



# SLMNA NEWSLETTER

SRI LANKA MEDICAL NUTRITION ASSOCIATION OFFICIAL NEWSLETTER

*Linking nutrition research to practice...*



## **This Month's Featured Articles**

- *Editor's Note*
- *Capture of the Month*
- *Carbonated Beverages*
- *Food of the Month - Microgreens*
- *Bee's Honey*
- *Coriander*
- *Madan (Black Plum)*
- *Kottamba (Tropical Almond)*
- *Past and Upcoming Events*

# EDITOR'S NOTE

*Mindfulness is a priceless gift if one can attain it,  
as it nurtures and nourishes the mind and spirit.*

*The acceptance of all thoughts,  
focusing one's awareness on the present moment,  
and trying to cultivate a sense of focused relaxation is  
one way of practicing it.*

*A sense of balance or peace of mind  
can often be challenging.*

*At times, it is necessary to harness the power of breath,  
life force to work with mind & body together,  
and stay connected,  
grounded that eventually raises you above adversity.*

*While doing it try to reiterate positive vibes that enhance  
the well being than weighing you down.*

*No harm in taking extra time in realizing what you do or  
what brings you joy,  
and engaging with the innermost workings of your mind.*

*Passing now are the last few days of the current year, and  
wait to step into the next year.*

*saying goodbye is hard for sure..,  
Your love & kindness were shared this year...  
filled every corner of our hearts with a tear...*

*This is such a best story in all our lives  
where we laughed until we had to cry  
and we loved each other right & tight until this goodbye.*

*So this is just a door through,  
which we all walk, that brings us to another good chapter,  
in our story together...*

*because it is neither an end nor a beginning,  
but just a going on...*

*Hasanthi and Udari*

# CAPTURE OF THE MONTH



# IS A SUGAR-FREE FIZZY DRINK GOOD TO QUENCH YOUR THIRST?

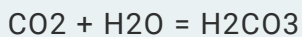
## ARTICLE OF THE MONTH

By Dr. Rasika Siriwardhana

Carbonated Beverages are drinks with added carbon dioxide.

Carbonated Beverages have carbonated water or soda water as their base. To that base, flavours and sweeteners are added additionally. So such beverages are mostly water (typically 90% or more, but in "diet" fizzy drinks, 99% is water.)

Though usual water often has a trace amount of carbon dioxide, carbonated beverages are saturated with carbon dioxide to create a pleasant bubbly sensation. When carbon dioxide mixes with water, it forms carbonic acid:



It is this acid that creates the tingling on the tongue.



Sugar-free carbonated drinks are carbon-infused drinks with high-intensity of artificial sweeteners/sugar substitutes. The manufacturers have added natural/artificial flavours, colourings, preservatives, and other ingredients with high-intensity artificial sweeteners. Aspartame, Saccharin, Acesulfame K are some of the sugar substitutes used as sweeteners in sugar-free carbonated drinks. So their calorie content is not considerable

With developing epidemiology to Non-communicable diseases, people with high craving for carbonated beverages are shifting from sugar-sweetened carbonated beverages to sugar-free/low calorie carbonated beverages.

It may be true that those fizzy drinks contribute to few or no calories to the diet. Furthermore, they do not raise blood sugar levels generally.

### So are they healthy?

According to "the Center for Science in the Public Interest", some unapproved artificial sweeteners and excessive consumption of approved high-intensity sweeteners may promote certain forms of cancers, thyroid problems and preterm births. Some people also claim that artificial sweeteners cause headaches and dizziness.

Even the high-intensity sweeteners found in these drinks may lead to weight gain. Because they partially activate the food reward pathways. So the activation of the hedonic component may contribute to the increased appetite. As high-intensity sweeteners are preciously sweet, they encourage sugar craving and sugar dependence.

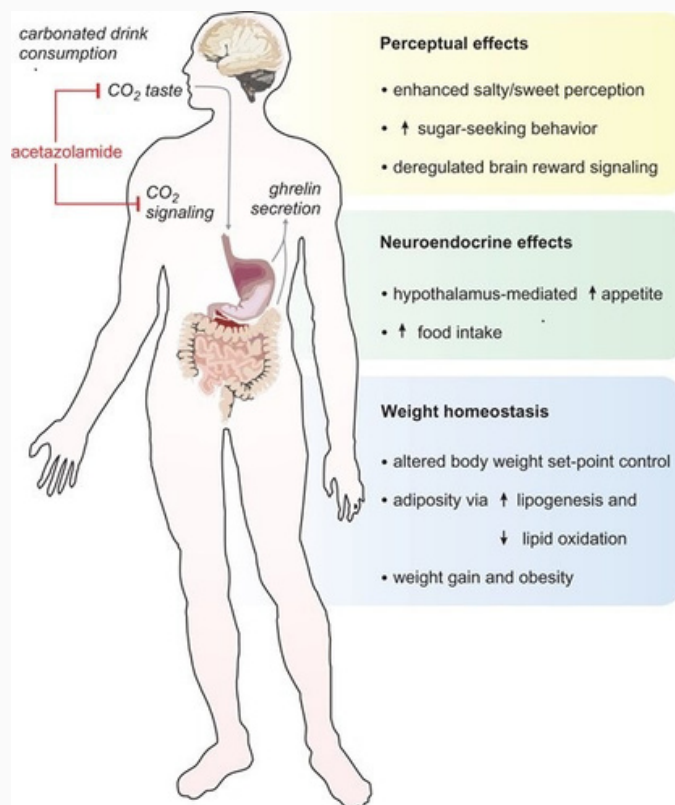
Daily drinking of diet soda may cause metabolic problems. So, diet soda consumption at least once a day was significantly associated with Metabolic syndrome and type2 diabetes mellitus.

According to the prospective cohort study "Sugar- and Artificially Sweetened Beverages and the Risks of Incident Stroke and Dementia", artificially sweetened soft drink consumption was associated with stroke and dementia. In addition, some studies suggest that phosphoric acid, which is often added to cola drinks, poses a risk factor for bone health with a higher risk of stroke and dementia.

Teeth problems mainly occur due to the high consumption of sugar-containing drinks. Because of the acidity that occurs with the carbonation, damage to the tooth enamel and caries formation can be seen with sugar-free fizzy drinks.

On the other hand, long-term carbonated soft drink consumption induces oxidative stress and alterations in antioxidants in the body. It also affects the expression levels of specific genes and is associated with altered brain function.

Apart from the above, regular consumption of carbonated drinks can lead to addiction. This addiction wastes your money.



## References

- Armfield, J. M., Spencer, A. J., Roberts-Thomson, K. F., & Plastow, K. (2013). Water fluoridation and the association of sugar-sweetened beverage consumption and dental caries in Australian children. *American Journal of Public Health*, 103(3), 494–500. <https://doi.org/10.2105/AJPH.2012.300889>
- Carbonated Beverages - CooksInfo. (n.d.). Retrieved December 8, 2021, from <https://www.cooksinfo.com/carbonated-beverages>
- El-Terras, A., Soliman, M. M., Alkhedaida, A., Attia, H. F., Alharthy, A., & Banaja, A. E. (2016). Carbonated soft drinks induce oxidative stress and alter the expression of certain genes in the brains of Wistar rats. *Molecular Medicine Reports*, 13(4), 3147–3154. <https://doi.org/10.3892/MMR.2016.4903/HTML>
- Hasselkvist, A., Johansson, A., & Johansson, A.-K. (2010). Dental erosion and soft drink consumption in Swedish children and adolescents and the development of a simplified erosion partial recording system. *Swedish Dental Journal*, 34(4), 187–195.
- Negative Effects of Sugar-Free Carbonate Negative Effects of Sugar-Free Carbonated Drinks. (n.d.). Retrieved December 9, 2021, from <https://healthyeating.sfgate.com/negative-effects-sugarfree-carbonated-drinks-9939.html>
- Drinks. (n.d.). Retrieved December 9, 2021, from <https://healthyeating.sfgate.com/negative-effects-sugarfree-carbonated-drinks-9939.html>
- Nettleton, J. A., Lutsey, P. L., Wang, Y., Lima, J. A., Michos, E. D., & Jacobs, D. R. (2009). Diet soda intake and risk of incident metabolic syndrome and type 2 diabetes in the multi-ethnic study of atherosclerosis (MESA). *Diabetes Care*, 32(4), 688–694. <https://doi.org/10.2337/dc08-1799>
- Pase, M. P., Himali, J. J., Beiser, A. S., Aparicio, H. J., Satizabal, C. L., Vasan, R. S., Seshadri, S., & Jacques, P. F. (2017). Sugar- and Artificially Sweetened Beverages and the Risks of Incident Stroke and Dementia: A Prospective Cohort Study. *Stroke*, 48(5), 1139–1146. <https://doi.org/10.1161/STROKEAHA.116.016027>
- Takeda, E., Yamamoto, H., Yamanaka-Okumura, H., & Taketani, Y. (2014). Increasing Dietary Phosphorus Intake from Food Additives: Potential for Negative Impact on Bone Health. *Advances in Nutrition (Bethesda, Md.)*, 5, 92–97. <https://doi.org/10.3945/an.113.004002>
- Wyshak, G. (2000). Teenaged girls, carbonated beverage consumption, and bone fractures. *Archives of Pediatrics & Adolescent Medicine*, 154(6), 610–613. <https://doi.org/10.1001/archpedi.154.6.610>
- Yang, Q. (2010). Gain weight by "going diet?" Artificial sweeteners and the neurobiology of sugar cravings: Neuroscience 2010. *The Yale Journal of Biology and Medicine*, 83(2), 101–108.

