

Unveiling the Therapeutic Potential of Coconut Oil: A Comprehensive Investigation into Health Benefits, Processing Techniques, and Mechanisms of Action

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Abstract

This research paper delves into the historical recognition of coconut oil's health benefits in Ayurveda medicine, drawing connections to the healing properties attributed to mother's milk in ancient literature. The focus is on the modern scientific understanding of coconut oil, particularly its lipid content, medium-chain fatty acids, and monoglycerides, which contribute to its miraculous healing powers and immune-modulating effects. The paper explores the composition of coconut oil, emphasizing the significance of wood-pressed (cold-pressed) extraction methods and their impact on nutritional properties. Furthermore, the study investigates the mechanism of coconut oil pulling and presents the benefits of wood-pressed coconut oil in diverse health aspects.

Keywords

Coconut Oil, Health Benefits, Lauric Acid, Fatty Acids

INTRODUCTION

Historical Recognition in Ayurveda Medicine:

Coconut oil's historical recognition in Ayurveda, the traditional system of medicine originating in ancient India, underscores its enduring significance in holistic health practices. Ayurveda, with roots dating back over 4,000 years, acknowledges coconut oil as a valuable therapeutic agent [1]. In Ayurvedic texts, coconut oil is celebrated for its multifaceted properties, ranging from its role in promoting digestive health to its application in skincare. Ayurvedic practitioners have long considered coconut oil as a versatile remedy, recognizing its potential to balance doshas, particularly its cooling effect on the body.

The historical use of coconut oil in Ayurveda extends beyond its medicinal applications. It is deeply ingrained in cultural rituals and daily routines, serving as an essential ingredient in various Ayurvedic formulations. The holistic approach of Ayurveda emphasizes the interconnectedness of mind, body, and spirit, and coconut oil's inclusion in Ayurvedic practices reflects its integral role in promoting overall well-being [2].

Modern Research on Lipid Content, Medium-Chain Fatty Acids, and Monoglycerides:

In contemporary times, scientific research has delved into the intricate composition of coconut oil, shedding light on its

lipid content, with a particular focus on medium-chain fatty acids (MCFAs) and monoglycerides. Modern research has unravelled the unique properties of coconut oil that contribute to its diverse health benefits [3].

Medium-chain fatty acids, including lauric acid, capric acid, and caprylic acid, have emerged as key players in the therapeutic potential of coconut oil. These MCFAs are metabolized differently in the body compared to long-chain fatty acids, providing a rapid source of energy, and exhibiting various bioactive properties. Lauric acid, for instance, has garnered attention for its antimicrobial and immune-modulating effects [4].

Monoglycerides found in coconut oil have also become a subject of scientific exploration. These compounds, formed through the hydrolysis of triglycerides, exhibit antimicrobial properties, and contribute to the overall health-promoting effects of coconut oil [5].

Modern research on coconut oil extends beyond its chemical composition to unravel the intricate mechanisms by which it interacts with the body. Understanding these mechanisms is crucial in establishing evidence-based applications for coconut oil in various medical contexts, paving the way for its integration into contemporary healthcare practices.

PLANT-BASED ORIGIN AND EXTRACTION METHODS

Coconut oil, derived from the fruit of the coconut palm (*Cocos nucifera*), boasts a plant-based origin that aligns seamlessly with the principles of natural and sustainable living. The process of obtaining coconut oil involves the extraction of its rich content from the dried kernels of coconuts, a meticulous procedure that has been refined over generations [6].

The traditional extraction methods used in coconut oil production reflect a harmonious blend of age-old practices and modern efficiency. The dried coconut kernels are subjected to methods such as cold pressing or expeller pressing, wherein mechanical pressure is applied to extract the oil without the use of excessive heat or chemical solvents. This ensures that the natural integrity of the oil remains intact, preserving its nutritional profile and bioactive compounds.

Wood-Pressed (Cold-Pressed) Coconut Oil: Purity, Nutritional Value, and Antioxidant Retention:

Wood-pressed, or cold-pressed, coconut oil represents a pinnacle in the quest for high-quality, unrefined coconut oil. This method involves the use of a wooden press to crush the dried coconut kernels, applying gentle pressure to obtain the oil. The process takes place at a low speed and temperature, preventing excessive heat generation that could compromise the oil's nutritional content and bioactive compounds [7].

