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PREFACE

The Academic Committee of the “XIII Congreso Nacional de Ciencias Farmacéuticas” is pleased to present this special edition of Universitas Scientiarum, dedicated to the research presented at the congress held in Barranquilla from August 21 to 23, 2025. Under the theme **"Integrating the Pharmaceutical Sciences for Building the Future"**, the meeting brought together almost 800 participants, including industry professionals, hospital and community pharmacists, scientists, regulators, suppliers, and logistics operators. The meeting provided a platform for sharing recent advances and engaging in discussions about the challenges and opportunities across the full spectrum of pharmaceutical sciences. More than 40 scientific contributions were presented through oral communications and poster sessions, facilitating a valuable exchange of knowledge and experiences among participants. Of these, 34 were selected for inclusion in this special issue through peer review, reflecting the scientific rigour and relevance of the congress proceedings.

Building on this vibrant exchange, this issue brings together contributions organized around four thematic areas (TA). The first, **Products Life Cycle (TA-1)**, encompasses the entire trajectory of pharmaceutical, phytotherapeutic, dietary supplement, food and cosmetic products, from initial design and development to final delivery. The second, **Advances in Innovation, Digital Transformation and Robotics (TA-2)**, underscores the ways in which digital tools and emerging technologies are reshaping pharmaceutical research and development. The third, **Optimization and Safety in Pharmaceutical Practice (TA-3)**, constitutes the most substantial body of work reflects the multifaceted nature of comprehensive pharmaceutical management systems, paying particular attention to strategies aimed at improving efficiency, safety, and quality. Finally, the fourth thematic, **Entrepreneurship, Sustainability and Marketing (TA-4)**, explores how entrepreneurship and sustainability can act as drivers of innovation and promote responsible business practices within the pharmaceutical sector.

We would like to extend our gratitude to the authors for entrusting their work to the congress and to the reviewers whose rigorous evaluations ensured the scientific quality of this volume. We would also like to acknowledge the efforts of the Organizing committee of the “XIII Congreso Nacional de Ciencias Farmacéuticas” and the **Colegio Nacional de Químicos Farmacéuticos de Colombia, Atlántico Sectional**, in fostering collaboration between among academia, industry, and regulators. We are confident that the studies compiled in this issue will inspire further research, drive innovation, and promote sustainable development in the field of pharmaceutical science, helping to shape a future in which integration, safety, and innovation define our profession.

Joe Luis Villa Medina
Director Comité Académico
XIII Congreso de Ciencias Farmacéuticas
Barranquilla, Colombia

Angela Caro
Directora Carrera de Química Farmacéutica
Facultad de Ciencias
Pontificia Universidad Javeriana.
Bogotá, Colombia

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Design of an amorphous solid dispersion of ibuprofen in a biocompatible polymeric matrix obtained by spray drying

Wilson García[1*], Juan José Carrascal S[1*], Carlos Alberto Bernal[1], Juan Urrego[1], Claudia Milena Baena Aristizabal[1]

1. Facultad de Ciencias Farmacéuticas. Universidad de Cartagena. Cartagena, Colombia

*jjcarrascals@gmail.com, danielgpwilson@gmail.com

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Abstract: Poor aqueous solubility remains one of the main challenges in the development of effective oral dosage forms. Approximately 40% of marketed drugs and nearly 90% of drug candidates exhibit solubility limitations, compromising absorption and bioavailability. Ibuprofen, a widely used non-steroidal anti-inflammatory drug, is a paradigmatic case due to its poor water solubility. This study aimed to design an amorphous solid dispersion (ASD) as a strategy to enhance ibuprofen solubility, employing spray drying as a scalable and versatile formulation technology. Two hydrophilic polymers, polyvinylpyrrolidone K30 (PVP K30) and hydroxypropylcellulose (HPC), were selected for their stabilizing capacity in amorphous systems. A 2^4 factorial design was applied to evaluate the effect of inlet temperature, feed rate, solid concentration, and drug/polymer ratio. The formulations were processed in a Büchi B-290 mini spray dryer. Critical quality attributes were assessed, including yield, flowability, residual moisture, and drug content. The optimized formulation was encapsulated, and dissolution studies were conducted in phosphate buffer pH 7.2, using USP apparatus II (paddle method) at 100 rpm for 4 h. Formulations with higher solid content and a 1:2 drug/polymer ratio achieved yields above 80% and good flowability, with repose angles between 30° and 35°. Residual moisture remained below 4.5% across all samples. Drug content was within 90–110% of the theoretical value. The optimized ASD achieved ∼80% ibuprofen release within 4 h, significantly higher compared to ∼30% release from crystalline ibuprofen under the same conditions. Spray drying proved to be an efficient strategy to improve ibuprofen solubility and dissolution profile through the formation of ASDs with PVP K30 and HPC. The optimized formulation demonstrated potential to increase bioavailability and may be applicable to other poorly soluble drugs, representing a promising approach for the pharmaceutical industry.

Keywords: Amorphous solid dispersion; bioavailability; ibuprofen; solubility enhancement; spray drying.

Study of the application of Basil (*Ocimum basilicum* L. 'Genovese') essential oil in a topical cosmetic formulation

Maryluz Escobar Mosquera[1*], Franklin Bermeo Acosta [1]

1. Grupo de investigación en física, estadística y matemáticas (GIFEM), Facultad de Ciencias Básicas, Universidad Santiago de Cali. Cali, Colombia.

*maryluz.escobar00@usc.edu.co

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Abstract: Facial skin care is important due to its influence on health and self-esteem. Facial toners play a key role by cleansing, balancing pH, and enhancing treatment effectiveness. The essential oil of *Ocimum basilicum* L. shows antimicrobial and anti-inflammatory activities, supporting its potential in acne treatment. Its antimicrobial effectiveness may vary with en-

vironmental and processing factors, highlighting the importance of formulation design. Despite its promising properties and local availability in Valle del Cauca, Colombia, few studies have explored its use in facial toners. This study evaluated the antimicrobial activity, stability, and consumer acceptance of formulations with different concentrations of basil essential oil. Fresh leaves of *Ocimum basilicum* L. 'Genovese' (12 kg) were shade-dried and steam-distilled for essential oil extraction. Three toner formulations (2%, 3%, and 5%) were prepared with standard cosmetic excipients. Physicochemical properties, stability at 40 ℃/75% RH, and microbiological safety were evaluated. Antimicrobial activity against *Propionibacterium acnes* was tested by sensitivity assays and analyzed with the Kruskal–Wallis's test. Consumer acceptance and efficacy were assessed through surveys, hydration tests, and acne reduction analysis. Steam distillation yielded 0.68% of pale-yellow essential oil. All formulations met cosmetic standards and remained stable for 90 days. Antimicrobial tests showed inhibition of *Propionibacterium acnes* at all concentrations, with the 3% formulation being the most effective (51 mm halo). Hydration assays indicated maintained or improved skin moisture, and microbiological analysis confirmed the absence of pathogens. Volunteer surveys reported full satisfaction with texture and cleansing, and 90% noted improved acne appearance. In conclusion, *Ocimum basilicum* essential oil can be successfully incorporated into cosmetic facial toners. The 3% formulation demonstrated the best balance between antimicrobial activity, stability, and consumer acceptance, supporting its potential as a natural alternative for acne treatment.

Keywords: Acne treatment; Basil essential oil; Cosmetic formulation; *Ocimum basilicum*; Topical application.

Cytotoxic potential of *Kalanchoe daigremontiana* extracts on hepatocellular carcinoma cells

Melany A. Pestana Martínez [1*], Jhoan H. Piermattey Ditta[1], Jorge L. Anaya Gil[1], Karina Caballero Gallardo[1]

1. Grupo de Investigación en Productos Naturales, Universidad de Cartagena. Cartagena, Colombia.

* mpestanam1@unicartagena.edu.co

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Abstract: *Kalanchoe daigremontiana*, a medicinal plant traditionally used for treating gynecological, gastrointestinal, and neurological disorders, contains bioactive compounds such as bufadienolides, flavonoids, and phenolic acids. Hepatocellular carcinoma (HCC) is a leading cause of cancer-related mortality, often associated with oxidative stress and chronic inflammation. Natural antioxidants, particularly flavonoids and phenolic acids, may modulate these processes. This study aimed to evaluate the cytotoxic activity of aqueous and ethanolic extracts of *K. daigremontiana* on HepG2 cells and correlate their phytochemical profiles with biological activity. Fresh leaves of *K. daigremontiana* were processed to obtain aqueous (1PNKA) and ethanolic (2PNKE) extracts. Phytochemical screening was performed using standard qualitative tests to identify secondary metabolites. Cytotoxicity was assessed using the MTT assay on HepG2 cells exposed to eight concentrations (3.9–500 µg/mL) of each extract for 24 h. Cell viability was measured at 620 nm using a microplate reader. Both extracts exhibited a dose-dependent cytotoxic effect. The ethanolic extract (2PNKE) showed greater potency (IC_{50} = 107.8 µg/mL) compared to the aqueous extract (1PNKA) (IC_{50} = 279.5 µg/mL). Phytochemical analysis revealed the presence of flavonoids, triterpenes, steroids, and tannins in both extracts, with exclusive detection of cardiotonic derivatives in the aqueous extract and free anthraquinones in the ethanolic extract. These differences highlight the solvent's influence on metabolite composition and biological activity. In conclusion, *K. daigremontiana* extracts demonstrated significant cytotoxicity against HepG2 cells, with the ethanolic extract being more effective. The variation in phytochemical profiles underscores the importance of solvent selection in optimizing the ex-

traction of bioactive compounds. These findings support the potential of *K. daigremontiana* as a source of antitumor agents and warrant further investigation into its active constituents and safety profile.

Keywords: Cytotoxicity; Hepatocellular carcinoma; *Kalanchoe daigremontiana*; Natural products; Phytochemicals.