# MICROGREENS – TINY BUT MIGHTY GREENS

## FOOD OF THE MONTH

By Dr. Menaka Koottage

### Types of microgreens

Microgreens can be grown from many different species of seeds. The most popular varieties are produced using seeds from the following plant families.

- Brassicaceae family: Cauliflower, broccoli, cabbage, kale, kohlrabi, radish
- Asteraceae family: Lettuce, endive, chicory, and radicchio
- Apiaceous family: Dill, carrot, fennel, coriander, and celery
- Amaryllidaceous family: Garlic, onion, leek
- Amaranthaceous family: Amaranth, quinoa Swiss chard, beet, and spinach
- Cucurbitaceous family: Melon, cucumber, and squash
- Lamiaceae family: Mint, Basil, rosemary, sage, and oregano
- Cereals:- rice, wheat, corn, barley, oats
- Lentils:- chickpeas, lentils, mung beans

Several species can be combined to create unique flavors, textures, and colours. Generally, the flavor is considered strong and concentrated, which can range from neutral to spicy, sometimes slightly sour or even bitter.

### Nutritional benefits

Although small in size microgreens are surprisingly rich in various micronutrients especially vitamins, minerals, and antioxidants. Some of the lipophilic vitamins are much higher in microgreens compared to their mature counterparts.

The world's population in the twenty-first century expects novel sources of food with distinct nutraceutical properties that are also convenient to consume. Microgreens could be one of the main players in this scenario's ongoing evolution.

They are first becoming popular in California, USA in the middle of the 1980s and the word "microgreens" was first used in the year 1998.

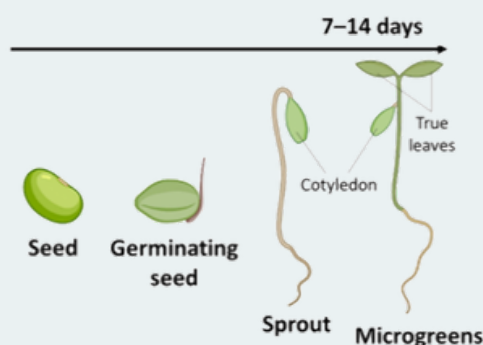
These tiny, soft, edible greens are produced from the seeds of vegetables, herbs, or grains, including wild or even decorative plant species. They have a brief, species-dependent production cycle which is of 1–3 weeks from seed germination

Despite their diminutive size, they are nutritionally dense and frequently carry higher quantities of nutritional and bioactive compounds than mature vegetable greens.

### Microgreens vs sprouts

Microgreens are frequently confused with sprouts, although the two are not the same. When seeds are germinated the first root and the first set of "leaves" (cotyledon leaf) that emerges to unfold from the seeds are called sprouts. Whereas microgreens are the next stage in a plant's development harvested when the germinated seeds have developed tiny roots and at least their first true leaves.

Microgreens have similar health advantages as sprouts but a higher nutritional content.



**Polyphenols** are one of the major bioactive compound categories found in microgreens. Which comprises important sub-classes of phytochemicals such as flavonoids (anthocyanin, flavonols), phenolic acids, and phytoestrogens (isoflavones).

**Glucosinolates (GLSs)**, also known as Nitro sulfur compounds are important plant secondary metabolites found exclusively in the genus Brassica, which includes kale, cabbage, and broccoli. The potential bioactive components are produced by the breakdown of GLSs.

## Health benefits of microgreens

### Antioxidant activity

Microgreens' antioxidant activity is a key characteristic for their use as functional foods. They have been shown to contain a wide spectrum of naturally occurring antioxidants, including both nutritive antioxidants like vitamins (especially vitamin C and E) and non-nutritive antioxidants like carotenoids and phenolic compounds.

### Anticancer activity

The high amount of glucosinolates (GLSs) has been related to the preventive action against cancer. GLSs and their hydrolysis products are a well-known family of cancer chemotherapeutic drugs that function by inducing apoptosis and halting cell cycle progression.

### Antimicrobial activity

Plant-derived bioactive molecules such as phenolic compounds, flavonoids, and glucosinolates can suppress the proliferation and activity of numerous microorganisms by plasma membrane instability or extracellular enzyme inhibition. Several studies have shown that antimicrobial action against foodborne pathogens and *Helicobacter pylori*.

### Anti-inflammatory activity

The anti-inflammatory properties are demonstrated by suppressing inflammatory mediators, reducing proinflammatory cytokines, and enhancing anti-inflammatory cytokines. Hence, the use of microgreens in the prevention and treatment of inflammatory bowel diseases such as ulcerative colitis and Crohn's disease holds potential.

### Anti-diabetic activity

$\alpha$ -amylase, the enzyme responsible for hydrolyzing the 1,4-glycosidic bonds in starch to generate glucose, was suppressed by 70% by microgreen extract during testing, indicating anti-diabetic potential. It also increased glucose absorption by 25% in L6 cells.

### Anti-obesity activity

Microgreens have anti-obesity properties due to their ability to modulate lipid metabolism. They improve lipid profiles by significantly lowering plasma low-density lipoprotein (LDL) and hepatic triglyceride levels. Furthermore, they aid in the downregulation of multiple lipogenesis-related genes, as well as lower mRNA expression of C-reactive protein and tumor necrosis factor in the liver, signaling an inhibitory effect on inflammation induced by a high-fat diet.

### Microgreens and food safety

Microgreens are typically regarded as safe to consume, but food poisoning is a concern. Growing techniques, particularly hydroponic systems, have recently been shown to be prone to pathogens such as *E. coli* O157: H7 and *Salmonella* multiplication when seeds are contaminated.

It is interesting to know that some of the anti-nutrient factors such as nitrates and nitrites are low in microgreens. In addition, microgreens were found to be moderate to good sources of protein, dietary fiber, and essential elements.

Table 1. Growth, and nutritional composition profile of Brassica microgreens

	Kohlrabi purple	Cabbage red	Broccoli	Kale Tuesan	Komatsuna red	Tatsoi	Cabbage green
Hypocotyl Length (mm)	46	47	42	49	44	46	45
Leaf Area (cm <sup>2</sup> )	1.82	1.93	1.65	2.02	1.75	1.86	1.83
Fresh weight (g)	0.44	0.46	0.42	0.47	0.41	0.45	0.44
Dry weight (%)	6.65	6.18	6.55	6.90	6.57	6.34	6.25
P (mg/100 g FW)	68	62	59	63	66	64	62
K (mg/100 g FW)	322	224	319	280	320	300	183
Ca (mg/100 g FW)	65	84	92	55	53	44	87
Na (mg/100 g FW)	46	40	50	46	28	35	69
Fe (mg/100 g FW)	0.77	0.69	0.74	0.76	0.76	0.65	0.67
Zn (mg/100 g FW)	0.43	0.40	0.42	0.38	0.38	0.41	0.33
Cu (mg/100 g FW)	0.08	0.10	0.11	0.07	0.05	0.08	0.06
Mn (mg/100 g FW)	0.39	0.35	0.41	0.46	0.34	0.35	0.37
Phylloquinone (µg/g FW)	2.6	2.3	2.0	1.7	2.2	1.5	1.4
α-tocopherol (mg/100 g FW)	17.6	29.5	17.3	19.4	25.0	29.3	14.3
Total Ascorbic Acid (mg/100 g FW)	77.1	127.4	84.6	73.2	97.5	99.5	118.9
β-carotene (mg/100 g FW)	6.6	9.9	6.9	5.4	7.1	10.6	9.6

### Macronutrients

Information on the fiber, protein, carbohydrate and fat composition of microgreens is scarce. According to certain research, they have low protein, fat, and carbohydrate content. Despite their low protein content, they are good sources of essential amino acids.

Microgreens also had low levels of dietary fibers, with the majority of crude fiber being composed of cellulose and lignin.

In general, microgreens are low in calories and high in moisture, with an overall caloric value ranging from 70 kJ to 100 kJ per 100 g.

### Micronutrients

#### Vitamins

Microgreens are excellent sources of some vitamins and their precursors. Even though high variability was observed when compared with different species satisfactory amounts of vitamin E, β-carotene (pro-vitamin A), vitamin C, and vitamin K1 are found in microgreens.

Since the aforementioned vitamins are abundant in microgreens, it is possible to demonstrate that a few grams of microgreens can entirely fulfill an adult's recommended daily intake.

#### Minerals

Microgreens are a good source of minerals with K and Ca being the most abundant mineral elements in all varieties of microgreens. In general, it is considered that 100g of fresh microgreens at least provides a 15% daily K and Ca requirement.

Other minerals, to varying degrees, are also found depending on the type of microgreens. S, P, Fe, Mn, Zn, Mg, Cu, Se, and Mo are abundant in microgreens compared to mature veggies. Asteraceae plants, for example, are high in phosphorus, while Brassicaceae species are high in sulfur.

The Mn content was found to be relatively high in all microgreens providing 34% - 66% of nutritional requirement which allows microgreens to be considered as Mn-rich food source.

### Other bioactive compounds

Bioactive compounds are non-nutritional constituents found in foods that have the ability to modulate metabolic processes and provide health benefits. Because their concentration of bioactive compounds is several times higher than that of mature plants, regular consumption of microgreens can stimulate natural defense systems and reduce the risk of chronic diseases.





Some plant species cannot be consumed as microgreens. The Solanaceae family, including potatoes, tomatoes, eggplants, and peppers, are such species where toxic alkaloids found in those plant seedlings can induce digestive and nervous system problems.

