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Posters

Joung Sook Hong et al., J Bioremediat Biodegrad 2017, 8:6 (Suppl)
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Toughness enhancement of pla/natural rubber blend by melt compounding with clays

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Poly(lactic acid) (PLA) is an aliphatic polyester that possesses various advantageous physical and thermal properties compared to other commercial biopolymers. It is thermally stable and biodegradable which promises a great processability for industrial applications while its brittleness limits usages. In this study, natural rubber was added to PLA to make up brittleness of PLA. Depending on the distribution of the rubber phase and the compatibility between rubber and PLA, the brittleness is able to be limitedly improved. On the other hand, organically modified clays were added in order to induce compatibilization and to enhance mechanical properties. Clays were introduced to PLA/NR blend with a weight fractions, 0-10 wt%. With a small amount of clays, the size of the dispersed Natural rubber phase was effectively decreased to sub-micronsize which seems compatibilize between the matrix PLA and the rubber phase. Then, the extendibility was improved (Figure1). Furthermore, the content of natural rubber was varied from 10 to 50% to observe the toughening effect. Mechanical properties including tensile strength and elongation breakage, rheological properties including storage and loss modulus as well as morphology were observed.

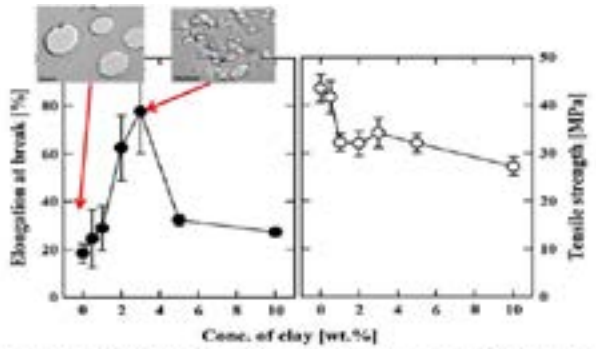

Figure 1. Elongation at break and tensile strength of the PLA/Rubber and PLA/Rubber/Clays blend-composites measured at room temperature(Ock et al. 2016)

Biography

Joung-Sook Hong received the B.S. degree in chemical engineering from Jeju National University, Jeju, Korea, in 1995, and the M.S. and Ph.D. degrees in chemical engineering from the Seoul National University, Seoul, Korea, in 1997 and 2005, respectively. She was a Research Associate at the University of Queensland in 2006, a Research Assistant Professor at Korea University in 2007, a Senior Researcher at Research Center, Samsung Cheil Industry, in 2008-2009, and an Assistant Professor in the Department of Chemical Engineering, Soongsil University, in 2009 through 2015. She is currently a Research Professor in the Center for nano-structured polymer processing technology, Seoul National University. Her current interests include the dispersion of particles in a non-Newtonian fluid and emulsion, interfacial rheology, microfluidics, and nanocomposite.

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Preparation and characterization of a bionanocomposite membranes with antibacterial properties composed by poly(l-lactic acid) and silver nanoparticles

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Statement of the Problem: The use of biopolymers in the medical area is extremely interesting for tissue engineering because they provide a favorable environment for the growth and differentiation of cells. Among the distinct applications, one of significant interest is related to the odontological area. In this area, a problem of major concern is the periodontal disease. It consists in an infectious process characterized by damages in the periodontal tissues induced by bacteria present in the gingival sulcus. Common treatments involve the use guided tissue regeneration (GTR) by using bioabsorbable membranes, but the commercially available membranes does not contain nanostructured antibacterial agents, such as silver nanoparticles.

Methodology & Theoretical Orientation: In the present study, silver nanoparticles (AgNp) were synthesized in an aqueous media and transferred to an organic solvent by using a fatty amine as a phase transfer agent. Such solvent was used in different amounts with fresh solvent to prepare functionalized PLLA membranes. The AgNp were characterized by UV-Vis spectrophotometry and transmition electron microscopy (TEM). Atomic absorption spectroscopy (AAS) was used to quantify the amount of silver presented in the solvent used to produce the membranes. The membranes, functionalized with different concentrations of AgNp, were characterized by thermal gravimetric analysis (TGA), differential scanning calorimetry (DSC), field emission scanning electron microscopy (FESEM) and standardized antibacterial assays (ASTM E-2180). The degradation behavior of the membranes in artificial saliva was also investigated.

Conclusion & Significance: The results revealed a reduction of the thermal stability and an increase of the crystallinity of the membranes by increasing the silver nanoparticles content. Moreover, the membranes containing concentrations of AgNp greater than 13 μg / g PLLA showed excellent antibacterial activity against the Gram positive bacteria *Staphylococcus aureus*. Such findings indicated that the produced antibacterial membranes have potential application in guided tissue regeneration treatments, such as in periodontal diseases

Biography

Ana Paula Testa Pezzin graduated in Chemistry, Master in Chemical Engineering and PhD in Mechanical Engineering from the State University of Campinas. She did postdoctoral studies at the Université Pierre et Marie Curie in Paris / France. She has been a leader in the POLYMERIC MATERIALS GROUP since 2001, working in research lines: Polymeric biomaterials for medical and dental applications; Composites, biocomposites, nanocomposites and bionanocomposites; Modification of biopolymers for different applications and synthesis and characterization of biopolymers by microbial culture. Currently, she is a Professor and Researcher at the University of Joinville Region (UNIVILLE), being a level 2 productivity fellow at CNPq.

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Production and characterization of nanobacterial cellulose (NBC) synthesized by *Glucanocetobacter hansenii* using corn step liquor and PRODEX® as nitrogen source

