LIBRO DE RESÚMENES

XIV SIMPOSIO de Investigación EN CIENCIAS EXPERIMENTALES

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Festividad de San Alberto Magno
Patrón de Ciencias Experimentales

13-14 Noviembre 2025

ciencias
UNIVERSITAS ALMERIENSIS
experimentales

XIV Simposio de Investigación en Ciencias Experimentales

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XIV Simposio de Investigación en Ciencias Experimentales

Festividad de san Alberto Magno
13-14 de noviembre de 2025

Lugar de Celebración

Hall y Sala de Grados Aulario IV
Universidad de Almería

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Comité Organizador

María Trinidad Angosto Trillo (Área de Fisiología Vegetal, Universidad de Almería)
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Elvira Navarro López (Universidad de Almería)
Encarnación Fenoy Castilla (Universidad de Almería)

2. Saluda del Decano de la Facultad de Ciencias Experimentales

Este curso académico la festividad de san Alberto cae en sábado y este es el motivo de haberla traslado al viernes catorce de noviembre. Por otra parte, dada la buena acogida del año pasado, el Simposio de Ciencias Experimentales ocupa la tarde del jueves y la mañana del viernes.

Alrededor de la festividad de nuestro patrón se realizan diversas actividades ligadas a la investigación. Si bien la Facultad como tal no tiene competencias en investigación sí que desarrolla actividades que buscan favorecer la que tiene lugar en las áreas vinculadas a nuestros títulos, en el convencimiento de que la investigación, la buena investigación, debe repercutir de manera positiva en la docencia. Recalco lo de la *buena investigación* pues, por desgracia, la irrupción de editoriales depredadoras está corrompiendo gravemente el sistema de investigación, afectando de manera negativa no solo a la investigación sino también a la carrera profesional de aquellos y aquellas que no entran a formar parte del fraudulento escenario al que nos llevan estas editoriales. Es algo ya contrastado por las sociedades científicas de todo el mundo. Por ejemplo, la *International Mathematical Union* y el *International Council of Industrial and Applied Mathematics* han emitido un informe conjunto muy duro, pero acertado, indicando, entre otras cosas, la poca relevancia científica de revistas situadas en el Q1 y Q2 del JCR. Esperemos que cada vez seamos más claros excluyendo este tipo de publicaciones. Por eso, os deseo y os aliento a hacer investigación buscando el avance de la Ciencia y en revista de reconocido prestigio.

El mes de noviembre es nuestro mes *grande,* celebramos el XIV Simposio de Investigación en Ciencias Experimentales, plenamente consolidado y que no ha dejado de acudir a su cita desde su comienzo, ni en el año de la pandemia. El Simposio va acompañado de la Conferencia de san Alberto a cargo de Francisco R. Villatoro en la Sala de conferencias del Edificio de Ciencias Económicas y Empresariales con el título "¿Por qué me dicen que llego tarde si no existe el tiempo? La física del tiempo", celebrando nuestro nuevo Grado en Física. Justo antes tendrá lugar el reconocimiento a los estudiantes con los mejores expedientes y el premio al mejor TFG en el marco del convenio UAL-Real Sociedad Matemática Española. Antes del Simposio, y como ya es tradición de los últimos años, se celebra la VI Jornada Científica san Alberto, que en esta edición ha otorgado catorce premios. Todas estas actividades muestran el apoyo de la Facultad a la actividad científica.

El Simposio cumple su XIV edición dirigido a los jóvenes investigadores para apoyarlos en su carrera investigadora y para que muestren lo último en investigación en sus respectivos campos. Con más de 170 participantes y 140 pósteres, es un gran reto organizativo. Por eso hemos de agradecer el trabajo de las personas involucradas en su organización: miembros del Comité Organizador; del Comité Científico; y de la Secretaría Técnica. Un especial agradecimiento a las empresas colaboradoras: Bruker; Cosentino; Dicsa; Roche; y Viagro, que junto con los centros de investigación: CDTIME; CIAIMBITAL; CIESOL; y ENGLOBA, la cátedra: Reference Laboratory, así como la EIDUAL, apoyan con financiación nuestro Simposio y muestran su compromiso con la Ciencia.

Os deseo, como todos los años, que disfrutéis de todas las actividades programadas. ¡Feliz XIV Simposio y feliz san Alberto! ¡Viva la Ciencia!

Juan J. Moreno Balcázar
Decano de la Facultad de Ciencias Experimentales

3. Carta del Comité Organizador

Es un placer daros la bienvenida a la decimocuarta edición del Simposio de Investigación en Ciencias Experimentales de la Universidad de Almería. Este encuentro, ya consolidado como una cita esencial para nuestra comunidad científica, alcanza este año un récord de participación con 173 inscritos y 140 comunicaciones en formato póster, lo que refleja el compromiso, la creatividad y la vitalidad de la investigación en nuestras disciplinas. De las contribuciones presentadas, 43 pertenecen al área de Biotecnología y Bioprocesos Industriales, 43 a Ciencias Aplicadas y Medioambientales, 39 a Química y 15 a Matemáticas. Este perfil de participación pone de manifiesto la fortaleza y dinamismo de las áreas vinculadas a la biotecnología, los procesos sostenibles y la química aplicada, donde los grupos de investigación están alcanzando una buena productividad y capacidad de atracción de financiación competitiva, consolidando estas líneas de trabajo.

El Simposio se reafirma así como un espacio de diálogo abierto, transversal y plural, donde convergen investigadores de todas las áreas de las ciencias experimentales, y donde se aprecia cada vez más la interdisciplinariedad como fuerza impulsora del avance científico. Este año, además, se observa una creciente presencia de trabajos con orientación biomédica y clínica, reflejo del dinamismo y la evolución natural de nuestras líneas de investigación hacia ámbitos de aplicación directa en la salud y el bienestar social. En este contexto, queremos destacar la incorporación de nuevos patrocinadores institucionales vinculados a la biomedicina y al diagnóstico clínico: el Seminario Permanente Roche Diagnostics en Diagnóstico In Vitro y la Cátedra Reference Laboratory en Sistemas Clínicos de Decisión mediante Biomarcadores de Resonancia Magnética Nuclear. Su participación simboliza la apertura de nuevas sinergias entre la ciencia básica y la aplicada, y el creciente interés del sector sanitario en la investigación que se desarrolla desde nuestras facultades.

Asimismo, mantenemos nuestro profundo agradecimiento a las empresas que continúan apoyando de forma constante este encuentro como son Cosentino, Bruker Española, Viagro y Dicsa, cuyo compromiso con la ciencia y la transferencia de conocimiento ha sido fundamental para consolidar el Simposio como una plataforma de referencia. En particular, agradecemos a Dicsa su generosidad al patrocinar, un año más, la tradicional copa de vino de clausura, que se ha convertido en un momento simbólico de encuentro y celebración entre investigadores de todas las áreas.

También queremos reconocer el apoyo continuado de las unidades y centros de investigación de la Universidad de Almería que hacen posible este evento: el Centro de Investigación en Energía Solar (CIESOL), el Centro de Desarrollo y Transferencia de Investigación Matemática a la Empresa (CDTIME), el Centro Andaluz para el Cambio Global Hermelindo Castro, y el Centro de Investigación en Biotecnología Agroalimentaria (CIAIMBITAL), cuya implicación refuerza el carácter multidisciplinar y transversal del Simposio.

Nuestro agradecimiento se extiende a la Escuela Internacional de Doctorado, que vuelve a apoyar la organización de las conferencias plenarias, protagonizadas este año por Elena Álvarez Ortiz, con la charla “Publicando: análisis y selección de revista científica”, y por Cristóbal Saraiba Bello, con la ponencia “A tus trámites de RAPI en el doctorado”. Ambas intervenciones aportarán una valiosa orientación práctica y académica para investigadores en formación y doctores en activo.

El Comité Organizador también se renueva este año. Queremos expresar nuestro más sincero agradecimiento a Miriam Álvarez-Corral e Irene Torres García por su dedicación y contribución al desarrollo del Simposio durante todos estos años. Al mismo tiempo, damos la bienvenida a Encarnación Fenoy y Juana María Pérez-Galera, cuyas incorporaciones aportan una nueva energía y visión al Comité, contribuyendo a reforzar la calidad, diversidad y proyección del encuentro.

Finalmente, nos gustaría resaltar que este Simposio continúa siendo una muestra del espíritu colaborativo que caracteriza a la Facultad de Ciencias Experimentales y a los centros e institutos de investigación de la Universidad de Almería. Cada edición confirma que la ciencia se construye colectivamente, mediante la cooperación entre disciplinas y generaciones, y que sólo a través de esa transversalidad podremos afrontar los retos científicos y sociales del futuro.

Esperamos que disfrutéis de esta nueva edición, que compartáis vuestros resultados, ideas y experiencias, y que sigamos celebrando juntos la ciencia con la misma pasión de siempre.

Nos vemos en la copa de vino. ¡Viva San Alberto Magno!

4. Información importante del Simposio

Podrán participar en este XIV Simposio cualquier investigador permanente y no permanente (estudiantes de máster, de doctorado o investigadores posdoctorales con vinculación laboral no permanente) de cualquier centro español relacionados a los ámbitos de Biotecnología, Ciencias Ambientales, Matemáticas y Química. Asistentes a este Simposio podrán ser todos aquellos miembros de la comunidad universitaria interesados en conocer las investigaciones más recientes llevadas a cabo en las disciplinas de Ciencias Experimentales.

El Comité Científico será el encargado de valorar todos los trabajos en formato póster enviados, y seleccionar 24 de todos ellos, para su posterior exposición oral en modalidad flash. Esta modalidad consiste en exponer el trabajo presentado en 5 minutos sin turno de preguntas. El comité científico valorará negativamente aquellas que sobrepasen el tiempo establecido. La exposición consistirá en un breve resumen de la investigación (temática, relevancia, equipo investigador, resultados más relevantes, etc.) no superior a 5 minutos. De las 24 exposiciones el comité escogerá aquellos merecedores del premio. La valoración estará basada en cuatro criterios: i) carácter divulgativo, ii) contenido, iii) calidad científica y iv) presentación.

Se otorgarán 4 premios de 1ª categoría valorados en 300 euros y, en función de la participación, otros premios de 2ª y 3ª categoría valorados en 200 y 100 euros, respectivamente, a las mejores contribuciones orales previamente seleccionadas de entre las mejores contribuciones tipo póster. Los investigadores con vinculación permanente no podrán optar a premios. Las temáticas abordadas por el Simposio son: 1) Biotecnología y Bioprocesos Industriales, 2) Ciencias Aplicadas al Medio Ambiente, 3) Matemáticas, y 4) Química. La resolución de los mismos se dará a conocer el día de san Alberto en el acto de clausura, el **14 de noviembre de 2025**. La selección de premios la llevará a cabo el comité científico.

5. Programa

Jueves 13 de noviembre (Tarde)

Lugar Aulario IV (Hall y Sala de Grados), excepto lo indicado expresamente.

16:30 – 17:00	Recepción y bienvenida
17:00 – 17:30	**Conferencia Plenaria:** Elena Álvarez Ortiz "Publicando: análisis y selección de revista científica"
17:30 – 18:00	Comunicaciones flash
18:00 – 18:30	Pausa Café
18:30 – 19:00	Comunicaciones flash
19:00 – 19:45	Sesión de Pósteres

Viernes 14 de noviembre (Mañana)

09:00 – 09:30	**Conferencia plenaria:** Cristobal Saraiba Bello "A tus trámites de RAPI en el doctorado"
09:30 – 10:00	Comunicaciones flash
10:00 – 10:30	Pausa Café
10:30 – 11:00	Comunicaciones flash
11:00 – 11:45	Sesión de Pósteres
12:00 – 12:15	Premio a mejores expedientes de grado y premio UAL–RSME – Lugar: *Sala de conferencias del edificio de económicas y ciencias empresariales*
12:15 – 13:15	**Conferencia san Alberto Magno:** Francisco Román Villatoro – Lugar: *Sala de conferencias del edificio de económicas y ciencias empresariales* "¿Por qué me dicen que llego tarde si no existe el tiempo? La física del tiempo"
13:15 – 13:45	Entrega de premios del Simposio y Clausura – Lugar: *Sala de conferencias del edificio de económicas y ciencias empresariales*
13:45	Copa de vino (cortesía Dicsa) – *Lugar: Hall Aulario IV*

6. Patrocinio del Simposio

7. Lista de títulos de pósteres

Biotecnología y bioprocesos industriales

BT-1.	Design and validation of a solar collector system with thermal storage for temperature control in microalgae reactors.	Á. Acién-Zapata
BT-2.	Study of inhibitory effect of phenolic compounds on the enzymatic activity of the recombinant enzyme endo-ß-1,4-xylanase from Geobacillus stearothermophilus CECT43 (GsXynA).	M. Baquero-Saz
BT-3.	Reutilización del agua de producción proveniente de la extracción del petróleo como solución osmótica: una alternativa innovadora en el proceso de ósmosis directa.	K. Botero-Ñañez
BT-4.	Protein recovery from porphyridium cruentum using ultrasound-assited isoelectric solubilization/precipitation.	F. Cáceres-Ferroni
BT-5.	Desentrañando la materia oscura microbiana de extractos acuosos de compost procedentes de lodos.	P. Campaña-Luque
BT-6.	Aplicación de inoculantes microbianos para la degradación de plaguicidas durante el compostaje industrial de residuos vegetales.	V. Carpena-Istán
BT-7.	Hormone-like biostimulant activity of nine microalgae species during seed germination and early plant development.	C. Cordero-Garzona
BT-8.	Biostimulant effect of spirulina with different biochemical compositions on plant physiological processes.	E. C. Duarte-Santos
BT-9.	Optimization of Operating Conditions in Microalgae Reactors for Urban Wastewater Treatment: Effect of Culture Depth.	H. Elgazaiel
BT-10.	Efectos de la inclusión de polifenoles de bagazo de uva (extracto NeoGiant ACA) en la dieta sobre el perfil de ácidos grasos en el pez Limón (Seriola dumerili).	S. C. Flores-Moreno
BT-11.	Characterisation of Moringa stenopetala organellar genomes.	A. Gálvez-Salido
BT-12.	Expression, purification, and catalytic insights into an LMPO from Serratia Marcescens (SMLPMOAA10A).	C. García-Zamora
BT-13.	Valorization of microalgal biomass cultivated in food industry effluents for circular bioproducts and wastewater treatment.	J. Garrido-Romero
BT-14.	New sustainable transparent antifouling coatings through lecithin phospholipid incorporation into PDMS matrix.	L. G. Granda-Guamán
BT-15.	Light intensity calibration in Haematococcus pluvialis culture to optimize astaxanthin production.	P. González-Cabrera
BT-16.	Aprovechamiento de residuos para la producción de bioestimulantes a partir de microalgas.	L. González-Fernández-Amela
BT-17.	Extractos de compost como biofertilizantes: impacto sobre el desarrollo de la planta y el microbioma rizosférico.	M. A. Ghouch-Mohamed
BT-18.	Essential role of SlAGO7 regulating vegetative architecture and reproductive organ development in tomato.	T. Ibáñez-Cortés
BT-19.	Extractos acuosos de compost con potencial probiotico y prebióticos en agricultura.	R. Jiménez-Rodríguez

BT-21.	Efecto de la inclusión de harina de Tenebrio molitor sobre las propiedades físicas de piensos extrusionados para langostino (Panaeus vannamei).	G. López-Gálvez
BT-22.	Extractos de compost como alternativa sostenible para la mejora de la fertilidad y la actividad rizosférica en tomate.	D. Lorente-escánez
BT-23.	La microbiota como bioherrramienta de modulación circadiana.	A. Mansilla-Jiménez-Alfaro
BT-24.	Episodic and ongoing mechanisms drive plastid-derived nuclear DNA evolution in angiosperms.	J. P. Marczuck-Rojas
BT-25.	Bioprospección de microorganismos en el digestivo de Paracentrotus lividus y entre la microbiota indígena de Rugulopteryx okamurae para acelerar la degradación de esta alga invasora.	P. Martín-Ruíz
BT-26.	Evaluación in vitro de la hidrólisis de la proteína de biomasa algal por las proteasas digestivas de dorada (Sparus aurata).	J. Martínez-Gómez
BT-27.	Substrate specificity of GH39 family β-xylosidase from Geobacillus stearothermophilus CECT43: Detection of new β-1,2-*D*-xylosidase activity.	S. Marzo-Cadarso
BT-28.	Aplicación de extractos bacterianos procedentes de compost mediante priming foliar: Efecto probiótico y prebiótico sobre el cultivo de tomate.	A. Miñarro-Padilla
BT-29.	Pretratamiento biotecnológico de una biomasa algal mediante hidrólisis enzimática para su inclusión en piensos acuícolas.	A. A. Morcillo-Guillén
BT-30.	Liver Disease Risk Estimation Using Hybrid Quantum Machine Learning.	J. J. Moreno-Riado
BT-31.	Uso de agua de mar para la adaptación de Scenedesmus almeriensis y producción sostenible de bioestimulantes y compuestos bioactivos.	E. S. Rivera-Sánchez
BT-32.	Estudio del efecto como bioestimulante vegetal de extractos de biomasa microalgal obtenida del tratamiento de aguas residuales.	N. Rodríguez
BT-33.	Aprovechamiento de subproductos de la industria vitivinícola y microalgas en la alimentación de juveniles de trucha arcoíris.	I. C. Ruiz-Rodríguez
BT-34.	Pilot-Scale evaluation of seawater-adapted Chlorella sorokiniana for resource-efficient production.	M. Salinas-García
BT-35.	Enhancing the Cytotoxic Potential of Pinostilbene in Cancer Cell Lines through Cyclodextrin Complexation: Improvements in Solubility and Stability.	A. Sánchez-Belmonte
BT-36.	The role of CpMYB62 in the determination of female flowers in Cucurbita pepo.	M. Segura-Morales
BT-37.	Stable and transparent PDMS-Based coatings grafted with polyalcohols for marine antifouling applications.	Y. Soriano-Jerez
BT-38.	The tomato mutant hairy reveals a new gene involved in trichome density.	A. Suárez-Alcaraz
BT-39.	ALBOR: Microalgae-based solutions for resilient and circular agriculture.	F. Tallei
BT-40.	Evaluación del efecto de la inclusión de postbióticos obtenidos a partir de Vibrio proteolyticusen piensos para juveniles de dorada (Sparus aurata).	V. Uribe-lópez
BT-41.	Evaluación de la recuperación de Fucoxantina y Pufas mediante un sistema de extracción de líquidos presurizados desde la biomasa de Phaoedactylum Tricornutum.	L. A. Villamarín-Palmero
BT-42.	Phenotypic and molecular characterization of BIS, a key regulator of inflorescence architecture and seedless fruit formation in Solanum pimpinellifolium L.	V. Villalobos-Ramírez

Ciencias aplicadas al medio ambiente

CA-3.	Nutritional and cosmetic potential of fatty acids from six edible wild fruits: a comparative lipid profiling approach.	F. Al-Ferjani
CA-4.	From knowledge to practice: exploring biocultural diversity in Rural Almería.	D. Alba-Patiño
CA-5.	Omega-3 and Antioxidant Potential in Moroccan Boraginaceae Seeds.	H. Benteima
CA-6.	Thermal performance assessment of encapsulated pcm geometries at pilot scale for cooling applications.	A. Castro-Vizcaíno
CA-7.	Variabilidad fitoquímica de compuestos bioactivos lipofílicos en diversas variedades de tomate (Solanum lycopersicum L.)	T. Chileh-Chelh
CA-8.	Superficies autolimpiables aplicadas a tecnologías solares: nanopartículas híbridas de óxido de titanio y nanoplaquetas de grafeno como elemento activo.	J. P. Choque-Juchani
CA-9.	Reactivation of HBV infection in people living with HIV after simplification of antiretroviral therapy.	D. Collado-Díaz
CA-10.	Exploring biodiversity and cultural values a rural case study in Almería.	Y. El-Ghafraoui
CA-11.	Isotopic trace of desalinated water used for irrigation. Campo de Níjar (SE España).	M. A. El-Mahjoubi
CA-12.	Indicadores de teledetección para el seguimiento del servicio de regulación hídrica en cabeceras de ríos de alta montaña	M. Escudero-Clares
CA-13.	Guardians of the sea, victims of plastic: seabirds as sentinels of marine litter in the southern Europe.	M. Expósito-Granados
CA-14.	Comparative profile of vitamin c and fatty acids in tissues of horse, calf, lamb, deer, and wild boar.	M. Ezzaitouni
CA-15.	Biocostra inducida como herramienta de restauración: efectos sobre la erosión y la pérdida de nutrientes en ecosistemas áridos.	J. Fernandez-Galera
CA-17.	Estudio del ahorro en el consumo de fertilizantes y agua de riego con el uso de lixiviados recirculados en un cultivo de calabacín sobre sustrato.	C. Galindo-Rodríguez
CA-18.	Between desert and green: exploring perceptions of urban nature in Almería.	E. Garau
CA-20.	Chemical characterization of tropical date fruits and seeds: a comparative study.	S. Haddou
CA-22.	Estudio preliminar de hongos entomopatógenos autóctonos para el manejo de Tuta absoluta.	D. López-Becerra
CA-23.	Influence of Temperature, Pressure, CO_2 concentration on Commercial Activated Carbons for CO_2 Adsorption Processes.	R. López-Pastor
CA-24.	Estudio de la incidencia de la recirculación de lixiviados y la salinidad en la calidad del fruto de calabacín en cultivo hidropónico.	P. Marín-Membrive
CA-25.	Late Holocene environmental variability in southern Iberia inferred from leaf wax biomarker stable hydrogen isotope ratios from Laguna Grande de Archidona (Málaga, Spain).	L. Martegani
CA-26.	Potencial de datos hiperespectrales para caracterizar la respuesta funcional de las biocostras.	J. Martínez-Sánchez

CA-27.	Exploring human-nature connectedness across urban nature spaces in the semi-arid city of Almería, Spain.	B. Martín-López
CA-28.	Solar Fe^{3+}-NTA/Peroxymonosulfate Process for Micropollutant Degradation and Disinfection in Microalgae-treated Wastewater.	M. Mekni
CA-30.	Estudio cinético del proceso cloro-foto-Fenton solar para la regeneración y reutilización de aguas depuradas en riego agrícola.	L. Nofuentes-Gómez
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CA-40.	Choques de CO_2 como alternativa sostenible para prolongar la vida en anaquel del tomate.	R. Tudor
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M-2.	Ultrasonic waves in viscoelastic media with blubble layers: a step toward acoustic metamaterials.	E. Carreras-Casanova
M-3.	Function approximation and decomposition with fractal structures.	J. F. Cuevas-Rodríguez
M-4.	Density estimation using compactly supported radial basis functions.	S. Díaz-Elbal
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8. Análisis bibliométrico de los resúmenes presentados en el XIV Simposio

El análisis bibliométrico constituye una herramienta esencial para la evaluación y visualización del conocimiento científico, permitiendo identificar las áreas de mayor actividad, las tendencias emergentes y los puntos de convergencia interdisciplinar. En el contexto de los congresos y reuniones científicas, este tipo de análisis aplicado a los resúmenes y palabras clave ofrece una valiosa radiografía del estado actual de la investigación y de las líneas prioritarias dentro de cada disciplina.

En esta edición del XIV Simposio de Ciencias Experimentales, hemos adoptado una aproximación basada en técnicas digitales de minería de texto y análisis de frecuencia, con el objetivo de explorar de manera visual la distribución temática de las contribuciones presentadas. A diferencia de los análisis bibliométricos tradicionales, más centrados en publicaciones indexadas o redes de citación, este enfoque se apoya en la extracción y tratamiento de palabras clave proporcionadas directamente por los autores de los resúmenes. Este método permite generar una representación sintética e intuitiva del contenido científico, alineada con las nuevas tendencias en ciencia de datos, análisis semántico y comunicación científica abierta.

El conjunto analizado incluye las palabras clave de 140 comunicaciones en formato resumen, lo que refleja el compromiso, la creatividad y la vitalidad de la investigación en nuestras disciplinas. De las contribuciones presentadas, **43** pertenecen al área de Biotecnología y Bioprocesos Industriales, **43** a Ciencias Ambientales y Aplicadas, **39** a Química y **15** a Matemáticas. Para cada una de estas categorías se ha elaborado una nube de palabras a partir de las palabras clave más frecuentes. En estas representaciones, el tamaño de cada término es proporcional a su número de apariciones, de modo que las palabras de mayor tamaño reflejan los conceptos más recurrentes y, por tanto, las áreas de mayor interés e innovación dentro de cada campo.

Biotecnología y Bioprocesos Industriales

La nube correspondiente a Biotecnología y Bioprocesos Industriales muestra como términos predominantes biotecnología, microalgas, acucultura, compostaje, biodegradación y enzimas, reflejando la amplitud de los trabajos presentados en torno a la valorización de residuos, la biotecnología azul y verde, y la optimización de bioprocesos. El énfasis en palabras como plant, fatty acids, bioreactors y microbiota sugiere además un fuerte componente aplicado, orientado al desarrollo sostenible y la producción biotecnológica.

Figura 1. Nube de palabras correspondiente al área de Biotecnología y Bioprocesos Industriales. Los términos más frecuentes ponen de relieve la relevancia de la biotecnología ambiental y de la valorización de recursos naturales. El protagonismo de *microalgas* y *bioreactors* refleja el enfoque hacia procesos de producción sostenibles, mientras que *enzimas* y *biodegradación* subrayan el interés por los mecanismos biocatalíticos y la innovación en bioprocesos.

Ciencias Aplicadas al Medio Ambiente

Finalmente, en la categoría de Ciencias Ambientales, destacan los términos biocostras, nematodos, desalado, agricultura, biodiversidad, paisaje y conectividad, lo que pone de relieve la orientación ecológica y agroambiental de las contribuciones. La recurrencia de palabras como semiárido, microplásticos, fatty acids y rural refleja la relevancia de los estudios en ecosistemas mediterráneos, así como el interés por la gestión sostenible de los recursos, la planificación territorial y los impactos del cambio climático.

Figura 2. Nube de palabras correspondiente al área de Ciencias Ambientales y Aplicadas. Los términos dominantes reflejan la diversidad temática del área, con una fuerte presencia de conceptos relacionados con la ecología del suelo, la biodiversidad y la sostenibilidad agrícola.

Matemáticas

En la categoría de Matemáticas, los términos más destacados son polynomials, regularization, inequality, zeros y distribution, lo que refleja un claro interés por el análisis matemático avanzado y la modelización. También aparecen con frecuencia conceptos como fractal, stochastic, gradient y bayesianas, que apuntan a la relevancia de la estadística, la teoría de la probabilidad y las matemáticas aplicadas en la resolución de problemas complejos, tanto teóricos como computacionales.

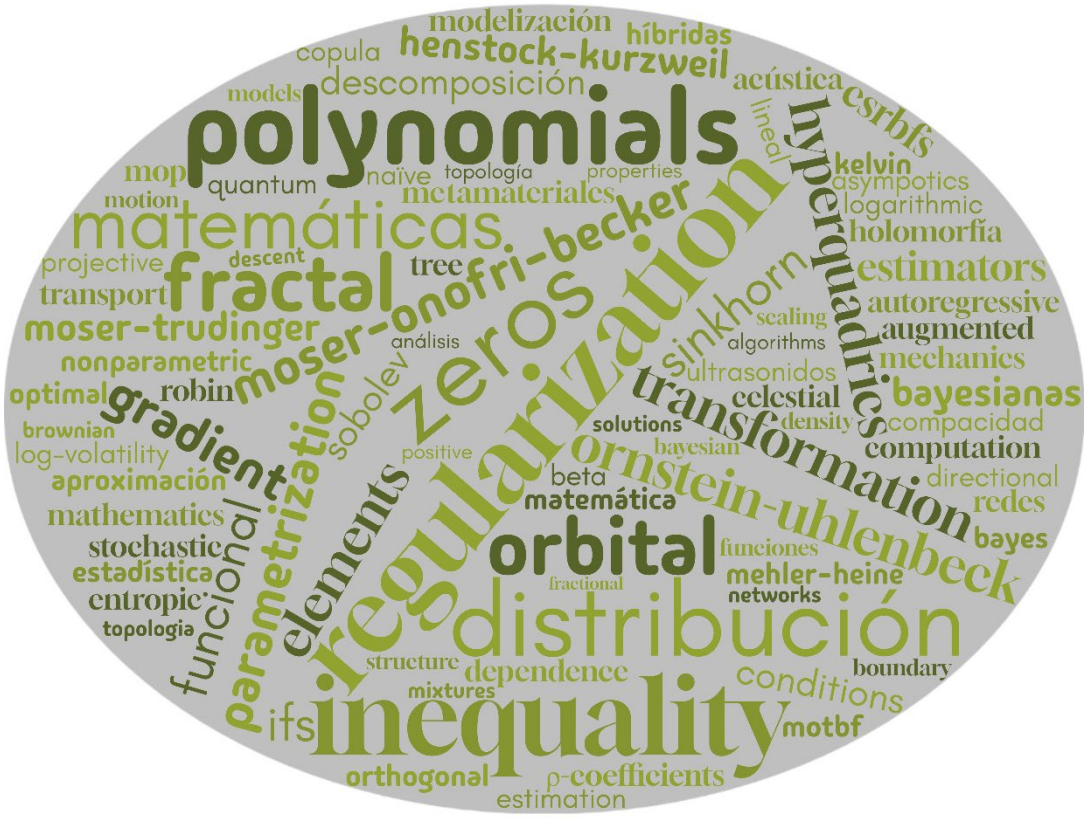

Figura 3. Nube de palabras correspondiente al área de Matemáticas. La frecuencia de términos como polynomials o regularization evidencia el predominio de estudios centrados en análisis funcional, modelización matemática y optimización. La presencia de palabras como stochastic y gradient refleja además la conexión de esta área con el aprendizaje automático y las matemáticas aplicadas a la ciencia de datos.

Química

En el área de Química, las palabras de mayor tamaño —metabolomics, catalysis, pfas, extraction, molecular, spectrometry y water— evidencian el peso de la metabolómica, las técnicas espectroscópicas como la resonancia magnética nuclear (RMN) o la espectrometría de masas, la catálisis y las aplicaciones medioambientales. También destacan términos como tomato, nanomaterials, organic, chromatography y microplastics, que reflejan la integración de enfoques experimentales, ambientales y bioquímicos. En conjunto, la nube muestra un equilibrio entre la investigación fundamental en química molecular y su proyección hacia la sostenibilidad y la salud.

Figura 4. Nube de palabras correspondiente al área de Química. Los términos más representativos revelan una fuerte orientación hacia la química aplicada y medioambiental. La aparición destacada de *metabolomics* y *spectrometry* resalta el uso de herramientas avanzadas de caracterización molecular, mientras que *catalysis* y *nanomaterials* indican el desarrollo de nuevos materiales y procesos sostenibles.

9. Resúmenes

BT-1

DESIGN AND VALIDATION OF A SOLAR COLLECTOR SYSTEM WITH THERMAL STORAGE FOR TEMPERATURE CONTROL IN MICROALGAE REACTORS

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Raceway reactors, despite being the most common system for microalgae production, often lack adequate temperature control, which limits their productivity[1,2]. This abstract presents a new control system that utilizes solar thermal collectors with integrated thermal storage. The system is connected to a heat exchanger installed directly within the reactor. It was successfully validated at a pilot scale on two identical reactors running in parallel. The solar field was precisely sized for the culture volume, allowing the accumulated heat to be efficiently transferred via the exchanger. The validation results confirm that the design effectively stores and transfers heat, significantly reducing the nocturnal temperature drop and stabilizing the overall culture temperature (20-25ºC). This control capability allowed us to increase the minimum culture temperature by up to +5 ºC. This improved temperature management resulted in a substantial increase in productivity, exceeding 20%. This simple, low-cost, and solar-powered approach offers a promising strategy to improve the thermal stability and overall yield of commercial microalgae cultures.

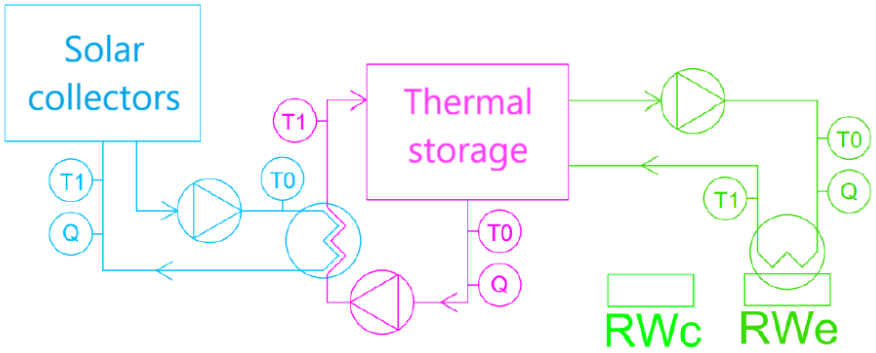

Figure 1. Process diagram of the implemented system.

***Keywords*:** Solar collector, Thermal storage, Temperature control, Microalgae.

Acknowledgements. This work has been financed by the European Union through the NIAGARA (Grant Agreement No. 101060211), REALM (Grant Agreement No. 101060991), and COSEC (Grant Agreement No. 101084131) projects. The authors also thank the CIESOL experimental platform for its support, where the tests were carried out.

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BT-2

STUDY OF INHIBITORY EFFECT OF PHENOLIC COMPOUNDS ON THE ENZYMATIC ACTIVITY OF THE RECOMBINANT ENZYME ENDO-ß-1,4-XYLANASE FROM *Geobacillus stearothermophilus* CECT43 (*Gs*XynA)

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This Bachelor´s thesis focuses on the kinetic characterization of the recombinant endo-ß-1,4-xylanase from *Geobacillus stearothermophilus* CECT43 (*Gs*XynA) and the study of enzyme inhibition mediated by phenolic compounds. For this purpose, the enzyme was expressed in *Escherichia coli* BL21 (DE3) with the plasmid pJMC118.1, purified by immobilized metal affinity chromatography, and its activity was evaluated using beechwood xylan as a substrate, with the release of xylose detected by the DNSA assay.[1]

First, the kinetic parameters of the reaction catalyzed by *Gs*XynA (*K*m, *V*max, *k*cat and catalytic efficiency) were determined to be 3,4 $mg \cdot mL^{-1}$, $4{,}7 \cdot 10^{-4}$ $mmol \cdot min^{-1}$, 261,19 s^{-1} y 76,82 $mL \cdot mg^{-1} \cdot s^{-1}$, respectively. Subsequently, the inhibitory effect of six phenolic compounds was studied.[2,3] The results showed that 4-hidroxyacetophenone, *p*-coumaric acid and 4-hidroxibenzoic acid exhibited the highest inhibition percentages than the other compounds, with values of 21,11 %, 58,64 % and 69,45 %, respectively. Kinetic analyses based on the Michaelis-Menten model, Lineweaver-Burk plots, and inhibition reversibility studies using dialysis allowed the determination of the mechanism of action for each inhibitor. [4] The results identified a reversible competitive inhibition for 4-hidroxyacetophenone, an irreversible competitive inhibition for p- coumaric acid, and a reversible uncompetitive inhibition for 4-hidroxibenzoic acid.

The effect of the temperature on *Gs*XynA activity in presence and absence of inhibitors was also evaluated to determine whether these compounds altered the temperature at which 50 % of the enzyme becomes inactive (T_m). It was found that the three inhibitors destabilized the enzyme, as evidenced by lower T_m values in their presence. The results obtained in this work provide fundamental information for optimizing the xylan saccharification, as the presence of certain phenolic compounds limits enzymatic activity.

Keywords**:** *Gs*XynA, enzymatic activity, enzyme kinetics, phenolic compounds, inhibitors.

Acknowledgements. *The research has been funded by the P_LANZ_2025/008 project of the University of Almeria.*

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BT-3

REUTILIZACIÓN DEL AGUA DE PRODUCCIÓN PROVENIENTE DE LA EXTRACCIÓN DEL PETRÓLEO COMO SOLUCIÓN OSMÓTICA: UNA ALTERNATIVA INNOVADORA EN EL PROCESO DE ÓSMOSIS DIRECTA

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La ósmosis directa (OD) es una tecnología prometedora para la desalinización y el tratamiento de aguas. Este estudio evalúa el uso del agua producida (AP) en la extracción de petróleo como solución osmótica (SO) alternativa, aprovechando su alta salinidad y disponibilidad.[1] Su desempeño se comparó con el KCl empleando membranas de triacetato de celulosa (CTA), analizando el flujo de agua, el flujo inverso de sales y parámetros de transferencia de masa. La concentración del KCl se ajustó según la presión osmótica del agua producida. Los resultados buscan contribuir al desarrollo de estrategias sostenibles para la valorización de efluentes.[2]

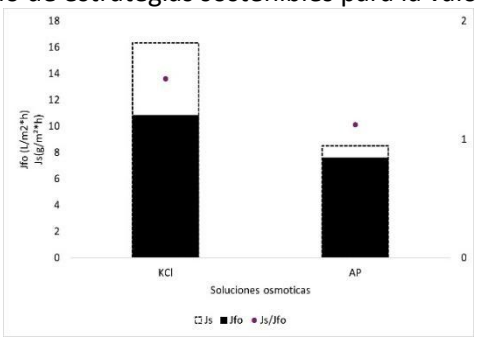

Figura 1. Flujo de permeado, flujo inverso de sal y flujo específico médio.

El estudio analizó el desempeño del AP como solución osmótica alternativa en procesos de ósmosis directa (OD), en comparación con el KCl. Los resultados mostraron que la solución con KCl presentó un mayor flujo de sal (Js), indicando una mayor cantidad de soluto transportado por unidad de agua permeada, lo que puede limitar su uso en aplicaciones que requieren baja salinidad. Por su parte, la AP exhibió un flujo de agua menor, pero un valor reducido de Js/JOD (1 g/L), lo que refleja menor pérdida de sal a través de la membrana. Este comportamiento se relaciona con la menor difusividad del NaCl, principal componente de la AP. Aunque su composición compleja y viscosidad afectaron el flujo de agua, la estabilidad operativa, el bajo costo y el carácter sostenible de la AP la convierten en una alternativa viable para la valorización de efluentes industriales y aplicaciones futuras en reúso de agua.

***Palabras clave*:** Ósmosis directa, Agua de producción, solución osmótica, reutilización de aguas industriales.

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BT-4

PROTEIN RECOVERY FROM *Porphyridium cruentum* USING ULTRASOUND-ASSISTED ISOELECTRIC SOLUBILIZATION/PRECIPITATION

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The growing demand for natural compounds in the food, cosmetic, and pharmaceutical industries is driving the search for sustainable sources of proteins and functional pigments. Among these, the microalga *Porphyridium cruentum* stands out for its high content of B-phycoerythrin, a red-coloured protein pigment with functional and commercial relevance. The recovery and comprehensive utilisation of all protein fractions from *Porphyridium cruentum* can maximise biomass valorisation, thereby supporting the circular economy and sustainable bioprocessing.[1]

The methodology focused on optimising cell disruption via sonication and subsequent isoelectric solubilization/precipitation to maximise protein recovery.

Results indicated that the most efficient cell disruption occurred at pH 8 and 100 $g \cdot L^{-1}$, achieving a maximum B-PE concentration of around 4 $g \cdot 100\ g^{-1}$ with an energy consumption approximately 40-fold lower than that obtained with the most diluted suspension. Optimal isoelectric precipitation occurred at pH 4.3, yielding around 30 $g \cdot 100\ g^{-1}$ of precipitate, with half protein content and enriched in B-phycoerythrin. Subsequent alkaline (pH 12) and acidic (pH 2) solubilizations, followed by precipitation at around pH 3.75, further enhanced overall protein recovery. The reuse of supernatants increased process efficiency by approximately 30 % while reducing water consumption. Finally, the obtained fractions were evaluated in germination assays, in which all solubilised fractions improved the seed vigour index of cucumber (*Cucumis sativus*) seeds between 30 and 60 % compared with the control, outperforming even the gibberellic acid treatment.

In summary, the combined strategy of optimised ultrasonication, isoelectric solubilization/precipitation, and supernatant reuse enabled a simple and low-cost method to recover phycoerythrin and proteins from *Porphyridium cruentum* whilst minimising energy and water consumption. The resulting fractions also demonstrated possible biostimulant activity, enhancing cucumber seed vigour.

***Keywords*:** Microalgae, *Porphyridium cruentum*, Sonication, Protein recovery.

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BT-5

DESENTRAÑANDO LA MATERIA OSCURA MICROBIANA DE EXTRACTOS ACUOSOS DE COMPOST PROCEDENTES DE LODOS

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El crecimiento de la población mundial ha generado una creciente demanda de alimentos y la modernización agrícola mediante el empleo indiscriminado de compuestos como agroquímicos,[1,2] lo que ha llevado al debilitamiento de la relación entre agricultura y ecología.[3] Debido a esto, se han explorado alternativas sostenibles al empleo de agroquímicos.[2] Los extractos de compost ofrecen una amplia gama de beneficios para las plantas,[4] ya que proporcionan nutrientes esenciales, mejoran la estructura del suelo y fomentan la actividad microbiana beneficiosa. El propósito de este trabajo fue evaluar el potencial agrobiotecnológico de extractos acuosos de compost obtenidos a partir de lodos mediante el análisis de las poblaciones existentes en los mismos, su capacidad para promover el desarrollo vegetal y su papel en la inducción de diferentes mecanismos y compuestos relacionados con la defensa vegetal. Para ello, se analizó el bacterioma de los extractos acuosos de lodos mediante metabarcoding, se evaluó *in vivo* la capacidad de dichos extractos para inducir la respuesta vegetal y se caracterizó el filobioma cultivable. Los resultados obtenidos demuestran que dentro de la microbiota de los extractos hay familias consideradas Rizobacterias Promotoras del Crecimiento Vegetal (PGPR), así como otras familias capaces de inducir mecanismos o compuestos relacionados con la resistencia vegetal (ISR/SAR). Además, la aplicación foliar de los extractos acuosos en las plantas de tomate afecta al desarrollo vegetal y a la expresión de clorofila total y proteínas[5], además de reducir la actividad de las enzimas catalasa (CAT) y ascorbato peroxidasa (APX). Por último, el filobioma presenta microbiota capaz de producir enzimas quitinolíticas, sideróforos y enzimas β-1,3-glucanasas, que juegan un papel fundamental en la mejora de la biodisponibilidad de nutrientes insolubles para las plantas y en mecanismos relacionados con la lucha contra fitopatógenos.

Palabras clave: Bioestimulación; Resistencia Sistémica Inducida (ISR), Resistencia Sistémica Adquirida (SAR), Microbioma, Filobioma, Plantas Promotoras del Crecimiento Vegetal (PGPR), Metataxonomía, Tomate.

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BT-6

APLICACIÓN DE INOCULANTES MICROBIANOS PARA LA DEGRADACIÓN DE PLAGUICIDAS DURANTE EL COMPOSTAJE INDUSTRIAL DE RESIDUOS VEGETALES

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Durante el proceso de compostaje de residuos vegetales se generan lixiviados líquidos como subproducto de la descomposición aeróbica de la fracción orgánica. Si bien el compost vegetal es una enmienda orgánica con reconocidos beneficios para el suelo y las plantas, los pesticidas utilizados en la agricultura intensiva pueden acabar concentrándose tanto en los compost como en los lixiviados generados durante el proceso, reduciendo así sus excelentes propiedades agronómicas.

Por ello, el objetivo de este trabajo fue la búsqueda de un consorcio microbiano degradador de plaguicidas y su posterior validación en procesos de compostaje de residuos vegetales a escala industrial.

Para ello, se utilizó la comunidad microbiana de lixiviados vegetales como cultivo iniciador y se sometió a un experimento de enriquecimiento secuencial utilizando flonicamida, un pesticida ampliamente utilizado en agricultura intensiva. Las cepas microbianas se seleccionaron en función de su capacidad para crecer en un medio mínimo de sales suplementado con el pesticida. Las cepas seleccionadas se utilizaron en un ensayo de degradación a escala de laboratorio, en el que se realizó el recuento de células bacterianas utilizando medios de cultivo específicos y la determinación de la degradación de flonicamida. Finalmente, una vez confirmada la eficacia de las cepas para degradar la flonicamida, se inocularon en un proceso de compostaje de residuos vegetales a escala industrial y se monitorizó la microbiota general y la degradación de la flonicamida durante el proceso. Los resultados obtenidos confirmaron que los lixiviados de compost vegetal son una fuente adecuada para la bioprospección de cepas degradadoras de pesticidas. Además, los resultados del trabajo revelan la viabilidad y eficacia de la metodología propuesta para la biorremediación de pesticidas durante el proceso de compostaje.

***Palabras clave*:** Microbiología, Degradación, Pesticidas, Compostaje.

BT-7

HORMONE-LIKE BIOSTIMULANT ACTIVITY OF NINE MICROALGAE SPECIES DURING SEED GERMINATION AND EARLY PLANT DEVELOPMENT

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The application of microalgae as biostimulants in agriculture represents a promising biotechnological strategy to enhance plant growth, nutrient uptake, and stress tolerance through the production of bioactive compounds, thereby promoting sustainable and resource-efficient crop management. Microalgae have demonstrated hormone-like effects that promote crop growth and development, yet these properties differ between species. Therefore, conducting simultaneous evaluations of different strains provides valuable insight into their specific properties and helps identify which microalgae are best suited for particular agricultural applications or desired effects. This study evaluated and compared the biostimulant potential of nine different microalgae biomasses (*Phaeodactylum tricornutum*, *Tetraselmis chuii*, *Chlorella vulgaris*, *Nannochloropsis oceanica*, *Scenedesmus almeriensis*, *Tisochrysis lutea*, *Arthrospira platensis*, *Skeletonema costatum*, and *Scenedesmus sp.* isolated in Cartago, Costa Rica) at different concentrations using four *in vitro* bioassays. The biostimulant activity of microalgae extracts was assessed through germination, cytokinin-like, and auxin-like bioassays. Watercress seeds, wheat leaves, cucumber cotyledons, and mung bean cuttings were treated with extracts at 0.1–2 g/L, and treatments showing higher responses than the control were considered active. *S. costatum, T. lutea, S. almeriensis, N. oceanica* at 0.1 g/L and *P. tricornutum* at 0.5 g/L presented a significantly higher germination index than the other treatments, yet only *S. costatum* and *P. tricornutum* were significantly higher than the negative control. Therefore, these microalgae exhibited higher gibberellin-like activity. During the wheat leaf bioassay, all microalgae extracts had biostimulant activity, except for *Scenedesmus sp*. They also presented a higher cytokinin-like effect at a higher concentration, with *T. chuii, A. platensis* and *T. lutea* values being significantly similar to kinetin at 0.3mg/L. Despite having significantly lower biostimulant activity on the wheat bioassay, the *Scenedesmus* strains surpassed the other microalgae's cytokinin-like effect on the cucumber cotyledon's expansion, with results significantly similar to kinetin at 1mg/L, thus indicating a positive impact on cell division. All treatments had higher biostimulant activity than the control during the root growth bioassay. Higher concentration of biomass for all microalgae resulted in a significantly higher number of new adventitious roots. While microalgae like *Scenedesmus* and *Arthrospira* have demonstrated their biostimulant potential in previous studies, these results show the untapped potential of other microalgae strains that have been overlooked for agricultural applications, such as marine microalgae like *Skeletonema, Tetraselmis, Tisochrysis, Phaedactylum* and *Nannochloropsis.* Additionally, the best treatments in each bioassay differed, thus suggesting that different microalgae should be employed depending on the desired hormone-like effect.

