Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2025; 14(1): 206-212
Received: 06-12-2024
Accepted: 08-01-2025

Jalpa L Kotecha
Assistant Professor, Shree MP Shah Arts and Science College, Surendranagar, Gujarat, India

Vijay R Ram
Associate Professor, Department of Chemistry, KSKV Kachchh University, Bhuj, Gujarat, India

Corresponding Author:
Jalpa L Kotecha
Assistant Professor, Shree MP Shah Arts and Science College, Surendranagar, Gujarat, India

Tropical Elixir: Unveiling the phytochemical magic of coconuts

Jalpa L Kotecha and Vijay R Ram

DOI: https://doi.org/10.22271/phyto.2025.v14.i1c.15236

Abstract
Coconuts, often revered as the "tree of life" in tropical regions, have captivated the world with their remarkable versatility and health-promoting properties. Beyond its delightful taste and aroma, coconut boasts a treasure trove of phytochemicals, bioactive compounds synthesized by plants that contribute to its remarkable health-promoting properties. From lauric acid to polyphenols, coconut phytochemicals exhibit a wide array of biological activities, including antioxidant, antimicrobial, anti-inflammatory, and immune-modulating effects. This comprehensive review explores the phytochemical composition of coconuts and their potential health benefits, shedding light on their role as a tropical elixir for promoting human health and well-being.

Keywords: Coconut, phytochemicals in coconut, health benefits of coconut, activities of coconut

1. Introduction

1.1 The Cultural and Culinary Significance of Coconuts

Coconuts (*Cocos nucifera*) have long been revered in tropical regions for their nutritional value, versatility, and cultural significance. Originating from the coconut palm, which thrives in coastal areas with warm climates, coconuts are known as the "tree of life" due to their ability to provide food, drink, shelter, and numerous other essentials [1]. From the shores of the Caribbean to the islands of the South Pacific, coconuts feature prominently in the culinary traditions, folklore, and daily rituals of tropical cultures. Whether enjoyed fresh, dried, or processed into various products, coconuts are celebrated for their unique flavour, aroma, and myriad uses [2].

1.2 Phytochemicals: Nature's Bioactive Compounds

Phytochemicals are bioactive compounds synthesized by plants that contribute to their colour, flavour, and disease resistance. These compounds, also known as secondary metabolites, encompass a diverse range of chemical classes, including polyphenols, alkaloids, terpenoids, and flavonoids. Phytochemicals are not considered essential nutrients, but they play a crucial role in promoting human health and preventing chronic diseases. Many phytochemicals exhibit antioxidant, anti-inflammatory, antimicrobial, and anticancer properties, making them valuable assets in the quest for optimal health and wellness [3, 4].

1.3 Scope of the Review

This review aims to provide a comprehensive overview of the phytochemical composition of coconuts and their potential health benefits [5]. By examining the latest research findings, clinical evidence, and mechanistic insights, we seek to unravel the therapeutic potential of coconut phytochemicals in promoting cardiovascular health, immune function, skin integrity, and digestive well-being [6]. Additionally, we will explore practical applications of coconut products in culinary practices, skincare routines, and dietary supplementation. Through this exploration, we hope to shed light on the role of coconut catalysts in unlocking health and vitality [3, 7].

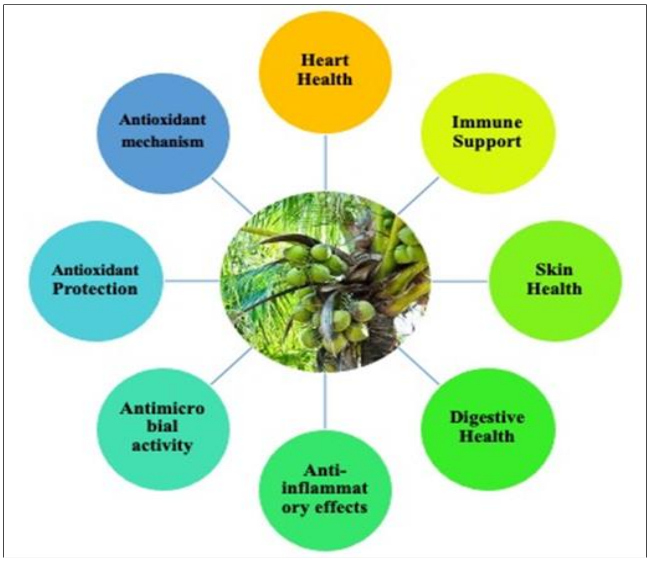
2. Phytochemicals in Coconuts

2.1. Lauric Acid

Lauric acid is a medium-chain fatty acid that accounts for a significant portion of the fat content in coconut oil. Unlike long-chain fatty acids, which are predominant in animal fats, lauric acid is metabolized differently in the body, exhibiting potent antimicrobial properties.

