 minutes using a charge of 40% NaOH and precipitated in a 50 % alcohol solution. Polyelectrolytes complexes (PECs) were prepared adding xylan solution (4 g/l) on PEI solution (2.5 g/l), and films were obtained by casting/evaporation technique. The effect of xyl/PEI mass ratio on mechanical properties and other characteristics of films was studied, using an increasing amount of xylan from 50/50 to 95/5 Xylan/PEI ratio. Colloidal electric charge was monitored by the streaming current analyzer. For ratios greater than the electric charge neutralization (85/15 and higher), the removal of a supernatant was possible which is beneficial for the reduction of evaporation energy and the removing of salts. The strength was higher and strain at break were lower when the xylan content was increased. The increase in ratio improved the stress at break up to 35 MPa but the strain was reduced from 22.0 to 2.0 %. A stepped change took place at the region of mass ratio corresponding to charge neutralization. Swelling of 85/15 and 90/10 xyl/PEI film was 190% and 160% respectively. The solubility of the 90/10 and 85/15 films was favorably reduced from 27% to 12% and from 22% to 12%, respectively, when supernatant was removed from the PECs precipitation. The rate of permeability to water vapor resulted notably low (WVTR = 0.0047 g/seg.m^2 for 85/15 film). Results indicate that PEI allow to obtain a xylan based film with acceptable properties for packaging.

Keywords: Sugar Cane Bagasse; Mechanical Properties; Swelling.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

EFFECT OF STARCH CONTENT ON THE MECHANICAL PROPERTIES OF THERMOPLASTIC FILMS PRODUCED BY TAPE CASTING

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Starch is a versatile natural polymer, and thermoplastic starch (TPS) films have been explored for diverse applications, including packaging, sensors, and biomedical applications. However, most TPS films are produced by casting, which does not allow thickness control and generally produces films with small sizes. To overcome these limitations, this work proposes the use of the tape casting method for large-scale production of multifunctional TPS films. Mixtures with different starch contents (5 and 10 wt%) were produced with 20% and 100% of glycerol (related to starch). The suspensions were stirred at 80 ºC until gelatinization and films were produced by tape casting. The influence of the starch content on the mechanical properties of TPS films was evaluated by tensile tests (ASTM D882). For the films with 20% of glycerol, the increase in the starch content from 5 to 10 wt% resulted in a significant enhancement in the elongation at break (from 21.1 to 49.8%, respectively), while no significant changes occurred in the tensile strength (6.6 ± 2.3 MPa) and the Young's Modulus (275.7 ± 147.0 MPa). On the other hand, in the films with 100% of glycerol, significant changes in both the elongation at break (from 12.8 to 25.1%, respectively) and the Young's Modulus (from 3.8 to 2.6 MPa, respectively) were observed, with no significant change in the tensile strength (0.4 ± 0.1 MPa). Overall, results show that the increase in the starch content promotes significant improvements higher than 100% in the elongation at break of TPS films produced by tape casting, causes no significant changes in their tensile strength, and decreases their Young's modulus as higher the glycerol content. This study gives insights into the mechanical properties of TPS films produced by tape casting as a function of composition, allowing their use in different applications that requires different mechanical properties.

Keywords: Starch; Tape Casting; Mechanical Properties.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

OBTAINING AND EVALUATING THERMOPLASTIC STARCH BIOCOMPOSITES FROM DIFFERENT BOTANICAL SOURCES WITH TIO2 AND GRAPHENE

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*Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (**X**) Multifunctional Applications*

The present work aims to analyze the behavior of titanium dioxide nanoparticles (TiO2) in the crystalline form anatase and commercial graphene in a polymeric matrix of thermoplastic starch (TPS) from different botanical sources (potato, cassava and corn). The nanoparticles were chosen to be complementary with each other, aiming at a production that had less environmental impact, either through the availability of raw materials in brazilian territory and its renewable nature, as well as the low toxicity index and low incorporated levels, aiming at a good dispersion of charges in the matrix. The biocomposites were produced through a solution and the films obtained by casting and characterized in terms of their physical properties. For this purpose, the X-ray diffraction (XRD) analysis evaluated the behavior of the nanoparticles in the matrices, as well as the influence of the starch granules from each source, showing a great influence on the gelatinization speed and degradation of the films. Due to the fact of having high hydrophilicity, causing low dimensional stability and reduction of mechanical properties that can interfere with its useful life, titanium dioxide anatase nanoparticles (0.5; 1; 3 and 5%) were added to the solution. aiming at biocidal action, for being a strong reducing and oxidizing agent, especially when exposed to ultraviolet (UV) radiation and graphene (0.1; 0.2; 0.5%) to provide greater resistance to the material. The dispersion of the graphene lamellae in the TPS was also evidenced by the absence of a peak at low angles, and the interaction of the spherical nanoparticle system of titanium dioxide and graphene lamellar together.

Keywords: Thermoplastic starch; Biocomposite; Nanomaterials.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização:

TRANSLUCENT CEMENTITIOUS COMPOSITES BASED ON MORTARS AND POLYMERIC OPTICAL FIBER AS SUSTAINABLE ALTERNATIVES FOR ENERGY SAVING

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The expansion of the energy sector has been stimulated to improve the quality of society´s life. This development, while meeting social and economic demands, can also trigger environmental problems. In this context, consumption reduction policies and sustainable practices, such as the use of natural light, have been adopted, mainly in the civil construction industry. Thus, one of the sustainable constructive innovations developed refers to the translucent concrete, obtained from the association of cementitious materials and polymeric optical fibers of high light transmission capacity. The application of these cementitious composites, as a substitute for artificial sources of lighting, represents savings of up to 50% in the consumption of electrical energy in a building. The addition of these polymeric fibers can also act as reinforcement agents of the cementitious composites, contributing substantially to the mechanical properties of these matrices, or as decorative elements due to their light transmittance characteristic. Thus, the objective of the study will be to evaluate the effect of two different polymeric optical fiber contents (2% and 4% wt/v$_{mortar}$) on the fresh and hardened properties of cementitious matrices, i.e., mechanical (compressive strength, tensile strength, flexural, elastic modulus), physical (consistency index, exudation rate, water retention), and light transmission. For this purpose, cement, sand, and fume silica mortars (dosage 1: 2.22: 0.11; and 0.55 w/c ratio) will be produced with fibers randomly and orderly manner distributed in the cementitious matrix, It should be noted that the study is still in its initial stage being conducted only the steps of dosage definition. Therefore, it is expected that this study may represent an innovative and environmentally sustainable alternative for the development of new materials for civil construction, due to its high efficiency in the use of natural light, reducing the electricity consumption.

Keywords: Natural Light; Cementitious Composite; Polymeric Optical Fiber.

Acknowledgement: The authors would like to thank FASA Fibra Óptica, IFSP, Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP (CEPID – CDMF 2013/07296-2 Grant), and CNPq (MRM 312530/2018-8; FAA 312414/2018-8 and 405680/2016-3). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – “Finance Code 001”.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

SYNTHESIS, EXTRACTION AND CHARACTERIZATION OF BIOPOLYMER POLY(3-HYDROXYBUTYRATE) AND POLY(3-HYDROXYBUTYRATE-CO-3- HYDROXYVALERATE)

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Polyhydroxyalkanoates (PHAs) are a family of natural polymers which properties and characteristics vary according to the chain length or chemical composition as a copolymer presence. Poly(3-hydroxybutyrate) [P(3HB)] and poly(3-hydroxybutyrate-co-3-hydroxyvalerate) [P(3HB-co-3HV)] are the most studied polyesters in the PHA family since they can be synthesized from renewable carbon sources. Besides, they are a promising material for biomedical applications due to the biocompatible and low-toxicity proprieties. The objective of the present study was to evaluate the synthesis of the polyesters P(3HB) and P(3HB-co-3HV) by *Cupriavidus necator* through different culture conditions and production strategies, to further characterization of chemical and physical proprieties. The fermentative process was performed in an agitated shaker culture (24 hours, 150 rpm) and in a bioreactor (30 hours, 400-780 rpm e 0,1-2 L/min). The fed- batch cultivation was performed under different feeding strategies. To promote P(3HB) production, pulse of glucose was added into the bioreactor while in the other culture, a continuous feed system of propionic acid; feeding rate of 15 mL.h-1, was used to stimulate the P(3HB-co-3HV) production. The culture medium was centrifuged and washed twice. . Afterwards, the polymer and copolymer ware extracted from cells with chloroform in a ball mill (30 min) and evaporated. The polymers were precipitated using n-hexane. P3HB and P(3HB-co-3HV) ware characterized by Differential Scanning Calorimetry (DSC), Fourier-transform infrared (FTIR) and Thermogravimetric Analysis (TGA). The DSC and TGA analysis demonstrated an effective thermal stability for both polymers with potential use in tissue engineering. However, the P(3HB) produced by shaker had a decrease in melt temperature. TGA results revealed that regardless of the operational process (shaker or bioreactor), P(3HB-co-3HV) has a superior thermal stability than the P(3HB), highlighting the P(3HB-co-3HV) processability characteristics. Gas chromatography demonstrated a higher concentration of impurities in the P(3HB) samples from shaker condition and consequently an inferior extraction efficiency.

Keywords: Biodegradable polymers; Polyhydroxyalkanoates (PHAs); *Cupriavidus necator.*

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

OPTIMIZATION OF ALGINATE MICROPARTICLES BY IONIC GELATION

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Area: () Food and Agriculture () Medical and Pharmaceutical (X) Multifunctional Applications

Microparticles produced from biopolymers have been widely used in pharmaceutical areas. The biopolymers guarantee the protection of the active compound from the external environment and allow a controlled release. Sodium alginate has been featured as one of the most widely used biopolymers for the formation of microparticles. This study aimed to optimize the process conditions to produce sodium alginate particles from the ionic gelation technique for a future application as encapsulation matrix of bioactive compounds. The microparticles were prepared from a solution of sodium alginate (3% m/v) that was extruded in a solution of calcium chloride (1% m/v) under magnetic stirring. An atomizer nozzle, peristaltic pump and a compressor were used to produce the microparticles. Optimization was performed using central composite designs with three independent variables: compressed air pressure, fluid flow rate and height between the atomizer nozzle and the gelling solution. The microparticles were analyzed in relation to their microstructure, size and shape by using optical microscopy. The results of the experimental design showed that the average diameter of the particles was affected, mainly, by the compressed air pressure used, and the values ranged from 2.07µm (in central point conditions of flow, pressure and height) to 5417.27µm (in the conditions of maximum height and minimum flow and pressure). The analysis of the particle shape indicated some irregular particles, and, for this reason, the aspect ratio was calculated, and values ranged from 1.0 to 1.30. This parameter was mainly affected by the height between the atomizer nozzle and the gelling solution. In the results of the second experimental design the values of the average diameter ranged from 18.76µm (in the conditions of maximum pressure and minimum flow) to 87.78µm (in the conditions of maximum flow and minimum pressure) and the aspect ratio values ranged from 1.3 to 1.52. From the results obtained, it can be concluded that microparticles with the desired shape and size can be obtained by changing the process conditions.

Keywords: Biopolymer; Extrusion; Microsphere.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

HIGH TRANSPARENT, BIOCOMPATIBLE AND RENEWABLE SUBSTRATES FOR FOLEDS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

A new biopolymer substrate obtained from Hyaluronic Acid, D-glucoronic acid and N-acetyl glucosamine linked by β (1,4) and β (1,3) glycoside bonds, was proposed to produce biocompatible and sustainable substrates for flexible organic light-emitting diodes (FOLEDs). The OLEDs are constituted by several thin films deposited onto a substrate. Glass is the most common substrate used. However, in the last years flexible substrates are employed to develop flexible OLEDs. The use of metal or polymer substrates lead to the development of new devices and applications. Particularly, the use of biopolymers opens the possibility to develop organic bioelectronic sensors, artificial retina, and photodynamic therapy devices. The hyaluronic acid has interesting properties to the development of such technologies, like biocompatibility, flexibility and high optical transmittance in visible spectral range. In this work we compare substrates based on hyaluronic acid transmittance (92% at 550 nm) whit substrates produced whit other biopolymers, like onion substrates and bacterial cellulose derivative substrates (50 - 70 % at 550 nm).

Keywords: FOLEDs; Biopolymer and Biocompatible.

Acknowledgments: FINEP, FAPESP, CNPq.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

PRODUCTION OF SILVER NANOPARTICLES: A REVIEW ABOUT BIOLOGICAL SYNTHESIS BY PLANTS EXTRACTS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The search for a green synthesis route for the production of nanomaterials is a very significant challenge to be accepted today, considering not only environmental, but also economic factors, since the use of renewable natural raw materials, in addition to not harming the environment. medium, are easily accessible and low cost. In this work, a bibliographic research was carried out based on several routes of green synthesis through plant extracts with the objective of knowing and structuring a new proposal for the synthesis of several metallic nanoparticles, in particular, silver nanoparticles. Due to their physical and chemical properties, the ease of obtaining and relatively low cost, silver nanoparticles have been widely used in several areas of knowledge, with emphasis on application in medical devices, due to their antimicrobial properties, which attribute a wide and important application to these nanoparticles. In addition, silver nanoparticles are easily chemically synthesized and can be reduced in a simple and practical way using plant extracts. Thus, this work aims to present a review of the literature on the various forms of synthesis of metallic nanoparticles, especially those of silver, using different plant extracts. From this review study, a new biosynthesis route will be proposed for the production of nanoparticles from the onion extract (*allium cepa*).

Keywords: Nanoparticles; *Allium Cepa;* Green Synthesis.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

CHITOSAN FILM - POTENCIAL APPLICATIONS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The research for the use of polymers from natural and renewable sources in the production of films is directly related to the reduction of the environmental impact. Chitosan is a biopolymer derived from chitin, in which it is found in the crustacean exoskeleton. Its ability to form gel makes it a promising material for research in different areas of knowledge. Among the numerous applications of chitosan films combined with an adjuvant capable of promoting a specific functionality, including active films, adsorbents and membranes. Active films are used as packaging for plant or animal products. Active packaging of chitosan slows or inhibits the growth of spoilage microorganisms in food and has antioxidant activities, without losing its primary function of protecting products from physical damage. Chitosan film adsorbents are being applied in order to remove heavy metals from effluents generated by industries, such as dyes in the textile industry, with chitosan having low cost and amino and hydroxyl groups that serve as active sites. And the chitosan membranes make it possible to separate substances, particles and / or ions dispersed in the solvent for water purification, drug dispersion, effluent treatment and antibacterial properties. Thus, the use of associated chitosan film may have great potential for commercial use.

Keywords: Natural Polymers; Chitin; Thematic Areas.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização:

EXTRACTION OF CORN ZEIN IN ETHANOLIC/ALKALINE AQUEOUS SOLUTION FOR BIOMEDICAL AND FOOD APPLICATIONS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Zein is a protein found in corn grains, however its concentration is about 8%(w/w) in the whole grain, which after starch extraction can reach 20% in dry residues of corn gluten meal (CGM), protenose or glutenose. The extraction process developed in ethanolic/alkaline aqueous solution was 15-20% of zein from corn gluten meal (CGM, glutenose) with using rotaevaporator, which was very interesting, since Brazil is the third largest producer of corn in the world. However, the zein extracted from DDG (distilled dried grain) was very small (<5%). Besides being a soluble protein in organic/aqueous solution, it has a melting temperature of about 60ºC with about 90% proteins present, which can be a strong candidate for biomaterial and/or bioplastic, since generally most proteins do not present melting temperature, but only degradation. Thus, several materials could be formatted with zein alone or with other materials forming biocomposites in both the biomaterial and bioplastic areas, such as, films, tubes, blocks, and others, which will be presented preliminary in this work. So lack just assemble the pilot manufactures.

Keywords: Zein; Biomaterial; Bioplastic.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

OBTAINING THE BACTERIAL CELLULOSE MEMBRANE IN SITU ASSOCIATED WITH HPMC AS A POTENTIAL STRATEGY FOR TRANSDERMAL DRUG RELEASE

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Among several biopolymers, cellulose is the most abundant and inexhaustible natural polymer on the planet. In particular, the bacterial cellulose (BC) is synthesized by bacterial species, especially gram-negative bacteria and consists of a network of cellulose nanofibers with unique characteristics. Because of its excellent mechanical properties, outstanding biocompatibilities, and abilities to form porous structures, BC has been studied for a variety of applications in different fields, including the use as a biomaterial for scaffolds in tissue engineering, as temporary artificial skin for therapy of burns and ulcers and as transdermal drug release among others areas. This work reports the preparation of Bacterial Cellulose Membrane (BCM) through in situ and post- grafting modification with Hydroxypropylmethylcellulose (HPMC) and evaluation as a potential strategy for transdermal drug release, more specifically the caffeine. When the BCM is functionalized with HPMC, which is a family of cellulose ethers with polarity controlled by the degree of substitution of methoxy groups (DS) and by the mass molar substitution of hydroxypropoxy (MS) groups, their structural aspects affect the drug delivery process, due to its various functions as a coating agent, film former, controlled release matrix and binding and stabilizing agent. Initially, BCM was prepared and functionalized with HPMC by in situ and characterized by several techniques, namely Scanning Electron Microscopy (SEM), Energy-Dispersive X-Ray Spectroscopy (EDS), Fourier Transform Infrared Spectroscopy with Attenuated Total Reflectance (FTIR-ATR) and Thermogravimetry Analysis (TGA). Subsequently, these functional BCM will be immobilized with caffeine and its potential transdermal release of this drug will be evaluated.

Keywords: Transdermal drug release; Bacterial Cellulose; Hydroxypropylmethylcellulose; Caffeine.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
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BACTERIAL CELLULOSE AS A VERSATILE PLATFORM TO MANUFACTURE CERIUM-DOPED CALCIUM PHOSPHATES AS BONE CEMENTS

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Bacterial cellulose (BC) is a biopolymer secreted by several species of bacteria, including Komagataeibacter rhaeticus. BC presents unique properties such as durability, resistance to tensile strength, biocompatibility, which enable this material to biomedical applications. Calcium phosphates (CaP), which are the main inorganic compounds of bones and teeth, have been explored to bone tissue engineering purposes in association with BC. In addition, CaP lattices allow the replacement of Ca sites to dopant ions, in order to enhance biological properties. Cerium ions (Ce3+/Ce4+) are attractive candidates for these purposes once there are some studies that focus on the role of cerium ions in bone repair. In this study, cerium-doped calcium phosphates were synthetized by using BC as platform. Bioceramics were precipitated onto BC fibrils by alternated soaking method in Ca2+, Ce3+ and PO43- solutions. After this, the materials were freeze- dried at -50 ºC for 72 h and the resulting composite (BC-Ce:CaP) was calcinated at 600 ºC for 3 h, in order to obtain Ce:CaP material. All the materials were characterized by field emission gun scanning electronic microscopy (FEG-SEM), energy-dispersive X-ray spectroscopy (EDX), X-ray diffraction and thermogravimetric analysis (TGA/DTG) and the cell viability were assessed by MTT method. FEG-SEM images of BC and BC-Ce: CaP presented uniform and continuous nanofibrils and heterogeneous distribution, respectively. BC-Ce:CaP showed higher thermal stability than BC. By XRD patterns analysis, two mineral phases were identified: NaCl and brushite (CaHPO4.2H2O). Ce:CaP materials presented a trabecular and 3D-structure with interconnected pores and were identified three phases: hexagonal chlorapatite and hydroxyapatite and orthorhombic buckwaldite (NaCaPO4). It was confirmed the presence of 0.4% (mol/mol) of Ce ions in Ce:CaP by EDX technique. BC, BC:Ce-CaP and Ce:CaP were non-cytotoxic to fibroblast cells (GM07492) and are promisor to biomedical applications. Ce:CaP in particular has been indicated for bone cement fillers.

Keywords: Natural polymer; Nanocellulose; Calcium phosphates.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

NANOCELLULOSE FILMS: INFLUENCE OF NANOPARTICLE ASPECT RATIO AND SURFACE CHARGE

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The present work investigated the influence of aspect ratio and surface charge of cellulose nanoparticles in the preparation of casting films. These cellulose nanoparticles were produced from sugarcane bagasse using oxidation with TEMPO (2,2,6,6-tetramethylpiperidine-1-oxyl) and do not required a mechanical defibrillation step. Variable NaClO concentrations were used to impart electrostatic repulsion between surface charged groups, facilitating fibril separation. Cellulose nanofibers (CNF) with diameters in the 3–5 nm range were obtained by oxidation of pulp with NaClO at 25 and 50 mmol/g. After a 30 min–sonication step, these CNFs were broken down into cellulose nanocrystals (CNC) by mechanical action. Then, films containing CNC or CNF were prepared by casting at 60 °C for 24 h. Our results showed that the mechanical properties of the dried films were not affected by the morphology or the number of carboxylate groups on the surface. On the other hand, when these films were immersed in water, the presence of high amounts of COO- (1.4 mmol/g) significantly reduced the stability of the nanocellulosic material, which rapidly swelled due to osmotic pressure effects and disrupted under mechanical stirring. By using an ionic crosslinking with Ca2+, the mechanical behavior of wet and highly charged nanocellulose films was substantially improved, probably due to the influence of high superficial charge that create a higher number of crosslinks and increased interfibrillar connections restricting water retention.

Keywords: Nanocristalline Cellulose; Nanofibrillated Cellulose; Cellulose Films.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

POLYMER/FE(III)-PORPHYRIN HYBRID FILM: APROMISING CATALYST FOR OXIDATIVE DECOLORIZATION OF TOXIC AZO DYES

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Nowadays, synthetic dyes are one of the most harmful chemicals present in the water. Due to their extensive use, mainly by the textile and finishing industries, millions of gallons of this effluent are discharged in the water bodies. Therefore, it was made a hybrid film of chitosan/poly(vinyl alcohol)/cationic Fe(III)-porphyrin (Cht/PVA-Fe(III)Pr) by solvent casting method, to act as a Fenton-like catalyst to decolorize methyl orange (MO) and methyl red (MR) azo dyes. The Cht/PVA-Fe(III)Pr film was characterized by different analytical and microscopy techniques, which indicated that the metalloporphyrin affects different properties of the hybrid film. Batch experiments revealed that Cht/PVA-Fe(III)Pr film exhibits enhanced catalytic activity towards the decolorization of MO and MR in the presence of Hydrogen peroxide (H2O2) as compared to the "free" Fe(III)Pr. Under mild conditions (pH 7 and room temperature), both azo dyes were decolorized quickly (90 min) using low amounts of the catalyst (60 mg) and H2O2 (1 mmol/L). After the decolorization process of the selected azo dyes, FTIR analysis showed that more simplest molecules are released as by-products. Additionally, the hybrid film performed well in cyclic runs without leaching out iron ions or losing its catalytic activity. All these features associated with its ease handling ranks the Cht/PVA-Fe(III)Pr hybrid film as a promising catalyst for heterogeneous Fenton-like reactions enhancing the removal of azo dyes from wastewaters.