***Keywords*:** Biostimulants, microalgae, sustainability, plant growth and development

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BT-8

BIOSTIMULANT EFFECT OF *SPIRULINA* WITH DIFFERENT BIOCHEMICAL COMPOSITIONS ON PLANT PHYSIOLOGICAL PROCESSEST

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This study evaluated the biostimulant potential of *Spirulina* (*Arthrospira platensis*) formulations with different biochemical compositions on physiological processes, aiming to identify how variations in its composition influence germination, growth, and hormonal activity in model plant systems. Four bioassays were conducted using model species: (1) adventitious root formation in mung bean (*Vigna radiata*), (2) cotyledon expansion in cucumber (*Cucumis sativus*), (3) germination index in watercress (*Lepidium sativum*), and (4) chlorophyll content in wheat (*Triticum aestivum*). The treatments consisted of *Spirulina* formulations enriched in carbohydrates, proteins, lipids, or with reduced levels of proteins and carbohydrates, applied at two concentrations (0.1 and 0.5% for watercress; 0.5 and 2% for the other species). Distilled water was used as a negative control, and specific plant growth regulators served as positive controls: indole-3-butyric acid (IBA) for root induction, kinetin for cotyledon expansion and chlorophyll content, and gibberellic acid (GA_3) for germination. Data were subjected to analysis of variance (ANOVA), and means were compared using the Tukey test ($p \leq 0.05$). IBA significantly increased adventitious root length in mung bean, confirming its auxinic activity, while *Spirulina* formulations promoted moderate increases, particularly those rich in proteins and carbohydrates. In cucumber, kinetin reduced cotyledon expansion, likely due to hormonal imbalance, an effect also reported in potato, where exogenous phytohormones reduced tuber weight[1]. The 2% Spirulina formulation rich in proteins significantly increased cotyledon expansion, indicating a balanced stimulation of growth. In watercress, formulations with lower protein and carbohydrate content and the protein-enriched formulation markedly increased the germination index, surpassing the GA_3 control. The lipid-rich formulation reduced germination, possibly due to seed impermeabilization, which limits water uptake and reserve mobilization[2]. In wheat, the protein-rich formulation at 2% showed the highest absorbance values, indicating greater accumulation of photosynthetic pigments, likely associated with the supply of nitrogen and essential micronutrients[3]. Protein-rich *Spirulina* formulations showed the highest biostimulant potential, promoting gradual and stable growth stimulation through their natural bioactive compounds, highlighting *Spirulina* as a sustainable alternative for plant growth management.

***Keywords*:** Biochemical Composition, Biostimulant, Plant Physiology, Sustainable Agriculture.

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BT-9

OPTIMIZATION OF OPERATING CONDITIONS IN MICROALGAE REACTORS FOR URBAN WASTEWATER TREATMENT: EFFECT OF CULTURE DEPTH

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This study reports the implementation and monitoring of a pilot-scale microalgae-based photobioreactor system for wastewater treatment, operated under real conditions at the IFAPA Research Center (La Cañada Almería, Spain). The system consists of three identical raceway reactors (RW1, RW2, and RW3), operated in parallel with water depths (20, 15, and 10 cm, respectively). The reactors were designed with continuous recirculation and operated at a dilution rate of 0.2 d^{-} to maximize algal growth and nutrient removal. Environmental and operational parameters, including pH, temperature, and dissolved oxygen, were continuously monitored via online sensors, while biomass concentration, Fv/Fm, nutrient composition, and microbiological indicators were routinely analyzed. Biomass separation was performed using an innovative ultrafiltration system, ensuring both energy efficiency and process sustainability.

During steady-state operation (September–October 2025), biomass productivity ranged from 0.07 to 0.09 g/L·d, with the highest biomass concentration (0.44 g/L) observed in the shallowest reactor (10 cm depth). Substantial improvements in water quality were recorded across all channels. Phosphate (PO_4^{3-}) removal reached 60–75%, while ammonium (NH_4^+) decreased by over 80%, accompanied by the appearance of NO_2^- and NO_3^-, indicating active nitrification. Chemical oxygen demand (COD) removal ranged between 39% and 51%, confirming efficient biological degradation. Microbiological analyses showed up to 3.5 log reduction in *Escherichia coli.* and *Clostridium perfringens* while 1.6 and 2.9 log-units were reduced for somatic coliphages, highlighting the wastewater matrix impact. Although effluent concentrations did not fully meet legal discharge limits and additional disinfection would be required to comply with European water reuse standards, the results demonstrate the strong potential of the system for sustainable wastewater treatment.

Overall, these findings highlight the influence of culture depth on the treatment targets. Shallow raceway reactors, benefiting from improved light penetration and mixing, significantly enhance nutrient removal, microorganism inactivation, carbon degradation, and biomass productivity. The system is robust, energy-efficient, and represents a promising platform for sustainable wastewater treatment and the recovery of valuable bioproducts, paving the way toward circular and resilient water management solutions.

***Keywords*:** Microalgae, solar treatment, disinfection, Culture depth; agriculture.

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BT-10

EFECTOS DE LA INCLUSIÓN DE POLIFENOLES DE BAGAZO DE UVA (extracto NeoGiant ACA) EN LA DIETA SOBRE EL PERFIL DE ÁCIDOS GRASOS EN EL PEZ LIMÓN (*Seriola dumerili*)

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La acuicultura moderna busca incorporar ingredientes ricos en compuestos bioactivos que mejoren la salud y el rendimiento de los peces. Entre ellos, los polifenoles de la uva destacan por sus efectos inmunoestimulantes, antioxidantes y antiestrés. Este estudio evaluó el efecto de añadir extracto de bagazo de uva Albariño en la dieta de juveniles de pez limón (*Seriola dumerili*). Se probaron tres dietas: control y dos con 750 y 1500 ppm de polifenoles. Los peces fueron alimentados durante 77 días y se analizaron parámetros de crecimiento, lípidos y ácidos grasos. Los resultados mostraron crecimientos similares pero los niveles de lípidos fueron menores en los peces del control y se obtuvo una respuesta dosis-dependiente en los niveles de DHA y ácidos grasos poliinsaturados n-3, que fueron superiores en los peces alimentados con polifenoles. Los resultados indican que la suplementación con extracto de bagazo de uva Albariño mejora el perfil lipídico y de ácidos grasos del pez limón, mostrando su potencial como ingrediente funcional y sostenible en la acuicultura.

Tabla 1. Contenido de ácidos grasos en el músculo de las seriolas al final del ensayo.

Ácidos grasos (%)	**Control**	**750ppm**	**1500ppm**
16:0 PA	20.36 ± 0.1	20.16 ± 0.1	19.53 ± 0.2
18:0	9.00 ± 0.0	9.44 ± 0.3	9.46 ± 0.0
AG Saturados	29.88 ± 0.3	31.29 ± 1.1	30.70 ± 0.7
18:1n-9. OA	9.69 ± 0.4	9.74 ± 0.4	9.26 ± 0.4
AG monoinsaturados	15.44 ± 0.8	15.32 ± 1.1	14.56 ± 0.7
18:2n-6. LA	7.12 ± 0.1	6.86 ± 0.8	6.38 ± 0.3
20:4n6. ARA	1.69 ± 0.0	1.76 ± 0.0	1.82 ± 0.0
AG n-6 poliinsaturados	10.35 ± 0.2	10.74 ± 1.0	10.40 ± 0.4
18:3n-3. LNA	0.37 ± 0.0	0.51 ± 0.0	0.51 ± 0.0
20:5n-3. EPA	4.22 ± 0.1	4.08 ± 0.1	4.12 ± 0.1
22:6n-3. DHA	29. ± 0.3 b	32.24 ± 0.8 a	34.14 ± 0.3 a
AG n-3 poliinsaturados	34.77 ± 0.7 b	37.42 ± 1.8 a	39.07 ± 0.7 a
n-3/n-6	3.06 ± 0.0	3.49 ± 0.0	3.75 ± 0.0

***Palabras clave*:** ácidos grasos, músculo, seriola.

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BT-11

CHARACTERISATION OF *Moringa stenopetala* ORGANELLAR GENOMES

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The monogeneric family Moringaceae comprises 13 species,[1] most of which are widely used for food, fodder, medicine, and a diverse range of industrial applications. One notable species is *Moringa stenopetala*, which is native to southern Ethiopia and northern Kenya. This species has a high nutritional value, making it a key crop for combating malnutrition in vulnerable populations.[2] Unlike many staple crops, *M. stenopetala* is recognized for its remarkable tolerance to drought and heat,[3] stresses that are expected to be aggravated under climate change. Despite its great agronomic, pharmacological and nutritional potential, this species is considered an orphan semi-domesticated crop and has received little attention from scientists and breeders. To help fill this gap, we present high-quality assemblies and annotations of the plastid and mitochondrial genomes of *M. stenopetala*, generated using long-read Next Generation Sequencing (NGS) Revio HiFi PacBio technologies. The plastid and mitochondrial genomes were 160,506 bp and 611,949 bp in size, respectively, containing 129 and 80 genes, within the typical range for seed plants. The plastid genome comprises 84 protein-coding genes, 8 rRNA genes, and 37 tRNA genes, while the mitochondrial genome contains 49 protein-coding genes, 4 rRNA genes, and 27 tRNA genes. The plastid genome has a GC content of 36.5%, while the mitochondrial genome has a GC content of 45.62%. Characterization of Simple Sequence Repeats (SSRs) revealed 63 SSR elements in the plastid genome (0.44% of its length), mostly A/T repeat motifs (55 of 63), while 87 SSRs were found in the mitochondrial genome (0.17% of its length), also mostly corresponding to A/T repeat motifs (58 of 87); this SSR repeat motif is the most abundant across seed plants. Finally, codon usage bias analysis using relative synonymous codon usage (RSCU) revealed similar trends in both genomes despite differences in GC content, with a consistent low CG3 bias, in agreement with codon usage trends observed across plant plastid and mitochondrial genomes. These genomic resources provide valuable tools for future plant breeding programs of this valuable orphan crop to expand its cultivation to dryland regions especially affected by desertification and climate change, including Almería in SE Spain.

Keywords**:** *Moringa stenopetala,* organelles, genome sequence, orphan crop.

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BT-12

EXPRESSION, PURIFICATION, AND CATALYTIC INSIGHTS INTO AN LPMO FROM *Serratia marcescens* (*Sm*LPMOAA10A)

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The discovery of Lytic Polysaccharide Monooxygenases (LPMOs) over the past decade has greatly enhanced our understanding of enzymatic saccharification. These enzymes have become highly relevant for industrial applications, particularly in the context of lignocellulosic biomass biorefineries. Their main function is to catalyze the oxidative cleavage of recalcitrant polysaccharides, thereby boosting the effectiveness of glycoside hydrolases in biomass degradation.[1] This work presents the expression, purification, and characterization of the LPMO enzyme from *Serratia marcescens* (*Sm*LPMOAA10A). The enzyme was successfully expressed via rhamnose induction in the presence of copper, a crucial cofactor for its activity. This condition led to improved expression levels and greater purity compared to induction without copper. The apparent molecular mass of *Sm*LPMOAA10A was estimated at 22.04 kDa, consistent with the predicted theoretical value. Optimization of experimental conditions revealed that *Sm*LPMOAA10A exhibits maximal activity at pH 7.5 and 25 °C. Notably, it retained more than 50% of its initial activity after one hour of pre-incubation at 60 °C, indicating strong thermostability. This result is consistent with the melting temperature determined by circular dichroism (T_m=62.9 °C), confirming the enzyme's thermal robustness despite its origin from a mesophilic bacterium. Structural analysis revealed that the enzyme´s secondary structure is predominantly composed of β-sheets, as is typical for AA10 family LPMOs. Kinetic studies revealed that the enzyme has a high affinity for hydrogen peroxide (K_m = 0.006 mM) and a high catalytic efficiency (13.13 s^{-1} mM^{-1}). Although lower affinity and efficiency were observed for the hydrolysis of 2,6-dimethoxyphenol (K_m = 0.2 mM; catalytic efficiency = 0.48 s^{-1} mM^{-1}), the enzyme still exhibited significant activity toward this substrate.[1,2] The enzyme's oxidative capability was further evidenced by its strong binding to microcrystalline cellulose and the formation of surface cavities. Additionally, the enzyme's synergistic effect on xylanase activity was evaluated. The presence of *Sm*LPMOAA10A resulted in increased xylose production, further supporting its role in enhancing xylan degradation. Collectively, these results demonstrate that *Sm*LPMOAA10A is a potent oxidative agent for degrading recalcitrant polysaccharides, exhibiting high activity on substrates such as cellulose and xylan. Its synergistic activity with other hydrolytic enzymes highlights its potential as a key component in biomass conversion and various biotechnological applications.[2]

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BT-13

VALORIZATION OF MICROALGAL BIOMASS CULTIVATED IN FOOD INDUSTRY EFFLUENTS FOR CIRCULAR BIOPRODUCTS AND WASTEWATER TREATMENT

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Microalgae-based processes represent an innovative and sustainable approach to transforming food industry effluents into valuable bio-based products. Within the coordinated PHOTOBIO+ project, we aim to cultivate and valorize microalgal biomass using both clean and contaminated effluents, aligning with circular economy principles and sustainable resource management (Figure 1). Two cultivation routes are explored depending on the effluent type. In clean effluents, microalgae are cultivated as a source of high-value biomolecules such as pigments. The harvested biomass will be fractionated through advanced ceramic membrane separation techniques to obtain proteins, carbohydrates, and lipids. Proteins will be evaluated for their nutritional properties and suitability for animal feed or agricultural applications, while carbohydrates will be used as raw material for biodegradable bioplastics. Lipids will be analyzed for their potential inclusion in feed formulations. This integrated fractionation strategy enables full biomass utilization, promoting a zero-waste process that generates diverse high-value products.

Conversely, microalgae cultivated in contaminated effluents will be used for nutrient and contaminant removal, achieving efficient wastewater treatment. The resulting biomass will be processed into biostimulants for agricultural use and tested in field trials to assess their capacity to enhance crop performance under stress conditions such as drought and salinity. Additionally, the project assesses the feasibility of reusing regenerated water from the cultivation process. Comprehensive characterization, including the analysis of emerging pollutants and compliance with EU directives, will ensure its suitability and safety for irrigation purposes. The impact of regenerated water on soil health and crop growth will also be evaluated to validate its potential in circular agricultural systems.

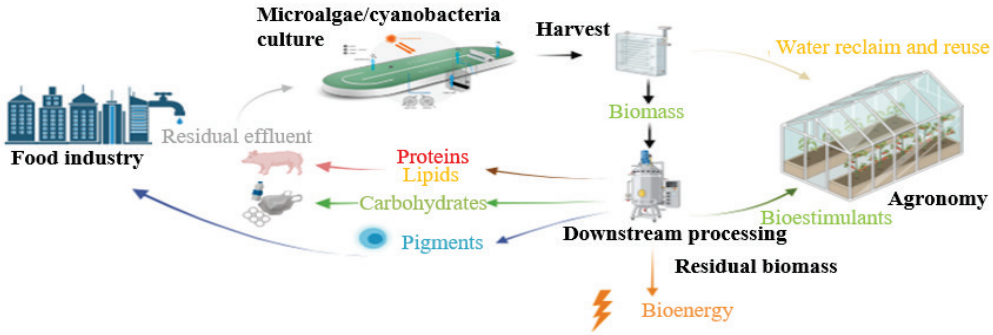

Figure 1. General scheme of PHOTOBIO+ project.

Overall, PHOTOBIO+ project aims to demonstrate the potential of innovative microalgal processes to convert food industry effluents into bio-based products, while simultaneously contributing to wastewater treatment and resource recovery. The expected outcomes will foster sustainable agricultural practices, improve resource efficiency, and advance in the field of circular bioeconomy solutions.

***Keywords*:** Microalgae, effluents, bioeconomy, bioproducts.

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BT-14

NEW SUSTAINABLE TRANSPARENT ANTIFOULING COATINGS THROUGH LECITHIN PHOSPHOLIPID INCORPORATION INTO PDMS MATRIX

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The development of sustainable and transparent antifouling coatings is essential for improving the efficiency of photobioreactors and other marine-related systems, where biofouling remains a critical limitation. This work investigates an innovative strategy based on the incorporation of natural phospholipids[1] into a polydimethylsiloxane (PDMS) matrix during curing reaction, aiming to provide durable and eco-friendly surface modifications. Phospholipids have been proposed for coating formulation, as amphiphilic moieties to provide amphiphilic character to the coating. They can interact with water molecules and form a protective hydration layer to avoid organisms' attachment[2]. Figure 1 illustrates the main interaction mechanisms between lecithin (phosphatidylcholine) and PDMS in aqueous environments. Three anchoring modes are proposed: (1) Physical adsorption, where lecithin's hydrophobic tails interact with PDMS via Van der Waals forces; (2) Siloxane–phosphate bonding, involving semi-covalent linkages between PDMS silanols and lecithin's phosphate groups; and (3) Silane anchoring, where functionalized PDMS forms covalent bonds with lecithin. The resulting surfaces combine a hydrophilic phosphocholine head with a hydrophobic PDMS matrix, which minimizes biofouling offering an eco-friendly route for antifouling coatings. In this approach, phospholipids were mixed according (1) with PDMS oil and crosslinking agent, prior to polymerization reaction. During this reaction, phospholipids become embedded in the silicone matrix and, when the coating is immersed in water, their polar head groups are oriented toward the surface. This amphiphilic arrangement mimics biological membranes and is expected to reduce nonspecific adsorption of proteins and microorganisms. Coatings formulated with lecithin, from sunflower, and soya, from vegetal residues, (2–5% w/w) were characterized for wettability, water adhesion tension, roughness and transparency (>85%), using PDMS elastomer and glass as control. Antifouling performance, evaluated via BSA protein adsorption assays, aimed for amphiphilic or moderately hydrophobic behaviour with at least a 50% reduction in adsorption relative to controls and strong resistance to long-term biofilm formation. This research highlights the potential of marine phospholipids as eco-friendly modifiers of silicone surfaces, enabling the design of transparent and long-lasting antifouling coatings. The proposed approach could enhance the efficiency of PBRs and be extended to other marine and industrial technologies where transparent antifouling surfaces are needed.

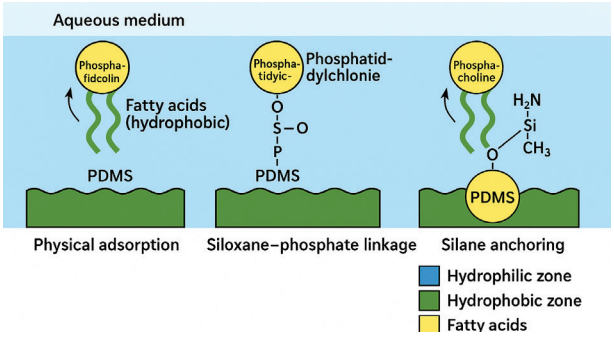

Figure 1. Main interaction mechanisms between lecithin (phosphatidylcholine) and polydimethylsiloxane (PDMS) in aqueous environments.

Keywords: *Phospholipids–PDMS; transparent antifouling coatings; photobioreactors; biofilm resistance; amphiphilic surfaces*.

Acknowledgements. This research was funded by the Spanish Ministry of Economy and Competitiveness (PDC2022-133206-I100, P_LANZ_2025/005, PID2024-157784OB-I00), the European Regional Development Fund Program. The authors also thank Postdoctoral FONDECYT project (Nº 3250682).

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BT-15

LIGHT INTENSITY CALIBRATION IN *Haematococcus pluvialis* CULTURE TO OPTIMIZE ASTAXANTHIN PRODUCTION

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Haematococcus pluvialis is a freshwater green microalga known for being the primary natural source of astaxanthin, a red carotenoid with high antioxidant activity. This molecule is gaining increased interest in the food and pharmaceutical industries. The production of this microalga is generally done in two phases: a green phase, for biomass production, and red phase, where astaxanthin accumulation is induced by stressful conditions (e.g., nutrient limitation, high irradiance). When *H. pluvialis* reaches N starvation, one of the most determinant factors in the astaxanthin production is the light irradiance supplied to the culture. Therefore, the aim of this study was to determine the best irradiance of 4 different light intensities (100%, 75%, 50% and 20% of the maximum irradiance which reaches the culture) in the red phase. The microalga was produced in fully controlled 0.25 L bubble columns at 25 °C and pH 8. The illumination was provided by LEDs following a 12h:12h light/dark cycle, a maximum irradiance of 1700 $\mu E \cdot m^{-2} \cdot s^{-1}$ and the different light conditions were obtained by covering the columns with different types of light filters. Each condition was performed in triplicate, and they were monitored for photosynthetic efficiency, spectrophotometric measurements, nutrient consumption, color, and biomass concentration. The results showed that 100% light irradiance was the most effective condition to induce stress and maximize the production of astaxanthin by *H. pluvialis*. Cultures under 100% light irradiance turned red the fastest, in just 5 days, and by the end of the experiment, these were the reddest, confirmed by the "Lab" coordinates, compared to the other conditions. Furthermore, *H. pluvailis* can increase its biomass in the red phase and 100% light irradiance displayed the best average productivity of biomass (0.127 $g \cdot L^{-1} \cdot day^{-1}$) in this case. In conclusion, astaxanthin accumulation, in addition to depending on nitrogen starvation, also it depends on the light applied to the culture, which is a key element to optimize this process.

***Keywords*:** Biomass, photosynthesis, microalgae, carotenoids, antioxidants.

Acknowledgements. This work is part of the SOLAR·FOODS (PID2022-136292OB-I00) project, funded by the Spanish Ministry of Science and Innovation, MCIN / AEI / 10.13039/501100011033, and the European Union NextGenerationEU/PRTR. This work also forms part of the BLUE·FUTURE (PCM_00083) project, funded by the Government of Andalusia and the European Union NextGenerationEU/PRTR.

BT-16

APROVECHAMIENTO DE RESIDUOS PARA LA PRODUCCIÓN DE BIOESTIMULANTES A PARTIR DE MICROALGAS

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La creciente preocupación ambiental y la necesidad de una agricultura más sostenible han impulsado la búsqueda de alternativas basadas en la valorización de residuos. En este trabajo se evaluó el potencial de dos especies de microalgas, *Chlorella vulgaris* y *Scenedesmus obliquus*, cultivadas en diferentes tipos de aguas residuales (purines, lixiviados de depuradora, lixiviados de compostaje y aguas residuales urbanas) para la producción de biomasa con actividad bioestimulante. Los cultivos se realizaron en sistemas semi-continuos, analizándose la productividad de biomasa, la eficiencia fotosintética y la capacidad de depuración de nutrientes. Además, se llevaron a cabo ensayos de actividad bioestimulante, incluyendo índice de germinación, formación de raíces, engrosamiento de cotiledones y retención de clorofilas, para evaluar el potencial bioactivo de los extractos de biomasa. Todas las aguas ensayadas dieron lugar a cultivos estables, excepto las aguas residuales urbanas, que resultaron inviables para *Chlorella vulgaris* y muy poco productivas para *Scenedesmus obliquus*. Entre los medios evaluados, los purines y los lixiviados de depuradora fueron los más adecuados para el crecimiento algal. *Chlorella vulgaris* alcanzó una productividad máxima de 0,32 g/L·día en purines, mientras que Scenedesmus obliquus logró hasta 0,18 g/L·día en ese mismo medio. Ambas especies mostraron una elevada capacidad de depuración de nitrógeno inorgánico (95–100%), y una eliminación de fósforo dependiente de su concentración inicial, con limitaciones observadas en medios con baja carga (aguas urbanas) y excesos en lixiviados de compostaje. En los ensayos de actividad bioestimulante (germinación, formación de raíces, engrosamiento de cotiledones y retención de clorofilas), los mejores resultados se observaron en los extractos obtenidos a partir de cultivos en lixiviados de depuradora, para *S. obliquus* y en los bioensayos de formación de raíces y de retención de clorofilas con porcentajes de 285% y de 243% respectivamente. Estos resultados respaldan la viabilidad de integrar el cultivo de microalgas en estrategias de economía circular, destacando la influencia del tipo de agua residual en la productividad, y confirmando el potencial bioestimulante de ambas especies microalgales.

Palabras clave: Aguas residuales, Bioestimulantes agrícolas, *Chlorella vulgaris*, Economía circular, Microalgas, *Scenedesmus obliquus*, Valorización de residuos

Agradecimientos. Este trabajo ha sido financiado por los proyectos europeos NAMOR (ref. 101182365), COSEC (ref. 101172850), PID2020-113544RB-I00 y REALM (Grant agreement 101060991), con el apoyo de la Unión Europea y del programa Horizonte Europa (2021–2027). Asimismo, ha recibido financiación de la Fundación BBVA a través del proyecto "ALBOR: Microalgae-based solutions for a resilient and circular agriculture", dentro del Programa de Fundamentos 2024 de la Fundación BBVA. Las opiniones expresadas son exclusivamente de los autores y no reflejan necesariamente las de la Unión Europea ni la Comisión Europea.

BT-17

EXTRACTOS DE COMPOST COMO BIOFERTILIZANTES: IMPACTO SOBRE EL DESARROLLO DE LA PLANTA Y EL MICROBIOMA RIZOSFÉRICO

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Las prácticas agrícolas intensivas han generado impactos ambientales importantes, principalmente por el uso excesivo de fertilizantes químicos y la gestión inadecuada de residuos orgánicos. Además, la creciente demanda alimentaria intensifica la presión sobre los recursos, lo que hace urgente implementar alternativas agrícolas sostenibles dentro de la economía circular. En este contexto, los extractos acuosos de compost, ricos en nutrientes y microorganismos beneficiosos, constituyen una estrategia prometedora para transformar residuos orgánicos en productos de valor añadido y mejorar la fertilidad del suelo de manera sostenible.

El objetivo de este trabajo fue evaluar el potencial agronómico de extractos acuosos obtenidos a partir de compost de distinta naturaleza (residuo vegetal y alpechín) mediante tres protocolos de extracción (CEP-1, CEP-2 y CEP-4). Los extractos se caracterizaron *in vitro* mediante el análisis de los perfiles microbianos para evaluar su capacidad biofertilizante y biopesticida, y mediante ensayos de germinación para determinar su efecto bioestimulante. Posteriormente, se evaluó su impacto *in vivo* en plantas de tomate (*Solanum lycopersicum* var. *San Pedro*), considerando la dinámica microbiana de la rizosfera, los parámetros agronómicos y el contenido de fósforo en los tejidos.

Los resultados reportaron que tanto el tipo de compost como el protocolo de extracción influyen en la abundancia de microorganismos capaces de solubilizar elementos esenciales y producir compuestos beneficiosos, como sideróforos y enzimas líticas. El protocolo CEP-4, con mayor tiempo de incubación, presentó mayor riqueza microbiana. Los ensayos de germinación descartaron efectos fitotóxicos y confirmaron un efecto bioestimulante de los extractos CEP-1 y CEP-4. En plantas de tomate, especialmente con extractos de compost de alpechín, se observaron mejoras significativas en el crecimiento, el contenido de fósforo y la microbiota rizosférica, evidenciando el potencial de los extractos como biofertilizantes eficientes y sostenibles.

En conclusión, los extractos acuosos de compost presentan alto potencial como biofertilizantes, constituyendo una alternativa viable a los fertilizantes químicos. La materia prima y el protocolo de extracción determinan la composición microbiana y la eficacia del producto, consolidando su valor como herramienta para una agricultura eficiente, sostenible y alineada con los principios de la economía circular.

***Palabras clave*:** Extracto de compost, potencial agronómico, biofertilizante, perfil microbiano, fósforo asimilable.

Agradecimientos. Este trabajo ha sido financiado por el proyecto COMPOBIOTICS (PID2023-149455OB-I00), con el apoyo del Ministerio de Ciencia, Innovación y Universidades (España).

BT-18

ESSENTIAL ROLE OF *SlAGO7* REGULATING VEGETATIVE ARCHITECTURE AND REPRODUCTIVE ORGAN DEVELOPMENT IN TOMATO

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Precise control of gene expression is fundamental for coordinated plant development. In tomato, *SlAGO7* plays a central role in integrating vegetative growth and reproductive patterning through small RNA–mediated regulatory pathways. Loss-of-function alleles of *SlAGO7* produce a distinctive wiry vegetative phenotype, characterized by severely reduced stature, narrow filamentous leaves, and poorly developed root systems. To determine whether root-derived signals contribute to this phenotype, we conducted reciprocal grafting assays. These experiments demonstrated that the shoot is the primary determinant of the developmental defects, indicating that *SlAGO7* exerts a systemic regulatory influence originating from aerial tissues. Beyond its functions in vegetative morphogenesis, *SlAGO7* is also required for normal floral and fruit development. Mutant flowers frequently form duplicated ovaries and exhibit reduced pollen viability, ultimately giving rise to parthenocarpic fruits. These reproductive abnormalities were fully reproduced in independently generated CRISPR/Cas9 knockout lines, confirming that the defects result directly from *SlAGO7* disruption. Despite its crucial developmental role, *SlAGO7* is one of the least abundantly transcribed *ARGONAUTE* genes in tomato. *In silico* expression profiling reveals that its activity is highly localized in developmental zones, with maximal expression in meristematic regions, ovaries, and pistils. This spatial specificity is consistent with its involvement in the trans-acting siRNA pathway regulating *ARF3* and *ARF4*, reinforcing its key function in organ identity and floral patterning. Altogether, our findings identify *SlAGO7* as a critical regulator of both vegetative architecture and reproductive competence in tomato, highlighting its value as a potential target for future crop improvement strategies.

***Keywords*:** CRISPR/Cas9, Plant development, *SlAGO7*.

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BT-19

HACIA UNA AGRICULTURA SOSTENIBLE: EXTRACTOS ACUOSOS DE COMPOST CON POTENCIAL PROBIOTICO Y PREBIOTICO

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Los extractos acuosos de compost (EAC) se presentan como una herramienta biotecnológica innovadora para la agricultura sostenible, al concentrar fracciones solubles ricas en nutrientes minerales (nitrógeno, fósforo y potasio), metabolitos bioactivos y comunidades microbianas beneficiosas (*Bacillus*, *Pseudomonas* y *Trichoderma*). Su aplicación contribuye no solo a mejorar la fertilidad y salud del suelo, sino también a potenciar la nutrición y resistencia de las plantas, reduciendo la dependencia de insumos agroquímicos sintéticos.

El presente estudio tuvo como objetivo principal evaluar las propiedades probióticas y prebióticas de EAC obtenidos mediante distintos protocolos de extracción (CEP-2 y CEP-4) y compost de partida (compost de residuos vegetales y compost de alperujo). Para ello, se adoptó una estrategia experimental dual, combinando caracterización *in vitro* y un bioensayo en planta con tomate. Tras la obtención de los EAC, estos se sometieron a una filtración esterilizante para obtener la fracción abiótica y biótica. Posteriormente, se llevó a cabo una exhaustiva caracterización *in vitro* de sus propiedades fisicoquímicas y microbiológicas, comparando parámetros críticos como la demanda biológica de oxígeno (DBO), índice de germinación, actividad microbiana funcional y concentración de metabolitos con potencial efecto prebiótico. Paralelamente, se realizó un bioensayo *in vivo* con plantas de tomate bajo condiciones controladas, aplicando los extractos por fertirriego y pulverización foliar, para analizar respuestas fisiológicas y agronómicas mediante variables como contenido de clorofila, prolina, aminoácidos libres, biomasa, diámetro de tallo y desarrollo radicular. Este enfoque permitió distinguir el efecto directo de los metabolitos solubles (fracción abiótica) del papel funcional de los microorganismos presentes (fracción biótica), proporcionando una evaluación integral de su potencial probiótico y prebiótico.

Los resultados indicaron que la composición de los extractos varió dependiendo del protocolo de extracción empleado, así como del compost de partida. Entre ellos, el extracto obtenido a partir de compost de alperujo mediante el protocolo CEP-4 presentó el mejor perfil funcional, caracterizado por una mayor microbiota solubilizadora de fósforo y potasio, menor DBO y mayor contenido de prolina y aminoácidos libres. Los ensayos de germinación *in vitro* revelaron un claro efecto bioestimulante en las fracciones bióticas, destacando CEP-2 de residuos vegerales (>107 %) y el extracto CEP-4 de alperujo (>105 %). Por el contrario, las fracciones abióticas mostraron índices de germinación significativamente inferiores, subrayando el papel funcional de la microbiota en reducir compuestos tóxicos y favorecer la germinación.

En tomate, los extractos seleccionados mejoraron significativamente parámetros fisiológicos y de crecimiento frente al control, incrementando el contenido de clorofila, biomasa, y estimulando la acumulación de aminoácidos libres totales. El extracto CEP-4 de alperujo destacó como el más eficaz, con efectos positivos tanto en aplicación foliar como por fertirriego, independientemente de la fracción biótica o abiótica. En el caso del extracto CEP-2 de residuo vegetal, se observaron mejoras en clorofila, crecimiento y metabolismo nitrogenado, con respuestas positivas en ambas fracciones y mayor efecto en aplicación foliar.

Estos resultados ponen de manifiesto el potencial de los extractos líquidos con propiedades probióticas y prebióticas como bioinsumos para mejorar la nutrición y la salud de las plantas. No obstante, se requieren estudios adicionales para profundizar en los mecanismos implicados y optimizar su aplicabilidad en condiciones de campo.

***Palabras clave*:** Extracto de compost, Biofertilizante, Probiótico, Prebiótico.

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BT-21

EFECTO DE LA INCLUSIÓN DE HARINA DE *Tenebrio molitor* SOBRE LAS PROPIEDADES FÍSICAS DE PIENSOS EXTRUSIONADOS PARA LANGOSTINO (*Panaeus vannamei*)

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La alimentación representa un gasto importante en la industria acuícola debido, entre otros factores, al precio de las materias primas usadas como ingredientes en la elaboración de piensos. En los últimos años, se ha buscado incorporar nuevas fuentes sostenibles, entre las que se encuentran las harinas de insectos, como la procedente de las larvas de *Tenebrio molitor*. La mayoría de los estudios acerca del uso de ingredientes alternativos se centran en la evaluación nutricional y en sus efectos sobre el crecimiento y estado de condición de los animales, sin embargo, hay poca información sobre los posibles efectos sobre la calidad física de los pellets. En este sentido, el objetivo del presente trabajo ha sido evaluar cómo diferentes niveles de inclusión de harina de *T. molitor* afectan a las propiedades físicas de los pellets de pienso para la alimentación de langostino (*P. vannamei*), especie que requiere gránulos de pienso con alta estabilidad en agua. Para ello, se analizaron 3 piensos extrusionados que incluían un 0% (CT), 50% (T-50) y un 100% (T-100) de sustitución de harina de pescado por harina de *T. molitor*. Para la elaboración de los pellets se utilizó un extrusor CLEXTRAL de doble tornillo bajo condiciones de trabajo estándar (90°C, 24 Bar, 110 rpm). Seguidamente, se evaluó su calidad física mediante el análisis de la densidad aparente, flotabilidad, durabilidad[1] y estabilidad en agua[2]. Los resultados obtenidos revelaron que la sustitución de la harina de pescado por harina de *T. molitor* no afectó a los parámetros de extrusión estipulados para el pienso control (sin inclusión de harina de insecto) (Figura 1). Al tratarse de piensos de hundimiento, diseñados para la especie objetivo, presentaron una elevada densidad, superior a 670 g/L, lo que generó una mayor compactación de los pellets. Por su parte, no se observaron diferencias significativas en cuanto a la durabilidad y estabilidad en agua de los piensos. En general, el presente estudio mostró que la inclusión de harina de *T. molitor* no afecta negativamente a la calidad física del pienso de acuerdo con los parámetros evaluados, obteniéndose valores de densidad, durabilidad, flotabilidad y estabilidad en agua similares a los obtenidos para el pienso control.

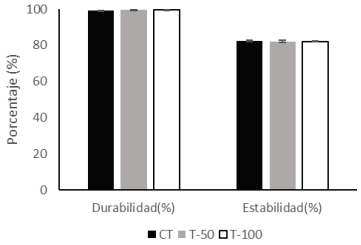

Figura 1. Propiedades físicas del pienso extrusionado.

***Palabras clave*:** Acuicultura, Piensos acuícolas, Extrusión, Propiedades físicas.

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BT-22

EXTRACTOS DE COMPOST COMO ALTERNATIVA SOSTENIBLE PARA LA MEJORA DE LA FERTILIDAD Y LA ACTIVIDAD RIZOSFÉRICA EN TOMATE

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El uso intensivo de fertilizantes químicos ha sido fundamental para sostener los niveles actuales de producción agrícola; sin embargo, su aplicación continua conlleva numerosos riesgos para la salud humana y el medio ambiente.[1] En este sentido, el compost ha ganado relevancia como fertilizante natural, al ofrecer una alternativa sostenible que contribuye a mantener la calidad del suelo y la salud de los cultivos.[2] Entre los productos derivados del compost, los extractos líquidos destacan por su potencial como insumos orgánicos aplicables mediante fertirriego. Los extractos de compost contienen metabolitos que estimulan el crecimiento vegetal, así como microorganismos beneficiosos que favorecen el reciclaje y la disponibilidad de nutrientes esenciales para los cultivos.[3]

El objetivo de este estudio fue evaluar el efecto de extractos de compost, obtenidos a partir de dos compost de partida (residuos vegetales y alpechín) y elaborados mediante distintos protocolos de extracción (CEP1-4), sobre las características biológicas y nutricionales del entorno rizosférico. Para ello, se llevó a cabo un ensayo *in vivo* en plantas de tomate (*Solanum lycopersicum*) con el propósito de analizar el impacto de los extractos sobre el microbioma y la funcionalidad enzimática rizosférica. Asimismo, se evaluó la influencia de los extractos en el contenido de fosfato inorgánico (Pi) de los sustratos tratados y en la concentración de proteínas del suelo relacionadas con la glomalina (GRSP), marcador de la actividad de hongos micorrízicos arbusculares.

Los resultados evidenciaron que los extractos obtenidos mediante tiempos de incubación prolongados y temperaturas moderadas (CEP-4) favorecieron la proliferación de microorganismos con funciones biológicas relacionadas con la promoción del crecimiento vegetal. Además, se observó un incremento en la intensidad de las actividades enzimáticas implicadas en la movilización de nutrientes del suelo. Finalmente, la aplicación de los extractos produjo un aumento generalizado tanto en el contenido de Pi como en el de GRSP en los sustratos tratados, destacando por su eficiencia los extractos derivados del compost de alpechín. En conjunto, estos resultados evidenciaron el potencial de los extractos de compost como herramientas sostenibles para mejorar la fertilidad del suelo.

***Palabras clave*:** Extracto de compost, rizosfera, actividad enzimática, glomalina.

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BT-23

LA MICROBIOTA COMO BIOHERRAMIENTA DE MODULACIÓN CIRCADIANA

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Los ritmos circadianos son oscilaciones biológicas que regulan funciones clave como el metabolismo, la inmunidad y la actividad mitocondrial. Estos ritmos están coordinados por una red de relojes centrales y periféricos, cuya sincronización adecuada es esencial para mantener la homeostasis. Sin embargo, factores propios del estilo de vida moderno —como los horarios sociales irregulares, la exposición a la luz artificial y el trabajo por turnos— pueden inducir una desalineación circadiana conocida como *jet-lag social*, una forma creciente de cronodisrupción que afecta hasta al 70% de la población. Estudios recientes sugieren que la microbiota intestinal, a través del eje intestino–hígado, participa en la regulación de los relojes periféricos, aunque su contribución en condiciones de *jet-lag* social aún no está claramente definida.[1,2]

La biotecnología nos ofrece herramientas esenciales para estudiar la interacción entre los sistemas biológicos y el entorno. En este estudio, se expuso un modelo murino a *jet-lag* social durante nueve días. Posteriormente, se realizó la depleción de la microbiota mediante antibióticos, seguida de un trasplante de microbiota fecal proveniente de donadores control o de animales expuestos al *jet-lag* social. La expresión génica se analizó mediante RT-qPCR, enfocándose en genes del reloj circadiano, así como en marcadores mitocondriales, inflamatorios y de la barrera intestinal.

Los resultados revelaron una respuesta específica según el tejido, siendo el hígado más sensible y capaz de resincronizarse antes que el colon. Bajo condiciones de *jet-lag* social, el trasplante de microbiota proveniente de animales control restauró parcialmente el fenotipo circadiano, incluyendo la reactivación de *Clock* en el colon y la modulación de *Rev-erbα* en el hígado. En contraste, la microbiota disbiótica de donadores sometidos a *jet-lag* social no provocó cambios significativos en los animales receptores, salvo una marcada reducción de *Scaf1*, lo que sugiere un efecto metabólico activamente perjudicial. Estos hallazgos respaldan el papel modulador de la microbiota intestinal sobre los relojes circadianos periféricos y destacan su potencial valor terapéutico en contextos de cronodisrupción.

Palabras clave: Ritmos circadianos, Jet-lag Social (JLS), Cronodisrupción, Microbiota intestinal, Trasplante de microbiota fecal (TMF), RT-qPCR.

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BT-24

EPISODIC AND ONGOING MECHANISMS DRIVE PLASTID-DERIVED NUCLEAR DNA EVOLUTION IN ANGIOSPERMS

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NUPTs are DNA sequences of plastid origin present in plant nuclear genomes to varying, though typically low, amounts. It is assumed that they are continuously formed and, due to their potentially mutagenic effect, removed at a constant turnover rate, which should result in an exponential decay of their age distributions and a negative correlation between age and size. However, these assumptions are based on analysis from a limited number of species and have never been explicitly tested. To gain insight into the mechanisms driving the origin and evolution of NUPTs, here we surveyed the plastid and nuclear genomes of 30 species representing the main angiosperm (flowering plants) lineages. By modeling the distribution of ages and sizes, examining their linear arrangement across the plastid genome, and statistically assessing spatial biases with respect to other genomic features, we showed that NUPTs are i) formed by both continuous and episodic mechanisms; ii) unevenly represented across the plastid genome; iii) consistently associated with certain classes of RNA genes, in particular rRNA, tRNA and regulatory RNA genes; iv) differentially contributing to structural genes; and v) closer than expected to different superfamilies of transposons in a species-specific manner. Our results reveal the unexpected complexity in the mechanisms driving the origin of NUPTs, which do not only involve their continuous formation but also episodic, highlight their role as a major source of non-coding RNA genes and other genomic features and provide a more complete picture of the different drivers of evolutionary change at the genome level.[1]

***Keywords*:** NUPTs, Plastid DNA, Genome evolution, Plants, Transposable elements, RNA genes.

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BT-25

BIOPROSPECCIÓN DE MICROORGANISMOS EN EL DIGESTIVO DE *Paracentrotus lividus* Y ENTRE LA MICROBIOTA INDÍGENA DE *Rugulopteryx okamurae* PARA ACELERAR LA DEGRADACIÓN DE ESTA ALGA INVASORA

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La rápida expansión del alga invasora *Rugulopteryx okamurae* en las aguas costeras del sur de Europa está provocando un grave impacto ecológico y socioeconómico, asociado a la pérdida de biodiversidad marina y la acumulación masiva de arribazones en el litoral mediterráneo.[1] Entre las estrategias propuestas para mitigar este problema, el compostaje se plantea como una alternativa sostenible para la gestión de dicha biomasa.[2] Sin embargo, la presencia de compuestos recalcitrantes en *R. okamurae* dificulta su degradación. En este contexto, se ha observado que el erizo de mar *Paracentrotus lividus* se alimenta eficientemente de este alga invasora,[3] lo que sugiere la posible presencia de microorganismos asociados con la capacidad degradadora.

El objetivo principal de este trabajo fue aislar y seleccionar microrganismos procedentes de *R. okamurae* y *P. lividus* con potencial enzimático para la degradación de la biomasa del alga. Para ello, se recolectaron ejemplares de *P. lividus* en las costas de Almería, Cádiz y Granada, así como biomasa algal en descomposición (ROD), procedente de arribazones presentes en la costa gaditana y ejemplares de alga viva (ROF) recogidos en las costas de Almería (ROF1) y Cádiz (ROF2). A partir de estas muestras, se realizaron siembras en medios de cultivo generales y específicos; posteriormente, se determinó la carga microbiana presente y se aislaron los morfotipos predominantes. Los aislados obtenidos fueron caracterizados para la producción de enzimas de interés, tales como celulasas, amilasas, quitinasas, ligninasas, xilanasas, pectinasas, proteasas y polifenoloxidasas.

Se obtuvo una colección de 70 aislados, que incluye distintas cepas de bacterias marinas, hongos y levaduras, varias de las cuáles mostraron un destacable potencial enzimático para degradar compuestos recalcitrantes. Los aislados con mayor versatilidad metabólica fueron seleccionados para su posterior aplicación como inóculos bioactivadores en el proceso de compostaje de *R. okamurae*. Hongos como *Aspergillus westerdijkiae* y *Penicillium brevicompactum*, procedentes de biomasa algal en descomposición, exhibieron un perfil enzimático notable para la degradación de materiales lignocelulósicos junto a *Bacillus velezensis*, bacteria procedente del intestino de *P. lividus*. Los resultados obtenidos indicaron que los aislados pueden contribuir a mejorar la degradación de la biomasa recalcitrante durante el proceso de compostaje, favoreciendo el aprovechamiento sostenible de esta especie invasora.

Palabras clave: *Rugulopteryx okamurae, Paracentrotus lividus*, Compostaje, Bioactivadores, Biodegradación.

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BT-26

EVALUACIÓN *in vitro* DE LA HIDRÓLISIS DE LA PROTEÍNA DE BIOMASA ALGAL POR LAS PROTEASAS DIGESTIVAS DE DORADA (*Sparus aurata*)

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El desarrollo de alimentos acuícolas sostenibles sigue siendo uno de los mayores desafíos de la industria acuícola actual. En las últimas décadas, se han realizado importantes esfuerzos para encontrar ingredientes alternativos que disminuyan la dependencia de los ingredientes habituales como la harina y el aceite de pescado. En este contexto, las microalgas despiertan un gran interés gracias a su alto valor nutricional y su facilidad de cultivo. En este sentido, este trabajo se centra en evaluar la capacidad de la dorada (*Sparus aurata*) para digerir una mezcla de algas (*Arthrospira* 30%, *Chlorella* 20%, *Microchloropsis* 10%, *Tisochrysis* 10% y *Ulva* 30%), a través de un ensayo de digestibilidad *in vitro* con enzimas digestivas de esta especie. Para ello, una cantidad de biomasa algal que proporcionaba 8 mg mL^{-1} de proteína se suspendió en 50 mM de Tris HCl, pH 9. Tras agitar durante 15 minutos, se añadieron 20 UA/mL de actividad proteasa intestinal de *S. aurata* para iniciar la digestión *in vitro*. A lo largo del proceso simulación digestiva se tomaron muestras en diferentes intervalos de tiempo (0, 15, 30, 60, 90 y 120 minutos) para cuantificar la cantidad de proteína soluble, aminoácidos totales, azúcares reductores y polifenoles liberados. Las simulaciones *in vitro* se realizaron por triplicado, y se llevó a cabo un ensayo control sin las enzimas del pez. Los resultados obtenidos mostraron un incremento significativo ($P < 0,005$) de la liberación de aminoácidos, azúcares reductores y polifenoles (Figura 1) derivados de la actividad de las enzimas digestivas de dorada sobre la biomasa algal. Por otro lado, la cuantificación de la proteína soluble presente en la mezcla de micro y macroalgas reveló un descenso pronunciado y significativo en los vasos de reacción donde se había incluido extracto digestivo de dorada. Estos resultados demuestran la eficacia de las enzimas digestivas de la dorada para digerir los nutrientes aportados por la biomasa algal, lo que supone una alternativa potencial para su uso generalizado en nutrición acuícola.

Figura 1. Aminoácidos y equivalentes de glucosa liberados al medio de reacción por la acción de las enzimas digestivas de dorada. El asterisco indica diferencias significativas entre tratamientos.

Palabras clave: Biotecnología, digestión *in vitro*, Nutrición acuícola, Microalgas, Acuicultura.