The benefits of wood-pressed coconut oil extend beyond its extraction method. The resulting oil maintains its purity, as it is not subjected to chemical processes or high temperatures. This preservation of natural purity ensures that the oil retains its original pleasant aroma, flavour, and the pure white colour of the coconut. Moreover, wood-pressed coconut oil stands out for its nutritional value, as it captures the essence of the coconut without compromising on vital nutrients.

The wood-pressed technique also plays a crucial role in preserving the oil's antioxidant content. By avoiding the use of heat-intensive extraction methods, wood-pressed coconut oil safeguards the natural antioxidants present in the coconut, such as polyphenols. These antioxidants contribute to the oil's ability to combat oxidative stress and protect the body's cells from free radicals, thereby promoting overall health and well-being [8].

Coconut oil, with its diverse array of bioactive compounds, exhibits multifaceted mechanisms of action that contribute to its therapeutic properties. Understanding how coconut oil interacts with cellular function, modulates the immune system, and operates in the unique practice of coconut oil pulling offers insights into its holistic impact on health.

IMPACT ON CELLULAR FUNCTION

The impact of coconut oil on cellular function is deeply rooted in its composition of medium-chain fatty acids (MCFAs), such as lauric acid, capric acid, and caprylic acid.

These MCFAs are metabolized differently than long-chain fatty acids, providing a readily available source of energy for cells. Lauric acid holds antimicrobial properties, disrupting the lipid membranes of pathogenic organisms and potentially aiding in the defence against infections [9].

Moreover, coconut oil's lipid content contributes to cellular membrane stability. The fatty acids present in coconut oil may influence membrane fluidity, potentially enhancing cellular communication and maintaining the structural integrity of cells. These aspects collectively contribute to the overall support of cellular function and health.

Immunomodulatory Effects:

Coconut oil has been recognized for its immunomodulatory effects, playing a role in regulating and optimizing the immune system's responses. Lauric acid, once metabolized, is converted into monolaurin, a compound with antimicrobial and antiviral properties. This process is believed to support the immune system by combating harmful bacteria, viruses, and other pathogens [1].

The immunomodulatory effects of coconut oil extend beyond direct pathogen defense. Studies have suggested that the bioactive compounds present in coconut oil may influence immune cell activity, potentially enhancing the body's ability to mount effective immune responses. This dual action of direct pathogen inhibition and immune system modulation positions coconut oil as a promising candidate for supporting overall immune health [10].

Coconut Oil Pulling Mechanism:

Coconut oil pulling is a traditional oral care practice that involves swishing coconut oil in the mouth for an extended duration. The mechanism behind coconut oil pulling encompasses several interrelated processes. As the oil is swished around the oral cavity, it undergoes an alkali hydrolysis process, emulsifying the fat and releasing bicarbonate ions found in saliva [11].

The viscous nature of the oil contributes to inhibiting the accumulation of plaque and the adhesion of bacteria to dental surfaces. The antioxidants present in the oil further support the detoxification process by preventing lipid peroxidation, creating an environment with an antibiotic-like effect. This process aids in the destruction of microorganisms, potentially reducing the bacterial load in the oral cavity [12].

The mechanisms of action associated with coconut oil encompass its impact on cellular function, immunomodulatory effects, and the unique process involved in coconut oil pulling. These mechanisms collectively contribute to the versatility of coconut oil as a natural health remedy, offering potential benefits for both systemic health and oral care [13].

BENEFITS OF COCONUT OIL

Coconut oil, celebrated for its rich composition of medium-chain fatty acids and bioactive compounds, unfolds

a spectrum of health benefits that span various aspects of overall well-being. From nutritional value to immune system support, coconut oil's versatility makes it a valuable addition to holistic health practices.