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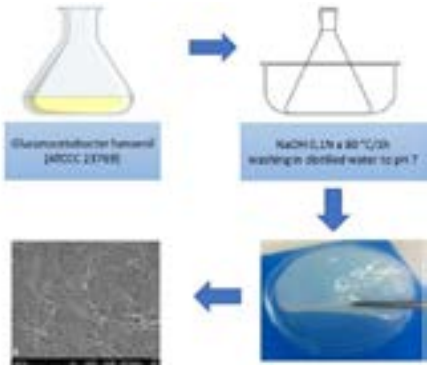
Bacterial nanocellulose (BNC) is an extracellular insoluble polysaccharide produced by some strains of *Gluconacetobacter*. BNC is produced by *Gluconacetobacter hansenii* has specific physical and chemical properties that distinguish it from plant cellulose, such as high crystallinity, chemical purity, mechanical strength, biocompatibility which leads BNC to become a new industrial material. Althought, to produce BNC on a large scale, culture conditions must be optimized. Many different nutrients have been evaluating. In this work, to evaluate the effect of different culture media, carbon and nitrogen sources were studied, seeking to optimize CB production. Glucose, fructose, inulin, glycerol, lactose, sacarose, mannitol were verified as carbon source using corn steep liquor and a crude yeast extract known commercially as Prodex Lac®, as nitrogen source. After culturing, cells were transferred at a 20% inoculum rate to a 125 mL Erlenmeyer flask containing 20 g/L of the sugar to be investigated, 5 g/L Prodex Lac® (yeast autolysate, nitrogen source) or 5 g/L corn (corn steep liquor, nitrogen source). The cultivation was kept static at 30ºC and sampling every 2 days for 12 days. After this period, the membranes formed were washed, dried and characterized (TGA, SEM and FTIR). The results revealed that regardless of the nitrogen source, it was observed that all carbon sources result in the formation of BNC and the best yields were found using fructose and mannitol. In the experiments that used fructose, the concentration of BNC was 2.484 g/L (corn steep liquor) and 4.222 g/L (Prodex Lac®). The good performance of Prodex Lac® can be justified considering it is a crude yeast extract, and the conventional medium for BC cultivation uses yeast extract and peptone as nitrogen sources. The obtained films presented variations in the thermal degradation profile, in comparison to the one reported in the literature. This fact resulted in possible impurities not completely removed with the purification method used. The FTIR analyzes did not differ from the literature, but also showed some bands that indicate impurities in the CB sample.



Biography

Ana Paula Testa Pezzin graduated in Chemistry, Master in Chemical Engineering and PhD in Mechanical Engineering from the State University of Campinas. She did postdoctoral studies at the Université Pierre et Marie Curie in Paris / France. She has been a leader in the POLYMERIC MATERIALS GROUP since 2001, working in research lines: Polymeric biomaterials for medical and dental applications; Composites, biocomposites, nanocomposites and bionanocomposites; Modification of biopolymers for different applications and synthesis and characterization of biopolymers by microbial culture. Currently, she is a Professor and Researcher at the University of Joinville Region (UNIVILLE), being a level 2 productivity fellow at CNPq.

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Mechanical and rheological analysis of biodegradable PLA/natural rubber blend with nanoparticles

Jung Hyun Ahn, Joung Sook Hong and **Kyung Hyun Ahn**
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Poly(lactic acid) (PLA), as an aliphatic polyester chemically synthesized from bio-derived monomers, is biocompatible and biodegradable. Different from other biodegradable polyesters, it is thermally stable which promises a great processability for industrial applications. However, its brittleness limits its usage. it is usually toughened with more ductile elastomer like polyurethane, rubber. In this study, natural rubber (NR) was added to toughen PLA and also nanoparticles were mixed in order to improve mechanical properties. In this case, the blend composition of two polymers was widely changed. As the composition increases, the polymer blends show interpenetrating structure of two polymers, which is expected to bring a large change in properties compared to other morphology like droplet/matrix. Since polymers are usually immiscible with low interfacial adhesion, its system is often unstable. So several factors like nature of polymers (interfacial tension, viscosities, ratio of viscosities), their volume fraction, processing conditions must be in consideration. With a fixed composition of NR, different types of nanoparticles were introduced with a small amount of weight fraction $W_{particle}$ to see their rheological and mechanical effect. With a small, $W_{particle}$ PLA/NR system showed different morphological change under FE-SEM images and this was reflected on rheological and mechanical properties.

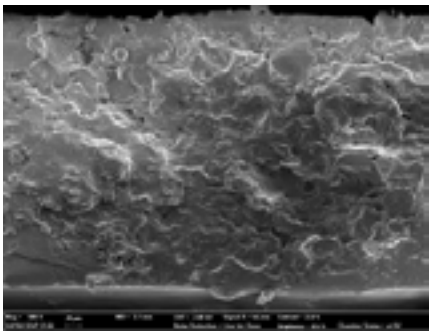

Figure 1. FE-SEM images of PLA/NR blend with nanoparticles.

Biography

Jung Hyun Ahn currently on a master's degree in mircorheology lab in Seoul National University since 2016. He is studying polymer melts and its blend, composite system with different types of filler. Also he is working on the effect of external field like electric field on polymer nanocomposites.

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Enantiomeric separation of DL-propranolol using cellulose membrane

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Since cellulose possesses multichiral carbon atoms in its molecular structure unit, an enantioselective membrane was prepared using cellulose as the membrane material. The flux and permselective properties of a membrane were studied using DL-propranolol racemate as the feed solution. In order to optimize the permselective properties of the cellulose membrane, the influences of different parameters such as operating pressure and feed concentration of racemates had been studied. The top surface and cross-section morphology of the resulting membrane were examined using scanning electron microscopy. An optical resolution of over 55% enantiomeric excess was achieved when the enantioselective membrane was prepared with 8.1wt% cellulose and 8.1wt% LiCl in the casting solution of N,N-dimethyl acetamide. This work indicates that the enantioselective cellulose membrane could soon become very attractive for industrial uses. The work is supported by National Natural Science Foundation (No. 21127012, 21675141) of China.

Biography

Li-Ming Yuan was born in Chongqing, China, 1961. He received his Ph.D. from Beijing Institute of Technology (1997, China) and then spent about two years (2002-2004) at the Nagoya University (Japan) as a postdoctoral fellow (JSPS) with Prof. Y. Okamoto. In 1998 he was promoted to professor in Yunnan Normal University of China. His current research interests focus on the enantioseparations by chromatography, polymeric membrane and extraction.

