

# **Nutraceutical Uses of Andean Grains (*Chenopodium Quinoa Willd, Chenopodium Pallidicaule Aellen, Amaranthus Caudatus L*) and Its Importance in World Food**

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## **Abstract**

Andean grains (Quinoa, Kiwicha, Cañihua), cultivated in the Andes with exceptional characteristics of climate, soil, altitude and in organic form, are important in human nutrition and food due to their high nutritional value, ideal balance of essential amino acids (high lysine), dietary fiber content, phytoestrogens (Daizein) responsible for the control of estrogens, such as breast cancer, diabetes, osteoporosis and cardiovascular diseases; minerals such as Ca, Mg, Li, Zn, Fe, K, Mo, vitamins of the complex B, C, E, gluten-free ideal for celiacs, unsaturated fatty acids (Omega 9, 6 and 3), presence of squalene, galactogenic, with the ability to reduce serum triglycerides in the blood, having nutraceutical uses that prevent and control many ailments of man, therefore it is considered a superfood, orthomolecular food, design, medical, functional, anti-aging, since its active compounds of its seeds, leaves and inflorescences, prevent the aging of cells with antioxidant effect by reducing free radicals, it has the presence of betacyanins, polyphenols, it also lowers glycemia levels in pre-diabetics and diabetics, it prevents inflammation which is the first warning of cancer, recommended to reverse childhood malnutrition and hypertension, preventing degenerative diseases such as Alzheimer's, in addition to diabetes, anemia and obesity. It currently has global importance, because these foods are being consumed and produced in much of the world, since their cultivation and production allows them to better adapt to climate change and mitigate harmful effects with greater advantage, in addition to having the ability to replace animal protein, being a source of energy for muscles, brain and nervous system, because it contains Alanine, it also has Glycine that acts as a calming neurotransmitter of the brain, regulating motor functions and proline, an amino acid involved in the repair of joints and to heal injuries. That is why it is of enormous importance in nutrition at a global level.

Keywords: Andean grains, cañihua, kiwicha, quinoa, nutraceutical uses.

# **Traditional Food Uses of llama Meat (Lama Glama L) in the Andes and Its Importance in Modern Food**

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## **Abstract**

The llama is a domesticated artiodactyls mammal, belonging to the Camelidae family, native to the South American Andes, it was obtained and domesticated by the native pre-Hispanic Andean cultures through artificial selection from the guanaco (*Lama glama* guanicoe L), having its meat varied uses in the Andean diet, it is considered highly nutritious because it has greater protein than traditional livestock species (26 %), little fat and cholesterol (1.6%), composed of oleic and linolenic acid, its meat being used in the diet of the Andean inhabitants from its domestication to the present day under various forms of preparation and now by the modern consumer considering it quite lean and gourmet meat, like all game meats, aroused interest among consumers who prioritize health and food quality. It provides very well absorbed iron (heme iron), as opposed to iron from plant-based foods. Llama meat provides important minerals such as: phosphorus, magnesium and zinc, vital at all stages of life, it has a special mild flavor and is culinary compatible with those of cattle, pigs and sheep. Among the most sought-after cuts are loin and shoulders, currently there is a growing recognition of the nutritional qualities of this meat. Exquisite dishes are made with llama meat, with a pleasant flavor such as: Meat stew, stew, adobo, heart anticuchos, grilled kidneys, sautéed meat, roasted in the pot, charqui (dehydrated meat and subjected to frost), charquecan (shredded dried meat with toasted corn and chuño), paruja (quinoa tarnish with blood), muccu (potato stuffed with meat), ccaspa or cancacho, chicharon, yahuar putti (little blood), blood sausage, grilled ribs, meat casserole and loin. Llama meat is sold as fresh and also dried meat (llama salami); by-products are made such as: frozen hamburgers and medallions, sausages, sausages, lomititos, chorizos, mortadella and other derivatives, with the objective being to achieve an integral use of the meat.

**Keywords:** Andes, food uses, llama meat, modern food.

# **Specialty Plant Seed Oils and their Potential Health Beneficial Properties**

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## **Abstract**

Oils from the selected fruit, vegetable and spices seeds were examined for Their triglyceride profile, fatty acid composition, oxidative stability, radical scavenging properties and total phenolic acid composition. For instance, our research identified that the major triglycerides were OLL, LLLn and LnLnL in the blackberry, raspberry and black berry seed oils, whereas blueberry seed oil was rich in LLLn, Loo and LnLnL. In addition, cranberry seed oil was rich in LOO, LOLn and LnLnL. These berry seed oils are excellent dietary sources for 18:3n3, the essential n-3 fatty acid, at a level of 31.1, 41.1, 44.6, 48.8 and 51.2 g per 100 g total fatty acids for the blackberry, red raspberry, black raspberry, blueberry and cranberry seed oils. Significant levels of phenolic compounds and scavenging capacities against ABTS cation, DPPH, and peroxyl radicals were observed in the oil extracts. Fruit seeds such as cranberry and blueberry seeds are by-products from food processing. Identification of their value-adding factors such as n-3 fatty acid composition and antioxidant capacities may lead to the value-added seed oil and flour utilizations in improving human health, and enhance the farm gate value of the fruits to enhance local agricultural economy.

