

# BIO-NEWS

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*Quarterly e-newsletter of the*

# INSTITUTE OF BIOLOGY SRI LANKA



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## DESIGN

Dr. A. M. Wickramasuriya



Institute of Biology, Sri Lanka  
120/10, Wijerama Mawatha  
Colombo 07

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[iob.newsletter@gmail.com](mailto:iob.newsletter@gmail.com)

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## COVER STORY

This stunning photograph, featured on our cover, is one of the winning photographs from the *IOBSL E-Photography Competition 2024*. It beautifully reflects the artistry and passion of biology enthusiasts, celebrating the intricate beauty of the natural world.

Photograph by Mr. M. A. S. N. Mallawaarachchi

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Happy  
**New Year**  
*2025*

**We wish all IOBSL members a very happy  
new year!**

**May this year bring you abundant joy,  
success, and countless opportunities for  
scientific exploration and achievement...**

**BIO-NEWS Editorial Team**

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# PRESIDENT'S MESSAGE

The Institute of Biology Sri Lanka (IOBSL), a leading professional body of Biologists in Sri Lanka, aims to promote education in biology at all levels. It has been established under the act of parliament of Act No. 22 of 1984. The institute deals with the government sector, private sector, and many other non-governmental organizations in the country pertaining to the various matters in the field of biology. The capacity of the IOBSL as an entrenched professional body reflects the nation from its widespread categories of membership and in terms of quality and quantity of the members. Under the highlighted objectives of the IOBSL, knowledge dissemination, encouraging biology education, and advice to the government and other institutions on all matters connected with the application of biology have been identified as key points. The IOBSL provides for special membership as a “Chartered Biologist” (C.Biol) other than the main membership category (M.I.Biol.), which endorses the high standards expected of biologists and is for international recognition as a hallmark of professional competence and ethical conduct. Chartered status represents a high level of biological expertise, personal integrity, and professional excellence, in addition to academic qualifications. In Sri Lanka, the IOB offers a prestigious senior professional membership category, known as the “Fellow of the Institute of Biology” (F.I.Biol). This honor is awarded to the most experienced biologists who are members of the IOBSL.

This year, the theme of the IOBSL is identified as '*Biological Innovation for Food Security and a Sustainable Green Economy*'. The significance of biological innovation lies not only in its potential to boost agricultural productivity but also in its ability to create a sustainable green economy in the country. Key advancements include the development of climate-resilient crops, as well as the development of non-traditional alternative food sources, and the application of digital agriculture and smart agriculture technologies that enhance the productivity of farmers. As technological progress intertwines with environmental sustainability, the success of biological innovation in agriculture will depend on robust knowledge dissemination, effective commercialization of novel research findings, and well-designed regulatory frameworks. In that respect, the IOBSL BIO-NEWS e-newsletter plays a significant role in disseminating knowledge and sharing new research findings in the field of biology in Sri Lanka. Although the BIO-NEWS e-newsletter was launched recently, it has significantly contributed to knowledge sharing among scientific communities. Therefore, I would like to express my profound gratitude to the editorial board and the scientists across the country who have contributed to the IOBSL BIO-NEWS e-newsletter.



**Prof. (Dr. rer. agr.) B. D. Rohitha Prasantha**  
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Institute of Biology, Sri Lanka (IOBSL)

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Faculty of Agriculture  
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**Dr. D. Halwatura**

BSc (Kelaniya), PhD (UQ)  
Department Zoology and Environment  
Sciences  
University of Colombo  
Sri Lanka



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**Dr. U. A. Jayawardena**

BSc (Peradeniya), MPhil (Peradeniya),  
PhD (Colombo)  
Department of Zoology  
Faculty of Natural Sciences  
The Open University of Sri Lanka



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**Dr. Vindhya K. Fernando**

BSc (Colombo), PhD (Colombo)  
Department of Zoology and Environment  
Sciences  
Faculty of Science  
University of Colombo  
Sri Lanka



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**Mr. K. M. Sudesh Ruvinda**

BSc (Kelaniya), MPhil (Kelaniya)  
Department of Zoology and Environmental  
Management  
Faculty of Science  
University of Kelaniya  
Sri Lanka



**EDITOR**

**Dr. A. M. Wickramasuriya**  
BSc (Colombo), PhD (Reading)  
Department of Plant Sciences  
Faculty of Science  
University of Colombo  
Sri Lanka



**ASSISTANT EDITOR**

**Dr. P. D. Dayananda**  
BSc (Colombo), PhD (SJP)  
Molecular Genetics Laboratory  
Department of Zoology  
University of Sri Jayewardenepura  
Sri Lanka



**SECRETARY**

**INTERNATIONAL RELATIONS**

**Prof. Hiran Amarasekera**  
BSc (SJP), PhD (Wales)  
Department of Forestry and Environmental  
Science  
Faculty of Applied Sciences  
University of Sri Jayewardenepura  
Sri Lanka



**COUNCIL MEMBER**

**Dr. K. G. Sameera U. Ariyawansa**  
BSc (Colombo), MSc (Colombo), PhD (Massey)  
Department of Plant Sciences  
Faculty of Science  
University of Colombo  
Sri Lanka



**COUNCIL MEMBER**

**Dr. I. U. Kariyawasam**  
BSc (SJP), MSc (Edinburgh),  
PhD (Edinburgh)  
Senior Lecturer  
Department of Botany  
Faculty of Applied Sciences  
University of Sri Jayewardenepura  
Sri Lanka



**COUNCIL MEMBER**

**Dr. P. K. C. B. Wijerathna**  
BSc (Colombo), MPhil (SJP) PhD (USQ)  
Department of Botany  
Faculty of Applied Sciences  
University of Sri Jayewardenepura  
Sri Lanka



**COUNCIL MEMBER**

**Dr. P. Dharmasena**  
BSc (RUSL), MSc (Peradeniya), PhD (India)  
National Institute of Plantation Management  
Ministry of Plantations Industries  
Sri Lanka



**COUNCIL MEMBER**

**Dr. Surani Ediriweera**  
BSc (Kelaniya), PhD (Colombo)  
Department of Plant Sciences  
Faculty of Science  
University of Colombo  
Sri Lanka



**COUNCIL MEMBER**

**Dr. W. M. T. P. Ariyaratne**  
BSc (Peradeniya), MSc (Japan),  
PhD (Colombo)  
Department of Crop Science  
Faculty of Agriculture  
University of Peradeniya  
Sri Lanka



**AUDITOR**

**Mr. P.G Maithirathna**  
Deputy Bursar  
University of Sri Jayewardenepura

# IOBSL NEWS AND EVENTS

## IOBSL's 44th Annual Sessions and the Annual General Meeting

The Institute of Biology, Sri Lanka (IOBSL), held its 44th Annual Sessions and Annual General Meeting on September 27, 2024, at the Center for Banking Studies, Sri Jayawardenepura Kotte. The event revolved around the theme "*Achieving a Circular and Sustainable Bioeconomy*," emphasizing the institute's commitment to sustainability and innovative biological research.

### **Presidential Address and Keynote Speech:**

Dr. K.G. Sameera U. Ariyawansa, President of IOBSL (2023/2024), delivered the Presidential Address titled "*The Role of Fungi in a Sustainable and Circular Bioeconomy: Current Status*." Dr. Ariyawansa highlighted fungi's essential contributions to ecological and economic sustainability, showcasing their transformative potential in sustainable practices.

The keynote speech, presented by Senior Professor Ajith de Alwis from the Department of Chemical and Process Engineering at the University of Moratuwa, further enriched the event. His address, titled "*Transitioning Our Economy - Go Circular and Embrace the Bioeconomy*," offered valuable perspectives on the shift towards a circular economy and the integration of bioeconomic principles.







### ***Tribute to Excellence in Fungal Biology:***

In a heartfelt tribute, IOBSL honored Emeritus Professor Nelum Deshapriya for her outstanding contributions to fungal biology and plant pathology. The citation, presented by Prof. Priyanganie Senanayake of the University of Kelaniya, highlighted Professor Deshapriya's lifelong dedication to advancing knowledge in these fields of study.

### ***Launch of Thematic eBook:***

One of the event's highlights was the official launch of IOBSL's thematic publication, "*Achieving a Circular and Sustainable Bioeconomy.*" Co-edited by Dr. Sameera Ariyawansa and Prof. H.D. Dharshani Bandupriya, this eBook is a valuable resource for academics, researchers, educators, and students exploring sustainable biology.

### ***Recognition of Emerging Scientists:***

The Young Scientist Award 2024 was presented to Dr. Danushika Charyangi Manatunga, Senior Lecturer at the University of Sri Jayewardenepura, for her outstanding contributions to Industrial Biosystems Technology. This recognition underscores IOBSL's dedication to fostering innovation and nurturing young talent in biological sciences.



### ***Technical Sessions:***

The technical sessions featured 87 peer-reviewed abstracts, presented by researchers on various topics aligned with the event's theme, further promoting knowledge sharing and scientific dialogue.



FOS  
media

The 44<sup>th</sup> Annual Sessions of the Institute of Biology  
Organized by Institute of Biology Sri Lanka

@Center for Banking Studies  
27 / 09 / 2024



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The 44<sup>th</sup> Annual Sessions of the Institute of Biology  
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27 / 09 / 2024



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The 44<sup>th</sup> Annual Sessions of the Institute of Biology  
Organized by Institute of Biology Sri Lanka

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*View all pictures from the event in our Facebook album*

# Highlights of IOBSL Activities: 2023/2024

## IOBSL Memorial Oration

The annual IOBSL Memorial Oration honors esteemed members of the IOBSL, recognizing their exceptional research contributions to biology and the institute. This year's oration was dedicated to the late Prof. B.A. Abeywickrama, celebrating his remarkable legacy in biology and his invaluable contributions to the IOBSL.



The event, held on 27th August 2024, featured an inspiring address by Prof. Siril Wijesundara from the National Institute of Fundamental Studies, Sri Lanka. His oration, titled "*Cultivating Conservation: Nurturing Sri Lanka's Plants through Ex-situ Conservation*," showcased strategies and approaches for preserving the nation's plant biodiversity.

The event was organized in collaboration with Dilmah Conservation, the sustainability arm of Dilmah Ceylon Tea, which is dedicated to promoting green restoration, research, education, awareness, and advocacy for environmental conservation.