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BT-27

SUBSTRATE SPECIFICITY OF GH39 FAMILY β-XYLOSIDASE FROM *Geobacillus stearothermophilus* CECT43: DETECTION OF NEW β-1,2-D-XYLOSIDASE ACTIVITY

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The intensive use of fossil fuels has led to serious environmental consequences, such as global warming, which is primarily caused by high carbon dioxide (CO_2) emissions.[1] The urgent demand for sustainable alternatives has driven the development of biofuels produced from lignocellulosic biomass. In this context, β-xylosidases, enzymes involved in the hydrolysis of xylooligosaccharides, play a crucial role in releasing fermentable sugars, such as xylose, which are essential for bioethanol production. This study focuses on the characterization of *Gs*XynB1, a β-xylosidase from *Geobacillus stearothermophilus* CECT43, which belongs to glycoside hydrolase family 39 (GH39).[2] The gene encoding *Gs*XynB1 was expressed in the recombinant strain *Escherichia coli* BL21 (DE3) harbouring the plasmid pJMC114. The recombinant enzyme was purified using immobilized metal affinity chromatography (IMAC), and its purity was verified by SDS-PAGE analysis. To assess substrate specificity, enzymatic activity was first evaluated using *p*-nitrophenyl-β-D-xylopyranoside (*p*NPX), a standard compound for β-xylosidase characterization. At 60 °C and pH 6.5, the enzyme exhibited K_m and V_{max} values of 14.25 ± 2.56 mM and (2.02 ± 0.17) × 10^{-5} mmol/min, respectively. Comparison with K_m values reported for other GH39 β-xylosidases revealed a variable affinity for this substrate within the enzyme family. Additionally, the specificity of *Gs*XynB1 toward various xylooligosaccharides was evaluated, including xylobiose (X2), xylotriose (X3), xylotetraose (X4), xylopentaose (X5), and xylohexaose (X6). The amount of xylose released was quantified using a coupled enzyme assay based on NADH detection, which is produced stoichiometrically with xylose. From the Michaelis-Menten kinetics obtained for each substrate, the kinetic parameters K_m, V_{max}, k_{cat}, and k_{cat}/K_m were calculated. Analysis of the catalytic efficiencies showed that *Gs*XynB1 hydrolyzed X4 with the highest efficiency (0.32 s^{-1} mM^{-1}), followed by X3. The overall order of catalytic efficiency was X4 greater than X3, followed by X5, X2, and finally X6. These results suggest that GH39 β-xylosidases preferentially act on xylooligosaccharides of intermediate chain length. The potential β-(1,2)-D-xylosidase activity of *Gs*XynB1 was also investigated by assessing its ability to hydrolyze notoginsenoside R1, a bioactive saponin from *Panax notoginseng* used in traditional Chinese medicine.[3] The enzymatic reaction yielded ginsenoside Rg1, a xylose-free compound with established pharmacological activity. *Gs*XynB1 was able to completely convert notoginsenoside R1 into ginsenoside Rg1 within one hour, marking the first report of such activity in a XynB1 enzyme from the *Geobacillus* genus. Finally, the hydrolysis products resulting from *Gs*XynB1 activity on both xylooligosaccharides and notoginsenoside R1 were analyzed by thin-layer chromatography (TLC). This analysis confirmed the expected β-(1,4)-D-xylosidase activity and, for the first time, revealed β-(1,2)-D-xylosidase activity. This discovery constitutes a novel contribution to the functional understanding of *Gs*XynB1 and significantly expands its biotechnological potential.

Keywords: β-xylosidase, xylose, xylooligosacharides, saponins, notoginsenoside R1, ginsenoside Rg1.

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BT-28

APLICACIÓN DE EXTRACTOS BACTERIANOS PROCEDENTES DE COMPOST MEDIANTE *PRIMING* FOLIAR: EFECTO PROBIÓTICO Y PREBIÓTICO SOBRE EL CULTIVO DE TOMATE

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El compost es una enmienda orgánica estable e higienizada, generada a partir de la biotransformación de residuos orgánicos bajo condiciones controladas de aireación, humedad y temperatura. Este producto es ampliamente valorado en la agricultura por su capacidad para mejorar la calidad del suelo, aportar nutrientes esenciales y promover la presencia de una microbiota beneficiosa para las plantas. No obstante, su aplicación directa presenta limitaciones en sistemas agrícolas intensivos basados en fertirrigación, lo que ha impulsado el desarrollo de diversos protocolos para la obtención de extractos acuosos de compost. Estos extractos, ricos en compuestos bioactivos y microorganismos promotores del crecimiento vegetal, se perfilan como una alternativa sostenible frente al uso intensivo de agroquímicos sintéticos, cuyo impacto acumulativo sobre los ecosistemas y la salud humana resulta preocupante. En este contexto, los extractos de compost se postulan como herramientas sostenibles capaces de contribuir a una agricultura más respetuosa con el entorno, alineada con las estrategias europeas de reducción de insumos químicos. Por ello, el objetivo de este trabajo fue evaluar el potencial de los extractos de compost para promover el crecimiento e inducir resistencia a enfermedades en plantas de tomate mediante su aplicación foliar.

Para ello, se obtuvieron extractos acuosos a partir de compost procedente del compostaje de mezclas elaboradas con restos vegetales y residuos de almazara (EC). Se aplicaron tres protocolos de extracción que variaron en tiempo, temperatura y agitación. Se caracterizó su microbiota mediante secuenciación masiva y análisis bioinformático. Tras su aplicación mediante priming foliar en plantas de tomate, se evaluaron parámetros básicos de crecimiento, y en hojas tratadas y controles se analizaron el contenido de proteínas totales, la actividad de enzimas relacionadas con estrés oxidativo (catalasa y ascorbato peroxidasa), así como la presencia de microorganismos endófitos y epífitos con actividad quitinasa, β-glucanasa y productores de sideróforos, con el objetivo de determinar su potencial para inducir resistencia vegetal.

A partir de los EC se detectó la presencia de miembros pertenecientes a las familias Bacillaceae, Rhodothermaceae, Carnobacteriaceae, Chitinophagaceae, Thermoactinomycetaceae y Dysgonomonadaceae, entre otras, con potencial para inducir resistencia en plantas. Su aplicación foliar favoreció el crecimiento radicular y aéreo, así como el aumento en el contenido de clorofila. En hojas tratadas se detectó un mayor contenido de proteínas totales, posiblemente asociado a la síntesis de proteínas relacionadas con la patogénesis (PR), implicadas en la defensa frente a patógenos. En cambio, la actividad catalasa fue generalmente más baja y la ascorbato peroxidasa similar a la de los controles, lo que sugiere una respuesta defensiva basada en especies reactivas de oxígeno, permitiendo cierta acumulación de H_2O_2 con función señalizadora, sin inducción de estrés oxidativo. Por último, no se observó un aumento significativo de microorganismos con actividad β-glucanasa, quitinasa o productora de sideróforos, lo que, junto con la evidencia de una mayor síntesis de proteínas, sugiere que los EC actúan principalmente como elicitores de respuestas de defensa en plantas.

***Palabras clave*:** Resistencia Vegetal; Diversidad Bacteriana; Filobioma; Tomate; Priming

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BT-29

PRETRATAMIENTO BIOTECNOLÓGICO DE UNA BIOMASA ALGAL MEDIANTE HIDRÓLISIS ENZIMÁTICA PARA SU INCLUSIÓN EN PIENSOS ACUÍCOLAS

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La creciente demanda de productos pesqueros y la necesidad de reducir el impacto económico y ambiental derivados del uso de harinas y aceites de pescado en acuicultura han impulsado la sustitución parcial de estas materias primas por harinas vegetales. Sin embargo, su limitada digestibilidad y la presencia de compuestos antinutritivos restringen su inclusión en altas proporciones en la dieta. En este contexto, las micro y macroalgas surgen como una alternativa prometedora, destacando por valor nutricional y su potencial como aditivos funcionales capaces de mejorar la salud de los peces.[1] No obstante, la complejidad estructural y resistencia de sus paredes celulares dificulta el aprovechamiento de sus componentes intracelulares. Para superar este obstáculo, se propone el uso de tratamientos enzimáticos que mejoren la liberación y biodisponibilidad de los nutrientes, favoreciendo su uso eficiente y sostenible en la formulación de piensos acuícolas. Por ello, el objetivo de este trabajo fue la evaluación de la hidrólisis enzimática de microalgas (*Dunaliella salina*, *Chlorella vulgaris* y *Haematococcus pluvialis*) y una macroalga (*Alaria esculenta*) mediante el empleo de un mix de enzimas comerciales.

Tras los 180 minutos de ensayo, se observó un incremento de la liberación de aminoácidos, proteína soluble, azúcares reductores y polifenoles totales al medio de reacción, lo que sugiere un incremento potencial en la biodisponibilidad de los compuestos intracelulares, favoreciendo su interacción con las enzimas digestivas de los peces y optimizando la absorción de metabolitos y compuestos funcionales.

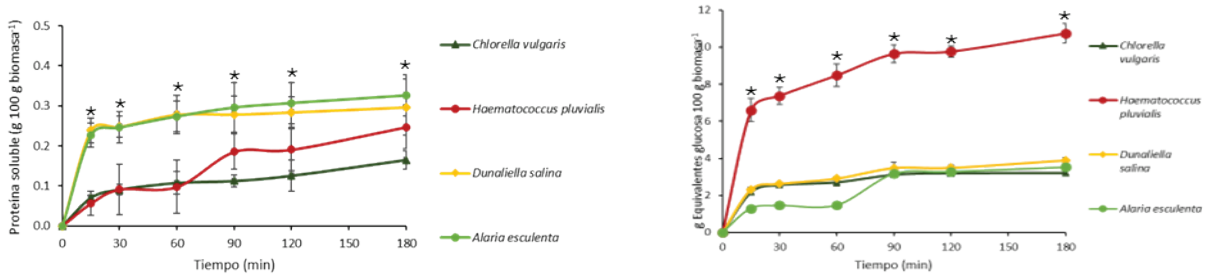

Figura 1. Proteína soluble y equivalentes de glucosa liberados al medio de reacción como consecuencia de la hidrólisis enzimática. El asterisco indica diferencias significativas entre tratamientos.

Palabras clave: Biotecnología, Hidrólisis enzimática, Nutrición acuícola, Microalgas, Acuicultura.

Agradecimientos. Ministerio de Ciencia e Innovación PID2021-122287OB-C21.

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BT-30

LIVER DISEASE RISK ESTIMATION USING HYBRID QUANTUM MACHINE LEARNING

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Liver diseases represent a major global public health concern, where early risk assessment is essential to prevent severe complications and support clinical decision-making. Classical Machine Learning (ML) techniques have proven effective for medical diagnosis but often face challenges related to data imbalance, limited computational resources, and reduced interpretability. In this context, Quantum Machine Learning (QML) emerges as a novel paradigm that combines the advantages of quantum computing and classical ML to capture complex, nonlinear relationships underlying disease risk. Quantum phenomena such as superposition and entanglement enable richer data representations and efficient learning with fewer samples.[1]

However, current quantum platforms, known as Noisy Intermediate-Scale Quantum (NISQ) devices, suffer from qubit scarcity and noise sensitivity, which restricts their practical applicability. To address these limitations, hybrid quantum-classical models have been developed to balance quantum efficiency and classical robustness. In this study, we present QML-Liver (QML-L), a hybrid neural architecture designed for liver disease risk estimation using the Indian Liver Patient Dataset (416 positive and 167 negative cases, unbalanced). The model combines classical preprocessing and dense layers with a quantum circuit implemented via PennyLane and Keras. The model integrates multiple dense layers and a quantum layer with two qubits and four connected layers. The hybrid model was trained using Stratified 5-fold cross-validation, ensuring consistent evaluation across the unbalanced dataset.

Experimental results show that QML-Liver achieves performance comparable to both classical and quantum baselines while requiring only two qubits and no data balancing. The proposed approach demonstrates a favorable trade-off between predictive capability and computational efficiency, achieving competitive accuracy with minimal quantum resource demands. These results underline the potential of QML as a practical framework for medical risk estimation in the NISQ era.

Table 1. Comparative performance of classical, quantum, and hybrid models for liver disease risk estimation. Metrics include Accuracy (Acc), Precision (Pre), Recall (Rec), Specificity (Spe), F1-score (F1), and ROC AUC (RAC), which evaluates the trade-off between performance and computational resources. Symbol '*' means metric was not reported.

Author (Model Approach)	*Qubits*	*Delay*	*Balancing*	*Acc – Pre*	*Rec – Spe*	*F1 – RAC*
Alyasin et al.[2] (Stacking - Classical)	N/A	*N/A*	Yes	0.9 – 0.9	0.9 – 0.7	0.9 – *
Safriandono et al.[3] (LR_QFE - Quantum)	10	*40*	No	0.7 – 0.8	1.0 – 1.0	0.9 – *
Proposal (QML-L - Hybrid QNN)	**2**	**20**	**No**	**0.8 – 0.8**	**0.9 – 0.7**	**0.9 – 0.9**

***Keywords*:** Liver Disease, Quantum Computing, Quantum Machine Learning, Hybrid Neural Network

Acknowledgements. This work has been supported by the projects: PID2021-123278OB-I00, PDC2022-133370-I00 funded by MCIN/AEI/10.13039/501100011033, 'ERDF A way of making Europe', by the 2024-2025 Research, by the Transfer Plan of the University of Almería and S-A-UEI-23-11 funded by the Research Council of Lithuania.

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BT-31

USO DE AGUA DE MAR PARA LA ADAPTACIÓN DE *Scenedesmus almeriensis* Y PRODUCCIÓN SOSTENIBLE DE BIOSTIMULANTES Y COMPUESTOS BIOACTIVOS

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Esta investigación evalúa la viabilidad del uso de agua de mar como alternativa sostenible al agua dulce para la producción de *Scenedesmus almeriensis*, analizando su adaptación a la salinidad y los efectos sobre crecimiento, morfología, composición bioquímica y potencial bioestimulante. Se realizó un ensayo con adiciones progresivas de agua de mar hasta alcanzar 103 mM de NaCl, demostrando que bajas concentraciones salinas incrementan la productividad de biomasa de 0.15 a 0.22 g·L^{-1}·día^{-1} y la tasa específica máxima de 0.14 a 0.26 día^{-1}, efecto atribuible a la presencia de micronutrientes y respuestas adaptativas; en un medio formulado únicamente con agua de mar la productividad disminuyó a 0.11 g·L^{-1}·día^{-1} pero el crecimiento se mantuvo (0.15 día^{-1}). En un escalado piloto en fotobiorreactores tubulares se alcanzaron concentraciones máximas de biomasa de 0.60 g·L^{-1} en agua dulce y 2.15 g·L^{-1} en agua de mar; los cultivos marinos mostraron mayor estabilidad, mejor eficiencia fotosintética (Fv/Fm), menor contaminación por zooplancton y hongos, y permitieron que *Scenedesmus* dominara hasta el 70 % de la comunidad. La salinidad indujo cambios morfológicos (perímetro celular +150 %; redondez 61.5 → 95.8 %) y composicionales, favoreciendo la síntesis de ácidos grasos poliinsaturados y la acumulación selectiva de antioxidantes y pigmentos sin reducir significativamente el rendimiento ni la Fv/Fm; el contenido proteico se mantuvo en torno al 40 %. Ensayos in vitro e in vivo confirmaron la capacidad bioestimulante de la biomasa, que mejoró la germinación, el enraizamiento y el vigor en plantas tratadas; la biomasa producida en agua dulce mostró mayor efectividad, posiblemente por una menor acumulación de compuestos salinos. Estos resultados posicionan al agua de mar como una fuente estratégica para sistemas de producción de microalgas más sostenibles, resilientes y económicamente atractivos.

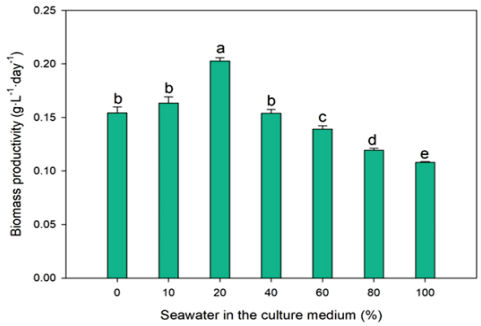

Figura 1. Efecto del agua de mar sobre la producción

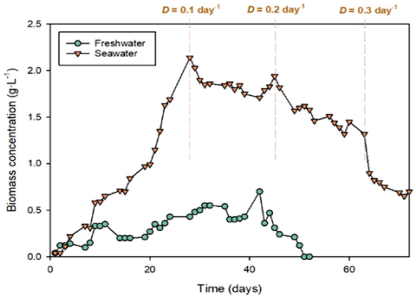

Figura 2. Concentración de biomasa en escalado.

Tabla 1. Composición macromolecular

Compound	Freshwater (g·100 g^{-1})	Seawater (g·100 g^{-1})
Proteins	44.59 ± 0.90 ^{a}	39.10 ± 0.95 ^{b}
Lipids	14.66 ± 1.88 ^{a}	16.17 ± 1.15 ^{a}
Ashes	9.47 ± 0.75 ^{a}	11.50 ± 1.57 ^{a}
Carbohydrates	31.27 ± 2.08 ^{a}	33.23 ± 2.06 ^{a}

*Significant differences are indicated by different letters in the same row (p<0.05)

Agradecimientos. Este trabajo forma parte de los proyectos SOLAR-FOODS (PID2022-13629OB-100) y BLUE-FUTURE (PMC_00083), financiados por el Ministerio de Ciencia e Innovación, la Unión Europea (NextGenerationEU/PRTR) y la Junta de Andalucía. Elia Rivera agradece a la Universidad Nacional de Agricultura por el financiamiento brindado al desarrollo de la investigación doctoral.

BT-32

ESTUDIO DEL EFECTO COMO BIOESTIMULANTE VEGETAL DE EXTRACTOS DE BIOMASA MICROALGAL OBTENIDA DEL TRATAMIENTO DE AGUAS RESIDUALES

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La gestión de lodos generados en el tratamiento de aguas residuales representa un importante desafío debido a sus altos costos de disposición final y a la pérdida de recursos potencialmente valorizables. Los cultivos de microalgas ofrecen una alternativa prometedora al combinar el tratamiento de aguas con la generación de biomasa de alto valor agregado, destacando su uso como bioestimulante vegetal[11]. Este estudio evaluó el efecto bioestimulante de extractos de biomasa microalgal procedente de una planta de tratamiento de efluentes (AySA, Argentina) sobre la tolerancia al estrés hídrico en plantas de lechuga (*Lactuca sativa*). La biomasa se sometió a ultrasonido en frío y se prepararon dos dosis (0.5 y 1 g/L). El ensayo se realizó en invernadero (IFAPA-UAL, 5 semanas) bajo un diseño bifactorial: dosis de extracto (control, 0.5 y 1 g/L) y nivel de estrés hídrico (sin y con estrés: 90% y 45% de la capacidad de campo). El bioestimulante se aplicó por riego y pulverización foliar en tres etapas del cultivo: siembra, tercera hoja verdadera e inicio del cogollo. Se registraron el diámetro de la roseta y el número de hojas durante el ensayo, y la longitud radical y el peso fresco (PF) el día de la cosecha. Los datos se analizaron mediante modelos lineales generales y generalizados con medidas repetidas en caso de corresponder. Se aplicó la prueba de ANOVA y pruebas post-hoc de Tukey.

Tabla 1. Parámetros de crecimiento evaluados en las plantas. PF: peso fresco. CC: capacidad de campo.

Dosis	Condición hídrica (% CC)	Diámetro roseta (cm)	Número de hojas	Longitud radical (cm)	PF biomasa radical (g)	PF biomasa aérea (g)
Control (agua de riego)	90%	14.8 ± 0.3 aA	2.3 ± 0.1 aA	23.3 ± 1.3 aA	3.4 ± 0.2 aA	8.9 ± 0.6 aA
	45%	14.7 ± 0.3 aA	2.2 ± 0.1 aA	17.4 ± 1.3 aB	1.3 ± 0.2 aB	8.1 ± 0.6 aA
0.5 g/L	90%	15.1 ± 0.3 aA	2.3 ± 0.1 aA	21.0 ± 1.3 aA	2.6 ± 0.2 aA	10.8 ± 0.6 abA
	45%	15.0 ± 0.3 aA	2.3 ± 0.1 aA	17.9 ± 1.3 aA	1.6 ± 0.2 aB	9.5 ± 0.6 aA
1 g/L	90%	16.2 ± 0.3 bA	2.4 ± 0.1 aA	19.9 ± 1.3 aA	2.6 ± 0.2 aA	11.1 ± 0.6 bA
	45%	15.3 ± 0.3 aB	2.3 ± 0.1 aA	16.1 ± 1.3 aA	1.7 ± 0.2 aB	8.6 ± 0.6 aB

Letras minúsculas distintas indican diferencias estadísticamente significativas entre dosis para una misma condición de estrés. Letras mayúsculas distintas indican diferencias estadísticamente significativas entre condiciones de estrés para una misma dosis (α = 0.05).

La dosis de 1 g/L incrementó un 9.4% el diámetro de roseta y un 24.7 % el PF aéreo respecto de las plantas control sin estrés. Bajo condiciones de estrés, ambas dosis de extracto evitaron la reducción significativa de la longitud radical que se observó en las plantas control. Las plantas tratadas con 0.5 y 1 g/L de extracto y bajo estrés hídrico mantuvieron valores comparables de PF aéreo y diámetro de roseta con los de las plantas control sin estrés. Estos resultados respaldan el potencial de los extractos de biomasa microalgal para brindar tolerancia al estrés hídrico.

***Palabras clave*:** Biotecnología microalgal, Economía circular, Estrés hídrico, *Lactuca sativa*.

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BT-33

APROVECHAMIENTO DE SUBPRODUCTOS DE LA INDUSTRIA VITIVINÍCOLA Y MICROALGAS EN LA ALIMENTACIÓN DE JUVENILES DE TRUCHA ARCOÍRIS

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El extracto de bagazo de uva, subproducto de la industria vitivinícola, presenta gran cantidad de antioxidantes, polifenoles y compuestos bioactivos, lo que resulta interesante para su utilización como ingrediente funcional en dietas acuícolas. La combinación del extracto de bagazo de uva blanca NeoGiant ACA junto con microalgas podrían paliar los efectos negativos asociados con la incorporación de harinas vegetales en los piensos para acuicultura mejorando la digestión y salud intestinal de los peces. Este estudio evaluó el efecto de añadir un aditivo funcional basado en extracto de bagazo de uva combinado con microalgas (Green Grape), en dos formatos distintos cuando se incorpora en piensos con alta proporción en proteína vegetal sobre el crecimiento y funcionalidad digestiva en juveniles de trucha arcoíris (*Oncorhynchus mykiss*). Se formularon tres dietas experimentales: una dieta control (CT), y dos dietas similares a la anterior, pero enriquecidas con un 2% del ingrediente funcional en formato líquido (NL) o sólido (NS). El peso final de los peces alimentados con la dieta NL (57,9 ± 12,2 g) fue superior al de los peces alimentados con las dietas CT (54,7 ± 12,3 g) o NS (54,0 ± 12,8 g). Por otro lado, se observaron mayores actividades de tripsina y quimotripsina en el grupo NS. Sin embargo, las actividades de leucina aminopeptidasa y fosfatasa alcalina fueron mayores en los peces del grupo NL en comparación con el grupo NS. Así mismo, no se observan diferencias significativas en el área de los enterocitos. A pesar de ello, la longitud de las microvellosidades fue mayor en los tratamientos NS y NL, traduciéndose en una mayor superficie de absorción por parte de los peces alimentados con la dieta NS. En términos generales, los resultados sugieren que la incorporación de este ingrediente funcional en la dieta podría modular la funcionalidad digestiva en los juveniles de trucha arcoíris.

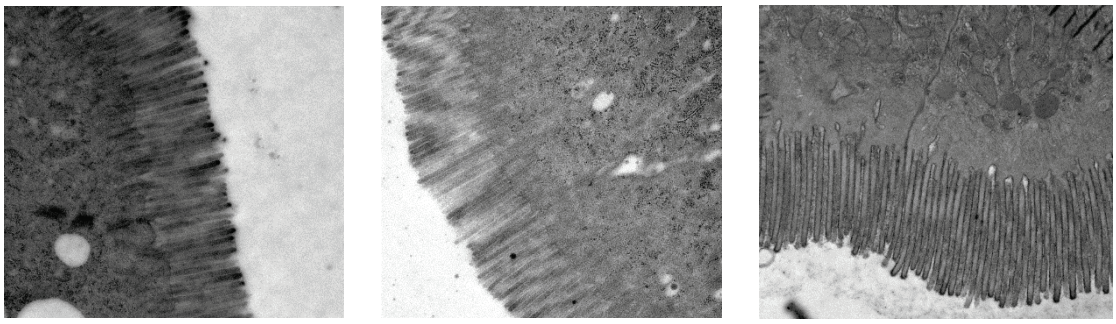

Figura 1. Imágenes TEM de las microvellosidades intestinales de trucha arcoíris alimentadas con las dietas experimentales A) CT, dieta control; B) NL, dieta con el aditivo en formato líquido; C) NS, dieta con el aditivo en formato sólido.

***Palabras clave*:** Bagazo de uva, microalgas, histología, funcionalidad digestiva, *Oncorhynchus mykiss.*

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BT-34

PILOT-SCALE EVALUATION OF SEAWATER-ADAPTED *Chorella sorokiniana* FOR RESOURCE-EFFICIENT PRODUCTION

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The microalga *Chlorella sorokiniana* represents a valuable source for future food production, due to its high nutritional content and capacity to accumulate high-value biomolecules. Nevertheless, its production using freshwater significantly depletes this vital resource. To address this limitation, *C. sorokiniana* was adapted to seawater, and scale up in 3.6 m³ tubular photobioreactors to evaluate the scalability and operational robustness under pilot scale conditions.

Initially, photorespirometry was conducted to evaluate oxygen production rates under varying pH and temperature conditions. Using these experimental data, a response surface quadratic model was developed for freshwater and seawater *C. sorokiniana* to determine their optimal operational conditions. These conditions were subsequently tested at pilot scale, where seawater cultures exhibited enhanced robustness, delaying the formation of biofouling from 17 to 37 days, and limiting the growth of rotifers. Metagenomic analyses revealed an increase of *C. Sorokiniana* abundance by 15% in seawater compared to freshwater, where notable populations of ciliates, rotifers, and other mixotrophic organisms were identified. To ensure free contamination cultures, the AI-based system Holodetect HiRes+Fluor3 was used for culture monitoring. The system integrates deep learning models to distinguish *C. sorokiniana* from contaminants, achieving a high classification accuracy (R^2=0.98).

The biochemical composition of both strains showed similar macromolecular profiles. This finding suggests that salinity adaptation did not affect the nutritional quality of the biomass. In contrast, volatile organic compounds (VOC) profile revealed different metabolic profile. The freshwater strain produced higher levels of ethyl acetate and acetic acid, whereas the seawater culture exhibited increased amounts of hexanal, heptadecane, and other long-chain alkanes, suggesting modified lipid metabolism under saline stress. These findings suggest that cultivating *C. Sorokiniana* in seawater is a viable strategy to enhance sustainable culture, ensuring high biomass yields while reducing freshwater consumption and enhancing culture stability.

***Keywords*:** Biotechnology, *Chlorella sorokiniana*, Water consumption, Metagenomic.

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BT-35

ENHANCING THE CYTOTOXIC POTENTIAL OF PINOSTILBENE IN CANCER CELLS LINES THROUGH CYCLODEXTRIN COMPLEXATION: IMPROVEMENTS IN SOLUBILITY AND STABILITY

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Pinostilbene is a naturally derived methoxylated stilbene known for its wide range of bioactive properties, including antioxidant, antimicrobial, and neuroprotective effects. Recent studies have also reported its cytotoxic or anticancer potential. However, similar to other stilbenes, pinostilbene exhibits poor aqueous solubility and rapid degradation under stress conditions, which limit its therapeutic applicability. This work aims to further characterize its cytotoxic activity in a colorectal cancer model and to address its physicochemical shortcomings through encapsulation in cyclodextrins. The cytotoxic effects of pinostilbene were assessed in vitro using Caco-2 colorectal cells via the neutral red assay. Various cyclodextrins were evaluated to identify the one with the highest inclusion constant and optimal complexation stoichiometry, determined through fluorescence spectroscopy and molecular docking simulations. The formation of inclusion complexes was verified by differential scanning calorimetry (DSC) and scanning electron microscopy (SEM). In addition, spectrophotometric monitoring was used to evaluate the protective capacity of cyclodextrins on the release and stability of pinostilbene over time[1].

Pinostilbene demonstrated in vitro cytotoxic activity against Caco-2 cells, as shown by the neutral red assay. Among the tested cyclodextrins, hydroxypropyl-β-cyclodextrin exhibited the highest encapsulation constant (KF = 10,074.45 ± 503.72 M−1) with a 1:1 stoichiometric ratio. DSC and SEM analyses confirmed the successful formation of the inclusion complexes. Encapsulation reduced the degradation of pinostilbene from 31% to below 15% after three months, increased its aqueous solubility by approximately tenfold, and modulated its release according to the pH of the surrounding medium. As conclusions, pinostilbene exhibits promising in vitro antiproliferative effects, suggesting its potential as an anticancer agent. Encapsulation within cyclodextrins effectively enhances its solubility and stability, highlighting a feasible strategy for improving its applicability in pharmaceutical and functional food formulations

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BT-36

THE ROLE OF CpMYB62 IN THE DETERMINATION OF FEMALE FLOWERS IN *Cucurbita pepo*

M. Segura

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Cucurbita pepo is a monoecious species that produces single male or female flowers on each node of the main shoot. The sexual development of the plant is divided into two main phases. During the first phase, the plant produces only male flowers. The second phase occurs after the female flowering transition, the moment when the plant begins to alternate the production of female and male flowers. As in other cucurbits, the main regulator of female flowering transition in this species is ethylene, which is also responsible for female flower determination by arresting stamen primordia and promoting carpel primordia development. Ethylene-deficient and -insensitive mutants are delayed in female flowering, have a reduced number of female flowers, and impair the arrest of stamen primordia in the floral meristem, thus converting monoecy to andromonoecy or androecy. The androecious phenotype of *myb62* showed that the transcription factor CpMYB62 regulates the transition to female flowering as well as the determination of the floral meristem into a female flower. To investigate its function, we performed RNAseq analysis on apical shoots of WT and mutant plants before and after female flower transition, and identified 1,014 DEGs potentially involved in sex determination. KEGG enrichment revealed that these DEGs are associated with hormone signaling, including ethylene, gibberellins, and auxins. In particular, several ethylene biosynthesis and signaling genes as well as genes associated with carpel identity were downregulated in the mutant. In addition, genes involved in gibberellin response and auxin signaling were altered, suggesting that CpMYB62 can integrate signals from different hormones. In the related species *Benincasa hispida*, CqMYB62 has been shown to regulate subgynoecy via gibberellic acid signaling, supporting a conserved function of this transcription factor in cucurbits. Our results indicate that CpMYB62 integrates multiple hormonal pathways to promote female flowering and carpel specification in *C. pepo*, positioning it as a key regulatory node in the gene network controlling sex determination in cucurbits.

Keywords: squash, transition to female flowering, sex determination, ethylene-GA crosstalk.

BT-37

STABLE AND TRANSPARENT PDMS-BASED COATINGS GRAFTED WITH POLYALCOHOLS FOR MARINE ANTIFOULING APPLICATIONS

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The development of transparent and durable antifouling materials is a major challenge for photobioreactors (PBRs) and aquaculture applications, where biofouling reduces light transmission and system efficiency. [1] In this study, two different polyalcohols (2-hydroxyethyl acrylate (polyalcohol 1) and 2,3-dihydroxypropyl methacrylate (polyalcohol 2)) were grafted during polymerization[2] into a polydimethylsiloxane (PDMS) matrix (0.027:1 and 0.037:1 w/w, respectively) to produce amphiphilic coatings with antifouling properties. The objective was to assess the long-term physicochemical stability of these materials in aqueous environments and to determine whether the polyalcohol moieties remained bound to the silicone network or migrated to the surface during immersion. The coated samples were immersed in distilled water, and their wettability (water contact angle), transparency (transmittance at 780 nm) and protein adsorption were evaluated. All coatings exhibited high optical transparency (>90%) throughout the immersion period, confirming that the incorporation of polyalcohols did not compromise the optical performance of PDMS. A slight decrease in transmittance (<5%) was observed over time, mainly attributed to minor surface rearrangements or water absorption, but transparency remained suitable for PBR applications. Regarding wettability, PDMS maintained its characteristic hydrophobic behaviour (contact angle around 115º), while polyalcohol-modified coatings showed lower contact angles (100-105º), indicating more hydrophilic and stable surface. The stable contact angles over 90 days confirmed the covalent integration of polyalcohols into the PDMS network, avoiding leaching or surface degradation. Protein adsorption tests using bovine serum albumin (BSA) [3] revealed a marked improvement in antifouling behaviour: Polyalcohol 1 and polyalcohol 2 coatings exhibited adsorption levels of 16.6 and 20.0%, respectively, compared to 43.6% for PDMS, when normalized to glass reference. These results confirm that the introduction of polyalcohol moieties effectively reduces nonspecific protein attachment by more than 50%, supporting the formation of a stable amphiphilic surface layer that limits biofouling. Overall, the polyalcohol-grafted PDMS coatings maintained excellent transparency, amphiphilic properties, and antifouling capacity after prolonged water exposure. These findings highlight their potential as stable, transparent, and environmentally friendly antifouling materials for long-term operation in PBRs and aquatic systems. Future work will focus on evaluating their biological performance under dynamic flow and real biofilm growth conditions.

***Keywords*:** transparent antifouling coatings; efficient photobioreactors; biofouling formation; amphiphilic surfaces.

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BT-38

THE TOMATO MUTANT *HAIRY* REVEALS A NEW GENE INVOLVED IN TRICHOME DENSITY

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Tomato (*Solanum lycopersicum* L.) is a crop of great economic and nutritional importance. However, the process of domestication has drastically reduced its genetic variability and, consequently, its capacity to defend against pests and pathogens. To increase the genetic diversity of cultivated tomato, our research group developed a mutant collection through a chemical mutagenesis program using EMS. From this collection, the *hairplus* mutant had previously been characterized, showing a high density of type I glandular trichomes associated with reduced pest susceptibility[1]. In this work we describe a new mutant, named *hairy*, which displays an even higher trichome density than *hairplus* mutant plants. Phenotypic characterization of *hairy* plants using optical microscopy and scanning electron microscopy (SEM) revealed a remarkable abundance of multicellular glandular type I trichomes, along with a moderate increase in other trichome types.

To identify the mutation responsible for the *hairy* phenotype, a cross was performed between a *hairy* mutant plant and a plant of the wild species *S. pimpinellifolium* (accession LA 1589). The F_1 plants showed a wild-type phenotype. The phenotypic segregation observed in the F_2 population indicated that the *hairy* mutation is inherited as a monogenic recessive trait. Using a mapping-by-sequencing approach, candidate genomic regions responsible for the mutant phenotype were identified, and the analysis of specific polymorphisms using molecular markers ruled out alterations in genes previously described as regulators of trichome development. These results point to the existence of a novel gene involved in determining trichome density in tomato. Given the key role of these structures in plant defense against biotic and abiotic stresses, the identification of the *Hairy* gene represents a valuable contribution to our understanding of the genetic network that regulates trichome development and offers new perspectives for tomato breeding.

***Keywords*:** Biotechnology, Genomics, plant defense, mutagenesis

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BT-39

ALBOR: MICROALGAE-BASED SOLUTIONS FOR RESILIENT AND CIRCULAR AGRICULTURE

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Water scarcity is one of the most pressing challenges for agriculture in Mediterranean regions, demanding innovative solutions that combine efficiency, sustainability, and circular economy principles. The ALBOR project tackles this challenge by developing and validating an advanced microalgae-based system capable of regenerating urban wastewater for safe agricultural irrigation under EU Regulation 2020/741, simultaneously producing high-value biofertilizers and biostimulants. This dual approach not only addresses water reuse but also enhances soil fertility and crop performance.

A full-scale demonstration facility at the University of Almería will process campus-generated wastewater using raceway reactors ranging from 100 to 600 m². State-of-the-art analytical technologies—including digital microscopy, flow cytometry, NIR spectroscopy, HPLC-MS, ICP-MS, and omics tools—will be applied to characterize microalgal communities, monitor contaminant removal, and assess impacts on soil and plant health.[1,2,3]

The project is organized into five integrated work packages (WPs): WP1 monitors and models the performance of full-scale reactors; WP2 conducts laboratory studies to evaluate cultivation parameters and contaminant removal kinetics, developing predictive models for scale-up; WP3 tests regenerated water and microalgae-derived products in agronomic trials, assessing soil and crop responses; WP4 validates models and optimizes system operation for safe, field-scale application; and WP5 ensures dissemination and stakeholder engagement through publications, workshops, public outreach, and technology transfer activities.

By combining wastewater regeneration, nutrient recovery, and the application of bioactive microalgae products, ALBOR paves the way for a new paradigm in sustainable Mediterranean agriculture: resilient, resource-efficient, and environmentally responsible. This project exemplifies how innovative biotechnology can transform a challenge—water scarcity—into an opportunity for sustainable growth.

***Keywords*:** Wastewater, Microalgae, Agronomy, Chemistry.

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BT-40

EVALUACIÓN DEL EFECTO DE LA INCLUSIÓN DE POSTBIÓTICOS OBTENIDOS A PARTIR DE *Vibrio proteolyticus* EN PIENSOS PARA JUVENILES DE DORADA (*Sparus aurata*)

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La salud de los peces constituye un pilar fundamental para lograr una acuicultura sostenible y eficiente. En este contexto, la búsqueda de estrategias nutricionales que fortalezcan las defensas naturales de los animales representa un reto destacado en la investigación acuícola. Entre las alternativas más recientes, destaca la incorporación de compuestos bioactivos derivados de microorganismos, conocidos como postbióticos, los cuales han demostrado poseer efectos beneficiosos sobre la microbiota intestinal, la función inmunitaria y la integridad de los tejidos. Su uso representa, por tanto, una vía prometedora para mejorar la salud general y el rendimiento productivo de las especies acuáticas cultivadas. Por ello, el objetivo principal de este trabajo fue evaluar el efecto de la inclusión de postbióticos obtenidos a partir de *Vibrio proteolyticus* (VP) en la dieta sobre el crecimiento, la composición proximal del músculo y la funcionalidad digestiva en juveniles de dorada (*Sparus aurata*).

Los resultados obtenidos pusieron de manifiesto que la inclusión del postbiótico VP no afectó negativamente al crecimiento ni a la composición proximal del músculo de los juveniles de dorada, obteniéndose valores similares en ambos tratamientos experimentales. Además, la evaluación histológica mostró que los peces alimentados con la dieta VP presentaron una mucosa intestinal sin signos evidentes de enteritis ni daño tisular, lo que sugiere la ausencia de efectos perjudiciales asociados a la administración del postbiótico (Figura 1). No obstante, se observó una reducción significativa en varios parámetros cuantificados en la mucosa intestinal, incluyendo la altura de las vellosidades intestinales, la altura de los enterocitos y el espesor de la lámina propia, la capa muscular y la submucosa, en comparación con los peces alimentados con el pienso control (CT), lo que podrían interpretarse como ajustes regulatorios en respuesta a dietas funcionales o compuestos microbianos.

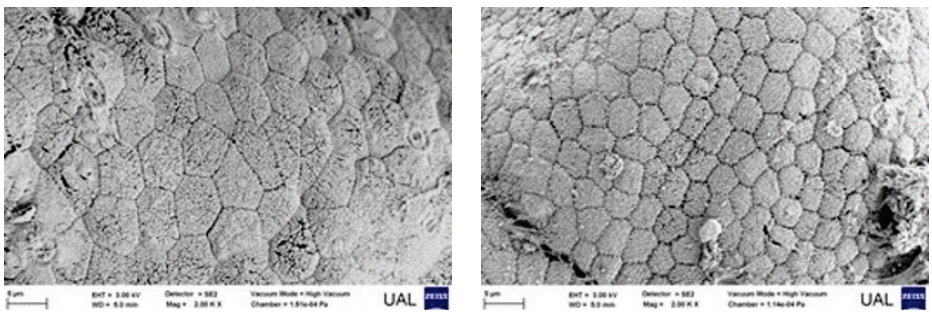

Figura 1. Imágenes obtenidas mediante microscopía electrónica de barrido de la región intestinal anterior en los juveniles de dorada alimentados con las dietas experimentales.

***Palabras clave*:** Acuicultura, Funcionalidad digestiva, Postbiótico, *Sparus aurata.*

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BT-41

EVALUACIÓN DE LA RECUPERACIÓN DE FUCOXANTINA Y PUFAs MEDIANTE UN SISTEMA DE EXTRACCIÓN DE LÍQUIDOS PRESURIZADOS DESDE LA BIOMASA DE *Phaoedactylum tricornutum*

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En general, la extracción de compuestos bioactivos presenta limitaciones importantes, principalmente por la rigidez de la pared celular de las microalgas, la afinidad química, el alto gasto de extractante y los bajos rendimientos de extracción. Por ello se piensa en la extracción de líquidos presurizados (PLE), técnica altamente eficiente, donde el disolvente se mantiene por debajo del punto crítico, la presión y temperatura se optimizan para aumentar la tasa de transferencia de masa.[1,2,3] Este trabajo tiene como objetivo optimizar las condiciones de extracción de carotenoides y ácidos grasos poliinsaturados (PUFAS). Con lo que se propone un sistema de extracción PLE, empleando por separado dos solventes considerados GRAS (Generally Recognised As Safe), etanol y una mezcla tricomponente de etanol:hexano:agua a 77:17:6 % v/v/v con un diseño experimental Compuesto Central (CCD) para optimizar la temperatura y presión de extracción de carotenoides y PUFAs desde la microalga *Phaeodactylum ticornutum* en ciclos de tres etapas de extracción para cada disolvente. La variable respuesta ha sido el rendimiento de extracción respecto a un método estándar de extracción sólido-líquido el cual se considera para el 100% de recuperación. La matriz de ensayo resultó en 12 combinaciones de variables incluido 4 puntos centrales. La identificación de los carotenoides se realizó por HPLC-PDA. Los PUFAS han sido cuantificados e identificados por GC-FID. Bajo condiciones óptimas de extracción para etanol se logró recuperar el 64% de la fucoxantina a 50°C y 75 bar, y el 65% de los PUFAS a 122°C y 150 bar. Para la mezcla tricomponente se logró extraer bajo condiciones óptimas el 68% de la fucoxantina a 122°C y 75 bar y el 80% de los PUFAS a 107 °C y 110 bar. Bajo condiciones óptimas el consumo de solvente es hasta 2 veces menor al método tradicional de extracción.

Palabras clave: Microalga, *Phaeodactylum tricornutum*, fucoxantina, PUFAs, sistema de líquidos presurizados.

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BT-42

PHENOTYPIC AND MOLECULAR CHARACTERIZATION OF BIS, A KEY REGULATOR OF INFLORESCENCE ARCHITECTURE AND SEEDLESS FRUIT FORMATION IN *Solanum pimpinellifolium* L.

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Inflorescence architecture is an important determinant of angiosperm diversity and crop yield. In sympodial species such as tomato (*Solanum lycopersicum* L.) and its wild ancestor *S. pimpinellifolium* L., pluripotent cells located in the shoot apical meristem undergo a transition to an inflorescence meristem, which in turn gives rise to the floral meristems that compose the inflorescence. Under normal conditions, pollination and fertilization act as triggers factors for ovary growth and seed formation, but certain genetic and hormonal signals can induce parthenocarpy, fruit set in the absence of fertilization, producing seedless fruits of commercial interest. Here we report a recessive mutant identified from a T-DNA insertional collection in *S. pimpinellifolium* L., named branched inflorescence and seedless (*bis*). Mutant plants exhibit markedly increased inflorescence branching with numerous flowers that lack viable pollen, which develop into seedless fruits that are slightly reduced in size relative to wild type. Genetic interaction assays indicate that *bis* exhibits synergistic and epistatic relationships with established regulators of inflorescence architecture. Molecular evidence indicates that the mutation results from somaclonal variation during tissue culture rather than from the T-DNA insertion. Using a mapping-by-sequencing approach, we localized the *BIS* locus to a centromeric region on chromosome 8. Currently, candidate genes within this region are being targeted via CRISPR/Cas9 genome editing to confirm the identity of *BIS*. Elucidating *BIS* function should provide mechanistic insight into the control of inflorescence branching and fruit set, with potential applications in breeding strategies aimed at optimizing tomato yield and fruit quality.

Keywords: Biotechnology, *Solanum pimpinellifolium* L., Inflorescence, parthenocarpic, T-DNA, CRISPR

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CA-3

NUTRITIONAL AND COSMETIC POTENTIAL OF FATTY ACIDS FROM SIX EDIBLE WILD FRUITS: A COMPARATIVE LIPID PROFILING APPROACH

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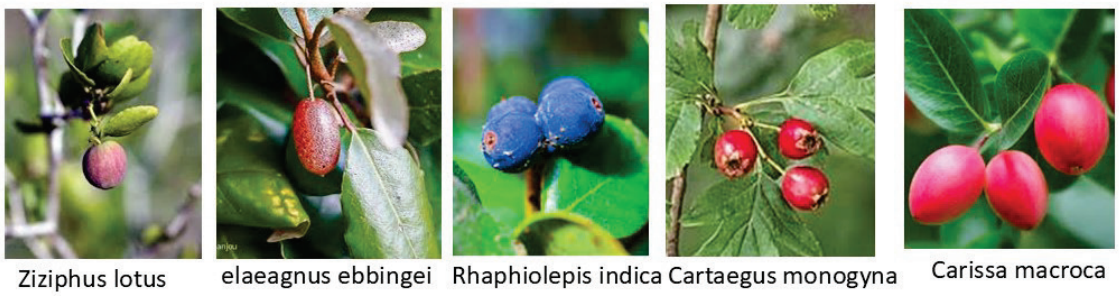
In this study, the fatty acid (FA) composition and lipid profile of six wild edible fruits —*Elaeagnus angustifolia*, *Carissa macrocarpa*, *Rhaphiolepis indica*, *Crataegus monogyna*, and *Ziziphus lotus*—were investigated. Fruits were collected at full ripeness between May and September 2025. All samples were obtained from naturally growing populations in southern Spain, except for *R. indica*, which was sourced from wild stands in the western Mediterranean region of Morocco. Pulp and seeds were separated, and total lipids were extracted and converted into FA methyl esters (FAMEs) using a one-step in situ transesterification method. The FA composition was determined by gas chromatography with flame ionization detection (GC-FID), and results were expressed as relative percentages of total FAs (TFA %).[1]



The results revealed clear interspecific variation in lipid content and FA profiles. Seed oils of *E. angustifolia* were predominantly composed of linoleic acid (LA, 18:2*n*-6, ~48%) and oleic acid (OA, 18:1*n*-9). In contrast, *C. macrocarpa* and *R. indica* exhibited a more balanced distribution of palmitic acid (PA, 16:0), LA, and OA. *C. monogyna* presented particularly high levels of polyunsaturated fatty acids (PUFAs), suggesting a favorable ω-6/ω-3 ratio. *Ziziphus* species were characterized by high proportions of OA (50–60%) and moderate levels of LA (12–17%) and PA (12–18%), confirming their nutritional relevance as sources of bioactive FAs. Overall, monounsaturated FA (MUFA) and polyunsaturated FA (PUFA) accounted for more than 85% of the total lipid fraction in most taxa. These findings underscore the nutritional and cosmetic potential of these wild fruits. Their FA offer health-promoting benefits, including cardiovascular protection, enhanced skin hydration, and antioxidant activity.[2] Collectively, these underutilized species represent promising natural sources of bioactive lipids for functional foods, nutraceuticals, and cosmetic formulations.

***Keywords*:** Wild edible fruits, Fatty acid profile, Nutritional value, Cosmetic potential, GC-FID.

Acknowledgements. This work has been supported by the Vicerrectorado de Investigación e Innovación de la Universidad de Almería, ceiA3, and CIAMBIT.