Lauric acid is converted into monolaurin, a compound with broad-spectrum antimicrobial activity against bacteria, viruses, and fungi. This antimicrobial action makes lauric acid a valuable asset in combating infections and supporting immune health [8, 9].

Graphical Abstract



2.2 Polyphenols-Antioxidant Powerhouses

Coconuts contain a variety of polyphenolic compounds, including flavonoids, phenolic acids, and lignans, which contribute to their antioxidant activity. These polyphenols scavenge free radicals, neutralize reactive oxygen species, and inhibit oxidative stress, thereby protecting cells from damage and reducing the risk of chronic diseases such as cardiovascular disease, cancer, and neurodegenerative disorders. Some of the key polyphenols found in coconuts include ferulic acid, catechins, and chlorogenic acid [10, 11].

2.3 Medium-Chain Fatty Acids-Capric Acid and Caprylic Acid

In addition to lauric acid, coconuts contain other medium-chain fatty acids, including capric acid and caprylic acid, which exhibit similar antimicrobial properties. Capric acid and caprylic acid have been shown to exert antimicrobial effects against various pathogens, including bacteria, yeast, and fungi. These fatty acids disrupt the cell membranes of microorganisms, leading to their destruction and inhibition of growth. As a result, coconut oil, rich in medium-chain fatty acids, is often used in natural remedies for skin infections, oral hygiene, and digestive health [8, 12].

2.4 Vitamin E-Skin Health and Beyond

Coconuts are a good source of vitamin E, a fat-soluble antioxidant that plays a crucial role in protecting cells from oxidative damage. Vitamin E helps maintain skin integrity by neutralizing free radicals generated by UV radiation, pollution, and other environmental stressors. By scavenging free radicals and reducing oxidative stress, vitamin E contributes to skin hydration, elasticity, and resilience. In addition to its skincare benefits, vitamin E supports immune function, cardiovascular health, and cognitive function [13, 14].

2.5 Phytosterols-Cholesterol-Lowering Agents

Phytosterols are plant-derived compounds structurally similar to cholesterol, but with subtle differences that enable them to reduce cholesterol absorption in the gut. By competing with cholesterol for uptake in the intestinal cells, phytosterols help lower blood cholesterol levels, particularly LDL cholesterol, which is associated with an increased risk of heart disease. Coconuts contain phytosterols such as beta-sitosterol, campesterol, and stigmasterol, which contribute to their cholesterol-lowering effects [15].

2.6. Saponins-Immune Modulators

Saponins are phytochemicals found in coconut meat that possess immune-modulating properties. These compounds stimulate the production and activity of immune cells, such as macrophages and natural killer cells, enhancing the body's defense against infections and tumours. Saponins also exhibit anti-inflammatory effects by inhibiting pro-inflammatory cytokines and mediators. By modulating immune responses and reducing inflammation, saponins contribute to overall health and resilience [16, 17].

2.7 Other Phytochemicals in Coconuts

In addition to the aforementioned phytochemicals, coconuts contain a variety of other bioactive compounds with potential health benefits. These include terpenoids, alkaloids, lignans, and phytates, which may exert antioxidant, anti-inflammatory, and anticancer effects. While less studied than the major phytochemical classes, these compounds contribute to the overall health-promoting properties of coconuts and warrant further investigation.

3. Health Benefits of Coconut Phytochemicals

3.1 Heart health-role in cardiovascular disease prevention

The phytochemicals found in coconuts, including lauric acid, polyphenols, and phytosterols, contribute to cardiovascular health through various mechanisms. Lauric acid and other medium-chain fatty acids help maintain a healthy lipid profile by raising HDL cholesterol levels and improving the LDL/HDL cholesterol ratio. Polyphenols, such as ferulic acid and catechins, protect against oxidative damage to blood vessels and reduce inflammation, thereby lowering the risk of atherosclerosis and hypertension. Phytosterols compete with cholesterol for absorption in the gut, leading to reduced cholesterol levels and decreased risk of coronary artery disease [18-20].

3.2 Immune Support-Strengthening the Body's Defense System

Coconut phytochemicals, particularly lauric acid and saponins, exhibit antimicrobial and immune-modulating properties that support the body's defense against infections. Lauric acid is converted into monolaurin, which has potent antimicrobial activity against bacteria, viruses, and fungi, including antibiotic-resistant strains. Saponins stimulate immune cell activity and enhance the production of antibodies, cytokines, and other immune mediators. By bolstering the immune system, coconut phytochemicals help protect against infectious diseases and promote overall health and resilience [21].