New insights into the degradation mechanism of dimercaprol based on liquid chromatography–tandem mass spectrometry (LC-MS/MS)

Vaneza P. Lorett Velásqueza[1*], Miguel F. Molano Cabrejo[2], Alejandro Moncayo Lasso[3], Carlos A. Bejarano Casas[4], Cristian Buendía Atencio[2], Miguel A. Delgado Gómez[5]

1. Grupo de investigación sobre agentes radiológicos, biológicos y químicos, Facultad de Medicina y Ciencias de la Salud, Universidad Militar Nueva Granada, Bogotá D.C., Colombia
2. Grupo de investigación modelado y computación científica MCC, Departamento de Química, Facultad de Ciencias, Universidad Antonio Nariño, Bogotá D.C., Colombia
3. Grupo de investigación en ciencias biológicas y químicas, Facultad de Ciencias, Universidad Antonio Nariño, Bogotá D.C., Colombia
4. Grupo de investigación en Fitometálica para el estudio de metabolitos secundarios y sus derivados, Facultad de Ciencias, Universidad Antonio Nariño, Bogotá D.C., Colombia
5. Facultad de Ciencias y Educación, Universidad Distrital Francisco José de Caldas, Bogotá D.C., Colombia

* vaneza.lorett@unimilitar.edu.co

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Abstract: Heavy metal poisoning remains a critical public health issue worldwide, causing neurological, renal, and systemic damage. Dimercaprol (British Anti-Lewisite, BAL), developed during World War II as an antidote against arsenic and other toxic metals, continues to be clinically relevant due to its strong chelating properties. Despite its long history of use, detailed biochemical data on its metabolic degradation and fragmentation pathways remain scarce. This study aims to elucidate the gas-phase degradation mechanisms of BAL using experimental tandem mass spectrometry (MS/MS). MS/MS analyses were performed on a Shimadzu LCMS-8050 triple quadrupole equipped with electrospray ionization (ESI). Dimercaprol was directly infused at 0.1 mg/L, and precursor ions were fragmented via collision-induced dissociation with argon. Collision energies ranged from 10 V to 50 V, and product ion spectra were acquired between 2 m/z–120 m/z. Spectral data were compared against predicted fragmentation patterns available in the DrugBank database. Distinct collision energy-dependent fragmentation patterns were identified. At -10 V and -20 V, the ion m/z 107 ([C3H7S2]+) was predominant, while at -40 V, fragments m/z 75 ([C3H7S]+) and m/z 61 ([C2H5S]+) were observed. These results diverged significantly ($\geq$15% intensity differences) from DrugBank simulations, highlighting the limitations of predictive models for organosulfur compounds. Thermochemical analysis indicated preferential stabilization of positive charge on sulfur centers, with reaction enthalpies between 221 kcal/mol–279 kcal/mol. A seven-step fragmentation pathway was proposed, leading to cyclic intermediates that explain BAL's metabolic behavior. This study experimentally identified key fragmentation markers of dimercaprol (m/z 107, 75, 61), providing robust fingerprints for its degradation. The discrepancies within *in silico* spectra emphasize the necessity of experimental validation, particularly for sulfur-containing pharmacological agents. These insights not only clarify BAL's degradation pathways but also support the rational design of novel therapeutic derivatives for heavy metal detoxification.

Keywords: Chelation therapy; Dimercaprol; Fragmentation pathways; LC–MS/MS; Organosulfur compounds.

Physicochemical characterization of ethanolic extract derived from the endosperm of *Mammea americana L.* seeds through qualitative-quantitative tests for its possible use in topical formulations

Camilo Pérez Acuña[1*], Angie Pertuz Guerrero[1*], Reinaldo Sotomayor Pino[1], Yina Pájaro[1], Gina Domínguez[1], Fredyc Díaz Castillo[2]

1. Grupo de investigación en Control y Tecnología Farmacéutica GITECFAR, Facultad de Química y Farmacia, Universidad del Atlántico. Colombia
2. Universidad de Cartagena. Colombia

* pcamilo098@gmail.com
apaolapertuz@mail.uniatlantico.edu.co

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Abstract: *Mammea americana L.*, a tropical tree belonging to the Calophyllaceae family, is known in South America as "Mamey" or "Mamey Cartagena". It is widely used in traditional medicine for treating skin diseases, fever, inflammation, and as an insect repellent. Despite the increasing interest in ethnopharmacology for treating various pathologies, further research is needed to explore the benefits of isolated components of Mamey as potential alternative substances for promoting human well-being. This study examined the physicochemical properties of the ethanolic extract derived from the endosperm of *M. americana L.* seeds using analytical and identification techniques. To obtain the extracts, dried plant material was ground into two particle sizes, macerated with 96 % USP-grade ethanol, filtered, and concentrated at 40°– 45°C. The physicochemical properties, chromatographic profiles, and stability of the extracts were subsequently analyzed. The results yielded two soft extracts with similar textures and scents, showing only slight variations in taste and color. Flavonoids, tannins, and coumarins (the main metabolite group) were identified, with coumarins showing luminescence at 330 nm. These metabolites influenced the partition coefficient and stability under specific conditions. The extracts displayed intermediate polarity and maintained stability under acidic pH. In conclusion, these results enhance understanding of the properties of *M. americana* ethanolic extract, supporting its potential use in topical products.

Keywords: Coumarins; Ethanolic extract; Mammea americana; Physicochemical characterization; Topical formulations.

Optimization of the preformulation of a topical product based on a plant extract using the Quality by Design (QbD) approach

Kevin Lasprilla[1*], Valentina Padilla[1*], Ana Reyes[1], Reinaldo G. Sotomayor[1]

1. Grupo de Investigación Control y Tecnología Farmacéutica GITECFAR, Facultad de Química y Farmacia, Universidad del Atlántico, Barranquilla, Colombia.

* kenriquelasprilla@mail.uniatlantico.edu.co,
vpadillao@mail.uniatlantico.edu.co

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Abstract: Natural products have exceptional drug potential. Isolation from plants is extremely challenging. Bioactive molecules like terpenoids, steroidal glycosides, alkaloids, and phenolic compounds have exhibited lead structure prospects in drug discovery. Though valuable, challenges in isolation, identification, and characterization have restricted utilization. Nonetheless, structural diversity is still the driving force for pharma innovation. In this study, a Quality by Design (QbD) strategy for preformulation of a topical formulation from a plant extract was adopted. The process comprised two phases. First, a target product profile and critical material attributes were set in place. Subsequently, experimental evaluations were made. Compatibility studies involved evaluating extract–excipient mixtures (1:5 ratio) at 30 $\pm$ 2°C and 80 $\pm$ 5% relative humidity for 30 days. Appearance and color variations were monitored by HEX codes. Characterizing the lipophilicity of the extract, lipid model formulations were designed. Critical factors were established, and

a robust design space was set in place employing experimental design. Accelerated stability tests (40 $\pm$ 2℃; 75 $\pm$ 5% RH, ICH IVb) were applied for a month. Antimicrobial efficacy was established by Mueller-Hinton agar diffusion tests, whose zones of inhibition were measured after incubation for 24 hours. The QbD approach allowed us to determine critical quality attributes, make rational excipient selections, and design optimum experiments. Compatibility studies indicated adverse interactions with viscous excipients (glycerin, cremophor, tocopherol) and color variations in the presence of citric acid, ascorbic acid, and Span 80. In conclusion, the preformulation study here illustrates that QbD allows for optimum excipient selection and design space identification for topical herbal products. Results validate stability, compatibility, and preservation of antimicrobial activity, in support of future formulation development.

Keywords: Antimicrobial activity; Natural products; Plant extract; Preformulation; Quality by Design.

Development and advanced characterization of a self-emulsifying drug delivery system (SEDDS) of Ibuprofen, through the implementation of a 3 Factorial Design for the 3 improvement of dissolution rate

María J. Jiménez [1*], Keyner De La Cruz [1*], Reinaldo G. Sotomayor [1], Sirce Salas[1], Ana Reyes[1]

1. Grupo de Investigación Control y Tecnología Farmacéutica GITECFAR, Facultad de Química y Farmacia, Universidad del Atlántico, Barranquilla, Colombia.

* mjjimenezcarrillo@mail.uniatlantico.edu.co, kdelacruzc@mail.uniatlantico.edu.co

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Abstract: It is currently estimated that more than 75 % of newly developed drugs exhibit limited aqueous solubility and, consequently, reduced bioavailability. This limitation particularly affects drugs classified as BCS classes II and IV. To address this issue, several formulation strategies have been proposed, among which self-emulsifying drug delivery systems (SEDDS) have gained attention. SEDDS are isotropic mixtures of oil, surfactant, and cosurfactant or cosolvent that spontaneously form emulsions upon contact with the gastrointestinal environment. The objective of this study was to preformulate and characterize the emulsifying properties of an ibuprofen (IBU) SEDDS, developed through a 3^3 factorial design, in order to enhance its dissolution rate. Thermodynamic solubility of IBU in four oils (soybean, lemon, peppermint, anise) was determined using the shake-flask method and UV-Vis analysis. Drug–oil compatibility was assessed using DSC on 1:1 (w/w) mixtures. Based on critical attributes, the surfactant and cosurfactant were selected. Twenty-seven formulations with varying component ratios were prepared. A 3^3 factorial design was applied, with visual appearance as the response variable, enabling the construction of a ternary diagram and ANOVA analysis. The most promising formulations, both drug-loaded (22.22 % w/w IBU) and unloaded, were characterized in four media (water, HCl buffer, phosphate buffer, citrate buffer) by evaluating self-emulsification time, transmittance, and 24-hour physical stability. Results indicated that the solubility of IBU in peppermint oil was 36.49 mg/mL. DSC analysis suggested a potential transition of IBU to an amorphous state. ANOVA revealed significant effects of peppermint oil and Tween 80. Eight formulations displayed optimal appearance. The unloaded system showed $>$ 90 % transmittance, self-emulsification times $<$ 120 s, and was stable after 24 h. Upon IBU loading, phosphate buffer maintained high transmittance (96.97 %), while a reduction occurred in other pH media; however, self-emulsification times remained under 120 s. The most efficient formulation (1:1:1 peppermint oil, Tween 80, Cremophor RH40) achieved a 43.4 s emulsification time and 97.91 % transmittance. In conclusion, the developed ibuprofen SEDDS demonstrated favorable physicochemical characteristics, supporting its potential as a promising strategy to improve the drug's dissolution rate.

Keywords: Dissolution rate; Factorial design; Ibuprofen; Self-emulsifying drug delivery system; Solubility.

Synthesis and characterization of mesoporous silica nanoparticles loaded with ibuprofen via the Sol-Gel method

Ronald A. Jiménez Cruz[1*], Laura C. Franky Galindo[1], Valentina Solorzano[1], Valentina Triana[1], Diana Millan[2]

1. Universidad El Bosque, Programa de Química Farmacéutica, Bogotá D.C. Colombia. 2. Universidad El Bosque, Facultad de Medicina, Bogotá D.C. Colombia.

