7th International Caparica Conference in

ULTRASONICS 2025

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22 – 26 JUNE

BOOK OF ABSTRACTS

7th International Caparica Conference on Ultrasonic-based applications from analysis to synthesis

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ULTRASONICS 2025

7th International Caparica Conference on Ultrasonic-based applications from analysis to synthesis

ISBN: 978-989-53350-8-4

Editors: José Luis Capelo, Carlos Lodeiro, Elisabete Oliveira, Hugo M. Santos,
Published by: PROTEOMASS Scientific Society (Portugal)
Print run: 25 Copies
Digital Edition: 250 PDF/ PDF/A
Design and Production: Frederico Duarte, Gonçalo Pedro, and Hugo M. Santos,
Website Design: Tomás Miranda
Poster Designer: Tomás Miranda

Caparica – Portugal, 2025

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Caparica | Portugal

22nd – 26th June 2025

PROTEOMASS

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INDEX

KEYNOTE PRESENTATIONS 81

SHOTGUN COMMUNICATIONS 117

WELCOME ULTRASONICS 2025

7th International Caparica Conference on Ultrasonic-based applications from analysis to synthesis

It is with great pleasure that we welcome you to Ultrasonics 2025, held in the coastal setting of Caparica, Lisbon, from June 22 to 26. This international conference represents a vital gathering point for researchers, engineers, clinicians, and innovators who are shaping the future of ultrasound science and technology.

Ultrasonics continues to evolve as one of the most versatile and rapidly expanding fields in contemporary science. The range of applications - from non-invasive diagnostics and therapeutics, to sustainable food processing and advanced materials engineering - reflects the breadth of creativity and technical excellence that defines this community.

This year's edition features an outstanding lineup of plenary speakers who exemplify the field's diversity and depth. Timothy Mason (UK), a pioneer in sonochemistry, has been instrumental in the development of ultrasound-based green technologies. Brijesh Tiwari (Ireland) brings innovative work in ultrasonic food processing and the extraction of bioactive compounds. Anu Subramanian (USA) contributes key advances in biomedical ultrasound, particularly in regenerative medicine and inflammation control. Joseph Kost (Israel) is internationally recognized for his work in ultrasound-mediated drug delivery and non-invasive therapeutic systems.

Andreas Herrmann (Germany) applies ultrasonics to materials synthesis and functional chemistry, while Kwanggeun Lee (South Korea) leads developments in high-frequency transducers and advanced medical imaging. Simon Rabinowitz (USA) is known for integrating ultrasound into clinical hepatology and pediatrics, and Gail ter Haar (UK) stands at the forefront of focused ultrasound therapy in oncology, translating fundamental research into impactful clinical tools.

In the past year alone, the field has seen major scientific breakthroughs. Researchers at Caltech developed an ultrasound-triggered 3D-printed drug delivery system capable of releasing chemotherapy in vivo, opening new avenues for personalized, implantable therapeutics (Reuters, 2025: https://www.reuters.com/business/healthcare-pharmaceuticals/health-rounds-ultrasound-triggers-experimental-3d-drug-delivery-implants-2025-05-09). At NC State University, a novel set of quantitative ultrasound parameters was used to accurately assess lung disease in animal models, representing a critical advance in bedside pulmonary diagnostics (NC State News, 2024: https://www.sciencedaily.com/releases/2024/08/240813131956.htm?utm_source=chatgpt.com).

Further innovations include the creation of wearable ultrasound devices—flexible, adhesive patches that can monitor muscle and joint activity in real time—ushering in a new era of mobile, non-invasive diagnostics. Focused ultrasound has also been shown to safely open the blood–brain barrier and assist in the reduction of amyloid plaques in Alzheimer's patients, pointing toward transformative potential in the treatment of neurodegenerative diseases. Additionally, the development of vortex ultrasound techniques for the non-invasive removal of blood clots in cerebral venous thrombosis illustrates the continuing power of ultrasonics to address urgent clinical challenges.

Under the scientific leadership of J.L. Capelo, Ultrasonics 2025 presents an ambitious and forward-looking program that reflects the dynamic and interdisciplinary nature of the field. Through plenary lectures, oral and poster sessions, workshops, and networking opportunities, this conference provides a platform for new ideas to emerge, collaborations to take shape, and applications to transition from the lab to the real world.

We would like to thank all participants, contributors, and partners for making this event possible. We look forward to an exciting and productive meeting, and to continuing the journey of discovery and innovation in ultrasonics—together.

Caparica, June 2025

José L. Capelo,
On behalf of the BIOSCOPE Group.

7th ULTRASONICS 2025 Geographic Distribution of Participants

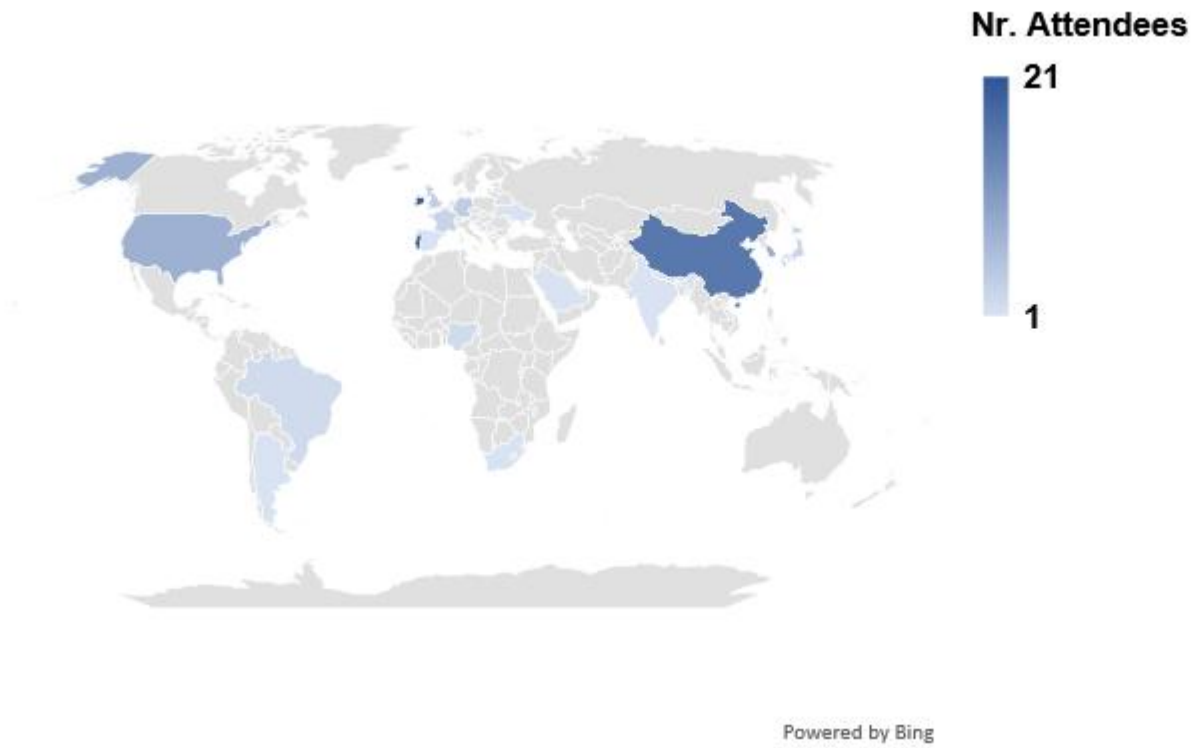

Figure 1 - Geographic distribution of delegates at the 7th ULTRASONICS 2025 Conference. Ireland (21), Portugal (19), China (16), South Korea (9), United States of America (8), Germany (4), UK (4), Croatia (3), France (3), Japan (3), Taiwan (3), United Kingdom (3), Azerbaijan (2), Brazil (2), Israel (2), Nigeria (2), Argentina (1), Belgium (1), Cyprus (1), India (1), Saudi Arabia (1), Serbia (1), South Africa (1), Spain (1), Ukraine (1).

COMMITTEES

CONFERENCE CHAIRS

José Luis Capelo Martínez

Full Professor

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Dr. J. L. Capelo got his PhD from the University of Vigo (2002), made a post-doc in the IST-UL in Lisbon (2002-2005) and then was appointed as a researcher at REQUIMTE (FCT-UNL, 2005-2009). Then, he moved to the University of Vigo as PI (2009-2012). He was appointed assistant professor in the NOVA FCT in 2012, where he is currently based. In 2017, he got a position in Analytical Proteomics at NOVA FCT and became an associate professor of Biochemistry in the Department of Chemistry at NOVA FCT. In 2024, he became a full professor of Biochemistry at the same institution. Dr. Capelo is a Fellow of the Royal Society of Chemistry and a member of the Portuguese Chemistry Society.
He is the head of the Bio-analytics & Proteomics Laboratory and co-head of the BIOSCOPE Research Group (www.bioscopegroup.org), Chairman of the PROTEOMASS Scientific Society, and Founder co-CEO of the Chemicals start-up Nan@rts. Dr. Capelo has developed research on the following topics: (i) Quantification of metal and metals species in environmental and food samples, (ii) new methods to speed protein identification and quantification using mass spectrometry-based workflows, (iii) accurate bottom-up protein quantification, (iv) Bacterial identification using mass spectrometry, (v) fast determination of steroids in human samples; (vi) biomarker discovery, (vii) Application of dyes and chemosensor to the detection/ quantification of metals and (vii) new applications of Nanoparticles in nanoproteomics and nanomedicine. Dr. Capelo has mentored 12 PhDs.

Carlos Lodeiro Y Espiño

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Professor C. Lodeiro graduated in Chemistry in 1995 and received his PhD in chemistry in 1999 by the University of Santiago de Compostela, Spain. In 1999 he moved to the NOVA University Lisbon (UNL), Portugal as a European Marie Curie postdoctoral researcher in a project concerning molecular devices and machines, and in 2004 he became a fellow researcher and invited assistant lecturer at the REQUIMTE-CQFB, Chemistry Department (UNL). In 2008 Dr. Lodeiro got the habilitation in Chemistry in Spain, and a year later in 2009 he moved to the University of Vigo, Faculty of Sciences of Ourense (FCOU), Spain as IPP (Isidro Parga Pondal) researcher-lecturer. In 2012 became Assistant Professor at the Chemistry Department UCIBIO-REQUIMTE Laboratory in the NOVA Science and Technology School, UNL. Dr. Lodeiro is Fellow of the Royal Society of Chemistry since 2014 and member of the Portuguese Chemistry Society since 2002 and the American Chemical Society since 2016. In 2017 got the habilitation in Inorganic Analytical Chemistry in Portugal at the FCT-UNL and became Associate Professor in the Chemistry Department FCT-UNL.

In 2024 became Full Professor in Chemistry. Prof Lodeiro is author and coauthor of more than 320 papers and 550 conference communications. Presently, he co-leads the BIOSCOPE research group (www.bioscopegroup.org), he is CEO of the PROTEOMASS Scientific Society, and Founder coCEO of the Chemical start-up Nan@rts. His research interest comprises (i) physical-organic and physical-inorganic chemistry of dyes and chemosensors, (ii) synthesis of Functionalized Nanoparticles, Nanocomposites and Nanomaterials (iii) applications of nanomaterials in environmental research, (iv) application of nanomaterials in bio-medical research, (v) supramolecular analytical proteomics, and (vi) Onco and Nanoproteomics. C. Lodeiro has mentored 13 PhDs plus 4 in progress.

Elisabete Oliveira

Head of the Laboratory for Mesoporous Silica Nanoparticles, Imaging and Drug Delivery
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Dr. E. Oliveira graduated, in 2006, in Applied Chemistry from FCT- Nova University Lisbon, Portugal, in 2007 obtained a master's in biotechnology and completed a PhD degree in Biotechnology in 2010, at the same University. In 2013, she obtained a second PhD degree in "Food Science and Technology" by the Science Faculty of Ourense Campus at the University of Vigo, Spain. Currently, she is Assistant Researcher at LAQV-REQUIMTE FCT NOVA (Portugal). In 2008, E. Oliveira received the prize in Creativity and Quality in Research Activity in sensors area, attributed by Foundation Calouste Gulbenkian, Portugal and in 2016 she was awarded with the Prize For Women in Science, "Medalhas de Honra L'Oréal Portugal para as Mulheres na Ciência" in the field of health Sciences. Her scientific interests are focused in (i) synthesis of new bio-inspired emissive ligands as fluorescence chemosensors, (ii) supramolecular chemistry (Photophysics and photochemistry), (iii) applications in vitro (solution and solid studies) and in vivo (cell imaging studies); (iv) synthesis of new emissive nanomaterials, as Quantum Dots and Mesoporous Silica nanoparticles for dual drug delivery and biomarker discovery in biological samples, and (v) Antibacterial studies of cargo-delivery mesoporous nanoparticles.

Hugo Miguel Santos

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HM Santos began his career in Proteomics in 2007, embarking on a joint PhD program in Biochemistry at NOVA University Lisbon (Portugal) and the Turku Centre for Biotechnology (Finland) working with state-of-the-art MS instrumentation for biomedical research. H.M. Santos took up a post-doc at the University of Vigo (2010-12 to 2011-03) followed by a move to the Institute of Biomedicine and Biotechnology (Barcelona, Spain, 2011-04 to 2012-12) to advance biomedical applications of mass spectrometry and translational research. In 2013 H.M. Santos moved to FCT NOVA to continue his research in Biological Mass Spectrometry. Currently, he is Assistant Researcher at LAQV-REQUIMTE FCT NOVA (Portugal). H.M. Santos is Member of the Royal Society of Chemistry. His scientific interests are focused on (i) Identification of molecules involved in complex biological processes, characterize their structure and monitor how their abundance may change during these processes, in order to gain insights into the underlying molecular mechanisms; (ii) nano-proteomics and nano-medicine; (iii) application of chemosensor to the detection/quantification of metals; (iv) Mass spectrometry analysis of organic molecules, metal complexes and supramolecular systems. To date, he has supervised six PhD students to completion and is currently mentoring an additional four.

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GENERAL INFORMATION

GENERAL  INFORMATION

Conference Language

English is the ULTRASONICS 2025 official language. No simultaneous translation is provided.

Certificate of Attendance

The Certificate of Attendance can be found in the conference pack for all the attendees.

Liability and Insurance

Registration fees do not include insurance coverage for participants regarding personal accidents, illness, cancellations by any party, theft, loss, or damage to personal belongings. The ULTRASONICS 2025 Conference and the Organizing Secretariat accept no liability for such incidents. Any disputes related to payment and participation will be governed and interpreted per the laws of Portugal. The parties irrevocably submit to the jurisdiction of the courts of Portugal, specifically within the Lisbon metropolitan area, for any disputes or issues arising from or related to participation in the ULTRASONICS 2025 conference. Cancellations must be made in writing. For cancellations made five months before the conference, 90% of the registration fee will be refunded. After this period, no refunds will be issued. In the event that the conference is cancelled or postponed due to natural causes or any other reasons beyond the control of the Organizing Committee, a voucher will be issued for participation in the next edition of the conference. No refunds will be provided.

Program Changes

Due to circumstances beyond the control of the Organization and ULTRASONICS 2025, last-minute changes to the programme may be unavoidable. All information in this program is accurate as of the date of printing (June 14, 2025).

Disclosure of Information

Proceedings Book is available for download at the conference website https://www.ultrasonics2025.com
Password for the book of abstracts: **S2aCrU@Li5SpCNaTcOIRA**

Privacy Policy

The right to one's image is protected under the Constitution of the Republic of Portugal and by law. Therefore, we kindly ask that you refrain from taking photographs or recording videos of any presentations, individuals, or activities during ULTRASONICS 2025 without explicit permission from the respective author or subject.

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No Photography or Videography please without permission of the author during oral or poster presentations.

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TYPE OF PRESENTATIONS

At ULTRASONICS 2025, plenary lectures, KPRK talks, keynote lectures, oral communications, shotgun communications, shotgun posters, and poster communications will be presented.

Please find important information below and carefully read the information that applies to your presentation mode.

SESSION TYPE	TOTAL LENGHT	PRESENTATION	Q&A
Plenary Lecture (PL)	40 min	30 min	10 min
Keynote Presentations (KN)	20 min.	17 min	3 min
Oral Communications (O)	15 min	12 min	3 min
Shotgun Communication (SG)	5 min.	5 min	n/a

PLENARY LECTURES (PL)

Each Plenary Speaker is allotted 30 minutes for their presentation, followed by a 10-minute question-and-answer (Q&A) session.

KEYNOTE PRESENTATIONS (KN)

Each Keynote Speaker is allotted 17 minutes for their presentation, followed by 3 minutes for Q&A.

ORAL ADVANCED COMMUNICATIONS (O)

Oral Communications is allotted 12 minutes for their presentation, followed by 3 minutes for Q&A.

SHOTGUN COMMUNICATION & POSTER (SG)

Shotgun communications will consist of **5 min** presentations (no questions) + a poster (**A0**, which must fit onto an 841 mm wide by 1189 mm long) that will be displayed and discussed during the Chillout Shotgun Poster Session.

The best Posters/Shotgun Posters presented during the conference will be awarded a certificate and a gift from the PROTEOMASS Scientific Society. They will be selected by online voting, and all the conference attendees are allowed to vote one time. Selection criteria will be based on excellent research, innovation, and presentation.

POSTER COMMUNICATIONS (P)

Posters should be **A0** (they must fit onto an 841 mm wide by 1189 mm long poster). During the poster sessions, each author must stand near the poster for Q&A.

The best posters presented during the conference will be awarded a certificate and a gift from the PROTEOMASS Scientific Society. The best posters will be selected by online voting, and all conference attendees are allowed to vote (one vote per attendee). Selection criteria will be based on excellent research, innovation, and presentation.

- All spoken presentations must be uploaded at the registration **desk HALF DAY prior** to the scheduled presentation date.
- The conference rooms will be equipped with **PowerPoint OFFICE 365** laptops.
- **Using your own laptop is not allowed.**
- **Apple platform is not supported**; ensure your files are PC compatible. Before the start of your session, visit the conference room to check your presentation, familiarize yourself with the audio-visual equipment and meet the chairperson.

MS POWERPOINT PRESENTATIONS SPECIFICATIONS

- Videos and pictures must be in the same folder as the MS PowerPoint presentation. They must be copied into the folder before being inserted into the presentation. Videos included in the presentation shall have the following extensions: ".avi", ".mpeg", ".mov," or ".wmv"
- JPG, GIF, and BMP compressed images are the preferred file format for inserted images (other types of extensions will also be accepted, provide that they are recognized by MS PowerPoint 2019).
- Use Microsoft Windows 10 default system font. Otherwise, please provide a font package for later installation.
- Please use Microsoft PowerPoint 2019 (*.pptx) to guarantee your presentation will open successfully on an on-site PC.
- Presentations must be designed in 16:9 format
- For MAC-Users: Export your Keynote presentation to PowerPoint for Mac or export it to PDF. Be aware of the need to edit/reformat the presentation - fonts, images and charts – especially when exporting to PowerPoint for Mac. For embedded movies, please use the possibility of "Quicktime" to save the movie in "*.mpeg 1(2)" or "*.avi" format.

CONFERENCE VENUE

TRYP Lisboa Caparica Mar

The conference venue, TRYP Lisboa Caparica Mar, is located in a charming village just a short 5-minute drive from Lisbon. It is situated near one of the most beautiful Atlantic beaches in Portugal, offering a perfect blend of convenience and scenic beauty.
https://www.tryplisboacaparica.com

How to reach the hotel Venue

From any place in Lisbon to the Congress Venue (Hotel TRYP LISBOA CAPARICA MAR) a taxi must be taken to the following address:

Avenida General Humberto Delgado, 47
2829-506 Costa da Caparica – Lisbon, Portugal
GPS. **38.641507 [N], -9.236489 [W]**

To ensure your smooth arrival at the conference venue, TRYP Lisboa Caparica Mar Hotel, from Lisbon Airport, we would like to provide you with the following transportation options. Please note that these recommendations have been carefully selected for your convenience:

- Uber Pickup point at Lisbon Airport. The Uber pick-up and drop-off point at Lisbon Airport is at the Departure area in Terminal 1. The Departures area is located on the first floor. After exiting the terminal, cross the street and wait for the Uber driver you requested on your app at the 'kiss & fly' parking lot. If you can't find your driver, contact him or her through the app.

- Taxi: Exiting the airport, you will find a taxi rank where licensed taxis are readily available. We strongly suggest choosing a licensed taxi with a meter to ensure a reliable and efficient journey. The estimated travel time from the airport to the hotel is approximately 20 to 30 minutes, depending on traffic conditions.

- Private Transfer: For a more personalised and comfortable experience, we highly recommend arranging a private transfer in advance. This option guarantees a seamless and stress-free journey directly to the hotel. (Contacts: Ms Isabel Morais ismorais@hotmail.com).

- Car Rental: If you prefer the flexibility of having your own vehicle, you can rent a car at Lisbon Airport. (https://www.aeroportolisboa.pt/en/lis/access-parking/for-your-full-comfort/car-rental). The hotel provides parking facilities for guests.

- Public Transportation: While public transportation is available, it may require multiple transfers and take longer to reach the hotel. However, if you prefer this option, you can take the metro from the airport to a central station, such as Cais do Sodré or Pragal, and then transfer to a bus or taxi for the final leg of the journey to the hotel.

- Avoid the following hours to travel from Lisbon to Caparica (most likely traffic jam): 18-21h
- Avoid the following hours to travel from Caparica to Lisbon (most likely traffic jam): 07-09:30h
- Always ask for a ticket from the taxi driver.

Recommended way to take a TAXI or UBER/BOLT at the Lisbon Airport

1. Before arriving at the airport, Download the App to your smartphone.
2. Call the Car from Airport Departures Zone.

Recommended private transfer for waiting for you at the Lisbon Airport

Ms. Isabel Morais
Tlf: 351 934 640 813
Email: ismorais@hotmail.com
Fixed price: **€**40

LOCAL INFORMATION

Host Capital
Lisbon

Discover the captivating allure of Lisbon, a city steeped in history and cultural richness since its establishment as the Portuguese capital in the mid-13th century. With a Mediterranean climate and a blend of ancient traditions and contemporary lifestyles, Lisbon offers a unique tapestry of character and charm.

According to legend, Lisbon was founded by Ulysses, but historical evidence points to the Phoenicians as its likely founders. The city's name, "Olissipo," derives from the Phoenician words "Aliss Ubbo," meaning "enchanting port," a testament to its captivating maritime heritage.

Lisbon holds a special place among Europe's top tourist destinations and has received numerous accolades over the years. Its timeless allure is complemented by warm hospitality, as locals embrace visitors with a familial embrace.

Prepare to be captivated by Lisbon's intriguing history, delightful cuisine, and the seamless blending of old-world charm and modern vibrancy. Join us on this extraordinary journey and uncover the wonders of Lisbon, a city that invites you to make unforgettable memories.