# **Influence of circadian rhythm on diet-induced energy production in young people with normal nutritional status**

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## **Abstract**

Total energy expenditure (TEE) comprises three components: basal metabolic rate (BMR), physical activity energy expenditure (PAEE), and diet-induced thermogenesis (DIT). Circadian rhythm influences DIT, with the body showing a difference in its ability to use ingested energy in a similar way through day and night. The objective was to assess the influence of circadian rhythm on diet-induced energy production (DIEP) in young people with normal nutritional status. Cross-sectional analytical study with a sample composed of 7 participants aged 20-25 years of whom 3 were men and 4 women. Participants' nutritional status was normal according to body composition, which was assessed by bioimpedanciometry and Body Mass Index (BMI). The concept of DIEP was used instead of DIT, considering that the indirect calorimetry (IC) method used for its measurement includes the sum of the thermal energy that is lost plus the chemical energy that is stored. The same meal was provided in the morning and afternoon sessions, which composition consisted of 55% carbohydrates, 15% protein and 30% fat, covering 25% of energy requirement of each participant. The DIEP was determined through the difference in resting metabolic rate measured by indirect calorimetry (RMR IC) prior to the ingestion of food as compared to postprandial RMR IC. DIEP and respiratory quotient (RQ) were determined on both sessions. Data were described by mean and standard deviation; the Student's t-test was used for paired samples using a significance level of  $\alpha < 0.05$ . The DIEP in the morning was higher with 18.9%, versus the afternoon with 14.3% ( $p = 0.0106$ ). In the group, the preprandial RQ of the afternoon ( $0.83 \pm 0.44$ ) versus postprandial RQ ( $0.88 \pm 0.41$ ) was different ( $p < 0.0321$ ). In conclusion, circadian rhythm influenced DIEP of the participants, with higher values being observed in the morning versus the afternoon.

**Keywords:** Circadian rhythm; diet-induced energy production; respiratory quotient; nutritional status.

# **From Bench to Bedside: Emerging Biomedical Applications of Polymer-Based Nanoparticles**

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Polymer-based nanoparticles (PNPs) have emerged as highly versatile platforms in the realm of biomedical science, offering unprecedented opportunities for targeted therapy, diagnostics, and regenerative medicine. Their biocompatibility, tunable physicochemical properties, and capacity for surface functionalization make them uniquely suited for addressing complex medical challenges. This abstract provides a concise overview of recent advancements in the design, development, and translational potential of PNPs in clinical applications.

At the preclinical level, innovations in polymer chemistry have enabled the fabrication of stimuli-responsive nanoparticles capable of controlled drug release in response to pH, temperature, or enzymatic triggers. Notably, biodegradable polymers such as PLGA, PEGylated systems, and natural polymers like chitosan have demonstrated efficacy in encapsulating a range of therapeutic agents—from small-molecule drugs to biologics—while minimizing systemic toxicity.

Despite encouraging preclinical outcomes, clinical translation remains a critical bottleneck. Challenges such as reproducibility, large-scale manufacturing, immunogenicity, and regulatory hurdles continue to limit widespread clinical adoption. However, ongoing interdisciplinary collaborations between materials scientists, bioengineers, and clinicians are actively addressing these gaps.

This presentation will explore key examples of polymer nanoparticle platforms transitioning from bench research to clinical trials, emphasizing design principles, biological interactions, and translational barriers. By illuminating the current landscape and future directions, this work underscores the transformative potential of polymer-based nanoparticles in redefining modern medicine.

# **An Innovative Antimicrobial Hydrogel Platform for Drug Delivery In Root Canal Treatments**

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## **Abstract**

**Introduction:** Conventional endodontic treatments rely on chemical-mechanical preparation and standard medications but often fail to fully disinfect root canals. These methods struggle to eliminate biofilms and residual bacteria, underscoring the need for more effective strategies. Antimicrobial hydrogels, with controlled drug release, provide a superior alternative by significantly improving the targeting of persistent root canal infections. This work focuses on developing a biocompatible antimicrobial hydrogel, using polyvinyl alcohol (PVA) and chitosan (CS), embedded with Poly(lactic-co-glycolic acid) (PLGA) nanoparticles (NPs) encapsulating clindamycin and nisin. The goal is to develop a hydrogel for commercial use in pre-filled syringes, easily applied with specific needles and tips for root canal treatment.