* rajimenez@unbosque.edu.co

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Abstract: Mesoporous silica nanoparticles (SiO_2-NPs) are promising systems for controlled drug delivery due to their biocompatibility, low toxicity, and functionalization potential. Identifying optimal synthesis parameters is essential to obtain nanoparticles with nanometric dimensions and physicochemical properties suitable for biomedical applications. In this study, the sol-gel method was employed using tetraethyl orthosilicate (TEOS) as a precursor and two surfactants for comparison: cetyltrimethylammonium bromide (CTAB) and Tween 80. Twelve experimental conditions were tested, varying pH (acidic and basic), homogenization type (magnetic stirring and ultrasonic cavitation), and reactant concentrations. The resulting samples were characterized by FT-IR, SEM, AFM, DLS, zeta potential, and cytotoxicity assays in L929 fibroblasts. The best synthesis conditions corresponded to high concentrations of TEOS and CTAB in a basic medium under ultrasonic cavitation. The nanoparticles obtained ranged from 50nm – 100nm in size, with spherical morphology and evidence of internal porosity. FT-IR confirmed Si–O–Si bond formation and surfactant removal after purification. SEM and AFM revealed homogeneous structures, while DLS corroborated particle size distribution within the expected range. Cytotoxicity assays demonstrated cell viability above 70 % for all samples, classifying them as non-cytotoxic according to ISO 10993-5. The combination of TEOS with CTAB under basic conditions and ultrasonic cavitation enabled the synthesis of stable, biocompatible, and non-cytotoxic mesoporous silica nanoparticles with potential for future drug delivery applications. The influence of surfactant type on internal morphology highlights the importance of optimizing critical synthesis parameters. Further studies on surface functionalization and pore size distribution are recommended to advance toward clinical applications.

Keywords: Biocompatibility; drug delivery; mesoporous silica nanoparticles; sol-gel method; surfactants.

Proposal for a sunscreen using botanical extracts from avocado (*Persea americana*) by products as a source of photoprotective compounds

Jorge Enrique Hernández Carvajal[1*], Ana María Acosta Palacio[1], Daniela Franco Betancur[1], Yhors A Ciro[1],

1. Programa de Química Farmacéutica, Facultad de Ciencias Básicas, Universidad Santiago de Cali. Cali, Colombia.

* jorge.hernandez08@usc.edu.co

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Abstract: Commercially available sunscreens contain filters that can affect not only human health, mainly by causing endocrine imbalances, but also the environment. It is therefore necessary to search for new natural ingredients from raw materials for the manufacture of sunscreens that can prevent diseases and other skin and health problems. This study evaluated the photoprotective activity of ethanolic extracts, as well as organic and aqueous fractions of the peel and seed of green and ripe avocados. Ethanolic extracts of *Hass* avocado peel and seed were prepared using the ultrasound method and then fractionated. The

flavonoid concentration of the samples was determined using the aluminum chloride method, and the absorbance at 510 nm was measured in triplicate. The organic fractions of ripe peel and seed, which showed the highest flavonoids concentration, were subjected to spectral scanning in the range of 290 nm - 320 nm at 5 nm intervals to calculate the Sun Protection Factor (SPF). Phytochemical analysis confirmed the presence of phenolic compounds, tannins, and flavonoids. The aqueous fraction of ripe peel and the organic fraction of ripe seed showed similar flavonoid concentration (242.67 mg rutin/g), while significant differences were observed among the other groups according to the ANOVA analysis ($p < 0.05$) and Tukey's test. The results of the SPF assessment established that the extracts of ripe avocado peel and seed showed the highest SPF 25 and 20, respectively. The seed:peel mixture (1:5) presented an SPF value 4.2, placing the formulation in the high range. The peel and seed of *Persea americana* represent a potential source of molecules with photoprotective activity. The ripe avocado peel extract demonstrated an SPF categorized as medium protection, which, in combination with other natural extracts, may enhance overall photoprotection.

Keywords: Photoprotective acivity, phenolic compounds, Persea americana, sun protection factor, SPF.

Advances in Innovation, Digital Transformation, and Robotics (TA-2)

Evaluation of the Preventive Effect of Tahiti Lime (*Citrus latifolia*) Extracts in a DSS-Induced Colitis Model

Laura V. Zambrano[1*], Gérman E. Matiz[1], Renato Pantoja[2], Luis A. Franco[3]

1. Departamento de Farmacia, Facultad de Ciencias, Universidad Nacional de Colombia. Bogotá, Colombia.
2. Facultad de Ingeniería Agroindustrial, Universidad de Nariño. Nariño, Colombia.
3. Departamento de Farmacia, Facultad de Ciencias Químicas y farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.

* lzambranon@unal.edu.co

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Abstract: Inflammatory bowel disease (IBD) is a chronic and increasingly prevalent condition, associated with inflammation and oxidative stress. Citrus flavonoids possess anti-inflammatory and antioxidant properties, with therapeutic potential in colitis. The preventive effect of the peel of the Tahitian lime (*Citrus latifolia*), a by-product rich in bioactive compounds and largely underutilised, was evaluated in a dextran sulfate sodium (DSS)-induced colitis model. An extract from Tahiti lime peel was obtained through lyophilization, grinding, and extraction with 60% ethanol. It was characterized by its phenolic and flavonoid content, as well as its *in vitro* antioxidant activity (DPPH and ABTS assays). Subsequently, its preventive effect was evaluated in a DSS-induced colitis model in CD-1 mice. The experimental design included three groups (healthy control, DSS, and DSS + extract), with oral administration for five days before induction and a 20-day follow-up. Colon length and weight were analyzed, along with histopathological studies. The Tahiti lime peel extract showed a high phenolic content (291.71 mg GAE/g) and flavonoid content (187.81 mg QE/g), along with significant *in vitro* antioxidant activity (DPPH: 232.09 μmol Trolox/g; ABTS: 442.9 μmol Trolox/g), comparable to well-known sources such as blueberries. This effect is attributed to the flavonoids' ability to neutralize free radicals due to their phenolic structure. In the murine model of colitis induced with 5% DSS, the extract administered preventively reduced weight loss, disease activity index, and macroscopic damage, as well as improving the histological architecture of the colon by preserving the mucosa and promoting crypt regeneration. These results suggest a protective effect against colitis, mediated by the reduction of oxidative stress. In summary, this study revealed that Tahiti lime peel extract possesses remarkable *in vitro* antioxidant activity, as well as high phenolic and flavonoid content. These properties significantly contributed to its ability to mitigate DSS-induced colitis in CD-1 mice. The results showed that the extract markedly reduced damage to the colonic mucosa, as evidenced by a reduction in disease signs such as weight loss, diarrhea, and histological alterations in tissue architecture.

Keywords: Antioxidant activity; Citrus latifolia; colitis model; DSS-induced colitis; Tahiti lime.

In silico analysis of the interactions of polyphenols from *Bactris guineensis* against proteins of methicillin-resistant *Staphylococcus* aureus (MRSA)

Javier Lombana[1,*],Juan Urrego[1],Velky Ahumada[1], Carlos Bernal[1], Claudia Baena[1]

1. Grupo de Investigación en Tecnología Farmacéutica, Cosmética y de Alimentos, Facul-

tad de Ciencias Farmacéuticas, Universidad de Cartagena, Cartagena, Colombia.

* jlombanae@unicartagena.edu.co

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Abstract: Antimicrobial resistance (AMR) poses a significant global health challenge, with methicillin-resistant *Staphylococcus aureus* (MRSA) being a major threat. The urgent need for novel therapeutic agents has driven research into natural bioactive compounds. *Bactris guineensis*, a native Colombian plant, is rich in polyphenols, which have demonstrated antimicrobial properties in prior studies. This research explores the potential of *B. guineensis* polyphenols as inhibitors of MRSA through molecular docking studies. Three-dimensional structures of 13 polyphenols from *B. guineensis* were retrieved from PubChem. Geometric optimization was performed using Gaussian 09 with Density Functional Theory (DFT) at the B3LYP/6-31G level. The optimized conformations served as ligands for molecular docking, which was conducted with AutoDock Vina, evaluating binding energy as the primary affinity metric. Seven *S. aureus* protein targets (PDB codes: 5M18, 6O9W, 4URO, 7JM2, 5TZJ, 3FRF, 6H5O) were obtained from the Protein Data Bank, prepared using SYBYL-X, and assigned Kollman charges with polar hydrogens in AutoDockTools. Validation was performed using crystallized endogenous ligands. The overall energy profile across all targets demonstrated favorable binding affinities, with values ranging from -5.9 to -10.3 kcal/mol. Isoorientin, a C-glucosylated flavone with known *in vitro* antimicrobial activity, exhibited the highest binding affinity (-10.3 kcal/mol) against the TarS enzyme (PDB: 5TZJ), which catalyzes β-O-GlcNAcylation of teichoic acids in the MRSA cell wall. Isoorientin formed key interactions, including two hydrogen bonds with aspartate 178 and additional contacts with residues R206, E177, H210, Q179, and S175. Schaftoside showed strong affinity (-9.7 kcal/mol) for dihydrofolate reductase, interacting with critical residues (L28, V31, I50, L54) in the enzyme's hydrophobic channel, mirroring known inhibitors. Polyphenols from *B. guineensis*, particularly isoorientin and schaftoside, demonstrate significant potential as anti-MRSA agents by targeting key bacterial enzymes. These findings highlight the value of characterizing bioactive metabolites from native Colombian plants for developing novel antimicrobial therapies.

Keywords: *Bactris guineensis*; In silico analysis; Methicillin-resistant *Staphylococcus aureus*; Molecular docking; Polyphenols

Structure–activity relationship of compounds present in the leaves of *Alstonia scholaris* (Ditta) with larvicidal activity

Ana M. Rodelo Cabarcas[1,*], Oscar I. Camacho Romero[1], Fernando S. Castro Gómez[2]

1. Grupo de Investigación Fitoquímica (GIF-UdelA), Programa de Farmacia, Facultad de Química y Farmacia, Universidad del Atlántico. Barranquilla, Colombia.
2. Grupo de investigación Max Planck, Programa de Farmacia, Facultad de Química y Farmacia, Universidad del Atlántico. Barranquilla, Colombia.