For more information regarding public transportations, please see:

- Metropolitano de Lisboa: https://www.metrolisbO.Apt/en/
- Carris – Transportes Públicos Lisboa (Bus): http://www.carris.pt/en/home/
- TST – Transportes Sul do Tejo (Bus): https://www.tsuldotejo.pt/?idioma=2
- Trantejo Soflusa (Boat): https://ttsl.pt/
- Fertagus (Train): https://www-fertagus.pt/en

Host city
Almada

As you immerse yourself in the scientific contributions within these pages, we invite you to discover some notable landmarks and destinations in the area. One such emblematic monument is the Santuário do Cristo-Rei, a towering masterpiece located in Almada. Standing at an impressive height of 110 meters, this statue was erected in 1959 and offers a breathtaking panoramic view of the capital city and the picturesque Tagus estuary. Inspired by the Cristo Redentor monument in Rio de Janeiro, the outstretched arms of Christ welcome both tourists and pilgrims alike, leaving an indelible impression.

Venture to the "other side" or the "south bank" of Lisbon, where you'll find the renowned Costa de Caparica. This stretch of coastline has earned a well-deserved reputation as one of the region's most beloved beach destinations. Its golden sands and inviting waters entice visitors seeking relaxation and rejuvenation.

Convento dos Capuchos

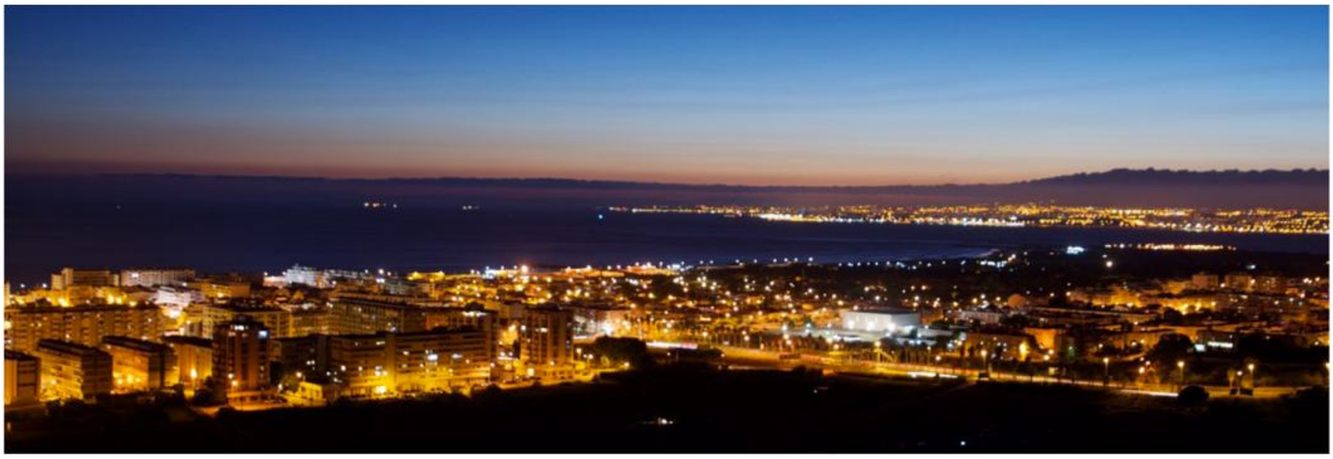
The elegant lines of the Capuchos convent set the point of equilibrium with the magnificent view reached from its viewpoint. Perched in a privileged location overlooking the Atlantic, this serene sanctuary offers an unrivalled panoramic view that stretches from Lisbon to the Serra de Sintra, the Bay of Cascais, the Bugio, the Tower of S. Julião, the Serra da Arrábida, and Cabo Espichel.

Built in the 11th century as a place of worship for the Franciscan Friars, the Capuchos Convent embodies simplicity and austerity, reflecting the principles cherished by its founders. Even after more than 400 years, this sacred site remains steeped in tranquility, providing a haven for meditation and solitude, just as its first inhabitants sought.

Meticulously restored by the Almada Town Hall, the convent seamlessly combines its original charm with modern amenities, creating an ideal cultural space particularly dedicated to music. Surrounded by idyllic gardens and embraced by the serenity of the sea, the Capuchos Convent is a sanctuary that transports visitors away from the bustling city, offering a respite for those seeking solace in heritage and nature.

Whether you love architectural marvels, seek spiritual serenity, or admire natural beauty, a visit to the Capuchos Convent is an absolute must. Immerse yourself in its timeless allure, where history whispers through its halls and the stunning vistas ignite a sense of wonder.

Costa da Caparica



Discover the hidden gem of Costa da Caparica, a dynamic and contemporary coastal town cherished by locals but often overlooked by international tourists. Prepare to be captivated by the awe-inspiring coastline, renowned for its expansive sandy beaches, breathtaking sunsets, invigorating surf, and stunning natural landscapes, all conveniently located within a short 20-minute drive from central Lisbon.

During the summer months, the Portuguese flock to Costa da Caparica, drawn by its inviting beaches, warm and welcoming family atmosphere, and the vibrant beach parties that continue late into the night at the secluded beach bars. It's a place where memories are made, laughter echoes through the air, and the spirit of celebration thrives.

Whether you seek relaxation on pristine shores, the thrill of riding the waves, or a lively beachside soirée, Costa da Caparica offers an unparalleled experience. Embrace the vibrant energy of this coastal paradise, where the fusion of natural beauty, friendly locals, and endless seaside adventures await.

Telecommunications

There are three major mobile telephone operators in Portugal that you can roam with MEO, NOS, and Vodafone. The digital mobile telephone transmission protocols are based on GMS technology, operating at frequencies of 900 and 1800MHz. Please contact your operator provider for further details.

Special numbers:

Lisbon Police: +351 21 765 4242

GNR Costa da Caparica: +351 212 909 340

Cacilhas Fireman: +3551 212 900 030

Lisbon airport: +351 21 8413500, lisbon.airport@ana.pt

SOCIAL PROGRAM

We hope ULTRASONICS 2025 will be an informative, educational, and enjoyable event. The ULTRASONICS 2025 Social Events will be a pleasant note in addition to conference sessions offering a great opportunity for networking.

Welcome Dinner

Sunday, June 22nd, 2025
Starting at 19:30
Venue: Hotel TRYP Lisboa Caparica Mar – Atlântida Room 8th Floor

Exclusive to all registered conference attendees and their accompanying guests, **registered at the venue with the conference pack**. The primary objective is to create opportunities for meaningful encounters that foster positive relationships between community members.

We want to provide a pleasant reception dinner for all our participants upon their arrival at ULTRASONICS 2025. The musical performance will be by Boemia do Fado.

Visit to Lisbon Downtown

Tuesday, June 24th, 2025
From 2:30 – 7:00 PM

Open to all registered delegates and accompanying persons. We invite you to find out more during your visit to Lisbon Downtown on Tuesday, June 24th, as scheduled in the programme, following our ULTRASONICS 2025 recommended tourist spots.

Chillout Shotgun Poster Session

Wednesday, June 25th, 2025
Starting at 18:45 – 19:30
Venue: Roof - HOTEL TRYP LISBOA CAPARICA MAR

Open to all registered delegates and accompanying persons. You are welcome to participate in the shotgun poster session by enjoying the chillout cocktail on the roof of the hotel venue TRYP LISBOA CAPARICA MAR.

Gala dinner & classical music concert

Wednesday, June 25th, 2025
Starting at 8:00 PM
Venue: Hotel TRYP Lisboa Caparica Mar – Atlântida Room 8th Floor

Exclusive to all registered conference attendees and their accompanying guests, **registered at the venue with the conference pack**. We are pleased to present diverse culinary delights inspired by Almada's rich gastronomic heritage. Nestled in a region blessed with a mild climate, fertile soil, and strong maritime connections, the local cuisine reflects the harmonious fusion of these elements.

Almada's gastronomy is intrinsically tied to the sea and its bountiful offerings. Fresh fish and shellfish abound due to its proximity to the Atlantic Ocean, forming the foundation of many renowned local specialities. Prepare to indulge in the region's flavours, including the delectable Fish Stew crafted with the finest ingredients from the sea. In addition to savouring the culinary delights, we invite you to immerse yourself in a mesmerizing musical performance by a classical Trio of violin, cello and harp. Let the enchanting melodies transport you to a world of harmony and bliss.

Join us as we celebrate Almada's vibrant culinary traditions and artistic talents during this extraordinary event.

Galician Queimada

Wednesday, June 25th, 2025
Starting at 22:00
Venue: Hotel TRYP Lisboa Caparica Mar – Atlântida Room 8th Floor

Open to all registered delegates and accompanying persons. The Queimada is a punch made from Galician *aguardiente* (orujo from Galicia, grappa in Italy, bagaço in Portugal, cachaça in Brazil)—a spirit distilled from the rest of winemaking—and flavoured with special herbs or coffee, plus sugar, lemon peel, orange peel, coffee beans, and cinnamon. It is traditionally prepared in a hollow pumpkin.

Typically, the *queimada* is set alight. While preparing the punch, a spell or incarnation (*concur* in Galician) is recited so that special powers are conferred to the *queimada* and those drinking it.

Professor Lodeiro will prepare the *Galician Queimada* in memory of all his Galician Ancestors.

Drinking together

Wednesday, June 25th, 2025
Starting at 22:30
Venue: Hotel TRYP Lisboa Caparica Mar – Atlântida Room 8th Floor

Feel free to bring a delightful beverage representing your country to share during our convivial gathering after the Gala Dinner. This unique opportunity allows us to engage in lively conversations about our places of birth or current residence, offering a fascinating glimpse into our diverse cultures and backgrounds.

As a tradition, participants often bring renowned beverages from their respective countries. Americans may bring their signature bourbon, Italians share the refreshing taste of limoncello or fine wines, Polish attendees showcase their renowned vodka, and Israeli participants proudly present their exceptional wines. The Chinese community brings the distinctive baiju, while our Japanese friends contribute sake and shochu. The list continues, celebrating the rich tapestry of global flavours and traditions. For those who prefer non-alcoholic options, we welcome an assortment of enticing beverages to suit everyone's preferences. It's during these moments of camaraderie and cultural exchange that lasting memories are made, fostering deeper connections, and creating cherished experiences at ULTRASONICS 2025.

AWARDS

The Criteria for eligibility will be based on the excellence and originality of the research presented. Selection will be made by online voting during the conference.

Best Shotgun Prizes

The best shotgun communication will be awarded a certification and a gift.

Best Posters Prizes

The best poster presentations will be awarded a certificate and a gift.

BIOSKETCHES

Timothy J. Mason, PhD

Tim Mason established the Sonochemistry Centre at Coventry University in the 1980's. In 1991 he was co-founder and then president of the European Society of Sonochemistry a post which he held until 2014. In 1994 he worked with Elsevier to establish the journal "Ultrasonics Sonochemistry" and later became its Editor in Chief until 2015. He has written or edited 19 text books on sonochemistry, the most recent was published in January 2025 and is the third edition of "Practical Sonochemistry" co-authored with Mircea Vinatoru (the first edition appeared in 1991). He has a wide range of interests in other applications of power ultrasound including environmental protection, materials and food processing, extraction technology and therapeutic ultrasound.

Andreas Herrmann, PhD

Available soon

Brijesh Tiwari, PhD

Prof. Brijesh K Tiwari is currently working as a Principal Research Officer within the Department of Food Chemistry and Technology at Teagasc Food Research Centre, Dublin, Ireland and as an adjunct professor at the School of Biosystems and Food Engineering, University College Dublin. He has an internationally recognised reputation for food engineering research as evidenced by his Highly Cited Researcher designation continuously since 2018 by Clarivates (Web of Science). His primary research interests relate to novel food processing, extraction and preservation technologies. A particular focus of his current research relates to the investigation of green and sustainable solutions to food industry challenges with the use of emerging novel technologies for the extraction of biomolecules from food processing by-products and side streams. Dr. Tiwari' scientific outputs include over 400 publications including peer-reviewed review papers, high impact research articles, conference papers and book chapters. He has also co-edited numerous books in the areas of food processing and preservation technologies. Dr. Tiwari is a fellow of International Union of Food Scientists & Technologists (IUFoST), Institute of Food Science & Technology (IFST, UK) and Fellow of Royal Society of Chemistry (RSC, UK). His editorial responsibilities include editor of LWT – Food Science and Technology and Food Chemistry.

Kwang-Geun (James) Lee, PhD

Kwang-Geun (James) Lee is a professor of Food Chemistry in Dongguk University, Korea and has a broad experience in the field of food toxicant analysis. He received his degrees in the area of food science and technology from Seoul National University (B.S. and M.S.) and University of California, Davis (Ph.D.). At Dongguk University his teaching and research is concerned with development of analytical method for various food toxicants such as furan, ethyl carbamate and mycotoxins and their reduction in food model systems. He has published 6 books and 145 refereed papers. He served as a dean for 2 years (2017-2019) in Dongguk University.

Anu Subramanian, PhD

I have spent my career as a very active researcher and I have thoroughly enjoyed the process of research, discovery and dissemination of research findings. My research interests have continuously evolved over the years within bioengineering, from molecular-affinity based separations to blood-compatible biomaterials, and now to personalized therapies using low intensity ultrasound (LIUS). I consider my research work in the area of LIUS and cartilage repair to be growing in impact in recent years due to an increase in trauma related cartilage malfunction, and our work in this area has been supported by the National Institutes of Health, most recently with a R01

Joseph Kost, PhD

Joseph Kost D.Sc. is University Distinguished Professor, holder of The Zacks Chair in Biomedical Engineering and the past Dean of the Faculty of Engineering Sciences at the Ben-Gurion University. He completed his undergraduate and graduate degrees at the Technion Israel Institute of Technology. He is a Fellow of the American Institute for Medical and Biological Engineering. International Member of the United States National Academy of Engineering (NAE). Honorary Fellow of the Israel Institute of Chemical Engineers. Member of the Controlled Release Society College of Fellows and Member of the Israel Academy of Sciences and Humanities. His research is at the interface of chemical engineering, biotechnology, nanotechnology and biomaterials to develop polymeric systems for targeted drug/gene delivery

Simon Rabinowitz, PhD MD

Dr Rabinowitz is an “old school” Pediatric gastroenterologist who has cared for and written about a wide variety of diseases in his specialty. Over 15 years ago, he felt that the prevailing approach to a relatively new disease, eosinophilic esophagitis, was fundamentally flawed. Despite meeting with substantial opposition from virtually the entire Pediatric gastroenterology community, he worked diligently to prove his hypothesis. Through the analysis of over 170 endoscopic ultrasound examinations, he was able to prove his theory and developed what he has called, Endoscopic Point of Care Ultrasound (E-POCUS).

His talk will (a) illustrate the basis for his original assumption, (b) present images whose analysis has provided new insights into the disease, (c) define E-POCUS and describe the challenges encountered in creating a novel application and (d) share an innovative solution to a particularly challenging issue. His journey will serve as a template for endosonographers interested in applying E-POCUS to new clinical problems. He will end by previewing the advances that will create an exciting future for E-POCUS.

Gail Ter Haar, PhD

After an undergraduate degree in Physics, and a masters in Medical Physics, Gail undertook a Physics PhD jointly between the Physics and Anatomy departments of Guys Hospital Medical School. She has subsequently been awarded a DSc in Clinical Medicine by Oxford University.

Gail's PhD topic dealt with the effect of ultrasound on biological tissues, and during much of her subsequent career she has continued studies in this area. These are important, both to ensure the safe use of diagnostic ultrasound, and to harness (and optimize) any therapeutic benefit that may be obtained from higher ultrasound outputs. She has been heavily involved in writing guidelines for the safe use of imaging ultrasound, especially in obstetrics.

Gail was recruited to the ICR with the brief to investigate how ultrasound might be used in cancer therapy. Her research has investigated not only the heating potential of ultrasound (both hyperthermia and thermal ablation) but also (more recently) the harnessing of its mechanical effects (cavitation) to produce tissue emulsification and to enhance immunotherapy. Her group investigates the basic science involved in the interactions between ultrasound and cells using in vitro, ex vivo and in vivo techniques, builds devices for pre-clinical and clinical studies, and is involved in clinical trials.

One of Gail's passions is to help promote the international community working in therapeutic ultrasound, and to this end she became the Founding President of the International Society of Therapy Ultrasound (ISTU) in 2000, she ran the EPSRC network ThUNDDAR (Therapy ultrasound network for drug delivery and ultrasound research) in the UK, and since 2007 she has been running (with a colleague from Paris (J-F Aubry)) the Therapy Ultrasound Winter School which is held in the École de Physique des Houches every two years.

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Kyungho Yoon, PhD

Professor Kyungho Yoon is dedicated to advancing next-generation digital and smart healthcare technologies through original research that integrates computational science, artificial intelligence, and biomedical engineering. His work focuses on combining physics-based simulations with AI models to overcome the limitations of conventional simulation approaches, enabling more efficient and accurate predictions grounded in real-world physical behaviors. These innovations contribute to the realization of personalized medicine through medical digital twin technologies. By collaborating closely with hospitals and industry partners, his research goes beyond theoretical development to produce practical systems deployable in real clinical settings.

Jeong Kyu Kim, PhD

Available soon

Hersh Sagreiya, PhD

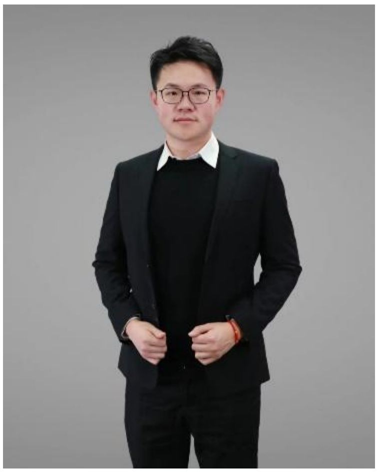
Hersh Sagreiya is an Assistant Professor of Radiology at the University of Pennsylvania and is board-certified in Diagnostic Radiology and Clinical Informatics. He graduated from Harvard College with an A.B. in Biochemical Sciences in 2007 and the Stanford University School of Medicine with an M.D. in 2012, completing a Howard Hughes Research Training Fellowship. He completed a Diagnostic Radiology residency at the University of Pittsburgh in 2017 and a fellowship at the Stanford Cancer Imaging Training Program in 2019.

As faculty at Penn, he has applied machine learning and deep learning to radiologic imaging. He received a Radiological Society of North America Scholar grant on the topic of automated fat quantification using machine learning. He also received a grant from the Society of Radiologists in Ultrasound to study how machine learning applied to thyroid nodules can predict their pathology, genetics, and clinical outcomes. A project using an unsupervised learning tool to evaluate COVID-19 on lung ultrasound was funded by the American Lung Association. He has collaborated with researchers on tools to automatically quantify imaging features, as well as the clinical implementation of these tools. He has also linked these image-derived phenotypes to large-scale clinical, genetic, and laboratory data.

Toru Omodani, PhD

Dr. Toru Omodani's medical journey is defined by a pioneering spirit in advancing musculoskeletal ultrasound and regenerative orthopedics. Throughout his career, he has combined clinical precision with innovative imaging techniques to enhance both diagnosis and treatment of sports-related injuries and degenerative conditions. A strong proponent of interdisciplinary and international collaboration, Dr. Omodani bridges orthopedics, rehabilitation medicine, and sports medicine, often leading cross-border initiatives and educational programs. His work has contributed significantly to the practical application of ultrasound-guided injections including ultrasonic tenotomy, particularly in the context of tendon pathology and joint preservation. As the director of Tokyo Advanced Orthopaedics, he continues to mentor global fellows, organize international conferences, and push the boundaries of minimally invasive musculoskeletal care.

Lionel (Xianglu) Zhu, PhD



Dr. Zhu is currently Deputy Editor in Food Science at Wiley and co-Editor-in-Chief of the journal *Food Science & Nutrition*. He is responsible for the academic development and internationalization of Wiley's food science portfolio. Dr. Zhu earned his Ph.D. in Food and Biosystems Engineering from University College Dublin, under the supervision of Academicians Da-Wen Sun and Brijesh K. Tiwari. His research interests include food science, biorefinery, food processing, and functional food development, with a focus on value-added utilization of food resources. Dr. Zhu has published nearly 30 SCI-indexed papers, authored six book chapters, and edited an international academic monograph. He serves as an editorial board member and reviewer for several high-impact journals. He has presented at over ten international conferences, including IUFoST, ACS, and Aquaculture Europe, contributing significantly to the fields of algal biorefining, ultrasonic food processing, membrane separation, and functional component development.

In addition to his academic achievements, Dr. Zhu has extensive experience in R&D and quality management in the food industry, having worked at Danone (France), Kerry Group (Ireland). His outstanding academic and professional achievements have earned him the 2024 Shanghai Pujiang Talent (Class A), the 2024 National Natural Science Youth Fund of China, and the National Postdoctoral Fellowship of China. Dr. Zhu is committed to fostering academic collaboration and promoting innovation in food science and technology.

Aleksandra Mišan, PhD

Aleksandra Mišan holds a Bachelor's degree in Chemistry and both MSc and PhD degrees in Biochemistry from the Faculty of Science, University of Novi Sad. Her career began in academia, where she served as a teaching assistant in Chemistry and Biochemistry at both the Faculty of Agriculture and the Faculty of Technology, University of Novi Sad. She later joined the Institute of Meat Technology at the same faculty, taking on the role of vice-coordinator of the HPLC and AAS divisions within the Laboratory for Food and Feed Testing.

Since January 2007, Aleksandra has been engaged at the Institute of Food Technology in Novi Sad, contributing to numerous national and international projects funded by the Ministry of Science and Technological Development of the Republic of Serbia, the Government of Vojvodina, and the European Union. Between 2007 and 2011, she also served as the coordinator of the Department of Instrumental Chemical Analysis within the accredited Laboratory for Food and Feed Testing at the Institute.

Aleksandra's professional interests lie at the intersection of food chemistry, biochemistry, and analytical sciences, with a strong focus on chromatographic techniques (HPLC and GC), natural antioxidants, functional foods, oxidative stability, and shelf-life assessment. Her work consistently bridges scientific disciplines, demonstrating a commitment to multidisciplinary collaboration that integrates chemistry, food technology, and health sciences.

Ronald Halim, PhD

Available soon

Rodrigo Costa-Felix, PhD

Rodrigo Costa-Felix has a degree in Mechanical Engineering (1995), a Master's degree in Mechanical Engineering with an emphasis in Psychoacoustic (1996) and a Doctor's degree in Biomedical Engineering (2005) with emphasis on Ultrasound Metrology.

He has been a metrology and quality researcher at the Brazilian National Metrology Institute (Inmetro) since 1996 and the head of the Laboratory of Ultrasound since 2008.

He has been training human resources and intellectual capital, having taught over 35 short courses and more than 50 lectures or seminars. Rodrigo is a professor in the Post-graduate Program in Metrology and Quality (2009-present), the Post-Graduate Program in Biotechnology (2013-present), and the Post-Graduate Program in Metrology (2019-present), all of them belonging to Inmetro. He is presently the Coordinator of Inmetro's Post-Graduate Program in Metrology and worked as Coordinator of the Post-Graduate Program in Biotechnology (2017-2021).