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CA-4

FROM KNOWLEDGE TO PRACTICE: EXPLORING BIOCULTURAL DIVERSITY IN RURAL ALMERÍA

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Mediterranean rural landscapes have undergone profound socio-ecological transformations in recent decades, shaped by agricultural intensification, land abandonment, and demographic decline. These dynamics have not only reconfigured local ecosystems but also eroded traditional knowledge, practices, and cultural ties that sustain rural identities. The concept of biocultural diversity (BCD) offers a holistic lens to understand these interconnections between biological and cultural systems, recognizing that biodiversity and cultural expressions co-evolve through time. However, translating this concept into practice remains challenging, especially in Europe, where operational frameworks that bridge ecological and cultural dimensions are still emerging. This study applies a participatory and place-based approach to explore how local communities perceive, spatialize, and envision BCD in a semi-arid Mediterranean landscape in southern Spain. We conducted two participatory workshops in the municipality of Abrucena (Almería, Spain), involving 25 local residents representing different ages, genders, and occupations. The workshops combined participatory scenario planning and participatory mapping to identify BCD elements across three temporal horizons: the past (1950), the present (2022), and the desired future (2030). Here, we focus on the main empirical findings related to the composition, spatial dynamics, and future strategies of BCD as expressed by the participants. Participants collectively identified 88 BCD elements for the past and 58 for the present, distributed among practices, traditional knowledge, and cultural traditions. The results reveal a clear erosion of biocultural richness over time, particularly in cultural traditions and traditional knowledge, while some agricultural practices remain relatively resilient. Spatial analyses also highlighted a contraction of the mapped area for BCD elements—more than 50% for knowledge and traditions, and 10% for practices—reflecting the concentration of cultural expressions in fewer, more symbolic locations. Looking forward, participants proposed 22 strategies for conserving and revitalizing BCD, grouped into three thematic areas: (1) water and land management; (2) socio-economic and institutional improvements; and (3) educational and cultural revitalization. Notably, participants adopted a selective approach to heritage conservation, choosing to recover meaningful traditions while discarding others incompatible with modern livelihoods. Overall, our findings reveal how participatory approaches can make biocultural diversity tangible and actionable at local scales. By linking collective memory, spatial knowledge, and future-oriented planning, communities can articulate pathways for conserving living landscapes that integrate cultural meaning and ecological functionality.

***Keywords*:** participatory mapping, future scenarios, traditional practices, rural abandonment.

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CA-5

OMEGA-3 AND ANTIOXIDANT POTENTIAL IN MOROCCAN BORAGINACEAE SEEDS

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This research examined the seeds of six species from the *Boraginaceae* family originating from Morocco: *Cerinthe major* subsp. *oranensis*, *Echium tenue*, *Echium horridum*, *Cynoglossum cheirifolium* and *Mairetis microsperma*. The seeds of each of these species were subjected to determining (1) fatty acid (FA) composition using GC-FID, and (2) antioxidant activity using DPPH and ABTS•+ radical scavenging methods.

Total polyunsaturated fatty acids (PUFA) varied from 21.5% in *C. cheirifolium* to 72.9% of total FA in *E. tenue*. The *n*-3 PUFA content was highest in *E. tenue* (39.1%) and *C. major* subsp. *oranensis* (38.1%), as these two species had high levels of *α*-linolenic acid (C18:3n-3), which were 29.2% and 34.5%, respectively. The highest *n*-6 PUFA concentration was observed in *M. microsperma* (47.0%), which had a remarkably high level of *γ*-linolenic acid (C18:3*n*-6) at 20.2%. The *n*-6/*n*-3 PUFA ratios varied from 0.3 in *C. major* to 2.7 in *M. microsperma*, generally indicating a favorable balance among the species analyzed. The highest monounsaturated fatty acid (MUFA) levels were found in *C. cheirifolium* (66.8%), while *E. horridum* showed the highest saturated fatty acid (SFA) content (35.8%). The stearidonic acid (C18:4*n*-3) levels ranged from 3.3% in *E. horridum* to 9.9% in *E. tenue*. Among the studied species, *E. tenue* exhibited the most favorable FA profile, combining a high proportion of total PUFA with a balanced *n*-6/*n*-3 ratio.[1]

In terms of antioxidant properties, the highest DPPH radical scavenging activity was observed for *M. microsperma* (5.54 mmol TE/100 g), followed by *E. tenue* (3.68 mmol TE/100 g) and *E. horridum* (3.58 mmol TE/100 g*). M. microsperma* also exhibited the highest ABTS•+ activity (3.56 mmol TE/100 g). The lowest antioxidant potential in the assays was found in *C. cheirifolium* (0.89 mmol TE/100 g).

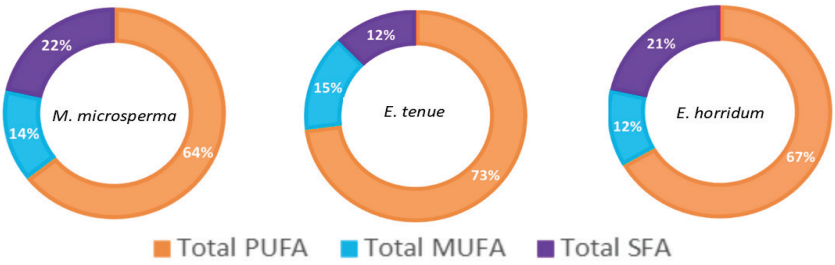

Figure 1. Fatty Acid Ratios in Seeds of *M. microsperma*, *E. tenue* and *E. horridum*.

In conclusion*, M. microsperma* and *E. tenue* showed the best antioxidant potential in relation to their PUFA content and moderate *n*-6/*n*-3 ratios. This demonstrates that Moroccan *Boraginaceae* seeds are valuable sources of bioactive fatty acids and natural antioxidants. This offers possibilities for their use in nutraceuticals and functional foods.

Keywords**:** *Boraginaceae*, fatty acid composition, *γ*-linolenic acid, antioxidant activity, DPPH, ABTS.

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CA-6

THERMAL PERFORMANCE ASSESSMENT OF ENCAPSULATED PCM GEOMETRIES AT PILOT SCALE FOR COOLING APPLICATIONS

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The effective integration of solar energy into air-conditioning applications requires robust and sustainable thermal energy storage (TES) solutions. Phase Change Materials (PCMs) store energy by phase changing because the latent heat is much higher than the specific heat in most materials. Thus, they stand out for their high energy density and their ability to reduce fossil energy dependence in building applications. However, their thermal performance strongly depends on the geometry, orientation, and arrangement of the encapsulated PCM inside the storage tank.[1,2] Within the European project COOLSPACES 4 LIFE, a pilot-scale experimental facility was developed to analyze the thermal behavior of different capsule geometries under realistic cooling conditions.

The system includes a vapor-compression chiller, an 80 L buffer tank, and a PCM-based thermal storage tank that can operate in sensible or latent heat modes. An electric resistance heater was incorporated to simulate discharge cycles and partial load conditions, allowing the analysis of both charging (cooling) and discharging (heating) processes under controlled scenarios. Automated valves, variable-speed pumps, and an array of temperature and pressure sensors ensured accurate monitoring and regulation of the operating parameters. Three commercially available encapsulated PCM geometries—heatSel (disc-shaped), heatStixx, and heatStixx HP (ellipsoidal)—filled with the same PCM (ATS-3) were evaluated at temperatures between −6 °C and −10 °C to determine their solidification and melting performance.

The results identified the heatSel geometry, vertically oriented and aligned with the fluid flow, as the most efficient configuration, providing the highest energy storage capacity, lowest subcooling, and best energy recovery. In contrast, heatStixx geometries exhibited greater subcooling, lower storage capacity, and occasional PCM leakage. The analysis also revealed that complete recovery of stored energy occurs under low load discharging conditions, highlighting the importance of optimized operating strategies. These findings provide a strong basis for the deployment of solar-powered cooling systems with PCM-based TES in buildings as tested in CIESOL (University of Almería, Spain) and L-1 (Wrocław University of Science and Technology, Poland), supporting the transition toward renewable and efficient climate control technologies.

***Keywords*:** Phase Change Materials (PCM), Thermal Energy Storage (TES), Solar Cooling Applications.

Acknowledgements. The COOLSPACES 4 LIFE project (LIFE20 CCM/PL/001607) is financed by the European Commission under the LIFE Programme and co-financed by the National Fund for Environmental Protection and Water Management in Poland (2244/2021/WN01/OA-PO-LF/D).

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CA-7

VARIABILIDAD FITOQUÍMICA DE COMPUESTOS BIOACTIVOS LIPOFÍLICOS EN DIVERSAS VARIEDADES DE TOMATE (*Solanum lycopersicum* L.)

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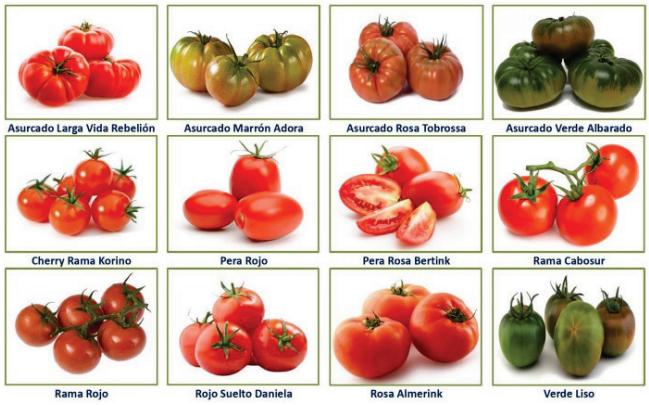
El tomate (*Solanum lycopersicum* L.) es una fuente destacada de compuestos bioactivos de baja polaridad, como licopeno, carotenoides, vitamina C, tocoferoles y fitoesteroles, asociados a efectos beneficiosos para la salud humana. No obstante, la variabilidad fitoquímica entre variedades ha sido escasamente evaluada, lo que limita la selección de genotipos con mayor valor nutricional y funcional. En este contexto, el presente estudio caracterizó el perfil fitoquímico de doce variedades tradicionales de tomate cultivadas en La Cañada (Almería), mediante la cuantificación de compuestos bioactivos de baja polaridad por cromatografía líquida de alta resolución (HPLC), con el objetivo de identificar cultivares con perfiles nutricionales distintivos.

Los resultados evidenciaron diferencias significativas en el contenido de todos los compuestos analizados. Los carotenoides totales oscilaron entre 4.7 mg/100 g de peso fresco (pf) (Pera Rosa Bertink) y 42.4 mg/100 g pf (Rojo Suelto Daniela), siendo esta última la de mayor concentración. En dicha variedad, el licopeno fue el carotenoide predominante (31.6 mg/100 g pf), seguido de β-caroteno (8.8 mg/100 g pf). La vitamina C varió entre 10.8 mg/100 g pf en Rama Cabosur y 32.8 mg/100 g pf en Asurcado Larga Vida Rebelión, esta última junto a Asurcado Verde Albarado (31.5 mg/100 g pf) destacaron por sus niveles superiores. Los tocoferoles totales fluctuaron entre 0.4 mg/100 g pf (Verde Liso) y 5.6 mg/100 g pf (Rama Rojo), con predominio de γ-tocoferol. Por su parte, los fitoesteroles presentaron valores comprendidos entre 3.5 mg/100 g pf (Rosa Almerink) y 9.0 mg/100 g pf (Rama Cabosur), observándose en esta y en Rojo Suelto Daniela las mayores concentraciones de β-sitosterol (6 mg/100 g pf).



La marcada heterogeneidad en la acumulación de compuestos bioactivos entre variedades evidencia la influencia de la genética y el tipo de fruto sobre el perfil fitoquímico. En el presente estudio se ha comprobado que la variedad de tomate Rojo Suelto Daniela se distingue por su elevado contenido en licopeno y β-caroteno, mientras que la variedad Asurcado Larga Vida Rebelión sobresale en vitamina C. Estos hallazgos permiten orientar la selección de cultivares con valor nutricional y funcional específico, constituyendo una base valiosa para programas de mejora genética orientados a incrementar compuestos bioactivos de baja polaridad.

***Palabras clave*:** *Solanum lycopersicum*, HPLC, Carotenoides, Compuestos lipofílicos.

***Agradecimientos*.** Este trabajo ha contado con el apoyo del Vicerrectorado de Investigación e Innovación de la Universidad de Almería, ceiA3, y CIAMBITAL.

CA-8

SUPERFICIES AUTOLIMPIABLES APLICADAS A TECNOLOGÍAS SOLARES: NANOPARTÍCULAS HÍBRIDAS DE ÓXIDO DE TITANIO Y NANOPLAQUETAS DE GRAFENO COMO ELEMENTO ACTIVO

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Los recubrimientos autolimpiables son clave para paliar la pérdida de eficiencia en los sistemas solares. Para conseguir estos recubrimientos, se apuesta por el uso de nanopartículas de óxido de titanio (TiO_2) modificadas con nanoplaquetas de grafeno (GNPs). El dopaje de TiO_2 con nanoestructuras de carbono permite mejorar la eficiencia fotocatalítica del TiO2 mediante la generación de nuevos estados energéticos intermedios que optimizan la absorción de luz visible. Estos sistemas fotocatalíticos híbridos TiO_2/GNPs se obtienen mediante síntesis solvotermal en dos etapas: primero se realiza la hidrólisis y condensación del precursor (isopropóxido de titanio) en presencia de las GNPs y posteriormente se tratan térmicamente a presión en un autoclave revestido con Teflón. Partiendo de la hipótesis de que un mayor número de grupos oxigenados en la superficie de las GNPs debe favorecer las reacciones de condensación entre las especies precursoras del TiO_2 y la superficie de las GNPs, se ha realizado la síntesis con dos nanoestructuras de GNPs moderadamente oxidadas. Unas GNPs se han tratado en un horno en aire (GNPs-aire) mientras que otras han sido oxidadas en medio acuoso con HNO_3 y H_2O_2 (GNPs-aq). Mediante espectroscopía UV/Vis se ha observado que la presencia de GNPs aumenta drásticamente la absorción de estos sistemas fotocatalíticos híbridos, siendo este aumento más significativo cuando las GNPs han sido oxidadas en medio acuoso (Figura 1). Estas nanopartículas han sido dispersadas sobre sustratos de vidrio mediante *spin-coating*, lo que permite consolidar el recubrimiento mediante la proyección posterior de un polímero transparente mediante técnicas de pulverización o incluso óxidos transparentes y conductores mediante *sputtering*.

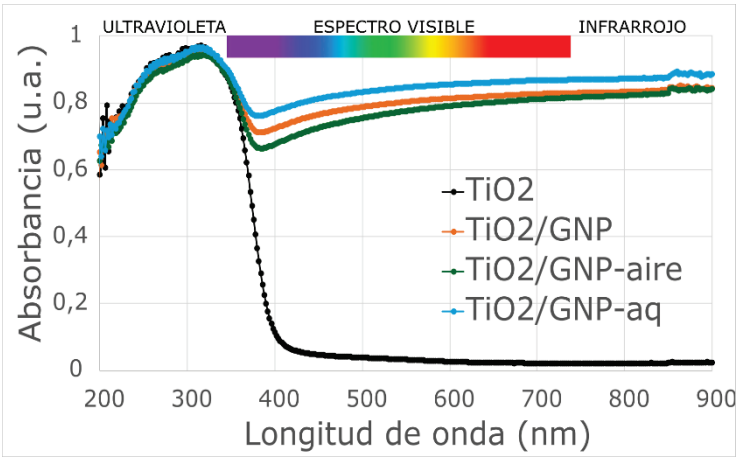

Figure 1. Espectros UV/Vis de los diferentes sistemas fotocatalíticos TiO_2/GNPs estudiados.

***Palabras clave*:** Autolimpiable, Antisuciedad, Fotocatálisis, Grafeno, Óxido de Titanio.

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CA-9

REACTIVATION OF HBV INFECTION IN PEOPLE LIVING WITH HIV AFTER SIMPLIFICATION OF ANTIRETROVIRAL THERAPY

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The human immunodeficiency virus (HIV) and the hepatitis B virus (HBV) share transmission routes and mechanisms, which means that the prevalence of HBV infection in people living with HIV (PLHIV) can be up to 10 times higher than in the general population.[1] Coinfection rates, however, can vary significantly between different geographic areas. In the natural history of HBV infection, four phases of active infection (not necessarily successive) and a functional recovery phase are academically distinguished.[2] In the functional healing phase, HBsAg has been lost with or without Anti-HBs, Anti-HBc is positive, aminotransferases are within the normal range, and HBV DNA is usually undetectable in serum. It is well known that in this phase, and especially in people with some type of immunosuppression, reactivation of HBV replication can occur, which is known as occult HBV infection (OI).[3]

In the first half of 2025, in a specialized clinic serving PLHIV at a tertiary care hospital, We observed 2 episodes of reactivation of HBV replication. among 21 individuals whose antiretroviral treatment (ART) was simplified to Dual Therapy (DT) free of analogues active against HBV and who had a functional cure. This represents an extremely high reactivation rate of 9.5%.

Given the clinical, epidemiological, social and economic repercussions that may arise from the reactivation of an HBV infection in PLHIV who are in a supposed situation of functional cure, we have proposed a research project based on the hypothesis of the importance of carrying out a complete serological and virological evaluation against HBV in PLHIV, especially in those who are going to simplify their ART to an analogue-free therapy with activity against HBV.

Our main objective will be to assess the virological, serological and liver function consequences in immunologically and virologically stable PLHIV (undetectable HIV viremia) with previous HBV infection in a functional cure situation, who simplify their antiretroviral treatment from a triple therapy based on nucleoside analogue reverse transcriptase inhibitors (NRTIs) with activity against HBV, to a DT without active HBV drugs.

To this end, we implemented a descriptive, observational study with an inferential "before-after" component in which previously defined variables will be analyzed in a cohort of PLHIV who have previously given their consent and undergo a regulated and systematic follow-up in a monographic consultation of Infectious Diseases from January 2025 to January 2026, using a database created for this purpose, with statistical analysis using the SPSS v21 program.

***Keywords*:** HIV, Antiretroviral Therapy, HBV, Functional HBV Cure, HBV Reactivation.

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CA-10

EXPLORING BIODIVERSITY AND CULTURAL VALUES A RURAL CASE STUDY IN ALMERÍA

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In the Mediterranean basin, rural depopulation and farmland abandonment have intensified, leading to biodiversity loss, soil erosion, and cultural degradation, though also allowing for natural revegetation and improved water retention.[1,2]

Rural landscapes, particularly those in interior regions, are recognized for their cultural significance, serving as cultural landscapes that embody the intertwined nature of biological and cultural diversity.[3] This concept is central to biocultural diversity (BCD), which refers to the co-evolution of biological, cultural, and linguistic diversity within complex socio-ecological system.[4,5]

Understanding how local communities perceive biodiversity and landscape changes, and the cultural values that conserve biodiversity is crucial for designing inclusive conservation strategies. This study examines local knowledge (LEK), values of nature, and perceived contributions of biodiversity to well-being in the region of Los Vélez. Twenty-five in-depth interviews were analyzed through qualitative coding using the IPBES framework for nature's contributions to people (NCPs) and good quality of life framework (GQL). Results show that most participants perceive biodiversity decline, primarily linked to climate change, habitat degradation, and agricultural intensification. While direct drivers were more frequently recognized than indirect ones, respondents emphasized the instrumental, relational, and intrinsic values of nature—highlighting its importance for physical health, cultural identity, and social cohesion. Despite concerns about land abandonment and rural depopulation, some identified positive trends such as habitat restoration and sustainable agriculture.

The study underscores the significance of LEK and locally expressed values of nature in capturing biocultural diversity and calls for integrating community perspectives and NCPs into conservation policies that jointly support ecosystems and rural well-being.

***Keywords*:** Biocultural diversity, Biodiversity perceptions, Cultural landscapes, Local ecological knowledge (LEK).

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CA-11

ISOTOPIC TRACE OF DESALINATED WATER USED FOR IRRIGATION. CAMPO DE NÍJAR (SE ESPAÑA)

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The region of Níjar (Almería), a benchmark for intensive greenhouse agriculture, has suffered from historic overexploitation of its groundwater resources, leading to the introduction of desalinated water as an alternative water resource for irrigation. The aim of this study is to evaluate the influence of this new external water supply on the isotopic composition of groundwater in the Níjar Basin. The isotopic tracers used were $\delta^{18}O$ and $\delta^{2}H$. The isotopic signatures of groundwater and seawater are clearly different, with the former showing noticeably negative values ($\delta^{18}O$=-7.2 to -5‰; $\delta^{2}H$:-46 to -32‰) compared to seawater, where they are close to zero ($\delta^{18}O$=+0.7‰; $\delta^{2}H$:+6.5‰). The isotopic values of seawater undergo virtually no change once it has undergone desalination by reverse osmosis, so the signal of the desalinated water remains close to zero. When large volumes of desalinated seawater are used for irrigation over a prolonged period of time, it is foreseeable that the isotopic signature of this desalinated water, which infiltrates the aquifer through the return of irrigation water, will end up modifying the original isotopic signature of the aquifer water.

This hypothesis has been tested in this study using the example of the Níjar Basin aquifer, which since 2005 has been largely irrigated with desalinated seawater from the Carboneras desalination plant. To this end, samples were taken from boreholes that take groundwater at different points in the basin, as well as from desalinated water from the desalination plant, which were then analysed isotopically.

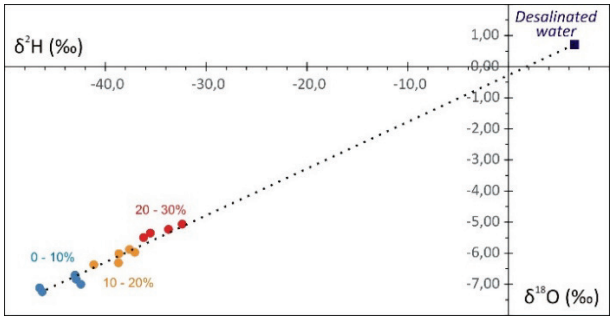

Figure 1. $\delta^{18}O$ vs $\delta^{2}H$ of the samples taken. The calculated percentages of desalinated water present in the groundwater samples are included.

When the distribution of the concentration of the $\delta^{18}O$ and $\delta^{2}H$ is plotted on a map, it can be seen that the most depleted samples are located in the areas bordering the basin, while the relatively more enriched samples are distributed over the central and more cultivated areas of the region. It is in the latter areas where irrigation with desalinated water has been most important. Part of this irrigation water will have infiltrated through irrigation return, thus modifying the isotopic content of the groundwater.

This would be the first example where a change in the isotopic chemistry of groundwater has been observed as a result of the use of desalinated water. This type of study would make it possible to recognise the improvement in the state of a groundwater body through the use of non-conventional water resources.

***Keywords*:** Non-conventional water resources, Desalination, Environmental Isotopes, Níjar basin.

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CA-12

INDICADORES DE TELEDETECCIÓN PARA EL SEGUIMIENTO DEL SERVICIO DE REGULACIÓN HÍDRICA EN CABECERAS DE RÍOS DE ALTA MONTAÑA

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La regulación hídrica es un servicio ecosistémico esencial en las cabeceras de ríos de alta montaña, donde la dinámica del deshielo, las características de los acuíferos alpinos y la vegetación controlan la liberación del agua hacia las cuencas fluviales. En este estudio se propone un conjunto de indicadores derivados de teledetección para el seguimiento de este servicio en las cuencas de Sierra Nevada (España). Se analizaron las series mensuales de los índices SAVI (Soil-Adjusted Vegetation Index) y LSWI (Land Surface Water Index), que estiman vegetación y contenido de humedad en la cobertura superficial del suelo y la vegetación, para el periodo 2018-2024 a lo largo del gradiente altitudinal y entre tipos de vegetación previamente identificados como vegetación dependiente de aguas subterráneas (GDV). [1] Los resultados muestran que los borreguiles, formaciones vegetales desarrolladas principalmente en zonas llanas o en suaves depresiones y pendientes donde se acumula el agua del deshielo que aflora en superficie, son los principales responsables de la regulación de los flujos superficiales. Estas comunidades herbáceas higrófilas, dominadas principalmente por cárices, juncos y gramíneas vivaces, crecen sobre suelos hidromorfos saturados durante buena parte de la primavera y el verano. Gracias a ello, los borreguiles almacenan el agua del deshielo y la liberan de manera progresiva, modulando el flujo superficial según la altitud. Por su parte, los enebrales–piornales, matorrales de alta montaña que se desarrollan en laderas pedregosas y bien drenadas, poseen raíces profundas que les permiten acceder a las reservas hídricas del subsuelo y mantener la actividad vegetativa durante el estiaje. Estas formaciones actúan como indicadores de la humedad edáfica o subterránea, sin desempeñar un papel regulador directo sobre los flujos superficiales. Las cuencas con mayor extensión y continuidad altitudinal de borreguiles (Genil, Dílar, Poqueira, Dúrcal y Trevélez) presentan la mayor capacidad de regulación hídrica potencial. En cambio, las cuencas centrales (Lanjarón, Monachil, Maitena) muestran una funcionalidad intermedia, dependiente de la conectividad entre cotas altitudinales, y las orientales (Válor, Nacimiento, Bérchules, Nechite), más áridas y simplificadas, apenas conservan capacidad reguladora. Este enfoque permite identificar gradientes funcionales y zonas prioritarias para el seguimiento del servicio de regulación hídrica en la alta montaña.

***Palabras clave*:** Borreguiles, LSWI, SAVI, Vegetación dependiente de aguas subterráneas.

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CA-13

GUARDIANS OF THE SEA, VICTIMS OF PLASTIC: SEABIRDS AS SENTINELS OF MARINE LITTER IN THE SOUTHERN EUROPE

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Plastic pollution has become a major issue for marine ecosystems, posing severe risks to marine wildlife.[1] Seabirds are particularly vulnerable to this pollution and are globally recognized indicators of the ecological state of marine environments because they occupy high trophic levels, have wide foraging ranges, and integrate contamination across large oceanic areas. In the North Atlantic, the Northern fulmar (*Fulmarus glacialis*) is used as an indicator species for plastic ingestion under the EU Marine Strategy Framework Directive (MSFD, Descriptor 10).[2] However, the context dependency of indicator species in southern Europe highlights the need to identify alternative sentinels for this region.

This study aims to analyse the presence and characteristics of plastics in the digestive tracts of three seabird species that may serve as sentinels of marine litter exposure in southern Europe. Individuals of the Northern gannet *(Morus bassanus*, n = 42), Atlantic puffin (*Fratercula arctica*, n = 20), and razorbill *(Alca torda*, n = 103) were collected along the Andalusian coast (southern Spain) between 2022 and 2024. Necropsies were performed, and ingested plastics were characterized both physically (size, shape, and colour) and chemically (polymer type) using FTIR spectroscopy.

Plastic ingestion was frequent across species, reaching 88.1 % in Northern gannets, 65.0 % in Atlantic puffins, and 18.4 % in razorbills. Microplastics dominated the debris spectrum (> 76 %), with fibres as the prevailing shape (up to 95 % in gannets) and transparent, black, and blue colours representing over 80 % of all items. Chemical analyses revealed a predominance of cellulosic and polyolefin-based polymers, mainly viscose/regenerated cellulose and polyethylene.

These findings provide a regional baseline for the integrated assessment of plastic ingestion in multiple seabird species from southern Europe,[3] offering valuable insights for improving marine litter monitoring and conservation efforts across Mediterranean and adjacent Atlantic regions.

***Keywords*:** Seabird conservation, Marine debris, Microplastics ingestion, Western Mediterranean.

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CA-14

COMPARATIVE PROFILE OF VITAMIN C AND FATTY ACIDS IN TISSUES OF HORSE, CALF, LAMB, DEER, AND WILD BOAR

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This research investigates the biochemical profiles of five game animals—horse (*Equus caballus*), calf (*Bos taurus*), lamb (*Ovis aries*), deer (*Cervus elaphus*), and boar (*Sus scrofa*)—through the vitamin C and fatty acid profiles of major body tissues. Domestic and wild species can offer an opportunity to understand nutrient variability and metabolic acclimatization.

HPLC quantification of Vitamin C revealed significant inter-organ variability. The deer brain had the highest concentration (79.8 mg/100 g), followed by the lamb kidney and liver (≈ 58 mg/100 g) and lamb eyes (42.5 mg/100 g). Intermediate values were seen in the horse kidney (46.5 mg/100 g) and calf eyes (35.6 mg/100 g), while all muscles and fat tissue of all species were low (< 5 mg/100 g and < 1 mg/100 g, respectively). Overall, these results demonstrate substantial antioxidant accumulation in metabolically active organs, especially in deer and lamb.

Chromatographic analyses (GC-FID) revealed distinct lipid patterns among species. Deer fat showed the highest PUFA proportion (60.6%), mainly n-3 fatty acids (57.7%), indicating high oxidative and nutritional potential. The wild boar brain contained notable PUFA (54.3%), dominated by n-6 fatty acids (45%). Lamb muscle presented a balanced profile (PUFA 24%, MUFA 19%, SFA 57%), while horse muscle and kidney were rich in MUFA (47% and 39%). The calf brain exhibited significant levels of both n-3 (15.9%) and n-6 (14.6%) fatty acids, reflecting its neural importance.

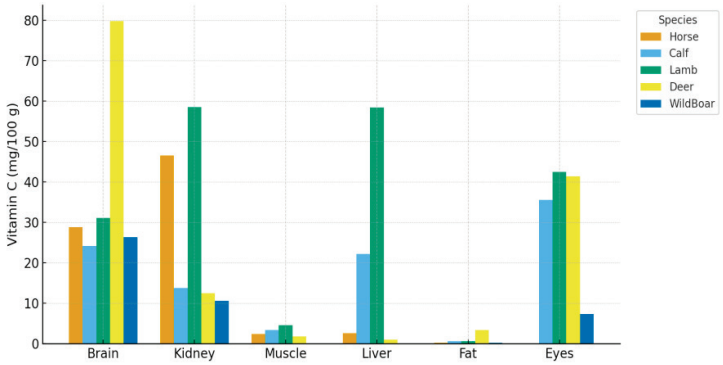

Figure 1. Vitamin C concentration by organ and especies

Overall, deer and lamb tissues high in vitamin C and PUFA while horse and wild boar had lipids higher in MUFA and beneficial for human nutrition. The results further emphasize the biochemical diversity of field animals and their potential for use as sustainable sources of bioactive compounds.

***Keywords*:** Vitamin C, Fatty acid profile, GC-FID, HPLC, Biochemical composition.

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CA-15

BIOCOSTRA INDUCIDA COMO HERRAMIENTA DE RESTAURACIÓN: EFECTOS SOBRE LA EROSIÓN Y LA PÉRDIDA DE NUTRIENTES EN ECOSISTEMAS ÁRIDOS

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Las biocostras constituyen una componente clave de los ecosistemas áridos, donde cumplen un papel fundamental en la estabilización del suelo, repercuten en los ciclos de nutrientes y modulan los procesos hidrológicos. Estas comunidades, formadas por organismos autótrofos y heterótrofos íntimamente asociados a las partículas del suelo, son altamente sensibles a las perturbaciones. Actualmente existen diversas estrategias para restaurar la biocostra en áreas degradadas, destacando entre ellas la inoculación con cianobacterias nativas. Aunque esta estrategia ha mostrado efectividad en la formación de la biocostra y la mejora de algunas propiedades del suelo, aún se conoce poco acerca de su papel en la recuperación de funciones clave, como son la reducción de la erosión y retención de nutrientes del suelo.

En este estudio se evaluaron el efecto de la eliminación de la biocostra y la recuperación de la biocostra mediante la inoculación de cianobacterias formadoras de biocostra sobre la escorrentía y la erosión y las pérdidas de C y N a través de la erosión, en condiciones de campo. El experimento se llevó a cabo en el Desierto de Tabernas (SE de España), una zona semiárida donde la biocostra cubre más del 50 % de la superficie, desempeñando un papel fundamental en el funcionamiento del ecosistema. A lo largo del año hidrológico 2024-2025, se monitorizaron las pérdidas de suelo y carbono orgánico (CO) y nitrógeno total (N) por erosión hídrica en tres tipos de cobertura: (1) biocostra intacta (control), (2) parcelas con biocostra eliminada (suelo desnudo) y (3) parcelas inoculadas con cianobacterias nativas para simular etapas tempranas de recuperación. Tras cada episodio de lluvia, se midió el volumen de escorrentía y se tomaron muestras de escorrentía donde se determinó la cantidad de sedimento exportado, así como el carbono orgánico (CO) y el nitrógeno (N) exportados a través de los sedimentos.

Los resultados muestran que la erosión fue mayor en las parcelas sin biocostra, intermedia en las inoculadas y mínimas en las intactas. Las biocostras intactas presentaron la mayor concentración de CO y N en sedimentos pero al reducir significativamente la erosión, presentaron las menores pérdidas de CO y N, demostrando así su papel en la estabilización y retención de nutrientes del suelo. En comparación con la biocostra inalterada, las parcelas desnudas presentaron exportaciones superiores aproximadamente 1,5 veces en el caso de CO y de casi 2,8 veces para N. Las parcelas inoculadas, redujeron la erosión en torno a un 40 % respecto a las parcelas eliminadas, aunque, mantuvieron exportaciones de CO ligeramente superiores (~10 % más) y de N similares (~2 % menos). Estos resultados evidencian la importancia de conservar las biocostras o en su caso, restaurarlas, para mejorar la estabilidad del suelo y el papel protector frente a la erosión y la retención de nutrientes en ecosistemas áridos.

***Palabras clave*:** Biocostras, Erosión, Pérdida de nutrientes, Cianobacterias, Zonas Áridas

Agradecimientos. Este trabajo forma parte del proyecto CNS2023-144749 financiado por MICIU/AEI/10.13039/501100011033 y la Unión Europea-NextGenerationEU/PRTR.

CA-17

ESTUDIO DEL AHORRO EN EL CONSUMO DE FERTILIZANTES Y AGUA DE RIEGO CON EL USO DE LIXIVIADOS RECIRCULADOS EN UN CULTIVO DE CALABACÍN SOBRE SUSTRATO

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El sector agrícola requiere un elevado aporte de agua de riego, y en muchas regiones se recurre intensivamente a recursos hídricos subterráneos, como ocurre en los invernaderos de la cuenca mediterránea y en otras zonas semiáridas donde la disponibilidad y la calidad del agua son limitadas. La utilización de agua de mar desalada (DSW) como recurso hídrico no convencional constituye una alternativa sostenible que permite reducir la sobreexplotación y degradación de los acuíferos. Por otro lado, el cultivo sobre sustrato representa una práctica ampliamente extendida en invernaderos, especialmente cuando se emplean sistemas cerrados con recirculación de lixiviados, los cuales mejoran la eficiencia en el uso de agua y fertilizantes.

El presente trabajo compara el comportamiento de un cultivo hidropónico de *Cucurbitapepo* establecido sobre sustrato en dos sistemas: abierto (sin recirculación de lixiviados) y cerrado (con recirculación de lixiviados). En el sistema abierto se utilizó para el riego del cultivo una mezcla de agua desalada y agua de pozo, con la adición de fertilizantes mediante un sistema de fertirriego. En el sistema cerrado, el riego se realizó con una mezcla de agua desalada, agua de pozo, lixiviados recirculados del propio cultivo y fertilizantes. En ambos tratamientos se mantuvieron constantes las concentraciones iónicas y la conductividad eléctrica, lo que permitió una comparación directa entre ambos ensayos. Se evaluaron la producción comercial, no comercial y total de fruto ($kg \cdot m^{-2}$), así como el consumo de agua y fertilizantes.

Los resultados indican que la utilización de agua de mar desalada constituye una opción adecuada para la mezcla con aguas de menor calidad, obteniéndose soluciones aptas para el uso agronómico. Asimismo, la recirculación de lixiviados en sistemas hidropónicos permite reducir significativamente el consumo de agua y fertilizantes sin afectar la producción de fruto comercial de calabacín.

Palabras clave: sustrato, agua desalada del mar, fertilizantes, calabacín, lixiviados.

Agradecimientos. Los autores agradecen la financiación del Ministerio de Ciencia e Innovación a través del Proyecto SEA4CROP (PID2020-118492RB-C21).

CA-18

BETWEEN DESERT AND GREEN: EXPLORING PERCEPTIONS OF URBAN NATURE IN ALMERÍA

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Understanding how urban residents perceive and value nature is fundamental to designing inclusive and climate-resilient planning strategies, especially in semi-arid cities where both ecological and social dimensions challenge conventional notions of "green" urbanism.

This research investigates residents' perceptions of urban nature in Almería, Spain, located in the driest continental regions of Europe. Employing a mixed-methods framework, we analyzed 205 in-person surveys through a combination of Latent Dirichlet Allocation, qualitative content analysis, and Bayesian multinomial logistic regression.

This integrative approach enabled us to identify different types of perceived urban nature, examine their associated meanings and values, and assess the influence of selected socio-demographic and perceptual variables (education, gender, and perceived availability of urban nature).

Three main perception profiles emerged: Desert–arid, emphasizing attachment to Almería's dry coastal identity; Aesthetic–ornamental, centered on visual attractiveness and designed greenery; and Ecological–benefit oriented, reflecting awareness of nature's environmental and health-related functions. Yet, approximately 37% of participants did not fit neatly into these groups, revealing hybrid views and a great diversity of visions toward nature. Qualitative findings also underscored strong emotional and symbolic dimensions, often exposing tensions between residents' expectations and the city's semi-arid reality. Bayesian modeling highlighted education level and perceived availability of urban nature as key predictors shaping these perception types.

Overall, the study reveals a complex mosaic of meanings attached to urban nature in semi-arid environments. These insights underscore the importance of planning approaches that integrate ecological particularities with local cultural narratives, fostering more socially resonant and climate-adaptive urban nature designs.

***Keywords*:** social values, narratives, drylands, cities.

Acknowledgements. Authors would like to thank all respondents of the city of Almería who answered our survey for their effort and time. EG would like to acknowledge the funding support provided by the Spanish Ministry of Science, Innovation and Universities, under the Juan de la Cierva 2022 Fellowship (JDC2022–048423-I).

CA-20

CHEMICAL CHARACTERIZATION OF TROPICAL DATE FRUITS AND SEEDS: A COMPARATIVE STUDY

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Tropical dates (*Arecaceae*) represent a potentially untapped source of functional vegetable oils. The objective of this study was to compare the fatty acid profiles of the pulp (fruit) and seeds of eight tropical species: *Attalea phalerata*, *Bactris gasipaes*, *Copernicia alba*, *Latania verschaffeltii*, *Syagrus kellyana*, *Syagrus orinocensis*, *Veitchia metiti*, and *Wodyetia bifurcata*.

Chromatographic analyses (GC-FID) revealed marked differences between the two fractions. The fruits had a higher proportion of polyunsaturated fatty acids (PUFA, 26–42%), dominated by linoleic acid (C18:2n-6) and α-linolenic acid (C18:3n-3). These acids were particularly abundant in *V. metiti* and *B. gasipaes*. Oleic acid (C18:1*n*-9) was the primary monounsaturated fatty acid, reaching up to 30%.

Conversely, the seeds had higher levels of saturated fatty acids (SFA, 60–86%). Lauric acid (C12:0) and myristic acid (C14:0) were the predominant components, especially in *B. gasipaes* and *S. orinocensis*. These acids impart elevated oxidative stability to the oils. However, some species, including *C. alba* and *W. bifurcata*, had high oleic acid content (>40%). This composition aligns more closely with that of high-quality edible oils. The distinguishing characteristics of the pulp include its nutritional potential. These features are characterised by balanced PUFAs and n-6/n-3 ratios below 1. The seeds are of technological and industrial interest due to their medium-chain saturated fatty acids and high stability.

These results underscore the lipid heterogeneity of tropical dates and provide a foundation for their potential utilization in functional foods and cosmetic applications.[1]

Figure 1. *Some fruits of tropical date palms: Copernicia alba, Veitchia metiti, and Latania verschaffeltii.*

Keywords: Arecaceae, fatty acids, tropical dates, oleic acid, lauric acid, pulp vs seeds.

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CA-22

ESTUDIO PRELIMINAR DE HONGOS ENTOMOPATÓGENOS AUTÓCTONOS PARA EL MANEJO DE *Tuta absoluta*

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La polilla del tomate (*Tuta absoluta* Meyrick) es un lepidóptero de origen sudamericano cuya presencia en España fue registrada por primera vez en 2006.[1] En la actualidad, constituye una de las plagas más relevantes de las solanáceas a nivel mundial, afectando de manera severa a cultivos de tomate -su hospedador principal-, así como a berenjena, patata y pimiento. Las larvas de este insecto presentan un hábito minador, pudiendo provocar en infestaciones severas la pérdida total del cultivo, con graves repercusiones económicas.

El manejo de *T. absoluta* resulta particularmente complejo, ya que los métodos tradicionales, como las prácticas culturales, el uso de trampas de feromonas y la aplicación de insecticidas químicos, han mostrado una eficacia decreciente. Ante esta situación, se ha promovido la implementación de estrategias de control más sostenibles, entre ellas el control biológico, que incluye el empleo de bacterias entomopatógenas, enemigos naturales (depredadores y parasitoides) y extractos vegetales con actividad insecticida.[2] Sin embargo, persiste la necesidad de identificar nuevos agentes de control biológico eficaces frente a este lepidóptero.

Diversos estudios han evidenciado que algunos hongos entomopatógenos presentan actividad significativa contra *T. absoluta*[3]. En este contexto, el presente trabajo tiene como objetivo la prospección y evaluación preliminar de nuevos aislamientos fúngicos con potencial entomopatógeno, con el fin de valorarlos como posibles bioplaguicidas en el manejo integrado de *Tuta absoluta*.

En esta investigación se han recogido un total de 70 muestras de suelo de la rizosfera de plantas autóctonas que prosperan en ambientes naturales en la provincia de Almería, con el fin de aislar los microorganismos fúngicos que presenten actividad entomopatógena y que estén adaptados a las condiciones climáticas del entorno. Se ha logrado identificar más de 25 especies diferentes de hongos a partir de los 137 aislados obtenidos. Un 17% del total de aislados han sido identificados como cepas de interés por pertenecer a géneros de hongos conocidos por su potencial uso en control de plagas, como son *Beauveria*, *Metarhizium* y *Trichoderma.*

Se puede concluir que el microbioma del suelo de la provincia de Almería alberga una elevada diversidad de microorganismos fúngicos con potencial entomopatógeno. Diversos estudios han demostrado que *Tuta absoluta* puede verse afectada por múltiples géneros de hongos entomopatógenos, lo que respalda la exploración de estos microorganismos como agentes de control biológico. Además, se han obtenido numerosos aislamientos pertenecientes al género *Beauveria*, lo que sugiere que este hongo presenta una notable abundancia en los suelos de la región. Además, se trata de un género reconocido por su alta eficacia en la infección y mortalidad de larvas de *T. absoluta*, lo que refuerza su interés como candidato a bioplaguicida.

***Palabras clave*:** *Tuta absoluta,* Control biológico, Bioplaguicida, Hongos entomopatógenos.

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CA-23

INFLUENCE OF TEMPERATURE, PRESSURE, CO_2 CONCENTRATION ON COMMERCIAL ACTIVATED CARBONS FOR CO_2 ADSORPTION PROCESSES

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In response to the growing concern overclimate change and the urgent need to mitigate greenhouse gas emissions, the development of efficient CO_2 capture and reuse technologies has become a major research priority. Among the available methods, adsorption using solid materials stands out as a promising and energy-efficient approach for separating CO_2 from flue gases and reusing it in controlled environments, such as greenhouses, to enhance plant growth and support circular carbon management.[1] In this study, the performance of three commercial activated carbons—GMIP 4S, GMIP 4-1S, and Filtracarb—was evaluated under different operational conditions for CO_2 adsorption and desorption. The experimental work focused on determining the influence of key parameters including adsorption pressure, inlet CO_2 concentration, gas temperature, and relative humidity. The selected conditions were designed to simulate realistic operation ranges: pressures from 1.1 to 2.5 bar, inlet CO_2 concentrations between 4 % and 16 %, temperatures ranging from 25°C to 100°C, and relative humidities from 5% to 65%.[2] Results showed a clear dependence of the adsorption capacity on both pressure and CO_2 concentration for all materials. The Filtracarb carbon exhibited the highest CO_2 uptake at elevated pressures, reaching 100 g CO_2/kg AC at 2.5 bar and 16 % CO_2. The GMIP 4-1S material showed its maximum performance at low pressure, with a capacity of 35 g CO_2/kg AC, while similar values were obtained for the GMIP 4S and GMIP 4-1S carbons under the same conditions. Increasing CO_2 concentration from 4 % to 16 % enhanced adsorption for GMIP 4S, GMIP 4-1S, and Filtracarb by 276 %, 229 %, and 364 %, respectively. Likewise, increasing the adsorption pressure from 1 bar to 2.5 bar improved CO_2 uptake by 324 %, 342 %, and 819 % for GMIP 4S, GMIP 4-1S, and Filtracarb, respectively. All three carbons showed good resistance to high temperatures and relative humidity, with no significant differences observed between 25–50°C or 5–35 % relative humidity. However, a decrease in adsorption capacity was observed for GMIP 4S, GMIP 4-1S, and Filtracarb of about 27 %, 16 %, and 33 %, respectively, when the inlet gas temperature increased from 25°C to 100°C, and decreased of 16 %, 8 %, and 16 %, respectively, when the relative humidity increased from 5 % to 65%. In summary, the three commercial activated carbons—GMIP 4S, GMIP 4-1S, and Filtracarb—showed strong dependence on pressure and CO_2 concentration, with Filtracarb achieving the highest adsorption capacity under optimal conditions (2.5 bar, [CO_2] about 16%, 25º C and RH of 5%). All materials exhibited good thermal and humidity stability, confirming their potential for efficient CO_2 capture and reuse in greenhouse applications.[3]

***Keywords*:** Carbon capture and utilization (CCU), Flue gas treatment, Climate mitigation technologies, Sustainable gas separation, Circular carbon management.

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CA-24

ESTUDIO DE LA INCIDENCIA DE LA RECIRCULACIÓN DE LIXIVIADOS Y LA SALINIDAD EN LA CALIDAD DEL FRUTO DE CALABACÍN EN CULTIVO HIDROPÓNICO

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El déficit hídrico en regiones áridas y semiáridas incrementa la presión sobre los recursos hídricos subterráneos destinados a la agricultura, afectando su disponibilidad y calidad. La implementación de agua de mar desalada (DSW) se postula como una alternativa viable para mitigar esta problemática. En este contexto, la combinación de DSW con aguas convencionales y sistemas de riego eficientes, como los cultivos hidropónicos, contribuye a la reducción del impacto sobre los acuíferos al evitar su sobreexplotación y deterioro de la calidad. Adicionalmente, los sistemas de cultivo hidropónico cerrados ofrecen ventajas superiores respecto a los abiertos, incluyendo una menor demanda de agua y fertilizantes.

El presente estudio evaluó el cultivo de calabacín en un invernadero tipo Almería, utilizando un sistema de cultivo hidropónico sobre sustrato. Se aplicó un diseño experimental de bloques al azar con dos factores: 1. Conductividad Eléctrica (CE) del agua de riego: Se establecieron tres niveles de salinidad: 2.5, 3.5 y 5.5 $dS \cdot m^{-1}$. Estas CE se lograron mediante la mezcla de agua de mar desalada, agua de pozo, lixiviados (en el sistema cerrado) y fertilizantes aplicados mediante fertirriego; 2. Tipo de sistema de riego hidropónico: Abierto (S, sin recirculación de lixiviados) y cerrado (R, con recirculación de lixiviados).

Se evaluaron un total de seis tratamientos de riego. Esta configuración permitió analizar los efectos de la recirculación de lixiviados en cada nivel de salinidad sobre la calidad de los frutos. La diferencia fundamental entre los sistemas radicaba en la utilización o no de los lixiviados recirculados, manteniendo iguales las CE y los contenidos de nutrientes para las plantas en las parejas de tratamientos comparados. Los parámetros de calidad del fruto considerados fueron peso, diámetro y longitud. El análisis estadístico de los datos obtenidos a lo largo del ciclo de cultivo indicó que no se observaron diferencias significativas en la calidad de los frutos entre los sistemas de cultivo hidropónico con y sin recirculación de lixiviados.

