Clarissa Ciarlantini

WORK EXPERIENCE

UNIVERSITÀ LA SAPIENZA DI ROMA – ROMA, ITALY

DOTTORATO DI RICERCA – 01/11/2020 – 31/10/2023

LA SAPIENZA UNIVERSITÀ DI ROMA – ROMA, ITALY

ASSEGNISTA DI RICERCA – 01/11/2023 – 31/10/2025

Vincitrice dell'assegno di ricerca all'interno del progetto europeo Life Muscle.
Caratterizzazione di retine in PP per lo sviluppo di un'acquacultura più sostenibile e green.
https://lifemuscles.eu/

EDUCATION AND TRAINING

2017 – 2020 Roma, Italy

LAUREA MAGISTRALE IN CHIMICA INDUSTRIALE (LM-71) CURRICULUM MATERIALI POLIMERICI
Università La Sapienza di Roma

Field of study Macromolecole | **Final grade** 110 e lode / 110 |

Thesis Scaffold biomimetici a base di chitosano e alginato per applicazioni biomediche

2014 – 2018 Roma, Italy

LAUREA TRIENNALE IN CHIMICA INDUSTRIALE (L-27) Università La Sapienza di Roma

Field of study Macromolecole | **Final grade** 110 e lode / 110 |

Thesis Funzionalizzazione di sistemi polimerici a base di chitosano per applicazioni biomediche

01/11/2020 – 31/10/2023 Roma, Italy

DOTTORATO DI RICERCA IN SCIENZE CHIMICHE La Sapienza Università di Roma

Field of study Chemistry | **Thesis** Sviluppo di sistemi polimerici bioattivi per applicazioni mediche

LANGUAGE SKILLS

Mother tongue(s): **ITALIAN**

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken production	Spoken interaction	
INGLESE	B2	B2	B2	B2	B2
SPAGNOLO	B2	B2	B2	B2	B2

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

SKILLS

Padronanza del Pacchetto Office (Word Excel PowerPoint ecc) | Scientific Software (Kaleidagraph) | Buona padronanza dei software di data-analysis Origin, Omnic e TA Netzsch | elaborazione dati | DSC | TGA | Spettroscopia IR | Spettroscopia UV | INSTRON | chemical preservation | operate scientific measuring equipment | types of polymers | types of pulp | consult students on learning content | water chemistry analysis | statistics | Prove antiossidanti | teach in academic or vocational contexts | HPLC-UVVis | Polisaccaridi e polimeri di sintesi | Tecniche di caratterizzazione | Sviluppo di sistemi polimerici per applicazioni biomediche | Sviluppo di sistemi polimerici bioattivi e antimicrobici | Caratterizzazione di polimeri di sintesi | Sviluppo di sistemi polimerici per il trattamento dei siti inquinati | Sviluppo di membrane per packaging | Sviluppo di processi green per il riciclo dei polimeri di sintesi

PUBLICATIONS

2021
Chitosan–graphene oxide composite membranes for solid-phase extraction of pesticides

Authors: Ilaria Silvestro, Clarissa Ciarlantini, Iolanda Francolini, Pierpaolo Tomai, Alessandra Gentili, Chiara Dal Bosco, Antonella Piozzi | **Journal Name**: International Journal of Molecular Sciences | **Volume, Issue and Pages**: Vol. 22, n. 16, pp. 8374

2022
Molecularly Imprinted Polymers Based on Chitosan for 2, 4-Dichlorophenoxyacetic Acid Removal

Authors: Ilaria Silvestro, Marta Fernández-García, Clarissa Ciarlantini, Iolanda Francolini, Annamaria Girelli, Antonella Piozzi | **Journal Name**: International Journal of Molecular Sciences | **Volume, Issue and Pages**: Vol. 23, n. 21, pp. 13192

2024
Design of bioactive and biomimetic scaffolds based on chitosan-alginate polyelectrolyte complexes for tissue engineering