He has been a full member of the Brazilian Society of Biomedical Engineering (SBEB) since 2006, in which he served as Secretary (2006-2008), Treasurer (2009-2010), SBEB Board Member (2013-2014), Vice-President (2015-2016), Secretary (2017-2018), President (2019-2020), and now is a Board Member (2023-2024). He has been a Member of the Brazilian Society of Metrology (SBM) since 2014, of which he worked as a member of the Financial Council (2014-2015), Vice-President (2016-2018; 2018-2020; 2020-2022), and currently he is the President (2022-2024). Rodrigo has been an Effective Partner of the Brazilian Association and Non-Destructive Testing and Inspection (Abendi) from 2010 to 2015.

He has been working on standardization since 1997, elaborating more than 35 national and 40 international technical standards. He worked as the Coordinator of the Committee on Metrology Studies in Equipment for Non-Destructive Testing of the Brazilian Association of Technique Standards (ABNT CE-53: 000.03) from 2010 to 2018. Rodrigo has been the convenor of IEC SCT62D JWG38 (Ultrasound Therapeutic Equipment) since 2022 and an expert in many working groups in IEC TC87 (Ultrasound) since 2010.

He is a member of the Assessing Committee for Technological Development (CA-DT) of the Brazilian National Council for Scientific and Technological Development (CNPq) (2021-2024). He has been a Scientific Advisory Committee member of a private Brazilian company (GM Metrologia) since January 2024. He has been a member of the Technical Consultive Committee of a private Brazilian Company (SENAI-ISI-SIM) since February 2024.

Rodrigo has experience in Mechanical Engineering, Biomedical Engineering, Metrology, and Ultrasound. Rodrigo has authored or co-authored more than 95 papers in peer-reviewed journals and 110 papers in conferences. He is the inventor of three granted patents and one pending patent.

Rodrigo Costa-Felix worked as the Professional Development Coordinator (PDC) at Interamerican Metrology System (SIM) for two consecutive terms (2017-2019; 2020-2023).

Full CV (in Portuguese): http://lattes.cnpq.br/9563523240856147

Daniel Anang, PhD

Dr D. M. Anang's key research interests are the control of food-borne pathogens, particularly *Campylobacter*, *Salmonella*, *E. coli* and *Listeria*, in meat and poultry and their products. The control of foodborne pathogens pre-harvest and during processing using various novel technologies including the use of organic acids, ozone, ultrasound technology, non-thermal atmospheric plasma and other natural preservatives. More recently, his interest is directed to the application of ultrasound technology in the extraction of bioactive compounds in selected food industry byproducts and underutilised plant material. Emphasis has been on antimicrobial and antiglycation compounds with subsequent application in food systems; some of the materials include *Moringa oleifera*, *Tetrapluera tetraptera*, cocoa beans shells, and several Indian spices and herbs.

Yinfei Zheng, PhD

Available soon

Jaesok Yu, PhD

Professor Jaesok Yu's scientific journey is driven by an enduring commitment to advancing biomedical imaging through the seamless integration of ultrasound and photoacoustics with cutting-edge signal processing. With a foundational expertise in electrical engineering, his work has consistently bridged the gap between engineering innovation and clinical translation.

Throughout his career, Dr. Yu has championed interdisciplinary collaboration—spanning robotics, biomedical science, artificial intelligence, and photonics. This integrative approach is at the Advanced Ultrasound Research Laboratory at DGIST, where he leads efforts to pioneer new modalities in 3D neurovascular imaging, sonogenetics, high-frequency ultrasound sensing with novel silicon photonics based sensor, and blood-brain barrier opening via HIFU. His work not only contributes to the understanding of complex biological and neurovascular systems, but also aims to deliver practical, scalable solutions for real-world diagnostic and therapeutic challenges

Moshen Gavahian, PhD

Dr. Mohsen Gavahian is an Associate Professor with expertise in food science and technology. He holds B.Sc., M.Sc., and Ph.D. degrees in the field and has dedicated his career to exploring emerging food processing technologies, such as ultrasound. He has established a reputation for developing innovative, energy-saving systems to valorize agri-food waste and promote sustainability. Dr. Gavahian has successfully led academic and industrial projects and has received numerous accolades for his outstanding contributions to the field. He is honored to be recognized as one of the "IUFoST Young Scientists" and "world's top 2% scientists". Additionally, he has contributed to the field through his editorial work, serving as an Associate Editor and Editorial Board Member for several highly reputable international journals. In addition, Dr. Gavahian is a prolific author, with over one hundred well-cited scientific papers published in leading journals. He is also the editor of "Protocols in Emerging Food Processing Technologies," the first internationally recognized book in the field. Nonetheless, he remains dedicated to exploring innovative solutions to the industry's challenges and continuing to make a positive impact in his field.

Petros Mouratidis, PhD

Dr Petros Mouratidis is an ICR Fellow at the Institute of Cancer Research London. Dr Mouratidis received his PhD in pancreatic cancer biology from St. George's Hospital Medical School University of London, where he investigated the apoptotic effects of small molecules in pancreatic cancer. He then undertook postdoctoral training in the biophysics of therapeutic ultrasound under the guidance of Prof. Gail ter Haar (Institute of Cancer Research, London). Dr Mouratidis uses therapeutic ultrasound to directly kill pancreatic cancer cells and tumours or sensitise them to the effects of immunotherapy and other traditional oncologic interventions.

Gisandro Reis de Carvalho, PhD

Dr. Gisandro Carvalho is a young researcher which started to work with emerging technologies, mainly high-intensity ultrasound, still during the master's degree and followed this research line. Specialist in food process engineering with application of different emerging technologies, extensively investigated how to improve the barley malt processing, evaluating the steps and product properties. With a multidisciplinary approach, developed research in food properties, rheology, textural properties, research and development and adding value and using by-products of Food Industry. Additionally, has experience as professor and supervising undergraduate and graduate students.

Pierre Gélat, PhD

Dr P Gélat is Associate Professor at the UCL Division of Surgery and Interventional Science (Faculty of Medical Sciences). He is a Chartered Engineer with a background in physical sciences and specialises in biomedical ultrasound numerical modelling and metrology. Pierre is an expert in the field of computational acoustics and therapeutic ultrasound applied to preclinical and translational medicine. He works closely with clinicians, engineers, biologists and mathematicians to develop mathematical, computational and experimental frameworks to address unmet clinical needs, particularly in the field of cancer research and liver disease. His research is situated at the interface of the physical sciences and biological sciences, harnessing UCL's biomedical healthcare engineering. Prior to joining UCL, Pierre was employed at the National Physical Laboratory (Teddington, UK) for 16 years, the UK's National Measurement Institute.

PLENARY LECTURES

PL.1 Sonochemistry and Sonomechanobiology - Exploring the Links

Timothy J Mason

School of Health, Coventry University, Coventry, UK
** email: apx077@coventry.ac.uk*

Sonomechanobiology is a modern term which has been introduced to bring together the many and varied ways in which vibrational energy can stimulate cells and in many cases lead to therapeutic applications [1]. This field of research is related to microbiology and the ways in which cells respond to vibrations, particularly at high ultrasonic frequencies. However, research into the effects of ultrasound on whole living systems can be traced to work from 100 years ago. In those days scientific instrumentation was not as well developed as the equipment available to modern-day researchers, but the observations opened up new fields of research into the effects of high frequency sound waves on living matter [2-4].

In this presentation we will explore how this early research, was further developed in the mid-20th century leading on to the establishment of *Sonochemistry*. By 1951 a literature search on the subject of vibrational effects on cells generated a bibliography with 580 references [5]. Later developments led to remarkable medical applications including focused ultrasound surgery, sonodynamic therapy, sonophoresis, sonoporation and accelerated wound and bone healing.

Keywords
vibrations; cell stimulation; ultrasound; standing waves; therapy

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PL.2 Sonopharmacology and Sonogenetics: Controlling the Activity of Drugs, Proteins and Nucleic Acids by Ultrasound

Andreas Herrmann

DWI – Leibniz Institute for Interactive Materials, 52074 Aachen, Germany and RWTH Aachen University, Aachen, Germany

The field of optogenetics has enabled the fundamental understanding of neural circuits and disorders.[1,2] However, current optogenetic techniques require invasive surgical procedures to deliver light to target cells due to the low penetration depth of light into tissue. Therefore, ultrasound (US) was used as alternative trigger since US can deeply penetrate tissue with high spatiotemporal control. Our group develops general molecular technologies based on polymer mechanochemistry to control the activity of drugs, proteins and nucleic acids by US.[3,4,5,6,7] While initial efforts relied on low frequency (20 kHz) US that is destructive to cells and tissues, our current efforts are dedicated to two technology platforms that allow the activation of bioactive compounds by biocompatible imaging US and low intensity focussed US (LIFU). The first technology relies on high molecular weight polynucleic acids that are produced by rolling circle ampliication or transcription and that encode multiple binding sites for drugs, proteins and nucleic acids. Once these loaded nucleic acid carriers are subjected to ultrasonication, covalent and non-covalent bond cleavage occurs by collapse of US-induced cavitation bubbles leading to activation of the cargoes. In this way, gene knock-down in vitro was achieved by liberating siRNA and immunostimulation was successfully realized in vivo by activating CpG oligonucleotides.[7] Similarly, protein activity can be switched on by US, involving the mechanochemical activation of a protease that subsequently triggers split intein function for controlling the activity of a broad scope of proteins.[8] A second platform technology for low-intensity US activation is mechanophore-incorporated microbubbles that also allow the spatiotemporally controlled release of bioactives.[9]

[1] W. Haubensak, P. S. Kunwar, S. Ciocchi, J. Biag, H.-W. Dong, K. Deisseroth, E. M. Callaway, M. S. Fanselow, A. Lüthi, A. J. Anderson, Nature 468, 270 (2010).

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PL.3 Ultrasonics in Agri-Food Innovation: Bridging the Gap from Lab Discovery to Industrial Scale-Up

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Cavitation, induced via ultrasonics or hydrodynamic forces, has emerged as a promising enabler in agri-food processing, offering enhancements in mass transfer, reaction kinetics, and process efficiency [1]. Within the scope of sustainable food innovation, cavitation-assisted technologies are being harnessed to extract high-value ingredients, improve food processing, preserve and valorise side streams and biomass for high value ingredients. These processes align strongly with circular economy principles by unlocking value from underutilised side streams and reducing overall resource consumption [2]. While applied research in cavitation technologies has generated discoveries with significant industrial potential, the path from lab-scale innovation to commercial implementation remains complex. Bridging basic science with applied engineering requires not only technological acumen but also cross-disciplinary integration and system-level thinking. Key challenges include the variability of agro-industrial feedstocks, the structural complexity of biomass, and the need for robust pre-treatment strategies to enable scalable biotransformation. Advanced cavitation-assisted extraction and biorefinery approaches are being developed to valorise diverse food and agricultural residues. However, scale-up often encounters limitations in process throughput, cost-effectiveness, and reproducibility. Despite these challenges, the industrial opportunity is substantial: valorised by-products can serve as clean-label, functional ingredients supporting sustainable product reformulation and reducing dependence on conventional additives. Such innovations directly contribute to zero-waste goals, promote circular bioeconomy models, and improve the environmental footprint of food production systems [3].
This lecture will present key applications of cavitation technologies in agri-food sector, with a focus on side stream valorisation, biotransformation, and microbial decontamination. Case studies will highlight multi-product cascade biorefinery approaches and demonstrate successful integration of ultrasound-based processes into industrial settings [4]. The session will also address key bottlenecks in scale-up, emphasizing the need for cross-disciplinary innovation to bridge the gap between laboratory discovery and commercial implementation. These developments underscore cavitation's role in building a resilient, resource-efficient, and sustainable agri-food future.

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PL.4 Effects of ultrasound on the structural and physicochemical properties of various extracts from food materials

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This study analyzed the effect of ultrasound treatment (up to 9 min, 20 kHz, 130 W) on the structural and physicochemical properties of various foods material such as soymilk and coffee beans. In the treatment of ultrasound on soymilk processed with microwave-roasted (700 W for 270 s) black soybean (*Glycine max* (L.) Merr.), 1-Hexanol and 1-octen-3-ol, unpleasant soybean flavors, were found to decrease by up to 96.13% and 93.04%, respectively, in ultrasound-treated soymilk compared to the control(1). 2,3-Diethyl-5-methylpyrazine, a baked flavor, which exhibited the highest odor impact ratio in soymilk processed with microwave-roasted soybean, increased significantly during ultrasound treatment ($p < 0.05$). The content of total isoflavones, polyphenols, and flavonoids increased ($p < 0.05$) with the increase in ultrasound treatment time. Spearman's correlation analysis showed that browning was positively correlated ($p < 0.01$) with total phenols, total furans, total pyrazines, total polyphenols, and total isoflavones. In the study of the effects of organic acid-soaking (malic, citric, tartaric, and succinic acid) and sonication on the formation of flavor and α-dicarbonyl compounds in Robusta (*C. canephora* syn. *Coffea robusta*) green beans, a total of 20 volatile compounds were identified in Robusta coffee. Furfural and 5-methyl furfural, two dominant volatile compounds in Arabica coffee, increased after organic acid pretreatment(2). In Robusta coffee processed from 3% malic acid-soaked coffee beans, furfural and 5-methyl furfural increased by 90.99% and 24.92%, respectively, compared to the control. In Robusta coffee processed from 3% malic acid-sonicated (280 W, 1 h) coffee beans, furfural and 5-methyl furfural increased by 236.03% and 114.77%, respectively. α-Dicarbonyls (glyoxal, methylglyoxal, and diacetyl) were significantly ($p < 0.05$) decreased in all Robusta coffees after organic acid pretreatment. In Robusta coffee processed from coffee beans soaked and sonicated in tartaric acid solution, the α-dicarbonyls decreased by up to 44% and 58%, respectively, compared to the control. This study suggested the pretreatment methods to enhance the flavor substances and reduce the α-DCs in Robusta coffee.

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PL.5 Inflammation Control in Cartilage Repair and Regeneration: Understanding the Basis of Ultrasound in Mitigating Inflammation and Promoting Repair

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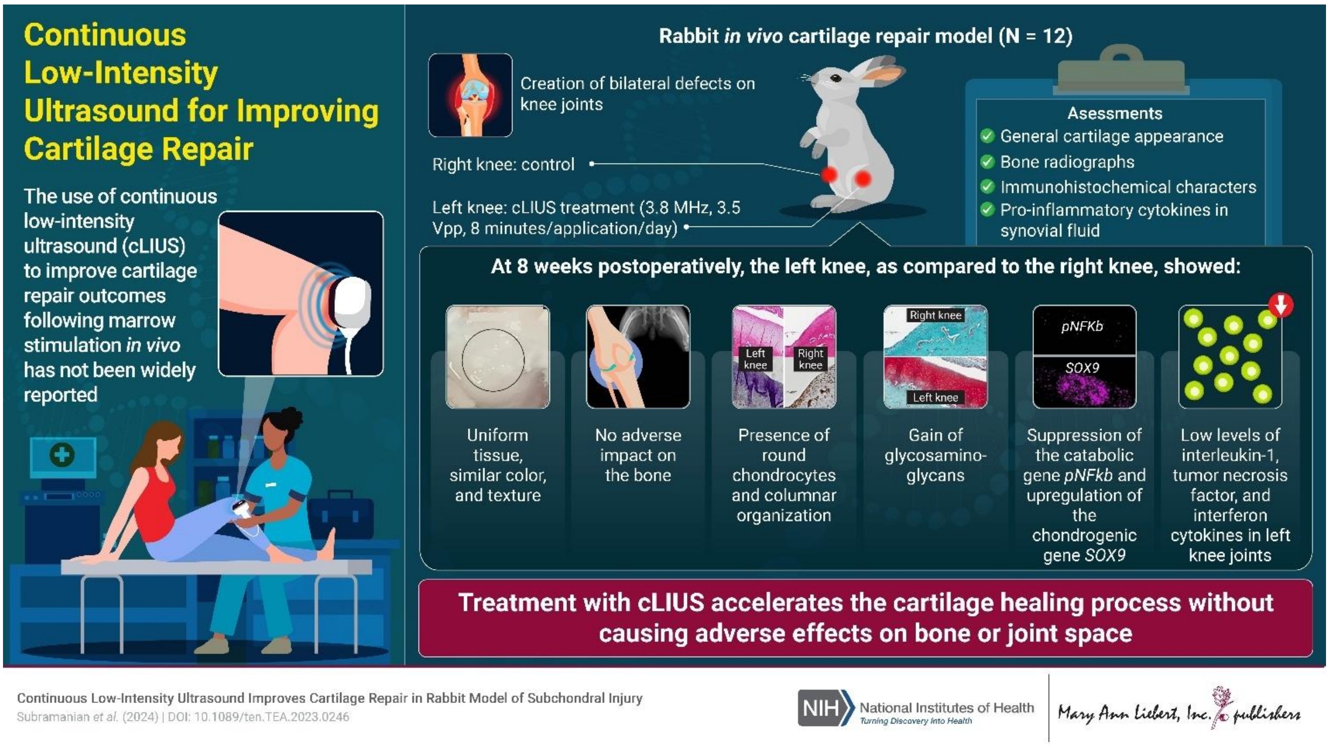
As articular cartilage is avascular with limited ability for self-repair, and as a result osteoarthritis and other cartilage injuries are biomedical burdens. Ultrasound has become an indispensable tool in diagnostic imaging, is an FDA approved noninvasive therapy mechanism and is used as an operative tool. While high intensity US (1-3 W/cm2) finds utility in ablative applications, there is a paucity of published work that investigates the ability of pulsed low intensity US (pLIUS, 1-50 mW/cm2) to improve cartilage repair outcomes. Thus we investigated continuous LIUS (cLIUS) in cartilage restoration. To attain clinically relevant transformative outcomes; in a departure from previous studies that employ empirical approaches, we opted for a systematic approach that combines modeling and experiments.

Our modelling efforts have identified a beneficial tissue resonant frequency bandwidth for ultrasound treatment where mechanical energy coupling is maximized. Building on in-vitro studies that demonstrated the ability of cLIUS to promote chondrogenesis and rescue chondrogenesis of stem cells impacted by a proinflammatory environment, the clinical efficacy cLIUS to yield superior repair outcomes upon microfracture in a rabbit model will be presented. In addition to improving treatment outcomes using cLIUS, our ongoing work focuses on understanding of early post-traumatic-osteoarthritic-progression and the role of joint non-articular cartilage tissues (synoviocytes) to OA disease initiation and progression. In-vitro models of early PTOA were developed for testing the potential of cLIUS to mitigate early inflammation and highlights of current findings will be presented.



Keywords
Low-intensity ultrasound, cartilage, inflammation, repair

Acknowledgements
This work was supported by National Health Institutes (R21; R03 and R01)

PL.6 Ultrasound for a noninvasive selective cancer therapy

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Cancer progression process involves changes in the mechanical phenotype of the tumor cells and their microenvironment, as reflected cells become softer as they transform from normal to cancerous cells. Since ultrasound (US) induces mechanical stress on cells and tissues, we hypothesize that the biomechanical properties differences between cancer cells and normal cells surrounding the tumor, can be the fundamental principle for their selective damage by US, and therefore provide the rationale to develop ultrasound-based treatment in oncology. Cells stiffness (Young's modulus) was measured by Atomic Force Microscopy. F-actin structure of different cell types was analyzed by confocal microscopy. US effect on cells' viability was tested *in vitro* and *in vivo* using 20KHz US. For the *in-vitro* experiments, benign skin cells (HaCat) and SCC cell lines from different sources were used. For the *in-vivo* experiments, NOD SCID mice were inoculated with CAL33 cells. For tumor morphology, we conducted immunohistochemistry analysis, evaluating the tumor cells damage in the treated area.

We found Young's modulus is significantly lower for superficial cancer cells compared with HaCat cells. F-actin staining demonstrated different inner structures in sub-types of cells. *In vitro* findings reveal a significant difference between cancer and HaCat cells viability at all US energy levels evaluated. In mice, repeated US treatment inhibits tumor growth without damaging healthy skin tissue[1]. Histopathological tumor analysis indicates US induced focal necrosis at the treatment site. We therefore suggest Young's modulus as a single biomechanical property can predict cell sensitivity to US treatment. Our findings provide a strong rationale for developing US as a noninvasive selective treatment for superficial cancers.

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Acknowledgments

The Israel Science Foundation (700/16) and the Ministry of Science, Technology & Space (78870)

PL.7 E-POCUS (Endosocopic POCUS) implementation to study esophageal remodeling in eosinophilic esophagitis (EoE).

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Background: Because of the dramatic increase in diagnostic endoscopic ultrasound (EUS), widespread training programs in the technique have been developed by a US endoscopic society. Virtually all of the recent applications revolve around noninvasively obtaining fluid or tissue during endoscopy which are then subsequently sent for diagnostic studies. In E-POCUS, like other Point of Care Ultrasounds, endosonographers obtain ultrasound images during endoscopies which are immediately employed to provide additional clinical insights. Eosinophilic esophagitis (EoE), a chromic immune and allergic inflammatory disease, is routinely evaluated by serial endoscopies to assess esophageal eosinophilia. However, the morbidity of EoE is related to progressive fibrostenotic changes in the esophageal wall, referred to as remodeling. The presentation will follow the development and implementation of E-POCUS to yield novel insights into the disease pathogenesis.
Methods: Seventy-eight patients (2-24 years) with suspected (29) or proven EoE (49) who were having routine endoscopies to assess their esophageal eosinophilia, were recruited into an IRB approved study which produced 178 serial EUS exams. Each EUS included a minimum of 12 reproducible measurements that quantitated the thickness of the total esophageal wall, and of the sublayers that compose the wall in both the mid and the distal esophagus. The presentation will chronicle the steps that were employed to create reproducible measurements, the problems that were encountered, and the implementation of a water filled balloon sheath to overcome some of the more challenging issues.
Results: E-POCUS was able to confirm smaller previous studies which showed that patients with active EoE (EoE-A) had thicker esophageal walls than either controls or treated EoE. The largest published EUS data set obtained in EoE patients will be presented which demonstrates for the first time that wall thickening (remodeling) in children mainly occurs in older adolescents, that the remodeling can be fully reversed with standard therapy, and that the mucosa and submucosa layers are the biggest contributors to the remodeling. Utilizing a water filled latex sheath to create the water/tissue acoustic interphase represents a faster, easier, safer, and more accurate adaptation of EUS. In a series of 22 consecutive patients, the average time to obtain the full set of data was less than 10 minutes. Outlier exams that took longer to complete will be discussed.
Conclusions: Specific applications of E-POCUS, like all new ultrasound examinations, require a comprehensive process to create standardized parameters. These need to be universally applied to yield meaningful data and ideally will emanate from a consortium of endosonographers working on the specific application. E-POCUS can successfully follow esophageal remodeling in EoE and thus provide patients with a greater understanding of their disease state at the time of their routine endoscopies. Theoretically, any disease involving subepithelial fibrostenosing changes, that is being investigated with any form of routine endoscopy, could benefit from incorporating E-POCUS to directly assess this process. In the future, more powerful, more accurate, and custom designed probes, coupled with artificial intelligence, will further extend potential applications of this technique to many areas of diagnostic medicine.

