Natural Cosmetics
International Meeting

Book of Abstracts

3rd Natural Cosmetics International Meeting

17-19 September 2025

The Center of International Education
Kielnarowa/Rzeszow, Poland

For more information
naturalcosmeticsim.org

Welcome address by Prof. Kazimierz Głowniak, Chairman of The NCIM Organizing Committee

Distinguished Guests, Ladies and Gentlemen.

On behalf of the Scientific and Organizing Committees and the Authorities of the University of Information Technology and Management I would like to warmly welcome the all participants of the 3rd Natural Cosmetics International Meeting, held at The Center of International Education in Kielnarowa near Rzeszów. This conference is organized by The Department of Cosmetology, and financially supported by Austrian Drug Screening Institute and the companies: Anchem, Colfarm, Shim-POL, API-Instruments and Orcideo. The conference received also financial support from the Marshall of the Podkarpackie Voivodeship and SunRISE project. I also would like to warmly welcome the Scientific Patrons of Conference, the Austrian Drug Screening Institute in Innsbruck, represented by Prof. Günter Bonn and Dr Thomas Jakschitz; the Phytochemical Society of Europe, represented by Dr Simon Vlad Luca. I also would like to thank the Polish Academy of Science, Committee Therapy and Drug Screening, PharmaGnose, Mattek and NaTrue. It is also our great pleasure to welcome the Honorary Consul of Mongolia in Krakow, Mrs. Urtnasan Tsakhiur.

The aim of this Meeting is to discuss all aspect related to natural products and modern research methods in the field of obtaining active natural ingredients of green cosmetics isolated mostly from plant material. We would like to join the scientific community and the representatives of the cosmetic industry in order to find a common field for cooperation. It is a great honor for me to host in Kielnarowa Campus all participants of this Meeting, representing numerous scientific and technological institutes, research centers, as well as cosmetic industry, who came from 19 countries.

We are very grateful to all authors of plenary lectures, short presentations and posters who have chosen this Meeting to present the results of their scientific work. Without your presence it would not be possible to organize this conference with such interesting plenary lectures and establish new scientific and business collaborations. On behalf of the Scientific and Organizing Committee I wish all participants to enjoy both scientific and the social program of the conference.

I hope you will leave Kielnarowa Campus with pleasant memories, new friendships and new ideas for future scientific and business collaborations. I also hope to meet you again in this beautiful subcarpathian region as participants of 4th Natural Cosmetics International Meeting in 2027.

Conference Venue

Center for International Education
The University of Information Technology and Management in Rzeszów
Kielnarowa 386 A 36-020 Tyczyn, Poland

Scientific Patronage

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Scientific Programme

Day 1 (September 17, 2025)

17:00 – 18:30 Registration Desk Open

18:00 – 18:15 Short Welcome of the Conference Participants by the Representatives of The Organizing Committee

18:15 – 19:00 From Tradition to Innovation – Advanced Analytical and Cell-Biological Techniques for Quality Control of Plant-Based Products in Medicine, Nutrition and Cosmetics – **Prof. Günther K. Bonn** (Austrian Drug Screening Institute, University of Innsbruck, Austria)

19:00 – 21:00 Welcome Reception with life music

Day 2 (September 18, 2025)

8:30 – 16:00 Registration Desk Open

9:00 – 9:15 Opening Ceremony

9:15 – 9:25 Presentation of the SunRISE Alliance

9:25 – 9:35 Presentation of the Phytochemical Society of Europe

9:35- 11:15 SESSION I: Extraction and isolation of natural cosmetic ingredients

Session chairs: Prof. Wirginia Kukuła-Koch, Prof. David da Silva

9:35– 10:00 Plenary Lecture I: **The olive tree (Olea europaea), an invaluable source of bioactive molecules" – Prof. Leandros Skaltsounis** (National and Kapodistrian University of Athens, Greece)

10:00 – 10:20 Keynote Lecture I: **Applying the Concept of Loan Chemical Extraction to Design and Manufacture the High Quality Natural Cosmetics – Prof. dr hab. Tomasz Wasilewski** (Casimir Pulaski University of Radom, Poland)

10:20 – 10:40 Keynote Lecture II: **Bioactive substances from medicinal mushrooms and their innovative applications in cosmeceuticals – Prof. Grzegorz Świderski/Dr Ewa Zapora** (Białystok University of Technology, Poland)

10:40– 10:50 Short lecture I: **Affordable Purification of Botanical Extracts with a New Chromatography Approach – Dr Katalin Radvánszky** (LiLiChro Ltd., Budapest, Hungary)

10:50 – 11:00 Short lecture II :**Calendula officinalis tissue cultures grown in Plantform™ bioreactors as a sustainable source of phenolic antioxidants for cosmetic applications** – Prof. dr hab. Agnieszka Szopa (Collegium Medicum, Jagiellonian University in Kraków, Poland)

11:00– 11:15 Discussion

11:15 – 12:10 Coffee Break + Poster Session

12:10 – 14:10 SESSION II: Modern technologies in natural cosmetics

Session chairs: Prof. Agnieszka Szopa, Dr. Simon Vlad Luca

12:10 – 12:35 Plenary Lecture II: **The Synergy of Nature and Nano: Advanced Skin Solutions – Prof. Dr. Ilkay Erdogan Orhan** (Lokman Hekim University, Türkiye)

12:35 – 12:55 Keynote Lecture III: **Setting and Reframing the Ambition: Cosmetic, Cosmeceutical or Pharmaceutical – Dr Martin Braddock** (GENIXICONSULTING LTD, UK)

12:55 – 13:15 Keynote Lecture IV: **Cosmetic innovation: how to combine naturalness, performance, an increasingly strict regulatory environment and industrial reality? – Prof. Michel Grisel** (University of le Havre, France)

13:15- 13:35 Keynote Lecture V: **Valorization of apple pomace by extraction of bioactive compounds for cosmetic products – Prof. Monika Kalinowska** (Białystok University of Technology, Poland)

13:35– 13:45 Short Lecture III: **Testing of cosmetics, ingredients and personal care products using 3D reconstructed human cornea -like tissue model – Dr Silvia Letasiova** (MatTek, Slovakia)

13:45 – 13:55 Short lecture IV **Exploring the cosmetic potential of grapevine: A metabolomic approach to bioactive compound identification** – Prof. Magdalena Malinowska (Cracow University of Technology, Poland)

13:55 – 14:10 – Discussion

14:10 – 15:20 Lunch

15:20 – 17:10 SESSION III: Traditional natural ingredients in modern cosmetology
Session chairs: Prof. Monika Kalinowska, Prof. Filip Boratyński

15:20 – 15:45 Plenary Lecture III: **Next-Gen Natural Cosmetics: The Synergy of Green Chemistry and Biotechnology. Early discoveries of GreenCosmin Project** – Prof. Maria Halabalaki/Dr Petros Tzimas (National and Kapodistrian University of Athens, Greece)

15:45 – 16:05 Keynote Lecture VI: **The potential of plant active substances in protecting the skin against infrared radiation** – Prof. Sławomir Wilczyński (Silesian Medical University, Poland)

16:05 – 16:25 Keynote Lecture VII: **Traditional application of desert Algerian plants in skin care products – Prof. Dr Noureddine Djebli** (University of Mostaghanem, Algeria)

16:25 – 16:35 Short lecture V: **Cosmetic Applications of Essential Oils Extracted from Taiwan's Indigenous Forest Species– Dr Senthil Kumar KJ** (National Chung Hsing University, Taiwan)

16:35– 16:45 Short lecture VI: **Isoquinoline Alkaloids from Papaveraceae – Prof. Sylwia Zielińska** (Wrocław Medical Univeristy, Poland)

16:45 – 16:55 Short Lecture VII: **Microbiome Regulation by Cosmetic Ingredients – Dr Magdalena Biesiadecka** (University of Information Technology and Management in Rzeszów, Orcideo, Poland)

16:55 – 17:10 Discussion

17:10 – 18:00 Coffee Break

17:30 – 18:30 Workshops (for Registered Participants only):

- **Reconstructed human cornea-like epithelial tissue model (EpiOcular) for the toxicity testing of chemicals, cosmetics, personal care and pharmaceutical products by MatTek**
- **Bioferments in cosmetics by Orcideo (Group 1)**

18:30 – 23:00 Conference Dinner – Taberna pod Sosnami, Kielnarowa (http://tabernapodsosnami.pl/)

Day 3 (September 19, 2025)

9:30 – 11:30 SESSION IV: Sustainability in natural cosmetics

Session chairs: Prof. Marijana Zovko Končić, Prof. Tomasz Wasilewski

09:30 – 09:55 Plenary Lecture IV: **Environmental Claims and Sustainability Labels: Substantiation and Certification –Dr Mark Smith** (NaTrue, Belgium)

09:55 – 10:15 Keynote Lecture VIII: **Zero-Waste Biorefinery: Transforming Agricultural By-products into High-Value Cosmetic Ingredients Using Probiotic Microorganisms – Prof. Marcin Łukaszewicz** (InventionBio, Univeristy of Wrocław, Poland)

10:15– 10:35 Keynote Lecture IX: **Extra virgin olive oil quality in sustainable production systems with local varieties – Prof. Enrico Maria Lodolini** (Marche Polytechnic University, Ancona, Italy)

10:35 – 10:55 Keynote Lecture X: **Innovating with Integrity: Sustainable Solutions in Natural Cosmetics – Dr Julia Moesslacher** (Cura Cosmetics, hollu GmbH, Paracelsus Medical University, Austria)

10:55 – 11:05 Short lecture VIII: **Sustainable beauty: unlocking the cosmetic potential of spent coffee grounds – Adrianna Maria Piasek** (EcoBean, Poland)

11:05 – 11:15 Short lecture IX: **From by-products to bioactive ingredients: A green extraction and nano-encapsulation approach for bioactive-rich sensitive skin cosmetics – Dr Eirini Sarrou** (Hellenic Agricultural Organization Dimitra, Institute of Plant Breeding and Genetic Resources, Thessaloniki, Greece)

11:15– 11:30 Discussion

11:30- 12:20 Coffee Break + Poster session

12:20– 13:50 SESSION V: The future of natural cosmetics from the perspective of young scientists
Session chairs: Dr Aleksandra Ziemlewska, Dr Bartosz Skóra

12:20– 12:30 Short lecture X: **Rapid Screening of Pyrrolizidine Alkaloids in Cosmetic Products: A Non-Chromatographic approach utilizing Compact Mass Spectrometry – Benedikt Schwartz** (Austrian Drug Screening Institute, University of Innsbruck, Austria)

12:30 – 12:40 Short lecture XI: **Valorizing Saffron By-Products and Bioactive Compounds as a Sustainable Source of Natural Colorants for Cosmetic Applications – Leonor Teixeira da Costa** (iBET – Instituto de Biologia Experimental e Tecnológica, Portugal)

12:40 – 12:50 Short lecture XII: **Callus extracts of Vitis vinifera L. as a novel ingredient for cosmetics – Marta Sharafan** (Jagiellonian University, Cracow University of Technology, Poland)

12:50 – 13:00 Short lecture XIII: **Unlocking Halophyte Plants' Potential for Skin Formulations: A Natural Source of Anti-aging, Anti-hyperpigmentation, and Wound Healing Ingredients – Juliana Oliviera** (iBET – Instituto de Biologia Experimental e Tecnológica, Portugal)

13:00 – 13:10 Short lecture XIV: **Overcoming the limitations of natural skin depigmenting agents: nature inspired cinnamic acid–amino acid derivatives with improved safety and efficacy of tyrosinase inhibition – Małgorzata Kabat** (Jagiellonian University in Kraków, Poland)

13:10 – 13:20 Short Lecture XV: **Bean to beauty: A circular approach to coffee-derived cosmetic ingredients – Zoja Trojan** (EcoBean, Poland)

13:20 – 13:30 Short lecture XVI: **Neuro-modulatory effects of cell-free supernatants from Hericium erinaceus and Ganoderma lucidum – relevance to the gut–brain–skin axis – Dominika Szlachcikowska** (University of Information Technology and Management in Rzeszów, Poland)

13:30 – 13:40 Short lecture XVII: **Lamiaceae Plant Extracts as Multifunctional Cosmetic Ingredients: Biological Activity and Safety Assessment – Anna Dziki** (Cracow University of Technology, Poland)

13:40– 14:00 Discussion

14:00 – 14:10 Award Ceremony

14:10 – 14:25 Closing Remarks

14:25 – 15:30 Lunch

14:50 – 15:50 Workshops (for Registered Participants only)

- **Formulation of natural cosmetics**
- **Bioferments in cosmetics by Orcideo (Group 2)**

16:00 – 17:00 Workshop (for Registered Participants only):

- **Real-Time Demonstration of CPC – A Liquid-Liquid Chromatography Method for Cosmetic Applications by LiLiCHRO and Anchem**

Opening lecture

em.o.Univ.Prof. Mag. Dr. Dr.hc. Günther K. Bonn

Professor Günther K. Bonn is Chief Executive Officer and Scientific Director of the Austrian Drug Screening Institute (ADSI) in Innsbrück, Austria, which bridges the gap between basic research and industry. He is also Chairman of the Board of Trustees of the Michael A. Popp Nature Science Foundation and Honorary Consul for Georgia I Tyrol, Austria. Professor Bonn studied Chemistry at the Leopold Franzens University of Innsbruck where he obtained his Mag. rer. nat. and PhD degrees. In 1985 he obtained his Habilitation for Analytical Chemistry, University of Innsbruck and in 1994 he became Full Professor for Analytical Chemistry at the Institute of Analytical Chemistry and Radiochemistry, Leopold-Franzens-University of Innsbruck. From 1995 – 2022 Professor Bonn was the head of the Institute of Analytical Chemistry and Radiochemistry.

Professor Bonn is co-author of over 400 scientific publications, 32 patents and two books. Professor Bonn has been awarded many prestigious awards, including Halasz´ Award (2003), Honorary Ring of the Austrian Academy of Sciences, Vienna (2009), EUSSS Nernst-Tswett Award (2010), Csaba Horváth Memorial Award (2011), UPV – Wissenschaftspreis, University of Innsbruck (2012) and A.J.P. Martin – Medal (2013). In 2014 he received the Honorary Doctorate Degree from the Medical University Lublin and the "Austrian Cross of Honor for Science and Art, 1st Class" in 2022. He is also Editorial Board member of several journals, e.g. Journal of Chromatographic Science, LC-GC Europe, Current Medicinal Chemistry, Current Analytical Chemistry, Bioanalytical Reviews, International Journal of Analytical Chromatography, Clinical Phytoscience and Biomedical Chromatography (Editor for Europe).

Professor Bonn's research interests include analytical chemistry, synthesis of new materials for enrichment and separation technologies, e.g. chromatography, electrophoresis, mass spectrometry and bioanalysis (genomics, proteomics, metabolomics, phytomics), especially in phytopharmacy, phytocosmetics, nutrition and food-supplements.

From Tradition to Innovation – Advanced Analytical and Cell-Biological Techniques for Quality Control of Plant-Based Products in Medicine, Nutrition and Cosmetics

Günther K. Bonn[1]

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Keywords: phytoanalysis, chromatography, enrichment, purification, LC-MS, product safety, protein sequencing

Driven by innovations in analytical chemistry, separation science has become the key enabler of precision and trust in phytochemistry. Modern plant-based products—from supplements and cosmetics to functional foods—must meet high standards for efficacy, purity, and safety to enable highest quality. However, the complex chemical nature of plant matrices, which can contain thousands of compounds at highly variable concentrations, poses major analytical challenges.

Advanced chromatographic techniques, especially solid-phase extraction (SPE), dual-flow chromatography, and high-resolution LC-MS, are now indispensable tools in unlocking nature's molecular treasures while ensuring the reliability and reproducibility of end products.

These technologies allow the targeted enrichment and purification of active constituents, minimizing contamination with unwanted substances such as allergens, biogenic amines, or environmental toxins. Coupled with spectroscopic methods (e.g., NIR, MIR), they also enable non-destructive quality control of raw materials. In addition, tailored stationary phases help capture and quantify low molecular weight compounds like phenolic acids, while the detection of proteins and DNA fragments is becoming increasingly relevant for verifying authenticity and identifying bioactive or allergenic compounds.

A major innovation is the use of Next-Generation Protein Sequencing™ (NGPS), which allows direct and highly sensitive identification of plant proteins at single-molecule resolution—providing new quality markers and ensuring batch-to-batch consistency. At ADSI, numerous applications have been developed that not only increase the extraction yield of desired phytochemicals but also significantly reduce matrix interference, helping to produce clean, stable, and standardized extracts with clear health claims. Examples include the analysis of polycyclic aromatic hydrocarbons (PAHs) in tea, pyrrolizidine alkaloids in botanicals, and hydroxytyrosol content in olive oil. These case studies underline how state-of-the-art separation science ensures not just molecular insight, but also regulatory compliance, enhanced product safety, and consumer confidence. This integration of separation technology with high-end detection and molecular biology is setting new standards in natural product research and industrial phytochemistry. Many of the developments presented here build on the pioneering legacy of Prof. Csaba Horváth, whose vision continues to shape the field till today.

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Plenary & Keynote Speakers

Prof. Dr. Leandros A. Skaltsounis

Full professor in Pharmacognosy of the Faculty of Pharmacy, National and Kapodistrian University of Athens. He obtained his Ph.D on 1987 at Descartes University, Paris V where he spent six year as academic staff. He was visiting professor in Orleans and Innsbruck Universities as well as in Chinese Academy of Science. At present he leads a research group of more than 20 researchers, focusing on natural product-based lead discovery, for various applications as therapeutics, functional foods, cosmetics and agrochemicals. Parallel research activities have been deployed concerning new agricultural processes related to medicinal plants and the solution in environmental problems derived from agricultural wastes. He is also the founder of Pharmagnose spin-off biotechnological company (2013). He has participated in 16 EU projects, 8 as coordinator and has organized the 7th Joint meeting on natural products chemistry and biology, Athens in 2008 and the IUPAC 30th International Symposium on the chemistry of natural products, Athens in 2018. To date he has published 450 papers and 20 patents with more than 28.000 citations and h-index 74.

PL1. The olive tree (Olea Europaea), an invaluable source of bioactive molecules

Leandros A. Skaltsounis[1]

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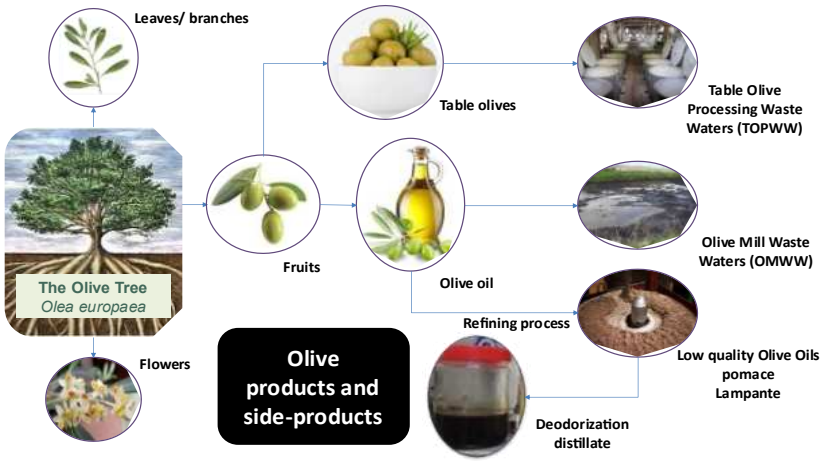
Extra virgin olive oil (EVOO), the main product of *Olea europaea* and the key ingredient of Mediterranean diet, is characterized by substantial nutritional and health beneficial value [1]. However, despite olive oil's economic and health impact, its industry is associated with environmental problems derived from the vast quantity of by-products, such as vegetation waters, olive cake, olive pulp and olive branches and leaves. [2] The amount of olive leaves produce every year exceed 18 million tons and mostly are used as animal feed, compost production or simply are burned, causing serious environmental damage. In a recent study was found that burning of olive tree branches is a major organic aerosol source in the Mediterranean region.[3] However this material still contains high value-added compounds such as triterpenoids, secoiridois, flavonoids, phenolic alcohols, phenolic acids, lignans which are known as olive polyphenols. All these constituents have a strong antioxidant profile and there is an increased industrial interest for possible nutraceutical, cosmetic and pharmaceutical applications. Our work is focused on finding alternative strategies to manage the residues of olive oil industry following two axis. Firstly the development of liquid/ liquid or solid/liquid extraction followed by partition chromatography techniques for the isolation of these

compounds in multi gram scale. Secondly the use of these compounds such as oleuropein, as starting material for the hemi-synthesis of new analogues.



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Prof. dr hab. inż. Tomasz Wasilewski

Obtained his doctoral degree at the Faculty of Materials Science and Engineering of the Warsaw University of Technology in 2004. Then, in 2014, at the Faculty of Commodity Science of the University of Economics in Krakow, he obtained the degree of habilitated doctor. In 2021, by the decision of the President of the Republic of Poland, he was awarded the title of professor. He works at the Faculty of Applied Chemistry at the University of Radom (Poland). In the years 2016-2019 he was the Dean of the Faculty, and in the years 2012-2016 he was the Deputy Dean for Research. In the years 2013-2020 he headed the Department of Chemistry, and then the Department of Commodity Science and Quality Sciences. He established and manages the work of the Laboratory of Commodity Science of Cosmetics and Household Chemistry Products. In 2024, he was appointed to the Advisory Team of the Minister of Science in the field of research infrastructure. In turn, in 2020, he was appointed by the Minister of Development, Labor and Technology as a member of the Council for Competences of the Chemical Sector. In the years 2017-2022, he served as Vice President of the Main Board of the Polish Society of Commodity Science, in the years 2019-2023 as Vice Chairman of the Commission of Commodity Sciences – Quality Sciences of the Polish Academy of Sciences, and in the years 2016-2021 as Editor-in-Chief of the Polish Journal of Commodity Science. He is a member of the Scientific Council of the journals: Przemysł Chemiczny and Cosmetics and Detergents. Since 2017, he has been a Member of the Competition Jury of the Gold Medal of the Poznań International Fair – Forum Beauty Vision. He is also an expert of the Polish Society of Commodity Experts in the field of cosmetics, toiletries and detergents. In 2020, he was appointed by the Minister of Development, Labor and Technology as a member of the Chemical Sector Competence Council. He is also an expert of the Polish Society of Commodity Science in the field of cosmetic, toilet and detergent products. Prof. Wasilewski conducts research and teaching activities related to the physicochemical and functional properties of surfactants, the development and production of modern delivery systems, optimization of formulations and quality assessment of cosmetics and household chemicals. He is the author of over 150 scientific articles, 1 scientific monograph, 1 US Patent and 54 Polish Patents. He presented the results of his work during more than 50 presentations at prestigious congresses and scientific symposia, including plenary speeches during, among others, IGWT Symposium Sustainability, Quality and Innovation in Rome or the International Conference on Surfactant & Detergent in Shanghai.index 74.

KL1. Applying the concept of Loan Chemical Extraction to the design and manufacture of high-quality natural cosmetics

Tomasz Wasilewski[1,2], Zofia Hordyjewicz-Baran[1], Maciej Zegarski[3]

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In recent years, there has been a significant increase in the number of natural cosmetics available on the market. Manufacturers, in response to consumer needs, are looking for solutions characterized by high safety of use (e.g. low drying and irritation effects). In addition, modern cosmetics must have high functionality, affordable price, meet the assumptions of so-called sustainable products and be characterized by a limited negative impact on the natural environment.
The paper presents the results of research on the possibilities of using the Loan Chemical Extraction (LCE) concept to produce natural cosmetics intended for hygiene. The essence of the method consists in borrowing components from the target cosmetic, preparing an extraction medium with their participation, carrying out the extraction (in the presented studies, micellar extraction was carried out), and then returning the obtained extract to the cosmetic mass. As a result - in the composition of a given preparation there appear ingredients isolated from the plant material, while the cosmetic mass does not contain any auxiliary substances (e.g. commonly used solvents) [1-2].
The presentation discussed the advantages and disadvantages of the new concept. The plant material used was grape pomace, obtained from Polish vineyards. The new method of producing natural cosmetics was illustrated with specific examples. It was shown that the obtained product prototypes have high application potential and are an interesting alternative to currently used solutions.

Acknowledgments
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Dr Ewa Zapora

Ewa Zapora is a researcher at the Białystok University of Technology, Faculty of Civil Engineering and Environmental Sciences. Her work focuses on natural products and bioactive compounds derived from fungi, as well as their potential applications in biotechnology and medicine. She is also involved in the development and coordination of the university's Fungi Extract Bank, supporting research on fungal biodiversity and bioactivity.

Dr hab. inż. Grzegorz Świderski, prof. PB

In 2004, he completed his Master's degree in Environmental Protection at the Białystok University of Technology. A year later, he completed his Master's degree in Chemistry at the University of Białystok. He obtained his PhD in Chemical Sciences from the University of Białystok in 2013. He obtained his postdoctoral degree in Chemical Sciences from Maria Curie-Skłodowska University in Lublin in 2022. He currently works as a professor at the Białystok University of Technology. His research interests include research on the physicochemical properties and structure of chemical compounds of natural origin, and the influence of metals on the physicochemical properties, structure, and biological properties of substances of natural origin. He has participated in eight projects (NCN, NCBiR, and the Ministry of Science and Higher Education). He is currently the project manager for projects funded under the ViaCarpatia program named after the President of the Republic of Poland, Lech Kaczyński, and the Regional Improvement Initiative at the Białystok University of Technology. He is the author of 57 scientific articles indexed in JCR, and about 30 monographic articles.

KL2. Bioactive substances from medicinal mushrooms and their innovative applications in cosmeceuticals.

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The integration of bioactive substances from medicinal mushrooms into cosmeceuticals represents a promising frontier in skincare innovation, driven by the burgeoning interest in natural and sustainable ingredients within the cosmetic industry. The Fungi Extract Bank® is a pioneering resource, providing a diverse collection of fungal extracts for extensive screening and application in the cosmetic industry.

Medicinal mushrooms have been identified as rich sources of bioactive compounds with significant cosmeceutical applications. These compounds exhibit a range of beneficial properties, which are crucial for skin health and cosmetic formulations [1,2,3]. *Ganoderma lucidum*, commonly known as Reishi, is renowned for its rich composition of polysaccharides and triterpenoids, which exhibit significant antioxidant, anti-inflammatory, and anti-aging properties. These compounds have been shown to enhance skin health by reducing oxidative stress and promoting collagen synthesis, making them ideal for anti-aging formulations [4,5,6]. Additionally, the β-glucans from *G. lucidum* have demonstrated potential in skin whitening by inhibiting melanin production, offering a natural alternative for hyperpigmentation treatments [4]. *Pleurotus ostreatus*, or the oyster mushroom, is another valuable source of bioactive compounds with cosmeceutical applications. Its extracts have been found to possess antioxidant and anti-inflammatory properties, which can help soothe irritated skin and protect against environmental damage [3,7]. The safety and efficacy of *P. ostreatus* extracts in cosmetic formulations have been confirmed through *in vitro* studies, underscoring their potential as safe ingredients for skincare products [3]. *Laetiporus sulphureus*, although less studied, holds promise due to its bioactive components that may offer antimicrobial and antioxidant benefits. These properties could be harnessed to develop products aimed at maintaining skin health and preventing infections [1]. Furthermore, innovative techniques such as microencapsulation have been employed to enhance the stability and controlled release of fungal-derived bioactive compounds, thereby maximizing their effectiveness[8].

Developing new formulations based on mushroom extracts is an innovative approach to cosmeceutical design.

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Prof. Dr. Ilkay Erdogan Orhan

Prof. Dr. Ilkay Erdogan Orhan holds a Pharmacist degree (1993) from Gazi University (Ankara, Türkiye), 1st M.Sc. degree from the Department of Pharmacognosy at the same Faculty (1996). She earned the Ph.D. degree in Pharmacognosy at the Faculty of Pharmacy, Gazi University (Ankara, Türkiye) in 2002. She was promoted to Assoc. Prof. position by the Higher Education Council (Türkiye) in 2004 and to full professor in 2009. Dr. Orhan was appointed as Dean of the Faculty of Pharmacy at Eastern Mediterranean University in Northern Cyprus (2011-2014) and Dean of the Faculty of Pharmacy at Gazi University in Ankara, Türkiye (2016-2024). Currently, Dr. Orhan is Dean of the Faculty of Pharmacy at Lokman Hekim University in Ankara, Türkiye.
Dr. Orhan received several awards such as Young Woman Scientist Award in Asia continent by OWSD (Organization of Women in Science in Developing Countries) & Elsevier, Science Award in Biology by COMSTECH (OIC Standing Committee on Science and Technological Cooperation) in 2010, Young Woman Scientist Award (in Life Sciences) by L'Oreal & Turkish Academy of Sciences in 2011, and Honor Award by Gazi University in 2011, Innovation Award for Women in Turkey in 2015, Science Award by Turkish Association of Pharmacists in 2016, Golden Mortar Science Award in Pharmacy in 2017, Silver Medal for Patent in International Invention Fair by Turkish Ministry of Science and Technology in 2017 as well as Best Academic Invention Medal by International Federation of Invention Associations (IFIA) in 2018. She also received the TWAS (The World Academy of Sciences) Science Award in Chemistry and a Certificate of Outstanding Service and Achievement from the Turkish Industrialists and Businessmen's Foundation (TÜSİAV) and Climate Ambassador Award by the Turkish Vegan and Healthy Life Tourism Association (TEVSAD) & Turkish Industrialists and Businessmen Foundation (TÜSİAV) & Ministry of Environment and Urbanization in 2024. She is the principal member of the Turkish Academy of Sciences (TÜBA) and served as the Representative of Southeast Europe & Turkey Region for the Phytochemical Society of Europe (PSE) for 2019-2023. She is currently the author of 307 scientific papers listed by SCI-E, 40 articles in other scientific journals, 24 book chapters, 4 patents (Turkish, US, & EP), 6 patent applications, and 3 books. Her h index is 59 (Web of Science) and 63 (SCOPUS) with over 17500 citations. Her research interests are chemistry and bioactivities of natural products, natural cosmetics, phytotherapy, sports pharmacy, and aromatherapy. She is presently the Associate Editor of Phytomedicine. According to standardized citation counts by Standford University AD index, she is among the "world's most influential scientists". In Turkish scientists national ranking in all fields, Prof. Orhan ranks 73rd, placed in top 100 scientists.

PL2. The Synergy of Nature and Nano: Advanced Skin Solutions

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A relatively new and transformative field, nanocosmetics, integrates nanotechnology to enhance the performance of beauty and personal care products. This approach often utilizes nanocarriers to improve the delivery and efficacy of active ingredients. These carriers can encapsulate and transport specific substances to targeted skin areas, maximizing their impact while minimizing potential side effects.

Nanocosmetics also streamline skincare routines by combining multiple benefits, such as hydration, anti-aging, and sun protection, into single products. The advantages of nanoforms extend beyond cosmetics, finding valuable applications in medical device formulations as well. We are dedicated to developing innovative, plant-based cosmeceuticals at a laboratory scale using nanotechnology. We employ rigorous screening methods, including *in vitro* enzyme inhibition assays, *in silico* molecular docking, and toxicity assessments alongside cell-based studies, to pinpoint effective plant extracts and natural compounds. For example, we have successfully integrated *Cotinus coggygria* extracts into niosome, nanofibre, and nanoemulgel formulations, where we developed polycaprolactone (PCL) electrospun nanofibres loaded with *C.s coggygria* extract and hyaluronic acid (HA) for wound healing application [1]. Additionally, we have created a patent-pending anti-acne formulation using a blend of plant extracts specifically designed to target *Propionibacterium acnes*. In another study, we have investigated 5alpha-reductase inhibitory effect of some *Lavandula* species, which are planned to be formulated against alopecia. The present talk will underline our newest outcomes on the development of some of novel phytocosmeceutical formulations, which have been achieved through our innovative approach.

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Martin Braddock, PhD, FRSB, FRAS

Founder and director of GENIXICONSULTING LTD, established in September 2024. He serves as a freelance independent scientific consultant, specializing in technological innovation, drug discovery, and clinical development, spanning from basic science to drug approval. Martin provides comprehensive scientific advice on all phases of drug discovery and development, from laboratory concepts to regulatory approval and subsequent commercialization. He collaborates with small, medium, and large biotechnology and biopharmaceutical companies, university departments, and research organizations within the United Kingdom and the European Union to contribute to the 'Science Behind the Business.' With over 40 years of experience, Martin brings objective, pragmatic, and independent opinions, offering guidance for progressing drug candidates through clinical development. His expertise includes building basic pharmacology studies for target validation, delivering target product profiles, developing clinical development plans, and advising on product potential and positioning within current and future competitive environments.
Dr Braddock has extensive line management experience at AstraZeneca and GlaxoSmithKline, where he served as Director of Discovery Bioscience and Disease Sciences Unit Head, respectively. He led large departments of up to 82 people, delivering biochemistry, pharmacology, and translational science to support the selection of 24 small molecule and four biological candidate drugs. Martin is recognized as a motivational leader and speaker, known for building and driving successful teams. He has established networks of academic collaborators, scientific, and clinical experts. As an invited expert reviewer and advisor for multiple international grant-awarding bodies, Martin provides independent assessments of the Technical Readiness Level (TRL) status and evaluates the readiness for progression to the next TRL for over 300 proposals. He also serves as an independent program progress assessor, consensus meeting leader, and panel representative. Martin is the recipient of significant awards, including a Royal Society University Research Fellowship and an Alumnus Achievement Award for outstanding contributions to science. He is an elected Fellow of the Royal Society of Biology in recognition of his contributions to biological sciences, an invited Fellow of the Royal Society of Medicine, and an elected Fellow of the Royal Astronomical Society.