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Solution to stop the contamination of soil caused by necroslurry polymer

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The most well-known destinations for lifeless bodies, used and defended by beliefs, religions and people, are graves and burial chambers. They are the forms of burial, which, in the majority, bring comfort to the families and people close to the deceased, for idealizing that they are religiously and socially intact to beloved beings. However, a large part of the population is unaware or not informed about the environmental problems that such burials bring to public health and the environment. After the burial, the body begins to go through physical, chemical and microbial processes. Necroslurry is a liquid resulting from the decomposition of corpses, which has a sound capacity to percolate soils and groundwater and therefore, contaminate both, soil and groundwater near the cemeteries, due to the presence of pathogenic microorganisms in its composition. The vulnerability of soils and aquifers, which can be classified as low, medium or high depending on where the burial occurred, medium or high permeability of the cemetery soil and the position either above or below ground level are some of the factors that Influence the way necroslurry may reach soils and groundwater. These impacts can cause disease and epidemics, as many cities use such groundwater as their water source and the soil is used produce food crop. Necroslurry is a greyish and brownish solution, mainly composed of cadaverine, an amine ($C_5H_{14}N_2$) with a repulsive and nauseating odor, a putrefaction by-product, besides being formed by water, minerals and organic degradable substances, the medium density is equal to 1.23g / cm^3, pH between 5 and 9, at 23 to 28°C, in its liquid state is more viscous than water, due to its polymerization and the chemical reactions that produce the polymers. Due to the fact that it is a polymerizable substance, the transportation of necroslurry in its liquid phase is aggravated. The ideal is to use a system that transforms the liquid necroslurry into gas, using burial and constructive methods proper for this phase, facilitating the transportation as well as preventing the contamination to the environment. This article will show how these polymers hamper processes of attempted contamination prevention. It will also show what happens to the polymers resulting from the chemical processes of decomposition of the human body, when they reach the soil and the water tables. Currently, in Brazil, there are already technologies that meet these needs, monitoring the treatment of gases by molecular dissociation. The use of modular structures made of carbon steel and materials, which are put to the performance of a leak test, ensuring that the passage of gases and liquids are prevented, thus creating a great capacity for sealing, has already been used in some cities Brazilians. This method is very effective and of low environmental impact, eliminating the difficulties of the necrochorume treatment and fully complying with CONAMA Resolution 335/2003.

Biography

Juliana da Silva e Mascarenhas Guedes holds a degree in Civil Engineering from Universidade Federal de Minas Gerais, a Master's Degree in Structural Engineering from Universidade Federal de Minas Gerais, a PhD in Earth Sciences from Universidade Fernando Pessoa, in Porto, Portugal. Currently, is a professor of Civil Engineering at Universidade FUMEC and post-graduate in Structural Engineering from Universidade FUMEC. She is an investigator at FP-ENAS, UFP Energy, Environment and Health Research Unit, Porto. Has experience in the structural and sanitary area. Articles in papers in sanitation, environmental and structural área.

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Biocompatible poly(Aspartic Acid) derivative-coated USPIO nanoparticles incorporated with anticancer drug for theranostic applications

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As a theranostic MRI contrast agent with high relaxivity, USPIONP (ultrasmall superparamagnetic iron oxide nanoparticle) was prepared and characterized. The USPIONP was composed of an IONP core, amphiphilic poly(aspartic acid) copolymer (P) shell and an anticancer drug, epirubicin (EPI). The polymer P, poly(2-hydroxyethyl aspartamide)-C_{16}-mPEG, was synthesized using a ring-opening reaction of polysuccinimide. The polymer P-coated IONP (P-IONP) was prepared via synthesis of IONP and coating of P on the IONP by using co-precipitation method. The P-IONP was a USPIONP having a hydrodynamic diameter of about 40 nm. EPI-loaded USPIO (EPI-USPIO) had a hydrodynamic diameter of about 50 nm. Notably high T2 relaxivity of EPI-USPIO corresponded to MR contrast enhancement 2.7-fold compared with a commercial contrast agent. The relaxivity was proportional to EPI encapsulation efficiency of the EPI-USPIO. The encapsulated EPI was released from EPI-USPIONP in a sustained manner. USPIONP had no cytotoxicity against HeLa cells, whereas EPI-USPIONP showed cytotoxicity increasing in an EPI dose-dependent manner. Flow cytometry revealed that cellular uptake of EPI from EPI-USPIONP was comparable to free EPI and confocal microscopy showed nuclear uptake of EPI from EPI-USPIONP. These results suggest that USPIONP is a promising theranostic platform whose MR contrast enhancement can be controlled by modulating encapsulation efficiency of the therapeutics.

Biography

Hasoo Seong has completed his PhD from Seoul National University and postdoctoral studies from Purdue University. He is a senior research scientist in Bio & Drug Discovery Division of Korea Research Institute of Chemical Technology, an organization supported by South Korea Government. He has his expertise in the field of drug delivery system and biomaterials.

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Waldo Arguelles-Monal et al., J Bioremediat Biodegrad 2017, 8:6 (Suppl)
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Chitosan-coated nanoliposomes as capsaicin carriers

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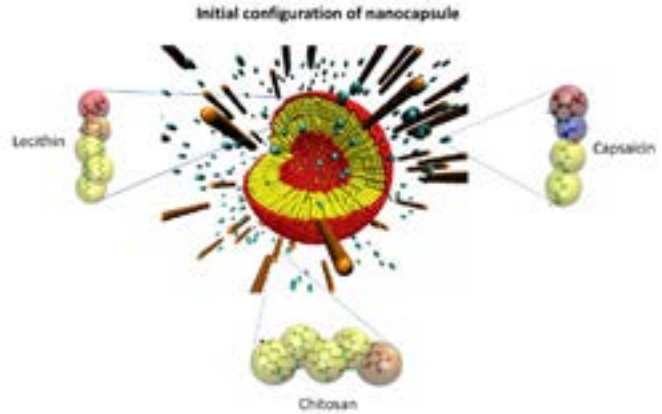
Transport of hydrophobic drugs in human body presents several complications. One of them is the low drug absorption due to their low solubility. In order of enhance the biodistribution of these drugs, recent investigations have propose the use of amphiphilic molecules, such as phospholipids, to synthesize nanoparticles or nanocapsules, given that phospholipids can self-assembly in micellar or liposomes structures. Thus, they are ideal candidates to function as nanocarriers of hydrophobic drugs. In this work, molecular simulations of nanoliposomes at the mesoscopic scale are performed. These nanostructures were constituted of lecithin, chitosan and capsaicin. The stability of the liposome and the efficiency of capsaicin encapsulation, as well as the internal and superficial distribution of capsaicin and chitosan molecules in the nanoliposome were analyzed. Characterization of the system was done through density maps in the xy-plane and the potentials of mean force (PMF) for interactions between lecithin-chitosan, lecithin-capsaicin and capsaicin-chitosan. The molecular simulation showed that chitosan is distributed on the surface of the nanoliposome. It was also observed that in spite of the fact that the nanoliposome had a diameter approximately of 18 nm, it was stable under a 24 microseconds window. The sizes obtained experimentally usually are among 100 nm and 200 nm.