## How to grow microgreens

Even if you don't have the time or space for gardening, microgreens can be simply grown at home in many climates. It is an excellent choice for home-grown and pesticide-free food. Microgreens are low-maintenance and ready to harvest in days, so you don't need special skills or a lot of patience to cultivate them successfully.

Steps to grow microgreens are very easy.

1. In a planter dish or tray, scatter seeds over an inch of potting soil and top with another thin layer of soil.
2. Spray the soil with water and place the container in a place where sunlight falls.
3. Mist the seeds every day to keep the soil moist and the plants from drying out.

In 2–3 weeks, the microgreens will be ready to harvest. Before consuming microgreens, people should cut them above the soil surface and thoroughly rinse them.

## How to include microgreens in diet

Microgreens are a versatile food that may be integrated into your diet in a variety of ways. They not only give a splash of color to your dishes but also taste delicious. Adding microgreens to your salads or wraps gives extra crunch while blended into smoothies and juices are especially helpful to start off your day healthily. Almost any dish can benefit from a garnish of microgreens. They're great on pizzas, soups, curries, omelets, stir-fries, spaghetti, and other hot foods.

## References

1. Bahadoran, Z., Mirmiran, P., Hosseinpahan, F., Rajab, A., Asghari, G., & Azizi, F. (2012). Broccoli sprouts powder could improve serum triglyceride and oxidized LDL/LDL-cholesterol ratio in type 2 diabetic patients: a randomized double-blind placebo-controlled clinical trial. *Diabetes Research and Clinical Practice*, 96(3), 348–354. <https://doi.org/10.1016/j.diabres.2012.01.009>
2. Butkutė, B., Taujenis, L., & Norkevičienė, E. (2019). Small-Seeded Legumes as a Novel Food Source. Variation of Nutritional, Mineral and Phytochemical Profiles in the Chain: Raw Seeds-Sprouted Seeds-Microgreens. In *Molecules* (Vol. 24, Issue 1). <https://doi.org/10.3390/molecules24010133>
3. de la Fuente, B., López-García, G., Mániz, V., Alegre, A., Barberá, R., & Cilla, A. (2019). Evaluation of the Bioaccessibility of Antioxidant Bioactive Compounds and Minerals of Four Genotypes of Brassicaceae Microgreens. In *Foods* (Vol. 8, Issue 7). <https://doi.org/10.3390/foods8070250>
4. Galieni, A., Falcinelli, B., Stagnari, F., Datti, A., & Benincasa, P. (2020). Sprouts and Microgreens: Trends, Opportunities, and Horizons for Novel Research. 1–45.
5. Gioia, F. Di. (2017). The nutritional properties of microgreens. October 2015.
6. Huang, H., Jiang, X., Xiao, Z., Yu, L., Pham, Q., Sun, J., Chen, P., Yokoyama, W., Yu, L. L., Luo, Y. S., & Wang, T. T. Y. (2016). Red Cabbage Microgreens Lower Circulating Low-Density Lipoprotein (LDL), Liver Cholesterol, and Inflammatory Cytokines in Mice Fed a High-Fat Diet. *Journal of Agricultural and Food Chemistry*, 64(48), 9161–9171. <https://doi.org/10.1021/acs.jafc.6b03805>
7. Ishida, M., Hara, M., Fukino, N., Kakizaki, T., & Morimitsu, Y. (2014). Glucosinolate metabolism, functionality and breeding for the improvement of Brassicaceae vegetables. *Breeding Science*, 64(1), 48–59. <https://doi.org/10.1270/jsbbs.64.48>
8. Jang, H. W., Moon, J.-K., & Shibamoto, T. (2015). Analysis and Antioxidant Activity of Extracts from Broccoli (*Brassica oleracea* L.) Sprouts. *Journal of Agricultural and Food Chemistry*, 63(4), 1169–1174. <https://doi.org/10.1021/jf504929m>
9. Kestwal, R. M., Lin, J. C., Bagal-Kestwal, D., & Chiang, B. H. (2011). Glucosinolates fortification of cruciferous sprouts by sulphur supplementation during cultivation to enhance anti-cancer activity. In *Food Chemistry: Vol. 126*. [Amsterdam]: Elsevier Science.
10. Kyriacou, M. C., Rouphael, Y., Di Gioia, F., Kyrtzia, A., Serio, F., Renna, M., De Pascale, S., & Santamaria, P. (2016). Micro-scale vegetable production and the rise of microgreens. *Trends in Food Science & Technology*, 57, 103–115. <https://doi.org/10.1016/j.tifs.2016.09.005>
11. Le, Thanh N., Chiu, C.-H., & Hsieh, P.-C. (2020). Bioactive Compounds and Bioactivities of Brassica oleracea L. var. Italica Sprouts and Microgreens: An Updated Overview from a Nutraceutical Perspective. In *Plants* (Vol. 9, Issue 8). <https://doi.org/10.3390/plants9080946>
12. Le, Thanh Ninh, Luong, H. Q., Li, H.-P., Chiu, C.-H., & Hsieh, P.-C. (2019). Broccoli (*Brassica oleracea* L. var. italica) Sprouts as the Potential Food Source for Bioactive Properties: A Comprehensive Study on In Vitro Disease Models. *Foods* (Basel, Switzerland), 8(11). <https://doi.org/10.3390/foods8110532>
13. Moon, J.-K., Kim, J.-R., Ahn, Y.-J., & Shibamoto, T. (2010). Analysis and anti-Helicobacter activity of sulforaphane and related compounds present in broccoli (*Brassica oleracea* L.) sprouts. *Journal of Agricultural and Food Chemistry*, 58(11), 6672–6677. <https://doi.org/10.1021/jf1003573>
14. Paradiso, V. M., Castellino, M., Renna, M., Gattullo, C. E., Calasso, M., & Terzano, R. (2018). Function packaged microgreens. 5629–5640. <https://doi.org/10.1039/c8fo01182f>
15. Paško, P., Tyszcza-Czochara, M., Galanty, A., Gdula-Argasińska, J., Żmudzki, P., Bartoń, H., Zagrodzki, P., & Gorinstein, S. (2018). Comparative Study of Predominant Phytochemical Compounds and Proapoptotic Potential of Broccoli Sprouts and Florets. *Plant Foods for Human Nutrition* (Dordrecht, Netherlands), 73(2), 95–100. <https://doi.org/10.1007/s11130-018-0665-2>
16. Reed, E., Ferreira, C. M., Bell, R., Brown, E. W., & Zheng, J. (2018). Plant-Microbe and Abiotic Factors Influencing Salmonella Survival and Growth on Alfalfa Sprouts and Swiss Chard Microgreens. *Applied and Environmental Microbiology*, 84(9). <https://doi.org/10.1128/AEM.02814-17>
17. Shahidi, F., & Ambigaipalan, P. (2015). Phenolics and polyphenolics in foods, beverages and spices: Antioxidant activity and health effects – A review. *Journal of Functional Foods*, 18, 820–897. <https://doi.org/10.1016/j.jff.2015.06.018>
18. Sirotkin, A. V., & Harrath, A. H. (2014). Phytoestrogens and their effects. *European Journal of Pharmacology*, 741, 230–236. <https://doi.org/10.1016/j.ejphar.2014.07.057>
19. Sotokawauchi, A., Ishibashi, Y., Matsui, T., & Yamagishi, S. (2018). Aqueous Extract of Glucoraphanin-Rich Broccoli Sprouts Inhibits Formation of Advanced Glycation End Products and Attenuates Inflammatory Reactions in Endothelial Cells. Evidence-Based Complementary and Alternative Medicine, 2018, 9823141. <https://doi.org/10.1155/2018/9823141>
20. Subedi, L., Cho, K., Park, Y. U., Choi, H. J., & Kim, S. Y. (2019). Sulforaphane-Enriched Broccoli Sprouts Pretreated by Pulsed Electric Fields Reduces Neuroinflammation and Ameliorates Scopolamine-Induced Amnesia in Mouse Brain through Its Antioxidant Ability via Nrf2-HO-1 Activation. *Oxidative Medicine and Cellular Longevity*, 2019, 3549274. <https://doi.org/10.1155/2019/3549274>
21. Sun, J., Xiao, Z., Lin, L.-Z., Lester, G. E., Wang, Q., Harnly, J. M., & Chen, P. (2013). Profiling polyphenols in five Brassica species microgreens by UHPLC-PDA-ESI/HRMS(n). *Journal of Agricultural and Food Chemistry*, 61(46), 10960–10970. <https://doi.org/10.1021/jf401802n>
22. Takó, M., Kerekes, E. B., Zambrano, C., Kotogán, A., Papp, T., Krisch, J., & Vágvolgyi, C. (2020). Plant Phenolics and Phenolic-Enriched Extracts as Antimicrobial Agents against Food-Contaminating Microorganisms. *Antioxidants* (Basel, Switzerland), 9(2), 165. <https://doi.org/10.3390/antiox9020165>
23. Teng, J., Liao, P., & Wang, M. (2021). The role of emerging micro-scale vegetables in human diet and health benefits—an updated review based on microgreens. *Food & Function*, 12(5), 1914–1932. <https://doi.org/10.1039/D0FO03299A>
24. Treadwell, D., Hochmuth, R., Landrum, L., & Laughlin, W. (2020). Microgreens: A New Specialty Crop. *Edis*, 2020(5), 1–3. <https://doi.org/10.32473/edis-hs1164-2020>
25. Verlinden, S. (2020). Microgreens. In *Horticultural Reviews* (pp. 85–124). <https://doi.org/https://doi.org/10.1002/9781119625407.ch3>
26. Wadhawan, S., Tripathi, J., & Gautam, S. (2018). In vitro regulation of enzymatic release of glucose and its uptake by Fenugreek microgreen and Mint leaf extract. *International Journal of Food Science & Technology*, 53(2), 320–326. <https://doi.org/https://doi.org/10.1111/ijfs.13588>
27. Wojdyto, A., Nowicka, P., Tkacz, K., & Turkiewicz, I. P. (2020). Sprouts vs. Microgreens as Novel Functional Foods: Variation of Nutritional and Phytochemical Profiles and Their In Vitro Bioactive Properties. 1–19.
28. Xiao, Z., Bauchan, G. R., Nichols-Russell, L., Luo, Y., Wang, Q., & Nou, X. (2015). Proliferation of *Escherichia coli* O157:H7 in Soil-Substitute and Hydroponic Microgreen Production Systems. *Journal of Food Protection*, 78(10), 1785–1790.
29. Xiao, Z., Lester, G. E., Luo, Y., & Wang, Q. (2012). Assessment of Vitamin and Carotenoid Concentrations of Emerging Food Products: Edible Microgreens. *Journal of Agricultural and Food Chemistry*, 60(31), 7644–7651. <https://doi.org/10.1021/jf300459b>