PL.8 Histotripsy: the new cavitation kid on the block

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Ultrasonically driven microbubbles have been studied for a long time, and they have been used for more than 50 years to improve diagnostic ultrasound image contrast following injection into blood vessels [1]. Low intensity ultrasound exposures have been used to stimulate bubble oscillation with the aim of enhancing uptake of drugs and other therapeutic agents, especially in the brain where bubble action can temporarily open the blood brain barrier.

The unwanted destructive nature of inertial cavitation has been a cause for concern when using therapy ultrasound, but it has now been realized that this effect may be harnessed for therapeutic advantage, as it that can be used for the selective emulsification of cells using beams designed to have high acoustic pressures solely at their focus [2]. The technique now known as histotripsy is becoming more accepted, and is being investigated for the treatment of solid cancers. In this review, histotripsy and its clinical potential will be discussed.

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KEYNOTE PRESENTATIONS

KN.1 Artificial Intelligence Assisted Transcranial Focused Ultrasound

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Transcranial focused ultrasound (tFUS) has emerged as a promising non-invasive brain stimulation technique with significant neurotherapeutic potential. However, skull-induced acoustic distortion presents a major challenge in accurately delivering the acoustic focus to the desired brain region. To address this, real-time feedback on transducer positioning and intracranial pressure distribution is essential for precise targeting and treatment efficacy. In this study, we propose deep learning-based guiding models: an inverse network model that provides spatial navigational information of the transducer and a forward network model that enables real-time simulation of intracranial pressure maps. Training datasets were generated through forward simulations incorporating subject-specific skull structures derived from computed tomography (CT) images. The developed models integrate convolutional neural networks and transformer-based architectures to achieve efficient and accurate inference. By facilitating real-time navigation and pressure estimation, the proposed approach enhances precision, safety, and effectiveness in tFUS applications, paving the way for improved non-invasive neuromodulation techniques.

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Acknowledgements

This work was supported by the National Research Foundation of Korea (NRF) funded by the Korean government (MSIT) under Grants RS-2024-00335185.

KN.2 Application of ultrasound in the salivary gland surgery

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Parotid gland tumors and salivary gland stones are the most common salivary gland diseases that require surgical treatment. During the preoperative evaluation of patients with parotid gland tumor, one of the main concerns is to determine the location of the parotid gland tumor in relation to the facial nerve. Ultrasound criteria such as Stensen's duct, retromandibular vein, line between mastoid and mandible, and minimum fascia-tumor distance can be used to plan the surgical strategy and also to obtain informed consent regarding postoperative risk of the facial nerve palsy. The modern management for salivary gland stones is to remove only the stones through minimally invasive surgery without resection of the salivary gland. Minimally invasive surgeries such as transoral approach, sialendoscopy, or extracorporeal shockwave lithotripsy, etc. can be selected mainly according to the location and size of the salivary gland stones. Among various imaging methods ultrasound has the advantage of being applied in real time before or during surgery to obtain data of size and location of the stones. Ultrasound guided surgery for parotid and submandibular gland stones can be excellent alternative in cases other minimal surgeries are difficult to apply, such as stones with acute infection or stones located in the deep proximal site.

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KN.3 Unsupervised Learning Approach for Treatment Effectiveness Monitoring Using Contrast-Enhanced Ultrasound and Curvature Learning

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Dynamic contrast-enhanced ultrasound (DCE-US) may determine whether cancer chemotherapy works within days, rather than waiting for months to determine response on CT/MRI, as is typical with the Response Evaluation Criteria in Solid Tumors (RECIST) [1]. This could help patients avoid expensive and ineffective chemotherapy, with associated side-effects. RECIST criteria are based on changes in tumor size, and there is not always a change in tumor size despite therapeutic response. With anti-angiogenesis medications that inhibit tumors' vascular supply, such as bevacizumab, therapy may induce changes in tumor perfusion before a change in tumor size. We present an unsupervised approach using curvature learning to assess treatment response. As an unsupervised rather than a supervised learning approach, it does not require training, is not subject to overfitting, and does not require manual tumor segmentation, which is impractical for daily radiological practice.

As previously described, 40 mice implanted with human colon cancer tumors were injected with perflutren microbubbles and imaged with DCE-US [2]. 20 mice were implanted with a tumor that responds to bevacizumab, and 20 were implanted with a tumor that does not. For both groups, 10 mice were treated with bevacizumab, and 10 were given saline as controls. This resulted in four groups: 1) treatment-sensitive, bevacizumab-treated mice; 2) treatment-sensitive, saline-treated mice; 3) treatment-resistant, bevacizumab-treated mice; and 4) treatment-resistant, saline-treated mice. Treatment response was only expected in treatment-sensitive, bevacizumab-treated mice. Tumors were imaged before treatment (baseline), and 1, 3, 7, and 10 days after treatment.

We applied nonlinear dimensionality reduction using diffusion maps to DCE-US images, mapping high-dimensional data into a 2D embedded space. Data were quantized into three classes—blue, yellow, and red—representing normal, intermediate, and high cancer probability. This was done for mice at baseline and post-treatment. A curvature learning score was calculated for each mouse using statistical measures representing the variation in color classes across each ultrasound frame during contrast administration on a specific day (*intra-day variability*) and between pre- and post-treatment days (*inter-day variability*). Qualitatively, there was a visual decrease in the amount of tissue that the algorithm recognized as tumor with treatment with bevacizumab in treatment-sensitive mice, and there was a visual increase in tissue suspicious for tumor in treatment-resistant mice or those treated with saline. A Wilcoxon rank-sum test showed a significant difference in curvature learning score between treated, treatment-sensitive mice and all others ($p = 0.0051$) after just one treatment day, despite stable tumor size. Curvature learning successfully identified treatment response, detecting changes in tumor perfusion before changes in size. This technique could potentially be further developed in humans.

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Acknowledgements

The authors thank the late Juergen Willmann, who was involved at the inception of this project.

KN.4 Ultrasound-Guided Percutaneous Ultrasonic Tenotomy for Refractory Patellar Tendinopathy in High-Level Athletes: A Case Series.

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Objective: To elucidate the clinical outcomes and return-to-sport status of high-level athletes with refractory patellar tendinopathy treated with ultrasound-guided percutaneous ultrasonic tenotomy (PUT).
Design: Case series study.
Setting: Single orthopaedic clinic.
Patients: Five cases involving eight knees from athletes (average age: 22 years, range: 17-30 years) who presented with refractory patellar tendinopathy and underwent PUT between 2022 and 2024. Conservative treatments had previously been attempted without sufficient pain relief or return to sports.
Interventions: All patients underwent ultrasound-guided PUT using the TX-2 device from Tenex Health. Jogging was resumed one month after surgery, and a return to competitive sports was permitted as early as three months post-surgery.
Main outcome measures: Preoperative and postoperative Victorian Institute of Sport Assessment (VISA) scores and Numerical Rating Scale (NRS) scores for pain. Time to return to full training and competitive sports, and presence of postoperative infection signs.
Results: The VISA score significantly improved from a preoperative average of 43.1 to a postoperative average of 77.1 (P=0.002). The NRS significantly decreased from a preoperative average of 6.4 to a postoperative average of 2.8 (P=0.005). Four cases involving six knees fully returned to sports, with an average return time of 3 months and 19 days (range: 3 months to 4 months and 13 days). One case involving two knees did not show sufficient pain improvement and the patient could not return to sports. No signs of infection were observed in any case.
Conclusion: PUT for refractory patellar tendinopathy in high-level athletes generally results in favorable treatment outcomes and successful return to sports. This study provides novel insights into the effectiveness of PUT for patellar tendinopathy in athletes, highlighting the need for future studies with larger sample sizes to validate these findings and explore factors associated with poor outcomes.

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KN.5 Wiley Empowers the Publication of Research Outcomes in Ultrasound Science and Its Interdisciplinary Fields in Food and Health Science

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This talk will introduce how Wiley, a global academic publisher, supports the dissemination of cutting-edge research in ultrasound science and its interdisciplinary applications in Food and Health Science. As Deputy Editor in Food Science and co-Editor-in-Chief of *Food Science & Nutrition*, I will provide insights into current publishing trends, peer review expectations, and strategies for enhancing international visibility and impact. Special focus will be given to emerging areas such as ultrasound-assisted food processing, bioresource valorization, and functional ingredient development. The session aims to equip researchers with practical guidance on manuscript preparation and navigating the publishing process in interdisciplinary fields where ultrasound technology plays a pivotal role.

Figure 1. *Wiley profile in general*

Keywords
Publication, Ultrasound, Life Science

KN.6 Ultrasound-Assisted Extraction Using Natural Deep Eutectic Solvents (NADES) for Enhanced Recovery of Bioactive Compounds

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Recently, the recovery of bioactive substances from sustainable raw materials, such as food industry and agricultural by-products and waste, has been widely studied for obtaining high-value compounds, such as phenolic compounds and carotenoids [1]. Traditional extraction methods face challenges in efficiency, sustainability, and economic feasibility, prompting a shift toward alternative techniques. Green extraction methods prioritize sustainability by reducing energy use and eliminating organic solvents while maintaining extract quality. Innovative approaches like microwave, ultrasound, and pressurized liquid extraction enhance efficiency, increase yield, and minimize environmental impact, ensuring cost-effectiveness and ecological responsibility.

In addition to green extraction techniques, the introduction of natural deep eutectic solvents (NADES)—natural product-based green liquids that offer a safer alternative to conventional organic solvents—can improve the safety and quality of extracts [2]. The synergy of UAE-NADES processes can provide a green and sustainable extraction procedure for the recovery of bioactive compounds, such as β-carotene from pumpkin [3]. However, although NADES production is well-suited for potential large-scale operations, as it uses commonly available, nontoxic materials, there is limited information regarding the scale-up potential of UAE-NADES.

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Acknowledgements

This research was done within the FAO's Benefit-Sharing Fund project of the International Treaty on Plant Genetic Resources for Food and Agriculture "Redesigning the exploitation of small grains genetic resources towards increased sustainability of grain-value chain and improved farmers' livelihoods in Serbia and Bulgaria—GRAINEFIT" (2020-2025), PR-166-Serbia.

KN.7 Ronald Halim

Available soon

KN.8 Measurement uncertainty for ultrasound applications: a fundamental tool for improving experimental reliability

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Metrology is the science of measurement and its application, as defined in the International Vocabulary of Metrology (VIM). Metrology encompasses some fundamental aspects that are pretty often disregarded in general. The most important consequence is a lack of reliability in many experimental works. Some terms, such as true quantity value, repeatability, measurement error, accuracy, precision, and uncertainty, are often misused. The worst outcome of that misunderstanding is the possible flaw in the reproducibility of experimental research. The metrological concepts are not complex to understand. On the contrary, the statistics behind the uncertainty assessment, for instance, are as simple as standard deviations and t-Student distribution. This lecture aims to introduce the most important terms and concepts presented in VIM, as well as provide an overview of uncertainty budget development as defined in the Guide for Uncertainty in Measurement (GUM). The talk will present and discuss the aforementioned terms, as well as a few additional ones based on VIM and GUM.

Metrology is the discipline devoted to measurement science and its practical application, as defined by the VIM. It is far more than a collection of unit definitions or calibration routines. It provides the conceptual and statistical bedrock on which all credible experimental work rests. Unfortunately, several of its core principles are often overlooked or misunderstood, resulting in unreliable data, irreproducible results, and wasted research effort. A few terms illustrate the problem. **True quantity value** refers to the “actual” value of a measurand; it is usually unknowable, yet it remains the reference point against which every measurement is judged. **Repeatability** speaks to the closeness of agreement among successive measurements under identical conditions, while **reproducibility** extends that idea to different laboratories, operators, or instruments. **Measurement error** is the difference between an indicated and a true value, whereas **accuracy** is a qualitative descriptor of how close a result is to truth. **Precision** concerns the spread of repeated results and must not be conflated with accuracy. Finally, **uncertainty** quantitatively expresses the doubt that accompanies any measurement; it is not a mistaken term but a rigorously defined interval that captures all recognised sources of variation.

When these definitions blur together in everyday usage, the consequences are severe. Data tables may appear tidy, yet if uncertainty budgets are missing or incoherent, reviewers cannot determine whether discrepancies arise from genuine physical effects or flawed methodology. At worst, promising findings cannot be replicated, eroding confidence in entire research programs.

The reassuring news is that the mathematics required to handle most metrological tasks is straightforward. For many laboratory-scale experiments, uncertainty evaluation boils down to computing standard deviations, applying *t-Student* factors for small samples, and combining contributions through the Guide to the Expression of Uncertainty in Measurement (GUM) “law of propagation of uncertainties.” What is often intimidating is not the arithmetic but the disciplined thinking demanded: listing each influence quantity, classifying it as Type A (statistical) or Type B (other evidence), evaluating its standard uncertainty, and then synthesising everything into a transparent, reproducible budget.

By the end of the lecture, participants should feel confident enough to draft an uncertainty budget for virtually any laboratory or field measurement. In doing so, they will be equipped not only to defend their data but also to scrutinise the claims of others, thereby strengthening the reliability and reproducibility of experimental science as a whole.

KN.9 Enhancing Salt Reduction in Meat Products through Ultrasound Technology: A Novel Approach

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The excessive consumption of salt in meat products poses significant health risks, including hypertension and cardiovascular diseases and concerns over meat's high contribution to dietary sodium have led to the development of reduced sodium chloride (low salt) meat products [1, 2]. Traditional methods of salt reduction often compromise the sensory qualities and shelf life of meat products. Whilst several salt reduction strategies have been tested; most have demonstrated less than optimal results, mainly due to the loss of product functionality and desirable sensory properties, making their industrial application difficult [3]. This study explores the application of ultrasound technology as a novel approach to enhance salt reduction in meat products without compromising quality. Ultrasound treatment facilitates the diffusion of salt and other curing agents when combined with tumbling, leading to reduced NaCl. Experimental results demonstrate that ultrasound-assisted processing can achieve substantial salt reduction by opening up the microstructure of the muscles and enhancing the diffusion of salt [4]. This innovative technique, when combined with current processing method such as tumbling, offers a promising solution for the meat industry to produce healthier products, aligning with consumer demand for lower-sodium options.

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KN.10 Yinfei Zheng

Available soon

KN.11 Ultra-sensitive Silicon-photonics optomechanical ultrasound sensor for photoacoustic microscopy: a feasibility study

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Traditional piezoelectric ultrasound sensors are limited by fixed sensitivity, potential signal saturation, and high production costs. To overcome these issues, we introduce a novel optomechanical ultrasound sensor that integrates a silicon photonic waveguide with a MEMS cantilever membrane.

The sensor operates by detecting changes in a light signal caused by the ultrasound-induced vibration of the cantilever, which alters the gap between two waveguides. A key advantage of this design is its tunable sensitivity and dynamic range, which can be controlled with an applied voltage.

In experiments, the developed sensor exhibited a sensitivity of 17 μV/Pa, six times greater than the traditional PZT sensor (2.5 μV/Pa). In a photoacoustic imaging test, it successfully rendered a highresolution image of a USAF-1951 target, while the signal from the traditional sensor was too low to form a clear image.

In conclusion, this new sensor, built on a silicon photonics platform similar to the CMOS process, allows for easier manufacturing and integration. It delivers superior performance in a significantly smaller form factor, and its feasibility for imaging has been successfully demonstrated. The system is currently being optimized for future in vivo biomedical applications.

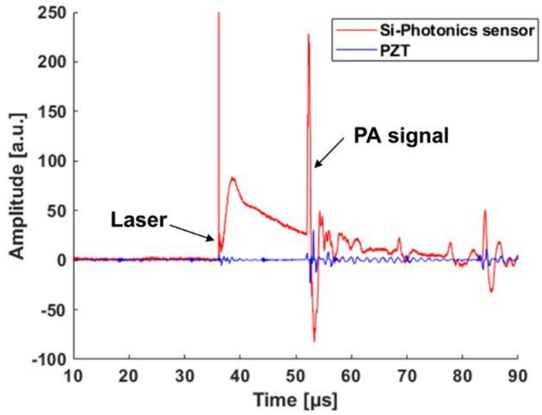

Figure 1. The measured photoacoustic signal from the point source. (red) the developed Si-photonics sensor, (blue) PZT sensor

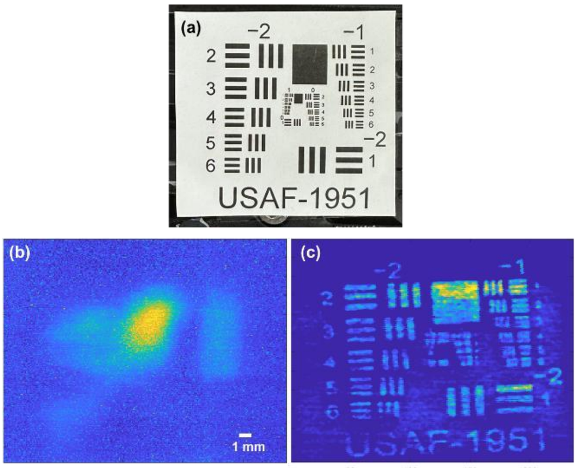

Figure 2. (a) The photography of USAF-1951; Photoacoustic C scan image acquired by (b) Traditional sensor, and (c) the developed Si-photonics sensor.

KN.12 Ultrasound-assisted Food Processing: Enhancing Sustainability through Bioactive Extraction and Retention

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Environmental resilience necessitates more resource-conscious approaches in the food industry, which can be achieved by implementing more efficient and sustainable processing methods that preserve nutritional value while utilizing less resources. Ultrasound-assisted food processing is a versatile and energy-efficient method, capable of accomplishing a wide range of processes such as extraction, preservation, and structural modification. Recent advances in ultrasound-assisted food processing will be discussed in this keynote session, with a focus on how they can boost bioactive yields and contribute to sustainability. According to the recent research findings, ultrasound is superior to conventional food processing technologies in terms of extracting and retaining bioactive compounds such as phenolics and flavonoids. These characteristics offers high ultrasonics capability for contributing to the 2nd goal of Sustainable Development Goals (SDG2-Zero Hunger) by enhancing food nutrition for promoting human health, particularly in SDG 2.2 ("End All Forms of Malnutrition") which focuses on improving nutrition for vulnerable populations by ensuring access to nutritious food. Non-thermal nature of ultrasound-assisted food processing is among the key underlying mechanisms that make this technology a more sustainable approach. At the same time, worldwide applications of ultrasound to achieve SDG2 could be challenging at the moment, necessitating further international collaboration and technological transfer. Therefore, the food industry can increase sustainability by utilizing ultrasound technology after developing practical and affordable ultrasound-based processing systems.

Keywords
Ultrasound; Food Processing; Sustainable food production; Sustainable development goals; Bioactivity; Improved food nutrition

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KN.13 Transcriptomic profiling of the immune response in orthotopic pancreatic tumours exposed to boiling histotripsy.

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Pancreatic cancer is a disease with a dismal prognosis, leading to approximately half a million deaths worldwide every year. The majority of patients are diagnosed with advanced pancreatic ductal adenocarcinoma for which few treatment options exist. Boiling histotripsy is a physical modality that uses high-pressure acoustic waves to induce intra-tumoural acoustic cavitation and emulsify target tissue. This study investigated the immune response of murine pancreatic ductal adenocarcinoma tumours to treatment with boiling histotripsy. Syngeneic pancreatic orthotopic KPC tumours were grown in the pancreas of immune-competent murine C57BL/6 subjects. Tumours were exposed to ultrasound-guided boiling histotripsy (peak negative pressure = 17-19 MPa, d.c.= 1 %, prf = 1 Hz, t = 15-25 seconds). Acoustic cavitation was detected using a passive cavitation sensor, haematoxylin and eosin staining was used for histological assessment, cell clusters were manually annotated, and transcriptomic profiling of $CD45^+$ tumour infiltrating cells was investigated 24 hours after treatment. Treatment of tumours with boiling histotripsy induced acoustic cavitation and tumour disruption. 30 cell types were distinguished in the tumours including cytotoxic and helper T cells, regulatory T cells and N2 neutrophils. Boiling histotripsy decreased regulatory T cells compared to sham-exposed tumours, increased the abundance of neutrophil subsets, activated the innate immune response and decreased the expression of genes associated with the class I MHC complex. These results suggest that boiling histotripsy activates the innate immune response, and an influx of neutrophils in the pancreatic tumours can be seen. However, these neutrophils have pro-tumourigenic N2-like gene expression profiles which may help explain the hostile-for-the-host pro-tumour growth pancreatic tumour microenvironment.

Keywords
Therapy Ultrasound; Histotripsy; Pancreatic cancer; Transcriptomics; Preclinical

Acknowledgements
The authors would like to acknowledge Selvakumar Anbalagan (The Institute of Cancer Research) and Ricardo Ferreira (University of Oxford) for their help in processing the transcriptomic data.

KN.14 High-Intensity Ultrasound as Alternative to Improve Barley Malt Production

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Barley is one of the most produced cereals and the primary raw material for malt, which is a key ingredient in the production of beer and whisky[1]. Malt production consists of three main steps: (i) steeping/hydration, (ii) germination, and (iii) drying/kilning. During hydration, the dormancy of the grains is broken, and the moisture content increases to approximately 40–42% (wet basis). In the germination phase, enzymatic synthesis and partial hydrolysis of the endosperm occur. Once the desired level of modification is reached, the grains are dried to halt germination, reduce moisture to below 5% (wb), and develop the flavor, aroma, and color of the malt[2,3]. High-intensity ultrasound (US) is a non-thermal technology that has been increasingly studied to enhance various industrial processes, including those in the food industry. The physical effects promoted by US, such as cavitation and microstreaming, can improve mass, heat, and momentum transfer[4]. This study provides an overview of the application of US during the hydration stage of barley for malt production and its impacts on subsequent steps—germination and drying—as well as on structural and biochemical characteristics of the final product. Two US systems were tested: a probe system (20 kHz, 51.12 and 84.68 W/L, 100 g barley per 1 L of water) with continuous and pulsed application (1 s ON: 4 s OFF), and a bath system (25 kHz, 91 W/L, 400 g barley per 4 L of water) with continuous application. In the probe system, US reduced hydration time by up to 40 % without significantly affecting the germination capacity of the grains. The activities of α- and β-amylases were higher at 51.12 W/L than in control and 84.68 W/L treatments. Ultrasound also affected the cellular structure of the grains, especially the endosperm and outer layers (aleurone, testa, and pericarp). In the bath system, US reduced hydration time by approximately 38% and promoted greater rootlet growth during germination. During convective drying at 50 °C, a slight reduction in drying time was observed. Additionally, US increased enzymatic activity, reduced the compression force of the grains, and decreased the apparent viscosity of pastes produced from barley and malt flour, indicating modifications in structure and biochemical reactions throughout the process. These findings demonstrate that ultrasound can be effectively applied to enhance malting performance and improve malt quality.