Biography

Inocencio Higuera-Ciapara has worked and directed three research centers in México; CIAD, CICY and CIATEJ. His main line of research has dealt with chitin and chitosan applications in the food and health sectors. His early work dealt with chitin and chitosan extraction from shrimp byproducts and their application in wound healing. More recently, he has also become interested in the molecular interactions between chitosan and various bioactive compounds. He is currently working on the chitosan-capsiacin interactions with the aim of developing functional bioconjugates.

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Barrier properties in selecting the plasticizer for formulation of biopolymers pectin

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Colombia has a variety of fruits that are currently agroindustrialized generating organic residues composed of pectin, a polysaccharide found in the shell of fruits like Passionfruit (Passiflora edulis Sims) being 60%; pectin possesses properties to produce new biodegradable polymeric materials, but in the formulation must analyze characteristics like; the availability of raw material, barrier and mechanical properties affected by the type and concentration of plasticizers. The objective of this study was to standardize the extraction of high methoxyl pectin (HDM) and to identify the concentration and type of plasticizer to be used. The complete shell was used to obtain pectin HDM, with extraction assisted by ultrasound varying the frequency between 12 kHz and 20 kHz at 15 min and 30 min with pH of the solution at 2.5 and 3.0, as a variable response the interaction between factors for % esterification of pectin. The film formation was performed by the casting method by mixing at 150 rpm / 60°C for 30 min the pectin solution and the plasticizers glycerin (G), polyvinyl alcohol (PVA) at a concentration of 5, 10 and 15% and mixing G-PVA at 10-10%, 5-5% and 10-5% concentration, applying a selection matrix where water solubility and water vapor permeability interact. Applying ultrasound at 20 kHz for 15 min at pH 2.5 generated a pectin with 90% HDM. Regarding the barrier properties, the PVA treatment at 5% concentration presented 40% un solubilized mass and the 10% -10% G-PVA treatment with lower value to water vapor permeability. These results show that ultrasound promotes the release of polysaccharides thereby reducing exposure to high temperatures while maintaining HDM property in the extraction; the physical properties of the barrier are inversely proportional, the higher the concentration the less permeability to water vapor and the greater the solubility of the mass in water, compared with recalcitrant polymers, the further improvement of the barrier properties of the mass in water, compared with recalcitrant polymers, the further improvement of the barrier properties.

Table 1. Barrier properties of plastic films

treatments %	solubility [%]	Permeability [kg (m*h*pa)]
G 5	22,031	2,04E-10
G 10	17,125	1,47E-10
G 15	12,340	1,28E-10
PVA 5	40,084	5,36E-11
PVA 10	21,848	2,74E-10
PVA 15	11,843	9,59E-07
AGUA 15	23,347	8,69E-11
G5 / PVA5	19,269	7,01E-11
G10 / PVA 10	6,593	1,09E-06
G10 / PVA 5	9,894	3,31E-07

Biography

Ahudrey Leal Quintero I am a Magister in Advanced Biotechnology, with experience in the implementation of research, innovation and development programs in technology-based entrepreneurship in areas such as; Biotechnology, Nanotechnology, Biopolymers. I am currently a project manager Tecnoparque SENA Node Bogotá D.C. (Colombia) where the use of polysaccharide-rich agro-industry wastes has been used for the formulation of degradable agro-polymers in order to reduce the environmental impact generated by the polymers.

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Accepted Abstracts

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Edible biological materials

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New kind of biological materials which are derived from chemically modified natural substances such as proteins, carbohydrates, lipids and nucleic acids will be addressed. The properties of these materials are under chemical control and they can be tuned to suit the needs of a specific application. There is an urgent need for such bio-derived materials which are also biodegradable when discarded after their useful life span without accumulation in the environment. One driving factor for this area of research has been the concern regarding the extensive accumulation of non-biodegradable materials in our environment which needs urgent attention. This talk will focus on several approaches to address this important problem. Our hypothesis is that bio-derived materials that are fully functional but can be readily degraded into their constituent components where these components can be safely consumed by bacteria, fungi, plants or animals is possible. The properties of such biological materials can be rationally programmed to degrade when exposed to the environmental conditions over pre-determined time scales without generating toxic waste. Some examples with recent advances in understanding their function will be provided.

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Synucleins form oligomers and induce oligomerization of other proteins

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Statement of the problem: Synucleins belong to a family of small naturally unfolded or intrinsically unstructured proteins consisting of three members: alpha-, beta and gamma-synuclein. Aggregation of alpha-synuclein is associated with Parkinson's disease and other neurodegenerative disorders. The susceptibility to the formation of protein aggregates depends on cooperative conformational changes which may contribute to the kinetic control of fibrillization with transitions between alpha-helical and beta-sheet secondary structure. The protein aggregates which may be formed under *in vitro* and *in vivo* conditions exhibit significant variations in their structure and function. Interaction of synucleins with other proteins promotes their oligomerization and affect their dynamics.

Findings: Alpha-synuclein binds to microtubules and tubulin tetramer inducing microtubule nucleation and growth rate thus affecting microtubule dynamics. Alpha-synuclein also affect superoxide dismutase 1 and Tau oligomerization and actin dynamics. Gamma-synuclein can affect microtubule properties and act as a functional microtubule associated protein. We found that gamma-synuclein after oxidation of Met-38 acts as anti-chaperone, which is able to enhance alpha-synuclein aggregation and form heterologous complexes containing both proteins. We identified specific post-translational modifications altering synuclein's susceptibility to aggregation. We also found that γ-synuclein affects the formation of actin–cofilin rods 11.2 ± 1.4 μm in length.

Significance: Such cross-seeding effects of intrinsically unstructured proteins play an important role in the pathogenesis of neurodegenerative diseases.

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Responsive properties of alginates in aqueous solutions: Influence of salts on the Gel-Sol-Gel transition

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Associating polymers have known a large development during the last decades due to their high performances as thickeners in aqueous media with important applications in various domains like oil recovery, cosmetics or paints. With time the systems become more efficient, even smart as they are able to change their properties under controlled environmental conditions. This is the case of responsive polymers1 which respond to stimuli like salt, pH, temperature, light or external fields. Under controlled conditions, these systems readily form physical networks or nanostructures which offer wide potentialities in biomedical engineering. In this context, biopolymers have an important role to play and we are currently developing a platform of responsive polysaccharides2-5. In this work, new thermoassociative copolymers have been prepared by grafting responsive polymers, characterized by a LCST-type phase transition, onto a rich mannuronic alginate backbone. Their solution properties were studied by differential scanning calorimetry and dynamic rheology. In pure water, the aggregation process of polymer side-chains above their LCST is weakened by electrostatic repulsions taking place between alginate backbones and only moderate thermothickening properties are observed. The responsive behavior of copolymer solutions can be largely improved by increasing the ionic strength and decreasing the electrostatic repulsions. In these conditions we show that alginate chains are very sensitive to the nature of monovalent cations and can selfassemble upon cooling in certain conditions. In the case of grafted copolymers, the superposition of these two associating mechanisms leads to an original double transition upon heating with a reversible gel-sol-gel behavior.