Authors: Clarissa Ciarlantini, Iolanda Francolini, Ilaria Silvestro, Alessia Mariano, Anna Scotto d'Abusco, Antonella Piozzi | **Journal Name**: Carbohydrate Polymers | **Volume, Issue and Pages**: Vol. 327, pp. 121684

2023
Design of a 3D Amino-Functionalized Rice Husk Ash Nano-Silica/Chitosan/Alginate Composite as Support for Laccase Immobilization

Authors: Francesca Romana Scuto, Clarissa Ciarlantini, Viviana Chiappini, Loris Pietrelli, Antonella Piozzi, Anna M Girelli | **Journal Name**: Polymers | **Volume, Issue and Pages**: Vol. 15, n. 14, pp. 3127

2024
Development of Antioxidant and Antimicrobial Membranes Based on Functionalized and Crosslinked Chitosan for Tissue Regeneration

Scrivi qui la descrizione...

Authors: Clarissa Ciarlantini, Elisabetta Lacolla, Iolanda Francolini, Marta Fernández-García, Carolina Muñoz-Núñez, Alexandra Muñoz-Bonilla, Antonella Piozzi | **Journal Name**: International Journal of Molecular Sciences | **Volume, Issue and Pages**: Vol. 25, n. 4, pp. 1961

2025
Antioxidant and UV shielding starch-based films plasticized using choline chloride and self-polymerized dopamine: effect of starch acetylation and polydopamine amount

Authors: Susanna Romano, Serena De Santis, Clarissa Ciarlantini, Antonella Piozzi, Giovanni Sotgiu, Daniele Rocco, Monica Orsini | **Journal Name**: International Journal of Biological Macromolecules | **Volume, Issue and Pages**: Volume 316, Part 2

CONFERENCES AND SEMINARS

04/09/2022 – 07/09/2022 Trento
XXIV Convegno Nazionale Associazione Italiana Macromolecole

Biomimetic scaffolds based on polysaccharides for tissue engineering
Abstract:
The present work concerned the development of biomimetic scaffolds applicable in tissue engineering. Spe-cifically, chitosan (CS) and alginate (AL) were mixed at different molar ratios to fabricate scaffolds by the freeze-drying technique. To increase physical properties, the 3D structures were then crosslinked with CaCl2. Finally, bioactive

molecules were introduced in the scaffolds using different procedures. Biological tests did not show an increase in cell viability for the different systems. Therefore, CS/AL scaffolds were fabricated by the electrospinning technique using polymers such as PVA or PEO as third component. SEM analysis evidenced that the morphology of these samples was more suitable for cell-biomaterial interaction. The electro-spun scaffolds were functionalized with biomimetic molecules. Biological tests are underway to verify the possible application of these systems in tissue engineering.

24/06/2024 – 28/06/2024 Roma

2nd Symposium for YouNg Chemists: Innovation and Sustainability (SYNC)