**Methods:** The PLGA NPs co-encapsulating nisin and clindamycin were formulated using a double emulsion process and several physicochemical properties were analyzed, such as zeta potential (ZP), particle size (PS), and polydispersity index (PDI). Hydrogels were obtained by combining aqueous solutions of PVA, containing the NPs, and CS, using citric acid as the crosslinking agent. Rheological properties were analyzed using a parallel-plate rheometer, with viscosity assessments at 8°C and 25°C, and oscillatory shear tests to measure storage and loss moduli across temperature variations.

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Results: Zetasizer analysis of the nisin and clindamycin nanoparticles revealed desirable characteristics for the intended formulation. The hydrogel, with a 30:70 PVA to CS ratio and citric acid, demonstrated optimal rheological properties for clinical use, with improved moduli upon increased chitosan ratios and higher viscosity at lower temperatures. The gel transition occurred as temperatures decreased from 40°C to 20°C, suitable for endodontic approach. Preliminary microbiological results were also promising, showing antimicrobial activity against *Pseudomonas aeruginosa*.

Conclusions: The developed hydrogel formulation has potential to be used endodontic treatment with expected infection control and success rates through controlled drug delivery.

# **Deep Convolutional Neural Network for Binary-Regression of Three Dimensional Objects using Information Retrieved from Digital Fresnel Holograms**

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## **Abstract**

A Deep Convolutional Neural Network (CNN) based binary-regression task on 3D objects using concatenated intensity-phase (whole information) image dataset retrieved from experimentally generated off-axis digital Fresnel holograms is utilized in this work. Images in the dataset were prepared using the intensity and the phase (depth) information retrieved computationally from the hologram presented as a single image in a concatenated fashion, which accommodates the whole information of the 3D object. The data set comprises of 2268 images of the chosen eighteen objects at different recording distances and various rotation angles. Binary regression task in deep learning done on holographic information of 3D objects is equivalent to the 3D objects prediction done on whole information objects data set, which produces continuous labels as output, justifies the intention of the present work. The Deep CNN was trained on the whole information image dataset to produce the results. The results such as loss, mean square error (MSE), and mean absolute error (MAE) curves are shown on training and validation sets. Further, the performance metrics namely R2score (coefficient of determination) and Explained Variance (EV) regression score are shown on the test and validation sets to justify the performance of the binary regression task. Further, the performance metrics obtained from the deep CNN namely R2 score and EV regression score were compared with machine learning binary regressors namely K-Nearest-Neighbor (KNN), Support Vector Machine (SVM), Multi-layer Perceptron (MLP), Decision-Tree (DT), Ada Boost (ADB), Random Forest (RF), Extra Trees (ET), Gradient Boosting (GB), Histogram Gradient Boosting (HGB), and Stochastic Gradient Descent (SGD) regressors on the test/validation sets.

Key words: deep learning, binary regression, 3D objects regression, Convolutional Neural Network (CNN), digital holography, complex wave retrieval method.

# **Water Resonant Framework, Water DNA Absorption Frequencies and Upper THz Notch**

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## **Abstract**

Water, main human body constituent, carries bound and partially bound resonant energy. Resonant electromagnetic components, water – dna absorption frequencies are integral part of a thermodynamic framework. This framework could also be viewed as signal's main transmission backbone.

Dna and water functions' absorption trends, once linearly scaled for intensity differences, are coextensive in frequency and space domain. Both functions indicate an absorption notch near 270nm over the frequency window analyzed, shifted by few nanometers with each other (estimated 4nm gap).

Free water resonance is characterized by quasi-linear moment attenuation, which becomes hyperbolic in bound and partially bound cases. Dna's absorption – hyperbolic – and water functions depart over low space frequencies – shorter wavelengths, they converge on high frequencies.

The study analyzes water and dna fields and derives a total field inclusive of divergence. Results show that water and dna frequencies, moments, interlink and work towards thermodynamic equilibrium in the upper THz band. Water resonance combined with dna absorptions lead a total field function where water acts as as modulator and stabilizer:

- I. Derivatives of water absorption frequencies and attenuation agree well with dna absorption frequencies, water absorption is 15dB down from dna, water resonance 30dB more – dna and water LF trends intercept at low angle;
- II. Reciprocal filtering of water and dna functions or their combination, synergy, results in higher bandwidth;
- III. Canonical photonic energy matches H2 energy near flex (4eVs);
- IV. The gap between dna and water translates to near 50THz frequency at luminal speed, and it coincides with mean cellular frequency red shift in relation to homeostasis thermodynamics.

For luminal speed and canonical water – dna refractivity indexes, total field output function indicates a clear resonance upper THz window.

# **Numerical Study of the Effect of Residual Stresses on Fracture Toughness in the Microstructure of ZrO<sub>2</sub> Ceramics**

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## **Abstract**

Zirconia-based ceramics (ZrO<sub>2</sub>) exhibit high mechanical strength and excellent oxidation resistance, biocompatibility, making them highly promising for application in high-temperature thermal protection systems, biomedical implants and structural components in extreme environments. However, despite these advantages, their inherent brittleness remains a critical limitation for their widespread use in aerospace, energy, and biomedical engineering applications.

