

Report Seminar on Global Health, Biodiversity, and Therapeutics

A. Seminar Overview

The Harvard Herbaria and the University of Costa Rica's Department of Pharmacy jointly organized a hybrid seminar on "Global Health, Biodiversity, and Therapeutics" on August 20 at the University of Costa Rica. A day-long event included 16 presentations from a multidisciplinary group of experts, from Latin America, the US, and Europe, presenting in-person and virtually (Annex 1).

The presentations covered various topics at the intersection of natural therapeutics, biodiversity, and global health challenges.

The R&D of new natural therapeutics for various health conditions:

- Neglected tropical diseases
- Cancer
- Dementia
- Long COVID-19

Presenters also discussed the science behind how plants produce important bioactive molecules for use in medicine.

Research Resources and Methodologies

Several presentations highlighted important data resources and techniques for researchers:

- The National Cancer Institute's dataset on natural products, which includes taxonomic information, and NCI-60 cancer screening data. The Universidad Católica de Santa María in Peru is developing PeruNPDB, a database of native natural compounds using cheminformatics format.
- DNA sequencing techniques were discussed, with a focus on barcoding using fungi as an example. A pre-seminar workshop on August 19 provided hands-on training for downloading sequencing data from the Sequence Read Archive (SRA).

Sustainable Production Methods

The company Botanical Solutions presented a sustainable industrial production model for plant-based compounds using in vitro cultivation methods.

Seminar Materials and Impact

- **Presentations:** All PowerPoint presentations are available for review at <https://hwpi.harvard.edu/biodivtherapeutics/global-health-biodiversity-and-new-medicines-Aug2024>

- **Recorded Video:** A full recording of the seminar with timestamps is accessible online <https://www.youtube.com/live/JfYnfu9NVsc>
- **Audience Engagement:** As of today, the recorded video has reached over 700 views.

B. Projects in discussion post-seminar

Search for therapeutics for specific diseases

Advancing Cancer prevention and treatment

To advance the development of innovative cancer treatments, a multi-institutional research team is being formed focusing on promising compounds derived from both traditional and non-traditional medicine. This collaborative effort includes the University of Costa Rica Institute of Pharmacy, INDICASAT in Panama (Dr. Spandafora), the Universidad Católica de Santa María in Peru, the Universidad La Frontera in Chile, and Emory University Hospital in the United States.

The team will systematically investigate compounds used in traditional medicine, adhering to the Nagoya Protocol to ensure fair benefit-sharing with Costa Rica, Panama, and Peru, all signatories of this agreement. Additionally, the research will explore non-traditional natural sources for potential therapeutic properties.

To advance to the preclinical evaluation process, the team will collaborate with Dr. Pamela Leal from Universidad La Frontera in Chile. Dr. Leal will use organoid models to test plant extracts for their efficacy against cancer cells. Further, promising phytochemicals will be advanced to clinical work in partnership with Dr. Omer Kucuk, an oncologist at Emory University Hospital.

This collaborative effort will try to identify angel investments from regional sources.

Available resources

The National Cancer Institute Natural Products branch is prepared to share its taxonomic identification and **NCI-60 anticancer screening data** on extracts from plants collected in host countries that allowed the NCI collection with those host country representatives. On a bilateral basis, and in the spirit of the arrangements outlined in the NCI NPB Letter of Collection.

Alzheimer and dementia

The Computational Biology and Chemistry Group from the Universidad Católica de Santa María in Peru is collaborating on a grant application to the Fogarty Institute. They are targeting the Institute's call for brain research proposals from middle- and low-income countries. To strengthen their application, the team has enlisted the support of Dr. Antonio Currais, an expert on Alzheimer's disease, dementia, and aging from the Salk Institute. Also, they consult with Dr. Carmenza Spadafora with many years of experience in applying for NIH grants. Dr. Flora Katz from the Fogarty International Center at NHI will also be consulted.

Research and Development Methodologies

Virtual screening

INDICASAT is developing an innovative new Strategic Plan for the use of natural compounds, to drive advances in biomedicine and agriculture. This plan includes the creation of a database of chemical structures derived from Panamanian biodiversity first and later from other countries, which will serve as a platform for virtual screenings. This will allow for analyses to identify promising molecules for the development of new drugs and agricultural products.

