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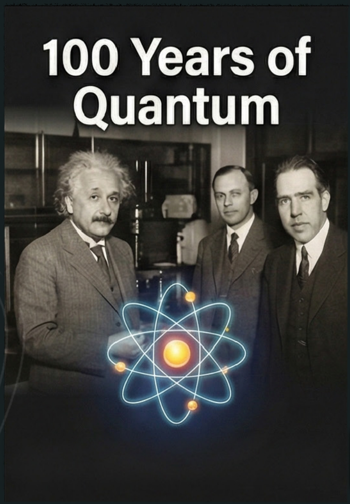

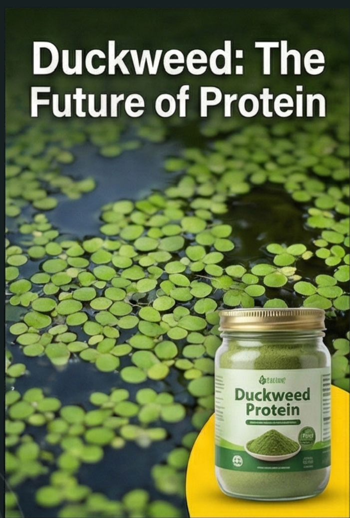

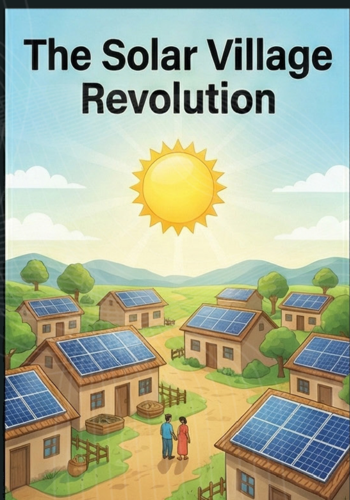

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Prof. Siril Wijesundara (Director - NIFS)

Designer
Menaka Seneviratne

Publisher
National Institute of Fundamental Studies
Hantana Road, Kandy, Sri Lanka
+94 81 22 32 106
+94 81 22 32 107

For more information
www.nifs.ac.lk

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Contributors

Kalpani Kumari
Condensed Matter Physics and Solid State Chemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Lakmal Jayarathna
Material Development and Pollutant Remediation Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Nazrim Marikkar
Food Chemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Ruvini Liyanage
Nutritional Biochemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Malmi Wickramasinghe
Nutritional Biochemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Ruvini Pesha Hiththatiyage
Nutritional Biochemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Nimal Adikaram
Natural Products Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Dhammika Magana-Arachchi
Molecular Microbiology and Human Diseases Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Shashini Gunathilaka
Molecular Microbiology and Human Diseases Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

I.M. Dharmadasa
Condensed Matter Physics & Solid State Chemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

M. Rawlins
Condensed Matter Physics & Solid State Chemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

N. Roelens
Condensed Matter Physics & Solid State Chemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

D. Jayasekera
Condensed Matter Physics & Solid State Chemistry Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Lalith Jayasinghe
Natural Products Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Nelum P. Piyasena
Natural Products Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

H. A. K. D. Premasiri
Natural Products Programme, National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Quantum Leap: A Century of Quantum Theory

Kalpani Kumari
National Institute of Fundamental Studies

The arrival of quantum theory in the early 20th century marked a revolutionary shift in scientific understanding, initiating a transformative era that deeply impacted and reshaped fields like physics, chemistry, material science, computing, and even philosophy. At the beginning of the 20th century, classical physics was the main source to understand nature, based on Newtonian mechanics and Maxwell's equations. Classical physics gave a clear and predictable view of the universe, explaining things like how planets move and how light behaves. Nonetheless, some phenomenon like blackbody radiation, the photoelectric effect, and the atomic spectra couldn't be explained by old theories. To solve these, scientists namely Max Planck, Albert Einstein, Niels Bohr, Werner Heisenberg, Erwin Schrödinger, and Paul Dirac developed a new idea called quantum theory. At first, it was a mix of different thoughts, but it grew into a surprising and powerful way to understand nature. This big change, known as the "quantum leap," not only changed the science of physics but also started a new wave of technologies and ideas that still continues today.

The centenary celebration of the quantum theory is meant to commemorate the foundation of modern quantum mechanics established, especially during the mid-1920s. This milestone highlights the ground-breaking contributions of scientists, whose work between 1900 and 1927 laid the foundation of quantum mechanics. As such, the year 2025 stands as a historic moment to celebrate a century of quantum theory, and is a timely opportunity to reflect on where we currently stand in the ongoing quantum revolution.

When we look back at the history of quantum theory briefly, in 1900 when Max Planck introduced the idea that energy is not continuous but comes in small, discrete units called quanta. He used this concept to solve the problem of blackbody radiation. A few years later, in 1905, Albert Einstein explained the photoelectric effect by suggesting that light itself is made up of energy packets called photons, which helped to confirm the quantum nature of light.

Building on these early ideas, Niels Bohr proposed a new model for atom in 1913. He suggested that electrons are supposed to orbit around the nucleus in specific energy levels and could jump between them by absorbing or emitting quanta of energy. While this model helped explain atomic spectra, it still depends partly on classical ideas. The full framework of modern quantum mechanics developed in the mid-1920s. In 1925, Werner Heisenberg introduced matrix mechanics, and in 1926, Erwin Schrödinger developed wave mechanics. Though different in form, both approaches are meant to describe atomic behaviour accurately. Schrödinger's famous equation became a core part of quantum mechanics.

In 1927, Heisenberg also introduced the Uncertainty Principle, which stated that certain pairs of properties, like position and momentum, could not both be known with exact precision. Thus the period from 1900 to 1927, is widely recognized as the birth of quantum mechanics.

Over the decades, quantum theory expanded far beyond its early focus on atoms. Scientists like Paul Dirac combined quantum mechanics with relativity, predicting antimatter. Quantum electrodynamics (QED) improved our understanding of how light and matter interact. These breakthroughs helped explain atomic structure, chemical bonds, and radioactivity, leading to major inventions such as semiconductors, lasers, and some applications in medicine. This period also saw the rise of nuclear physics and quantum statistics, which helped explain how matter behaves in stars and at extremely small scales.

In the mid-20th century, quantum theory became the basis for various modern technologies. The invention of the transistor in 1947 and the laser in 1960, both rooted in quantum principles, led to the advancements in electronics, telecommunications, and computing. Technologies like integrated circuits, Light Emitting Diodes (LEDs), Global Positioning System (GPS), and atomic clocks also rely on quantum effects, driving the information age. Meanwhile, quantum field theory (QFT) emerged to unify particle physics. This led to the Standard Model, which accurately describes fundamental particles and their interactions. Experiments at large particle colliders, such as the European Organization for Nuclear Research (CERN), confirmed this model with great precision.

Quantum theory also began to explore deeper questions about reality. Bell's theorem and quantum entanglement, challenged traditional ideas about cause and effect, raising interest in quantum information science. In the 21st century, we entered a second quantum revolution. Technologies like quantum computing, quantum cryptography, and quantum sensing are now being developed. Unlike traditional computers, quantum computers use qubits that can be in multiple states at once, allowing much faster problem-solving in areas like cybersecurity, drug discovery, and materials science. Quantum sensors can detect extremely subtle changes using quantum superposition and entanglement. These tools are being used to detect gravitational waves, improve navigation systems, and advance medical imaging, showing the growing impact of quantum theory on everyday life.

Today, several countries are at the forefront of quantum theory-related research and technological development. While the world is rapidly embracing quantum science and its applications in computing, communication, sensing, and cryptography, Sri Lanka is still in the early stages of engaging with this technological revolution. Though not yet a global leader in quantum research, the country is showing growing interest and foundational activity in this emerging field. In recent years, Sri Lankan universities and research institutions have begun exploring quantum-related topics through academic programs, collaborative research, and student-driven projects. Some postgraduate students and researchers are also pursuing quantum-related studies abroad and collaborating with international laboratories and universities, helping to build local capacity.