Keywords: Hybrid materials; heterogeneous catalysis; chitosan.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

STUDY OF INFLUENCE OF TYPE OF TEA ON THE PRODUCTION OF BACTERIAL CELLULOSE IN KOMBUCHA TEA AND EVALUATION OF ITS ANTIMICROBIAL ACTION

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Kombucha is a craft drink produced by the bioprocessing of sweetened teas through a symbiotic culture of bacteria and yeasts. Among the bacteria present in this culture is the *Gluconacetobacter xylinus*, capable of producing cellulose and organic acids. Bacterial cellulose (CB) is a biopolymer known by has high purity, high water retention capacity, and excellent biocompatibility, with a broad spectrum of applications. This study aims to optimize CB production, evaluating the characteristics of the membranes produced and verify the antimicrobial activity of Kombucha teas, against the microorganisms *Escherichia coli*, *Staphilococcus aureus* and *Candida albicans*. The determination of the best medium and cultivation conditions was evaluated using a fractional experimental design 3^{4-1}, analyzing the influence of the type of tea (black, matte, and green), tea concentration (5, 10, and 15 g/L), temperature (25, 35 and 45 °C) and bioprocess time (7, 14 and 21 days). The membrane produced in the best conditions was characterized by FTIR, SEM, TGA, and water absorption capacity. At the same time, teas used with Kombucha culture media that showed the highest total acidity were analyzed for their antimicrobial activity. The results of the analysis of variance (ANOVA) showed that the type of tea and the incubation temperature had a significant influence on membrane production, with black tea at room temperature being the best condition. As for acidity, the parameters most significant were the type of tea, the temperature, and the incubation time, and the media prepared with green tea and incubated at 35 °C for 17 days showed the best result. The CB produced was presented as a random arrangement of nanofibrils with high water absorption capacity (464%) and characteristic properties such as functional groups and T_{max} = 300 ºC. Kombucha teas did not show antimicrobial activity against the tested microorganisms.

Keywords: Kombucha; Bacterial Cellulose; Tea.

EVALUATION OF RESIDUAL DIMETHYLSULFOXIDE IN ELECTROSPUN FIBERS

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

The use of electrospun fibers as a controlled drug delivery device is a consolidated alternative. Dimethylsulfoxide (DMSO) has been used as an organic co-solvent along with acetone, once it reduces the evaporation rate of the system. However, despite its low toxicity, it can cause irritations in topical use. The present study aims to determine the presence of DMSO in cellulose acetate electrospun fibers. The fibers were produced through the electrospinning process of a solution containing 15%wt cellulose acetate. The experimental assembly used a voltage of 15 kV, a metal collector with diameter size of 15 cm, distance between needle and collector of 10.5 cm and feed flow of 0.05 mL.min-1. The Fourier Transform Infrared Spectroscopy (FTIR) technique was chosen to characterize the materials and identify the presence of DMSO. FTIR has a growing pharmaceutical interest over other analytical techniques, like HPLC, due to easy sample preparation. Also, it has been used with satisfactory results for impurities detection. The fibers were submitted to FTIR with wave number between 4000 and 250 cm-1. From the results of the FTIR, it is observed that the pure DMSO presents four peaks: two more explicit between 1000 and 1100 cm-1. Cellulose acetate has four characteristic peaks where one of these between 1800 and 1700 cm-1 and the other three between 900 and 1400 cm-1, which was also observed in the fibers produced, proving that they have unique characteristics of pure cellulose acetate, without traces of DMSO. It is possible to conclude that there is no evident presence of DMSO in the electrospun fibers. Thus, the solvent system is adequate for the production of controlled drug release devices.

Keywords: Electrospinning; Drug delivery systems; Nanotechnology.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

IMMOBILIZING CUBOSOMES IN HYALURONIC ACID HYDROGEL

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Hyaluronic acid (HA) is a natural biopolymer, containing functional groups for chemical modifications that favor the production of stable, thermo-sensitive and injectable hydrogels. Partially oxidized hyaluronic acid (oxi-HA) crosslinked with adipic-acid dihydrazide (ADH) was loaded with labelled cubosomes, composed of phytantriol, Nile Red (hydrophobic fluorescent dye) and stabilized by Pluronic F127, and assessed for their ability of dispersion and distribution by optical confocal fluorescence microscopy images. Cubosomes are lyotropic liquid crystals nanoparticles that have been an assertive option to carry biomolecules and drugs. They can offer high efficiency of entrapment, specificity to targets and responsivity to external stimuli. Hydrogel immobilization of cubosomes may allow for a depot in specific regions of the body, helping drugs, peptides or proteins to act more locally and with more prolonged release of the compounds if compared with a pure gel. Cubosomes were prepared by tip ultrasonication method and characterized by DLS and SAXS, while hydrogels were prepared oxidizing HA with $NaIO_4$ and crosslinking with ADH in the presence of cubosomes. Our results show that cubosomes are homogeneously distributed into HA/ADH hydrogels. Some degree of cubosome leaching is detected from fluorescence in the continuous aqueous phase. These injectable hydrogels loaded with cubosomes display potential as carrier of bioactive compounds in biomedical field.

Keywords: Cubosome; Hydrogel; Drug Delivery.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

TESTS OF CELLS WITH SCAFFOLDS OF CHITOSAN AND SYNTHETIC POLYMERS

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Chitosan (Ch) is a natural polymer, biocompatible, biodegradable and bioabsorbable, widely used in tissue engineering. The aim of this study has been to develop Ch scaffolds and to compare them with scaffolds of synthetic polymers as well as three commercial dermal substitutes, on the viability of human keratinocytes. The scaffolds were produced in two forms: manual deposition and electrospinning. For the preparation of the scaffolds, the following concentrations of polymers were used: 1% Chi; 24% polycaprolactone (PCL); 12% poly(lactic acid-glycolic acid) (PLGA). Cells from the immortalized keratinocyte line (HaCaT) were seeded at a 50,000/well density. Cell viability was assessed based on Cell Counting Kit-8 (CCK-8) and Live/Dead assays after five days of cultivation and expressed as the mean related to the tissue culture plate (TCP), which was used as a control group (considered 100%) and mean standard error values obtained from the absorbance. The results of the viability of the cells cultivated on the TCP was 100±3%. Manually conducted cell viability on the scaffolds and that by electrospinning was 82±5% and 109±2% of Chi, 92±2% and 108±2% of PLGA, 60±1% and 111±6% of PCL, respectively. The statistical comparison of cell viabilities on scaffolds versus the control indicated that cell viability was maintained, except on the manually deposed PCL films, which decreased ($p<0.01$). The results regarding the dermal substitutes were 43±1% using Integra™, 42±1% using Matriderm™, 42±1% using Pelnac™. Comparing the dermal substitutes with the control group, all showed a statistically significant decrease in cell viability ($p<0.01$). Despite the success of the commercially available products in aiding dermal healing, they decreased the viability of keratinocytes *in vitro*. The Ch scaffolds allowed for similar viability of keratinocytes compared to the scaffolds of synthetic polymers, indicating an alternative low-cost and renewable material for skin regeneration.

Keywords: Biomaterials; Electrospinning; Regenerative Medicine.

Acknowledgments: MCTIC; FINEP; CNPq; IPCT.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

MANUFACTURE OF BIOPOLYMER OF WASTE FROM THE AGRO- INDUSTRIAL SECTOR AND EVALUATION OF MECHANICAL PARAMETERS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Technological innovations in the field of polymeric sciences that use agro-industrial resources have been increasing in recent decades, providing an improvement in bioproducts from residual origins and sectors (such as green technology) are expanding sustainable research in Brazilian universities. The materials used in this study originate in the paper & cellulose industry (PCI) (in partnership with Klabin S.A.) and in the food industries (FI). PCI's discard kraft lignin (KL) on a large scale, being a major problem in the waste sector and unfortunately directed towards combustion, emitting high rates of polluting compounds. Therefore, FI's produce in large quantities of soy derivatives (such as milks, tofu, oils, among others), generating exacerbated waste that needs specific treatment before being properly disposed of in water courses. The study aims to prepare and evaluate biopolymeric films, in order to reach the packaging sector. To perform the procedure, the soy protein isolate (SPI) was used as a matrix and as a reinforcement to KL, as solvents for the homogenization action of the bioplastic constituent materials, water, ethylene glycol and glycerol plasticizer were used. The methodology constitutes a matrix of SPI 25g/ L, KL (0.5%, 1.0% and 2.0%), using water/ ethylene glycol/ glycerol (3:1:1) for the formation of the biopolymer. Subsequently carrying out tests to assess its mechanical properties (tensile strength and the percentage of elongation at break), in which they were within the standards of the American Society for Testing and Materials. The results inferred that the higher the reinforcement concentration, the bioplastic showed a lower elongation rate (which can be observed similarly in the tensile test), when compared to the control. Thus, the biopolymer has a high potential for use in the packaging sector,but needs improvement of the technique.

Keywords: Technological innovation of waste; Natural biopolymers; Sustainable packaging.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

CELLULOSE NANOCRYSTALS-BASED COMPOSITES AS PLATFORM FOR DRUG DELIVERY SYSTEMS

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

In recent years, the use of natural polymers in a variety of devices and biomedical materials including drug delivery has attracted great interest from researchers. Nanocelluloses, a unique and promising natural material extracted from native cellulose, has gained much attention for its use as biomedical material, because of its remarkable physical properties, special surface chemistry, sustainability, biosafety and excellent biological properties such as biocompatibility, biodegradability and low toxicity. Nanocellulose defines the different types of cellulose in which at least one dimension is less than 100 nm. This includes materials such as bacterial cellulose produced from *Acetobacter xylinum* bacteria with reduced size (20-100 nm) and numerous fibrils, cellulose nanofibers consisting of individual and aggregated nanofibers of 1µm extension and 10- 100 nm a diameter range and cellulose nanocrystals with a 5–20 nm diameter range and 100 nm to several micrometers length range. Cellulose nanocrystals possess needle-like geometry structures which are obtained by chemical processes, such as acid hydrolysis of cellulose, in which the amorphous regions are removed, preserving only the crystalline portion. The dimensions of the cellulose nanocrystals are majorly depending upon the source of the cellulose. The cellulose nanocrystals modification before the development of biomaterials is important, which will determine its potential biological applications. This leads to the improvement of the properties of cellulosic materials because the strong intra- and intermolecular interactions between their chains limit the swelling of the cellulose and thus, preventing the hydrogen bonds from being broken by the water molecules. Surface modification improvement the loading and unloading of medications that are hydrophobic or non-ionic that usually does not adhere to cellulose nanocrystals. Cellulose nanocrystals can be modified by different routes such as click chemistry, polymer grafting, sol-gel process, silanization reaction and chemical modification with isocyanates.

Keywords: Nanocellulose; Cellulose Nanocrystals; Drug Delivery.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

MICROCAPSULES WITH ANTIOXIDANT PROPERTIES: FOR POTENTIAL USES AS FUNCTIONAL TEXTILE

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

In recent years, the textile industry and research have evolved towards innovative products and processes in accordance with the needs and expectations of the consumer for a healthier and more comfortable life. Consequently, functional textiles have gained significant interest in various applications. In particular, cosmetotextiles bring cosmetics ingredients that are gradually released on the user skin. It is known that free radicals and other reactive species can cause severe damage to cells and cell components of the skin. To prevent those, the use of topical antioxidant supplementation is a strategy used in the cosmetics industry. For Instance, a functional fabric with skin-protective properties for making garments in direct contact with the skin can be developed. One of the techniques used to apply different finishes and properties to textiles is the microencapsulation. In the present work, the preparation of a series of chitosan microspheres loaded with retinyl palmitate (vitamin A ester) is described first, by means of a simple, economical, industrially scalable and environmentally friendly process. The methodology used to prepare the microspheres consisted of spraying an emulsion of chitosan and retinyl palmitate on a solution of the crosslinking reagent of sodium lauryl sulfate (SLS). The microspheres obtained were analyzed by Optical Microscopy (OM). It was possible to determine that the size of the microspheres, as well as their spherical shape, increases as a function of the chitosan concentration. The results obtained indicate that the use of a 2% m / v solution of chitosan and the regulation of the pH of the starting solutions used, contribute to the formation of chitosan microspheres with defined morphology. On the other hand, it could be determined that centrifugation turns out to be an isolation method as effective as decantation. Secondly, for the next stage of this work, the different anchoring methods that could be used for the superficial adhesion of the obtained microspheres to the fabric are detailed, in order to develop a functional textile with skin-protective properties.

Keywords: Microencapsulation; Textile; antioxidant.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

FUNCTIONALIZED CELLULOSE FILTER PAPERS WITH BETA-CHITIN NANOFIBERS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The search for sustainable sources of polymeric materials is an ever-growing field of study. In this sense, chitin extracted from the fishing industry waste has been studied for quite some time, since its biodegradable, biocompatible and it has a remarkable annual renewal rate, even higher than that of cellulose. With these features, chitin, and its main derivative, chitosan have several applications. In particular, chitin nanofibers and nanocrystals have the ability to interact with many metal ions, as well as dyes and organic molecules, making it a good candidate for the development of water treatment materials. In this study, a novel and cheap filtration membrane made of cellulose filter paper and beta-chitin nanofibers is proposed. Beta-chitin extracted from squid pens (*Doryteuthis spp.*) was subjected to acidic hydrolysis using different acids (3M HCl, 3M H_2SO_4 and concentrated H_3PO_4) under reflux for 3h to obtain the desired beta-chitin nanofibers. After extensive washing and dialysis, the stable nanofiber suspensions were diluted to 0.5mg/mL and filtered through a cellulose paper sheet using a positive pressure filtration setup. In order to guarantee the deposition of beta-chitin nanofibers, the filtration rate was set to 5mL/min. The surfaces of the dried filtration membranes were visibly different, indicating the successful deposition of the beta-chitin nanofibers. FTIR measurements of both surfaces confirmed the formation of the asymmetric material. Currently, filtration tests with copper and tetracycline solutions are being carried out.

Keywords: Chitin Nanofibers; Cellulose; Filtration Membrane.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

BIOCELLUOSE-GELATIN BASED PLATFORM FOR CELL CULTURE

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The paper as the oldest and most used tool in history has been gaining prominence as a platform for cell culture. Bacterial cellulose (BC) or biocellulose presents itself as a promising platform for cell culture, as the random arrangement of its nanofibers makes the material resemble the extracellular matrix. However, BC has a chemically inert surface, so it does not present itself as a suitable surface for cell adhesion, requiring surface modification in order to have a more appropriate cell-BC interaction. Gelatin, a polypeptide derived from collagen denaturation, allows good adhesion and cell proliferation on its surface, in addition to being biocompatible and non-toxic. In this sense, the present study aimed to modify the BC surface with different concentrations of gelatin (1%, 5%, 10% and 20%) and to characterize these materials by SEM, FT-IR, UV-VIS, TGA and DTG. It was observed that the modification has changed the morphological aspects of BC. In the thermal analysis, it was observed that the native BC does not present residues at 600 °C, while the modified membranes present residues between 3-7% at the same temperature. In addition, it was possible to observe that there was an increase in thermal stability after the modification, since there was an increase in the temperature of the first BC degradation event, going from about 200°C for native BC to 250°C for the modified platforms. Regarding FT-IR, it was observed the appearance of two peaks in the modified membranes at 1542cm-1 and 1647cm-1 referring to the stretching bands of amine II and amine I from gelatin, respectively. In UV-Vis spectrum, it was observed that the modified platforms present an improved optical transparency with transmittance values from 12-25% at 500nm compared to 10% of transmittance for pure BC. The next step entails the cytotoxicity assay as well as both cell adhesion and proliferation assays.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

INCORPORATION OF MALT BAGASSE IN CALCIUM ALGINATE BEADS FOR OIL BIOREMEDIATION

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The economic and technological growth of the last decades is closely linked to the use of oil as an energy source. As a result, there were also several environmental disasters related to the extraction and/or transport practices of this fossil resource. Of the different alternatives known for the remediation of environments contaminated with oil, bioremediation, mainly the technique of encapsulating microorganisms, stands out for its removal efficiency, low cost, and relatively low environmental impact. However, specific difficulties are observed, such as lack of nutrient, the high toxicity of oil, low initial growth, and fragility of the capsules. Therefore, the goal of the study is to evaluate the incorporation of malt bagasse (natural biodegradable polymer) in alginate beads, to improve the mechanical properties of the spheres and microbial growth. Different malt bagasse content (0, 0.25, 0.75, 1.5, 3 and 5% wt/wt) were added in the calcium alginate spheres by the extrusion method. The evaluation of malt bagasse incorporation into the spheres was performed by scanning electron microscopy (SEM) technique and mechanical strength to compression was evaluated by elasticity module in dynamic mechanical equipment. The microbial growth test was performed in an orbital shaker (T = 30ºC, 180 rpm) with synthetic saline medium. SEM showed the successful incorporation of the malt bagasse particles in alginate matrix. The initial results show that the increase in malt bagasse improves, relatively, the initial microbial growth. It was also noted that, to some extent, the increase of malt bagasse content improves the mechanical resistance (modulus of elasticity), with the largest modulus observed (398 kPa) in a sphere with 3 % wt/wt of malt bagasse.

Keywords: Biorefinery; Sustainability; Biomass.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

SCIENTIFIC PROSPECTION OF THE USE OF ALGINATE COMPOSITES USED IN 3D CARTILAGE BIOPRINTING

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Recent studies have sought new means of treatment for articular cartilage injuries through 3D bioprinting of cartilage parts for implantation in people with injuries or genetic problems. Many biological substitutes investigated, alginate-based composites have been increasingly used in tissue engineering. In this sense, the present study aimed to conduct a search on the Scopus and Web of Science databases, relating the results of studies on the use of alginate composites used in 3D cartilage bioprinting. The results were collected and classified in September 2020, by combining the following keywords: alginate and composite and cartilage and bioprinting. The SCOPUS database showed a total of 13 results, against 14 found in the Web of Science database. The first document was published in 2014, and in the following years the number of publications was low, with no significant increase in the following years, maintaining a constant volume. About countries that publish in this area, the United States is more prominent, followed by Ireland and China. The largest number of publications are classified in the area of Engineering, Materials Science and Chemical Engineering. However, in relation to the impact, it was noticed that the theme has been showing a positive response, since there are increasing numbers of citations, demonstrating the increase in the production of research on the theme, which is being increasingly cited by new works. It is concluded that the question raised was still little explored, but that it has been drawing the attention of researchers due to its technological potential and advances that it can bring to biomedical science.

Keywords: Alginate; Bioprinting; Cartilage.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

OPTICAL PROPERTIES OF CHITOSAN FILMS CONTAINING ANTHOCYANINS STABILIZED WITH A SYNTHETIC LAYERED SILICATE

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

This work aimed to characterize the optical properties of colorimetric indicator films based on chitosan and a nanostructured biohybrid (BH) integrated by laponite® (Lap) and anthocyanins (ACNs) from eggplant (*Solanum melongena*) peel. The films were manufactured by casting method and they were characterized to assess the initial color and opacity, as well as the visual color alteration after contact with buffer solutions and after light irradiation for 15 days at 4 ºC and 20 ºC. The films displayed color change in the presence of the BH, in this way, control films showed a grey color, whereas the films containing the BH exhibited bluish color. The presence of BH did not alter the opacity values of films. The films containing the BH showed color change from blue to red and finally to yellow after contact with buffer solutions with pH 1 and 13, respectively. This color change was due to the presence of ACNs on the BH. Finally, the films containing the BH showed color alteration after light irradiation, being promoted with the increasing of storage temperature (20ºC). This result suggests that the ANCs adsorbed on the Lap can be degraded during the storage of films. However, this anthocyanin degradation was lower when compared with the literature, probably because Lap could reduce the anthocyanin degradation in the films exposed to light irradiation. Based on these results is possible to suggest the application of chitosan films containing the BH as colorimetric materials able to detect pH alterations in foods.

Keywords: Ph Indicator Films; Biopolymers; Synthetic Silicate.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

EFFECT OF OXIDATION REACTION TIME ON WATER RETENTION PROPERTIES (WRV) OF BACTERIAL CELLULOSE NANOFIBERS

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Nanomaterials studies have been widely explored because of their functionalities due to their large and active surface areas. In this context, bacterial cellulose nanofibers stand out for their high crystallinity properties, high elastic modulus and satisfactory water absorption, which diversifies their application in the areas of medicine, cosmetics, textile industry among others. Another reason for choosing the application of this type of cellulose is that it is a biopolymer synthesized by bacteria, free of impurities as opposed to vegetal cellulose that present in its constitution other biopolymers such as hemicellulose and lignin. The objective of the present study was to comparatively evaluate the water-retention value (WRV) of bacterial cellulose nanofibers extracted by means of oxidation mediated by 2,2,6,6-tetramethyl-1-piperidinoxyl in different oxidation times (2 and 5 hours) and sonication (5 and 10 minutes). The samples were described as NTO2TS5, NTO2TS10, NTO5TS5 and NTO5TS10, where "N" refers to the bacterial cellulose nanofiber, "TO" oxidation reaction time and "TS" sonication time. The water-retention value was calculated using the equation $WRV\ (\%) = 100\ x\ (W_W - W_d)/W_d$, where W_W is the wet sample mass after centrifugation, and W_d is mass after drying the wet sample at 40°C until a constancy of mass was verified. The results demonstrated that WRV were 3555.76+370.23%, 3868.17+189.42%, 2050.75+153.56% and 1823.50+131.06% to samples NTO2TS5, NTO2TS10, NTO5TS5 and NTO5TS10 respectively. Although the results obtained indicated that sonification time does not influence in the WRV average, the oxidation time is a parameter that must be controlled, because it samples with 2 hours of oxidation produce nanofibers with high WRV values. The oxidation time possibly influences in carboxylate groups formation in the nanofibers structures. Thus, the reactional parameter studies to nanofiber extraction are important to development materials with satisfactory properties to specific applications such as reinforcement agents or controlled release systems.