Identifying, and validating natural materials

Identifying and naming are fundamental for the effective and safe use of medicinal plants. Methods bridge traditional practices with modern science. Latin America and the Caribbean region, face significant knowledge gaps in plant and fungi identification. In addition, we plan to start developing a comprehensive database using a robust methodology to evaluate the medicinal properties of native plants and fungi. This will be based on both published and unpublished literature. The participating institutions are:

- The Universidad la Frontera in Chile is working to expand and improve its herbaria.
- APTA hub (Andes Pacific Technology Access), a consortium of 20 Chilean universities focused on supporting innovation, including biotechnology includes the University of Chile and the Catholic University exploring to contribute to building the dataset.
- The Universidad Católica de Santa María in Peru is involved in developing PeruNPDB, a database of natural compounds using a cheminformatics format. This database could be improved to include data with therapeutic applications.

Available for collaborating on data analysis and validation

Professor Ryan Nett's lab at Harvard University uses innovative approaches to understand how plants synthesize bioactive molecules that are critical to medicine, agriculture, and industry. The long-term goal is to elucidate pathways for valuable plant-derived compounds such that these molecules can be engineered in tractable systems. His lab has expertise in the chemistry of plant natural products and is well-positioned to analyze biochemical data related to the research and development of these compounds in drug discovery. This expertise includes the isolation, purification, and structural validation of diverse metabolites that are produced in plants, as well as the characterization of biosynthetic enzymes that are responsible for building these molecules.

Professor Matthew Smith and his team at the University of Florida offer valuable collaborative opportunities for identifying and studying fungi and their biology. Smith identifies fungal species using traditional methods and advanced DNA sequencing techniques. The lab also supports the curation of specimens for long-term preservation in fungaria, ensuring both proper documentation and storage. Finally, Smith is willing to collaborate with institutions working on

the biological and chemical properties of fungi. Improving knowledge of biodiversity and conservation

Available for collaboration in identifying, naming, and curating native plants

The Royal Botanic Gardens, Kew is a world-renowned botanical research and education institution that places a strong emphasis on building and curating extensive datasets and herbarium collections. As part of its mission to document and understand global plant and fungal diversity, Kew maintains several important databases and digital resources, including *Plants of the World Online*, *International Plant Names Index*, and *Plants for Health* directed by Bob Allkin.

Intellectual Property and Benefit Sharing

Data sharing emerges as a prominent theme in this year's post-seminar discussion, reflecting the current boom in Artificial Intelligence. However, this trend introduces new intellectual property challenges, particularly when dealing with compounds derived from traditional knowledge. Equally important is non-traditional knowledge requiring protection for both the researcher's and the country's sovereignty. So, open data in scientific research must be balanced against the need to safeguard valuable intellectual assets.

We can learn valuable lessons from best practices in implementing Access and Benefit Sharing (ABS) mechanisms and sharing data for example,

India's National Biodiversity Authority (NBA) is a prime example of ABS implementation. Recognizing the importance of protecting traditional knowledge, the NBA has created a database that is accessible to patent examiners worldwide. This database serves as a reference to prevent patents on existing knowledge without proper acknowledgment. When violations are detected, the NBA usually facilitates compliance through education and communication.

GISAID's Genomic Database, sponsored by the World Health Organization, is another example. During the COVID-19 pandemic, GISAID played a crucial role by providing a platform for rapid and open sharing of SARS-CoV-2 genomic data. This facilitated global collaboration among researchers and accelerated the development of diagnostics, vaccines, and surveillance of viral variants. GISAID offers a model for responsible data sharing by providing open access to data while requiring contributors and users to register and agree to a Database Access Agreement. GISAID gives contributors enduring control over the genetic data they upload, fostering trust and collaboration within the scientific community. This protects contributors' rights while ensuring the data is accessible for research and development.

For further collaboration on Benefit-Sharing Access (ABS) Alejandro Lago, international consultant on environmental law and policy, former Manager of the UNDP-GEF Global project on ABS, and Ashwin Budden now a fellow at the Center of Bioethics at the Medical School at Harvard are interested in presenting and co-sponsoring a webinar.

**Annex 1. Program Global Health, Biodiversity, and Therapeutics Hybrid Seminar,
Harvard University Herbaria and University of Costa Rica
Costa Rica August 20, 2024**

Opening remarks 9:00-9:25 am Costa Rica Time

María Laura Arias Echandi MSc Vicerrectora de Investigación de la Universidad de Costa Rica

Dr. Luis Esteban Hernández Decano de la Facultad de Farmacia de la Universidad de Costa Rica

Prof. Donald Pfister, former director of the Harvard Herbarium and curator of the Farlow Library and Herbarium. Harvard Faculty of Arts and Sciences

Veronica Vargas, Ph.D. Research Associate, Harvard Faculty of Arts and Sciences

Intellectual Property

9:25-9:45 am

The current state of Access and Benefit Sharing (ABS) for genetic resources in Latin America

Dr. Jorge Cabrera Medaglia, Professor at the University of Costa Rica.