# BEE'S HONEY- A MIRACULOUS GIFT FROM NATURE TO MANKIND

By Dr. Ssjeetha Musathique

Bee's honey is consumed by people as a food as well as medicine since ancient times. It is being widely appreciated by mankind for its nutritional, therapeutic, cosmetic, and industrial benefits. Bee's honey is the only insect-derived natural product widely accepted in Sri Lanka by all religions, generations, and civilizations. Thus bee's honey has enormous historical, religious, and nutraceutical value.

It is an amazing fact that mummified man or mummies are created in the ancient period by immersing human cadavers in honey thus showing the powerful preservative nature of honey as well as its eternal shelf life.

## Formation of bee's honey

Honey bees produce honey by sucking sugar-rich nectar from flowers and processing the nectar with repeated regurgitation, enzymatic digestion, and evaporation. It is stored in honeycomb cells. Bees seal the cells with wax to prevent further fermentation. Bees maintain the optimum temperature of hives to store honey. Raw honey is collected from beehives. Nutritional values vary with honey according to its concentration and geographic origin. According to studies the best bee's honey is made by the *Apis mellifera* bee. In Sri Lanka honey is predominantly made by *Apis cerana*.



## Production of bee's honey

Annual world honey production is about 1.2 million tons. China is the largest producer of honey and other top honey exporting countries are Argentina, Turkey, and the USA. Consumption of honey vary from country to country and it's higher in developed countries.

Apiculture or beekeeping is popular in Sri Lanka and most honey is produced from upcountry areas. Locations in wet zones for apiculture are changing with seasons whereas dry zones are appropriate throughout the year. Local bee honey production per year is 30 to 40 tons. Sri Lanka imports 80 to 120 tons, major consumers are the Ayurveda medical system.

## Types of bee's honey

There are several types of honey – it varies according to botanical sources, geographical regions, and processing methods.

Blossom honey or nectar honey – It is classified according to floral sources.

- Monofloral e.g.: Manuka honey from Manuka plant made in New Zealand, Australia.
- Polyfloral
- Blended - most commercially available honey with a mixture of two or more different types of honey.

Honeydew honey – it is made from secretions of aphids or other plant-sucking insects and it is less sweet than nectar honey.



Honey can be divided into several types according to traditional medicines also. There are many types of Ayurveda, 'Makshika' is considered medicinally the best in Ayurveda.

Raw honey, crystallized honey, pasteurized honey, comb honey, and filtered honey are a few examples according to processing and packaging.

**The nutritional profile of bee's honey**

The amazing nature of honey is the qualitative and quantitative composition varies with the type of bee, floral sources, environmental factors, seasonal and climatic conditions.

Honey is a mixture of carbohydrates, proteins, amino acids, vitamins, minerals, antioxidants, water, and other compounds. Honey mainly consists of sugar, the most abundant sugar in honey is fructose followed by glucose.

The color of the honey depends on its antioxidant content, naturally darker honey has a higher amount than lighter honey. Bee's honey is free of cholesterol.

**Nutritional composition of bee's honey**

**Substances amount (g/100g of honey)**

- Energy 304 Kcal**
- Water 15-20**
- Total sugars 79.7**
- fructose 30-45**
- glucose 24-40**
- sucrose 0.1-4.8**
- oligosaccharides 3.1**
- minerals 0.1-0.5**
- Amino acids, proteins 0.2-0.4**
- Phenolics 5-50**
- acids 0.2-0.8**
- PH value 3.2-4.5**

**Chemical elements found in bee's honey**

Minerals	Amount (mg/100g)	Vitamins	Amount (mg/100g)
Sodium	1.6-17	Thiamine	0.00-0.01
Calcium	3-31	Riboflavin	0.01-0.02
Potassium	40-3500	Niacin	0.1-0.2
Magnesium	0.7-13	Pantothenic acid	0.02-0.11
Phosphorus	2-15	Pyridoxine	0.01-0.32
Selenium	0.002-0.01	Folic acid	0.002-0.01
Copper	0.02-0.6	Ascorbic acid	2.2-2.5
Iron	0.03-4	Phylloquinone	0.025
Manganese	0.02-2		
Chromium	0.01-0.3		
Zinc	0.05-2		

**Advantages of bee's honey**

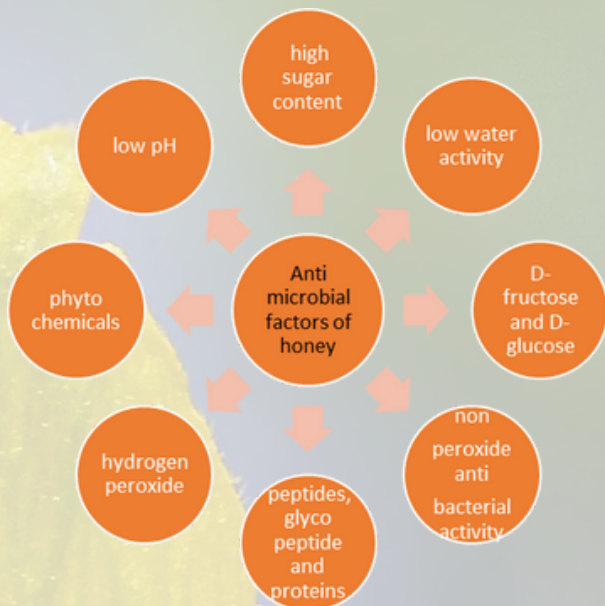
**Antioxidant activity**

Honey is a rich source of antioxidants and the major group of antioxidants in honey are the flavonoids. Some types of honey constitute important phenolic, flavonoid, and carotenoid concentrations with high antioxidant capacity. It has a preventive role from the damage of free radicals and reactive oxygen species (ROS) which is culpable in the process of cellular dysfunction, aging, metabolic and cardiovascular disease.

**Antimicrobial and antiviral properties**

Bee's honey exerts antimicrobial activity through a complex mechanism of action. Studies have shown honey exhibits antimicrobial activity against both gram-positive and gram-negative bacteria. Besides that, it is said that different honey bee products can boost the immune system in several ways. Studies have shown that honey is having antiviral properties against several viruses and antimycotic effects against non-pathogenic fungi and pathogenic fungi as well as antiprotozoal activity against intestinal parasites.





### Anti-inflammatory property

Bee's honey contains flavonoids other antioxidants which inhibit the release of pro-inflammatory cytokines thus enabling the use of honey flavonoid fraction in inflammatory conditions. It is also reported that honey protein has immunomodulatory effects. Glycopeptides and glycoproteins isolated from some kind of honey have an inhibitory action on ROS release.

### As a natural preservative

Honey has been used as a preservative since ancient times. The preservative property of honey is due to the high concentration of sugars and hydrogen peroxide. A high concentration of sugar in honey inhibits bacterial growth and fermentation by osmosis. Hydrogen peroxide has bactericidal properties as well as preservative properties. Honey can be used to preserve foods including milk samples.

### Wound healing property

Honey has been used for wound healing since ancient times. Studies revealed Manuka honey that contains a unique manuka factor is used in honey dressings. It is observed epithelialization and contraction are higher in honey-treated wounds compared to untreated wounds. Antimicrobial activity and immunomodulatory properties are considered important factors in wound healing.

### Hypoglycaemic property

Studies revealed bee's honey is beneficial in diabetes due to the following factors:

- Bee's honey mainly contains fructose as a major sugar component which has a low glycaemic index (GI).
- Honey is sweeter than sugar but gives lesser calories than sugar. Therefore it is needed a much smaller quantity of honey as a sweetener.
- Some recent studies reveal that the synergistic effect of fructose and glucose constituents of honey might contribute to the low glycaemic response following a honey meal.
- When honey is dissolved in water hydrogen peroxide is produced which helps to secrete insulin by stimulating beta cells of the pancreas as well as honey helps regeneration of damaged beta cells.
- The presence of multi-characteristic constituents mainly the antioxidants in bee's honey also has a significant role in the reduction of hyperglycemia.
- Honey is beneficial as it provides a lot of vitamins and minerals.
- It is hypothesized that the presence of non-digestible oligosaccharides in honey which have prebiotic effects on intestinal flora has a preventive role against obesity, insulin resistance, and diabetes mellitus.

In animal model studies honey has been shown positive impacts on diabetic patients and its intake doesn't induce metabolic syndrome. However dietary or therapeutic use of honey in diabetic patients is still inconclusive and requires large sample-sized, multi-center clinical trials to achieve better conclusions.