At the educational level, quantum mechanics is part of undergraduate physics curricula, but hands-on research in quantum technologies remains limited due to resource constraints, infrastructure gaps, and minimal industry involvement. However, there is a growing recognition among Sri Lankan scientists and engineers of the strategic importance of quantum science, particularly in areas such as cybersecurity, advanced computing, material research, and sensor technologies. Collaborating with leading countries in quantum technology can help train scientists, attract funding, and develop infrastructure. However, with its academic foundations and intellectual potential, Sri Lanka can grow in the quantum domain. With the right vision, policy support, and collaborative strategy, the country can pursue making meaningful contributions to the global quantum ecosystem in the decades ahead.

Why We Need to Care About Microplastics: The Sri Lankan Scenario

Lakmal Jayarathna
National Institute of Fundamental Studies

Sri Lanka is often celebrated for its golden beaches, lush tea plantations, and rich biodiversity. Tourists flock to our shores for pleasant sunshine, diverse culture, and the vibrant marine life that makes the island nation so unique. Yet beneath this postcard image lies an invisible and insidious problem: **microplastics**.

These tiny fragments smaller than 5 millimeters are formed when larger plastic waste breaks down into pieces in the environment.

Unlike discarded bottles or shopping bags, which are visible to collect, microplastics infiltrate soil, rivers, oceans, and even the air we breathe. They can enter the food chains and ultimately, our own bodies through diet.

For Sri Lanka, an island nation heavily dependent on the ocean for food and tourism, the rising risk of microplastics is not just an environmental challenge but it's a threat to public health, economic stability, and national sustainability.

What Are Microplastics?

Plastics have been hailed as one of the most versatile inventions of the modern world. Plastics are cheap, durable, and adaptable and used in everything from packaging and textiles to electronics and automobiles. Nonetheless, their very durability is what makes them problematic. Unlike other organic waste, plastics do not biodegrade quickly. Instead, actions of sunlight, wind, and wave can break them into smaller and smaller particles.

Microplastics fall under the following two broader categories:

• **Primary microplastics:** manufactured intentionally, such as microbeads in cosmetics, industrial abrasives, or resin pellets.
• **Secondary microplastics:** formed when larger plastic debris bags, bottles, fishing nets degrades over time.

Recent research has identified another type of plastics known as **nanoplastics** (smaller than 100 nanometers), which are so tiny and thin. They can even penetrate cells and potentially disrupt biological functions.

The Global Microplastic Crisis

Around **400 million metric tons of plastic** are produced globally every year. Of this, at least **11 million tons** leak into oceans annually. The United Nations warns that by 2050, the ocean could contain more plastic than fish (by weight). Microplastics have been reportedly found in the following:
• Arctic snow and Antarctic ice cores
• The deepest point of the ocean, the Mariana Trench
• Bottled water, sea salt, honey, and even beer
• Human blood, lungs, and placental tissue
This makes microplastics not just an environmental concern but a **global health issue.**

Sri Lanka's Plastic Challenge

According to the Central Environmental Authority (CEA), Sri Lanka produces **1.6 million metric tons of plastic waste annually**. Worryingly, a significant portion of it ends up in open dumps, rivers, or directly in the ocean. With limited recycling infrastructure in Sri Lanka, only about **4-6% of plastic wastes** are recycled.

Based on a 2019 global study, Ocean Conservancy ranked Sri Lanka as one of the **top plastic polluters of the ocean**, largely due to improper waste disposal and weak enforcement of plastic regulations.

Some examples of our home country:

• The **Kelani River**, one of the island's major water sources, has been identified as carrying large amounts of plastic into the Indian Ocean.
• Popular beaches like Mount Lavinia, Negombo, and Unawatuna often show alarming levels of plastic waste after festivals or monsoons.
• Studies from the University of Kelaniya and the National Aquatic Resources Research and Development Agency (NARA) confirm the presence of microplastics in **shrimp, crabs, and lagoon fish** all of which are part of local diets.

Image: Kelani River

Microplastics in Our Food and Water

Microplastics are now a dietary reality in Sri Lanka. A single serving of shellfish or mussels might have hundreds of microplastic particles. In Sri Lanka, where fish is a staple and accounts for over 50% of protein intake, this is a serious concern.

Occurrence of microplastics is not limited to seafood:

• Microplastics are detected in drinking water; both tap and bottled.
• Tea bags made from nylon release billions of microplastic particles per cup.
• Agricultural soils contaminated with plastic mulch and use of wastewater in irrigation are other hidden entry points into food crops.

This means that whether you eat rice and curry, drink a cup of Ceylon tea, or enjoy seafood by the beach, microplastics may already be part of your daily life.

Human Health Risks

The full health impacts of microplastics are still under investigation, but early findings send alarming signals:

• Respiratory risks: Inhaled microplastics may lodge in the lungs, causing inflammation or respiratory diseases.
• Digestive risks: Ingested particles can irritate the gut, alter microbiota, and potentially leach toxic additives like phthalates or heavy metals.
• Hormonal disruption: Many plastics contain endocrine-disrupting chemicals that mimic or block hormones, affecting fertility and development.
• Long-term risks: Evidence shows that nanoplastics can cross the blood-brain barrier and accumulate in organs, raising concerns of cancers and neurological impacts.

For Sri Lanka, where public health systems already face strain from dengue, diabetes, and chronic kidney disease, the additional burden of microplastic exposure could be devastating.

The Socio-Economic Dimension

1. Fisheries:
Over two million Sri Lankans depend on fisheries for their livelihood. Contamination of marine resources by microplastics threatens exports (like shrimp and tuna) and local food security.
2. Tourism:
Tourism contributes nearly 5% of Sri Lanka's GDP. Dirty beaches and declining coral health due to plastic pollution could tarnish the island's reputation as a paradise destination.
3. Healthcare Costs:
If microplastic-related illnesses rise, treatment costs could burden both families and the state health sector.
4. Agriculture:
Microplastics can affect soil fertility, alter water retention, and even impact crop yields posing a risk to Sri Lanka's food security.

Policy Gaps in Sri Lanka

Sri Lanka has taken steps, such as banning polythene bags below 20 microns and restricting single-use plastics like lunch sheets and sachets. Nonetheless, enforcement remains weak, and alternatives are not widely adopted.

Key challenges:

• Lack of nationwide recycling infrastructure
• Open dumping culture in both urban and rural areas
• Weak public awareness of microplastic dangers
• Limited scientific monitoring (only few studies exist on microplastics in drinking water or agricultural soils in Sri Lanka)

In contrast, the **European Union** has banned single-use plastics while countries like India and the Maldives have launched aggressive reduction programs. Sri Lanka needs to accelerate reforms on the use of plastics to keep pace.

Possible Solutions

1.Policy and Regulation
o Enforce stricter bans on single-use plastics.
o Introduce Extended Producer Responsibility (EPR) where manufacturers are accountable for post-consumer plastic waste.

2. Technology and Innovation
o Develop biodegradable plastic-alternatives using natural fibers like coir, banana, or areca leaf.
o Promote waste-to-energy and plastic recycling plants.

3. Community education and Behavior Change
o Promote zero-waste schools and community-led cleanups.
o Encourage refill stations for drinking water, reducing plastic bottles.

4. Research and Monitoring
o Establish national monitoring programs on microplastics in rivers, soil, seafood, and drinking water.
o Promote research collaborations with universities to develop low-cost detection methods.

Why Microplastics Matters for Sri Lanka's Future

Ignoring microplastics today might lead to irreversible consequences tomorrow. They are persistent (lasting for centuries), **bioaccumulative** (building up in living organisms), and **toxic**. If Sri Lanka does not act swiftly, the island risks not only in its environment but also its food security, human health, and economic prosperity.

A Wake up Call for Action

Microplastics may be invisible, but their impact is massive. For Sri Lanka, the stakes are high: our oceans, our health, our economy, and our children's future are all at risk. Combating this crisis requires a whole-of-society approach—from policymakers and scientists to business leaders and everyday citizens.

The good news is that solutions exist within Sri Lanka, with its rich tradition of sustainable living. It has the cultural and scientific capacity to rise to the challenge. What is needed now is political will, collective action, and urgency. In the end, the story of microplastics is not just about pollution—it's about survival, justice, and the kind of world we leave for the generations to come.