Keywords: Bacterial cellulose; Water retention; Oxidation.

Acknowledgment: FAPESP, CNPq, CAPES and UNESP.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

NANOCELLULOSE MICROSPONGES OBTAINED BY SPRAY DRYING

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Cellulose has great potential for technological development, since it is an extremely abundant, low-cost, biodegradable and non-toxic material. Thus, the aim of this study was to evaluate the effect of spray drying conditions on the powerd Cellulose. The dried extracts were obtained in a laboratory-scale spray dryer with a concurrent flow regime. The main components of the system were an extract feed system composed of a peristaltic pump and a pneumatic (two-fluid) spray nozzle with an inlet orifice of 1.2 mm diameter The maximum water evaporation capacity was 0.5 L per hour at an inlet air temperature of 180°C. The dried powder was separated from air in the cyclone and was collected in glass flasks. The following conditions were set and fixed for all experiments: suspension feed rate of 6ml/min, atomization air pressure of 5.0 bar, drying air flow rate 0.6 m3/min, percent solid 2%. Solutions of cellulose were drying at 40 ºC, 60 ºC, 80ºC, 100ºC and 120ºC. There is little difference between the value Hr, Ic and angle of repose between the drying methods studied, but observed is lower in spray dried at 60º.C indicating better flow property. Therefore, all the particles produced by the spray drier process had a large distribution range (span), indicating the heterogeneous nature of the process. Fourier Transform Infrared spectra indicates that no matter the drying form applied to the materials in this study, the chemical structure of the cellulose was not altered. The samples have relative crystallinity values dependent on the drying forms. For samples a gradual increase in relative crystallinity values due to increased temperature is observed. The results showed that powders obtained in spray dryer had low moisture, high yield and excellent pharmacotechnical properties. In addition, there are few differences with the powders obtained by spray dryer.

Keywords: Cellulose; Pharmacotechnical Properties; Spray Dryer.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

REVIEW ON 3D PRINTING BY FUSED DEPOSITION MODELING AND ITS PROCESSING CONDITIONS FOR THE MANUFACTURING OF PLLA- SODIUM ALENDRONATE SCAFFOLDS FOR BIOMEDICAL APPLICATION

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Additive manufacturing has demonstrated potential for mass production of drugs and components customized for individual needs in the bone tissue engineering field. The 3D printing by fused deposition modeling (FDM) is one of the most investigated methods. Enable manipulating the drug distribution, fast production of varied and complex geometries and waste reduction. It also dismisses solvent use, it is fast and low cost. The sodium alendronate is a drug used in treatment of bone tissue diseases as Paget's disease and osteoporosis. This drug has great affinity for human bone matrix, ability to inhibit bone resorption and to increase bone construction. However, it has low bioavailability and side effects by oral and intravenous administration. Local administration can reduce the necessary drug dosages and side effects, ensure bigger patient's compliance and quality of life. In this context, 3D printing enables the production of *scaffolds* with different sizes of interconnected or semi-connected macropores and varied *scaffold* size and design. In the other hand, 3D printing FDM can degrade the drug during the fusion, thus, the printing parameters must be optimized, such as the printing temperature, which may be lower than the drug degradation temperature; printing velocity might be increased since it decreases the exposure time to the heated nozzle; the object's fill density, area/volume ratio and geometry also must be selected correctly. As polymeric matrix PLLA is one of the most used materials for 3D printing FDM due to its easy processability extrusion, mechanical resistance, and low thermal expansion coefficient properties. PLLA can be manufactured by renewable sources as maize starch and sugar cane, making it accessible, low cost and biodegradable. Therefore, it degrades into non-toxic byproducts over a long period of time and release the compound slowly and continuously. PLLA transparency, biocompatibility and approval by American regulatory agencies also favor biomedical applications.

Keywords: PLLA; 3D Printing; Bone Tissue Engineering.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

CHEMICAL MODIFICATION OF CHITOSAN THROUGH GRAFTING WITH FATTY ACIDS TO IMPROVE ITS SOLUBILITY

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The chitosan (CH) is a natural cationic co-polymer obtained by partial deacetylation of the chitin. It have many properties for being: biocompatible, biodegradable and antimicrobial, moreover its degradation products are non-toxic; therefore is a polysaccharide very engaging to be used in biomedical applications and/or pharmacological, as well as for other areas of industrial interest. But CH present a disadvantage: it is soluble only in solutions at acid pH (< 5.5). This makes it difficult its use in many applications related to these areas. Searching for a way to enlarge the applications of this interesting biopolymer, the aim of this research is performing a chemical modification of chitosan grafting with two fatty acids: enanthic acid (EA C7H14O2) and stearic acid (SA C18H36O2); with the purpose of improving the solubility of CH at values close to neutral pH. The CH used comes from the shrimp shells of the species Litopenaeus vannamei. Initially, it was determined the CH deacetylation degree (%DD), to estimate the amino groups free which are fundamental for graft the mentioned fatty acids. The derived obtained CH-g-EA and CH-g-SA were characterized using spectroscopy techniques ATR-FTIR and 1H-NMR to corroborate the graft of the aliphatic chain of EA and SA into the main chain of the polysaccharide. Also, a hemocompatibility test of each derivative was perform with human erythrocytes, obtaining that they are non-cytotoxic. In the solubility test, it was obtained that the functionalization of chitosan induces a slight change in the solubility of both CH-g-EA and CH-g-SA towards neutral pH at a temperature of 60°C, as well as in aqueous ethanol/water solution (1:1). In same solubility experiments at 25°C these derivate were insoluble. Finally, these CH-g-EA and CH-g-SA present attractive qualities and expand their potential for to be use in the development of biomaterials because their hemocompatibility and improved solubility.

Keywords: Chitosan; Chemical Modification; Fatty Acids.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

EVALUATION OF THE ADDITION OF CELLULOSE NANOFIBRILS IN WOOD ADHESIVE

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

With the growing concern with the excessive use of materials from the petrochemical industry and with the serious problems resulting from the accumulation of these in the environment, different studies have appeared in order to obtain new materials that are less aggressive to the environment, using renewable sources. In this sense, nanostructures from cellulose represent an alternative for the development of new products of an ecological character, thus being able to contribute to the effects of accumulation of these materials, as well as to generate a product less harmful to the environment and human beings. Thus, the present work aims to carry out a literature survey in order to verify the effect of the addition of nanocellulose on the properties of thermoset synthetic adhesives for wood panels. The present study was carried out by accessing the databases of the Web of Science, Scielo and Scopus databases, between August 15th and September 10th, two thousand twenty. It was reported in the literature that the increase in nanocellulose in adhesives for the production of panels promotes a reduction in formaldehyde emission, together with an increase in viscosity and a reduction in gel time (gel time), without changing its behavior during storage. Thus, the use of cellulose on a nanometric scale in association with synthetic adhesives for the manufacture of panels can be a promising activity with a sustainable character in all its production stages.

Keywords: Nanocellulose; Wood Panels; Adhesive.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

PREPARATION AND CHARACTERIZATION OF β-CHITIN NANOFIBERS/ LAPONITE FILMS

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The production of biodegradable and renewable composites to be used as biomaterials is highly desirable. Natural polymers, such as chitin, are often studied due to its characteristics, *i.e*. biocompatibility, biodegradability and non-toxicity. Laponite, a synthetic nanoclay, has been proposed to certain biomedical applications due to its ability to induce bone tissue growth and for playing a role as a reinforcement in polymer-based materials. β-chitin was extracted from squid pens (*Doryteuthis spp.*), and the fraction of particles possessing average size close to 425 μm were used for the production of nanofibers through acidic hydrolysis (3M HCl for 3h under reflux). The resulting nanofiber suspension was mixed with glycerol and Laponite to produce the composite films using the casting technique. Films with different Laponite contents were produced, by adding up to 20wt%. The average degree of acetylation (*DA%*) and viscosity average molar mass (*Mv*) of the parent β-chitin and its nanofibers were evaluated. Laponite and β-chitin were characterized by X-ray diffraction. TEM images were used to evaluate the morphology of the nanofibers. The films were characterized in terms of porosity and swelling capacity. The results showed that *DA%* of β-chitin and the extracted nanofibers were higher than 85% while *Mv* of β- chitin was 82 times higher as compared to the nanofibers, revealing that β-chitin acidolysis occurred mainly on the glycosidic bonds of the amorphous sites. Typical peaks were observed in XRD patterns at 2θ = 6,39°, 2θ = 19,7° and 2θ = 34,9° for Laponite, and at 2θ = 8,1° and 2θ = 19,1° for both β-chitin and the nanofibers. TEM images showed the formation of nanofibers with an aspect ratio of about 8.5. The composite films showed swelling capacity in the range 70–100% after 4 hours in PBS and a relative low porosity (< 8%). Typical β-chitin and Laponite bands were observed in the infrared spectra of the films. These results indicate that a novel composite material with promising applications as biomaterials was successfully produced.

Keywords: Chitin; Nanofibers; Laponite.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

PREPARATION, CHARACTERIZATION AND DISSOCIATION STUDY OF A SALT FROM NAPROXEN AND CHITOSAN

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Ionic interaction became an attractive issue in the study of dissociation of matrixes formed by chitosan (CTS) and other molecules, such as drugs that are sensitive to pH changes. Optimization of reactional conditions was performed in order to prepare salts from naproxen (NAP) and CTS, as well as NAP salt CTS crosslinked with epichlorohydrin (EP), named CEPN. The resulting salts (CN) and (CEPN) with the best reaction yield was used to study the anti-inflammatory-CTS dissociation equilibrium. The salts were characterized by ^{13}C NMR solid state, FTIR, diffuse reflectance spectroscopy, XRD and thermal analytical techniques: TG/DTG/DTA and DSC. The higher yield in preparation of CN and CEPN salts was reached under the following reaction conditions: 24 h under constant stirring at 60 °C in the molar ratio of 1 mol of CTS to 1.05 mol of NAP. This reaction product was named CN1 and CEPN. The degree of substitution ( ) were 19.1% for CN1 and 3.57 % for CEPN, both determined by ^{13}C NMR. In the FTIR spectra bands were observed corresponding to the formation of salts. In the reflectance spectrum three bands were observed for the absorption of the chromophore groups present in the salts. In the XRD, the products presented changes in the crystallinity index when compared with CTS. The TG/DTG/DTA curves revealed changes in the thermal behavior of CN1 in relation to CTS. The equilibrium of dissociation of the CN1 and CEPN salts, at pH 2.00 and 7.00, were investigated by HPLC. It was observed that at pH 2.00 for CN1, the salt dissociation occurs more rapidly when compared to pH 7.00. For CEPN, the dissociation at pH 2.00 occured slower than at pH 7.00. The constants of partition were also calculated from the respective dissociation curves.

Keywords: Chitosan; Naproxen; Chitosan Salts.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

PRELIMINARY STUDY OF SURFACE MODIFICATION OF POLYMERIC FILMS BY CORONA TREATMENT AND MULTI-LAYER PACKAGING FORMATION

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Polypropylene (PP) and polyethylene (PE) films - polyolefin resins - present excellent moisture barrier but are usually coated with other polymers to improve the low oxygen barrier. This leads to an increase in production cost, and also in the non-recyclability of the material. The replacement of these synthetic coatings with natural polymers capable of forming effective oxygen barrier films, such as chitosan films, is an excellent marketing and sustainable alternative. Therefore, this work aimed to develop a multi-layer film that is formed by PE and coated with layers of chitosan films, using corona treatment. The corona discharge wire-plane system has the wire and the plane as metallic electrodes. The surface treatment was carried out at 24 °C ± 3 °C and relative humidity of 60% by applying a polarization voltage between the electrodes. The corona treatment time used in the PE samples and the distance between the electrodes were experimental parameters analyzed in order to study and understand their influences during the treatment by means of a factor planning 22 +CP (Central Point). The variables analyzed were treatment time and distance between the electrodes. The chitosan solution was submitted to magnetic stirring until complete dissolution. After the treatment of PE films by corona discharge, the point representing a higher hydrophility of the film was chosen. The PE film was then placed and fixed on a Petri dish and then the chitosan solution was added by means of a pipette. It can be concluded that corona treatment is an efficient technique in the surface treatment of polymers, because up to now it has been observed qualitative changes in hydrophilicity, porosity, surface tension and adhesion. This could be proved by the visible adhesion of the chitosan film to the PE film.

Keywords: Polymers; Chitosan; Corona Treatment.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ALGINATE BILAYER MEMBRANES FOR SIMVASTATIN RELEASE FOR WOUND HEALING

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Alginate is a polysaccharide biocompatible, low cost with healing properties and it has been used as a matrix for wound dressing. In order to improve the healing properties in alginate dressings, some pharmaceutical molecules have been introduced to produce bioactive dressings. Simvastatin is a statin that acts by inhibiting hydroxymethyl glutaryl coenzyme A reductase and is commonly used as a hypocholesterolemic agent. Recently, the anti-inflammatory and restorative effects have been investigated, showing as a promising drug for dermal treatment. This study aimed to produce and characterize three types of alginate membranes: the first as a single alginate membrane, the second as a bilayer alginate membrane, in which each layers has different crosslinking degree, and a third bilayer membrane, in which one of the layers is a porous alginate membrane (obtained by freeze-drying). The membranes were characterized by weight, thickness, surface pH, infrared spectroscopy (ATR-FTIR), scanning electron microscopy (SEM) and water vapor transmission rate (WVTR). The difference in the crosslinking degree (bottom and top layers) influenced the membrane's morphology and consequently, in their physical barrier properties. Comparing the two types of bilayer films, it was observed that the higher crosslinking degree influenced the structure more significantly, since the increase in the interconnection between the polymer chains made the film a little more rigid and. On the other hand, the lyophilization process influenced the thickness more significantly, resulting in a greater thickness in the lyophilized layer. The results of WVPR were higher in the lower layer due to a low hydrophobic interaction in that layer. For the lyophilized layers, the higher porosity increased the WVPR values. For membranes with simvastatin it was observed that simvastatin addition decreased WVPR, probably due to the hydrophobic characteristics, reducing the hydrophilicity of the membranes. The films demonstrated good reproducibility with potential application for dressings.

Keywords: Alginate; Simvastatin; Dressings.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

FUNCTIONALIZATION OF TANNINS FROM *MYRACRODRUON URUNDEUVA* BARK FOR USE IN CLARIFICATION WATER

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The demand for treated water is expected to grow in the coming decades as a result of the increase in the world population. The most used water treatment method is coagulation and flocculation, however, coagulating agents used can present some problems such as alteration of the pH of the treated water, ecotoxicological impacts, and posed risks to human health. Tannins are natural polymers and can be an interesting option for developing environmentally friendly coagulants. *Myracrodruon urundeuva* is a forest species that presents high bark production that are rich in tannins. The objective of this work was to functionalize the tannins from *Myracrodruon urundeuva* barks, and to evaluate its performance in water clarification. Stiasny index and condensed tannins content were determined. Two types of functionalization were performed, one following Mannich reaction and another one was an attempt to cationize without the use of formaldehyde using dimethyl carbonate. *M. urundeuva* tannins presented Stiasny index of 66.7% and the yield of condensed tannins was 11.1%. FTIR analysis indicated that both cationization processes occurred. Cationized tannins with dimethyl carbonate had low turbidity removal efficiency, however, can be tested as a secondary coagulant agent. Tannin-derived coagulants produced by Mannich reaction presented the turbidity removal around 96%. This result shows that the Stiasny index, considered low for other applications (for example, adhesives for wood), did not negatively influence the clarification of water. Tannin-based coagulants did not change the pH of the water. This performance in the drinking water treatment is interesting, since it dispenses the use of reagent pH controllers and consequently reduces the cost with chemicals. *Myracrodruon urundeuva* tannin-derived coagulants presented satisfactory results for use clarification water. The use of this bark in order to obtain a value-added product contributes to the economic and environmental valorization of the Cerrado and Caatinga biomes.

Keywords: Coagulant; Mannich reaction; Bark.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

THE STATE-OF-THE-ART OF THE DRUG DELIVERY SYSTEMS USING CELLULOSE AS/WITH MOLECULARLY-IMPRINTED POLYMER

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Polymers have been used for many applications and including cellulose which can be synthesized or naturally obtained by bacteria. It is well-known as a polymeric biodegradable backbone for the drug delivery system because of being biocompatible with high permeability and mechanical strength. However, the release control of drugs has been made by a more sophisticated delivery modulator called molecularly imprinted polymer (MIP) which is functionalized into or composed by cellulose. MIP's formation is based on a matrix that traps target molecules during the process "imprinting" and releases those by solvents, creating cavities. That behaves as “gates” for holding analytes in the polymer and so, managing the selectivity and sensibility as well as the release of those. Cellulose can be also polymerized as MIP or be a functionalized platform of MIP film. In this case, it drains easily the target molecules, held on the film, into biological systems. These methods make the final product more feasible for biological applications, and so, it has been studied in order to mimic "lock and key" mechanism of enzymes in medicine. The cellulose as/with MIP with the high stability and durability does the controlled drug release by varying factors among the great regulation of the cross-linking, and the enhanced affinity of the template correlated to the time holding the drug. In cancer treatment, for example, it is needed the guarantees of no change in the native conformation of the template happens during the uptaking and the permeability of the material into the target tissues. In addition, the naturally-cellulosic MIP presents stereoselectivity and that can be applied in therapeutic treatments and so, the desired enantiomer release’s behavior may be compatible with in-vivo tests. In summary, cellulose has upgraded the designing of MIP for strategic performance in drug delivery systems.

Keywords: Cellulose; Molecularly Imprinted Polymer; and Drug Delivery System.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

HYDROPHILICITY OF STARCH/CHITOSAN FILMS ADDED WITH UREA FOR USE AS NITROGEN FERTILIZER

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The urea is used in the agriculture as fertilizer, however, in contact with the urease enzyme found on the soil is converted in ammonia, causing the volatilization of the nitrogen. The ammonia excess can be converted by the bacteria of the soil in nitrate what presents mobility in direction to deep layers of the soil, contaminating the groundwater. The incorporation of the urea in a polymeric system can reduce the solubility and availability of the urea for reactions in the soil. The objective of this work was to evaluate the effect of the hydrophilicity of starch and of starch/chitosan films in the control of the liberation of the urea in aqueous medium. The isotherms of the sorption, water vapor permeability (WVP), solubility coefficient and diffusion coefficient of the water vapor were obtained, as well the volatilization of the nitrogen when the films remained for 35 days in contact with the soil. The films with 100% of starch and 50% of urea showed a value of the monolayer of 3.98 g water/100g of film, twice minor that chitosan/starch films with 50% of urea (F50A50U). However, films F50A50U solubilized less quantity of urea, nearly 2.8% and reduced in 200 times the WVP due the minor diffusion coefficient of water vapor. Also, films with 50% of urea reduced the volatilization of the nitrogen of the 67 for nearly 37%. The results suggest that films with minor diffusion coefficient to water vapor and solubility reduced the liberation of the urea in aqueous medium, increasing the control of the nitrogen volatilization.

Keywords: Barrier Properties; Biodegradable Films; Eco-friendly Material.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

COMPATIBILITY STUDY BETWEEN POLY (L-LACTIC ACID) ANDSODIUM ALENDRONATE BY PHYSICOCHEMICAL TECHNIQUES

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Sodium alendronate (AS) belongs to bisphosphonate group and has an affinity for human bone matrix and the ability to inhibit bone resorption, is used to treat bone tissue disorders as osteoporosis and Paget's disease. Poly (L-lactic acid) (PLLA) is the most advanced aliphatic polyester for biomedical applications, approved by regulatory agencies. PLLA is transparent, biocompatible, mechanically resistant, low cost, and biodegradable - it degrades into non-toxic by-products and slowly and continuously releases the encapsulated substance. Thus, this work aimed to study the compatibility between PLLA and AS by thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and Fourier transformed infrared (FTIR) techniques and to make possible a pre-formulation of the components for biomedical application. The pharmaceutical dosage forms are composed of the drug and excipients with specific functions. However, excipients can interact with the drug and catalyze degradation. Therefore, pre-formulation is indispensable to develop effective, stable, and safe dosage forms. Interactions that alter chemical, physical, and therapeutic properties are called incompatibilities. Physical mixtures of the drug and components in a 1:1 (m/m) ratio are made and analyzed by characterization techniques. The PLLA-AS TGA showed two main stages of degradation, with the maximum degradation temperature (T_{max}) very close to the drug. The T_m of the drug obtained by DSC remained constant while the melting enthalpy was half the pure drug value due to the proportion of PLLA and AS in the mixture. There was a decrease in T_m of PLLA in mixture, it might indicate that thermal stability of PLLA was decreased in mixture. FTIR showed bands similar to those of pure PLLA and AS. The AS bands are broader than PLLA bands, and there have been no changes in bands of their reactive functional groups. The results suggest that there was an interaction between PLLA-AS but it wasn't necessarily an incompatibility.

Keywords: *PLLA; Compatibility Study; Physicochemical Techniques*.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

NATURAL POLYMERS APPLIED TO MENISCUS BIOPRINTING: A NARRATIVE REVIEW

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The meniscus are noble and complex fibrocartilaginous components present in the knee joint, with essential functions in the transmission and absorption of forces, stabilization, and nutrition of the articular cartilage. The meniscus is exposed to high levels of mechanical stresses and often suffers damage resulting in pain and functional disability. Current treatment procedures are directed to suture or remove it (meniscectomy). These approaches are ineffective in preventing osteoarthritis due to the irreversible biomechanical and biological changes occurring in the joint. Tissue engineering (TE) emerges as an alternative to improve the rates of therapeutic success. It is based on the concept of replacing the injured meniscus with a three-dimensional cellular scaffold that faithfully mimics the structure and function of the original one. Among the most prominent techniques in TE for meniscus is 3D-bioprinting (3D- BP), considering its potential for building hierarchically complex three-dimensional structures through the deposition of cells and biomaterials with a high degree of precision. Biomaterials represent the major challenge in 3D-BP strategies, since they are a link between the adaptations needed in the 3D printing process and the biological and mechanical characteristics indispensable to correctly set up and perform the function of the meniscus extracellular matrix. The inclusion of natural polymers (NPs) in inks and bioinks composition provides a desirable microenvironment to printed structures, maintaining the viability and regulating the differentiation and gene expression profiles of the cellular contingent. These biomodulatories' effects, either by direct physical interaction with the cell or by determining a biomimetic mechanical environment to the scaffold, are mandatory to the conclusion of the meniscus' maturation. The main NPs used in meniscus 3D-BP are collagen, hyaluronic acid, gelatin, silk fibroin, fibrin, alginate and chitosan used in isolation or as part of synthetic- biological hybrid materials. Given the above, the benefits of exploring the properties of NPs for use in meniscal TE become indisputable, thus eliciting a series of opportunities for future therapeutic applications.