Nutritional Value and Antioxidant-Rich Properties:

Coconut oil stands out for its impressive nutritional profile, housing medium-chain fatty acids (MCFAs) such as lauric acid, capric acid, and caprylic acid. These MCFAs are a readily available source of energy for the body and are metabolized differently than long-chain fatty acids [14]. Additionally, coconut oil is rich in antioxidants, including polyphenols, which protect cells from oxidative stress and free radical damage. The nutritional value of coconut oil extends beyond its caloric content, offering a unique combination of health-promoting elements [9, 15].

Heart Health and Blood Sugar Regulation:

Studies suggest that coconut oil may contribute to heart health by positively influencing lipid profiles. Lauric acid, a prominent component of coconut oil, has been associated with raising high-density lipoprotein (HDL), the "good" cholesterol, which is beneficial for cardiovascular health. Additionally, coconut oil's medium-chain fatty acids may have a positive impact on blood sugar regulation, promoting more gradual increases in blood sugar levels. Incorporating coconut oil into a balanced diet, when done in moderation, may support heart health and aid in maintaining stable blood sugar levels [16].

Weight Management and Brain Function:

Medium-chain triglycerides (MCTs) present in coconut oil are easily absorbed and metabolized by the body, offering a potential aid in weight management. Unlike long-chain fatty acids, MCTs are broken down without requiring bile, providing a rapid source of energy, and potentially improving metabolism. Moreover, the MCTs in coconut oil can be transformed into ketones, which serve as an alternative energy source for the brain. This property may contribute to improved brain function, memory, and mental clarity [17, 18].

Skin and Hair Care:

Coconut oil's moisturizing properties make it a versatile natural remedy for skin and hair care. When applied externally, it nourishes the skin, maintains hydration, and prevents dryness [19]. The antimicrobial and anti-fungal properties of coconut oil make it an effective treatment for various skin conditions, including ringworm, psoriasis, and candidiasis. Regular use of coconut oil in hair care routines can contribute to a healthy scalp, preventing issues such as dandruff, baldness, and graying hair [20]. The lauric acid in coconut oil, known for its antibacterial properties, further supports skin health.

Digestive Health and Immune System Support:

Coconut oil's antibacterial and antiviral properties can aid

in maintaining a healthy digestive system. It combats microorganisms in the gut, promoting a balanced microbial environment and potentially alleviating issues such as indigestion and bloating. The medium-chain free fatty acids and monoglycerides found in coconut oil are absorbed intact in the small intestine, providing a direct source of energy, and supporting immune system function. Lauric acid, when converted to monolaurin, may contribute to the body's defence against bacteria and viruses, providing immune system support [1].

The benefits of coconut oil extend from its nutritional richness and antioxidant properties to its potential contributions to heart health, weight management, brain function, skin and hair care, digestive health, and immune system support. These multifaceted advantages position coconut oil as a versatile and holistic health-promoting agent when incorporated into a balanced lifestyle.

WOOD-PRESSED COCONUT OIL VS. MARKET VARIANTS:

Wood-pressed coconut oil and its commercially available counterparts in the market exhibit notable differences in their composition, nutritional attributes, and extraction methods. A comparative analysis of these aspects sheds light on the potential distinctions that can influence their health-related properties.

Composition Analysis - Lauric Acid, Myristic Acid, Palmitic Acid, Stearic Acid, Capric Acid, Caprylic Acid:

A crucial aspect of differentiating wood-pressed coconut oil from market variants lies in the detailed composition analysis of specific fatty acids. Lauric acid, a medium-chain fatty acid renowned for its antimicrobial properties, is found abundantly in coconut oil. Myristic acid, palmitic acid, stearic acid, capric acid, and caprylic acid are additional fatty acids present in varying proportions, each contributing distinctively to the oil's overall composition [21, 22].

Wood-pressed coconut oil, extracted through traditional methods, may exhibit differences in the concentration of these fatty acids compared to mass-produced market variants. The extraction process, maturity of coconuts selected, and adherence to traditional techniques can influence the final composition, potentially leading to variations in the proportions of these beneficial fatty acids (Table 1).