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Multiscale modeling of nanoengineered drug delivery systems based on smart nanofibers

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Nanotechnology-based smart drug delivery systems becoming one the most promising directions in the development of modern therapies which could dramatically improve drugs efficiency through targeted/precise delivery. However, despite the progress made during last years, there still remains an enormous potential for further development which could revolutionize the area. Unfortunately, in some cases, this potential is screened out by the complexity and multilevel character of systems and processes at the nanoscale. The success of future applications in high-tech medicine requires a deep understanding of fundamental mechanisms at different levels of description and their communication. That could be provided only by an appropriate combination of experimental study with predictive theoretical modeling. This study addresses the multiscale modeling of drug release (on/off states) in the smart nanofiber-based drug delivery systems to better understand the process and factors defining the mechanism, which could be efficiently used to deliver drugs. The properties (as well as the ratio) of monomers and temperature are becoming important variables that affect the drug release. So first, the constituent monomers and small copolymers were studied by quantum chemical methods. Next, the number of different copolymer systems was constructed and the molecular dynamics calculations were performed in water solvent with ions. The resulting trajectories were analyzed in detail (structure of radial distribution functions, a number of hydrogen bonds, etc.) to study the crosslinking between polymers. The MD calculations were also supported by statistical mechanical studies (3D-RISM) to get the solvation properties and thermodynamics of the equilibrium arrangements. Finally, the detailed structure of favorite relative orientations of copolymers was studied by quantum chemical methods to understand the factors affecting drug release process.

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The effect of feeding profile in the distribution of chains composition and mechanical performance of styrene/butyl acrylate emulsion copolymers

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Semicontinuous seeded emulsion copolymerizations, using 5 different types of feeding profiles of comonomers (styrene/butyl acrylate, S/BA) were carried out, to vary in a gradual manner the composition of the copolymer chains formed throughout the reactions (gradient composition copolymer, GCC). For comparison, equivalent core-shell type polymeric materials were synthesized in two stages (TS). In all reactions, the S/BA global mass ratio was: 70/30. To estimate the weight composition distribution (WCD) of the copolymer chains, the cumulative styrene content in the polymer mass was followed throughout the reaction (1H-NMR). Average molecular weights were determined using SEC. The differences in mechanical performance were established, carrying out a mechanodynamic (DMA), and mechanostatic characterization (stress-strain at several temperatures and, Izod testing). The area under the loss modulus curve (LA) was correlated with Izod impact strength, showing the damping superiority of the GCCs over the T-S material. At all tested temperatures (between 25 and 70°C), the GCC materials exhibited yielding and plastic deformation, while the T-S material presented brittle fracture in that temperature interval. The WCDs were used to elucidate the differences in mechanical behaviour among GCC materials. The feeding profile variation in combination with the WCD analysis represents a novel methodology to produce tailor made copolymers.

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Enzyme-incorporated metal-organic frameworks for biocatalysis

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Re-engineering enzyme catalysts by immobilization on nanomaterials represents a simple but effective route. In this presentation, I would like to introduce the self-assembly process in aqueous solution to prepare enzyme-inorganic crystal hybrid nanocomposites and enzyme-incorporated metal-organic frameworks with high enzymatic activity and stability. We proposed that these enhanced enzymatic activities and stabilities can be attributed to the well-designed specific interactions between immobilization nanocarriers and enzymes. The preparation of novel type of nanostructured enzyme catalysts and understanding the origin of enhanced activity and stability may provide new insights and inspiration to design efficient enzyme catalysts for practical applications.

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Effect of chitosan derivatives grafted poly(ethylene glycol) on the interaction with human DNA

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Chitosan is one of the natural materials used for gene delivery; this is why the current study focused on getting chitosan from chitin extracted from shrimp shells by known and modified chemical methods to obtain chitosan with a high Degree of Deacetylation to increase its solubility. It was characterized by Fourier Transform Infrared and intrinsic viscosity measurement in order to determine the degree of deacetylation and average molecular weight of purified Chitosan. Some chitosan derivatives were prepared by reaction of chitosan with maleic anhydride, adipic anhydride and sebacic anhydride in DMF to prepare N-malonyl chitosan, N-adipoyl chitosan and N-sebacoyl chitosan respectively, and because of low % yields of the resulting products, the three anhydrides were grafted to chitosan in toluene which is nearly doubled the products % yields. The acidic water-soluble derivatives of N-malonyl, N-adipoyl, and N-sebacoyl Chitosan were extended by grafting process in toluene with different poly(ethylene glycol) molecular weights (2000, 40000, and 20000 g/mole). Different %yields were obtained depending on the type of the derivative and the poly (ethylene glycol) chain length to evaluate their effect on binding to the human genomic DNA. The effect of these chitosan derivatives grafted poly (ethylene glycol) samples with human DNA has been explored by using electronic absorption spectroscopy and gel electrophoresis techniques. The observed changes in the physicochemical features of the polymers derivatives on binding to DNA suggest that they may bind to DNA with electrostatic interaction mode.

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Thermo-responsive hybrid microgel particles with gold nanorods

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Microgels are intramolecularly cross-linked polymer particles of colloidal size that swell and deswell in a good solvent in response to external stimuli. Depending on the composition, they can be sensitive to external conditions such as temperature, pH, magnetic field, light, osmotic strength, and solvent composition; with temperature being considerably investigated because it represents an effective stimulus in many applications. I will be talking about thermoresponsive hybrid materials based on the assembly of gold nanorods, Au NRs, into the multi-responsive, cross-linked copolymer microgel particles. These microgel particles were prepared by the surfactant-free emulsion polymerization of N-isopropylacrylamide and acrylic acid with N,N'-methylene bis-acrylamide as a cross-linker, which provides particles sized approximately 160 nm that are interconnected with one other. CTAB-stabilized Au NRs were also prepared independently using a seed-mediated growth method and then loaded into swollen, deprotonated, acrylic acid-containing microgel particles using the electrostatic interactions between the oppositely charged particles. Transmission electron micrograph of the as-prepared hybrid Au NRs-microgel particles confirmed that the Au NRs were attached to the surface of the microgel particles. The size-dependent temperature-responsive characteristics of the hybrid microgel particles were studied by dynamic light scattering, and it was found that as the temperature increased across the phase transition temperature, the particle size decreased to 56 % of the original volume. The thermo- and pH-responsive optical properties of the hybrid microgel particles were also systematically investigated.