Keywords: Natural polymers; Bioprinting; Tissue engineering; Meniscus.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

EVALUATION OF HUMAN CELLS ADHESION ON ORGANIC3INORGANIC SCAFFOLDS OBTAINED BY USING REGENERATED CELLULOSE TEMPLATE

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Tissue engineering is a branch of regenerative medicine in which biomaterials are used for reconstruction of tissues and organs. Scaffolds and cells are the two major components of tissue engineering. Biomaterial scaffolds provide a threeKdimensional architecture that supports cell adhesion, proliferation, differentiation, migration, and extracellular matrix production. The aim of the present study was to evaluate human cells adhesion on regenerated cellulose sponge (RCS), on RCS coated with boehmiteKGPTS (3Kglycidoxypropyltrimethoxysilane), and on porous aluminaKsilica scaffold, this last one produced by thermal treatment of RCS coated with boehmiteKGPTS. The cytotoxicity assays based on the resazurin metabolism were performed by using human dermal fibroblast (HDFa) and human osteoblastic cells (MC3T3KE1). The results had shown that cell viability was greater than 85% for all the materials 24 hours after the introduction of the samples extraction medium in the culture medium (indirect method), confirming that the tested materials are nonKcytotoxic. The Scanning Electron Microscopy images had shown that the cells adhered to the materials have not elongated, as opposed to what was observed in the monolayer culture. Still, all materials supported cell adhesion.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

OBTENTION OF CHITOSAN THROUGH FISH WASTE

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

This research is focused on Materials Chemistry and Green Chemistry, and its purpose is the analysis of chitosan, a biopolymer derived from chitin through deacetylation of acetamide group, extracted from fishing waste. The raw material for the experiment came from shrimps' shells, which were washed, dried, and demineralized in HCl (hydrochloric acid) and then deproteinized in NaOH (sodium hydroxide). The chitosan compound was synthesized over oxidation process, leaving a primary amine in the polymeric structure with a molecule of acetic acid. In order to obtain chitosan microspheres, the substance was subjected to coagulation process, dripping liquid chitosan in alkaline solution. Infrared spectroscopy of chitosan was obtained through the Shimadzu IR Prestige-21 model, ranging from 4000cm-1 to 400cm-1, and resolution of 2cm-¹. After this process, the deacetylation degree obtained was of 90,43%, acceptable for its application. However, the microspheres did not have the desirable morphological structure, reaching only its organoleptic characteristics. The chitosan molecule is more active than chitin, mostly because of the presence of amine group (-NH2) in the structure, which affects its polarity, geometry, and solubility. Nevertheless, its application can be useful in many areas, such as Environmental Chemistry, reducing polluted water per adsorption with chitosan microspheres.

Keywords: Chitosan; Biopolymer; Green Chemistry.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

USE OF SODIUM POLYSTYRENE SULFONATE IN THE SYNTHESIS OF ADSORBENT MATERIAL

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Environmental pollution caused by the most diverse industrial sectors is a problem that is getting worse with each passing year. In particular, the pharmacological, textile, cosmetic and food industries that use materials composed of organic molecules that contaminate the environment, due to high toxicity and because they are not biodegradable. Therefore, this work aims to apply material in the removal of the rhodamine B textile dye. The evaluation of the influence of the mass of the adsorbent with a mass of 10 mg showed removal capacity around 121 mg g-1, a decrease of this value was observed to approximately 38, 25, 15 and 11 mg g-1 when the mass is changed to 20, 30, 40 and 50 mg, respectively. It is suggested that this result is due to the fact that the increase in mass combined with agitation (a process necessary in the study of adsorption) will provide greater shocks between the spheres, where they may consequently enter the process of coalescence and thus reduce the surface area. However, it is clear that despite the reduction occurring, it still has significant potential for the removal process. In the pH study, there was a variation in the removal capacity in the studied values, a significant change in pH in relation to the others, where the removal capacity for pH was approximately 184 mg g-1. It was observed that under the adopted experimental conditions, that the time to establish the dynamic balance was after about 30 minutes of contact between the adsorbent and the adsorbent. Isotherms using a temperature of 298 K, 308 K and 318 K showed that at 298 K the adsorption capacity is about 217 mg g-1, suggesting that the material has the potential to remove the rhodamine B textile dye in aqueous medium.

Keywords: Removal; Dye; Rhodamine B.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

DEVELOPMENT OF GELLAN GUM/ COLLAGEN HYDROGELS CONTAINING ALGINATE MICROPARTICLES

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The microencapsulation of bioactive compounds is a technique in which active substances are coated with a wall material, being protected in relation to the external environment. This technology can be applied in several areas, such as medical, pharmaceutical and cosmetics, and the study of the release profile of encapsulated compounds is essential to determine possible applications. Co-encapsulation systems are capable of encapsulating two or more bioactive compounds, without interaction between them, with the possibility of simultaneous and independent release. These devices can be prepared from natural materials, such as biopolymers, which make these systems biodegradable and biocompatible with a wide variety of cells and tissues. Thus, the objective of this project was to develop biopolymeric systems for co-encapsulation and release of active compounds. For this purpose, alginate microparticles were produced from ionic gelation techniques and incorporated into gellan gum/collagen hydrogels. Concentrations of alginate, gellan gum and collagen were fixed at 3%, 0.95% and 0.05% (w/v), respectively, and the amount of microparticles was varied (0, 0.02; 0.1; 0.2; 1; 2) g of microparticles in 4 mL hydrogel. Systems were evaluated using oscillatory shear measurements, uniaxial compression and water holding capacity. The results indicated that systems with the addition of smaller amount of microparticles (0.02 g and 0.1 g) showed a lower stress at fracture, but became more deformable in relation to the hydrogels without microparticles. The addition of higher amount of microparticles led to an opposite effect. The crossover between G 'and G' varied from 52.4 to 69.7 ° C, increasing with the increase of microparticle addition, indicating that the incorporation of the particles favored the formation of the gel at higher temperatures.

Keywords: Biopolymer; Co-Encapsulation; Mechanical Properties.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

Preparation and characterization of gelatin microfibrous membranes obtained from nile tilapia (*oreochromis niloticus*) residues

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

World aquaculture is a sector that has been growing considerably in the last 60 years. In the period from 2010 to 2016, the world aquaculture production grew at an annual rate of 5.8 %. Currently Brazil is the 4th world-s largest tilapia producer, with about 400 thousand tons in 2018. As a result of the wide production, a large amount of by-products, like skin and bones, resulting from the processing of tilapia are produced. Search for ways to take advantage of these by-products, in which to assign applications such as in the area of packaging food, health and tissue engineering, becomes a promising task. This study is focused on fabrication and characterization of tilapia gelatin microfibrous membranes, produced by the solution blow spinning technique. Polymeric fibers were obtained by tilapia gelatin dissolved in acetic acid/deionized water (80/20 v/v), with different concentrations. Using the program Image J, the diameters of the fibers was measured and it was verified that increasing the solution viscosity, the average fiber diameter was increased from 280±73 nm (0,086 Pa.s) to 1195±365 nm (1,88 Pa.s). As an alternative for cross-linking microfibers, microfibrous gelatin membranes incorporated with tannic acid (TA) in different concentrations and the crosslinking were verified using FT-IR and also measuring the dry mass of the membranes after submerged in water for a certain period. A shift of the amide I band to a lower wave number value was observed, indicating the occurrence of crosslinking. After submerged in water, an increase in the remaining mass (dry mass) was observed with the increase in TA concentration, indicating the occurrence of crosslinking.

Keywords: Tilapia Gelatin; Solution Blow Spinning; Tannic Acid; Gelatin Microfibers.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

THERMAL KINETICS STUDY OF CALABASH FRUIT SHELL AND DRAGON FRUIT PEEL AND THEIR VIABILITY AS AN ENERGY RESOURCE

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

In the last time biomass residues are being considered of potential use as energetic resource, at the same time it represents a waste management opportunity. Nevertheless, technologies for energy conversion from biomass still needs to be studied. Biomass pyrolysis, is an emerging thermochemical conversion technology that can help in energy provision, is still being elucidated due to biomass complexity. It is important to study the thermal decomposition behavior of biomass residues in order to determine pyrolysis viability and operation parameters. Accordingly, the objective of this study, was to elucidate the thermal and kinetics characteristics of calabash fruit (*Crescentia cujete*) shell (CFS) and dragon fruit (*Selenicereus megalanthus*) peel (DFP), using proximate analysis, thermogravimetric analysis (TG), differential scanning calorimetry (DSC), and mass spectrometry (MS). TG data was used to identify the kinetic behavior using the isoconversional methodology of Friedman and KAS for pyrolysis. Compositional characteristics of CFS and DFP indicated lignocellulosic content. Thermograms from TG analysis showed three characteristic stages related to drying, active pyrolysis, and final decomposition. Particularly in the pyrolysis stage the decomposition of lignocellulosic compounds is evident and presents differences for CFS and DFP which are studied deconvoluting the thermogram peaks and identifying the decomposition of hemicellulose, cellulose and lignin individually. The main volatile compounds present in thermal degradation for CFS and DFP were water and methane, although CFS released a wider variety of volatile compounds. Activation energies obtained were calculated for each deconvoluted peak with Friedman and KAS methods did not present further differences, varying from 159 to 316 kJ / mol along the heating process. The kinetic reaction mechanism was identified through master plots fitting in which finding a correlation for Avrami-Erofeev model. Both residues showed a good performance as energy resources, although CFS showed to be more suitable for bio-oil production, while DFP for bio-char production.

Keywords: Pyrolysis; Biomass Residues; Thermogravimetric Analysis.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

SCAFFOLDS 3D PRINTED BY FDM TECHNIQUE: DENSITY AND PORE SIZE

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

The reuse of agro-industrial waste is an environmentally friendly alternative, as it reuses biomass wasted by burning or destined for landfills. The insertion of natural waste as fillers in biomaterials resignifies the waste for a noble application as in scaffolds for regenerative medicine. The residue of the palm comes from the palm heart extraction industry, where 99% of the palm is wasted. This fact demonstrates the need for destination and research with palm residue. In these residues, surface treatments such as bleaching can be done, facilitating the fiber/matrix interaction as they result in higher cellulose content. So, this work purposes the use of bleached fiber from royal palm residues as reinforcement in PHBV (115 mesh, with 1, 2.5, 5, 7.5, and 10% w/w), obtaining porous cylindrical scaffolds using the FDM technique. The relative density of the scaffolds was calculated as the ratio of mass per unit volume. The scaffold pores were measured by the ImageJ software using images from a stereomicroscope. The composite scaffolds were the lightest and, consequently, had a lower density than the pristine PHBV (between 0.41 - 0.47 g/cm³ and 0.48 g/cm³ respectively), which can be explained by the characteristic low density of natural fibers and small impregnation of the matrix in the fiber. From the stereomicroscopic images, it was observed that the composite scaffolds showed an interconnected pore structure. The gradual addition of fiber to the scaffolds made them darker and with irregular pores. The FDM technique presents challenges in obtaining small pores due to the extrusion process through a 0.6 mm diameter nozzle, which the molten thermoplastic passes. However, there was a tendency to decrease pores, the scaffold with 10% fiber presented measurements of 939 ± 402 µm, while the scaffold of pristine PHBV obtained 1396 ± 502 µm, respectively.

Keywords: Agroindustrial Waste; PHBV; Scaffold; Density; Pore Size.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

THERMAL STUDY OF *AMBURANA CEARENSIS* EXUDATE AND GUM IN ITS PURIFICATION STAGES

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Some polysaccharides have units of reducing sugar in their structure, so they can be used not only as stabilizers, but also as reducing agents in the synthesis of metallic nanoparticles. The polysaccharide extracted from the exudate, or gum, of *Amburana cearensis* (GAmb), is still underexplored, however, preliminary tests developed in our research group (MATSenS) showed the capacity of this biopolymer to act as a reducing agent in the green synthesis of nanoparticles of gold. However, before exploring such an application, it is necessary to study the thermal behavior of GAmb. The present work aims to study the thermal behavior of the polysaccharide extracted from GAmb, a species typical from the Brazilian Northeast. The TG / DTG and DSC analyses, in an oxygen atmosphere, were performed for GAmb in its raw state (exudate), after the isolation step (IS) and after the 1st and 2nd purification steps, called P1 and P2, respectively. In the TG and DTG tests, three thermal loss events were recorded, the first was an endothermic event (loss of 11.56%) attributed to water adsorbed on the polysaccharide. The second event is exothermic (loss of 54.68%), is attributed to the degradation of the polymeric chain, while the third event, was attributed to the oxidation of carbonaceous compounds formed during the decomposition step of the polysaccharide. The thermal analysis showed that the polysaccharide has similar thermal behavior and stability up to about 200 ° C for the raw gum and for the IS, P1 and P2 states.

keywords: Polysaccharide; Exudate; Thermal Behavior.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

DEVELOPMENT OF NEW EDIBLE FILMS FOR ORAL DELIVERY OF RIBOFLAVIN

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

The medicines in tablets form are very used due to the administration facility. However, in patients who have deglutition difficult, especially among pediatrics and geriatrics area, drug delivery systems in orally disintegrating films (ODFs) being very promising. The present work has the objective to produce ODFs using hydroxypropyl methylcellulose (HPMC) like matrix film-forming containing riboflavin (vitamin B2) incorporated. Films were obtained by casting and characterized in terms of moisture content and water solubility. Was obtained control films containing only HPMC at 2% (w/v) and films with HPMC at 2% (w/v) and riboflavin at 0.4% (w/v). Firstly, the films were cut in rectangular forms and weight recorded after being kept in the oven at 105 ° C for 24 hours to remove moisture. Then, the films were immersed in 50 mL of distilled water. The system was sealed and shaken at 50 rpm for 24 h at 25 °C. Then filtered to recover the remaining undissolved film, desiccated at 105 °C for 24 h and weighed. Moisture content remained practically the same after the addiction of the vitamin (4.3 ± 0.7 and 4.3 ± 0.2, respectively) and was obtained by the difference in masses between the films before and after being dried for 24 hours. Solubility was calculated by the weight of the films desiccated difference before and after the water solubilizing divided by the initial mass of the film. The HPMC films showed 91 ± 3 percent of solubility. After riboflavin added, the value was 92 ± 7. According to the results, the riboflavin does not affect the solubility, continuing close 100 percent. This result is very important because even after the drug was added, moisture and solubility were not affected, which makes these films material with great potential to be used ODFs development.

Keywords: Orally Disintegrating Films; Biopolymers; Natural Polymers.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

USE OF AGRO-INDUSTRIAL RESIDUES FOR THE PRODUCTION OF BC FOR APPLICATION AS A SUPPORT FOR SUSTAINED RELEASE OF RIFAMPICIN

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Bacterial cellulose (BC), a glucose homopolymer, produced especially by the *Komagataeibacter* genus has potential for application in the pharmaceutical and biomedical industries due to its physicochemical properties. The high cost is a major challenge for large-scale production in the BC, which stimulates the search for alternative means to reduce costs. The objective of this work was to use agro-industrial residues for the production of BC, using *K. rhaeticus* AF-1, and its application as a support for sustained release of antibiotic rifampicin (RFM) a drug used for treatment of skin wound infection. The extracts of the agro-industrial residues used as a culture medium were obtained by two processes, the first by subjecting the residue to a "squeezer" (T), and the second by infusing the solid leftovers from the first processing (M). The extracts without dilution (T/M100) and diluted 10% (T/M10), 40% (T/M40), 70% (T/M70), obtained in both processes were used as culture medium. The cultures were incubated for 7 days in B.O.D. at 28°C. The BC membranes obtained were processed for cleaning and purification and analyzed for dry mass and swelling, characterized by thermogravimetric analysis, and used for the sustained release test, by diffusion in disks, of antibacterial drugs. The BC membranes were loaded with 3,6 mg de RFM. The results showed that *rhaeticus* was capable to produce BC with elevated capacity to sustained release antibacterial drugs, using agro-industrial residues. The BC membranes produced in the media T10 and M10, that showed more swelling capacity, were able to maintain the release of RFM for 648 and 624 hours, respectively. Thus, the use of agro-industrial waste has great potential to be used in the production of BC for use in medicine, to sustained release antibacterial drugs, and other industrial areas.

Keywords: Bacterial Cellulose; Agro-Industrial Residues; Drug Release.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

BACTERIAL CELLULOSE FILMS COVERED WITH NANOFIBERS. A SAFRANINE RELEASE STUDY

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Different materials based on cellulose are usually employed in the biomedical field. Specifically, bacterial cellulose (BC) can be used as wound dressing, scaffolds for tissue engineering and drug delivery systems. On the other hand, cellulose nanofibers (CNF) can produce hydrogels with similar applications in biomedicine than BC. However, BC structures are not able to carry molecules for control release and should be modified. In the present work, the synthesis of a hybrid material constituted by BC films and CNF oxidized with TEMPO (2,2,6,6-Tetramethyl-1- piperidinyloxy) leading to a high carboxil content (1000 mEq/g) were performed to obtain a drug delivery system. The cellulose hybrids were fabricated by ex situ employing BC membranes produced by Komagataeirbacter xylinus (ATCC 23760) in batch culture for 48 h and purified with NaClO/NaOH. Later, pure BC membranes were modified with CNF dispersion in acetate/acetic acid buffer (pH= 5). Safranin (3,7-dimethyl-10-phenylphenazin-10-ium-2,8-diamine chloride) was selected as a model drug because contains conjugate aromatic rings with amino groups in its structure like many bioactive molecules. Scanning electron microscopies of the BC dopped films showed changes in the topological surface compared to control films, attributed to NCF agglomerations. The safranin loading studies were carried out with hybrid films immersed in a 150 µM dye solution in acetate-acetic acid buffer (pH= 5) and its release was evaluated spectrophotometrically at 422 nm. The hybrid BC-NCF films can load twice the amount of Safranin compared to BC control ($p< 0.05$, $n= 3$). Both release profiles fit first order kinetic obtaining R2 values of 0,95 and 0,98 for safranin released from BC-CNF and control films, respectively. Next step will include gentamicin to study incorporation and release for a system with antibacterial properties. This partially results showed that the hybrid BC-CNF could be a potential drug delivery system for wound healing applications.

Keywords: Bacterial cellulose; Nanofibers; Drug Delivery.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

BACTERIAL CELLULOSE APPLIED TO ANIMAL WOUNDS TREATMENT

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The present study is a review about bacterial cellulose or biocelulose and its advantage for application in animals as alternative treatment of wounds. The method used was research in databases and scientific journals in order to select studies to discuss the topic related. As a result, for the treatment of wounds, biocelulose was considered effective in its application. Moreover, the biocelulose consists in a natural biopolymer, synthesized by bacteria, and it has unique properties such as high liquid adsorption, high chemical purity, biocompatibility, biodegradability in the environment, and high mechanical resistance. In addition, the biocelulose is able to be irradiation sterilization without any change in its structure and properties. Furthermore, it is capable to form a network of nanometric threads, being a viable matrix to assist the treatment of dermal lesions as temporary skin substitute, for burns, ulcers, and others. Most of the protocols for wounds in animals require dressing changes, especially when related to alternative methods that requires less frequency of change. The biocelulose shows a promising effect, according to the literature, it was possible to reduce the frequency of dressings and healing occurred in satisfactory period, the wounds remained moist, without contamination, with intense neovascularization and granulation, that helps in the treatment. Thus, the biocelulose membrane represents a current variation in the treatment of skin wounds, especially in animals.

Keywords: Bacterial Cellulose; Biocelulose; Wounds Treatment.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

GREEN AND CHEMICAL SILVER NANOPARTICLES AND POMEGRANATE FORMULATIONS AS POTENTIAL WOUND HEALING AND ANTIMICROBIAL DRUG

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Infected cutaneous ulcers from diabetics rats infected with *Candida albicans* and *Staphylococcus aureus* were treated with three different spray preparations: silver nanoparticles produced through the chemical route, silver nanoparticles produced through the green route using pomegranate peel extract as silver reducing agent and pomegranate peel extract spray. Animal groups treated with each formulation separately were compared to negative (without treatment) and positive groups (silver sulphadiazine). Following the development and infections of wounds, the treatments were performed for 14 days and applied twice/day. After 2, 7 and 14 days of treatment, analyses of wound closure (healing process), determination of CFUs, inflammatory infiltrate, angiogenesis, fibroplasia, myeloperoxidase determination and the indirect evaluation of collagen production were performed. An expressive improvement in the wound healing activity could be noted for chemical and green silver nanoparticles administration after 7 days of treatment and after 14 days all treatments showed superiority when compared to negative and positive groups. All treatments reduced the number of CFU of *S. aureus* after 14 days of treatment. Chemical silver nanoparticles showed better anti-inflammatory results, while pomegranate spray showed a pro-inflammatory activity, corroborating with the myeloperoxidase assay. Both silver nanoparticles induced a higher number of fibroblasts when compared with other treatments corroborating also with the results obtained for collagen deposition. Although the limitations inherent to the techniques, formulations containing silver nanoparticles regardless of the synthesis route, being chemical or green, have shown a considerable potential for the treatment of wounds and the same is true for the pomegranate spray formulation. It is important to note that in these cases, the wound healing was reached by completely different mechanisms. Even taking into consideration the ease reproducibility of the green synthesis, low cost, eco-friendly besides other properties that it could present, these proposals needs to be more explored as a wound healing medicines.