Development of antioxidant wound dressings based on functionalized and crosslinked chitosan
Abstract:
The development of systems that can heal a high percentage of wounds quickly, completely, and sustainably is of paramount importance in daily clinical practice. This necessity has led researchers to develop bioactive membranes, i.e., systems capable of encapsulating components that can have a positive action on the healing process, limiting inflammatory phenomena. In the realization of these devices, polymers of natural origin are widely used, thanks to their biocompatibility, absence of toxicity, and biodegradability [1]. In the present work, innovative dressings based on modified chitosan (CS) were developed using the solvent casting technique. In particular, CS, characterized by good antimicrobial activity [2] but poor dimensional stability in physiological environment, was first modified with glycidylmethacrylate (GMA) and glycerol (GLY) and then with ethylene glycol dimethacrylate (EGDMA). GMA was introduced into the polysaccharide to have a functionality (double bond) to be exploited in the subsequent crosslinking reaction with EGDMA, while GLY was taken into consideration as a plasticizer to provide a good degree of elasticity to polymer films. To evaluate the effect of GLY on the mechanical properties of the developed matrices, the films were obtained by varying the glycerol concentration (10, 20 and 30% w/v). For all samples, at each concentration of GLY, an increase in the elongation at break and in the dimensional stability in an aqueous environment was observed, accompanied however by a considerable decrease in the elastic modulus. However, for amounts above 20% GLY, the matrix was too fragile and therefore not suitable for applications in tissue regeneration. Furthermore, the GLY concentration that ensured the greatest elongation at break was 20% (w/w). Therefore, this matrix was subjected to the cross-linking process. To evaluate how the cross-linking process affected the elasticity of the films, three different concentrations of EGDMA (0.05–0.1–0.5 mM) were tested for the same reaction time (5 min). The cross-linked matrices showed a significant increase in the elastic modulus value for all the concentrations. However, the concentration that allowed the maintenance of adequate elongation at break values and allowed maintaining the hydrophilicity (θ° = 86.5 ± 0.6) and the appropriate water vapour transmission rate (WVTR = 450 ± 10) was 0.05 mM. To avoid possible inflammatory reactions during the healing phase, the films were functionalized with 3,4 hydroxycinnamic acid (HCAF), an antioxidant capable of limiting the phenomenon of oxidative stress [3]. The introduction of the antioxidant into the films was carried out both by covalent bonding between CS amino groups and the ortho position of the catechol ring, using laccase as catalyst, and imbibition. In both cases, the introduction of HCAF molecules increased the antioxidant and adhesive properties. Finally, antimicrobial tests in broth showed the effectiveness of the membrane containing the physically bound antioxidant.
[1] Sahana T.G., Rekha P.D. *Mol Biol Rep*, 2018, 45, 2857.
[2] C. Goy R., De Britto D., B. G. Assis O., *Polímeros: Ciência e Tecnologia*, 2009, 19, 241.
[3] Hussain T., Tan B., Yin Y., Blachier F., C. B. Tossou M., Rahu N., O*xidative Medicine and Cellular Longevity*, 2016, 2016, 1.

20/06/2022 – 23/06/2022 Roma

First Symposium for YouNg Chemists: Innovation and Sustainability

Preparation of biomimetic polysaccharide-based scaffolds for tissue engineering
Abstract:
Biomedicine is an area of medical sciences that applies principles of natural sciences to obtain new diagnostic and therapeutic techniques and technologies, which can be used in various applications. In this context, biomaterials [1] offer numerous opportunities and challenges in fields such as wound healing, drug delivery and tissue engineering. For this latter application, it is crucial to produce synthetic extracellular matrices (ECM) capable of promoting cell-biomaterial interaction, ensuring the correct supply of gas and nutrients to the cells and avoiding the production of inflammatory reactions or the release of toxic molecules. Among the materials that most attracted the attention of the research, polysaccharides (for example chitosan, alginate, or hyaluronic acid) play an important role as they possess biocompatibility, bioactivity, and biodegradability features. Furthermore, the presence of functional groups in their backbone makes them easily modifiable by both chemical reactions and physical interactions with different molecules, allowing the development of structures that could mimic the extra cellular matrix [2]. In the present work, innovative biomimetic polysaccharide-based scaffolds were developed by using the freeze-drying technique. In particular, Chitosan (CS), characterized by a good antimicrobial activity [3] but poor mechanical properties, was mixed with Sodium Alginate (AL), polymer able to produce resistant gels by using divalent cations [4]. To investigate the influence of the different contents of the two polymers on the mechanical, biological, and physical properties of the systems, the scaffolds were prepared by using different molar ratios of CS and AL. In addition, to improve the poor dimensional stability of polysaccharides in aqueous medium, the scaffolds were cross-linked with calcium chloride ($CaCl_2$). The obtained systems showed a significant increase in mechanical resistance compared to homopolymer-based scaffolds and non-crosslinked matrices. However, the crosslinking reaction with Ca^{2+} ions led to a slight collapse of the 3D structure and a minor pore interconnection. To promote cell interactions, the scaffolds were functionalized with an