### Oral health

Honey is considered cardio-protective due to its antibacterial property and its constituents like calcium, fluoride, phosphorus, and other colloidal components.

### Gastro intestinal benefits

Honey contains many enzymes which facilitate the digestion of food substances especially carbohydrates. Several studies documented prebiotic effects of bee's honey due to its component of oligosaccharides which favor the growth of beneficial bacteria such as bifidobacteria and lactobacilli. Honey can be used as a sweetening agent which can provide additional nutritional advantages by providing small nutrients.

### Exercise and Sports performances

Some data suggest honey is an effective substitute to sports supplements during physical exercise for energy replenishment. Fructose in honey slowly metabolizes and act as a sustained energy boost whereas glucose in honey can be rapidly metabolized and provide energy. Various phytochemicals in honey also contribute to the slow rate of fructose metabolism. Additionally, honey contains disaccharides like sucrose and oligosaccharides that are slow-burning sugars.

### Adverse effects

Bee's honey can be contaminated by environmental pollutants like heavy metals, pesticides, antibiotics, and other toxic compounds. It can result from disease control, accidental exposure, environmental hazard, and improper human practices. Lead, arsenic, cadmium are major heavy metals causing honey contamination due to the use of agrochemicals in the growing flowers. Chromium and zinc contamination also occurs due to honey harvesting, processing, and storage. A high concentration of heavy metals beyond safe limits can give rise to potential hazards to human health.

Honey contamination from toxic compounds from toxic plant sources also can occur – so-called 'mad honey'. These phytochemical toxic compounds are mostly neurotoxic.

Another concern regarding honey is the presence of *Clostridium botulinum* in natural honey as it is mostly a non-sterilized food. It is advised not to feed infants with raw honey to avoid exposure of their immature gut with *Clostridium botulinum* spores. To alleviate this bacterial contamination, honey can be sterilized with gamma irradiation without losing its nutraceutical value.

### Few points to think

- Promoting low-cost new technology in apiculture from the farm level including honey extraction and processing will contribute significantly to the economical gain of our country.

- Establishing organic farming and reducing the use of pesticides is important in the pollination process to reduce health hazards.
- Improving standards and testing with certification reduces adulteration and provides better quality honey to consumers.
- In addition to honey, Beehives produce royal jelly, propolis, pollen, and beeswax which have numerous benefits to humans with its bioactive components should be used wisely as value-added products.
- Beeswax which is often discarded can be transformed into value-added products such as cosmetics, candle making, and polishing cream, etc.

### References

1. Cornara, L., Biagi, M., Xiao, J., & Burlando, B. (2017). Therapeutic properties of bioactive compounds from different honeybee products. *Frontiers in Pharmacology*, 8(JUN), 1–20. <https://doi.org/10.3389/fphar.2017.00412>
2. Abdulwahid Ajibola, Joseph P Chamunorwa, & Kennedy H Erlwanger. (2012). Nutraceutical values of natural honey and its contribution to human health and wealth. *Nutrition and Metabolism*, 9(61), 1–12. <http://www.nutritionandmetabolism.com/content/9/1/61>
3. Ediriweera, E. R. H. S. S., & Premarathna, N. Y. S. (2012). Medicinal and cosmetic uses of Bee's Honey - A review. *AYU (An International Quarterly Journal of Research in Ayurveda)*, 33(2), 178. <https://doi.org/10.4103/0974-8520.105233>
4. Bernklau, E., Bjostad, L., Hogeboom, A., Carlisle, A., & Arathi, H. S. (2019). Dietary phytochemicals, honey bee longevity and pathogen tolerance. *Insects*, 10(1), 1–12. <https://doi.org/10.3390/insects10010014>
5. Almasaudi, S. (2021). The antibacterial activities of honey. *Saudi Journal of Biological Sciences*, 28(4), 2188–2196. <https://doi.org/10.1016/j.sjbs.2020.10.017>
6. [https://www.eusl-ruraldevelopment.org/wp-content/uploads/2019/11/8\\_TAMAP\\_VC\\_Study\\_Apiculture\\_2019\\_08\\_12.pdf](https://www.eusl-ruraldevelopment.org/wp-content/uploads/2019/11/8_TAMAP_VC_Study_Apiculture_2019_08_12.pdf)
7. <https://www.labrujulaverde.com/en/2019/09/mellification-the-process-of-dissolving-a-human-body-in-honey-to-create-a-healing-confection>
8. <https://entonation.com/eu-food-safety-watchdog-ban-bee-killing-pesticides>
9. Lima, W. G., Brito, J. C. M., & da Cruz Nizer, W. S. (2021). Bee products as a source of promising therapeutic and chemoprophylaxis strategies against COVID-19 (SARS-CoV-2). *Phytotherapy Research*, 35(2), 743–750. <https://doi.org/10.1002/ptr.6872>
10. Meo, S. A., Ansari, M. J., Sattar, K., Chaudhary, H. U., Hajjar, W., & Alasiri, S. (2017). Honey and diabetes mellitus: Obstacles and challenges – Road to be repaired. *Saudi Journal of Biological Sciences*, 24(5), 1030–1033. <https://doi.org/10.1016/j.sjbs.2016.12.020>
11. Mohammad, S. M., Mahmud-Ab-Rashid, N. K., & Zawawi, N. (2021). Stingless bee-collected pollen (bee bread): Chemical and microbiology properties and health benefits. *Molecules*, 26(4), 1–29. <https://doi.org/10.3390/molecules26040957>
12. Krushna NS, Kowsalya A, Radha S, Narayanan RB. Honey as a natural preservative of milk. *Indian J Exp Biol*. 2007 May; 45(5):459-64. PMID: 17569289

# CORIANDER AS A PROMISING FUNCTIONAL FOOD TOWARDS THE WELL-BEING

By Dr. Devasri Herath

*Coriandrum sativum* (*C.sativum*) or Coriander is one of the most popular spices around the world and also it has many medicinal values and a wide range of functional properties and it has been recognized since ancient times across regions. (Adams M, 2012) It belongs to the family *Umbelliferae/Apiaceae* a glabrous aromatic and herbaceous annual plant that originated in the eastern Mediterranean. (Laribi B, 2015). Other nomenclatures of *C.sativum* include Chinese parsley, cilantro (Spanish), phak chee (Thai), dhanya (Sanskrit) (Singletary, 2016). All parts of the Coriander plant are edible including seeds and leaves. (Mandal S, 2015) Each part of the Coriander plant gives a unique scent due to the different chemical compounds of its essential oil. (Freires I.D.A, 2014). However, these bioactive compounds are affected by several factors, including the developmental stage of the plant, geographical region, cultivate conditions, storage duration, and storage conditions. In the food industry Coriander is approved for food by the US food and Drug Administration and the Flavor and Extract Manufacturers Association also the Council of Europe.

## Why you should know about Coriander?

- Coriander contains a high amount of vitamin C, vitamin A, vitamin B12, folate, and polyphenols.
- Potential psychoneuroimmune mechanism properties modulating immunity against infections.
- As a natural food preservative due to its potent antioxidant, antifungal and antibacterial properties.
- Coriander has been traditionally used as an appetite and digestive stimulant.
- As a diuretic and lipid and glucose-lowering agent.
- An antimicrobial agent.
- It also has been used to treat digestive disorders like diarrhea, jaundice, vomiting, and dysentery.



- Diseases of the central nervous system (anxiety, insomnia).
- An anti-inflammatory agent.
- As an analgesic.
- Coriander has been used as an ingredient of Ayurveda cosmetic formula (Varnakarlepa) and also as an ingredient of perfumes.
- As an herbal seasoning for aroma and taste.

## Antioxidant activity of coriander

Antioxidants are used to increase and preserve the shelf-life of food. Evidence showed that essential oil from Coriander seeds had significant radical scavenging activity. (M.K.Shahwar, 2012). Key compounds of anti-oxidant activity are polyphenols, flavonoids, ascorbic acid PUFA s.

## Anti-cancer activity of coriander

The extracts from *C.sativum*, have been investigated for their antiproliferative activities against the breast cancer cell line. Ethyl acetate root extract, which showed the highest antioxidant and anti-proliferative activities as well as inhibited cancer cell migration. (Tang, 2013) Linalool has been identified to show anticancer properties against several cancer cell lines such as leukemia (Gu et al., 2010), lymphoma, breast, liver, melanoma, and renal cancer cell lines (Loizzo et al., 2008).

## Therapeutic effects of coriander for the central nervous system (CNS)

Antioxidant property gives therapeutic effects for the central nervous system of *C.sativum*, including neuroprotective effect, anxiolytic effect, and anticonvulsant effect. Furthermore, *C.sativum* elicited a protective effect against ischemia-induced neuronal damages and against Alzheimer's disease.

## Migraine and coriander

C.sativum seed has been documented to relieve headaches in Persian medicine since ancient times (Ibn-e-Sina, 2005). Recently, C.sativum seed syrup has been reported to alleviate migraine headache in humans (Delavar Kasmaei et al., 2016).

## Hypoglycemic effect of coriander

C.sativum hypoglycemic effects have been tested in type 2 diabetes patients, in this study Coriander dry powder, aqueous and alcoholic extract of the plant can decrease blood glucose level of the body. The possible mechanism includes modulates enzymes in carbohydrate metabolism, increasing insulin sensitivity, activating insulin receptors and signaling, and inhibiting GI absorption of glucose.