Keywords: Silver; Nanoparticles; Punica granatum; Wound Healing.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

INFLUENCE OF CARBOXIMETHYLCELLULOSE HYDROGELS ON THE MOISTURE RETENTION, POROSITY AND SOIL DENSITY PROPERTIES

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

This work aimed to evaluate the applicability of hydrogel based on carboxymethylcellulose as a soil conditioner. The hydrogel was incorporated into the sandy texture soil at different concentrations 0 % (control), 0.1 %, and 0.5 % concerning to dry weight of soil. The samples were collected by a cylindrical stainless ring and leave to saturate for 24 hours. After, the samples were analyzed through Richard´s pressure plate. The moisture retention values at zero CCA tension for soil treated with 0 %, 0.1 % and 0.5 % of hydrogel were 0.360, 0.399 and 0.408 cm3/cm3, respectively. For 300 CCA tension, the control and soil with 0.1 % hydrogel had similar moisture retention results (0.100 and 0.101 cm3/cm3). However, the moisture retention of the soil treated with 0.5 % of hydrogel was approximately 23.6 % higher than both samples. A more efficient gain in this soil property was observed for higher tension. For instance, for 15000 CCA tension, the moisture retention of the soil treated with 0.5 % hydrogel was 37.1 % higher than the other treatments. The results of density and porosity revealed that the increase in the concentration of hydrogel increased the soil porosity (35.9; 39.9 and 40.8 % for 0 %, 0.1 %, and 0.5 % hydrogel, respectively) and decreased the soil density (1.52; 1.49; 1.43 g/cm3 respectively for the same treatments). These results are related to the swelling of the hydrogel particles in the soil during the water absorption, causing displacement and reorganization of the soil particles around the swollen hydrogel particles. Therefore, it is evident that this material has great potential for agriculture as a soil conditioner.

Keywords: Hydrogel; Soil Conditioner; Agriculture.

Acknowledgments: The authors would like to thank FAPESP and CNPq. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – “Finance Code 001”.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

BIOPOLYMER BASED ON THE PUREE OF MESOCARP OF MELON (*Cucumis melo* L.)

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The melon (Cucumis melo L.) has high socioeconomic importance in the Northeast of Brazil. Currently, the state of Rio Grande do Norte and Ceará stand out as the largest producers. The most cultivated melons belong to the yellow types, which are preferred due to their long useful life and the resistance to transport and acceptance in the domestic and foreign markets. It is a commercially important species worldwide, with fruits consumed fresh, as an ingredient in salads and juice. However, most of the time, the melon mesocarp is discarded, and it consists of a renewable and biodegradable source. From the environmental point of view, the number of residues generated by the disposal of packaging used in food products produced by non- renewable sources grows every year, which arouses interest in developing edible biodegradable films obtained through biopolymers. The objective of this work was to obtain films based on the melon mesocarp puree using the casting process. W-HTP films are semi-transparent and have some flexibility. Thermogravimetric analyzes were performed at heating rates of 5, 10, and 20 °C min-1 under a nitrogen atmosphere. The data for evaluation of thermal stability were obtained by Thermogravimetry (TG/DTG), indicating only one decomposition for the film (155.8 - 397.0 °C). Incremental non-isothermal isoconversional methods applied to DTG data were used to obtain kinetic parameters. Scanning Electron Microscopy (SEM) presents images in 100 µm, with wavy surfaces and tangles of fibers of varying thickness. Other techniques such as infrared spectroscopy (FTIR) and X-ray spectroscopy were also used to characterize the film.

Keywords: Biopolymer; Casting process; *Cucumis melo* L.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ACTIVATED CARBON FROM COFFEE RESIDUES BY A COMBINATION OF CARBONIZATION AND ZNCL$_2$ CHEMICAL ACTIVATION PROCESSES

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Brazilian economy depends in a large extent of agriculture, which produces a great number of residues that, if not processed properly, might harm the environment. Lignocellulosic biomass is a resource for renewable electricity, thermal energy, biofuels, and chemicals. Coffee is widely produced worldwide, and it is considered as the second largest traded commodity in the world, Brazil is the largest producer. In this work, the epicarp of coffee (husks), collected in Pedrinópolis-MG, was processed to produce activated carbon, a versatile material used for gas pollution abatement, heavy metal sorption, dye removal and water purification, electrochemical energy storage. The biomass was characterized, and the adsorption capacity of the activated carbon was investigated. The proximate analysis of the husks indicate that the material presented average values of 1.72% of moisture content, 5.82% of ashes, 66.91% of volatiles and 26.04% of fixed carbon. The activated carbon was produced in two steps. Initially, the coffee husks were carbonized in a muffle oven, the material was heated from room temperature to 500 ºC at 10 ºC min-1, and then kept at this temperature for 2 h. The char was activated using ZnCl2 (14.5 mol dm-3) being initially heated up to 110 ºC for 18 h, then to 400 ºC for 1 h and finally to 600 ºC for 1 h, after which the activated carbon was thoroughly washed and dried. The produced activated carbon was characterized according to its adsorption capacity of aqueous solutions of methylene blue (MB). The results indicate a high value for the maximum MB adsorption capacity, 5.3 mg/mg, indicating the viability of the proposed methodology to produce the renewable adsorption material.

Keywords: Coffee Residues; Activated Carbon; Adsorption.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

BIOCELLULOSE/PROPOLIS HYDROGELS FOR WOUND TREATMENT

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The increase in population ageing and in the incidence of diabetes favors a greater occurrence of wounds, which encourages research that seeks more efficient methods of treatment that support wound healing. In this context, biocellulose hydrogels containing standardized propolis extract (EPP-AF®) were developed aiming application in wound treatment, since biocellulose accelerates the healing process and propolis has antimicrobial activity, helping to control or prevent the occurrence of infections. The formulations were produced from grinded BC membranes and EPP- AF® at concentrations of 1.2, 2.4 and 3.6%. Scanning Electron Microscopy (SEM) images showed that the three-dimensional structure of BC nanofibers was maintained after the process, and propolis was properly incorporated into BC pores. This incorporation was confirmed by spectra obtained from Fourier Transform Infrared Spectroscopy (FTIR) and thermal analysis. The study of rheological behavior was favorable for topical application and the mutagenicity test discarded the mutagenic potential of EPP-AF® in hydrogels with the tested concentrations. Using Franz cells, the release of two important propolis biomarkers, Artepillin C and *p*-cumaric acid, was measured and it was observed that the formulation containing 1.2% of EPP-AF® was the one that proportionally more released both compounds. This result may be due to the fact that formulations containing higher concentrations of propolis have more intermolecular interactions with CB networks, hindering the biomarkers release. Other tests are still needed, including antimicrobial, preclinical and clinical, but so far the results are favorable to the production of biocellulose/propolis hydrogel for wound treatment.

Keywords: Bacterial Cellulose; Propolis; Wound.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

SUSTAINABLE USE OF CANADIAN SWEET POTATO STARCH IN THE ELABORATION OF BIODEGRADABLE FILMS

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Data from the European Commission (2018) report that global plastics production has increased twenty-fold since the 1960s, reaching 322 million tonnes by 2015. About 42% of this production is used in packaging and approximately half of this is destined for the food sector. Due to these amazing numbers, the pollution has grown concomitantly, creating the research program to develop a biodegradable film with properties similar to a conventional plastic packaging. For this, the casting method was used, which consisted of the preparation of a filmogenic solution, composed of distilled water, polymeric matrix (sweet potato starch - 2% weight/volume), and plastifying agent (sorbitol) in different concentrations, under magnetic stirring. Variations were made in other determining factors in the film, such as plasticizer concentration about starch mass, agitation time, types of support, and drying temperature of the material. We found subjective data from the various films tested such as homogeneity, continuity and maneuverability. The best film obtained to the properties was the film with 20% sorbitol concentration with the starch mass, two hours of stirring of the solution, mylar support and drying at room temperature. This film presented all the analyzed properties demonstrating excellent application potential as a replacement for non- biodegradable packaging. This film presented all the analyzed properties demonstrating excellent application potential as a replacement for non-biodegradable packaging. Acknowledgement: FAPESP, CNPq, CAPES, and UNESP.

Keywords: Biodegradable Film; Sweet Potato Starch; Sorbitol.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

MICROPARTICLES OF AÇAÍ EXTRACT (*Euterpe oleraceae Martius*) BASED ON ALGINATE OBTAINED BY THE TECHNIQUE OF IONIC GELATION: CHEMICAL AND THERMAL CHARACTERIZATION

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Microparticles of açaí extract (*Euterpe oleracea Martius*) based on alginate cross-linked with calcium were prepared aiming at the elaboration of a product with mutual function: release of antioxidant compounds and which are sensitive to pH variation through color. The lyophilized microparticles were chemically and thermally characterized by means of the following analyzes: Fourier-transform infrared spectroscopy (FTIR) using a Perkin Elmer Frontier Spectrophotometer and Differential Scanning Calorimetry (DSC) by a TGA thermal analyzer (Q600, TA 30 Instruments, USA). The spectroscopy curves of the lyophilized alginate microparticles with concentrations of 1% and 2% (g/g alginate) of açaí extract were very similar to those without added extract. However, it can be evidenced that the extract was successfully encapsulated, because in the wavelengths of 2853 cm^{-1} and 1746 cm^{-1} specific bands appeared in the spectrum of açaí extract (2855 cm^{-1} referring to the C-H2 group and in 1744 cm^{-1} of the stretch of group C=O). These peaks gradually increased in intensity with an increase in the concentration of the extract, showing an interaction between the alginate polymeric chain and the extract. The Differential Scanning Calorimetry (DSC) curves of the microparticles showed three endothermic events at temperatures of 65°C, 235°C and 495°C, differing from those determined for the pure compounds (alginate and açaí). The event at 65 ° C represents the dehydration of microparticles, at 235 ° C it is the fusion of the created material and at 495 ° C its degradation. The structural change of the macromolecules in the presence of the açaí extract provided a change in the melting temperature of the microparticles, indicating the formation of a material with different physical characteristics from the original ones. It is concluded that the microparticles of alginate and açaí extract formed a miscible blend, presenting a single phase.

Keywords: Microparticles; Alginate; Açaí extract.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização:

AN INCREMENTAL ISOCONVERSIONAL METHOD APPLIED TO KINETIC ANALYSIS OF PUREE FILMS FROM ONION BULB (*Allium cepa L.*)

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

In general, isoconversional methods for the kinetic analysis of condensed-phase reactions under non-isothermal conditions are based on an equation that describes the kinetics of reactions that are governed by a single kinetic mechanism. Thus, in the case of processes involving two or more stages, such methods can be used only as an approximation, replacing the set of intermediate kinetic equations in a single general kinetic equation. To avoid errors arising from this approach are used the so-called incremental methods, in which the isoconversional methods are considered over sufficiently small conversion intervals. This work aims to present an incremental isoconversional procedure based on the mean value theorem for integrals. As an application, experimental thermogravimetric curves (TG / DTG curves) obtained in studies of thermal stability evaluation of films obtained from onion puree (*Allium cepa L.)* were used. In addition to the estimated kinetic parameters, the presence of four decomposition steps was also observed; that is, four intermediate steps influence the total reaction rate.

Keywords: Non-isothermal kinetics; Isoconversional methods; Biopolymer; *Allium cepa L*.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ANTICARIE AND ANTIBIOFILM ACTIVITY OF PHYTOTHERAPY FORMULATIONS FOR MOUTHWASH

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Area: ( ) food and agriculture (x) medical and pharmaceutical ( ) multifunctional applications

This in vitro study aimed to evaluate anticaries and antibiofilm activity of mouthwash formulations containing pomegranate (*Punica granatum*) peel extract, sodium trimetaphosphate (TMP) and fluoride (F). The formulations were comprised of 3% of extract, 0.2 or 0.3% of TMP, and 100 or 225ppm of F. Bovine enamel blocks were treated with the formulations twice a day for 1 minute and subjected to five pH cycles (demineralizing/remineralizing solutions). Next, the integrated loss subsurface hardness (ΔKHN) and the concentrations of calcium (Ca) and phosphorus (P) in the enamel were determined. The formulations which promoted lower ΔKHN were used to treat dual biofilms of *Streptococcus mutans* (ATCC 25175) and *Candida albicans* (ATCC 10231) grown for 24 hours on hydroxyapatite discs for 1 or 10 minutes. Pomegranate peel extract significantly reduced (p<.001) the lesion body (ΔKHN) on the enamel blocks subjected to pH cycles, regardless of the TMP and F concentration tested. Formulation containing 225ppm of F provided the highest concentration of Ca and P in the enamel surface. The highest rates of viable cells reduction were provided by treating the biofilm for 10 minutes with formulation containing extract+03%TMP+225ppmF. In conclusion, the addition of 3.0% of pomegranate peel extract in mouthwashes with TMP and F promoted a remarkable decrease in mineral loss of dental enamel besides considerable reducing cariogenic biofilm formed by *S. mutans* and *C. albicans*.

Keywords: *Punica granatum*; Polyphosphates; Desmineralization.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

BIOPOLYMERIC MICROPARTICLES OF EXTRACT FROM LEAVES OF *Baccharis dracunculifolia* (ASTERACEAE) OBTAINED BY SPRAY DRYING: PHYSICOCHEMICAL CHARACTERIZATION AND BIOLOGICAL ACTIVITY

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Baccharis dracunculifolia (Asteracea), a plant native from Brazil, is the main natural source used to produce green propolis by the Apis mellifera. In folk medicine, it has been used for treatment of inflammation, gastric and hepatic diseases. Recent researches have been reported phenolic and prenylated compounds, such as coumaric acid, cinnamic acid, artepellin C, and baccharin, as the ones responsible by its biological activities. However, due to low stability of these compounds, their use as herbal medicine is difficult. To solve this, microencapsulation technologies are a viable option to maintain chemical stability of active compounds. Among these technologies, spray drying is a fast and a low-cost technology widely used in pharmaceutical and food industries for the encapsulation of bioactive compounds, which are heat-sensitive with low thermal degradation, by their encapsulation with a material known as wall material. In this study, leaves extract from B. dracunculifolia was encapsulated by spray drying using maltodextrin (MD) and hydroxyethylcellulose (HEC) as wall material, outlet temperature at 60 °C and 90 °C, and two concentrations of biopolymers (50% and 100%). The obtained biopolymeric microparticles were characterized by scanning electron microscopy (SEM), Fourier transform infrared (FTIR), and termogravimetric (TG) analyses and was performed cell viability assay. The SEM images showed that only microparticles with 50% of HEC and dryer at 60°C presented smaller particles aggregates, spherical morphologies, and regular surface. FTIR confirmed the interaction between wall material and extract from leaves which was observed for a small band at 2990 cm-1 and vibrational frequencies at 1682 a 979 cm-1 assigned to wall materials and phenolic compounds, respectively. TG and DTG analyses showed that thermal stability of biopolymers was not affect by spray drying process. In additional, cell viability assay showed that cytotoxicity of microparticles decreased compared to cytotoxicity of extract from leaves of B. dracunculifolia.

Keywords: *Baccharis dracunculifolia;* Microparticles; Biopolymers.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

CHEMICAL MODIFICATION OF CELLULOSE FROM OAT HULLS BY COMBINATION OF ULTRASONICATION AND CITRIC ACID

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Lignocellulosic fibers are complex materials composed essentially of cellulose, hemicellulose and lignin. The agribusiness is responsible for bring forth numerous lignocellulosic residues, such as oat hulls, the main by-product of oat milling, which is often used for animal feed. Therefore, the present study aimed to modify cellulose from oat hulls by combination of ultrasonication and citric acid and to analyze the consequences of the modification in terms of hydrophobicity and by Fourier transform infrared spectroscopy (FTIR). For the extraction of cellulose, the dried and ground oat hull was subjected to a solution of peracetic acid, under constant agitation, for 24 hours, resulting in a material with high cellulose content (> 83% cellulose). The modification was carried out submitting the obtained cellulose to ultrasonication in an ethanolic solution (1 g of citric acid/38 g of ethanol). The FTIR spectrograms of the modified cellulose exhibit an expressive new band at 1740 cm-1, a band not presented in the cellulose in natura spectrum, associated with ester carbonyl groups (C=O) that were introduced in cellulose after modification, which also presented a higher hydrophobic character observed by a decrease in its the water holding capacity and an increase in its oil retention capacity. The new properties of modified cellulose expand its use in the industry, mainly in wastewater controls.

Keywords: Agroindustrial Residue; New Materials; Cellulose.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

THE USE OF ACETATE CELLULOSE, AS BIODEGRADABLE POLYMER MATRIX, FOR THE INTELLIGENT PACKAGING PRODUCTION

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Cellulose is a natural polymer formed by glycoside rings linked. Cellulose chemical modification through hydroxyl group reactions can produce different derivatives. Cellulose acetate (CA) is one of the cellulosic derivatives of greatest commercial importance used for the production of biodegradable food packaging. CA can be incorporated with polydiacetylene (PDA) to serves as a communication instrument to inform about product conservation. PDA is a synthetic material that can be used as a sensor substance capable to detect chemical or biochemical changes in foods. Therefore, this work focused on the development of an intelligent packaging to detect temperature and pH changes. CA films (3% wt.) were developed by a casting method, incorporating triethyl citrate as plasticizer (7% wt.) and PDA (1.4% wt.) as the sensor compound. Colorimetric analysis was performed in the ColorQuest XE (HunterLab®) colorimeter, illuminant D65, 10° angle (field of view), CIELAB scale and the coordinates evaluated were: L* value (luminosity), a* (green to red) and b* (blue to yellow). The intelligent films that were immersed in a 4.0 pH solution maintained blue color (L*40.1, a*-0.5, b*-4.3) at 28.0 °C; however, they changed the color to purple-pink (L*42.1, a*0.4, b*0.3) at 71.1 °C. Moreover, intelligent films turned to red (L*39.7, a*7.4, b*3.2) after exposure to a pH-9.0 solution at 71.1 °C. The color changes occurred due to the deprotonation of the carboxylic acids, which increased Coulombic repulsive force, leading to a new zig-zag PDA's polymeric carbonic chain and the color change was enhanced by thermochromism. This work contributed to the development of the intelligent packaging produced by the PDA incorporation into an acetate cellulose matrix, providing a simple and cheap technology to monitor the temperature of food products during the entire production chain.

Keywords: Smart Packaging; Quality Food; Acetate Cellulose.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

POTENTIAL APPLICATION OF SILK FIBROIN AS A NATURAL BIODEGRADABLE POLYMER FOR MECHANICAL BONE STIMULATION

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Natural polymers have promising applications as biodegradable materials for regenerative medicine. Among them, silk from *Bombyx mori* cocoons presents biocompatibility and an interesting versatility in terms of biodegradation rate, mechanical and structural properties. The aim of this study was synthesize hybrid scaffolds based on silk fibroin (SF) and magnetic nanoparticles (MNp) in order to promote an external stimulation of the mechanoreceptors for cellular regeneration improvement. Salt leaching was employed to scaffolds synthesis of SF purified by boiling. Different boiling times and differents pHs were explore during the SF purification and scaffold synthesis respectively. MNp were synthetized by co-precipitation from basic solutions of Fe^{2+}/Fe^{3+} under inert atmosphere. These nanoparticles were characterized using a Vibrating Sample Magnetometer. The results showed mass magnetization value of 87.76 emu/g, close to the saturation magnetization of magnetite in bulk at low temperature (92 emu/g) and above the value corresponding to maghemite. MNp were introduced into the scaffolds via inclusion during the gelation process or after the obtention of the scaffold by dip-coating technique. Optimized scaffold, prepared with SF obtained after 40 minutes of thermal digestion and pH 6 presented highly homogeneous and interconnected pores with pore sizes distribution of 340 µm +/- 10 (SEM observation with ImageJ® Software analisys). The presence of MNp did not affect the scaffold formation or the structural properties and the MNp showed magnetic suceptibilty which could be profited as stimulator of natural bone mechanical receptors. The promising results observed for hybrid scaffolds open the possibility for future extended uses as a valid alternative for bone regeneration in tissue engineering therapies.

Keywords: Silk fibroin; Magnetic nanoparticles; Biomaterials.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

INFLUENCE OF ASSOCIATION OF ALGINATE, POLYCAPROLACTONE (PCL) AND BIOCERAMIC (BC) IN BONE REGENERATION

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Alginate is a natural polymer frequently used in tissue engineering and can be associated with other biomaterials for bone regeneration. The viability of stem cells isolated from teeth and cultivated on scaffolds were evaluated by MTT and the osteogenic differentiation was induced in cells cultivated with biomaterials. Bone regeneration was tested in the calvaria of rats. The results of cell viability comparing different solvents for alginate did not demonstrate statistical difference ($p=0.55$), with mean absorbance ± standard error of the mean of 0.13±0.01 when phosphate-buffered saline (PBS) was used, 0.14±0.01 using water and 0.14±0.01 with sodium chloride (NaCl), after six days. The comparison of 2.5 and 3% alginate in water resulted in 0.14±0.01 and 0.18±0.01 ($p<0.01$), respectively, showing that the higher concentration of alginate increases cell viability. The cell viability results were: 0.21±0.01 for the control (well plate); 0.07±0.01 ($p<0.01$), when cells were cultivated in PCL scaffolds by 3D printing; 0.41±0.02 ($p<0.01$) on PCL electrospun scaffolds; 0.36±0.03 ($p<0.01$) in 0.1mL of alginate; and 0.33±0.02 ($p<0.01$) when the cells were cultivated with the 3 associated biomaterials. The combined biomaterials maintained high cell viability and promoted mechanical properties. The osteogenic differentiation, confirmed by the presence of calcium deposits stained by alizarin red, was more intense in the biomaterials. *In vivo* tests showed the presence of apparently thinner tissue when observed macroscopically in the skull caps in the rats with only surgical intervention, while in the treated group (alginate+PCL+BC), the biomaterials were integrated into the animal tissue. Alginate associated with BC and PCL demonstrated promise as an alternative for bone regeneration.

Keywords: Bone Tissue; Engineering; Scaffolds.

Acknowledgments: MCTIC, FINEP; CNPq; Stem Cell Research Institute (IPCT).