El análisis estadístico de los datos recopilados a lo largo del ciclo de cultivo indicó que no se observaron diferencias significativas en la calidad de los frutos entre los sistemas de cultivo hidropónico con y sin recirculación de lixiviados. Estos resultados sugieren que la recirculación de lixiviados constituye una estrategia efectiva para reducir el consumo de aguas convencionales y de agua de mar desalada, sin comprometer la calidad del fruto cosechado.

Palabras clave: riego; agua desalada del mar; cultivo hidropónico; calabacín; lixiviados.

Agradecimientos. Los autores agradecen la financiación del Ministerio de Ciencia e Innovación a través del Proyecto SEA4CROP (PID2020-118492RB-C21).

CA-25

LATE HOLOCENE ENVIRONMENTAL VARIABILITY IN SOUTHERN IBERIA INFERRED FROM LEAF WAX BIOMARKER STABLE HYDROGEN ISOTOPE RATIOS FROM LAGUNA GRANDE DE ARCHIDONA (MÁLAGA, SPAIN)

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The study of the distribution and abundance of long chained *n*-alkanes derived from vascular plant leaf waxes that are well-preserved in lake sediments provides valuable insights into past vegetation dynamics and hydroclimatic variability throughout their specific stable isotopic signatures, contributing to the development of detailed paleoenvironmental reconstructions. In this work, we examine the sedimentary sequence of Laguna Grande de Archidona (LGA), a perennial saline lake located in the province of Málaga, southern Spain. LGA is one of many karstic-origin lakes in the region, with sediment deposition spanning approximately the last 3 millennia. Previous investigations based on geochemical, mineralogical and sedimentological proxies have revealed a detailed reconstruction of the main climatic shifts and human influence in the lake area during this period. However, organic-based geochemical proxies, such as these plant-wax derived biomarkers have not yet been thoroughly explored. Here, we examine the abundance and distribution of these long chained *n*-alkanes in LGA sediments to infer past vegetation characteristics and primary productivity within the lake and its surrounding catchment area. Furthermore, stable hydrogen isotope (δD) analysis of *n*-alkanes is expected to shed light on past precipitation and evaporation patterns. Our results could potentially be compared with stable hydrogen isotope values from gypsum hydration water at the same stratigraphic levels, allowing the evaluation of the isotopic composition of the lake water through two independent proxies. This approach contributes to a more robust reconstruction of regional hydrological variability by complementing existing multiproxy data from the same sedimentary archive and enhancing our understanding of the environmental history of southern Iberia over the last millennia.

***Keywords*:** lake sediments, n-alkanes, paleoclimate, stable isotopes.

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CA-26

POTENCIAL DE DATOS HIPERESPECTRALES PARA CARACTERIZAR LA RESPUESTA FUNCIONAL DE LAS BIOCOSTRAS

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Las costras biológicas del suelo, o biocostras, son comunidades muy complejas que se desarrollan en la superficie del suelo y cuya producción primaria está impulsada por organismos fotosintéticos como cianobacterias, líquenes o musgos, que junto a organismos heterótrofos como arqueas, bacterias u hongos, viven en íntima asociación con las partículas del suelo. Estas aparecen principalmente en los espacios abiertos que la distribución espacial de la vegetación genera en los ecosistemas de tierras secas debido a la escasez de agua. Estos organismos, que forman una capa cohesiva en la superficie del suelo son esenciales para el funcionamiento del ecosistema, ya que regulan los ciclos de agua, C y N, estabilizan el suelo y controlan la erosión, y modulan el balance radiativo del suelo debido a la presencia de pigmentos fotoprotectores y fotosintéticos que absorben la energía en diferentes longitudes de onda, modificando la respuesta espectral y la radiación absorbida por la superficie terrestre. A pesar de cubrir alrededor del 12 % de la superficie terrestre, las biocostras soportan una gran presión antrópica y climática que puede provocar la disminución de sus funciones y el retroceso de su cobertura a nivel global, lo cual puede tener impactos importantes a escala global (reducción de las emisiones de polvo en un 50 %; fijación entre 40 y 70 % del nitrógeno fijado biológicamente). Por lo tanto, evaluar su cobertura, estado y papel en los procesos ecosistémicos clave, es un reto. El objetivo de este trabajo es desarrollar una nueva metodología para realizar la evaluación y seguimiento del papel de las biocostras en procesos ecosistémicos clave a partir de datos hiperespectrales. Para ello se seleccionó el área experimental del Cautivo como zona de estudio. En esta zona se analizaron muestras de 3 tipos diferentes de biocostra: i) biocostra dominada por cianobacterias, ii) Ciano líquenes, iii) y Cloro líquenes además de iv) suelo desnudo. Éstas se recolectaron en dos periodos diferentes (condiciones de sequía tras el verano (S) y en primavera, tras la época de lluvias (H) que representan diferentes periodos de actividad de las biocostras. Sobre cada muestra se midió su respuesta espectral con un espectrorradiómetro en condiciones homogéneas de iluminación en laboratorio y se calcularon diferentes indicadores espectrales relacionados con la absorción de radiación PAR, el contenido en pigmentos o la presencia de biocostras. Además, se analizaron indicadores relacionados con funciones clave de las biocostras como el contenido de carbono orgánico, rugosidad superficial y el contenido en escitonemina, carotenos y clorofila. Los resultados obtenidos muestran cómo el grado de desarrollo y tipo de biocostras modifica los diferentes indicadores funcionales como la escitonemina o la clorofila, con valores más altos en las costras más evolucionadas. Todo ello modifica la reflectancia superficial y los valores de los índices espectrales analizados, permitiendo la discriminación entre suelo y grupos biocostras, sobre todo cuando se utiliza la transformación del continúo quitado para resaltar los picos de absorción específicos de cada cubierta. Finalmente, a partir de la aplicación de modelos estadísticos multivariante PLSR hemos visto que existe una relación clara entre la respuesta espectral y los indicadores funcionales analizados que se hace más evidente cuando utilizamos el CR en vez de la reflectancia. También hemos visto que, en condiciones húmedas, cuando los rasgos espectrales de las biocostras son más evidentes, esta capacidad predictora de la respuesta espectral mejora. Las bandas espectrales con mayor peso en los modelos fueron las relacionadas con la absorción de la escitonemina (384 nm), carotenos (490 nm), clorofila (663 nm), agua (1400 y 2000 nm). Estos resultados, abren un nuevo abanico de posibilidades en el estudio y monitoreo de los ecosistemas dominados por biocostras con la aplicación de esta metodología a las imágenes de los satélites hiperespectrales ENMAP y EMIT que permitirán conocer la dinámica intra e interanual de las zonas cubiertas por biocostras de forma espacialmente distribuida.

***Keywords*:** Biocrust, Hiperespectral, rasgos funcionales, índices espectrales.

CA-27

EXPLORING HUMAN-NATURE CONNECTEDNESS ACROSS URBAN NATURE SPACES IN THE SEMI-ARID CITY OF ALMERÍA, SPAIN

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Urban nature spaces shape how people perceive and connect to nature, influencing attitudes toward sustainability and climate adaptation. This study investigates Human–Nature Connectedness (HNC) in the semi-arid city of Almería, Spain, examining how perceptions and physical features of different urban nature space types relate to HNC.

A total of 205 face-to-face surveys were combined with field assessments and spatial data collected across six nature space types, analyzing spatial, physical and land cover characteristics.

Overall, results revealed neutral HNC toward urban nature with participants favoring spaces that foster experiential and emotional over material connections. Greener, tree-rich spaces were considered to have most nature and elicited more positive emotions, while ecologically authentic but sparsely vegetated sites evoked more negative reactions. Correlation analyses revealed that nature perception, expected ecosystem services, and perceived native biodiversity are interrelated and serve as reliable proxies for HNC. Having divers physical features (e.g. benches, bins) and specific land cover patterns (e.g. reduced impervious surface) within urban nature spaces significantly supports stronger connectedness.

The findings underscore the challenge of aligning ecological authenticity with public preference in semi-arid urban planning. They highlight the value of integrating native, climate-adapted vegetation with accessible and visually appealing design to strengthen emotional and ecological bonds with urban nature.

***Keywords*:** Human-Nature Connectedness, Urban planning, Social preferences, Semi-arid landscape.

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CA-28

SOLAR Fe^{3+}-NTA/PEROXYMONOSULFATE PROCESS FOR MICROPOLLUTANT DEGRADATION AND DISINFECTION IN MICROALGAE-TREATED WASTEWATER

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The growing demand for wastewater reuse necessitates the development of advanced oxidation processes (AOPs) capable of ensuring water quality suitable for safe and sustainable reuse. To meet this challenge, a solar-driven ferric nitrilotriacetate (Fe^{3+}-NTA)/Peroxymonosulfate (PMS) as photo-Fenton-type system was evaluated for the simultaneous degradation of microcontaminants and bacterial inactivation in microalgae-treated wastewater.

Wastewater collected from the University of Almería campus was first treated in a microalgae-based wastewater treatment system. The resulting microalgae-treated effluent was then used as influent for the solar Fe^{3+}-NTA/PMS process. Two matrices were examined: (i) a coagulated effluent to remove residual biomass and (ii) an ultrafiltrated effluent, allowing comparison between a low-cost physicochemical clarification and a membrane-based treatment typically constrained by high operational costs.

Comprehensive physicochemical and microbiological characterizations were performed prior to treatment. Solar Fe^{3+}-NTA/PMS experiments were conducted in 5-cm deep raceway pond reactors (19-L capacity) under natural sunlight using 0.1 mM Fe^{3+}-NTA and 0.47 mM PMS, including both illuminated and dark controls. Benzotriazole (BZT, 100 µg/L) degradation, used as a model microcontaminant, was monitored by HPLC-UV, while PMS and Fe^{3+}-NTA concentrations were determined spectrophotometrically. Disinfection efficiency was assessed via membrane filtration and cultivation on selective media for *Clostridium perfringens*, *Escherichia coli*, *Pseudomonas*, *Staphylococcus*, and *Enterococcus spp*.

The solar Fe^{3+}-NTA/PMS system achieved substantial removal of BZT and effective inactivation of pathogenic bacteria across both effluent matrices. These results highlight the potential of this solar-assisted AOP as a sustainable and cost-effective strategy for enhancing the safety and quality of reclaimed wastewater.

***Keywords*:** Advanced oxidation processes, solar treatment, Wastewater reuse, Micropollutant removal, Pathogen inactivation.

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CA-30

ESTUDIO CINÉTICO DEL PROCESO CLORO-FOTO-FENTON SOLAR PARA LA REGENERACIÓN Y REUTILIZACIÓN DE AGUAS DEPURADAS EN RIEGO AGRÍCOLA

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La escasez de agua, agravada por el cambio climático y la sobreexplotación de los recursos hídricos, impulsa la necesidad de alternativas sostenibles como la reutilización de aguas residuales. El Reglamento (UE) 2020/741[1] y la Directiva (UE) 2024/3019[2] han reforzado los requisitos de calidad microbiológica y redefinido los tratamientos terciarios y cuaternarios para eliminar microcontaminantes. En este contexto, el proceso cloro-foto-Fenton solar (CFFS) surge como una tecnología prometedora de oxidación avanzada. Este estudio analiza la influencia de la temperatura, la concentración de reactivos y la absorción de fotones en la cinética del proceso CFFS para la eliminación de microcontaminantes y la inactivación de patógenos en efluentes secundarios de depuradora.

Los ensayos se realizaron con un efluente secundario procedente de la depuradora El Toyo (Almería), evaluando la degradación del inhibidor de corrosión benzotriazol (BZT, 50 µg/L) y la inactivación de *Escherichia coli (E. coli)* y *Clostridium perfringens (C. perfringens)*. El estudio experimental se desarrolló en tres etapas: ensayos en oscuridad para evaluar la influencia de la temperatura (15, 25 y 35 °C), y las concentraciones de nitrilotriacetato férrico (Fe^{3+}-NTA; 0,1 y 0,2 mM) e hipoclorito de sodio (NaClO; 0,134, 0,269 y 0,403 mM); experimentos en simulador solar (10-40 W/m², 25 °C) para determinar el efecto de la irradiancia; y validación en un reactor tipo *raceway* de 80 L (10 cm de profundidad de líquido), empleando las mejores concentraciones de reactivos.

Los resultados mostraron que la degradación de los microcontaminantes está principalmente influenciada por la temperatura y la irradiancia. Al aumentar la temperatura de 25 °C a 35 °C, la constante cinética de descomposición del Fe^{3+}-NTA aumentó 1,7 veces y la de consumo de H_2O_2 se duplicó, lo que refleja una aceleración de las reacciones de Fenton. De forma similar, al incrementar la irradiancia de 10 a 40 W/m², las constantes cinéticas aumentaron proporcionalmente, lo que denota condiciones de fotolimitación. El aumento en la concentración de Fe^{3+}-NTA de 0,1 a 0,2 mM, favoreció la absorción de fotones y, en consecuencia, aceleró el consumo de H_2O_2 por la reacción de Fenton, así como la degradación de BZT. En conjunto, se alcanzó la eliminación completa del BZT, a pesar de ser uno de los microcontaminantes más recalcitrantes de los incluidos en la Directiva (UE) 2024/3019. En cuanto a la desinfección, principalmente dependiente del NaClO, alcanzó la inactivación instantánea de *E. coli* y colífagos somáticos, cumpliendo con los requisitos más restrictivos (clase A). Asimismo, mediante el ajuste de la dosis de NaClO o el tiempo de reacción, se pueden alcanzar los criterios de inactivación de *C. perfringens*, microorganismo más resistente al tratamiento, sin comprometer el equilibrio entre la eficiencia y la sostenibilidad.

Estos resultados son clave para el desarrollo de herramientas basadas en modelos cinéticos para el control y la optimización del proceso CFFS.

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[1] Reglamento (UE) 2020/741 del Parlamento Europeo y del Consejo, de 25 de mayo de 2020, relativo a los requisitos mínimos para la reutilización del agua (DO L 177 de 5.6.2020, pp. 32-55). https://www.boe.es/doue/2020/177/L00032-00055.pdf

[2] Directiva (UE) 2024/3019 del Parlamento Europeo y del Consejo, de 27 de noviembre de 2024, sobre el tratamiento de las aguas residuales urbanas, (versión refundida). Diario Oficial de la Unión Europea. L 2024/3019, 12.12.2024. https://eur-lex.europa.eu/eli/dir/2024/3019/oj

CA-31

WHICH FACTORS DETERMINE PEOPLE'S PERCEPTION OF BIOCULTURAL DIVERSITY? INSIGHTS FROM TWO CONTRASTING SPANISH VILLAGES

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Rural areas across Europe are undergoing rapid socio-ecological transformations driven by urban expansion, agricultural intensification, land abandonment, migration to cities, and demographic decline.[1] These changes threaten the persistence of biocultural refugia—places where nature and culture have co-evolved through generations.[2] Understanding how people perceive biocultural diversity in these areas is critical for designing effective conservation and rural revitalization strategies.[3]

This study explores how human–nature connectedness and socio-demographic factors shape people's recognition of biocultural components (i.e., plants, animals, practices, and traditions) in two contrasting Spanish villages: Arazuri (Navarra) and Felix (Almería). Through 109 semi-structured surveys, we compiled biocultural inventories and analyzed responses through descriptive statistics, cluster analysis, and non-metric multidimensional scaling (NMDS) to identify knowledge profiles and their socio-ecological determinants.

Results reveal that in Arazuri respondents exhibited high recognition and richness of biological components, suggesting a strong awareness of local biodiversity. Yet, this specialization resulted in a dispersed pattern of knowledge when considering practices and traditions. In Felix, the responses illustrated a more balanced recognition across all components. In both villages age was a determining factor: adults and elders displayed the highest recognition of biocultural components, while youth and newcomers—with higher formal education—showed a lower capacity to perceive biocultural diversity and exhibited weaker connection to nature. The modernization and partial loss of practices and traditions were more marked in Arazuri, while Felix maintained higher continuity. Cluster analysis identified distinct respondent profiles ranging from knowledge holders (elders, locally rooted residents) to potential transmitters (younger, educated but disconnected). These findings highlight conservation and resilience of local communities and their associated biocultural diversity depend on interactions between these groups rather than on isolated knowledge preservation.

Our approach demonstrates that biocultural inventories can be decision-support tools, enabling policymakers to locate knowledge holders, vulnerable practices, and leverage points for intervention. Promoting intergenerational learning, integrating biocultural indicators into rural policy, and recognizing biocultural refugia as living heritage are key to ensuring the sustainability of rural socio-ecological systems.

***Keywords*:** Biodiversity; culture; rural resilience; social-ecological systems; traditional knowledge.

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CA-32

CIANOBACTERIAS DE BIOCOSTRAS: UN PROMETEDOR BIOESTIMULANTE PARA POTENCIAR EL CRECIMIENTO VEGETAL Y LA RESILIENCIA FRENTE A LA SALINIDAD

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La salinidad del suelo representa una limitación importante para la productividad agrícola a nivel mundial, especialmente en regiones áridas y semiáridas, donde las prácticas de riego y el cambio climático exacerban la acumulación de sales en los suelos. Por ello, desarrollar estrategias sostenibles y de base biológica para aliviar el estrés salino en los cultivos es esencial para garantizar la seguridad alimentaria y la estabilidad de los ecosistemas. En este estudio, investigamos el potencial bioestimulante de un hidrolizado rico en proteínas derivado de la cianobacteria *Nostoc commune*, aislada de biocostras, con un enfoque específico en su aplicación para mejorar la resiliencia de las plantas frente al estrés salino.

El estudio se llevó a cabo en dos fases experimentales utilizando lechuga (*Lactuca sativa* var. longifolia) como cultivo modelo. En la primera fase, se probaron diferentes concentraciones del hidrolizado de *N. commune* mediante remojo de semillas y pulverización foliar para determinar las condiciones óptimas para promover la germinación y el crecimiento vegetativo temprano bajo condiciones no estresantes. En la segunda fase, las plantas se sometieron a condiciones de estrés salino (tratamientos con NaCl), y se evaluó la efectividad del hidrolizado para mitigar los impactos fisiológicos en las plantas a través de un conjunto de indicadores de crecimiento, biomasa y estrés.

Nuestros resultados demostraron que el hidrolizado de *N. commune* mejoró significativamente las tasas de germinación y el desarrollo vegetativo bajo condiciones normales, y proporcionó una mitigación parcial pero consistente de los efectos del estrés inducido por la sal. Las plantas tratadas mostraron niveles de estrés reducidos bajo condiciones salinas, como lo indica una menor acumulación de prolina en comparación con los controles no tratados. Si bien el hidrolizado no eliminó completamente los efectos negativos de la alta salinidad, contribuyó a aumentar la tolerancia general de las plantas, lo que sugiere su potencial como herramienta complementaria en estrategias integradas de manejo de la salinidad.

Estos hallazgos destacan el potencial de los hidrolizados de cianobacteria como bioestimulantes sostenibles y de bajo insumo capaces de mejorar el desempeño de las plantas bajo condiciones salinas, al mismo tiempo que contribuyen al ciclo de nutrientes y a la salud del microbioma del suelo. Dada su composición multicomponente, los hidrolizados de cianobacteria ofrecen una alternativa viable a los agroquímicos convencionales, alineándose con los objetivos de una agricultura inteligente frente al clima y eficiente en recursos. Se recomienda continuar con investigaciones para perfeccionar la formulación, evaluar la eficacia a escala de campo y explorar combinaciones sinérgicas con otros enmiendas microbianas u orgánicas.

***Palabras clave*:** Biocostras, Cianobacteria, Bioestimulante, Salinidad

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CA-33

PEST MONITORING AND EARLY DETECTION: OVERCOMING BARRIERS FOR SUSTAINABLE AGRICULTURE

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The development of sustainable agricultural production systems aims to reconcile productivity with environmental protection and the responsible use of natural resources, in line with the 2030 Agenda for Sustainable Development.[1] Within this transition, Integrated Pest Management (IPM) plays a key role by reducing reliance on chemical pesticides through the integration of biological control, cultural practices, and systematic monitoring. This approach not only mitigates environmental and health risks but also enhances the long-term resilience and efficiency of agricultural systems.[2]

Achieving the sustainable use of pesticides is a primary goal of IPM strategies, requiring precise and informed pest management decisions. Scientific research integrating monitoring tools and ecological knowledge enables the advancement of sustainable pest management to spatio-temporal scales beyond traditional practices.[3] In this regard, the development of low-cost and easily scalable early-warning networks plays a pivotal role.[4] To achieve this, designing accessible tools for local farmers demands addressing the practical challenges imposed by the complexity of agricultural landscapes. For example, limitations related to data collection automation and logistical challenges posed by field infrastructure call for adaptive, context-specific solutions. My PhD thesis will address these challenges by advancing two key innovations: the creation of computationally efficient pest counting algorithms and the design of low-cost monitoring devices, which together will enhance data acquisition and processing while maintaining affordability and scalability. Furthermore, a transdisciplinary approach will assess the willingness of key actors, including farmers and technicians, to collaborate in a large-scale and long-term pest early-warning network. Together, these technical innovations and social engagement will enable the long-term viability of a scalable pest monitoring network.

Incorporating early warning systems into IPM strategies can enable targeted interventions, enhance the efficiency of pesticide applications, and reinforce non-chemical control strategies.[5] Collectively, these efforts consolidate the scientific foundation of sustainable pest management and contribute directly to the development of a more resilient and environmentally responsible agricultural production.

***Keywords*:** Sustainable agriculture, Pest Modelling, Automation, Early Warning Systems.

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CA-34

METABOLOMIC MODULATION AND HEALTH BENEFITS OF FRUIT AND VEGETABLE EXTRACTS AFTER REGENERATIVE AGRICULTURE

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Regenerative agriculture (RA) represents an innovative agro-food production approach focused on restoring and enhancing soil health, biodiversity, and the ecological balance of agricultural systems through sustainable and environmentally respectful practices. Beyond its environmental benefits—such as carbon sequestration and climate change resilience—this agricultural model may also influence the biochemical and nutritional composition of crops.[1] Recent evidence suggests that RA can induce significant metabolomic shifts in plants, stimulating the biosynthesis of secondary metabolites such as polyphenols, flavonoids, terpenoids, and phenolic acids. These compounds are associated with antioxidant, anti-inflammatory, and protective properties that may strengthen the functional and health-promoting potential of fruits and vegetables. In this context, the present study aimed to evaluate the potential biological effects of natural extracts from *Brassica oleracea* var. *botrytis* (cauliflower) and *Prunus persica* (peach) cultivated under conventional (CT) and regenerative (CAR) agricultural systems implemented by Viagro S.L. Methanol–water extracts were prepared and analyzed by nuclear magnetic resonance (NMR) spectroscopy at the University of Almería, revealing distinct metabolomic profiles between CT and CAR crops. These extracts were subsequently assessed *in vitro* for their antioxidant capacity, modulation of cell migration, and induction of detoxifying enzymes—glutathione S-transferase (GST) and quinone reductase (QR)—in human colorectal cancer cell lines. Additionally, a chorioallantoic membrane (CAM) assay was performed to evaluate their potential impact on angiogenesis.Biological evaluation demonstrated that both CAR extracts increased cell proliferation under oxidative stress ($p < 0.05$), indicating a cytoprotective effect. Notably, the CAR cauliflower extract exhibited the strongest antioxidant response, increasing cell viability by 6.1% compared to its CT counterpart ($p < 0.001$). Furthermore, CAR peach extracts significantly enhanced fibroblast (L929) migration by 8.1% relative to CT ($p < 0.05$), suggesting an influence on wound-healing–related pathways. Regarding detoxifying enzyme induction, the CAR cauliflower extract increased GST activity 1.12-fold ($p < 0.05$), whereas no significant changes were observed for CAR peach extracts. In contrast, the CAM assay revealed no measurable pro- or anti-angiogenic effects for either extract, indicating selective modulation of cellular responses. Overall, these findings suggest that regenerative agricultural practices may trigger metabolomic alterations capable of enhancing specific biological activities in fruits and vegetables. Such modifications could contribute to improved antioxidant defenses and cellular protection, reinforcing the potential link between sustainable cultivation systems and human health. Further investigations in more complex experimental models will be necessary to elucidate the underlying mechanisms and confirm the broader implications of these results.

***Keywords*:** Applied Sciences, Regenerative agriculture, Metabolomic, Antioxidant capacity

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CA-36

RIPARIAN ALDER: A TOOL TO MITIGATE PINE-PLANTATION EFFECTS ON INSTREAM FOOD WEBS?

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Over the past century, drylands have undergone significant landscape transformations. Abandonment of traditional crops and pastures led to development of extensive afforestation programs with conifers, which often lacked an ecologically sound orientation, raising concerns about their potential consequences on recipient ecosystems. Forest streams heavily rely on inputs of terrestrial organic carbon and thus are particularly vulnerable to human-driven changes in catchment and riparian forests. One point of uncertainty is whether existing stands of deciduous trees in the riparian zone may buffer headwater stream food webs from the impacts of afforestation on the surrounding landscape.

We used stable isotopes of carbon and nitrogen to investigate whether the presence of the nitrogen-fixing black alder (*Alnus glutinosa* (L.) Gaertn.) in the riparian zone alters the impacts of pine plantations on macroinvertebrate food webs of headwater streams.

We observed a consistent consumption of leaf litter by shredders, but a higher importance of autochthonous support to all macroinvertebrate functional feeding groups than initially expected, especially in absence of alder. In addition, we discerned a potential trend toward a food chain lengthening at streams holding riparian alder in winter.

Overall, our results indicate that riparian alder can enhance the buffer effect exerted by other broadleaf species through a reduction of the usual wide nutritional imbalance existing between benthic consumers and resources, which may translate into longer food chains. These findings highlight the critical role of riparian vegetation, particularly deciduous species like black alder, in maintaining headwater stream ecosystem integrity within afforested landscapes. Incorporating riparian vegetation management into afforestation planning can enhance stream food-web stability and support more balanced aquatic ecosystems.

***Keywords*:** aquatic-terrestrial linkages, N-fixing species, macroinvertebrates, stable isotopes.

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CA-37

PALEONTOLOGY OF THE ALPUJÁRRIDE COMPLEX IN SIERRA DE GÁDOR

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The paleontology of the Alpujárride Complex has traditionally been a scarcely explored subject, primarily due to its complexity arising from the structural and metamorphic factors associated with these materials. In this study, Sierra de Gádor is analyzed from a paleontological perspective, and several previously unreported genera of invertebrates and vertebrates are described from the area. Among the most noteworthy are *Aspiduriella montserratensis*, *Diplopora annulatissima*, *Lingularia* sp., *Daonella cf. moussoni*, *Pleuromya* sp., and *Elegantinia betica*, as well as vertebrate remains belonging to the genus *Nothosaurus*. Based on these new paleontological and sedimentological data, a new hypothesis is proposed for the formation of the range, along with a reconstruction of the possible paleoenvironmental evolution recorded in the rocks during the Middle Triassic.

The stratigraphic succession recorded in the Sierra de Gádor begins in the Early Triassic (approximately 250 Ma) with deposits of continental origin. However, the basin became marine due to a transgression during the Anisian, leading to the development of rocks characteristic of shallow marine environments. Toward the Ladinian, a regression caused a drop in sea level, resulting in the continentalization of the area around the Carnian. The Triassic succession in the Sierra de Gádor concludes with a new transgressive event that restored marine conditions during the Norian (approximately 227 Ma).

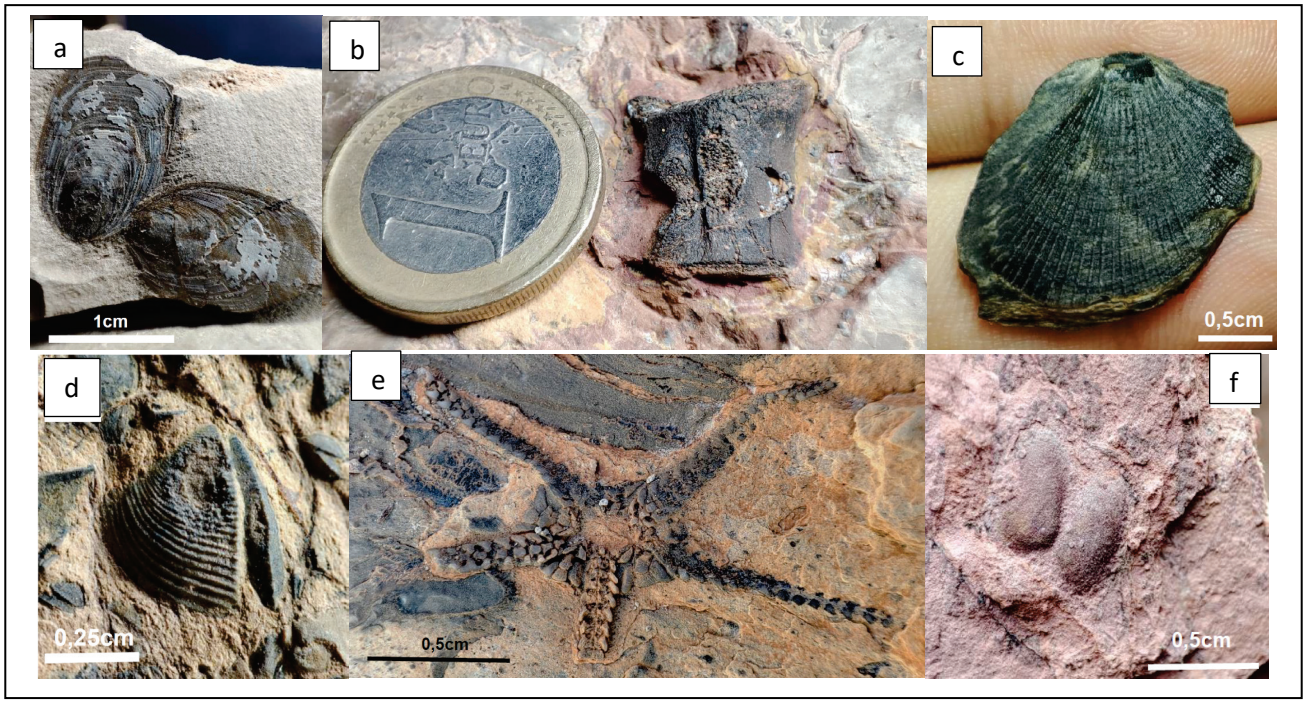

Figure 1: Some of the fossils identified in Sierra de Gádor; a) *Lingularia* sp., b) vertebra of *Nothosaurus* sp., c) *Daonella cf. moussoni*, d) *Elegantinia betica*, e) *Aspiduriella montserratensis*, f) articulated *Pleuromya* sp.

Keywords: Paleontology, Sedimentology, Triassic, Alpujárride Complex.

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CA-38

COMPARATIVE ANALYSIS OF AIRBORNE MICROPLASTIC PARTICLES IN EDUCATIONAL ENVIRONMENTS OF MADRID AND ALMERÍA

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The presence of microplastics in air, water, and food has made them an emerging concern for environmental and human health. While extensive research has documented their presence in aquatic systems, airborne microplastics remain less characterized. Understanding presence of these particles in educational settings is key to evaluating human exposure to microplastics. This study compares abundance, morphology, and polymer composition of airborne microplastics collected from two educational institutions in Madrid and Almería. Particles were sampled using air samplers equipped with stainless steel mesh filters. A total air volume of 5 m^3 was analyzed per site, using five filters per orientation during each sampling event. Subsequently, filters were extracted with 75 mL of filtered distilled water, subjected to 15 minutes of ultrasonic agitation, and vacuum-filtered through cellulose membranes. Natural fibres (cellulose, rayon, and cotton) were systematically excluded, counting only synthetic polymers for analysis. Optical microscopy was used for particle morphology classification into fibres**,** fragments, and films, while micro-FTIR (µFTIR) spectroscopy was applied for polymer identification. Length, width, and calculated area (μm^2) of each particle were determined to enable direct comparison. At both educational centres, measurable quantities of microplastic particles were detected within 5 m^3 sampled air volume. In Madrid, the detected particles included multiple morphological categories including fibres, fragments, and films, each with distinct polymer compositions. Compositional analysis identified several synthetic polymers across both sites: polyethylene (PE), polyethylene terephthalate (PET), polytetrafluoroethylene (PTFE), polyamide (PA), polyacrylonitrile (PAN), polypropylene (PP), polyvinyl acetate (PVA), polyurethane (PU), and cellulose propionate (CP). The Madrid samples were dominated by fibres followed by fragments and films were the least detected. Films at this location were mostly comprised of PAN and PE; fragments included PAN, PE and PU while fibres included PP, CP, PU, PA and PAN. Detected colours across all particle types included black, blue, green, pink/red, brown and translucent. In Almería, morphological classification showed representation of fibres, fragments, and films, with fragments being the most common followed by fibres and then films. µFTIR confirmed the same main polymer families as in Madrid. However, in Almería, films were almost completely composed of PU, fragments included CP, PET, PU and PAN while fibres included PA, PP, PVA and PE. Comparatively, the total area of detected particles was higher in Almería for all three particle types (fibres, films and fragments) than the same morphological types detected in Madrid. At both locations, fibres contributed to the highest calculated area while the calculated areas for fragments and films were significantly lower. Detection of synthetic polymeric particles in both educational sites confirms that educational environments are relevant microplastic exposure setting**.** Presence of respirable-size fibres and fragments within air volumes equivalent to those encountered by students and teachers highlights inhalation as plausible exposure route**,** particularly for children**,** whose higher breathing rates may amplify uptake potential. These findings provide early quantitative evidence supporting the inclusion of microplastics in air quality assessments and human exposome frameworks. By applying a standardized sampling and µFTIR-based and microscopic characterization, this work lays foundation for expanded monitoring across different facilities and for developing policies aimed at reducing airborne microplastic exposure in humans.

Keywords**:** Airborne microplastics, Human exposome, Plastic pollution, Microplastic analysis.

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CA-39

NUEVA LOCALIDAD DEL ENDEMISMO MAGREBÍ *Eukoenenia maroccana* BARRANCO & MAYORAL, 2007

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Los palpígrados (Arachnida: Palpigradi) constituyen uno de los órdenes más enigmáticos y menos estudiados de los arácnidos, principalmente adaptados a ambientes subterráneos como cuevas y suelos profundos. Estos microarácnidos de menos de 2mm y cutícula muy delgada, presentan adaptaciones notables a la vida hipogea, como la ausencia de ojos, despigmentación y un flagelo segmentado en el extremo del opistosoma, utilizado para la percepción ambiental.[1,2,3]

Con 138 especies descritas[4], el género *Eukoenenia* Börner, 1901 es el más diverso del orden. Casi cosmopolita, agrupa la mayoría de las especies conocidas, muchas de ellas con distribución restringida y escasa capacidad de dispersión, lo que favorece la especiación local y la diferenciación genética entre poblaciones.[1,2,3]

El descubrimiento de *Eukoenenia maroccana*, Barranco & Mayoral, 2007 en la cueva Kef Aziza, en Tazzouguert, Marruecos, supuso un avance significativo en el conocimiento de la biodiversidad subterránea del norte de África, destacando por caracteres morfológicos únicos como la presencia de setas glandulares esternales engrosadas en los machos y diferencias en la genitalia y quetotaxia respecto a otras especies del género[5]. Conocida únicamente en su localidad tipo hasta ahora, los autores presentan una nueva localidad para *E. maroccana* en la cueva Akhiam (31°57'20.4"N 5°32'33.3"W), de la región de Agoudal ampliando así su rango de distribución conocido.

Se han estudiado y comparado 4 individuos recolectados (2 machos, 1 hembra y 1 inmaduro con ejemplares de la serie típica (dos paratipos: uno macho, y otro hembra) encontrando semejanzas en el órgano frontal, número de órganos laterales (6) y genitalia. Además, existen similitudes en el número y disposición de las setas de los basitarsos III y IV de las patas I y basitarso IV de la pata IV, así como en las quetotaxias ventrales y dorsales del opistosoma.

Ecológicamente, a pesar de la distancia que las separa (unos 160 km), ambas surgen de procesos de disolución en rocas carbonatadas jurásicas, influenciados por la orogenia atlasica (Cenozoico), pero mientras Kef Aziza refleja un contexto más estable y árido del Anti-Atlas oriental, con énfasis en procesos hipogénicos por aguas subterráneas ascendentes. Akhiam se ve afectada por el intenso levantamiento del Alto-Atlas teniendo un componente hipogénico más marcado, con un río subterráneo que sugiere flujos ascendentes, lo que la hace más dinámica en términos hidrológicos.

Este hallazgo subraya la importancia de continuar explorando los hábitats subterráneos, no solo para documentar la diversidad de palpígrados, sino también para comprender los procesos evolutivos y ecológicos que modelan la fauna hipogea. La ampliación de la distribución de *E. maroccana* refuerza la necesidad de conservar estos ecosistemas frágiles y poco estudiados, que albergan especies de gran interés científico.[1,2,3]

***Palabras clave*:** Distribución, Palpígrados, *Eukoeneniidae*, Marruecos.

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CA-40

CHOQUES DE CO_2 COMO ALTERNATIVA SOSTENIBLE PARA PROLONGAR LA VIDA EN ANAQUEL DEL TOMATE

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La Organización de las Naciones Unidas para la Alimentación y la Agricultura (FAO) estima que las pérdidas postcosecha en Europa alcanzan un 14% (2019). Estas pérdidas, además de implicar un impacto económico, ejercen presión sobre el medio ambiente y los recursos naturales. Su reducción se incluye entre los Objetivos de Desarrollo Sostenible (ODS), concretamente el Objetivo 12 (Producción y consumo responsables), y en el Pacto Verde Europeo (De la granja a la mesa). El tomate es uno de los principales cultivos de las provincias de Almería y Granada. En la campaña 2023/2024, su producción alcanzó más de 900000 toneladas (Observatorio de Precios y Mercados, CAPADR 2024). Sin embargo, su alta perecibilidad genera importantes pérdidas en las primeras etapas de la cadena alimentaria, lo que hace necesario implementar estrategias que las minimicen.

Diversos estudios han demostrado que los choques de CO_2 regulan el metabolismo de los carbohidratos y los genes relacionados con el etileno, prolongando la vida útil del tomate[1,2]. En este estudio se trabajó con tres variedades precomerciales de tomate asurcado tipo mini buey (kumato, rojo y naranja), cultivadas en un invernadero situado en el Poniente almeriense. Los frutos se cosecharon en su punto de madurez comercial y fueron transportados al Centro IFAPA La Mojonera, donde se llevó a cabo un muestreo exhaustivo. A continuación, se expusieron durante 3 h a 10 °C bajo diferentes condiciones atmosféricas: aire (control) y dos tratamientos de atmósfera controlada (Tratamiento 1: 30% CO_2 / 5,5% O_2 / 64,5% N_2; Tratamiento 2: 60% CO_2 / 5,5% O_2 / 34,5% N_2;). Tras los choques, los tomates se almacenaron a 10 °C y 90% HR durante 9 días, y posteriormente se trasladaron a 20 °C (90 % HR) hasta el final de su vida útil, evaluada mediante análisis sensorial. Durante todo el proceso, se determinaron parámetros de calidad fisicoquímica (pérdida de peso, firmeza, color, sólidos solubles totales, pH y acidez titulable) y funcional, tanto al inicio como al final del periodo de conservación. La calidad funcional se evaluó a partir de la capacidad antioxidante, determinada por voltamperometría de micropartículas y el método $ABTS^{\bullet+}$, y del contenido ácido ascórbico, licopeno y compuestos fenólicos totales.

Los resultados indicaron que los choques de CO_2 ejercieron un efecto positivo sobre la vida útil y la composición funcional de los tomates, favoreciendo la preservación de la capacidad antioxidante y de compuestos como ácido ascórbico, fenoles y licopeno. Además, este tratamiento constituye una estrategia sostenible y sencilla de implementar, basada en la recuperación y reutilización del CO_2, que permite prolongar la vida útil de los frutos, disminuir las pérdidas postcosecha, optimizar el uso de recursos en la producción hortofrutícola y reducir el uso de envases plásticos, potenciando así su comercialización en anaquel.

***Palabras clave*:** Atmósfera controlada, calidad funcional, optimización de recursos, reducción de pérdidas postcosecha.

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CA-41

LAS BIOCOSTRAS REDUCEN LAS EMISIONES DE POLVO ATMOSFÉRICO

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Las tierras secas constituyen el bioma más extenso del planeta, cubriendo aproximadamente el 40% de la superficie terrestre del planeta, y se caracterizan por presentar precipitaciones escasas, elevada temperatura y radiación solar. Estas condiciones limitan la disponibilidad de agua y el desarrollo de cobertura vegetal, generando grandes espacios abiertos entre la vegetación. Sin embargo, estos espacios de las tierras secas suelen estar colonizados por costras biológicas del suelo o "biocostras". Estas son comunidades formadas por una serie de organismos fotoautótrofos (cianobacterias, líquenes o briófitos) y heterótrofos (bacterias, hongos y arqueas). Las biocostras regulan el ciclo del agua y fijan carbono y nitrógeno atmosférico que incorporan a la superficie de éste mejorando su fertilidad. Además, una parte importante del carbono fijado se segrega en el suelo en forma de exopolisacáridos (EPS), formando una capa cohesiva en la superficie del suelo que lo protege de la acción erosiva del viento y del agua. Así, diferentes experimentos de simulación en túnel de viento han demostrado que las biocostras disminuyen significativamente la pérdida de suelo por acción erosiva del viento y aumentan la velocidad mínima del viento necesaria para iniciar el desprendimiento de partículas superficiales del suelo o TFV (de sus siglas en inglés "threshold friction velocity"), con implicaciones en el ciclo del polvo global. El objetivo de este estudio es investigar el efecto de los diferentes tipos de biocostras y la textura del suelo sobre el TFV y la erosión eólica en dos ecosistemas semiáridos con texturas contrastadas. Los sitios de estudio seleccionados fueron: Las Amoladeras (Parque Natural Cabo de Gata – Níjar; franco-arenosa) y El Cautivo (Desierto de Tabernas; franco-limosa). Se tomaron 4 muestras por cada tipo de biocostra, de menor a mayor grado de desarrollo: i) suelo desnudo, ii) biocostra dominada por cianobacteria, iii) biocostra dominada por liquen y iv) biocostra dominada por musgo. En el laboratorio, se midieron propiedades fisicoquímicas de la biocostra relacionadas con su efecto protector frente a la erosión eólica. Concretamente se midió la rugosidad superficial con un láser escáner terrestre, el SOC mediante oxidación por vía húmeda, el nitrógeno total cuantificado con un analizador de N y los EPS totales medidos por el método del fenol-sulfúrico. Además, se determinó el TFV y la producción de sedimento mediante simulaciones en un túnel de viento abierto. Los resultados muestran que los suelos de Las Amoladeras presentaron mayores emisiones de polvo, con valor de 13.0±10.7 g m^{-2} en suelo desnudo y 7.9±12.3 g m^{-2} en El Cautivo. Las biocostras redujeron las emisiones de polvo y aumentaron el TFV en ambos sitios de estudio. Además, este efecto fue mayor a medida que aumentó el grado de desarrollo de la biocostra, excepto en la biocostra dominada por musgo. Un análisis detallado de los factores a través de los cuales la biocostra aumentan el TFV y reducen la erosión eólica y la emisión de polvo atmosférico, demuestra que este efecto se debe principalmente a su efecto sobre la rugosidad y la textura, así como a la mejora de las propiedades del suelo en carbono, nitrógeno y compuestos orgánicos como EPS. Por lo tanto, podemos concluir que las biocostras modulan el TFV y las emisiones de polvo atmosférico en ecosistemas semiáridos y que este efecto es mayor en suelos más erosionables y cuando la biocostra es más evolucionada.

***Palabras claves*:** Biocostras, TFV, tierras secas, erosión.

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CA-42

NEGLECTING VEGETATION RESPONSE TO CO_2 IN FUTURE ESTIMATION LEADS TO A SYSTEMATIC OVERESTIMATION OF DROUGHT

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Anthropogenic climate change is strongly impacting the water cycle by increasing global temperatures and altering precipitation patterns. Drought projections mostly depict dwindling water resources and escalating dryness. Increased atmospheric CO_2 concentration triggers not only radiative effects but also physiological responses. These include increased biomass production and plant water-use efficiency, through the so-called CO_2 fertilization effect and stomatal conductance suppression. These responses, however, are often neglected in offline drought assessments, leading to a systematic overestimation of future droughts. We investigate to what extent current literature includes vegetation response to CO_2 in drought projections, and quantify the potential overestimation of future drought predictions when response to CO_2 is not considered. Our results show that ~90% of the evapotranspiration-based drought projection studies neglect vegetation response to CO_2. Among them, only ~10% mention it as a potential limitation or uncertainty of the study. As a major concern, most studies (~60%) consider the long-term future period under high-emission scenarios (CO_2 > 900 ppm) upon which drought overestimation is even more significant. While there are many approaches to consider vegetation response to CO_2, so far drought projections only considered few ones. Literature indicates that disregarding the response may lead to an overestimation of future drought areas worldwide of 14 ± 8.2% for the high emission scenarios. Even more importantly, some studies depict that, in some areas of the world, the consideration of vegetation response influences the sign of change for future drought characteristics. Drawing from the extensive literature available, we strongly recommend caution in the analysis of current drought projections with evapotranspiration-based indices – especially in dry climates – and interdisciplinary collaborations to expand our understanding of vegetation response to CO_2 effects.

***Keywords*:** Drought, Climate change, Vegetation Response to CO_2, Atmospheric Evaporative Demand.

CA-43

MICROALGAE-BASED WASTEWATER TREATMENT: BIOMASS COMPOSITION MODELLING AND EFFECT OF OPERATIONAL CONDITIONS ON MICROBIAL DIVERSITY

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Water is an essential resource not only for human health and physical well-being but also for carrying out numerous activities, from food production to energy generation. The water derived from these activities is classified as wastewater because it is generally eutrophicated, with high quantity of phosphorous and nitrogenous compounds and other substances that can make it toxic to humans and the environment. As several regions of our planet are already facing water scarcity due to climate change and over-population; it is essential to develop water purification and recovery strategies. Wastewater treatment using a consortium of microalgae and bacteria is a promising technology where the synergistic interactions between different groups of microorganisms led to the removal of the contaminants, that serve as nutrients.

The process is generally carried out in raceway ponds reactors, an open type of reactor that are economical, easy to operate and permit the treatment of high wastewater volumes.

This work aimed at evaluating the nutrient recovery capacity of a consortium of microalgae and bacteria that grew naturally in wastewater. The process was carried out using three identical outdoor raceway reactors for three months. Different operational parameters were tested to evaluate how they affect microbial diversity and biomass composition. Three different culture depths and six dilution rates were applied to the cultures maintained in continuous mode for the whole experiment. The harvested biomass was analyzed to evaluate the macromolecular composition while the microorganism's abundance was assessed through metagenomic analysis.

The goal was to identify the optimal conditions to achieve an effective bioremediation process and a good quality biomass which could be further used for other applications.

***Keywords*:** Microalgae, biomass, Wastewater bioremediation, photosynthesis.

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M-1

H-REPRESENTATION OF DISTRIBUTION FUNCTIONS

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In this work we develop a theory that allows us to represent any distribution function on any space as a distribution function on another space with better properties. In particular, we will define one-dimensional representations of classical multidimensional distribution functions.

A linearly ordered topological space (LOTS) is a triple $(X, \tau, \leq)$, where $(X, \leq)$ is a linearly ordered set and τ is the topology of the order $\leq$. Given a LOTS $(X, \tau, \leq)$ we can define the cumulative distribution function (cdf) of a measure.[1] Given two LOTS X and Y, and an order preserving map $H: X \to Y$, it is possible to represent cdfs on X as distribution function on Y. Given a cdf $F: X \to [0,1]$, we say that a distribution $L: Y \to [0,1]$ is an H-representation of F if $F = L \circ H$. The existence and properties of the H-representations depends on the topological nature of the spaces X and Y. The main factor is compactness of the LOTS.