The mechanical properties of ceramics are influenced by multiple factors, including matrix grain size, the presence and size of second phase grains [cubic (C) and/or monoclinic (M)], pore size and distribution, and the presence of a glassy phase at the grain boundaries. Due to the simultaneous influence of these factors, isolating their individual effects is highly challenging.

This study investigates the influence of residual stresses on crack propagation in the microstructure of zirconium ceramics using the element elimination technique (EET) within the finite element method (FEM) framework. The effect of grain size distribution, morphology, and phase distribution are examined. The crack resistance is evaluated for two representative microstructures of zirconia ceramics, considering the role of residual stresses in the constitutive phases. The analysis is conducted under both uniaxial tension and three-point bending conditions.

Results indicate that under tensile loading, residual stresses reduce the maximum sustainable load and, consequently, decrease crack resistance by approximately 30%. In contrast, under three-point bending, residual stresses enhance the crack resistance. The computational modeling results are validated through experimental testing of sintered ceramic samples with a similar grain structure in 3-point bending. The strong agreement between numerical and experimental results confirms the accuracy of the proposed model and highlights the significant role of residual stresses in determining the mechanical properties of zirconia ceramics.

# **Optimization of the Layout for a Cocoa Powder Processing Plant**

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## **Abstract**

This study focuses on optimizing the production processes of a cocoa company in Santander, Colombia, through a redesign of the plant layout and the integration of new technologies. Following a detailed diagnosis of the work areas, SOLVER software was used to minimize costs and improve productivity, achieving a 25% increase in delivery punctuality. Additionally, new machines were implemented, including a roaster (ROASTY 35), a sheller, a conveyor belt, a cleaning machine, and a packaging machine. These enhancements increased production capacity from 48 kg to 288 kg per workday, representing a 500% improvement. The plant redesign considered safety, ergonomics, and compliance with technical regulations, ensuring an efficient and secure work environment. The use of Flex Sim simulation software allowed the modeling of various configurations, optimizing workflow and reducing production times by 20%. These innovations position the company competitively in the cocoa market, enabling it to meet higher demand, reduce unit costs, and establish a foundation for sustainable growth. This approach demonstrates how modernization and automation can significantly transform operations in the cocoa sector, contributing to increased efficiency, enhanced product quality, and long-term competitiveness.

# **Healthcare Service 5.0: Integration of Artificial Intelligence and Emerging Technologies for Medical Care Optimization**

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## **Abstract**

This research explores the impact of Industry 5.0 on the healthcare supply chain, highlighting how the integration of advanced technologies and a human-centric approach enable greater personalization and operational efficiency. Unlike Industry 4.0, the fifth industrial revolution prioritizes synergistic collaboration between humans and machines, sustainability, and process resilience. This study reviews recent research to analyze how tools such as artificial intelligence (AI), blockchain, the Internet of Medical Things (IoMT), and digital twins are transforming inventory management, improving drug traceability, and tailoring the supply of resources to specific needs. The findings reveal that Industry 5.0 provides an agile response to fluctuating demands, reducing operational costs and enhancing the quality of medical services. However, it faces significant challenges, including the need for robust technological infrastructure, specialized training, and effective regulatory frameworks to protect sensitive data privacy. Opportunities for the implementation of clean technologies and sustainable practices that strengthen operational resilience are also identified. The study concludes that Industry 5.0 fosters a more efficient, adaptable, and patient-centered management model, offering tangible benefits for healthcare. This transformation significantly reshapes the sector toward a more sustainable and innovative approach, positioning Industry 5.0 as a key driver in the evolution of modern healthcare systems.

# **Radiofrequency Therapy and Nanocomposites: Evidence of Synergism**

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## **Abstract**

This Talk will explore the use of the Hill model to assess the benchmark dose (BMD), the lethal dose 50 (LD50), the cooperativity (E) and the dissociation constant (K) while analyzing cell viability data using nanomaterials. The presentation is addressed to discuss the antitumor efficacy while combining radiofrequency (RF) therapy and selected nanomaterials. In particular, it will be discussed the use of nanocomposites, for instance the one comprising graphene oxide (GO) surface functionalized with polyethyleneimine (PEI) and decorated with gold nanoparticles (GO-PEI-Au). Data collected from the cell viability assays using different tumor cell lines (e.g. LLC-WRC-256 and B16-F10) will be presented and discussed. The findings will demonstrate that while the tested nanocomposite (e.g. GO-PEI-Au) may be biocompatible against different cancer cell lines in the absence of radiofrequency (nRF), the application of radiofrequency (RF) enhances the cell toxicity by orders of magnitude, pointing to prospective studies with the tested cell lines using tumor animal models.