KL3. Setting and Reframing the Ambition: Cosmetic, Cosmeceutical or Pharmaceutical

Braddock M.

GENIXICONSULTING LTD, United Kingdom

The road from exciting laboratory science to a marketed profitable product is filled with challenges and opportunities. Drawing on a deep understanding of pharmaceutical drug discovery and development with both synthetic and natural products, the similarities and differences in the journey from lab to paying customer will be described. Target and customer product profiles will be introduced with case examples. The possibilities and implications for switching from cosmetic/cosmeceutical to pharmaceutical and vice versa

will be presented and illustrated with products that have made the transition. In this context the original set ambition may be reframed, knowledge and experience gained, and value for investors realised.

Prof. Michel Grisel

Prof. Michel Grisel obtained his Master's Degree in 1993 in Chemistry at Rouen University (Normandy, France) followed by a Ph.D. in polymer chemistry in 1996. He joined University Le Havre Normandy in 1998; he was first appointed as an assistant Professor at the Faculty of Technical Sciences and got a Professor position in 2006. He has been Head of the Laboratory URCOM (Research Unit for Organic and Macromolecular Chemistry) for 9 years, and Leader of a research group dedicated to polymer and colloid sciences. He was Vice-President in charge of Research for the University of Normandy (consortium of 3 universities and a number of schools of engineering) for 4 years. He is member of the Committee for Scientific Expertise of the French Cosmetic Valley cluster, and is currently involved in a number of collaborations with academic teams; among (including Pr. E. Sikora and Pr. A. Sionkowska here in Poland) and a variety of private companies (in France and abroad).
His ongoing research interests are mainly related to cosmetic field: soft matter, colloids, formulation technologies, rheology and texture analysis, surfaces and interfaces science, cosmetic raw materials (particularly natural polymers and innovative ingredients), emulsions including Pickering, encapsulation and release of actives, product/packaging interactions, mechanisms for ageing. His research is strongly linked to cosmetic science and applications.

KL4. Cosmetic innovation: how to combine naturalness, performance, an increasingly strict regulatory environment and industrial reality?

Grisel M.[1]

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In recent years, the cosmetics sector has been moving towards placing on the market products with more and more natural ingredients or derived from bioresources, without compromising either performance or quality as well as consumer safety.
The high expectations of these latter have led researchers to evolve in their practices which are now part of a global approach to eco-design respecting the principles of green chemistry: new modes of sourcing ingredients such as biotechnology, bio-inspiration, use of less energy-consuming processes, limitation of the number of ingredients, reduction of the environmental impact of packaging…
Thus, the scientific challenges to be addressed are very numerous, especially since they necessarily fall within an ever more restrictive regulatory framework (sunscreen, preservatives, nanomaterials, microplastics, …). As if that were not enough, for anyone wishing to market innovative and safe products, this whole approach must consider the industrial reality.
In this context, research is undeniably a major lever, more than ever essential to hold its place in this extremely competitive sector.

Dr hab. Monika Kalinowska, Prof. PB

Chemist, Head of the Department of Chemistry, Biology and Biotechnology at Bialystok University of Technology (BUT), co-founder and member of the scientific board of natureTECH Centre for Natural Product Research at BUT; project manager or research team leader of 19 projects financed by National Science Centre (OPUS, SONATA projects), National Centre for Research and Development, Ministry of Science and Higher Education, author of 82 publications indexed in the Scopus and Web of Science database, 56 chapters in monographs, 65 presentations at international conferences and 38 presentations at national conferences; scientific interests: chemistry of natural products, plant phenolic compounds, antioxidant, antimicrobial activity and bioavailability of biologically active compounds, valorization of industrial waste (especially apple pomace).

KL5. Valorization of apple pomace by extraction of bioactive compounds for cosmetic products

Kalinowska M. [1,2]

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[2] natureTECH Centre for Natural Product Research, Bialystok University of Technology

Apple pomace, a by-product of the fruit processing industry, represents a valuable source of bioactive compounds that can be effectively used in cosmetic formulations. It contains numerous substances with proven health-promoting and skin-beneficial properties, including polyphenols (such as flavonoids and phenolic acids), pectins, sugars, and compounds with antioxidant, anti-inflammatory, and moisturizing effects.
The aim of this presentation is to highlight the potential of apple pomace as a raw material for producing active ingredients in cosmetics. Various modern and sustainable extraction techniques will be discussed, including cyclodextrin-assisted extraction, enzyme-assisted extraction, fermentation-assisted extraction - as well as their influence on the quality and stability of the obtained extracts. The presentation will also cover the results of studies confirming the biological potential of these extracts, with particular focus on their antioxidant and protective effects on the skin. Practical applications of apple pomace extracts in cosmetic formulations will be presented, including creams, masks, toners, and skincare products. The environmental and industrial benefits of such an approach will also be emphasized - reducing organic waste and introducing new, sustainable active ingredients in line with current trends in eco- and clean beauty.

This lecture aims to promote a “zero waste” strategy as a realistic opportunity for the development of innovative and environmentally responsible cosmetic products that combine high performance with sustainability.

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Prof. Maria Halabalaki

Maria Halabalaki: Assoc. Professor, Division of Pharmacognosy and Natural Products Chemistry, Department of Pharmacy, National and Kapodistrian University of Athens (NKUA). To date, she has been the author of >160 papers in peer-reviewed journals and her work has been also presented in more than 80 international conferences. Also, she belongs at the coordinating team of several EU (>20) and National (>40) research programs. In 2015, she was awarded Egon Stahl in silver, an EU medal, recognizing and promoting young scientists working in the field of Pharmacognosy (Pharmaceutical Biology) and Analytical Phytochemistry. Also, in 2023 she was awarded with the prestigious Bionorica Phytoneering award acknowledging outstanding research in the field of development and application of phytopharmaceutical products She is a member of several National and International committees and societies e.g. in the BoD of GA society (Medicinal Plant and Natural Products Research) and Group of Experts in European Pharmacopoeia (EDQM – working group 13A for Herbal Drugs and Herbal Drug Preparation). Her scientific interests are based on natural products chemistry and pharmacognosy i.e. extraction, isolation and structural elucidation of bioactive natural compounds. The recent years, her scientific interests focus on the development and application of analytical methods for qualitative and quantitative characterization of medicinal plant extracts and foods by LC-HRMS and NMR; dereplication methods; quality control aspects; quantification of small molecules in biological fluids; metabolomics approaches for the discovery of biomarkers and investigation of mechanism of action of small molecules as well as metabolism studies.

Dr Petros Tzimas

Petros Tzimas is a Postdoctoral Researcher at the National and Kapodistrian University of Athens. His academic work is based at the Faculty of Pharmacy, where he focuses on natural products, phytochemistry, and metabolomics. His research interests include the study of plant-derived compounds and the development of modern analytical approaches for quality assessment of natural materials. He has contributed to several international scientific publications and actively participates in research projects related to the chemistry and biology of medicinal plants.

PL3.: Next-Gen Natural Cosmetics: The Synergy of Green Chemistry and Biotechnology – Early Discoveries of the GreenCosmIn Project

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The demand for sustainable, high-performance cosmetic ingredients is rapidly increasing, driven by consumer awareness, regulatory pressures, and the urgent need to reduce the environmental impact of production processes. This shift calls for innovative, science-based approaches that combine green chemistry, biotechnology, and biodiversity-informed discovery to develop safe and effective bioactive compounds from natural sources. Addressing this need, the GreenCosmIn project establishes an integrated research framework for the sustainable exploitation of natural resources toward next-generation cosmetic formulations. A multidisciplinary strategy is applied, combining eco-friendly extraction methodologies such as Natural Deep Eutectic Solvents (NaDES), Supercritical CO_2, and other low-impact media with advanced analytical platforms (UHPLC-HRMS/MS, NMR, and chemoinformatics) to support high-throughput dereplication, structure elucidation, and compound profiling. Initial results have led to the identification of novel or undercharacterized compounds from diverse plant sources, with demonstrated activities relevant to skin health, including antioxidant, anti-ageing, anti-hyperpigmentation and anti-inflammatory properties. *In vitro* bioassays targeting specific molecular pathways (e.g., tyrosinase inhibition, NF-κB modulation, ROS neutralization) confirm their potential. Complementary biotechnological approaches such as microbial fermentation, biocatalysis, and metabolic engineering are employed to enable scalable production and structural diversification of lead compounds.

These active ingredients are being further evaluated for formulation compatibility, safety (e.g., cytotoxicity, irritation potential), and sustainability through life cycle assessment (LCA) and consumer perception studies. The project's strong academic–industrial consortium, supported by partners from biodiversity hotspots i.e. Mongolia, Tunisia, Greece, French Polynesia, ensures scientific excellence, translational capacity, and fair knowledge exchange. GreenCosmIn thus represents a model of how rigorous, green-oriented science can drive innovation in the cosmetic sector while aligning with global sustainability goals.

Dr hab. n. farm. Sławomir Wilczyński, prof. SUM

Head of the Department and Department of Basic Biomedical Sciences, Faculty of Pharmaceutical Sciences, Medical University of Silesia in Katowice. He is professionally involved in the field of bioengineering. His scientific interests are focused on modern imaging methods used in medicine and pharmacy, including hyperspectral imaging, dynamic thermal analysis, high-resolution ultrasound as well as other techniques such as EPR, NMR and hemispherical directional reflectance. He is author of over 200 scientific papers, patents and industrial designs. He serves as an expert for the of the Polish National Center for Research and Development, the Ministry of Economy of the Republic of Poland, the Medical Research Agency, the Polish Accreditation Commission and the Polish National Economy Bank. Member of the Investment Committee in the Bridge Alfa NCBiR program. Member of the Technical Committee (KT) 334 for Cosmetic Products in the Polish Committee for Standardization (PKN) and in the Working Group 7 Sun protection test methods (WG 7) operating within the ISO/TC 217 Committee. He is Editor-in-chief of a professional journal in the field of aesthetic medicine and dermatology – Aesthetica and editor of Advances in Therapy (Springer Nature). He is an executor and coordinator in Polish and international grants.

KL6.: The potential of plant active substances in protecting the skin against infrared radiation

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Infrared radiation (IR), a significant component of solar exposure, contributes to skin photoaging and carcinogenesis by inducing reactive oxygen species, degrading protective carotenoids, and disrupting cellular homeostasis. Unlike ultraviolet (UV) filters, current sunscreens offer limited protection against IR [1,2]. This study aimed to evaluate the photoprotective potential of ten cold-pressed plant oils by measuring changes in the directional–hemispherical reflectance (DHR) of human skin in the 1000–2500 nm spectral range. The study involved 12 healthy volunteers, with in vivo reflectance measured before oil application, immediately after, and 30 minutes post-application.

Four oils—chokeberry, fig, pomegranate, and perilla—demonstrated a statistically significant increase in reflectance in the 1700–2500 nm range ($p < 0.05$), suggesting their potential as IR-protective agents. The increase in DHR values after 30 minutes indicates the oils' ability to alter the optical properties of the skin following epidermal penetration. Correlation analysis revealed that higher chlorophyll a and lycopene content in the oils was associated with a greater reduction in skin reflectance immediately after application ($R = -0.72$ and -0.75, respectively), indicating their potential IR-absorbing capacity.

These findings highlight the potential of selected plant oils as natural IR photoprotectants, complementing traditional UV filters. Moreover, the use of DHR measurements presents a novel, non-invasive approach to assessing IR protection efficacy. Further studies are needed to confirm these preliminary results across broader populations and over longer observation periods.

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Prof. Dr. Noureddine Djebli

Obtained his doctoral degree PhD in 2005 in Neuro-Biochemistry by Es-senia ORAN University and postdoctoral studies from University of Mostaganem. He has worked as professor (lecturer) of Pharmacology and Pharmacognosy Faculty of natural and life sciences,at Abdelhamid ibn badis-Mostaganem- University, ALGERIA. He is Director of pharmacognosy & Api-Phytotherapy laboratory, Chairman of Master-Pharmaco-Toxicology. Member of editorial board of international scientific journals as well as reviewer, with H-index of 19, research interest in drug discovery from natural products, sophisticated chromatographic and spectroscopic techniques for isolation and identification of natural products, analysis of herbal drugs and phytotherapy in vitro and in vivo biological activities of natural products. .

KL7.: Traditional application of desert Algerian plants in skin care products

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Keywords: Traditional application, desert Algerian plants, skin

The development of a healthy and environmentally friendly lifestyle has led to an increased interest in natural products, including phytocosmetics. Natural cosmetics are most often chosen by individuals who care about the environment, health, and beauty, and phytotherapy is widely considered a safe alternative to conventional therapies, sometimes even the only effective one in the case of certain skin conditions. A clear trend of replacing synthetic cosmetic ingredients with natural ones can be observed in modern cosmetology. Since ancient times, plants have been used in cosmetics due to their antioxidant, skin regenerating and moisturizing properties. This entails the need to search for bioactive ingredients in the natural environment, especially in plants. The natural body and cosmetic care sector in Algeria is enjoying unprecedented momentum. Algeria is experiencing a growing demand for natural cosmetics, driven by a rising awareness of the harmful effects of chemical-based products on the environment and personal health. In Algeria, Africa's largest country, The Sahara, the largest of the hot deserts, of which Algeria has the largest part, is an arid zone characterized by a low rainfall regime; it has a very particular flora and fauna, adapted to very harsh climatic conditions.

Dr Mark Smith

Dr Mark Smith holds a MChem (Hons) degree in Chemistry and an interdisciplinary PhD. between chemistry and genetics. Prior to his appointment at NATRUE in 2014, Mark gained significant research expertise holding key roles in the fields of biotechnology (Leeds, UK) and the biomedical/pharmaceutical sector (Montréal, Canada). Assuming the role of Director General in July 2016, Mark is responsible for the general management of NATRUE on a day-to-day basis, while also playing a lead role in all political, regulatory, and scientific affairs of the association including representing NATRUE at international public or private organisations and institutions. Mark leads the Public Affairs & Regulatory and Scientific Working Group, provides support to the NATRUE Scientific Committee, and is a co-chair of the UK Sustainable Beauty Coalition.

PL4.: Environmental Claims and Sustainability Labels: Substantiation and Certification

Smith M. [1]

[1] NaTrue, The International Natural and Organic Cosmetics Association

As part of the green transition, control authorities, investors and consumers all need greater clarity to ensure malpractices like greenwashing are restricted and informed decision-making is supported. Around the global environmental and product claims, including natural or organic, remain an import factor for consumers orientation and choice when it comes to sustainability. Building on what is happening both within and outside the EU, NATRUE will provide an overview of notable global examples where harmonised criteria and third-party certification are being used to substantiate sustainability-linked characteristics, enhance circularity, support cosmetic product claims, and assist informed consumer choice.

Prof. dr hab. inż. Marcin Łukaszewicz

Prof. Marcin Łukaszewicz is a biotechnologist specializing in the biotransformation by probiotic microorganisms in biorefinery of agro-food industry by-products into high-value natural cosmetic ingredients and bio-products. He holds a PhD in Plant Molecular Biology from Université Catholique de Louvain (Belgium) and serves as CEO and co-founder of InventionBio S.A., an innovative enterprise that develops sustainable solutions, including natural cosmetic ingredients, biosurfactants, multifunctional feed additives, biofertilizers, and biostimulators through waste-free biorefinery processes.
As Dean of the Faculty of Biotechnology at the University of Wrocław Prof. Łukaszewicz oversaw significant advancements, notably leading the development of the Faculty's new state-of-the-art research facility. His career encompasses extensive experience managing interdisciplinary R&D projects funded by national and European agencies (NCBiR, NCN, EU), resulting in several scientific publications, numerous patents, and prestigious industry awards such as The Cosmetic Victories Industry Prize (2021). In addition to his leadership roles within academia and industry, Prof. Łukaszewicz actively engages in international collaborations and scientific governance. He serves as an expert for the Polish Accreditation Committee and holded key roles in various scientific organizations, including Secretary of the Polish Biotechnology Association (Polish Academy of Sciences). Prof. Łukaszewicz's contributions significantly advance biotechnology applications in cosmetics, circular economy practices, and quality management systems, positioning him as a prominent leader within the global innovation ecosystem.

KL8.: Zero-Waste Biorefinery: Transforming Agricultural By-products into High-Value Cosmetic Ingredients Using Probiotic Microorganisms

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Zero-waste biorefineries promise a circular cosmetics economy, yet most schemes valorize only isolated fractions or depend on water-hungry submerged fermentations. InventionBio has realized a mixed solid-/liquid-state platform that upgrades various plant-or microbial-based by-products, such as rapeseed meal, molasses, spent yeast, into a complete palette of food-grade actives. Every cascade step is designed under a "less-is-more" philosophy so that each gram of biomass emerges as an active, biodegradable carrier or a nutrient stream, leaving no effluent behind.

The original plant design enabled six 5 m^3 packed-bed fermenters to operate in concert with three 0.5 m^3 liquid state reactors, producing lipopeptide biosurfactants, extracellular biopolymers, self-assembling Smart Delivery Capsules™, and other products in a single pass, cutting specific water and energy demand by more than 40% retaining full food-grade status. The nanocapsules match the diameter of

natural pores in the stratum corneum and deposit ≈90% of encapsulated actives in the target layer, increasing nine-fold the performance of conventional formulations without leaving persistent "packaging" residues. A flagship breakthrough was the $scCO_2$ extraction of bakuchiol followed by nano-emulsification inside our smart delivery capsules, which doubled oxidative stability and tripled dermal flux versus neat oil.

The technology is already thriving in the market. OnlyBio brand embedded the InventionBio actives into various products such as its "Hair-in-Balance" and "Anti-Age Elixir" lines. Developed and implemented innovations surge outpaced the Polish beauty sector. All continuous improvements are orchestrated with the EFQM Model, whose holistic framework accelerated cross-functional learning and supported our pathway to net-zero operations.

Together, these achievements offer a tangible blueprint from agricultural residue to high-performance, planet-positive cosmetics that prove eliminating waste can magnify both efficacy and growth

Enrico Maria Lodolini, PhD, Associate Professor

Associate Professor of Arboriculture and Olive Growing at the Department of Agricultural, Food and Environmental Sciences (D3A) of the Marche Polytechnic University. Ph.D. in Plant Production and Environment. Visiting professor at the Facultad de Agronomia e Ingenieria Forestal de la Pontificia Universidad Catolica de Chile. "Lecturer" in olive growing at the Faculty of Agriculture, University of Rio Grande do Sul, Brazil. He previously covered the position of senior researcher at the Council for Agricultural Research and Economics, Research Center for Olive, Fruit and Citrus Crops in Rome. He participated as coordinator and researcher in many international and national projects. He participated as expert in several international cooperation and development projects for the European Commission (TAIEX Expert) and International NGOs with several missions in the Countries of the Mediterranean basin, in the Middle-East and Northern Africa. His main research interests are olive ecophysiology, tree architecture and canopy management, root topography and growth, cultivation management in increasing planting systems, sustainable soil management in traditional and intense olive orchards, agroecology, germplasm evaluation and valorization for biodiversity valorization, sustainable management of fruit species and olive agro-ecosystem, intensification and sustainability of tree crops, precision agriculture and the use of biostimulants. He participated to local projects in Marche Region, including 'Valorizzazione dell'olivo DOP di Cartoceto' and 'Oliva Tenera Ascolana'.

KL9.: Extra virgin olive oil quality in sustainable production systems with local varieties

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Olive cultivation is spread in the Mediterranean basin since ages and its products and by-products are used for food, energetic and cosmetics purposes. Olive is a very resilient species well adaptable to limiting climatic conditions and with several varieties, very often locally diffused. Nowadays the olive tree is subjected to an intensification process moving from single big-size trees (low density plantation) to small-size hedgerow systems (high or super-high-density plantation) to allow mechanization of some practices [1]. Cultivation must be properly applied according to the plantation system, pedo-climatic conditions and cultivar in order to ensure high quality and constant productions. Nowadays, precision farming and mechanization tools can be adopted also to olive tree cultivation to allow economic and environmental sustainability [2]. Moreover, olive productions (table olives and extra virgin olive oil) are very beneficial for the human health due to the high antioxidant components, so that the combination of intensive mechanizable systems and the production of high-quality products must be explored. It is therefore crucial to optimize each step of the whole olive oil production cycle to maximize the polyphenols content that play a protective effect on human health [3]. At the same time, in a circular economy approach, the use of olive tree by-products, like olive leaf extract, have also been considered as contributing to health promotion, such as in controlling or preventing inflammatory responses associated with viral respiratory infections and aging [4].

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Dr Julia Moesslacher

Julia Moesslacher holds a doctoral degree in pharmaceutical sciences and a diploma in pharmacy from the University of Innsbruck. Her research activities focussed on antiviral drug discovery and optimization and led to several publications in peer-reviewed journals as well as to a patent application.
She switched to industry in 2016 joining Cura Cosmetics Group. There she has held several positions, last Vice President Innovations and Managing Director of the Chemical Laboratories, where she was responsible for 4 departments R&D, Innovation Lab incl. product development (> 200 market launches per year), Regulatory Affairs and Skin Research Institute (> 150 studies per year).
Julia Moesslacher joined the Paracelsus Medical University as Visiting Professor for Pharmaceutical Technology and Biopharmaceutics in 2023, where her teaching activities were awarded twice.
Currently, Julia Moesslacher is Director Innovation Management at Hollu GmbH and works still as consultant for the Cura Cosmetics Group as well as for the ADSI. Beside these, she is still Visiting Professor at the Paracelsus Medical University of Salzburg and giving selected lectures at Management Center Innsbruck as well as at the University of Innsbruck. She is author of the column „Pharma & Beyond" in the magazine PharmaTime.

KL10. Innovation with Integrity – Sustainable Solutions for Natural Cosmetics

Moesslacher J. [1]

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As environmental awareness rises and regulations evolve, sustainability has become a central focus in cosmetics development. In response to increasing consumer expectations for 'green' and ethical solutions, the natural segment emerges as a key area for sustainable innovation. Beside natural replacements for conventional ingredients, strategies like vertical farming, upcycling, and ethical sourcing are currently in the spotlight of product innovation:

Vertical farming offers a resource-efficient method to cultivate high-quality botanical raw materials under controlled conditions, drastically reducing water consumption, land use, and pesticide application. It also enables year-round production and traceability which are crucial elements for natural cosmetic formulations.

Upcycling turns by-products from the food and plant industries into valuable cosmetic ingredients, thus contributing to a circular economy. Bioactive compounds extracted from fruit peels, seeds, plant residues or even waste not only reduce refuse but also offer proven benefits for skin and hair care.

Ethical sourcing ensures that raw materials are obtained under fair, transparent, and socially responsible conditions. Practices such as Fair Trade certification, direct partnerships with smallholder farmers and

support for local harvesting communities not only guarantee better income distribution, but also strengthen regional economies, preserve traditional knowledge and enhance supply chain transparency.

By integrating scientific advances with responsibility, the cosmetic industry can deliver natural products that align with growing consumer expectations for ethical, ecological and performance expectations.

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SL2. Calendula officinalis tissue cultures grown in Plantform™ bioreactors as a sustainable source of phenolic antioxidants for cosmetic applications
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SL3. Testing of cosmetics, ingredients and personal care products using 3D reconstructed human cornea -like tissue model
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SL5. Cosmetic Applications of Essential Oils Extracted from Taiwan's Indigenous Forest Species
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SL10. Rapid Screening of Pyrrolizidine Alkaloids in Cosmetic Products: A Non-Chromatographic approach utilizing Compact Mass Spectrometry
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SL11. Valorizing Saffron By-Products and Bioactive Compounds as a Sustainable Source of Natural Colorants for Cosmetic Applications
Teixeira da Costa L., Nunes A. N., Saldanha do Carmo C., Bronze M. R., Serra A. T.

SL12. Callus extracts of Vitis vinifera L. as a novel ingredient for cosmetics
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SL13. Unlocking Halophyte Plants' Potential for Skin Formulations: A Natural Source of Anti-aging, Anti-hyperpigmentation, and Wound Healing Ingredients

Oliveira J. , Mecha E., Bronze M.R. , Serra A.T.

SL14. Overcoming the limitations of natural skin depigmenting agents: nature inspired cinnamic acid–amino acid derivatives with improved safety and efficacy of tyrosinase inhibition

Kabat M., Popiół J., Gunia – Krzyżak A.

SL15. Bean to beauty: A circular approach to coffee-derived cosmetic ingredients

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SL16. Neuro-modulatory effects of cell-free supernatants from Hericium erinaceus and Ganoderma lucidum – relevance to the gut–brain–skin axis

Tabęcka-Łonczyńska A., Skóra B., Szlachcikowska D., Jastrząb R., Marć M.A., Mytych J., Koszła O.,Sołek P., Szychowski K.A.

SL17. Lamiaceae Plant Extracts as Multifunctional Cosmetic Ingredients: Biological Activity and Safety Assessment – Anna Dziki

Dziki A., Malinowska M.A., Szopa A., Miazga-Karska M., Klimek K. and Sikora E.

SL1. Affordable Purification of Botanical Extracts with a New Chromatography Approach

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In the dynamic world of natural cosmetics, manufacturers and R&D professionals face increasing pressure to develop high-purity, stable, and sustainable formulations — all while staying cost-effective and responsive to supply variability. Centrifugal Partition Chromatography (CPC), a liquid–liquid chromatography technique, offers a unique solution.

Unlike traditional methods, CPC operates without solid supports, minimizing sample loss and contamination risk. What makes it particularly attractive for the cosmetics sector is its affordability and low initial investment, making advanced purification accessible to labs of any size. Its scalability from gram to kilogram range supports both small-batch innovation and industrial production, while the solvent-efficient and gentle process preserves sensitive compounds such as flavonoids, lipids, terpenes, and fatty acids — and can also assist in the removal of unwanted residues like pesticides.

For those working with seasonally variable or botanically diverse harvesting bulks, CPC provides flexible process adaptation, ensuring consistency in extract quality across different plant batches. If you're looking for a robust, affordable alternative to classic purification tools — CPC might be the most elegant solution you haven't tried yet.

SL2. *Calendula officinalis* tissue cultures grown in Plantform™ bioreactors as a sustainable source of phenolic antioxidants for cosmetic applications

A. Szopa[1], Bąk W.[1], Kubica P.[1], Łukaszyk A.[1], Kulik-Siarek K.[2], Klimek-Szczykutowicz M.[2], Kwiecień I.[1]

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The growing demand for natural, sustainable, and biologically active ingredients in cosmetic formulations has highlighted the importance of innovative biotechnological approaches to plant-based metabolite production. *Calendula officinalis* L., widely known for its dermatological and anti-inflammatory properties, is rich in phenolic compounds, particularly flavonols like phenolic acids, flavonoids and coumarins with proven antioxidant potential.

This study aimed to evaluate the biosynthetic capacity of *C. officinalis* cultivated *in vitro* using temporary immersion systems (TIS) Plantform™ bioreactors. Two types of tissue cultures—shoot and embryogenic, were propagated under controlled conditions on Murashige and Skoog media supplemented with different plant growth regulators. For comparative purposes, conventional material, herb and flower of parent soil grown plants were studied.

High-performance liquid chromatography with diode-array detection (DAD-HPLC) revealed the presence of 14 major phenolic metabolites, including chlorogenic acid, caffeic acid, m-coumaric acid, rutin, isoquercetin, scopoletin, and umbeliferone. The total phenolic acid content reached up to 426.93 mg/100 g DW in shoot cultures, while total flavonol content peaked at 523.33 mg/100 g DW. Notably, embryogenic tissues cultivated in TIS showed significantly enhanced biosynthesis of phenolics, with chlorogenic acid levels up to four times higher than those found in the flowers of the parent plant.

Antioxidant activity assays confirmed the efficacy of the extracts. Antioxidant activity, expressed as Trolox equivalents (nmol/mg dry extract), was evaluated using different assays. Total phenolics (TPC) ranged from 147.78 (shoots) to 440.34 (flower); FRAP from 16.31 (shoots) to 77.44 (flower); CUPRAC from 160.87 (shoots) to 275.73 (flower); DPPH from 22.20 (shoots) to 77.77 (flower); and ABTS from 30.01 (shoots) to 105.82 (flower). Notably, embriogenic cultures demonstrated moderate antioxidant capacity, with values such as 254.24 TPC, 44.57 FRAP, and 191.93 CUPRAC, highlighting their potential as a scalable source of bioactive compounds.

In conclusion, the results demonstrate that *C. officinalis in vitro* cultures, particularly embryogenic lines maintained in Plantform™ TIS bioreactors, represent a promising and sustainable biotechnological platform for the production of phenolic-rich extracts with potent antioxidant properties. These findings support the application of bioreactor-based systems in the development of natural, high-value ingredients for skincare and anti-aging formulations.

SL3. Testing of cosmetics, ingredients and personal care products using 3D reconstructed human cornea-like tissue model

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Determination if a compound causes serious eye damage/eye irritation originally involved the use of laboratory animals (OECD TG 405), but the 7th Amendment to the EU Cosmetics Directive and the EU REACH Regulation accentuated the need for in vitro ocular test methods. Validated and non-validated in vitro ocular toxicity tests using 3D reconstructed human cornea-like tissue models that can predict the human response to chemicals, cosmetics, ingredients and other consumer products, are required for the safety and risk assessments of materials that intentionally, or inadvertently, come into contact with the eye. The EpiOcular Eye Irritation test (EIT) according to OECD TG 492 and EpiOcular time-to-toxicity tests (ET-50 methods) have been developed to address this need.

EpiOcular, is a ready-to-use, highly differentiated 3D tissue model consisting of normal, human epidermal keratinocytes (NHEK) which have been cultured in serum free medium to form a stratified, squamous epithelium, similar to in vivo human corneal epithelium. EpiOcular has been validated for the Eye Irritation Test as part of OECD TG 492 which allows to distinguish between chemicals, substances and mixtures including raw materials and finished products not requiring classification and those that must be labeled for eye irritation or serious eye damage. EpiOcular time-to-toxicity tests (neat, dilution, subDraize ultramild tests) are used to screen the irritation potential of the materials and identify their eye irritation potential.

The presentation will provide a short overview of the use of *in vitro* 3D reconstructed human cornea-like tissue model, EpiOcular, in ocular toxicology for safety and risk assessment of chemicals, cosmetics, ingredients, household and other products.

SL4. Exploring the cosmetic potential of grapevine: A metabolomic approach to bioactive compound identification

Malinowska M.[1],*, Ferrier M.[2], Gémin M.P. [2], Unlubayir M[2], Munsch T.[2], Billet K.[2], Abdallah C.[2], Giglioli-Guivarc'h N.[2], Hano C[3], Lanoue A[2]*

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Keywords : polyphenols, grapevine extracts, cosmetics, metabolomics.

Grapevine (Vitis vinifera) is a rich source of plant-specialized metabolites, including polyphenols such as flavonoids, stilbenoids, and phenolic acids, which show a wide range of biological activities relevant for cosmetic applications, particularly in antioxidation, anti-aging, and skin protection (1). While most studies focus solely on grape berries, our research expands the scope to include other plant parts—such as seeds and canes —to comprehensively assess their bioactive potential. The aim of this study was to identify the key compounds and environmental factors influencing the metabolic profiles of grapevine extracts in order to develop a data-driven strategy for selecting the most promising plant organs, cultivars, and growing conditions for cosmetic use.

Extracts were prepared from different organs (berries, seeds, leaves, canes) of selected grapevine varieties cultivated in Loire valley in France. Metabolomic profiling was performed using UPLC-DAD-MS/MS, enabling the relative and absolute quantification of bioactive compounds. Antioxidant capacities were assessed and multivariate statistical analyses (PCA, hierarchical clustering, and heatmaps) were applied to correlate metabolite profiles with biological activities, and to evaluate the influence of cultivation region and horticultural treatments.

A total of 58 metabolites were identified across different organs and cultivation conditions, including anthocyanins, flavonols, stilbenoids, flavan-3-ols, and phenolic acids. Significant differences in compound profiles and antioxidant activities were observed between plant organs, with seeds, leaves and canes showing high levels of certain stilbenoids, producing targeted metabolites under optimized conditions. Statistical analyses revealed strong correlations between specific compounds and antioxidant capacities, providing clear criteria for selection. Cultivation conditions and horticultural treatments had a measurable effect on the phytochemical composition, highlighting the importance of environmental factors in compound biosynthesis.