## Inter-University Biology Quiz Competition

The IOBSL successfully organized the Inter-University Biology Quiz Competition for the 7th consecutive year, open to undergraduates from state and non-state universities/educational institutes recognized by the University Grants Commission, Sri Lanka. The competition was held in two stages. Stage I took place virtually on 15th June 2024, with the participation of 44 undergraduate students representing 13 universities/educational institutes. The Centre for Education Technology and Media (CETMe) at the Open University of Sri Lanka facilitated the online examination via Learn OUSL. Following Stage I, the top 16 students based on their performance were selected to advance to Stage II, which was held on 6th July 2024, at the University of Colombo. The winners were:

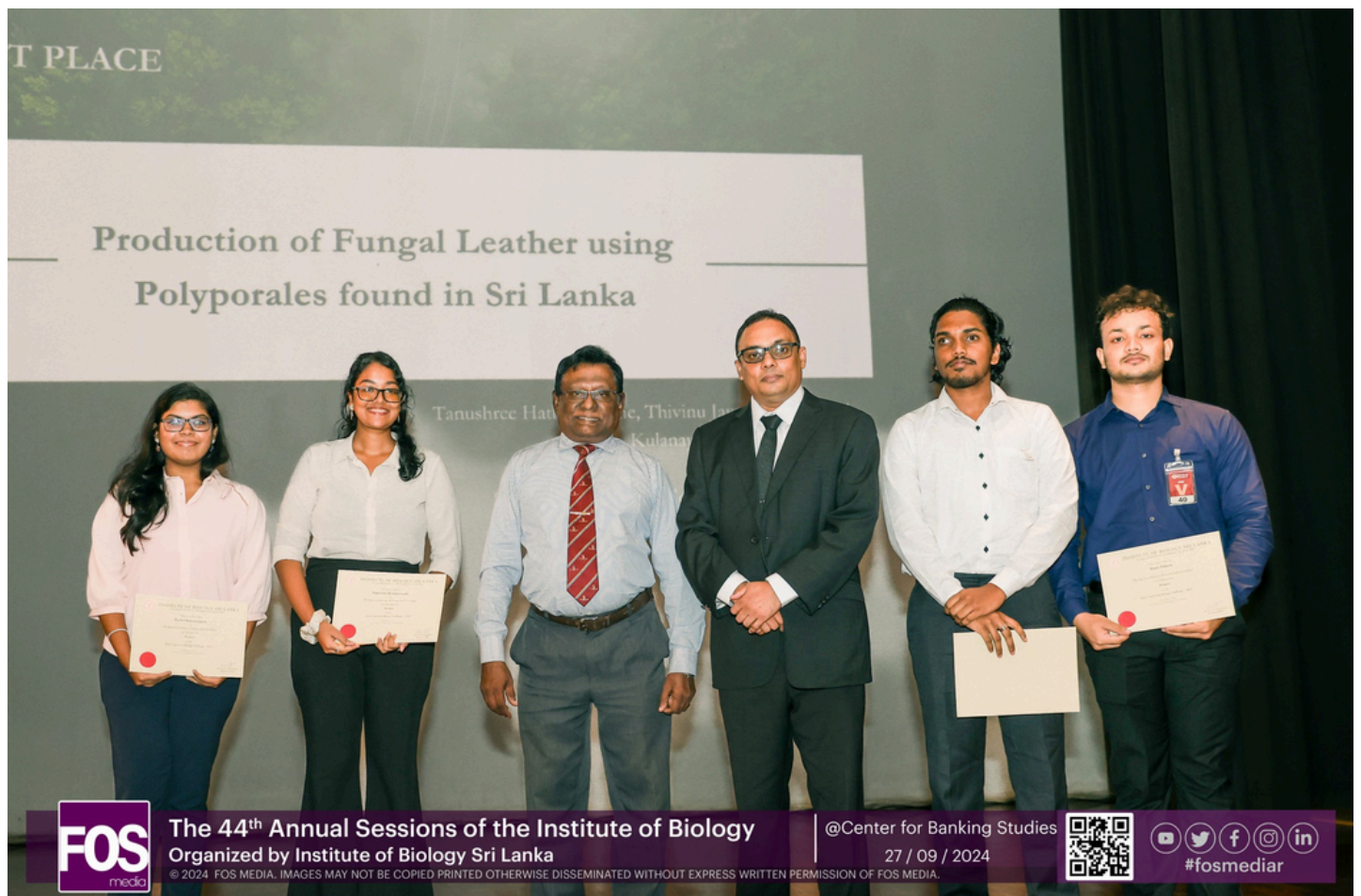
- Champion: Ms. B. K. G. N. H. Gunawardhana (University of Sri Jayewardenepura)
- First runner-up: Mr. T. H. Nishen Malinda (University of Colombo)
- Second Runner-up: Ms. M. R. Rizna (University of Colombo)



## Inter-University Biology Challenge 2024

This competition was opened to multidisciplinary teams of undergraduate students from both state and private universities in Sri Lanka. The competition aimed to inspire innovative, impactful proposals aligned with the IOBSL's theme of the year, “Sustainable Bioeconomy.” Following a thorough evaluation of both the proposals and team presentations, three winning teams were selected:

- First Place: The team from Spectrum Institute of Science and Technology, consisting of Tanushree Hatharasinghe, Thivinu Jayasinghe, Rachel Kulanayagam, and Manic Edman, won with their proposal titled “*Production of Fungal Leather Using Polyporales Found in Sri Lanka.*”
- Second Place: The team from Uva Wellassa University of Sri Lanka, consisting of N.D.M. Kodikara, W.A.C.N. Wickramasinha, S.P.U. Kaveesha, and W.P.S.S. Warnasooriya, received the award for their proposal “*Introducing a Novel Enhanced Biofertilizer: A Three-in-One Seaweed-Based Solution Leveraging VRT Technology Beyond Traditional Biofertilizers.*”
- Third Place: The team from the University of Sri Jayewardenepura, including W. Rachini Ishara Rajapaksha, M.M. Muhammadu Musni, K.A. Sapna Madurika Jayarathne, and N.V. Dasuni Nethmini, secured third place with their proposal “*Unlocking the Blue Treasure: The Hidden Potential of Aquaculture Waste for Bioplastic.*”



## Young Scientist Award 2024

The Young Scientist Award of the IOBSL was introduced in 2022 to recognize the achievements and contributions of young biologists who demonstrate excellence in research, leadership, and innovation within the field of biology in Sri Lanka.

In 2024, the prestigious award was presented to Dr. Danushika Charyangi Manatunga, Senior Lecturer at the Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura. Dr. Manatunga was recognized for her outstanding contributions to the field of Industrial Biosystems Technology.



## e-Photography Competition

The IOBSL held an exciting e-Photography competition under the theme "*Art of Nature*" to celebrate the beauty and diversity of the natural world. The competition featured two categories: Best Biology Photographer of the Year (18 years and over) and Best Young Biology Photographer of the Year (under 18 years).

In the 18 years and over category, Mr. Vanodhaya Warnasooriya was named Best Biology Photographer of the Year for his outstanding photography. Mr. M.A.S.N. Mallawaarachchi secured the first runner-up position, while Mr. U. W. A. C. Lakmal claimed the second runner-up. Six additional contestants were recognized with merit awards.

In the under 18 years category, Master Resen Fernando was awarded Best Young Biology Photographer of the Year. Master Ramith Bandara and Ms. Kanimozhi Kanesananthan were named first and second runners-up, respectively, with three other contestants receiving merit awards. Additionally, the photograph titled "*Shot of Flight*" submitted by Master Resen Fernando was selected as the Most Popular Biology Photograph of the Year, reflecting the admiration and popularity of his captivating image.

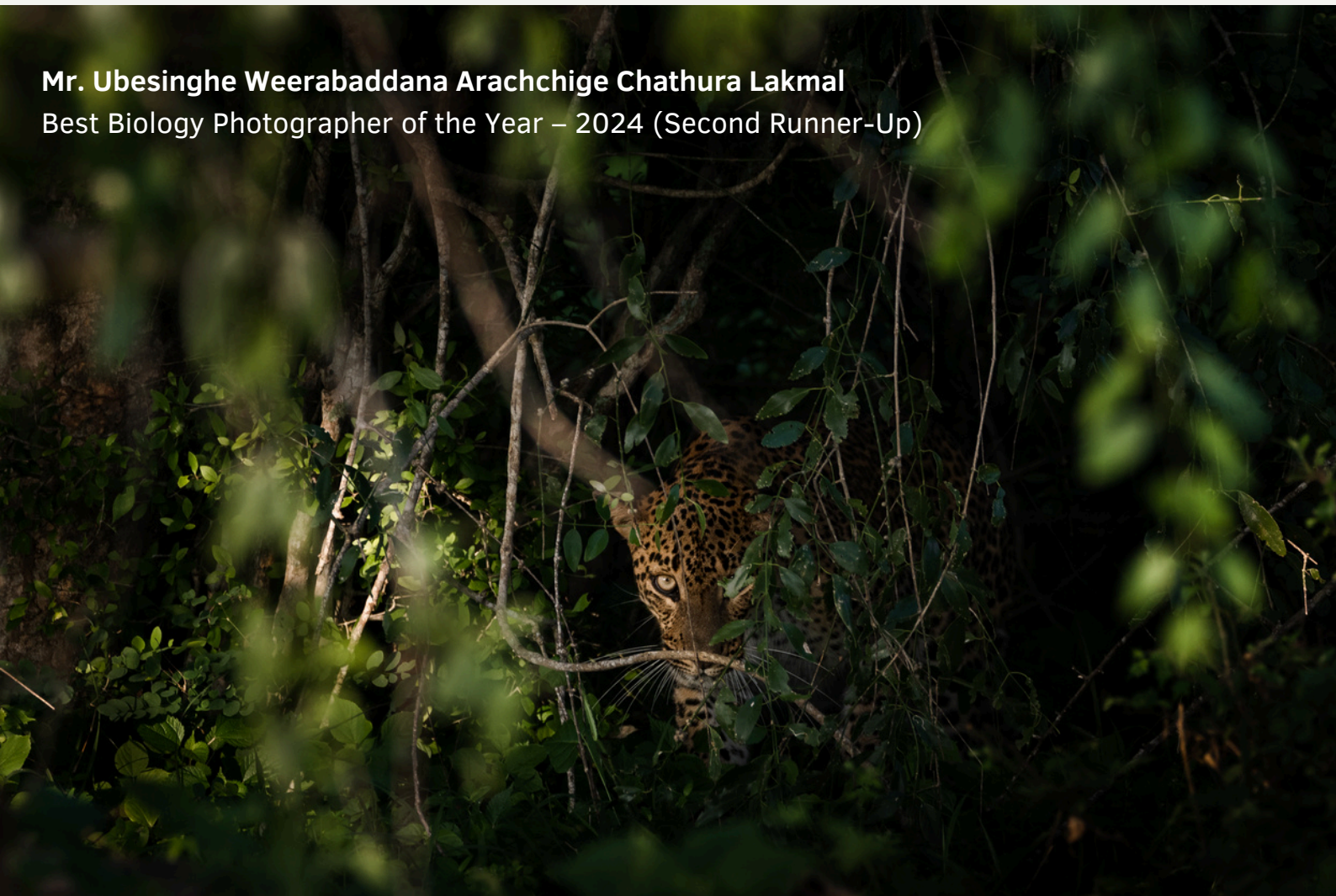


**Mr. Vanodhaya Warnasooriya**  
Best Biology Photographer of the Year – 2024



**Mr. M. A. S. N. Mallawaarachchi**  
Best Biology Photographer of the Year – 2024 (First Runner-Up)

**Mr. Ubesinghe Weerabaddana Arachchige Chathura Lakmal**  
Best Biology Photographer of the Year – 2024 (Second Runner-Up)



**Master Resen Fernando**  
Best Young Biology Photographer of the Year – 2024





**Master Ramith Bandara**  
**Best Young Biology Photographer of the Year – 2024 (First Runner-Up)**



**Ms. Kanimozhi Kanesanathan**  
**Best Young Biology Photographer of the Year – 2024 (Second Runner-Up)**



**Master Resen Fernando**  
**Most Popular Biology Photograph of the Year – 2024**



## Courses, Workshops and Webinars

**Workshop on Identification of Tropical Plant Families:** A two-day workshop on tropical plant identification took place on 30th August and 1st September 2024 at the Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura. The workshop aimed to spark interest among undergraduates, postgraduates, and researchers in various aspects of plant biology, focusing on identifying tropical plant families using floral and vegetative characters. This engaging workshop, organized by the IOBSL in collaboration with the Botany and Plant Biotechnology Society of the University of Sri Jayewardenepura provided participants with hands-on experience in identifying tropical plant species and enhanced their theoretical and practical knowledge in plant taxonomy and biodiversity.