# **Future Perspectives and Challenges Green Nano Material Applications in Industry 6.0 and it's Contribution towards SDGs**

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## **Abstract**

Industry 6.0 is a major transition to new industrial practices based on Internet, Digital technology, AI, & sustainability development technologies. Green nanomaterials that are known for their environmental application, excellent mechanical, thermal, electrical characteristics are ready to shape the Industry 6.0. Such materials are made from sustainable resources and process, and can be further recycled hence fitting the undergoing Sustainable Development Goals, including the seventh (Affordable and Clean Energy), ninth (Industry, Innovation and Infrastructure) and twelfth (Responsible Consumption and Production). Applying green nanomaterial in Industry 6.0 provides the new prospect of decreasing carbon footprints, minimizing the reliance on resources, raising energy efficiency in the product production process and the product life cycle. One of the major future prospects in the usage of green nanomaterials is the link to circular economy which is the key for creating sustainable industrial systems. For example, nanocellulose, biochar and Nano silica are inherent, compostable, and environmentally friendly, which would benefit application in closed-loop systems. These innovations can mimic non renewable raw materials, increase durability of products thereby leading to reduced waste production. On the flip side, advanced Industry 6.0 utilizes Artificial Intelligence and Machine Learning, which can optimize the green nanomaterial design and its production, control the material parameters and possesses less resource consumption, high production rate, and efficiency. These advancements enhance SDG 9 as it fosters sectorial resilient infrastructure and sustainable Industrialization. Green nanomaterials can be difficult to scale up, raise cost concerns, and may not be conclusively environmentally benign. The current methodologies of production that are employed are usually so sophisticated and expensive, thus making it hard to popularize. Also, in the long run, nanomaterials have a large potential to cause harm to the environment and the toxicity level of the product when used in nanotechnology-constructed consumer items is still questionable and therefore anybody wishing to engage in the use of nanotechnology products should ensure that he or she complies with all the safety measures recommended by the government. These challenges can however be surmounted with the help of both the private enterprises and governmental institutions, researchers and policy makers in developing the right regulatory mechanisms in production, testing, and disposal, which will encourage the safe usage of the material. Therefore, green nanomaterials lie ready to be the cornerstone of Industry 6.0, driving the achievement of SDGs by applying sustainable advancement, inclusion of resources and environmental stewardship. If these cases can surmount scalability and regulatory issues, these materials can help shape a greener, more industrial future. Including them in realizing Industry 6.0 technologies mark a path through which productivity can be advanced with the simultaneous conservation of natural resources – the progress of a shift in industrial focus that complements the sustainability objectives set at the international level.

# **Epoxy Composite Materials Reinforced with Fibers from the Bark of Acacia Caesia**

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## **Abstract**

Polymer materials are versatile, yet composite materials are often preferred due to the inherent weakness of pure polymers compared to metals. Composite materials primarily consist of polymers and fibers. Those made with synthetic fibers tend to be heavier and more prone to thermal degradation. To address this, composite materials incorporate natural fibers, which offer strength comparable to synthetic fibers. This study evaluates the mechanical properties of reinforced epoxy composites made with Acacia Caesia bark (ACB) fiber. The fibers were mechanically, morphologically, and thermally characterized after extraction. Scanning electron microscopy (SEM) was utilized to elucidate the microscopic structure of the modified fibers. Composite specimens were created by combining epoxy resin with ACB fibers, placed on the lower mold surface, and subjected to a hydraulic pressure of 103.42 bar using compression molding at 80°C. The flexural, impact, and tensile strengths were measured following ASTM guidelines after cutting the specimens. Specimens were prepared with fiber contents of 10%, 15%, and 20% by weight. The results indicated that flexural and tensile strengths increased with higher fiber content. Impact strength also showed a gradual increase from the 10% to the 20% sample. Hardness testing was conducted using the Shore D Durometer, revealing hardness values for ACB composites at fiber weights of 10%, 15%, and 20% to be 62.40 Shore D, 67.84 Shore D, and 69.95 Shore D, respectively, indicating enhanced stable hardness. The composite's qualities can be further improved by optimizing the fibers' angular alignment in relation to strength.

# **Azodye Photoaligned Nanolayers for Liquid Crystal Photonics Applications**

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## **Abstract**

Photoalignment and photopatterning has been proposed and studied for a long time. Light is responsible for the delivery of energy as well as phase and polarization information to materials systems. It was shown that photoalignment liquid crystals by azodye nanolayers could provide high quality alignment of molecules in a liquid crystal (LC) cell. Over the past years, a lot of improvements and variations of the photoalignment and photopatterning technology has been made for photonics applications. In particular, the application of this technology to active optical elements in optical signal processing and communications is currently a hot topic in photonics research. Sensors of external electric field, pressure and water and air velocity based on liquid crystal photonics devices can be very helpful for the indicators of the climate change.

