



PHARMACOLOGICAL PROPERTIES OF COCO NUT (*COCOS NUCIFERA*) OIL: A REVIEW

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ABSTRACT

Coconut tree termed “Tree of Life” is the only palm that produces coconut and is known for its therapeutic, traditional, spiritual, nutritional, cosmetic and industrial values. In addition, coconut oil has been shown to have pharmacological benefits and nutritional values. Coconut oil is a good source of physiologically active natural compounds such as lauric acid (monolaurin), medium chain triglycerides (MCTs) and polyphenols. Among the refined and unrefined coconut oil, virgin coconut oil is considered the best coconut oil because it is refined naturally and has the highest polyphenol content, and should be considered as part of a healthy balanced diet. It is pharmacologically active and has been reported to possess antibacterial, antiviral, anti-hypertensive, anti-hyperglycemic, anti-obese, anti-oxidative and anti-inflammatory and other properties. This review x-rayed some of the pharmacological and therapeutic benefits of coconut oil.

KEYWORDS: *Coconut oil, Cocus nucifera, medium-chain fatty acids, antioxidant, anti-obesity, anti-lipidemic*

INTRODUCTION

The coconut tree (*Cocos nucifera*) is a member of the Arecaceae family (Palm family). The term coconut is derived from the 16th century Portuguese and Spanish word coco meaning “Head” or “Skull”, “a grin” “Monkey face” respectively since there is slight resemblance to a human face or a monkey head because of the three indentations on the coconut shell that resemble facial features.¹

Coco palm, (*Cocos nucifera*) is the only palm tree that produces coconut within the species. There are two main varieties of Coconut palm: tall and dwarf. The coconut fruit consist of three layers, the exocarp, mesocarp and endocarp around a hollow center. The exocarp and mesocarp makes the outermost layer or husk which is green, red or yellow at first but brown as the coconut matures.² Coconuts are different from any other fruits

because they contain a large quantity of water. When immature they are known as tender-nuts or Jelly-nuts and may be harvested for drinking. In tropical countries the immature fruits are usually sold with their top cut open and a straw inserted to provide a delicious and refreshing drink as the hollow of the coconut is filled with coconut water. When matured, they still contain some water and pressed to give oil from the kernel, charcoal is obtained from the hard shell and coir from the fibrous husk.

Coconut is well known for its nutritious qualities, and it is part of daily diets of many people. The fruit is used as food and can be cooked in many different ways. It is enriched with vitamins and minerals. The oil and milk derived from it are commonly used in cooking, frying, and widely used in production of soaps and cosmetics.³ The husk and leaves are used as materials to make a variety of products for furnishing and decoration.

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The fruit is believed to possess a lot of healing properties. It is famous for its strong aphrodisiac property. The milk and endosperm restore energy and enhance the physical state of the body, rejuvenate and improves eye sight, and normalizes digestion. The water is commonly taken as an antidote to drug overdose and poisons.

Coconut oil is a term used to refer to the oil derived from coconuts.⁴ The oil is commonly used for cooking because of its fatty acid content and related health properties, and also in cosmetics.⁵ Its application in non-cosmetic products extends to soaps, edible fats, chocolate, candies, candles, and night lights.⁵ Because of its high saturated fat content, it is slow to oxidize and, thus, resistant to rancidification, lasting up to six months at 24 °C (75 °F) without spoiling.

Coconut oil is derived from the copra of the coconut (the dried meat of the coconut) which is 60-70% fatty acids, 4-10% water, and has a protein and carbohydrate content (protein of less than 10% and non-sugar carbohydrate less than 20%).⁴

Coconut oil is largely comprised of saturated fatty acids, making it extremely stable and resistant to oxidation. It has a half-life of about 2 years but it can last a lot longer. Coconut oil is unique in its structural make-up due to its medium-chain fatty acids, the closest to those found in human, like the breast milk that nature provides. Consequently, coconut oil is found in baby formula, sports drink and energy drinks, as medium-chain triglycerides (MCTs). Medium chain fatty acids are more easily

digested than fats found in other oils because they are processed directly in the liver and immediately converted into energy. They also tend to improve the absorption of other nutrients and are also used as moisturizer for dry skin and hair.⁶

Coconut oil which comprised of median chain fatty acids (MCFAs) are easily digested and readily cross cell membranes and may promote more efficient fat burning and weight loss. MCFA are immediately converted by the liver into energy rather than being stored as fat and does not produce insulin spike on blood stream.⁷ Coconut oil composes of saturated, mono-unsaturated and poly unsaturated fatty acids (SFA: MUFA: PUFA) at a ratio of 86.5: 5.8: 1.8 fats.⁸ The saturated fats however, fall into the medium-chain triglycerides or medium-chain fatty acids (MCFAs) group. The MCT's in this oil are lauric acid (C-12), capric acid(C-10), caprylic acid (C-8) and caproic acid(C-6). Together, they constitute 68% of total saturated and 59% of total fat content.⁵ Lauric acid being a 12-carbon saturated fats constitute the major portion of MCTs, constituting more than 45% of total fat content. In the gut lauric acid and other MCTs are absorb directly into the blood stream and thus save energy and bring early sense of satiety.