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Synthesis, characterization and application of biopolymer (Pullulan)-mediated silver nanoparticles

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Metal-based nanoparticles serve very good applications in biomedical, nutritional, environment and electronic sectors. In the recent times, a novel concept, called as 'green synthesis of silver nanoparticles by combining biopolymer with silver nitrate for their stabilization. In this study, a rapid method for Pullulan-stabilized silver nanoparticles (PuAgNPs) synthesis has been developed. Different concentrations of Pullulan biopolymer (0.1-5.0% w/v) and Silver nitrate (1-12 mM) and effects of reaction time (0-30 min.), pH (@ 7.0, 9.2) were examined to investigate the formation of silver nanoparticles. The synthesized Pu-AgNPs were first screened and identified using surface Plasmon peaks of UV–VIS spectroscopy. The research results indicated that the surface Plasmon resonance peaks were observed between 410–460 nm wavelengths in UV-VIS spectroscopy studies. The morphology of the synthesized AgNPs proved a variation in spherical shape and polydispersed with an average size of 10-55 nm, using TEM. Further, five characteristic peaks (111, 200, 210, 211, 220) confirmed the presence of elemental silver and the crystalline structure of silver nanoparticles from XRD analysis. The sizes of the formed Pu-AgNPs estimated from the Debye–Scherrer's formula and the calculated nanoparticle size (in nm) also confirm the results obtained in average particle diameters from TEM studies. From FTIR spectra, stretching vibrations of hydroxyl (OH), Carbonyl (C=O) and C=C stretches exhibits the reduction and stabilization of AgNPs. Further, these pullulan-reduced AgNPs' potent antibacterial activities were analyzed using the agar well diffusion for the pathogens such as Escherichia coli, Staphylococcus aureus, Bacillus subtilis and Serratia marcescens. The synthesized PuAgNPs have shown clear zones of inhibition (about 10-25 mm) against these four bacterial pathogens in the antibacterial studies. Thus, the experimental results demonstrated that pullulan biopolymer could be used as reducing and stabilizing agent for formation of AgNPs and can be used as redoubtable bactericidal agents.

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How biodegradable plastics can help to solve plastic pollution and accumulation

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In just over 60 years since the world began to produce plastic products in earnest, close to 5 billion tonnes of plastic has been produced and this volume is set to exponentially increase. Almost all of this plastic is still present in one form or another and is accumulating both on land and in the oceans. It is imperative that plastic pollution and accumulation is reduced. One proposed solution is biodegradable plastics. However, there is a debate surrounding their ultimate role in solving plastic waste accumulation and assisting the transition towards a circular economy. The purpose of this review is to objectively review both sides of the debate so as to present a considered conclusion. The review focuses on a number of key points such as the need to challenge aspects of the debate that revolve around factors, which while having some basis, can be addressed. These include the perceived lack of true biodegradability in the marine environment, the perception that biodegradable plastics cannot readily be recycled, and the concern for emissions of methane when disposed of in anaerobic landfills. Discussion also touches upon the implications of the limited mechanical recycling lifetime of all plastic materials. The conclusion is that biodegradable plastics are a part of the solution to waste accumulation but that their efficacy will depend on the co-emergence of affordable waste sorting technology and investments in organic waste handling facilities (compost and anaerobic digestion). Significantly, this work develops the idea that there are a range of target plastic products and materials where substitution with biodegradable plastics would be the most effective way to address the issue of plastic solid waste accumulation. These can be determined by considering material flows and identifying the materials most likely to be mismanaged or not practically recyclable.

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Enhancement of mechanical and thermal properties of Poly (Lactic Acid)/ Poly (Ethylene-Co-Glycidyle Methacrylate) / hexagonal boron nitride blend-composites through electron-beam irradiation

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The main objective of this work is to determine the influence of electron beam irradiation on thermal and mechanical properties of most promising bio-based and biodegradable Poly (lactic acid) (PLA) based blend-composites. The PLA/PEGM blend is prepared, to reduce the brittleness and improve the toughness of PLA, by using twin-screw Micro compounder. However, the heat deflection temperature (HDT) and other tensile properties were reduced. The HBN has been incorporated as part per hundred i.e. 5 phr and 10phr to improve the HDT of prepared blend. The prepared specimens of blend and blend-composites were irradiated to high energy (4.5 MeV) electron beam (E-beam) at different radiation doses to introduce the cross linking among the polymer chains and uniform dispersion of HBN particles in the PLA/PEGM/HBN blend-composites. The further improvements in the notched impact strength and HDT have been achieved in the case of PLA/PEGM/HBN blend-composites. The irradiated PLA/PEGM/HBN 5phr blend composite shows high notched impact strength and HDT as compared to other Unirradiated and E-beam irradiated blend and blend-composites. The improvements in the yield strength and tensile modulus have also been noticed in case of E-beam irradiated PLA/PEGM/HBN blend-composites as compared to Unirradiated blend-composites.

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Comparison of polydioxanone and polyhydroxyalkanoate barbed and non-barbed surgical sutures: The effect of hydrolytic degradation on mechanical and morphological properties

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Introduction: Since approved by the US FDA in 2004, barbed surgical sutures have been applied to various fields, such as cosmetic, orthopedic, urological and other types of surgeries. Polydioxanone (PDO) is a well-studied absorbable suture material. An innovative biopolymer, poly-4-hydroxybutyrate (P4HB) manufactured by Tepha Inc. has been converted to various resorbable medical devices, including sutures. Both polymers are hydrolytically degraded in the body and the byproducts are metabolized and eliminated from the body without cytotoxic effects. Given the increased surface of barbed sutures, the purpose of the study was to compare the rate of change in mechanical and morphological properties of the hydrolytically degraded PDO and P4HB barbed and non-barbed sutures.

Methods: PDO and P4HB barbed sutures were fabricated with a laboratory mechanical cutting machine. Suture segments were immersed in PBS and stored in an incubator shaker maintained at 37°C. Suture samples were extracted every week for 10 weeks for measurement of weight, tensile properties and morphology.