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

CHARACTERIZATION OF EDIBLE FILMS OF MANGOES CV. PALMER VIA CONTINUOUS CASTING

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The technique of film production by continuous casting has a high potential for application on an industrial scale, mainly because it is low cost and allows high productivity. Mango pulps are strong candidates for use as biodegradable packaging, in addition to adding other features in the postharvest of fruits and vegetables, such as prolonging the shelf life and improving the appearance of the products. Thus, the work aimed to develop and characterize films based on 'Palmer' mango pulps using the continuous casting technique. Commercial pectin (5%) was added to the mango pulps to form the filmogenic solution. Subsequently, the solution was inserted in a coating device with a layer thickness of 1.5 mm, pre-dried in infra-red (IR), and dried in an air circulation oven (100 ºC). After collection at the exit of the oven, the films were stored and characterized in microscopic and thermal properties. For characterization, the ultrastructure of the films was analyzed in a scanning electron microscope (SEM), model JEOL-JSM 6510, with 1000x magnification. The thermal degradation profiles of the films were determined in a TGA Q500 with a heating rate of 10 °C min-1 between 10 and 600 °C. Weight loss (%) and the derivative (%/°C) were determined in temperature function. From the qualitative analysis of the fractured films, it can be observed that they presented a more heterogeneous structure, possibly associated with the presence of sugars in the pulps. For the TGA analysis, TG and DTG curves showed three distinctive stages of mass loss: the release of adsorbed water (45-120 ºC), decomposition of the pectin chains (200-300 ºC) and combustion of the polymeric residue (T> 300 ºC). Therefore, it is possible to affirm that mango pulp films have a potential application in edible food packaging.

Keywords: Mango Pulp; Biodegradable Films; Sustainability.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

MECHANICAL PROPERTIES OF CASSAVA STARCH FILMS INCORPORATED WITH NANOFIBRILLATED CELLULOSE FROM YACON PLANT (*Smallanthus sonchifolius*) STEM

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Petroleum-based polymer packaging can cause serious damage to the environment, requiring alternatives that are eco-friendly. Cassava starch (CS) appears as a promising matrix for the production of biodegradable packaging/films. However, CS-films have some mechanical limitations. Nanofibrillated cellulose (NFC) is a nanoscale biomaterial that can be added during the production of CS-films, but this can affect its mechanical properties. Therefore, the objective of this study was to evaluate the effect of adding NFC from the yacon stem on the mechanical properties of CS-films. Commercial starch and glycerol were used to produce the films and the yacon stems were provided by a farmer from São José dos Pinhas–PR. NFC suspension was extracted in a colloidal grinder (Masuko Sangyo®, MKCA6-2J) from bleached pulp obtained from the stems of yacon. The films were produced by the casting method with 4% CS and 1% glycerol in 100 mL of distilled water in a thermostatic bath (72°C/5min). In the formulation were added 16 (%) of NFC (F16) and a film without NFC (F0) was produced. Mechanical tests of the tensile strength (TS, MPa) and elongation (ELO, %) were performed in a texturometer (Brookfield Engineering®, Brookfield CT3). TS and ELO were 8.8 MPa and 23% for F0 and 11.1 MPa and 9.7% for F16. NFC increased TS by 25.4% and reduced ELO by 142.2% at the CS-films. These properties presented by the films are probably related to the strength of the hydrogen bonds between the NFC and the other components of the polymeric matrix, as well as the higher surface/volume ratio of the NFC, which promotes its dispersion in the film. The mechanical properties of films-CS were influenced by the addition of NFC. TS was increased by NFC which resulted in the formation of more rigid films, which may be desirable for application as food packaging.

Keywords: Nanotechnology; Packaging; Biodegradable Film.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

REPLACING THE SYNTHETIC POLYMER WITH THE NATURAL ONE FOR WATER PURIFICATION

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Moringa oleifera (*M. oleifera*) is a nutrient-rich plant. The presence of useful nutrient gives the high importance to *M. oleifera* in medical sciences. Besides this aspect, all parts of *M. oleifera* are rich in protein contents thus used as protein source in many developing countries. The proteins of *M. oleifera* have many useful applications. The present work describes extraction and purification of the flocculating protein, a natural polymer from *M. oleifera* seeds for wastewater purification. The crude proteins were extracted by using four extraction solutions and the purification of the flocculating protein from the crude extract was done using ammonium sulfate precipitation method. The purity of the protein was analyzed by SDS-PAGE. The quantification of extracted protein was done on a spectrophotometer. The results showed that the pure flocculating protein was obtained with 90% ammonium sulfate saturation and displays an apparent molecular weight of 6.5 kDa. The pure protein was further characterized for its antifungal, antibacterial, and flocculating activity and it was shown to kill the bacterial strains (*Enterococcus durans* (S2C) and *Enterococcus lactis* (R13) which were used in this study which indicates that flocculating proteins shows the antibacterial activity against the strains we used. The pure protein didn't display antifungal activity against pathogenic fungus i.e. *Fusarium oxysporium* which was extracted from pea plant (pathogenic), and *Macrophmina phaseoline* PCMC F1. The flocculating protein purified the turbid water which indicates that of *M. oleifera* seeds can be used to treat wastewater. The flocculating protein also precipitates iodine from iodine solution, showing that these proteins are positively charged. This work will help us to replace the synthetic polymer like poly alum salts, Iron (III) chloride and chlorine with the natural one for water purification.

Keywords: *Moringa Oleifera* Seeds Proteins; Natural Polymer; Waste Water Purification; Antibacterial And Antifungal Activity.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

POLYMERIC FILMS OF SODIUM ALGINATE AND PEG CROSSLINKED WITH TEOS AND DOPED WITH ZNO FOR THE COATING AND PROTECTION OF SEEDS

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Brazil is the third-largest producer of seeds with solid domestic industry and a market value of approximately 10 billion reais. Soy and corn account for 74% of the Brazilian seed market. During the storage period, fungicides and insecticides are used to obtain high performance and avoid seed degradation and deficiencies in the germination process. Thus, in order to achieve this goal, polymeric films were developed containing necessary substances for plant growth, chemical and physical protection, water retention and agricultural pesticides release. The protection provided by antibacterials and fungicides in the polymeric film provides the optimal amount of pesticides since its surplus causes a decline in the population of bees and other insects in agricultural environments surroundings. The aim of this work was to create polymeric films, formed with different proportions of natural polymer (sodium alginate) and synthetic polymer (polyethylene glycol) crosslinked with tetraethoxysilane (TEOS) and doped with zinc oxide nanoparticle (antimicrobial properties) to apply on the cover and protection of soybean seeds. The polymeric films were characterized using Raman and infrared spectroscopic and characteristic bands of the compounds observed. The crosslinking process was verified by the presence of Raman 1098 and 965 cm^{-1} bands, attributed respectively to ν_{as}(Si-O-Si) e ν(Si-OH) modes. Similarly, the crosslinking process was confirmed using infrared spectroscopy. Lastly, the Raman image was obtained and a uniform distribution of both polymers was observed.

Keywords: Seeds; Polymeric Film; Vibrational Spectroscopy.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

EXTRACTION AND CHARACTERIZATION OF MANGARITO STARCH

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The mangarito (*Xanthosoma mafaffa* Schott) is a species of the Araceae family, considered an unconventional source of starch and its cultivation is generally subsistence. Within the context, the objective of this study was the extraction and characterization of starch from mangarito rhizomes. To obtain the starch, the rhizomes of mangarito were ground with distilled water (1:2 w/v) and the suspension was filtered through sieves (10, 40 and 100 mesh), then, after decanting (5 ± 2 °C for 12 hours), the supernatant was removed, the starch was dried in an oven (40 °C for 5 hours) and to obtain the powdered starch, porcelain gral and pistil were used. Starch was characterized in terms of proximal composition, amylose content, optical microscopy (OM), scanning electron microscopy (SEM) and particle size. The extraction resulted in 10.12 ± 0.73% yield of a white starch with the naked eye and odorless, similar to commercial starches from conventional sources. Starch has 7.91 ± 0.11%, 0.15 ± 0.06%, 0.03 ± 0.03%, 2.24 ± 0.02% and 89.58 ± 0.13% moisture, ash, fat, proteins and carbohydrates, respectively, and amylose content of 25.78 ± 0.49%. From the MO it was possible to observe the presence of hilum, which corresponds to the beginning of the formation of the granular structure and the presence of some damaged granules, probably due to the extraction processing. From the SEM images it was found that the starch granules present spherical and polyhedral in shape, with an average diameter of 6.56 ± 0.25 µm. The mangarito showed potential for obtaining starch and a high content of amylose, which is desirable for different applications in food and flexible films for packaging production. In addition, starches from unconventional sources appear as an alternative to chemically modified starches and can be used by industry.

Keywords: *Xanthosoma Mafaffa* Schott; Unconventional Source; Amylose.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

PHYSICOCHEMICAL PROPERTIES OF MODIFIED STARCHES CONTAINING ANTHOCYANINS FROM JAMBOLAN (*Syzygium cumini*) FRUIT

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Starch nanoparticles have been used to retain and stabilize bioactive compounds, such as anthocyanins (ACNs), which are related to disease prevention. The aim of this work was to study the effect of the two most common starch crystalline structures (A- and B-type from cassava and potato starch, respectively) and the starch concentration (5 or 10 % w/v) in the trapping of ACNs from jambolan fruit during anti-solvent precipitation method, as well as the main physicochemical properties of powders based on ACNs and modified starches (MS). The results indicated that after anti-solvent precipitation, all MS showed a V-type crystalline structure, typical of starches with low crystallinity. The relative crystallinity in the MS decreased, being ranged between 1.0% and 2.5%, compared to native starches (14.2 and 20.9%). The amorphization of MS was confirmed by polarized light microscopy and by the DSC curves of the samples that did not show a gelatinization transition. The MS displayed bimodal distributions with particle size between 30 and 100 nm, and between 200 and 900 nm. There was no effect of the starch type and concentration on the particle size distribution of the MS ($p > 0.05$). Samples with 5% w / v starch concentration showed trapping efficiency (TE) values ranging from 9.89 to 12.37% and those with 10% w / v starch concentration showed TE values of 2.78%. TE values were not influenced by the starch source. In this study, amorphous MS were obtained. It was found that the type of crystalline structure does not significantly affect the properties of MS and that the concentration of starch affected only TE values. Future research works could be carried out to check the total phenolic contents and antioxidant capacity of the MS containing anthocyanins.

Keywords: Anti-Solvent Precipitation; Starch Nanoparticles; Anthocyanins.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

INFLUENCE OF BIOPOLYMERS CONCENTRATION IN THE STABILIZATION OF MUSTARD OIL-BASED EMULSIONS

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Allyl isothiocyanate (AITC) is the main component of essential mustard oil (Brown & Morra, 2005) and has high volatility. One way to preserve volatile compounds is through microencapsulation (Robert-Blondel, 2014). Therefore, the objective of this work was to evaluate the influence of maltodextrin concentration and the blend of soy protein and high methoxylation pectin (bilayer) on the stabilization of mustard oil emulsions. An experimental design was performed and the independent variables evaluated were the maltodextrin concentration (5 - 25%) and protein: pectin concentration (0.5 - 1.5%) in the proportion of 1:1. The dependent variables evaluated were the droplets size and the creaming index of the emulsions for seven days. The droplets size was performed by optical microscopy, while the creaming index was determined as the ratio between the lower phase height and the emulsion initial height in the tube. The mustard oil was characterized by the quantification of AITC, according to Adolfo Lutz Institute (2004), and presented 56.31% of AITC. Droplets size is an important parameter to determine the physical stability of the emulsion. The instability of the emulsion affects the creaming rate (cream formation) and flocculation (KIM et al., 1996). The mean size varied from 1.62 to 2.09 from time zero to 7 days, respectively. Through the tests, it could be noted that the emulsions with a higher concentration of protein, pectin and maltodextrin remained stable for seven days. It was also noted that the more stable emulsions had a smaller droplets size and showed no significant difference between zero and seven days, demonstrating that the higher concentration of polymers resulted in more stable emulsions. Carvalho, Silva, Hubinger (2014), produced green coffee oil emulsions stabilized by lecithin-chitosan and obtained smaller droplets size after the addition of chitosan, which resulted in good emulsion stability. This study concluded that the combinations of pectin, protein and maltodextrin are capable of stabilizing mustard oil emulsions for seven days.

Keywords: Mustard Oil; Bilayer Emulsion; Stability.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização:

PROSPECTIVE STUDY OF THE USE OF CHITOSAN COMPOSITES FOR THE PRODUCTION OF BURN DRESSINGS

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Chitosan is a biocompatible and biodegradable polymer, non-toxic, with antimicrobial and healing properties. Chitosan is commonly combined with other materials, forming composites with superior properties, so that these compounds can be used for the manufacture of burn dressings. In this sense, the present study aimed to conduct a search in the Scopus and Web of Science document bases, relating the results of studies on the use of chitosan composites for the production of burn dressings. The data collected by the survey were classified in September 2020, using the following keywords: chitosan and composite and burn and dressing. The SCOPUS database showed 30 results, against 49 found in the Web of Science database. The first document was published in 1999, and in the years that followed the number of publications did not increase considerably, with the year with the largest volume of publications being 2019. Of the countries that publish in this area, China gets the most prominence, followed by India, United States and Brazil. Regarding the research area, the largest number of publications is classified in the area of Materials Science, followed by Engineering and Chemistry. However, in relation to the impact, it was noticed that the theme has been reaching great importance among researchers, increasing numbers of citations, reaching higher levels in 2019, counting 210 citations. Therefore, it can be considered that the question raised is increasingly in evidence, and researchers are very interested in the great technological potential of this area, which promises to bring important advances to the science of polymers.

Keywords: Burn Dressing; Chitosan; Composite.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

POTENTIAL AND CHALLENGES OF CULTURE MEDIA MODULATION FOR BACTERIAL NANOCELLULOSE PRODUCTION

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Bacterial nanocellulose (BNC) has emerged as a promising biomaterial in many areas, such as medical, food, cosmetics, textile and environmental. BNC is produced by bacteria, being *Komagataeibacter xylinus* one of the most common producing bacteria. Due to its nanostructure, BNC provides interesting properties, including high water holding capacity, crystallinity and high mechanical strength. Several studies identified different methods for BNC modification, combining it with others components in order to potentialize useful properties and its application. This review focuses on the potential and challenges of modulating culture media for BNC biosynthesis, describing the advantages and limitations of undefined and defined media. Most researches on culture media are based in complex media through modification of carbon and nitrogen sources, or focused on the addition of non-conventional components (e.g. agricultural residues) to improve BNC yield and reduce the production cost. These are known as undefined media, which have some expensive complex ingredients, such as yeast extract and peptone, in unknown proportions. Even though, all these researches proposed the modification of complex media to potentially enlarge, speed up and cheapen BNC production, without the exact composition of the complex media the reproducibility of each fermentation is uncertain, as well as the BNC properties. To overcome such limitations, this review identifies the defined media as a potential BNC culture media that presents the exact amounts in its formulation, such as chemically defined medium (CDM) and minimal defined medium (MDM). CDM is composed of several components whereas, the MDM contains only the minimum amount of nutrients to support BNC production. In conclusion, this study showed that defined media have many advantages, compared to complex media, including enhanced process consistency, better control and monitoring, improved process scale-up and product quality through metabolic studies. The media choice will determine the yield, costs and properties of the BNC.

Keywords: Nanocellulose; Complex Media; Defined Media.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

PROCESS OPTIMIZATION FOR OBTAINING BIOPOLYMER-BASED FILMS REINFORCED WITH BACTERIAL CELLULOSE NANOCRYSTALS FOR FOOD PACKAGING APPLICATIONS

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The use of petroleum-based plastic packaging is a major environmental problem. Besides utilizing a fossil source of raw material, these materials can take hundreds of years to degrade, generating a growing concentration of solid wastes. To soften this issue, researches have been focusing on the development of new biopolymer-based packaging materials, which might not only originate from renewable sources but also be biodegradable. However, biopolymer-based packaging can present high water solubility and low mechanical resistance if compared with traditional synthetic materials. The use of nanotechnology is promising to overcome this hurdle. In this regard, this work aims at the extraction of bacterial cellulose nanocrystals (BCNs) as a reinforcing agent in biopolymeric film-forming matrices and the use of gelatin-based films, in order to compare their properties and enhancements. The BCNs were extracted through sulfuric acid hydrolysis using bacterial cellulose from Nexfil®. The films will be obtained through casting and the process involved in the dispersion of the BCNs within the polymer matrices will be optimized by studying the complex coacervation and surface chemistry of the film. Different film compositions will be investigated to obtain films with different properties, thus allowing a broader application as a packaging material. Acknowlegment: FAPESP, CNPq, CAPES and UNESP

Keywords: Biopolymers; Food packaging; Gelatin; Nanocellulose; Nanocomposites; Complex coacervation.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

EFFECT OF SEPIOLITE ON THERMAL PROPERTIES OF BIODEGRADABLE POLY(LACTIC ACID) PREPARED BY CASTING AND MELTING

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Poly(lactic acid) (PLA) is one of the most extensively investigated and used aliphatic polyesters due to some aspects e.g. biodegradability and biocompatibility. However, PLA has some disadvantages that restrict its applicability such as limited thermal resistance due to its intrinsic characteristics. The effect of nanoclay mineral sepiolite (Sep) on the thermal properties of PLA/Sep composites prepared via casting and melting was investigated using differential scanning calorimetry (DSC), thermogravimetric analysis (TGA) and scanning electron microscopy (SEM) with Energy Dispersive X-Ray Analysis (EDX). For casting sample preparation, PLA solutions using chloroform were prepared under stirring. The Sep was added in 1.0, 3.0 and 5.0% *v/w*. The solutions obtained were spread on glass plates to obtain films with fixed thickness and then, dried. PLA and Sep were processed via melt using a thermokinetic mixer. Based on DSC results, for the casting samples, the glass temperature (T_g), the melting enthalpies (ΔH_m) and the crystallinities (X_c) increased with the addition of Sep. No variation of melting temperature (T_m) was noticed for the casting samples. Melting samples showed a reduction in the cold crystallization temperature (T_{cc}) and no significant change in T_g and T_m with the increase in the Sep content. This indicates that Sep acts as nucleating agent. TGA results showed that for the casting and melting samples, the initial temperature of mass loss (T_i) did not change considerably. However, the degradation kinetic increased for the casting sample with 5.0 wt% Sep. SEM-EDX images showed aggregation of silicon (Si) for casting samples and that Sep was more dispersed in PLA matrix when melting process was applied. In conclusion, the Sep content in PLA changed in a different way the thermal properties depending on the type of processing.

Keywords: Poly(Lactic Acid); Sepiolite; Thermal Properties.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

ORGANIC-INORGANIC NANOCOMPOSITES BASED ON BIOPOLYMER *ALLIUM CEPA* CONTAINING SIMVASTATIN FOR APPLICATION IN DENTISTRY

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Bone regeneration has taken on a place of great interest within medical specialties, especially, mainly in the dental field. There is a concern on the part of these professionals when it comes to the bone repair process, since the regenerated bone may serve as a support for oral rehabilitation at that location. Therefore, bone volume in the alveolar region is essential for successful dental treatment. In view of the need for the bone regeneration procedure, research has been directed in this direction with the creation of biomaterials as is the case with biopolymers for presenting remarkable physical properties, special surface chemistry, sustainability, biosafety and excellent biological properties, such as biocompatibility, biodegradability and low toxicity. In the present work, the onion (*Allium cepa L.)* W-HTP pulps were obtained in association with simvastatin in concentrations of 0.1%, 0.5%, 1%, 5% and 10%. Finally, W-HTP/S films were obtained by the casting process. Analysis by TG / DTG allowed to verify that the drug simvastatin presents less thermal stability, not indicating loss of water, but thermal decomposition between 175-371 ° C and 369-470 ° C, on the other hand the W-HTP/S films indicating greater simvastatin stability in the films, with water loss between 30 and 160 ° C, and thermal decomposition between 175 and 389 ° C and 384 and 512 ° C. Scanning Electron Microscopy (SEM) provided morphological aspects indicating the presence of simvastatin crystals between fibers present in the films. Infrared Spectroscopy (FTIR) presents W-HTP/S films with the same bands relative to the chemical groups of simvastatin, indicating its presence in the films, but without significant chemical interaction. This is a preliminary work aiming the perspective of use in guided bone regeneration, with application in dentistry.

Keywords: Bone regeneration; Biomaterials; *Allium Cepa*.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

USE OF PINE RESIN FOR THE WOOD PROTECTION AGAINST HUMIDITY

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The wood has a lignocellulosic nature and it may be a drawback for the manufacture of solid products since some of its polar chemical groups may impair its hygroscopic performance and these compounds increase the overall bulk hydrophilicity, which may lead to severe defects in solid products. Some treatments have been shown excellent performances for these purposes, including furfurylation, acetylation, and CCA impregnation. However, these products are toxic to the environment and human beings. In this study, a renewable, non-toxic, and low-cost resin extracted from the stalk of pine trees was used for the treatment of a pine wood, aiming at its improvement in relation to moisture absorption. Twenty-five years old pine (*Pinus elliottii* Engelm.) trees were transformed into samples with the dimensions of 3,0 × 4,0 × 5,0 cm^3 (radial × tangential × longitudinal). The pine resin was used with pure (99 wt%) ethyl alcohol (that acted as a catalyst) in a resin: ethanol weight ratio of 4:1. For the resin's impregnation, a vacuum-pressure method (-100 kPa for 20 min, followed by 0.8 MPa for 120 min) was used after was then cured at 160 °C for 20 min. Hygroscopic properties of the wood samples were determined according to ASTM D 2395-17. The untreated pine wood had a volumetric shrinkage mean of 10.05% (0.845 SD), while the treated one presented 6.89% (3.30 SD) in the same property. Regarding the water uptake, the treated and untreated pine woods presented means of 18.77% (4.90 SD) and 34.13% (3.81 SD), respectively. These improvements are probably justified by the resin, which filled empty spaces of the wood ultrastructure, covering some cell walls and hindering the access of the water. The impregnation and *in situ* polymerization of the pine resin seems to be a promising environmentally friendly alternative for improving hygroscopic properties of the wood.