Keywords
Emerging Technologies; Process Intensification; Bioprocess Improvement; Malting; Grain Structure.

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Acknowledgements
FAPESP (2018/17844-0 and 2019/05043-6); Communauté Urbaine du Grand Reims, D´epartement de la Marne, Région Grand Est, and European Union (FEDER Grand Est 2021–2027) For finantial support to CEBB

KN.15 OptimUS: An open-source Python library for 3D ultrasonic wave propagation

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The Helmholtz equation for harmonic wave propagation is widely used to solve a range of problems in acoustics, such as sonar, room acoustics, and biomedical ultrasound. The boundary element method (BEM) is one of the most efficient numerical methods to solve Helmholtz transmission problems and is based on boundary integral formulations that rewrite the volumetric partial differential equations into a representation of the acoustic fields in terms of surface potentials at the material interfaces.
OptimUS [1] is a Python library developed at University College London and Pontificia Universidad Católica de Chile. Centred around the BEM, it offers a user-friendly interface via Jupyter Notebooks, enabling the prediction of acoustic waves in piecewise homogeneous media in the frequency domain, with minimal numerical pollution and dispersion effects [2]. OptimUS naturally handles unbounded domains and can significantly reduce run times relative to traditionally used volumetric solvers.
This talk will provide an overview of the OptimUS interface, with a focus on case studies where objects are large relative to the wavelengths involved. This will include biomedical ultrasound, which has a growing number of therapeutic applications such as the treatment of cancers of the liver, kidney, and of osteoid osteoma. The modelling of transcranial ultrasound neurostimulation, an emerging modality which may one day treat mental health conditions such as depression, will also be reviewed. Acoustic wave propagation into the uterus at frequencies at the limit of the human audio range will be presented to provide awareness of the impact of everyday noise exposure on the developing fetus [3].
Finally, prospective solutions to address nonlinear wave propagation using volume integral methods will be reviewed, as well as methods to treat piecewise heterogeneous media, such as skull bone, within the propagating medium.

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ORAL COMMUNICATIONS

OA.1 Pressure sensitivity of contrast microbubbles for subharmonic aided pressure estimation (SHAPE)

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Ultrasound contrast agents are micron-sized bubbles coated with lipids or proteins to stabilize them in the bloodstream. Apart from enhancing the contrast of the image, there are active investigations for their potential applications in many innovative biomedical applications such as drug and gene delivery. I will present an overview of our research efforts on using the subharmonic signals from microbubbles for subharmonic aided organ level blood pressure estimation (SHAPE) for diagnosis of many vascular diseases. Specifically, we have theoretically shown that contrary to the intuitive expectation of a reduction of bubble response with ambient pressure increase, the subharmonic shows a nonmonotonic response with pressure—the response can either increase or decrease with the ambient pressure. [1] Such behaviours have since been seen in experiments by us and others (Figure 1). We explain the phenomenon in terms of the excitation frequency nondimensionalized by the resonance frequency. We will present our hierarchical approach to modelling and characterization of contrast microbubbles using an interfacial rheological approach for the microbubble shell [2] and discuss experimental SHAPE results from commercially available contrast microbubbles such as Definity, Sonazoid and Lumason as well as lipid-coated microbubbles made in our lab discussing the effects of different shells and gas cores. [3,4,5] We will discuss how our findings might help increase the efficacy of SHAPE.

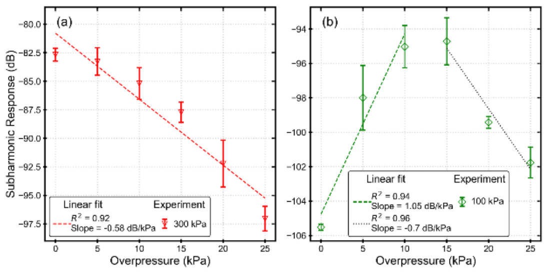

Figure 1. Linear fit to subharmonic data with strongest subharmonic ambient pressure sensitivities at 2MHz excitation frequency. (a) Linear decrease in subharmonic at 300 kPa acoustic pressure. (b) Non-monotonic increase in subharmonic at 100 kPa acoustic pressure. (Calibri Italic, font size 9pt, full justification, spacing after 10pt, line spacing exactly 14pt)

Keywords
Contrast agents, microbubbles, subharmonic, pressure estimation

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Acknowledgements
Write here your acknowledgements (Calibri light, font size 9pt, full justification, line spacing exactly 14pt)
Partially supported by the National Science Foundation, USA and the National Institute of Health, USA.

OA.2 Scalable Ultrasonic Manufacturing of Nano-Formulations for Enhanced Pharmacokinetic Performance of Bioactive Compounds

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Oral administration of poorly water-soluble bioactives often results in low bioavailability and delayed onset of action. Due to their insolubility in water, these compounds cannot be absorbed in the gastrointestinal tract until they are incorporated into mixed micelles—a process that occurs slowly in the small intestine, significantly delaying and reducing absorption efficiency.

This presentation will showcase the ultrasonic manufacturing of liquid and powdered "water-soluble" nano-formulations of poorly water-soluble bioactives. These formulations can be easily infused into beverages or administered as effervescent or fast-disintegrating tablets. Nanoemulsion droplets, which closely mimic naturally formed mixed micelles, are rapidly transported to intestinal absorptive cells, dramatically enhancing the absorption of incorporated bioactives. Similar improvements are observed with other types of nano-formulations.

Examples of various nano-formulation types incorporating different bioactive compounds will be presented, along with findings from our recent preclinical pharmacokinetic study. This study compared the performance of two orally administered Δ8-THC nanoemulsions (liquid and powdered) to an MCT oil solution [1], demonstrating approximately 19-fold and 4-fold higher Δ8-THC exposure during the first 1 hour and 4 hours, respectively.

Liquid and powdered pharmaceutical and nutraceutical nano-formulations can be efficiently manufactured using directly scalable Barbell Horn Ultrasonic Technology® (BHUT) [2] combined with All-in-One NanoStabilizer® excipient packages. BHUT enables the development of both bench-scale and industrial-scale processors operating at high ultrasonic amplitudes, effectively bridging the gap between laboratory research and commercial production.

This presentation will outline the key principles of BHUT, demonstrating how it facilitates scale-up factors of approximately 55 compared to conventional high-amplitude ultrasonic technology [2].

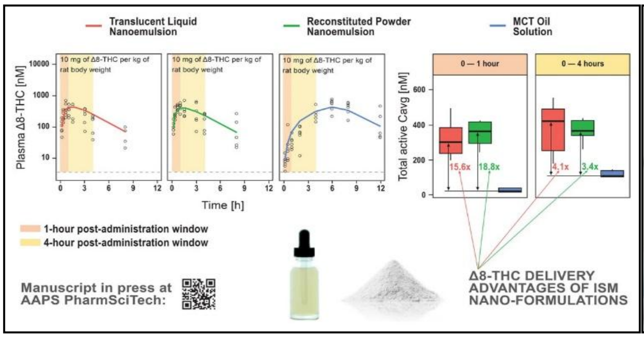

Figure 1: Pharmacokinetics of two ultrasonically manufactured

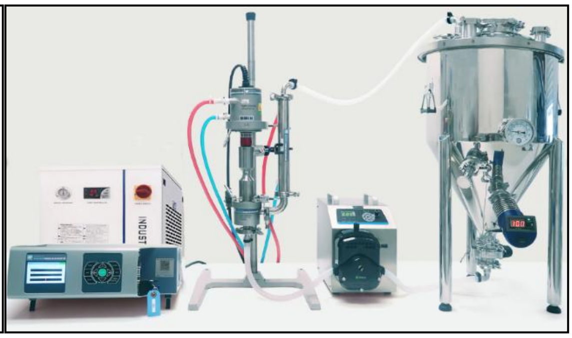

Figure 2: Industrial-Scale Ultrasonic Liquid Processor, ISP-3600.

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OA.3 Advanced Perovskite based X-ray Detection and Imaging Applications using Ultrasonic Spraying Techniques

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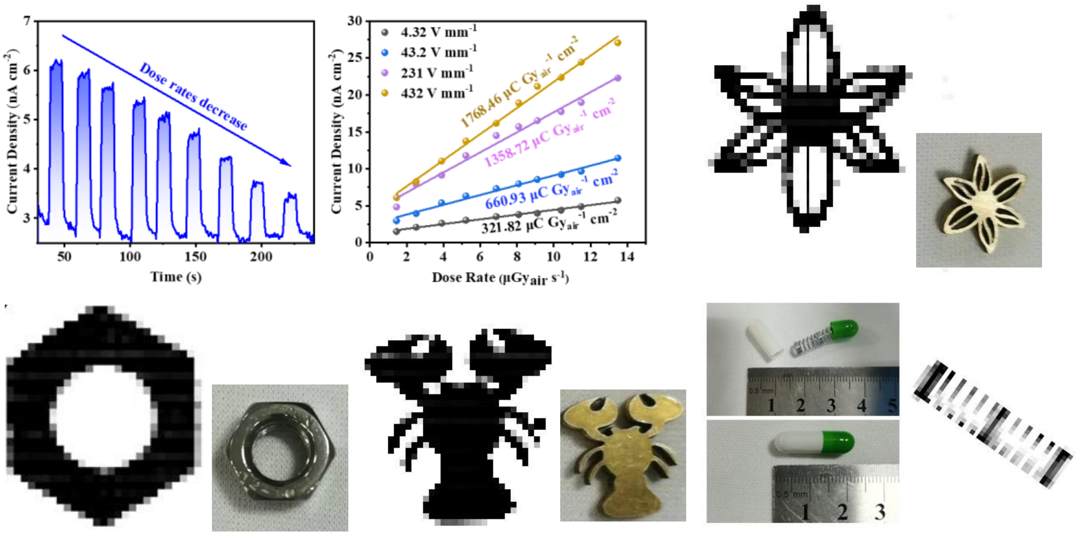
X-ray detectors are widely used in various fields such as scientific research, biomedical imaging, and security screening [1]. Due to the high radiation energy of X-rays and the associated health risks, there is a growing demand for X-ray detectors that operate at low radiation doses while providing high image quality. Perovskite materials with an ABX_3 structure exhibit high X-ray attenuation coefficients due to the high atomic number of their constituent elements, making them promising candidates for X-ray detection semiconductors [2]. However, the fabrication of perovskite thick films currently faces challenges, particularly in achieving large-area, high-quality integration of perovskite thick films onto thin-film transistor (TFT) arrays [3]. Therefore, it is crucial to develop perovskite materials with excellent optoelectronic properties and strong stability to enable low-dose and high-quality X-ray detection and imaging. In this work, we employed a highly controllable ultrasonic spray coating technique to prepare orthorhombic-phase perovskite thick films, achieving large areas (≥10 × 10 cm^2) and thicknesses (≥100 μm). The sensitivity of the X-ray detector reaches up to 1768.46 μC Gy_{air}^{-1} cm^{-2}. The stable phase structure allowed the X-ray detector to retain 91.34% of its initial sensitivity after seven days of exposure in ambient air. Furthermore, by integrating the perovskite thick films with TFT arrays, we successfully achieved 8-bit imaging capability with a resolution of 64 × 64 pixels.



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Acknowledgements

This work is supported by National Natural Science Foundation of China (52404275); University of Electronic Science and Technology of China Fundamental Research Funds for the Central Universities - "Startup Fund for New Faculty" (ZYGX2024XJ013); The Sichuan Province Science and Technology Activities Funding for Returned Overseas Scholars.

OA.4 Modulating the Neurochemical Environment with Focused Ultrasound: Insights from *In Vitro* and *In Vivo* Models

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Focused ultrasound (FUS) neuromodulation holds great promise for treating neurological disorders. However, a detailed understanding of its immediate and long-term effects is essential to support its clinical translation. In this study, we investigated how megahertz-range FUS stimulation protocols influence the release of neurotransmitters and other neurochemical agents that modulate neural activity in in vitro and in vivo experimental settings.

In in vitro studies, intracellular calcium (Ca^{2+}) mobilization and glutamate realease produced by single-pulse FUS stimulation (f: 8.24 MHz, duration: 400µs, $pSAR_{,-3dB}$ < 10 MPa) was assessed via real-time fluorescence imaging on a human neural progenitor cell line (RenCell VM loaded with Ca^{2+} marker Fluo-4). In vivo studies were aimed at exploring local extracellular neurotransmission dynamics induced by FUS ultrasound of the rat brain's striatum. Pulsed FUS was applied for 20 min at f = 8.24 MHz, pmax=0.7 MPa, pulse duration of 500 µs and PRF=100 Hz. CoperniFUS, an open source software for treatment planning of neuromodulation studies using stereotaxic systems, was used for precise positioning of the FUS focus and the microdialysis probe on the striatum[1]. Microdialysates were collected at a rate of 1 µL/min every 2-4 min throughout the experiment. Several amino acids were measured from all collected samples. Results from FUS group (n=6) were compared to those from sham group (n=6).

Single-pulse FUS stimulation evoked strong and sustained intracellular Ca^{2+} elevations in cells located within the focal region followed by a slow (v[0, 30]s ≈ 6 µm.s-1) and omnidirectional propagation of a Ca^{2+} wave across the surrounding neural network, consistent with the spatiotemporal dynamics of glutamate release observed after single-pulse FUS stimulation. The collected microdialysates were analyzed with HPLC for changes in amino acid content before, during and after FUS application, with particular attention to neurotransmitters glutamate and GABA. Early results show that FUS can modulate the release of several neurochemical compounds including glutamate and GABA which seem to be sustainably altered for several minutes after FUS stimulation, as compared to animals in the sham group.

This study showcases local neurochemical alterations produced in by targeted FUS in neural structures. Indeed, evaluating potential local changes in extracellular amino acid content produced by FUS neuromodulation sequences can give an insight into long-term, offline effects that can have a sustained impact on local neural activity.

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OA.5 Acoustic manufacturing technology of high-performance components and regulation mechanisms

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We originally propose a new theory using sound waves to directly manufacture parts, and named it Acoustic manufacturing (AM), which is completely different from the ultrasonic assisted machining mechanism such as intermittent cutting, medium impact, and cavitation effect. By using the complex mechanical, physical, and chemical interactions between focused acoustic energy and thermosetting materials, the microstructure and interface bonding can be regulated by controlling the generation, focusing and transmission of acoustic wave, to achieve continuous, stable, and reliable regulation of structure-performance for high-performance components. We have preliminarily explored the acoustic manufacturing of several thermosetting materials. AM is shown to enable continuous production of homogeneous and heterogeneous thermosets. Its combination with a robotic arm allows for 360° omnidirectional continuous production, which is demonstrated by the successful construction of lateral and vertical oriented spiral structures via unsupported fabrication. Multi-scale filaments with diameters ranging from 150 µm to 2 cm were manufactured and were shown capable of producing functionally graded materials with mechanical property gradients of up to five. The direct fabrication via AM of a set of functional composites is demonstrated and a novel fabrication technique for multilayer carbon fiber-reinforced plastic laminates is presented. Looking ahead, it will create a new research field of acoustic manufacturing and more relevant new research fields by integrating with other physical fields, such as optical, mechanical and microwave.

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OA.6 Diagnose and monitor urothelial carcinoma of dogs using ultrasound imaging and urine proteomics

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Urothelial carcinoma (UC), such as bladder cacer and urethra cancer, accounts for approximately 2% of all cancers in dogs. Almost all UC of dogs is a muscle-invasive cancer at the initial diagnosis. *BRAF* mutation, which is prevalent in 65-80% of UC and prostatic cancer, are used for the first step of the diagnosis of UC. No standard of treatment has been established for UC, and the goal of treatment is often to improve quality of life rather than to cure the disease. Dogs with UC generally dye or are ehthanized within one year mainly because of tumor local progression.

Ultrasound imaging in veterinary medicine is a minimally invasive modality for detecting UC and used to monitor the local progress of the desease. In addition, an ultrasound mediated drug delivery technology may be a useful tool for treating UC in dogs [1]. Although ultrasound-related technology is a promising modality for imaging and treating UC, there are some disadvantages. It is sometime difficult to differenciate UC at its early stage from other diseases such as cystitis using ultrasound imaging. Ultrasound imaging is often subjective and is not a monitoring method with high sensitivity of detecting the local progress of disease. Hence, new and minimally approach are needed to aid the diagnosis and monitor UC in dogs. Rescently, Carvalho *et al* reported urinary proteomic analysis indicated disease progession of human bladder cancer and helped to optimise the use of further medical intervention [2]. Therefore, urinary proteomics may be a minimally invasive tool for the diagnosis and monitor UC in dogs. Here we introduce our attemps for combining ultrasound imaging and urinary proteomic analysis in canine UC.

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Acknowledgements

This research was partly supported by JSPS KAKENHI, Grant number JP23K11888 (NS).

OA.7 Acoustic Cavitation Driven protein colloid formation: Structural Mechanism and Rheological Insights

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Protein colloids and aggregates has gained significant importance recently in the field of biotherapeutics. Proteins are essential biomolecules that perform a wide range of functions in biological systems. However, under certain conditions, proteins can self-assemble into aggregates, forming structures that range from soluble oligomers to insoluble fibrils. Protein aggregation can occur due to various factors, including changes in pH, temperature, shear forces, and interactions with other biomolecules. In the therapeutics industry, protein aggregation plays a dual role—both as a challenge and an opportunity. On one hand, aggregation is a major concern in biopharmaceuticals, particularly in the production of monoclonal antibodies, vaccines, and enzyme-based drugs. On the other hand, controlled protein aggregation has promising applications in drug delivery and biotechnology. Aggregated protein structures, such as colloidal protein particles and hydrogels, are being investigated for sustained drug release, targeted delivery, and biomaterial development. These engineered protein aggregates offer unique advantages, such as increased stability, prolonged circulation time, and enhanced bioavailability, making them valuable tools in precision medicine and regenerative therapies.

This work investigates the effect of acoustic cavitation (AC) on Bovine serum albumin (BSA) over time and monitor the changes in the protein structure. BSA solutions have been prepared at two different pH (pH 3.5 and pH 7.5). AC has been introduced to the protein solutions for varying durations ranging from 1 min to 7 min. With time, the protein changes from solution to colloids, colloids to aggregates and from aggregates to crystals [1]. These changes in protein have been studied using various analytical techniques. The change in size of the proteins has been monitored by studying the particle size distribution using dynamic light scattering (DLS) and their morphology has been studied using Scanning electron microscopy (SEM) and Atomic force microscopy (AFM). The change in the viscoelastic property of protein has been studied using Quartz crystal microbalance with dissipation (QCM-D) [2]. The pH and the influence of AC on the protein solution plays a vital role in forming the colloids and aggregates. Understanding the mechanisms of protein aggregation is crucial for both mitigating undesired aggregation in biopharmaceuticals and harnessing it for innovative biomedical applications.

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OA.8 Marco Garcia-Vaquero

Available soon

OA.9 Controlling radicals generation towards selective sonoelectrocatalytic reactions by coupling high-frequency ultrasound with electrochemistry

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Electrochemical water splitting is a crucial process for the efficient production of green hydrogen and oxygen, via the hydrogen and oxygen evolution reactions (HER and OER, respectively). The efficiency of such reactions depends heavily not only on the electrocatalytic activity and selectivity of the electrode surface, but also on mass transport efficiency [1], [2]. A promising strategy to partially overcome the physico-chemical limitations of HER and OER is to couple the electrochemical system with ultrasound (US). This coupling is studied in the field of Sono-Electrochemistry [3]. The irradiation of a liquid solution induces the formation of micron-sized cavitation bubbles capable of splitting water vapor trapped in these bubbles into hydrogen and hydroxyl radicals. The radicals can in-turn recombine to form hydrogen and oxygenated species that can interact with electrode surfaces, either to improve or inhibit electrocatalytic reactions.
In this work, by coupling a multi-functional ultrasound frequency reactor (584-1140 kHz) with electrodes, in-situ generated radical species concentrations can be tuned based on the ultrasound frequency and amplitude applied, with respect to the electrode surfaces. Using this synergistic approach, we investigate the reduction and oxidation of sugars (for instance glucose to sorbitol, or glucose to formic acid or oxalic acid).

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Acknowledgements

This work is part of the EU-ELOBIO project. The project ELOBIO received funding from the European Union's Horizon Europe EIC-2021- PATHFINDERCHALLENGES-01-04, under grant agreement N° 101070856.

OA.10 Development of methodology for the pilot-scale ultrasound treatment for the removal of pesticides residues from fresh zucchinis

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The development of innovative technique in the framework of pesticides treated vegetable cleaning represents a huge stake and different challenges in the sector of food industries and their equipment manufacturers [1-3]. This project was carried out on the development of ultrasound technique for cleaning zucchinis after pesticides treatment. Our approach considered the whole itinerary from the field to the cleaning step. Zucchinis were cultivated at the station of the regional center for experimentation in vegetable crops by Pôle Légume Région Nord to allow the control of the cultivation itinerary of the samples. They were treated in the field with fungicides composed of fluxapyroxad and difenoconazole. Fresh treated zucchinis collected from the field were cleaned by using a pilot-scale ultrasound bath containing tap water. An experimental design of the treatment was applied by playing with parameters such as time and use or non-use of ultrasound technique. After cleaning, the dynamic of fungicides removal from the zucchinis to the cleaning water was monitored by using two techniques of injection on gas chomatography coupled to mass spectrometry (GCMS), namely liquid injection (LI) and Stir Bar Sorption Extraction (SBSE). For this purpose, fungicides molecules remained on zucchinis and those removed in the cleaning water were monitored using LI and SBSE, respectively. The results obtained showed that the use of ultrasound technique allowed to increase the yield of removal efficiency of molecules such as fungicides when compared to the normal treatment. This yield can reach a value varying between 66 % and 92 % for fluxapyroxad according to the level of the field treatment of zucchinis and the duration of cleaning. The same tendency was obtained with difenoconazole (Fig 1). Looking ahead, food quality assessment represents the next strategy to be addressed along with the development of an environmentally friendly method to decontaminate pesticide-laden cleaning water.

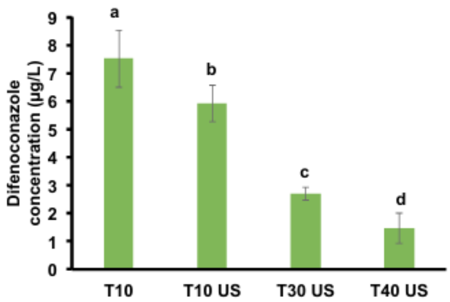

Figure 1. Evolution of difenoconazole concentration remained on zucchinis peels after the application of different cleaning conditions: 10 minutes without ultrasonic treatment (T10) and 10, 30, and 40 minutes under ultrasonic treatment (T10US, T30 US, T40US).

