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Editorial

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Dear reader,

Since the pioneering experiments of Louis Pasteur, conducted in collaboration with Marie Laurent in the nineteenth century, chirality has captivated scientific, artistic, and philosophical thought. By observing crystals derived from tartaric acid, Laurent and Pasteur distinguished mirror-image forms and opened a window onto one of the most profound problems in science: the preference for one symmetry over another in matter. In living systems, this asymmetry is clearly manifested, as certain molecular forms predominate over their mirror images and acquire specific functions. Chirality can be recognized at multiple scales, from subatomic particles to biological systems and cosmological structures. This special issue of *La Granja: Revista de Ciencias de la Vida*, in collaboration with the *Institute of Nuclear Sciences of the National Autonomous University of Mexico (UNAM), the Chemical Research Center of the Autonomous University of the State of Morelos (UAEM), Mexico, the Faculty of Sciences of the National Autonomous University of Mexico (UNAM)*, and the *Interdisciplinary Research Network on Chirality (RiiQ)*, explores some of its multiple facets and its role in the organization of matter and living systems.

The study of chiral symmetry breaking in crystalline systems has provided a robust theoretical and experimental model for understanding how asymmetry may have emerged before the origin of life. The crystallization of $NaClO_3$, an achiral compound in solution that forms enantiomorphic conglomerates, demonstrates that chirality can emerge at the supramolecular level from simple systems. This phenomenon is addressed in the manuscript by Cruz-Rosas, H. et al., "*Chiral Symmetry Breaking in $NaClO_3$ Crystals as a Model for the Study of Biological Homochirality*," which analyzes experimental conditions that allow a system initially lacking chiral preference to transition toward states of high enantiomeric purity.

Processes such as secondary nucleation and Viedma deracemization show that local fluctuations, coupled with dissolution and crystallization cycles induced by mechanical or thermal energy, can amplify an asymmetry without necessarily requiring an initial external bias. These nonequilibrium processes offer plausible scenarios for understanding how an initially racemic prebiotic chemistry could have evolved toward chiral preferences. However, the transition between this physicochemical asymmetry and its fixation in self-replicating systems remains an open question. Were crystalline processes decisive in biasing chemical evolution, or did they act jointly with other physical mechanisms?

Biological homochirality, particularly the predominance of L-amino acids in protein synthesis, has traditionally been considered a characteristic property of life. However, as Díaz Aguilar, J. et

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al. explain in "*A Look at* D*-Amino Acids in Living Organisms*," this view has been enriched by the discovery of essential functions performed by D-enantiomers in different organisms.

D-amino acids such as D-alanine and D-glutamate are fundamental components of bacterial peptidoglycan, whereas D-serine and D-aspartate perform relevant functions in mammals. This coexistence raises a central question: how do organisms preserve the chiral fidelity of their proteome while selectively using the opposite enantiomer? Enzymatic mechanisms such as D-aminoacyl-*tRNA* deacylases contribute to this control. Rather than absolute homochirality at all levels, life thus reveals a scenario in which homochirality and heterochirality can functionally coexist.

At a higher level of complexity, chirality is also manifested in the organization of genetic information. The work by Rios-Willars et al., "*Tendency Toward Functional Asymmetry and Microsatellite-Induced Helical Chirality in Staphylococcus aureus*," explores this dimension through the analysis of repetitive sequences or microsatellites. The differences observed in the distribution of motifs such as ATAT, AGAG, and ACAC suggest a reorganization of repetitive architecture with possible structural and evolutionary implications. This asymmetry introduces a spatial and conformational dimension into genome organization that transcends its description as a simple linear sequence.

We currently have more tools available to understand chiral symmetry breaking and its amplification, yet we have still not unraveled why asymmetry appears so persistently in nature. Is the chiral preference of biological systems the consequence of initial fluctuations amplified through nonlinear and autocatalytic processes, or does it reflect more fundamental asymmetries in the laws of physics, such as parity violation in the weak interaction? The answer may lie at the convergence of different levels of explanation.

This search resonates with the work of Germinal Cocho Gil† and Thomas Buhse†, two leading figures in the study of complexity and chirality, whom we miss and remember with admiration in these pages. Their contributions broadened our understanding of irreversibility, symmetry breaking, and the emergence of order in chemical and biological systems.

In this context, the Interdisciplinary Network for Research on Chirality in Mexico constitutes a space for dialogue and collaboration among those who study these phenomena from different disciplines. Its annual meeting, which this year will be held at the Institute of Nuclear Sciences of UNAM on November 12, 2026, represents an opportunity to share ideas and chart new avenues of research. This special issue of *La Granja* contributes to this effort by providing a platform for disseminating knowledge and stimulating debate.