Our integrative metabolomic and statistical approach enables a rapid, efficient, and data-driven selection of grapevine parts, varieties, and cultivation conditions optimized for the production of bioactive compounds with high cosmetic potential. This strategy supports the sustainable and targeted development of plant-based cosmetic ingredients from grapevine extracts.

SL5. Cosmetic Applications of Essential Oils Extracted from Taiwan's Indigenous Forest Species

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Essential oils, also known as plant volatiles, have garnered attention in cosmetic applications due to their array of beneficial properties, including their aromatic fragrances and potential therapeutic effects on the skin and hair. These oils serve as natural sources of biologically active ingredients, offering a broad spectrum of bioactivities such as antioxidant, anti-inflammatory, dermato-protection, antiaging, and antimicrobial properties, thus becoming integral components of herbal cosmetic products. Taiwan's rich forest biodiversity hosts over 5000 known native species of flora. Our ongoing research focuses on exploring the skin health benefits of essential oils extracted from indigenous forest species of Taiwan. In our investigations, we initially screened the anti-melanogenic properties of 16 essential oils extracted from native forest species in Taiwan, along with 31 commercial essential oils. Among them, *Alpinia nantoensis* leaf and rhizome [1], *Calocedrus formosana* wood [2], *Pogostemon cablin* [3], and *Glossogyne tenuifolia* [4], along with their bioactive compounds, exhibit robust melanin inhibition through tyrosinase inhibitory activities in skin melanocytes. Furthermore, our studies have unveiled that these essential oils not only inhibit cellular tyrosinase activity but also modulate melanin biosynthesis pathways. Additionally, we have discovered that *Glossogyne tenuifolia* essential oil and limonene from *Alpinia nantoensis* essential oil protect skin keratinocytes from ultraviolet irradiation-induced photodamage and photoaging [5]. Collectively, our findings underscore the potential of essential oils as promising natural sources for the development of skin whitening/lightening and anti-aging agents for cosmetic applications.

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SL6. Isoquinoline Alkaloids from Papaveraceae

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Papaveraceae plants are known for producing a diverse group of biologically active isoquinoline alkaloids (IQAs), many of which contribute to the distinctive yellow-to-red coloration of their latex. These compounds demonstrate antiviral, antiparasitic, and antimicrobial properties. While certain IQAs, such as berberine and coptisine, are now commercially produced via plant tissue cultures, numerous other alkaloids abundant in medicinal poppies remain largely unexplored.

In our study, we employed plant tissue and organ cultures, alongside cultivated plants, to monitor the biosynthesis of these compounds. We also assessed their biological efficacy against several Candida strains and pathogenic bacteria, including biofilm-forming species. Furthermore, we developed an innovative cell-support platform by immobilizing Chelidonium majus L. cells on bacterial nanocellulose, aiming to stimulate the cells and enhance antimicrobial activity. C. majus, traditionally used to treat skin infections, was our primary focus, though we also investigated several other poppy family members.

The results highlight the considerable potential of Papaveraceae plants in the production of pharmacologically valuable IQAs, opening strategy for future biotechnological applications. Additionally, we suggest that other specialized metabolites, particularly polyphenols, may act synergistically to enhance the observed antimicrobial effects.

Acknowledgements

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SL7. Microbiome Regulation by Cosmetic Ingredients

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The main text of the abstract should be written with Calibri font, Size 10, in Justify Align. The abstract text must not exceed 300 words. One table or figure is accepted in the Abstract if necessary. The references should be marked in the main text in brackets. The skin microbiome is a crucial ecological layer that plays a fundamental role in maintaining skin barrier function, regulating immune responses, and protecting against external pathogens. A balanced microbiome supports healthy skin by contributing to homeostasis, producing antimicrobial peptides, and outcompeting harmful microorganisms.

Disruptions in the skin microbiome—caused by environmental stressors, medical treatments, or underlying health conditions—can result in chronic skin problems. These imbalances are particularly evident in individuals with immunological skin diseases such as psoriasis and atopic dermatitis. Numerous studies have shown that in these conditions, the skin microbiome is often dominated by pathogenic strains, particularly Staphylococcus aureus. This microbial dominance correlates with more frequent and more extensive skin lesions, which can be triggered by even minor irritations.

In addition, antibiotic therapy, while necessary in some clinical situations, can further disrupt the microbial ecosystem of the skin. It creates favorable conditions for opportunistic pathogens, such as Candida species, to overgrow—contributing to infections, inflammation, and delayed skin recovery.

Recent advancements in dermatological science suggest that targeted microbiome modulation may provide a promising therapeutic approach. By using microbiome stimulants, boosters, or postbiotical bioferments and also it may be possible to restore a healthy microbial balance, suppress pathogenic strains, and enhance skin resilience. This strategy does not rely on eliminating microbes, but rather on promoting beneficial microorganisms and improving their interactions with the skin barrier and immune system. In this context, cosmetic ingredients with microbiome-regulating properties represent a new frontier in skincare. Their application may help prevent inflammation, support skin regeneration, and offer long-term benefits in managing microbiome-related skin conditions. Further research is needed, but early results are encouraging and point to a paradigm shift in the way we approach skin health.

SL8. Sustainable beauty: unlocking the cosmetic potential of spent coffee grounds

Piasek A.[1]

A single cup of coffee generates approximately 8 grams of spent coffee grounds. In Poland, we consume an estimated 12 billion cups of coffee annually [1,2]. Combined with waste generated during production, this results in around 120,000 tons of coffee waste each year.

The composition of spent coffee grounds (SCG) reflects both the inherent properties of coffee and the effects of brewing, including Maillard reaction products. The primary components include cellulose and hemicellulose, with coffee oil accounting for approximately 15%, alongside a significant fraction of lignin. SCG also contains 7–14% proteins. Polyphenols and other antioxidant compounds constitute a smaller fraction, up to 2.5%.

EcoBean company has developed the most advanced in the world and patented technology for full valorization of Spent Coffee Grounds. Within the biorefinery technology the rich biomass is turned into 5 chemicals fractions to be used in multiple industries. This study explores a dual-extraction approach to maximize the cosmetic potential of SCG. Through sequential oil separation and ethanol/water extraction, two high-value products were obtained: a SCG antioxidant extract and coffee oil.

Together, these two SCG-derived fractions present a circular and eco-conscious alternative to conventional cosmetic ingredients. EcoBean's Coffee Oil and Antioxidants Extract have been thoroughly evaluated in cosmetic emulsions, demonstrating consistent integration and stability without separation. These SCG-derived ingredients have also passed cytotoxic and aging tests. Notably, they retain their antioxidant activity at temperatures up to 90°C, supporting their use in a range of advanced skincare formulations.

This research is conducted within the framework of the Implementation Doctorate Program (5th edition), funded by the Ministry of Science and Higher Education in Poland.

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SL9. From by-products to bioactive ingredients: A green extraction and nano-encapsulation approach for bioactive-rich sensitive skin cosmetics

Sarrou E. [1], Baixauli E. [2], Rahmani Samani M. [3], Mullor J.L. [2], Merino M. [2], Martens S.[3], Papastavropoulou K. [4], Kopsacheli A. [4], Pasvanka A. [4], Tsikrika K. [4], Serrano P. [5], and Proestos C. [4]

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NanoCosmos MSCA-RISE project presents an interdisciplinary, intersectoral and international approach to harness the recovery of valuable bioactive compounds from medicinal plants post-distillation and post-harvest by-products, implementing green extraction techniques, efficacy studies and liposomal nanotechnology, to produce ingredients for sensitive skin cosmetic products. In detail the scientific program of NanoCosmos involved the extraction of Saffron petals (*Crocus sativus*), *Rhodiola rosea* herba (leaves including flowers), Chamomile (*Matricaria chamomilla*) and Lavender (*Lavandula angustifolia vera*) post distillation biomass through Supercritical Fluid Extraction (SFE), Ultrasound Assisted Extraction (UAE) and maceration in hydroethanolic solvents and oils (grape seed and safflower oil). The metabolomic analysis through UPLC-HRMS and UPLC-DAD, -MS/MS of the extracts presented a considerable phytochemical diversity, identifying phenolic acids (chlorogenic acid derivatives, rosmarinic acid), flavonols (quercetin and kaempferol derivatives), flavones (apigenin and luteolin derivatives) and coumarins (umbeliferone) as the most abundant class of metabolites. The most diverse extracts were selected for safety and efficacy testing considering their *in vitro* antioxidant, anti-inflammatory and cytotoxic/cytoprotective properties. Based on the safety and efficacy results obtained, selected extracts will be further nano-encapsulated in liposomes to develop novel cosmetic formulas for sensitive skin following the circular economy rules.
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(www.nanocosmos.eu)

SL10. Rapid Screening of Pyrrolizidine Alkaloids in Cosmetic Products: A Non-Chromatographic approach utilizing Compact Mass Spectrometry

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Pyrrolizidine alkaloids (PAs) are hepatotoxic secondary plant metabolites that can contaminate herbal-based consumer products, including cosmetics [1]. Due to their low concentrations and the complexity of cosmetic matrices, sensitive and selective analytical methods are essential. This study presents an integrated workflow for PA detection using nano-zirconium silicate (NZS)-based solid-phase extraction (SPE) coupled with compact mass spectrometry (CMS) for rapid analysis [2].
Originally developed for plant extracts, the NZS sorbent binds PAs through coordination with nitrogen and oxygen donor atoms. The method enables efficient matrix clean-up and enrichment, improving sensitivity and reducing solvent use compared to conventional C18 SPE. Method validation followed ICH guidelines, with recovery rates of 70 - 95% for most PA free bases [2].
Conventional PA analysis relies on time-consuming chromatographic separation due to structural diversity among over 660 known PAs and N-oxides. To streamline screening, we employed CMS without chromatographic separation. A preceding hydrolysis step was used to cleave esterified PAs and simultaneously reduce their N-oxides, thereby liberating retronecine, which served as a sum parameter for detection. Flow-injection analysis (FIA) targeting retronecine-derived ions enables rapid detection of total retronecine-type PAs. The combined NZS-SPE and CMS method achieves analysis times under 2 minutes per sample, with sufficient sensitivity for cosmetic and botanical matrices. Though individual PAs are not resolved, this approach is ideal for high-throughput pre-screening, flagging suspect samples for confirmatory UHPLC-MS.
Furthermore, to evaluate dermal exposure, selected PA-containing cosmetic samples were applied to a reconstructed human epidermis (RHE) mode. PA bioavailability across the skin barrier was assessed, alongside toxicological endpoints (e.g., cell viability) and innate immune responses via cytokine release. This analytical-biological workflow contributes to the safety assessment of PAs in topical formulations and supports future regulatory screening efforts.

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SL11. Valorizing Saffron By-Products and Bioactive Compounds as a Sustainable Source of Natural Colorants for Cosmetic Applications

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The growing demand for safer and environmentally-friendly cosmetics has driven interest in natural-based ingredients [1,2]. Saffron by-products, primarily composed of flower tepals, represent approximately 93% of saffron biomass and emerge as a promising source of natural pigments. Their anthocyanin and flavonol content gives them relevant functional properties [3,4]. As co-pigments, flavonols may help stabilizing anthocyanins structure and color.

This study aimed to optimize a hydroalcoholic extraction process to maximize total anthocyanin content (TAC), anthocyanin yield (AY), and extraction yield (EY) from saffron tepals, while also evaluating the bioactive properties of the resulting extracts for cosmetic aplications. Response Surface Methodology (RSM) following a Central Composite Face-Centered design was applied to assess the effects of ethanol concentration (0–100%, pH 2), extraction time (10–60 min) and solid-to-solvent ratio (1:125–1:40g/mL). Seventeen extracts were analyzed for TAC (using pH differential method and HPLC-DAD), antioxidant activity (ORAC method) and color parameters (CIELAB method). Tyrosinase and matrix metalloproteinase-1 (MMP-1) inhibition assays were performed to investigate the anti-hiperpigmentation and anti-ageing potential of saffron-based extracts.

Ethanol concentration was the most influential factor, with lower ethanol levels enhancing EY, AY, TAC, and ORAC values. Under optimal extraction conditions, EY, AY and TAC reached 71.1%, ≈100% and 1.13g/100 g, respectively. The optimized extract exhibited a dark bluish-red hue and an antioxidant capacity of 2124±179$\mu mol_{TEAC}/g$ attributed to kaempferol-3-sophoroside (1044±19$\mu mol_{TEAC}/g$), delphinidin-3,5-diglucoside (184±3 $\mu mol_{TEAC}/g$) and kaempferol-3-sophoroside-7-glucoside (157±3$\mu mol_{TEAC}/g$). Compared to a previous study [5], this process reduced extraction time to up to 1 hour and solvent use was decreased by six times. Enzyme-inhibition assays showed that the extract (61 mg/mL) inhibited tyrosinase and MMP-1 by up to 78% and 99%, respectively, suggesting protective effects against melanogenesis and collagen degradation.

These findings contribute to the valorization of saffron by-products as a sustainable source of natural bioactive colorants towards the development of cosmetic ingredients.

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SL12. Callus extracts of *Vitis vinifera* L. as a novel ingredient for cosmetics

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Skin aging is complicated biological process, accelerated by external factors such as UV radiation or pollution through oxidative stress. For this reason, natural compounds, particularly those with anti-aging properties, are in high demand [1-2].
Grapevine (*Vitis vinifera* L.) is one of the most important fruit crops all over the world. *In vitro* cultures of *Vitis vinifera* are becoming increasingly popular subject of scientific studies, which is determined by its broad profile of biological activity [3-6].
The aim of the studies was initiation and optimization the conditions for maintaining callus cultures of various *V. vinifera* cultivars (white: Chardonnay, Hibernal, and red varieties: Marechal Foch, Regent and Rondo) and to assess its biological potential. Cultures were grown in 30-day cycles on MS (Murashige and Skoog) and SH (Schenk and Hildebrandt) medium containing different combinations of plant growth regulators: 'W1' – MS with 0.9 ml/l BA and 0.1 ml/l IBA; 'W2' – MS with 1.5 ml/l BA and 0.2 ml/l NAA; 'W3' – SH with 0.9 ml/l BA and 0.1 ml/l IBA and 'W4' – SH with 1.5 ml/l BA and 0.2 ml/l NAA.
The extract was obtained using ultrasound-assisted extraction. The ultrahigh-performance liquid chromatography coupled with mass spectrometry (UPLC-MS) analysis was applied for metabolite profiling. An antioxidant activity of grapevine callus extracts was evaluated using ABTS and FRAP methods. Moreover, tyrosinase and elastase inhibition tests were performed to assess the anti-aging potential of the extracts.
The obtained results showed that the dominant groups of compounds in the extracts are amino acids and stilbenoids. The results of ABTS and FRAP assays revealed moderate antioxidant activity of extracts. The results of enzyme assays confirmed that the extracts could act as tyrosinase and elastase inhibitors.
Due to rich content of active compounds and beneficial biological properties, grapevine callus extracts can be applied as valuable raw materials in cosmetic formulations.

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SL13. Unlocking Halophyte Plants' Potential for Skin Formulations: A Natural Source of Anti-aging, Anti-hyperpigmentation, and Wound Healing Ingredients

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Halophytes synthesize a range of phenolic compounds with antioxidant properties, contributing to skin health. In response to the growing demand for natural cosmetic ingredients, this study evaluated the cosmetic potential of five halophyte species (*Salicornia ramosissima*, *Sarcocornia fructicosa*, *Inula crithmoides*, *Mesembryanthemum nodiflorum*, and *Crithmum maritimum)* by characterizing their phenolic compounds, *in vitro* antioxidant capacity, cytotoxicity, inhibition of key skin enzymes, and wound-healing effect [1,2].

Hydro-alcoholic extracts were analyzed for phenolic composition and content (TPC) using liquid chromatography (HPLC-DAD) and the Folin-Ciocalteu method. Antioxidant capacity was assessed through chemical assays (ORAC and HOSC) and cell-based assays using keratinocytes (HaCaT) (CAA). Skin-related enzymes inhibition (tyrosinase, elastase, hyaluronidase, and MMP-1) was quantified spectrophotometrically. Wound-healing potential was evaluated using *in vitro* scratch assays in HaCaT.

Analysis revealed that *S. fructicosa*, *I. crithmoides*, and *M. nodiflorum* were rich in flavonoids, while *S. ramosissima* and *C. maritimum* were rich in phenolic acids. *S. ramosissima* exhibited the highest TPC (7.8±0.6 mg GAE/g dry plant (DP)) and antioxidant values (ORAC: 121.7±10.8 µmol TEAC/g DP; HOSC: 121.4±12.0 µmol TEAC/g DP). *C. maritimum* showed the highest CAA (5.2±0.7 QE µmol/g DP), while *M. nodiflorum* had the lowest TPC (3.6±0.5 mg GAE/g DP) and antioxidant effect (ORAC: 26.1±4.4 µmol TEAC/g DP; HOSC: 44.4±3.7 µmol TEAC/g DP; CAA: 0.2±0.0 QE µmol/g DP). Concerning cosmetic applications, *S. fructicosa* exhibited the highest anti-hyperpigmentation effect, inhibiting tyrosinase activity by 29% at 0.5 g DP/mL concentration, while *M. nodiflorum* demonstrated the major anti-aging effect by inhibiting the MMP-1 enzyme by 92% at 0.5 g DP/mL concentration. Regarding the wound-healing properties, only *S. ramosissima* and *S. fructicosa* showed significant healing effects after 24 hours in keratinocytes, compared to the control ($p < 0.05$).

These findings highlight halophyte plants as a source of valuable natural ingredients, like phenolic compounds, for developing cosmetic formulations with health-promoting effects on skin.

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Fishery Industry Residues:Sardine Wastes and Codfish Frames. Antioxidants, 2022, 11, 1925.

SL14. Overcoming the limitations of natural skin depigmenting agents: nature inspired cinnamic acid–amino acid derivatives with improved safety and efficacy of tyrosinase inhibition.

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Skin hyperpigmentation has various causes and is a significant aesthetic issue that negatively impacts self-perception and quality of life. Melanogenesis, the multistep process of melanin biosynthesis, involves three main stages: synthesis of tyrosinase - the key enzyme catalysing the initial reactions in the pathway, conversion of dopachrome into eumelanin and pheomelanin and transfer of melanin from melanocytes to surrounding keratinocytes. Numerous depigmenting agents are used in pharmaceutical and cosmetic formulations, most of which act by inhibiting tyrosinase or disrupting melanin distribution. However, many of these compounds suffer from limitations such as photo instability, cytotoxicity, or regulatory constraints [1]. Cinnamic acid, a natural substance extracted from cinnamon essential oil, is widely used in cosmetics, mostly as a fragrance component. Its (E)-β-phenyl-α,β-unsaturated carbonyl group plays a key role in the inhibition of tyrosinase activity [2].
The aim of this study was to design nature inspired depigmenting agents: cinnamic acid - amino acid hybrids, with enhanced stability and biological efficacy. The compounds were synthesized via N-acylation reactions, and their identity and purity were confirmed using spectroscopic and chromatographic methods. Biological evaluation included a mushroom tyrosinase inhibition assay (using L-DOPA as substrate) and assessment of melanogenesis inhibition in α-MSH-stimulated murine melanoma cells. To preliminarily assess biological safety, cytotoxicity was evaluated in vitro using human keratinocyte and fibroblast cell lines, and skin irritation potential was tested according to OECD Test Guideline 439 using the reconstructed human epidermis model - Episkin.
The results indicate that cinnamic acid-amino acid hybrids demonstrate promising tyrosinase inhibitory activity and melanogenesis reduction, combined with low cytotoxicity and non-irritant properties. These findings suggest that such compounds may offer a safer and more effective alternative to conventional skin-lightening agents, aligning with the concept of sustainable and bioinspired skin care.

Table 1. Mushroom tyrosinase diphenolase inhibition assay for the most promising compounds along with their IC_{50} values.

Concentration [µM]	Inhibition H570 [%] ± sd	IC_{50} H570 [µM] ± sd	Inhibition H549 [%] ± sd	IC_{50} H549 [µM]± sd	Inhibition H581 [%] ± sd	IIC_{50} H581 [µM] ±sd	Inhibition H571 [%] ± sd	IIC_{50} H571 [µM] ± sd
500,0	61,59 ± 0,94	179,16 ± 18,05	53,62 ± 1,24	327,74 ± 22,71		227,56 ± 19,47		162,37 ± 18,06
250,0	54,77 ±2,1		49,59 ± 7,29		48,00 ± 2,69		55,98 ± 2,64	
125,0	44,97 ± 2,13		38,38 ± 2,6		45,43 ± 3,31		46,50 ± 0,92	
62,5	37,76 ± 1,64		30,32 ± 0,29		38,05 ± 2,36		38,18 ± 2,17	

31,25	28,65 ± 4,04		25,30 ± 1,69		22,95 ± 3,04		27,20 ± 1,26	
15,6					17,20 ± 1,35		20,29 ± 0,66	

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SL15. Bean to beauty: A circular approach to coffee-derived cosmetic ingredients

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Drinking coffee - one of the most widely consumed beverages globally, generates million tons of spent coffee grounds (SCG) annually in the whole world. A significant share of this waste ends up in landfills, endangering the environment. However, SCG still remains a rich source of bioactive agents, including lipids and antioxidants, which can be extracted as coffee oil and antioxidant extracts. These compounds are believed to have a positive effect on skin health, which makes them suitable for potential use in cosmetics. This study aims to assess the feasibility of using SCG-derived products in cosmetic emulsions.

Oil-in-water (O/W) emulsions with various concentrations of SCG-derived ingredients were prepared using hot emulsification method. The physical stability of the emulsions was assessed in the accelerated aging test. The SCG-derived products were tested for maintaining antioxidant properties in high temperature (CUPRAC assay) and their cytotoxicity was assessed on human keratinocytes in a 3D cell culture (FDA/PI and MTT assays). The efficacy of the creams containing SCG-derived ingredients was studied in the *in vitro* cytotoxicity assessment and in the *in vivo* sensory and instrumental tests.

The emulsions showed good physical stability in the accelerated aging test. Both antioxidant extract and coffee oil maintained their antioxidant activity after the exposure to high temperatures. SCG-derived products as well as the emulsions containing them did not show cytotoxic effect towards the keratinocytes. The *in vivo* test results were in favor of the emulsions with SCG-derived ingredients in terms of hydrating effect and overall test subject satisfaction.

Spent coffee grounds contain various valuable compounds, thus should be considered a resource rather than a waste. The SCG-derived products examined in this study have been proven to be suitable and effective active or base ingredients in cosmetic emulsions.

SL16. Neuro-modulatory effects of cell-free supernatants from *Hericium erinaceus* and *Ganoderma lucidum* - relevance to the gut–brain–skin axis

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The gut–brain–skin axis is an emerging paradigm linking gut microbial activity with systemic and skin health [1]. In this context, functional natural ingredients derived from traditional medicinal fungi are gaining attention as modulators of neuroimmune and metabolic homeostasis [2]. With this background, the aim of our study was to investigate the biological activity of microbiome-derived cell-free supernatants (M-CFS) from *Hericium erinaceus* and *Ganoderma lucidum* on hippocampal HT-22 neuronal cells, with a particular focus on their potential to modulate neuronal function *via* the aryl hydrocarbon receptor (AhR). HT-22 cells were exposed to the M-CFS and analyzed for key cellular responses: metabolic activity, lactate dehydrogenase release, cell cycle progression, and caspase-3 activity. Additionally, expression of proteins related to oxidative stress (SOD1), autophagy (Beclin-1, SQSTM1/p62), proliferation (PCNA), intracellular signaling (ERK1/2, c-SRC) levels was assessed by Western blot. The study demonstrated that the tested M-CFS exhibited no cytotoxic effects on HT-22 cells within the concentration range of 2.5% to 10% of the culture medium. Treatment with these compounds led to elevated expression levels of proteins associated with cellular stress response and proliferation, including SQSTM1/p62, PCNA, c-SRC, SOD1, AhR, Beclin 1, and ERK1/2. Notably, AhR appeared to play a key role in mediating the cellular response, as indicated by its increased protein expression. The upregulation of proliferation- and survival-related markers suggests a potentially beneficial effect of these fungal-derived cell-free supernatants on neuronal cells, thereby supporting the use of *Hericium erinaceus* and *Ganoderma lucidum* as safe, health-promoting supplements with potential applications in dietary or dermocosmetic strategies targeting the microbiota–brain–skin axis.

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Influence on the Gut-Brain-Skin Axis. Biochemical and Biophysical Research Communications, 2024.

SL17. *Lamiaceae* Plant Extracts as Multifunctional Cosmetic Ingredients: Biological Activity and Safety Assessment

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Plants from the *Lamiaceae* family are a promising natural source of bioactive compounds with potential applications in skincare products designed for problematic and acne-prone skin [1]. The proven antibacterial, antioxidant, and anti-inflammatory properties support their use as multifunctional cosmetic ingredients
[2, 3].
This study aimed to evaluate the biological activity and safety profile of extracts obtained from *in vitro* and *in vivo* cultures of the selected *Lamiaceae* species: *Mentha, Salvia splendens, Salvia farinacea, Salvia officinalis, Ocimum basilicum, Lavandula* and *Melissa officinalis*. The research included the analysis of antibacterial activity (minimum inhibitory concentration – MIC, and minimum bactericidal concentration – MBC) against acne-associated strains (*Staphylococcus aureus, Staphylococcus epidermidis, Cutibacterium acnes, Escherichia coli*), the evaluation of antioxidant capacity, metal ion chelation ability, and cytotoxicity toward human dermal fibroblasts (BJ cell line) [4]. To assess the balance between efficacy and safety, the therapeutic index (TI) was calculated.
Among others, the extracts of *Ocimum basilicum* and *Salvia officinalis* demonstrated the most promising features: the antibacterial activity, strong antioxidant potential, and efficient metal-chelating properties. Notably, no cytotoxic effects were observed within the tested concentration ranges, and the calculated TI values confirmed a good safety profile for cosmetic use.
To sum up, the obtained results suggest that *in vitro*-derived extracts of *Lamiaceae* plants, due to the broad spectrum of biological activity, combined with good tolerability, could be applied as valuable multifunctional ingredients in natural cosmetics, dedicated for problematic skin e.g. anti-acne cosmetic products.

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List of Posters

* indicates posters presented by young scientists (PhD candidates)

P1. Rheology of the toothpaste
Adamczyk G., Pawłowska A., Kaszuba J., Jaworska G.

P2. Polymers used to modify the rheological properties of cosmetics
Adamczyk G., Pawłowska A., Jaworska G., Hanus P.

P3. Valorization of apple by-products: phytochemical profiling and anti-aging potential of peel and flesh extracts for sustainable cosmetic applications
Antoniadi L., Gkiouvetidis P., Michailidis D., Papaefstathiou G., Skaltsounis A., Halabalaki M., Mitakou S., Skaltsounis L.A.

P4. Metabolomic analyses of fungus-resistant grape varieties (PIWI) cultivated in Poland in relation to their antioxidant activities to develop active ingredients in skin care formulations.
Malinowska M.A., Ferrier M., Gémin M.P., Abdallah C., Giglioli-Guivarc'h M., Hano C., Lanoue A.

***P5. Neem (*Azadirachta indica*) leaf extracts: cosmetic potential and application in green synthesis of AgNPs**
Barańska A., Balon B., Sandomierski M., Gaweł-Bęben K.

***P6. Investigation of the lipase-mediated synthesis of alkyl esters of hydroxycinnamic acids**
Baskaran A., Zhang W., Crisafulli N., Brenna E., Boratyński F.

***P7. Fruit extracts of *Cornus mas*, *Hippophae rhamnoides*, and *Chaenomeles japonica* as modulators of adenosine metabolism**
Berezovska D., Świder O., Olędzka A., Bryła M., Czerwińska M. E.

***P8. Electromagnetic Field-Assisted Modulation of Flurbiprofen in Transdermal Applications**
Bilska K., Nowak A., Zagórska-Dziok M., Ziemlewska A., Muzykiewicz-Szymańska A., Kucharski Ł., Ossowicz-Rupniewska P.

***P9. Chemical modifications of flurbiprofen – evaluation of antioxidant, anti-inflammatory properties and cytotoxicity in cell models**
Bilska K., Zyburtowicz-Ćwiartka K., Nowak A., Konopacki M., Muzykiewicz-Szymańska A., Kucharski Ł., Rakoczy R., Ossowicz-Rupniewska P.

***P10. Total Phenolic and Flavonoid Contents, Antioxidant and Urease Inhibitory Activities of a Wild Amaranthaceae Halophyte from the Algerian Sahara**

Boubekeur R., Messaouda D. ,Belguidoum M. ,Touahria T.,Bensouici C. ,Khattabi L., Zahnit W.

***P11. Freeze-dried chitosan/shikonin scaffolds as a promising structures for skin repair**

Brudzyńska P., Kurzawa M., Grisel M., Sionkowska A.

***P12. Advancing cosmetic ingredient development through innovative mass spectrometry approaches**

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P1. Rheology of the toothpaste

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Toothpaste is a product a paste or gel dentifrice. Toothpastes are substances with a complex structure and is dedicate to promote oral hygiene. This products aid in removing dental plaque and food from the teeth, delivers active ingredients i.e. fluoride, to help prevent tooth decay and gum disease [1]. Toothpastes are highly viscous substances, therefore their quality is described mainly by assessing rheological parameters which can have complex rheological behaviors due to the ingredients used in their formulation [2]. Thixotropy and viscoelastic properties are often found in these products. Furthermore such a product must exhibit shear-thinning flow so that the viscosity decreases under the influence of force, e.g. when squeezing it from the tube and brushing the teeth. The rheology has broadened recently through its integration with other technologies such as environmental engineering or artificial intelligence. As cosmetic products evolve and become more complex, because of new formulations, especially in the biocosmetics, the role of rheology is poised to grow even more significant [3]. Using rheological measurements, by determining the relevant rheological parameters, can be established relationships between structure, process behavior and final product properties [4]. Th toothpaste is an example for Bingham plastic behavior [5]. Barnes listed toothpaste as a shear-thinning but toothpaste is usually considered as a thixotropic material [6].

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P2. Polymers used to modify the rheological properties of cosmetics

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Rheological modifiers play an important role in cosmetics technology, because are responsible for the ability to spread onto surfaces (skin layer), their sensory attributes or stability. The polymers are used as thickening agents by the different mechanisms: chain entanglement, associative mechanism and covalent cross-linking. Rheological modifiers can be classified as an organic and inorganic substances. Organic modifiers are sorted as a i) natural polymers (derived from plant, animal or microbial origin) based on polysaccharides or proteins, ii) naturally modified modifiers (natural polymers treated by the chemical modifications). Whereas non-organic polymers are i) synthetic modifiers are derived from oil-based polymers, ii) inorganic modifiers based on mineral substances [1]. The current trends in cosmetics technology going to increasing push using for greener, sustainable, and non-oil based raw ingredients in the rheology modifiers, but also use of renewable energy [2, 3]. A variety of different viscometers and measuring techniques are now available to measure rheological properties: capillary viscometers, rotation viscometer, falling ball viscometer, bubble viscometer, efflux viscometer forced or oscillatory shearing [1].

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P3. Valorization of apple by-products: phytochemical profiling and anti-aging potential of peel and flesh extracts for sustainable cosmetic applications

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The apple tree (*Malus domestica*, Rosaceae) is the most extensively cultivated fruit crop worldwide, accounting for nearly half of global deciduous fruit production. Traditionally appreciated for its nutritional value, apple consumption has also been associated with numerous health benefits—primarily attributed to its rich content of phenolic compounds with potent antioxidant properties [1]. The main by-product of apple processing is peel, which is typically discarded despite being a rich source of these bioactive compounds.
This study explores the phytochemical diversity and biological activity of selected apple cultivars, focusing on the comparative analysis of peel and flesh. The objective is to evaluate their potential as natural, functional ingredients for eco-conscious skincare formulations, emphasizing the sustainable use of fruit by-products.
Fruit samples were manually separated into peel and flesh and subjected to various extraction techniques, including maceration, ultrasound-assisted extraction using graded hydroalcoholic solvent systems, and supercritical fluid extraction (SFE) [2]. The resulting extracts were analyzed using High-Performance Liquid Chromatography (HPLC), High-Performance Thin-Layer Chromatography (HPTLC), and Liquid Chromatography–Mass Spectrometry (LC-MS) to identify key phenolic constituents such as quercetin, catechin, phloridzin, and cyanidin-7-glucoside. Select extracts were further treated with adsorption resins to enrich their content with active metabolites and reduce sugar content. Furthermore, in vitro assays assessed antioxidant potential (DPPH assay), total polyphenolic content (TPC), and inhibitory activity against skin-aging related enzymes—tyrosinase, elastase, and collagenase. Notably, the hydroalcoholic extracts of apple peel and their resin-enriched fractions exhibited significantly higher polyphenol levels and superior antioxidant and enzyme inhibitory effects compared to flesh extracts.
These findings highlight apple peel, particularly its hydroalcoholic fraction, as a high-value, sustainable source of bioactive compounds for anti-aging skincare applications. The study supports the growing demand for natural and environmentally responsible cosmetic solutions through innovative upcycling of agri-food waste.