antioxidant (3,4 hydroxycinnamic acid), capable of limiting the oxidative stress phenomenon. The introduction of the antioxidant in the scaffolds showed an increase in the porosity as well as in pore interconnection of the matrix which, however, maintained a good dimensional stability in aqueous medium and very good mechanical resistance. Finally, two procedures were used for developing of biomimetic scaffolds: introduction of sulfonate groups ($SO3^-$) and functionalization of the 3D structures with heparin. Biological tests showed no increase in cell viability of these matrices compared to the non-functionalized ones, probably due to the low porosity of the scaffolds not allowing proper cell adhesion and proliferation. For this reason, the electrospinning technique was considered for the development of 3D matrices. Preliminary results confirmed the potentiality of this technique in producing porous fibrous structures with different fiber diameters and a high pore interconnection. Biological tests are underway to verify the possible application of these systems in tissue engineering.

[1] L. G. Griffith, «Polymeric Biomaterials» Acta mater., vol. 48, pp. 263-277, 2000.
[2] S. S. Rajesh R. Naik, «Introduction: Bioinspired and Biomimetic Materials» Chem. Rev., vol. 117, pp. 12581-12583, 2017.
[3] D. d. B. O. B. G. A. Rejane C. Goy, «A Review of the Antimicrobial Activity of Chitosan,» *Polímeros: Ciência e Tecnologia,* vol. 19, n. 3, pp. 241-247, 2009.
[4] M. P. K. CK, «Ionically crosslinked alginate hydrogels as scaffolds for tissue engineering: part 1. structure, gelation rate and mechanical properties,» *Biomaterials,* vol. 22, pp. 511-521, 2001.

12/06/2024 – 13/06/2024 Rimini
Macrogiovani 2024

Development of magnetic molecular imprinted polymer systems for biomedical applications
Abstract:
In recent years, molecularly imprinted polymers (MIPs) have received increasing attention due to their unique characteristics such as high stability, simple preparation, robustness, specificity in molecule capture, and low cost of production. The molecular imprinting approach has allowed the development of promising systems to be used both in environmental applications for the capture of pollutants[1], and in the biomedical field for drug administration, to remove undesirable substances from the body or as diagnostic sensors[2]. Moreover, the functionalization with small molecules can make MIPs a powerful tool for drug delivery. MIPs can also be combined with different nanomaterials such as silica (SiO_2), iron oxide (Fe_3O_4), gold (Au) and silver (Ag) to produce multifunctional composite systems with improved properties[3]. In this work, innovative magnetic MIPs for ciprofloxacin (CPR) delivery were developed. CPR, a fluoroquinolone antibiotic of second-generation, possesses activity against Gram-positive and Gram-negative microorganisms and is frequently used for treating bacterial infections. We developed a nanostructured magnetic composite system consisting of an inorganic core (Fe_3O_4 nanoparticles) and two polymeric shells, the first composed of chitosan (CS), to avoid nanoparticle aggregation phenomena, and the second one of a molecular imprinted acrylic polymer. CS was chosen for its biocompatibility, good antimicrobial activity, and absorbent capacity[4].
To obtain the MIP system, an in-situ polymerization of methacrylic acid (MAA) with ethylene glycol dimethacrylate (EGDMA), as a crosslinking agent, and CPR, as a template, was used. Different concentrations of MAA, EGDMA and CPR were investigated. Finally, to evaluate the effectiveness of nanostructured magnetic MIPs, non-imprinted systems (NIPs) were also prepared. The successful coating of Fe_3O_4 was confirmed by FTIR and elemental analysis. FESEM analysis showed the production of spherical nanoparticles with size of about 10 nm. Following the coating processes with CS, MMA and EGDMA the particle size increased up to 60 nm. The CPR absorption kinetics highlighted the greater effectiveness of MIP compared to NIP, due to the formation of specific cavities of the target molecule. Finally, antimicrobial tests showed a 100% reduction in bacterial growth in the case of MIPs, due to the higher release rate compared to NIPs.
1. I. Silvestro, M. Fernández-García, C. Ciarlantini, I. Francolini, A. Girelli, A. Piozzi, Int. J. Mol. Sci., 23, 1–18, 2022.
2. A.G. Ayankojo, R. Boroznjak, J. Reut, A. Öpik, V. Syritski, Sensors Actuators B Chem., 353, 1-7, 2022.
3. S. A. Zaidi, Biomater. Sci., 5, 388–402, 2017.
4. I. Aranaz, A. R. Alcántara, M. C. Civera, C. Arias, B. Elorza, A. H. Caballero, N. Acosta, Polymers, 13, 1–27, 2021