As living beings, we embody symmetry breaking in our cells, amino acids, proteins, and in the helical structure of DNA. Molecular asymmetry is not merely a geometric curiosity: it is intimately linked to the organization and functionality of life. However, life is also a dynamic and fragile process. When it ends, the slow process of racemization begins; the molecular orientation associated with function fades, and the system once again moves toward thermodynamic equilibrium. The amino acids that once formed part of active proteins progressively tend toward racemic states, like an echo of the prebiotic chemistry of the early Earth from which they emerged.

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Chirality at different scales confronts us with questions that span physics, chemistry, and biology, and invites us to reflect on the relationship between elementary particles, life, and the cosmos; between order and equilibrium; between functional asymmetry and thermodynamic symmetry. This special issue of *La Granja* does not seek to offer definitive answers, but rather to delineate some of the frontiers that our academic community continues to explore. In this sense, it constitutes an invitation to critically examine one of the most persistent questions in science: how, from matter and its interactions, could the organization that gave rise to life have emerged?

Following the three manuscripts in the special section on chirality, the issue opens to seven miscellaneous articles in the life sciences. Although diverse, they share the same purpose: to transform rigorous observation into knowledge capable of explaining the complexity of living systems and guiding their care. Watersheds, reserves, native species, and foods thus trace a continuity between fundamental research, conservation, and innovation.

Two studies highlight the need for continuous observation of environmental changes. First, Raúl Moreno and María Flores analyze the Wawayme River watershed in Ecuador, where the reduction in vegetation cover associated with mining activities modifies the hydrological response and demonstrates that changes in land use directly affect water availability and dynamics. The study emphasizes the importance of combining monitoring, mitigation, and conservation with actions that strengthen the resilience of local communities.

Meanwhile, Jaime Enrique Maza, Hugo Anazco, Darwin Poma, and Alex Luna study the Arenillas Ecological Reserve. The analysis identifies high-risk areas near roads and productive activities and confirms that protecting the interior of a reserve is insufficient if its boundaries are not managed. Conservation requires protecting adjacent areas, reducing anthropogenic pressures, and maintaining connectivity with other natural remnants.

Regional biodiversity, in turn, is presented as a source of knowledge and added value. Laura Scalvenzi, Sting Luna Fox, and Matteo Radice optimize a freeze-dried extract of *Ilex guayusa* rich in caffeine. Ultrasound-assisted aqueous extraction and product characterization provide a technological basis for developing ingredients intended for energy drinks. The study shows how an Amazonian resource can generate added value when innovation is grounded in rigorous and responsible processes.

Likewise, Johana Meneses, Stephanie Moncayo, María Elena Maldonado, and Ramiro Acurio evaluate extracts of *Vaccinium floribundum* against *Staphylococcus saprophyticus*. The marked antimicrobial activity observed *in vitro* links the phenolic and anthocyanin richness of mortiño with a promising response. The study broadens the scientific horizon of an Andean species of cultural and productive relevance.

Food systems complete this journey. David Vivanco, Haydee Rodríguez, Raúl Siche, and David Callirgos optimize the drying of Muscat of Alexandria grapes. Indirect solar drying reduces processing time and maintains high acceptability, demonstrating that the use of mathematical models can improve efficiency without compromising quality. This approach offers relevant alternatives for agri-food chains seeking to make better use of solar energy.

Likewise, Luis David Jarquín-Izaguirre, Luisa

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Fernanda Correa Díaz, and Saúl Alejandro Jarquín-Izaguirre review the management of *Zabrotes subfasciatus* in common bean. The integration of cultural, physical, chemical, and plant-breeding methods emerges as the most robust strategy for protecting stored grains and reducing dependence on insecticides. Monitoring, resistant varieties, and producer training are essential for food security.

Environmental quality is also expressed through what is not always visible. The study conducted in Espíndola by David del Pozo, María de los Ángeles Álvarez, and Bryan Valle found concentrations of settleable particulate matter below the regulatory limit, but confirmed the presence of heavy metals. Compliance with a standard, therefore, should not be interpreted as the absence of risk. Strengthening air-quality monitoring in rural communities will make it possible to identify at an early stage the effects of vehicular emissions and extractive activities, areas in which information remains limited.

Taken together, this issue articulates two complementary perspectives within the life sciences. The special section on chirality investigates the fundamental asymmetries involved in the organization of matter and biological systems; the miscellaneous section extends this same commitment to understanding toward concrete challenges involving territories, biodiversity, food production, and environmental quality. From molecular architecture to watershed dynamics or forest conservation, the works brought together here confirm that life can only be understood through dialogue across scales, disciplines, and contexts. With this issue, *La Granja* renews its commitment to plural, rigorous, and context-sensitive science, capable of posing fundamental questions while simultaneously providing tools for building healthier, more sustainable, and more resilient futures.

Sincerely,

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