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P4. Metabolomic analyses of fungus-resistant grape varieties (PIWI) cultivated in Poland in relation to their antioxidant activities to develop active ingredients in skin care formulations.

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Grapevine presents a large cultivar diversity worldwide regarding; their use (wine or table), berry color (black, red or white), maturity time (early, medium or late) and their tolerance to environmental stress like pathogen attack. The grapevine resistance is partly dependent on the capacity to accumulate 'plant-specialized metabolites' as polyphenols including phenolic acids, anthocyanins, flavonols, stilbenoids or condensed tannins. Besides antimicrobial activities, some of these compounds exhibit various biological activities relevant for cosmetics [1, 2]. Among them, reactive oxygen scavenging activities are one of the crucial mechanism in the prevention of skin degeneration process, including accelerated aging.
In this study, we investigated the metabolic composition of 12 fungus-resistant grape varieties also known as PIWI (German abbreviation of Pilswiederstangfähige) [3] collected in the Jura vineyards of Poland situated near Krakow. After performing the metabolomic profiling of hydroalcoholic berry extracts using UPLC-DAD-MS/MS, the relative and absolute quantification of metabolites was done. In vitro antioxidant activities of the corresponding extracts were assessed using ORAC, ABTS, DPPH, FRAP, CUPRAC and iron chelation assays and finally the pairwise correlations between polyphenol and antioxidant activities were represented on heatmaps.
The metabolomic profiling of PIWI varieties enabled the identification of 43 metabolites belonging to amino acids, anthocyanidins, flavan-3-ols, flavonols, phenolic acids as well as monomeric and dimeric stilbenoids. We found positive correlations of several antioxidant activities (DPPH, ABTS, FRAP and CUPRAC) with anthocyanidins and negative correlations with stilbenoids, probably due to their low content in these extracts. We found no correlation between iron chelation property and any polyphenols.
The use of metabolomic approach makes it possible to screen the phytochemical composition of PIWI varieties and evaluate the key metabolites involved in the inhibition of accelerated skin aging.

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P5. Neem (Azadirachta indica) leaf extracts: cosmetic potential and application in green synthesis of AgNPs

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Neem (*Azadirachta indica*) is an important Ayurvedic medicinal plant that has been used for thousands of years for its antiviral, antioxidant, and anticancer properties. The wide range of Neem applications is due to the presence of numerous bioactive compounds in the bark, leaves, fruits and seeds of this plant, in particular nimbidine and nimbolide, terpenoids and limonoids, e.g. azadirachtin [1, 2]. Recently, leaf extracts from *A. indica* were shown as effective reducing agents that might be used for the green synthesis of silver nanoparticles (AgNPs) [3].

The main aim of this study was to compare selected cosmetic properties of extracts obtained from *A. indica* leaves using green solvents easily applicable in cosmetic formulations: H2O (W extracts), 20% (v/v) glycerin in water (HG extracts) and 20% (v/v) pro and propanediol in water (HP extracts). The extracts were characterized for their content of polyphenols and flavonoids and tested for their antioxidant properties using DPPH and ABTS scavenging assay. Neutral Red Uptake Test was used to compare their potential cytotoxicity towards skin cells (HaCaT keratinocytes and A375 melanoma). Finally, the extracts were used to induce the synthesis of AgNPs which were characterized using spectrometric and spectroscopic methods.

All prepared extracts contained significant levels of bioactive compounds and showed high antioxidant potential. HG and HP extracts contained slightly higher concentration of polyphenols than W extracts and were also more effective in neutralization of DPPH and ABTS radicals. HG and HP extracts were significantly cytotoxic for A375 melanoma cells at 2% and 5% concentrations and less cytotoxic for HaCaT keratinocytes, suggesting their potential application in the prevention of skin cancer. W extract was significantly cytotoxic for melanoma cells only at 5%. Mixing of W, HG and HP extracts with AgNO3 sulution resulted in the formation of AgNPs with mean size of 667.3 nm, 207.0 and 176.14 nm, for W, HP and HG extracts, respectively. Zeta potential od obtained particles was measured as -41.7 mV, -35.8 mV and -33.5 mV, indicating that application of HG and HP extracts in the green synthesis of AgNPs leads to smaller but less stable particles. To summarize, presented study characterizes for the first time HP and HG leaf extracts from *A. indica* and shows their broad possible application in cosmetics and dermatological products.

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P6. Investigation of the lipase-mediated synthesis of alkyl esters of hydroxycinnamic acids

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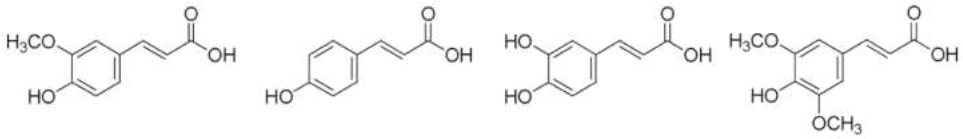
Hydroxycinnamic acids, i.e. ferulic, p-coumaric, caffeic and sinapic acids (1-4), are a class of naturally occurring organic compounds that belong to the family of phenylpropanoids. They are widely found in plants and can be recovered from agro-industrial waste.



ferulic acid (**1**) p-coumaric acid (**2**) caffeic acid (**3**) sinapic acid (**4**)

The corresponding alkyl esters exhibit more interesting biological activities than the parent carboxylic acids thanks to their greater lipophilicity. Their remarkable antioxidant and antimicrobial properties find fundamental applications in the field of additives for food preservation [1], emollients and stabilisers for cosmetic products [2], and fungicides for plant preservation [3].
The transesterification of the ethyl esters of acids 1-4 with octanol and 2-phenylethanol in diisopropyl ether as a solvent and catalysed by the immobilized lipase Novozym 435 was investigated in batch with conventional heating, in batch with microwave heating and in a continuous flow mode using a packed-bed column. The results of this research will be presented and discussed, making a comparison among the three approaches.

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P7. Fruit extracts of Cornus mas, Hippophae rhamnoides, and Chaenomeles japonica as modulators of adenosine metabolism

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Adenosine plays a key role in skin physiology, particularly in tissue repair and regeneration. By activating A2A adenosine receptors (A2AAR), it promotes wound healing through enhanced collagen synthesis and stimulation of connective tissue growth factor (CTGF) production. This signaling pathway facilitates dermal remodeling by increasing collagen type III deposition, supporting both scar formation and restoration of skin integrity [1]. Ecto-5′-nucleotidase (CD73, EC 3.1.3.5) catalyzes the hydrolysis of adenosine monophosphate to adenosine, whereas adenosine deaminase (ADA, EC 3.5.4.4) catalyzes the hydrolysis of adenosine to inosine [2].

This study investigated the in vitro inhibitory effects of a 70% aqueous-ethanolic extract from Cornus mas L. (CM) fruits, along with aqueous extracts from Hippophae rhamnoides L. (HR) and Chaenomeles japonica (Thunb.) Lindl. ex Spach. (CJ) fruits, on CD73 and ADA activity. The enzymatic activity was measured spectrophotometrically. CD73 activity was determined using 5'AMP as a substrate and the Taussky-Shorr reagent for phosphate detection (at λ=660 nm). ADA activity was evaluated using the Blum and Shwed method, with adenosine serving as the substrate (at λ=625 nm).

The inhibitory effects were assessed based on IC_{50} values, with lower values indicating stronger inhibition. The strongest ADA inhibition was observed for extracts of CJ and HR, both with an IC_{50} of 2.1 ± 0.18 mg/mL and 2.1 ± 0.17 mg/mL, respectively. CM showed moderate inhibition for ADA with IC_{50} = 10.3 ± 0.83 mg/mL. In the case of CD73, all extracts displayed lower inhibitory activity: HR IC_{50} = 14.0 ± 1.39 mg/mL, CM IC_{50} = 15.2 ± 3.26 mg/mL, and CJ IC_{50} = 14.5 ± 1.25 mg/mL.

These results suggest that certain fruit extracts, particularly CJ and HR, could potentially influence adenosine pathways by significantly inhibiting ADA, which warrants further investigation for their applications in conditions related to tissue repair and regeneration.

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P8. Chemical modifications of flurbiprofen – evaluation of antioxidant, anti-inflammatory properties and cytotoxicity in cell models

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Flurbiprofen, a widely employed non-steroidal anti-inflammatory drug (NSAID), is limited by its poor aqueous solubility and suboptimal transdermal permeability, which restrict its clinical efficacy [1]. Structural modifications, including the development of novel derivatives and eutectic mixtures, have been proposed to surmount these challenges by enhancing drug dissolution and bioavailability [2]. Such approaches aim to refine the pharmacokinetic profile of flurbiprofen and mitigate adverse gastrointestinal effects typically associated with NSAID therapy [3].

The purpose of this research was to improve and evaluate the biological properties of flurbiprofen, particularly its antioxidant, anti-inflammatory and cytotoxic effects, through structural modifications. To achieve this, a comprehensive evaluation of modified flurbiprofen formulations was undertaken using four principal assays. Antioxidant activity was quantified via the DPPH assay, while anti-inflammatory efficacy was assessed by determining IL-1β and COX-2 expression in LPS-stimulated fibroblast cells. Complementary cell culture studies were performed employing HDF and HaCaT cell lines, and cytotoxicity was evaluated using the Alamar Blue Assay. Notably, a novel menthol derivative of flurbiprofen was synthesized through a three-step process: (1) Formation of L-alaninium menthyl ester hydrochloride via reflux in toluene with p-toluenesulfonic acid under Dean-Stark conditions; (2) Neutralization of the hydrochloride to obtain the menthol ester of L-alanine; and (3) Protonation of the resulting ester with flurbiprofen to yield the final ionic salt, L-alaninium menthyl ester flurbiprofenate (AlaOMent·F). This derivative, along with other mixtures, underwent comprehensive physicochemical and biological characterization.

Overall, the study successfully yielded several innovative formulations, including both individual compounds and eutectic mixtures. Among these, three key mixtures of flurbiprofen with L-alanine (1:1) and with menthol (1:1), as well as a ternary mixture of flurbiprofen, L-alanine and menthol with a molar ratio of 1:1:1, exhibited antioxidant capacities comparable to unmodified flurbiprofen, while demonstrating significantly improved anti-inflammatory efficacy and enhanced skin permeability. These findings support the potential of chemical modifications and eutectic strategies in enhancing the biological performance of NSAIDs.

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P9. Electromagnetic Field-Assisted Modulation of Flurbiprofen in Transdermal Applications

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Flurbiprofen, a non-steroidal anti-inflammatory drug (NSAID), is widely used in the treatment of pain and inflammation due to its well-established efficacy and favorable pharmacological profile [1]. Its physicochemical characteristics also make it a suitable candidate for transdermal formulations, which offer an attractive alternative to conventional drug administration routes by improving patient compliance and avoiding systemic side effects.

One of the main limitations of transdermal drug delivery is the low permeability of the outermost skin layer—the stratum corneum—which restricts the diffusion of many therapeutic molecules. To overcome this barrier, physical enhancement techniques are being explored [2-3]. Among them, electromagnetic fields (EMFs) have attracted increasing attention as a non-invasive method capable of modifying both drug properties and skin transport mechanisms. EMFs may influence molecular organization, solubility, and lipophilicity of active compounds, thereby enhancing their ability to penetrate the skin.

This study examines the impact of different EMF types—including rotating, oscillating, pulsed, and static magnetic fields with varying polarizations—on the physicochemical characteristics and transdermal permeability of flurbiprofen. The findings may contribute to a better understanding of how EMF exposure can support the development of improved transdermal delivery strategies, particularly for drugs with limited skin permeability.

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P10. Total Phenolic and Flavonoid Contents, Antioxidant and Urease Inhibitory Activities of a Wild Amaranthaceae Halophyte from the Algerian Sahara

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Halophytic plants of the Amaranthaceae family are increasingly recognized for their nutritional value, ecological resilience, and promising biotechnological applications, including their use as "green salt" in food products. Sabkhas, which are salt-rich landscapes commonly found in arid and semi-arid regions, offer ideal conditions for the growth of these salt-tolerant species. This study investigates a native halophyte that grows naturally in the saltmarshes of the Oued Righ region in the Algerian Sahara, traditionally consumed for its therapeutic benefits. Its environmental adaptability and seasonal visual appeal make it a strong candidate for use in sustainable green infrastructure projects in saline or degraded landscapes. Phytochemical screening was conducted on both aqueous (AqE) and hydroethanolic (80:20 v/v) extracts (EtE), with all analyses performed using UV-Vis spectrophotometry. The total phenolic content (TPC), determined using the Folin–Ciocalteu method at 760 nm and expressed in gallic acid equivalents (GAE), was 28.19 mg GAE/g extract for AqE and 33.89 mg GAE/g extract for EtE. The total flavonoid content (TFC), measured by the aluminum nitrate [$Al(NO_3)_3$] method at 415 nm and expressed in quercetin equivalents (QE), was 92.08 mg QE/g extract for AqE and 243.13 mg QE/g extract for EtE. Antioxidant activity, evaluated by the ABTS radical scavenging assay, showed IC_{50} values of 78.47 ± 4.12 μg/mL for AqE and 179.85 ± 5.35 μg/mL for EtE. The silver nanoparticle (SNP) assay revealed $A_{0.5}$ values of 94.06 ± 3.5 for AqE and 173.40 ± 8.19 for EtE, indicating a notable reducing capacity. Urease inhibitory activity, tested using thiourea as a reference standard, showed weak inhibition by both extracts, with IC_{50} values greater than 200 μg/mL. These findings highlight the richness of this underexplored Saharan halophyte in secondary metabolites that help reduce oxidative stress. Future work will focus on mineral composition, isolation, and characterization of bioactive compounds using high-performance liquid chromatography (HPLC), mass spectrometry (LC-MS/MS), and nuclear magnetic resonance (NMR) spectroscopy. This research will contribute to the discovery of novel natural compounds and support the integration of traditional knowledge into modern pharmaceutical and food development.

Keywords: Amaranthaceae, halophyte,antioxidant activity, urease inhibition, Algerian Sahara, phenolic content, flavonoids

P11. Freeze-dried chitosan/shikonin scaffolds as a promising structures for skin repair

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Nature is a rich source of active compounds that can ensure accelerated and more effective skin regeneration as well as indicate the beneficial effect on skin parameters and functions. Such a natural, multifunctional active ingredient for skin repair may be shikonin. This red naphthoquinone pigment, extracted from the roots of Lithospermum erythrorhizon, is characterized by several therapeutic properties such as antimicrobial, anti-inflammatory, antiviral, anti-tumor, and wound healing. Progress in research related to shikonin application in the treatment of skin diseases for instance, dermatitis, psoriasis, skin cancer or scarring is observed [1,2]. To produce shikonin-based biomaterials intended for skin regeneration or wound healing, this bioactive pigment can be incorporated into a chitosan matrix. This chitin-derived cationic polysaccharide promotes wound healing, possesses antimicrobial and antioxidant properties as well as allows for the production of innovative 2D or 3D materials [3].

The aim of the study was the characterization of chitosan scaffolds enriched with shikonin. To prepare 3D materials acidic solution of low molecular weight chitosan was used. After incorporation of selected naphthoquinone pigment into the biopolymer solution, samples were mixed, frozen, and subsequently freeze-dried. For chitosan/shikonin materials mechanical testing and porosity measurements were performed. Moreover, for obtained structures antioxidant activity was determined as well as swelling degree in phosphate buffered saline with pH 5.5 and 7.4 simulating the pH of healthy skin and wound environment, respectively. For all samples ATR-FTIR spectra were also registered. Porous chitosan-based scaffolds were obtained. After incorporation of shikonin slight alternations in chitosan characteristic band positions were observed. Results indicated that shikonin addition influenced the physicochemical properties of chitosan scaffolds. However, further advanced research such as biological studies are essential to consider chitosan/shikonin materials for skin applications.

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P12. Advancing cosmetic ingredient development through innovative mass spectrometry approaches

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The cosmetic industry is increasingly embracing natural and locally sourced ingredients to meet growing consumer demand for eco-friendly products. A significant focus is on utilizing plant biomass, particularly the aerial parts like leaves and flowers, which are currently better exploited. However, using the entire plant can minimize waste and enhance molecular diversity and activity, aligning with consumer, environmental, and economic expectations. This study investigates the application of mass spectrometry analysis as a tool to advance the development of cosmetic ingredients. By examining various plant parts (flowers, leaves, and roots), we aim to identify and characterize bioactive compounds using two analytical tools: molecular networks from plant extract and mass spectrometry imaging (MSI) directly on different organs. Molecular networks are used to facilitate the rapid identification of molecular fingerprints through spectral comparison using UHPLC-HRMS/MS analysis. This technique efficiently maps molecular similarities and differences, revealing clusters of ions that may correlate with specific biological activities. The MSI is to map molecular distribution based on plant cutting or organ state.

Our findings highlight distinct molecular families within leaf extracts and a notable similarity between flower and root extracts. Root extracts, in particular, showed interesting cosmetic properties, with molecular networks identifying triterpenoids, saponins, and procyanidins as potential active compounds.

This approach not only accelerates the identification of active ingredients but also supports sustainable research practices by reducing the use of samples, energy and solvents. Integrating molecular networks and MSI into the development process enhance the efficacity and sustainability of cosmetic ingredients, opening the way for more effective and environmentally friendly products in the industry.

P13. High-Resolution Metabolic Profiling Reveals Heat-Induced Accumulation of Cytotoxic Cucurbitacins in *Ecballium elaterium*

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Ecballium elaterium, a widely distributed Mediterranean plant, is among the earliest species recorded in traditional medicine [1]. Adapted to the region's challenging climate, it has been historically used to treat edema, rheumatic disease, and even cancer [1]—uses attributed mainly to its triterpenoid cucurbitacins (notably A, E, and I) [2]. Despite its therapeutic value, the plant's fruit is highly toxic, affecting the respiratory, cardiac, and gastrointestinal systems [3].

In the context of rising global temperatures, this study examined the morphological, physiological, and metabolic responses of *E. elaterium* to thermal stress, with emphasis on its secondary metabolites and cytotoxic potential. Seedlings were cultivated under controlled conditions and exposed for one week to 22 °C (control) or 35 °C (heat stress). Leaves were extracted using ultrasound-assisted extraction with solvents of increasing polarity (DCM, MeOH, and MeOH/H_2O 50:50).

High-resolution LC-HRMS/MS analysis enabled the annotation and comparative assessment of metabolite profiles. Methanolic extracts from heat-stressed plants exhibited pronounced metabolic shifts, particularly in glycosylated cucurbitacin derivatives. Notably, cucurbitacins B, E, and S, along with glycosylated forms such as Arvenin I, Arvenin II, and Elaterinide, were significantly upregulated under thermal stress. The increased abundance of these compounds was associated with enhanced in vitro cytotoxic activity, particularly against DU-145 (prostate) and SH-SY5Y (neuroblastoma) cancer cell lines.

Additionally, thermal stress induced notable physiological and anatomical changes, including increased oxidative markers and tissue-specific adaptations, which likely contributed to the observed metabolic reprogramming.

Overall, LC-HRMS/MS profiling revealed that environmental stress modulates the biosynthesis of bioactive metabolites in *E. elaterium*, highlighting the species' potential as a source of thermoresponsive cytotoxic agents with therapeutic relevance.

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P14. Algae as an environmentally friendly source of components for cosmetics

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Since the dawn of time, cosmetics have been used to enhance the looks and treat various skin conditions. In the last couple of centuries they have become a profitable industry, with a constantly growing customer base, to which needs it has to cater [1]. Recent years have seen the switch in focus to sustainable, environmentally friendly practices, such as the use of natural ingredients, including algae [2]. Algae is a diverse group of organisms, which inhabit bodies of water as well as aeroterrestial and extreme environments. Their composition is abundant with various bioactive compounds, for example amino acids, polyssacharides and phlorotannins, which can improve the condition of the skin or provide colour to the product. Some common effects of bioactive compounds present in algae include: protection from ultraviolet rays, improved water retention and inflammation prevention [3–7]. As the composition of algae varies between species, in order to achieve desired results one needs to use the right type of algae.
The following work explores the purposes of algae usage in cosmetics and their various potential applications, as well as the biochemical composition of specific algae groups, distinguishable by pigmentation. The analysis of the bioactive compounds present in algae allows for their informed and effective utilization in the targeting of specific blemishes and ailments. Described below are the characteristics of the most important algal properties, vital for the development of both cosmetics and cosmeceuticals.

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P15. Influence of *Arctium lappa* leaf extract and its fractions on UVB-induced cytotoxicity and inflammation in human keratinocytes: biological and phytochemical insights

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Excessive ultraviolet B (UVB) radiation exposure is a major contributor to skin inflammation and photoaging, mainly through oxidative stress and the induction of pro-inflammatory cytokines such as interleukin-6 (IL-6) and interleukin-8 (IL-8) [1]. These cytokines play a crucial role in mediating inflammatory responses that can lead to tissue damage and impaired skin barrier function [2].
The aim of the study was to determine whether the crude extract and its fractions from *Arctium lappa* leaves can protect human keratinocytes from UVB-induced cytotoxicity and inflammation, as measured by cell viability and IL-6/IL-8 secretion levels, and to determine the chromatographic profiles of the extract and its fractions.
The study of viability and interleukin secretion levels included two experimental setups to assess both protective and regenerative effects. In the first, keratinocytes were irradiated with a sub-cytotoxic UVB dose and then treated with the extract or fraction for 24 hours. In the second, cells were pre-treated for 24 hours before UVB exposure. Cell viability was measured by MTT assay, while IL-6 and IL-8 levels in the culture supernatants were quantified using enzyme-linked immunosorbent assay (ELISA). Chromatographic profiling was performed using HPLC-DAD-IT-MS/MS on a reversed-phase Zorbax SB C18 column (150 mm × 2.1 mm, 1.9 μm; Agilent, CA, USA) at 25 °C. The mobile phases were water/formic acid (A) and acetonitrile/formic acid (B), with a flow rate of 0.2 mL·min^{-1}. The gradient elution program was as follows: 0–7 min, 10–20% B; 7–20 min, 20–22% B; 20–40 min, 22–26% B; and 40–45 min, 26–95% B.
The extract and several fractions significantly improved cell viability after UVB exposure. Some fractions also reduced IL-6 and IL-8 levels, indicating anti-inflammatory activity. Chromatographic profiles revealed a predominance of flavonoids and phenolic acids, while lignans were additionally detected only in one fraction.

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P16. Comparison of the Anti-Pigmentation Potential of *Achillea filipendulina* Extracts from Field-Grown and In vitro Plant Cultures

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In vitro plant culture is a promising tool in biotechnology for the production of bioactive compounds under controlled conditions, independently of environmental factors. This approach allows the year-round production of high-quality plant biomass and is particularly valuable for species that are rare, endangered, or naturally grown only in specific regions. [1] *Achillea filipendulina* (fernleaf yarrow) is a less-studied member of the Asteraceae family, characterized by a rich phytochemical profile. Its extracts contain diverse secondary metabolites, including flavonoids, phenolic compounds, and sesquiterpenes, which contribute to antioxidant, anti-inflammatory, antimicrobial, and potential skin-brightening or anti-pigmentation activities. [2]

The aim of this study was to compare the anti-pigmentation potential and phytochemical composition of *A. filipendulina* extracts obtained from traditional cultivation (flover extract AFF and herb extract AFH) with in vitro microshoot cultures (AFiv) and bioreactor-grown cultures (AFB). In vitro cultures were established from seeds and maintained on Murashige and Skoog (MS) medium supplemented with appropriate growth regulators. After three weeks, biomass was harvested, and a portion was transferred to platform bioreactors for 21 days of controlled growth. Aqueous, hydroethanolic (50% EtOH, v/v), and ethanolic (96% EtOH, v/v) extracts were prepared using ultrasound-assisted extraction. Extracts were analyzed their anti-pigmentation properties using two experimental models: commercially available fungal tyrosinase and mammalian tyrosinase, contained in the lysate of B16F10 murine melanoma cells [Strzępek-Gomółka et al. 2021]. Cellular cytotoxicity of *A. filipendulina* extracts was evaluated in human keratinocytes (HaCaT), mouse B16F10 melanoma cells, and human A375 melanoma cells using Neutral Red Uptake Test [Repetto et al. 2008]. Additionally, cellular tyrosinase activity was measured for selected extracts as L-DOPA oxidase activity [Manandhar et al. 2019]. The presence of bioactive compounds was characterized using LC-MS analysis.

The highest tyrosinase inhibitory activity was observed for the 50% EtOH extracts, with the AFiv extract being the most active (63.84% inhibition at 0.50 mg/mL). Importantly, while AFiv extracts retained cytotoxic activity against cancer cells (B16F10), they were not decreasing the viability to normal human keratinocytes (HaCaT), indicating selective action and improved skin compatibility compared to AF extracts, which showed significant cytotoxicity toward HaCaT cells. LC-MS analysis revealed that 50% EtOH AFiv extracts contained the greatest diversity of bioactive compounds, which may explain their tyrosinase inhibitory effects. For the cellular tyrosinase activity assay, AFiv extracts were selected based on the results of previous studies. Obtained data confirmed their significant anti-pigmentation potential, as they demonstrated a comparable ability to inhibit tyrosinase to the reference compound, kojic acid.

These findings indicate that in vitro cultures of *Achillea filipendulina* provide a reproducible and controllable source of biomass with potential anti-pigmentation activity.

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P17. Enhancing keratinocyte viability with *Lucilia sericata* larval secretions: in vitro assessment

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The therapeutic properties of *Lucilia sericata* larvae secretions (excretions/secretions, ES) have gained renewed interest in regenerative medicine and wound healing [1]. This study aimed to evaluate the effects of lyophilized and non-lyophilized ES, with or without a protease inhibitor cocktail (PIC), on the metabolic activity and cytotoxicity of human keratinocytes (HaCaT cells). ES were collected under sterile conditions and tested across a range of concentrations using MTT and LDH assays after 48 hrs and 72 hrs of exposure. MTT results demonstrated that both lyophilized and non-lyophilized ES significantly enhanced HaCaT viability in a concentration-dependent manner. Lyophilized ES (without PIC) showed maximal metabolic stimulation at 0.5 mg/mL ($p < 0.001$), with maintained but reduced effect after 72 hrs. Non-lyophilized ES exhibited similar stimulatory trends, particularly at dilutions from 1:80 to 1:20. Interestingly, the use of PIC significantly reduced viability ($p < 0.001$), yet this effect was abrogated when co-administered ES with PIC, suggesting a cytoprotective role of maggot-derived compounds. LDH tests confirmed that none of the ES secretions caused significant membrane damage. All treatment groups, regardless of lyophilization status or PIC presence, maintained LDH release comparable to untreated controls, indicating preserved membrane integrity. The cytotoxic effects were confined to positive controls (Triton X-100), validating assay sensitivity. These findings suggest that Lucilia sericata ES not only support keratinocyte viability but may also mitigate external cytotoxic stress. Application of *Lucilia sericata* ES in wound care products or natural skin-regenerating formulations is supported by their potential proliferative benefits for epidermal cells [2].

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3D model by Lucilia sericata larval secretions. J Invest Dermatol. 2006;126(6):1410-1418.

P18. Bioactive Constituents of Grape Pomace as Potential Agents in Skin Regeneration and Anti-Aging Applications

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The aim of this study was to assess the biological activity of plant-derived metabolites present in wine pomace from three red grape varieties—Regent, Rondo, and Marechal Foch—on human fibroblast cells in vitro. Wine pomace, a byproduct of the winemaking process, is rich in polyphenols and other antioxidant compounds, which may have beneficial effects on skin cells. Extracts from the freeze-dried pomace of each variety were applied to fibroblast cultures at a concentration of 25 μg/ml. The results showed that extracts from Regent and Rondo significantly enhanced fibroblast proliferation ($p < 0.05$), while Marechal Foch also increased proliferation, though not to a statistically significant degree. Additionally, in the scratch assay used to assess cell migration, the Regent extract demonstrated the most pronounced stimulatory effect. Chemical analysis indicated that the Regent extract had the highest levels of flavonoids and vitamin C, as well as strong antioxidant activity. These properties likely contributed to its superior effect on fibroblast proliferation and migration. The findings suggest that Regent wine pomace may serve as a valuable natural source of bioactive compounds suitable for use in cosmetic formulations, particularly those aimed at skin regeneration, anti-aging, and protection against oxidative stress and UV radiation. Nevertheless, further research is necessary to confirm these preliminary observations and explore the mechanisms involved.

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P19. Polysaccharides from *Polygonum cuspidatum*: proliferative and cytoprotective potential for oral health and regenerative applications.

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The polysaccharide fraction (POS1) of *Polygonum cuspidatum*, a plant traditionally used in Asian medicine to support oral hygiene, was obtained from traditionally prepared decoctions through gradient precipitation with 96% ethanol. The chemical composition of POS1 was characterized using FTIR, HPLC-MS, HPLC-RI, and NMR analyses. POS1 exhibited pronounced biological activity in human gingival fibroblasts (HGF-1). In the MTT assay, it induced a dose-dependent increase in cell viability across a wide concentration range (10–2000 µg/mL), with the strongest effect observed at 500 µg/mL (+29.4% compared to control). Proliferative activity was further confirmed by Ki-67 immunostaining, which revealed an elevated proportion of Ki-67$^+$ cells, indicating stimulation of fibroblast proliferation. Cell cycle analysis demonstrated a significant reduction in the G0/G1 phase population (-11.4%, $p < 0.005$) accompanied by a substantial increase in the S-phase fraction (+62.6%), consistent with enhanced DNA synthesis and promotion of cell cycle progression. Apoptosis assessment under basal conditions showed no pro-apoptotic effect of POS1. Under oxidative stress (200 µM H_2O_2), POS1 notably increased the proportion of live cells (LL), indicating strong cytoprotective potential against oxidative damage. Moreover, DNA damage analysis confirmed that POS1 decreased oxidative DNA damage (~44.9%), further supporting its cytoprotective potential. Collectively, these results highlight the dual activity of POS1, combining stimulation of fibroblast proliferation with mitigation of oxidative stress-induced DNA damage, which may be relevant for oral tissue repair and regeneration.

P20. Microbial transformation of lavender infusion polyphenols: balance between neuroactive potential and safety

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Lavender (*Lavandula officinalis*) infusion is traditionally used to relieve mild anxiety and depression [1]. We characterized a commercial flower infusion by UHPLC-DAD-IT-MS and isolated major constituents by preparative HPLC with NMR confirmation. Thirty-one phenolics were identified, mainly flavone glycosides and methoxylated hydroxycinnamate derivatives (e.g., Z/E-melilotoside and 4-methoxymelilotosides). Ex vivo anaerobic incubation with human fecal slurries (n=6) showed extensive biotransformation: glycosides were hydrolyzed and reduced to smaller metabolites, including coumarin and herniarin from melilotoside isomers, o-coumaric and 4-methoxy-o-coumaric acids, and the flavone aglycones luteolin and apigenin. Importantly, the infusion did not induce dysbiosis; α-diversity remained stable and relative abundances of beneficial genera such as Faecalibacterium and Prevotella increased versus controls, indicating a prebiotic-like shift [3]. Because coumarin is a known human hepatotoxicant, its microbial formation highlights a safety consideration for chronic intake [2]. Collectively, these data provide a mechanistic link between lavender's polar phytochemicals and gut microbiota, suggesting that microbial production of postbiotic metabolites may contribute to reported anxiolytic effects, while underscoring the need to monitor coumarin exposure. Further in vivo studies should quantify these metabolites in humans and relate them to clinical endpoints.

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P21. Polyphenol accumulation in *Salvia bulleyana* shoots cultivated in Temporary Immersion Systems

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Salvia bulleyana is a folk medicinal plant native to Chinese Yunnan Province. It has been used in the treatment of liver fibrosis, osteoporosis, inflammatory, cardiovascular and heart diseases [1]. The pharmacological activity of this species is primarily attributed to the presence of polyphenols with multiple pharmaceutical and cosmetic potential, including rosmarinic acid, caffeic acid, and salvianolic acids [1,2].
As effective large-scale cultivation is crucial for commercial viability, the aim of this study was to establish *S. bulleyana* shoot cultures in bioreactor systems and to evaluate the accumulation of bioactive phenolic compounds in the resulting biomass.
Shoot tips of *S. bulleyana* were cultured in Murashige and Skoog medium [3] supplemented with 0.1 mg/L indole-3-acetic acid and 1 mg/L meta-topolin, using two commercial temporary immersion systems (TIS): Plantform and RITA®. The immersion interval has been optimized, with cultures immersed for 5 minutes every 1.5 h, 3 h, or 6 h. After five weeks of cultivation, biomass yield and polyphenol content were analyzed.
Significant differences were observed in shoot growth and secondary metabolite accumulation depending on the TIS type and immersion frequency. In terms of biomass production, the RITA® system with 3-hour intervals yielded the highest fresh weight (213.7 g/L) and dry weight (20.27 g/L).
Twelve phenolic compounds were identified in the shoots, with rosmarinic acid as the predominant metabolite. In the Plantform system, the frequency of immersion had no significant effect on rosmarinic acid or total polyphenol content. In contrast, reducing immersion to four times per day in the RITA® caused a substantial decline in metabolite accumulation. The highest rosmarinic acid content (about 40 mg/g DW) was achieved in shoots cultured in the RITA® system with 3-hour immersions and in the Plantform system with 6-hour intervals. The value was approximately 6.5 fold higher than that in shoots of field-grown *S. bulleyana* plants [2].