Images: Kandy lake polluted with plastic (Near Mahamaya girls College)

Food and Nutritional Value of Edible Soft Stem of Banana Crop

Nazrim Marikkar
National Institute of Fundamental Studies

Banana can be identified as one of the most extensively grown fruit crops in Sri Lanka. This versatile crop can be cultivated throughout the different agro-climatic regions including wet, intermediate, and dry zones. Banana cultivation generates a large volume of wastes including peduncle, pseudostems, leaves, banana peel, corm, etc. Particularly, after harvesting the banana bunch, farmers face a significant challenge in managing the waste and remnants of the tree (Arvanitoyannis and Mavromatis, 2009). The soft-stem, which is within the pseudostem is one of the edible parts of the banana tree, containing a high amount of carbohydrates and dietary fiber (Bhatnagar et al., 2015; Subagyo and Chafidz, 2018). Nonetheless, it is one of the parts which is underutilized for human consumption due to lack of knowledge about its culinary uses. Although low in calories, it can be incorporated into various foods like flour, pastries, candies, fruit juice etc. (Palde et al., 2022). In a recent study, NIFS scientists investigated the nutritional and biological activities of the dried soft stem powder prepared from four locally cultivated banana varieties namely Ambul kesel (AM), Alu kesel (AL), Seeni kesel (SE) and Suwandel (SU) (Lyadhipitiya et al., 2025).

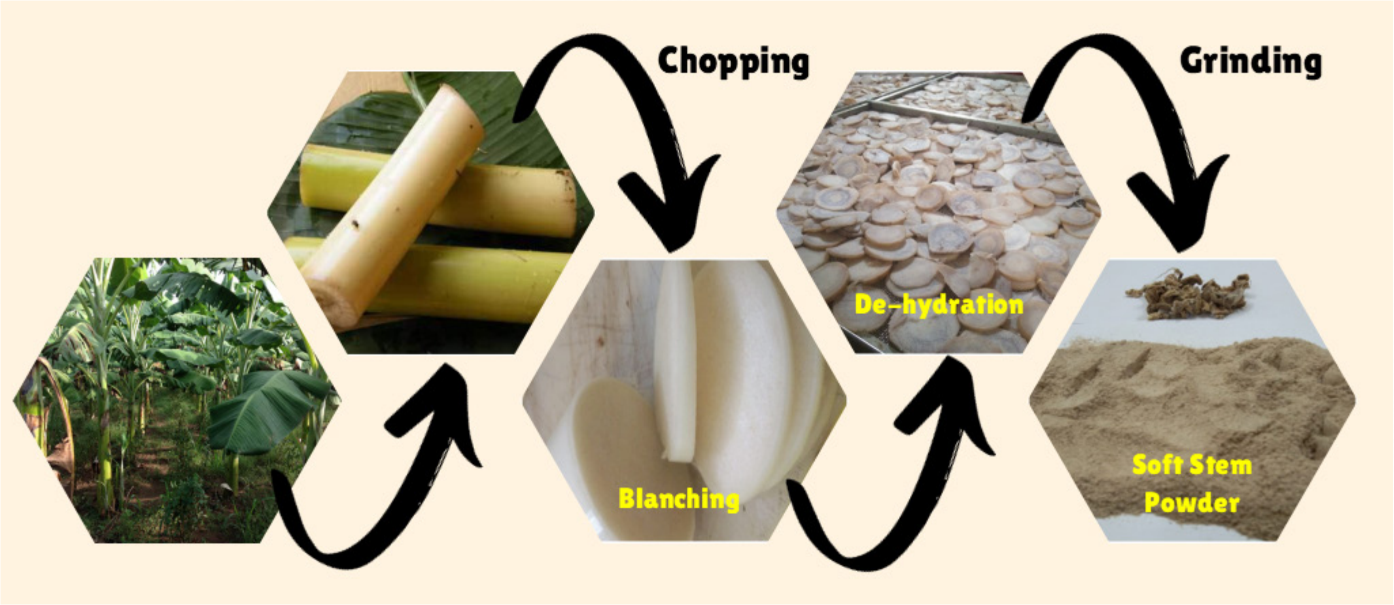


Figure 3: Process flow diagram of soft-stem powder preparation

The recovery weights of the soft stems of different banana cultivars are given in Table 1. According to Table 1, more than 2.0 kg of soft stems were required to get at least 500g of the dry powder of banana soft stems. Ambulkesel and Seenikesel cultivars have yielded higher recovery amounts when compared to other two cultivars.

Table 1 –Weight recovery of soft stem powder of different local banana cultivars

Banana cultivar	AM	SE	SU	AL
Banana soft stems weight	1250 g	1650 g	3100 g	2000 g
Soft stems powder weight	313 g	450g	510 g	365 g

The morphological appearance of soft stem powder from several banana cultivars is illustrated in Figure 4. This showed that dry powder of soft stems of banana cultivars exhibits brownish yellow color appearance, flour-like qualities with a fibrous outlook.

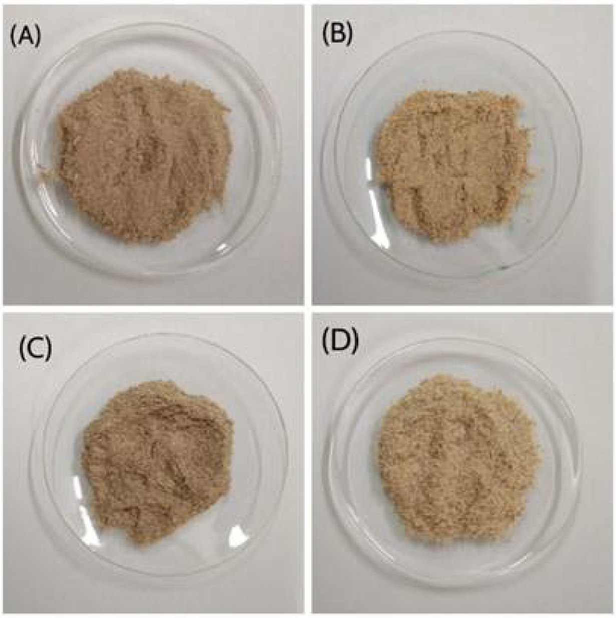


Figure 4: Soft stem powder, Ambulkesel (A), Seenikesel (B), Suwandel (C), and Alukesel (D)

Based on proximate analysis, carbohydrate is the most abundant nutritional component in the soft-stem powder, ranging from 65.96 to 77.06 %. The carbohydrate content percentages of the AM, SE, SU, and AL cultivars were 66.87 %, 72.53 %, 65.96 %, and 77.06 %, respectively. Ash was the second largest nutrient of the soft-stems of all four cultivars. The ash contents of the AM, SE, SU, and AL were 17.89 %, 9.41 %, 14.29 %, and 10.61 %, respectively. Fat was the nutrient lowest in abundance in the soft-stems of all four cultivars of this study. The amounts present in AM, SE, SU, and AL were 1.69 %, 1.87 %, 1.26 %, and 1.38 %, respectively.

Based on the detailed analysis of ash, macro minerals were K, Ca, Mg, and Na while micro minerals present were Zn, Mn, Ba, Sr, Fe, and Al. K was the most abundant mineral (26937-55445 mg/kg), followed by Mg (1600-2389 mg/kg) and Ca (1442-2385 mg/kg). Mg was the next most abundant mineral detected in banana soft stems of the local varieties. The Mg contents of the samples ranged from 1600 to 2389 mg/kg. Calcium being a mineral typically linked with strong bones and teeth, plays key functions in blood clotting, muscle contraction, and normal maintenance of heart rhythms. Micro minerals also play some important roles in human physiology; for instance, Zn as integral part of the immune function and wound healing, Mn supporting bone health, and Fe being essential part of the oxygen transport.

Conclusion

In this study, varietal differences on nutritional composition of the banana soft-stem from four local varieties were compared. As a common feature, all four local varieties were possessed with high contents of carbohydrate and ash, but low proportions of fat and protein. Except for moisture, remarkable differences were noticed in the contents of fat, ash, carbohydrate, and protein. Regardless of the varieties, K, Ca, Mg and Na were the macro minerals present while Zn, Mn, Ba, Sr, Fe, and Al were the micro minerals.