08/09/2024 – 11/09/2024 Napoli
XXV Convengo Nazionale Associazione Italiana Macromolecole

Antioxidant and antimicrobial functionalized chitosan membranes to promote tissue regeneration
Abstract:
In this study, membranes based on chitosan (CS) modified with glycidyl methacrylate (GMA) were prepared using the solvent casting technique. Exploiting the double bonds of GMA, the membranes were then cross-linked with ethylene glycol dimethacrylate (EGDMA). GLY was used as a plasticizer to provide the systems with a good degree of elasticity. To evaluate how the crosslinking process and plasticizer content affected the mechanical properties of the films, different concentrations of EGDMA and GLY were investigated. Furthermore, to make membranes bioactive, a functionalization or imbibition reaction with 3,4-dihydroxyhydrocinnamic acid (HCAF) was carried out. While both membranes maintained good elongation at break and water absorption values, only the one imbibed in HCAF showed excellent antioxidant properties. Antimicrobial tests also demonstrated the potential of this membrane for applications in tissue regeneration.

01/09/2024 – 04/09/2024 Ischia

SusChem'24 - Workshop on Sustainable Polymers and Circular Economy of Plastics

Recovery and recycling of polypropylene socks to increase the sustainability of mussel farming

Abstract:
Mussels represent an important source of low-cost protein for many people [1] and their production is an environmentally friendly and sustainable activity, as mussels feed themselves by filtering nutrients from seawater. Nevertheless, the accidental dispersion of the seabed and along beaches of plastic "socks" used for their farming represents a significant environmental problem. Basically, for each kg of mussels produced, about 0.5 linear meters (20 g/m) of polypropylene (PP) net is used. Therefore, in the face of the Mediterranean Sea production (320 ktonnes), about 4000 tonnes of plastic waste could be produced. Considering the landfill disposal cost (0.25–0.30 €/kg), it is plausible to hypothesise that a certain number of mussel farmers usually abandon used socks at sea contributing significantly to marine litter. The recovery and recycling of the polymer material can represent a proper solution for the management of the plastic waste produced by mussel farming. However, the presence of organic materials, algae and biofouling on the surface of mussel socks makes PP not easily recyclable with traditional systems. The LIFE MUSCLES project, funded by the EU, was established to develop a new treatment method for recovering polypropylene from mussel nets [2]. Through experiments performed on a laboratory scale, it was verified that it is possible to effectively remove biofilm (93%) from the polymeric material using the Fenton like reaction (30% H_2O_2 solution, t=40 min, pH=2, T=25°C and FeSO4 as catalyst). However, to simplify the process and reduce costs, further experiments were carried out with pressurized water (25-30 bar) and in the absence of oxidizing agent (H2O2). The results showed excellent biofilm removal (98%) after 30 minutes. Moreover, process costs could be further reduced by recycling the washing water after filtration. The spectroscopic, thermal and mechanical characterization of the socks shredded and washed for 30 minutes demonstrated that the treatments undergone by the polymer had a non-significant impact on the PP physical properties, thus allowing its reuse in the same supply chain. In particular, the regenerated PP had an elastic modulus value (0.697±0.058 GPa) comparable to that of pristine PP (0.758±0.069 GPa). Therefore, as the Life MUSCLES project fully embraces the circular economy as a production model, prioritizing material recycling, to demonstrate the feasibility of this treatment process, a mobile recycling pilot plant capable of processing 300 kg of mussel nets per day was constructed. This approach will effectively lower expenses associated with new mussel nets while mitigating environmental damage.