Keywords: Eco-friendly treatment; Natural Resin; Wood Treatment.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

PHARMACEUTICAL APPLICATIONS OF STERCULIA FOETIDA GUM

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Introduction: Trees of the genus *Sterculia* are known for their gummy exudates, which are full of polysaccharides that are biodegradable, with high viscosity, low toxicity and gelling properties, such as karaya gum (*Sterculia urens*) and chicha gum (*Sterculia striata*). The species *Sterculia foetida* L. has subproducts with promising characteristics, especially its gum, a multifunctional polymer with various applications in the pharmaceutical industry. However, this species is poorly explored in the scientific literature. This study aimed to evaluate the properties of *Sterculia foetida* gum (SFG) and its potential pharmaceutical applications. Methodology: Searches were made in the databases Science Direct, PubMed, Google Scholar and Springer with the terms "Sterculia foetida" and "gum" or "polysaccharides". The search was conducted in September 2020. The inclusion criteria were articles from 1990 to 2020 that addressed the gum of the species *Sterculia foetida* in Portuguese and English. Results and discussion: In the initial search, 1,079 articles were found in the databases and after evaluation of the inclusion criteria, only 10 articles were selected. These results indicate the scarcity of scientific studies related to this gum. In all analyzed publications, SFG was used in pharmaceutical area as a polymeric excipient in controlled release systems, in the following formulations: matrix for tablets (6), gels (2), mucosal films (1) and nanoparticles (1). The authors addressed SFG as a polymeric matrix, mucoadhesive agent, gelling and disintegrating, demonstrating that this polymer can act with more than one function in the desired formulations. Conclusion: These results showed that SFG has promising properties for pharmaceutical applications, especially as an excipient in controlled release systems. However, it is still necessary to conduct more studies to evaluate its properties, effectiveness and safety.

Keywords: Natural gums; *Sterculia foetida* L.; Excipient.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

STARCH AND NANOCELLULOSE BASED BIONANOCOMPOSITE COATINGS FOR PACKAGING APPLICATIONS: A REVIEW USING METHODI ORDINATIO

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The global economy has been passing through a shift in the last few years regarding traditional products and technologies over a “greener” economy that seeks for more sustainable practices. Paper and cellulose can be used in packaging applications instead of plastic, but their use is somewhat hindered by their low porosity and hydrophilic character. In order to achieve biodegradable cellulosic packaging with better mechanical and barrier properties, synthetic polymers can be substituted by bio-based coatings since they can be found widely in nature and have relatively low cost. Therefore, the present study aims to conduct a systematic literature review of high impact research on coating applications based on bionanocomposites. This study extracted the data from Science Direct and Scopus databases to compare the bibliometric indicators of the published productions. In spite of bibliometric analysis advantages to knowing about the trends in a study area, this research requires methods to support the investigation process through the selection of a relevant bibliographic portfolio. The Methodi Ordinatio, based on factors such as year of publication, number of citations and impact factor, was applied to identify the most relevant, high impact, studies in the area, resulting in 20 publications. Mendeley and VOSviewer were used, respectively, for reference management and clustering topics. The results show the main trends are related to the best techniques and combinations of biopolymers that can used to produce bio-based coatings with good properties. Starch can be combined with plasticizers and modified through crosslinking with citric acid in order to exhibit hydrophobic characteristics, for example. When nanocellulose is added, some features such as oxygen permeability and tensile strength can also be improved. But one of the challenges remain the machinability of the resulting suspension. This study suggests the main pathways for the following researches to produce better alternatives for packaging industry.

Keywords: Bionanocomposite Coatings; Starch; Nanocellulose; Methodi Ordinatio.

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II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

BIOCELLULOSE AND 3D BIOPRINTING IN REGENERATIVE MEDICINE: A REVIEW

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

The technique of three dimensional (3D) bioprinting has been drawn attention in the last years. Most part of studies related to this area had shown the use of hydrogels as component for bioprinting. Hydrogels are characterized by the network of crosslinked hydrophilic polymers chains, which are capable to assimilates a large amount of water. Furthermore, the polymers commonly used to bioprinting are correlated to natural polymers, because its characteristics as biocompatibility, cytocompatibility, and its capacity of to simulate the extracellular matrix. As examples of natural polymers it is possible to cite the alginate, collagen, chitosan, gelatin, nanocellulose (cellulose nanofibers, cellulose nanocrystals, bacterial cellulose) and cellulose derivatives (carboxymethylcellulose, methylcellulose). Moreover, the cellulose derivatives gained prominence leads to its high crystallinity, purity, large capacity for water absorption, excellent mechanical properties, easily mass prodution, non-toxic and non-allergen characteristics. For these reasons it is considered as a substance with a current commercial importance across a range of industries, such as food and cosmetics. In this review, the objective was to provide a brief description of cellulose and its derivate applicability in bioprinting and regenerative medicine. Studies in the literature shown the use of the cellulose derivate as nanocrystals, methyl cellulose, nanofibers and associations with other polymers forming a blend or composites to production of scaffolds, soft tissues, and applicable to regeneration of other tissues. In conclusion the cellulose derivate are a versatility material with large spectra to application in biomedical area, the actual studies reveal that it is a promissory biomaterial for the development of innovative treatments.

Keywords: Cellulose; 3D Bioprinting; Biopolymers.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

BIOPLASTIC FILMS DERIVED FROM PURE OF MESOCARP OF THE WATERMELON (*Citrullus lanatus*)

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The packaging industry allocates its largest share to the food sector with 51% and the beverage sector 18%, cosmetic 20%, pharmaceutical 6%, and personal hygiene 5%. Within this sector, plastics are widely used due to some characteristics such as durability, transparency, and good barrier properties but highly harmful to the environment and are not sustainable. That is why there is a growing interest in the food industry in the development of edible films and coatings based on biopolymers, and that can simultaneously perform functions of protection against deterioration and preservation of flavor and aroma. For these films to be part of the food to be consumed, the raw materials used in their formulations must be non-toxic and safe for human consumption. The objective of this work was to obtain films from the watermelon mesocarp (Citrullus lanatus) using the casting process. This proposal is relevant since the watermelon mesocarp is discarded during processing and consists of a renewable and biodegradable source. It is possible to obtain two different products: unwashed and washed pulp films. The first is flexible and slightly reddish, and the second semitransparent with less flexibility. Thermal stability was evaluated by Thermogravimetry (TG/DTG), indicating only one decomposition for the washed film (179.5 - 403.5 °C), two for the unwashed one (117.1 - 253.2 °C and 253.2 - 357.0 °C). Fourier Transform Infrared Spectroscopy (FTIR) showed less intense bands for the washed film and absence of bands 863, 825, and 772 cm^{-1}, probably due to the solubilization of sugars eliminated by washing. Scanning Electron Microscopy (SEM) showed unwashed films with a dense surface with reliefs, and the washed films present a surface with fibers randomly interwoven.

Keywords: Bioplastics; Polymeric Films; Casting Process.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

THE USE OF CELLULOSE APPLIED TO THE MANUFACTURE OF BIODEGRADABLE SMART PACKAGING: A PROSPECTIVE STUDY

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Biodegradable polymers are undoubtedly more advantageous than conventional synthetic polymers. Natural polymers such as cellulose are used to manufacture smart biodegradable packaging for foods capable of responding to external stimulus, and may even indicate whether the food is fit for consumption, damaged or contaminated. The present study aimed to conduct a search on the Scopus and Web of Science bases, relating results of studies on the use of cellulose applied to the manufacture of biodegradable smart packaging. The results were collected and classified in September 2020, through the combination of the following keywords: cellulose and smart and packaging and biodegradable. The SCOPUS database showed 19 results, against 14 found in the Web of Science database. The first 2 documents were published in 2006, and in the following years no new publications were registered until 2013. However, there was no considerable increase in the production of articles until 2020, which hold the largest volume of published documents, 6 until the time of the research. Of the countries that publish, China, India and the United States are the most prominent. The main areas of publication are Materials Science, Polymer Science, Chemistry and Engineering. The types of documents published, the highest percentage is related to articles, followed by review, conference paper, book chapter and Conference review. It is observed that in the years that followed, the first publications did not have citations until 2013, so that soon after that year the number of citations behaves in an increasing manner, demonstrating the increase in the production of research on the subject that is being more and more cited by new works, corroborating the increased impact of this area. It is concluded that the question raised is still incipient, but that it has attracted the attention of researchers, promising important scientific and technological advances.

Keywords: Cellulose; Packaging; Smart.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

MODIFICATION AND CROSSLINKING OF CORN STARCH FOR SYNTHESIS AND CHARACTERIZATION OF BIOMATERIAL FOR BIOLOGICAL APPLICATION

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The search for new materials derived from biopolymers has received attention due to its potential for applicability in several sectors, including the health area. However, biopolymers still find little use in this area due to their limited mechanical properties and rapid biodegradability under physiological conditions, such as starch, for example. Starch is a polymer from a renewable source, low cost, high biocompatibility, and biodegradability in the physiological medium. The presence of hydroxyls in its structure allows its chemical modification, allowing crosslinking. Thus, this project deals with the application of the chemical reaction of Diels Alder's click (DA) for the crosslinking of starch, in order to obtain a hydrogel with longer biodegradation time in a physiological environment. For this, modifications were made to starch such as oxidation, esterification, and cross-linking, which were confirmed by Optical Microscopy (MO), Fourier Transform Infrared Electroscopy (FTIR), conductometric titration, and Nuclear Magnetic Proton Resonance (NMR-1H). Through the FTIR it was possible to observe that in the control starch sample, the 1600 cm-1 band corresponding to the C=O group is in accordance with the characteristic; oxidized starch, on the other hand, shows an increase in this band suggestive of an increase in COOH, and in the sample of esterified starch there is a decrease in it and, in addition, the band appears in 885 cm-1 correspondings to furanic rings, suggesting the COOH in furan. It was quantified that the substitution was 13%. Confirmed by NMR-1H in which the H5, H4, and H3 protons of the furan groups in positions 7.4; 6.2, and 6.4 ppm. In addition, the crosslinking of the material was successful with the formation of the hydrogel. Therefore, a new material with innovative properties has been synthesized with possible promising applications, mainly in the area of regenerative medicine.

Keywords: Click chemistry; Diels Alder; Biopolymer.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

GUM ARABIC-GRAFT-POLY(ACRYLIC ACID) SUPERABSORBENT HYDROGEL APPLIED ON ADSORPTIVE REMOVAL OF ANXIOLYTIC DRUG FROM WATER

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

Recently, the deliberately and non-controlled consumption of medicines resulted in the massive release of these emerging contaminants into the water bodies. Recognizing this fact, numerous efforts have been made to develop methods for the removal of these drugs from wastewater such as advanced oxidative processes, bacteria and microorganisms-based processes, adsorption, flocculation, among others. In this view, adsorptions systems are an efficient, simple and low-cost method, it does not generate secondary pollution and the materials used as adsorbent generally possess an attractive reuse capacity. Thus, a superabsorbent hydrogel was prepared by grafting of a mixture of acrylic acid (AA) and gum arabic (GA) by free radical polymerization technique using KPS as initiator and N, N'-methylene-bis-acrylamide (MBA) as a cross-linking agent in water medium. The hydrogel was characterized by FTIR, SEM and TG. Swelling studies were evaluated in aqueous media and under different pH conditions (3,6,9). The prepared superabsorbent hydrogel was used as an adsorbent for the removal of anxiolytic drug (Diazepam) from their aqueous solutions. Several conditions for the optimization of the adsorption process were evaluated, such as pH, contact time, drug concentration, temperature, among others. The adsorption process was evaluated under different kinetic and isotherms models (intra-particle, pseudo first order, pseudo second order, ELOVICH Model, Langmuir isotherm, Dubinin- Radushkevich Isotherm, Freundlich Isotherm and Temkin Isotherm) and adsorption followed pseudo first order kinetics and Langmuir isotherm model. The maximum adsorption capacity was found to be ~ 14 mg/g for the Diazepam. A GA-g-PAAc superabsorbent hydrogel exhibited a very high adsorption potential and stability. We recommend GA-p-PAAc as an environmentally benign and readily non-toxic material with an excellent adsorption capacity for application in drug removal systems.

Keywords: Environmental remediation; Water treatment; Superabsorbent hydrogel.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

APPLICATION OF HYBRID BIODEGRADABLE NANOCOMPOSITES BASED ON HYDROGEL AND NANOCLAY IN CEMENT MORTARS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

The development of hybrid nanocomposites based on acrylamide, carboxymethylcellulose, and nanoclay has become an interesting option to expand their technological application in several areas, due to its good mechanical and biodegradability properties. In this context, these three- dimensional crosslinked polymers with the capacity to absorb and release water controlled over time have their improved hydrophilic properties due to the presence of carboxymethylcellulose. This polysaccharide has carboxylic groups in its chemical structure increased the swelling degree of the matrices because the repulsion of these functional groups presents. However, to ensure the mechanical stability of these hydrogels it is very common to synthesize them with synthetic monomers, such as acrylamide, and the addition of reinforcing agents such as nanoclay. The objective of this study was to analyze the effect of nanocomposite hydrogels with different concentrations (0, 10, and 20% wt/v) of cloisite-Na+ nanoclay, on the exudation index, water retention, and consistency index of cementitious mortars in its fresh state. The hydrogels werethen synthesized by free radical polymerization, and the cementitious mortars prepared with dosage 1:2.16, 0.40 water/cement ratio, and 0.50% hydrogel (wt/wtcement). The results indicated that the exudation index in the mortars with hydrogels was lower than the control sample, being that the most pronounced reductions were for those with the highest nanoclay amount. It was no observed significant variation in the water retention of the cement mortars, presenting an average value of 99%. Slump flow decreased around 0.90%, 1.13%, and 4.85% in relation to the control, when 0, 10, and 20% of nanoclay was respectively added. Thus, the presence of the hydrogel in the mortar can improve water retention and decrease the exudation index, indicating that this polymer acts as a potential additive to the construction industry. Because it is an innovation biodegradable that can control better an important factor in cement-materials that is the water.

Keywords: Civil Construction; Internal Curing; Hydrogel.

II EPNAT
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Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

BABASSU COCONUT MESOCARP (*ORBIGNYA PHALERATA MART*) AND ITS POTENTIAL USE IN THE PRODUCTION OF COPOLYMERIZED HYDROGELS: INCORPORATION INTO SUBSTRATE TO IMPROVE SEEDLINGS

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Among the ways that guarantee the correct availability of water resources in agricultural crops, hydrogels are the most promising technologies to avoid wasting water. In addition to being able to optimize water availability, reduce losses due to percolation and leaching of nutrients and accelerating the development of the root system and the aerial part of plants. Therefore, this work aimed to develop babassu coconut mesocarp hydrogels, copomelirized with acrylamide, for incorporation into substrate, in order to improve cherry tomato seedlings (Lycopersicon lycopersicum). The experimental design was completely randomized, adopting the factorial scheme (5x3), with 5 doses of hydrogel (0 - control; 0.2; 0.4; 0.8; 1.0 g/L of substrate) and 3 water replacement regimes (1 day with irrigation and 01 day without irrigation, 1 day with irrigation and 2 days without irrigation and 1 day with irrigation and 3 days without irrigation). The characteristics of the plants were measured using a 150 mm analog pachymeter, with an accuracy of 0.05 mm. The concentrations of 0.2 and 0.4 g/L were presented the best results in all irrigation systems considering the characteristics of total plant height, number of leaves, lengths of the aerial part and the root. The synthesized material has a swelling percentage of 100,000.00% in water (pH = 7.0), with an absorption quotient of 1000 g H_2O/g hydrogel.

Keywords: Babassu Coconut; Agriculture; Hydrogels.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

FABRICATION OF GELATIN-BASED NANOFIBROUS SCAFFOLDS FOR CELL CULTURE

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The design of biomimetic biomaterials for stem cell culture is a critical tool in our efforts to study cell behavior; understand tissue development, regeneration, and disease; and ultimately control the stem cells' fate and produce stem cell-based tissues. Scaffolding structures should mimic not only biological properties of extracellular matrix (ECM), but also morphological and topographical features. In this study, we focused on the preparation and characterization of nanofibrous scaffolds from blends of gelatin methacrylate (GelMA) and poly (ethylene glycol) dimethacrylate (PEGDMA) fabricated via electrospinning. Electrospinning parameters were optimized in order to obtain electrospun scaffolds of both randomly oriented and aligned nanofibers of GelMA/PEGDMA blends (mass ratios 4:1, 2:1, and 1:1). All scaffolds were then photo-crosslinked under UV light using Irgacure 2959 as photoinitiator, aiming to improve their stability at physiological conditions. GelMA/PEGDMA mats were characterized by SEM, FTIR, DSC, TGA, and contact angle. SEM images corroborated that defect-free scaffolds with random and aligned nanofibers were obtained. GelMA/PEGDMA 2:1 blend exhibited the better processability for both collector configurations than that of other blends and thus was further characterized in terms of his swelling and degradation behavior. After one week of immersion in PBS at 37°C, GelMA/PEGDMA 2:1 electrospun mats were still not fully degraded. These results show the feasibility of the use of PEGDMA as chemical cross-linker for gelatin-based scaffolds to modulate the degradation behavior, being promising for cell culture applications.

Keywords: Biomaterials; Electrospinning; Gelatin.

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21 a 23 de novembro de 2020.
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NATURAL POLYMERS IN THE SPRAY DRYING OF ENTOMOPATHOGENIC FUNGI

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

Actually, there is a growing concern regarding environmental problems, especially in agriculture. Thus, In this context, the biological control using entomopathogenic fungi, such as M. anisopliae, B. bassiana and T. harziuanum, is a great and sustainable alternative because cause less impact to the environment. However, the applicability of these fungi as bioinsecticides is limited to concerns the stability and storage, also abiotic factors such as UV radiation that appears as an aggravator for fungi after the application in the field. To solve this, natural polymers are an option along with the association to the Spray Dryer technique. Among the works involved, sodium alginate, maltodextrin, starch and some different gums have been used for the coating by this technique. The spray drying technique is widely used to treat a single step and has flexibility in use on a large scale, also reaching 30 to 50 times cheaper than other means, there are also the advantage of being able to work with different materials including polymers. In this Review, the objective was to compare the different natural polymers and different temperature to encapsulate entomopathogenic fungi, using the scientific platforms.

Keywords: Bioinsecticides; Natural polymers; Entomopathogenic fungi.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

HEMOCOMPATIBILITY PROPERTIES OF CHITOSAN AND AGARAN BLENDS

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

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Chitosan blends with natural polymers have been studied as polymeric coatings in order to increase the hemocompatibility on metal surfaces of cardiovascular stents. Agaran sulfated polysaccharide obtained from *Gracilaria birdiae*, contains sulfated groups, which are related to the anticoagulant activities. This study proposed a polyelectrolyte complex (PEC) of chitosan and agaran and it was evaluated its hemocampatility. Platelet adhesion is one of the first steps in inflammatory processes, thrombosis and immune response. The deposition of platelets in the polymers is critical, because it can complicate endothelization and facilitate thrombotic events. Agaran, chitosan and PEC (1.5Aga1.5Chit) films were submitted to the platelet adhesion assay. Chitosan 3% (m/m%) in acetic acid solution (2.5% v/v) was added to the solution of agaran 3% (m/m%). Platelet-rich plasma (PRP) from centrifugated blood was placed over the substrate (2h incubation). The surfaces were stained with Calcein-AM. Then, un-adhered cells were aspirated. Films were rinsed (PBS 2x). 1 mL of a 5 µM of Calcein-AM in PBS was added to the surfaces (20min). Then, the solution was aspirated, and the surfaces rinsed (PBS 2x). The surfaces were imaged using fluorescent microscope. All images were processed using Image J software. Platelet adhesion was evaluated by the percentage platelet coverage area. The percentage of platelets adhered to the positive control (polystirene), agaran, PEC and chitosan were 4.69 ± 1.27; 1.13 ± 0.66; 4.37 ± 0.88 and 40.15 ± 11.04, respectively. The percentage of platelets adhered to agarana was significantly lower than the control. In the chitosan, the adhesion area was higher than the control surface. The lower number of platelets adhered to agaran film is probably due to the negative charges present on the surface. Indeed, sulfated groups increase the density of electrons on the surface. The PEC is a promising material that showed a reduction in platelet adhesion.

Keywords: Sulfated groups; Platelet and Stents.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

BACTERIAL CELLULOSE BIOCURATIVE IN THE TREATMENT OF INJURIES BY PRESSURE IN HOSPITALIZED PATIENTS

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Introduction: Pressure injuries (PI) occur due to tissue compression and, consequently, ischemia due to pathological changes in the local blood perfusion. Being characterized by necrotic areas that affect adipose tissue, muscles, bones and skin. The treatment of wounds with the use of bacterial cellulose (BC) is promising, since this material is non-toxic, biocompatible and stimulates tissue remodeling by maintaining the wound's moisture and activating growth factors. Studies have shown that BC was effective as a mechanical barrier and adjuvant in the treatment of ulcerative lesions and surgical wounds. In addition, cellulose is one of the most abundant, low-cost and most widely available polymers in the world, with a better cost-benefit ratio when compared to imported raw materials. Objective: To evaluate the healing of stage 1 and 2 PI using bacterial cellulose hydrogel. Materials and Methods: descriptive, prospective and clinical study. The study sample will consist of 40 patients with confirmed diagnosis of PI at Hospital Santa Casa de Misericórdia de Araraquara, randomly divided into 2 distinct groups, with 20 patients each, the group treated with BC hydrogel of the Nexfill brand, registered with ANVISA, and the control group receiving standardized treatment by the hospital. Expected results: At the moment, we have no results due to the COVID-19 pandemic, but it is expected that the BC dressing will accelerate the wound healing process, by stimulating dermal growth, and reducing patients' suffering, by isolating the nerve endings at the site, and reduce costs for the institution by being composed of more abundant and cheaper raw material. In addition, BC favors granulation, reducing dressing changes and, consequently, reducing the work of the multidisciplinary team.

Keywords: Hydrogel; Bacterial cellulose; Pressure injury.