What Sri Lankan Twins and Their Families Eat, and How It Affects Their Health

Malmi Wickramasinghe & Ruvini Liyanage
National Institute of Fundamental Studies

The food we eat gives us nutrients that help us stay healthy and protect us from diseases. In countries like Sri Lanka, people face two serious problems; some do not get enough food or nutrients (undernutrition), while others suffer from illnesses such as diabetes and heart disease because of unhealthy diets. The recent economic crisis in Sri Lanka (2020–2023) made things worse by making it harder for many families to afford a variety of healthy foods, creating bigger gaps in nutrition between the rich and poor.

To improve people's health, it's important to know exactly what and how much they eat. One way to measure this is the 24-hour dietary recall (24HDR), where people are asked to remember and list all the food and drinks, they had the previous day. Nonetheless, this method isn't always accurate, because people may forget or misjudge their portions. A more accurate way is to test blood or urine, which can show the actual nutrients in the body.

Studying twins and their children is especially useful because it might help researchers understand how much of our eating habits come from family environment and how much is due to genetics. A study carried out by us focused on Sri Lankan twins and their children in Colombo, comparing between what they ate with biological test results to get a better picture of their nutritional status.

Study design

The study included 164 twins and 138 offspring recruited from the Colombo District, Sri Lanka. Participants were aged between 18–65 years and provided informed consent. Ethical approval was obtained from the Ethical review committee of University of Sri Jayewardenepura.

Lab Tests

Interviews with participants

Outcome of the study

Energy, macronutrient consumption and dietary trends

The study found that both men and women were not eating enough energy (calories) each day comparable to the levels recommended for Sri Lankans. On average, women ate about 1,955 calories per day while men about 2,507 calories; both lower than the amounts Only 3 out of 10 women met their daily energy needs, even though most of them (71%) ate enough carbohydrates. This shows a strong dependence on starchy foods like rice, a common staple food in Sri Lankan diets.

Nearly half of the women also had low food consumption scores, meaning their diets lacking variety. The recent economic crisis (2020–2023), caused by food shortages and rising food prices, may have made this situation worse. Particularly, women might have been a more affected segment of the society, as they often prioritize their families' needs first when coming to food consumption.

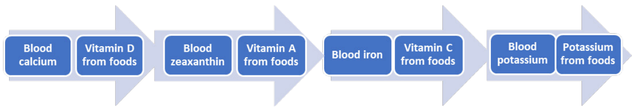
Micronutrient deficiencies

The study showed that many people were not getting enough essential vitamins and minerals. In fact, there were big gaps in vitamins B2, B3, B12, C, and calcium. This problem is nothing new. According to some previous research, even though people eat plenty of staple foods like rice, they often miss out some important nutrients. One likely reason is that diets are low in animal-based foods like meat, fish, eggs, and milk and fresh fruits and vegetables, which are key sources of these vitamins and minerals.

Nutrient	% Below recommended consumptions
Vitamin B2	68%
Vitamin B3	62%
Vitamin B12	55%
Vitamin C	71%
Calcium	77%

Biomarker validation of dietary intake

One of the key strengths of this study was that it could check the accuracy of people's reported diets using lab tests. The research compared what participants said they ate in the 24-hour food recall with actual nutrient levels measured through their blood and urine samples. The results showed a clear match, meaning that the recall method worked well in the Sri Lankan setting. Although food recalls can sometimes be inaccurate—because people may forget or misreport what they ate. The strong relationship between recall data and lab test reports showed the validity of this method for both research and health assessments.



Why this study matters

This study showed that many Sri Lankan people aren't getting enough nutrients they need, especially due to the recent economic crisis. Often times, meals don't have enough variety, and people miss out healthy fats, fiber, vitamins, minerals, etc.

To fix this, the study suggests the following:

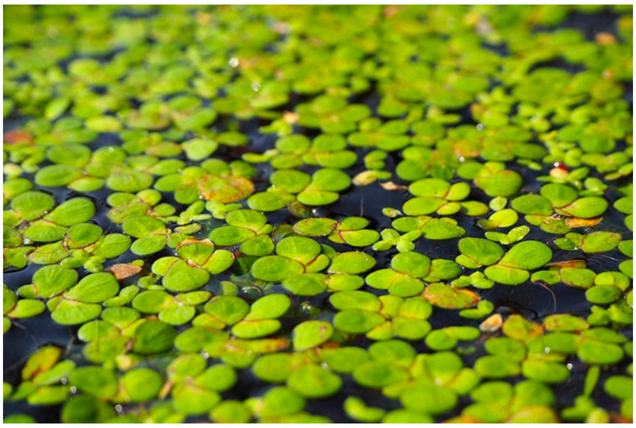
• Promoting cheaper but healthy foods like beans, vegetables, and animal products.
• Using lab tests to double-check whether what people say they eat matches the nutrients in their bodies.
• Paying special attention to women and other vulnerable groups when planning nutritional programs/ Hence, everyone can get the amount of nutrients they require.

If not, these deficiencies might increase health risks. This also highlights the need for nutrition education, food fortification, and targeted public health programs. Future studies should focus on a larger population, considering dietary patterns and sociodemographic factors, and use of biomarkers to guide personalized nutrition strategies. Further, these results can guide the government and health workers to make better planning and policies to improve nutrition and health across the country.

Unlocking the Potential of Duckweed: Expanding the Sustainable Bio-Protein Frontier Amid Global Demand Surge

Ruvini Pesha Hiththatiyage & Ruvini Liyanage
National Institute of Fundamental Studies

Duckweed, also known as water lentils (called Karali penda or Pas penda in Sinhala), is a tiny plant that floats on water. It grows very fast and can live in many types of water bodies, which makes it easy to grow. Duckweed can be found almost everywhere in the world. It doesn't need much land, water, except in deserts, icy polar regions, or places with too much of rain. As it grows in so many conditions, duckweed could help improve food supplies and protect the environment. In Sri Lanka, with its rivers, wetlands, and warm climate, duckweed can be grown all year round.



Nutritional significance

Duckweed is now getting attention as a healthy food because it is rich in protein with a good balance of essential nutrients, similar to what the World Health Organization recommends. Its nutritional value can change depending on the type of plant and the conditions it grows in, but if things like water, light, and temperature are managed properly, its quality improves. Under good conditions, duckweed can produce 6–10 times more protein per hectare than soybeans. In addition to protein, it also contains carbohydrates, healthy fats, and natural plant compounds like flavonoids and phenols. These compounds help fight harmful substances in the body, lower the risk of diabetes, obesity, and heart disease, and support a healthy weight. Because of these health benefits, duckweed is now being used in health foods, dietary supplements, and even natural cosmetics

Scientists have studied different types of duckweed and found that they have many health benefits. They can act as natural antioxidants, help control diabetes, and even fight bacteria and fungi, which means they may help protect us from infections and improve immunity. Because duckweed grows very fast and adapts well, researchers are also testing it as a natural way to produce medicines like vaccines and antibodies. In Sri Lanka, there hasn't been much research on duckweed yet, even though it could be very immensely useful, especially since many when people face economic hardships and don't get enough protein in their diet. As such, Duckweed is a green, eco-friendly option that could to help improve nutrition and reduce malnutrition.

Studies show that some duckweed types found in Sri Lanka, like Spirodela polyrhiza, Lemna minor, Lemna perpusilla, and Landoltia puntata contain 17–26% protein, which can go up to 25–33% with fertilizer use. They also provide carbohydrates, healthy fats, fiber, and important minerals. Duckweed is especially rich in omega-3 fatty acids (44–50%), which are good for heart and brain health. The main fatty acids in duckweed are linolenic acid, palmitic acid, and linoleic acid. Certain varieties, such as Spirodela polyrhiza and Landoltia puntata, may even help manage diabetes and obesity by slowing down the digestion of sugar and fat. Spirodela polyrhiza has also shown to have strong effect against harmful bacteria and fungi, while Landoltia puntata was found to be effective in fight against infections.

One challenge is that duckweed can absorb heavy metals if grown in polluted water, which can make it unsafe for human consumption. In order to prevent this, it needs to be cultivated in clean water under controlled conditions. Research has shown that with proper care, duckweed can be grown safely to provide high-quality protein without harmful levels of toxic metals. Overall, Sri Lankan duckweed varieties are highly nutritious and offer several health benefits. By improving cultivation methods and processing, duckweed could become an important, sustainable source of protein and help fight against malnutrition.