Energy Content and Fatty Acid Distribution:

Understanding the energy content and distribution of fatty acids in wood-pressed coconut oil versus market variants is pivotal for assessing their nutritional value. Wood-pressed coconut oil, owing to its traditional extraction methods, may offer a unique fatty acid distribution, with a potential emphasis on lauric acid, recognized for its health-promoting properties.

On the contrary, market variants may undergo refining processes that could alter the distribution of fatty acids, impacting the oil's overall nutritional profile. The energy

content, expressed in terms of kilocalories, provides insights into the caloric density of the oils and their potential impact on dietary energy intake.

The comparative analysis of wood-pressed coconut oil and market variants encompasses a meticulous examination of their fatty acid composition, with a focus on lauric acid, myristic acid, palmitic acid, stearic acid, capric acid, and

caprylic acid. Additionally, evaluating their energy content and fatty acid distribution offers a comprehensive understanding of the nutritional distinctions between these oil variants. This analysis contributes to informed consumer choices, aligning with preferences for specific health benefits and extraction methods.

Table 1: Fatty acids profiles of Wood pressed and commercial coconut oil.

S.No	Parameters	Wood pressed coconut oil	Commercial coconut oil	Specification as per codex std
1	Lauric Acid	49.23%	48.5%	45-53%
2	Myristic Acid	19.41%	18.63%	16.8-21%
3.	Palmitic Acid	7.30%	7.49%	7.0-10.2%
4	Stearic Acid	2.46%	2.50%	2.0-4.0%
5	Capric Acid	6.62%	6.12%	5.0-8.0%
6	Caprylic Acid	8.9%	8.30%	4.6-10.0%

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CLINICAL STUDIES AND RESEARCH FINDINGS:

Scientific exploration into the potential health benefits of coconut oil has led to several clinical studies and research findings, shedding light on its efficacy in diverse medical contexts. These studies offer valuable insights into the impact of coconut oil on various health conditions, ranging from infectious diseases to oral health and immune responses.

HIV-AIDS Clinical Trial in the Philippines:

A groundbreaking clinical trial conducted in the Philippines examined the effects of coconut oil in individuals diagnosed with HIV-AIDS. In this study, 15 HIV patients, aged between 22 to 38 years, including both males and females, were administered daily doses of coconut oil for a

duration of six months. Remarkably, the trial reported a minimal fatality rate, with 11 out of the 15 patients exhibiting higher CD4 and CD8 counts after the six-month period. This compelling evidence suggests a potential role for coconut oil in supporting immune function and influencing key markers in HIV-positive individuals [23].

Gingivitis Intervention Study:

An intervention study focused on gingivitis explored the effectiveness of coconut oil in reducing plaque-related gum inflammation. In this prospective interventional study, 60 adolescent boys and girls aged 16-18, suffering from plaque-induced gingivitis, incorporated oil pulling with coconut oil into their oral hygiene routine for a period of 30 days. The results revealed a significant decrease in both plaque and gingival indices, emphasizing the potential of coconut oil as an adjunctive measure in combating oral health issues, particularly gum inflammation [24].

Antibacterial and Antifungal Properties in Atopic Dermatitis:

Research findings in a double-blind controlled study investigated the topical application of virgin coconut oil (VCO) in individuals suffering from atopic dermatitis. This common skin condition, characterized by dry and inflamed skin prone to bacterial colonization, was addressed by prescribing VCO. The study demonstrated a notable reduction in the colonization of *Staphylococcus aureus*, a bacteria often associated with atopic dermatitis. These findings underscore coconut oil's potential antibacterial and antifungal properties, presenting it as a natural remedy for managing skin conditions [25, 26].

Immune Responses in Very Pre-Term Infants

Studies conducted on very pre-term infants, a population highly susceptible to immune responses and blood infections, explored the effects of topical application of coconut oil. The research revealed an increase in monolaurin levels in blood plasma after 14 days of coconut oil massage. Monolaurin, at this level, demonstrated significant activity against

gram-positive late-onset sepsis pathogens, indicating coconut oil's potential role in enhancing immune function and protecting pre-term infants from infections [27].