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P22. Bakuchiol: The Plant-Based Retinol Alternative—Exploring Its Antioxidant Properties

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Bakuchiol is a meroterpenoid compound, classified within the meroterpene group. It is primarily extracted from the fruits of Psoralea corylifolia *(Fabaceae*), a plant utilised in traditional Chinese medicine and Ayurveda for centuries. Despite its initial isolation nearly six decades ago [1,2], it has attracted significant interest in recent years within the cosmetic and cosmeceutical industries due to its comparable efficacy to retinol in topical therapies [3].

Scientific studies have demonstrated that bakuchiol exhibits similar biological activities to retinol, including the inhibition of matrix metalloproteinases such as elastase and collagenase, leading to enhanced skin firmness and reduced wrinkle depth. Furthermore, it has been demonstrated to stimulate the synthesis of proteins that are essential for maintaining skin hydration, including cadherins and aquaporins [4]. Bakuchiol is distinguished from traditional retinoids by virtue of its high photostability, a property that is likely associated with the antioxidant properties described in the literature [5]. This characteristic contributes to a superior safety profile and provides an additional mechanism against the effects of photoaging.

The antioxidant properties of bakuchiol were evaluated and compared with those of retinyl palmitate and L-ascorbic acid using FRAP and DPPH assays. The efficacy of pharmaceutical formulations of retinyl palmitate was also assessed by means of these methods. This was done in order to compare the efficacy of available formulas in preventing vitamin A oxidation, thus ensuring greater safety with regard to topical usage. Samples of cosmetic formulations (face serum) were analysed for bakuchiol content and compared with each other in terms of antioxidant potential using the FRAP assay.

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P23. Evaluation of activity and safety of cosmetic formulation containing a recently identified cinnamic acid derivative with melanogenesis inhibitory activity

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Hyperpigmentation disorders constitute significant aesthetic and medical conditions affecting a large number of patients all over the world. Several strategies could be implemented to fight hyperpigmentation. Topical cosmetic formulation containing active depigmenting ingredients such as isobutylamido thiazolyl resorcinol, kojic acid, arbutin, verbascoside, or ascorbic acid derivatives could be recommended. However, these known strategies are often ineffective, so searching for new effective and safe melanogenesis inhibitors is an important issue [1,2].
Recently a cinnamic acid derivative, (E)-3-(4-chlorophenyl)-N-(5- hydroxypentyl)acrylamide, with promising melanogenesis inhibitory activity was identified using in vitro methods including pigmented reconstructed
human epidermis [3]. A cosmetic formulation containing this novel melanogenesis inhibitor was prepared and further tested. The ingredients used for the formulation were as follow: water, PEG8, cetyl alcohol, isopropyl palmitate, Simmondsia chinensis seed oil, Butyrospermum parkii butter, ceteareth-20, glyceryl stearate, phenoxyethanol, (E)-3-(4- chlorophenyl)-N-(5-hydroxypentyl)acrylamide, BHT, ethylhexylglycerin, xanthan gum. The anti-melanogenic activity was confirmed in pigmented reconstructed human epidermis (MelanoDerm, MatTek). There was observed decrease of melanin content in inserts treated with test formulation by 37.46% when compared to inserts treated with blank formulation. The formulation was found to be non-phototoxic in the study in EpiDerm (MatTek). Studies in reconstructed human epidermis (Episkin®) proved sufficient bioavailability of the cinnamic acid derivative.
Current findings together with former studies proved the potential of utilization of (E)-3-(4-chlorophenyl)-N-(5-hydroxypentyl)acrylamide as an active ingredient in depigmenting cosmetic formulations.

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P24. Directional-hemispherical reflectance and thermal emissivity of common plantain and lanceolate plantain in the context of skin protection from solar radiation

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To protect the skin from the harmful effects of sunlight, it is recommended to use high-SPF sunscreens, avoid midday sun exposure, and wear protective clothing [1,2]. In the absence of photoprotective products, one of the basic methods of limiting the progression of skin damage by solar radiation is the use of physical barriers, i.e., covering the most exposed areas of the body (arms, nose) with clothing or natural plant materials. In Polish folk medicine, leaves of common plantain (*Plantago major*, PM) and lanceolate plantain (*Plantago lanceolata*, PL) were used for this purpose [3].
The study aimed to assess the directional-hemispherical reflectance (DHR) of radiation in a range from UVA to infrared, and the emissivity of the PM and PL leaves.
Plantain leaves were collected in Gliwice (Poland). A Solar-410 Reflectometer and an ET-100 Emissometer (Surface Optics Corporation, USA) were used to measure DHR and directional and hemispherical thermal emissivity of DTE 20°, DTE 60°, and HTE on both the upper and lower leaf surfaces.
The highest DHR values were observed in the 700-1100 nm range for both plantain species, with both the upper and lower sides of the PM leaf exhibiting significantly lower DHR values compared to PL ($p<0.001$) (Tab.1). The DHR and thermal emissivity results for PM and PL are presented in the table. The lowest DHR values for both plantain species were observed in the range of 10.5-21.0 µm at 20° of beam radiation. The DTE and HTE values for the upper leaf surface differed significantly between PM and PL ($p<0.001$).
In conclusion, in the absence of professional photoprotective products, it seems reasonable to shield skin areas with PM or PL leaves. The lower surface of PM leaves exhibits higher reflectance than the upper surface, which, given the natural leaf shape, is advantageous for shielding convex body parts.

Table 1. Median of DHR for various angles of beam radiation and wavelength ranges (λ) and median of thermal emissivity parameters (DTE 20, DTE 60, and HTE) for the upper and lower sides of leaves of PM and PL. ***p<0.001, **p<0.01, *p<0.05 (Kruskal-Wallis test, bilateral multiple comparisons)

		Plantago Major (PM)		*Plantago Lanceolata (PL)*		p-value upper side vs lower side		p-value *PM vs PL*	
Wavelength range		upper side	lower side	upper side	lower side	*PM*	*PL*	upper side	lower side
DHR at 20° angle of λ [a.u.]	0,335-0,38	0,0000	0,0130	0,0080	0,0090	***	-	***	-
	0,40-0,54	0,2150	0,2550	0,2330	0,2420	***	-	***	-
	0,48-0,60	0,2340	0,2830	0,2400	0,2550	***	-	-	**
	0,59-0,72	0,1990	0,2460	0,2130	0,2240	***	-	-	*
	0,70-1,10	0,6970	0,6935	0,7140	0,7120	-	-	***	***
	1,00-1,70	0,5090	0,5225	0,5440	0,5380	-	-	***	*

	1,70-2,50	0,1730	0,2055	0,2100	0,2110	***	-	***	-
DHR at 20° angle of λ [a.u.]	1,5-2,0	0,2295	0,2620	0,2530	0,2650	***	-	**	-
	2,0-3,5	0,0965	0,1280	0,1095	0,1210	***	-	*	-
	3,0-4,0	0,0330	0,0380	0,0370	0,0430	-	-	-	-
	4,0-5,0	0,0320	0,0405	0,0340	0,0380	***	-	-	-
	5,0-10,5	0,0250	0,0285	0,0300	0,0305	-	-	***	-
	10,5-21,0	0,0255	0,0260	0,0295	0,0280	***	-	***	-
DHR at 60° angle of λ [a.u.]	1,5-2,0	0,2745	0,3270	0,3145	0,3160	***	-	***	-
	2,0-3,5	0,1360	0,1815	0,1605	0,1640	***	-	***	-
	3,0-4,0	0,0470	0,0510	0,0575	0,0520	-	-	*	-
	4,0-5,0	0,0640	0,0750	0,0780	0,0705	**	-	***	-
	5,0-10,5	0,0510	0,0535	0,0605	0,0580	-	-	***	-
	10,5-21,0	0,0580	0,0570	0,0590	0,0560	-	-	-	-
Emisjsivity [a.u.]	DTE 20°	0,9740	0,9730	0,9710	0,9700	-	-	***	-
	DTE 60°	0,9445	0,9455	0,9390	0,9430	-	-	-	-
	HTE	0,9500	0,9485	0,9450	0,9425	-	-	***	-

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P25. Chitosan as a valuable active ingredient in cosmetic formulations

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In line with the principles of sustainable development and green chemistry, the use of naturally derived ingredients in the cosmetic and pharmaceutical industries is purposeful and effective. Biodegradable, non-toxic and biocompatible compounds such as chitin and its derivative, chitosan, are highly valued for their unique biological and technological properties. These biopolymers are primarily sourced from crustacean shells, fungal cell walls and insects. Chitosan can be used as an active ingredient in skin and hair care products, oral hygiene formulations and as a carrier for active substances. The swelling capacity, viscosity, solubility, and antimicrobial and antioxidant activities of chitosan are influenced by factors such as molecular weight, pH, and degree of deacetylation [1, 2]. However, its potential as an ingredient in cosmetic products still seems to be underestimated. Despite its many beneficial properties, chitosan also poses technological challenges in cosmetics formulation due to its limited solubility and variability in properties depending on physicochemical parameters and interactions with other ingredients. Since chitosan can be easily modified chemically, its derivatives can acquire the desired properties for specific applications [3]. Investigating the potential use of a soluble chitosan derivative — specifically, chitosan lactate — in aqueous formulations, we developed a cosmetic tonic containing 0.5% chitosan lactate, along with hyaluronic acid, geranium hydrolate, and neroli hydrolate. The tonic had a pleasant fragrance and a clear, slightly viscous consistency, and it spread easily on the skin. Its physicochemical properties were as follows: pH 4.12–4.17; electroconductivity 427–445 µS/cm; and density, 0.998 g/cm³. The cosmetic exhibited antioxidant properties, reducing the DPPH radical by 6.68–6.72%, and contained trace amounts of phenolic compounds due to the use of plant hydrolates in the formulation. Its properties remained stable during five weeks of storage at room temperature, except for electroconductivity, which decreased significantly.

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P26. Biological activity of *Rubus caesius'* extracts from leaves collected in different vegetation periods

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The European dewberry (*Rubus caesius* L., Rosaceae) is a medicinal shrub known and used for its pro-health properties in many parts of Europe and Asia. Ethanol extract obtained from the leaves of the plant is a rich source of biologically active compounds with antioxidant, antiaging and antibacterial properties [1,2]. Strong or long-lasting oxidative stress is often associated with the development of premature aging process. The European dewberry is reach in polyphenolic compounds with high ability to capture free radicals. In this work authors present the results of antioxidant and antielastase properties of extracts obtained from the European dewberry' leaves from different vegetation periods.

Ethanol extracts (70%, v/v) were prepared from leaves collected during one vegetation season in year 2024: early spring before flowering and autumn-after fruiting period, but before first frosts. The antielastase properties of the European dewberry extracts were tested spectrophotometrically with the use of SANA as a substrate. The antioxidant activity of the extracts were estimated with DPPH, ABTS, and β-carotene reduction assays in vitro. The results indicated that the most active against elastase was extract obtained from leaves collected in the spring with IC50 = 49.03 µg/mL, while from the autumn with IC50 =143.18 µg/mL. Furthermore, the antioxidant test indicated higher ability of the extracts obtained in autumn to fight free radicals (IC50 = 19,02 ±2,14 µg/mL, and 12,77±1,06 µg /mL, in ABTS test for spring and autumn extracts respectively; and 22.35 ±0,66 and 5,12 ± 0,25 in DPPH test for spring and autumn extracts respectively).

Obtained results show that both seasons are good to collect the European dewberry as a source of biologically active metabolites. However, it should be emphasized that the properties of plant material harvested in both seasons differ significantly. Extracts obtained from the spring material exhibit anti-inflammatory activity by inhibiting elastase activity, while those obtained from autumn are more potent antioxidants. This variability in activity should be taken into account when planning further research on this plant material.

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P27. A hyphenated approach for the preparative isolation of bioactive constituents from turmeric (*Curcuma longa* L.) for cosmetic applications

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Curcuma longa L. (turmeric), a perennial rhizomatous plant of the Zingiberaceae family, has been widely used in traditional medicine, food preservation, and cosmetic formulations due to its diverse bioactive properties [1,2]. Beyond its well-known curcuminoids, turmeric's essential oil—rich in bisabolene sesquiterpenes—exhibits significant therapeutic potential, including anti-inflammatory, antimicrobial, and antioxidant effects, making it valuable for natural cosmetics [2]. This study focuses on the efficient preparative-scale isolation of turmeric's key bioactive compounds using an innovative hyphenated approach. A streamlined methodology combining ultrasound-assisted extraction (UAE) with stepwise gradient centrifugal partition chromatography (CPC) and prep-HPLC-DAD was developed, enabling rapid recovery and high-purity isolation of major curcuminoids and turmerones. The isolated compounds were structurally characterized using LC-HRMS and NMR. The proposed workflow is efficient, time-saving, and scalable, offering a practical solution for obtaining high-purity turmeric bioactives for cosmetic applications. This research highlights the potential of turmeric-derived compounds as multifunctional ingredients in natural cosmetic formulations.

Keywords: Curcuma longa; curcuminoids; turmerones; CPC; preparative HPLC

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P28. Effect of selected cyanotoxins and domoic acid on antioxidant properties of glutathione

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In recent years, there has been a growing interest in the use of natural products in cosmetic formulations. Many modern cosmetics now incorporate extracts from aquatic organisms such as algae, cyanobacteria, and diatoms. While these organisms are rich sources of bioactive secondary metabolites with beneficial properties, they also produce various toxins that may pose risks to human health. Notably, compounds such as microcystin-LR, nodularin, anatoxin-a, β-N-methylamino-L-alanine (BMAA), and domoic acid have been studied for their potential to disrupt antioxidant defense mechanisms.
This study investigated, for the first time, whether these naturally derived toxins directly affect the radical-scavenging activity of glutathione (GSH), a key intracellular antioxidant, using a DPPH-based in vitro colorimetric assay.
Our results demonstrated that none of the tested compounds impaired the antioxidant capacity of GSH, even at concentrations reflecting realistic environmental exposure. These findings provide valuable insights for toxicology and cosmetic science, suggesting that GSH- based formulations retain their antioxidant effectiveness despite the presence of certain cyanotoxins. This work highlights the stability of GSH in oxidative environments and supports its continued use as a natural and potent antioxidant in skincare products.

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P29. Biosynthesis efficiency comparison of in vitro culture systems for producing botanicals from plant stem cells of *Aralia racemosa* L. for cosmetic applications

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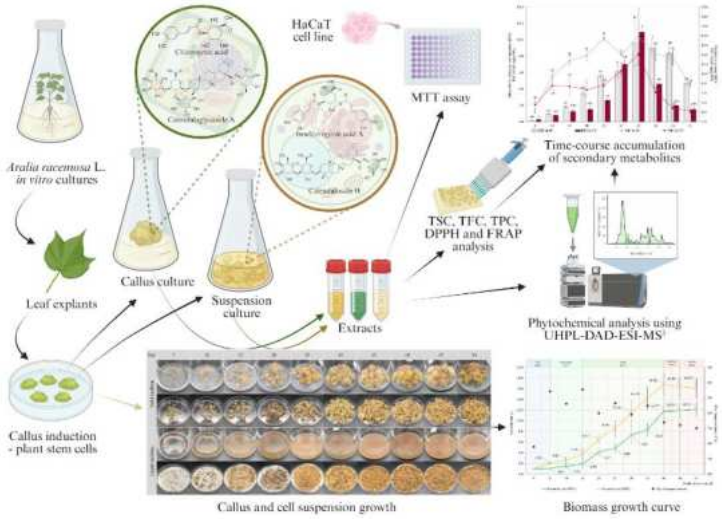
Aralia racemosa L., known in traditional North American medicine for its anti-inflammatory and skin-soothing properties [1], has been used for centuries to treat various skin conditions such as eczema, inflammation, burns, itching, and wounds [2]. In response to the growing demand for sustainable sources of secondary metabolites in cosmetics [3], we aimed to explore the potential of *A. racemosa*. This was achieved by developing plant stem cell cultures using biotechnological methods.

This study compares two in vitro culture systems, callus and cell suspension cultures, established from leaf explants of A. racemosa. In vitro cultures were carried out using Murashige and Skoog (MS) medium [4] with 2,4-dichlorophenoxyacetic acid (2,4-D) and monitored over a 50-day period. Growth dynamics, biomass accumulation, and phytochemical profiles were evaluated, including total saponin (TSC), phenolic (TPC), and flavonoid (TFC) content, antioxidant capacity (DPPH and FRAP method), and UHPLC-DAD-ESI-MS3 based qualification and quantification of key metabolites such as calenduloside H, calendulaglycoside A, and chlorogenic acid. To assess the safety for topical application of the obtained extracts MTT assay was conducted on normal human keratinocytes (HaCaT).

A novel quantitative index, biosynthetic efficiency per inoculum (BEI), was introduced, defined as the amount of compound produced per gram of fresh inoculum [mg/g FWI]. BEI allows for meaningful comparisons of biosynthetic output between culture types and timepoints, particularly when standard units such as [mg/L] or [mg/g dry weight] do not adequately reflect growth dynamics across different systems.

Results revealed that both callus and suspension accumulated triterpenoid saponins and phenolic acids with significant antioxidant capacity. Importantly, extracts from both culture types showed very low cytotoxicity toward HaCaT, supporting their potential use in cosmetic applications.

This work presents a standardized framework to assess and compare culture productivity and proposes a sustainable platform for generating skin-beneficial compounds using plant stem cells without harvesting wild plants.



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P30. Application of sea buckthorn seed oil in skin care cosmetics

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Sea buckthorn (*Hippophae rhamnoides* L.) comes from the Elaeagnaceae family of plants, known as the light plant family. It is a thorny shrub that has long, narrow leaves and golden-orange berries, small in size. Sea buckthorn seed oil contains unsaturated fatty acids, linolenic (35-40%) and α- linolenic acid (20-35%), oleic (15-20%) and palmitoleic (<0.5%) and saturated palmitic acid (6-10%). It is a source of phytosterols, tocopherols, carotenoids, vitamin K [1]. It has antioxidant, anti-inflammatory properties, stimulates epidermal regeneration, accelerates wound healing and reduces transdermal water loss [2-3]. For this reason, the plant has become extremely popular in cosmetology. However, there is little information in the literature on the properties of cosmetics with sea buckthorn seed oil. This provided the impetus for an attempt to develop formulations of skin care cosmetics with sea buckthorn seed oil.
Formulations were developed and 5 skin care creams were made, differing in the mass ratio of sunflower oil to sea buckthorn seed oil: 3:0, 2:1, 1:1, 1:2, 0:3. Physicochemical and performance tests were then conducted for the created creams: stability, dynamic viscosity, hardness, adhesion force, skin hydration and transepidermal water loss. All tested creams were stable, as confirmed by Turbiscan tests. The higher the concentration of sea buckthorn seed oil, the dynamic viscosity and hardness of the cosmetics increased, and the values of adhesion force decreased. The addition of sea buckthorn seed oil increased skin hydration and reduced transepidermal water loss after application of the tested creams.

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Trends in Medicine Sciences, 2024, 5(1), 35-44.

P31. Biological evaluation of *Aster amellus* L. extracts: antioxidant properties and tyrosinase inhibition

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Aster amellus L. (Asteraceae) is distributed throughout Central and Eastern Europe as well as Western Asia. Its natural habitats include grasslands, clearings, forest edges, slopes, roadsides, and open woodlands. In many parts of Central Europe, A. amellus has become endangered. Despite its traditional use, the biological activity of this species has not been fully investigated.

The aim of this study was to assess the antioxidant potential and tyrosinase inhibitory activity of ethanol/water (70:30 v/v) extracts obtained from the leaves and flowers of *A. amellus*. Plant material was collected in July 2023 from the Botanical Garden in Kielce. The extracts were dried and dissolved in DMSO for further biological evaluation. Antioxidant activity was determined using the ABTS and DPPH methods. Tyrosinase inhibition was assessed spectrophotometrically using mushroom tyrosinase.

All tested extracts demonstrated antioxidant activity. In the ABTS assay, the highest activity was observed in the leaf extract (86.39%), while the flower extract showed 68.96%. In contrast, in the DPPH assay, the flower extract exhibited higher antioxidant potential (55.16%) compared to the leaf extract (36.90%). Tyrosinase inhibition varied depending on the concentration used from 43.67% to 97.24%. The highest tyrosinase inhibition was observed in the flower extract (97.27%), while the leaf extract reached a maximum of 58.19%.

The results suggest that extracts from the leaves and flowers of *A. amellus* possess significant antioxidant and tyrosinase inhibitory activities. These findings indicate the potential application of *A. amellus* extracts in cosmetic formulations, particularly in products with anti-aging and skin-brightening effects.

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P32. Preliminary phytochemical and biological activity studies of *Trifolium rubens* L. callus cultures and the parent plant

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Trifolium rubens L. remains an insufficiently investigated species, with its phytochemical composition and biological activities largely uncharacterized. It is classified as "vulnerable" (VU) on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Moreover, it is considered critically endangered in Bulgaria, Spain, and Luxembourg.
The aim of the study was the comparative assessment of extracts from the leaf, flower, and agar callus culture of *T. rubens.* The callus cultures were maintained on Murashige and Skoog (MS) medium with 1 mg/L BA (6-benzyladenine), 0.5 mg/L NAA (1-naphthaleneacetic acid) and 0.25 mg/L gibberellic acid (GA_3), under continuous LED white light. The phenolic profile in ethanol/water extracts (70/30: v/v) was tested by HPLC-DAD method. Moreover, *ex vivo* skin permeation of genistein was evaluated using Franz diffusion cells; antioxidant potential was assessed *via* ABTS and DPPH assays; elastase and murine tyrosinase (from lysates of murine melanoma B16F10 cells ATCC CRL-6475) inhibition were tested spectrophotometrically. The cytotoxicity on HaCaT keratinocytes was determined using the neutral red uptake test. The phytochemical studies confirmed the qualitative and quantitative differences between extracts of parent plant material and callus culture. Among isoflavonoids, the dominant compound in extracts of leaf and flower was genistein (193.88 and 160.82 mg/100 g DW, respectively), while in callus cultures calycosin 7-*O*-glucoside (516.01 mg/100 g DW). The highest skin penetration of genistein was observed from the extract of *T. rubens* leaves. All tested extracts indicated antioxidant potential and exhibited elastase inhibitory activity, ranging from 64.57% (flower) to 97.33% (leaf). Moreover, all extracts showed high tyrosinase inhibition ranging from 84.84% (leaf) to 97.09% (callus cultures). All studied extracts were also found to non-cytotoxic to HaCaT keratinocytes, with cell viability remaining above 75%. These findings underscore the promising potential of *T. rubens* extracts for cosmetic applications.

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P33. *In vitro* cytotoxic activity of ethanol extract from *Rubus caesius* L. leaves on human melanoma A-375 cell line

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Introduction: The leaves of European dewberry (*Rubus caesius* L.) have long been used for medicinal purposes, and recent research confirms their antioxidant, antimicrobial, and anti-inflammatory properties [1, 2]. This study assessed the *in vitro* cytotoxic effects of leaf extracts collected in spring and autumn on human melanoma A-375 cells and non-cancerous human fibroblasts HFF-1.
Materials and Methods: Leaves were harvested seasonally, dried, and extracted in 70% ethanol via ultrasonic treatment. The extracts were filtered, concentrated, frozen, and lyophilized, then dissolved in 50% DMSO for testing. Cell cultures of A-375 and HFF-1 were incubated with varying extract concentrations (10–350 µg/mL) for 24 hours, and viability was assessed using MTT assay.
Results: The study showed significant cytotoxicity of the spring leaf extract against melanoma cells, with an IC_{50} of 94.2 µg/mL. Cell viability declined from 100 ± 1% at 10 µg/mL to 3 ± 1% at 350 µg/mL. The autumn extract showed a milder reduction in melanoma cell viability, from 100 ± 1% to 33 ± 9% across the same concentration range and IC_{50} value was 158 µg/mL. Both extracts caused decreases in fibroblast viability (spring: 105 ± 5% – 39 ± 5%, IC_{50} = 146 µg/mL; autumn: 100 ± 3% – 40 ± 4%, IC_{50} = 221,1 µg/mL), indicating selective action against cancer cells.
Conclusion: Both extracts exhibited selective cytotoxicity toward melanoma cells, with spring leaves being more potent. Fibroblasts were largely unaffected, indicating possible therapeutic selectivity. These findings suggest that European dewberry leaf extracts, particularly from spring harvests, may offer promising selective cytotoxicity against melanoma and merit further studies to determine their mechanisms, therapeutic potential and safety profile.
Keywords: European dewberry; *Rubus caesius;* leaves; bioactivity; cytotoxic effect; cancer cells

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P34. Centrifugal Partition Chromatography as a tool for the isolation of polyphenols from ginger rhizomes

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Zingiber officinale Rosc. (Zingiberaceae) belongs to the most widely consumed spices around the world. Its vast application in traditional medicine as an antiemetic, antibacterial, anti-inflammatory or bile production enhancing agent still triggers numerous studies on its metabolites [1,2]. Phenolic compounds from ginger, particularly those in the gingerol group, possess valuable cosmetic properties. Among them, their strong antioxidant and anti-inflammatory effects should be highlighted, as well as their ability to stimulate microcirculation, which supports skin regeneration, improves skin tone, and enhances elasticity. Therefore, finding an effective method to enrich ginger extracts with gingerols is important from a cosmetic point of view.

The study aimed to optimise the protocol for the recovery of ginger polyphenols using centrifugal partition chromatography (CPC). The applied gradient of hexane, ethyl acetate, buthanol and water enabled a fast recovery of the major phenolic components from the preparative CPC instrument equipped with a one-liter-volumed column, directly from the crude oleoresin. The performed optimisation of the biphasic solvent composition, rotation speed and solvent flow allowed for the selection of beneficial settings for the isolation of different polyphenols. The undertaken tasks allow for a large scale recovery of single polyphenols of ginger for food, cosmetic and pharmaceutical applications as both SFE and CPC can be operated in preparative or industrial scales.

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P35. Optimizing Cranberry Extraction for Cosmetic Applications: HRMS/MS-Based Phytochemical Profiling

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Cranberry (*Vaccinium macrocarpon*) is a rich source of polyphenolic compounds, such as flavonoids, anthocyanins, and phenolic acids, with proven antioxidant, anti-inflammatory, and antimicrobial activities. These bioactivities make cranberry extracts attractive for use in cosmetics aimed at skin protection, soothing, and anti-aging [1].

In this study, twenty-seven cranberry extracts were prepared using different extraction techniques — maceration, ultrasound-assisted extraction (UAE), microwave-assisted extraction (MAE), and Soxhlet extraction — using solvents with or without citric acid, and under variable extraction times. All extracts were purified via solid phase extraction (SPE) to eliminate sugars and improve identification of secondary metabolites.

High-resolution tandem mass spectrometry (Orbitrap MS/MS) was employed to identify phytochemicals based on accurate mass measurements and characteristic fragmentation patterns. Although the overall chemical composition of the extracts remained relatively consistent, the choice of solvent system significantly affected the diversity and detectability of phenolic compounds. Pure water, water–ethanol, and ethyl acetate–water mixtures enabled detection of a broader spectrum of phytochemicals compared to pure ethanol. Isopropanol-based extracts generally yielded poor MS/MS signals, except in Soxhlet extraction, where prolonged heating allowed partial recovery of mid-polar compounds. The addition of citric acid slightly stabilized the content of anthocyanins and organic acids, particularly in aqueous systems. The identified compounds — including quercetin derivatives, chlorogenic acid, and anthocyanins — are known for their antioxidant, soothing, and protective effects on the skin [2]. The study highlights the potential of optimized cranberry extracts as natural multifunctional ingredients in cosmetic formulations. Orbitrap MS/MS analysis proved to be a powerful tool for detailed phytochemical profiling of plant-based cosmetic actives.

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P36. Physicochemical analysis of cosmetical formulations containing bakuchiol

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Bakuchiol is a meroterpene isolated from Psolarea corylifolia, plant used in traditional chinese medicine. With its anti-aging and antioxidant properties it is described as retinoid analogue with different structure and thus its medical potential is constantly evaluated. As for now it is admitted to use in cosmetic (and 'cosmeceutical') products, however due to limited control of such products, the question of their quality is raised. Four methods of both qualitative and quantitative analytical methods (spectroscopic - UV-Vis, qNMR with internal and external standard, chromatographic - HPLC) were applied to examine declared bakuchiol content in five cosmetic samples collected from market, varying in price and composition. All methods were compared and found usable in such analysis with spectroscopic methods being the most promising for future applications as they provided convergent results with HPLC in shorter time of analysis.
Selected methods will be used in future to further investigate the molecule and impact of different factors on its concentration and form allowing to better describe mechanism of its action.

P37. Exploring the cosmeceutical properties and combined effects of Tanzanian seaweed extracts

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Skin conditions can significantly impact health and quality of life through psychological and social effects. For decades, marine macroalgae have been a source of bioactive compounds with diverse therapeutic activities. The study aimed to explore the biological activities and combined effects of Tanzanian seaweed extracts (*Sargassum oligocystum*, *Turbinaria conoides*, and *Ulva fasciata*) for cosmeceutical applications. Cytotoxicity screening using the 3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide (MTT) assay was performed on HaCaT keratinocytes and HS27 fibroblasts to establish suitable combination treatments. Initial cytotoxicity tests showed that combinations of all three seaweeds (varying concentrations of 12.5, 25 and 50 µg/ml) were toxic, but combinations of two species were feasible. Non-toxic combinations (varying concentrations of 12.5 and 25 µg/ml of two seaweed species) were assessed via metal ion chelation, resistance to oxidative stress in tert-butyl hydroperoxide(TBHP)-induced HaCaTs, nitric oxide inhibition in lipopolysaccharide(LPS)-activated RAW 264.7 macrophages, keratinocyte proliferation, and inhibition of tyrosinase, elastase and collagenase activity. *U. fasciata* displayed the most promising metal ion chelating properties and no combination was able to outperform it. *S. oligocystum* displayed the highest antioxidant activity alongside combination B1 (consisting of 12.5 µg/ml *S. oligocystum* and *T. conoides*) which indicated possible synergism. All seaweed species and combination treatments showed similar anti-inflammatory activity. No collagenase inhibition, elastase inhibition, tyrosinase inhibition or enhanced HaCaT proliferation was found for any of the seaweed species or combination treatments. In conclusion, the seaweed species possess bioactivities suitable for cosmeceutical applications individually, however, their combined effects (through combinations) may either be pointless or unfavourable.

P38. The Cosmetic Potential of Mushroom: A Natural Source of Multifunctional Bioactive Agents

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In recent years, there has been a growing interest in natural cosmetic ingredients. As a result, fungi, and more specifically mushrooms, are gaining importance. They fit perfectly into this trend, while also having a long history of use in cosmetics in Asian countries such as Japan and Korea. Both their fruiting bodies and mycelium are used to obtain extracts with a number of beneficial biological properties [1].
Rich in compounds such as polysaccharides, peptides, amino acids, terpenoids, and phenolic compounds, mushroom extracts demonstrate anti-inflammatory, antioxidant, antimicrobial, moisturizing, skin-regenerating, and anti-aging activities. They also show inhibitory effects on key skin-aging enzymes such as collagenase, elastase, and tyrosinase, making them particularly attractive and safe active ingredients in cosmetic formulations [2].
The effectiveness of mushroom extracts largely depends on the extraction method, which affects the composition, bioactivity, and bioavailability of the compounds obtained [3]. Methods such as water, alcohol, or supercritical CO_2 extraction allow for selective isolation of actives and targeted modulation of biological effects.
The broad spectrum of activity, combined with the desire to maintain youthful, clear and radiant skin, suggests that the demand for mushroom-derived ingredients in cosmetics and cosmeceuticals will continue to grow. Consequently, further in-depth research into their bioactive properties and extraction methods represents a promising and important direction in both scientific and applied contexts.

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P39. Characteristics of nasal products based on natural plant ingredients with a cleansing and moisturizing properties.