3.3 Antioxidant Protection-Fighting Free Radicals

The antioxidant properties of coconut phytochemicals, particularly polyphenols and vitamin E, play a crucial role in protecting cells from oxidative damage and reducing the risk of chronic diseases. Polyphenols scavenge free radicals, neutralize reactive oxygen species, and inhibit oxidative stress, thereby preventing cellular damage and inflammation.

Vitamin E, as a fat-soluble antioxidant, protects cell membranes from lipid peroxidation and maintains the integrity of tissues and organs. By reducing oxidative stress, coconut phytochemicals help prevent oxidative damage to DNA, proteins, and lipids, which is implicated in aging, cancer, and degenerative diseases [14, 22-24].

3.4 Skin Health-Moisturizing and Nourishing Properties

Coconut oil, rich in medium-chain fatty acids, vitamin E, and other phytochemicals, has long been used for skincare due to its moisturizing and nourishing properties. Medium-chain fatty acids, such as lauric acid, capric acid, and caprylic acid, penetrate the skin easily, hydrating and softening the skin without leaving a greasy residue. Vitamin E, as an antioxidant, protects the skin from oxidative damage caused by UV radiation, pollution, and other environmental stressors. Additionally, the antimicrobial properties of coconut oil help prevent and treat skin infections, acne, and dermatitis. By promoting skin hydration, elasticity, and resilience, coconut phytochemicals contribute to healthy, radiant skin [25, 26].

3.5 Digestive Health-Supporting Gut Microbiota

Emerging research suggests that coconut phytochemicals, particularly saponins and medium-chain fatty acids, may have beneficial effects on digestive health by supporting gut microbiota. Saponins exhibit prebiotic activity, promoting the growth of beneficial bacteria such as Lactobacillus and Bifidobacterium while inhibiting the growth of pathogenic bacteria. Medium-chain fatty acids, such as lauric acid and capric acid, have antimicrobial properties that help maintain a healthy balance of gut flora. By modulating gut microbiota composition and activity, coconut phytochemicals contribute to digestive health, immune function, and overall well-being [27-29].

4. Mechanisms of Action

4.1 Antimicrobial activity

The antimicrobial properties of coconut phytochemicals, particularly lauric acid and medium-chain fatty acids, are attributed to their ability to disrupt the lipid membranes of microorganisms, leading to cell lysis and death. Lauric acid is converted into monolaurin, a compound with broad-spectrum antimicrobial activity against bacteria, viruses, and fungi, including antibiotic-resistant strains. Medium-chain fatty acids, such as capric acid and caprylic acid, exert similar antimicrobial effects by disrupting the cell membranes of pathogens, thereby inhibiting their growth and replication. Additionally, saponins in coconut meat possess antimicrobial properties that help protect against infections and promote immune health [30-33].

4.2 Anti-inflammatory effects

Coconut phytochemicals, including polyphenols, saponins, and medium-chain fatty acids, exhibit anti-inflammatory effects by modulating inflammatory mediators and pathways. Polyphenols, such as ferulic acid and catechins, inhibit the production of pro-inflammatory cytokines and enzymes, thereby reducing inflammation and oxidative stress. Saponins suppress inflammatory responses by inhibiting the activation of nuclear factor-kappa B (NF-kB) and other inflammatory signaling pathways. Medium-chain fatty acids, such as lauric acid and capric acid, mitigate inflammation by modulating immune cell activity and cytokine production. By reducing inflammation, coconut phytochemicals help alleviate symptoms of inflammatory conditions such as arthritis, asthma, and inflammatory bowel disease [34-36].

4.3. Antioxidant mechanisms

The antioxidant properties of coconut phytochemicals, particularly polyphenols and vitamin E, stem from their ability to scavenge free radicals and inhibit oxidative stress. Polyphenols, such as flavonoids and phenolic acids, donate hydrogen atoms or electrons to free radicals, neutralizing their reactivity and preventing cellular damage. Vitamin E, as a fat-soluble antioxidant, protects cell membranes from lipid peroxidation by scavenging lipid peroxyl radicals. Additionally, polyphenols and vitamin E enhance the activity of endogenous antioxidant enzymes, such as superoxide dismutase and catalase, further enhancing cellular antioxidant defenses. By reducing oxidative stress, coconut phytochemicals help prevent oxidative damage to DNA, proteins, and lipids, which is implicated in aging, cancer, and degenerative diseases [37-41].

4.4 Immune modulation

Coconut phytochemicals, particularly lauric acid and saponins, exert immune-modulating effects by stimulating immune cell activity and cytokine production. Lauric acid is converted into monolaurin, a compound that enhances the activity of immune cells such as macrophages, natural killer cells, and T cells. Monolaurin also stimulates the production of cytokines, such as interferons and interleukins, which regulate immune responses and inflammation. Saponins in coconut meat stimulate the proliferation and activity of immune cells, including lymphocytes and monocytes, enhancing the body's defense against infections and tumours. By modulating immune responses, coconut phytochemicals help maintain immune homeostasis and protect against infectious diseases and autoimmune disorders [42, 43].