Figure 1: *Lemna minor*

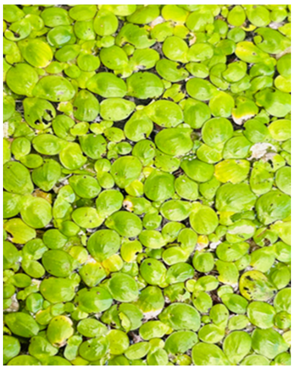
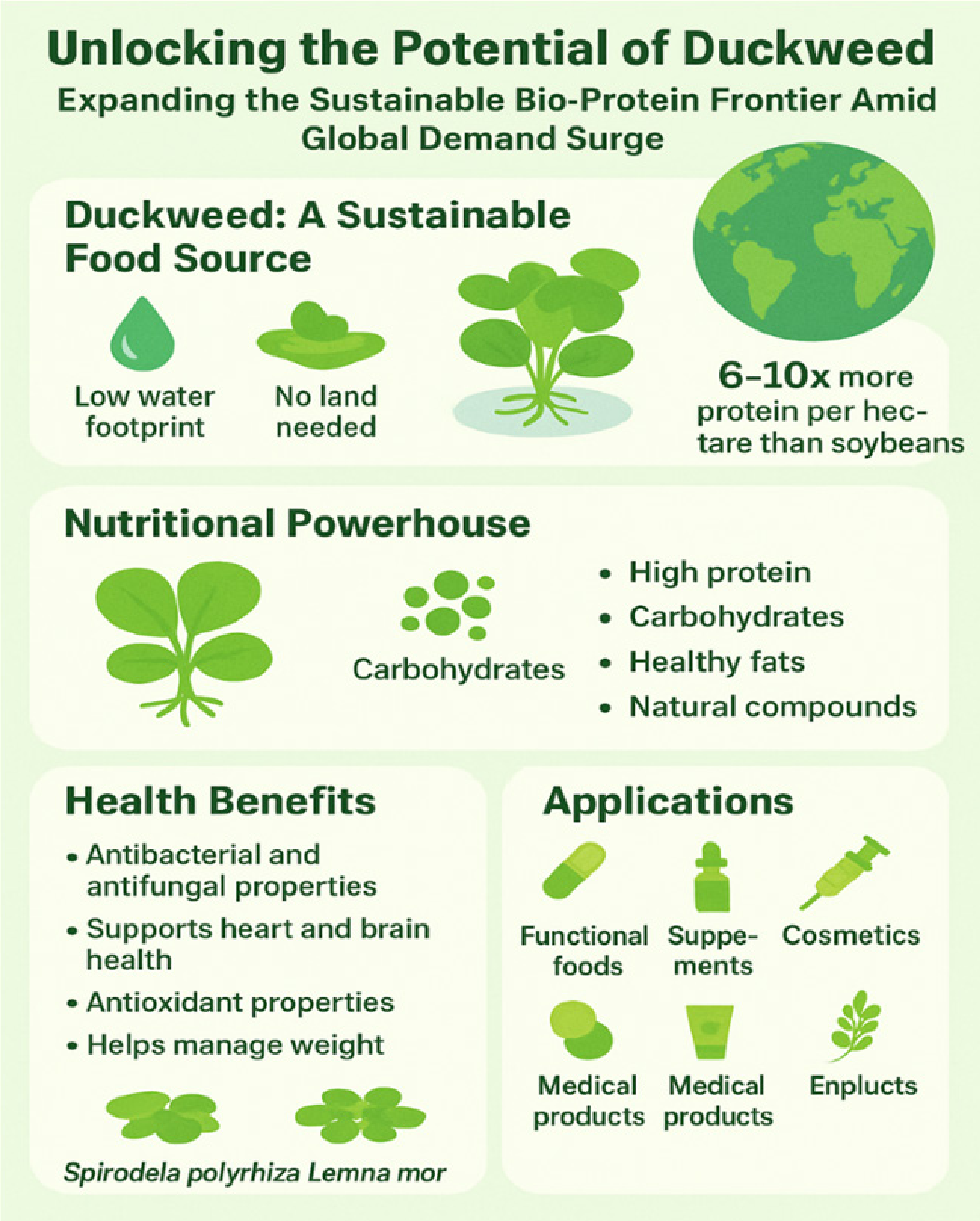


Figure 2: *Spirodela polyrhiza*

Figure 3: *Lemna perpusila*

Figure 1: *Landoltia punctata*


Unlocking the Potential of Duckweed
Expanding the Sustainable Bio-Protein Frontier Amid Global Demand Surge
Duckweed: A Sustainable Food Source
Low water footprint
No land needed
6–10x more protein per hectare than soybeans
Nutritional Powerhouse
Carbohydrates
• High protein
• Carbohydrates
• Healthy fats
• Natural compounds
Health Benefits
• Antibacterial and antifungal properties
• Supports heart and brain health
• Antioxidant properties
• Helps manage weight
Spirodela polyrhiza Lemna mor
Applications
Functional foods
Suppe- ments
Cosmetics
Medical products
Medical products
Enplucts

Fungal Diseases of Tropical and Subtropical Fruit Plants

Nimal Adikaram
National Institute of Fundamental Studies

Fungi are the most important group of plant pathogens responsible for a half of documented diseases. Basically, they are eucaryotic, usually filamentous, with branched mycelia, spore-bearing organisms that lack chlorophyll. Their cell walls might contain chitin and glucans, which are embedded in a matrix of polysaccharides and glycoproteins as skeletal components. They usually obtain nutrients from the environment by adsorption across the cell membranes. They secrete degradative enzymes into external medium to break down complex polymeric substances such as saccharides, protein and tri-glycerides lex polymeric substances (polysaccharides, proteins, and tri-glycerides) into simple compounds (sugars, fatty acids, amino acids). These can be subsequently absorbed using membrane-located transformers. They store carbohydrates as glycogen, like in animals, but not as starch. The revolution in DNA sequencing of fungi in the last 31 years has shown that there are many more species of fungi. According to DNA studies, there are at least 2 million species that have been fully described, but only around 2000 of them are being added to the databases each year.

Plant diseases of selected fruit trees

Avocado (*Persea americana Mill.*)

Avocado is a tree crop belonging to the family Lauraceae. The fruit has a high oil content and is rich in certain vitamins, dietary fiber, and minerals but low in sugars. A high proportion of the oil is made up of monosaturated (75%), and polyunsaturated (10%) fatty acids. In addition, it may contain several phytochemicals that are considered to be beneficial for health. Avocado is a climacteric fruit, with a marked rise in respiration rate at the onset of ripening, followed by a decline. It is commonly consumed as a fresh fruit besides its uses in oil, cosmetics, soap and shampoo industries. Unlike many fruits that typically have a sweet or acidic taste, avocado is used to have a smooth consistently and rich flavor.

Postharvest losses of avocadoes are high, and smooth skin varieties are more prone to physical injuries during handling and transportation. The most important causes of postharvest losses include mechanical, physiological disorders especially chilling injury, disease and insect damage. The main symptoms of chilling injury are black stains in epidermis and grey and brown discoloration in the flesh. Anthracnose disease caused by Colletotrichum spp. and the stem-end rot incited by several fungi, including L*asiodiplodia theobromae*. Avocado scab diseases caused by *Sphaceloma perseae* are among the most common diseases incurring fruit losses and fruit quality reduction.

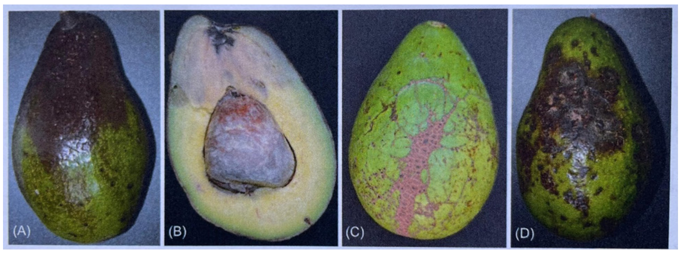


Figure 1:
Disease symptoms of avocado fruits

Mango (*Mangifera indica* L.); Family: Anacardiaceae

Mango (Mangifera indica L.) is native to South Asia and has been moved to different parts of the world over the past centuries. The mango tree is an arborescent evergreen tree. There is a great diversity among mango cultivars distributed throughout the world. The mango fruit is large, freshly drupe containing edible mesocarp of varying thickness. Based on the variety and genotype, the fruit is highly variable in shape, color and size. Nutrition wise, mango fruit is reported to contain carbohydrates, proteins, fatty acids, minerals, vitamins etc.