Results: During the 10-week study, the weight loss of PDO suture was 6.5%, while there was no weight loss for the P4HB sutures. The cutting of barbs on suture's surface resulted in 42% and 62% strength loss for PDO and P4HB barbed sutures compared with non-barbed ones. Starting with same level of maximum tensile strength of 30 N, P4HB barbed sutures maintained 66% higher strength than PDO barbed sutures after 8 weeks and maintained at least 60% strength during 10-week hydrolysis (Figure 1.). SEM images indicated the integrity of barbs was maintained for both materials during the process of hydrolytic degradation.

Conclusions: P4HB barbed sutures have a longer degradation profile compared with PDO and significantly higher strength retention. In addition to the prolonged degradation profile, anchoring performance should be measured first *in vitro* and then *in vivo* to verify the unique characteristics of P4HB barbed sutures.

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An investigation on the application of chitosan based organic-inorganic hybrid biocomposites in water treatment

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Chitosan and its derivatives have got a wide range of applications in the field of environmental engineering field for the removal of innumerable noxious contaminants because of their several distinctive features such as being low cost, non-toxic, biocompatible, biodegradable, and adsorptive property. In this study, three types of crosslinked organic-inorganic hybrid biocomposites, such as chitosan/bentonite, chitosan/titanium oxide were prepared and utilized for the removal of nitrate from water by batch biosorption experiments. Effects of crosslinker dose, initial nitrate concentration, contact time, initial pH of the nitrate solution, biosorbent dose, temperature, and the presence of competitive ions on adsorption capacities were investigated. Actual adsorption capacities of ChBT, ChTi, and ChAl at a crosslinker to chitosan solution ratio of 1:40 were 35.68 and 43.62, and 45.38 mg/g as nitrate respectively. The actual adsorption capacities decreased with increase in crosslinker dose. Adsorption equilibrium isotherm models data were well fitted to the linear Freundlich isotherm model. Thermodynamic parameters indicate that adsorption process was spontaneous and endothermic. The adsorption process was better described by a pseudo-second-order equation. The results show that chitosan based organic-inorganic biocomposites are effective, low cost, and reusable for the removal of nitrate from water. This an indication of the applicability of biocomposites in water treatment.

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Innovation & sustainability in the contemporary fashion

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On the dynamic "Metropolis Age" , the Circular Economy and the Innovation Trifecta are the most valuable asset to become a reference in our markets. The global Fashion market promotes the implementation of Nanotech and Bio composites projects in this field. Please note the market by moving beyond traditional path of what means value and fulfilling business future. We can identify the strategic alliance between Fashion industry and several markets as Biopolymers, Cosmetic, Health, Architecture. For several years, while these "ECO-Fashion" program have been able to go beyond the original objectives and is seeking its way towards industrialization and mass production for enhancing the breakthrough of intelligence systems.

Every Innovative initiative are committed in improving the convergence between industries and the leading edge of the Fashion market; on this scenario is a priority the deep understanding of megatrends and new segments.

We discuss about the Unique development that will define the architecture future of ECO-Fashion world: MICRO KNITTING YARN BIOCOMPOSITES (COTTON, WOOL, SILK, GOLD & BIODEGRADABLE RESIN) FOR THE LACE ART MARKET. Include our Unique Systems of GOLD MINING COCOON SILK TREATMENT, MICRO KNITTING BIOYARN MACHINE AND PRODUCTION to Install in the Field MICROENCAPSULATION OF COSMETOTEXTILE AND HEALTH TEXTILE FUNCTIONALITIES in the Fabric. It is the evolution of Green Products to Smart products and service. SMART is all about efficiency, convenience and savings. It is a Mega Vision. It will be huge progress Innovation to zero embrace research development planning and execution. All linked to the common labyrinth of sustainability as ECO- Fashion. Unique project which combine Nano, engineered surfaces and Biopolymers to create a seamless and intelligent life for us. Every project conceive in terms of human factor with profound impact on our society. A revolution on the innovative and promissory market!

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The effect of cross-linking and anti-microbial agent on the performance of poly(vinyl alcohol) and cellulose acetate based membranes designed for wound dressings

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In recent years, research focusing on developing biomedical products from various polymeric membranes has witnessed a tremendous expansion attributed to their unique properties. Flexible thin polymeric membranes prepared from bioresorbable and biocompatible polymers, having a cross-linked network, are known to absorb and maintain their physical structure and integrity at the site of implantation. This generates the release of various biologically active components thus helping to restore the structure of injured and diseased tissues. The present work focuses on evaluating polyvinyl alcohol (PVA) and cellulose acetate (CA) based membranes cross-linked with tetraethylorthosilicate (TEOS) for wound dressing applications. These membranes contain varying percentages of alumina (Al_2O_3) and chitosan to provide them with antimicrobial properties. Previously, these membranes were developed for filtration and desalination, and we plan to use them as occlusive wound dressings, where the exudate absorption, water vapor transmission and ion exchange will be crucial performance properties. Following synthesis, this project is currently in its characterization phase, which is critical to wound dressings development. The thermal, chemical and surface characterization of the PVA and CA based membranes is being executed using TGA, FTIR, SEM, optical microscopy, TOF-SIMS and XPS. The samples were observed to have cross-links by identifying the presence of certain peaks throughout the FTIR fingerprint region. Additionally, through SEM we could witness a smooth continuous surface and layered cross-section lacking porosity both on the surface and through the cross-section for the samples. Further, TGA data confirmed that the elevated temperature for processing and sterilization will not contribute to premature degradation since the degradation peak was above 250°C for all samples. Characterization of these membranes to analyze their surface and antimicrobial properties is still ongoing.

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Advanced smart medical stockings using stress-memory polymeric filaments for chronic disorders

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Severely damaged veins in the human body leads to development of phlebological and lymphatic diseases such as venous ulcers, edema, and deep vein thrombosis (DVT). Compression stocking is considered as gold standard in the conservative treatment of chronic venous disorders i.e. compression therapy. It has always been a great challenge for both health practitioners and manufacturers to maintain the desired level of compression pressure in the stockings. At present, there are several shortcomings such as different class of stockings needed for different legs, different class of stockings, no massage benefits, leading to patients' noncompliance and in effective compression therapy. There is a need of any scientific approach to solve such real problems by discovering any smart material whose internal pressure can be controlled externally. In line with this, a novel phenomenon of stress-memory was discovered in a semi-crystalline memory polyurethane filaments, whose stress can be programmed, stored, and retrieved reversibly upon an external heat stimulus. Stress-memory filaments were integrated into a smart flexible textile structure to make a medical stocking and its structure was varied with different knitting parameters and optimized to achieve the maximum interfacial compression pressure results. The optimized smart stockings were studied for the effect of physical parameters such as temperature, strain, and leg radius. Further smart stocking structures were investigated for the dynamic pressure (massage) test and selected the best one which gives maximum massage benefits and sustenance. The massage effect on the blood flow was also confirmed by Doppler ultrasound scanning. The interfacial pressure of the stockings can be varied via temperature, number of stress memory filaments, structure design externally on a human leg unlike conventional ones. Multifunctional smart medical stockings would revolutionize the way of compression therapy by providing static and massage functions, easy wear ability, and selective pressure control.