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Nowadays using products which cleanse and moisturize the nasal mucosa becomes important to prevent many diseases. The use of natural raw materials, which are a source of active ingredients with anti-inflammatory, moisturizing and irritation-soothing properties, has a positive impact on the effectiveness of such products. The nose is the first part of the respiratory tract which is hit by pollutions. It filters particles from the air we breathe by trapping pollutant particles in the nasal mucus. Air pollution could cause [1-2]:
- irritation of the respiratory tract, causing inflammation, scratching, sore throat and coughing,
- rhinitis caused by mucus build-up, nasal itching and swelling, that may extend to eyes redness and tearing.
Natural plant ingredients and biotechnological origin uses in medical devices significantly support the regeneration and hydration of mucous membranes. To such group of compounds includes:
- pentacyclic triterpenoids and glycoside saponins (anti-inflammatory properties),
- polysaccharides and pectins (occlusive properties),
- tannins and flavonoids (soothing properties),
- polyols (mucosal microbiome-supporting properties).
Natural plant ingredients dissolved in water must be such selected to rinse out microorganisms from polluted air and gently cleanse the nasal cavity giving a moisturizing and soothing effect on the nasal passage. Such ingredients as *Centella asiatica, Althaea officinalis* and *Plantago lanceolata* extracts have strong anti-inflammatory, soothing and regenerating properties, making them valuable in the treatment of irritations. Biosaccharides obtained in plant fermentation process (known under the trade name Rhamnosoft®), ectoine or trehalose, also have the ability to protect cells against environmental stress [3-13]. The doctoral thesis will present information on selected raw materials which due to their content of active ingredients and the resulting effects, would be used in products intended for the care of the nasal mucosa.

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P40. Salicylic Acid Under Electromagnetic Influence: A Study on Physicochemical Shifts and Skin Permeation Potential

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Salicylic acid, a well-known keratolytic agent and β-hydroxy acid, has long been utilized in dermatological and cosmetic formulations. Its lipophilic nature and low molecular weight make it suitable for topical applications, yet its transdermal migration remains limited by the skin's natural barrier properties. Exploring methods to modulate its penetration through the *stratum corneum* remains a relevant area of interest in the development of enhanced topical therapies [1-3].

In this study, salicylic acid was subjected to various electromagnetic field (EMF) conditions to assess their potential influence on its physicochemical profile and skin permeation behavior. A range of EMF modalities—including static, pulsed, oscillating, and rotating fields—was applied under strictly controlled laboratory conditions. The goal was to investigate whether electromagnetic stimulation could induce subtle yet meaningful changes in solubility, crystallinity, or partition characteristics that may correlate with improved permeability through biological membranes.

Analytical techniques such as FTIR, XRD, DSC, and TG were used to monitor changes in structural and thermal properties, while *ex vivo* skin diffusion experiments provided insight into the influence of EMFs on salicylic acid transport across porcine skin.

The study represents an exploratory step toward understanding how external physical stimuli may be leveraged to fine-tune the behavior of active ingredients in topical delivery. Salicylic acid serves here not only as a pharmacologically relevant compound but also as a model molecule for assessing EMF-assisted delivery strategies in dermatological science.

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142.

P41. Implementation of Precolumn Biochromatographic Methodology for Identifying Tyrosinase Inhibitors in *Chamomilla recutita* (L.) Rauschert

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In recent years, the cosmetic industry has witnessed a growing trend towards natural products, as consumers increasingly prefer formulations derived from plants over synthetic alternatives. This study investigates *Chamomilla recutita*, which was selected from various plant extracts from the Lubelskie region of Poland as a tyrosinase inhibitor, focusing on its whitening effects, which are essential in treating skin pigmentation disorders. The research introduces an HPLC-ESI-QTOF-MS/MS-based chromatographic methodology designed to identify active components in 50% ethanol *C. recutita* extract without the need for prior isolation. This approach is particularly relevant as traditional spectrophotometric assays often fail to pinpoint the contributions of individual compounds within complex mixtures. Through the analysis, several active compounds, including organic acids and phenolic compounds, were identified as active inhibitors in a precolumn bio-chromatographic assay. The conclusions were drawn by comparing the injections of extracts with and without the addition of an enzyme. Mass chromatograms show markedly reduced peak areas of components interacting with the enzyme. The study on pure compounds indicated ferulic acid as the most significant inhibitor (IC50 = 0.484 μM), followed by quinic acid and citric acid. The bioactivity of chamomile extract was further validated in vivo using a zebrafish model, where it effectively inhibited pigmentation in *Danio rerio* larvae, confirming its potential as a natural whitening agent.
The findings underscore the efficacy of the proposed chromatographic approach in screening for bioactive compounds, providing a pathway for the development of safe and effective cosmetic products targeting hyperpigmentation. In conclusion, this study presents an analysis of the whitening properties of chamomile and other local flora, suggesting their potential utility in cosmetic formulations designed to reduce skin discoloration and promote overall skin health. Future research is encouraged to refine extraction methods and further investigate the mechanisms of action of the identified compounds in skin whitening.

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P42. Analysis of phytochemical constituents and antioxidant potential of *Inula ensifolia* L. leaf and flower extracts

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Inula ensifolia L. is a perennial herbaceous species from the Asteraceae family, naturally distributed in Central and Southeastern Europe. It prefers open, dry, sunlit habitats, often occurring on calcareous soils. In Poland, it is considered rare and legally protected. The chemical composition and biological activity of this species have not been fully investigated.

The aim of this study was to assess the phenolic compound content and antioxidant activity of extracts obtained from the leaves and flowers of *I. ensifolia*. The phenolic profile of methanol extracts was analyzed using the HPLC-DAD method. The antioxidant potential of ethanol/water (70:30 v/v) extracts was evaluated using ABTS and DPPH radical scavenging assays.

HPLC-DAD analysis confirmed the presence of nine phenolic acids and three flavonoids. Among the phenolic acids, the dominant compound was 1,5-dicaffeoylquinic acid (3132.66 mg/100 g DW in flowers and 1752.00 mg/100 g DW in leaves). In the leaf extracts, high contents of chlorogenic acid (1743.61 mg/100 g DW) and isochlorogenic acid (1441.39 mg/100 g DW) were also found.
In contrast, their content in flower extracts was significantly lower (238.06 and 382.64 mg/100 g DW, respectively).

Among the flavonoids, rutin was dominant in the leaf extracts (177.00 mg/100 g DW), while hyperoside prevailed in the flower extracts (357.33 mg/100 g DW).

Antioxidant capacity, assessed *via* ABTS and DPPH assays, revealed that leaf extracts exhibited the highest activity in the ABTS assay (99.11%), compared to flower extracts (62.95%). In the DPPH assay, flower extracts showed slightly higher activity (53.02%) than leaf extracts (48.68%).

I. ensifolia leaf and flower extracts are rich in phenolic compounds and exhibit significant antioxidant activity. The results indicate their potential for use as natural ingredients in pharmaceutical, nutraceutical, and cosmetic products aimed at protecting against oxidative stress.

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P43. Inhibition of tyrosinase and elastase by *Artemisia pontica* L. extracts: a promising approach for cosmetic applications

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Artemisia pontica L. (Asteraceae) is a perennial plant native to southeastern Europe and western Asia. Its phytochemical profile and biological activity remain insufficiently explored, particularly in the context of its potential as a natural inhibitor of enzymes involved in melanogenesis and the skin aging process.
The aim of this study was to assess the tyrosinase and elastase inhibitory activity of ethanol/water (70:30 v/v) extracts obtained from the aerial parts of *A. pontica*. Plant material was collected in July 2023 from the Botanical Garden in Kielce. The extracts were dried and dissolved in DMSO for further biological evaluation. Inhibition of elastase, mushroom tyrosinase, and murine tyrosinase (isolated from lysates of B16F10 murine melanoma cells, ATCC CRL-6475) was assessed spectrophotometrically.
In the fungal tyrosinase assay, depending on the concentration used, the inhibitory activity ranged from 71.83% (0.1 mg/mL) to 84.30% (0.025 mg/mL), with the highest inhibition observed at the lowest tested concentration. Similarly, in the murine tyrosinase assay, inhibition varied from 61.78% (0.1 mg/mL) to 87.95% (0.025 mg/mL), confirming strong activity against both enzyme sources.
In the elastase inhibition assay, the herb extract demonstrated high inhibitory potential across all tested concentrations. The most pronounced effect was recorded at 0.1 mg/mL (93.89%), while substantial inhibition was still observed at 0.025 mg/mL (83.22%).
The results indicate that *A. pontica* herb extract exhibits significant inhibitory activity against both tyrosinase (fungal and murine) and elastase. These findings suggest its promising potential as an active ingredient in cosmetic formulations aimed at skin brightening and anti-aging.

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P44. Biopolymeric formulations containing niacinamide – a multifunctional skincare ingredient

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Niacinamide is a hydrophilic substance with a proven positive impact on the cutaneous. It is also known as nicotinamide and classified as a form of niacin (vitamin B_3), alongside nicotinic acid [1]. In contrast to the acid form, the amide form of this vitamin doesn't cause skin irritation at higher concentrations, concurrently, it manifests the same level of activity. Niacinamide has brightening, photo-protective, antipruritic, antibacterial, and sebostatic properties [1,2]. Following the identification of its 'pellagra-preventive' properties, the substance has also been designated 'vitamin PP'.
Many different formulations are used to deliver active ingredients to the target site. A polymer matrix may be one of them. A special group of polymers that can be used in cosmetology and biomedical-related fields is the biopolymers family. They are a diverse type of materials of natural origin that are characterised by biocompatibility, biodegradability, and bioactivity. In the present study, two polysaccharides, chitosan and konjac glucomannan, were utilised as a matrix for niacinamide implementation. Chitosan is a chitin derivative that can be produced from crustacean exoskeletons or fungi. This natural polymer has antimicrobial and antioxidant properties. Its polycationic nature allows it to interact with negatively charged blood elements and the skin surface. The properties of the konjac glucomannan, are as valuable as those of chitosan. This plant-origin carbohydrate has the remarkable ability to absorb large amounts of water and easily forms gels. Several studies confirmed its protective and regenerative properties for the skin [3,4].
This study explores the possibility of using polymeric films containing niacinamide for skin applications. Two different concentrations of active substance were added to the polymer matrix. The prepared materials were examined using swelling and moisture vapour transmission rate analyses, antioxidant testing, and release assessment. The manufactured biopolymeric film materials appear to exhibit optimal properties for cutaneous applications.

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improving fibrinogen adsorption. Mater Sci Eng C, 2020, 110, 110718.

P45. Evaluation of the Impact of Argan Oil on Skin Parameters Using Corneometry and Evaporimetry with Open and Closed Chambers

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One of the recurring trends in both home-based and professional skincare is skin oiling, where unprocessed oils are applied directly to the skin. Although increasingly popular, this method has rarely been investigated scientifically. The oils used are, however, generally recognized as safe (GRAS).
The aim of this study was to evaluate the effect of a single application of argan oil on skin hydration and transepidermal water loss (TEWL).
The study included 37 women. Skin parameters were assessed at four time points: baseline (I), after a model barrier disruption procedure (tape stripping) (II), and one hour after oil application to both the stripped (III) and unstripped (IV) skin. Measurements were performed using the Corneometer®CM 825 and Tewameter®TM 300 (Courage + Khazaka), and the VapoMeter® (Delfin Technologies).
Statistically significant differences in hydration were found between I vs. II and III vs. IV (both $p < 0.001$). TEWL assessed with the open-chamber device showed significant differences for I vs. II ($p < 0.001$), I vs. IV ($p = 0.004$), II vs. III ($p = 0.001$), and III vs. IV ($p < 0.001$). Results from the closed-chamber device were comparable, with the exception of no significant difference between III and IV. Strong correlations between open- and closed-chamber TEWL values were observed for time points II, III, and IV ($r = 0.723$, 0.722, and 0.684 respectively; all $p < 0.001$). Corneometry results did not correlate with TEWL measurements. Additionally, significant TEWL differences after barrier disruption were found between smokers and non-smokers, confirmed by both probes ($p = 0.046$ and $p = 0.038$).
These findings indicate the beneficial effects of argan oil on both intact and impaired skin. Although absolute TEWL values varied between devices, their strong correlation suggests they may be used interchangeably. Notably, smokers exhibited greater barrier impairment, highlighting the need for further research.

P46. Skin-lightening potential of *Rosa platyacantha* Schrenk from Kazakhstan

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Extracts and essential oils from various *Rosa* species have been used for centuries in both traditional medicine and modern cosmetology. Their enduring popularity comes from the presence of numerous biologically active ingredients, such as polyphenols and flavonoids, with extraordinary antioxidant, anti-inflammatory, and regenerating properties [1,2]. *R. alba, R. canina, R. centifolia, R. damascena,* and *R. gallica* are just few examples of rose species particularly important for the cosmetic industry, used in skin conditioning, skin lightening and anti-aging products [CosIng, 3]. *Rosa platyacantha* Schrenk is a yellow-flowering, less studied species, growing in mountainous regions of Kazakhstan. Our previous study showed that extracts from various morphological organs of *R. plathyacantha* are rich in active ingredients with anti-oxidant, anti-aging, skin-lightening and anti-melanoma properties. Extract obtained from rose buds showed particularly significant properties [1]. This study presents a comparative evaluation of aqueous (**A**), hydroethanolic (**HE**, 70%, *v/v*), and hydroglycerinic (**HG**; 20%, v/v), and hydroglycolic (**HP**; 20%; *v/v*) extracts from buds of *R. plathyacantha*. The extracts were assessed for their antioxidant properties, using DPPH and ABTS scavenging assays. Anti-pigmentation potential was compared using fungal and murine tyrosinase inhibitory assays and the composition of extracts was compared using thin-layer chromatography (TLC). Finally, the safety of the extracts was established by analysis their cytotoxic potential toward human keratinocytes HaCaT.

All extracts demonstrated significant antioxidant activity, regardless of the solvent used. The strongest antipigmentation effect against fungal tyrosinase was observed with the **HE** extract, (29% inhibition at a 5% concentration). However, the extracts did not demonstrate significant inhibitory activity against murine tyrosinase. TLC showed that rutin, gallic acid, and isoquercitrin were major components of **HE** extract and that **A** extract contains higher amounts of gallic acid than the HE extract. None of the extracts demonstrated significant cytotoxicity against HaCaT cells within tested concentration range.

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P47. Applying green extraction and separation methods to obtain cosmetic ingredients from black chokeberry (*Aronia melanocarpa* (Michx.) Elliott) fruits

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Black chokeberry (*Aronia melanocarpa* (Michx.) Elliott) is a raw material rich in numerous active compounds which have proven strong antioxidant, anti-aging, and protective properties. Among the most important components that shape the biological active profile of the fruit are anthocyanins, procyanidins, tannins, phenolic acids, and flavonoids. Due to the rich phytochemical composition, aronia fruit has found wide application in the food, pharmaceutical, and cosmetics industries [1,2].
The aim of the project was to use "green" extraction methods to obtain active cosmetic ingredients from black chokeberry fruit. The hydroethanolic extract prepared in 70% EtOH (*v/v*) by ultrasound-assisted extraction was subjected to fractionation by CPC (Centrifugal Partition Chromatography) and TLC (Thin Layer Chromatography) analysis. The fractions obtained were compared in terms of antioxidant properties (using the DPPH radical neutralization method), tyrosinase and elastase inhibitory assays, and safety of use by determining *in vitro* cytotoxicity against human HaCaT keratinocytes. The results confirmed the high antioxidant potential of the fractions – the EC_{50} value of the most active fraction 8 was 0.22 µg/mL, compared with 2.33 µg/mL for vitamin C. Fractions 2, 3, 6 and 8 strongly inhibited tyrosinase activity (>80% inhibition), and fractions 3 and 6 significantly inhibited elastase (>50% inhibition). The fractions and the total extract were not significantly cytotoxic for keratinocytes (>70% viability at all tested concentrations).
The conducted research confirms that green extraction and separation methods may be applied to obtain active ingredients for cosmetic use from black chokeberry fruits.

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P48. Procyanidin-rich extract from *Prunus spinosa* L. branches for topical application: phytochemical profile and antibacterial-antioxidant activity

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Prunus spinosa L. (blackthorn) is a widespread rosaceous shrub/small tree with acknowledged application in traditional medicine of its fruits, flowers, and young branches. The branches of *P. spinosa* are primarily used as vasoprotective agents and topical astringents [1]. Although previous studies on blackthorn branches are scarce, the available data suggest the presence of a rich polyphenol fraction, especially A-type proanthocyanidins, which might contribute to the biological effects of the plant material due to their antioxidant, anti-inflammatory, and antimicrobial capacities [2]. However, a thorough and extended evaluation is required to verify these observations.

Therefore, the purpose of this study was to conduct detailed phytochemical profiling and assessment of antibacterial and antioxidant activity of the polyphenol- and proanthocyanidin-rich extract (obtained after prior optimisation) from blackthorn branches. The extract (70% ethanol-water) was subjected to qualitative and quantitative chemical profiling using a panel of analytical methods, including UHPLC-PDA-ESI-MS/MS and spectrophotometric assays. Antioxidant activity was evaluated through in vitro spectrophotometric assays for scavenging of reactive oxygen species (i.e., $O_2^{\bullet -}$, HClO, $ONOO^-$). Antimicrobial properties against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Cutibacterium acnes* were evaluated by determining the minimum inhibitory concentration (MIC) and the minimum bactericidal concentration (MBC) using a broth microdilution method. The extract's ability to prevent biofilm formation was evaluated using a fluorescence-based resazurin test. The time-kill assay measured the bactericidal dynamics of the extract within 24 hours, using CFU/ml to quantify bacterial viability.

The LC-MS study resulted in the identification of over 60 compounds, predominantly A- and B-type proanthocyanidin dimers and trimers. Quantitative analysis confirmed high total polyphenol (352.7 ± 5.8 mg GAE/g) and proanthocyanidin levels (282.1 ± 4.1 mg CYE/g). The extract exhibited promising activity against *S. aureus* and *C. acnes*, with MIC values of 4.14 and 2.07 mg GAE/mL, respectively. Furthermore, it inhibited the formation of *S. aureus* biofilm. The extract also demonstrated potent scavenging activity, surpassing the positive control Trolox® in neutralizing $O_2^{\bullet -}$ and HClO.

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P49. Bird cherry (*Prunus padus* L.) bark for topical use: Optimization of the extraction of bioactive constituents

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Prunus padus L. (bird cherry) is a deciduous, small tree widespread in Europe and northern Asia, with recognized applications in traditional medicine for its bark, leaves, and flowers. Ethnopharmacological sources indicate that bark is primarily used to treat skin infections and wounds. Polyphenols, especially flavones and procyanidins, might contribute to the therapeutic potential of the plant material due to their anti-inflammatory, antioxidant, and antimicrobial properties [1,2]. However, a deeper investigation of the phytochemical profile and molecular mechanism of action of bird cherry bark is still required to validate the plant material for pharmaceutical applications. The effective extraction process is the first crucial step for obtaining high-quality extracts with an eligible composition and efficacy that can be used for further studies.

Thus, the present study aimed to optimize the conditions for extracting polyphenols, in particular proanthocyanidins, from *P. padus* bark. The process was optimized in terms of techniques (reflux, ultrasonic-assisted, maceration), solvents (water, ethanol, ethanol-water), and other parameters, including temperature, time, and ultrasound frequency. The extraction efficiency was monitored using various chromatographic and spectrophotometric methods. In particular, the obtained extracts were subjected to qualitative and quantitative phytochemical analyses (UHPLC-PDA-ESI-MS^3, HPLC-PDA), as well as evaluation of their antioxidant activity in a semi-biological model based on $O_2^{\bullet -}$ scavenging.

In total, more than 20 extracts were prepared. The LC-MS study resulted in the full or partial identification of over 30 phenolic constituents, revealing that the qualitative composition of the extracts is relatively stable. However, significant differences were noted in the quantitative profile; for example, the total polyphenolic content ranged from 141.6 to 282.9 mg gallic acid equivalents/g dw of the extracts. Moreover, they differ significantly in terms of antioxidant activity (SC_{50} range 4.2-14.7 μg/ml; Trolox 137.0 μg/ml). The results enabled the identification of optimal conditions for obtaining extracts rich in active polyphenols.

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P50. *Rhodiola herba* – new source of bioactive extracts for sensitive skin cosmetics??

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Rhodiola rosea L. (Golden Root; Crassulaceae) is a perennial herbaceous plant, widely spread in the mountainous regions in the Northern Hemisphere. Roots and rhizomes have been used in traditional and modern medicine as an adaptogen over centuries [1]. Medicinal use of the plant is mainly concentrated on the underground part of the plant that contains its main bioactive phenylpropanoids, rosarin, rosin, and salidroside [1]. Although the aerial parts of the plant are less studied, they can be found occasionally in health stores as food supplements due to the described radical scavenging activity [2 and references therein]. However, in most commercial cultivations of *R. rosea* the herba is not exploited and left on the field after harvest which takes place usually in autumn. As the highest concentration of the active metabolites is during blooming stage in early summer [3] a harvest at this time will give the opportunity to utilize leaves and flowers as by-products for the development of novel products (e.g., food supplements, natural cosmetics). The MSCA-RISE project **NanoCosmos** aims to recover valuable bioactive compounds from *Rhodiola* herba (mainly highly decorated flavonoids) to develop novel nano-encapsulated biocomponents for cosmetic formulations supported by green extraction technologies. To achieve this aim two different ingredients were performed: A. hydroalcoholic extraction using different ratios of water:ethanol (0 to 100% ethanol) and maceration in two different commercial oils (grape seed and safflower oil). Both extractions were performed with and without ultrasonic support. A chemical fingerprint and LC-MS/MS based quantification of key metabolites were performed directly on the different extracts while the macerates were prior analysis extracted with organic solvent to obtain the released metabolites. Three contrasting extracts and the two oils were submitted to evaluate the solubility in relevant solvents, cytotoxicity, and antioxidant capacity. Based on the results obtained further bioassay for possible cosmetic application will be selected and performed.

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P51. Can the EFQM model be a driver of success in the cosmetics industry?

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The EFQM model combines strategic thinking, a focus on operational activities and a results-oriented approach. This makes it an excellent tool for verifying the consistency of an organisation's ambitions with its current practices and for responding to challenges and problems. It is currently the only management framework with a global reach.

Success in the biotechnology industry requires a specific approach to management due to:
☑ Long research and development cycles
☑ Strong legal regulations
☑ High dependence on innovation
☑ Complex biological production
☑ High costs
☑ Ethics and social acceptance

These conditions force managers to be constantly alerted to change and manage risk within the organisation. The EFQM model helps to build an organisational strategy and shape an organisational culture that focuses on improving the competence of employees and the activities of the entire organisation. It shapes cooperation with key stakeholders and their contribution to the organisation's activities, improves efficiency and stimulates the transformation of the organisation to achieve its future goals. Thanks to the ESG goals included in the model's criteria, it helps the company build lasting and sustainable value based on the circular economy.

P52. Topical oil-in-water emulsion with *Humulus lupulus L*. extract: formulation, stability, and skin barrier support

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Humulus lupulus L. (hops) is a perennial climbing herbaceous plant belonging to the *Cannabaceae* family, which also encompasses Cannabis species. Hops are a rich source of bioactive phytochemicals, notably α-acids (humulone), β-acids (lupulone), and prenylated flavonoids such as xanthohumol, which exhibit well-documented calming, soothing, and antioxidant properties. These bioactivities render hops a promising candidate for incorporation into cosmetic formulations aimed at reinforcing the skin's natural barrier function (*stratum corneum*). The present study involved the development and optimization of oil-in-water (O/W) emulsion systems incorporating *H. Lupulus L*. extract. Given the inherent thermodynamic instability of emulsions—biphasic systems consisting of immiscible liquids—formulation stability was achieved through the use of amphiphilic emulsifiers capable of reducing interfacial tension between the dispersed and continuous phases. Multiple O/W emulsions were formulated in accordance with regulatory and dermatological standards for products intended for sensitive and dehydrated epidermis. The formulations were subjected to comprehensive physicochemical characterization, including rheological analysis (viscosity), pH determination, stability testing, and sensory evaluation. Furthermore, the antioxidant potential of the hop extract was quantified using standard *in vitro* assays. Preliminary *in vivo* and instrumental assessments (Visioscan®, Corneometer®) demonstrated that the selected formulations significantly improved skin parameters, including hydration, smoothness, and barrier integrity, while reducing erythema, roughness, and exfoliation. These findings substantiate the application potential of *H. Lupulus L*. extract as an efficacious bioactive ingredient in topical formulations. The results provide a scientific basis for the development of evidence-based cosmetic products targeting the enhancement of skin barrier function.

P53. Natural plant oils as a key ingredient in hand care products

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The use of vegetable oils during the production of semisolid cosmetic formulations, including hand care products, is a fixed point in the formulation. Due to the conditions of the technological process, it is advantageous to use plant oils which, on the one hand, carry beneficial properties and, on the other, are resistant to elevated temperature conditions. The aim of this study was to develop a formulation for hand care products (O/W emulsions) based on a natural emulsifier and selected vegetable oils – jojoba oil and sweet almond oil [1]. The formulations were characterised in terms of physicochemistry (pH, viscosity). A long-term stability study was also carried out using multiple light scattering method (MLS) to identify instabilities invisible to the human eye, related to both particle migration (creaming, sedimentation) and particle size changes (flocculation, coalescence). Stability assessments were carried out to ensure that the products tested behaved correctly over their declared shelf life, under specified storage conditions, and during their normal use in the final packaging [2]. After an assumed three months, a normal pH value was recorded for the formulations obtained, as well as slight changes in their viscosity over time and under the influence of the specified storage temperature. The stability of the tested cosmetic formulations was determined independently of storage time and temperature, and the type of vegetable oil used ($\Delta BS<3\%$). Based on the results obtained, the developed hand care products were determined to be stable for the introduction of additional active substances and qualified for the following in the next stage of application tests (*in vivo*).

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P54. Integrative phytochemical, molecular and antimicrobial assessment of *Salvia* subg. *Perovskia* species – the traditional Iranian dermatological herbs

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Perovskia (*Salvia* subg. *Perovskia*, called Brazambol in Persian) root and leaf extracts are used in Iranian folk medicine in various dermatological complaints, including cutaneous leishmaniasis and other skin infections. The compounds attributed to pharmacological activity of these herbs belong to oxidated abietane diterpenoids (carnosic acid and carnosol) in the aerial parts and nor-diterpenoids (also known as tanshinones) in the roots. Furthermore, these plants are abundant in rosmarinic acid and other polyphenols that can add antiinflammatory and antioxidant properties. However, there is a need to understand the regulation of the bioactive terpenoid biosynthesis and environmental factors that influence the phytochemical composition. Here, we used an integrative approach combining molecular and phytochemical with antimicrobial screening to extend our understanding of the complex mechanisms orchestrating biosynthesis of these compounds and that may enable a selection of high-quality plant material and designing optimal cultivation and processing measures for developing efficient dermocosmetics and dermatological drugs to aid in skin infections.

As a result, the comparative transcriptomics combined with LC-MS profiling of the two most common species – *Salvia abrotanoides* (Kar.) Systma and *S. yangii* BT Drew generated a dataset of candidate genes for elucidation of terpenoid biosynthesis and to follow their expression [1]. By drought stress and chitosan treatment we demonstrated the significant increase of cryptotanshinone – the major diterpenoid in the roots , accompanied by the upregulation of both MEP (methylerithritol phosphate) and MVA (mevalonic acid) pathways [2]. Finally, by bio-guided separation of extracts using anti-Candida and anti-Trichomonas assays, we indicated that carnosol from perovskia shoots is another candidate compound for further development as an antimicrobial principle [3].

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P55. Sustainable extraction and purification of olive leaves triterpenoids: pioneering bioactive solutions for cosmeceuticals

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Olive tree (*Olea europaea* L., Oleaceae) is one of the most historically significant trees of the Mediterranean basin, primarily valued for olive oil production, a dietary cornerstone rich in health-promoting lipids [1]. However, olive cultivation generates significant biomass waste, with olive leaves accounting for nearly 10% of the total material processed in mills. These underutilized byproducts are a rich source of bioactive secondary metabolites, particularly polyphenols and pentacyclic triterpenoids. Among the latter, oleanolic acid (OA) and maslinic acid (MA) are high-value compounds known for their anti-inflammatory, anti-diabetic, antimicrobial, and hepatoprotective properties [2].

This study focuses on the development of a green, scalable, and efficient chromatographic approach for the extraction and purification of OA and MA from olive leaves. The methodology combines Supercritical Fluid Extraction (SFE) and Centrifugal Partition Chromatography (CPC), two modern techniques with industrial-scale potential. Initially, 21 g of pulverized olive leaves were extracted using CO_2 in supercritical conditions with ethanol (EtOH) as a co-solvent, applying a step gradient from 0% to 10% EtOH (in 2.5% increments every 20 minutes). Fractions enriched in OA and MA (totaling 500 mg) were subsequently subjected to CPC purification using pH-zone refining. The biphasic solvent system comprised n-hexane: ethyl acetate: ethanol: water (8:2:5:5, *v/v/v/v*), with trifluoroacetic acid (TFA) in the stationary phase and triethylamine (TEA) in the mobile phase. This process yielded 19.5 mg of OA and 28.5 mg of MA with >95% purity, as confirmed by HPLC-ELSD and ^{1}H-NMR. Furthermore, both enriched fractions and purified compounds exhibited significant inhibitory activity against elastase and collagenase—two key enzymes involved in skin aging—highlighting their promising application as active ingredients in dermo-cosmetic formulations.

This integrated, eco-conscious approach not only valorizes agricultural waste but also introduces sustainable pathways for the development of innovative cosmeceutical ingredients.

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P56. Cosmetological potential of selected honey varieties

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Honey is a natural substance that has health-promoting properties due to the presence of many biologically active compounds. Cosidering growing interest in natural ingredients in cosmetology, the aim of this study was to evaluate the antioxidant potential and cytotoxicity of selected varieties of honey (buckwheat honey and heather honey) on skin cells in the context of their possible use in skin care products.
Antioxidant activity was assessed using ABTS, DPPH, and FRAP tests, which determine the ability of the tested samples to neutralize free radicals (ABTS i DPPH) and reduce metal ions (FRAP). In addition, in vitro studies were conducted on human dermal fibroblasts (HDF) and keratinocytes (HaCaT), analyzing the levels of reactive oxygen species (ROS) and superoxide dismutase (SOD) activity as markers of oxidative stress. The cytotoxicity and viability of HDF and HaCaT cells were assessed using the Alamar Blue and Neutral Red tests. The analyses showed that the honey samples tested exhibited significant antioxidant activity. The ability to remove free radicals, increase SOD activity, and reduce metal ions in the tested samples can be attributed to the presence of antioxidant compounds. In vitro studies showed a reduction in ROS levels in HDF and HaCaT cells, indicating the protective effect of honey under oxidative stress conditions. Cytotoxicity tests using Alamar Blue and Neutral Red showed that most honey samples at the tested concentrations (1, 10, 25 mg/mL) exhibited proliferative properties. However, at the highest concentration (50 mg/mL), the honey samples exhibited the cytotoxicity. The results confirm that selected honey varieties have beneficial antioxidant properties and can be used as valuable ingredients in cosmetic preparations with protective and regenerative effects on the skin. These findings justify further research into their potential use in cosmetic products.

P57. Genomic Approaches to Plant-Based Pharmaceutical Compounds

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Plants produce a wide range of secondary metabolites (SMs), which can be divided into terpenoids, polyketides, and phenylpropanoids based on the biosynthesis origin. Many SMs are widely used in the pharmaceutical industries as food additives or fine chemicals[2]. Therefore, SMs produced by plants are an important source to identify new products of medicinal value. Plants used in traditional medicine or have toxic properties are of particular interest. The roots of the perennial vine, native to the Yucatan peninsula, *Pentalinon andrieuxii* (MÜLL.ARG) B.F.HANSEN & WUNDERLIN, are used for the treatment of localized cutaneous leishmaniasis[3]. By analyzing the phytochemical knowledge of *P. andrieuxii*, it was found to produce various SMs, including the terpene betulinic acid, which is reported to possess antiparasitic, antiviral, and antileukemic properties[3]. Among the terpenoids produced by *P. andrieuxii*, Urechitol A, a tri-nor-sesquiterpenoid, was identified, showing an unusual carbon skeleton, whose biosynthetic pathway is yet to be elucidated[3]. *Rhododendron ferrugineum*, known as a toxic plant, produces compounds with potential cytotoxic activity, among which three new compounds, Ferruginenes A-C, showed structural similarities to cannabinoids[4]. Therefore, the identification of biosynthetic pathways of these compounds would be interesting. To analyze the biosynthetic pathways, the DNA was extracted from the leaves and sequenced using the PacBio Sequel II System. Since in *P. andrieuxii*, the compound of interest was only found in adult staged roots, a differential expression analysis of RNA of young and adult staged roots was performed. To further look into the biosynthetic pathways, the completeness of the genomes was analyzed using the Bench-marking Universal Single-Copy Orthologs (BUSCO). As a next step, enzymes involved in the production of potential pharmaceutical compounds, such as polyketide synthases and terpene synthases, have been analyzed and identified using deep learning machines.