4.5 Other Potential Mechanisms

In addition to their antimicrobial, anti-inflammatory, and antioxidant effects, coconut phytochemicals may exert other beneficial effects on human health through various mechanisms. For example, polyphenols in coconuts have been shown to improve insulin sensitivity, glucose metabolism, and lipid profile, thereby reducing the risk of type 2 diabetes and metabolic syndrome. Medium-chain fatty acids, such as lauric acid and capric acid, promote fat oxidation, thermogenesis, and satiety, making them potential aids in weight management and obesity prevention. Saponins in coconut meat have been found to inhibit the growth and metastasis of cancer cells by inducing apoptosis, suppressing angiogenesis, and modulating signaling pathways involved in tumor progression. While further research is needed to elucidate these mechanisms fully, coconut phytochemicals hold promise as natural agents for preventing and managing a wide range of health conditions [44-46].

5. Clinical Evidence and Research Studies

5.1 Human Studies on Coconut and Health Outcomes:

Numerous epidemiological studies and clinical trials have investigated the health effects of coconut consumption and coconut-derived products on various health outcomes. For example, several population-based studies have found an inverse association between coconut consumption and cardiovascular disease risk, attributed to the cholesterol-lowering effects of coconut phytochemicals. Clinical trials have demonstrated the efficacy of coconut oil in improving lipid profiles, reducing inflammation, and promoting weight loss in obese and overweight individuals. Additionally, topical application of coconut oil has been shown to improve skin hydration, reduce eczema severity, and accelerate wound healing in human subjects. While the results of human studies on coconut are promising, further research is needed to confirm these findings and elucidate the underlying mechanisms of action [43, 47, 48].

5.2 Animal Studies and *In vitro* Research

Animal studies and *in vitro* experiments have provided valuable insights into the mechanisms of action and therapeutic potential of coconut phytochemicals. Animal models of cardiovascular disease, diabetes, obesity, and cancer have demonstrated the beneficial effects of coconut oil, coconut water, and coconut-derived products on disease outcomes. For example, feeding rats a diet supplemented with coconut oil has been shown to reduce serum cholesterol levels, inhibit atherosclerosis progression, and improve insulin sensitivity. *In vitro* studies have elucidated the antimicrobial, antioxidant, and anticancer activities of coconut phytochemicals, providing evidence of their potential therapeutic applications. While animal and *in vitro* studies are essential for hypothesis generation and mechanistic exploration, their findings need to be validated in human subjects through well-designed clinical trials [49, 50].

5.3 Future Directions-Areas for Further Research

Despite the growing body of research on coconut phytochemicals, several knowledge gaps and research priorities remain. Future studies should focus on elucidating the bioavailability, metabolism, and pharmacokinetics of coconut phytochemicals in humans, as well as their interactions with other dietary components and medications. Additionally, well-designed clinical trials are needed to assess the long-term effects of coconut consumption on cardiovascular health, metabolic parameters, immune function, and cancer risk. Furthermore, studies exploring the synergistic effects of coconut phytochemicals with other plant-based compounds, such as polyphenols from fruits and vegetables, may uncover novel therapeutic combinations for disease prevention and management. By addressing these research gaps and priorities, we can gain a deeper understanding of the health-promoting properties of coconut phytochemicals and harness their therapeutic potential for improving human health and well-being [51, 52].

6. Practical Applications

6.1 Incorporating Coconut Products into the Diet

Coconut products, including coconut oil, coconut milk, coconut water, and shredded coconut, can be easily incorporated into a balanced diet to reap their health benefits. Coconut oil can be used for cooking, baking, and frying, as well as for making salad dressings, sauces, and marinades. Coconut milk adds richness and creaminess to curries, soups, smoothies, and desserts, while coconut water serves as a refreshing beverage and natural sports drink. Shredded coconut can be sprinkled over oatmeal, yogurt, salads, and baked goods for added flavor and texture. By incorporating coconut products into your diet in moderation, you can enjoy their unique taste and nutritional advantages while supporting your health and well-being [53].

6.2 Coconut-Based Skincare Products

Coconut oil is a popular ingredient in skincare products due to its moisturizing, antimicrobial, and antioxidant properties. You can use coconut oil as a natural moisturizer for your face, body, and hair, applying it directly to clean, dry skin or mixing it with essential oils for added fragrance and benefits. Coconut oil can also be used as a carrier oil for diluting essential oils in aromatherapy massage or as a base for homemade skincare recipes, such as body scrubs, lip balms, and hair masks. Additionally, you can find a wide range of commercial skincare products containing coconut oil, such as lotions, creams, soaps, and shampoos, which can help nourish and protect your skin and hair [54, 55].