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Studies on modification of poly lactic acid to enhance its thermal and mechanical properties

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Poly Lactic Acid's (PLA) industrial applications are limited due to its poor thermal and mechanical properties. Rationale of this present work is to modify PLA by reinforcing it with organically modified MMT clay, thereby making films with properties that are ideally suited for packaging application. PLA flexible films are developed using solvent casting method. The mechanical and thermal properties are studied using tensile test and thermo-gravimetric analysis there by determining the optimum percentage of clay to be loaded. The incorporation of organically modified clay in PLA matrix offered better effect than the incorporation of unmodified clay. The organically modified clay has increased the thermo-mechanical properties. The water absorption and solubility test also support the data from thermo-mechanical tests. The 3 wt % OMMT clay loaded PLA films showed the best results among all. The scope of this work is to extend the level and usage of PLA in packaging and other outdoor applications.

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Biopolymeric nanoparticles in analytical sensing tools

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Biopolymer derivatized nanoparticles offer many advantages to be incorporated in various tools and technologies being developed by sensing fraternity. Chitosan, starch and many other biopolymers are suitable biopolymers as these natural polymers have excellent properties such as biocompatibility, biodegradability, non-toxicity and adsorption properties. Being environment friendly with such excellent characteristics prompted us to exploit it as polymeric format for developing molecularly imprinted polymers (MIP). Molecular imprinting offers creation of artificial receptor in a facile manner. MIPs often named as 'artificial enzymes' and/or 'artificial antibodies' are one of the most promising technique in sensor designing. The major benefits of MIPs compared with antibodies are their high and almost unlimited-stability and easy way of preparation at a large scale that unquestionably outperform antibodies in terms of costs. Nanoparticles of chitosan and starch with selective molecular recognition properties are attractive as they can easily be incorporated into existing analytical or preparative platforms to unravel various practical problems. An attempt is made in our laboratory to use biopolymer chitosan and starch as polymeric formats to imprint some analytes in nano-configuration. Chitosan, bearing primary amine groups, soluble in aqueous medium at acidic pH < 6.0, endowing them positive charge ($-NH_3^+$), can easily be attached with negatively charged surface or can adsorb negatively charged material, hence, commonly used for dispersing nanomaterials and immobilizing the target material for preparing sensing matrices. A simple, facile, cost-effective, sensitive and selective but still easy to fabricate sensors by molecular imprinting of biopolymer chitosan/starch in nanoformat are effective eco-friendly alternatives to other synthetic sensing matrices and they were able to detect analytes at trace level. Being simple, inexpensive, ecofriendly, rapid, high sensitivity and improved detection limit are promising for these tools.

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Optimization and preparation of Methylcellulose edible film combined with of *Ferulago angulata* essential oil (FEO) nanocapsules for food packaging applications

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The films based on methylcellulose with biodegradable and antioxidant activity incorporated with nano capsule suspension containing F. angulata essential oil were developed. Oil extraction and identification of F. angulata essential oil compounds was done. Nano capsule suspension containing F. angulata essential oil was prepared by ultrasonic bath. The films were prepared by a casting method in three different ratios. The mechanical properties, colour, light transmission, antioxidant activity and release rate characteristics of the films were studied. The addition of nano capsule suspension to methylcellulose films decreased the thickness, tensile strength but increased the percentage elongation at break (%E) and lightness. High antioxidant activity and a prolonged release of F. angulata essential oil were also reported. Five factors design of Response Surface Methodology were used to optimize the thickness, holding time and anti-oxidant effect of edible film based on methylcellulose incorporated with nano capsule suspension containing F. angulata essential oil. Design of experiments was carried out by the software: Minitab 17 (Sigma package). Optimization of thickness, 2, 2-diphenyl-1-picrylhydrazyl radical scavenging and holding time would yield the best mixture proportions of methylcellulose and nano capsule suspension 30%, 30% and 70%; oil.

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Alginate/κ-Carrageenan and alginate/gelatin composite hydrogel beads for controlled drug release of curcumin

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Hydogel beads based on natural polymers like alginate, κ-carrageenan and gelatin represent an efficient scaffold for targeted hydrophobic drug delivery. We report herein the development and characterization different formulations of hydrogel systems based on the above mentioned polymers having adequate properties as drug delivery matrices. Different combinations of alginate/κ-carrageenan and alginate/gelatin hydrogel beads were developed and drug release properties were compared using curcumin as a model drug. Morphology, swelling behavior and analytical characterization of the matrices were carried out using IR spectroscopy and SEM. Alginate/κ-carrageenan hydrogel beads with 50:50 weight ratio exhibited higher swelling and better drug release percentage than compared to other beads. Encapsulation efficiency and drug release behavior of different formulations of alginate/κ-carrageenan and alginate/gelatin, indicates that the polymer blends synthesized possess considerable potential in pharmaceutical and medicinal applications.

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Alkaline surfactant enhanced oil recovery with special emphasis of chemical adsorption onto the porous media

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In Alkaline Surfactant Enhanced Oil Recovery (ASEOR) an alkali and surfactant/surfactants are used to recover the residual oil that remains after secondary brine flooding. The alkali, which is Sodium Hydroxide (NaOH) in this case, reacts with acidic components in the crude oil to form surface-active substances. A GC-MS spectrum of Upper Assam crude oil reveals the presence of carboxylic acid groups leading to in situ formation of surfactants, which in turn decreases the interfacial tension (IFT) between the oleic and aqueous phases for better oil recovery. While the anionic surfactants used were Black Liquor (BL) and Sodium Dodecyl Sulphate (SDS). The Critical Micellar concentration (CMC) of BL and SDS one at a time was added to NaOH to enhance the effectiveness of NaOH in further decreasing the IFT of the Alkali-Surfactant (AS) slugs. The paper also makes an attempt to study the adsorptive nature of the AS slugs. The best fit adsorption isotherm was derived by using SciDAVis scaled Levenberg-Marquaradt algorithm regression co-efficient.

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