These clinical studies and research findings collectively contribute to the growing body of evidence supporting the diverse health benefits of coconut oil, ranging from immune system support to oral health and skin conditions. As research in this field continues to evolve, coconut oil holds promise as a natural therapeutic agent with potential applications in various medical domains.

CONCLUSION

This research paper provides a comprehensive overview of the historical roots, composition, processing techniques, and mechanisms of action of coconut oil. The analysis encompasses the benefits of wood-pressed coconut oil, drawing attention to its nutritional value, antioxidant-rich properties, and clinical applications. The findings underscore the potential of coconut oil as a holistic health remedy, linking traditional wisdom with modern scientific understanding. Further research and clinical trials are warranted to explore its full therapeutic potential and establish evidence-based guidelines for its effective use in the medical field.

REFERENCES

- [1] Joshi, S., Kaushik, V., Gode, V., & Mhaskar, S. (2020). Coconut Oil and Immunity: What do we really know about it so far? *The Journal of the Association of Physicians of India*, 68(7), 67–72.
- [2] Devraj, V. (2022). Importance of coconut oil in Ayurveda. *Sitaram retreat*. <https://sitaramretreat.com/importance-of-coconut-oil-in-ayurveda/>
- [3] Jadhav, H. B., & Annature, U. S. (2023). Triglycerides of medium-chain fatty acids: a concise review. *Journal of food science and technology*, 60(8), 2143–2152.
- [4] Dayrit, F. M. (2015). The properties of lauric acid and their significance in coconut oil. *Journal of the American Oil Chemists' Society*, 92(1), 1–15.
- [5] Maher, T., & Clegg, M. E. (2021). A systematic review and meta-analysis of medium-chain triglycerides effects on acute satiety and food intake. *Critical reviews in food science and nutrition*, 61(4), 636–648. <https://doi.org/10.1080/10408398.2020.1742654>.
- [6] Ng, Y. J., Tham, P. E., Khoo, K. S., Cheng, C. K., Chew, K. W., & Show, P. L. (2021). A comprehensive review on the techniques for coconut oil extraction and its application. *Bioprocess and biosystems engineering*, 44(9), 1807–1818. <https://doi.org/10.1007/s00449-021-02577-9>
- [7] Sundrasegaran, S., Hui Mah, (2020). Extraction Methods of Virgin Coconut Oil and Palm-pressed Mesocarp Oil and their Phytonutrients. *International Association of Dietetic Nutrition and Safety*. <https://doi.org/10.2991/efood.k.201106.001>.
- [8] Agarwal, R. K., Bosco, S.J.D. (2017). Extraction processes of virgin coconut oil. *MOJ Food Process Technol.* 4(2):54-56. DOI: 10.15406/mojfpt.2017.04.00087.
- [9] Ramya, V., Shyam, K. P., Kowsalya, E., Balavigneswaran, C. K., & Kadalmani, B. (2022). Dual Roles of Coconut Oil and Its Major Component Lauric Acid on Redox Nexus: Focus on Cytoprotection and Cancer Cell Death. *Frontiers in neuroscience*, 16, 833630. <https://doi.org/10.3389/fnins.2022.833630>.
- [10] Widianingrum, D. C., Noviandi, C. T., & Salasia, S. I. O. (2019). Antibacterial and immunomodulator activities of virgin coconut oil (VCO) against *Staphylococcus aureus*. *Heliyon*, 5(10), e02612. <https://doi.org/10.1016/j.heliyon.2019.e02612>.
- [11] Woolley, J., Gibbons, T., Patel, K., & Sacco, R. (2020). The effect of oil pulling with coconut oil to improve dental hygiene and oral health: A systematic review. *Heliyon*, 6(8), e04789. <https://doi.org/10.1016/j.heliyon.2020.e04789>.
- [12] Shanbhag V. K. (2016). Oil pulling for maintaining oral hygiene - A review. *Journal of traditional and complementary medicine*, 7(1), 106–109. <https://doi.org/10.1016/j.jtcme.2016.05.004>.