We will demonstrate a physical model of photoalignment and photopatterning based on rotational diffusion in solid azodye nanolayers. We will also highlight the new applications of photoalignment and photopatterning in display and photonics such as: (i) fast high resolution LC display devices, such as field sequential color ferroelectric LCD; (ii) LC sensors; (iii) LC lenses; (iv) LC E-paper devices, including electrically and optically rewritable LC E-paper; (v) photo induced semiconductor quantum rods alignment for new LC display applications; (vi) 100% polarizers based on photoalignment; (vii) LC smart windows based on photopatterned diffraction structures; (viii) LC antenna elements with a voltage controllable frequency.

# **Development of Morphological, Mechanical and Biological Properties in Hydroxyapatite, Zirconia and their Various Composites for Biomedical Use**

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## **Abstract**

This study explores the synthesis, structural characterization, and biomedical potential of hydroxyapatite (HAp), titanium carbide (TiC), and zirconia (ZrO<sub>2</sub>) reinforced composites tailored for bone and dental implant applications. Hydroxyapatite, owing to its chemical similarity to natural bone and excellent biocompatibility, was synthesized using a wet chemical precipitation method, while HAp/TiC composites were fabricated through a solid-state reaction technique. Structural and morphological investigations were conducted via X-ray diffraction (XRD), FTIR, Raman spectroscopy, UV-VIS spectroscopy, SEM, TEM, and EDAX. XRD analysis revealed a decrease in crystallite size with increasing TiC content, indicating successful composite formation. SEM and TEM studies demonstrated uniform dispersion and integration of TiC within the HAp matrix, enhancing surface morphology and particle distribution. Optical studies showed absorption behavior suitable for bio-implant compatibility with a band gap ranging from 3.87 to 3.96 eV. Mechanical tests revealed that the composite with 5 wt% TiC exhibited the highest compressive strength (186 MPa) and improved fracture toughness, suggesting optimized load-bearing capability for orthopedic applications. ALP and MTT assays confirmed superior osteogenic activity and cell viability for the 95HAp–5TiC composition. Additionally, zirconia-reinforced PMMA composites were prepared using a heat-cure technique to enhance the mechanical performance of denture base materials. XRD and SEM analyses confirmed improved crystallinity and structural integrity with increasing ZrO<sub>2</sub> content. Mechanical tests indicated a notable enhancement in hardness and Young's modulus, particularly in composites containing 1–5 wt% ZrO<sub>2</sub>, supporting their application in dental prosthetics. Overall, the incorporation of TiC and ZrO<sub>2</sub> significantly improves the mechanical, structural, and biological performance of HAp and PMMA matrices, making them strong candidates for next-generation biomedical implants and prosthetic materials.

# **Improving the Fatigue Design of Mechanical Systems such as Refrigerator**

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## **Abstract**

To enhance the lifetime of mechanical system such as automobile, new reliability methodology – parametric Accelerated Life Testing (ALT) – suggests to produce the reliability quantitative (RQ) specifications—mission cycle—for identifying the design defects and modifying them. It incorporates: (1) a parametric ALT plan formed on system BX lifetime that will be X percent of the cumulated failure, (2) a load examination for ALT, (3) a customized parametric ALTs with the design alternatives, and (4) an assessment if the system design(s) fulfil the objective BX lifetime. So we suggest a BX life concept, life-stress (LS) model with a new effort idea, accelerated factor, and sample size equation. This new parametric ALT should help an engineer to discover the missing design parameters of the mechanical system influencing reliability in the design process. As the improper designs are experimentally identified, the mechanical system can recognize the reliability as computed by the growth in lifetime, LB, and the decrease in failure rate. Consequently, companies can escape recalls due to the product failures from the marketplace. As an experiment instance, two cases were investigated: 1) problematic reciprocating compressors in the French-door refrigerators returned from the marketplace and 2) the redesign of hinge kit system (HKS) in a domestic refrigerator. After a customized parametric ALT, the mechanical systems such as compressor and HKS with design alternatives were anticipated to fulfil the lifetime – B1 life 10 year.

# **Electrochemical Performance of Supercapacitor Nanocomposites Electrode Based on Bamboo and Coconut Coir Activated Carbon with Mangan Dioxide**