6.3 Coconut Oil-Cooking and Culinary Uses

Coconut oil is prized for its high smoke point, mild flavour, and long shelf life, making it a versatile cooking oil for various culinary applications. You can use coconut oil for sautéing, stir-frying, roasting, and baking, as well as for greasing pans and grilling. Coconut oil adds a subtle coconut flavour to dishes, enhancing their aroma and taste, making it particularly well-suited for Asian, Caribbean, and tropical cuisines. Additionally, coconut oil can be used as a dairy-free alternative to butter or margarine in vegan and lactose-free recipes. When choosing coconut oil for cooking, opt for virgin or extra-virgin varieties for maximum flavor and nutritional benefits [56, 57].

6.4 Potential Adverse Effects and Considerations

While coconut products offer numerous health benefits, they may not be suitable for everyone, particularly those with allergies, sensitivities, or dietary restrictions. Coconut allergies are rare but can cause allergic reactions ranging from mild itching and hives to severe anaphylaxis in susceptible individuals. Additionally, coconut oil is high in saturated fat, which may raise LDL cholesterol levels in some people, although the effects on cardiovascular risk are still debated. Those with existing heart conditions or hyperlipidemia should consume coconut products in moderation and consult with a healthcare professional if concerned. Furthermore, coconut oil may cause digestive discomfort, particularly in large quantities, due to its high fat content and laxative effects. Individuals with gastrointestinal issues such as irritable bowel syndrome (IBS) or inflammatory bowel disease (IBD) should consume coconut products cautiously and monitor their symptoms accordingly [58, 59].

7. Conclusion

7.1 Recapitulation of Key Findings

In conclusion, coconuts are a rich source of phytochemicals with diverse health-promoting properties, including antioxidant, antimicrobial, anti-inflammatory, and immune-modulating effects. From lauric acid to polyphenols, coconut phytochemicals exhibit a wide array of biological activities that contribute to cardiovascular health, immune support, skin integrity, and digestive well-being. By incorporating coconut products into your diet, skincare routine, and lifestyle, you can harness the therapeutic potential of coconut catalysts for improved health and vitality.

7.2 Implications for Health and Wellness

The findings presented in this review have important implications for health and wellness, highlighting the role of coconut phytochemicals in preventing chronic diseases, enhancing immune function, and promoting overall well-being. By embracing coconut products as part of a balanced diet and lifestyle, individuals can optimize their health outcomes and reduce their risk of developing lifestyle-related diseases such as cardiovascular disease, diabetes, obesity, and cancer. Additionally, the use of coconut-based skincare products can help nourish and protect the skin, keeping it healthy, radiant, and youthful.

7.3 Future Perspectives-Opportunities and Challenges

While the research on coconut phytochemicals is promising, several opportunities and challenges remain for future investigation. Further studies are needed to elucidate the mechanisms of action, bioavailability, and long-term effects of coconut phytochemicals in humans, as well as their potential interactions with other dietary components and medications. Additionally, well-designed clinical trials are needed to validate the health benefits of coconut consumption and coconut-derived products and to identify optimal dosage regimens for different health conditions. Furthermore, efforts should be made to address knowledge gaps and research priorities in coconut research, including the exploration of synergistic effects with other plant-based compounds and the development of innovative applications for disease prevention and management.

This detailed review provides a comprehensive overview of coconut phytochemicals and their potential health benefits, serving as a valuable resource for researchers, healthcare professionals, and individuals interested in harnessing the therapeutic potential of coconut catalysts for improved health and wellness. By unlocking the secrets of coconut phytochemicals, we can embark on a journey toward optimal health and vitality, powered by nature's bounty.

8. Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

9. References

1. Chan E, Elevitch CR. *Cocos nucifera* (coconut). In: Traditional Tree Initiative-Species Profiles for Pacific Island Agroforestry. Vol. 2.1, 2006, p. 1-27.
2. Rajamohan T, Archana U. Nutrition and health aspects of coconut. In: The Coconut Palm (*Cocos nucifera* L.)-Research and Development Perspectives. Springer Singapore, 2019, p. 757-77. https://doi.org/10.1007/978-981-13-2754-4_15.
3. Kaushik B, Sharma J, Yadav K, Kumar P, Shourie A. Phytochemical properties and pharmacological role of plants: secondary metabolites. Biosci Biotechnol Res Asia. 2021;18:23-35. https://doi.org/10.13005/bbra/2894.
4. Debmandal M, Mandal S. Coconut (*Cocos nucifera* L.: Arecaceae): In health promotion and disease prevention. Asian Pac J Trop Med. 2011:241-247.
5. Enig MG. The health benefits of coconuts & coconut oil. Nexus Magazine, 2002.
6. Pattigadapa HS, RM, PSCH, BRU, LG, AM, BNJ. Cardiotonic activity of coconut water (*Cocos nucifera*). Recent Res Sci Technol. 2011;3:155-7.
7. Enig MG. Coconut: In support of good health in the 21st century. Nexus Magazine. 2002:9-2.
8. Sheela LD, Nazeem PA, Narayanankutty A, Manalil JJ, Raghavamenon AC. *In silico* and wet lab studies reveal the cholesterol lowering efficacy of lauric acid, a medium chain fat of coconut oil. Plant Foods Hum Nutr. 2016;71:410-415. https://doi.org/10.1007/s11130-016-0577-y.
9. Lieberman S, Enig MG, Preuss HG. A review of monolaurin and lauric acid. Altern Complement Ther. 2006;12:310-314.
10. Lattanzio V, Kroon PA, Quideau S, Treutter D. Plant phenolics-secondary metabolites with diverse functions. In: Recent Advances in Polyphenol Research, vol. 1. Wiley, 2008, p. 1-35. https://doi.org/10.1002/9781444302400.ch1.
11. Esquenazi D, Wigg MD, Miranda MMFS, Rodrigues HM, Tostes JBF, Rozental S, *et al*. Antimicrobial and antiviral activities of polyphenolics from *Cocos nucifera* Linn. (Palmae) husk fiber extract. 2002;153.
12. Esteves W, Soares LAS, Hartman L, Pereira AS. Determination of lipids, including medium-chain fatty acids, in human feces. Clin Chem. 1982;28:603.
13. Schünemann HJ, Mccann S, Grant BJB, Trevisan M, Muti P, Freudenheim JL. Lung function and dietary antioxidants. Schünemann *et al*. Lung function in relation to intake of carotenoids and other antioxidant vitamins in a population-based study. 2002;155.
14. Skinner WA, Parkhurst RM. Antioxidant properties of a-tocopherol derivatives and relationship of antioxidant activity to biological activity. Lipids. 1970;5:184-6.
15. Cui J, Yang Z, Xu Y, Tan CP, Zhang W. Lipidomics insight on differences in lipid profiles and phytosterol compositions of coconut oils extracted by classical and green solvents. Food Res Int. 2023;174:113653. https://doi.org/10.1016/J.FOODRES.2023.113653.
16. Guclu-Ustundag Ö, Mazza G. Saponins: Properties, applications, and processing. Crit Rev Food Sci Nutr. 2007;47:231-258. https://doi.org/10.1080/10408390600698197.
17. Shi J, Arunasalam K, Yeung D, Kakuda Y, Mittal G, Jiang Y. Saponins from edible legumes: Chemistry, processing, and health benefits. J Med Food. 2004;7:67-78.
18. Kumar PD. The role of coconut and coconut oil in coronary heart disease in Kerala, South India. Trop Doct. 1997;27:215-217. https://doi.org/10.1177/004947559702700409.
19. Agbafor K, ELOM S, Ogbanshi M, OKO A, Uraku A, Nwankwo V, *et al*. Antioxidant property and cardiovascular effects of coconut (*Cocos nucifera*) water. Int J Biochem Res Rev. 2015;5:259-263. https://doi.org/10.9734/ijbcrr/2015/9805.
20. Nevin KG, Rajamohan T. Beneficial effects of virgin coconut oil on lipid parameters and *in vitro* LDL oxidation. Clin Biochem. 2004;37:830-5. https://doi.org/10.1016/j.clinbiochem.2004.04.010.
21. Elsbaey M, Ibrahim MAA, Bar FA, Elgazar AA. Chemical constituents from coconut waste and their *In silico* evaluation as potential antiviral agents against SARS-CoV-2. South Afr J Bot. 2021;141:278-89. https://doi.org/10.1016/j.sajb.2021.05.018.
22. Srivastava G, Arora A, Sairam RK. Oxidative stress and antioxidative system in plants. Curr Sci. 2002;82:1227-38.
23. Miller DD, Li T, Liu RH. Antioxidants and phytochemicals. Reference Module in Biomedical Sciences. Elsevier, 2014. https://doi.org/10.1016/b978-0-12-801238-3.00236-1.
24. Silva RR, Silva EDO, Fontes HR, Alviano CS, Fernandes PD, Alviano DS. Anti-inflammatory, antioxidant, and antimicrobial activities of *Cocos nucifera* var. typica. BMC Complement Altern Med. 2013;13:1-8.