This talk will present the latest developments in implementing Access and Benefit Sharing in Latin America and the Caribbean.

Finding New Natural Products for Diseases

9:45-10:05 am

The MEDINA Foundation pioneering work in natural-products-based drug discovery for neglected diseases

Olga Genilloud, Scientific Director MEDINA Foundation, Spain

This Foundation is dedicated to discovering drugs for neglected diseases overlooked by pharmaceutical companies, such as antibiotics and antiparasitic molecules.

10:05-10:25 am

Phytochemicals in cancer prevention

Dr Omer Kucuk, Emory University, United States

Phytochemicals have great potential in cancer prevention because of their safety, low cost, and oral bioavailability. In this presentation, their potential for cancer prevention will be discussed.

Coffee break 10:25-10:55 am

10:55-11:15 am

National Cancer Institute's Program for Natural Product Discovery

Dr. Tanja Grkovic, Staff Scientist at Natural Products Branch, DTP,

National Cancer Institute, USA

An overview of the current research and collaborations of the NCI will be presented.

11:15-11:35 am

Screening for novel therapeutics for treating dementia

Dr. Antonio Currais, Staff Scientist, Salk Institute for Biological Studies, USA

A brief review of cell-based and animal models of aging and dementia to identify therapeutics from natural products.

11:35-11:55 am

The quest for natural products with antitrypanosomal and anticancer potential using computational biology and chemistry.

Miguel Angel Chavez, Computational Biology and Chemistry, Universidad Catolica de Santa Maria – Peru

Computer-aided drug discovery applied to compounds derived from natural sources can speed up drug design and save costs.

11:55-12:15 pm

Understanding and harnessing the diversity of plant chemistry and metabolism

Ryan Nett is an Assistant Professor of Molecular and Cellular Biology at Harvard University

Understanding plants' diverse chemical compounds and metabolic processes is crucial for their adaptation, survival, and applications in medicine and biotechnology.

Funding Opportunities

12:15-12:30 pm

Funding opportunities for natural products research

Flora N. Katz, Ph.D. Director, Division of International Training and Research

Fogarty International Center, National Institute of Health, USA

Large extract banks and local capacities

12:30-12:50 pm

Natural Products-based Bioprospecting Program at INDICASAT: Tackling the Panamanian Biodiversity Hotspot for Drug Discovery

Dr. Marcelino Gutiérrez – INDICASAT Center for Biodiversity and Drug Discovery

Panama is one of the megadiverse zones of the planet. Our program explores different taxa of biodiversity as a source of novel molecules with biomedical applications.

12:50-1:10 pm

Basic of barcodes and their uses

Mattew E. Smith, University of Florida, Gainesville, Florida

The talk will describe how to build molecular barcoding capacity-building projects at the country level.

Lunch 1:10 pm – 2:30 pm

Natural product supplements

2:30-2:50 pm

Exploiting the plant *Quillaja Saponaria* as a source of therapeutic compounds - industrial production

Gaston Salinas, CEO of Botanical Solutions

BSI has developed "ABM-01" based on a plant native to Chile. This product is the active ingredient used in producing therapeutics.

2:50-3:10 am

Exploring Costa Rica's potential for novel drug development

MSc. Gustavo Carazo Berrocal, Director of the Industrial Department, Pharmacy Faculty, University of Costa Rica.

The research projects of the Pharmacy Faculty of the University of Costa Rica

Coffee Break 3:10-3:30 pm

3:30-3:50 pm

Validating the Bioactivity of Panama's '*Desbaratadora*': In Vitro Approaches

Dr. Carmenza Spadafora, Center for Cellular and Molecular Biology of Diseases (CBCMe), Panamá

Updates on searches for cancer therapeutics

3:50-4:10 pm

Using natural extracts in the fight against COVID-19 and its sequelae

Dr Tamara Rubilar, Universidad Nacional de la Patagonia San Juan Bosco, Argentina
Updates on the project that searches therapeutics for COVID-19.

4:10-4:30 pm

Herbal medicines from the Araucania Region: an opportunity for Human and Societal well-being

Dr. Pamela Leal-Rojas and Dr. Adinson Altamirano, Department of Natural Resources, Faculty of Agricultural and Environmental Sciences, University of La Frontera, Chile

Adopting a holistic perception of bioactive compounds offers a new opportunity for sustainable development and supporting women 's businesses in the Araucania.

Closing remarks

German Madrigal, Director, Department of Pharmacy, University of Costa Rica

Dra. Giselle Tamayo, Director, Center for Research of Natural Products