If the spaces X and Y are compact and the map H is injective, then an H-representation of F can be defined by $L = F \circ H'$, where $H': Y \to X$ is a map such that it is non-decreasing and $H' \circ H = id$. If the spaces X and Y are not compact, then we can't define H-representations directly on the original spaces. We must work with the Dedekind-MacNeille completion of the spaces,[2] $DM(X)$.

These H-representations can be used to study classical multidimensional cdfs as if they were one-dimensional. If the cdf is defined on $[0,1]^n$ (for example, a copula) we can define an H-representation on $[0,1]$. If the original space is R^n we can define an H-representation on the completion of R, $\underline{R} = R \cup \{-\infty, +\infty\}$. These representations allow us to apply one-dimensional techniques and theory to multidimensional cdfs. For example, we can generate random samples from multidimensional cdfs without the need to work with its copula, simply by sampling from the representation. We can also apply one-dimensional goodness-of-fit test to the representations, in order to study the fitness of the original cdfs. For example, we can determine if some samples of different random variables are independent from each other by comparing their associated copulas with the independent copula.

***Keywords*:** Mathematics, Topology, Distribution functions, Statistics.

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M-2

ULTRASONIC WAVES IN VISCOELASTIC MEDIA WITH BUBBLE LAYERS: A STEP TOWARD ACOUSTIC METAMATERIALS

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The presence of small bubbles in a fluid significantly alters its acoustic properties, generating an acoustic field very different from that of a pure medium. When these air bubbles gather in specific regions, forming layers or clouds, they produce localized modifications of the acoustic field. This raises a key question: how can bubble populations be used to design acoustic metamaterials?

The control of sound through oscillating gas bubbles led to the concept of bubbly-liquid-based acoustic metamaterials[1] (BLAMMs). These are artificial materials whose properties allow the control and manipulation of vibrations and acoustic waves in ways not achievable with conventional media. Maintaining uniform bubble sizes and stability remains a major challenge; therefore, in this work, the liquid host medium was replaced with viscoelastic materials, providing a more practical and stable configuration.

We studied the nonlinear propagation of ultrasonic waves in viscoelastic media containing non-homogeneous bubble distributions. In this semi-infinite domain, bubbles are not uniformly distributed but concentrated in specific regions, forming layers where the bubble number density $N_g(x)$ varies with position and vanishes outside these regions. One-dimensional plane waves were considered, where bubble oscillations interact with the acoustic field through a coupled differential system[2]: the nonlinear Rayleigh–Plesset equation for bubble dynamics and the linear wave equation for sound propagation. The model also incorporates the Kelvin–Voigt viscoelastic framework to capture viscous and elastic effects of the medium.

Results for the one-layer configuration showed that the dominant parameter governing propagation is the resonance condition of the pre-layer domain (PRD). Resonance occurs when the distance between the source and the layer (or the layer thickness itself) matches a multiple of the acoustic wavelength, leading to standing-wave formation and strong energy localization. When the PRD is resonant, acoustic energy becomes trapped, limiting transmission into both the bubbly layer and the post-layer domain (POD). When the PRD is not resonant, energy passes through the layer, and its behavior depends on whether the layer itself is resonant or not. Nonlinear effects increase with layer thickness: a wider layer enhances nonlinear distortion, and when resonant, it traps more energy. Beyond the layer, nonlinearity intensifies as more energy is transmitted.

Overall, the results highlight the key role of resonance in determining whether the bubbly layer behaves as an acoustic shield or as a nonlinear transmission window, providing valuable insights for the design of bubble-based acoustic metamaterials.

***Keywords*:** Nonlinear acoustics, Metamaterials, Bubbly Viscoelastic Media.

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M-3

FUNCTION APPROXIMATION AND DECOMPOSITION WITH FRACTAL STRUCTURES

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Fractal structures provide a general framework for the study of functions defined over complex or irregular spaces. These structures,[1] conceived as families of coverings with recursive refinement, allow defining approximation processes that extend classical notions such as orthogonal or wavelet-based expansions to more general topological settings.

In this work, we formalize a method to approximate and decompose continuous functions over topological spaces endowed with a fractal structure. For each level of the structure, an approximation function is defined, whose convergence properties are analyzed under different assumptions, including compactness, starbase, and irreducibility. Several theorems ensure both pointwise and uniform convergence of these approximations.

Furthermore, we introduce a notion of decomposition functions, which allow expressing a given function as the sum of contributions from each level of the structure. This leads to a scale-wise interpretation of functional behavior, where finer levels provide more detailed descriptions. Under appropriate conditions, absolute convergence of the decomposition is guaranteed.

This approach offers a flexible tool to analyze functions on spaces beyond the Euclidean setting, providing a theoretical basis for future developments in functional analysis, signal processing, and the study of complex systems through topological methods.

***Keywords*:** Fractal structures, Function approximation, Function decomposition, Topological spaces, Convergence.

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M-4

DENSITY ESTIMATION USING COMPACTLY SUPPORTED RADIAL BASIS FUNCTIONS

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Density estimation is a fundamental task in statistics and machine learning, concerned with inferring the underlying probability distribution of a random variable from a finite set of observations. This work addresses the challenge of estimating a probability density function (PDF) from a univariate dataset $X = \{x_1, x_2, \dots, x_M\}$. We propose a method based on a finite mixture of Compactly Supported Radial Basis Functions (CSRBFs). The model is formulated as a convex combination of K basis functions:

$$p(x) = \sum_{j=1}^{K} \frac{w_j}{N_j} \phi(\varepsilon_j \ |x - c_j|),$$

where ϕ is a Wendland compactly supported RBF, c_j and ε_j are its center and shape parameter, respectively, and w_j are the mixture weights satisfying $w_j \geq 0$ and that sum up to 1. Centers are previously fixed by a k-means clustering algorithm. The remaining set of model parameters $\theta = \{w_j, \varepsilon_j\}_{j=1}^{K}$ is learned by minimizing the negative log-likelihood in the training dataset:

$$obj = -log\left(\sum_{j=1}^{K} w_j \, \phi\big(|x - c_j|\varepsilon_j\big)\right) + log\ log\ (N)\ + \lambda\, ||(w_1, \dots, w_K, \varepsilon_1, \dots, \varepsilon_K)||_2^2,$$

through a regularized stochastic gradient descent (SGD) algorithm, which provides computational efficiency and scalability.

The proposed approach is validated in two experiments. First, we apply it to a real dataset, estimating the density of several variables and comparing its performance against standard Kernel Density Estimation (KDE). The models are evaluated by comparing the log-likelihood on held-out test data, demonstrating the competitive performance of our RBF mixture. Second, we perform a quantitative analysis on synthetic data generated from a known Beta distribution. Using sample sizes of 500, 1000, and 5000, we assess the convergence and accuracy of the estimated density against the true distribution and compare also with KDE.

The results indicate that the proposed method is a robust and effective alternative to kernel methods for univariate density estimation, benefiting from the stability of SGD and the locality of compactly supported bases.

***Keywords*:** Density estimation, CSRBFs, Stochastic Gradient Descent, Regularization.

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M-5

ON A WEIGHTED MOSER-ONOFRI-BECKNER INEQUALITY: EXTENSION AND EQUIVALENCE

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In this work we study the Moser-Onofri-Becker and logarithmic Moser-Trudinger inequalities. In particular, our results are based on two previous articles[1,2] and can be summarized as follows:

1. We extend the class of functions for which the Moser–Onofri–Beckner inequality with singular weight[1] on R^N, $N \geq 2$, holds. Specifically, from the smooth compactly supported functions to a suitable weighted Sobolev space.
2. We establish a logarithmic Moser–Trudinger inequality with a singular weight and achieve the equivalence between this inequality and the previous extended Moser–Onofri–Beckner inequality, generalizing some results obtained for the non-singular weight[2].

***Keywords*:** Moser-Onofri-Becker inequality, singular weight, logarithmic Moser-Trudinger inequality, Kelvin transformation.

Acknowledgements. This work was supported by Junta de Andalucía (FQM-194) and Plan Propio de Investigación y Transferencia de la Universidad de Almería.

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M-6

NONPARAMETRIC ESTIMATORS FOR DIRECTIONAL DEPENDENCE AMONG RANDOM VARIABLES

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This contribution presents a comprehensive study of nonparametric estimators for d-dimensional directional ρ -coefficients, [1] measures introduced to quantify the directional dependence [2] exhibited by multivariate random vectors. These coefficients, ρ_d^α, assess the simultaneous occurrence of extreme values along a specified direction $\alpha \in \{0,1\}^d$, providing a refined characterization of multivariate dependence structures.

We propose rank-based estimators for ρ_d^α, inspired by previous papers, [3,4] that rely on adjusted component ranks according to the direction vector, yielding consistent and unbiased estimation from a finite sample. The estimators can be expressed as linear combinations of lower-dimensional estimators, which allows efficient computation even in higher dimensions. Their theoretical properties, including unbiasedness and consistency are illustrated through Monte Carlo simulations using the parametric 4-copula family of Clayton. Simulation results confirm the rapid convergence of the estimators and their ability to capture directional dependence accurately across different sample sizes and copula parameters.

Furthermore, we present an applied study using daily log-returns from three companies (Intel, General Electric, and Microsoft) over five years. The estimators reveal the directions in which high or low values of the assets tend to occur simultaneously, demonstrating their practical relevance for financial risk management. The largest estimated coefficients were observed in directions $(1,1,1)$ and $(-1,-1,-1)$, indicating that extreme market movements occur in a coordinated manner among the three assets.

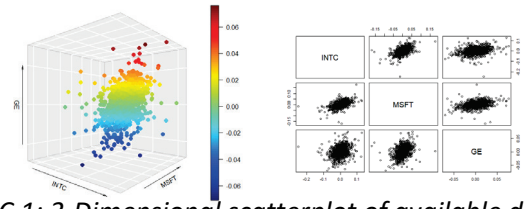

Figure 1. *SEQ Figure * ARABIC 1: 3-Dimensional scatterplot of available data for the three companies and 2-dimensional scatterplots involving only two copanies.*

Overall, this work provides estimators which are designed to capture patterns of dependence that remain undetected by traditional measures, thus providing a deeper understanding of the dependence structure among the involved random variables.

***Keywords*:** Directional dependence, ρ-coefficients, Nonparametric estimators, Copula.

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M-7

STOCHASTIC APPROACHES TO FINANCIAL LOG-VOLATILITY MODELING

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Previous studies have achieved solid results by modeling asset returns as $R \sim N(0, \sigma)$, where the variance follows $log\ log\ (\sigma^2) \sim N(\mu_\sigma, \sigma_\sigma)$. The present work seeks to extend these approaches by introducing temporal dependencies in volatility dynamics through the explicit modeling of the time structure of σ. This allows the model to capture persistence and long-memory effects, thus approaching more complex and realistic market scenarios.

To this end, we present a comparative analysis of three stochastic processes for modeling the log-variance: the Ornstein–Uhlenbeck (OU) process,[1] the autoregressive process of order P (AR(P)),[2] and the fractional Brownian motion (fBm).[3] The parameters (μ, θ, σ) of the OU process and the Hurst exponent (H) of the fBm were estimated by maximum likelihood, while the optimal order P of the AR(P) model was determined using the Bayesian Information Criterion (BIC).

Model validation relies on several Kolmogorov–Smirnov (KS) goodness-of-fit tests. On one hand, simulated returns generated by each model are compared with their empirical counterparts. On the other hand, both samples are tested against the expected theoretical probability distribution (CDF), thereby assessing the model's internal consistency and its ability to reproduce the observed returns. The CDF is estimated through both empirical (kernel density estimation, KDE) and analytical (Monte Carlo integration) methods.

The results show that the AR(P) model, by adaptively optimizing P, reproduces the empirical structure of log-normal variance with remarkable accuracy, achieving a fit comparable to that of the OU process. Both models exhibit excellent performance across nearly all assets and time horizons. The fBm model, while somewhat more variable at short horizons, offers a richer description of temporal persistence in volatility.

In conclusion, the findings confirm the suitability of the log-normal variance framework and demonstrate that both the OU and adaptive AR(P) processes provide robust, analytically consistent, and computationally efficient alternatives to conventional GARCH-type specifications, while the fBm model broadens the interpretation of volatility dynamics by incorporating long-memory behavior.

***Keywords*:** Log-volatility, Ornstein-Uhlenbeck, Autoregressive models, Fractional Brownian motion.

Acknowledgements. To all those who dedicate themselves to providing young researchers with the opportunity to showcase their work.

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M-8

PROJECTIVE GEOMETRY AND ORBITAL MECHANICS

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Keplerian orbits are conic sections (ellipse, hyperbola, parabola), so they can be shown as the projection of metrics. This allows to work with linear and matrix algebra in any Cartesian reference frame. To work in the 3-dimensional space, the quadric associated to the conic is constructed (ellipsoid, hyperboloid, paraboloid) and the intersection of the quadric with the orbital plane, gives the orbital conic. The orbital plane is a diametral plane, so it is the polar of a point of the improper plane. The set $\{\lambda_1, \lambda_2, u_1, u_3, t_0\}$ defines the orbital elements, being λ_i, I =1, 2 the eigenvalues and u_i, I = 1, 3 the eigenvectors corresponding to the improper quadric matrix associated with the orbit, and t_0 is the time of passing for a reference point (for example: periastro). The eigenvalues give the orbit shape and the eigenvectors give its space orientation. All the geometrical information of the orbit can be stored in a 4x4 matrix.[1]

For projective hyperquadrics, the polarity map establishes a correlation between points and hyperplanes with respect to a given hyperquadric. The polar of a point is a hyperplane and the pole of a hyperplane is a point, so it is possible to parametrize orbits[2] in two and three dimensions by the eccentric anomaly or the true anomaly using the improper hyperplane or the directrix, instead of the orbit itself, to compute the state vector directly in any Cartesian reference frame.

For the parametrization of the improper hyperplane (a line for a 2-dimensional projective space and a plane for a 3-dimensional projective space), the center is the pole of the improper hyperplane. The polars of the points of the improper hyperplane, which does not contain their own pole, are hyperplanes that cross the hyperquadric center (diametral hyperplanes). So in the 3-dimensional space, the intersection between a diametral plane, the orbital plane and the orbital quadric gives the position. The velocity vector can be obtained from the conjugate parametrization because it gives the corresponding diametral plane that is parallel to the tangent plane to the quadric at that position. This parametrization has the advantage that it is independent of the origin of the reference frame.

The directrix can be parametrized by the true anomaly, whose polars form a pencil of hyperplanes crossing the hyperquadric focus. In the 3-dimensional space, the intersection of these planes with the orbital plane and the quadric gives the positions for each true anomaly. The velocity vector is computed obtaining the tangent vector directly from the tangent plane to the orbital position, which can be computed as the polar of the orbital position.

***Keywords*:** Celestial Mechanics, Projective Hyperquadrics, Orbital Elements, Orbital Parametrization.

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M-9

POSITIVE SOLUTIONS TO SEMILINEAR ROBIN PROBLEMS WITHOUT AREA CONDITION

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In this work[1], we study existence and multiplicity of positive solutions to the semilinear Robin problem

$$(P)\{-\Delta u = \lambda f(u) \text{ in } \Omega, \qquad \frac{\partial u}{\partial \nu} + \gamma u = 0 \quad \text{on } \partial\Omega,$$

where $\Omega \subset R^N$ is a smooth bounded domain, and $\lambda, \gamma > 0$. Our main assumption is that $f: R \to R$ is a locally Lipschitz function such that $f(s) > 0$ when $s \in (\alpha, \beta)$, where $0 < \alpha < \beta$. We stress that f may change its sign.

Without any further conditions, we show that this problem has two positive solutions with maximum in (α, β) when λ is large enough. The behaviour of the solution set when $\gamma \to 0$ or when $\gamma \to \infty$ is also analyzed.

***Keywords*:** Mathematics, Positive solutions, Robin boundary conditions.

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M-10

ENTROPIC OPTIMAL TRANSPORT VIA QUANTUM AMPLITUDE ESTIMATION

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We introduce a quantum formulation of the entropically regularized optimal transport problem:

$$\gamma_\tau = arg\ min_{\gamma \in U(\mu,\nu)} \langle C, \gamma \rangle + \tau H(\gamma),\ \ H(\gamma) = -\sum_{ij} \gamma_{ij}\ log\ \gamma_{ij},$$

where $U(\mu,\nu) = \{\gamma \geq 0 : \gamma 1 = \mu,\ \gamma^T 1 = \nu\}$ and τ > 0 is the entropy parameter. Classically, the unique minimizer admits the scaling form:

$$\gamma_\tau = diag(u) K\ diag(v),\ \ K = e^{-\tau C},$$

and is obtained through alternating normalizations of the Gibbs kernel (Sinkhorn iterations). We construct a **quantum Sinkhorn procedure** that coherently embeds ***K*** into the amplitudes of a quantum state:

$$|\psi_{u,v}\rangle \propto \sum_{i,j} \sqrt{(u_i\ K_{ij}\ v_j)}\ |i,j\rangle\,,$$

and enforces the marginal constraints through **quantum amplitude estimation (QAE)**.
Each iteration replaces the classical marginal computations:

$$M_i = \sum_j u_i\ K_{ij}\ v_j,\ \ N_j = \sum_i u_i\ K_{ij}\ v_j,$$

by quantum estimators $\widehat{M_i}$, $\widehat{N_j}$ with additive error *O(ε)* using only *O(1/ε)* oracle queries, yielding a quadratic improvement over classical stochastic Sinkhorn methods that require *O(1/ε²)* samples[1].

Let *T(ε)* denote the number of iterations required for marginal accuracy *ε*. Under standard assumptions on ***K*** (strict positivity and bounded condition number), we prove:

$$T(\varepsilon) = O(log(1/\varepsilon)),\qquad and \qquad Q(\varepsilon, n) = \tilde{O}(\frac{polylog(n)}{\varepsilon}\ log\frac{1}{\varepsilon}),$$

where *Q* denotes the total quantum query complexity.

Hence, the quantum Sinkhorn algorithm achieves a **quadratic improvement in precision** and **polylogarithmic dependence on the problem dimension** n, while preserving the contraction property of classical entropic scaling. Mathematically, the scheme defines a fixed-point map:

$$\Phi(u,v) = (\mu \oslash (K\ v), \nu \oslash (K^{\mathrm{T}}\ u)),$$

whose quantum implementation preserves positivity and convergence under noisy estimates. The convexity of *H(γ)* and the contraction of *Φ* ensure stability of the iteration, extending classical matrix scaling theory to the quantum domain.

This framework establishes the first rigorous connection between **entropic optimal transport and quantum amplitude estimation**[2], revealing deep analogies between entropy regularization, unitary reweighting, and fixed-point theory in Hilbert spaces.

Keywords**:** Optimal transport, entropic regularization, Sinkhorn scaling, quantum algorithms.

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M-11

MODELOS DE REDES BAYESIANAS CON MIXTURAS DE DISTRIBUCIONES BETA

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Actualmente las redes bayesianas son una herramienta muy útil para el análisis de datos en diferentes campos como pueden ser la medicina o el ámbito financiero. Para su modelización, partiremos del estudio de las Mixturas de Funciones de Base Truncadas[1,2] (MoTBFs), en particular, de las Mixturas de Polinomios (MoPs). Sin embargo, nuestra idea es encontrar otra forma nueva de aproximar dichas funciones con el fin de conseguir modelar la red. Para ello, observamos las diferentes funciones de densidad que provienen de una distribución beta en función de los valores que pueden tomar sus dos parámetros. A continuación, basándonos en sus buenas propiedades, procedemos a estudiar cómo aproxima las funciones de densidad de varias variables continuas con diferentes distribuciones. Del mismo modo, se realiza con las MoPs y se comparan ambos resultados. Una vez comprobado su correcto funcionamiento con una variable, continuamos con una red bayesiana con dos variables tanto con padre discreto (usando la herramienta de discretización) como con un padre continuo.

Algunos de los principales resultados de estos experimentos son:

-La distribución beta puede llegar a proporcionarnos tan buenos resultados como las aproximaciones con las MoPs, a veces incluso mejores.

-Una gran ventaja frente al uso de las MoPs, es la necesidad de un número inferior de parámetros en cada aproximación, sin la pérdida de buenos resultados similares a aquellos obtenidos en el caso de las MoPs.

***Palabras clave*:** Redes bayesianas híbridas, distribución beta, MoP, MoTBF.

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M-12

PROPERTIES OF THE HK-INTEGRAL WITH FRACTAL STRUCTURES

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The aim of this work is showing that the Henstock-Kurzweil integral defined in a measure space $(X, \mathcal{A}, \mu)$ with a fractal structure[1] $\mathbf{\Gamma}$ preserves some desirable properties that the classical one has when supposing conditions of the fractal structure.

Basic properties such as *linearity, uniqueness* and *monotonicity* could be easily proved. Moreover, *Cauchy's Criterion*[2] (a characterization of HK-integrability) still holds and one may prove *additivity* of the integral and *Henstock's Lemma*2 using the previous result when $\mathbf{\Gamma}$ is a tiling. "Limit theorems" are also admitted, such as *Monotone* and *Dominated Convergence theorems*.

Finally, integration in spaces with a *natural fractal structure* might be possible, like in the attractor of an *Iterated Function System* (IFS)[3] as a recursive structure can be easily defined.

Figure 2. Representation of the first four iterations of the Sierpinski's triangle.

Keywords: Henstock-Kurzweil, fractal structure, properties, IFS.

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M-13

SOBOLEV ORTHOGONAL POLYNOMIALS RELATED TO A FREUD WEIGHT

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In this work, we consider the polynomials orthogonal with respect to a Sobolev inner product involving the Freud weight $exp\,(-x^4)$ given by[1]

$$(p,q)_S = \int_{-\infty}^{\infty} p(x)q(x)\,exp\,(-x^4)dx\, + \lambda \int_{-\infty}^{\infty} p'(x)q'(x)\,exp\,(-x^4)dx\,, \qquad \lambda > 0\,. \tag{1}$$

Our first objective is to study the local asymptotics known as Mehler-Heine asymptotics for this family of polynomials, that is, we obtain the following result:

Theorem.[2] Let $\{q_n\}_{n\geq 0}$ be the sequence of orthonormal polynomials with respect to the Sobolev inner product (1). Then, the polynomials q_n satisfy the following Mehler-Heine formulae

$$(-1)^n\, n^{3/4} a_{2n}^{1/2} q_{2n}\left(\frac{z}{b_{2n}}\right) = \frac{\Omega}{\sqrt{\lambda}} cos\, z\,,$$
$$(-1)^n\, n^{3/4} a_{2n+1}^{1/2} q_{2n+1}\left(\frac{z}{b_{2n+1}}\right) = \frac{\Omega}{\sqrt{\lambda}} sin\, z\,,$$

both uniformly on compact subsets of C, where $\Omega = \frac{3^{3/4}}{2^{15/8}\sqrt{\pi}}$, and $a_n = \left(\frac{2n}{3}\right)^{1/4}$, $b_n = \frac{4}{2^{1/4}3}\frac{n}{a_n}$.

Moreover, this result together with the well-known Hurwitz's Theorem allows us to establish the asymptotic behavior of the zeros of these polynomials. Motivated by this consequence, we also tackle the computation of the zeros of the polynomials $\{q_n\}_{n\geq 0}$. To this end, we formulate a generalized eigenvalue problem derived from the five-term recurrence relation satisfied by these polynomials, so that, the computation of the zeros is equivalent to computing the generalized eigenvalues. Numerical experiments illustrating the algorithm for computing the zeros for different values of λ are also given. Finally, we deduce the fourth-order differential equation satisfied by these polynomials.

Keywords: Sobolev orthogonal polynomials, Mehler-Heine asympotics, zeros, computation.

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M-14

(p, q)-COMPACTNESS IN SPACES OF HOLOMORPHIC MAPPINGS

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Based on the concept of (p,q)-compact operator[1] for $p \in [1,\infty]$ and $q \in [1,p^*]$, we introduce and study the notion of (p,q)-compact holomorphic mapping[2] between Banach spaces. We prove that the space formed by such mappings is a surjective $pq/(p+q)$-Banach bounded-holomorphic ideal[3] that can be generated by composition with the ideal of (p,q)-compact operators. In addition, we study Mujica's linearization[4] of such mappings, its relationship with the $(u^*v^* + tv^* + tu^*)/tu^*v^*$-Banach bounded-holomorphic composition ideal of the (t,u,v)-nuclear holomorphic mappings for $t,u,v \in [1,\infty]$, its holomorphic transposition via the injective hull of the ideal of $(p,q^*,1)$-nuclear operators, the Möbius invariance[5] of (p,q)-compact holomorphic mappings on D, and its full compact factorization through a compact holomorphic mapping, a (p,q)-compact operator, and a compact operator.

***Keywords*:** Vector-valued holomorphic function, Linearization, Factorization theorems, (p,q)-Compact operator, (p,q)-Compact holomorphic mapping, (t,u,v)-Nuclear holomorphic mapping.

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M-15

GENE DUPLICABILITY CLASSIFICATION USING TAN WITH MOPs

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Bayesian networks[1] (BNs) offer several advantages over other statistical methods, as they provide an interpretable and compact representation of the joint probability distribution based on the conditional dependencies among variables. The Tree-Augmented I Bayes[2] (TAN) classifier is a specific type of BN in which each feature variable has at most one other feature variable as a parent, besides the class variable.

In this study, we focus on the classification of gene duplicability in *Arabidopsis thaliana*. In hybrid domains, the most common approach in Bayesian networks (BNs) is either to discretise continuous variables or to employ the Conditional Gaussian (CG) model. However, the latter imposes two major restrictions: (i) continuous variables must follow a multivariate Gaussian, and (ii) discrete variables cannot have a continuous parent. These limitations have prompted the development of alternative approaches, such as Mixtures of Polynomials[3] (MoPs).

In this work, we use MoPs representations to learn the TAN topology and parameters. This new methodology has been compared with TAN using both discrete CPT and Conditional Gaussian representations. In addition, we compared with the Naïve Bayes topology using the same CPD representations. We considered the global accuracy and minority class recall as performance criterion in a filter-wrapper variable selection, as well as a non-selective model for comparison. To measure the goodness of fit of each model, AUC was used.

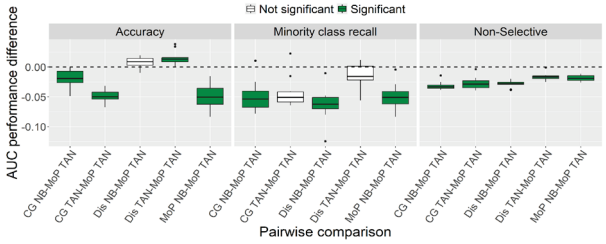

Figure 1. Boxplot showing the difference in AUC performance between the proposed MoP TAN model and each of the other models constructed for every variable selection criterion. Filled boxes indicate significant differences between the MoP TAN model and the corresponding model, according to the Wilcoxon signed-rank test. Lower values denote better performance of the MoP TAN model.

The results indicate that MoP TAN is not outperformed by CG models, and it shows similar performance as discrete TAN model in the different variable selection criteria.

Keywords: Bayesian networks, Tree Augmented Naïve Bayes, Mixtures of Polynomials.

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Q-1

ANÁLISIS METABOLÓMICO POR ESPECTROMETRÍA DE MASAS EN PLANTAS EXPUESTAS A MICROPLÁSTICOS

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La metabolómica, disciplina que estudia metabolitos de bajo peso molecular, permite caracterizar perfiles metabólicos y detectar cambios asociados a condiciones fisiológicas o ambientales. En este estudio, se ha analizado la respuesta metabolómica de *Lactuca sativa* expuesta a microplásticos de diferentes tamaños (**Fig. 1**), utilizando metabolómica no dirigida con espectrometría de masas de alta resolución. Para ello se evaluaron cinco productos de base polimérica de polietileno con diversos usos agrícolas. Se priorizaron las masas más relevantes mediante análisis multivariante, y luego fueron identificadas con un software especializado. El primer paso en la identificación tentativa consiste en determinar la fórmula molecular a partir de la masa exacta de los iones precursores detectados. A partir de la fórmula obtenida, se busca inferir una posible estructura química mediante la consulta de bases de datos especializadas. Esta búsqueda se complementa con literatura científica, conocimientos previos y el uso de bibliotecas espectrales en línea que permiten comparar los espectros experimentales con espectros de referencia para refinar la identificación.

Figura 1. Montaje plántula de *Latuca sativa* con partículas de microplásticos de distintos tamaños y evolución a lo largo de una semana.

Los resultados obtenidos confirmaron que la exposición a microplásticos de PE afecta significativamente el metabolismo de *Lactuca sativa*, evidenciado por una marcada reducción en los niveles de diversos metabolitos. Entre ellos, el ácido α-linolénico fue el compuesto que mostró una alteración más pronunciada, especialmente en presencia de partículas con un tamaño inferior a 10 µm. Esto permite confirmar el valor de la metabolómica basada en la espectrometría de masas como una herramienta sensible y eficaz para detectar alteraciones bioquímicas inducidas por contaminantes, aportando información crítica para la evaluación del riesgo ambiental en sistemas agrícolas expuestos a contaminación por microplásticos.

***Palabras clave*:** metabolómica, HRMS, microplásticos, *latuca sativa*, ácido α-linolénico.

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Q-2

SYNTHESIS OF BROMINATED BUTENOLIDES FROM MARINE NATURAL PRODUCTS

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The marine natural products isolated from the ascidian *Polycarpa procera*, known as procerolides and procerones, constitute a group of biosynthetically related brominated metabolites.[1] Procerolides, in particular, belong to the class of brominated γ-butenolides, a family of compounds that has attracted considerable interest due to their broad spectrum of biological activities, including antibacterial, antiviral, and anti-inflammatory effects, as well as inhibition of protein aggregation processes associated with neurodegenerative diseases such as Parkinson's and prion disorders.[2] Among them, procerolide D (**1**) and procerone A (**2**) stand out as representative examples (Figure 1).

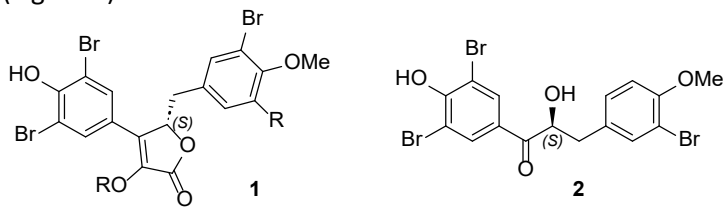
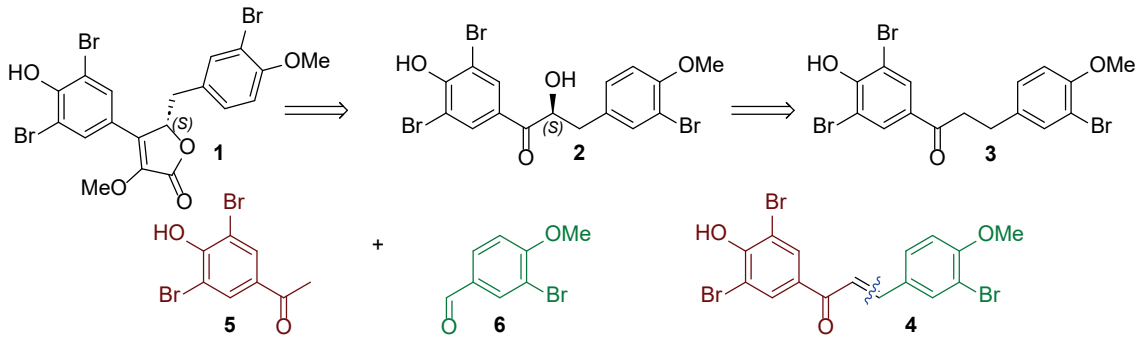


Figure 1. Proposed structures for procerolide D (**1**) and procerone A (**2**).

The present study focuses on the enantioselective synthesis and preliminary biological evaluation of brominated γ-butenolides. It also outlines a general route (Scheme 1) for the synthesis of related norneolignans bearing a γ-benzyl-β-phenylbutenolide scaffold —a family of bioactive natural products whose preparation has been scarcely reported in the literature— and thereby contributes to advancing the synthetic and biological understanding of marine-derived brominated butenolides (**2**).



Scheme 1. Retrosynthetic pathway for procerolides (**1**) and procerone A (**2**)

The preparation of compound **2** was achieved in three steps: (i) synthesis of chalcone **4** via a Claisen–Schmidt condensation between brominated acetophenone **5** and anisaldehyde derivative **6**; (ii) reduction of the double bond in compound **4** by catalytic hydrogenation; and (iii) asymmetric α-hydroxylation of ketone **3**.

***Keywords*:** Procerones, *Policarpa procera.*, α,β-unsaturated γ-lactones, bioactive compounds.

Acknowledgements. Financial support from PPIT-UAL, Junta de Andalucía-ERDF 2021–2027 (Objective RSO1.1), and the Innovation Framework Programme of the European Commission is gratefully acknowledged.

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Q-3

PFASs ADSORPTION USING HYDROGELS BASED ON ACRYLIC ACID/ACRYLAMIDE

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Per- and Polyfluoroalkyl substances (PFASs) have been widely used in different applications in the industry. All PFASs have been considered as Persistent Organic Chemicals due to their presence in water, soils and air because of their stability, toxic and bioaccumulative properties. All these factors make their removal from water and wastewater crucial. Hydrogels are polymeric materials that can act as adsorbents due to their porous structure and the presence of functional groups on their surface.[1] The aim of this work is to use hydrogels based on acrylic acid and acrylamide as monomers and N,N'-methylenebisacrylamide as crosslinking agent to remove PFASs from water samples and to study the different factors that can affect the process.

The viability of the synthesized hydrogel as adsorbent was tested towards 20 regulated PFASs by using preliminary batch adsorption experiments. The remaining concentration of PFASs was measured by using an ultra-high-performance liquid chromatography system coupled with mass spectrometry and the influence of the medium pH and consecutive adsorption cycles was also evaluated.

The results (Fig. 1) indicate that the pH at which the adsorption process is carried out is a kay point, establishing the optimum value at 2,5. This is probably due to the protonation of the carboxylic acids of the hydrogel, that reduces the repulsion with the negative charges of the PFASs and allows the formation of hydrogen bonds between the carboxylic groups and the PFASs. Results from this study showed that PFASs removal increased as increases the number of adsorption cycles (up to 2 cycles), which could be explained by the fact that larger PFASs adsorb faster than short-chain PFASs and block the adsorption sites for the short-chain PFASs. Thus, once the long-chain PFASs are removed from water, the short-chain ones can be adsorbed.

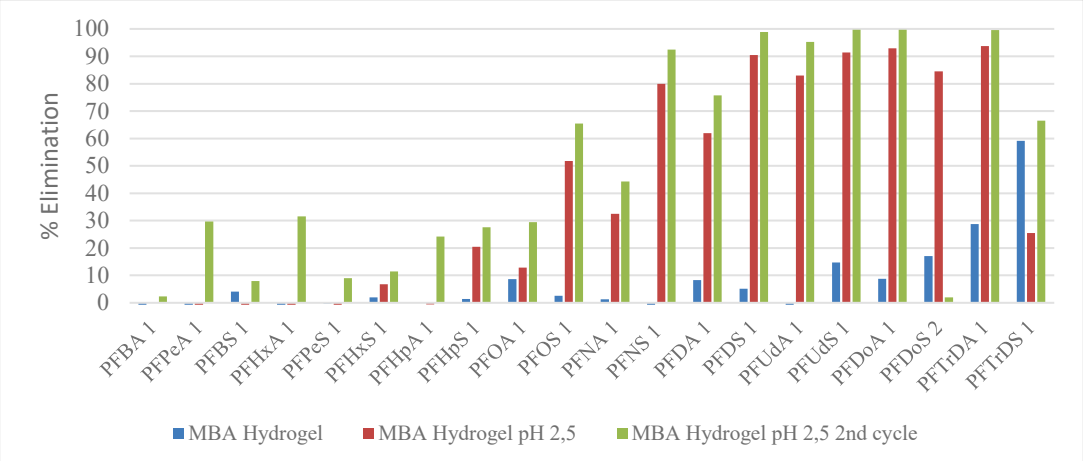

Figure 1. Effects of pH and consecutive adsorption cycles on the adsorption of PFASs.

***Keywords*:** Hydrogel, per- and polyfluoroalkylated substances (PFAS), Adsorption, pH.

Acknowledgements. The authors acknowledge the Spanish Minister of Science and Innovation and the ERDF for funding ANDROMEDA Project (References: PID2022-140875OB-C31).

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Q-4

GESTIÓN AVANZADA DE PFAS MEDIANTE PRETRATAMIENTO BIOLÓGICO Y ADSORCIÓN HÍBRIDA DE CARBÓN

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Las sustancias per-y-polifluoroalquiladas (PFAS) son contaminantes altamente persistentes y de creciente preocupación a nivel global, especialmente en los lixiviados de vertedero. Este estudio evaluó una línea de tratamiento que combina un reactor secuencial por lotes con biopelícula granular (SBBGR) con una columna híbrida de carbón activado para la eliminación de PFAS bajo condiciones reales y de alta carga. El pretratamiento con el SBBGR redujo el total de PFAS ($\Sigma PFAS_{14}$) en aproximadamente un 51 %, con una disminución significativa de las especies de cadena larga (PFOA, PFOS, PFNA), mientras que los ácidos perfluorocarboxílicos de cadena corta (PFBA, PFPeA) apenas se vieron afectados. Los experimentos de ruptura en flujo continuo (con un tiempo de contacto en lecho vacío de ≈66,7 min) revelaron dinámicas específicas por clase: PFBA y PFPeA presentaron una ruptura temprana (BV_{50} ≈ 86–185), mientras que PFOS y PFOA alcanzaron BV_{50} más tarde (≈361–446); PFHxS y PFDA no alcanzaron BV_{50} durante el periodo de monitoreo. Un balance de masas integrado sobre ~1,9 L de efluente tratado mostró una captura total de PFAS de ~73 %, aunque el PFOA siguió siendo el principal contribuyente a la carga residual debido a su alta concentración en el influente.

Estos resultados coinciden con estudios previos sobre el tratamiento de PFAS en sistemas reales[1] y subrayan la importancia de un pretratamiento biológico eficaz que acondiciones la matriz antes de aplicar procesos de adsorción avanzados. En particular, la adsorción posterior se vuelve esencial para controlar los PFAS móviles de cadena corta, tal como ha sido documentado en estudios recientes.[2] Las métricas basadas en volumen de ruptura (BV_{10}/BV_{50}) ofrecen puntos de operación prácticos para sistemas híbridos con carbón activado, respaldando configuraciones con doble medio (carbón activado granular + resina de intercambio aniónico) y la optimización del EBCT como estrategias viables para cumplir con normativas estrictas sobre PFAS, priorizando puntos de ajuste enfocados en los PFAS más móviles para mantener bajas concentraciones totales en el efluente. Las concentraciones de PFAS se cuantificaron mediante cromatografía líquida de ultra alta resolución acoplada a espectrometría de masas con tiempo de vuelo y analizador cuadrupolar (UHPLC-QTOF-MS), lo que permitió un análisis de alta resolución de un amplio espectro de especies de PFAS.

***Palabras clave*:** Adsorción, Contaminantes emergentes, Lixiviados, PFAS, Tratamiento de aguas residuales, UHPLC-QTOF-MS

Agradecimientos. *Los autores agradecen el apoyo financiero del Ministerio de Ciencia e Innovación de España a través del proyecto ANDROMEDA (PID2022–140875OB-C31), y de la Junta de Andalucía (España) mediante el proyecto MODITRAGUA (ProyExcel_00585).*

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Q-5

POROUS LIQUIDS AS NEXT-GENERATION NANOMATERIALS FOR CLIMATE CHANGE MITIGATION: INSIGHTS FROM MOLECULAR SIMULATIONS

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This study presents a computational investigation of porous liquids derived from the same cage molecule, Cryptophane-111 (C-111). The analysis focuses on the influence of temperature, pressure, solvent environment, and gas identity on the adsorption and stability of guest species within the molecular cavities.

Computational studies were conducted in three solvent media: dichloromethane, water, and a water–triethylene glycol mixture, with CO_2, SO_2, and H_2 selected as representative guest gases. Our results indicate that CO_2 preferentially occupies the internal cavities of C-111; however, this selectivity decreases with increasing temperature. No significant interactions were observed between H_2 and CO_2 within the cage, nor between H_2 molecules themselves or with the C-111 framework.[1,2] In contrast, CO_2 molecules can be displaced from the cavity either by additional CO_2 or by SO_2. Once encapsulated, SO_2 exhibits strong retention within the cavity, although weak interactions with external gas molecules are evident.[3] Hydrogen, by comparison, shows negligible interaction with the cage and is not effectively captured under the studied conditions.[1]

The structural characteristics of the cage, including pore cavity and accessible volume, were examined alongside host–guest interaction profiles.[1,2] Furthermore, the thermodynamic stability of encapsulated SO_2 and CO_2 was evaluated using density functional theory (DFT) calculations, providing molecular-level insights into the preferential binding and retention mechanisms.[3]

***Keywords*:** Porous Liquids, Molecular Dynamics, Absorption, Greenhouse effect.

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Q-6

METARAMINOL: ACCESS TO THE DRUG VIA A NOVEL CHEMOENZYMATIC ROUTE

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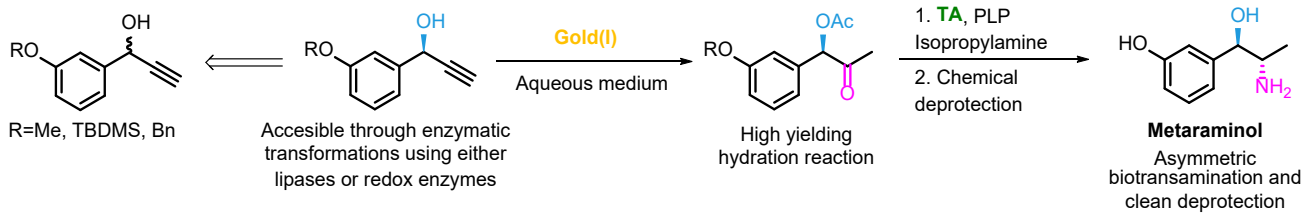
Metaraminol, (1*R*,2*S*)-3,β-dihydroxyamphetamine, is as sympathomimetic drug from the (nor)ephedrine family, employed as bitartrate salt in the prevention and treatment of hypotension.[1] Several synthetic routes have been described in the literature, although generally they suffer of the need of harsh reaction conditions, low yields, difficult-to-remove impurities, or doubtful optical purity.[2] Herein, we have tried to solve these problems by reporting a chemoenzymatic approach involving alkyne hydration catalyzed by gold(I) *N*-heterocyclic carbenes, and stereoselective enzymatic transformations using alcohol dehydrogenases (ADHs) and amine transaminases (ATAs), thus making possible to introduce two chiral centers in a highly stereoselective fashion and with good chemical yields.



Scheme 1. Aim of this work for the chemoenzymatic stereoselective synthesis of Metaraminol.

Our research group has been recently focused on chemoenzymatic processes by merging gold(I) catalysts and biocatalysts for the development of efficient stereoselective transformations.[3] Particularly, gold-catalyzed hydration is an highly atom economy reaction for the synthesis of alkynes from carbonyl groups that has made possible the synthesis of norephedrine precursors,[4] which later have been smoothly transformed to diols, diamines or amino alcohols. In this contribution, we proposed the combination of biocatalysis and gold(I) catalysis in a sequential cascade process to obtain Metaraminol precursors with different protecting groups such as methyl (Me), *tert*-butyldimethyl silyl ether (TBDMS) and benzyl (Bn) that are easily to remove in late-stage functionalization to obtain the desired drug with good yields and excellent enantiomeric and diasteromeric excess.

Keywords: Biocatalysis, Gold(I) catalysis, Metaraminol

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Q-7

^{1}H NMR METABOLOMIC FINGERPRINT REVEALS THE BIOCHEMICAL IMPACT OF REGENERATIVE AGRICULTURAL INPUTS ON TOMATO SEEDLINGS

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Contemporary agriculture faces major challenges such as climate change, environmental degradation, and global population growth, all of which threaten global food security. In this study, ^{1}H NMR-based metabolomics was employed to investigate the biochemical and physiological responses of tomato (*Solanum lycopersicum L.*) seedlings treated with regenerative agricultural inputs. Three treatments were applied (regenerative, control, and negative control), under controlled phytotron conditions through spraying. After five applications, leaves and stems were collected and prepared for metabolite extraction using methanol (0.012% of TMS), and a methanol–phosphate buffer solution (80:20, v/v; 0.01% of TSP), respectively. The extracts were analyzed on a 600 MHz spectrometer with a 5 mm quadruple QCI cryoprobe.

NMR data were submitted to multivariate statistical analyses, including both unsupervised and supervised methods such as Principal Component Analysis (PCA), Partial Least Squares Discriminant Analysis (PLS-DA), and Soft Independent Modeling of Class Analogy (SIMCA). These analyses revealed clear differentiation among treatments and highlighted distinct metabolic fingerprints associated with each input. Statistically significant discriminant metabolites were identified based on variable importance in projection (VIP) scores greater than 1. In leaves, the regenerative treatment led to increased levels of trigonelline, rutin, and triacylglycerols (TAGs), among others, compared with both control and negative groups, while γ-aminobutyric acid (GABA) levels decreased. In contrast, in stems, the regenerative treatment resulted in increased concentrations of malic acid, whereas choline, choline derivatives, ethanolamine, nucleosides, rutin, TAGs and trigonelline were found at lower levels relative to the other groups. These metabolite variations reflect adjustments related to plant defense, stress adaptation, membrane integrity, energy balance, and photosynthetic activity.

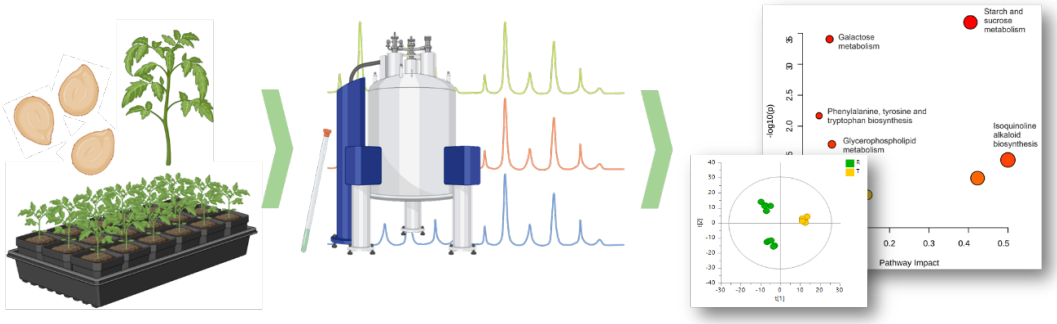

Figure 1. Experimental workflow for NMR-based metabolomic analysis in tomato seedlings.

***Keywords*:** Metabolomics, Agriculture, Nuclear Magnetic Resonance, tomato seedlings.

Acknowledgements. This research was funded by the State Research Agency of the Spanish Ministry of Science, Innovation and Universities (PID2021-126445OB-I00, PID2023-150047OA-I00 and CPP2022-009967), by the Gobierno de España MCIN/AEI/10.13039/501100011033/FEDER, EU, and by the European Union "Next Generation EU"/PRTR. S.F., C.G.-M., and A.C.A. acknowledge financial support from the Universidad de Almería (CPRED_2024_013), the AECC (PRDAM234245GARC), and the Junta de Andalucía (DGP_EMEC_2023_00195), respectively.

Q-8

OPTIMIZED DETERMINATION OF ORGANIC MICROCONTAMINANTS IN WETLAND PLANTS USING QuEChERS EXTRACTION AND LC-MS/MS ANALYSIS

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Constructed wetlands offer a sustainable and promising approach to wastewater treatment. Although their effectiveness in removing organic microcontaminants (OMCs) has been well established, limited information is available regarding their retention within plant biomass. In this study, several extraction methodologies were evaluated for the analysis of 80 OMCs in wetland plants. The optimized protocol involves ultrasound-assisted QuEChERS extraction followed by analysis using liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS) (**see Figure 1**).