- [13] Naseem, M., Khiyani, M. F., Nauman, H., Zafar, M. S., Shah, A. H., & Khalil, H. S. (2017). Oil pulling and importance of traditional medicine in oral health maintenance. *International journal of health sciences*, 11(4), 65–70.
- [14] Ingle, D.L., Driedger, A., Traul, K.A., & Nakhasi, D.K. (1999). Dietary Energy Value of Medium-chain Triglycerides. *Journal of Food Science*, 64, 960-963.
- [15] Silalahi, J. (2020). Nutritional Values and Health Protective Properties of Coconut Oil. *Indonesian Journal of Pharmaceutical and Clinical Research (IDJPCR)*, 3(2), 01 – 12.
- [16] Eyres, L., Eyres, M. F., Chisholm, A., & Brown, R. C. (2016). Coconut oil consumption and cardiovascular risk factors in humans. *Nutrition reviews*, 74(4), 267–280. <https://doi.org/10.1093/nutrit/nuw002>.
- [17] Adel, K. (2019). IsMCT Oil Beneficial for the Brain and for Weight Loss? <https://www.soscuisine.com/blog/mct-oil-beneficial-brain-weight-loss/>.
- [18] McCarty, M. F., & DiNicolantonio, J. J. (2016). Lauric acid-rich medium-chain triglycerides can substitute for other oils in cooking applications and may have limited pathogenicity. *Open Heart*, 3(2), e000467.
- [19] Varma, S. R., Sivaprakasam, T. O., Arumugam, I., Dilip, N., Raghuraman, M., Pavan, K. B., Rafiq, M., & Paramesh, R. (2018). In vitro anti-inflammatory and skin protective properties of Virgin coconut oil. *Journal of traditional and complementary medicine*, 9(1), 5–14. <https://doi.org/10.1016/j.jtcme.2017.06.012>.
- [20] Saxena, R., Mittal, P., Clavaud, C., Dhakan, D. B., Roy, N., Breton, L., Misra, N., & Sharma, V. K. (2021). Longitudinal study of the scalp microbiome suggests coconut oil to enrich healthy scalp commensals. *Scientific reports*, 11(1), 7220. <https://doi.org/10.1038/s41598-021-86454-1>.
- [21] Deen, A., Visvanathan, R., Wickramarachchi, D., Marikkar, N., Nammi, S., Jayawardana, B. C., & Liyanage, R. (2021). Chemical composition and health benefits of coconut oil: an overview. *Journal of the science of food and agriculture*, 101(6), 2182–2193. <https://doi.org/10.1002/jsfa.10870>.
- [22] Suryani, S., Sariyani, S., Earnestly F., Marganof, M., Rahmawati, R., Sevindrajuta, S., Mahlia, Fudholi, A. (2020). A Comparative Study of Virgin Coconut Oil, Coconut Oil and Palm Oil in Terms of Their Active Ingredients. *Processes*; 8(4):402. <https://doi.org/10.3390/pr8040402>.
- [23] Widhiarta, D.K. (2016). Virgin Coconut Oil for HIV-Positive

People.

- [24] Peedikayil, F. C., Sreenivasan, P., & Narayanan, A. (2015). Effect of coconut oil in plaque related gingivitis - A preliminary report. *Nigerian medical journal: journal of the Nigeria Medical Association*, 56(2), 143–147. <https://doi.org/10.4103/0300-1652.153406>
- [25] Evangelista, M. T., Abad-Casintahan, F., & Lopez-Villafuerte, L. (2014). The effect of topical virgin coconut oil on SCORAD index, transepidermal water loss, and skin capacitance in mild to moderate pediatric atopic dermatitis: a randomized, double-blind, clinical trial. *International journal of dermatology*, 53(1), 100–108. <https://doi.org/10.1111/ijd.12339>
- [26] Marina, A. M., Che Man, Y. B., & Amin, I. (2009). Virgin coconut oil: emerging functional food oil. *Trends in Food Science & Technology*, 20(10), 481–487.
- [27] Pupala, S. S., Rao, S., Strunk, T., & Patole, S. (2019). Topical application of coconut oil to the skin of preterm infants: a systematic review. *European journal of pediatrics*, 178(9), 1317–1324. <https://doi.org/10.1007/s00431-019-03407-7>