* amrodelo@mail.uniatlantico.edu.co

Abstract: Vector-borne diseases cause 700,000 deaths annually. *Aedes aegypti* (Stegomyia) is a transmitter of infections such as dengue, which results in 96 million symptomatic cases and 40 000 deaths per year. According to the INS, in March 2025 a total of 47 559 dengue cases were reported. This issue carries both health and economic implications due to this vector; therefore, plant extracts offer potential as pesticides and repellents. Accordingly, this study aimed to evaluate the structure–activity relationship of compounds present in *Alstonia scholaris* (Ditta) leaves with larvicidal activity. Ditta leaves were processed following the guidelines of Quality Control Methods for Medicinal Plant Materials. Chemical groups were identified through qualitative and quantitative tests using UHPLC-ESI$^+$-Orbitrap-HRMS. Subsequently, computational predictions and bioassays were performed on *Ae.*

aegypti larvae and *Artemia salina* nauplii exposed to different concentrations and controls, where mortality and LC_{50} were evaluated. A molecular docking analysis was carried out between the identified phenolic compounds and biological targets related to the vector's life cycle; binding energies and interactions were recorded in each simulation. The leaves of *A. scholaris* met the established criteria for the species. The extract revealed the presence of alkaloids, tannins, saponins, flavonoids, phenols, leucoanthocyanidins, sterols, and terpenes, consistent with the literature reports. The polyphenolic compounds identified were ursolic acid (71.3 mg/kg) and rosmarinic acid (5.7 mg/kg), both possessing pharmacokinetic properties that would allow them to exert biological effects. They are non-toxic to humans, although rosmarinic acid is more toxic in other species. Molecular docking showed binding energies from –5.50 kcal/mol to –6.08 kcal/mol for rosmarinic acid and from –8.01 kcal/mol to –11.64 kcal/mol for ursolic acid, indicating favorable ligand–target interactions. *In vivo* assays yielded LD_{50} values of 733.612 mg/L for *Aedes aegypti* and 403.82 μg/L for *Artemia salina*, consistent with predictive models. *Alstonia scholaris* demonstrated activity against *Ae. aegypti* (Stegomyia); however, its toxic potential should continue to be explored through the combination of *in silico* and *in vivo* approaches. Furthermore, this study highlights the importance of pharmacognostic research to ensure quality, identity, and purity of plant species.

Keywords: *Aedes aegypti*; *Alstonia scholaris*; larvicidal activity; molecular docking; phytochemical analysis.

Review of the benefits of computer tools for pharmacotherapeutic monitoring of antibiotics and anticoagulants in hospital settings

John Echeverry [1*], Nicolas Severino[2], Palmira Muñoz[3], Manuel Torres, Estefanía Torres

1. Universidad Santiago de Cali. Colombia.
2. Universidad Católica de Chile. Chile.
3. Christus México. México.

* jhon.echeverry00@usc.edu.co

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Abstract: Currently, clinical software is revolutionizing healthcare practice by providing healthcare professionals with advanced IT tools that employ sophisticated algorithms and electronic medical records, thereby facilitating pharmacotherapeutic monitoring, particularly in the management of critical medications such as antibiotics and anticoagulants in hospitalized patients. The importance of this study arises from two serious problems: antimicrobial resistance (AMR) and anticoagulant-related adverse events. According to data from the World Health Organization (WHO), AMR is responsible for more than 700 000 deaths annually, consolidating its position as a critical public health challenge. Furthermore, anticoagulants generate approximately 25 % of adverse drug events, many of which are preventable. This research aims to review literature on the benefits of various IT tools for the management of antibiotics and anticoagulants in hospital pharmacotherapeutic monitoring. A systematic review was conducted following the methodological guideline established by the Joanna Briggs Institute (JBI) for this type of study. This methodological guideline ensured the consistency and transparency of the review process. Antimicrobial stewardship programs are key tools in healthcare systems to reduce harm from inappropriate antimicrobial use. Antibiotic management through information technology tools such as the Telemedicine Competency Network, hospital information systems, electronic prescribing, and clinical decision support systems (CDSS) optimizes prescribing by generating real-time alerts, monitoring resistance patterns, and adjusting doses based on pharmacokinetics, reducing prescribing errors by 30 %. Clinical software algorithms also enhance documentation and safe use of anticoagulants. Optimizing anticoagulant use through multidisciplinary models, CDSS, hospital systems, and e-prescribing has been crucial, as these drugs account for 16 % of hospital medical errors. Overall, clinical software improves outcomes, reducing antibiotic use by 20 %, inappropriate anticoagu-

lant use, and readmissions by 16 % within 6 months. Still, challenges remain, including data privacy, system integration, and physician acceptance, requiring multifaceted strategies for effective adoption.

Keywords: Clinical software; Pharmacotherapeutic monitoring; Antibiotics; Anticoagulants; Computer tools.

Optimization and Safety in Pharmaceutical Practice (TA-3)

Adherence and identification of access barriers in patients with autoimmune diseases treated with an adalimumab biosimilar in Colombia

Dayan A. Sánchez Aguilera[1*], Diego A. Galvis Sánchez[2], Hernan D. Torres[2]

1. Soulmedical, Bogotá, Colombia.
2. Fresenius Kabi Colombia S.A.S.

*as080200@gmail.com

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Abstract: Currently, one of the treatment options for rheumatic diseases is bFAME biological drugs, which have been fundamental to the management of these pathologies. Patient follow-up programs are presented as a strategy to ensure treatment efficacy by allowing close monitoring of clinical response and promoting treatment adherence, which are essential aspects for therapeutic success in autoimmune diseases. This is a descriptive cross-sectional observational study based on monthly administrative reports of barriers to access, adherence, and safety of a biosimilar product of Adalimumab in 95 naive and switch patients enrolled in the patient program in 2024. Adherence is identified for each model with a value of 70% for the PYP program and 40% for the patient support program (PSP). Adherence is negatively affected in patients in the subsidized regime, unlike those in the contributory regime, who express greater adherence. However, patients who remained in the PSP showed a high rate of adherence to treatment. Among the interactions with patients, an 85% improvement in health status was observed, with a significantly greater improvement in functional and clinical outcomes in PSP users than in those who are not enrolled. Evidence shows that structured support improves adherence among patients treated with an Adalimumab biosimilar and strengthens the perception of improved quality of life in more than 80% of patients. Thus, the follow-up program is positioned as a key tool to facilitate the transition to the use of biosimilars, optimize healthcare system resources, and ensure sustainable clinical outcomes.

Keywords: Adalimumab; Autoimmune diseases; Biosimilars; Patient adherence; Patient support programs.

From Ethnobotanical Knowledge to Ethnopharmacological Safety: Anti-inflammatory Potential of Leaf Extracts of *Persea americana*, *Malachra alceifolia*, and *Heliotropium indicum*

Sandra Coronado Rios S [1,2*], Sánchez J[1], Gómez-Estrada H[1,2], Jiménez T [2], Palacio Y [3]

1. Grupo de Investigación en Química Orgánica Medicinal, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.
2. ENAIKA S.A.S.
3. Grupo de Investigación en Sustancias Promisorias, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena, Colombia.

* scoronador@unicartagena.edu.co

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Abstract: Inflammatory skin diseases represent a global health concern, affecting nearly 25% of the population. Atopic dermatitis (AD) is the most prevalent form, resulting from the interplay of genetic predisposition, epigenetic factors, and environmental influences. Conventional treatments include topical corticos-

teroids and antibiotics; however, their high cost and limited accessibility in rural populations foster reliance on medicinal plants. Nevertheless, the lack of scientific validation regarding the safety and efficacy of herbal extracts hinders their formal therapeutic use. This study aimed to identify plant species traditionally used in the Colombian Caribbean for inflammatory skin diseases and to evaluate the safety and anti-inflammatory activity of their extracts. An ethnobotanical survey was conducted in eight semi-rural localities of the Bolívar Department, Colombia, using TRAMIL-type questionnaires. Skin conditions were categorized into four groups: inflammatory, infectious, traumatic, and insect bites. The species with the highest fidelity index were collected, and aqueous and ethanolic leaf extracts were prepared. Extracts were phytochemically characterized and evaluated *in vitro* using human keratinocytes (HaCaT, HeK) and murine macrophages (RAW264.7). Cell viability, cytokine production (IL-1β, IL-6), alarmins (IL-25, IL-33, TSLP), nitric oxide (NO) release, and anti-inflammatory effects under TNFα/IFNγ stimulation were assessed. The survey yielded 156 records and 385 reports of traditional use. Leaves (72.73%) were the most frequently employed plant part, and poultices were the most common form of preparation. The species with the greatest therapeutic potential were *Heliotropium indicum*, *Malachra alceifolia*, and *Persea americana*. Extracts contained flavonoids, coumarins, tannins, terpenoids, and alkaloids. Aqueous extracts exhibited lower cytotoxicity compared to ethanolic ones. Notably, aqueous extracts of *H. indicum* induced a strong pro-inflammatory response (IL-6, IL-1β, and NO), while *M. alceifolia* and *P. americana* did not stimulate inflammatory cytokines and displayed marked anti-inflammatory activity in the TNFα/IFNγ model. Traditional knowledge in the Colombian Caribbean reveals consistency in the use of plants for inflammatory skin diseases. Among them, aqueous extracts of *M. alceifolia* and *P. americana* exhibit a safe profile and anti-inflammatory properties, making them promising candidates for topical formulations. Conversely, *H. indicum* showed high cytotoxicity and pro-inflammatory effects, limiting its dermatological applications.

Keywords: Anti-inflammatory activity; Ethnobotany; Ethnopharmacology; Medicinal plants; *Persea americana*.

Community Pharmacy Model based on pharmacotherapeutic diagnosis for comprehensive pharmaceutical care of the patient Cartagena, Colombia.

Guiomara Gómez Jaramillo[1*], Yaneth García Milano[1], Antistio Alviz Amador[1], Mariana Mercado Imitola[1]

1. Programa de Química Farmacéutica, Facultad de Química Farmacéutica, Universidad de Cartagena. Cartagena, Colombia.

*ggomezj@unicartagena.edu.co

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Abstract: Self-medication without medical or pharmaceutical supervision carries significant risks, such as inappropriate use of medications, incorrect dosages, premature prolongation or discontinuation of treatment, drug interaction, and public health issues such as antimicrobial resistance. In Colombia, the use of over-the-counter medicines increased by 80% during the pandemic, highlighting the need to strengthen community pharmaceutical care. The study's objective was to develop a preliminary Community Pharmacy Model in the Zaragocilla community of Cartagena, Colombia. An analytical, prospective, and cross-sectional observational study was conducted using non-probabilistic convenience sampling. The activities were carried out in three phases: (1) Diagnosis — literature review, community awareness, and collection of sociodemographic and epidemiological data with a validated survey; (2) Intervention — identification of pharmaceutical care needs and actions directed by the pharmaceutical chemist; (3) Community Pharmacy Model — implementation of comprehensive, systematic, and structured care. The results showed a high prevalence of chronic diseases such as

hypertension and diabetes in 45% of the respondents, 72% of whom were housewives, and 76% belonged to socioeconomic stratum 2. Alarmingly, 63% of participants had never received proper guidance on medication use, and 66% reported disposing of medications improperly in household trash. Additionally, unhealthy lifestyle habits were identified, with 38% not engaging in physical activity and 53% reporting insomnia. The proposal of a Community Pharmacy Model is a direct response to the real needs of the population, with a high prevalence of poorly controlled chronic diseases, low health literacy regarding medication use, and inadequate disposal practices. Implementation of this model, led by the pharmaceutical chemist, would significantly improve community health by integrating medication dispensing, patient education, and therapeutic follow-up.