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P58. Evaluation of the Antimicrobial Activity of Selected Essential Oils Against *Malassezia furfur* and Other Dandruff-Related Pathogens

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Methods

In this study, the antimicrobial activity of three essential oils (tea tree, peppermint, and lavender), widely used in natural cosmetics, was evaluated against *Staphylococcus epidermidis* ATCC 12228, *Candida albicans* ATCC 90028, and *Malassezia furfur* ATCC 14521—dandruff-associated pathogens. The oils were analyzed using a SHIMADZU GC-2010 Plus with GC-MS and FID detectors and a CP-Sil 5CB column. Compounds were identified via Wiley and Adams-LIBR(TP) libraries, and RRIs were calculated using a C9–C40 n-alkane standard mixture [1]. A modified broth microdilution method based on CLSI M7-A7 and M27-A2 protocols was used to determine minimum inhibitory concentrations (MICs) at 24, 48, and 72 hours. [2,3]. To assess potential interactions, checkerboard assays were performed, and data were interpreted using the fractional inhibitory concentration index (FICI). All experiments were performed in duplicate [4,5,6].

Results

Tea tree oil and peppermint oil showed the strongest antifungal effect against *Malassezia furfur*, with MIC values of 312.5 μg/mL at 24 hours, maintaining their activity up to 48 hours, whereas lavender oil exhibited weaker inhibition. Against *Candida albicans* and *Staphylococcus epidermidis*, both tea tree and peppermint oils demonstrated MICs ranging from 625 to 1250 μg/mL. Checkerboard assays revealed additive effects for tea tree and peppermint oil combinations against *C. albicans* (FICI: 0.75) and *M. furfur* (FICI: 0.625–0.75). Triple combinations including lavender oil also exhibited additive activity against *C. albicans* (FICI: 0.73).

Conclusion

This study demonstrates the antifungal properties of peppermint and tea tree essential oils against *Candida albicans* and *Malassezia furfur*. The inclusion of such combinations in natural cosmetic formulations for scalp care and dandruff prevention is supported by the observed additive effects. These findings provide a scientific basis for the rational design of essential oil-based cosmetic products and suggest further *in vivo* testing for clinical relevance.

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P59. Optimization of a Grapeseed Oil-Based Nanoemulsion Using Box-Behnken Design for Cosmetic Applications

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The growing demand for natural cosmetic formulations emphasizes the need for stable, advanced delivery systems. Nanoemulsions, with fine droplet size, enhanced skin absorption, and improved stability, are ideal for modern cosmetic applications. Grapeseed oil, with antioxidant and skin-conditioning properties, was chosen as the oil phase. This study aimed to develop and optimize a lecithin-based grapeseed oil nanoemulsion using a Quality by Design (QbD) approach [1-3].

Homogenization method was used to prepare the nanoemulsion by dissolving lecithin in ethanol with grapeseed oil, then mixing with aqueous phase containing polysorbate 80, and homogenizing with an Ultra-Turrax at 3000 rpm for 5 min at room temperature [4]. A three-factor, three-level Box-Behnken design (BBD) was used to evaluate the effects of lecithin (0.1–2% w/w), polysorbate 80 (0.5–1% w/w), and grapeseed oil (5–10% w/w). Design-Expert® software (Version 13, Stat-Ease Inc., Minneapolis, MN) was applied for optimization and Analysis of Variance (ANOVA). Dynamic light scattering was used to measure nanoemulsion critical quality attribute i.e., droplet size, PDI, and zeta potential [5].

ANOVA indicated that all models were highly significant ($p < 0.05$). The interaction between lecithin and grapeseed oil had the greatest effect on droplet size ($p < 0.0001$). PDI was mainly influenced by polysorbate 80 concentration ($p = 0.0173$), whereas zeta potential was most affected by lecithin ($p = 0.0038$). Among the 15 experimental runs, formulation 11 (0.1% lecithin, 1% polysorbate 80, 7.5% grapeseed oil) achieved the most desirable responses with a droplet size of 609.8 nm, PDI of 0.53 and zeta potential of -16.3 mV.

BBD design enabled effective modeling of formulation variables, reducing trial and error, development time, and cost. QBD predictive approach facilitates the selection of a single formulation as the optimal composition. Overall, the strategy supports the efficient, science-driven development of stable cosmetic formulations.

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P60. Transdermal Delivery of Ketoprofen – Evaluation of Skin Permeation Efficiency and Physicochemical Properties

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Transdermal drug delivery systems (TDDS) are gaining increasing attention as an alternative to conventional drug administration routes, such as oral or parenteral. They offer several advantages, including avoidance of first-pass metabolism, more stable plasma drug levels, reduced systemic side effects, and improved patient compliance. However, the effectiveness of transdermal delivery is often limited by the skin's natural barrier function, primarily due to the stratum corneum, which restricts the penetration of many active pharmaceutical ingredients [1-8]. The present study focused on evaluating the transdermal permeation of ketoprofen, a widely used non-steroidal anti-inflammatory drug (NSAID), known for its favorable physicochemical characteristics suitable for skin delivery. *Ex vivo* permeation experiments were conducted using Franz diffusion cells and porcine skin, which closely mimics human skin. The cumulative amount of ketoprofen that penetrated through the skin, as well as permeation parameters such as flux and permeability coefficient, were determined under controlled laboratory conditions. Additionally, the accumulation of the drug in skin layers was analyzed after prolonged exposure, offering insight into its distribution and retention. Physicochemical properties of ketoprofen, including solubility, lipophilicity (log P), thermal stability, were also examined to assess the impact of different conditions on its permeation potential. The results highlight the promise of transdermal approaches for delivering ketoprofen and underscore the importance of optimizing formulation and physical enhancement strategies to improve skin permeability. The study contributes to the broader understanding of ketoprofen's behavior in transdermal applications and supports further development of advanced topical or transdermal therapeutic systems.

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P61. Kombucha-Fermented Extracts of *Daucus carota*, *Apium graveolens*, and *Petroselinum crispum* as a Rich Source of Active Substances with Antioxidant and Skin-Protective Properties for Skin Care

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Natural plant substances play a key role in skin care and have been used for centuries in both medicine and cosmetology due to the presence of numerous biologically active compounds.

Plant-derived raw materials represent a valuable source of natural extracts with antioxidant, anti-inflammatory, and antimicrobial properties, which makes them widely applicable in dermocosmetic and skincare formulations. This study aimed to analyze selected members of the *Apiaceae* family, including celery (*Apium graveolens*), carrot (*Daucus carota*), and parsley (*Petroselinum crispum*), as potential cosmetic raw materials.

The primary objective of the research was to compare the biological activity of extracts obtained from the roots of these plants with their fermented counterparts, produced using a symbiotic culture of microorganisms known as kombucha. The analysis focused on the capacity of these preparations to neutralize intracellular free radicals in skin cells, as well as their potential effects on keratinocyte and fibroblast cell lines. Additionally, their antimicrobial properties and influence on the expression of key pro-inflammatory mediators, such as interleukins IL-6 and IL-1β, were assessed to estimate their anti-inflammatory potential.

Both the non-fermented extracts and those subjected to 10 and 20 days of fermentation were evaluated using cytotoxicity assays, including Alamar Blue and Neutral Red. The results demonstrated that, at appropriately selected lower concentrations, the extracts and ferments did not exert harmful effects on skin cells, confirming their biological safety. A notable enhancement in antioxidant and antimicrobial activity was observed in the fermented extracts compared to the non-fermented ones. It was also found that the bioactive properties of the preparations were significantly influenced by both the fermentation duration and the extract concentration.

In conclusion, the findings suggest that fermented extracts derived from *Apiaceae* plants, using kombucha fermentation, may serve as valuable, innovative, and multifunctional ingredients in cosmetic formulations.

P62. Influence of Electromagnetic Fields on Transdermal Permeability and Physicochemical Properties of Ibuprofen: An Ex Vivo Study

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Ibuprofen, a commonly used NSAID, is a promising candidate for transdermal delivery systems due to its relatively low molecular weight and suitable lipophilicity [1-2]. To improve its penetration through the skin barrier, this study explores the effect of various electromagnetic field (EMF) modalities on both its transdermal transport and physicochemical behavior.
Ex vivo diffusion studies were performed using porcine skin mounted in Franz diffusion cells with a 1% ibuprofen solution in 70% ethanol as the donor phase. The skin was exposed to different EMF types, including rotating, oscillating, pulsed, and static magnetic fields with both positive and negative polarizations.
To investigate whether EMF exposure alters the drug's structural or physicochemical characteristics, ibuprofen was analyzed post-exposure using FTIR, XRD, DSC, and TG methods. Solubility and log P values were also measured.
This approach enables comparison of EMF-induced effects on molecular organization, thermal behavior, and partitioning properties of ibuprofen, alongside its ability to cross the skin barrier under various electromagnetic conditions.

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P63. Evaluation of the Biotechnological Potential of the Endangered Species *Eryngium maritimum* for Producing High-Quality Botanicals for Cosmetic Applications

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Eryngium maritimum L. is a rare and endangered halophyte exceptionally rich in specialized metabolites: phenolic acids, flavonoids, and triterpenoid saponins [1]. These compounds exhibit antioxidant, anti-inflammatory, and antibacterial properties, making the species attractive for cosmetic applications [2]. Current industrial approaches predominantly rely on undifferentiated callus cultures of *E. maritimum* (CELTOSOME™) [3]. In the present work, we demonstrate that it also has the potential for micropropagation and organ culture, enabling production of plant material *in vitro* for acquisition more phytochemically complex botanicals.

New highly efficient protocol for the micropropagation of *E. maritimum* was established, using Murashige&Skoog medium containing 2% of glucose supplemented with 2.00 mg·L^{-1} of 6-benzylaminopurine, and 0.25 mg·L^{-1}of indole-3-acetic acid, leading to plant acquisition within 12 weeks (Figure 1). Using HPLC-DAD-ESI-MS^3 analysis, phytochemical quality of extracts from aerial and underground parts of *in vitro*- and *ex vitro*-grown plants was evaluated. Additionally, spectrophotometric assays were conducted to determine total polyphenol, flavonoid and saponin content, along with standard antioxidant activity assays (DPPH, FRAP).

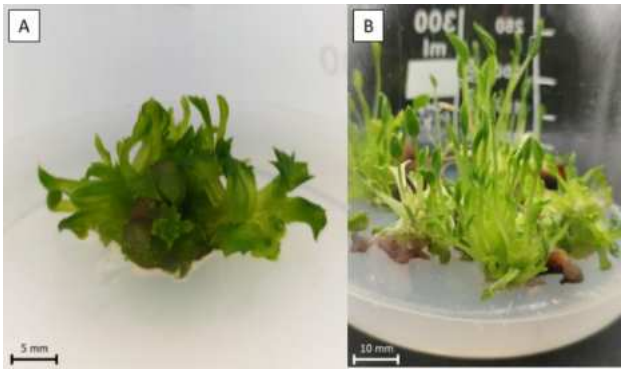

Figure 1 Differentiation of *E. maritimum* organs after 6 weeks (A) and 12 weeks (B) of culture according to micropropagation protocol

Phytochemical profiling revealed the presence of multiple triterpenoid saponins, including several eryngiosides (e.g., eryngioside A, G and J), known for their anti-inflammatory and anti-proliferative properties [4]. Rosmarinic acid, as major antioxidant phenolic compound, was quantified in all samples. *In vitro*-grown organs were comparable to their *ex vitro* counterparts.

The study highlights technical viability and phytochemical value of *E. maritimum* as natural candidate for biotechnological applications utilizing organ culture systems. The proven ability to produce high-quality plant material under controlled conditions makes it a sustainable alternative to the callus culture currently employed in the cosmetics industry. This approach is particularly relevant for formulations targeting sensitive, delicate skin environments often exposed to microbial imbalances, where standardized, safe, and multifunctional plant-derived ingredients are essential.

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P64. The role of vegetable oils in lip balms

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Plant oils have been an essential part of skin and hair care for centuries, both in traditional formulas and in modern natural cosmetics. Extracted from the seeds, fruits and nuts of plants, they are rich in unsaturated fatty acids, vitamins (especially A, E and K), antioxidants and phytosterols. Thanks to their moisturizing, regenerating and protective properties, vegetable oils effectively support natural skin functions, strengthen the hydrolipid barrier, soothe irritation and delay the aging process. Their diversity makes them precisely adaptable to different skin types from dry to sensitive to oily and problematic [1-5]. In an era of growing interest in ingredients of natural origin, vegetable oils are gaining importance as the foundation of modern, conscious skin care.

In the present study, an attempt was made to analyze the effect of the type of vegetable oil on the physicochemical and functional properties of lip balms. For this purpose, formulations were developed and a series of protective lip balms differing in the vegetable oil used were made. Sunflower oil, sesame oil, grapeseed oil, almond oil and castor oil were selected for the study. Then for the lip balms created, physicochemical and usability tests were performed: adhesion force, hardness, product color evaluation, skin gloss. Based on the results, it was found that the highest hardness results were characterized by balms containing sunflower, grapeseed and sesame oils, while the lowest adhesion force values were found for lip balms with grapeseed and sweet almond oils. It was also found that products with sunflower oil, sweet almond oil and grapeseed oil had a favorable effect on skin shine. In addition, lip balms with these oils, according to the testers, received the highest scores from the consumer evaluation of sensory appeal.

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P65. Modulation of Transdermal Ibuprofen Permeability Using Electromagnetic Fields

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The effectiveness of transdermal drug delivery systems (TDDS) is often limited by the low permeability of active pharmaceutical ingredients through the skin barrier. This study investigates the enhancement of ibuprofen permeability from a transdermal patch using various electromagnetic field (EMF) types. The patch was based on an acrylic pressure-sensitive adhesive matrix crosslinked with UV radiation, enabling high cohesion and stability in drug delivery.
To overcome the stratum corneum barrier, five EMF conditions were applied: rotating magnetic field (RMF, 30 Hz), oscillating magnetic field (OMF, 55 Hz), pulsed magnetic field (PMF, 65 Hz), and static magnetic fields with positive and negative polarity (SMF+ and SMF-). In vitro permeation studies using porcine skin revealed that RMF significantly enhanced ibuprofen permeability, increasing steady-state flux by 34% and the cumulative permeation mass by 43% compared to the control. RMF also reduced lag time and skin accumulation, indicating improved transdermal passage. In contrast, PMF and SMF- conditions showed reduced permeability parameters.
The results demonstrate that electromagnetic stimulation, particularly with rotating magnetic fields, can effectively modulate skin permeability and enhance transdermal drug delivery. This approach holds promise for optimizing non-invasive therapies, especially in pain management applications.

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P66. Advanced Extraction Methods Unlock Polyphenol-Rich Herbal Antioxidants for Natural Cosmetics

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Polyphenols from culinary herbs (rosemary, thyme, oregano, basil, lemon balm, coriander) are potent antioxidants with high value in natural cosmetic formulations.

This study compares four extraction techniques – conventional maceration (with and without shaking) versus advanced methods (Accelerated Solvent Extraction, ASE, and Ultrasound-Assisted Extraction, UAE) – to determine their efficacy in isolating polyphenols and antioxidant activity from these herbs. Total phenolics content, total flavonoid content and antioxidant capacities (DPPH, ABTS radical scavenging, and FRAP reducing power assays) were measured for each extract. The advanced techniques yielded significantly higher polyphenol levels and stronger antioxidant activities than conventional maceration. ASE produced extracts richest in flavonoids and key phenolics, with the highest radical scavenging activity (ABTS, DPPH assays), while UAE gave the greatest total polyphenol yields and ferric reducing power. In contrast, static and mechanically-shaken maceration extracted substantially lower amounts and antioxidant capacity. Chromatographic profiling via UPLC-PDA-MS confirmed the presence and concentration of key phenolic compounds, which were most abundant in ASE extracts across multiple herbs. This analytical data further validated the superior selectivity and efficiency of advanced techniques.

These results underscore that modern extraction methods can maximize the yield and quality of bioactive polyphenols, directly enhancing the potency of natural antioxidant ingredients. Such polyphenol-rich extracts can improve cosmetic efficacy (protecting skin and preventing product oxidation), enhance formulation stability by slowing rancidity, and support sustainability – ASE and UAE use less solvent and energy than traditional extraction. This work highlights the critical impact of extraction choice on obtaining high-efficacy, stable, and eco-friendly herbal extracts for cosmetic applications.

P67. Food By-Products as Sustainable Raw Materials in Cosmetics

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Post-production residues generated in processes where their creation is not the primary aim are considered by-products rather than waste, provided that specific legal conditions are fulfilled. Such materials may be traded and reused in other production processes [1]. Food production in particular generates large amounts of residues, which—owing to their valuable chemical composition and low processing costs—can often be reclassified as by-products with significant potential for further utilization [2]. This approach contributes to achieving the Sustainable Development Goals and is consistent with the principles of the circular economy [3,4]. The cosmetics industry is a notable example of the potential for valorizing plant-derived by-products. These materials serve as a valuable source of biologically active compounds beneficial to skin health [5,6]. Their use also helps reduce the consumption of primary raw materials and lowers production costs, while simultaneously supporting sustainable practices [7].

Post-industrial residues from plant processing most commonly include fruit and vegetable peels, seeds, pomace, and press oil cakes. These by-products are rich in proteins, starch, dietary fiber, and bioactive compounds such as carotenoids, tocopherols, glucosinolates, phenolic compounds, and fatty acids. Such constituents exhibit a wide range of skin-protective properties and can be incorporated into cosmetic formulations, particularly those designed with moisturizing, anti-aging, and antimicrobial functions [8].

Beyond cosmetics, food by-products also demonstrate potential in other sustainability-oriented applications. For example, residues from fruit and vegetable processing are increasingly used in the production of biodegradable packaging films. These bio-based materials offer numerous advantages, including favorable physical properties, economic efficiency, and environmental benefits, making them a sustainable alternative to conventional synthetic polymers [9].

Nevertheless, despite these advantages, several challenges remain. The effective processing, extraction, and purification of valuable compounds from plant by-products require further technological optimization. Overcoming these barriers is essential for maximizing the potential of such residues in sustainable cosmetic and packaging production [10].

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P68. *Herniaria* L. (rupturewort) as a promising source of biosurfactants

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Herniaria species (rupturewort) have a long-standing ethnopharmacological record, and their safety and therapeutic efficacy are acknowledged in official monographs by the European Medicines Agency. These plants are rich in triterpenoid saponins, with contents reaching approximately 6–7% (w/w) in *H. glabra* L.
Three species (*H. glabra*, *H. incana*, *H. polygama*) exhibited significant surface activity. Dynamic surface tension profiles of their aqueous extracts were nearly identical, indicating comparable interfacial behaviour. Surface pressure values for 1% solutions ranged between 25–28 mN/m (corresponding to 45.7–47.4 mN/m equilibrium surface tension). While these values are inferior to those of low-molecular-weight synthetic surfactants (e.g., sodium dodecyl sulfate), they are comparable to other saponin-rich botanical extracts such as *Saponaria officinalis*.
Notably, the surface compression rheology (storage modulus, E′) of the *Herniaria's* adsorbed layers exceeded 100 mN/m, surpassing most synthetic surfactants and matching other plant saponins. Similar chromatographic profiles of triterpenoid saponins explain this behaviour: all tested extracts were dominated by herniariasaponin (HS) 5, HS 6 and HS 7. The aqueous extract of *H. glabra* exhibited the highest E′ value (>150 mN/m).
Two fractions—herniariasaponins and terpene glycosides with C_9–C_{12} fatty acid residues—were identified as the main contributors to surface activity and the solubilization of poorly water-soluble compounds, such as flavonoids. The purified herniariasaponin fraction reduced surface tension more effectively than the crude aqueous extract [1].
These findings highlight the potential of *Herniaria* spp. extracts as natural, plant-based biosurfactants suitable for cosmetic formulations, particularly in gentle cleansing products or for enhancing solubility of hydrophobic actives.

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P69. Coamorphic form of curcumin with gallic acid as a component of hydrogels with increased curcumin solubility

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Curcumin is the main compound of the curcuminoid group found in the turmeric rhizome. It is a compound with strong antioxidant and anti-inflammatory properties [1]. Numerous studies also point to curcumin's antimicrobial activity [2]. However, a limitation of curcumin's use is its low solubility in water (0.6 µg/mL) [3]. The aim of this study was to obtain a form of curcumin with increased solubility as an ingredient for the preparation of hydrogels. The method used was to grind curcumin with gallic acid in a ball mill to obtain cocrystals of curcumin and gallic acid [4]. However, PXRD analysis of the obtained form showed that cocrystals were not obtained, but an amorphous form. In order to characterize the obtained form, an FTIR, DSC and TGA study was performed. FRAP and DPPH tests were also performed to evaluate the antioxidant activity. Finally, dissolution and solubility profile tests were performed. The obtained forms of curcumin showed improved solubility in water and gave better results in antioxidant tests compared to curcumin.

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P70. The beneficial effects of *Lythri herba* and *Quercus cortex* extracts on the vaginal epithelium and microbiota

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Vaginal dysbiosis, characterized by a loss of *Lactobacillus* dominance in favor of pathogens, affects approximately 60% of women of reproductive age. It is associated with an elevated inflammation and impaired epithelial barrier function, increasing susceptibility to STIs or premature birth. In traditional medicine, herbal substances rich in tannins have been used to alleviate symptoms of intimate infections, irritation, and inflammation. Today, these substances are also widely included in intimate hygiene products that support epithelial health. Nevertheless, studies on their biological activities remain limited.
The objective of this study was to assess the chemical composition and effects of 70% ethanolic extracts of *Lythri herba* (LH) and *Quercus cortex* (QC) on viability and inflammatory response of VK2/E6E7 vaginal epithelial cells. Furthermore, their impact on the proliferation of *Lactobacillus gasseri* and *Gardnerella vaginalis*, representing beneficial and pathogenic vaginal microbiota, respectively, was evaluated.
Qualitative phytochemical profiling was carried out using UHPLC-DAD-MS^n, with additional colorimetric assays used to quantify dominant compound groups, polyphenols and tannins. Cell viability was assessed via the MTT assay after 24 h of incubation with the extracts. IC_{50} values were 596.89 ± 61.76 µg/mL for LH and 552.31 ± 59.23 µg/mL for QC. The effect on the inflammatory response was analyzed on cells stimulated with TNF-α (10 ng/mL). The extracts demonstrated a significant inhibitory effect on the release of chemokine 8 by the cells, with IC_{50} values of 19.19 ± 7.62 µg/mL and 20.32 ± 5.94 µg/mL for LH and QC, respectively. At concentrations that did not affect *L. gasseri*, the extracts were shown to inhibit the growth of *G. vaginalis* (at 0.5 mg/mL and above).
In summary, the findings indicate that *Lythri herba* and *Quercus cortex* positively affect vaginal dysbiosis by reducing epithelial inflammation and promoting growth of optimal vaginal microbiota.

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P71. Raw materials of traditional Chinese medicine (TCM) in cosmetic applications

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Traditional Chinese Medicine (TCM) raw materials are gaining increasing scientific attention due to their broad therapeutic properties, in particular antioxidant activity [1], making them valuable components in modern cosmetic and pharmaceutical products.

The aim of our study was to conduct an extensive literature review on selected natural raw materials used in TCM, especially those with antioxidant activity, and to assess public awareness of Traditional Chinese Medicine in Poland, including its principles, raw materials, and cosmetic applications.

The selected plant raw materials, such as *Diospyros kaki*, *Nephelium lappaceum*, *Lycium barbarum*, *Scutellaria baicalensis*, *Fortunella Swingle, Lithospermum erythrorhizon*, *Lonicera japonica*, and *Polygonum cuspidatum*, were identified botanically, then characterized in terms of their chemical composition and pharmacological properties. They are a rich source of carotenoids, polyphenols, vitamins, and other antioxidants. Their potential uses in pharmaceutical and cosmetic formulations were also discussed. The survey research and results analysis were conducted using an original questionnaire completed by 135 respondents to evaluate the state of knowledge and social awareness. The study concerned the knowledge of TCM, selected herbs and treatments, and consumer behavior towards TCM-based cosmetic products.

The results indicated that although most respondents had heard of TCM, detailed knowledge about its therapeutic approach, plant materials, and applications was minimal. Most participants had never used any TCM methods or products and did not associate the presence of TCM ingredients in cosmetics with high bioactive value.

In conclusion, the study highlights a clear gap between the scientifically proven potential of TCM raw materials and public awareness in Europe. Although these ingredients offer significant antioxidant and pharmacological benefits, their presence in consumer products is often overlooked. Increasing public education on the efficacy and advantages of TCM-based ingredients could enhance their recognition and encourage their use in both health and beauty sectors.

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P72. Isolation and characterization of betaxanthins from *Beta vulgaris* L. with antimicrobial properties for cosmetic applications

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The increasing interest in plant-derived ingredients for use in natural cosmetics has highlighted *Beta vulgaris* L. as a valuable source of betaxanthins—yellow to orange pigments with well-documented antioxidant properties [1]. These compounds may have beneficial effects on skin condition, making them attractive candidates for cosmetic applications [2].
This study aimed to isolate and structurally characterize betaxanthins from selected *B. vulgaris* cultivars, as well as to assess their antimicrobial properties through the broth microdilution assay. Extraction was performed by maceration of the peel and flesh from five *B. vulgaris* cultivars: Tytus, Ceryl, Chrobry, Forono, and Boldor. HPLC-DAD-ESI-MS/MS analysis enabled the identification of 23 betaxanthins, including two previously unreported compounds—arginine-betaxanthin and ornithine-betaxanthin—detected for the first time in *B. vulgaris*.
The peel contained significantly higher levels of betaxanthins compared to the flesh, highlighting its potential as a valuable, yet underutilized, by-product for further applications. Among the analyzed samples, the highest betaxanthin content was observed in the peel of the Tytus cultivar (1231 mg/100 g dry extract). Notably, extracts derived from the peels of Tytus and Chrobry cultivars demonstrated strong antimicrobial activity, particularly against Gram-positive bacteria and the majority of tested fungal strains (MIC = 0.125–0.5 mg/mL). Correlation analysis indicated that the presence of asparagine-betaxanthin and phenylalanine-betaxanthin was strongly associated with the most pronounced antimicrobial effects.
Beta vulgaris L. shows promising potential as a cosmetic ingredient due to its antimicrobial activity, suggesting its suitability for use in formulations aimed at supporting skin microbiome balance, managing acne-prone or sensitive skin, and providing natural protection against microbial contamination.

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of Collagen in Wistar Strained Rat (Rattus Norvegicus) Exposed to Ultra Violet-B Light. *European Journal of Biology and Biotechnology*, 2023, *4*(3), 17-22.

P73. Study of biological activity of *Coleus aromaticus* Benth. extracts

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Coleus aromaticus Benth. (syn. *Coleus amboinicus*, *Majana amboinica*, *Ocimum vaalae*, *Plectranthus aromaticus*), a medicinal herb from *Lamiaceae* family, is widely used in traditional, Ayurvedic, and folk medicine [1]. This plant has diverse bioactive compounds, including phenolic acids, flavonoids, and terpenoids [2,3]. Many studies have highlighted its significant biological and pharmacological activities, such as antimicrobial, antifungal, antioxidant, antidiabetic, anticancer, and larvicidal [1,2]. In this study, we investigated the antimicrobial, antioxidant and cytotoxic effect of ethanol, ethanol/water extracts and juice of *C. aromaticus* obtained from above-ground parts of the plant. Antimicrobial assay was done with *Streptococcus* β-hemolytic group A, *Enterococcus faecalis*, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella enterica*, *Shigella sonnei*, *Clostridium bifermentans*, *Clostridium perfringens*, *Helicobacter pylori*, and *Candida albicans*. The minimum inhibitory concentration (MIC) was determined by broth microdilution technique. Antioxidant tests were performed with ABTS and DPPH. Cytotoxic activity was done with human colon cancer HCT-116 and gastric cancer AGS cells using MTT assay. Phytochemical analysis of volatile compounds in the extracts was done with GC-MS. The obtained results showed that the strongest biological activity had the ethanol extract. The IC_{50} values on HCT-116 and AGS cell lines were 24.99 ± 1.80 and 4.94 ± 0.48 µg/mL, respectively. In ABTS and DPPH assays, the IC_{50} values of the ethanol extract were 23.86 ± 0.52 and 22.9 ± 1.3 µg/mL, respectively. Also, the ethanol and ethanol/water extracts turned out to be the most active on *Clostridium perfringens* with MIC values <0.02 mg/mL. Phytochemical analysis showed that carvacrol, camphor, and oleamide were the most abundant compounds in the tested extracts. In conclusion, the ethanol extract of *C. aromaticus* has great biological potential and should be subjected to further *in vitro* and *in vivo* studies.

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P74. Deep Eutectic Solvent-Based Extraction of *Paeonia officinalis* L. Flowers for Use in Cosmetic Anti-Aging Hydrogels

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Paeonia officinalis L., known for its long-standing use in traditional medicine, is a rich source of bioactive compounds with potential applications in modern skincare [1]. Recent research has increasingly focused on green extraction methods to improve the safety and sustainability of extracting plant-derived products [2]. Therefore, this study aimed to evaluate the biological activity of *P. officinalis* flower extracts obtained using deep eutectic solvents (DES). The most active extract was further subjected to HPLC analysis. In addition, the study focused on optimising the formulation of an alginate-based hydrogel intended for topical anti-ageing applications.

Thirteen eutectic solvent systems were prepared and used for ultrasonic extraction of *P. officinalis* flowers. The resulting extracts were analysed for total polyphenol content, antioxidant activity (DPPH• and CUPRAC assays), and inhibitory effects on enzymes relevant to skin ageing (hyaluronidase, elastase, tyrosinase) [3,4]. Based on the biological activity results, a selected extract was further analysed by HPLC and incorporated into alginate hydrogels using a Design of Experiments (DoE) approach.

The extract prepared using a mixture of sorbitol and lactic acid exhibited antioxidant properties and high enzyme inhibitory activity. HPLC analysis revealed a notable presence of gallic acid as a major constituent. The most effective hydrogel formulation contained 5% extract and 1.6% sodium alginate and exhibited high viscosity.

This study highlights the potential of deep eutectic solvents for extracting biologically active compounds suitable for incorporation into cosmetic hydrogels with anti-ageing properties.

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P75. Cosmetic Potential of Bioactive Flower Extracts of *Ptelea trifoliata* L.

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Ptelea trifoliata L. is a perennial plant from the Rutaceae family, native to North America and rich in bioactive constituents [1]. Due to limited data on its biological activity, this study evaluated the biological properties of flower extracts, focusing on activities relevant to cosmetic applications. Moreover, their phytochemical characteristics were also determined.
P. trifoliata flowers, collected from the Botanical Garden of Adam Mickiewicz University in Poznan, were dried, and then methanolic, aqueous and 60% methanolic extracts were prepared using ultrasound extraction. Their antioxidant capacity was measured using DPPH, CUPRAC, FRAP, and iron chelation assays [2]. Inhibition of hyaluronidase was studied to assess the potential to prevent hyaluronic acid degradation and anti-inflammatory potential [2]. Tyrosinase inhibition was assessed to evaluate potential skin-whitening properties [2]. *In vitro* wound healing was also assessed using a scratch assay. Additionally, the samples were analysed using liquid chromatography tandem mass spectrometry (LC–MS/MS) for qualitative identification of main polyphenolic compounds. Total polyphenol and flavonoid contents were determined spectrophotometrically [3].
The obtained results showed that the methanolic and 60% methanolic extracts exhibited the most potent antioxidant activity. The strongest hyaluronidase inhibition was observed with the methanolic extract, while the 60% methanolic extract most effectively inhibited tyrosinase. Scratch assay revealed that after 24 h, the 60% methanolic and aqueous extracts significantly enhanced wound closure. Furthermore, phytochemical analysis revealed the presence of chlorogenic acid, rutin, hyperoside and astragalin in the extracts. Moreover, the 60% methanolic extract exhibited the highest total polyphenol content, whereas the methanolic extract exhibited the highest flavonoid content.
These findings suggest that *P. trifoliata* flower extracts have antioxidant and wound-healing properties. They may modulate enzymes linked to skin ageing and hyperpigmentation, indicating their possible use in natural skincare formulations.

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P76. Beauty by Algorithm: Decoding the Cosmetic Potential of *Achillea millefolium* via Chemometric Profiling based od LC-MS/MS.