**Nature Trails Workshop Series on Wildlife Management in Plantation Ecosystems:** The National Institute of Plantation Management (NIPM) and IOBSL successfully organized the first session of the Nature Trails Workshop Series titled “*Wildlife Management in Plantation Ecosystems*”, held from 26th to 28th April 2024, in the Knuckles Mountain Range. This workshop brought together experts, enthusiasts, and professionals from the plantation, environmental, and tourist sectors. Participants had the opportunity to explore the conservation and management of wildlife within plantation ecosystems, focusing on balancing agricultural practices with ecological preservation.





**Talk on Molecular Diagnostics of Emerging Diseases:** The Base for Enthusiasts in Environment and Zoology (BEEZ), in collaboration with the Identification of Emerging Agents Laboratory of the Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, and IOBSL organized a lecture on ‘*Molecular Diagnostics of Emerging Diseases*’ on 21st, November 2023. The event held at the Prof. V. K. Samaranyake Auditorium, University of Colombo School of Computing, featured Prof. Andreas Nitsche, Head of the Division of Highly Pathogenic Viruses at the Robert Koch Institute, Germany.



**Short Course Series in Statistics for Biologists:** A virtual short course series in statistics, tailored specifically for biologists, was successfully conducted, targeting undergraduate and postgraduate students, researchers, and clinicians. This comprehensive series aimed to enhance statistical knowledge and practical skills essential for biological research.

**VIRTUAL SHORT COURSE SERIES IN STATISTICS FOR BIOLOGISTS**

Starting from 12th August 2024

**TARGET GROUP**

- Undergraduate and postgraduate students, researchers and clinicians

**COURSE CONTENT**

- Data collection and exploration
- Hypothesis testing and experimental design
- Statistical modeling
- Multivariate data
- Forecasting methods

Provide hands-on experience using R

**COURSE FEE**  
5,000 LKR (Per course)

**BUNDLE OFFER**  
20,000 LKR (if registering for all 5 courses)

**CLOSING DATE FOR REGISTRATION**  
10th August 2024

Register Now

A certificate of participation will be awarded for each module (if 75% of attendance is fulfilled per module)



## ESSENTIALS IN BIOINFORMATICS

An online workshop specially designed for undergraduate and postgraduate students, as well as young researchers who are new to bioinformatics.

20 Hours After 6 PM (Weekdays/Weekends) Commencing from 10th August 2024

### COURSE CONTENT

- Biological databases and tools
- Protein bioinformatics
- Introduction to NGS analysis using Galaxy

### Course Fee

EARLY REGISTRATION: 6,500 LKR  
LATE REGISTRATION: 8,500 LKR  
REGISTRATION DEADLINE: 7TH AUGUST 2024

### RESOURCE PERSONS



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DEPARTMENT OF PLANT SCIENCES  
FACULTY OF SCIENCES  
UNIVERSITY OF COLOMBO



**DR. PASAN FERNANDO**  
DEPARTMENT OF PLANT SCIENCES  
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Register Now



<https://forms.gle/kar03ekthioviayjPA>

A certificate of participation will be awarded to those who fulfill 75% attendance

More information: Dr. Anushka Wickramasuriya anushka@pbs.cmb.ac.lk +9471 155 4123

**Two-Day Workshop for GCE Advanced-Level Biology Teachers and Students:** A two-day online workshop was held on 11th September and 18th September 2024. The workshop covered topics such as Immunity and various Techniques used in DNA analysis, providing teachers and students with valuable resources for enhancing their understanding of these essential biological concepts.

**TWO DAY ONLINE WORKSHOP**  
G.C.E. ADVANCED LEVEL BIOLOGY UNIT 7

**INSTITUTE OF BIOLOGY SRI LANKA**  
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11 & 18 September 2024  
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Medium: Bilingual

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+94718113301  
devan.halwatura@zoology.cmb.ac.lk  
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*The IOBSL extends a warm invitation to all passionate individuals interested in the diverse realms of biology to join its esteemed community today*

To join the IOBSL and become part of this dynamic community, visit our website  
<https://www.iobsl.org/how-to-join-the-institute>





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# FEATURE ARTICLES

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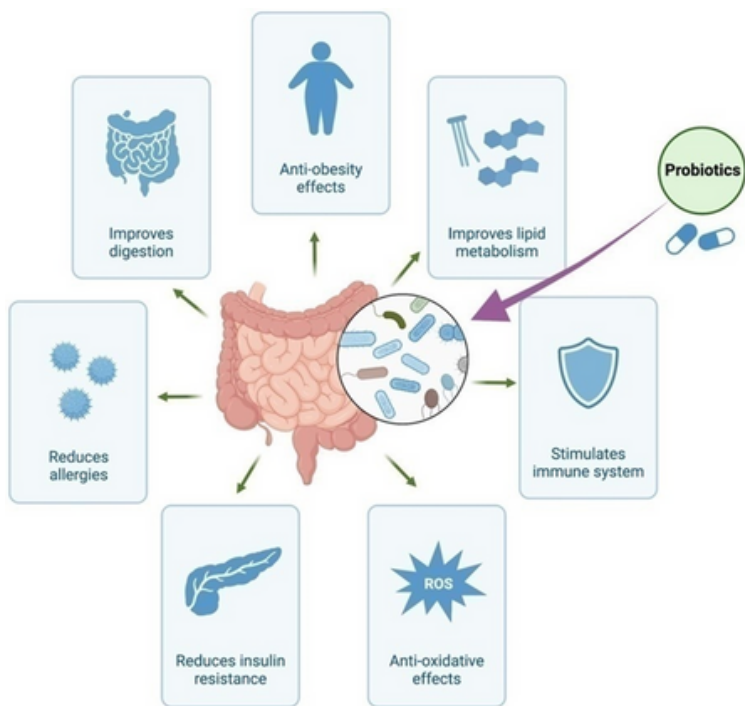
## Paraprobiotics and Postbiotics: Novel and Emerging Concepts Beyond Synbiotic Functional Foods

In recent years, the growth of the consumer demand for probiotic functional food has prominently continued, emphasizing consumer awareness of functional foods and beverages for a healthy life. Probiotic functional foods expanded the global food and beverage market growth and reached 68.56 billion USD in 2022 and are expected to reach 133.92 billion USD in 2030. Researchers and manufacturers are extensively studying administering probiotics and prebiotics in a single product and producing synbiotic functional foods to gain more health benefits and conquer consumer demand. Postbiotics and paraprobiotics are two newly emerging concepts that are furthering the synbiotic functional food concept. This short account is intended to discuss the current functional foods, their implication on health, and the trends toward novel functional products.

### Synbiotic food products

Synbiotic functional foods are a combination of probiotics and prebiotics which show synergistic beneficial effects for host health, with improved survival and colonization of probiotics in the gut. Since ancient times, probiotic consumption has been notable among Egyptians and Middle Eastern civilians and fermentation has been used to improve the keeping quality and to extend the shelf-life of foods.

In 2014, the International Scientific Association for Probiotics and Prebiotics (ISAPP) revised the existing definition of probiotics by the World Health Organization (FAO/WHO) as “live microorganisms that, when administered in adequate amounts, confer a health benefit on the host”. The main probiotic genera are *Lactobacillus* and *Bifidobacterium* which are generally regarded as safe (GRAS) for consumption. The common health benefits of probiotics are shown in Figure 1.



**Figure 1** Health benefits of probiotics  
Source: Prajapathi et al. (2023)

As per Martyniak et al. (2021), prebiotics are defined as “non-digestible food ingredients that selectively stimulate the growth of beneficial bacteria such as *Lactobacillus* and *Bifidobacterium* in the intestine that have a positive influence on the host’s health”. The most common prebiotics, inulin, fructooligosaccharides, and glucooligosaccharides which are not digested by gastrointestinal enzymes reach the colon to be fermented by the bacterial microflora. Therefore, prebiotics are important to retain and transport probiotics inside the gut environment.

Mostly, probiotics modulate immunity and stimulate the immune defense system. The important defense mechanisms are strain-specific including the production of antibacterial compounds such as lactic acid, hydroperoxides, and bacteriocins. Moreover, probiotics prevent allergic reactions including

inflammations, and enhance anti-infection activities. Further, probiotics contribute to maintaining a healthy digestive tract. However, maintaining the viable cell count of  $10^8$ -  $10^9$  colony-forming units/gram during the processing, storage, and digestion is quite a challenge in the functional food industry in relation to technological and therapeutic aspects.

### Concept and definition of paraprobiotics and postbiotics

The majority of consumers benefit from consuming live probiotic food products however, some individuals do not prefer functional food containing live probiotics due to specific health concerns. Therefore, the novel concept of introducing and administering inactivated bacterial strains, bacterial fragments, and their metabolic products to obtain similar therapeutic effects is currently in consideration. Further, probiotic viability is a crucial factor during large-scale industrial production up to consumption since it depends on the composition and the nature of the food matrix, and the processing and storage conditions. However, industrially, paraprobiotics and postbiotics are more stable and safer than probiotics, therefore, application in food products is important due to the technological and economic advantages for the food manufacturers and consumers compared to the viable probiotics.

Thus, the term “paraprobiotics” was introduced and defined by FAO/WHO as “non-viable microbial cells (intact or ruptured) or raw cellular extracts (with complex chemical composition), which when administered (orally or topically) in adequate amounts, confer a

benefit to the human or animal consumer". The term was first used by Tavertiti and Guglielmetti. Paraprobiotics offers health benefits similar to probiotics. Therefore, this phenomenon was called as "the probiotic paradox".

The term "postbiotics" or "metabiotics" are "probiotic cell fragments" or "probiotic cell-free supernatants" which are bioactive soluble byproducts or factors produced by live probiotic bacteria or released after rupturing cells that offer health benefits to the host directly or indirectly.



**Ms. T. M. D. A. Jayawardana, M. I. Biol. (Sri Lanka)**  
Food Technology Section  
Industrial Technology Institute, Sri Lanka



**Prof. C. M. Nanayakkara, M. I. Biol. (Sri Lanka)**  
Department of Plant Sciences  
Faculty of Science, University of Colombo  
Sri Lanka



**Dr. H. M. T. Herath**  
Food Technology Section  
Industrial Technology Institute, Sri Lanka



**Dr. D. U. Rajawardana, M. I. Biol. (Sri Lanka)**  
Food Technology Section  
Industrial Technology Institute, Sri Lanka

## Categories of paraprobiotics and postbiotics

During the commercial production processes, selected probiotic strains will be cultivated and then inactivated with ionization, radiation, high-pressure drying, and changing the pH values. Categories of paraprobiotics are peptidoglycan, teichoic acid, cell wall polysaccharides, cell surface proteins, Leu-Pro-X-Thr-Gly (LPXTG) proteins, S-layer proteins, pili proteins, and moonlighting proteins.