Mango is a climacteric fruit and exhibits a burst in the respiratory activity and ethylene release during the ripening. The ripening process of mango fruit involves numerous biochemical and textural changes; fruit softening, chlorophyll degradation and carotenoid synthesis are some of them. Along with this, several other metabolic activities tend to cause changes in carbohydrates, organic acids, lipids, phenolics and volatile compounds. If mangos are to be stored, they should be harvested at the mature green stage prior to start of the climacteric stage, and stored at temperatures between 10°C and 15°C.

Figure 2:
Disease symptoms of mango fruits

Diseases and Disorders

Numerous disorders and diseases, pre-or postharvest, have been reported for mango. Among the disorders, chilling injury, sap burn, internal breakdown (soft nose, jelly seed, stem-end cavity), lenticel darkening, under-skin browning, pitting disorder and internal pulp browning are notable. Physiological and nutritional disorders are the most troubling problems experienced by fruit growers. Mango fruits are highly susceptible to many pre- and postharvest diseases. The susceptibility to postharvest diseases increases during storage after harvest. This is mainly due to physiological changes and senescence favoring pathogen development. Anthracnose, stem-end rot and Alternaria rot are the major postharvest diseases that limit the shelf life of mangos.

Hidden Hotspots: How the Environment Fuels the Rise of Antibiotic Resistance

Shashini Gunathilaka & Dhammika Magana-Arachchi
National Institute of Fundamental Studies

Antibiotic resistance is often seen as an impending public health crisis connected to hospitals, patients, and medicine misuse. However, this situation is much more complicated than it appears. Resistance arises not only in clinics and intensive care units but also in rivers, soils, wastewater, and even remote places like natural hot springs. These environments support diverse microbial communities that tolerate antibiotics and develop resistance. Following these transformations, nature becomes a potent source of resistance genes. Recently, scientists have identified different trends indicating that environmental bacteria increasingly acquire and exchange resistance traits faster than ever before. Research studies across Europe and Asia have found high levels of resistance genes such as sul1, ermB, and intI1 in soils contaminated by wastewater effluents, even in regions with limited antibiotic use. In aquatic ecosystems, bacteria often resist common antibiotics like sulfamethoxazole and ciprofloxacin(Franklin et al., 2024). These events tend to highlight how human activities, including agriculture and pharmaceutical wastes, could accelerate this evolutionary change.

KINNIYA & WAHAWA HOTSPRINGS:
UNCOVERING THE HIDDEN RESISTANCE

One bacterial group, Pseudomonas, has emerged as a key player in this story. Pseudomonas is one of the first microorganisms to respond in polluted ecosystems. It is known for its capacity to adapt to harsh conditions. Pseudomonas is a frequent carrier of multiple antibiotic resistance genes. For example, a 2024 study from Bangladesh found that Pseudomonas aeruginosa isolated from the Buriganga River demonstrated widespread resistance to tetracyclines and cefotaximes. It also indicates growing resistance to carbapenems, the antibiotics once considered the last line of defence (Sharif et al., 2024).

Our recent studies at NIFS provide new insights into how environmental factors might influence resistance profiles, even in untouched natural areas. We investigated Pseudomonas isolates from two geothermal sites in Sri Lanka: the Kinniya and Wahawa hot springs, and the results were striking. According to our findings, both sites harboured Pseudomonas strains resistant to two antibiotic classes, namely aminoglycosides and fluoroquinolones, which are widely used in clinical medicine. As a noteworthy feature, the resistance levels and diversity varied significantly between the two sites, suggesting that environmental factors play a crucial role in shaping resistance patterns (Gunathilaka et al., 2024).

The Kinniya hot spring is a well-known tourist destination often visited by locals and foreign travellers. Tourists and residents of the area regularly use the Kinniya hot spring for spiritual bathing. It exhibited a significantly higher level of antibiotic resistance. Isolates from Kinniya hot spring showed stronger resistance patterns for fluoroquinolones like ciprofloxacin and aminoglycosides such as gentamycin and amikacin, with some even showing intermediate resistance to these antibiotics. The increased resistance could be due to those reasons that can introduce antibiotic residues and resistant bacteria into the environment via wastewater and runoff.

On the other hand, the Wahawa site is a tube well system in a relatively undisturbed area. It exhibited lower antibiotic resistance levels than the Kinniya hot spring. Although Pseudomonas strains from Wahawa continued to resist aminoglycosides and fluoroquinolones, the overall resistance level decreased. They were susceptible to several β-lactam antibiotics. This difference highlights how human presence and pollution can speed up the evolution of resistance among environmental microbial communities.

These findings are highly consistent with what we see in other parts of the world, particularly that human activities play a significant role in driving environmental antibiotic resistance. Natural microbial communities have the potential to spread the developed resistance genes within themselves to other bacteria through horizontal gene transfer activities. This indicates that the environments such as hot springs, rivers, and groundwater are not isolated ecosystems; they are linked to human health through water use, recreation, agriculture, and the food chain.

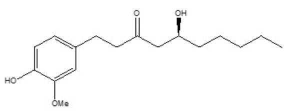
Fighting antibiotic resistance is not only a clinical or pharmaceutical issue but also an environmental concern. Monitoring environmental resistomes, expanding genomic surveillance, and integrating molecular tools such as metagenomics could help trace how resistance evolves and spreads. A key part of these efforts is reducing the flow of antibiotics and resistant microbes into the natural environment. Improving wastewater treatment, regulating antibiotics used in agriculture, and ensuring safer disposal of pharmaceuticals, like more innovative prevention strategies, are vital steps to decrease the entry of antibiotics into the ecosystem.

The emergence of antibiotic resistance in Pseudomonas species in Kinniya and Wahawa hot springs is a powerful reminder that resistance is never an isolated process. Antibiotic resistance in natural microbiota is interconnected with several other factors, such as human activities, infrastructure, and environmental interactions. We can intensify our efforts to reduce the spread of resistance by pinpointing and managing these underlying causes. Thus, it might help mitigate the overuse of antibiotics and protect ecosystems that sustain life.

Zingiber officinale: More Than Spice – A Bioactive Powerhouse

H. A. K. D. Premasiri, K. G. Nelum P. Piyasena & Lalith Jayasinghe
National Institute of Fundamental Studies

Zingiber officinale, commonly known as ginger, is a widely utilized culinary spice and medicinal plant with a long history of use in traditional medicine, owing to its diverse pharmacological properties. From Ayurvedic medicine to Chinese traditional medicine, ginger was recommended for use in control of cold, nausea, gastrointestinal problems, and even pain. It is particularly noted for its immunomodulatory effects. The pharmacological versatility of ginger can be attributed to its diverse array of phytochemicals. The major bioactive compounds include: gingerol (1), shogaol (2), paradol (3), and zingerone (4). These compounds possess significant anti-inflammatory, antioxidant, and antimicrobial activities. These activities contribute to support and strengthening of the immune system. The gingerols contain anti-inflammatory abilities, which act against free radical damage. The shogaols produced by ginger when dried or heated, may be even stronger to act against germs and cancer at times. Paradols contain additional antioxidant actions. The zingerone is what makes ginger smell and aids in metabolism.