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Achillea millefolium L., has long been recognized for its diverse applications in traditional medicine. Its health-promoting properties are attributed to a wide array of secondary metabolites, including flavonoids, phenolic acids, terpenes, guaianolides, phytosterols, fatty acids, and organic acids. In recent years, growing scientific interest has focused on the dermatological and cosmeceutical potential of Achillea extracts [1]. These natural compounds have demonstrated anti-inflammatory, wound-healing, antioxidant, antimicrobial, and skin-soothing effects, making *A. millefolium* a promising ingredient in formulations designed to protect the skin from environmental stressors and promote skin health [2]. This study applies chemometric tools to link the chemical composition of *Achillea millefolium* to biological activity relevant for cosmetic applications, with a focus on enzyme inhibition. Four standardized extracts obtained from different *Achillea* varieties were characterized in terms of the content of 19 individual chemical compounds, as well as their total polyphenol and flavonoid levels. The ability of these extracts to inhibit activity of three selected enzymes was also evaluated. By performing principal component analysis (PCA) followed by VARIMAX rotation and subsequently treating the resulting factors as explanatory variables for biological activity, it was possible to determine both positive and negative contributions of specific compounds present in the extracts to the inhibition of enzymatic activity observed in the conducted assays. Based on this analysis, citric acid, coumaroylquinic acid and the total phenolic and flavonoid content showed the strongest positive influence on tyrosinase inhibition and free radical scavenging, while apigenin was found to diminish these effects. Elastase inhibition correlated positively with rutin and neochlorogenic acid, whereas the presence of cynarin and fumaric acid was linked to reduced activity. These findings highlight the value of chemometric approaches in decoding the complex biochemical profiles of botanical extracts and optimizing their use as multifunctional, evidence-based ingredients in advanced cosmetic formulations.

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Hydroglycolic Extracts-Bioactive Ingredients for Cosmetic Use. Molecules, 2020, 25(15), 3368

P77. Skincare Practices and Aesthetic Objectives Across Three Generations of Women: Mothers, Grandmothers, and Daughters

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Contemporary cosmetic trends emphasize personalized and targeted skincare. A wide range of product forms and formulations support this approach. However, just two decades ago, the cosmetics market in Poland was significantly more limited. As a result, women's skincare behaviors were shaped largely by product availability, potentially influencing long-term habits.
The aim of this project was to analyze skincare behaviors and knowledge among women from different generations.
A total of 400 women born between 1930 and 2007 participated in the study. Statistically significant generational differences were identified regarding the perceived importance of appearance for self-esteem ($p = 0.002$), with younger respondents more likely to associate their looks with self-worth. Differences in hygiene practices related to cosmetic tools were also noted ($p = 0.026$), possibly reflecting increased awareness or stronger hygiene habits among younger women. No significant differences were observed in the purpose of makeup use; regardless of age, women primarily used makeup for self-expression and to conceal imperfections. The way skincare knowledge and skills were acquired showed only partial generational variation. No significant differences were found in whether participants learned skincare routines from their mothers. A strong generational gap emerged in social media usage ($p < 0.001$), with younger participants relying heavily on digital platforms. Additional differences were found in self-rated skincare knowledge ($p = 0.0018$), UV protection behaviors ($p < 0.001$), and attention to product certification ($p = 0.025$). No significant differences were reported in the frequency of seeking professional skincare advice. These findings suggest that although certain aspects of daily skincare and makeup routines have evolved across generations, others particularly the purpose of makeup use-have remained relatively stable. Overall, the data indicate a higher level of skincare awareness among younger generations, particularly regarding daily habits, sun protection, and sensitivity to product quality and certification.

P78. Exploring *Melilotus officinalis* cell cultures for cosmetic bioactives: a phytochemical study

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Melilotus officinalis L. (yellow melilot, Fabaceae) is a plant with well-established traditional use in medicine and cosmetology. Its aerial parts (*Meliloti herba*) are recognized as a valuable herbal substance by regulatory authorities such as EMA and EFSA. The herb is known for its antioxidant, anti-edematous, and wound-healing properties, and is also a rich source of coumarins [1], [2]. To date, no large-scale studies on *in vitro* cultures of this plant have been conducted. The aim of this study was to develop agitated callus cultures and evaluate the chemical composition of the obtained tissue.

In vitro callus cultures were initiated from seeds and maintained in agitated flasks on Murashige and Skoog (MS) medium supplemented with plant growth regulators (PGRs), specifically cytokinins and auxins in the following combinations: BA + IBA, BA + NAA, 2iP + IBA, and 2iP + NAA (each at 1 mg/L) [3]. Control cultures were maintained without PGRs. The cultures were tested over 21-day growth cycles (three independent series, n=5). Methanolic extracts from *in vitro* biomass and the parent plant herb were analyzed using LC-HRMS/MS for phytochemical profiling, while quantitative analysis of major compounds was performed using LC-DAD.

Over 30 compounds were identified in the extracts by LC-HRMS/MS, with significant qualitative and quantitative differences between the parent plant and *in vitro* tissues. The predominant metabolites in the herb extracts were coumarin (786.64 mg/100 g DW) and rutin (223.67 mg/100 g DW). In contrast, coumarin and rutin were not detected in the *in vitro* tissues. The main compounds in the cultures were ononin (up to 382.4 mg/100 g DW), daidzein, and daidzin. Daidzin was found exclusively in the *in vitro* cultures. Metabolite concentrations varied depending on the PGR combination used, with the highest ononin content observed in control cultures.

The study confirmed that *M. officinalis in vitro* cultures can serve as a potential source of various bioactive compounds, with a composition distinct from that of the parent plant herb.

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P79. Isolation of bioactive metabolites from *Beta vulgaris* L. with antioxidant potential for cosmetic applications

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The increasing demand for natural antioxidants in the cosmetics industry has stimulated the development of efficient methods for isolating bioactive compounds from plant-derived sources. *Beta vulgaris* L. is regarded as a rich source of secondary metabolites, including phenolic compounds, betalains, and saponins, which possess notable antioxidant and potential anti-aging properties [1].

This study aimed to extract, purify, and assess the antioxidant activity of selected secondary metabolites derived from *B. vulgaris*. Extraction was performed by maceration using 55% (v/v) aqueous acetone, followed by purification *via* column chromatography on an ODS as a stationary phase. The chemical composition of the resulting fractions, crude extract, and beetroot juice was analyzed using HPLC-DAD-ESI-MS/MS.

Quantitative analysis revealed substantial differences in the content of active compounds among the obtained fractions. Betaxanthins were most abundant in fraction I, betacyanins in fraction II, and saponins in fraction III. The antioxidant potential of each fraction was evaluated using ABTS and FRAP assays. Fraction II demonstrated the highest antioxidant activity (ABTS: 1.93 ± 0.016 mmol Trolox/g; FRAP: 0.40 ± 0.007 mmol Trolox/g), exceeding that of the crude extract, beetroot juice, and the other fractions.

Beta vulgaris L. is a promising natural source of bioactive compounds with notable antioxidant potential. The extracts obtained may be used as valuable active ingredients for the development of cosmetic formulations with protective and anti-aging properties.

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P80. Dried Spot Sampling for Natural Product Analysis with Cosmetic Applications

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The demand for efficient quality assessment of natural products and plant-derived ingredients is increasing, particularly in cosmetic applications. Although powerful analytical techniques such as LC-MS have improved efficacy and safety evaluations, sampling and sample preparation procedures remain major constraints, requiring considerable resources and effort. Dried spot microsampling, commonly employed in clinical settings for dried blood spots, offers noteworthy advantages such as minimal sample volume, convenient remote and on-site sampling, and easy transportation via mail [1]. This format is compatible with various analytical platforms, including LC-MS, and can be fully automated [2,3]. Despite such benefits, dried spot techniques remain largely unexplored in this field.

The present study introduces dried spot methodologies for the characterization of natural products with cosmeceutical relevance. Through targeted and untargeted proof-of-concept applications using *Cannabis sativa* L. (hemp) products rich in non-psychoactive cannabinoids (plant material, extracts, CBD oils, etc.) and polyphenol-rich matrices like wine, robust workflows were developed, that could be translated to analysis of cosmetic product ingredients. Efficient LC-HRMS/MS methods were established based on an automated card extraction system, with a focus on sensitivity, throughput, and reproducibility. The proposed volumetric microsampling on paper cards is user-friendly, suitable for non-specialists and adaptable to regulatory environments.

The developed dried spot methodologies yielded comparable chemical results to conventional sample preparation while reducing resource usage and logistical burdens. Overall, this novel approach featuring dried spot microsampling shows promise for the quality assessment of complex natural products in modern cosmetic applications, by enabling high-capacity analysis with simplified logistics.

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P81. *Glechoma hederacea* extract as an active ingredient of a cosmetic gel for skin restoration after laser hair removal

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Laser hair removal has recently become one of the most popular cosmetic procedures, which in some cases can cause side effects (allergies, skin inflammation, and folliculitis). Objective: to develop the composition and technology of a gel product with *Glechoma hederacea* L. extract for use after laser hair removal.
The aqueous-ethanolic extracts of *G. hederacea;* phyto-chemical, microbiological and technological methods were used.
Follicular damage creates ideal conditions for bacteria to enter through skin pores or microtraumas after the procedure. After bacteria penetration into damaged follicles, pustular inflammation occurs, and to prevent complications, specialists most often prescribe products that have an antimicrobial effect and contain panthenol and moisturizing ingredients. Information about the high content of various phenolic and other compounds in extracts of *G. hederacea* with antioxidant, antiproliferative, antimicrobial activity (1,2,3,4) has become the basis for the creation of a gel using them. *G. hederacea* extracts prepared with aqueous ethanol of different concentrations demonstrated zones of growth inhibition of *Escherichia coli*, *Bacillus subtilis* and *Candida parapsilosis* with a diameter of 8.7–21.0 mm (4). Since moisturizing and wound-healing components that promote skin regeneration and protect tissues from drying out also have a positive effect on the skin after laser hair removal, hyaluronic acid and D-panthenol were also added to the gel. Carbopol, sodium hydroxide, glycerin, phenoxyethanol and purified water have used as auxiliary components in the gel. In vitro study was found that the gel diffuses well into the agar medium and retains its antibacterial properties, which is confirmed by the clear zones of growth retardation of the microorganisms under study (from 12 to 15 mm).
The use of *Glechoma hederacea* extract as an active ingredient of a cosmetic gel will provide a moderate antimicrobial effect and contribute to the prevention of negative consequences and complications after laser epilation.

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P82. Evaluation of *Sambucus nigra* extracts as potential sources of bioactive compounds for dermatological applications

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The study examined the bioactive potential of *Sambucus nigra* (elderberry), a species with a well-documented history in traditional Polish medicine, focusing on its applicability in cosmetic formulations. Crude extracts were fractionated using centrifugal partition chromatography (CPC), and the resulting fractions were evaluated for antioxidant activity in HaCaT human keratinocyte cell line.
The cytotoxic effects of plant-derived extracts and fractions were assessed using the AlamarBlue assay. In parallel, their capacity to attenuate intracellular reactive oxygen species (ROS) generation in HaCaT cells was investigated.
Selected fractions of the studied plant extracts demonstrated antioxidant activity and exhibited no cytotoxic effects against HaCaT human keratinocytes. These findings suggest their potential safety and efficacy for use in dermatological applications, particularly in protecting skin cells from oxidative stress.
Following the assessment of the most active fraction, selective extraction was performed using various extraction techniques, including traditional models and green technologies. Further bioactivity-guided fractionation allowed for the tentative identification of compounds responsible for the strongest antioxidant effects. Additionally, the impact of the obtained fractions on the tyrosinase enzyme in a mushroom tyrosinase model was assessed.
Collectively, these findings advance the pharmacognostic characterization of *Sambucus nigra* and underscore its promise as a safe and efficacious ingredient in cosmeceutical formulations targeting oxidative skin damage.

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P83. Surface activity of lupin concentrates

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The increasing ecological awareness of the cosmetic industry stimulates development of new surfactants for cosmetic formulations derived from natural and renewable resources with minimum chemical transformation. For this purpose, the plant extracts rich in biosurfactants (e.g. saponins or proteins) seem to be especially promising candidates. Lupin belongs to a *Fabaceae* family and is typically cultivated for animal feed, nutritional, medicinal or ornamental purposes, as well as and for its unique ability to fix nitrogen from the atmosphere which fertilizes the soil for the subsequent crops. The high protein content of lupin seeds opens several possibilities of their use as a source of plant-derived biosurfactants. In the present study, aqueous extracts of various lupin species (blue or narrowleafed - *Lupinus angustifolius* and yellow - *Lupinus luteus*), with high ("bitter") and low ("sweet") alkaloid content were prepared. Their surface activity was assessed by measuring surface tension (γ_{eq}) and surface compression rheology parameters of the adsorbed layers (E', E''). The effect of extraction conditions on the protein recovery and its surface tension will be discussed. We will show that with relatively simple modifications of the extraction conditions, the extracts can be turned into efficient biosurfactants solutions [1].

Acknowledgments
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P84. Anti-tyrosinase and anti-hyaluronidase activity of extracts from two *Lysimachia* L. species

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Hyperpigmentation is a dermatological and aesthetic problem that is difficult to combat or alleviate through daily care, especially when combined with other conditions such as inflammation, dryness or accelerated aging. Tyrosinase is a key enzyme in melanin synthesis. By blocking it, the chain reactions leading to pigment production are inhibited [1]. This results in a brightening effect. Hyaluronidase blockers, on the other hand, help to maintain skin hydration, elasticity and volume promoting its healthy appearance [2]. Furthermore, they limit the spread of inflammation, soothing it. With regard to complex skin problems, multifunctional cosmetics are much valued. For blemished, dry or even irritated complexion, products with tyrosinase and hyaluronidase blockers can be used. Plant extracts, i.e. mixtures of multiple ingredients extracted from the plant material with a given solvent, showing different directions of activity are often used to prepare such formulations.

Lysimachia punctata L. and *L. vulgaris* L. (Primulaceae) are both widely distributed in Poland. These plant species are characterized by the content of various phytochemicals, such as unique benzoquinones, saponins and phenolics in different proportions depending on the species and morphological parts [3].

The aim of our study was to evaluate the anti-tyrosinase and anti-hyaluronidase activities of extracts from the aboveground parts of the two *Lysimachia* species.

By means of ultrasound-assisted extraction, methanolic and dichloromethane extracts were obtained. In vitro tests were used for the evaluation of biological activity. The IC_{50} values were calculated where possible. The differences in the activity of the extracts depending on the polarity of the solvent towards the enzymes: tyrosinase and hyaluronidase, were presented

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P85. Evaluation of Biological Activity of Plant-Based Waste Materials in Cosmetic and Dermatological Applications

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The growing demand for sustainable and multifunctional cosmetic ingredients has encouraged the exploration of underutilized plant materials, particularly those derived from agricultural waste. In this study, we evaluated the biological activity of leaf extracts obtained from cherry (*Prunus cerasus*), apple (*Malus domestica*), and apricot (*Prunus armeniaca*), with the aim of assessing their potential use in dermatological and cosmetic formulations. The investigated extracts, obtained from post-harvest plant waste, were subjected to a range of *in vitro* assays to determine their antioxidant, anti-inflammatory, anti-aging, and antibacterial properties.

Antioxidant activity was assessed using DPPH free radical scavenging and ferric reducing antioxidant power (FRAP) assays. Anti-inflammatory potential was evaluated by quantifying pro-inflammatory cytokines using the ELISA method. Cytotoxicity and cell viability were analyzed in keratinocytes (HaCaT) and dermal fibroblasts (HDF) using the Alamar Blue and Neutral Red assays. Our findings demonstrate that all tested extracts exhibited notable antioxidant activity, effectively reducing oxidative stress. Additionally, anti-inflammatory potential was confirmed through the downregulation of inflammatory mediators (IL-6, IL-1β and TNF-α). Anti-aging activity was evidenced by the modulation of enzymes involved in extracellular matrix degradation, while antimicrobial effects were observed against selected bacterial strains relevant to skin health. Importantly, the extracts maintained or enhanced the viability of skin cells, indicating good safety and biocompatibility. These findings are consistent with our previously published research, which demonstrated the broad-spectrum biological activity of different extracts derived from the same plant leaves [1].

The results highlight the value of leaf-derived extracts as promising bioactive agents with multiple skin-beneficial functions. Their origin from plant waste materials aligns with current trends in circular economy and green chemistry, offering an environmentally responsible alternative to conventional cosmetic ingredients. These findings support the consideration of such extracts as multifunctional components in the development of innovative formulations for skin care and dermatological applications.

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Inflammatory activity of aqueous and ethanolic extracts from *Malus domestica*, *Prunus armeniaca*, and *Prunus cerasus* leaves. Molecules, 2025, 30(10):2085.

P86. Targeting the Skin Microbiome with *Calendula officinalis* L.-Based Nanoformulations: A Dual-Extract Strategy for Cosmeceutical Innovation

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Modern natural cosmetology is increasingly focused not only on the safe and effective delivery of bioactive compounds but also on modulating the skin microbiome as a critical factor in dermatological health. Our contribution explores the potential of natural active ingredients, with particular emphasis on *Calendula officinalis* L. (marigold) extract, to interact with the cutaneous microbiota, supported by advanced nanocarrier systems for targeted delivery [1, 2].
C. officinalis L. extract, well-known for its anti-inflammatory, antioxidant, and wound-healing properties, also exhibits promising prebiotic and microbiome-modulating effects [3]. When incorporated into nanocarriers such as liposomes, niosomes, or lipid-based nanoparticles, its biological activity and skin penetration can be significantly enhanced while maintaining biocompatibility and stability [1]. We further discuss the implications of using such formulations in the management of microbiome-related skin disorders, including atopic dermatitis, acne, and psoriasis. By modeling targeted delivery and site-specific activation of natural actives within the skin's microbial environment, we propose a framework for designing the next generation of natural cosmeceuticals that synergistically integrate phytotherapy and nanotechnology.
Building on this concept, we introduce a dual-extract formulation strategy that combines two distinct preparations from *Calendula officinalis* L., a polar-rich ethanolic extract (containing flavonoids, phenolic acids, and saponins) and a lipophilic oil macerate (rich in triterpenes and carotenoids), obtained *via* cold maceration in cold-pressed hemp oil. A natural oil-in-water emulsion system was designed to incorporate both fractions while maintaining their stability and functional synergy. The selected excipients follow clean-label and skin-tolerant principles, intentionally excluding synthetic preservatives and colorants. Phytochemical compatibility and functional complementarity were analyzed to support the hypothesis of a synergistic effect on skin hydration, regeneration, and microbiome balance. This dual-extract approach exemplifies a holistic methodology for leveraging the full phytochemical spectrum of a single botanical source and aligns with current market demand for multifunctional, plant-based, and microbiome-friendly cosmetics.

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P87. Evaluation of the protective and moisturizing properties of kombucha-fermented Aloe vera gel formulations for cosmetic applications.

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Aloe barbadensis Miller gel is a valuable raw material widely used in the cosmetic industry due to its moisturizing, regenerating, anti-inflammatory, and anti-aging properties. The fermentation process of plant raw materials is increasingly being used to increase the bioactivity and improve their biological properties. An innovative example is kombucha—a fermented beverage derived from a symbiotic culture of bacteria and yeast (SCOBY). Unlike traditional ferments, such as aloe fermented with lactic acid bacteria, kombucha features a distinct metabolic profile, including glucuronic acid, acetic acid, B vitamins, polyphenols and enzymes with antioxidant and regenerative properties.

The purpose of the study was to evaluate the cosmetic properties of fermented Aloe vera gel using kombucha. Fermentation was carried out for a period of 10 and 20 days. Based on these, four model gel preparations were prepared containing: unfermented aloe vera gel and its ferments (F10 and F20) at a concentration of 5% (*w/w*), as well as a base gel not containing the tested compounds. The formulations were subjected to cytotoxicity evaluation on human keratinocytes (HaCaT) using Alamar Blue and Neutral Red assays. The results showed no cytotoxicity against skin cells, and the formulations containing ferments showed additional cytoprotective effect. Skin hydration, transepidermal water loss (TEWL) and skin surface pH were also measured. Products containing ferments showed more significant moisturizing properties compared to non-fermented gel. In particular, formulations with F20 had a favorable effect on the skin's pH, restoring it to physiological values, which is particularly important in care after the use of cleansers.

The results obtained are in line with the authors' previously published studies, which confirm the wide spectrum of biological activity of Aloe vera gel and its ferments obtained using kombucha [1]. Fermentation of aloe vera gel using kombucha can therefore be an effective method of enriching the cosmetic properties.

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Potential of Aloe Vera Gel by Kombucha-Mediated Fermentation: Phytochemical Analysis and Evaluation of Antioxidant, Anti-Aging and Moisturizing \Properties. *Molecules* **2025**, *30*, 3192. https://doi.org/10.3390/molecules30153192

P88. Formulation of a Moisturizing Cream Using Bioactive Compounds Extracted from Olive Mill Wastewater

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This study highlights the cosmetic potential of olive mill wastewater, a liquid by-product of olive oil extraction often regarded as a polluting agricultural waste. Solvent extraction using ethyl acetate yielded extracts rich in phenolic and flavonoid compounds, identified by HPLC-DAD [1]. Antioxidant (DPPH, FRAP, CAT) and antibacterial tests revealed significant bioactivity. Incorporated into a moisturizing cream, these extracts demonstrated good stability and promising efficacy. This work supports the sustainable valorization of olive mill wastewater in the development of natural cosmetic formulations with antioxidant and moisturizing properties [2].

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waste, fruit pulp, and seeds of the olive plant on skin." *Plants* (2021).

P89. Anti-tyrosinase properties of green extracts from *Salvia bulleyana* shoot culture

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Biotechnological methods are often used to obtain a significant amount of plant material with limited distribution in the nature and/or to increase the level of bioactive compounds. *Salvia bulleyana* Diels, Lamiaceae is a perennial species native to the Yunnan Province in China, often used in traditional Chinese medicine as a substitute of *Salvia miltiorrhiza*. The aim of this work was to assess anti-tyrosinase properties of the extracts from *S. bulleyana* shoots cultivated in a commercial temporary immersion system Rita. In order to optimize the chemical composition of the extracts in an environmentally-friendly way, the extracts were prepared using several green solvents such as mixtures of water with ethanol, glycerol, beta-hydroxypropil cyclodextrin and natural eutectic solvents. The suitability of the tested solvents for extraction of total phenols (TP), total phenolic acids (TPA) and total flavonoids (TF) were assessed. The best efficiency for extraction of natural phenolics was observed using eutectic solvents, BGG1 (betaine:glycerol:glucose, 4:20:1, w:w:w) and BGG2 (betaine:glycerol:glucose, 4:5:1, w:w:w) diluted with water to obtain 50% solution (-50). The maximum amount of TP (5250.03 µg/mL ± 326.21 µg/mL) and TPA (3382.82 µg/mL ± 425.47 µg/mL) was obtained using BGG1-50, while the maximum extraction of TF (876.31 µg/mL ± 58.26 µg/mL) was achieved with BGG2-50. The anti-tyrosinase effects of the two extracts were tested along with the solvents used for their preparation. The extracts demonstrated notable activity with IC_{50} values 127.67 µg/mL ± 10.92 µg/mL (BGG1-50 extract) and 157.20 µg/mL ± 20.89 µg/mL (BGG2-50 extract), albeit somewhat lower than the activity of the standard kojic acid (78.18 µg/mL ± 0.46 µg/mL). It was interesting to note that the employed solvents played an active role in the observed activity contributing to it with more than 70%. In conclusion, the green extracts from *Salvia bulleyana* shoot culture have showed potential for further cosmeceutical development.

P90. Structural modifications for enhanced drug bioavailability: Synthesis and examination of key properties

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Global research efforts are increasingly focused on enhancing the bioavailability of active substances and optimizing strategies for their delivery across biological barriers. Bioavailability is a critical determinant of drug efficacy, influenced by factors such as route of administration, the physicochemical properties of the active compound, and the presence of biological barriers that limit its absorption into the bloodstream [1-3]. One of the primary strategies for improving drug bioavailability involves the structural modification of active substances. Alterations in molecular structure, such as the formation of ionic liquids, can significantly enhance the therapeutic effectiveness of drugs [4-5]. Mefenamic acid (MA) is a nonsteroidal anti-inflammatory drug (NSAID) commonly used to alleviate moderate pain. Its clinical efficacy is limited by low water solubility, which constitutes a major barrier to optimal bioavailability [6].
In this study, three organic derivatives of mefenamic acid were synthesized using a two-step reaction process: didecyldimethylammonium mefenamate ([DDA][MA]), 1-ethyl-3-methylimidazolium mefenamate ([EMIM][MA]), and choline mefenamate ([Chol][MA]). The chemical structures of these compounds were confirmed by spectroscopic techniques, including 1H NMR, 13C NMR, and FT-IR spectra. Their physicochemical properties were further characterized using X-ray diffraction (XRD), solubility in water measurements, octanol-water partition coefficient (log P), differential scanning calorimetry (DSC) for phase transition analysis, and thermogravimetric analysis (TG) for thermal stability assessment.
The structural modifications led to derivatives with enhanced solubility and improved thermal stability. These findings provide insights into the relationship between chemical structure and physicochemical properties, which may support the development of novel pharmaceutical agents. Research into alternative drug forms and their bioavailability, as well as their ability to traverse biological barriers, is essential for the advancement of pharmaceutical technology. Enhancing the bioavailability of active substances holds promise for increasing therapeutic efficacy, minimizing side effects, and improving patient compliance.

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P91. Electromagnetic Field-Assisted Transdermal Transport: Insights from a Model NSAID

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Transdermal administration presents a non-invasive alternative to traditional drug delivery routes, offering benefits such as reduced systemic side effects, consistent therapeutic levels, and avoidance of gastrointestinal metabolism. Nevertheless, the outermost layer of the skin, the stratum corneum, poses a significant challenge by impeding the diffusion of most pharmaceutical substances [1-5].
In this study, the effects of various electromagnetic field (EMF) modalities on the transdermal permeation of naproxen were systematically evaluated. Naproxen, a small-molecule anti-inflammatory agent, served as a model compound due to its established therapeutic profile and physicochemical properties compatible with skin delivery. The investigation encompassed a range of EMF conditions, including time-varying (oscillating, pulsed, rotating) and static fields, with controlled exposure settings. Using an ex vivo model with porcine skin in Franz-type diffusion chambers, the research focused on quantifying changes in drug transport efficiency under the influence of EMFs. Among the tested parameters, exposure to a 50 Hz rotating magnetic field resulted in the highest enhancement of naproxen permeation, marked by increased diffusion rates and reduced accumulation in superficial skin layers. Conversely, negatively polarized static fields were found to suppress transdermal transport. Complementary analyses explored potential alterations in the compound's physicochemical profile post-exposure, assessing properties such as solubility, partition behavior, and thermal stability. Notably, EMF exposure—without inducing structural degradation—was associated with changes that may favor skin permeation, such as improved solubility and modified lipophilicity.
These findings suggest that electromagnetic field application, particularly in the form of dynamic fields, may be a promising strategy to support the development of enhanced transdermal drug delivery systems. The ability to modulate permeability without compromising drug integrity opens new avenues for optimizing non-invasive therapeutic technologies.

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P92. C-glycosylated flavones across Caryophyllaceae

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Plants from the Caryophyllaceae family are a rich but almost unused source of C-glycosylated flavones, which are known in pharmacy for their valuable therapeutic and preventive properties, including in cardiological disorders and so-called lifestyle diseases. They also exhibit anti-inflammatory, antibacterial, and antiviral activities. Pilot studies have demonstrated the presence of luteolin and apigenin derivatives from the group of C-glycosides in several species, including those planned for investigation in this project. The main components are orientin and isoorientin and their analogues, as well as vitexin and its derivatives, along with several unidentified compounds.
The research objective of the project is to verify the hypothesis of the possibility of enhanced biosynthesis of C-glycosides under in vitro culture conditions in species of the genera Dianthus sp., Viscaria sp., and Gypsophila sp., including undifferentiated systems and organ cultures. We will also undertake experiments aimed at optimizing the conditions to obtain the desired phytochemical profile.
The present study reports the results of the preliminary stage of research. Seeds of 10 plant species from the Caryophyllaceae family were used in the study. The seeds were sterilized with sodium hypochlorite and then placed on Petri dishes containing MS (Murashige & Skoog) medium. For the following 3 weeks, the germinated seeds were counted daily to determine the rate and vigor of germination. Subsequently, the developed seedlings were transferred to culture jars containing MS medium. All cultures were maintained in a phytotron chamber under controlled conditions: a temperature of 25 ± 2 °C, an 18h light/6h dark photoperiod,
and illumination provided by white LED lighting. After 4 weeks, the morphological characteristics of the explants were evaluated. The content of C-glycosides was determined using DAD-HPLC in reversed-phase mode with orientin, isoorientin, vitexin, and isovitexin standards.

Workshops

Formulation of natural cosmetics

The popularity of natural cosmetics is constantly growing. This is due to the growing awareness of consumers about the negative impact of synthetic substances on the human body and the natural environment, as well as the growing knowledge about the high effectiveness and multidirectional effects of natural raw materials on the skin. Plant extracts are an important group of active ingredients used in formulation of natural cosmetics. Due to the varied physicochemical properties, various types of plant extracts require the use of an appropriate method of introducing them into the cosmetic product. The Workshop will present the types of plant extracts used in the cosmetics industry. Participants will have the opportunity to independently prepare a formulation for a washing cosmetic and a cosmetic emulsion, as well as learn the methods of introducing plant extracts into the recipe depending on their physicochemical properties.

The workshop will be conducted by the employees of the Department of Cosmetology and scientists working within the Biomedical Research and Service Center of UITM in Rzeszów, Poland.

Bioferments in cosmetics (by Orcideo)

Bioferments are innovative cosmetic ingredients obtained by fermentation of natural raw materials with appropriate strains of microorganisms, such as *Lactobacillus* sp., *Saccharomyces* sp. or *Bacillus* sp. fermentation process allows the transformation of the complex bioactive compounds present in plants into simpler forms, often with higher biocompatibility, increased transepidermal penetration, novel biological properties. Biofermented products are an increasingly common group of raw materials, which includes both the fermentation of plant raw materials and microbiome stimulants that give very interesting properties to cosmetics. Appropriate selection of bioferment therefore seems crucial to give the cosmetic better care properties, and the proposed workshops are the best opportunity for this.

The workshop will focus on the application of bioferments supporting the skin microbiome in cosmetic formulations. Participants will discuss the principles of appropriate selection of biofermented raw material for the skin type and selected skin problem and their possible use in various types of cosmetic formulations.

The Workshop will be held by representatives of Orcideo – Polish cosmetic company based in Tyczyn, Poland, specialized in the production cosmetics containing traditional active ingredients as well as innovative bioferments supporting skin microbiome.

EpiOcular Eye Irritation Test Workshop (by MatTek)

Reconstructed human cornea-like epithelial tissue model (EpiOcular) for the toxicity testing of chemicals, cosmetics, personal care, and pharmaceutical products.

The workshop will provide an overview of the use of in vitro 3D reconstructed tissue model EpiOcular (by MatTek) in toxicology for hazard and risk assessment. The program includes a short presentation on the reconstructed human cornea-like epithelial tissue model, practical hands-on training in the EpiOcular Eye Irritation Test (EIT) according to OECD test guideline 492 (OECD TG 492), and discussion. EpiOcular is a ready-to-use, highly differentiated 3D tissue model consisting of normal, human epidermal keratinocytes (NHEK) which have been cultured in serum-free medium to form a stratified, squamous epithelium, similar to in vivo human corneal epithelium. EpiOcular provides a non-animal model to assess ocular irritation, formulation toxicology, ocular inflammation, and other toxicological endpoints. EpiOcular is most commonly used for ultra-mildness testing and ocular irritation studies. EpiOcular has been validated for the Eye Irritation Test as part of OECD TG 492 and is widely used to meet regulatory testing requirements for testing raw materials and finished products and product optimization studies. The workshop is suitable for anyone who would like to practice the method, consult the specific problem, and receive valuable information, as well as those who are just considering the use of *in vitro* models in their research.

Real-Time Demonstration of CPC (by LiliCHRO & Anchem)

This session offers an in-depth introduction to Centrifugal Partition Chromatography (CPC), a gentle, scalable, and affordable purification technique from LiLiChro Ltd. particularly well suited to cosmetic ingredient development. Participants will observe a live demonstration of the separation of methyl- and ethyl-parabens, two widely used preservatives in personal care formulations, using the midiLiLi instrument. Throughout the demonstration, we will walk through the full CPC workflow: from solvent system selection and phase behavior to sample injection, fraction collection, and chromatogram interpretation — all explained in real time.

The session will also highlight CPC's key advantages for extraction specialists:

- No solid support means minimal sample loss and no risk of contamination.
- High recovery and reproducibility, even across seasonally variable plant batches.
- Solvent-efficient operation, with easy recycling options and a reduced environmental footprint.
- Seamless scalability from lab to production scale (miniLiLi → midiLiLi → maxiLiLi).
- Wide polarity range, allowing both polar and non-polar compounds to be purified using the same system.

Designed for R&D and analytical scientists, this session illustrates how support-free liquid–liquid chromatography can simplify purification processes, reduce costs, and offer long-term flexibility — making it an elegant and accessible solution for modern natural ingredient development.

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