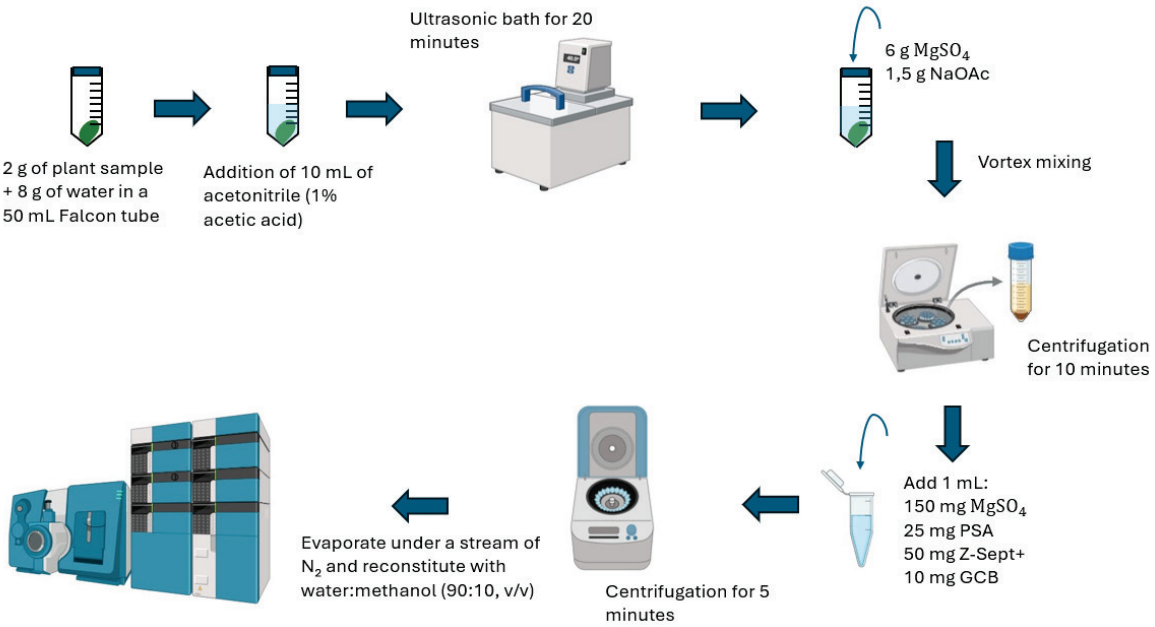

Figure 1. Scheme of the selected method for the extraction of wetland plants.

The method was validated at three concentration levels, yielding satisfactory results for at least one level in 70 of the compounds analyzed. This validated approach was then applied to the analysis of OMCs in plant samples from two wetland sites. A total of 31 contaminants were detected, with concentrations ranging from 28 ng/kg for tebuconazole to 35315 ng/kg for sulfamethoxazole. These findings highlight the ability of wetland systems to accumulate OMCs and underscore the need for further research into their behavior within plant matrices.

Keywords: *Organic micropollutants, constructed wetlands, QuEChERS extraction, liquid chromatography, mass spectrometry.*

Acknowledgements. The authors acknowledge the financial support from the Andalusian Regional Government (Junta de Andalucía, Spain) through the project MODITRAGUA (ProyExcel_00585).

Q-9

LIXIVIACIÓN DE MPS EN SUELO BAJO CONDICIONES DE INVERNADERO SIMULADAS

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Los plásticos son una parte importante de la agricultura moderna. Mejoran la productividad de los cultivos, reducen las pérdidas de agua y protegen los alimentos durante la cosecha y el almacenamiento. Sin embargo, su uso genera residuos y contaminación. La agricultura utiliza una amplia variedad de polímeros plásticos, cada uno de ellos diseñado con aditivos y propiedades físicas adecuadas a la finalidad para la que están destinados. Estudios recientes han suscitado preocupaciones sanitarias, ya que los residuos plásticos y sus aditivos pueden entrar en la cadena alimentaria, lo que podría afectar a la salud humana y animal. Por ese motivo, en los últimos años ha aumentado el interés de la comunidad científica por estudiar la presencia de plásticos en el medio terrestre. Este trabajo se centra específicamente en el estudio de la migración de los microplásticos a través del suelo.

Para evaluar la lixiviación de los microplásticos en condiciones similares a las de un invernadero, se diseñó un experimento de laboratorio utilizando columnas de suelo natural. Se prepararon tres cilindros transparentes de metacrilato, cada uno con un diámetro interno de 7 cm y una altura de 10 cm, que representaban la zona radicular típica de los invernaderos. Una columna sirvió como control, mientras que las dos restantes se utilizaron como columnas de prueba. Todas las columnas se llenaron con suelo recogido de un invernadero y tamizado previamente a 1 mm para homogeneizar la fracción gruesa. Las columnas de prueba se adicionaron con 5 mg de fragmentos de polietileno de baja densidad (LDPE) negro (50-200 µm) y 5 mg de esferas de polietileno (PE) rosa (125-150 µm). Se simuló el riego por goteo aplicando 1 L de agua destilada filtrada al día, añadida gota a gota para evitar el encharcamiento y emular un régimen hídrico realista, dado que el consumo de agua por planta durante el ciclo invernal suele oscilar entre 0,7 y 1,2 L al día. Durante 12 días consecutivos, se recogió y filtró el volumen recogido de cada columna para confirmar la ausencia de pérdida de microplásticos por lixiviación. Tras el periodo experimental, se abrieron y seccionaron las columnas para analizar la distribución vertical de los microplásticos, lo que permitió determinar tanto la profundidad de penetración como los patrones de migración dentro del perfil del suelo. Los resultados mostraron que las esferas de microplásticos aparecieron en los matraces de recogida al sexto día de riego, lo que indica que, en las condiciones hidráulicas aplicadas, las esferas pudieron migrar a través del suelo. Por el contrario, no se detectaron fragmentos a lo largo de los 12 días que duró el experimento, lo que sugiere su retención dentro del perfil del suelo. Todos los polímeros fueron detectados mediante el uso de la micro espectrometría de infrarrojos por Transformada de Fourier (µ-FTIR).

***Palabras clave*:** Agricultura, µ-FTIR, Lixiviación, Microplásticos, Polietileno.

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Q-10

QUANTITATIVE QUADRUPOLAR NMR (qQNMR) DETERMINATION OF TAURINE IN HUMAN URINE SAMPLES USING 1D AND 2D ^{33}S NMR

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Nuclear magnetic resonance (NMR) is a powerful analytical technique that enables selective detection of specific nuclei, minimizes matrix effects, and allows accurate quantification without derivatization or separation steps. Being is non-destructive and non-invasive, NMR simultaneously provides structural and quantitative information. Sulfur, widely present in biological and industrial systems, has four stable isotopes, but only ^{33}S (I = 3/2, 0.76% natural abundance) is NMR-active. Its low gyromagnetic ratio, low receptivity, and quadrupolar broadening have historically limited its use. However, in symmetric environments such as sulfonates, quadrupolar effects are reduced, producing narrow signals suitable for quantification— thus opening new opportunities for ^{33}S quantitatve quadrupolar NMR (qQNMR). Taurine (2-aminoethanesulfonic acid), abundant in tissues, foods, and energy drinks, requires reliable, derivatization-free quantification for many applications. In this context, ^{33}S NMR provides a promising yet underexplored alternative.

In this work, we demonstrate for the first time the direct and validated quantification of taurine in undiluted human urine using ^{33}S-based qQNMR. Two complementary approaches were employed: (i) direct detection of ^{33}S, and (ii) indirect 2D ^{1}H-^{33}S gHMBC detection, which effectively overcomes the inherent sesitivity limitations of direct ^{33}S observation. The method exhibited excellent analytical performance, showing linearity (R^2 = 0.9993), trueness (recoveries 96.9–101.6%), precision (CV < 1.1%), and robustness under varying experimental conditions. The detection limits were 7 mg mL^{-1} (LOD) and 11 mg mL^{-1} (LOQ) for the 1D–^{33}S experiment. Using the ^{1}H–^{33}S gHMBC approach significantly improved sensitivity, lowering these values to 1.2 and 4 mg mL^{-1}, respectively.[1] The combination of short acquisition times, minimal spectral interference, and high reproducibility establishes this approach as a validated and efficient method.

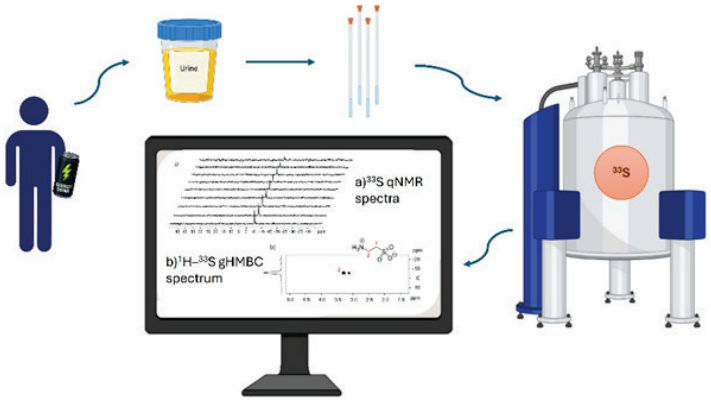

Figure 1. Quantitative Analysis of Taurine in Urine by ^{33}S NMR: Sample-to-Spectrum Workflow.

***Keywords*:** ^{33}S NMR, qNMR, Taurine, Urine.

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Q-11

OVERVIEW OF PRIMARY AND SECONDARY METABOLITES OF *Rugulopteryx okamurae* SEAWEED: ASSESSING BIOACTIVITY, SCALABILITY, AND MOLECULAR MECHANISMS

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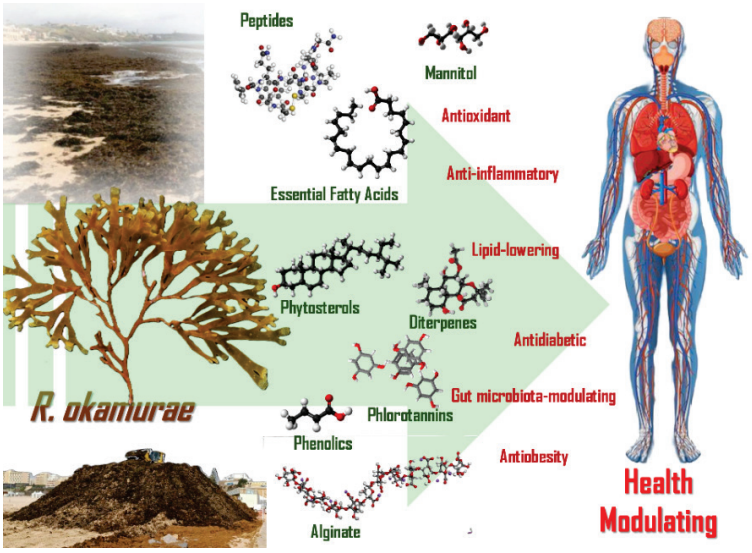
Rugulopteryx okamurae, a brown macroalga considered invasive, has rapidly expanded across the Mediterranean and northeastern Atlantic, causing significant ecological and economic challenges. Its biomass is rich in a variety of structurally diverse compounds, including polysaccharides (such as alginate, fucoidan, and laminaran), phlorotannins, diterpenoids, fatty acids, and peptides, many of which demonstrate notable antioxidant, anti-inflammatory, antimicrobial, and anticancer effects. Studies comparing extraction methods, chemical composition, and biological activities highlight phlorotannins and diterpenoids as particularly promising, showing strong bioactivity at low micromolar concentrations and favorable predicted interactions with molecular targets linked to inflammation and programmed cell death. The polysaccharides present in this alga exhibit multiple biofunctional properties and are especially amenable to large-scale, sustainable industrial applications. In contrast, fatty acids and peptides show more selective activities, but their structural diversity and mechanisms of action remain poorly understood. Evidence from in vitro experiments and computational models suggests that phlorotannins may modulate NF-κB and MAPK signaling pathways, whereas diterpenoids could induce apoptosis through mitochondrial pathways. Nevertheless, practical utilization is limited by variable extraction protocols and a lack of comprehensive in vivo data on pharmacokinetics and therapeutic efficacy.[1]



Keywords**:** *Rugulopteryx okamurae*; alginate; diterpenoids; polyphenols; antioxidant activity; Invasive species valorisation.

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Q-12

[1]H NMR-BASED METABOLOMIC ANALYSIS OF URINE SAMPLES REVEALS METABOLIC DIFFERENCES IN ADHD AND OCD ADULTS

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Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental condition characterized by inattention, hyperactivity, and impulsivity. While these symptoms are clear in children, they tend to be more subtle in adults, making diagnosis difficult, especially given the high rate of comorbidities such as obsessive-compulsive disorder (OCD). The overlap in symptoms between ADHD and OCD can obscure accurate identification and treatment of each condition. Additionally, the heterogeneity of ADHD subtypes in adults further complicates diagnosis and management. ^{1}H NMR-based metabolomics offers a promising avenue for improving diagnostic precision through detailed metabolic profiling. This study aimed to identify metabolic differences in urine among ADHD subtypes, OCD and healthy controls with the goal of enhancing diagnostic accuracy and understanding of these overlapping disorders. A total of 105 urine samples were analyzed. Significant metabolic differences were observed among all groups, including between ADHD subtypes as well as between each subtype, OCD and healthy controls. Pathway analysis highlighted alterations in amino acid metabolism, particularly in the phenylalanine, tyrosine and tryptophan biosynthesis pathway. Preliminary Machine Learning (ML) models were developed for the diagnosis of these disorders. This approach combined NMR urinary profiles with clinical variables, achieving a modestly superior level of performance compared to models based solely on clinical variables.

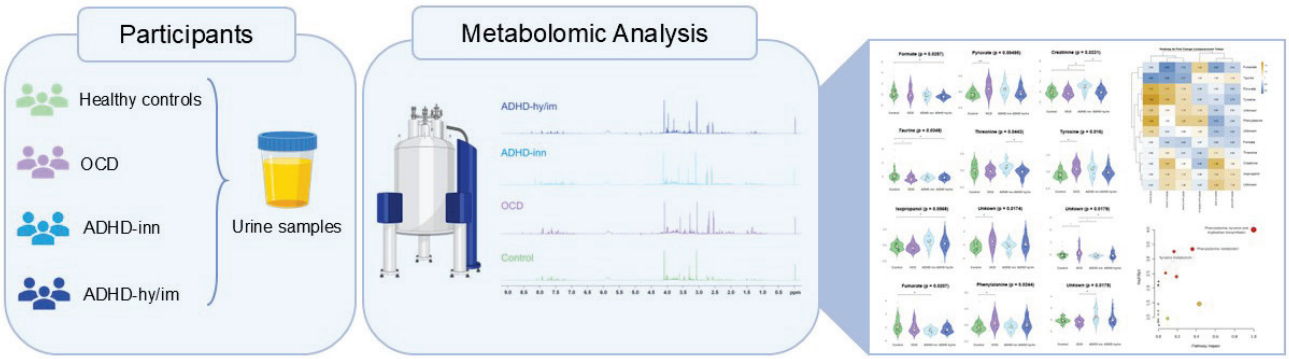

Figure 1. Graphical workflow of metabolomic analysis in urine samples from ADHD, OCD, and healthy control patients.

***Keywords*:** ADHD, metabolomics, urine biomarkers, OCD, ^{1}H NMR.

Acknowledgements. This research was funded by the State Research Agency of the Spanish Ministry of Science, Innovation and Universities (PID2021-126445OB-I00, PID2023-150047OA-I00 and CPP2022-009967), by the Gobierno de España MCIN/AEI/10.13039/501100011033/FEDER, EU, and by the European Union "Next Generation EU"/PRTR. C.G-M. thank to the Agencia Española Contra el Cáncer (AECC) for a predoctoral grant PRDAM234245GARC. A.C.A. acknowledges the Junta de Andalucía for the postdoctoral Emergia grant (DGP_EMEC_2023_00195).

Q-13

LEVULINIC ACID AS A GREEN PLATFORM MOLECULE FOR DIVERSIFIED RESIN CURING PROMOTERS

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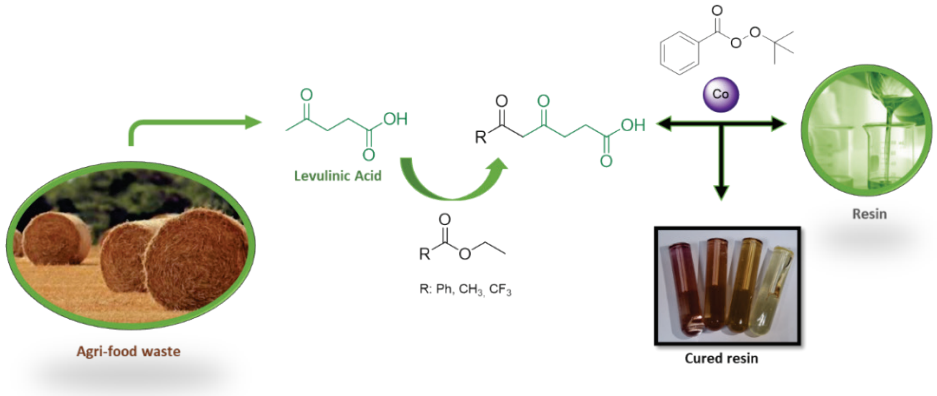
The composite materials sector faces increasing environmental and health concerns due to the use of petroleum-derived reagents and micronized inorganic fillers. To address these challenges, growing interest has been directed toward the valorization of agri-food waste into value-added chemical products. Levulinic acid is a key bio-based platform molecule, mainly obtained through the acid-catalyzed hydrolysis of lignocellulosic biomass such as agricultural and forestry residues. Due to its versatile reactivity, it serves as a green platform molecule for the synthesis of biofuels, green solvents, plasticizers, and sustainable polymeric materials. In resin manufacturing, acetylacetone, a β-dicarbonyl compound, is commonly used as a curing promoter, facilitating the reaction between the peroxide initiator and the unsaturated polyester resin (UPR) and thereby speeding up the crosslinking process. Previous studies within our research group have explored the replacement of micronized fillers with lignocellulosic materials derived from agri-food industry waste such as olive stone.[1] Building on these efforts, the current work aims to develop novel curing promoters derived from levulinic acid as an eco-friendly alternative to conventional petroleum-based synthetic promoters, with the goal of maintaining or improving curing efficiency while enhancing the overall sustainability of composite formulations (**Scheme 1**).



Scheme 1. General procedure for the eco-friendly synthesis of promoters and curing process.

***Keywords*:** agri-food waste, resin, levulinic acid, β-dicarbonyl.

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Q-14

CONCENTRATION-INDEPENDENT MOLECULAR WEIGHT DETERMINATION OF POLYMERS VIA DIFFUSION NMR: A UNIVERSAL APPROACH ACROSS SOLVENTS[1]

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Diffusion NMR is widely used to estimate polymer molecular weight (Mw) via scaling relationships of viscosity-corrected diffusion (Dη).[2] However, solvent choice, polymer concentration (C), and weighing errors at very low C often bias Mw estimates and prolong experiments. We introduce an iterative concentration-aware scaling that embeds crowding effects through $D\eta|_c = D\eta|_{1/\infty} e^{-\kappa C^{\nu}}$ with κ depends on Mw. Assuming $\kappa = mM_w + n$ yield the new scaling law $D\eta|_c = \mathrm{a}e^{-(mMw+n)C^{\nu}} M_w^{-b}$. Fitting this model across data acquired at high concentrations and/or in different solvents provides solvent- and concentration-independent Mw, tested until 150 mg/mL of solute concentration, while reducing sensitivity to weighing errors and the need for extreme dilution.

A robust iterative nonlinear fit is implemented, which jointly optimizes (a, b, m, n, v) and Mw, using multi-concentration (and optionally multi-solvent) datasets. In comparison with conventional single-concentration scaling, the method has been shown to improve Mw accuracy, mitigate solvent-specific bias, and shorten acquisition by relaxing dilution requirements (see table 1). The framework is compatible with standard DOSY workflows and readily extends to automated quality control, high-throughput polymer screening, and in-line monitoring.

In the future, the same formulation can incorporate polydispersity, temperature-dependent viscosity, and mixture deconvolution, enabling generalizable, portable diffusion-NMR protocols for precise polymer characterization.

Table 1. Diffusion values (m2 s−1) a) and predicted weight average Mw for PPG3250, PPG5300 and PS335k in three different solvents and different concentrations fitting this new model.

Solvent	Polymer	C (mg/mL)	C (wt%)	Dη(10^{-3})	Av-Mw	Error
Toluene-d_8	PPG3250	91.01	10.5	0.0826	3126	3.7%
THF-d_8	PPG5300	33.91	3.9	0.0818	5408	2.0%
$CDCl_3$	PS335k	108.35	7.3	0. 00137	343649	2.5%

Keywords: diffusion NMR, polymers, molecular weight scaling, concentration-viscosity correction.

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Q-15

NEW LANTHANIDE-BASED COORDINATION POLYMERS AS ANTI-CANCER AGENTS: INDUCTION OF APOPTOSIS AND *IN VIVO* IMAGING IN HUMAN COLORECTAL CANCER

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Over recent decades, interest in medicinal inorganic chemistry has increased with the development and application of novel metallodrugs. Nowadays, one of the most widely used anti-cancer drugs is cisplatin.[1] Although its efficiency to treat several cancers, this platinum complex is non-selective, resulting in severe adverse effects on patients. Consequently, it is necessary to develop new metallic compounds with better therapeutic properties.[2] In this work, a new family of four coordination polymers based on the ligand 2,6-dichloronicotinic acid (DCNA) and lanthanides with the general formula $\{[Ln(DCNA)_3(H_2O)_2]\cdot H_2O\}_n$ (Ln = Eu (**1**), Tb (**2**), Gd (**3**) and Dy (**4**)) (LnDCNA) were synthesized and fully characterized (**Figure 1a**). Their anti-cancer activity has been evaluated using the human colorectal cancer cell line HT-29. Importantly, compound **1** showed selective cytotoxicity against colorectal cancer cells (IC_{50} = 73.35 µg/mL) in the MTT assay (**Figure 1b**). This result is associated with the ability to Eu(III) to reduce to Eu(II), which generate reactive oxygen species (ROS) and induces apoptosis in cancer cells. Moreover, compound **1** exhibits luminescence properties, showing an efficient antenna effect in biological medium, which facilitates the visualization of its cellular internalization by confocal microscopy, enabling new applications in biomedicine (**Figure 1c**).

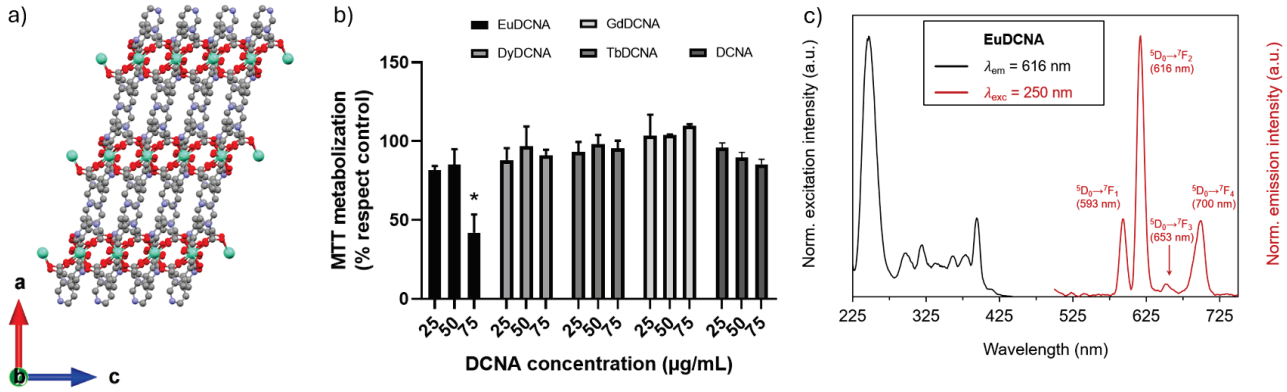

Figure 1. Molecular packing of LnDCNA (a); MTT metabolization of compounds at doses 25-75 µg/mL of DCNA for 72 h (b); Excitation and emission spectra of EuDCNA in biological medium (0.36 mg/mL) (c).

Keywords: Metallodrugs, Lanthanides, Cancer, Luminescence.

Acknowledgements. P.G.-G. thanks to the project DGF.PLSQ.2023.00188 from Consejería de Universidad, Investigación e Innovación de la Junta de Andalucía con cargo al Programa Operativo FEDER de Andalucía 2021-2027.

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Q-16

STUDY OF THE STABILITY OF THE RECOMBINANT ENZYME HISTIDINE AMMONIUM LYASE FROM *Serratia marcescens*

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C. García, A. Carrillo, S. Marzo-Cardoso, F. Rodríguez-Vico, L. M. Contreras-Moyeja, J. M. Clemente-Jiménez and F. J. Las Heras-Vázquez

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The enzyme Histidine Ammonium Lyase (HAL, EC 4.3.1.3) catalyzes the transformation of L-histidine into trans-urocanic acid. In the present work, the stability of the HAL enzyme from *Serratia marcescens* (*Sm*HAL) against temperature and denaturing agents (urea) was investigated using enzyme activity assays and Circular Dichroism (CD) spectroscopy. Its catalytic and conformational stability was evaluated from a kinetic perspective. The activation energy (E_a) of enzymatic inactivation was calculated, providing insights into the enthalpy changes (ΔH^*), Gibbs free energy (ΔG^*) and entropy (ΔS^*) changes between the native and denatured states. The apparent melting temperature (T_m) was found to be dependent on the heating rate, suggesting that the thermal denaturation process is kinetically controlled. The calculated E_a values suggest that *Sm*HAL is a kinetically stable enzyme, an important aspect in future biotechnological applications.

***Keywords*:** Histidine Ammonium Lyase, Conformational stability, Thermostability, Catalysis.

Acknowledgements. This work has been funded by project P_LANZ_2025/008 from the University of Almería

Q-17

DESIGN OF ELECTROSPUN POLYCAPROLACTONE NANOFIBERS WITH TUNABLE MORPHOLOGY AND CONTROLLED DRUG RELEASE

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In this work, the electrospinning technique is used to fabricate a series of polycaprolatone (PCL) nanofibers (NFs) by systematically modifying key processing parameters, establishing a methodology that enables controlled tuning of NF diameter in line with previous electrospinning optimization strategies. Specifically, the applied flow rate, solvent ratio during polymer preparation, the amount of polymer delivered through the Taylor cone, and the solution viscosity were varied. The influence of these parameters on the PCL NF diameter was evaluated using three dimensional (3D) graphical representation, where data were projected across XY, ZX and YZ plane), facilitating the simultaneous comparison of multiple variables. In all cases, the average NF diameter and standard deviation were determined from scanning electron microscopy (SEM) images. By adjusting these parameters, PCL NF diameters were successfully tuned from 727 to 3603 nm in a controlled manner. Additionally, the release kinetics of ferulic acid from PCL NFs prepared under different flow rates solvent ratios, and loading percentages were investigated. Release profiles were fitted to the Higuchi diffusion model, the Peppas-Shalim model, as well as a first-order kinetic model. A burst-like release consistent with first-order kinetics, followed by a diffusion-controlled release described by the Peppas-Shalim model, was observed depending on the fabrication conditions. Overall, this study demonstrates a versatile strategy for producing polymeric NFs with tunable diameter and controlled release properties, paving the way for improved delivery systems.

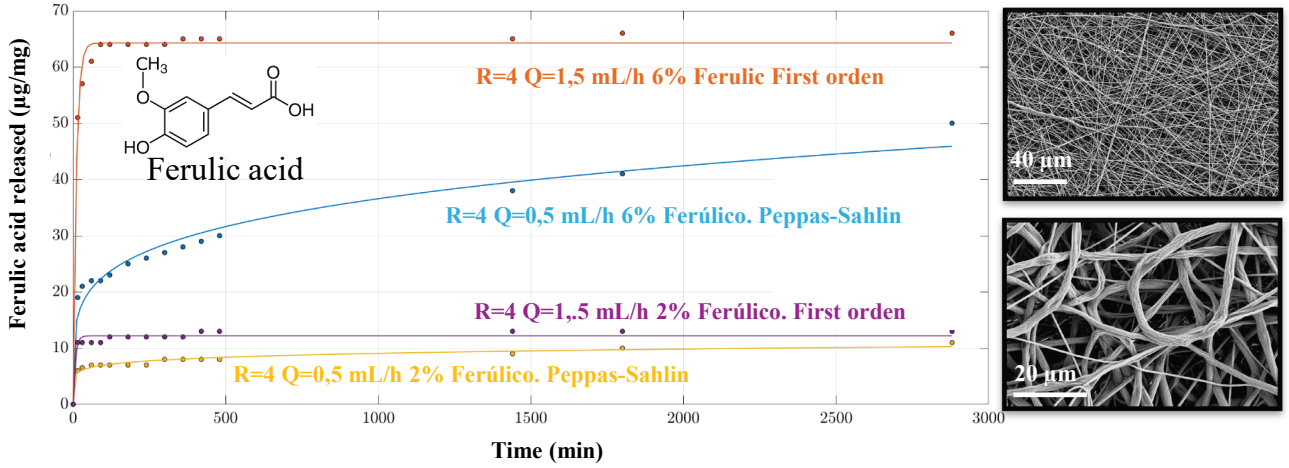

Figure 1. Fitting of the ferulic acid released per milligram of NFs. Representative SEM images of the obtained PCL NFs.

***Keywords*:** Electrospinning, PCL nanofibers, Ferulic acid, 3D graphical representation, Kinetics releases.

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Q-18

DEGREE OF DEACELYLATION-DEPENDENT RELEASE BEHAVIOR OF CHITOOLIGOSACCHARIDES (COS) FROM ELECTRSOPUN PVA NANOFIBERS

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The release kinetics of chitooligosaccharides (COS) molecules incorporated into polyvinyl alcohol (PVA) electrospun nanofibers (NFs) were investigated as a function of their degree of deacetylation (DD), which refers to the proportion of acetyl groups removed from chitin in chitosan structure Two COS systems with similar molecular weight (~1 kDa) but distinct DD values—synthesized COS1 (DD = 76.6%) and commercial CMCOS1 (DD = 88.2%)—were embedded into PVA by electrospinning to form composite nanofibers (PVA@COS1 and PVA@CMCOS1 NFs) containing from 1-5% of COS. UV–vis spectroscopy was employed to quantify the cumulative release of COS over 24 h in water medium, and the resulting data were fitted to eight kinetic models (Zero-order, First-order, Second-order, Higuchi, Hixson–Crowell, Korsmeyer–Peppas, Weibull, and Peppas–Sahlin). Model comparison revealed distinct release mechanisms governed by DD and COS content. For PVA@COS1, samples 1–3% followed the Weibull model, sample 4% the Peppas–Sahlin model, and sample 5% the First-order model. For PVA@CMCOS1, samples 1–3% best fitted the First-order model, while samples 4% and 5% corresponded to the Weibull and First-order models, respectively. The dominance of Weibull and First-order behaviors indicates diffusion-controlled release modulated by polymer–solute interactions, where higher DD enhances hydrogen bonding with PVA and slows molecular diffusion. This work highlights the critical influence of the DD on encapsulation efficiency and release kinetics of COS in PVA NFs, providing a mechanistic basis for designing tunable electrospun delivery platforms for biomedical applications.

Table 1. Summary of best-fit kinetic models for each PVA@COS system.

Sample	*Type and % of COS*	*Best-fit model*	*Mechanism interpretation*
PVA@COS1-1	Synthesized-1%	Weibull	Distributed diffusion
PVA@COS1-2	Synthesized-2%	Weibull	Diffusion-controlled
PVA@COS1-3	Synthesized-3%	Weibull	Stretched exponential diffusion
PVA@COS1-4	Synthesized-4%	Peppas–Sahlin	Diffusion + polymer relaxation
PVA@COS1-5	Synthesized-5%	First-order	Concentration-driven desorption
PVA@CMCOS1-1	Commercial-1%	First-order	Diffusion-controlled
PVA@CMCOS1-2	Commercial-2%	First-order	Diffusion-controlled
PVA@CMCOS1-3	Commercial-3%	First-order	Diffusion-controlled
PVA@CMCOS1-4	Commercial-4%	Weibull	Distribution-limited diffusion
PVA@CMCOS1-5	Commercial-5%	First-order	Diffusion-controlled

***Keywords*:** Chitooligosaccharides, PVA, Degree of Deacetylation, Release model, Nanofibers.

Acknowledgements. This research was funded by the Spanish MICU (PID2021-126445OB-I00 and CPP2022-009967), by the MCIN/AEI/10.13039/501100011033/FEDER, UE, and by the EU "Next Generation EU"/PRTR. RCC acknowledges funding to the Spanish MICIU for the Ramón y Cajal fellowship (RyC2021-03447-I), and the University of Almería through the "Proyecto de Investigación Lanzadera 2024" (P_LANZ_2024/004). LQL. thanks the China Scholarship Council (CSC) for predoctoral support.

Q-19

ANALYSIS OF 20 REGULATED PER- AND POLYFLUOROALKYL COMPOUNDS (PFAS) IN DRINKING WATER BY SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY COUPLED TO MASS SPECTROMETRY

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Per- and polyfluoroalkyl substances (PFAS), known as "forever chemicals",[1] are contaminants of emerging concern[2] and form a set of organic chemicals compounds, whose structure is constituted by aliphatic chains where the hydrogen atoms are totally or partially substituted by fluorine atoms. This type of compounds represents a worldwide problem due to their persistence, toxicity and extensive presence in the environment, especially in aquatic environments.[1] Because of their characteristics, the Directive (EU) 2020/2184 establishes, in drinking water, limits of 500 ng/L for the parameter of "total of PFAS" and 100 ng/L for the parameter of "sum of PFAS".[3] In Spain, the Royal Decree 3/2023 establishes a parametric value of 100 ng/L for Σ 20 PFAS, and a value of 70 ng/L for 4 PFAS (PFOA, PFOS, PFNA and PFHxS).[4]

This study presents an analytical method for determining the 20 PFAS regulated in drinking water. This method involves solid phase extraction (SPE), followed by liquid chromatography coupled with mass spectrometry (LC-MS/MS) analysis. For the optimization of the SPE method, 5 types of adsorbents were evaluated, as shown in **Figure 1**, and the Strata-X-AW cartridge was finally selected. The validated method provided good recoveries (75%-104%), high precision (intra-day relative standard deviations (RSDs) 1-19%) and excellent limits of quantification (LOQs) (1,4-25,8 ng/L). The method was applied to actual drinking water samples.

Figure 1. Recovery (%) and RSD (%) values of 5 cartridges evaluated in fortified (5 ng/L) drinking water samples

***Keywords*:** drinking water, PFAS, solid phase extraction, liquid chromatography, mass spectrometry.

Acknowledgements. The authors acknowledge the Spanish Minister of Science and Innovation and the ERDF for funding ANDROMEDA Project (References: PID2022-140875OB-C31).

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Q-20

AN ELECTROMECHANICAL DEVICE OF LARMOR PRECESSION FOR TEACHING THE PHYSICAL PRINCIPLES OF NUCLEAR MAGNETIC RESONANCE (NMR)

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We present a low-cost electromechanical device that physically simulates Larmor-like precession, offering a bridge between quantum concepts and classical electromagnetism for NMR education. The device couples a rotating permanent magnet with a pair of Helmholtz coils driven to produce a homogeneous field of ≈1.42 mT at the center. Coil geometry was derived from the Biot–Savart law and validated with Ansys Maxwell simulations, confirming uniformity along all three spatial axes (Figure 1). Mechanical support and guides were modeled in SolidWorks and 3D-printed to ensure precision and reproducibility. A stepper motor, controller, frequency driver, and digital tachometer provide synchronized electronic control of the magnet's rotation, enabling stable, visible precessional motion near 9.5 Hz (≈570 rpm).

Experiments demonstrate that the platform reliably reproduces the macroscopic analog of Larmor precession: a magnetic moment in a homogeneous field undergoes steady precession, closely mirroring nuclear-spin behavior while remaining directly observable. This prototype establishes a robust basis for hands-on NMR pedagogy, low-field instrumentation training, and the development of portable, didactic spectrometers. In terms of future developments, the field of architecture offers a range of possibilities for the integration of closed-loop control, field-mapping probes and sensor integration, which are well-suited to quantitative labs and inquiry-based learning modules.

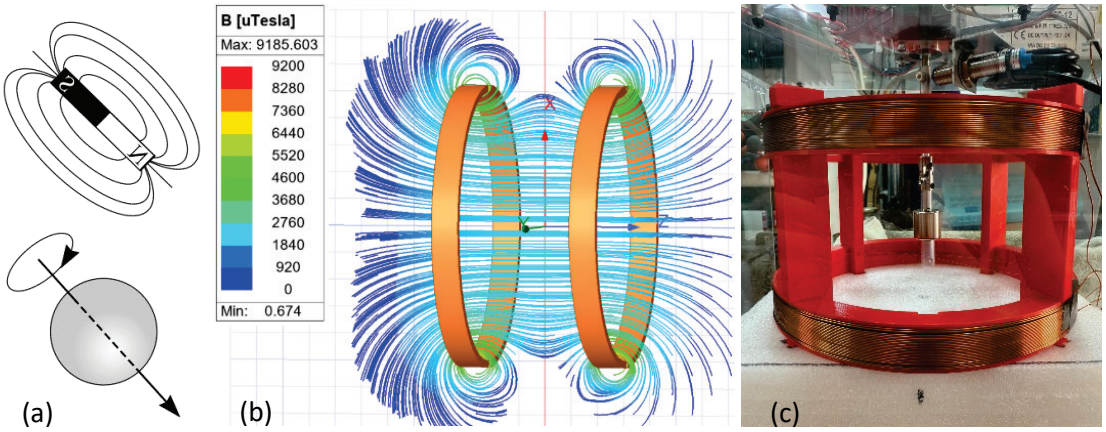

Figure 1. Analogy of the magnetic moment of a rotating charged particle and a magnet (a). Simulation of the magnetic field lines generated by a Helmholtz coil (b). Finished device (c).

***Keywords*:** NMR education, Larmor precession, Helmholtz coils, electromechanical simulator, low-field instrumentation.

Acknowledgements. This research was funded by the State Research Agency of the Spanish Ministry of Science, Innovation and Universities (PID2021-126445OB-I00, PID2023-150047OA-I00 and CPP2022-009967), by the Gobierno de España MCIN/AEI/10.13039/501100011033/FEDER, EU, and by the European Union "Next Generation EU"/PRTR.

Q-21

ADVANCED Py-GC-MS METHOD FOR MICRO(BIO)PLASTICS DETERMINATION IN MEDITERRANEAN SEAWATER

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The increasing production and use of plastics, driven by their high chemical and mechanical resistance, has significantly enhanced the occurrence of microplastics (MPs) in the environment. These particles, ranging in size from 5 mm to 1 µm, pose environmental risks due to their persistence, detection challenges, and widespread distribution. One of the main strategies to reduce MPs generation is the use of biodegradable plastics, designed to degrade completely without leaving persistent residues. However, the natural degradation of these materials is often incomplete, leading to the formation of microbioplastics (MBPs).

To address the need for effective analytical methods for detecting these emerging pollutants, this study developed a methodology based on pyrolysis coupled with gas chromatography and mass spectrometry (Py-GC-MS). The method was applied to the simultaneous determination of MPs and MBPs in seawater samples from the Mediterranean Sea of the coast of Almería. The method development included optimization of the extraction stage through sequential filtration using membranes of different pore sizes (1, 0.45, and 0.1 µm), as well as a comparison of different acquisition modes to select the most sensitive and selective approach, minimizing sample treatment. Selected Ion Monitoring (SIM) was chosen over full scan as the optimal acquisition mode, improving selectivity as well as sensitivity.

The developed method enables the identification and quantification of 14 polymers, including 10 conventional polymers listed in the EU Delegated Decision 2024/1441,[1] and 4 biodegradable polymers. In less than 26 minutes per analysis, this thermoanalytical approach provides a rapid and reliable alternative for the simultaneous detection of MPs and MBPs, compared to conventional microspectroscopic techniques. Analysis of seawater samples revealed the presence of 10 polymers, with concentrations ranging from 0.18 $mg \cdot m^{-3}$ to 116.21 $mg \cdot m^{-3}$, highlighting the occurrence of biopolymers such as polylactic acid (PLA). These results underscore the importance of monitoring biodegradable polymers, previously considered harmless, due to their potential environmental impact.

***Keywords*:** Pyrolysis, MPs, MBPs, MS-acquisition.

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Q-22

CHEM21 TOOLKIT-GUIDED GREEN METRICS AND MECHANISTIC ASSESSMENT OF CA-MOF CATALYZED CYANOSILYLATION AND HYDROBORATION REACTIONS

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Green chemistry metrics such as atom economy (AE), mass intensity (MI), reaction mass efficiency (RME), and carbon efficiency (CE) are commonly employed to quantify the environmental performance of catalytic processes. However, these parameters alone often fail to provide a complete sustainability profile. To address this limitation, the CHEM21 assessment toolkit offers an expanded evaluation framework, assigning green, amber or red flags to each category.[1] We present herein, a comprehensive CHEM21-based evaluation of the cyanosilylation and hydroboration of carbonyl compounds catalyzed by the calcium-based metal-organic framework $\{Ca(BCA)\cdot 2H_2O\}_n$ (H_2BCA = 2,2'-bicinchoninic acid).[2] The catalyst displays excellent recyclability, maintaining high activity over multiple cycles with minimal metal leaching. The overall sustainability profile is remarkably positive, with green flags dominating across the CHEM21 criteria set, particularly in terms of catalyst recovery, metal sourcing, solvent selection, and atom economy. To further explore the mechanistic relevance of Ca(II) as a Lewis acid site, poisoning assays using trimethylamine *N*-oxide, pyridine, and 4-dimethylaminopyridine were conducted. These experiments supported the proposed catalytic mechanism, confirming the active role of accessible Ca(II) sites within the MOF framework.

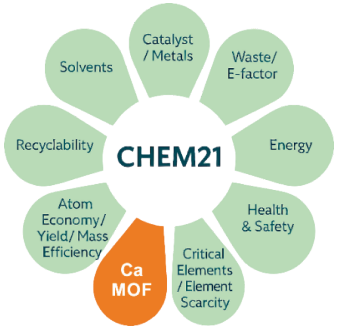

Figure 1. CHEM21 toolkit criteria used for sustainability assessment.

Keywords: Green chemistry, CHEM21 toolkit, MOF, mechanistic studies.

Acknowledgements. This research has been funded by the State Research Agency of the Spanish Ministry of Science, Innovation and Universities (PID2021-126445OB-I00, PID2023-150047OA-I00, CPP2022-009967, CNS2022-135779 and PID2022-139956OB-I00), by the Gobierno de España MCIN/AEI/10.13039/501100011033/FEDER, EU, by the Europena Union "Next Generation EU"/PRTR, Junta de Andalucía (FQM-376, FQM-394 and ProyExcel_00105) and University of Almería (P_LANZ_2024/009). M.E.L-V, P.S.-A., S.R., and J.M.P. acknowledge their FPU (grant no. FPU22/01199), Juan de la Cierva (grant no. JDC2022-048964-I), Ramón y Cajal (grant no. RYC2021-032522-I) and University of Almería (grant no. HIPATIA2021_04) fellowships, respectively.

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Q-23

EMPLOYING MOFs FOR SUSTAINABLE MANAGEMENT AND RECYCLING OF AGROCHEMICALS

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Water pollution is increasingly becoming a challenge due to the presence of novel organic pollutants of anthropogenic origin known as Emerging Organic Pollutants (EOCs).[1] Among them, agrochemicals are substances of particular concern, as they are widely used around the world, their persistence in water systems, and their potential toxicity. In this regard, the European Union, among other agencies, has set a maximum concentration of agrochemicals in drinking water (0.1 and 0.5 $\mu g \cdot L^{-1}$ for a single or the sum of several agrochemicals, respectively). In response to this challenges, metal-organic frameworks (MOFs) have demonstrated exceptional performance in the removal of various EOCs. However, this new research field has plenty of room for improvement, and the potential of MOFs in agrochemicals removal and recovery remains largely unexplored.[2,3]

On the other hand, the archetypal Fe-based MOFs MIL-127, MIL-53-NH_2 and MIL-88B-NH_2 are known for their biocompatibility and adsorptive properties in solution.[2] In this work, the ability of these three MOFs to selectively capture and subsequently release agrochemicals of interest have been studied. The flexible MIL-88B-NH_2 demonstrated outstanding capacity in the elimination of various tested agrochemicals from contaminated water (bentazone, clopyralid, and glyphosate) from contaminated water, even after three cycles, reaching a removal capacity of 73 $mg \cdot g^{-1}$ in the case of the herbicide bentazone. In view of their reutilization, up to the 40% of the herbicide loaded into the MOF can be slowly released in water. Finally, the obtained composites (MOF@Herbicide) were tested to assess their herbicidal activity against *Amaranthus retroflexus*, demonstrating that the materials inhibited root development in the seedlings. This innovative approach explores MOFs as platform for the cycling of agrochemicals, through an adsorption/desorption cycling, **reducing** the quantity of agrochemicals applied in soil and contributing to the sustainable environmental.

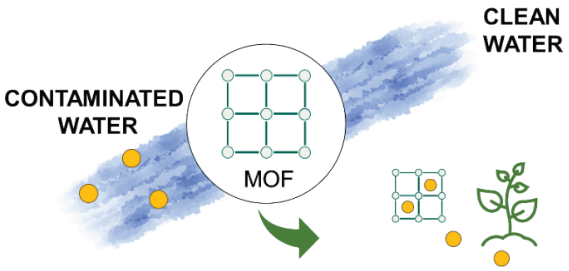

Figure 3. Schematic representation of circular economy of agrochemicals using MOFs.

***Keywords*:** Agriculture, Metal-organic frameworks, Water remediation, Chemistry.

Acknowledgements. Projects MOFCycle (30RP230005) funded by MCIN/AEI/10.13039/501100011033, POR4WATER (PLSQ_2023_00188) concedida por la Consejería de Universidad, Investigación e Innovación de la Junta de Andalucía con cargo al Programa Operativo FEDER de Andalucía 2021-2027, and B-FQM-394.

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Q-24

HACIA UNA NUEVA METODOLOGÍA ANALÍTICA PARA LA CARACTERIZACIÓN INTEGRAL DE PRODUCTOS FITOSANITARIOS

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Los productos fitosanitarios (PPPs) son grandes aliados de la agricultura moderna gracias a su elevada efectividad en control de plagas. Están compuestos de una o más sustancias activas, habitualmente plaguicidas, y de múltiples aditivos, destacando los coformulantes. Dichos aditivos pueden ser disolventes, tensoactivos, emulsificantes, protectores, o amplificadores del efecto de sustancias activas (sinergistas), entre muchas otras, combinándose un elevado número de ellos durante la fabricación de PPPs.

Si bien dichos aditivos representan habitualmente más del 80 % (p/v) del contenido de los PPPs, la normativa permite a fabricantes no revelar su composición,[1] a pesar de que diversos estudios alertan de sus posibles efectos nocivos.[2] Con todo, a nivel europeo tan solo 144 aditivos se encuentras prohibidos a través del Reglamento EC 2021/383. Dada la preocupación que todo ello suscita, resulta fundamental desarrollar metodologías analíticas que permitan la caracterización de aditivos presentes en PPPs.

Con este fin se propone una metodología analítica novedosa con un flujo de trabajo que integra preparación de muestra, análisis de la muestra, validación del método, identificación tentativa, cuantificación, y que permite el análisis de compuestos de diferente polaridad y volatilidad a través de técnicas como la cromatografía de gases y cromatografía de líquidos, acopladas a espectrometría de masas de alta resolución Q-Orbitrap-HRMAS, empleando diferente métodos de adquisición, como adquisición independiente de datos (DIA) o Full Scan MS.