II EPNAT
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Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização:

ELECTROSPUN SOY PROTEIN ISOLATE MATS: EFFECTS OF STERILIZATION BY UV-RADIATION ON SCAFFOLD PROPERTIES

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The electrospinning technique is very versatile for obtaining micro/nanofiber matrices from polymer solutions. These matrices have a high surface-to-volume ratio; a complex porous structure with interconnected pores; and different fibrous morphologies; these features show similarities to the extracellular matrix, which is ideal for cell adhesion and proliferation. Due to these advantages, electrospun structures are of great interest for tissue engineering applications. Among natural polymers, some studies showed interesting results of electrospun soy protein isolate (SPI) for biomedical applications. Furthermore, the development of biomedical devices requires material stability against sterilization process. There are different methods: thermal (autoclave), chemical (ethylene oxide), radiation (UV, e-beam, or gamma rays). Due to the instability of the SPI upon autoclaving and ethylene oxide sterilization techniques, the feasibility of using UV radiation (254 nm) as an alternative to sterilize electrospun membranes based on SPI was studied. Bilayer matrices (SPI-PEO/PCL) were obtained using an electrospinning device equipped with a rotating drum as collector. An electric field of 0.55-0.8 kV/cm, a flow rate of 0.2-0.5 mL/h and a collector rotation speed of 300-1200 rpm were used. The membranes were exposed to UV radiation (254 nm) for different times: 10, 20 and 40 minutes. Scanning electron microscopy (SEM) micrographs showed a continuous fibrous structure in all samples, no structural damage was observed after exposure to UV radiation at different periods. Differential scanning calorimetry (DSC) experiments were also carried out and thermal properties did not undergo significant alterations after exposure to UV radiation. In conclusion, the exposure to UV radiation did not change the SPI-based electrospun mats properties, being a feasible method for sterilizing these membranes.

Keywords: Electrospinning; Soy Protein Isolate; UV sterilization.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

DEVELOPMENT AND HYDROPHILIC PROPERTIES OF A NOVEL MAGNETIC NANOCOMPOSITE HYDROGEL BASED ON POLYSACCHARIDE, ZEOLITE AND FE_3O_4@GO NANOPARTICLES

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

In this work, a novel nanocomposite hydrogel based on poly(methacrylic acid)-co-polyacrylamide (PMAA-co-PAAm), carboxymethylcellulose (CMC), zeolite, and iron oxide nanoparticle functionalized with graphene oxide (Fe_3O_4@GO) was developed as a new drug carrier for delivery controlled system. The methodology was optimized as a function of dispersion methodology, hydrogel composition, and amount of nanoparticle. Reproducible and stable hydrogel with magnetic properties were obtained from a facile method. After optimization, the influence of the magnetic nanoparticles (0 to 2% w/v) on the hydrophilic property and mechanism water transport of these magnetic nanocomposite hydrogels were investigated through swelling degree measurements in distilled water. The results indicated that the swelling degree of nanocomposite hydrogels containing Fe_3O_4@GO is smaller than the nanocomposite without Fe_3O_4@GO nanoparticles. The kinetic parameters measured by Ritger and Peppas method showed that the insertion of the magnetic nanoparticles did not change the water transport mechanism. All *n* diffusional exponent values were approximately 0.5 (*Fickian diffusion*). However, the diffusional constant *k* had a slight improvement when the nanoparticles are added, indicating an increase in the molecule's absorption velocity. This improvement is probably related to the rise of ionic charges provided by the Fe_3O_4@GO nanoparticles. The results indicated that the Fe_3O_4@GO insertion in the nanocomposites can enhance their applicability in the medicine, especially in drug delivery systems targeted on specific organs induced by a magnetic field.

Keywords: Hydrogel; Nanocomposite; Magnetic; Nanoparticles.

Acknowledgments: The authors would like to thank FAPESP and CNPq. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – "Finance Code 001".

II EPNAT
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Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

METHODOLOGIES FOR CROSS-LINKING COLLAGEN-BASED MEMBRANES MODIFIED WITH A BIOACTIVE MOLECULE FOR APPLICATION AS AN ARTERIAL PATCH

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

The functionalization strategies of natural polymeric matrices with chemical cross-linked agents, such as glutaraldehyde or N-ethyl-N- (dimethylaminopropyl) carboimide (EDC) and N- hydroxysuccinimide (NHS) (EDC / NHS), can provide an interconnected 3D network with the collagen to host other bioactive molecules. Likewise, it should also directed to ability to obtain more or less compacted matrices, which directly influence permeability and fluid absorption. In this perspective, it could allow interesting properties for the development of biomaterials applicable in the area of regenerative medicine, such as arterial patch, which are used in cases of several disorders affecting cardiovascular system. In this context, the present work consisted of the synthesis of glutaraldehyde crosslinked collagen (COL-GA) and EDC/NHS crosslinked collagen (COL-EDC / NHS) membranes, as an alternative to arterial patch. The non-modified collagen membranes (COL) were used as control samples. The membranes were obtained by casting process. In order to improve a therapeutic profile, nanoparticles of bioactive Curcumin were incorporated in the membranes. The characterization of the samples was performed by attenuated total reflection Fourier-transform infrared (ATR-FTIR) spectroscopy; permeability to water vapor; degree of swelling and *in vitro* release kinetics. FTIR results have confirmed an effective crosslinking system that suggests a connected network structure. Therefore, it is possible to conclude that the crosslinking methodologies influenced the physical properties of the membranes.

Keywords: Cross-linking; Collagen; Cardiac tissue engineering.

II EPNAT
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Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

INFLUENCE OF SONICATION TIME AND TANNIC ACID ON SOYBEAN PROTEIN ISOLATE MICROGEL PROPERTIES

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Area: (x) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The solid particles utilization for stabilizing emulsions have been drawing attention due to its advantages, compared to emulsions stabilized by conventional surfactants. Pickering emulsions have better kinetic stability than conventional emulsions; however, the particle properties (*e.g.* size, wettability, hydrophobicity balance and shape) are very important to produce long-time kinetically stable emulsions, and the chemical crosslinking with organic acids, such as tannic acid, can improve their characteristics. Our objective was to evaluate the physical and physicochemical properties of soybean protein isolate (SPI) microgels produced with tannic acid and submitted to different times of sonication. Aqueous suspensions with 10 wt% of SPI were produced (with and without addition of tannic acid, 3:1 tannic acid:protein, molar basis) by mechanical stirring followed by denaturation of protein at 90ºC/30 minutes and cooling at 4ºC for 12h. Subsequently, the suspensions were diluted with distilled water, had their pH adjusted to 7.0 and were homogenized in ultra-turrax followed by ultrasonication at 400 W/15 kHz for 1 and 3 minutes, resulting in suspensions of SPI microgels. The average size of SPI microgels was clearly affected by sonication time: microgels without tannic acid had their average particle size decreased from 317.4 ± 13.54 nm to 266.50 ± 4.03 nm when sonication time increased from 1 to 3 minutes. In contrast, addition of tannic acid in the suspensions did not show a pronounced difference in the average sizes, which resulted in 353.90 ± 27.83 nm and 279.8 ± 11.03 for 1 and 3 minutes of sonication, respectively. The interfacial tension measured in a plane interface formed between microgel suspensions and canola oil increased with addition of tannic acid (10.15 ± 0.13 mN/m and 11.63 ± 0.17 mN/m with 1 and 3 minutes of sonication, respectively), whereas microgel suspensions without tannic acid showed similar results to native protein solution (control assay).

Keywords: Pickering Emulsions; Crosslinking; Denaturation.

II EPNAT
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Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

ESSENTIAL OILS ENCAPSULATED IN CHITOSAN MICROPARTICLES AGAINST *Candida albicans* BIOFILMS

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Area: ( ) Food and Agriculture (x) Medical and Pharmaceutical ( ) Multifunctional Applications

Candida spp. are commensal and opportunistic fungi. *C. albicans* is the most prevalent and pathogenic species involved in fungal infections, mainly due to its ability to form biofilm. *Candida* biofilm has been reported to be 4.000 times more resistant to the antifungal drugs, compared to the planktonic cells. There is an urgent need to develop alternative drugs against *C. albicans* biofilm. Therefore, the aim of this study was to produce and characterize chitosan microparticles loaded with essential oils (CMEOs), evaluate the essential oil (EO) release profile and the CMEOs' anti- *Candida* activity. The chitosan microparticles (CMs) loaded with EO were produced by the spray- drying method and characterized regarding CMEO morphological, physicochemical parameters, EO encapsulation efficiency (EE) and release profile. The planktonic activity was quantified by broth microdilution and the activity against biofilm was quantified by biomass formation measurement. To show structural differences between the biofilms of *C.albicans* treated with CMEOs and those which were untreated, confocal microscopy and scanning electron microscopy were performed. The main components finding in the essential oils were citral (83.17%) and citronellol (24.53%). The CMs and CMEOs showed regular distribution and spherical shape (1 to 15 µm), without any morphological and physical modifications after EO incorporation. EE% ranged from 12 to 39%. *In vitro* release tests demonstrated the EO release rates, after 144 h, were 33% and 55% in PBS and HCl media, respectively. The minimum inhibitory concentration (MIC) values for CMEOs were lower than for CMs and pure EOs ($P<0.05$), indicating the sinergical effect of EO and chitosan. The greatest biomass reductions in biofilm were caused by microparticles incorporated with essential oil ($P<0.05$). Microscopy images revealed a reduction in metabolic activity and structural differences in relation to untreated biofilms. These results indicate that CMEOs are promising compounds that have antibiofilm activity against *C. albicans*.

Keywords: Microparticles; Biofilm; *Candida Albicans*.

II EPNAT
Encontro de Polímeros Naturais
Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

BOVINE SERUM ALBUMIN NANOPARTICLES ENCAPSULATED WITH TOLUIDINE BLUE AS A DRUG DELIVERY SYSTEM FOR PHOTODYNAMIC THERAPY APPLICATION

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Area: ( ) Food and Agriculture (X) Medical and Pharmaceutical ( ) Multifunctional Applications

Photodynamic therapy (PDT) is a potential antimicrobial therapy that combines a visible light (at an appropriated wavelength) and a photosensitizer (PS), which in the presence of molecular oxygen produces reactive oxygen species (ROS), including singlet oxygen, which are highly reactive to biological components. Nanoparticles made of biological macromolecules such as bovine serum albumin (BSA) can act as efficient drug delivery system (DDS) for controlled and targeted release, aiming to improve the therapeutical effects and reduce the side effects of the formulated drugs. Toluidine Blue (TB) is a PS that has a maximum absorption of 630 nm with antifungal and antibacterial efficiency. The aim of this work was to develop BSA nanoparticles incorporated with TB as DDS to antifungal application by PDT protocol. The nanoparticles were developed by the one-step desolvation method. The nanoparticulate system was characterized by techniques in steady state. The nanoparticles showed spherical morphology, average size of 389 nm, with polydispersity index less than 0.01. TB loaded nanoparticles maintain its photophysical behaviour after encapsulation. Based on all studies, it can be concluded that the TB-loaded gelatin nanoparticles are promising delivery systems for use in PDT.

Keywords: Bovine serum albumin; Nanoparticles; Photodynamic Therapy.

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21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

REVIEW ON THE USE OF GREEN BANANA STARCH AND BACTERIAL CELLULOSE (CB) IN THE APPLICATION IN POLYMERIC PRODUCTS OF QUICK DISCARTABILITY

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (x) Multifunctional Applications

The search for biodegradable materials has been growing in significant proportions because we live in a sustainable economy. Starch is considered a very promising polymer for biodegradable products due to its low cost compared to synthetic polymers and its abundance. Starch consists mainly of two polysaccharides, amylose, and amylopectin, and is considered a thermoplastic biopolymer, which, when heated in the presence of a plasticizer such as water, and exposed to shear forces, forms a thermoplastic starch (TPS) or unstructured starch. Green banana starch has a high degree of resistant starch and higher amylose content than starch from other sources, such as potatoes, corn, and wheat. However, biodegradable polymers produced from starch as the only raw material have a low moisture barrier and low mechanical resistance. Thus, the use of other biopolymers in the composition is a viable alternative. Bacterial cellulose (CB) is another biopolymer that has been studied in recent decades and gaining attention from the research community in the scientific and industrial fields. CB is used in several segments, among which we can highlight the use in the food industry and biodegradable polymers. CB is one of the most promising biopolymers in this field due to its high degree of purity, high crystallinity, high resistance, excellent elasticity, mechanical stability, being non-toxic, extremely hydrophilic, edible, biodegradable, with the possibility of modifications in situ and ex-situ, and ease of changing taste and color. Another essential product is plasticizers, such as glycerin, to prevent the polymer's breakdown after drying and bring greater flexibility to the material. Due to these three products' characteristics, mixtures produced with green banana starch associated with other biopolymers such as CB and glycerin have been of great interest for products with rapid disposability, resulting in materials with superior properties when compared to the properties of each component individually.

Keywords: Starch; Bacterial cellulose; biopolymers.

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Meeting on Natural Polymers
21 a 23 de novembro de 2020.
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP UFPI

PERFORMANCE ASSESSMENT OF STARCH-MALTODEXTRIN POLYMERIC SYSTEMS BY SPRAY DRYING

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The spray drying is a well-established technique for producing particles, turning fluid materials into dry particles. This is a versatile technique that can be applied to microencapsulation of various materials, including active substances and microorganisms. Then, the aim of this work, was to evaluate the spray drying performance of starch-maltodextrin polymeric systems at different outlet temperatures to obtain the best dry conditions that will be applied to encapsulate entomopathogenic fungi. For this, three different polymeric systems were prepared: 2% (w/v) of starch (system 1), 1% (w/v) of maltodextrin (system 2), and 3% (w/v) of starch-maltodextrin (system 3). The drying process was carried out in the mini Spray Dryer MSD 1.0 (LabMaq do Brasil Ltda) at three outlet temperatures: 40, 70 and 100 °C. The drying yields at 40 °C for systems 1, 2 and 3 were 40%, 31% and 27%, respectively. The increase in outlet drying temperature to 70 °C resulted in a higher encapsulation efficiency for all systems: 72% (system 1), 35% (system 2) and 52% (system 3). On the other hand, at 100 ° C the encapsulation yields decreased a little to 62%, 26% and 52%, respectively. Therefore, based on these results, we can conclude that the better outlet temperature for drying was 70 °C and the better polymeric systems were starch and starch-maltodextrin. These formulations will be tested as microencapsulation systems of entomopathogenic fungi by using the spray drying technique.

Keywords: Spray Drying; Drying Yield; Starch-Maltodextrin Polymers.

II EPNAT
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Meeting on Natural Polymers
21 a 23 de outubro de 2020
Organização: UNIARA FZEA USP unesp UNIFESP UNICAMP

THE REGULATION FOR ACCESS TO THE BRAZILIAN GENETIC HERITAGE IN THE DEVELOPMENT OF BIOPOLYMERS SYNTHESIZED BY MICROORGANISMS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Brazil is internationally recognized for its biodiversity. Considered the country with the greatest genetic variability, it has between 15 and 20% of the world's diversity. There are more than 100 thousand species of fauna and about 50 thousand species of flora, considered the most diverse on Earth. However, many species are not yet catalogued, so it is estimated that these numbers are much higher. For the protection and conservation of this biodiversity, the access to the genetic resources is foreseen in the Law 13.123/2015, regulated by the Decree 8.772/2016, both the research activities and the process of development and commercialization of products are controlled and inspected. Among the determinations is the requirement of a previous register on the National System of Management of the Genetic Patrimony and of the Associated Traditional Knowledge (SisGen), electronic system of the Council of Management of the Genetic Patrimony (CGEN), created by Law 13.123/2015 and linked to the Ministry of Environment. The CGEN is the competent national authority for the management of the access and distribution of benefits of the genetic patrimony in Brazil. By means of literature review research, among them the current national legislation, the present work verified the main requirements for access to genetic heritage in the development of biopolymers synthesized from microorganisms, demonstrating, in general lines, the application of biopolymers, their future perspectives and the care that the researcher/entrepreneur must take in the process of research and development (R&D) of products involving genetic resources.

Keywords: Biopolymers Regulation; Brazilian Genetic Heritage.

PROMISING ADSORBENTS OF TANNIN-IMMOBILIZED NANOCELLULOSE: A SHORT REVIEW

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Tannin is an organic material obtained from different structures of plants, like leaves and bark. It is water soluble and composed of polycyclic aromatic rings with high molecular weight. Tannin has been highlighted as a sustainable alternative to treat effluents when compared to inorganic products since the last one can result in undesirable residues in water after the decontamination. The literature presents many methodologies to apply tannin as adsorbent. This application as adsorbent is commonly driven for decontamination of aqueous media containing heavy metals and dyes. Nevertheless, the chemical modification of tannin is required due to its solubility in water. We can emphasize the immobilization of the tannin to form insoluble complexes. Thus, nanocellulose can be considered as a potential and interesting renewable agent for tannin immobilization. Here, we develop a short review of the state-of-art of the use of tannin-immobilized nanocellulose as an adsorbent of contaminants. Its potential was evidenced, as well as the recent and continuous development of new scientific researches in this field of study. Among the most relevant results, we can highlight these researches, as following: Pei *et al*. immobilized *Areca catechu* tannin in cotton cellulose to produce hydrogels. These hydrogels presented efficient removal of methylene blue in alkaline effluents. Zhang *et al.* produced adsorbents of collagen/cellulose containing *Myrica esculenta* tannin, with high potential for Pb(II) retention in pH 5.5. Likewise, Xu *et al.* immobilized black wattle tannin in dialdehyde nanocellulose for decontamination of effluents containing Cr(VI), Cu(II), and Pb(II). This bio-based adsorbent was efficient to remove Cr(VI) in pH 2, and Cu(II) and Pb(II) in pH 6. In summary, all methodologies presented good results for the retention of contaminants. Therefore, we conclude immobilization of tannin in the nanocellulose is a potential alternative to produce new bio-based adsorbents for the decontamination of urban and industrial effluents.

Keywords: Organic material; Wastewater treatment; Sustainable alternative.

PREPARATION AND CHARACTERIZATION OF CELLULOSE CARBAMATE. COMPARISON OF TWO METHODS

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Area: ( ) Food and Agriculture ( ) Medical and Pharmaceutical (X) Multifunctional Applications

Cellulose is one of the most abundant and available organic materials in nature. The high crystallinity and strong inter- and intra-molecular hydrogen bonding make their processing and functionalization difficult. Furthermore, since the melting temperature is higher than the degradation temperature, dissolution is the only way to obtain regenerated cellulose products. The most widely used industrial dissolution process is viscose, but it presents serious environmental pollution problems. Cellulose carbamate (CC) technology constitutes a good alternative to replace it, since it uses urea as an esterification reagent with less environmental impact. In this line, from dissolving pulps, it is proposed the comparison of two methods for preparing CC with microwaves, one by mechanical dry impregnation and the other by activation and wet impregnation. The CC are characterized by the intrinsic viscosity in cuprietylenediamine, nitrogen content by elemental analysis CHONS and degree of substitution (DS). Carbamate groups are identified by infrared spectroscopy (FTIR). The results show that with both methods an adequate degree of substitution is achieved in the derivatized cellulose. However, the wet impregnation method is the one that presents intrinsic viscosity values greater than 150 mL/g that would be favourable for preparing regenerated cellulose products.

Keywords: Dissolving Pulp; Cellulose Carbamate; Nitrogen Content.

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FOURIER TRANSFORM INFRARED SPECTROSCOPY (FT-IR) SPECTRUM OF CELLULOSE OBTAINED FROM ORANGEBAGASSE

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The increasing production of lignocellulosic residues by the Brazilian agroindustry has caused serious environmental impacts, which has encouraged research that makes feasible the use of these materials. The objectives of this study were to produce cellulose from orange bagasse (OB) using a combination of ultrasound and peracetic acid (PA) treatment and also to characterize the obtained materials according to FT-IR. The OB was subjected to ultrasound and treated with PA, the suspensions were maintained on a mechanical stirrer with a controlled temperature of 60 °C at different times, 12 and 24 h (USPA12 and USPA24). The control samples were treated with PA without being submitted to ultrasound (PA12 and PA24), and one of the control samples were treated only by ultrasound (US). The FT-IR spectrum of the samples presented bands similar to each other. In the raw OB spectrum, it was possible to observe that all the bands characteristic for cellulose, hemicellulose, and lignin are present. The bands corresponding to hemicelluloses usually appears in the region between 1700-1740 cm-1, and PA24, USPA12 and USPA12 samples presented these bands with lower intensities, indicating the removal of hemicelluloses from them. Also, the bands at 1430, 1059, and 897 cm-1 that are typical of pure cellulose appeared in the FT- IR spectra of PA24, USPA12, and USPA24 samples, which presented the higher cellulose content. Ultrasound is an alternative and effective method for extracting cellulose from lignocellulosic residues, and it has the advantages of simplicity and lowest polluting potential than conventional methods based on multiple steps protocols.

Keywords: Lignocellulosic residues; Cellulose; New materials

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REUSE OF TOMATOES FROM RESIDUES FOR THE DEVELOPMENT OF EDIBLE FILMS WITH POTENTIAL USE IN PACKAGING

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Area: (X) Food and Agriculture ( ) Medical and Pharmaceutical ( ) Multifunctional Applications

The use of edible films has become a topic of great interest, due to the potential to prevent food spoilage and the characteristic of biodegradability. Research on the packaging has been focused on edible films based on biopolymers, such as proteins, polysaccharides, and lipids, which are completely biodegradable, within a considerably short period, greatly contributing to the reduction of environmental pollution. The reuse of tomatoes (*Solanum lycopersicum*) in puree form arouses interest in Brazil due to the tropical climate, which makes this product have a short life span in supermarkets. The development of these new materials has become a great alternative for the replacement of synthetic polymers with specific applications and has been attracting the attention of researchers due to the advantages that include the low cost. The main evaluation to which the films were submitted concerns a subjective analysis of this material, that is, an evaluation that serves as an initial parameter for directing the characterizations and better evaluation of the material. For this, the casting method was used, which consisted of the preparation of a filmogenic solution, composed of distilled water, polymeric matrix (pectin - 2% weight/volume), and tomatoes puree in different concentrations, under magnetic stirring. The films were evaluated visually subjectively, the main parameters being the handling, that is, whether the film could be handled or not without the material breaking; continuity, that is, absence of fractures or ruptures after drying; and finally, as for homogeneity, with the absence or not of insoluble particles, or even, variation in transparency over the material area. Thus, the parameter studies to film preparation are important to develop materials with satisfactory properties to specific applications such as potential use in packaging. This film presented all the analyzed properties demonstrating excellent application potential as a replacement for non-biodegradable packaging. Acknowledgment: FAPESP, CNPq, CAPES, and UNESP.

Keywords: Edible films; Tomatoes; Packaging.