## Hypolipidemic effect of coriander

Linalool, the key compound decreases cholesterol synthesis, inhibits HMG-CoAR, decreases fatty acid synthesis, inhibits lipogenic enzymes also increases lipid elimination, and activates LCAT and tissue lipases. C.sativum contains PUFA which decreases LDL oxidation.

## Blood pressure-lowering effect of coriander

Hypotensive property of C.sativum seed crude extract has been reported, as a vasorelaxant also enhances NO release and inhibits Ca<sup>2+</sup> influx or acts as Ca<sup>2+</sup> channel antagonist and enhances K<sup>+</sup> channel opening and hyperpolarization. It also acts as an antioxidant, increases NO availability. As a diuretic, it increases urine output.

## Anti-inflammatory effect of coriander

C.sativum exhibits anti-inflammatory property and Possible mechanisms are inhibits of NF- $\kappa$ B pathway in macrophages suppresses pro-inflammatory mediators and inhibits macrophage activation also infiltration, and aggregation.

## Anti-microbial activity of coriander

Inhibitory effects of C.sativum essential oil against bacteria, fungi, parasites including a wide spectrum of nosocomial and food-borne bacteria identified. The antimicrobial activity has been reported against both gram-positive bacteria (i.e., Bacillus cereus, Enterococcus faecalis, Staphylococcus aureus, and Methicillin-resistant Staphylococcus aureus (MRSA) (Silva et al., 2011) and gram-negative bacteria (i.e., Klebsiella pneumonia, Pseudomonas aeruginosa, A Escherichia coli, Salmonella typhimurium (Silva et al., 2011), and Campylobacter jejuni. Key compounds showing anti-microbial activities are linalool, volatile fats.

## Food preservation property of coriander

Coriander extracts and their isolated bioactive compounds have been remarked as alternative agents for food preservation. It is proposed that bioactive antioxidants from C.sativum could act as reducing agents, free radical scavengers, and singlet oxygen quenchers (Ramadan, Kroh, & Mörseel, 2003). Key compounds include PUFA and polyphenols.

## COVID-19 and Coriander

The COVID-19 pandemic has led to high levels of psychological distress in the population including anxiety and depression and it has the potential to adversely impact immunity. A recent meta-analysis shows that it leads to increase susceptibility to viral upper respiratory tract infections. (Pedersen A, 2010). . In response to the COVID-19 pandemic, the Indian government has released a set of guidelines that listed ten measures that were aimed at boosting immunity and made them available to the general population in India. It includes the use of specific spices including Coriander due to its potential psychoneuroimmune property with evidence of monoamine and gamma-aminobutyric acid neurotransmission and alleviation of depression in controlled trials.

## Conclusion

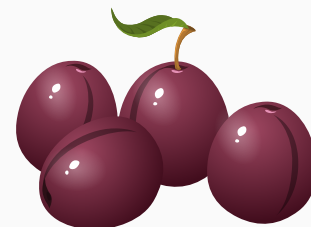
Coriander has been integrated in human life as a food, medicine and as a fragrance since ancient time exhibiting a wide range of bio activities that are beneficial for diseases mediated by modern sedentary life style as well as diseases associated with aging. Apparently anti-oxidant property of *C.sativum* is the key mechanism giving rise to the other properties of it. Additionally, more studies about the optimal ratio and dosing regimens also about toxicity need to be carried out. The further development of such promising functional food could facilitate a more synergistic interaction between traditional and modern medicine during disease outbreaks such as COVID-19, hopefully maybe helpful in developing new drug formulations in the future.



## References

- Adams M, S. &. (2012). Epilepsy in the Renaissance: A survey of remedies from 16th and 27th century German herbals. *Journal of Ethnopharmacology*, 1-13.
- Chaudhry, N. (2006). Bactericidal activity of black pepper, bay leaf, aniseed and coriander against oral isolates. *Pakistan Journal of pharmaceutical sciences*, 214-218.
- Daly T, J. ,. (2010). Carotinoid content of commonly consumed herbs and assessment of their bioaccessibility using an in vitro digestion model. *Plant foods for Human Nutrition*, 164-169.
- Emamghoreishi, M. A. (2005). Corianderum sativum: evaluation of its anxiolytic effect in the elevated plus-maze. *Ethnopharmacology*, 365-370.
- Freires I.D.A, M. S. (2014). Corianderum sativum (Coriander) Essential Oil: Antifungal Activity and mode of action on *Candida* spp. *PLoS ONE*.
- Khan, S. (2008). Ethnobotanical studies on some useful herbs of Haramosh and Burgote valley in Gilgit, northern area of Pakistan. *Pakistan Journal of Botany*, 43-58.
- Kim, S. (2020). Using psychoneuroimmunity against COVID-19. *Brain Behavior Immun*. doi:10.1016/j.bbi.2020.03.025.
- Laribi B, K. K. (2015). Coriander (*Coriandrum sativum* L) and its bioactive constituents. *Fitoterapia*, 9-26.
- M.K.Shahwar, A.-G. (2012). Characterization of coriander seeds and leaves: volatile and non volatile extracts. *Int J Food Prop*, 736-747.
- Mandal S, &. M. (2015). Coriander essential oil: Chemistry and biological activity. *Asian Pacific Journal of Tropical Biomedicine*, 421-428.
- Pedersen A, Z. D. (2010). Influence of psychological stress on upper respiratory infection. a meta analysis of prospective studies, 823-832.
- Platel, K. S. (2004). Digestive stimulant action of spices: a myth or reality? *The Indian Journal of Medicinal Research*, 167-179.
- Sarris, J. (2018). Herbal medicines in the treatment of psychiatric disorders: 10-year updates review. *Phytother.Res*, 1147-1162.
- Singletary, K. (2016). Coriander: Overview of potential health benefits. *Nutrition today*, 151-161.
- Tahraoui A., E.-H. (2007). Ethnopharmacological survey of plants used in the traditional treatment of hypertension and diabetes in south-eastern Morocco. *Journal of Ethnopharmacology*, 105-117.
- Tang, E. L. (2013). Antioxidant activity of *Coriandrum sativum* and protection against DNA damage and cancer cell migration. *BMC Complementary and alternative medicine*, 13,347.
- Thabrew, M. S. (2003). Anti-inflammatory and analgesic activities in the polyherbal formulation Maharasnadhi Quathar. *Journal of Ethnopharmacology*, 261-267.





# "MADAN" - BLACK PLUM

By Dr. Fathima Shifa

## A. Introduction

'Madan' tree is a food crop and traditional medicinal plant used worldwide for centuries. It is commonly known as black plum, Jamun, Madan, and java plum. The botanical name is *Syzygium cumini* (Family Myrtaceae). It is widely found in various Asian countries including Sri Lanka, India, Bangladesh, Pakistan, Nepal, Malaysia, Philippines, Indonesia, and other countries like eastern Africa, South America, Madagascar.

## B. Season/Availability

It naturally grows in a wide range of areas from north to south in Sri Lanka. It is a large green tree with a height of 30m on average. It can live more than 100 years. Bearing starts after 10 years of planting and continues till 50 to 60 years old. The average yield is 80 to 100kg from a full-grown tree. The tree fruits once a year. The flowering starts in March and continues until May. The fruits develop by May or June. The fruits are types of berries with a sweetish sour taste. Fully mature fruit is dark red to purple in colour. Available in two varieties; Madan with white-toned flesh and with dark purple flesh.

## C. Applications

Traditionally 'Madan' has been used for its rich nutritional, medicinal, and cosmetic values. The ripened fruits are used in health drinks, juices, syrup, squashes, jellies, wine, and making preserves. Bottled drinks are available in other countries. Can make jam, tarts, and sauces, ice creams as well. Fruit can be consumed as raw, which has a sweet or subacid flavor with minimum astringency. White flesh black plum has adequate pectin and is used to make a very stiff jelly. Pectin serves as a thickening agent while making jams and jellies. 'Madan' with purple flesh is rich in colour but they are lack pectin, so it requires a commercial jelling agent. Fermented fruits are being used to make wine which usually resembles brandy or distilled liquor.

It has diverse pharmacological actions. Biomedical substances are found in each part of the plant as fruit, flower, bark, roots, leaves, and seeds. It has been proven in several animal and human studies that 'Madan' has the potentials of treating diabetes, diarrhoea, hypertension, inflammation, cancer, etc. Seeds are used to treat diabetes mellitus in ayurvedic and Unani medicine. Phytochemical analytical studies reveal that the seeds contain jambosine, glycoside, and alkaloids, which withhold the conversion of starch to sugar. Plant possesses anti-inflammatory, anti-oxidant, neuro-psychopharmacological, anti-microbial, radio-protective, anti-histamine properties. Various parts of trees are being integrated into health supplements in the form of tablets and capsules. Cosmetically it is considered to provide radiant skin, by reducing pimples and dark spots. Astringent act as a toner and reduces pores and control oily secretion.

## D. Nutritional composition

Table 1. Proximate composition of 'Madan' fruit

Nutrients	Fruit raw-Content (g/100g)
Energy	60 kcal
Moisture	83.13g
Carbohydrate	15.56g
Protein	0.72g
Fat	0.23g
Vitamin A(Retinol)	3 IU
Vitamin C (Ascorbic acid)	14.3mg
Vitamin B3(Niacin)	0.260mg
Vitamin B2(Riboflavin)	0.012mg
Vitamin B1(Thiamine)	0.006mg
Pantothenic acid(B5)	0.160mg
Iron	0.2 mg
Calcium	19mg
Magnesium	15mg
Phosphorus	17mg
Potassium	79mg
Sodium	14mg

The Fruit is low in calories. It has enough amount of protein, fat, and fructose, and glucose (no sucrose), fiber, Vitamin A, B, C, minerals (potassium, magnesium, calcium, phosphorus, sodium, and iron), antioxidants such as anthocyanins, tannins, and flavanols.