Keywords
ultrasound; pesticides; pilot scale; zucchinis; SBSE-GCMS

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Acknowledgements
The authors gratefully acknowledge the financial support from Region of Hauts-des-Frances in the framework of STIMuL-STIP financial instrument for funding ULTRAFEL project.

OA.11 Batch optimisation of ultrasound-assisted alkaline extraction of oat proteins and its scale-up in a laboratory ultrasonic continuous reactor

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Recent research has focused on meeting the rising demands for sustainable protein sources. Oats (*Avena sativa*) are recognized for their exceptional nutritional profile and rich source of plant-based protein [1]. Compared to the time-consuming and energy-inefficient conventional protein extraction methods, new innovative approaches such as ultrasound and hydrodynamic cavitation are being explored [2]. The objectives of this current experimental research were to optimise the alkaline sonoextraction (at a frequency of 20 kHz) using a batch system and advancing it on a continuous mode of operation for commercial applications. Response surface methodology using a two-level factorial central composite design approach was employed to investigate the effect of process variables; amplitude (20-100%) and sonication time (5-35 min) at a temperature of 20°C on the ultrasound-assisted alkaline extraction of protein from oat flakes. Ultrasonication at 80% amplitude for 30 min yieded the highest protein recovery (65%) compared to the 18 hrs of conventional stirring (250 rpm) at room temperature. Further, this optimized ultrasonic condition was selected to perform the protein extraction kinetics in a continuous ultrasonic reactor operated at a controlled temperature of 20°C. This study demonstrates that ultrasound assisted extraction can enhance recovery of high value ingredients in a shorter duration, and is therefore proposed as a green and an environment friendly technique for protein extraction with potential for scale-up to pilot and industrial scale [3].

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Acknowledgements

The authors would like to acknowledge Teagasc Walsh Fellowship programme and Department of Agriculture, Food, and Marine (DAFM) for the funding and providing the facilities and infrastructure to carry out this research work.

OA.12 Scalable ultrasound assisted extraction of pectin from apple pomace for biodegradable packaging applications

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The growing demand for sustainable food packaging solutions has intensified research into natural biopolymers such as pectin. Apple pomace (AP), a significant agro-industrial by-product from juice processing, is notably rich in pectin. However, traditional acid-based extraction methods can compromise the structural integrity and functionality of pectin, highlighting the need for alternative extraction strategies. This research aimed to optimize pectin extraction using advanced techniques, evaluate their efficiency, and assess the extracted pectin's applicability in biodegradable film production.

Initially, the study explored the impact of high-hydrostatic pressure (HHP) at 200 and 600 MPa for 10 min, combined with conventional extraction (CE: 30-180 min) and ultrasound-assisted extraction (UAE: 30-60 min), on pectin yield, structural, and rheological properties from both fresh and dried apple pomace. Results indicated that dried apple pomace treated with HHP at 200 MPa (10 min) followed by UAE (30 min) yielded the highest pectin content (12.32%), preserving molecular integrity and high galacturonic acid content. Contrarily, application at 600 MPa significantly degraded polymer structures, reducing viscosity and functional properties. Rheological analyses confirmed shear-thinning behavior with prominent viscosity variations at lower shear rates, stabilizing at higher shear rates due to polymer breakdown. Degree of esterification (DE) analyses revealed all pectin extracts as high-methoxyl pectin (DE range: 57.44–74.02%).

Building on these findings, a comparative study of CE, UAE, and a hybrid ultrasound-assisted conventional extraction was performed, focusing specifically on biodegradable film development. The hybrid method significantly improved pectin yield (fresh: 17.28%, dried: 15.17%) and retained both high- and low-molecular-weight fractions, enhancing structural and thermal stability. FTIR confirmed characteristic ester and hydroxyl groups crucial for film hydrophilicity, while thermal analysis demonstrated improved stability compared to conventional extraction.

Subsequently, pilot-scale ultrasound-assisted conventional extraction (US-CE) was developed, achieving a pectin yield of 15.00% with high DE (58.62%). The extracted pectin was plasticized and melt-compounded with polycaprolactone (PCL), forming extrusion-based biodegradable films suitable for food packaging applications.

Overall, this comprehensive research highlights moderate pressure and hybrid ultrasound techniques as optimal strategies for high-quality pectin extraction from apple pomace, providing viable pathways for sustainable packaging applications.

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OA.13 Evaluation of ultrasound-assisted extraction (UAE) for chitosan extraction from different treated shrimp shells

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Shrimp consumption generates a high amount of shrimp shells which is an abundant source of chitosan. Conventional extraction of chitosan from shrimp shells faces challenges in terms of chemical residue as well as energy consumption due to the long processing time required [1]. The application of ultrasound-assisted extraction (UAE) in obtaining chitosan from shrimp shells has been reported [2], not only reduces the chemical utilization but also the processing time [3]. The study investigated the potential application of chitosan extraction from shrimp shells in assisting the chemical extraction from treated and non-treated shrimp shells. Initially, there were two separate preliminary studies conducted involving UAE processing. First one, different techniques were compared in chitosan extraction including 3-h conventional and US probe 1000 hdT for 30 min, with and without enzymatic process for 24 h; the results showed that the optimum results were given by US probe 1000 hdT for 30 min for both demineralization and deproteinization, continued with conventional method on deacetylation. The second preliminary study was the shell's dissolution of different solvents (distilled water, 1M hydrochloric acid - HCl, or 1M acetic acid) with and without US bath 25 kHz at an interval time (0 – 1 h); the results demonstrated that 1M acetic acid for 30 min without US had a comparable dissolution to that of 1M HCl. Further experiments were conducted for chitosan extraction from three different shrimp shells including non-treated as a control, acetic acid treated shells, and enzymatic treated shells, following the optimum conditions from the first preliminary study. The optimum methods (demineralization: US probe 1000 hdT for 30 min; deproteinization: US probe 1000 hdT for 30 min; and deacetylation: 2.5h conventional) generated a higher chitosan yield (69.7%) and degree of deacetylation (98.6%) and lower solubility (92.1%) compared to that of the conventional methods. When the optimized method was applied on different shell treatments (acetic acid and enzymatic), it generated a similar range of yield (47 – 49 dried chitosan/ 1 kg of fresh shrimp shells) and degree of deacetylation (95 – 96%) with that of the non-treated shells. However, the treatments increased the purity of the chitosan from 93% to 99%, solubility from 96% to 98 – 99%, viscosity from 35 mPa.s to 57 mPa.s, and crystallinity index from 76% to 79 – 88%. In addition, the treatments also increased the thermal stability. The chitosan extracted by the optimized methods and treated shells had a higher degree of deacetylation and solubility, as well as a similar level of thermal stability and viscosity, when compared to commercial chitosan. In conclusion, UEA improved the chitosan extraction both from chitosan properties and processing efficiency.

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Acknowledgements

This study is funded by The European Union through IMPRESS project (101084437). Project website https://impress-he.eu/.

OA.14 Ultrasound-Assisted Hydrodynamic Cavitation for Efficient Protein and Starch Recovery from Potato Processing By-Products

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The food industry generates substantial quantities of by-products and waste, posing both environmental and economic challenges. Valorising these side-streams is crucial for promoting sustainability and advancing the transition toward a circular bioeconomy, particularly through the development of new functional and nutritional ingredients. In Ireland, potato processing represents one of the largest food waste streams, mainly comprising discarded unselected whole potatoes, potato slurry, and wastewater. These materials are typically sent to landfill, used as animal feed, or discharged to wastewater treatment plants. However, they are rich in valuable nutrients such as starch and proteins, which have functional and bioactive properties, making them promising substrates for industrial applications. Efficient recovery of these compounds could reduce waste, lower processing costs, and open new market opportunities [1].
This study investigates the large-scale application of ultrasound-assisted extraction using a hydrodynamic cavitation system to enhance the recovery of starch and proteins from potato slurry. This technology leverages controlled cavitation phenomena to disrupt cellular structures, improve mass transfer, and increase extraction efficiency. Hydrodynamic cavitation generates localized high-energy zones through pressure fluctuations, causing microbubble collapse and intensified molecular interactions. This facilitates cell wall disruption and the release of intracellular compounds without requiring intensive thermal or chemical treatments [2].
Initial optimization was performed at laboratory scale, followed by pilot-scale trials. The effect of cavitation was evaluated in combination with conventional extraction techniques, including acid precipitation, thermal coagulation, and enzymatic hydrolysis. Water- and alkali-based extractions were also tested. Pilot-scale results were consistent with laboratory-scale findings, confirming the scalability of the approach. Notably, a protein recovery protocol involving heating at 80 °C combined with isoelectric precipitation yielded a protein-rich precipitate containing approximately 60% protein.
Hydrodynamic cavitation emerges as a promising strategy for the valorisation of potato processing side-streams, offering an efficient, scalable, and environmentally friendly solution. Its implementation could generate significant economic and ecological benefits, reinforcing the principles of the circular economy.

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Acknowledgements: This research was funded by the project "Upcycling Side-Streams for Sustainable and Healthy Ingredients and New Food Concepts (UP4Food, 2024-2027)", supported by the Department of Agriculture, Food and the Marine (DAFM). The funding falls under the EU Joint Programming Initiative "A Healthy Diet for a Healthy Life" (JPI HDHL).

OA.15 Effect of ultrasound treatment on mannitol crystallization from *Alaria esculenta* seaweed extract

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Mannitol is a sugar alcohol broadly employed as an excipient in commercial pharmaceutical formulations and for its efficiency as a stabilizer in biological and medicinal products [1]. Additionally, due to its high stability, mannitol meets many applications in the food industry, mainly as a low calorific sweetener [2]. The use of ultrasound to favour active ingredients' crystallization is known as sonocrystallization. Notably, this process can affect particle size distribution, enhance crystallization reproducibility, and minimise the use of seed crystals or other external materials. Antisolvent sonocrystallization is based on the selection of an antisolvent for the precipitation of dissolved constituents, supported by non-thermal ultrasound application [3]. In this study, the impact of antisolvent sonocrystallization factors was investigated as a way of optimization of mannitol crystallization yield. The best conditions for mannitol crystallization to be applied on *Alaria esculenta* L. seaweed extract were preliminarly assessed using pure commercial mannitol. After dissolving the latter in water (1:2.5 w/v ratio), heating up to 60°C, and cooling the solution to room temperature, ethanol was added as antisolvent in different amounts. The mixture was then placed in a water bath at 15°C for 3o min for the crystallization step. After filtration, the crystalline residue was rinsed with ethanol and dried at 105°C overnight. A 2:1 w/v ratio of initially used mannitol and added ethanol gave the highest increase in the recovery of crystallized mannitol. Thus, this condition was selected and maintained in the next steps. Ultrasound irradiation was investigated after ethanol addition to understand the treatment effect on the recovery rate of crystallized mannitol. To do so, the ultrasound bath frequency (35 and 130 kHz), sonication duration (10 and 15 s), and immersion time (10 and 15 min) into the water bath at 15°C before sonication were varied. After sonication, the mixture was cooled again in the water bath at 15°C. As a result, the optimal crystallization conditions were sonication for 10 s at 35 kHz, carried out after 10 min cooling at 15°C, providing about 65% mannitol recovery. Based on these preliminary findings, the above conditions were employed to crystallize mannitol from *A. esculenta*. The seaweed was previously dried, milled, soaked in 0.1 M HCl (1:14 biomass:solvent ratio) overnight and then subjected to hydrodynamic cavitation (50 passes). After the process, the mixture was filtered by mesh sieve and the resulting supernatant underwent 10kDa membrane ultrafiltration. The obtained permeate was spray dried and used for mannitol crystallization, after being hydrolysed with 1.2 M H_2SO_4 at 100°C for 3 h. The sugar was quantified in the extract before and after sonocrystallization, and in comparison to the initially-described conventional crystallization, by using high performance anion exchange chromatography-pulsed amperometric detection (HPAEC-PAD), with a Thermo Scientific Dionex ICS-6000 system and a CarboPac PA20 column.

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Acknowledgements

IMPRESS Horizon Europe co-funded Innovation Action (101084437, HORIZON-CL6-2022-FARM2FORK-02-two-stage) "Innovative approaches for marine and freshwater based ingredients to develop sustainable foods and value chains".

OA.16 Polysaccharide-protein composite extracts from residue of brown seaweed *Alaria esculenta*: Influence of ultrasonication compared against other advanced technlogies on extraction efficiency, structural, and functional properties

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This study investigated the extraction and characterisation of polysaccharide–protein composite extracts derived from the residue of *Alaria esculenta* (AE), a brown seaweed, obtained after prior extraction of hydrocolloids. Advanced extraction technology of ultrasound, both probe (USP) and bath (USB) systems were applied and compared against microwave (MW), high hydrostatic pressure (HPP), pulsed electric field (PEF), enzymatic hydrolysis (EAE) and conventional stirring (CE) assisted extraction, in combination with alkaline pH shifting to enhance protein recovery and purity. AEUSP achieved the greatest protein recovery (40.60 ± 0.23 %) and smallest particle size (Dv50 = 7.83 µm), while AEHPP yielded the highest protein content (40.38 ± 0.66 %). AEMW produced the highest extraction yield (28.13 ± 1.02 %) and foaming capacity (73.81 ± 3.37 %), whereas AEHPP showed superior foam stability (FS at 60 min: 88.18 ± 2.57 %) and total amino acid content. Structural analyses via FTIR and DSC revealed enhanced interaction between proteins and polysaccharides, and increased thermal stability, respectively in all the extracts. Among functional properties, AEPEF showed the highest protein solubility (44.03 ± 0.18 %), while AEUSP exhibited superior oil holding capacity (7.56 ± 0.13 g/g) and emulsifying activity (24.62 ± 0.80 m^2/g), attributed to its higher protein content and reduced particle size. AEHPP displayed the lowest water holding capacity, likely due to protein aggregation. All extracts retained essential amino acids with essential amino acids/nonessential amino acids ratios up to 0.90.

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Acknowledgements

UCD Ad Astra Doctoral fellowship supported by University College Dublin (UCD); AMBROSIA project funded by the Department of Agriculture Food and the Marine (DAFM), IMPRESS project co-funded by the European Union (GA No. 101084437)

OA.17 Wastewater to Food Ingredient: Ultrasonic-assisted and Enzymatic-assisted Extraction for Efficient Recovery of Taurine from Spent Ham Curing Brine

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Spent curing brines from ham production pose a disposal challenge due to their high levels of BOD and salt. However, this liquid by-product still contains soluble proteins, amino acids, and other organic compounds that leach from the meat during brining, making it a valuable resource for recovering bioactive compounds such as taurine. Taurine has recently gained attention for its potential benefits in heart health, metabolism, and brain function, as well as its widespread use in food, pharmaceutical, and nutraceutical applications [1]. Taurine is a sulfur-containing amino acid naturally found in mainly fish, eggs, meat, and milk as a free amino acid [1]. In this study, an enzymatic hydrolysis and ultrasound-assisted extraction method was developed for recovering crude taurine from spent ham curing brine. The enzymatic process was performed using Alcalase, and the effects of experimental factors, including ultrasound amplitude (50% and 100%) and hydrolysis time (30 minutes, 1 hr, 2 hrs, 3 hrs, and 18 hrs), on degree of hydrolysis, taurine yield, and free amino acids were evaluated. By optimizing these conditions, this study aims to develop an efficient and scalable approach for taurine recovery, contributing to the valorization of meat industry by-products. Based on the results obtained, we intend to produce a functional ingredient that can be commercially utilized, offering both functional benefits and enhanced sustainability, while being cost-effective. Preliminary findings suggest that optimizing parameters such as ultrasound amplitude and hydrolysis time may enhance taurine recovery [3]. Thus, developing an efficient extraction process enables a sustainable, alternative source of taurine beyond traditional animal-derived sources.

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Acknowledgments

This work was supported by the TU Dublin Researcher Award and the Department of Agriculture, Food and the Marine (2023RP1040).

OA.18 Synergistic Ultrasound-Microwave Extraction of Humic Substances from Dairy Digestates

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Anaerobic digestion (AD) is considered a sustainable solution for renewable energy production and bio-waste management. The technology is increasingly being adopted, but management of the resulting digestate remains limited in application. Land spreading, the primary disposal method, raises significant challenges such as high microbial load, fluctuating nutrient distribution, contaminant led environmental risks, and logistical constraints. Digestates from AD however represent a promising alternative feedstock for humic substance (HS) recovery, with the potential to reduce dependency on traditional, non-renewable sources like coal and peat. The applications of HS extend across the agri-environmental sector, with organic biostimulants representing a key area of utilization. This study looks at biorefining digestates from dairy processing industry to extract value added agrochemicals.

Efficiency limited conventional extraction methods were challenged by the developed novel pretreatment-based extraction methods. Ultrasound (US), microwave (MW) and combined ultrasound microwave (USMW) assisted extractions were tested at varying power setting. The synergetic effect from USMW demonstrated significant recovery improvements, while considerably reducing extraction times. This approach leveraged the complementary benefits of enhanced solubilization and matrix breakdown, enabling higher yields of HS, with a 4.5-fold increase in the case of humic acids. Additionally, the impact of high-energy treatment on the structural and macromolecular properties of HS was assessed, as such treatments can influence the complex bonding and structural integrity of HS. Spectrometric analyses, including FTIR, NMR, and elemental analysis were performed to identify changes, coupled with evaluations of the applicability of the extracted HS as a plant biostimulants in the agro-industrial sector.

The higher extraction efficiency, presence of diverse functional groups, and increased micro minerals presents the potential of the combined US+MW method as a green, efficient, and scalable extraction technique for high-quality HS extraction. This approach aligns with the EU Fertilizer Product Regulation (EU 2019/1009) and contributes to the valorization of AD by-products within a circular bioeconomy framework. By emphasizing zero-waste principles and sustainable resource utilization, this research underscores the viability of transforming digestate into valuable biostimulants, paving the way for innovative applications in sustainable agriculture. The study not only advances the understanding of HS extraction but also provides a foundation for future research into the optimization and commercialization of these processes.

Acknowledgements

This work was supported by the Environmental Protection Agency of Ireland and the Department of Agriculture, Food and the Marine under Facilitating a Green and Circular Economy Hub 2021 Research funding award [Grant no.: 2021-GCE-1040].

OA.19 Upcycling Bovine Blood: Innovative Ultrasound-Assisted Processing for Functional Ingredient Recovery and Sustainable Food Systems

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The valorization of bovine blood, a major by-product of the meat processing industry, presents an untapped opportunity to advance sustainability and resource efficiency in the food sector. Rich in high-quality proteins and bioactive compounds, bovine blood is often discarded, contributing to environmental pollution due to its high biological and chemical oxygen demand [1, 2]. This study explores an integrated bioprocessing approach, combining enzymatic hydrolysis—alcalase, nutrase, and flavourzyme—and ultrasonic treatment, to convert bovine blood into functional protein and peptide fractions with enhanced properties. The recovered hydrolysates demonstrate significant potential across the food industry—as protein enrichers, emulsifiers, and foaming agents—offering functional properties suitable for incorporation into value-added food products. Fresh bovine blood was obtained from a local slaughterhouse, immediately cooled to 4°C to prevent degradation, and homogenized prior to processing. Three hydrolysis treatments were applied: (i) enzymatic hydrolysis using a mixture of enzymes under optimized conditions (pH 7, 50°C, 3 hours); (ii) enzymatic hydrolysis preceded by ultrasonic pre-treatment (25 and 45 kHz, 1000 W); and (iii) a combined treatment involving ultrasound application at varying amplitudes (25% and 100%, 1000 W) followed by enzymatic hydrolysis. These approaches aimed to enhance enzyme accessibility and improve protein solubility. Following hydrolysis, samples were centrifuged, and the supernatants containing soluble proteins and peptides were collected, freeze-dried, and subjected to further analysis. Functional properties of the protein and peptide fractions were assessed using standard methods. Protein solubility was measured through centrifugation and quantified using the Bradford assay. Emulsifying properties were determined by calculating emulsion activity and stability indices following oil–protein homogenization and absorbance readings at 500 nm. Foaming capacity and stability were evaluated by measuring foam volume at 0, 30, and 60 minutes [3]. The results demonstrated that the combination of ultrasonic and enzymatic hydrolysis significantly enhanced solubility, emulsification, and foaming performance compared to enzymatic hydrolysis alone. These findings highlight the synergistic effect of ultrasound-assisted enzymatic hydrolysis in improving functional characteristics of blood-derived proteins and peptides, making them suitable for application in high-value food products, functional beverages, nutraceuticals, and cosmetic formulations. In addition to their functional attributes, such hydrolysates may also contribute health-promoting benefits, including antioxidant and antihypertensive potential, thus opening avenues for therapeutic use. Moreover, this study reinforces the concept of circular bioeconomy by converting a challenging waste stream into valuable ingredients, reducing environmental impact, and supporting sustainable development goals. Future research should enhance processing efficiency, assess peptide stability, and explore industrial-scale feasibility. Overall, this bioprocessing approach offers a sustainable and innovative way to valorize bovine blood into functional ingredients for food systems.

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Acknowledgements

The authors would like to acknowledge the Department of Agriculture, Food, and the Marine (DAFM) and CircoVal project for funding this research.

SHOTGUN COMMUNICATIONS

SG.1 Ultrasound Assisted Salmon By-products Valorisation: Oil Biorefinery and Encapsulation with Polyphenol Extract

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Salmon processing generates significant amounts of waste, including fish heads, backbones, skin, and viscera, which serve as valuable sources of nutrients and bioactive compounds. Salmon oil is particularly rich in omega-3 fatty acids (EPA and DHA), fat-soluble vitamins, and astaxanthin, offering important nutritional and health benefits such as antioxidant, anti-inflammatory, cardiovascular protective, and neuroprotective effects[1]. However, conventional fish oil extraction methods, including industrial dry and wet processing, require integration with non-thermal techniques to improve cost-effectiveness and efficiency[2]. Encapsulation techniques are also essential to minimize oxidation, protect fish oil from moisture and high temperatures, and mask undesirable odors[3].

This study aims to refine salmon oil and enhance its encapsulation to preserve unsaturated fatty acids and antioxidant properties. At the laboratory scale, a combined microwave and ultrasound-assisted extraction method was employed to replace traditional heat-based wet processing, increasing extraction efficiency while mitigating lipid oxidation caused by high temperatures. A novel encapsulation system was developed using polyphenol extracts from blackberries as the continuous phase to reduce oxidation and biodegradation, extending the shelf life and maintaining oil quality over longer storage periods. The encapsulation efficiency of freeze-drying and spray-drying techniques was compared under different ultrasound amplitude-stabilized emulsion conditions.

Preliminary results showed that the microwave-ultrasound method achieved a fish oil recovery of 58%. Additionally, ultrasound-assisted emulsification contributed to the formation of stable fish oil emulsions, as demonstrated through the evaluation of emulsion stability, zeta potential, particle size, and surface morphology. After drying, volatile compounds responsible for undesirable odors were significantly embedded within the gelatin matrix. This study introduces a greener, innovative approach to salmon byproduct processing, enhancing fish oil storage stability and overcoming its application limitations.