Asimismo, la metodología propuesta gira en torno al novedoso y potente análisis de desconocidos (unknown analysis), responsable de la identificación de la mayoría de aditivos, el cual se combina con el clásico análisis dirigido (target analysis) para maximizar la identificación de aditivos en PPPs. Adicionalmente, se proporciona una serie de valiosos criterios y niveles de confianza para la identificación tentativa de aditivos, en los casos en los que no se disponga de patrón analítico.

La metodología desarrollada se aplicó en el análisis de 15 PPPs de difenoconazol y clorantraniliprol, identificándose tentativamente 120 aditivos, de los cuales 21 fueron confirmados y cuantificados mediante patrones analíticos, siendo pentametilbenceno y dodecilbencenosulfonato de sodio los más frecuentes. Los aditivos analizados mediante GC-HRMS y HPLC-HMRS, tras la confirmación mediante patrón analítico, presentaron una tasa de identificación correcta del 92% y 100% respectivamente, lo que demuestra la elevada eficacia de la metodología propuesta, que no solo se limita a aditivos a PPPs, sino que dada su versatilidad puede ser de gran utilidad para la caracterización de diversos analitos y muestras en otros contextos analíticos.

***Palabras clave*:** Coformulantes, productos fitosanitarios, HPLC-MS, GC-MS.

Agradecimientos. Los autores agradecen al Ministerio de Economía y Competitividad y a FEDER-EU (project ref. PID2019-106201RB-I00) por el apoyo financiero. RLR agradece a la Consejería de Transformación Económica, Industria, Conocimiento y Universidades de la Junta de Andalucía por el apoyo financiero (Ayudas para Captación, Incorporación y Movilidad de Capital Humano de I+D+I, PAIDI 2020). AJMR agradece al Ministerio de Universidades por el apoyo financiero (FPU, ref FPU19/04260).

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Q-25

URINE2SERUM: AN INDIRECT NMR-BASED MACHINE LEARNING STRATEGY FOR COVID-19 DIAGNOSIS USING URINE NMR PROFILES

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Current diagnostic methods for Coronavirus disease 2019 (COVID-19) are effective, but limited by turnaround time, sensitivity, and patient discomfort. Urine provides a non-invasive, stable, self-collectable alternative matrix, making it an attractive candidate for developing large-scale, patient-friendly diagnostic approaches based on metabolic fingerprints. However, unlike serum—whose metabolic profile reliably reflects systemic host responses—urine composition is highly influenced by diet and lifestyle. In this study, we propose Urine2Serum, an indirect diagnostic framework that employs ^{1}H NMR metabolomic data and machine learning (ML) to infer serum metabolic profiles from urine spectra. A regression model was trained to reconstruct serum profiles from urine data, achieving moderate but encouraging predictive accuracy. To demonstrate its validity, these reconstructed ("virtual") serum profiles were subsequently used as inputs for ML classifiers aimed at diagnosing COVID-19 and predicting disease severity. Remarkably, the resulting indirect models achieved performance comparable to those trained on experimentally measured serum profiles. Urine2Serum demonstrates that integrating metabolomics with ML can transform non-invasive urinary data into clinically informative serum surrogates, opening new perspectives for accessible, patient-friendly, and scalable diagnostics within precision medicine.

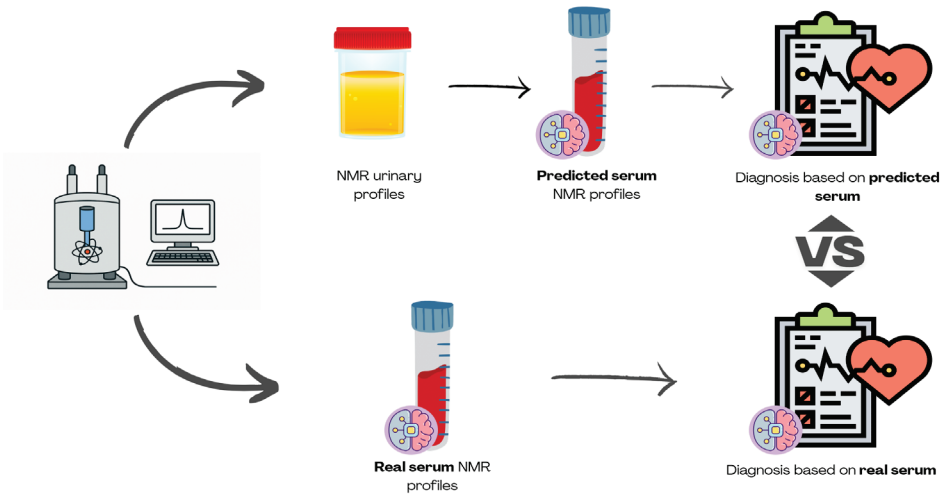

Figure 1. Schematic overview of the study workflow. Urine ^{1}H NMR profiles were used to predict serum metabolomic profiles, which were then employed as inputs for machine learning models designed to diagnose COVID-19 and predict disease severity.

Keywords: Metabolomics, Machine Learning, Data Analysis, NMR spectroscopy, COVID-19

Acknowledgements. This research was funded by the State Research Agency of the Spanish Ministry of Science, Innovation and Universities (PID2021-126445OB-I00, PID2023-150047OA-I00 and CPP2022-009967), by the Gobierno de España MCIN/AEI/10.13039/501100011033/FEDER, EU, and by the European Union "Next Generation EU"/PRTR.

Q-26

AIRBORNE TRANSPORT AND CHARACTERIZATION OF MICROALGAL BIOAEROSOLS GENERATED IN RACEWAY AND TUBULAR PHOTOBIOREACTORS

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The increasing demand for natural products has attracted special attention to microalgal biomass, which is often cultivated in open ponds. These systems are vulnerable to biological contamination, which reduces both the yield and quality of the biomass. The contamination process, particularly through airborne transport of unwanted microalgae, fungi, or bacteria, is poorly understood. In this study, bioaerosols were collected in quartz filters through a low-volume sampler located at different locations at the CIESOL demonstration plant (Almeria, Spain). The samples were analysed using metagenomics and SEM-EDS to assess the number of cells and the microbial diversity of the filters. The results revealed airborne transport of microalgae across different locations, with a gradual decrease in cell numbers as the distance from the source increased ($p < 0.05$). Additionally, although different microalgal strains were detected in the filters, the most abundant belonged to the *Chlorellaceae* family. The results of this study highlight, for the first time, that the paddlewheels of raceway ponds and the bubbling columns of tubular reactors act as significant sources of bioaerosols, which have the potential to travel considerable distances and contaminate open ponds and even closed photobioreactors.

***Keywords*:** microalgae, bioaerosols, airborne transport, contamination.

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Q-27

SÍNTESIS Y CARACTERIZACIÓN DE COMPLEJOS DE Ru(II) CON *p*-CIMENO, FENANTROLINA Y DERIVADOS DE 1,3,5-TRIAZA-7-FOSFAADAMANTANO

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Dos de los principales escollos a los que deben hacer frente los fármacos tradicionales empleados en regímenes de quimioterapia contra el cáncer son la farmacorresistencia y los indeseables efectos secundarios.[1] Una de las alternativas a los tratamientos anticancerígenos tradicionales se basa en las fototerapias, donde se administran fármacos que son activados únicamente en la región de interés tras ser irradiados con luz visible de una longitud de onda adecuada.[2]

Con estas premisas, en este trabajo se ha sintetizado y estudiado la fotoreactividad de una serie de complejos tipo RAPTA (Rutenio-Areno-PTA) con los ligandos *p*-cimeno, fenantrolina (phen) y derivados de la fosfina hidrosoluble 1,3,5-triaza-7-fosfaadamantano (PTA). Estos complejos, con fórmula $[Ru(L)(\eta^6\text{-}p\text{-cym})(phen)](CF_3SO_3)_n$ (L = mPTA, n = 3 (**2**); DAPTA, n = 2 (**3**); HdmoPTA, n = 3 (**4**); $[ZnCl_2(\kappa^2N,N'\text{-dmoPTA})]$, n = 2 (**5**)), se han preparado por sustitución de ligando a partir del complejo $[Ru(OH_2)(\eta^6\text{-}p\text{-cym})(phen)](CF_3SO_3)_2$ (**1**), y se han caracterizado por resonancia magnética nuclear, FT-IR y ultravioleta visible, así como por difracción de rayos-X de monocristal. El estudio de UV-vis reveló que los complejos tienen una banda de absorción en el rango del visible, cuyos máximos están comprendidos entre 360 y 370 nm, con caída en 450-500 nm. Ensayos de irradiación con luz visible de disoluciones acuosas de los complejos **1**-**5** durante 72 h mostraron la formación de especies de color azulado y la descoordinación del ligando fosfina, proponiéndose que las especies formadas estén compuestas por complejos dimetálicos Ru(II)/Ru(II), observados por espectrometría de masas y potencialmente activos para la oxidación catalítica del agua.[3,4]

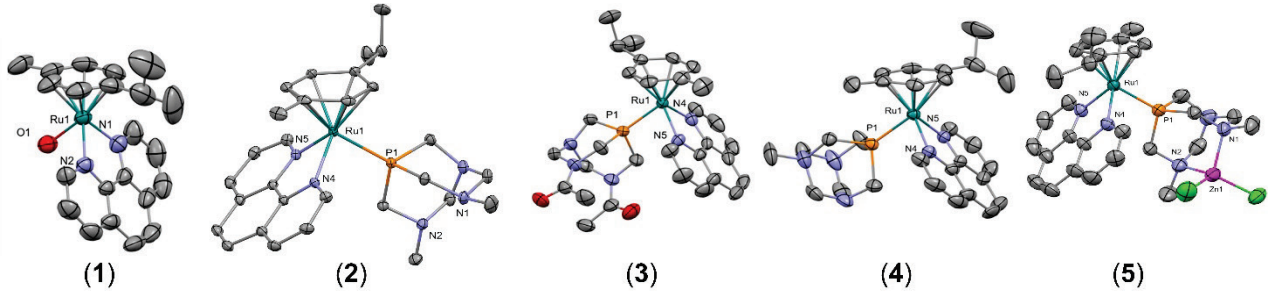

Figura 1. Estructuras cristalinas de los complejos sintetizados en este trabajo.

Palabras clave: Rutenio, fototerapia, cáncer, fosfinas hidrosolubles.

Agradecimientos. F. Martín agradece al Ministerio de Educación, Formación Profesional y Deportes por la Beca de colaboración en Departamentos Universitarios 24CO1/007377 así como al ceiA3 por la Beca para la Realización de Prácticas de Grado en Empresas.

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Q-28

THE EFFECT OF HALOGEN SUBSTITUTION ON THE ANTIPROLIFERATIVE ACTIVITY OF MONO- AND HETEROMETALLIC RAPTA-TYPE COMPLEXES

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Cancer remains one of the leading causes of mortality worldwide, and the emergence of resistance to conventional chemotherapeutic agents continues to represent a major challenge in oncology.[1] The investigation of transition metal-based cytotoxic compounds capable of overcoming this limitation has therefore become a critical point in contemporary bioinorganic chemistry. In this context, we have previously reported that RAPTA-type complexes, in which a ruthenium center is bridged to a secondary metal unit through a bidentate ligand, exhibit enhanced selectivity toward multiple cancer cells lines as a consequence of synergistic interactions between the two metal centers. [2] The PTA-derived ligand dmoPTA (3,7-dimethyl-1,3,7-triaza-5-phosphabicyclo[3.3.1]nonane) is able to chelate an additional metal center,[3,4] giving rise to the most active heterometallic species synthesized to date by us, with IC_{50} values in the range of 20-41 nM.[5]

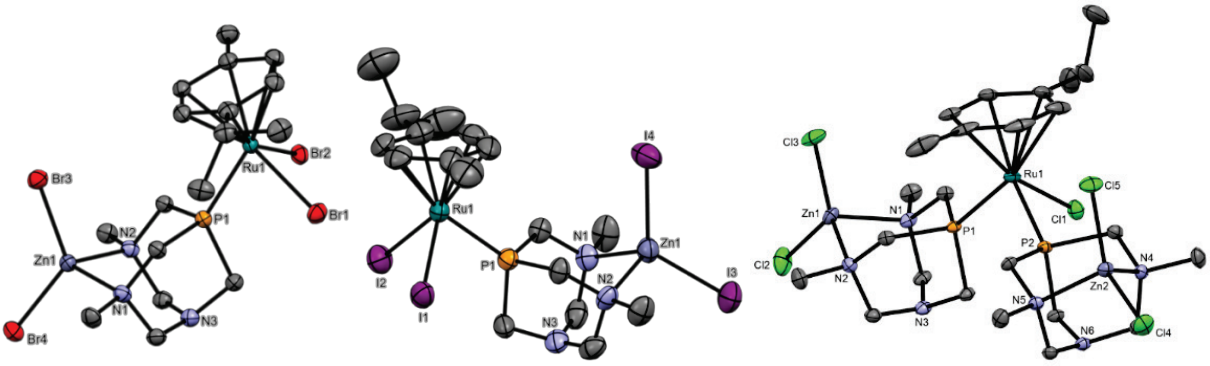

Figure 1. Crystal structures of RAPTA-type heterometallic synthesised complexes.

Building upon these findings, and in order to advance the design of novel complexes exhibiting notable antiproliferative properties and to understand their underlying mechanisms of action, we have developed a new series of monometallic precursor complexes with the general formula $[Ru(\eta^6\text{-}C_{10}H_{14})(L)(L')(L'')]^{n+}$ (L = Cl, Br, I; L' = Br, I, HdmoPTA; L'' = HdmoPTA, dmoPTA; n = 0-3) as starting points for subsequent heterodimetallic complexes with enhanced cytotoxic activity $[Ru(\eta^6\text{-}C_{10}H_{14})(X)_2(\mu\text{-dmoPTA-1}\kappa P\text{:2}\kappa^2 N,N'\text{-}ZnX_2)]$ (X = Br, I), and also a new generation of novel heterotrimetallic complexes (**Figure 1**).

***Keywords*:** Ruthenium, Halogen, Zinc, PTA derivatives, RAPTA, heterometallic complexes, antiproliferative activity.

Acknowledgements. A. Martinez-Aguilera acknowledges the FPU fellowship (grant FPU22/00921).

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Q-29

A. aerophoba: A MEDITERRANEAN RESERVOIR OF BROMINATED COMPOUNDS

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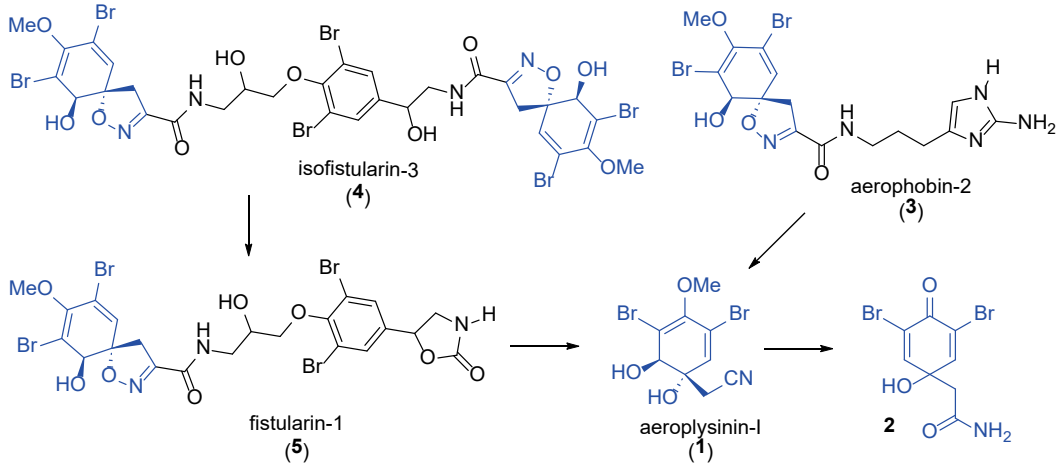
Marine sponges (Phylum Porifera) are benthic invertebrates of great ecological and biotechnological significance and rank among the most prolific sources of marine natural products, producing a wide range of structurally diverse and bioactive metabolites with pharmaceutical and industrial potential. However, many populations are threatened by climate change, overexploitation, and recurrent disease outbreaks. The Mediterranean sponge *Aplysina* (formerly *Verongia*) *aerophoba* (Schmidt, 1862) typically inhabits shallow marine environments, being found at depths as little as 1 m and it is protected under various legal frameworks, notably the Barcelona and Bern Conventions.[1] To date, 26 brominated compounds have been isolated from this sponge.[2] Structurally, these metabolites can be classified into several groups, including spiroisoxazolines, dibromocyclohexadienes, verongiaquinols, verongiabenzenoids, cavernicolins, bromotyrosine lactone derivatives, bromotyramines, bromotyrosine ketals, oxazolidinones, and related structures. These brominated metabolites represent a remarkable example of marine chemical diversity rarely encountered in nature.

Low-molecular-weight compounds such as aeroplysinin-1 (**1**) and the corresponding dienone (**2**) are enzymatic degradation products of aerophobin-2 (**3**) and isofistularin-3 (**4**), which is first converted into fistularin-1 (**5**). This transformation occurs when cellular compartmentalization in sponge tissue is disrupted. These degradation products display markedly higher antibacterial and cytotoxic activities than their biosynthetic precursors, which generally exhibit little or no biological activity. This enzyme-mediated conversion constitutes a rapid, wound-activated chemical defense mechanism, which likely accounts for the low incidence of fish predation observed in these sponges.[3]



Scheme 1. Biotransformation of brominated compounds in *Aplysina aerophoba*.

***Keywords*:** *Aplysina aerophoba*, Mediterranean sponge, brominated metabolites.

Acknowledgements. We thank "CIAIMBITAL" and "CeiA3" for their support and Junta de Andalucía for the Predoctoral Contract DGP_PRED_2024_02216.

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Q-30

DESIGN AND SYNTHESIS OF COORDINATION POLYMERS AS POTENTIAL ANTICANCER AGENTS

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Cancer is a life-threatening disease characterized by abnormal cell growth and uncontrolled division, often leading to invasion of nearby or distant tissues. It remains the second cause of mortality worldwide.

Metal-based compounds have played a central role in anticancer therapy since the discovery of cis-platin, one of the most widely used chemotherapeutic agents. Despite its clinical success, the severe side effects and drug resistance associated with platinum complexes have prompted the search for new coordination compounds that combine biocompatibility, stability, and selectivity. In this context, coordination polymers (CPs) have emerged as attractive systems due to their modular structures, chemical versatility, and ability to act as drug carriers or bioactive agents.[1,2]

In our aim to synthetize more efficient coordination polymers (CPs), different ligands with relevant pharmacological properties were selected, focusing on cinnamic acid and pyrazole derivatives as functional organic linkers capable of providing both structural stability and biological activity. Cinnamic acid derivatives, known for their broad pharmacological profile, low toxicity, and antitumoral and antimetastatic effects, were represented by the selected ligand trans-3,4-difluorocinnamic acid (HDFCA), which enhances framework stability through its aromatic and carboxylic functionalities. Similarly, pyrazole derivatives exhibit diverse biological and anticancer activities; the chosen ligand, 4-nitro-1H-pyrazole, contains a nitro group with strong electron-withdrawing character, often associated with enhanced biological reactivity and potential pharmacological activation.[3,4] A new Zn-based coordination polymer, $[Zn(DFCA)(4\text{-}NO_2\text{-}pz)]_n$, was synthesized and characterized by single cristal diffraction as a 1D network formed through carboxylate and pyrazolate bridges.

Additionally, stability studies in aqueous media indicated a controlled and sustained release profile of both ligands, supporting its potential as a drug delivery system. Finally, preliminary antitumoral activity assays on HT-29 human colon cancer cells were performed, showed promising cytotoxic behavior and suggested the possible involvement of non-apoptotic cell death mechanisms.

These results demonstrate the potential of $[Zn(DFCA)(4\text{-}NO_2\text{-}pz)]_n$ as promising candidates for the development of advanced anticancer treatments.

***Keywords*:** Cancer, Coordination polymers, Controlled release, Antitumoral activity.

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Q-31

IDENTIFICACIÓN DE MARCADORES PARA LA AUTENTICACIÓN DE LA MIEL MEDIANTE METABOLÓMICA BASADA EN ESPECTROMETRÍA DE MASAS DE ALTA RESOLUCIÓN Y FUSIÓN DE DATOS

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La miel es un alimento natural muy valorado por su sabor dulce y sus propiedades organolépticas y medicinales. Su perfil sensorial, especialmente el sabor y el aroma, depende principalmente del origen floral y de la presencia de compuestos volátiles específicos. Según su procedencia botánica, puede clasificarse como monofloral, cuando proviene mayoritariamente de una sola especie floral, o multifloral, cuando el néctar procede de diversas fuentes. Dado que el origen floral influye significativamente en la composición química, la calidad y el valor económico de la miel, resulta esencial desarrollar métodos analíticos precisos que permitan verificar su autenticidad y prevenir posibles fraudes.[1]

En este estudio se desarrolló un enfoque metabolómico no dirigido basado en cromatografía de gases acoplada a espectrometría de masas de alta resolución (GC-Orbitrap-HRMS), con el objetivo de diferenciar los orígenes botánicos de mieles comercializadas en España, específicamente de eucalipto, romero, azahar y multifloral. Para la caracterización del perfil metabólico, se aplicó una extracción líquido-líquido asistida por sales (SALLE) y se emplearon herramientas estadísticas multivariantes, incluyendo el análisis de componentes principales (PCA) y el análisis discriminante ortogonal de mínimos cuadrados parciales supervisado (OPLS-DA). Los modelos obtenidos mostraron una excelente capacidad predictiva ($R^2Y > 0,8$ y $Q^2 > 0,7$), con tasas de clasificación comprendidas entre el 94 % y el 100 %. Se identificaron siete metabolitos previamente no descritos en la literatura científica, clasificados como marcadores de nivel 2 según la Iniciativa de Estándares Metabolómicos (MSI), es decir, compuestos anotados de forma tentativa o con estructuras probables. Estos metabolitos se evaluaron mediante comparaciones entre los diferentes tipos de miel: azahar frente a eucalipto, romero frente a eucalipto, romero frente a azahar, y miel multifloral frente a mieles monoflorales. Los marcadores identificados incluyeron deshidrovomifoliol, 3-oxo-α-ionona, 1,2-dihidro-1,1,6-trimetilnaftaleno, cafeína y 4-cetoisoforona. Las tres primeras se encontraron en concentraciones más altas en la miel de eucalipto, mientras que la cafeína y la 4-cetoisoforona fueron características de la miel de azahar. En la discriminación entre mieles monoflorales y multiflorales destacaron deshidrovomifoliol, 4-cetoisoforona, 3-oxo-α-ionona, 1,2-dihidro-1,1,6-trimetilnaftaleno, 3-oxo-7,8-dihidro-α-ionona y 4-metilenoisoforona, con mayor acumulación en las mieles monoflorales, lo que refleja su mayor complejidad organoléptica.

Asimismo, se integraron los resultados de GC-Orbitrap-HRMS con los obtenidos mediante UHPLC-Q-Orbitrap-HRMS, [2] demostrando la complementariedad entre ambas técnicas y mejorando la capacidad discriminante del modelo. Este trabajo evidencia el potencial del enfoque metabolómico no dirigido para autentificar la miel según su origen botánico e identificar nuevos marcadores útiles para la diferenciación precisa de variedades comerciales.

***Palabras clave*:** Cromatografía de gases, Metabolómica no dirigida, Quimiometría, Fusión de datos.

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Q-32

EVALUACIÓN DE LA EXPOSICIÓN HUMANA A LOS CONTAMINANTES ATMOSFÉRICOS EN LA POBLACIÓN EN EDAD ESCOLAR

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Los contaminantes ambientales son causantes de una gran preocupación debido a sus impactos negativos sobre el medio ambiente y sobre la salud. Por ello, en este trabajo se han estudiado en adolescentes tres grupos de contaminantes distintos: plaguicidas, PAHs (Hidrocarburos Policíclicos Aromáticos) y FRs (Retardantes de Llama), empleando para ello un muestreador pasivo combinado, que consiste en una pulsera de silicona que porta otro muestreador a base de Tenax®, analizados mediante GC-MS/MS y LC-MS/MS.

En primer lugar, en este estudio se han comparado ambos muestreadores, silicona y Tenax®, analizando 206 plaguicidas, 33 PAHs y 10 FRs en muestras reales obtenidas de niños de entre 12 y 16 años en colegios de Madrid y Almería.

Tras analizar los plaguicidas, PAHs y FR en la silicona en el Tenax®, se ha observado que en la silicona se obtiene un mayor número de positivos de los tres tipos de contaminantes estudiados que en el Tenax®, aunque cabe destacar que las pulseras tienen más interferentes que dificultan el análisis de algunos compuestos y ensucian más el equipo, requiriendo mayor mantenimiento de este.

En segundo lugar, se han comparado los datos de contaminación de las muestras de Madrid con respecto a las de Almería. En Madrid en la mayoría de las muestras se han detectado menos de 2 plaguicidas, mientras que en la mayoría de las muestras de Almería se han detectado 2 o más plaguicidas. En el caso de los PAHs y Retardantes de llama se ha evaluado la carga total de cada uno de ellos en cada muestreador y se ha observado que tanto PAHs como de FRs tienen una carga mayor en las muestras de Madrid que en las de Almería.

Atendiendo el numero de detecciones y la concentración de los contaminantes, la permetrina ha sido el plaguicida más detectado, y el segundo con mayor concentración media después del DEET; mientras que de los PAHs, los más detectados han sido el 1-methylnaphthalene, el 2-methylnaphthalene y el phenanthrene, siendo el de mayor concentración media este ultimo y en el caso de los retardantes de llama, los que se han detectado un mayor numero de veces son el DPEHP y el TPP, mientras que el que se ha detectado a mayor concentración ha sido el TBEP.

Se utilizaron encuestas realizadas a los alumnos y la localización geográfica de los colegios para justificar los datos obtenidos y evaluar posibles fuentes de emisión.

***Palabras clave*:** plaguicidas, hidrocarburos policíclicos aromáticos, retardantes de llama, muestreador pasivo, GC-MS/MS, LC-MS/MS.

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Q-33

REACTOR FLUJO DE VÓRTICES EN LECHO EXPANDIDO: UNA SOLUCIÓN SOSTENIBLE PARA EL DESAMARGADO DE ZUMO DE NARANJA CON PULPA

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El desamargado del zumo de naranja con pulpa continúa siendo un desafío tecnológico, ya que los métodos convencionales de clarificación y adsorción requieren zumos previamente filtrados, lo que elimina la pulpa y altera sus propiedades nutricionales y organolépticas. Estas limitaciones han impulsado el desarrollo de nuevas alternativas para el tratamiento del zumo natural, capaces de preservar su calidad nutricional y sensorial. En este contexto, el reactor de flujo de vórtice en lecho expandido (RFV-EB) se propone como una tecnología innovadora y sostenible, que permite eliminar etapas convencionales como la clarificación y el calentamiento, evitando la formación de canales preferentes y obstrucciones propias de las columnas de adsorción utilizadas tradicionalmente en la industria para el desamargado del zumo de naranja.[1] Además, su aplicación contribuye al cumplimiento de los Objetivos de Desarrollo Sostenible (ODS) 6, 7, 9 y 12 al reducir la necesidad de procesos térmicos, los ciclos de limpieza CIP y la cantidad de equipos involucrados, lo que se traduce en un menor consumo de agua y energía, así como en una reducción significativa de la huella de carbono y promover el consumo sostenible de zumo a partir del exceso de producción de naranjas. La figura 1 resume el impacto de los ODS en la evolución del proceso de desamargado desde la perspectiva de los cambios implementados en la etapa de adsorción al sustituir una columna convencional por el RFV-EB.

En este trabajo se realizan estudios visuales de expansión del adsorbente y de formación de vórtices en el RFV-EB, utilizando partículas de mica dorada como trazador visual. Estos ensayos permiten analizar el comportamiento fluidodinámico del reactor, identificar el régimen de flujo laminar con vórtices de Taylor y determinar el rango óptimo de parámetros de operación, como la altura del lecho, la velocidad axial y la rotación del cilindro interno. Con las condiciones obtenidas, se desarrollan los ensayos de desamargado del zumo de naranja con pulpa, determinándose la concentración de limonina tras el tratamiento. Los resultados muestran una reducción de la limonina a valores inferiores a 5 ppm, umbral aceptable para el paladar humano, preservando las propiedades organolépticas del producto. Esto confirma la viabilidad del RFV-EB como una tecnología eficiente, sostenible y alineada con los ODS, destinada al procesamiento de zumos naturales con pulpa.

Figura 1. Impacto de los ODS en la evolución del proceso de desamargado desde la perspectiva de los cambios implementados en la etapa de adsorción al sustituir una columna convencional por el RFV-EB.

Palabras clave: *Reactor Flujo de Vórtices, Zumo de Naranja con Pulpa, Objetivos de Desarrollo Sostenibles*.

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Q-34

EMPLEO DE DISOLVENTES EUTÉCTICOS PROFUNDOS NATURALES (NADES) JUNTO CON TÉCNICAS MINIATURIZADAS PARA EXTRACCIONES SOSTENIBLES DE BIOPLAGUICIDAS EN AGUA

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En los últimos años con el auge de la producción integrada y agricultura ecológica se ha empezado a sustituir el uso de plaguicidas convencionales por plaguicidas derivados de compuestos naturales o bioplaguicidas. Sin embargo, el análisis de estos bioplaguicidas en muestras agroalimentarias se realiza empleando disolventes orgánicos que suelen ser tóxicos como *n*-hexano o cloroformo.[1,2] Estos disolventes no cumplen los principios de la química analítica verde,[3] poniendo en riesgo al operador y el medio ambiente. Por ello, en este estudio se ha evaluado la eficacia derivada de la sustitución de los disolventes convencionales por otros considerados más sostenibles, como son los disolventes eutécticos profundos naturales (NADES). Éstos están formados por azúcares, aminoácidos, etc., que, al mezclarse, forman un líquido, presentando bajos puntos de fusión. Además, con el fin de reducir el volumen de disolvente y de muestra usados se ha evaluado el uso de técnicas de microextracción.

En concreto, se ha estudiado la extracción de bioplaguicidas derivados de extractos vegetales como piretrinas, 1,8-cineol, alcanfor, rotenona, entre otros en muestras de agua. Como técnica de extracción se ha empleado una microextracción líquido-líquido dispersiva junto con la formación de una gota orgánica flotante (DLLME-SFOD). Para ello, se ha empleado 1-dodecanol como agente extractante, el cual solidifica a temperatura ambiente, y se han evaluado diferentes NADES hidrofílicos como agentes dispersivos. Para la determinación de los bioplaguicidas se utilizó cromatografía de gases para los compuestos más volátiles, y cromatografía de líquidos para los menos volátiles, ambas acopladas a un analizador de espectrometría de masas de alta resolución tipo cuadrupolo (Q)-Orbitrap. La optimización del método se realizó primero de forma univariable para seleccionar el NADES y la sal óptimos, y después se realizó una optimización multivariable para el resto de variables independientes del método. Se determinó que los parámetros óptimos para esta extracción fueron: 120 µL de 1-dodecanol como volumen de extractante, 2 mL del NADES cloruro de colina:urea:agua (relación molar 1:2:3) como agente dispersivo, 0.5 g de sulfato de sodio y 20 min de tiempo de extracción. Los bioplaguicidas estudiados presentaron límites de cuantificación (LOQs) bajos, entre 1 y 25 µg/L, con recuperaciones entre el 71-110% y una precisión inferior al 20%. Finalmente, se evaluó la sostenibilidad del método desarrollado comparándolo con otro método similar de extracción de bioplaguicidas mediante DLLME.[1] Para ello, se empleó la métrica de sostenibilidad para la preparación de muestras (SPMS),[4] obteniéndose que el método desarrollado presentaba mejor puntuación y por tanto una mayor sostenibilidad. Se ha demostrado que se pueden extraer bioplaguicidas de muestras de agua con buenos valores de recuperación empleando técnicas y disolventes más sostenibles

***Palabras clave*:** Bioplaguicidas, NADES, agua, extracción sostenible.

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Q-35

REDUCTION OF PYRUVIC ACID IN WATER BY TRANSFER HYDROGENATION FROM FORMIC ACID AND SODIUM FORMATE CATALYZED BY $[RuCp(H_2O)(mPTA)_2](CF_3SO_3)_3$

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Among the most significant reactions in the chemical industry, catalytic reduction by gaseous hydrogen is particularly noteworthy. These reactions are well established and exhibit excellent conversion efficiencies; however, their implementation requires stringent safety measures and costly infrastructure due to the use of pressurized hydrogen. In this study, the catalytic activity of the complex $[RuCp(H_2O)(mPTA)_2](CF_3SO_3)_3$ (Cp = cyclopentadienyl; mPTA = *N*-methyl-1,3,5-triaza-7-phosphaadamantane) [1] (**1**) was evaluated for the hydrogenation of pyruvic acid via hydrogen transfer from formic acid and sodium formate in aqueous media (**Figure 1**). Key parameters investigated included the molar concentration of complex **1** (ranging from 2 to 0.2 mol%), substrate concentration in water (0.4 to 0.1 M), and temperature (25 to 80 °C). The highest turn over number (TON) and turn over frequency (TOF) obtained were 470 and 2640 h^{-1}, respectively, the latter value being the highest reported to date[2]. The species in the reaction mixture were characterized, being the cyclic dilactone 3,6-dihydroxy-3,6-dimethyl-1,4-dioxane-2,5-dione (**V**) one of the most significant formed product as evidences support that its possible stereoisomeric forms (D, L and meso-**V**) are generated in the reaction (**Figure 2**).

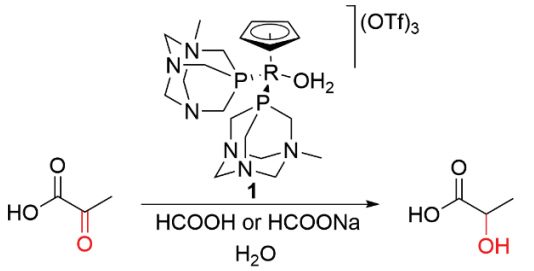

Figure 1. Transfer hydrogenation reaction of pyruvic acid catalyzed by **1**.

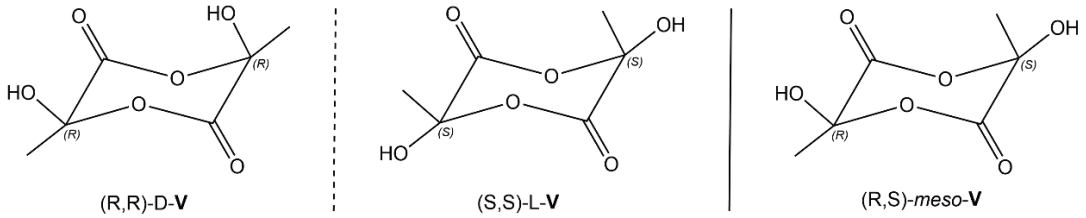

Figure 2. Compound **V** and its stereoisomeric forms.

***Keywords*:** Transfer hydrogenation, formic acid and sodium formate, homogeneous catalysis, ruthenium complexes, water.

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Q-36

DISTINCT METABOLIC SIGNATURES IN TOMATO LEAVES UNDER INFESTATION BY THREE MAJOR GREENHOUSE PESTS

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Tomato (*Solanum lycopersicum*) plants are highly susceptible to multiple arthropod pests that threaten global production by reducing yield and compromising fruit quality. Early detection remains a major challenge, and metabolomics represents a promising strategy to identify biochemical indicators of stress and to capture early and differential metabolic responses to pest attack, offering new insights and potential markers for improved pest monitoring and management in tomato cultivation.

In this study, we employed ^{1}H NMR metabolomics to characterize the reprogramming molecular fingerprint of tomato leaves infested by three major pests (*Aculops lycopersici*, *Bemisia tabaci*, and *Frankliniella occidentalis*) under controlled greenhouse conditions. Leaf extracts were prepared using a methanol–phosphate buffer solution (1:1, v/v) containing TSP as an internal standard. NMR acquisition was performed on a Bruker Avance III 600 MHz spectrometer equipped with a 5 mm quadruple QCI cryoprobe and high throughput thermostated autosampler. Multivariate orthogonal partial least squares discriminant analysis (OPLS-DA) models of NMR data of these leaves revealed both common and pest-specific alterations, including changes in sugars, amino acids, organic acids, fatty acids, sterols, and glycoalkaloids, with *A. lycopersici*-infested leaves showing the greatest metabolic differentiation (**Figure 1**). Additionally, partial least squares (PLS) regression models revealed specific markers associated with infestation severity for *B. tabaci*, and *F. occidentalis,* including some amino acids, α-tomatine, rutin and hydroxycinnamic acids.

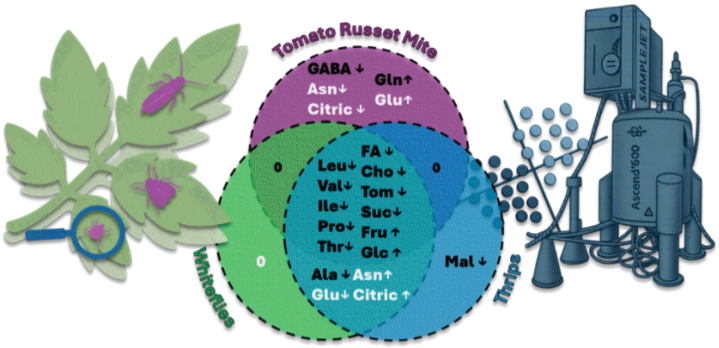

Figure 1. Venn diagram showing shared, specific, and differential metabolites (VIP > 1 from OPLS-DA analyses) among *A. lycopersici*, *B. tabaci*, and *F. occidentalis*.

Keywords: NMR, metabolomics, tomato, *Aculops lycopersici*, *Bemisia Tabaci*, *Frankliniella occidentalis*.

Acknowledgements. This research was funded by the State Research Agency of the Spanish Ministry of Science, Innovation and Universities (PID2021-126445OB-I00, PID2023-150047OA-I00 and CPP2022-009967), by the Gobierno de España MCIN/AEI/10.13039/501100011033/FEDER, EU, and by the European Union "Next Generation EU"/PRTR. A.C.A. acknowledges the Junta de Andalucía for the postdoctoral Emergia grant (DGP_EMEC_2023_00195). A.M.S. thanks the support of the Erasmus+ KA131 grant for carrying out her predoctoral stay in Leiden University.

Q-37

NMR-BASED METABOLOMIC PROFILING OF PEACH AND CAULIFLOWER UNDER CONVENTIONAL AND EPIGEN® TREATMENTS

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The integration of metabolomics with innovative agronomic technologies provides valuable insights into the biochemical mechanisms influencing fruit quality and stress responses. In this study, ^{1}H NMR-based metabolomics was employed to evaluate the metabolic impact of Epigen® biostimulant treatments compared to conventional cultivation in two crops: peach (*Prunus persica*) and cauliflower (*Brassica oleracea var. botrytis*). Polar extracts were prepared using a methanol:phosphate buffer (1:1) mixture and analyzed on a 600 MHz spectrometer. After metabolite identification and quantification, multivariate analysis (PCA, PLS-DA) was performed. Discriminant features (VIP > 1) were identified and represented in heatmaps and VIP plots.

Clear treatment-dependent metabolic differences were observed in both species. In peach, Epigen®-treated fruits showed higher concentrations of amino acids, organic acids, and sugars than conventional counterparts. In cauliflower, Epigen® mainly increased amino acids, while sugars, organic acids, and fatty acids remained comparable between treatments. Overall, the results demonstrate that Epigen® technology modulates primary metabolism, promoting biochemical profiles linked to fruit quality and physiological performance.

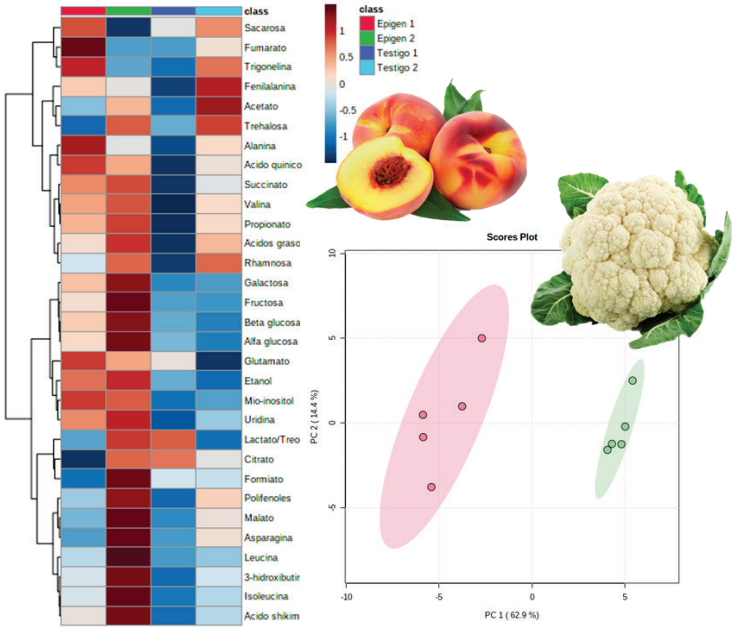

Figure 1. Overview of metabolomic differences between treatments. The heatmap highlights discriminant metabolites in peach samples, while the PLS-DA plot shows clustering patterns in cauliflower.

***Keywords*:** NMR Metabolomics, Peach, Cauliflower, Epigen®, Multivariate Analysis, Crop Quality.

Acknowledgements. This research was funded by the State Research Agency of the Spanish Ministry of Science, Innovation and Universities (PID2021-126445OB-I00, PID2023-150047OA-I00 and CPP2022-009967), by the Gobierno de España MCIN/AEI/10.13039/501100011033/FEDER, EU, and by the European Union "Next Generation EU"/PRTR. A.I.T and A.C.A. acknowledges the Junta de Andalucía for the predoctoral (PREDOC_01024) and the postdoctoral Emergia grant (DGP_EMEC_2023_00195), respectively.

Q-38

COMPARISON OF THE QUALITY OF DRINKING WATER FROM FOUR (4) SANITATION SERVICE ADMINISTRATIVE BOARDS IN SANTO TOMÁS, CHUMBIVILCAS - CUSCO

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The quality and supply of drinking water is a growing concern worldwide, with millions of people facing the reality that the water they consume may not meet basic safety standards. Ensuring access to safe drinking water has become a critical challenge, as factors such as climate change, pollution and population growth affect the availability and quality of drinking water.[1] The objective of this study was to compare the quality of of water for human consumption from from the four (4) sanitation service management boards (JASS) of Pfullpuri, Q'enko, Soñaqque and Q'ello Q'ello in the district of Santo Tomás, province of Chumbivilcas, Cusco, Perú, with the Maximum Permissible Limits of MINSA,[2] Environmental Quality Standards (ECA) of MINAN[3] and international standards. Physicochemical parameters (pH, ORP, electrical conductivity, total dissolved solids, turbidity, dissolved oxygen, chlorides, total hardness, alkalinity, acidity, sulphates, free chlorine and total chlorine) and metals (Na, Ca, K, Mg, Cr, Zn, Al, Cu, Fe, Pb, Ba, Ni and Mn) have been determined in 43 samples collected from drinking water systems. Equipment such as a colorimeter (DR900), oximeter (HI98193), pH meter (HI 9125), conductivity meter (HI9835) and microwave plasma atomic emission spectrometer (MP-AES 4210) were used to evaluate the parameters. The results of the metal analysis were compared with a Certified Reference Material (CRM) "*ERA a Waters Company*" matrix for human consumption water. In all JASS, metal concentrations were found to be within the values established in the regulations. However, some variability was observed in the physicochemical parameters. In the JASS of Pfullpuri, Q'ello Q'ello and Q'enko, the values of pH, turbidity, free chlorine, dissolved oxygen and oxidation-reduction potential were not found to be within the limits established at some sampling points. In contrast, the JASS of Soñaqque does comply with the physicochemical parameters evaluated. Consequently, the water supplied by this JASS is of better quality for human consumption compared to the other JASS.

***Keywords*:** Water quality, JASS, MP - AES.

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Q-39

SYNTHESIS AND CHARACTERIZATION OF Eu AND Tb-BASED MOFs WITH LUMINESCENT PROPERTIES

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Metal–Organic Frameworks (MOFs) are crystalline porous materials formed by metal nodes and organic linkers assembled into highly ordered three-dimensional structures with potential porosity.[1] Their exceptional properties have made them one of the most rapidly growing class of advanced material, culminating in the novel prize in chemistry this year.[2] In particular, lanthanide-based MOFs stand out due to their luminescent properties through energy transfer from the organic ligand to the metal center.[3]

In this work, three original luminescent MOFs were synthesized by solvothermal methods using europium, terbium, or a mixture of Eu/Tb and the ligand 5-amino-2,4,6-triiodoisophthalic acid (H_2attip). After crystal formation, several structural, spectroscopic, and luminescence characterization techniques were applied to confirm the successful synthesis of the materials and study their structural and luminescent properties. First, structural analyses confirm that the materials are isostructural, exhibiting identical crystalline frameworks. Then, luminescent studies were carried out, showing the characteristic emission of Eu^{3+} and Tb^{3+} ions, with higher intensity in the europium based compound and lower intensity in the terbium-based one, while the mixture material exhibited an intermediate behavior. Finally, structural stability studies were performed, first by suspending the materials under different solvents (ethanol, DMF and water) and the other one by exposing the materials to high temperatures (from 0°C to 500°C). All of the materials maintain their structural integrity up to 200°C, and also remain stable in DMF and ethanol, although they have poor stability in aqueous media.

The results open the door to exploring applications in which their luminescent properties can be properly used without exposing the materials especially to aqueous media that compromise their structure.

***Keywords*:** Metal-Organic Frameworks, luminescence, structure, stability

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CP-1

PUBLICANDO: ANÁLISIS Y SELECCIÓN DE REVISTAS CIENTÍFICAS

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El proceso de publicación científica comprende desde la concepción del manuscrito hasta su difusión y evaluación, siguiendo unas pautas en la redacción y teniendo en cuenta el itinerario editorial: la preparación del borrador, la selección de la revista mediante criterios de calidad, la adecuación temática e impacto, el envío del manuscrito y la evaluación por pares, subrayando la necesidad de identificar revistas de confianza evitando publicaciones depredadoras.

El personal investigador debe tener en cuenta, a la hora de publicar los resultados de sus investigaciones, las novedades que ha introducido la reforma de evaluación de la ciencia. Es necesario saber comprender y localizar los nuevos indicadores que van a utilizarse para medir la actividad investigadora, así como la elaboración de la narrativa para describir el impacto de sus publicaciones.

CP-2

TUS TRÁMITES DE RAPI EN EL DOCTORADO

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En esta charla veremos las principales funcionalidades y trámites que podemos realizar en la aplicación RAPI (Registro de Actividades y Plan de Investigación). RAPI es la herramienta utilizada por los alumnos y alumnas de doctorado a la hora de registrar las actividades que realizan en su formación como investigadores, y en describir el plan de investigación que llevarán a cabo. Veremos que trámites podemos realizar, que plazos hay para hacerlo, y la importancia de los mismos, así como el papel que también desempeñan las personas que se encargan de la tutorización y dirección de las doctorandas y doctorandos.

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CP-3

¿POR QUÉ ME DICEN QUE LLEGO TARDE SI NO EXISTE EL TIEMPO? LA FÍSICA DEL TIEMPO

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La charla presenta distintas técnicas desarrolladas en la historia para la medición del tiempo. Cuenta la historia de los relojes, antes y después de Galileo, la revolución newtoniana (el tiempo absoluto) y la contrarrevolución einsteiniana (el tiempo relativo), los relojes de luz de Einstein y el funcionamiento del GPS, los relojes atómicos, habla del tiempo más corto que hemos logrado medir, y del futuro de la tecnología de relojes. También habla del tiempo en física cuántica y del tiempo emergente en la física actual (de ahí el título «el tiempo no existe»).

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