**Table2. Phytochemicals present in the *S.cumini* Plant**

Plant part	Chemicals present
Stem bark	Friedelin, friedelan-3- $\alpha$ -ol, betulinic acid, $\beta$ -sitosterol, kaempferol, $\beta$ -sitosterol-Dglucoside, gallic acid, ellagic acid, gallotannin and ellagitannin and myricetine
Leaves	B-sitosterol, betulinic acid, mycaminose, crategolic (maslinic) acid, n-hepatcosane, n-nonacosane, n-hentriacontane, noctacosanol, n-triacontanol, n-dotricontanol, quercetin, myricetin, myricitrin and the flavonol glycosides myricetin 3-O-(4"-acetyl)- $\alpha$ -Lrhamnopyranosides
Flowers	Oleanolic acid, ellagic acids, isoquercetin, quercetin, kampfero and myricetin
Fruit pulp	Anthocyanins, delphinidin, petunidin, malvidin-diglucosides
Seeds	Jambosine, gallic acid, ellagic acid, corilagin, 3,6-hexahydroxy diphenoylglucose, 1-galloylglucose, 3-galloylglucose, quercetin, $\beta$ -sitosterol, 4,6-hexahydroxydiphenoylglucose
Essential oils	A-terpeneol, myrtenol, eucarvone, muurolol, $\alpha$ -myrtenal, 1, 8-cineole, geranyl acetone, $\alpha$ -cadinol and pinocarvone

**E. Medical and nutritional values of ‘Madan’**

**1. Anti-oxidant activity:**

‘Madan’ seed, leaves, fruit, and bark have been shown to possess free radical scavenging effect and anti-oxidant activity in multiple studies. Tannins, polyphenols, flavonoids, carotenoids, vitamin C & E are the anti-oxidants found in ‘Madan’ fruit.

**2. Anti-inflammatory activity:**

The bark extract of *Syzygium cumini*, the essential oil of *Syzygium cumini* leaves, seeds has been proven to have compounds with significant anti-inflammatory potential.

**3. Anti-microbial property:**

Phytochemical investigation and antimicrobial activity of *Syzygium cumini* leaves extract, essential oil had shown potential inhibitory activity against gram-negative (*Salmonella typhi*, *S. enteritidis*, *S. paratyphi*, *E. coli*, *Pseudomonas*) and gram-positive (*S. aureus*, *Bacillus subtilis*) bacteria. Potential antifungal activity against fungal strains; *Penicillium chrysogenum*, *C.albicans*, *Aspergillus niger*, in fruit and leaf extracts have been observed in studies. Studies conclude *Syzygium cumini* seed has the potential for treating colic and/or diarrhoea as its antibacterial and anti-spasmodic and antidiarrheal activity.

**4. Anti-diarrhoeal property:**

Studies reveal *Syzygium cumini* seed extracts found significant and dose dependant antidiarrhoeal, anti-secretory, and anti-motility effects. The anti-diarrhoeal effect can be explained by blockade of calcium influx through Cav and thus reduction in intestinal transit time and antispasmodic activity.

**5. Potential of reducing high blood sugar levels:**

*S. cumini* seeds and pulp of fruit have been most studied for their anti-diabetic property and proven in many animal studies. The extract of seeds is known to have inhibitory effect on alpha-amylase enzyme inhibition activity and BSA-glucose glycation inhibitory activity. Significant amount of flavonoids in seeds is responsible for these action. Several studies show high alkaloid content in Madan (seed, fruit, leaves, bark) have potential in controlling hyperglycaemia. As it has anti diuretic effect it relieves symptoms of diabetes like frequent urination and thirsting

**6. Cardioprotective property:**

Madan has a high amount of potassium. 100g of the fruit contains 79mg of potassium. The extract from *Syzygium cumini* leaves incubated with platelets of diabetes individuals decreased the thrombogenic enzyme, adenosine deaminase. Antiatherosclerosis activity was observed when aqueous extract of *Syzygium cumini* fruit in a high fat-fed diabetic animal model. Seeds contain compounds against cardiometabolic disorders.



## 7. Anti-cancer activity:

Studies in the last decade show phytochemicals in the fruit and plant parts possess chemoprotective, cardioprotective, and antineoplastic properties. Fruit extract was tested for antileukemic activity, it was correlated with the presence of  $\gamma$ -sitosterol and kaempferol 7-O-methyl ether.

## F. Some value additions

- Madan Juice
- Madan lemonade
- Madan smoothie
- Madan ice Cream
- Madan Sharbat
- Madan salad
- Madan mousse

## G. Why we should never skip eating 'Madan'?

- It helps to control blood sugar
- It helps to maintain blood pressure and a healthy heart
- It improves blood haemoglobin level
- Fights against respiratory illness
- It aids in digestion
- It shields against infection
- It helps for radiant skin
- Useful in Weight loss
- Improves oral hygiene
- It prevents cancer

## G. Uses in traditional medicine:

Traditionally Madan seeds, fruits, leaves, bark all are used in Ayurveda, Unani, Chinese, and traditional folk medicines. From all over the world the fruit has been used by traditional practitioners for treating diabetes, cough, dysentery, inflammation, and ringworm, blisters in the mouth, pimples, stomach ache, wounds, etc. Bark has tannins to combat dysentery. Black plum fruit seeds and pulp are used in diabetic patients to delay the complications like neuropathy and cataract. In Unani medicine various parts of plants are used to strengthen teeth and gums, enrich the blood, liver tonic, removing ringworm and lotions. *S. cumini* vinegar is used to treat enlargement of the spleen, urine retention, and chronic diarrhea. Water diluted juice is used for gargle for sore throat, lotion for scalp ringworm. It also acts as a liver stimulant, coolant, digestive, and blood purifier.

## G. In essence:

As a fruit crop, it has a tremendous contribution to the healthy life of concerns. This fruit is available only for a brief period during summer. But Madan juice, jams, syrup, vinegar are there to stretch its usage beyond the season. In Sri Lanka, it naturally grows in a wide range of places from north to south. It is very much underutilized fruit and crop in Sri Lanka, in spite of having innumerable health benefits. Thus, community use can be enhanced by increasing awareness of its health properties, promoting its use, improving cultivation and economic value.

## References:

1. Dharmasena, G, Wimalasiri, Eranga, Dissanayake, P. (2018) 'Diversity of antioxidant properties among Madan (*Syzygium cumini*) trees in Belihuloya Region, Sri Lanka: Potential for improvement for community use'.
2. D.S.A. Wijesundara P.K. Dissanayake, W.G.C. Wekumbura, A.W. Wijeratne, M. L. M. C. D. (2019) 'Diversity of fruit morphology and taste of *S. cumini* trees in Batticaloa region of SL', International Journal of agriculture, forestry and plantation.
3. Muruganandan, S. et al. (2001) 'Anti-inflammatory activity of *Syzygium cumini* bark', *Fitoterapia*, 72(4), pp. 369–375.
4. Velioglu, Y. S. et al. (1998) 'Antioxidant Activity and Total Phenolics in Selected Fruits, Vegetables, and Grain Products', *Journal of Agricultural and Food Chemistry*, 46(10), pp. 4113–4117. doi: 10.1021/JF9801973.
5. Nagla M Nazif (no date) 'The anthocyanin components and cytotoxic agent of *S. cumini* Fruits in Egypt'.
6. Kohli K., Singh R. (1993). A clinical trial of jambu (*Eugenia jambolana*) in non-insulin dependent diabetes mellitus. *J. Res. Ayurveda Siddha* 13 89–97
7. Subhasis Chattopadhyay, R. C. S. G. J. D. J. B. (2019) 'Anti-diabetic Activity of Black Berry (*Syzygium cumini* L): A Review', *Journal of the Gujarat Research Society*, 21(16), pp. 1514–1527.
8. Karine S De Bona 1, Gabriela Bonfanti, Paula E R Bitencourt, Lariane O Cargnelutti, Priscila S da Silva, Thainan P da Silva, Régis A Zanette, Aline S Pigatto, M. B. M. (2014) 'Syzygium cumini is more effective in preventing the increase of erythrocytic ADA activity than phenolic compounds under hyperglycemic conditions in vitro'.
9. Salwan, R. and Sharma, V. (2020) 'Molecular and biotechnological aspects of secondary metabolites in actinobacteria', *Microbiological Research*, 231, p. 126374.
10. Chagas, V. T., França, L. M., Malik, S., & Paes, A. M. (2015). *Syzygium cumini* (L.) skeels: a prominent source of bioactive molecules against cardiometabolic diseases. *Frontiers in pharmacology*, 6, 259. <https://doi.org/10.3389/fphar.2015.00259>
11. Mastan S., Chaitanya G., Bhavya Latha T., Srikanth A., Sumalatha G., Eswar Kumar K. (2009). Cardioprotective effect of methanolic extract of *Syzygium cumini* seeds on isoproterenol-induced myocardial infarction in rats. *Der Pharm. Lett.* 1 143–149.
12. Katiyar, D., Singh, V. and Ali, M. (2016) 'Recent advances in pharmacological potential of *Syzygium cumini*: A review', *Pelagia Research Library Advances in Applied Science Research*, 7(3), pp. 1–12.
13. Iqbal, J. et al. (2017) 'Plant-derived anticancer agents: A green anticancer approach', *Asian Pacific Journal of Tropical Biomedicine*, 7(12), pp. 1129–1150.
14. Baliga, M. S., Bhat, H. P., Baliga, B. R. V., Wilson, R., and Palatty, P. L. (2011). Phytochemistry, traditional uses and pharmacology of *Eugenia jambolana* Lam. (black plum): a review. *Food Res. Int.* 44, 1776–1789.