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Acknowledgements

The authors would like to acknowledge the UCD-CSC Scholarship Scheme supported by University College Dublin (UCD) and China Scholarship Council (CSC) for this study, and the ERA-NET BlueBio Project "IMPRESSIVE" (grant No. 341732 of RCN) for the financial support.

SG.2 Acoustical Study of Pure Synthesized $NiFe_2O_4$ Nanofluids at Different Concentration and Temperatures by using 5 MHz Ultrasonic Waves

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In this present research, the pure $NiFe_2O_4$ nanoparticle was synthesized using the sol-gel method. Nickel Nitrate Hex-hydrate (Ni $(NO_3)_2.6H_2O$) and Iron Nitrate Nona-hydrate ($Fe(NO_3)_3.9H_2O$) are used as precursors and Citric Acid used as chelating/stabilising agent which helps in controlling the morphological size and help in uniformity formation of nanoparticle. The obtained $NiFe_2O_4$ nanoparticle undergoes Ultraviolet (UV) spectroscopy to enhance the size, and band gap of $NiFe_2O_4$ nanoparticles. The pure synthesized $NiFe_2O_4$ nanoparticle also was transformed to liquid by mixing and dispersed into Polyethylene Glycol (PEG) polymer at 2%, 4% and 6% concentration for ultrasonic characterization. The obtained liquid was poured into the cylinder of an ultrasonic interferometer and undergoes through ultrasonic characterization by sending ultrasonic wave of frequency 5 MHz to measure the ultrasonic velocity, density, and viscosity at different temperatures (303K to 333K). Also, the related ultrasonic parameters such as adiabatic compressibility, acoustic impedance, and ultrasonic attenuation were also determined using the experimental parameters such as ultrasonic velocity, density, and viscosity. Ultrasonic characterization of material was played an important phenomena to study the struct ural, intermolecular interaction and properties of matter.

Keywords

Nickel Ferrite Nanoparticle; Nanofluids; Ultrasonic parameters; Ultrasonic wave;

SG.3 Cementation of Platinum-Group Metals onto Copper: Feasibility, Kinetics, and the Effect of Ultrasound

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The cementation of platinum-group metals (PGMs) onto copper is thermodynamically feasible but remains virtually undocumented in the scientific literature, despite extensive research on other metal cementation systems. In this study, we investigate the potential of this process through both electrochemical and batch cementation experiments, with a particular focus on the role of ultrasound. Electrochemical tests—including Open Circuit Potential (OCP) measurements, Cyclic Voltammetry (CV), and Electrochemical Impedance Spectroscopy (EIS)—confirm the spontaneous reduction of platinum onto copper and highlight a diffusion-controlled mechanism characterized by significant Warburg impedance. Batch cementation experiments conducted with synthetic and real Pregnant Leach Solution (PLS) demonstrate that platinum, palladium, and rhodium can be efficiently recovered under optimized conditions. In synthetic platinum solutions, complete cementation is achieved at 65°C, 200 rpm, and a Cu/PGM molar ratio of 16. In real mixed-PGM PLS at 65°C, 400 rpm, Cu/PGM = 13, palladium exhibits the highest recovery (~90%), whereas platinum and rhodium reach (~50%). Higher recoveries were obtained at 85°C, 200 rpm, Cu/PGM = 13, but at the expense of filtration efficiency.
Ultrasound significantly enhances cementation kinetics and efficiency, particularly under conditions similar to those optimized for conventional cementation (i.e., cementation conducted under identical conditions but without ultrasound). Under sonication at 20 kHz and 0.01 W/cm^3, palladium cementation in a real mixed-PGM solution at 65°C, 400 rpm and Cu/PGM = 13, reaches 90% recovery in 30 minutes, compared to 120 minutes without ultrasound, representing a fourfold acceleration of the process. Platinum and rhodium also exhibit reduced deposition times under ultrasonic activation, although to a lesser extent. At 85°C, ultrasound further improves recovery rates, achieving the highest recoveries obtained in this study within 2 hours: 100% for palladium, 75% for platinum, and 85% for rhodium. The improved kinetics are attributed to enhanced mass transfer, suppression of passivating layers, and facilitated nucleation of PGM deposits, leading to a more uniform and continuous cementation process. However, electrochemical studies reveal that excessive ultrasonic intensity can induce partial reoxidation of deposited platinum, emphasizing the need for an optimized balance between agitation and ultrasonic power.
These findings could contribute to the development of a more efficient process for PGM recovery and offer valuable insights into the role of ultrasound in cementation mechanisms. The optimized approach could be implemented for sustainable recycling strategies in the recovery of PGMs from industrial and automotive catalysts, addressing both supply constraints and environmental concerns.

Acknowledgements
The authors gratefully acknowledge Dr. Jinu Joseph John from the Process Engineering for Sustainable Systems (ProcESS) section of the Department of Chemical Engineering at KU Leuven, Dr. Anastasia Maria Moschovi and MONOLITHOS Catalysts and Recycling LTD., Prof. Jochen Petersen and Dr. Kathija Shaik from the Hydrometallurgy Research Group of the Department of Chemical Engineering at the University of Cape Town, and Paul André from the GeMMe Group at the University of Liège for their contributions to this research.
This study was supported by European funding from the Marie Skłodowska-Curie Actions under the ChemPGM project.

SG.4 Ultrasound Assisted Extraction of Protein from Duckweed.

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Due to the increased demand for plant-based protein, duckweed has gained considerable interest as a sustainable source. In this study, protein was extracted by various techniques from both dried and fresh undried biomass. Firstly, dry biomass extractions were completed; a method which combined ultrasound, and enzymes (USE) was carried out. This was compared to a similar method which employed traditional 'orbital shaking' used in conjunction with enzymes (OSE). Ultrasound and orbital shaking were then combined (USOSE) to investigate a synergistic effect between ultrasound and orbital shaking. In addition, a pH shift technique (USpH) was conducted as a control.

Fresh biomass also underwent protein extraction. A two-step protocol was established, whereby the first stage was carried out in a solvent composed of purely water, the residue was then re-combined with a high pH solvent and reprocessed to extract the remainder of the proteins. Blending and ultrasound (USF) were the pretreatments selected for this technique. As a control, blending and magnetic stirring (MSF) were selected as alternative pretreatments.

Of all techniques investigated, the most promising extraction result was achieved using dried biomass treated with ultrasound, orbital shaking and enzymes (USOSE). The novel USOSE method yielded significantly more protein than all other techniques. The development of eco-friendly protein extraction techniques without the use of harmful chemicals is required to improve the sustainability of plant protein extraction processes. This research shows duckweed is an accessible source of protein.

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SG.5 Enhancing the physicochemical properties of cold brew Robusta and decaffeinated coffee through ultrasound-assisted soaking and extraction

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This study investigated the effect of ultrasound treatment on the physicochemical properties of cold brew Robusta and decaffeinated coffee. It also examined the potential of ultrasound technology to mitigate quality deterioration in Robusta coffee and decaffeinated coffee through physical modifications [1]. Green beans were soaked in D-xylose and L-leucine solutions and treated using a bath-type sonicator (280 W, 40 kHz) for 30 or 60 minutes to improve flavor and sensory characteristics [2]. Additionally, probe-type sonication (130 W, 20 kHz) at 80% amplitude was applied for 0, 5, and 10 minutes to evaluate its impact on extraction efficiency compared to traditional cold brew methods. Ultrasound treatment altered the physical properties of the coffee, resulting in a lighter color, increased pH, and reduced viscosity. Droplet size significantly decreased ($p < 0.05$) after 10 minutes of probe-type sonication, and particle size distribution became more uniform, as reflected by a reduced polydispersity index (PDI). Scanning electron microscopy (SEM) revealed the formation of numerous pores in probe-type sonicated samples, resulting in a more porous structure, which, due to acoustic cavitation, facilitates easier compound extraction [3]. Antioxidant activity, measured via total phenolic content (TPC) and total flavonoid content (TFC), increased significantly ($p < 0.05$) with prolonged ultrasound exposure. These findings suggest that ultrasound treatment enhances both the physical properties and antioxidant potential of cold brew coffee, offering a promising approach for quality improvement.

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Acknowledgements

This study was supported by the Basic Science Research Program through the National Research Foundation of Korea [grant number NRF, S-2024-A0496-00153].

SG.6 Analysis of α-dicarbonyl compounds, furans, and volatile compounds in cold brew coffee prepared by ultrasound-assisted soaking and extraction.

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In this study, we evaluated the applicability of ultrasound treatment to enhance the flavor characteristics of cold brew Robusta and decaffeinated coffee. Ultrasound treatment was applied at two stages of the coffee preparation process. First, ultrasound was applied during the soaking process of green beans in D-xylose and L-leucine solutions. Pre-treatment of green beans in polar and non-polar solutions is recognized as a chemical method for modifying coffee flavor precursors [1]. To assess the penetration efficiency of these compounds, green beans were soaked in the two solutions and sonicated for 30 and 60 minutes using a bath-type sonicator (280 W, 40 kHz) [2]. Second, ultrasound was utilized to assist the extraction of cold brew coffee and shorten the extraction time [3]. To evaluate this effect, a probe-type sonicator (130 W, 20 kHz) was used at 80% amplitude for 0, 5, and 10 minutes. The impact of these processing techniques on volatile and non-volatile compounds in cold brew Robusta and decaffeinated coffee was investigated. A total of 32 volatile flavor compounds were identified in the analyzed samples of cold brew Robusta and decaffeinated coffee. As ultrasound treatment time increased, the total peak area ratio of volatile compounds significantly increased ($p < 0.05$). In particular, samples treated with D-xylose exhibited an increased content of furfural compounds, which are responsible for fruity and sweet flavors, compared to the control samples. Meanwhile, the samples treated with L-leucine demonstrated a significant increase in pyrazine content, which is associated with roasted and nutty flavors. The content of chlorogenic acid, which is known to contribute to the bitterness and astringency of coffee, significantly increased with prolonged ultrasound treatment ($p < 0.05$). Additionally, α-dicarbonyl compounds and furans, recognized as harmful volatile compounds associated with the Maillard reaction, exhibited the highest levels at 5 minutes of ultrasound treatment but significantly decreased at 10 minutes ($p < 0.05$). This study suggests the effectiveness of ultrasound treatment as a method for improving the flavor characteristics and reducing harmful compounds in cold brew Robusta and decaffeinated coffee.

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Acknowledgements

This study was supported by the Basic Science Research Program through the National Research Foundation of Korea [grant number NRF, S-2024-A0496-00153].

SG.7 Design, Fabrication, and Characterization of high-frequency PMUT for Transcranial Neurostimulation

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The significantly high acoustic attenuation coefficient of the skull, compared to tissue, necessitates the use of sub-MHz frequencies in low-intensity transcranial focused ultrasound stimulation (tFUS), as lower frequencies experience less attenuation [1]. However, this frequency range limits spatial precision due to larger focal volumes, reducing the accuracy of targeted brain stimulation while high-frequency ultrasound provides superior spatial resolution by reducing the focal volume [2]. Conventional bulk piezoelectric transducers face inherent limitations in miniaturization potential, portability, and spatial resolution [3]. In contrast, micromachined ultrasound transducers (MUTs) represent a significant technological advancement, featuring micro-scale membrane structures coupled with precisely engineered acoustic cavities that can be fabricated using advanced micro-electromechanical systems (MEMS) techniques with precise control over geometry and dimensions. This work presents a groundbreaking transducer architecture, term as MetaPMUT, which integrates Helmholtz resonators (HRs) configuration with silicon nitride (SiNx) membranes within the AIN-based piezoelectric MUT. When the PMUT vibrates, resulting in the compressive vibration in the cavity, the resulting acoustic waves subsequently pass through the HR and sequentially interact with the SiNx membrane along the acoustic transmission line, enabling precise manipulation of wave propagation characteristics. This innovative design simultaneously exploits the piezoelectric effect and double-negative acoustic metamaterial properties to achieve enhanced transcranial energy transmission efficiency. The design methodology, fabrication, characterization, and experiments of 10 by 10 elements MetaPMUT with an operating frequency of 5 MHz in water are systematically described. Based on the mechanism of vibration coupling between the membranes and HRs, a lumped model and an equivalent circuit model are formulated. Meanwhile, the finite element method (FEM) is developed to retrieve the effective densities and elastic moduli of the MetaPMUT from these results. The single MetaPMUT chip driven with 20 Vpp square unipolar pulses generated a maximum peak-to-peak acoustic pressure output of 65.79 kPa at a focal distance of 17 mm with a -3dB focal width of 2.11 mm. This pressure output corresponds to a spatial-peak pulse-average intensity (ISPPA) of 36 mW/cm^2, well within the safety threshold for tFUS applications. Through the strategic spatial arrangement of multiple MetaPMUT chips into a phased array configuration, precise control over ultrasound beam focusing and electronic steering can be achieved. The MetaPMUT's unique combination of MEMS technology and metamaterial engineering demonstrates significant potential for advancing non-invasive neurostimulation applications, particularly in tFUS paradigms.

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Acknowledgments

This work was supported in part by the National Key Research and Development Program of China (2022YFB3204300), and the Zhejiang Provincial Key Research and Development Program of China (2022C01002).

SG.8 Ultrasonication to enhance physicochemical properties of freeze-dried bananas

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Bananas are a fruit that is abundant in Taiwan all year round, but they will soften after ripening, and storage at low temperatures will cause bananas to turn black. Drying can extend bananas' shelf life and increase their economic value. In recent years, freeze-drying has become a high-tech technology for dehydrating and drying agricultural products because it can effectively retain the flavor and nutritional value of products [1]. Ultrasound is a non-thermal technology that can affect the structure of the sample through various mechanisms. During ultrasonic treatment, microchannels are formed, and cavitation effects occur at the liquid-liquid or liquid-solid interface, resulting in physical changes and plant cell wall destruction [2]. This technology has been used as a drying pretreatment to shrink and expand materials to achieve a sponge-like structure [3]. However, a combination of ultrasound and freeze-drying for banana slices remained unexplored. This study used the Taguchi method for process optimization of banana freeze-drying integrated with ultrasound pre-treatment. Variables include ascorbic acid soaking solution concentration, bananas-to-liquid ratio, ultrasonic treatment time, and raw material thickness. Dried products were analyzed for color values, moisture content, texture, phenolic content, 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity, and rehydration ability. The products were then compared with those of the conventional hot-air drying method. According to the results, ultrasonic pre-treatment can effectively reduce the moisture content of bananas after freeze-drying and increase the rehydration ability of dried samples.
At the same time, sample soaking in ascorbic acid can effectively inhibit the browning issue that occurs during banana pre-treatment, further enhancing the products' properties. The findings indicated the capability of ultrasound in producing dried bananas with enhanced bioactive compounds, contributing to improved food nutrition in line with sustainable development goals.

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Acknowledgments

The authors appreciate the National Pingtung University of Science and Technology (NPUST) and the National Science and Technology Council, R.O.C (NSTC).

SG.9 A feasibility study of ultrasound-assisted valorization of coffee silver skin into extract with high antioxidant capacity

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Coffee is one of the most common beverages in the world. However, by-products, such as coffee silver skin (CS), are produced during coffee bean roasting [1]. The phenolic compounds in CS have biological activities, including hypoglycemic, liver-protective, antiviral, antibacterial, anti-carcinogenic, and anti-inflammatory properties [2]. High antioxidant capacity also highlights its potential health benefits [3]. Various extraction technologies have been used to achieve the added value of CS. However, limited information was reported on the application of power ultrasound for CS valorization. This study aimed to extract Taiwanese coffee silver skin by ultrasound and optimize the process using the Taguchi Method. Independent parameters were extraction time, ultrasound amplitude, ethanol concentration, and initial temperature. Samples were analyzed for total soluble solids (TSS), color values, antioxidant capacity, and total phenolic content (TPC). The results revealed that TSS increased with the increase of ethanol solvent concentration, and the blue-yellow value (b*) also showed a trend of higher values under the conditions of 80% ethanol solvent extraction. The highest TPC of 7.445 mg/g GAE /g CS was achieved at 1 minute, 50% amplitude, 80% ethanol, and an initial temperature of 25°C. The IC_{50} range of DPPH radical scavenging ability was 0.634-1.283 mg/g, indicating the high antioxidant capability of extracts obtained by ultrasound. According to the findings of the present study, silver skin coffee has a strong antioxidant capacity, while the selection of optimal parameters is crucial for minimizing the degradation of bioactive compounds in the extract. The potential of ultrasonically extracted CS can be further explored in future studies to enhance its utilization value for practical contributions to sustainable food production and waste valorization.

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Acknowledgments

The authors appreciate the National Pingtung University of Science and Technology (NPUST) and the National Science and Technology Council, R.O.C (NSTC).

SG.10 Optimization of alginate pre-extraction processes by green solvents and technologies for the development of high intensity ultrasound-aided alginate production

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Alginate is widely used in the food industry, but more recently has gained prominence as a biomaterial due to its biocompatibility, biodegradability, and non-toxic nature [1,2]. However, growing environmental concerns highlight the need for sustainable extraction methods to replace conventional processes [3]. Ultrasound-assisted extraction (UAE) has attracted significant attention by improving polysaccharide yields and decreasing solvent consumption and extraction time [4]. This study aims to optimize the pre-extraction conditions of alginate from *Alaria esculenta* using UAE by response surface methodology (RSM) using food grade solvents. RSM with three-factor, four-level Box-Behnken Design (BBD) was used to study and optimize the pre-extraction variables ultrasonic amplitude (60-100%), temperature (20-80°C) and time (30-70 min) at fixed seaweed to solvent ratio of 1:10 (w/v) using 3% w/v citric acid in an ultrasonic processor (UIP500hdT, Hielscher Ultrasonics GmbH, Teltow, Germany). After this pre-extraction step, all samples were processed to extract alginate following previously reported UAE conditions in sodium bicarbonate and alcohol precipitation [5]. High-performance liquid chromatography with a refractive index detector (Agilent Technologies, USA) was used to quantify the amount of alginate in each extract (n=3).The response variables for RSM were yields of extract (%) and alginate purity (%). The highest yields of alginates were of 3.7 g extract/100 g seaweed (UAE: 80°C, 50 min, 60% amplitude). These results indicated that higher temperatures (80°C) produced greater alginate yields. The highest purity extracts were recorded following extraction conditions at 80°C, 30 min and 80% amplitude (98.1 g alginate/100 g extract). While optimal conditions for the production of alginate using fully UAE method and food grade solvents have been elucidated here, future research will include further characterization of the alginates using UAE processing and non-UAE processing, to understand changes in chemical structure that may affect their industrial use.

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Acknowledgements

This work was supported by the McCarrick Graduate Research Scholarship in memory of Dr Roger McCarrick.

SG.11 Effect of longitudinal-bending elliptical ultrasonic vibration assistance on electrosurgical cutting and hemostasis

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Electrosurgical devices are widely used for tissue cutting and hemostasis in minimally invasive surgery (MIS) for their high precision and low trauma. However, tissue adhesion and the resulting thermal injury can cause infection and impede the wound-healing process. This paper proposes a longitudinal-bending elliptical ultrasonic vibration-assisted (EUV-A) electrosurgical cutting system that incorporates an ultrasonic vibration in the direction of the cut by introducing an elliptical motion of the surgical tip. Compared with a solely longitudinal ultrasonic vibration-assisted (UV-A) electrosurgical device, the EUV-A electrode contacts the tissue intermittently, thus allowing for a cooler cut and preventing tissue accumulation. The experimental results reveal that the EUV-A electrode demonstrates better performance than the UV-A electrode for both anti-adhesion and thermal injury through in vitro experiments in porcine samples. The tissue removal mechanism of EUV-A electrosurgical cutting is modeled to investigate its anti-adhesion effect. In addition, lower adhesion, lower temperature, and faster cutting are demonstrated through in vivo experiments in rabbit samples. Results show that the EUV-Al electrode causes lower thermal injury, indicative of faster postoperative healing. Finally, efficacy of the hemostatic effect of the EUV-A electrode is demonstrated in vivo for vessels up to 3.5 mm (equivalent to that of electrocautery). The study reveals that the EUV-A electrosurgical cutting system can achieve safe tissue incision and hemostasis.

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Acknowledgements

This work was supported by the National Natural Science Foundation of China (Grant No. 52105435). The authors would thank Guangdong Provincial Key Laboratory of Minimally Invasive Surgical Instruments and Manufacturing Technology and State Key Laboratory for High Performance Tools.

SG.12 A green approach for protein extraction from *Porphyra* sp. using sequential alkaline and ultrasound-assisted based methodology

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In recent years there has been significant development in alternative based proteins such as seaweeds. Seaweeds have been shown to not only to be a good source of proteins at 47% (based on dray mass) but also a source of bioactive compounds that have demonstrated antibacterial, antiviral, antifungal, anti-inflammatory and antioxidant properties [1]. *Porphyra umbilicalis Kützing* is a red seaweed known commonly as "Nori" is widely consumed in East Asia. The extraction of seaweed based protein has been problematic as the polysaccharide-rich cell wall poses issues concerning overall extractible yield and protein bioavailability. Ultrasound assisted extraction (UAE) has gained special interest in protein extraction due to its low solvent use, mild operating conditions, short and simple operating process and its capacity to be scaled up to pilot scale in the extraction of seaweed protein [2]. In this study, *Porphyra umbilicalis Kützing* were initially extracted using an alkaline pretreatment trialled under alkaline conditions proceeded by ultrasound based extraction. It was found that the best yields were obtained using the 60 °C at 38.1 ± 1.16 %. A protein content of 40.0 ± 0.95 % was obtained following extraction and subsequent protein determination using the DUMAS method which was close to the stated limit of 47 % based on dry mass recorded for red seaweeds [3]. Antioxidant activity via the FRAP assay indicated values between 2 and 12.8 mg/g trolox equilivant (TE) values. Therefore, the combination of alkaline/ultrasound based extraction protocol can successfully be employed in the isolation of *Porphyra umbilicalis* proteins. Moreover these extracts indicated some antioxidant activity and as a result these proteins may have a functional uses within the pharmaceutcial and food industry.

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SG.13 USE OF ULTRASOUND FOR THE EXTRACTION OF CARBOHYDRATES AND PROTEINS FROM OLIVE OIL POMACE

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One of the most important socio-economic activities in the Mediterranean region is the olive oil sector, with production having tripled since 1960, reaching approximately 3×10^6 tons in the 2021-2022 season. However, its production generates a large amount of a semi-solid residue known as olive oil pomace or "alperujo," which accounts for 80% of processed olives (1), posing a serious environmental problem.

Despite this, alperujo is a promising source of high-value-added substances, notably phenolic compounds and fiber (2), among others. For this reason, sustainable alternatives for the valorization of this by-product are currently being explored. Enzymatic, acid-thermal hydrolysis, high-pressure treatments, and ultrasound are some of the most commonly used techniques for the utilization of agro-industrial by-products. Specifically, ultrasound-assisted extractions have received considerable attention due to their numerous advantages, including reductions in energy costs (3).