1. Matarazzo Suplicy F., *Reviews in Aquaculture* 2020, 12, (204–223).
2. Pietrelli L., *Polymers* 2022, 14, 3469.

22/06/2025 – 27/06/2025 Groningen

EPF European Polymer Congress

Recycling and replacement of polypropylene socks for greater sustainability in mussel aquaculture

Abstract:
Mussels are a sustainable and affordable protein source that naturally filters nutrients from seawater [1]. However, the use of polypropylene (PP) "socks" in mussel farming creates a significant environmental issue. For every kilogram of mussels produced, about 0.5 meters of PP net (20 g/m) is required. With Mediterranean production at 320 ktonnes annually, this results in approximately 4,000 tonnes of plastic waste. High landfill disposal costs (0.25–0.30 €/kg) lead some farmers to discard used socks into the sea, contributing to marine pollution. To address this, the EU-funded LIFE MUSCLES project developed a method for recovering and recycling PP from mussel socks. Initial tests using the Fenton-like reaction (30% H2O2, pH=2, FeSO4, 40 min, 25°C) achieved 93% biofilm removal. To simplify the process and lower costs, pressurized water (25-30 bar) was used, achieving 98% biofilm removal in 30 minutes without oxidizing agents. Recycling the washing water further reduced operational costs. Spectroscopic, thermal, and mechanical analyses confirmed minimal impact on material properties. The elastic modulus of PP washed for 30 minutes (0.697 ± 0.058 GPa) and extruded PP (0.675 ± 0.098 GPa) closely matched that of pristine PP (0.758 ± 0.069 GPa), enabling reuse in the same supply chain. In line with circular economy principles, the project developed a mobile pilot plant processing 300 kg of mussel nets daily. This innovation reduces costs for farmers and minimizes environmental harm, offering a practical waste management solution for aquaculture.

1. Matarazzo Suplicy F.; A review of the multiple benefits of mussel farming. Reviews in Aquaculture 2020, 12, 204–223. DOI:10.1111/raq.12313.
2. Pietrelli L.; Polypropylene Recovery and Recycling from Mussel Nets. Polymers 2022, 14(17), 3469. DOI:10.3390/polym14173469.

18/09/2022 – 22/09/2022 Graz

8th International EPNOE Polysaccharide Conference 2023

Development of antioxidant wound dressings based on functionalized and crosslinked chitosan

Abstract:
Tissue engineering is an interdisciplinary field that develops new methods to enhance the regeneration of damaged tissues. Skin tissue engineering takes advantage of principles of engineering, biology and chemistry for manufacturing dressings that can promote the regeneration of injured skin. Polysaccharides such as hyaluronic acid, alginate and chitosan have appropriate biological properties to be used as wound dressings [1]. Furthermore, the presence of functional groups in their backbone makes them easily modifiable both by chemical reactions and physical interactions

with different molecules, allowing the development of materials with better antibacterial and/or anti-inflammatory activity. In the present work, innovative dressings based on modified chitosan were developed using the solvent casting technique. In particular, chitosan (CS), characterized by good antimicrobial activity [2] but poor dimensional stability in physiological environment, was first modified with glycidylmethacrylate (GMA) and glycerol (GLY) and then with ethylene glycol dimethacrylate (EGDMA). GMA was introduced into the polysaccharide to have a functionality (double bond) to be exploited in the subsequent crosslinking reaction with EGDMA, while GLY was taken into consideration to provide a good degree of elasticity to polymer films, which must be able to adapt to the skin. To evaluate the effect of GLY on the mechanical properties of the developed matrices, the films were obtained by varying the glycerol concentration (10, 20 and 30% w/v). For all samples, at each concentration of GLY, an increase in the elongation at break and in the dimensional stability in aqueous environment was observed, accompanied however by a considerable decrease in the elastic modulus. The matrices were then subjected to chemical crosslinking using EGDMA in order to create bridges between the GMA-modified CS chains. To evaluate how the cross-linking process affected the elasticity of the films, three different concentrations of EGDMA (0.05-0.1-0.5 mM) were tested for the same reaction time (5 min). The crosslinked matrices showed a significant increase in the value of the elastic modulus, but only in the case of the lowest EDGMA concentration the matrices maintained an elongation at break suitable for the development of dressings. With the aim of avoiding possible inflammatory reactions during the healing phase, the films were functionalized with 3,4 hydroxycinnamic acid (HCAF), an antioxidant capable of limiting the phenomenon of oxidative stress [3]. The introduction of the antioxidant into the films was carried out both by covalent bonding between CS amino groups and the ortho position of the catechol ring, using laccase as catalyst, and imbibition. In both cases, the introduction of HCAF molecules increased the antioxidant properties and the elastic modulus of the films. Biological tests are underway to verify the possible application of these systems in skin tissue engineering.
[1] Sahana, T.G., Rekha, P.D., «Biopolymers: Applications in wound healing and skin tissue engineering». Mol Biol Rep, vol. 45, pp. 2857–2867, 2018.
[2] D. d. B. O. B. G. A. Rejane C. Goy, «A Review of the Antimicrobial Activity of Chitosan,» *Polímeros: Ciência e Tecnologia,* vol. 19, n. 3, pp. 241-247, 2009.
[3] Tarique Hussain, Bie Tan, Yulong Yin, Francois Blachier, Myrlene C. B. Tossou, Najma Rahu, "Oxidative Stress and Inflammation: What Polyphenols Can Do for Us?", Oxidative Medicine and Cellular Longevity, vol. 2016, pp. 1-9, 2016.