# THE UNSUNG HERO - "KOTTAMBA" / TROPICAL ALMOND

*Terminalia catappa*



By Dr. Pamoda Madarasinghe

Tropical almond (*Terminalia catappa* L.), locally known as 'Kottamba' is a multifunctional species that possesses substantial beneficial attributes compared with the other tree nut species. However, it is listed under the category of "underutilized fruit crops" due to the lack of demand and industrial applications.

It is found in tropical countries including Sri Lanka and is called a 'multipurpose species' as every part of the tree can be used for various economic purposes. It usually thrives in a humid climate, low altitude and necessitates satisfactory rainfall. The seeds can remain viable for longer periods and germinate rapidly splitting away from the husk, even after floating in salt water for long distances. There are one or two fruiting seasons per year depending on the area of growing. It has large nutty fruits that are edible and taste very much like almonds which can be eaten raw with roasting or frying.

## Nutritional properties

Following results were obtained at the proximate composition analysis of tropical almond kernels.

### Proximate Composition (dry basis) %

- Moisture	5.35
- Crude Fat	50.09
- Crude Protein	32.30
- Carbohydrate	5.13
- Crude Fibre	1.81
- Ash	5.31

Vitamin and Mineral Composition (µg/g)	
- Vitamin C	0.329
- P	2200
- Mg	400
- Ca	320
- Cu	81
- Fe	58
- Na	13.61
- Zn	ND

The caloric value of the tropical almond seed was 593.48 kcal. It contains high protein (32.3%) and carbohydrates which are easily digested, providing necessary calories hence an energetic food. Except for sucrose (95.82 %), other sugars were present in low amounts in the seed. The low sugar level of *T.catappa* seeds makes it a good snack for diabetics.

The amino acid profile of the seeds revealed that glutamic acid was the first essential amino acid in tropical almond nuts followed by arginine, whereas methionine and lysine were the limiting amino acids.

It is a good source of fat (50.09 %) which is vital for structural and biological functions and required for fat-soluble vitamins. It contained 61.76% of unsaturated edible oil much more than most conventional oils. Further, it is rich in palmitic (40.03%), oleic (27.08%), and linoleic acids (26.64%). This unsaturated oil classified in the oleic-linoleic acid group possessed weak antioxidant activity and can be used in food and as a technical adjuvant.



Minerals are important in the diet because they serve as cofactors for many physiologic and metabolic functions. Calcium, an important mineral required for bone formation and neurological function, was found to be present at significant levels (320 µg/g) in tropical almond seeds. Therefore average serving of tropical almonds per day would satisfy the daily requirement of calcium for children and adults. It contains large amounts of magnesium (400 µg/g) which is essential for many enzyme systems and important in maintaining the electrical potential of nerves and muscles and an adequate serving would satisfy Recommended Daily Allowance. Also, significant consumption of tropical almond nuts will provide the daily requirement of sodium (13.61 µg/g) which is vital in maintaining the body fluid volume, osmotic equilibrium, and acid-base balance. Further, the nut contains some levels of iron which can supplement other sources of dietary iron. It also contains a high amount of phosphorus and adequate levels of copper as well.

## Uses

Tropical almond has been recognized for its medicinally essential phytoconstituents, such as phenol, flavonoid, and carotenoid. It also exhibits antimicrobial, anti-inflammatory, antidiabetic, antioxidant, hepatoprotective, and anticancer activities. In its anti-oxidative properties, it inhibits lipid peroxidation and hydrogen peroxide formation shows good superoxide scavenger activity and antihepatotoxic activity, formation of superoxide, and free radical scavenger activity. *T.catappa* ointment induces epithelization and promotes considerable wound-healing activity. The leaves have been used for the treatment of dermatitis and hepatitis in folk medicine. It has excellent preventive and curative effects against *H. pylori* which cause acute and chronic gastric ulcers.



## Value Addition

The tasty kernels or nuts of 'kottamba' can be incorporated into the diet of people in modest quantities. It can be consumed shortly after extraction as fresh seeds from the shell or preserved by smoke which can be consumed years later. Due to its versatile attributes and uses, tropical almond possesses alternative to other nuts such as almond and cashew. The 'no' cholesterol level holds it as a medicinally beneficial nut and healthy snack. Further, it can be prepared as curries, incorporated to complement taste as in sweets and desserts, or roasted.

The equal taste to cashew and other attributes of 'kottamba' is lesser known by people and if they were made aware and encouraged to cultivate, it will be beneficial due to its high yield and ease of cultivation.

## References

1. AOAC INTERNATIONAL - In Food & Agriculture, We Set the Standard. (2021). Retrieved September 25, 2021, from <https://www.aoac.org/>
2. Barreca, D., Nabavi, S. M., Sureda, A., Rasekhian, M., Raciti, R., Silva, A. S., ... Mandalari, G. (2020). Almonds (*Prunus Dulcis* Mill. D. A. Webb): A Source of Nutrients and Health-Promoting Compounds. *Nutrients*, 12(3), 672. <https://doi.org/10.3390/NU12030672>
3. Gunasena H P M. (2007). *Catappa*.Pdf (pp. 437–451).
4. Hayward, D. F. (1990). The phenology and economic potential of *Terminalia catappa* L. in South-Central Ghana. *Vegetatio* 1990 90:2, 90(2), 125–131. <https://doi.org/10.1007/BF00033022>
5. Kalita, S., Khandelwal, S., Madan, J., Pandya, H., Sesikeran, B., & Krishnaswamy, K. (2018). Almonds and Cardiovascular Health: A Review. *Nutrients*, 10(4). <https://doi.org/10.3390/NU10040468>
6. Kottamba Images, Stock Photos & Vectors | Shutterstock. (2018). Retrieved December 15, 2021, from <https://www.shutterstock.com/search/kottamba>
7. Ng, S., Lasekan, O., Muhammad, K. S., Hussain, N., & Sulaiman, R. (2015). Physicochemical properties of Malaysian-grown tropical almond nuts (*Terminalia catappa*). *Journal of Food Science and Technology*, 52(10), 6623. <https://doi.org/10.1007/S13197-015-1737-Z>
8. Orwa et al. (2009). *Terminalia catappa* Combretaceae *Terminalia catappa*. *Agroforestry Database* 4.0, 1.
9. Polynesian\_Produce\_Stand. (2015). Retrieved December 15, 2021, from [http://ez2plant.com/product/\\_template=iphone/lid=48395974](http://ez2plant.com/product/_template=iphone/lid=48395974)
10. Salehi, B., Gültekin-Özgüven, M., Kirkin, C., Özçelik, B., Morais-Braga, M. F. B., Carneiro, J. N. P., ... Cho, W. C. (2019, September 1). Anacardium plants: Chemical, nutritional composition and biotechnological applications. *Biomolecules*. *Biomolecules*. <https://doi.org/10.3390/biom9090465>
11. Sifflora. (2014). Sri Lanka Almond Tree - Kottan (Kottamba) | SL Flora. Retrieved August 22, 2021, from <https://sifflora.blogspot.com/2014/10/sri-lanka-almond-tree-kottan-kottamba.html>
12. The Unsung Hero - Explore Sri Lanka - Once discovered, you must explore..... (2014). Retrieved November 26, 2021, from <http://exploresrilanka.lk/2014/12/unsung-hero/>
13. Thomson, L. A. J., & Evans, B. (2016). *Terminalia catappa* (tropical almond). Retrieved from [www.traditionaltree.org](http://www.traditionaltree.org)

# EVENTS SINCE LAST PUBLICATION

1. Grand Finale of 'Low Salt Cooking Challenge - 2021' was held on 30th October at Galle Face Hotel, Colombo. It was organized by SLMNA In collaboration with WHO, Ministry of Health, and Chefs Guild of Sri Lanka in order to increase the awareness of the public regarding the importance of low salt consumption.



# EVENTS SINCE LAST PUBLICATION

2. Monthly Clinical Meeting was held on 5th November 2021, under the topic of "Diarrhea in patients on Enteral Nutrition" by Prof. Stephane Schneider.

3. 6th Clinical Nutrition Annual Academic Sessions -Sri Lanka Medical Nutrition Association held on 20th November 2021 at Shangri-LA, Colombo, as a hybrid session. The theme was "Nutrition in Gastrointestinal Diseases" and it has led all on-site & online participants to gain scientific knowledge regarding both adult and paediatric Gastrointestinal diseases.





## EVENTS SINCE LAST PUBLICATION

4. Market fair held on 30th November 2021 at Golden Rose Hotel, Boralesgamuwa. The participants were able to gain updates regarding the newer nutritional supplement formulas, preparations, and also scientific instruments in delivering nutrition to hospitalized patients.





## UPCOMING EVENTS

1. "Protection from Nutrition" based on FBDG - National Nutrition Month program, 2021

2. Monthly clinical meeting regarding "Psychological & Ethical Aspects of Artificial Nutrition" will be held on 20th Jan 2022.

3. Annual General Meeting - Sri Lanka Medical Nutrition Association will be held on 22nd Jan 2022

**STAY CONNECTED WITH**

**SLMNA**

Sri Lanka Medical Nutrition Association,  
17/1 Wijerama Road, Nugegoda, Sri Lanka

Email - [slmna2015@gmail.com](mailto:slmna2015@gmail.com)