https://doi.org/10.1186/1472-6882-13-107.
25. Tuyekar SN, Tawade BS, Singh KS, Wagh VS, Vidhate PK, Yevale RP, *et al*. An overview on coconut water: As a multipurpose nutrition. Int J Pharm Sci Rev Res. 2021;68. https://doi.org/10.47583/ijpsrr.2021.v68i02.010.
26. Radenahmad N, Sereemaspun A, Bueraheng N, Hutapea AM. Beneficial effects of young coconut juice on increasing skin thickness, enhancing skin whitening, and reducing skin wrinkles in ovariectomized rats. Appl Sci (Switzerland), 2022, p. 12. https://doi.org/10.3390/app12031584.
27. Alviano WS, Alviano DS, Diniz CG, Antoniolli AR, Alviano CS, Farias LM, *et al*. *In vitro* antioxidant potential of medicinal plant extracts and their activities against oral bacteria based on Brazilian folk medicine. Arch Oral Biol. 2008;53:545-552. https://doi.org/10.1016/j.archoralbio.2007.12.001.
28. Kumar G, Jayaveera K, Kumar AC, Sanjay UP, Vrushabendra Swamy B, Kishore Kumar D, *et al*. Antimicrobial effects of Indian medicinal plants against acne-inducing bacteria. Department of Pharmacognosy. 2007;6.
29. Price KR, Johnson IT, Fenwick GR. The chemistry and biological significance of saponins in foods and feedingstuffs. Crit Rev Food Sci Nutr. 1987;26:27-135. https://doi.org/10.1080/10408398709527461.
30. Singla R, Jagani H. Investigation of antimicrobial effect of dry distilled extract of *Cocos nucifera* Linn endocarp. Pharm Sci, 2012, p. 3. https://doi.org/doi: 10.9754/journal.wmc.2012.003671.
31. Rukmini JN, Manasa S, Rohini C, Sireesha LP, Ritu S, Umashankar GK. Antibacterial efficacy of tender coconut water (*Cocos nucifera* L) on *Streptococcus mutans*: An in-vitro study. *J Int Soc Prev Community Dent*. 2017;7:130-134. https://doi.org/10.4103/jispcd.JISPCD_275_16.
32. Oyi AR, Onaolapo JA, Obi RC. Formulation and antimicrobial studies of coconut (*Cocos nucifera* Linne) oil. Res J Appl Sci Eng Technol. 2010;2:133-7.
33. Ogbolu DO, Oni AA, Daini OA, Oloko AP. *In vitro* antimicrobial properties of coconut oil on *Candida* species in Ibadan, Nigeria. J Med Food. 2007;10:384-7. https://doi.org/10.1089/jmf.2006.1209.
34. Intahphuak S, Khonsung P, Panthong A. Anti-inflammatory, analgesic, and antipyretic activities of virgin coconut oil. Pharm Biol. 2010;48:151-7. https://doi.org/10.3109/13880200903062614.
35. Naskar S, Mazumder UK, Pramanik G, Saha P, Haldar PK, Gupta M. Evaluation of antinociceptive and anti-inflammatory activity of hydromethanol extract of *Cocos nucifera* L. Inflammopharmacology. 2013;21:31-5. https://doi.org/10.1007/s10787-012-0135-7.
36. Ajeigbe KO, Ndaman ZA, Amegor OF, Onifade AA, Asuk AA, Ibironke GF, *et al*. Anti-nociceptive and anti-inflammatory potential of coconut water (*Cocos nucifera* L.) in rats and mice. *Aust J Basic Appl Sci*. 2011;5:1116-1122.
37. Benzie IFF, Strain JJ. The Ferric Reducing Ability of Plasma (FRAP) as a measure of "antioxidant power": The FRAP assay. Anal Biochem. 1996;239:70-76. https://doi.org/10.1006/ABIO.1996.0292.
38. Phisut N, Jiraporn. Characteristics and antioxidant activity of Maillard reaction products derived from chitosan-sugar solution. Vol. 20, 2013.
39. Loki AL, Rajamohan T. Hepatoprotective and antioxidant effect of tender coconut water on carbon tetrachloride-induced liver injury in rats. Indian J Biochem Biophys. 2003;40:354-7.
40. Onyechi TO, Joshua P, Obidoa O, Elijah NJ. Phytochemical analysis of *Cocos nucifera* L. J Pharm Res. 2009;1:87-96.
41. Marina AM, Che Man YB, Nazimah SAH, Amin I. Antioxidant capacity and phenolic acids of virgin coconut oil. Int J Food Sci Nutr. 2009;60:114-23. https://doi.org/10.1080/09637480802549127.
42. Marina AM, Che Man YB, Nazimah SAH, Amin I. Chemical properties of virgin coconut oil. JAOCS, J Am Oil Chem Soc. 2009;86:301-307. https://doi.org/10.1007/s11746-009-1351-1.
43. Widianingrum DC, Noviandi CT, Salasia SIO. Antibacterial and immunomodulator activities of virgin coconut oil (VCO) against *Staphylococcus aureus*. Heliyon, 2019, 5. https://doi.org/10.1016/j.heliyon.2019.e02612.
44. Fugate NAE, Lenz K, Skenandore C, Nowak RA, White BA, Fleming BA. Effects of coconut oil on glycemia, inflammation, and urogenital microbial parameters in female Ossabaw mini-pigs. PLOS One, 2017, 12. https://doi.org/10.1371/journal.pone.0179542.
45. Das RR, Rahman MA, Al-Araby SQ, Islam MS, Rashid MM, Babteen NA, *et al*. The antioxidative role of natural compounds from a green coconut mesocarp undeniably contributes to control diabetic complications as evidenced by the associated genes and biochemical indexes. *Oxid Med Cell Longev*. 2021, 2021. https://doi.org/10.1155/2021/9711176.
46. Kotecha JL, Ram VR. Extraction and identification of phytochemicals in N-hexane and methanol extracts of *Cocos nucifera* L. leaves. Adv Zool Bot. 2023;11:213-219. https://doi.org/10.13189/azb.2023.110307.
47. Deen A, Visvanathan R, Wickramarachchi D, Marikkar N, Nammi S, Jayawardana BC, *et al*. Chemical composition and health benefits of coconut oil: an overview. J Sci Food Agric. 2021;101:2182-93. https://doi.org/10.1002/jsfa.10870.
48. Kotecha JL, Ram VR. A review on plant nutrients correlation with fruit production of *Cocos nucifera* L. Asian Pac J Health Sci. 2022;9:240-242. https://doi.org/10.21276/apjhs.2022.9.2.48.
49. Hima L, Pratap UP, Karrunanithi S, Ravichandran KA, Vasantharekha R, Thyagarajan S. Virgin coconut oil supplementation in diet modulates immunity mediated through survival signaling pathways in rats. J Complement Integr Med, 2020, 17. https://doi.org/10.1515/jcim-2019-0114.
50. Zhang X, Peng L, Dai Y, Xie Q, Wu P, Chen M, *et al*. Anti-cataract effects of coconut water in vivo and *in vitro*. Biomed Pharmacother. 2021;143:112032. https://doi.org/10.1016/J.BIOPHA.2021.112032.
51. Ignacio IF, Miguel TS. Research opportunities on the coconut (*Cocos nucifera* L.) using new technologies. South Afr J Bot. 2021;141:414-420. https://doi.org/10.1016/J.SAJB.2021.05.030.
52. Nampoothiri KUK, Krishnakumar V, Thampan PK, Achuthan Nair M. The coconut palm (*Cocos nucifera* L.)-Research and development perspectives. Singapore: Springer Singapore, 2019. https://doi.org/10.1007/978-981-13-2754-4.