Keywords: Chronic diseases; Community pharmacy; Pharmaceutical care; Pharmacotherapeutic diagnosis; Self-medication.

Institutional cost savings through dose banding strategy of Pembrolizumab in oncology patients: a real-world data analysis

Ivan E. Henao Torres[1*], Antistio A. Alviz Amador[2]

1. Asisfarma S.A.S., Bogotá, Colombia.
2. Programa de Química Farmacéutica, Facultad de Química Farmacéutica, Universidad de Cartagena. Cartagena, Colombia.

*Ihenao@asisfarma.com.co

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Abstract: The high cost of oncology treatments challenges the sustainability of health systems, particularly in low- and middle-income countries. Pembrolizumab, a monoclonal antibody targeting PD-1, improves the antitumor immune response but represents a significant financial burden. Dose banding, which standardizes weight-based doses into predefined ranges, has been proposed to reduce costs and minimize vial waste. This study aimed to estimate potential institutional savings from implementing a pembrolizumab dose banding strategy using real-world data from oncology patients. We conducted an observational, retrospective, and analytical study at Asisfarma IPS (January to March 2025). Adult oncology patients receiving pembrolizumab 200 mg every 21 days were included. The unit of analysis was the individual dose. For patients without recorded body weight, values were estimated using an age- and sex-adjusted formula inspired by the Devine method, applying a 10% reduction to account for cancer-related weight loss. Theoretical doses were calculated (2 mg/kg every 3 weeks) and matched to standardized bands according to the UK NHS pembrolizumab dose banding table (80 to 200 mg). Costs were modeled assuming full vial efficiency (100 mg vials, $137,638 COP/mg), comparing fixed dosing (200 mg) with dose banding. Savings were expressed in absolute values and percentages. We analyzed 107 pembrolizumab doses administered to 54 patients (mean age: 61.1 years; 68.5% female; mean body weight: 68.5 $\pm$ 10.9 kg). Estimated weights accounted for 89.7% of cases. Under fixed dosing, total pembrolizumab cost was $2,945 million COP, whereas dose banding reduced this to $2,006 million COP, representing $938.7 million COP ($\approx$ USD 221,000) in savings, or 31.9% of costs. Median savings per dose were $10.32 million COP. Most doses (82.2%) were distributed within the 125 mg and 150 mg bands, highlighting the relevance of exploring smaller vial sizes (e.g., 50 mg) to optimize banding and further reduce residual waste. Pembrolizumab dose banding achieved a potential 31.9% institutional cost reduction in a real-world oncology setting. Wider availability of smaller vial presentations could enhance the efficiency of this strategy. Despite limitations from estimated weights, findings support dose banding as a clinically feasible and economically valuable approach for optimizing high-cost cancer therapies.

Keywords: Dose banding; Health economics; Oncology; Pembrolizumab; Real-world data.

Diagnostic Tests for Latent Tuberculosis from a Societal Perspective: Are They Cost-Beneficial for the Colombian Health System in Patients on Peritoneal Dialysis, Hemodialysis, and Kidney Transplant Recipients?

Nicolás Currea Carrillo[1*], Leonardo Melo Velandia[1], Paola Forero López[1], Raphael Oliveira[2]

1. Advance Scientific de Colombia S.A.S.
2. QIAGEN N.V.

*clinical@asg.com.co

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Abstract: The National TB Program indicates that the number of tests for latent tuberculosis infection (LTBI) in patients with chronic kidney disease on renal replacement therapy (CKD-RRT) is insufficient. The objective of this study was to establish the cost-benefit of diagnostic pathways for LTBI versus the natural history of the disease in CKD-RRT patients, from a societal perspective. A cost-benefit analysis was conducted from a societal perspective using a hybrid prediction model. A decision tree was used to evaluate the diagnostic performance of each pathway, and a Markov model was employed to predict the outcomes of LTBI identification at 5, 10, and 20 years. Study parameters were derived from literature on Tuberculin-PPD and QuantiFERON® TB-Gold-Plus in the CKD-RRT population, studies on LTBI to active tuberculosis progression, official financial and epidemiological sources, and data on the catastrophic costs of TB in Colombia. The annual discount rate was set at 3%, and deterministic and probabilistic sensitivity analyses were performed. The model identified a cost per patient of $92.59 USD for the PPD pathway and $197.30 USD for the QFT pathway; out-of-pocket expenses for the patients were $13.29 USD in both pathways. The cost of an active tuberculosis event was $4,810.47 USD, of which $1,633.45 USD was borne by the patient. The decision tree suggested better performance for QFT versus PPD (0.29 vs. 0.27). At 10 years, the diagnostic pathway that generated the best net monetary benefit (NMB) was QFT (NMB vs. Natural History: $154.41 USD; NMB vs. PPD: $88.22 USD), generating savings from year 6 onwards. PPD could be the pathway with the best NMB between 3 and 6 years; prior to any test would generate a net health cost. The factors with the greatest uncertainty were identified for QFT (LTBI prevalence, PPV, NPV), PPD (NPV, LTBI prevalence, PPV), and NMB (probability of progression from "CKD-RRT and LTBI-negative" to ATB). It can be concluded that the implementation of QuantiFERON® TB-Gold-Plus, followed by Tuberculin-PPD, are cost-beneficial scenarios for the CKD-RRT population from a societal perspective, compared to the natural course of the disease as the current prevention strategy in Colombia.

Keywords: Chronic kidney disease; Cost-benefit analysis; Latent tuberculosis; QuantiFERON-TB Gold Plus; Tuberculin skin test.

Design and validation of an instrument to determine the pharmacotherapeutic profile of pediatric and adult inpatients in pharmaceutical care consultation at IPS Colsubsidio, Bogotá D.C., 2025

Nicoll M. Gonzalez [1*], Luz D. Aponte[2]

1. Facultad de Ciencias, Pontificia Universidad Javeriana. Bogotá, Colombia.
2. Clínica Infantil Colsubsidio. Bogotá, Colombia.

* gonzalez.nicollm@gmail.com

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Abstract: In clinical pharmacy, the Pharmacotherapeutic Profile (PP) serves as a key tool for documenting patient information, treatment, and clinical progression. At IPS Colsubsidio, PP is used for pharmacotherapeutic follow-up; however, it presents limitations: a design focused on dispensing that does not adapt to

clinical documentation needs, the absence of a coded format hindering information analysis and organization, and institutional perception of the pharmacist as an administrative rather than a clinical professional. The objective was to design and conduct face and content validation of an instrument to determine the PP of hospitalized pediatric and adult patients at IPS Colsubsidio between February and May 2025. The development and validation studies were conducted in five phases: (1) construct definition; (2) literature review; (3) item identification, domain specification, and preliminary instrument design; (4) face and content validation through the Delphi technique, conducted in two rounds with expert reviewers using Face and Content Validity Ratio (FVR, CVR) and Face and Content Validity Index (FVI, CVI), both evaluated through a Likert scale; (5) final PP design. A total of 75 items were collected from 24 reviewed references and subsequently validated through face and content validity by six pharmacists. After implementing suggested adjustments, a final PP was designed, comprising 72 items distributed across six domains, with high FVI and CVI values of 0.96. The PP optimizes clinical and pharmacotherapeutic data collection and analysis, enabling personalized care and enhancing the pharmaceutical care program.

Keywords: Clinical pharmacy; Instrument validation; Pediatric patients; Pharmacotherapeutic profile; Pharmaceutical care.

Characterization of the drug desensitization process in patients at a level IV clinic in Barranquilla, Colombia

Dadier Antonio Arroyo Monterroza[1*], María Isabel Pulgar Emiliani[1], Carlos Ramon Renowitzky Zabarain[2]

1. División de Farmacia Clínica, Clínica Centro, Universidad Simón Bolívar, Barranquilla, Barranquilla, Colombia.
2. Servicio de Cardiología, Dirección Científica, Clínica Centro. Barranquilla, Colombia.

*dadierarroyom@gmail.com

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Abstract: Adverse drug reactions represent a major clinical and public health concern, with hypersensitivity reactions accounting for up to 20% of cases and associated with potentially life-threatening events such as anaphylaxis. When no therapeutic alternatives exist, drug desensitization becomes a critical strategy, inducing temporary tolerance through progressive dose escalation of the culprit agent. Common targets include acetylsalicylic acid, iodinated contrast media, antibiotics, diuretics, and antituberculosis drugs. This study aimed to characterize the drug desensitization process in patients from a level IV clinic in Barranquilla, Colombia, between 2021 and 2025. An observational, descriptive, and retrospective study was conducted, including all patients undergoing desensitization protocols. Demographic, clinical, pharmacological, and immunological variables were collected, alongside protocol details (drug, monitoring, outcome) and clinical courses (ICU stay, vital signs, adverse events). Descriptive statistics were applied using RStudio. Desensitization was performed in ICU or equivalent units under continuous monitoring by a multidisciplinary team. Protocols were adapted from validated international guidelines or developed de novo when no standardized approach was available. Thirty-one patients underwent desensitization, with a mean age of 58.5 years (range 30–85) and balanced gender distribution. Most had high cardiovascular risk, with hypertension (67.7%), acute coronary syndromes (45.2%), and type II diabetes mellitus (38.7%) as predominant comorbidities. The most frequent hypersensitivity involved nonsteroidal anti-inflammatory drugs and acetylsalicylic acid (58.1%), followed by iodinated contrast media (22.6%). Acetylsalicylic acid was the main target of desensitization (58.1%), particularly in the context of percutaneous coronary interventions, while contrast media accounted for 32.2%. Less common protocols involved furosemide, pyrazinamide, and even saline solution. Cardiac catheterization was the most frequent associated procedure (54.8%). Hemodynamic stability was preserved, with mean blood pressure 137/78 mmHg, heart rate 75 bpm, and oxygen satura-

tion 98.5%. Overall, desensitization was successful in 96.8% of cases; only one patient (3.2%) experienced a mild mucocutaneous reaction, without discontinuation. Protocol implementation increased progressively, reflecting institutional expertise. Drug desensitization in a high-complexity setting proved to be safe and effective, enabling access to essential drugs in patients with confirmed hypersensitivity. The integration of clinical pharmacists was pivotal to ensuring safety, individualized protocol adaptation, and improved outcomes. Prospective studies are needed to consolidate standardized protocols and expand institutional capacity in allergy and immunology.