The production of postbiotics is done by rupturing viable probiotic cells with heat, ultrasound, solvent treatment, and enzymatic activities. Then the required compounds can be extracted and cleaned by centrifugation, dialysis, lyophilization, and column purification. The most important postbiotics are short-chain fatty acids, organic acids, enzymes, peptides, tryptophan, bacteriocins, endopolysaccharides and exopolysaccharides, cell surface proteins, and vitamins which can be found in probiotic functional foods.

## Important therapeutic aspects of paraprobiotics and postbiotics

Presently, many scientific studies prove that paraprobiotics and postbiotics are excellent sources for human health. Paraprobiotics and postbiotics are safer alternatives for those who cannot directly consume live cells such as immune-deficient and immune-compromised patients. The use of paraprobiotics and postbiotics reduces the risks of developing opportunistic pathogen attacks, developing antibiotic-resistant pathogenic bacteria and

commensals, gastrointestinal disorders, cancers, and microbial translocation. According to the studies, the consumption of heat-inactivated probiotics offers various biological responses. These biological response-modifying activities are almost similar to the oral administration of an immunizing vaccine. Therefore, modulating adaptive and innate immune systems is the main feature of the paraprobiotic action. Research showed that similar species of viable and non-viable probiotic cells trigger similar immunological responses in similar pathways or different mechanisms of action. For instance, live and dead fecal *Lactobacillus acidophilus* inhibited the attachment of pathogenic *Escherichia coli* and *Salmonella* to Caco-2 cells. Although some of the mechanisms of paraprobiotics are not clearly examined, they exert anti-inflammatory responses in the gastrointestinal tract. To gain specific health benefits, the modes of inactivating probiotic live cells are very important.

Short-chain fatty acids (SCFA) are one of the major postbiotics that preserves gut barrier function. Further, SCFA is involved in energy and lipid metabolism reducing obesity, diabetes, and inflammatory risk diseases. Bacteriocins are extracellular antimicrobial peptides that inhibit the growth of pathogens by creating pores in cytoplasmic membranes causing leakage of intracellular components. Exopolysaccharides produced by lactic acid bacteria confer anti-oxidative characteristics by scavenging free radicals, regulating gut microbiota, lowering cholesterol activity, and immunomodulatory effects. Peptidoglycan is a bacterial cell wall component responsible for inhibiting interleukin-12 production that regulates T-cells, interferon-gamma (IFN- $\gamma$ ), and tumor necrosis factor-alpha

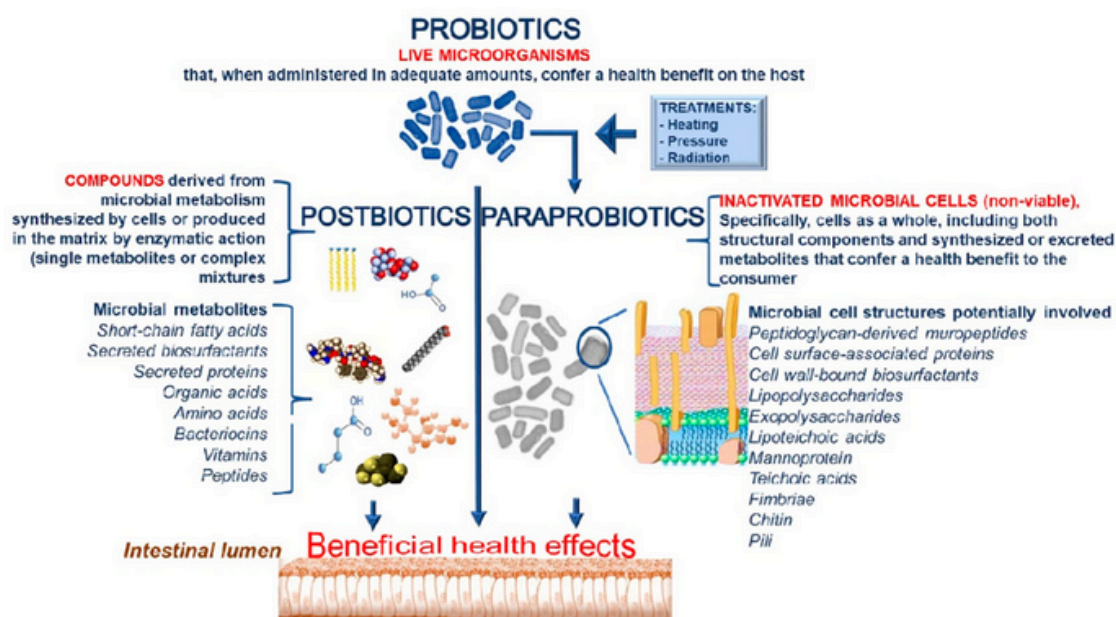
(TNF- $\alpha$ ). Many health benefits can be acquired through the consumption of postbiotics including fermented foods. The beneficial health effects of “paraprobiotics” and “postbiotics” are illustrated in Figure 2.

## Technological aspects of paraprobiotics and postbiotics in the functional food industry

With the introduction of novelties in the concepts of paraprobiotics and postbiotics, new perspectives are opened up overcoming drawbacks associated with live probiotics and simplifying industrial handling and marketing in the functional food industry. Compared to probiotics, paraprobiotics and postbiotics are more stable, easy to store and handle, and do not need to maintain cold preservation during transport. During the processing, paraprobiotics and postbiotics do not directly interact with food matrices and do not cause changes in organoleptic properties. Further, these can be added to foods before thermal

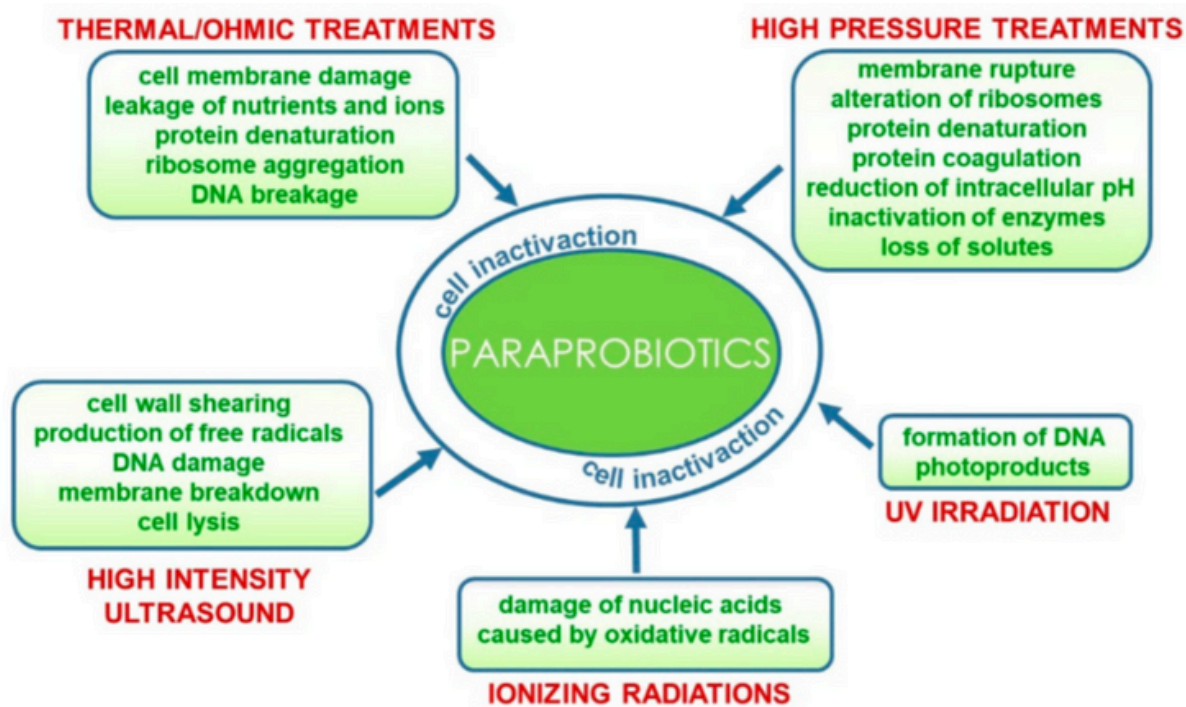
treatments assuring food safety. Since paraprobiotics and postbiotics are not live components, prolonged shelf-life can be guaranteed for such products ensuring the economic advantages.

For paraprobiotics, probiotic cells can be inactivated through physical or chemical treatments, as a result, microbial cell components and physiological functions are modified without destroying the cell. Figure 3 illustrates different types of cell inactivation methods. More effective inactivation methods and targeted health benefits can be achieved by combining several inactivation techniques. The introduction of Ohmic heating is an alternative to conventional heating methods which could lead to a fast and uniform heating process. Further, the high-intensity ultrasound (HIUS) technique was recently introduced for the inactivation of probiotics. This method leads to cell lysis followed by the formation of acoustic cavities that break down the cell membrane, and cell wall and damage genetic materials.



**Figure 2** Definitions of probiotics, postbiotics and paraprobiotics and beneficial health effects

Source: Siciliano et al. (2021)



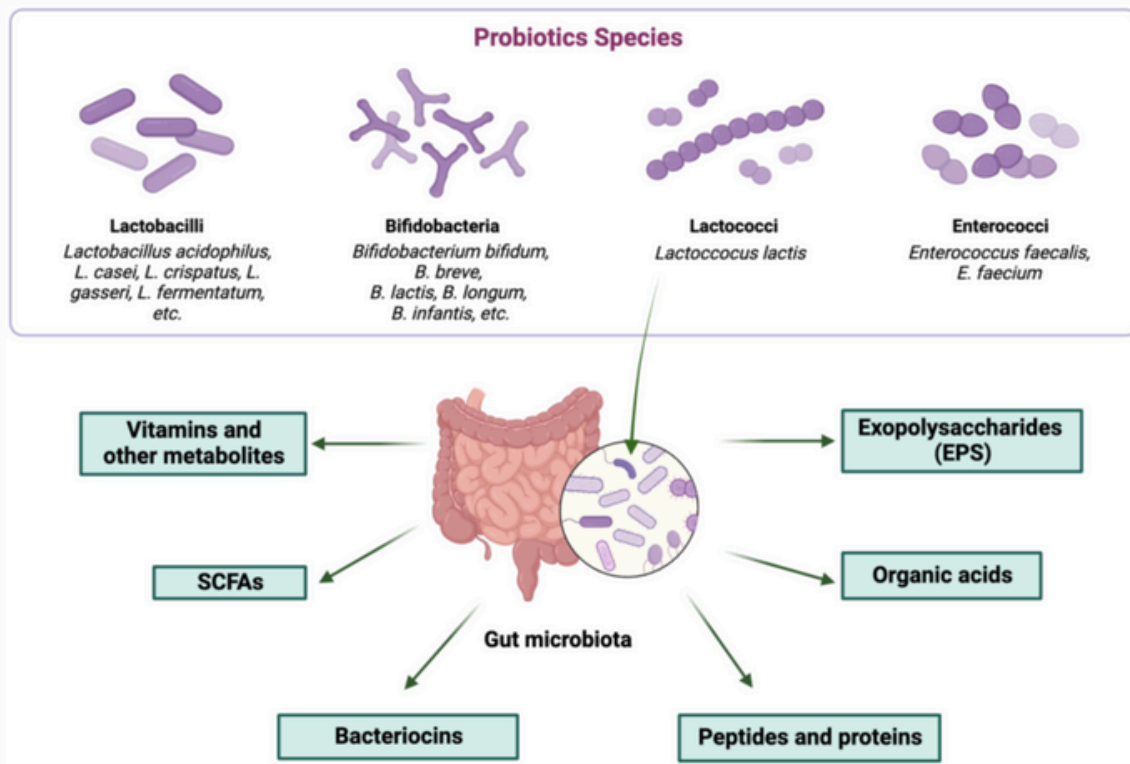
**Figure 3** Production processes of “paraprobiotics”