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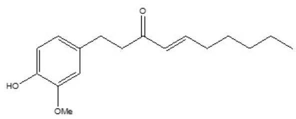

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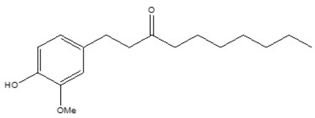

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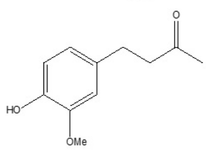

(4)

Ginger exhibits broad-spectrum of antimicrobial activities. Its extracts have demonstrated efficacy against a variety of pathogenic microorganisms, including bacteria, fungi, and viruses. These antimicrobial effects are reported to reduce pathogen burden, thereby alleviating stress on the immune system and enhancing its efficiency. This dual role direct pathogen inhibition and immune support highlights ginger's value as an immunomodulatory agent. In addition, ginger possesses well-documented anti-inflammatory, analgesic, and anti-edematous properties. Animal studies have revealed its capability to reduce inflammation and edema in models of arthritis while clinical trials have confirmed its effectiveness in alleviating pain. These effects are largely attributed to the inhibition of pro-inflammatory mediators such as cytokines and prostaglandins, contributing to improved immune homeostasis and prevention of chronic inflammatory conditions. Furthermore, ginger demonstrates promising cytotoxic effects against various cancer cell lines, indicating potential application in oncology as a plant-based chemotherapeutic. Its active constituents have shown the ability to inhibit cancer cell proliferation, inducing apoptosis, and suppressing angiogenesis. Ginger is also recognized for its efficacy in managing nausea and vomiting, particularly during pregnancy and chemotherapy-induced cases. Numerous clinical and preclinical investigations have supported its use as a safe and effective adjuvant in these contexts.

Extensive research done in the past has demonstrated that ginger possesses potent antioxidant activity, contributing to cellular protection as well as the enhancement of immune system function. Ginger exerts its antioxidant effects primarily through the neutralization of free radicals. Key bioactive constituents such as gingerol and zingerone play a central role in this process by directly scavenging reactive oxygen species and enhancing the activity of endogenous antioxidant enzymes. The essential oil of ginger has been shown to increase the level of superoxide dismutase, glutathione peroxidase and glutathione-s-transferase in liver, showing the role of ginger essential oil in protecting the cells from extracellular deleterious radicals, by increasing the serum and liver antioxidant enzymes. This enzymatic upregulation underscores ginger's ability to bolster systemic antioxidant defenses and its protective effect on tissues, particularly hepatic cells. Among these, the principal bioactive component, gingerol, has been shown to reduce inflammation by inhibiting the release of pro-inflammatory cytokines, thereby promoting immune homeostasis and helping to prevent chronic inflammatory conditions.

Collectively, these compounds exhibit synergistic interactions, which contribute to their broad spectrum of biological activities. Depending on the concentration, environmental conditions, as well as the specific biological target, different subsets of compounds may dominate, thereby shifting the overall response toward either inhibitory or stimulatory effects. In addition, it has wider implications for existing sustainability effort and drug discovery processes. Plant compounds from ginger can act as substitutes where antibiotic resistance is a major issue. The bioactive compounds of ginger are amendable for creating novel antimicrobial agents or being transformed into anti-inflammatory drugs having fewer side effects.

Conclusions

Given these pharmacological properties, ginger is a valuable dietary component, especially during time periods of increased susceptibility to infections. It can be consumed in various forms such as fresh, dried, powdered, or as an extract offering a safe and natural approach to support immune health. The rich composition of bioactive compounds in ginger might provide significant benefits for immune function through its antioxidant, anti-inflammatory, and antimicrobial effects, as well as its capacity to enhance immune cell activity. Regular consumption of ginger may contribute to improved overall health and greater resilience against infections. The characteristic warmth associated with ginger is not merely a sensory attribute but a reflection of its complex phytochemical composition and bioactive functionality. This insight transcends culinary interest, highlighting the scientific importance of re-evaluating traditional remedies through the lens of modern pharmacological research. As such, the future of integrative medicine may increasingly rely on the therapeutic potential of natural products like ginger, once confined to traditional use, now recognized as candidates for evidence-based clinical application.

Adjunct corner: Transforming Rural Communities Through Solar Villages

I.M. Dharmadasa, M. Rawlins, N. Roelens & D. Jayasekera
Condensed Matter Physics & Solid State Chemistry Programme, National Institute of Fundamental Studies

Use of solar technology has become an innovative and abundant source of renewable energy which can support community development in rural Sri Lanka. This shift has become increasingly important to move away from the country's historic reliance on fossil fuels, obviate the need for nuclear power and to meet its international climate targets ahead of 2030. Solar Village SDG is a community interest organisation, which aims to empower rural villages in Sri Lanka by harnessing solar energy. The project also targets to improve environment, education, living standards and uplift communities out of dire poverty. In fact, the project aligns with 14 out of 17 sustainable development goals (SDGs) and six other key transitions identified by the United Nations to deliver the SDGs. The key transitions that can have catalytic and multiplier effects across the SDGs include (1) food systems; (2) energy access and affordability; (3) digital connectivity; (4) education; (5) jobs and social protection; and (6) climate change, biodiversity loss and pollution.

The 'Solar Village' or 'CARES' (Centres for Application of Renewable Energy Sources) initiative has been working in selected rural areas of Sri Lanka with communities in need, to promote renewable, clean solar energy solutions and generate regular income to support sustainable development. In this article, we attempt to highlight the progress of the Solar village project to date.

Climate risks

Sri Lanka is facing several challenges including the climate crisis. The country is highly vulnerable to climate risks like increasing temperature, rising sea level and other natural disasters. These may pose significant threats to its ecosystems, economy, and communities. The devastation caused by climate change might pose severe threats as the island nation is frequently battered by recurrent droughts, hurricanes, landslides and severe floods. They may disproportionately affect the poorest communities in several rural areas.

The challenges of poverty

Roughly about a quarter of the Sri Lankan population lives below the poverty line and is extremely vulnerable to economic shocks. More than eight out of every ten (80.9%) people living in rural areas are lacking the basic health facilities, cooking fuel, clean drinking water, and sanitation. Despite youth literacy of almost 99% and adult literacy of over 92% (World Bank and government data), the overall rates of digital literacy (38.7%), financial literacy (35%), and English literacy (22%) still remain below the expected level. Young children face multi-dimensional poverty with deprivation in nutrition and early childhood development. If these children and vulnerable communities are not supported, poverty will spiral upwards.

The energy sector

For the past several decades, the power sector in Sri Lanka has been heavily reliant on fossil fuels such as coal, oil and gas. In 2023, fossil fuels accounted for 50% of power generation. This dependency poses risks such as price volatility and supply chain disruptions. According to Sri Lanka's commitments in relation to its Nationally Determined Contributions the country has committed to reduce greenhouse gas (GHG) emissions by 14.5% for the decade to 2030, including an unconditional reduction of 4%. Despite having a low carbon footprint and highly vulnerable status, Sri Lanka is committed to a 32% increase in its forest cover by 2030 and established targets to achieve 70% renewable energy in electricity generation by 2030.

Following the energy crisis brought about by the financial crisis of 2022, foreign nuclear powers have sought to influence the nation's energy plans by offering nuclear power plants within the energy mix. Nonetheless, the inherent dangers, the costs, loss of energy independence from geo-political pressures in such a solution makes the 100% renewable energy option more attractive and suitable for Sri Lanka's needs.

Solar Village Concept

In an attempt to accelerate and promote scale-up of solar power, which is readily available in Sri Lanka, "the solar village concept" was designed by us and piloted in 2008. When introducing any new technology to the community, there are numerous issues to solve at the technology/community interface. The main steps to deliver each solar village project focus on raising required funds, selecting suitable sites, working with the community to share the benefits of the project, establishing the project, monitoring, guiding and reporting on the progress of the project.

Five solar villages were gradually established over a fifteen-year period due to the time and effort. Based on the wealth of knowledge and experience gained during this time, the solar village team managed to establish another set of four solar villages during the year 2024. Building on this expertise and success, a community interest company called Solar Village SDG CIC, was founded in the United Kingdom in November 2024, to expand and attract external funds for rapid replication (www.solarvillagesdg.org). Over the subsequent seven months, required funding was raised for six more new solar villages to accelerate the process to establish more solar villages.