Keywords: Drug hypersensitivity; Desensitization immunologic; Acetylsalicylic acid; Contrast media; immunology.

Effectiveness of oromucosal medical Cannabis versus placebo in reducing chronic musculoskeletal pain: a systematic review and meta-analysis

Germán Alberto Hurtado Guevara[1,2*], Lina Marcela Medina Rojas[2,3], Leyda Maritza Moreno Beltrán[2]

1. Universidad de Antioquia. Colombia
2. Fundación Universitaria del Área Andina. Colombia
3. Universidad Pedagógica y Tecnológica de Colombia (UPTC). Colombia

* german.hurtadog@gmail.com

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Abstract: Chronic musculoskeletal pain is highly prevalent in the adult population, causing disability and negatively impacting quality of life. Conventional analgesics, including opioids, present risks of dependence and adverse effects. In this context, medical cannabis is proposed as a therapeutic alternative. The objective of this study was to determine the effectiveness of medical cannabis administered via the oromucosal route, compared to placebo, in reducing chronic musculoskeletal pain in adults. A systematic review with meta-analysis was conducted following PRISMA 2020 guidelines and the Cochrane Handbook. The protocol was registered in PROSPERO (CRD42023430465). Randomized controlled clinical trials published between 2012 and 2023 in English, Spanish, and Portuguese were included. Data extraction and risk of bias assessment were carried out by independent and blinded reviewers. Statistical analysis was performed using RevMan 5.4 with random-effects models. Out of 2 398 identified records, five randomized clinical trials were included, with a total of 384 participants with fibromyalgia, multiple sclerosis, and sickle cell disease. The cannabis group showed a significant reduction in pain intensity, with a mean difference of 1.10 (95% CI: 0.65–1.55; $p < 0.00001$) compared to placebo. High heterogeneity was observed ($I^2 = 93\%$), attributed to clinical and methodological differences. The placebo group showed a smaller reduction of 0.43 points. Oromucosal medical cannabis demonstrates greater effectiveness than placebo for the management of chronic musculoskeletal pain in adults. Nevertheless, the heterogeneity of the studies and the limited sample sizes justify the need for additional, higher-quality, and longer-duration clinical trials to confirm its long-term efficacy and safety.

Keywords: Chronic musculoskeletal pain; Medical cannabis; Meta-analysis; Oromucosal administration; Placebo.

Penicillin-associated toxicodermia: case report and literature review

Dadier A. Arroyo[1*], Maria C. Quintero[2], Yerlan A. Bahos[2]

1. División de Farmacia Clínica, Clínica Centro, Universidad Simón Bolívar. Barranquilla, Colombia.
2. Programa de Farmacia y Química, Universidad Simón Bolívar. Barranquilla, Colombia.

* dadier.arroyo@unisimon.edu.co

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Abstract: Toxicoderma refers to undesired mu-

cocutaneous manifestations induced by drugs and ranges from mild exanthema to life-threatening conditions. Early identification and withdrawal of the causative agent are essential to reduce morbidity and mortality. We present a clinical case report of a young adult admitted after appendectomy who developed cutaneous reactions associated with beta-lactam therapy. A focused literature review on penicillin-related hypersensitivity and toxicoderma was performed to contextualize the case and management decisions. A 20-year-old female with no prior allergy history received IV ampicillin-sulbactam post-appendectomy. On inpatient day 2, she developed pruritic erythematous macules on the lower limbs; symptoms initially improved after transient antibiotic withdrawal and antihistamine administration. After discharge and oral sultamicillin, she was readmitted with generalized pruritic rash and urticaria. Laboratory tests showed leukocytosis with relative eosinophilia but no organ involvement. Naranjo score supported a probable drug-related reaction. Management included antihistamines and systemic corticosteroids with progressive clinical and laboratory improvement; beta-lactams were avoided thereafter. The presentation was consistent with general drug-induced toxicoderma likely related to ampicillin-sulbactam, probably mediated by delayed (type IV) hypersensitivity. This case highlights the importance of chronological drug review, prompt withdrawal of the suspected agent, and appropriate symptomatic therapy. Avoiding re-exposure to the implicated beta-lactam family is recommended.

Keywords: Adverse drug reaction; Beta-lactams; Case report; Penicillin; Toxicoderma.

Pertinence of antimicrobial prescriptions in the management of community-acquired pneumonia in Cartagena, Colombia, 2021.

Sergio Uribe Merlano [1,3*], Nelson Alvis Guzman [2], Antistio Alviz Amador[3], Roger Caraballo Marimón[3], Adriana Yepes Terril[4]

1. Doctorado en Ciencias Biomédicas, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.
2. Alzak Foundation, Universidad de Cartagena. Cartagena Colombia.
3. Grupo de Farmacología y Terapéutica, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.
4. Clínica Neurocardiovascular. Cartagena, Colombia.

* suribem@unicartagena.edu.co

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Abstract: Community-acquired pneumonia (CAP) remains one of the most prevalent infectious diseases worldwide, with substantial morbidity and mortality, especially in children under five years old and older adults. In Colombia, CAP accounts for approximately 60 % of deaths from respiratory diseases. The appropriateness of empirical and definitive antimicrobial therapy has a direct impact on clinical outcomes, antimicrobial resistance, and healthcare costs. The objective of this study was to assess the pertinence of antimicrobial prescriptions in hospitalized patients diagnosed with CAP at a tertiary care institution in Cartagena, Colombia, in 2021. Methodology A descriptive, retrospective study was conducted using medical records of adult patients ($\geq$ 18 years) hospitalized for CAP for at least 24 hours. Patients with multiple infections, lymphoproliferative disorders, cirrhosis, or receiving steroids or chemotherapy were excluded. Data on demographics, CURB-65 score, microbiological findings, antimicrobial regimens (empirical and/or definitive), and clinical response were collected. Prescription adequacy was evaluated according to the 2019 ATS/IDSA clinical practice guidelines for CAP. Descriptive statistical analyses were applied. A total of 72 % of patients were $\geq$ 65 years of age. *Streptococcus pneumoniae* was the most frequently isolated pathogen (47 %). Resistance to penicillin in *S. pneumoniae* (3.0 %), ampicillin resistance in *H. influenzae* (2.1 %), and methicillin resistance in *S. aureus* (1.3 %) were observed. The CURB-65 score was not applied in all cases, limiting the precision of therapeutic decision-making. Empirical therapy was initiated in all patients; in

74.5 % of cases, the regimen was maintained as definitive therapy, while in 25.5 % it was modified after pathogen identification. In patients without microbiological diagnosis, empirical therapy was often adjusted up to three times without targeted therapy. The most commonly used regimen was ampicillin/sulbactam combined with clarithromycin (70 %), consistent with guideline recommendations. Severe cases more often received piperacillin/tazobactam-based regimens, sometimes combined with vancomycin or meropenem. Empirical antimicrobial therapy was widely prescribed but not always effective, leading to multiple modifications in some cases. Definitive therapies were more successful; however, their selection was influenced by comorbidities and drug hypersensitivity. The limited use of the CURB-65 score and the lack of microbiological identification contributed to deviations from ATS/IDSA guidelines, highlighting the need for improved diagnostic and prognostic strategies to ensure rational antimicrobial prescribing in CAP.

Keywords: Antimicrobial resistance; Community-acquired pneumonia; Empirical therapy; Prescription pertinence; Streptococcus pneumoniae.

Impact of an antimicrobial stewardship program on safety and efficiency in medical care

Joel Alejandro Llanes Beltrán[1*], Dailin Márquez Domínguez[1*], Iván Jesús Zuluaga De León[1], Idenis Espeleta Niño[1], Sandra Avendaño de Oro[1], Mark Corredor Arenas[1]

1. Clínica del Caribe, Barranquilla, Colombia.

* farmaceuticoasistencial@clinicadelcaribe.com, infectologia@clinicadelcaribe.com

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Abstract: Healthcare-associated infections (HAIs) are a significant public health issue, increasing costs and mortality. Antimicrobial resistance (AMR) is a global concern exacerbated by indiscriminate antibiotic use, leading to longer hospital stays and higher mortality. Antimicrobial stewardship programs (PROA) promote the optimal use of antibiotics to reduce resistance and improve clinical outcomes. The COVID-19 pandemic led to excessive antibiotic use globally, worsening AMR. This study followed the Plan-Do-Check-Act cycle with four stages: initial diagnosis; standardization of antibiotic prescription and treatment algorithms based on resistance profiles; cultural transformation through education and communication with healthcare teams; and active monitoring and evaluation. The program improved adherence to rational antibiotic use from 74.82 % in 2023 to 91.13 % in 2024 among 1,135 patients. HAIs decreased by 55.74 % compared to the previous year, reaching the lowest rate in six years. Carbapenem-resistant bacterial infections declined significantly. Antibiotic consumption, measured in Defined Daily Dose, decreased alongside increased adherence. Economic analysis revealed cost savings with ceftriaxone and ciprofloxacin, with reductions of 2 406 123 COP and 9 482 696 COP, respectively between 2023 and 2024. The program generated a significant positive economic impact alongside clinical benefits. It effectively reduced HAIs and antimicrobial resistance through interdisciplinary leadership, standardized prescribing protocols, education, active surveillance, and data-driven decision-making. This initiative has positioned the institution as a local reference for antimicrobial stewardship.

Keywords: Antibiotic consumption; antimicrobial resistance; antimicrobial stewardship; healthcare-associated infections; rational antibiotic use.