Source: Siciliano et al. (2021)

Postbiotics are produced by probiotics utilizing prebiotics guaranteeing more health benefits. This is explained in Figure 4. Some postbiotics such as exopolysaccharides are intentionally added to the food products due to their technological functions to improve the organoleptic properties of the final products. The yield of postbiotics can be increased via process optimization such as the selection of suitable probiotic strains, optimizing the growth conditions suitable for the specific metabolic pathways, and optimizing fermentation conditions to achieve maximum productivity. Since postbiotics are composed of complex molecules, specialized qualitative and quantitative techniques are required for the characterization and identification of such molecules. Chromatography and capillary electrophoresis can be possibly used for isolation and quantification purposes. However, spectroscopic techniques are available to identify the composition of the

structures. Thus, an innovative approach called extracellular metabolomics, which is a collection of several analytical techniques capable of monitoring primary and secondary metabolic levels secreted during microbial fermentation would be useful in the future for the quality control of postbiotics and probiotics in the food industry.

**To summarize, the evolving concept of “paraprobiotics” and “postbiotics” in the synbiotic functional food arena creates novel pathways for food production processes, food ingredients and products, and medication for various diseases highlighting the superior stability over “probiotics” and “prebiotics”. Further, more human/clinical trials are highly needed for the validation and confirmation of health claims on these biomolecules.**



**Figure 4** Production of postbiotics from probiotics  
Source: Prajapati et al. (2023)

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# UPDATES ON THE LATEST RESEARCH

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## Understanding Drinking Water Sources: Key to Quality and Sustainability

### Drinking water sources

Drinking water source is the key to providing clean water where it meets the basic needs of any community. With the increasing population, the demand for drinking water has risen, and providing clean water has become more challenging. United Nations' Sustainable Development Goals: Goal 6 calls for the importance of clean water and sanitation, in terms of protecting public health and environmental sustainability.

The World Health Organization (WHO) states that a drinking water source must come from an improved water source, be located on premises, be available when needed, and be free from faecal and priority chemical contamination. In general, both surface water and groundwater sources are used as drinking water sources at the global scale.



**Ms. L. M. L. D. Jayasinghe**

Department of Zoology and Environment Sciences  
Faculty of Science, University of Colombo  
Sri Lanka



**Dr. A. Witharana, M. I. Biol. (Sri Lanka)**

Department of Zoology and Environment Sciences  
Faculty of Science, University of Colombo  
Sri Lanka



**Figure 1** Surface water resources: Labugama reservoir used as a water source for drinking  
Photo credit: Ms. L. M. L. D. Jayasinghe

**Surface water sources:** Surface water sources are water bodies found above the ground, such as rivers, streams, lakes, and ponds (Figure 1). These sources are often easily accessible and typically carry or store large volumes of water. Surface water is naturally replenished by precipitation, snowmelt, and surface runoff and is mainly used for drinking, irrigation/agriculture, and industrial purposes. However, these surface water bodies are at risk of being contaminated from industrial discharges, agricultural run-off, and sewerage discharges. While surface water remains a vital resource for drinking water, its sustainability depends on good management practices and protections to prevent contamination and overuse.

**Groundwater:** Groundwater sources refer to waters that exist beneath the Earth's surface that are found as underground water storages or aquifer systems with diversified geological and geochemical characteristics. It is a critical resource for drinking, irrigation, and industrial use, especially in regions where surface water sources are limited or unreliable. Groundwater sources are replenished primarily through infiltration and percolation of rainwater through the soil, a process called recharging. The sustainability of groundwater mainly depends on its extraction rate; if the extraction is faster than its recharge rate, it can lead to a decline in the groundwater levels drastically.

On the other hand, groundwater is susceptible to contamination from agricultural practices (e.g., overuse of agrochemicals such as pesticides, herbicides, and fertilizers), industrial processes, sewage, and landfills. Once contaminated, it could be very difficult to clean them. Therefore, it requires careful monitoring and management to ensure that it remains a reliable, clean, and sustainable resource.

In Sri Lanka, groundwater aquifers play a vital role as drinking water sources, with people accessing groundwater primarily through springs, dug wells, or tube wells (Figure 2). In ancient times, people mostly used groundwater as their main water source. Approximately 36.4% of the Sri Lankan population uses dug wells, and 3.2% of the population uses tube wells as their main water resource.

Even though the population depending on a groundwater source (39.6%) has not been expanded, pipe-borne water users have increased from 36.8% to 51.5% during the last decade (2009-2019). It should be noted that certain water supply schemes under the National Water Supply and Drainage Board (NWSDB) obtain groundwater for water supply schemes in some areas of Narammala, Natthandiya, and Ambanpola.

### **Drinking water treatment**

Water treatment technologies are of paramount importance in fulfilling the task of clean water. Most of the water sources selected for drinking water can be used after simple treatment. The majority of drinking water treatment plants extract raw water from major rivers such as Mahaweli and Kelani as



**Figure 2** Groundwater sources: a natural water spring located in Peellakanda, Narammala (Kurunegala district, Northwestern Province, Sri Lanka)

Photo credit: Dr. A. Witharana

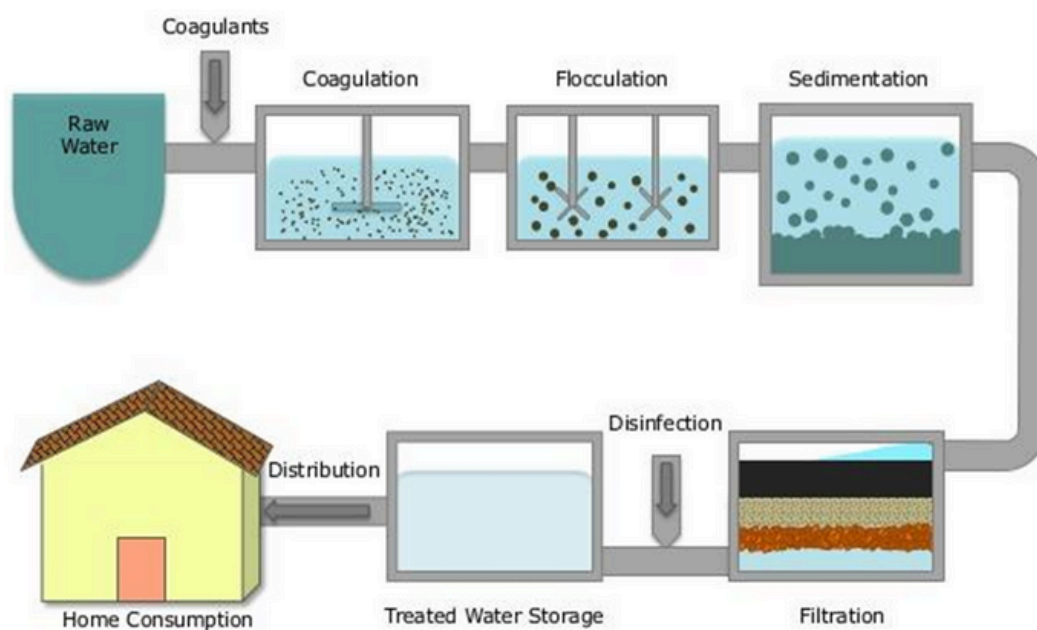
well as reservoirs like Labugama and Kalatuwawa (Figure 1). The ancient tank cascade system also plays a vital role in providing a drinking water source, especially in the dry zone of Sri Lanka. Conventional drinking water treatment systems typically include simple treatment methods and basic steps are described below (Figure 3).

- **Coagulation and flocculation:** Chemicals (coagulants) like aluminum sulfate are added to the water, causing small particles to clump together. Then the water is gently mixed to encourage these clumps (flocs) to form larger aggregates.
- **Sedimentation:** The flocculated water forms heavy flocs, and they are settled in a sedimentation tank and form sludge. This process removes a significant portion of suspended solids.
- **Filtration:** The clarified water is passed through sand or gravel, filter media to remove remaining particles, including microorganisms and smaller flocs.

- **Disinfection:** Commonly used disinfectants are chlorine and chloramine. In addition, UV light is introduced. This step verifies the microbiological safety of the water by killing or inactivating pathogens.
- **pH adjustment and chemical addition:** The pH is adjusted to prevent corrosion in pipes.
- **Storage and distribution:** The treated water is stored in reservoirs or tanks before being distributed to consumers through a network of pipes.

### Economic sustainability of drinking water treatment plants

Operation and maintenance of a drinking water treatment plant include electricity usage, chemicals, and labour charges. In addition, repairs, replacements, and upgrades come under maintenance costs. The annual energy cost for water production and pumping is about 6500 LKR (mn). The average chemical cost per 1 m<sup>3</sup> of water is 47.79 LKR (Table 1).



**Figure 3** Water treatment process  
Source: Arachchige et al. (2021)

**Table 1** Average chemical consumption in a drinking water treatment plant

Chemical Name	Average Chemical Cost per 1 kg (LKR)	Average Dose (kg) per daily production	Cost (LKR) per daily production	Chemical Cost (LKR) per cubic meter
Polyaluminum Chloride (PAC)	175.00	5250.0	918,750.00	30.63
Lime	105.00	500.0	52,500.00	1.75
Chlorine	544.00	850.0	462,400.00	15.41
<b>Average chemical cost per 1 m<sup>3</sup> of water</b>				<b>47.79</b>

Note: Surface water is used as the drinking water source to be treated under conventional treatment methods. The average chemical cost was quantified using the data obtained from personal interviews with water treatment plant engineers and the Annual Reports of Water Supply & Drainage Board, 2022.

A water unit is defined as one cubic meter of water. Thereby, the percentage of chemical cost per unit is 59.74%. By considering other costs such as energy and labour, the average cost for total production per 1 unit is 80 LKR. National Water Supply and Drainage Board, Sri Lanka's average total cost per unit sold is 68.43 (LKR/cubic meter).