Implementation of the Solar Village Concept

The Solar Village team identifies a community in need and works with the local village cluster which comprises around 1000 people to set up a solar power system and follows the steps below:

1. Raise funds necessary to establish a solar village and an accompanying smart room in the local school.
2. Solar Village team meet the community leaders, explain the project's aims and objectives, and decide a regular income generation method using renewables, mainly solar energy, using the Net plus scheme or any other method like solar water pumping for drinking or irrigation.
3. Select suitable sites for relevant installations. Henceforth the Solar Village team will seek schools in the community or suitable communal buildings to enable the establishment of IT facilities for education.
4. Establish a village development committee (VDC) consisting of ~50% female members and open a bank account for the VDC to credit the regular income.
5. Install and commission the system by signing a contract with a solar solution installation company, and direct payment to the company by the sponsoring party. These systems become a property of the whole community.
6. Advise and guide the VDC to organise various sustainable development projects relevant to the local community, and manage funds with full transparency, i.e. with zero corruption or misappropriation.
7. Solar village team meet the community, introduce new projects, guide and monitor the progress to disseminate best practices in each solar village.
8. The project empowers the community to develop themselves, by planting the "seed of the solar village" and enables them to grow into "a successful solar village" where they manage their own advancement.

What Happens in a Typical Solar Village

Solar Village SDG supports communities to work together, to transform their lives and livelihoods and to improve sustainable development. Solar roofs are connected to the national grid via the net-plus scheme to provide regular income coming from Ceylon Electricity Board (CEB). Another method used is to provide water aid via solar water pumping for clean drinking water, irrigation/drip-irrigation for food production via similar schemes which provide regular income. People who use pumped water pay a locally decided regular amounts to the VDC bank account.

Using solar energy and tree planting projects we seek to mitigate climate change effects via reducing CO_2 emission through clean energy use and reabsorbing CO_2 from the atmosphere through photosynthesis. Various projects like bee-keeping and road repairs using community voluntary work are also encouraged. Education improvement is also a key component of the solar village project. By setting up a smart room in the local school, with access to electricity through the solar power installation or any other means, will enable deprived children to access IT and internet facilities. This will be opening up a window to limitless opportunities and knowledge. The facilities can also be extended to Adult Education programmes, teacher's continuous professional development and benefit the parents in evening classes.

Figure 1:
Typical Solar Village implementations and community involvements

How It All Began

The Solar Village project evolved out of a six-year Higher Education Link (HE-Link) programme completed in the early 1990s, which was funded by DFID-UK (now FCDO) and administered by the British Council to facilitate professional mobility between the two countries. Professor I. M. Dharmadasa, initiated and led the programme between Sheffield Hallam University, his employer and several Sri Lankan Universities – Peradeniya, Colombo, Moratuwa, Kelaniya & Ruhuna. The main objective was to collaborate on solar energy conversion research in Sri Lankan universities and promote renewable energy applications. After a six-year funding period, this link activity is self-sustaining. As a result, a national and regional network – the South Asia Renewable Energy Programme (SAREP) was formed, and public engagement efforts inspired the 'Solar Asia' conference series and the 'Solar Village' social development project.

Where We Work

To date, we have successfully set up nine solar villages across Sri Lanka at Kaduruwewa, Pulmoddai, Nochchiya, Puthier-Nagar, Monaragala, Sobithagama, Mediyawa, Kanatholuwa and Panama. At present, the tenth solar village is forming at Handungamuwa village in the Matale District.

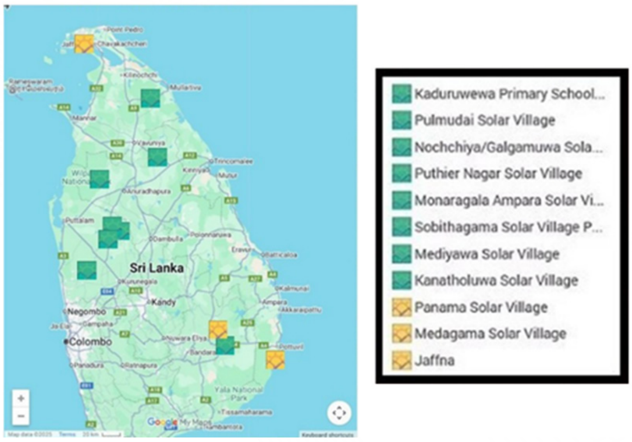

Figure 2:
Map of Solar Villages across Sri Lanka

Solar villages were set up in different locations often at the request of the community and have had a transformative impact on numerous local families through work overseen by the village development committee (VDC). The Solar Village SDG directors mainly reside in the UK, and collaborate closely with a well-established, dedicated local team in Sri Lanka. The local team consists of voluntary members, several local universities (Wayamba & Colombo), NSF-National Science Foundation and Sarvodaya. Currently, there are requests for approximately 25 potential sites, and the team is working to select the most suitable sites to establish new solar villages. In the Summer of 2025, the solar village team visited Hadungamuwa in Matale District to have the first meeting with the community to establish a new solar village. However, the recent reduction of the solar tariff from Rs 37 to Rs 27, and now to ~Rs 19 per kWh drastically reduces the income to these needy communities and therefore, slow down the spreading rate of solar villages in the country.

Spotlight on Nochchiya Village

Nochchiya Village is located in the Northwestern Province in Sri Lanka with approximately 1200 residents. The community had no clean drinking water and faced challenges with elephant-human conflict. After some villagers heard about the pilot solar village, they visited Kaduruwewa pilot project to see the working system and then sent a letter with 104 signatures to the Project Leader requesting solar facilities in their village. As a result, two solar roofs of 3.5-kW each were installed in 2017 with funding from two charities. Each system costed Rs 830,000 (£4,500), with a total cost of Rs 1.66 million (£9,000) during that time. The power produced from 7-kW solar roofs was fed into the national grid and the income generated was used to cover the cost of two water pumping stations and a water purification system operated using grid electricity. Surplus purified water was made available to seven surrounding villages to purchase at a nominal cost thus cascading the benefits beyond the village. In these villages, there were many patients suffering from kidney related illnesses. After providing clean drinking water, villagers reported no new such cases. A key component to transforming the future of the village is focusing on education and setting up a smart room for rural children to be able to access educational materials and IT facilities to improve their Maths, English, and other creative skills. The VDC also organises voluntary activities for the community to improve their environment by planting trees, beekeeping, repairing roads and supporting vulnerable families to become self-sufficient. The VDC maintains transparency by maintaining an auditable statement of accounts for all the projects.

Kaduruwewa Village

Kaduruwewa Primary School was built through voluntary contributions by community members in the mid-1950s. It operated for 50 years without electricity and tap water; teacher turnover was high due to the poor facilities. Student numbers dropped to a low of 20 pupils in 2007, at which point, the government decided to close down the school. The Kaduruwewa Head teacher shared how the village was transformed: “When Prof. Dharmadasa visited to the village, I explained the situation. He did not want to see the primary school close. With his own funding, he arranged to get electricity from the nearby national grid and installed a solar water pumping system to provide clean water to the community in 2008. The village became the pilot solar village, with many donors providing computers and facilities to uplift the school. Within the first year, student numbers rose to about 85 and we built a new building for the library and a classroom with donations and villagers’ voluntary work. By empowering the community and schoolteachers, the school is now in the top three primary schools in the Maho zone, with a 60% pass rate from the year-5 scholarship exam results. The village has shown huge development to improve the environment and living standards”.

Nochchiya Village

Similar to this, in Nochchiya village their treasurer shared about the impact of the solar energy system on the community. "The 7-kW solar roof was a great present given to our village in 2017, arranged by Professor Dharmadasa. The monthly income received from the Ceylon Electricity Board was managed by our VDC carefully to pump water, purify and distribute to the villagers and to sell to the surrounding seven villages. This helped us to grow our bank account while slowing down rapidly spreading kidney diseases in this area. We have saved about Rs 7.3 million (£18,250) in our VDC bank account, in addition to adding two new buildings to the community. Project leaders make annual visits to our village to discuss the progress and guide us on various development ideas. We plan to install another solar roof on our new building with our own funding. Our village has transformed from a very poor village to a bright and fast developing green, solar village".

Figure 3:
VDC office and library coming up in the Nochchiya solar village next to the water purification system under the solar roof.

For any further details about Solar Village projects, please contact Professor I.M. Dharmadasa on: +44 757 241 5184 or via email: dharme@shu.ac.uk or chair@solarvillagesdg.org

"A PERSON WHO NEVER MADE A MISTAKE NEVER TRIED ANYTHING NEW"

- Albert Einstein

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