16/10/2023 – 18/10/2023 Firenze
AMYC-BIOMED

Development of magnetic molecular imprinted polymer systems for biomedical applications
Abstract:
In recent years, molecularly imprinted polymers (MIPs) have received increasing attention due to their unique characteristics such as high stability, simple preparation, robustness, specificity in molecule capture, and low cost of production. The molecular imprinting approach has allowed the development of promising systems to be used both in environmental applications for capture of pollutants [1], and in biomedical field for drug administration, to remove undesirable substances from the body or as diagnostic sensors [2]. MIPs can also be combined with different nanomaterials such as silica (SiO_2), iron oxide (Fe_3O_4), gold (Au) and silver (Ag) to produce multifunctional composite systems with improved properties [3]. Moreover, the functionalization with small molecules may make MIPs a powerful tool for drug delivery. In this work, innovative magnetic MIPs for ciprofloxacin (CPR) delivery were developed. CPR, a fluoroquinolone antibiotic of second-generation having activity against Gram-positive and Gram-negative microorganisms, is frequently used for treating bacterial infections. We developed a nanostructured magnetic composite system consisting of an inorganic core (Fe_3O_4 nanoparticles) and 2 polymeric shells, the first composed of chitosan (CS) to avoid nanoparticle aggregation phenomena, and the second of a molecular imprinted acrylic polymer. While the magnetic nanoparticles were chosen for their easy recovery through the application of a magnetic field, and for relatively low manufacturing costs relatively low, CS was preferred for its biocompatibility, good antimicrobial activity, and good absorbent capacity [4].
To obtain the MIP system an in situ polymerization of methacrylic acid (MAA) with ethylene glycol dimethacrylate (EGDMA) as a crosslinking agent and CPR as template were used. Particularly, different concentrations of MAA, EDGMA and CPR were investigated. Finally, to evaluate the effectiveness of nanostructured magnetic MIPs, non-imprinted systems (NIPs) were also produced. UV-vis spectroscopic analysis highlighted the greater ability of imprinted systems compared to NIPs to bind CPR. Biological tests are underway to verify the possible application of these systems in drug release.
1. Silvestro, I.; Fernández-García, M.; Ciarlantini, C.; Francolini, I.; Girelli, A.; Piozzi, A. Molecularly Imprinted Polymers Based on Chitosan for 2,4-Dichlorophenoxyacetic Acid Removal. *Int. J. Mol. Sci.* **2022**, *23*, 1–18, doi:10.3390/ijms232113192.
2. Ayankojo, A.G.; Boroznjak, R.; Reut, J.; Öpik, A.; Syritski, V. Molecularly Imprinted Polymer Based Electrochemical Sensor for Quantitative Detection of SARS-CoV-2 Spike Protein. *Sensors Actuators B Chem.* **2022**, *353*, doi:10.1016/j.snb.2021.131160.
3. Zaidi, S.A. Molecular Imprinting Polymers and Their Composites: A Promising Material for Diverse Applications. *Biomater. Sci.* **2017**, *5*, 388–402, doi:10.1039/c6bm00765a.
4. Aranaz, I.; Alcántara, A.R.; Civera, M.C.; Arias, C.; Elorza, B.; Caballero, A.H.; Acosta, N. Chitosan: An Overview of Its Properties and Applications. *Polymers (Basel).***2021**, *13*, 1–27, doi:10.3390/polym13193256.