### A case study from Narammala Water Supply Scheme (NWSS)

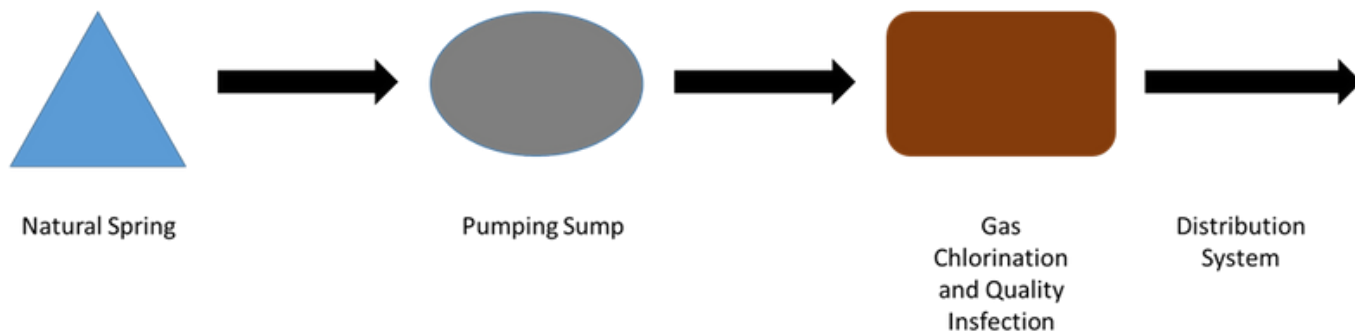
Study area: Peellakanda Underground Aquifer (PUA) located in the Kurunegala district, is an invaluable resource of drinking water which

fulfills domestic requirements and supplies water for farming for hundreds of years. This underground aquifer is also utilized as the raw water source for the NWSS and serves water for 27 Grama Niladhari Divisions (GNDs).

Narammala Water Treatment and Supply System: The total population of 27 GNDs is 37,250 and 18,684 of them (approximately 50%) are served by this PUA. There are three types of water supply connections: domestic, commercial, and other, and their details can be demonstrated as below (Table 2).

**Table 2** Water usage by intended users in NWSS (2020 August)

Customer Category	Number of Connection Metered	Users
Domestic	3,711	16,699
Commercial institutes	377	1,696
Other	64	14,507
<b>Total</b>	<b>4,152</b>	<b>32,902</b>



**Figure 4** Drinking water treatment process at NWSS

NWSS has a simple treatment process that consists of gas chlorination only, due to the higher purity of raw water (Figure 4). Table 3 shows the maximum requirement for water quality to be considered as raw water for drinking water supply and reported water quality for PUA.

### Cost estimation for water treatment in NWSS

Gas chlorination: The addition of chlorine ensures the removal of bacterial hazards. The average water quantity treated in NWSS per day is 2400 m<sup>3</sup>. Since the only chemical used here is chlorine, the average chemical cost for the production of 1 unit (1 m<sup>3</sup>) is about 0.51 LKR. Thereby, the percentage of chemical cost per 1 unit is 1.28%. Therefore, the total production cost per 1 unit is 40 LKR which is 50% less than the conventional water treatment method.

**Table 3** Maximum requirements of the drinking water quality standards (tolerance limits as in Sri Lankan Standards (SLS) 614: 2013 revised)

Water Quality Parameter	Maximum Requirement	Raw Water Quality Value (PUA)	Unit
Colour (NTU)	15	7.0	Hazen units
Turbidity (NTU)	2	1.7	NTU
pH	6.5-8.5	6.8	
Electrical Conductivity	750	438.2	μS/cm
Chloride (as Cl)	250	20	mg/L
Total Alkalinity (as CaCO <sub>3</sub> )	200	110	mg/L
Free Ammonia (as NH <sub>3</sub> )	0.06	0.05	mg/L
Nitrate (as NO <sub>3</sub> )	50	0.0132	mg/L
Nitrite (as NO <sub>2</sub> )	3	3.08	mg/L
Fluoride (as F)	1	0.36	mg/L
Total Phosphates (as PO <sub>4</sub> )	2	0.41	mg/L
Total Hardness (as CaCO <sub>3</sub> )	250	120	mg/L
Total Iron (as Fe)	0.3	0.46	mg/L
Sulfate (as SO <sub>4</sub> )	250	60	mg/L
Manganese (as Mn)	0.1	0.15	mg/L
Free Residual Chlorine	1	0.2	mg/L
Total Coliform/100ml, 37 °C	0/3	NIL	No/100ml
<i>Escherichia coli</i> /100ml, 44 °C	00/00	NIL	No/100ml

## Outcomes of the study

This NWSS water treatment process only uses gas chlorination while the other surface water treatment plants comprise multiple steps before distribution in which more chemicals are consumed expending more cost. The average cost for chemicals used in a conventional water treatment plant that uses surface water as source water is 47.6 LKR while it is 0.51 LKR for NWSS where PUA is used as source water. The same can be reported as a percentage for chemical cost per unit as 59.5% and 1.28%, respectively. Therefore, PUA is more cost-effective in terms of the chemical cost per water unit. Moreover, lowering chemical quantity is preferable in terms of public health.

Some research findings indicate the generation of trihalomethane (THM) as a byproduct of water chlorination due to the reaction between chlorine and natural organic substances which is potentially harmful to people. There are multiple health risks linked with long-term exposure to high levels of THM, such as bladder cancer, and damage to the immune system. Based on the findings of PUA water quality, total coliform and fecal coliform have not been reported (Table 3). Therefore, it can be recommended to apply disinfection after regular monitoring. The underground aquifer found in the Peellakanda area demonstrates higher water quality, making it a better raw water source for drinking water.

## Special Acknowledgement

The authors would like to extend sincere gratitude to the former Officer In Charge (OIC) in Narammala Water Supply Scheme (NWSS) Mr. S. M. A. Samarakoon for his invaluable assistance in the successful completion of this study.

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# CORNER FOR YOUNG BIOLOGISTS

## Navigating the Obesity Pandemic – Strategies for a Healthier Future

### The Obesity Pandemic

Obesity is a complex, multifactorial, and preventable chronic disease defined as abnormal or excessive body fat accumulation in adipose tissue. It is associated with dysregulated adipocyte differentiation due to an unbalanced metabolic flux. Economic growth and globalization have changed people's lifestyles, leading to altered consumption patterns, and habits. When coupled with low physical activity, this increases the risk of obesity. Obesity is considered as "the real pandemic in the 21st century" as global obesity rates are growing at an alarming rate. In 2022, 43% of adults aged 18 years and over were overweight and 16% were living with obesity. Additionally, 37 million children under the age of five were overweight. Obesity has been reported to be associated with increased mortality, morbidity, and numerous non-communicable diseases (NCDs), while also indirectly affecting the quality of life of obese people. With the rising incidence of obesity, the associated health consequences, socio-economic burden, and the management prevention of obesity have gained significant attention.



**Ms. Imani Pavithra Wijerathne, S. Biol. (Sri Lanka)**  
Department of Zoology and Environmental  
Management, Faculty of Science  
University of Kelaniya, Sri Lanka

### The utility of BMI as a parameter for obesity evaluation

Healthcare providers use body mass index (BMI) to screen for overweight and obesity in adults. BMI is a measure of body fat based on height and weight and is defined as the body mass (in kilograms) divided by the square of the body height (in meters). The BMI categories for defining obesity vary by age and gender (Figure 1).

# WHO CLASSIFICATION OF WEIGHT STATUS

WEIGHT STATUS	BODY MASS INDEX (BMI), kg/m <sup>2</sup>
Underweight	<18.5
Normal range	18.5 – 24.9
Overweight	25.0 – 29.9
Obese	≥ 30
Obese class I	30.0 – 34.9
Obese class II	35.0 – 39.9
Obese class III	≥ 40

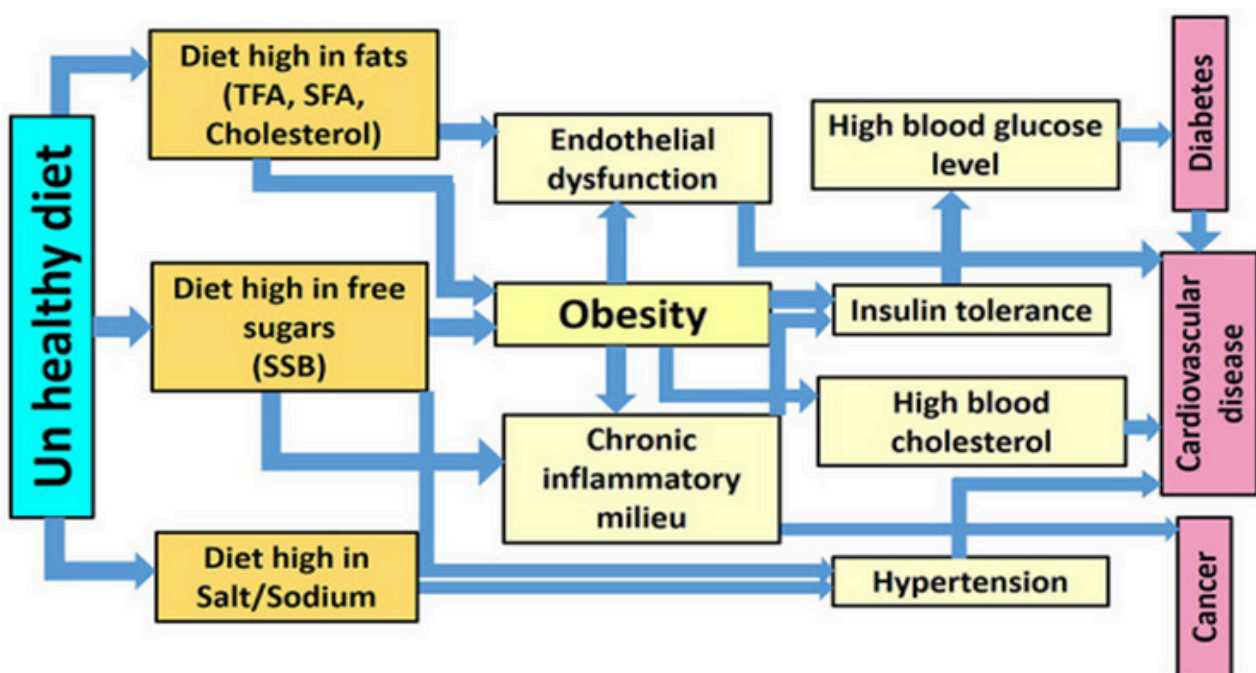
**Figure 1** BMI chart with obesity classifications

Source: <https://www.ncbi.nlm.nih.gov/books/NBK551660> (Accessed: 03 June 2024)

## Causes of Obesity

Several factors can play a role in gaining and retaining excess weight. These include diet/eating behavior, lack of exercise, environmental factors, and genetics.

**Unhealthy eating behavior** can increase the risk of overweight and obesity. Dietary factors play a key role in the process of developing obesity in three ways: consuming more calories than used, consuming too much saturated fat, and consuming foods high in added sugar (Figure 2).



**Figure 2** The interdisciplinary relationship between unhealthy diet consumption, obesity, and other non-communicable disease risk factors

Source: Al-Jawaldeh and Abbass (2022)

**Lack of physical activity:** regular physical activity is important for better physical and mental well-being, as well as for the prevention of various health issues. Due to the rapid growth of technology and the increasing scope of social media, physical inactivity has become a universal pandemic.

**Long-term stress** can affect the brain and trigger the body to produce high levels of hormones, such as cortisol. High levels of these hormones can increase appetite and promote cravings for foods high in fats and added sugars.

**Health conditions** such as metabolic syndrome and polycystic ovary syndrome can cause weight gain. Some medicines contribute to weight gain by disrupting the chemical signals that trigger hunger. These include antidepressants, beta-blockers (used to treat high blood pressure), birth control, and insulin.