In this study, alperujo from the Arbosana olive variety was used for the extraction of functional compounds through ultrasound (US) and its combination with enzymatic hydrolysis. Prior to this, a proximal characterization was performed, highlighting 12% proteins and 46% carbohydrates of which 69% is fiber.

Two methods were used for the extraction of carbohydrates and proteins. In the first method (Method 1), the samples were treated with US at 0% (control), 50%, and 100% (1000 hDT). Subsequently, the solid fraction was enzymatically hydrolyzed with 5% (v/w) Viscozyme. In the second method (Method 2), the treatments were reversed: first, enzymatic treatment was applied, followed by US treatment under conditions similar to those in Method 1. The extraction sequence in both methods ensured full utilization of the starting material.

The extracts from both methods were analyzed, concluding that the concentration of extracted proteins is higher in Method 1, reaching up to 16.5% as compared to 9% in Method 2, regardless of US power. However, the extraction of total carbohydrates was not affected by the use of US, ranging between 50-90%. In the monomeric composition of these extracts resulting from US treatments, the release of polysaccharides derived from galacturonic acid, originating from pectic compounds in the cell wall, was observed.

In conclusion, the extraction of proteins and specific carbohydrates is enhanced by the combination of US followed by enzymatic hydrolysis.

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Acknowledgements

A. Marina and S. Gorgojo (Bioanalytical Techniques Unit (BAT), CIAL), and MICINN of Spain, Project PID2021-123862OB-I00.

SG.14 How does low-intensity pulsed ultrasound effect intramembranous ossiffication compared to the autologous bone gold standard?

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Low-intensity pulsed ultrasound (LIPUS) has been extensively utilized as a biophysical modality to enhance osteogenesis and accelerate fracture consolidation, particularly in bones undergoing endochondral ossification. However, its efficacy in facilitating osteogenesis within bones that ossify intramembranously remains indefinite[1]. The hypothesized mechanisms of LIPUS-mediated osteoregenerative effects encompass mechanotransduction phenomena such as acoustic streaming [2]. This investigation aimed to elucidate the therapeutic impact of LIPUS and autologous bone grafts on the reparative dynamics of the critical-size bone defect (CSBD) in the rat calvarium. The CSBD represents the minimal osseous defect that is incapable of spontaneous regeneration, making the calvarial defect an optimal experimental paradigm for assessing intramembranous ossification. In transplant surgery, autologous bone remains the gold standard due to its inherent osteogenic, osteoinductive, and osteoconductive properties [3]. We performed histological, histomorphometric, and immunohistochemical analyses on bone specimens to assess osteogenesis. By the thirtieth day, histological evaluation revealed that LIPUS facilitated substantial defect closure, with the majority of the area populated by woven bone. However, the central region remained infiltrated with fibrous tissue, while lamellar bone formation was evident along the defect margins. In the autologous bone group, woven bone predominantly occupied the central and inferior regions of the defect, whereas the superior portion exhibited a dense fibrous matrix interposing woven and lamellar bone. Conversely, in the control group, woven bone formation was restricted to the periphery of the defect, while the central region remained bridged by fibrous tissue. Regarding histomorphometric analysis, by the thirtieth day, the highest bone volume percentage was noticed in the autologous bone graft group (20.35%), followed by the LIPUS group (19.12%), while the control group exhibited the smallest bone volume (5.11%). Regarding immunohistochemical analyses, the autologous bone group demonstrated the highest levels of cyclooxygenase-2 (167.7 ± 1.1) and osterix (177.1 ± 0.9) on the thirtieth day. In the LIPUS group, peak cyclooxygenase-2 levels were recorded on the seventh (169.7 ±1.6) and fifteenth day (92.7 ± 2.2), whereas peak osterix levels occurred on the seventh day (131.9 ± 0.9). Despite autologous bone grafts yielding the highest total bone formation, LIPUS induced a comparable osteogenic response, as evidenced by substantial newly formed bone volume and upregulated expression of cyclooxygenase-2 and osterix. Our findings propose that LIPUS may serve as a potential substitute to autologous bone in the repair of bone defects undergoing intramembranous ossification.

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Acknowledgements

This work was aided by these University of Rijeka grants: UNIRI-prirod-18-75, UNIRI-iskusni-prirod-23-53, UNIRI-biomed-18-280 and the Croatian Science Foundation, grant no. IP-2020-02-7875.

SG.15 Effect of Therapeutic Ultrasound on Biomimetic Models of Cancer

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Quality of life is a persistent issue observed in patients receiving conventional cancer therapies due to the invasive and systemic nature of these methods. Therapeutic ultrasound has the potential to overcome these concerns, proving a versatile contender to treat a variety of disorders by inducing beneficial biophysical effects in tissue, including generating promising results in different cancer types [1]. Applications of ultrasound with intensities < 3 $W{\cdot}cm^{-2}$ have been suggested as low-intensity ultrasound (LIUS), but to date the thresholds remain debated. Interestingly, LIUS has been proposed to selectively eradicate breast cancer cells without harming non-malignant counterparts [2]. However, ultrasound based *in vitro* experiments have relied heavily in 2D monocultures, which are inadequate to reflect the complex tumour microenvironment (TME), highlighting the need to progress towards 3D cancer models that replicate the conditions found in the TME [3]. Additionally, there is a lack of generally accepted guidelines that inform the design of *in vitro* ultrasound experiments, resulting in difficulties in comparing and interpreting results across published data. This work aims to characterise this LIUS phenomenon using biomimetic 3D models and consider the potential factors that could influence *in vitro* outcomes. A platform that aims to reduce the influence of conventional culturing vessels was used, opting to utilise mylar film windows that can be placed underwater to achieve homogeneous cell sonication. Using this platform, breast cancer cells were seeded within collagen to form 3D hydrogels, known as tumouroids, with the aim to recapitulate relevant *in vivo* conditions. These tumouroids consisted of a multicompartment composed of central artificial cancer mass surrounded by a healthy stromal compartment. To investigate the effect of LIUS on breast cancer viability, compartmentalised tumouroids of MDA-MB-231 and MCF-7 were exposed to a spatial peak temporal average intensity of 1.36 $W{\cdot}cm^{-2}$ for a total excitation time of 10 minutes using a 1 MHz, 15 mm active diameter planar transducer (Precision Acoustics Ltd.). This transducer was characterised at the last axial maximum using a calibrated 0.2 mm diameter element needle hydrophone (Precision Acoustics Ltd.). Tumouroids were exposed to this LIUS regime daily for a total of 7 days, at an operating frequency of 1 MHz, 20% duty cycle and 100 Hz pulse repetition frequency. Viability is reduced following consecutive sonication. Interestingly, MDA-MB-231 tumouroids displayed increased sensitivity to LIUS when compared to MCF-7 cultures. These observations under the current treatment regime are in agreement with studies that have also shown LIUS induction of cell death in cancer cell lines. However, the lack of cell death in non-malignant comparisons is yet to be shown in our work [2]. Additionally, the underlying mechanism still remains unknown, but likely due to mechanotransduction pathways following the induction of shear stresses. Moving forward, investigations will focus on exploring the potential pathways responsible for cellular responses to mechanical stimuli, and we will investigate the impact of LIUS on important cancer outcomes such as invasion.

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POSTER COMMUNICATIONS

P.1 Holistic Valorisation of Blue Whiting and Boarfish Using Ultrasound Technology for the Recovery of Oil and Proteins

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The increasing demand for sustainable food systems calls for the full valorisation of underutilised marine resources [1]. Blue whiting (*Micromesistius poutassou*) and boarfish (*Capros aper*) are low-value species with significant potential for high-quality oil and protein recovery. Traditionally discarded or used for low-return purposes, such as fishmeal, these species can serve as valuable raw materials for functional food and nutraceutical applications [2,3]. Emerging green technologies, such as ultrasound (US) -assisted extraction, offer efficient, non-thermal solutions to enhance yield and preserve bioactive quality [4]. This study explores the holistic use of US technology to recover lipids and proteins from these species with no use of solvents, having ,thus, minimal environmental impact.

Specifically, in this study, five different approaches were tested for the recovery of lipids and proteins from blue whiting and boarfish. These methods were compared not only in terms of lipid and protein yield but also based on quality parameters, including omega-3 and omega-6 fatty acid profiles and protein characteristics, using GC-MS analysis. Whole fresh blue whiting fish and boarfish were first milled and mixed with distilled water at 1:1 ratio (*w/v*). The following five treatments were then applied: (i) addition of an enzyme cocktail (EC) consisting of alcalase, flavourzyme and neutrase and magnetic stirring at 55°C for 30 min, (ii) addition of EC, magnetic stirring at 55°C for 10 min followed by US treatment using a probe-type 1000 hdT for 10 min, (iii) initial US probe treatment for 10 minutes, followed by EC addition and magnetic stirring at 55°C for 10 minutes (iv) addition of EC and simultaneous exposure to US probe and magnetic stirring and (v) addition of EC, magnetic stirring at 55°C for 10 min, followed by US treatment using bath-type system 25 kHz for 10 min. After treatment, samples were heated in a water bath at 90°C for 10 min to deactivate the enzymes, centrifuged, and then freeze-dried for quantitative and qualitative protein and lipid characterisation.

The dried blue whiting fish biomass contained (dry basis) 67.5% protein, 13.7% fat, and 14.7% ash, whereas the dried boarfish biomass contained (dry basis) 47.9% protein, 31.5% fat, and 16.9% ash. The preliminary results of our study showed that all used techniques were effective in recovering significant quantities of lipids and proteins. Among them, the application of ultrasonic bath proved to be the most efficient method for both blue whiting and boarfish, obtaining the highest amounts of oil. These findings highlight the potential of US technology for the transformation of underutilised marine species into valuable sources contributing to more sustainable and circular use of marine resources.

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Acknowledgements

The work was funded by the projects PERFECTO-3 (grant agreement No. 101211693) and IMPRESS (grant agreement No. 10108443) that received funding from the European Union.

Funded by the European Union

P.2 Evaluating Ultrasound-Assisted Techniques for Protein Extraction: Implications for Environmental Sustainability

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Ultrasonic-assisted extraction (UAE) is a well known novel methods that has been applied applied for enhancing the extraction efficiency of food ingredient production and side-stream biorefinery purpose, which in turn serves as an environmentally friendly technology [1]. This study aims to capture the efficiency scale of the extraction process using the life cycle assessment (LCA) method and to evaluate the environmental impact differences between UAE and traditional protein extraction technologies. Duckweed is a promising potential protein source for human consumption and animal feed and could combat the growing necessity for alternative protein source, however currently some limitation associated with the human consumption. Duckweed has a charactertic features such as rapid growth, abundant availability, and high protein content. Therefore, a common duckweed species (*Lemna minor*) was selected and evaluated its protein extraction efficiency interm of impact of the extraction techniques applied as the focus of this study. The assessment was based on six experimental extraction techniques :((a) ultrasound assisted enzymatic protein extraction; (b) Orbital-shaker assisted enzymatic protein extraction; (c) ultrasound assisted extraction of protein by pH shift, (d) ultrasound, shaker and enzyme assisted protein extraction from dry duckweed biomass, (e) ultrasound assisted protein extraction from fresh duckweed biomass and (f) Magnetic stirrer assisted protein extraction from fresh duckweed biomass). Additionally, environmental impacts across 18 categories were assessed per gram of extracted protein using the ReCiPe 2016 methodology. The results demonstrated that the use of UAE technology in the duckweed protein extraction process yields a higher protein output compared to traditional methods (orbital shaker), while simultaneously reducing the environmental impact across all categories. Additionally, the study found that extracting protein from fresh duckweed significantly lowers environmental impacts compared to extraction from dried duckweed, highlighting that optimizing the drying process can effectively enhance the product's life cycle assessment. Notably, the study revealed that marine ecotoxicity and fossil resource scarcity onsistently emerged as the two most factors that impact environmental categories across all extraction methods emphasing the need of substitutable fuel source instead of chemicals which needed for extraction of proteins, especially with the technique "c" whenusing the pH-shifting method used for extraction of proteins. These findings suggest that advancing protein extraction technologies to minimize the use of harmful chemicals can substantially improve the environmental sustainability of duckweed protein extraction processes.

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Acknowledgements

This research was funded by the Department of Agriculture, Food and the Marine, Government of Ireland (2021R487: DuckFeed).

P.3 Ultrasound-Assisted Enzymatic Extraction of Proteins from Sunflower Oilseed Meal: Optimization Using Mixture Design and Response Surface Methodology

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Sunflower oilseed meal (SOM), a protein-rich oil extraction by-product containing about 30-50% protein, is an important source of plant proteins with great potential for food applications. However, efficient extraction of its proteins remains a challenge due to strong protein-cell wall interactions, protein denaturation during industrial processing, and low solubility around the isoelectric point [1]. In recent years, ultrasound technology (20–100 kHz) has become a powerful pretreatment in food processing, significantly enhancing enzymatic hydrolysis, improving peptide bioactivity, and optimizing protein recovery and functionality [2].
This study investigated the use of ultrasound-assisted enzymatic hydrolysis to improve the recovery of proteins from SOM. Ultrasound pretreatment disrupts cell structures, improving substrate accessibility, while enzymatic hydrolysis further breaks down cell wall components. Three enzymes—Visco, Cellulase, and α-Amylase—were selected and systematically evaluated to determine their individual contributions and interactions in the extraction process. Here Visco degrades plant cell walls, Cellulase hydrolyses cellulose to release bound proteins, and α-Amylase removes starch residues that may interfere with extraction. A mixture design was applied to identify the optimal enzyme combination for maximizing protein and lipid yield, followed by a central composite design (CCD) to optimize enzymatic hydrolysis time and ultrasonic power. Furthermore, a predictive mathematical model was developed to establish correlations between processing parameters and extraction efficiency. The results demonstrate that the integration of ultrasound and enzymatic hydrolysis significantly enhances protein and lipid recovery compared to conventional methods. This optimisation approach provides a sustainable, data-driven strategy for increasing the value of oilseed meal in food applications.

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Acknowledgement

The authors gratefully acknowledge the University College Dublin (UCD) and the China Scholarship Council (CSC) for providing the UCD-CSC scholarship scheme that supported this research.

P.4 Agar-based breast tissue tumour model phantom for MRgFUS breast applications

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Agar-based phantoms are a prominent tool in the preclinical evaluation of Magnetic Resonance Imaging Guided Focused Ultrasound (MRgFUS) systems and protocols [1]. In this study, an agar-based phantom which includes a tumour, capable of mimicking cancerous human breast tissue, was developed for MRgFUS breast applications. The phantom consists of a breast tissue mimicking hydrogel containing 2% w/v agar which was developed with an anthropomorphic breast shape. The embedded tumour model was developed in a spherical form using 6% w/v agar and 4% w/v silica. A series of experiments were performed to determine the acoustic, thermal, magnetic and mechanical properties of the fabricated phantom. Acoustic attenuation was measured using a standard through-transmission method, whereas the ultrasonic propagation speed was measured utilising a pulse-echo technique at 2.7 MHz. Thermal properties were determined utilising the transient method, whereas nanoidentation tests were performed to estimate the mechanical properties of the phantom. A clinical 3T MRI scanner was employed to evaluate the T1 and T2 relaxation times. The measured acoustic attenuation coefficients for the breast tissue and tumour models were 0.18±0.04 dB/cm.MHz and 1.04±0.03 dB/cm.MHz, respectively, while the corresponding ultrasonic propagation speeds were 1514.1±0.1 m/s and 1532.3±0.2 m/s. For the two compartments, the thermal conductivity was between 0.545-0.55 W/m.K, whereas specific heat capacity ranged between 1853-2080 J/kg.K. Regarding mechanical properties, Young's moduli of 2 kPa and 5.4 kPa were obtained for the breast tissue and tumour models, respectively. The fabricated phantom exhibited a tissue-like visibility within the MRI scanner, with the measured T1 and T2 relaxation times being 1827.1±124.7 ms and 80.2 ± 5.2 ms for the breast tissue mimic, and 1318.7±77.9 ms and 23.1 ± 2.5 ms for the tumour model. The majority of the measured properties of both phantom components align with corresponding values reported in the literature for human breast glandular tissue and tumours. These findings indicate that this phantom adequately replicates critical acoustic, thermal, magnetic, and mechanical characteristics of human breast tissue and tumours, making it a cost-effective preclinical evaluation tool for MRgFUS breast applications.

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This study was funded by the Republic of Cyprus, through the Research and Innovation Foundation under the project BREASTASONIC (PHD IN INDUSTRY/1123/0004).

P.5 Ultrasound-Microwave Assisted Innovative Oat Hull Valorisation of Arabinoxylan and Structure Effects

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Under the context of European health regulations,arabinoxylans (AX) is called for 8 grams of AX per 100 grams of available carbohydrate to meet the residents daily nutritional requirements [1]. AX are the main hemicelluloses found in many cereals and have a variety of health benefits such as altering intestinal flora, regulating glycolipid metabolism, and improving immune regulation [2-3]. Oat hull, as a cereal side stream containing a very high hemicellulosic content (35.3%), has a great potential for the production of dietary fibre [4]. Conventional exraction for arabinoxylan, using traditional hot water, alkali and enzyme extraction methods, has inefficiency, and high expenditure to be optimized.
The aim of this study is to explore the research gap of ultrasound, microwave and their combined green innovative technologies as assistance in oat hull AX extraction and to evaluate the structural effects of different extraction methods. In this research, six different experimental groups were set up: room temperature water extraction, hot water extraction, ultrasound-assisted room temperature water extraction, ultrasound-assisted hot water extraction, microwave extraction, and ultrasound-microwave combined extraction. The effects of different power indices like US25, US50, US100, MW 25%, MW50% and US25+MW25%, US25+MW50%, US50+MW25%, US50+MW50, US100+MW25%, US100+MW50% will be evaluated. It is expecting to optimize the innovative technical route with the highest AX yield, and evaluate the structure effects recycling as valuable ingredients. This study is able to convert agricultural by-products such as cereal side stream into high value-added functional food ingredients and provides a greener and more efficient alternative to traditional AX extraction methods.

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Acknowledgements

The authors would like to acknowledge UCD-CSC Scholarship Scheme supported by University College Dublin (UCD) and China Scholarship Council (CSC) for this study.

P.6 Ultrasound and Engineering of Si/PEDOT:PSS structures

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Ultrasound (US) was extensively utilized as an active tool at various stages of semiconductor device manufacturing. One notable advantage of this approach for modifying semiconductor systems is its broad versatility, which arises from the ability to adjust the type of oscillations, frequency, and intensity of the ultrasound, as well as its sustainable and environmentally friendly nature. As a result, ultrasound is being increasingly applied in fabricating thin film photovoltaic systems. For example, the effectiveness of ultrasonically generated spray techniques has been established, along with the use of ultrasound during forming contacts [1]. Furthermore, enhancements in photovoltaic properties have been observed when acoustic vibrations are applied to the substrate during the spray deposition of polymer layers [2]. Our study aimed to explore the potential of using ultrasound to control the interface properties of silicon-polymer systems fabricated via spin coating. This focus was motivated by two key factors: first, these systems are among the most promising candidates for next-generation photovoltaic converters, and second, their properties are predominantly influenced by the interface.

The n-Si/PEDOT:PSS structures were fabricated as follows. PEDOT:PSS layer was deposited on a cleaned silicon substrate by spin coating for 60 seconds. The structures were kept at room temperature for 20 minutes, then baked at 140 °C for 15 minutes. An additional step was used for some samples: ultrasound treatment (UST) during isothermal holding at room temperature. Two types of acoustic waves were employed: longitudinal (UST-L, 2.5 MHz) and radial (UST-R, 500 kHz). Polymer layers of different thicknesses, fabricated using two spin-coating speeds (3000 and 5000 rpm), were also studied.

The electronic properties of the structures were determined via capacitance-frequency and capacitance-voltage measurements. Frequency-dependent data were collected from 100 Hz to 1 MHz at 0 and 0.4 V biases, enabling estimation of the density of states (DOS) near the interface. Without ultrasound, measurements at zero bias showed a single DOS peak ~300 meV above the valence band edge, likely due to Pb centers (dangling bonds). Under forward bias, an additional energy level at E_v+0.38 eV appeared, more prominent in thinner PEDOT:PSS layers. UST modified the DOS depending on wave type and polymer thickness: UST-R amplified the deep-level peak, while UST-L suppressed it. Capacitance-voltage measurements at 10 kHz, 100 kHz, and 1 MHz enabled the estimation of the built-in potential (V_b) from the reverse branch and the effective hole injection voltage (V_p) from the forward branch. At 10 kHz, V_b was 0.65 V, matching the work function difference between Si and PEDOT:PSS. At higher frequencies, V_b increased, indicating an additional dielectric layer, whose effect was reduced by UST. UST-L also decreased V_p. The results show that ultrasound effectively controls the electronic properties of organic heterostructures, with different wave types enabling tailored modifications.

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Acknowledgements

O. O. and S. K. are thankful to National Research Foundation of Ukraine (Pr. Nos. 2023.03/0252 and 2023.03/0060) for partially funding this work.

P.7 Sonochemical Approach for the Functionalisation and Nanotransformation of Lignocellulosic Biomass

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Lignocellulose represents the most abundant renewable resource from plants mainly composed of polysaccharides (cellulose and hemicelluloses) and an aromatic polymer lignin. Annually, the paper industry alone generates approximately 70 million tonnes of lignin as a byproduct, yet only 2–5 % of this waste is revalorised. The use of lignin in various industrial applications is gaining significant attention, however, its inherent heterogeneity and complexity present major challanges. While different methods have been developed to process and functionalise lignin, most of them use harsh chemicals and extreme conditions. Stepping on our experience in biotechnology and sonochemistry for lignin processing [1], we have developed environmentally-friendly continuous sono-enzymatic process for simultaneous lignin biomass functionalisation and nanotransformation, yielding highly concentrated and stable dispersions of lignin nanoparticles for a number of nano-enabling applications, ranging from lightweight (bio)composites to novel antimicrobials. In this work, lignocellulosic biomass was enzymatically functionalised with tannic acid, a low molecular weight natural phenolic, for improved reactivity in composite matrices, antioxidant and antimicrobial properties, and nanoformulated in a single step process. Following optimisation of the process parameters through a design of experiments (DoE), we successfully scaled up the production of these bio-based actives to a 10 L reaction volume, demonstrating the potential for industrial implementation. The single step waterborne sono-enzymatic process achieved significantly increased throughput, nearly 100 % reaction yield and zero waste. The obtained lignin-based nanoparticles are safe for both humans and the environment and have been employed in our group individually or in combination with metals for a wide range of applications. These include coating of medical devices, chronic wound dressings, water treatment and purification, as well as additives in composite materials for the constuction and automotive industry [2][3] [4].

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Acknowledgements

This work was supported by the EU project R-LIGHTBIOCOM - New bio-based and sustainable raw materials enabling circular value chains of high performance lightweight biocomposites (HORIZON-101091691) and BIOMAT - An Open Innovation Test Bed for Nano-Enabled Bio-Based PUR Foams and Composites (H2020-953270)

AUTHOR INDEX

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Y

Z