Safety in switching from innovator Adalimumab to its biosimilar and from biosimilar to biosimilar

Sindy L. Manjarrez[1*], Daniela P. Arboleda[1], Yesith G. Toloza[1], Carolina Becerra[1], Jorge H. Donado[1], Natalia Duque[1]

1. Medicarte. Colombia

* smanjarrez@medicarte.com.co

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Abstract: A multicenter retrospective study was conducted in rheumatoid arthritis (RA) patients treated at Medicarte, a specialized center for immune-mediated diseases. Eligible patients were adults ($>$ 18 years) with RA who switched from innovator adalimumab to a biosimilar between July 2024 and February 2025. Follow-up was carried out through the pharmacovigilance program, responsible for detecting adverse drug reactions (ADRs) and therapeutic failures (TFs). The program ensured dispensing traceability, follow-up dates, and pharmacist interventions. Statistical analysis was performed using R (v 4.4.2). A total of 4 665 patients were followed. After the first switch, patients were distributed as follows: Amgevita (n=2,985; 64.0 %), Humira (n=1,027; 22.0 %), Idacio (n=602; 12.9 %), and Hyrimoz (n=47; 1.0 %). In the second switch, 2 980 patients moved from Amgevita to Idacio (n=1,886), and 1 024 from Humira to Yuflyma (n=386; 8.3 %), resulting in the following distribution: Idacio (n=1,902; 74.6 %), Yuflyma (n=397; 15.6 %), Amgevita (n=179; 7.0 %), Hyrimoz (n=40; 1.6 %), and Humira (n=30; 1.2 %). Subsequently, 156 patients switched again: Idacio (n=85; 54.5 %), Amgevita (n=29; 18.6 %), Humira (n=19; 12.2 %), Yuflyma (n=16; 10.3 %), and Hyrimoz (n=7; 4.5 %). During follow-up, 384 ADRs were reported, with rates per 1 000 patients of 7.6 for Amgevita, 5.3 for Humira, 27.5 for Idacio, 22.9 for Yuflyma, and 34.9 for Hyrimoz. In addition, 157 TFs were identified, with rates of 9.5 for Amgevita, 3.0 for Humira, 4.3 for Idacio, 8.0 for Yuflyma, and 23.3 for Hyrimoz. While evidence exists on switching from innovator to biosimilar, published data on biosimilar-to-biosimilar switching remain scarce. Most patients in this cohort successfully switched from the innovator drug. Adalimumab biosimilars were well tolerated, with 96.7 % continuing on the biosimilar at 24 weeks after the switch, 1.1 % remaining on the innovator, and 3.3 % discontinuing or changing treatment. Medicarte has focused on patient education, ensuring treatment continuity, preventing overstocking, and strengthening pharmacovigilance.

Keywords: Adalimumab; Biosimilars; Pharmacovigilance; Rheumatoid arthritis; Switching safety.

Implementation of a new methodology for staff qualification in sterile preparations center according to USP Chapter <797>

Oscar Fernando Cárdenas Pachón[1*], Janis Morales[1]

1. Unidad Central de Preparaciones Estériles, Droguerías y Farmacias Cruz Verde. Colombia

* oscar.cardenas@cruzverde.com.co

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Abstract: Staff qualification is essential in sterile preparation centers to ensure assigned responsibilities are clearly defined, meet established specifications, and are executed under written procedures. Traditional qualification methods often rely on checklists that may not reflect real-time performance. This study introduces an innovative methodology using visual inspection, real-time evidence collection, and *in situ* evaluations to enhance the accuracy and reliability of staff qualification. This applied research involved verifying staff competence through experience, training, visual inspection, and practical tests. Evaluated activities included personal hygiene, clinical and surgical handwashing, sterile gowning, entry and exit from controlled areas, laminar flow hood cleaning, and aseptic manipulation. Evidence was collected via photographs and interviews, and microbiological sampling was performed to validate aseptic techniques. During the qualification process, staff were interviewed and observed performing critical tasks. Photographic evidence was collected at each stage, including sterile gowning and laminar flow hood cleaning. Microbiological samples from personnel, equipment, and environments showed no microbial growth, confirming proper aseptic technique. All evaluated staff met acceptance criteria across all activities, demonstrating high technical competence and adherence to protocols. The implementation of this methodology significantly improved the quality of collected information and the verification of staff compe-

tence. It enabled the identification of procedural weaknesses not detectable through written tests alone. The approach provided actionable insights for targeted training and ensured compliance with sterile preparation standards. The qualification process was successfully completed with all staff receiving a 'Compliant' rating.

Keywords: Aseptic technique; microbiological monitoring; sterile compounding; training evaluation; visual inspection.

Vitamin K as a trigger strategy: characterization of anticoagulated patients and opportunities for clinical pharmacist intervention

Michael Stiven Mosquera Martínez[1,2*], María Fernanda Hernández Giraldo[2,3] Roberto Torres[2,4]

1. Universidad Nacional de Colombia. Colombia.
2. Grupo de Investigación en Farmacoepidemiología, Audifarma S.A. Pereira, Colombia.
3. Universidad de Antioquia. Colombia
4. Universidad de Cartagena. Colombia

* qfmsmosqueram@gmail.com

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Abstract: Vitamin K antagonists (VKAs), particularly warfarin, remain widely used in Colombia despite the availability of direct oral anticoagulants. Their narrow therapeutic index and variability in response require intensive INR monitoring and close surveillance. Administration of vitamin K1 (phytomenadione) is an essential tool to reverse over-anticoagulation and can also serve as a pharmacotherapeutic "trigger strategy" to identify high-risk patients. This study aimed to characterize a subcohort of patients exposed to vitamin K, focusing on clinical, pharmacological, and demographic factors, and to highlight opportunities for clinical pharmacist intervention. An observational, retrospective, and cross-sectional study was conducted within an institutional outpatient–inpatient anticoagulation program in Bogotá, Colombia. From a cohort of 752 anticoagulated patients, a sub-cohort of 52 patients who received vitamin K between March 2024 and February 2025 was identified. Inclusion criteria were adults ($\geq$ 18 years) with $\geq$ 6 months of warfarin therapy; exclusions were dialysis and pregnancy. Clinical and pharmaceutical variables included age, hemoglobin (Hb), hematocrit (Hct), estimated glomerular filtration rate (eGFR, Cockcroft–Gault), body mass index (BMI), number of prescribed drugs, and major drug–drug interactions. Descriptive statistics were applied. Among the 52 patients exposed to vitamin K, 39 (75 %) were on active VKA therapy and 13 (25 %) were not. The overall mean eGFR was 65.0 mL/min, Hb 12.6 g/dL, Hct 38.5 %, BMI 25.5 kg/m², and age 64.4 years. Polypharmacy averaged 10.3 drugs per patient, higher in VKA users (10.5 vs. 9.6). Elevated INR values ($\geq$ 4) were found in 28/39 VKA users (71.8 %), while none were reported in the non-VKA group. Patients with VKA exposure showed more drug interactions (2.59 vs. 1.31 per patient), especially in those with INR $\geq$ 4. Compared with 700 VKA patients without vitamin K exposure, this subgroup had greater polypharmacy (10.3 vs. 6.4) and more interactions (2.27 vs. 0.9). Vitamin K exposure identifies a high-risk subgroup of anticoagulated patients with greater polypharmacy, interactions, and altered INR values. This supports its role as a pharmacotherapeutic "trigger strategy" for early detection of adverse events and reinforces the importance of clinical pharmacist-led interventions.

Keywords: Clinical pharmacy; drug interactions; polypharmacy; trigger strategy; warfarin.

Use of aluminum sulfate in continuous bladder irrigation for the treatment of hematuria

Didier A. Arroyo Monterroza[1*], Dina L. Rodríguez Rodríguez[2], María F. Suarez Sánchez[2] María I. Pulgar Emiliani[2], Daniel Ospina Herrera[3]

1. Universidad Simón Bolívar. Barranquilla, Colombia.
2. Centro Académico de Investigación Clínica.

Clínica Centro (CIACC). Barranquilla, Colombia.
3. Servicio de Hospitalización, Departamento de Medicina Interna, Clínica Centro (CIACC). Barranquilla, Colombia.

* dadier.arroyo@unisimon.edu.co

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Abstract: Hematuria is a common clinical finding, with an estimated prevalence ranging from 2.5 % to 20 % in adults and is of urological origin in most cases. Standard management includes hydration, bladder irrigation with saline, and clot evacuation; however, refractory cases require alternative therapies. Aluminum sulfate, owing to its astringent and hemostatic properties, has emerged as a promising therapeutic option. This study aimed to describe the clinical experience with continuous bladder irrigation using 1 % aluminum sulfate in refractory hematuria. An observational, descriptive, and retrospective study was conducted in a tertiary referral hospital in Barranquilla, Colombia, in 2024. Ten male patients hospitalized with spontaneous hematuria unresponsive to conventional management were included. The intervention consisted of continuous bladder irrigation with a 1 % aluminum sulfate solution (30 g in 3000 mL of sterile water, infused at 200 mL/h). Clinical variables, comorbidities, cystoscopic findings, infectious parameters, and therapeutic outcomes were analyzed. The median age was 71 years. The most frequent comorbidities were prostatic disease (90 %), arterial hypertension (60 %), and chronic kidney disease (60 %). During hospitalization, 60 % of patients developed bacterial colonization, progressing to urinary tract infection in 30 % and bacteremia in 10 %. The most prevalent microorganism was *Klebsiella pneumoniae* (30 %), followed by *Escherichia coli* and *Acinetobacter baumannii* (10 % each). Urinalysis confirmed significant hematuria in all cases, with $>$3 red blood cells per field, predominance of fresh erythrocytes, and marked leukocyturia in 40 %. Cystoscopic findings revealed prostatic abnormalities in 90 %, bladder inflammation in 20 %, and lithiasis in 10 %, with retained clots in all cases. Following irrigation with aluminum sulfate, complete resolution of hematuria was achieved in 100 % of patients within 48–72 hours, with no major adverse events attributable to aluminum. Continuous bladder irrigation with 1 % aluminum sulfate proved to be a safe and effective therapeutic alternative in refractory hematuria. Its mechanism of action, based on protein precipitation and local vasoconstriction, reduces capillary permeability, edema, and blood extravasation, promoting hemostasis. Further prospective studies are warranted to validate its safety and establish standardized treatment protocols.

Keywords: Hematuria, Alum, Therapeutic bladder irrigation.

Entrepreneurship, Sustainability and Marketing (TA-4)

Evaluation of the *in-vitro* removal capacity of mixtures of activated carbon and acetaminophen bentonite in water

Angie C. Fuertes Hernández [1*], Juan F. Molina Quiros [1], Johan S. Yandi Suarez [1], Liseth Suárez Osorio [2], Yhors A. Ciro Monsalve [1]

1. Grupo de Investigación en Química y Biotecnología (QUIBIO), Facultad de Ciencias Básicas, Universidad Santiago de Cali. Cali, Colombia.
2. Grupo de Investigación en Electroquímica y Medio Ambiente (GIEMA), Facultad de Ciencias Básicas, Universidad Santiago de Cali. Cali, Colombia.