**Genetic and epigenetic variations** contribute to obesity by influencing the function of metabolic pathways in the body and regulating neural pathways and appetite centers. Genetic mutations can occur through mechanisms such as deletion, genetic imprinting, and translocation. However, epigenetic modifications are more complex and can occur at any time, potentially contributing to the development of obesity.

## Common health consequences of obesity

The health risks associated with overweight and obesity are well documented and understood. Being overweight in childhood and adolescence affects immediate health and is linked to a greater risk and earlier onset of various NCDs such as type 2 diabetes, cardiovascular disease, musculoskeletal disorders, and certain cancers. These conditions contribute to premature death and substantial disability.

Childhood and adolescent obesity have adverse psychosocial consequences, affecting school performance and quality of life, compounded by stigma, discrimination, and bullying. Children with obesity are more likely to become adults with obesity and are at a higher risk of developing NCDs in adulthood.

The economic impacts of obesity must be considered. If no action is taken, the global costs of overweight and obesity are predicted to reach US\$ 3 trillion per year by 2030 and exceed US\$ 18 trillion by 2060. The rise in obesity rates in low- and middle-income countries leads to a double burden of malnutrition, as these countries continue to struggle with infectious diseases and undernutrition.



## Prevention and management

Overweight and obesity are preventable and manageable. At the individual level, people can reduce their risk by adopting preventive interventions throughout the life cycle. This includes limiting energy intake from total fats and shifting fat consumption from saturated fats to unsaturated fats; increasing the consumption of fruits, vegetables, legumes, whole grains, and nuts; and limiting sugar intake. Additionally, people can boost their levels of physical activity levels by engaging in at least 150 minutes of moderate aerobic activity per week and incorporating physical activity into daily routines such as walking, cycling, or taking the stairs.

Obesity is a societal rather than an individual responsibility, and as such, policies and actions have been introduced to address it. These include structural and regulatory actions aimed at creating healthy food environments that make healthier food options more accessible. Health sector responses are designed and equipped to identify risks and prevent, treat, and manage obesity. These efforts are supported by regular monitoring and follow-up check-ups, along with continuous support through awareness programs to help manage obesity effectively.

## Innovative approaches and technologies to combat obesity

Innovative approaches and technologies are emerging as powerful tools in the fight against obesity, offering new hope for the effective prevention and management of this complex condition.

### *Obesity-treated chemical drugs*

In past years, numerous chemical drugs have been approved for the treatment of obesity. However, most of these have been withdrawn from the market due to their adverse health effects, including increased cardiovascular risk, strokes, and limited long-term success.

### *Natural ingredients to treat obesity*

The growing threat of obesity to global health has prompted scientists to intensify efforts in finding effective anti-obesity ingredients. Numerous potential materials from natural sources, along with their active ingredients have been investigated. These natural materials are mostly derived from plants, including fruits, vegetables, grains, and herbs. Examples include green tea, citrus, garcinia, and grains such as soybeans.

### *Innovations in the use of interactive technology to support weight management*

Digital health solutions offer a promising new tool for managing patients undergoing health interventions, through mobile apps, wearable devices, telemedicine, or video games. Mobile apps, in particular, can promote a healthy lifestyle, encourage individuals to adopt healthier habits, and provide smartphone-based physical activity coaching interventions. Users have reported feeling better and healthier as a result of using these tools, suggesting that digital health solutions are effective in improving physical activity levels and supporting weight management.

### *Bariatric surgery*

In addition to medicines, bariatric surgery has shown beneficial effects in reducing body weight and managing obesity-related morbidities. However, the procedure is highly invasive and is typically recommended for individuals with extreme obesity.

## **Challenges in combating obesity**

**Health complications of obesity:** Obesity is a significant risk factor for various chronic diseases such as type 2 diabetes, cardiovascular diseases, and certain cancers. It is also associated with an increased risk of mental health issues, including depression, anxiety, and low self-esteem.

**Medicine:** While weight loss drugs may appear to be a solution to obesity, the potential side effects or adverse drug reactions remain a major public health concern and a major barrier to the development of new drug products.

**Economic burden:** Treating obesity and its related health conditions places a substantial financial burden on healthcare systems. Additionally, obesity-related health issues can lead to decreased productivity due to illness, disability, and premature mortality.

**Social and cultural factors:** Individuals with obesity often face social stigma and discrimination, negatively impacting their quality of life and mental health. In some cultures, perceptions of body image and dietary habits can either exacerbate or mitigate the prevalence of obesity.

**Behavioral and environmental factors:** The "obesogenic environment" refers to factors such as the availability of high-calorie foods, urban designs that discourage physical activity, and advertising that promotes unhealthy eating. These factors contribute to the growing prevalence of obesity.

## **Future directions**

Efforts to combat obesity are increasingly focusing on comprehensive, multi-sectoral approaches. This includes implementing policies to improve access to healthy foods, promoting physical activity, and integrating obesity care into health systems. Additionally, there is a growing recognition of the need to address environmental factors, such as urban design and food systems, which contribute to unhealthy behaviors.

*Medical and technological advancements:* pharmacotherapy – to develop new medications that effectively treat obesity; surgical options: advances in ‘bariatric surgery’ techniques to improve outcomes and reduce complications; digital health tools: utilization of apps and wearable technology to monitor and encourage healthy behaviors.

*Research and innovation:* ongoing research aims to better understand the genetic, biological, and psychological aspects of obesity, paving the way for more personalized and effective prevention and treatment strategies.



**The obesity pandemic is a multifaceted health crisis driven by genetic, environmental, and lifestyle factors. Effective management requires integrating traditional methods with behavioral therapy and in some cases, medical or surgical interventions. Innovative technologies offer new opportunities for prevention and management.**

**However, significant challenges remain, particularly in addressing behavioral and psychological barriers and the biological complexity of obesity. Moving forward, a concerted effort involving individuals, healthcare providers, policymakers, and communities is essential to create sustainable solutions for obesity.**

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# Unraveling Thyroid Disorders

The global impact of thyroid disorders is increasing by around 3.3% each year. However, statistics may vary in narrow limits due to differences in diagnostic thresholds, test sensitivity, and the populations chosen for research. Thyroid disorders can affect people at any age, but the highest frequency is seen in elderly people. According to the American Thyroid Association, females are five times more prone to thyroid disorders than males, with one in eight females likely to develop a thyroid disorder during their lifetime, making thyroid disorders a significant factor impacting the quality of life.

The thyroid gland is a vital and the largest purely endocrine gland in our body, weighing around 20-25 grams. This butterfly-shaped organ consists of the right and left lobes connected via an isthmus. Located inferior to the larynx, the thyroid gland curves across the trachea extending from the fifth cervical to the first thoracic vertebrae. It plays a vital role in regulating the basal metabolic rate, growth, and brain development during an individual's fetal stage. The regulation functions are maintained by the thyroxine (T4), triiodothyronine (T3), and calcitonin hormones which are secreted by the follicular cells and the parafollicular cells of the gland.



**Ms. A. A. A. P. Ishara, S. Biol. (Sri Lanka)**  
Department of Zoology and Environmental  
Management, Faculty of Science  
University of Kelaniya, Sri Lanka

Normally, the gland produces 93% thyroxine and 7% triiodothyronine, but the biological potency of triiodothyronine is 3-5-fold greater than the thyroxine hormone. Thyroid disorders range from harmless goiters to harmful cancers. This article focuses on common disorders in the Asian region which are goiter, hypothyroidism, and thyroid cancers.

**Goiter:** It is the most common thyroid disorder, with a prevalence of 80%. It is a benign (non-cancerous) condition that leads to changes in the shape and size of the thyroid gland. Goiter can be classified into two types: diffuse non-toxic goiter (simple goiter) and toxic goiter (nodular goiter) (Figure 1).

In simple goiter, the entire gland swells symmetrically and appears smooth to the touch (Figure 1a). Since the enlarged follicle cells are full of colloid this condition is also known as colloid goiter. Most diagnosed patients are clinically euthyroid, with serum triiodothyronine and thyroxine hormone levels within the normal range. Therefore, clinical manifestations are done based on the mass effects of the swollen gland and the elevated or near-upper range levels of thyroid stimulating hormone (TSH).

Research indicates that iodine deficiency is the major causative agent of goiter. Furthermore, mutations in the genes related to thyroglobulin and pendrin-like proteins, intrinsic thyroid hormone production defects, and external factors such as dietary substances, medications, and exposure to goitrogenic substances (substances that interfere with normal thyroid hormone synthesis process) also have goiter-causing potential. Vegetables from the Brassicaceae or Cruciferae family contain goitrogens. For example, cassava root contains thiocyanate which slows down the iodine transportation which can result in iodine deficiency. The interplay of these factors results in a range of symptoms that characterize simple goiter. The most visible symptom is the enlargement of the neck area just below the Adam's apple,

which in turn causes a tight feeling in the throat along with hoarseness. Other reported symptoms include a swollen jugular vein, dizziness, breathing difficulties, and swallowing difficulties.



**Figure 1** Types of goiter. (a) Simple goiter (b) multinodular goiter

Sources : (a) Macon (2012); (b) Lame et al. (2023)



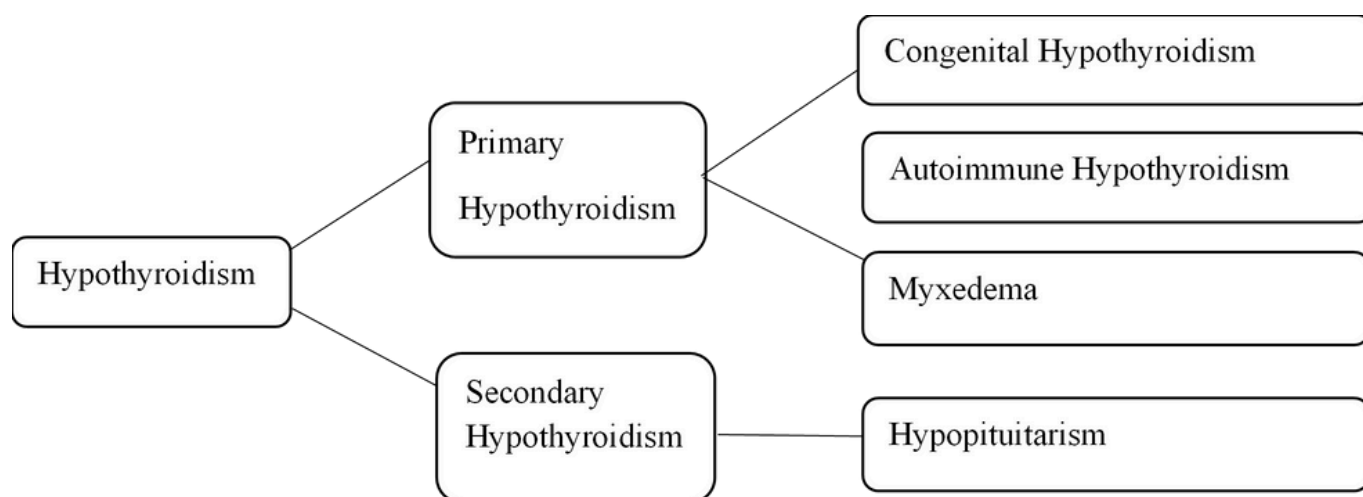
Multinodular goiter is the asymmetrical enlargement of the thyroid gland characterized by the production of nodules or lumps, with a prevalence of only 1% (Figure 1b). The functional heterogeneity of normal follicular cells is a primary causative factor while elevated TSH levels, the effects of thyroid stimulators, certain drugs, smoking, and stress are considered secondary causative factors. Unlike simple goiter, elevated thyroid hormone levels are seen in multinodular goiter. Additionally, the condition causes difficulties due to the mass effect and physical difficulties resulting from varying hormone levels.