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## **Abstract**

Fabrication of nanocomposites electrode based on activated carbon has been continuously developed for increasing electrochemical performance of super capacitor. The low energy density of super capacitors has restricted them from many applications that require devices with long duration. The nanocomposite electrode based on Bamboo Activated Carbon with Mangan dioxide (BAC/MnO<sub>2</sub>) and Coconut Coir Activated Carbon with Mangan Dioxide (CCAC/MnO<sub>2</sub>) have been fabricated with composition of 730/30% by weight ratio. Characterization of the electrical conductivity of (BAC/MnO<sub>2</sub>) and (CCAC/MnO<sub>2</sub>) nanocomposites electrode were carried out using Point Probe measurement. The electrochemical performance of super capacitor nanocomposite electrode using CV measurement. The measurements results of electrical conductivity of the BC/MnO<sub>2</sub> and BAC/MnO<sub>2</sub> nanocomposite electrode are 426  $\square$  S/cm and 482  $\square$  S/cm respectively. And for the CCC/MnO<sub>2</sub> and CCAC/MnO<sub>2</sub> nanocomposite electrode are 81.1  $\square$  S/cm and 88.2  $\square$  S/cm respectively. The results measurements for electrochemical performance (specific energy) of the BC/MnO<sub>2</sub> and BAC/MnO<sub>2</sub> nanocomposite electrode are 0,0098 Wh/kg and 0,0682 Wh/kg respectively. And for the CCC/MnO<sub>2</sub> and CCAC/MnO<sub>2</sub> nanocomposites electrode are 0,0179 Wh/kg and 0,0493 Wh/Kg respectively.

## **Keywords**

Nanocomposite electrodes, electrochemical, MnO<sub>2</sub>.

# **Assessing Congo Basin Forest Vulnerability from Photochemical Ozone and Stratospheric Tropospheric Exchange using Hysplit and NCEP Reanalysis Models**

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## **Abstract**

The purpose of this paper is to document and warn scientists and politics about the vulnerability of Congo basin forest with regards increasing tropospheric ozone increasing due to climate change using Hysplit back trajectory and forecasting, and NCEP reanalysis models over the Congo. It is common knowledge that this part of the world is poorly documented, despite the important role the Congo basin forest plays to regulate global climate (Carbon sequestration, 1.7 tonne/ ha versus 1.2 T/ha for Amazonian basin forests). Located either side of the equator, this African hub is exposed to all sort of anthropogenic and abiotic drivers ranging from rapid population growth, deforestation due to anthropogenic activities (agriculture, illegal logging, forest by-products collection...), long lasting armed conflicts and climate change effects. Increasing tropospheric ozone concentrations noticed over the region for the last past three decades as well as the intrusion of stratospheric ozone into the troposphere constitute an indubitable pressure to forest loss. Remote sensing data from Mozaic and SHADOZ and NOAA reanalysis on zonal wind and composite plot of back trajectory HYSPLIT model representing the air mass pathway at three different altitudes 3000 m, 5000 m and 7000 m have proven the increasing tropospheric ozone over the region. Long term mean eddy divergence 1 sigma computed from NCEP reanalysis model provides evidence of positive values higher in spring, which vary from 1.5e to 4.5 e. These parameters confirm well the higher contribution of stratospheric tropospheric exchange, although the contribution of Indian Ocean on the synoptic weather system in equatorial eastern Africa have been noticed. We suggest the control of ozone precursors over the region as well as over remote surrounding trans boundary areas to evaluate the contribution from long range transport of air mass containing tropospheric ozone that are able to destroy Congo basin forest due to climate change.

# **Nutritional food intake and body composition according to phases of the menstrual cycle in university women with excess malnutrition, belonging to the University of Bio-Bio, Chile**

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## **Abstract**

The phases of the menstrual cycle cause hormonal changes that influence eating behaviour and body composition. The aim of the study was to analyse nutritional food intake and body composition according to luteal and follicular phases of the menstrual cycle in university women with excess malnutrition, belonging to the Universidad del Bío-Bío, Chile. Cross- sectional analytical study, which included 15 adult women with excess malnutrition (fat mass>26%). Dietary intake was measured by 24-hour multi-step recall survey, applied on 3 non-consecutive days of the week in the follicular and luteal phase of the menstrual cycle. Body composition was measured by tetrapolar bioelectrical impedance in the follicular and luteal phase of the menstrual cycle. Statistical analysis was performed with STATA 17.0 software at a statistical significance level of  $p<0.05$ , paired t-test was applied for comparison. In the luteal phase the average protein intake was 66.1 g versus the follicular phase 55.9 g, higher by 10.2 g ( $p=0.0168$ ). In the follicular phase, the average sucrose intake was 30.9 g versus 20.7 g in the luteal phase, higher by 10.2 g ( $p=0.0039$ ). In terms of body composition, only the luteal phase showed numerical differences in hip circumference, body weight and

extracellular water, plus 1.8 cm, 0.3 kg and 0.8%, respectively, compared to the follicular phase. Participants showed a significant increase in protein intake in the luteal phase and sucrose intake in the follicular phase, but not in the other macronutrients; no statistically significant differences in body composition were observed between the two phases.

**Keywords:** menstrual cycle, luteal phase, follicular phase, dietary intake, composition

# **Cubosomes as a Platform for Intranasal Delivery of Cannabidiol**

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## **Abstract**

Cubosomes are created of amphiphilic polar lipid in the presence of a suitable stabiliser. The amphiphilic substances above critical micellar concentration form micelles. With an increase in concentration, the micelles are forced to form a cubic structure. Cubosomes have the ability to encapsulate hydrophilic, hydrophobic and amphiphilic drugs, sustaining the drug release. They are biocompatible, bioadhesive and have thermodynamic stability.