* Angiefh03@outlook.com

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Abstract: Water pollution is a critical environmental issue due to its wide-ranging repercussions. Of particular concern are emerging contaminants (ECs), which were previously overlooked due to their low concentrations. However, their resistance to decomposition allows them to remain in water bodies and accumulate in soils for prolonged periods, generating toxicity, altering the food chains, degrading soil quality, and even modifying water composition. Among the most common pharmaceutical ECs are non-steroidal anti-inflammatory drugs such as acetaminophen. A useful strategy for removing these ECs is adsorption, employing materials such as activated carbon and bentonite. In this study, mixtures of activated carbon and bentonite in 4:6, 5:5, and 6:4 proportions were made under reflux with sulfuric acid for one hour. The mixtures were characterized using infrared spectroscopy, Boehm titration, and point of zero charge (PZC). Subsequently, acetaminophen adsorption capacity was evaluated by varying contact time (20 and 120 minutes), and the data were adjusted to adsorption isotherm models. The Boehm titration identified the presence of phenolic groups (predominant in the 4:6 mixture), as well as lactone and carboxyl groups, conferring an acidic character to the adsorbent surface after sulfuric acid treatment. The PZC of the mixtures ranged from 2.7 to 4.0. Acetaminophen adsorption capacity depended on the carbon:bentonite ratio and contact time. The 6:4 mixture showed the highest adsorption capacity for 20 minutes (95.08 %) and 120 minutes (94.54 %) compared to the others and presented a type I Langmuir isotherm. These findings highlight the potential of activated carbon:bentonite mixtures for the removal of EC from water.

Keywords: Acetaminophen; Removal; Pollutant; Activated carbon; bentonite.

Evaluation of the adsorption capacity of crude diatomite in the removal of Losartan from synthetic aqueous solutions

Maria A. Castellar Contreras[1*], Néstor J. Cubillán Acosta[2], Grey C. Castellar Ortega[2]

1. Grupo de Investigación en Biotecnología de Microalgas, Fisicoquímica Aplicada y Estudios Ambientales, Departamento de Farmacia, Facultad de Química y Farmacia, Universidad de Atlántico.
2. Grupo de Investigación en Biotecnología de Microalgas, Fisicoquímica Aplicada y Estudios Ambientales, Departamento de Química, Facultad de Ciencias Básicas, Universidad de Atlántico.

* cdcastellar@gmail.com

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Abstract: The presence of emerging contaminants, such as pharmaceuticals, in different water sources has been increasingly studied in recent years due to their long-term negative effects on the environment and human health. Considering that conventional wastewater treatment methods are unable to adequately remove these contaminants, it is necessary to explore alternative solutions. In this study, the adsorption capacity of raw diatomite in the removal of Losartan from synthetic aqueous solutions was evaluated. A factorial experimental design was applied to assess the effect of initial Losartan concentration (5 mg/L, 10 mg/L, 20 mg/L, 30 mg/L, 40 mg/L, and 50 mg/L), initial solution pH (5, 7, and 9), and adsorbent dose (250 mg/100 mL, 500 mg/100 mL, and 1000 mg/100 mL) on adsorption capacity of diatomite and removal efficiency at constant temperature. In addition, the inorganic functional groups of diatomite and Losartan were analyzed using Fourier transform infrared spectroscopy (FTIR), and the point of zero charge (PZC) of the material was determined to establish possible correlation with equilibrium behavior. The experimental data were fitted to the Freundlich isotherm model to describe the adsorption process. The adsorption results showed that diatomite achieved a maximum removal percentage of 98.26 % with an adsorbent dose of 1000 mg/100 mL, an initial Losartan concentration of 30 mg/L, and a pH of 5. Average removal exceeded 90.0 % in most experimental conditions. Adsorption capacity increased with initial Losartan concentrations and lower adsorbent doses. The Freundlich model confirmed that the adsorption process was favorable. These findings demonstrate that diatomite exhibits high removal percentage efficiency and adsorption capacity for the elimination of Losartan, supporting its potential as a suitable adsorbent material for the elimination of pharmaceutical emerging contaminants.

Keywords: Adsorption; Diatomite; Emerging contaminants; Losartan; Wastewater treatment.

Harnessing avocado seeds in the production of extracts as a potential raw material for the pharmaceutical and cosmetic industries

Elkin Torres Sierra[1*], Harold Gómez Estrada[1], Jairo Mercado Camargo[1], Jorge Sánchez Hoyos[1], Carlos, Bernal Rodríguez[2], Juan Urrego Álvarez[2], Juan J. Carrascal Sánchez[2]

1. Grupo de investigación en Química Orgánica Medicinal, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.
2. Grupo de investigación en Tecnología Farmacéutica, Cosmética y de Alimentos, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.

* etorress@unicartagena.edu.co

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Abstract: Global avocado production generates a high volume of waste, with the seed representing an abundant and underutilized byproduct. Within the framework of a circular bioeconomy, this study conducted a systematic review of the scientific evidence on the potential of avocado seed as a raw material for the pharmaceutical and cosmetic industries. The review followed the PRISMA 2020 methodology to ensure transparency and reproducibility. The search was carried out in high-impact scientific databases (PubMed, ScienceDirect, Scopus, and Scielo), yielding a total of 482 records. Subsequently, a screening process was applied, removing duplicates and filtering by title and abstract. Finally, the preselected articles were evaluated in full text according to specific eligibility criteria. This resulted in 62 studies being included in the final evidence base for the qualitative synthesis and analysis of this review. The analysis revealed that avocado seed exhibits remarkable pharmacological and cosmetic potential due to its diverse phytochemical profile. Its potent antioxidant and anti-aging activities are attributed mainly to the high content of proanthocyanidins and flavonoids such as catechin, while its anti-inflammatory effects modulate key cellular

pathways. Unique compounds like acetogenins (*e.g.*, *Avocatin B*, *Persenone A*) are responsible for its promising antineoplastic activity by selectively inducing cancer cells death, and for its broad antimicrobial spectrum. These bioactivities enable industrial applications, positioning avocado seed functions as a photoprotective ingredient, natural preservative, sustainable exfoliant, and unique coloring agent through the perseorangin molecule, consolidating it as a multifunctional, high-value raw material within the circular economy. The valorization of the avocado seed represents an innovative strategy based on the circular economy, transforming agro-industrial waste into a high-value raw material. The standardization of sustainable extraction methods will be essential to ensure extract stability and yield, consolidating their potential for developing new bioproducts for use in the pharmaceutical and cosmetic sectors.

Keywords: Antioxidant activity; Avocado seed; Circular bioeconomy; Cosmetic industry; Pharmaceutical applications.

Business model for the development of a sustainable bioproduct from avocado seed waste in Colombia

Thulie P. Jiménez Villalobos[1*], Olga I. Cuadrado Vega[1], María del Rosario Osorio Fortich[1], Leonor Cervantes Ceballos[2], Claudia Baena Aristizábal[3], Dolly Mayorca Beltrán[1]

1. Grupo de investigación ENAIKA, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.
2. Grupo de Investigación en Química Orgánica Medicinal, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.
3. Grupo de Investigación en Tecnología Farmacéutica, Cosmética y de Alimentos, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.

* tjimenezv@unicartagena.edu.co

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Abstract: In the Montes de María region of Colombia, avocado cultivation faces significant challenges, primarily due to the inadequate management of avocado seed waste. This situation not only causes damages crops and the environment but also affects the sustainability and profitability of agricultural production in the area. In this context, developing sustainable bioproducts from avocado seeds represents an innovative strategy to promote agro-industrial waste valorization and strengthen bioeconomy-based agriculture. This study aimed to design a business model for *MicroHass*, a bioproduct derived from avocado seeds with potential applications in organic and regenerative agriculture A mixed qualitative–quantitative exploratory design was applied, structured in four phases. First, a documentary review and participatory diagnosis with key actors (farmers, distributors, agricultural technicians) were conducted to identify unresolved problems and market inefficiencies, Second, user-centered innovation tools, including design thinking, empathy mapping, and co-creation workshops, were employed. Third, a business model was designed using the Business Model Canvas framework. Finally, the proposal was validated through SWOT analysis to assess viability. The participatory diagnosis identified a limited availability of effective bioproduct formulations from agro-industrial residues, insufficient technical knowledge in field applications, and weak market articulation. The business model highlighted *MicroHass* as an ecological, safe, and easy-to-apply solution within the organic agriculture market. Key activities include raw material collection, technical formulation, field trials, and farmer training. Distribution strategies combine direct sales, agricultural fairs, and e-commerce. SWOT analysis highlighted strengths such as ecological formulation, circular economy innovation, and university spin-off support, alongside opportunities arising from the growing demand for sustainable solutions.

Keywords: Agro-industrial waste; Avocado seed; Bioeconomy; Business model; Sustainability.

Contribution to the development of a liposomal system formulation containing avocado seed oil, with a view to the sustainable use of biodiversity

Olga I. Cuadrado Vega[1*], Tania Ballestas[1], Lorena Chima[1], Carlos Bernal[1], Leonor Cervantes[2], Claudia Baena[1]

1. Grupo de Investigación en Tecnología Farmacéutica, Cosmética y de Alimentos, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.
2. Grupo de Investigación en Química Orgánica Medicinal, Facultad de Ciencias Farmacéuticas, Universidad de Cartagena. Cartagena, Colombia.

* ocuadradov@unicartagena.edu.co

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Abstract: The growing demand for avocados in Colombia has led to a significant increase in production, which in turn generates a large amount of waste, primarily seeds, constituting approximately 25 % of the fruit. This waste has negative environmental impacts. Although some initiatives for reusing avocado waste exist, the utilization of its seeds in the cosmetics industry is still limited. However, studies have shown that oil extracted from avocado seeds contains valuable fatty acids, including linoleic, oleic, and palmitic acid. The increasing demand for natural cosmetics presents an opportunity to capitalize on this waste, as avocado seed oil is valued for its hydrating properties due to its richness in monounsaturated and polyunsaturated fatty acids. The aim of this study was to develop a liposome formulation to encapsulate avocado seed oil and enhance its moisturizing effects by improving skin penetration, thereby offering a potential solution to the problem of agricultural waste. Avocado seed oil was first extracted and characterized to determine its physicochemical properties, including density, acid value, and peroxide value. Then, the liposomes were prepared using the ethanol injection method and a Plackett-Burman experimental design. Variables analyzed included stirring time and speed, oil concentration, the presence of polysorbate 80, and the use of rotary evaporation. Particle size and encapsulation efficiency were measured as response variables. The prepared liposomes had particle sizes ranging from 100 nm to 1.6 µm. Statistical analysis showed no significant effect of any individual factor on particle size or encapsulation efficiency. However, the interaction between oil concentration (percentage) and solvent evaporation appeared to have some influence both. Encapsulation efficiencies ranged from 10 % to 72.57 %, with formulation eight achieving the highest efficiency. These findings demonstrate the potential of encapsulating avocado seed oil in liposomes for the cosmetic applications. Furthermore, the ethanol injection method proved to be effective for creating avocado oil-containing liposomes. This formulation represents a viable and sustainable alternative for producing high-value moisturizing ingredients from agricultural waste.

Keywords: Avocado seed oil; Biodiversity; Cosmetics; Liposomes; Sustainability.