Both conditions are treated with Levothyroxine and Methimazole as medications. Oral radioactive iodine treatment, followed by lifetime hormone therapy is used for patients with large goiters.

Removal of part or the entire gland is practiced in patients with breathing difficulties.

**Hypothyroidism:** It is characterized by reduced thyroid hormone production and decreased circulating levels of free thyroid hormones. The prevalence increases with age, and females over 40 show a significantly higher prevalence than males. Hypothyroidism can be classified into several distinct categories based on its underlying causes and mechanisms (Figure 2).

**Primary hypothyroidism** occurs when the thyroid gland is diseased and cannot produce adequate hormones. Secondary hypothyroidism occurs when the pituitary gland is not stimulating the thyroid gland to produce enough hormones, accounting for only 5% of all hypothyroidism cases.



**Figure 2** Types of hypothyroidism  
Source: Moini, Pereira and Samsam (2020)

**Congenital hypothyroidism** is the most severe condition present from birth. In rare instances, it may involve inborn thyroid metabolism problems. Cretinism can develop if this condition persists for a prolonged period. Iodine deficiency has been identified as the major causative agent. Additionally, iatrogenic causes such as treatments for hyperthyroidism may lead to hypothyroidism. Focusing on the infants, as their developing glands are extremely sensitive, exposure of mothers to povidone iodine-like disinfectants and consumption of antithyroid drugs can impair fetal thyroid hormone production. Prolonged physiological jaundice which occurs due to delayed hepatic system maturation and affects bilirubin conjugation, is considered an initial sign of hypothyroidism. This condition can lead to feeding and breathing difficulties along with sluggish movements, an enlarged abdomen, and the presence of an umbilical hernia. Hypothyroidism patients are treated with Levothyroxine to maintain normal thyroid hormone (TH) levels and in the case of infants, TH replacement therapy is continued until the infant reaches one year of age. Infant affected by congenital hypothyroidism is shown in Figure 3.



**Figure 3** Infant diagnosed with congenital hypothyroidism

Source: Rastogi and LaFranchi, (2010)

fibrous tissue replaces the normal thyroid gland, which is observable in the skin and visceral organs of the individual.

In **autoimmune hypothyroidism**, the immune system of an individual causes the destruction of the thyroid gland, leading to a loss of thyroid function. The symptoms and the treatments are very similar to those of congenital hypothyroidism. The danger of untreated hypothyroidism is that it may lead to myxedema, a condition in which delicate

**Thyroid cancer:** Although thyroid cancer can occur at any age, the most common age of onset is around 30. However, the aggressiveness of the disease increases in older patients. Three main types of thyroid cancers have been identified: differentiated cancer, medullary cancer, and anaplastic cancer.

**Differentiated cancer:** This type of cancer develops in thyroid follicular cells and the cancer cells resemble normal cells in appearance which gives this cancer the name differentiated. It can be further categorized into papillary cancer, follicular cancer, and Hurthle cell cancer. Statistics show that papillary cancer is the most common type. It usually grows very slowly and develops in only one lobe. Although it may spread to the neck's lymph nodes, successful treatment generally prevents fatal conditions. Follicular cancer may spread to the lungs, bones, and other parts of the body but not to lymph nodes. The final subtype, Hurthle cell cancer, is harder to detect and treat.

**Medullary cancer:** This type of cancer occurs in the parafollicular cells and may affect the lungs, liver, and lymph nodes even before the nodule is discovered. Its rapid spread makes this condition very difficult to treat.

**Anaplastic cancer:** This is an undifferentiated cancer because the cancer cells do not resemble normal thyroid cells. It is a very rare form, accounting for only 2% of all thyroid cancers.

In addition to the three major types mentioned above, thyroid lymphomas, thyroid sarcomas, and other tumors can also be observed. The real danger is that most of the causative factors are unknown.

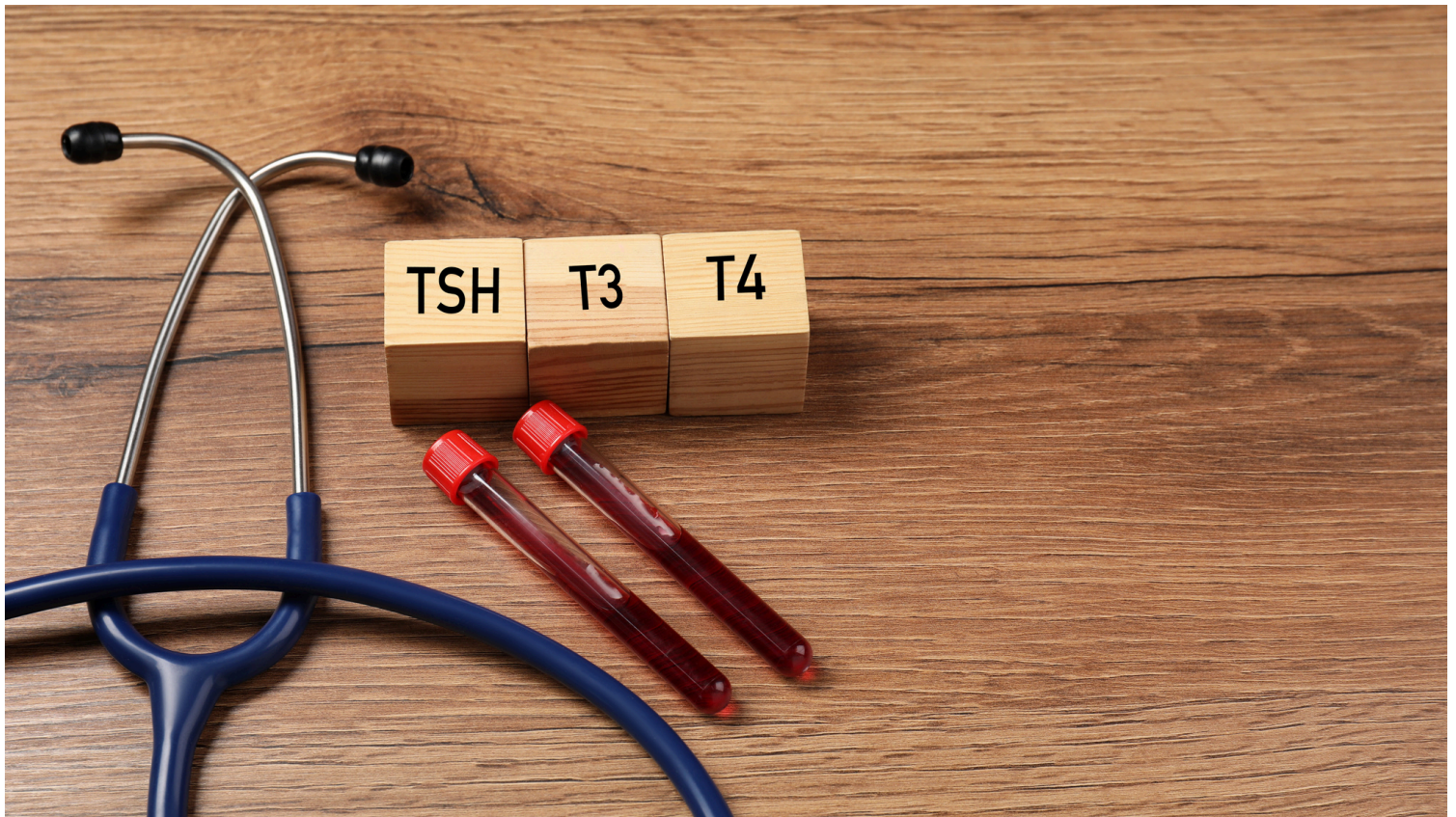
Oncogenes have been identified in papillary carcinoma and it has also been noted that follicular carcinoma is associated with Ras oncogene mutations. Most cancer patients experience enlarged lymph nodes, hoarseness, neck pain, changes in voice, breathing and swallowing difficulties, or sometimes a cough with bleeding.

Surgery, followed by either external or internal radiation, is considered the standard treatment for thyroid cancer. In this approach, the entire thyroid gland and lymph nodes are removed, and post-operative radioactive iodine therapy is given for remnant destruction. Since the thyroid gland does not respond well to conventional chemotherapy, targeted therapies are emerging. As thyroid cancers are associated with mutations in the B-Raf serine-threonine kinase (BRAF) gene, kinase inhibitors are used as medications.

**Thyroid disorders are a spectrum of conditions affecting a vital gland crucial to metabolism. Understanding the causes, such as iodine deficiency, autoimmune diseases, and medical treatments, empowers individuals to recognize potential symptoms like fatigue, weight changes, and mood swings. Early diagnosis, followed by proper treatments such as medication, radioactive iodine, or surgery, can effectively manage most conditions.**

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# NATURE CAPTURES

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*Henckelia humboldtiana*

*Henckelia humboldtiana* is a striking perennial herb native to the tropical regions of South India and Sri Lanka, where it thrives in the lush, humid environments of the wet tropical biome. A member of the family Gesneriaceae, this species is renowned for its vibrant, textured foliage and intricately structured flowers that attract both botanists and nature enthusiasts alike. Its delicate blooms, set against verdant leaves, make it a favorite subject for botanical photography and a testament to the beauty of tropical flora.

Photographs by  
**Mr. A. M. Kosala L. Abeykoon, S. Biol. (Sri Lanka)**  
Department of Plant Sciences, Faculty of Science  
University of Colombo, Sri Lanka



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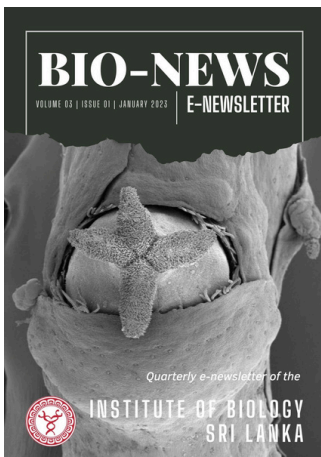
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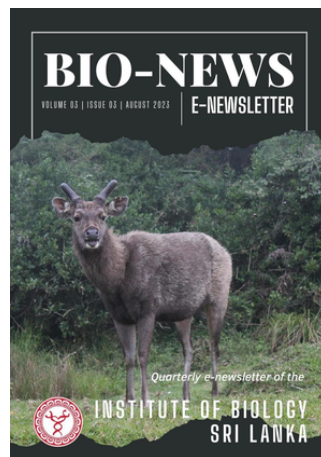
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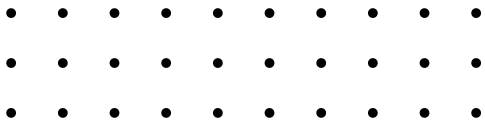
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