21/06/2023 – 23/06/2023 Catania
Macrogiovani 2023

Development of antioxidant wound dressings based on functionalized and crosslinked chitosan

Abstract:
Tissue engineering is an interdisciplinary field that develops new methods to enhance the regeneration of damaged tissues. Skin tissue engineering takes advantage of principles of engineering, biology and chemistry for manufacturing dressings that can promote the regeneration of injured skin. Polysaccharides such as hyaluronic acid, alginate and chitosan have appropriate biological properties to be used as wound dressings[1]. Furthermore, the presence of functional groups in their backbone makes them easily modifiable both by chemical reactions and physical interactions with different molecules, allowing the development of materials with better antibacterial and/or anti-inflammatory activity. In the present work, innovative dressings based on modified chitosan were developed using the solvent casting technique. In particular, chitosan (CS), characterized by good antimicrobial activity[2] but poor dimensional stability in physiological environment, was first modified with glycidylmethacrylate (GMA) and glycerol (GLY) and then with ethylene glycol dimethacrylate (EGDMA). GMA was introduced into the polysaccharide to have a functionality (double bond) to be exploited in the subsequent crosslinking reaction with EGDMA, while GLY was taken into consideration to provide a good degree of elasticity to polymer films, which must be able to adapt to the skin. To evaluate the effect of GLY on the mechanical properties of the developed matrices, the films were obtained by varying the glycerol concentration (10, 20 and 30% w/v). For all samples, at each concentration of GLY, an increase in the elongation at break and in the dimensional stability in aqueous environment was observed, accompanied however by a considerable decrease in the elastic modulus. The matrices were then subjected to chemical crosslinking using EGDMA to create bridges between the GMA-modified CS chains. To evaluate how the cross-linking process affected the elasticity of the films, three different concentrations of EGDMA (0.05-0.1-0.5 mM) were tested for the same reaction time (5 min). The crosslinked matrices showed a significant increase in the value of the elastic modulus, but only in the case of the lowest EDGMA concentration the matrices maintained an elongation at break suitable for the development of dressings. With the aim of avoiding possible inflammatory reactions during the healing phase, the films were functionalized with 3,4 hydroxycinnamic acid (HCAF), an antioxidant capable of limiting the phenomenon of oxidative stress[3]. The introduction of the antioxidant into the films was carried out both by covalent bonding between CS amino groups and the ortho position of the catechol ring, using laccase as catalyst, and imbibition. In both cases the introduction of HCAF molecules increased the antioxidant properties and the elastic modulus of the films. Biological tests are underway to verify the possible application of these systems in skin tissue engineering.

1.T. G. Sahana, P. D. Rekha. Mol Biol Rep, *45*, 6, 2857-2867, **2018**
2. R. C. Goy, D. de Britto, O. B. G. Assis. Polímeros: Ciência e Tecnologia, *19*, 3, 241-247, **2009**
3.T. Hussain, B. Tan, Y. Yin, F. Blachier, M. C. B. Tossou, N. Rahu. Oxidative Medicine and Cellular Longevity, 2016, 1-9, **2016**

23/10/2024 – 25/10/2024 Barcellona
SMS 2024/ NanoMed 2024/ EGF 2024/ Sensor 2024

Development of magnetic molecular imprinted polymer systems for biomedical applications

02/05/2023 – 05/05/2023 Bertinoro
11th EPF Summer School 2023 - Polymers and Ionic Liquids