53. Swamy GJ, Mithra A, Chandrasekar V, Shanmgam S. Coconut-value-added products. J Indian Food Ind Mag. 2013;32:29-36.
54. Satheeshan K, Author C, Seema B, Meera Manjusha A. Development of virgin coconut oil based body lotion. Pharma Innov. 2020;9:96-101.
55. Varma SR, Sivaprakasam TO, Arumugam I, Dilip N, Raghuraman M, Pavan KB, *et al*. *In vitro* anti-inflammatory and skin protective properties of virgin coconut oil. J Tradit Complement Med. 2019;9:5-14. https://doi.org/10.1016/j.jtcme.2017.06.012.
56. Azevedo EP de P, dos Santos Alves EM, de Souza JRB, de Araújo KS, de Santana Khan S, Alves de Mendonça CE, *et al*. Fatty acid in raw and heated coconut oil in eleven coconut oil food preparations analysed by gas chromatography. Int J Gastron Food Sci, 2021, 24. https://doi.org/10.1016/j.ijgfs.2021.100329.
57. Srivastava Y, Semwal AD, Sharma GK. Virgin coconut oil as functional oil. In: Therapeutic, Probiotic, and Unconventional Foods, 2018, p. 291-301. https://doi.org/10.1016/B978-0-12-814625-5.00015-7.
58. Eyres L, Eyres MF, Chisholm A, Brown RC. Coconut oil consumption and cardiovascular risk factors in humans. Nutr Rev. 2016;74:267-280. https://doi.org/10.1093/nutrit/nuw002.
59. Yeboah AF. Health benefits of coconut (*Cocos nucifera* Linn.) seeds and coconut consumption. In: *Nuts and Seeds in Health and Disease Prevention*. Elsevier, 2011, p. 361-7. https://doi.org/10.1016/B978-0-12-375688-6.10043-X.