The aim of this study was to enhance the delivery of cannabidiol (CAN) to the brain through the transnasal route by cubosomes. Cubosomes were prepared using glycerol monooleate and Tween 80 by probe sonication method. Optimization of cubosomes was made. The selected sample was cubical in shape, having mean particle size  $90.5 \pm 0.12$  nm. Entrapment efficiency was found to be 93.08% with zeta potential of  $-24.9$  mV. After optimization, a dissolution test was performed. In vitro release of cubosomal sample showed controlled release of drug profile (72%) up to 24 h. Loaded cubosomes are stable for 6 months at  $4 \pm 2^\circ\text{C}$  (refrigerator) and  $25^\circ\text{C} \pm 2^\circ\text{C}$ , 60% RH  $\pm 5\%$ . The cubosomal dispersion could be considered as a promising carrier for brain targeting of CAN through the transnasal route.

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# **Development and Analysis of a Dermal System for Traumatic Skin Conditions Based on KIT6/PAMAM Dendrimers**

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## **Abstract**

Dendrimers are highly branched, nanoscale polymeric structures with unique physicochemical properties, making them promising agents for dermal drug delivery. Their well-defined architecture allows precise functionalization with hydrophilic or hydrophobic groups, facilitating drug solubilisation and controlled release. As penetration enhancers, dendrimers interact with the stratum corneum, disrupting its lipid bilayer and increasing skin permeability into the deeper skin layers. This property enhances the dermal delivery of both hydrophilic and lipophilic drugs. Additionally, dendrimers can reduce drug degradation and improve bioavailability. Poly (amidoamine) (PAMAM) dendrimers is particularly studied for their ability to encapsulate active molecules and transport them within the skin layers, offering potential in treating localized conditions. The synergistic use of dendrimers and mesoporous silica (MSNs) in dermal applications offers significant advantages for drug delivery. Dendrimers, with their branched architecture and functional surface groups, enable precise drug loading and controlled release, enhancing solubility and stability of therapeutic agents. MSNs provide a biocompatible framework with high surface area and tunable pore sizes, facilitating efficient drug encapsulation and protection from degradation. When combined, dendrimers can be integrated into MSNs' pores or surface, creating a dual delivery system that enhances skin permeability and prolonged release. This synergy optimizes drug bioavailability, minimizes side effects, and demonstrates potential for treating skin disorders effectively. Mesoporous silica KIT-6 exhibits a three-dimensional cubic pore structure and high surface area, making it a promising candidate for dermal applications. Its uniform mesopores facilitate the loading and controlled release of bioactive molecules. KIT-6's biocompatibility and potential for enhancing drug permeation through the skin position it as an innovative platform in topical drug delivery systems.

The aim of the present study is to combine the beneficial properties of PAMAM dendrimers with those of KIT-6 mesoporous silica nanoparticles in a drug delivery system for use in traumatic skin disorders. The developed system has been physicochemically and biopharmaceutically characterized, demonstrating high potential for dermal application in cases of traumatic skin conditions.

# **Innovative Framework for Improving Medical Biotechnologies**

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## **Abstract**

Bioreactors in which processes based on cell multiplication are carried out can have different configurations, but all must take into account the characteristics of biochemical systems. Thus, the geometry of the system must consider the size, morphology and evolution of biomass concentration, the special sensitivity of cells and enzymes to environmental factors and shear forces, the need to carry out biochemical processes under aseptic conditions.

The objective of this study is to explore process improvement strategies aimed at optimizing bioreactors, separation units, and other equipment used in biomedical processes. The analysis of mixing in bioreactors through the level of homogenization creates the premises for selecting the most efficient stirring system, respectively for optimizing the mixing of a particular fermentation broth. One of the most used criteria for characterizing mixing efficiency is the mixing time, defined as the time required to reach a certain mixing intensity, starting from a completely segregated situation. 3D printing technology plays a crucial role in the design and manufacturing of various bioreactor components. Its application enables enhanced customization, rapid prototyping, and cost-efficient production. As material, Polylactic Acid is suitable for bioreactor agitators due to its biocompatibility and low environmental impact, being an excellent choice for the pharmaceutical applications. Advantages of 3D Printed Agitators include a rapid prototyping and flexibility (researchers can easily modify and iterate on designs, enabling continuous improvement and adaptation to evolving bioprocess requirements). Also, an optimal mixing time, in accordance with the specifics of the cell culture, leads to the overall efficiency of the process. Last but not least, 3D printing reduces material waste and lowers production costs, making it an economical choice for lab-scale production, for now. Thus, it is possible to select a type of agitator or a combination of agitators for each fermentation liquid or fermentation liquids with similar characteristics.