Figure 1: Coconut, its endosperm and water, extracted coconut oil, soap produced using coconut oil and palm frond.⁹

There are two major types of coconut oil:

a. Virgin coconut oil

Virgin coconut oil (VCO) can be produced from fresh coconut milk, meat, or residue. Producing it from the fresh meat involves removing the shell and washing, then either wet-milling or drying the residue, and using a screw press to extract the oil. VCO can also be extracted from fresh meat by grating and drying it to a moisture content of 10–12%, then using a manual press to extract the oil. Producing it from coconut milk involves grating the coconut and mixing it with water, then squeezing out the oil. The milk can also be fermented for 36–48 hours, the oil removed, and the cream heated to remove any remaining oil. A third option involves using a centrifuge to separate the oil from the other liquids. Coconut oil can also be extracted from the dry residue left over from the production of coconut milk.¹⁰

b. Refined coconut oil

This type of coconut oil is also referred to as "Refined, bleached, and deodorized" (RBD) oil. It is gotten from dried endosperm of coconut which is placed in a hydraulic press with added heat. This extracts practically all the oil present, amounting to more than 60% of the dry weight of the coconut. This crude coconut oil may be further refined by heating and filtering to remove the contaminating materials.¹¹ Another method for extraction of coconut oil involves the enzymatic action of alpha-amylase, polygalacturonases, and proteases on diluted coconut paste.¹² Unlike virgin coconut oil, refined coconut oil has no coconut taste or aroma. RBD oil is used for home cooking, commercial food processing, and cosmetic, industrial, and pharmaceutical purposes.

Composition of coconut oil

Coconut oil contains the following fatty acids; caprylic, capric, lauric, myristic, palmitic, stearic oleic and linoleic acids.^{4,8} Of these fatty acids, approximately 65% are designated as medium-chain triglycerides.⁴

Pharmacological effects of coconut

Coconut oil, a saturated fat has been shown to have significant health benefits and pharmacological effects.

While coconut possesses many health benefits due to its fibre and nutritional content, it is the oil that makes it a truly remarkable food and medicine. The oil was once erroneously believed to be unhealthy because of its high saturated fat content, however it

is now known that the fat in coconut oil is unique and different from most all other fats and possesses many health benefits. There are different classes of fatty acid, short-chain fatty acids (SCFA), medium-chain fatty acid (MCFA), and long-chain fatty acid (LCFA). Coconut oil is composed predominantly of medium – chain fatty acids (MCFA), also known as medium – chain triglycerides (MCT). The benefits of this type of acid can be attributed to the fact that medium-chain fatty acids, in addition to not been absorbed are also rapidly metabolised. Thus they can further be converted to ketone bodies. Some of the pharmacological effects of coconut oil include.

1. Anti-lipidemic, anti-hypertensive and cardioprotective effects

Coconut oil is loaded with saturated fats, which actually do not harm the blood lipid profile as previously thought but raises HDL (the good) cholesterol and changes the LDL cholesterol to a benign subtype.¹³ A study revealed that coconut oil reduced total and LDL cholesterol while increasing HDL cholesterol.^{8,14,15} Coconut oil has also been demonstrated to reduce triglycerides, total and LDL cholesterol, increases HDL and improves blood coagulation factors and antioxidant status.^{16,17} There is an inverse relationship between HDL and heart disease

Lauric acid present in coconut oil actively helps in various cardiovascular problems such as high cholesterol levels and high blood pressure. The regulatory effect of VCO on blood pressure has been reported.¹⁸

2. Anti-microbial effects

The fatty acid in coconut oil is mainly the 12-carbon lauric acid. When coconut oil is enzymatically digested, it liberates a monoglyceride called monolaurin. Both lauric acid and monolaurin can kill harmful pathogens like bacteria, viruses and fungi.^{19, 20}

These substances have been shown to be lethal to *Staphylococcus aureus* and *Candida albicans*.^{20,21} Decoction obtained from coconut tree roots is traditionally used as mouthwash or gargle.⁴ an action which may be related to the potential anti-infective properties secondary to lauric acid. Using VCO as a mouthwash is called oil pulling, and this has been shown to eliminate Streptococcus mutant counts in saliva and kill some of the harmful bacteria in the mouth, improve dental health and reduces bad breath.^{22, 23, 24} Monolaurin has been shown to have the capacity to destroy the lipid

coating of most bacteria, thus rendering them susceptible for destruction.⁴

Studies have also shown that oil pulling is an effective procedure to prevent gum disease and tooth decay.²⁵ The antibacterial properties of VCO has made an alternative means for mouthwash, and it has been shown to significantly reduce plaque formation and plaque induced gingivitis.^{25, 26}

3. Hepatoprotective and nephroprotective effects

The presence of medium-chain triglycerides and MCFAs in coconut oil is beneficial in preventing liver diseases. They also help in preventing kidney and gall bladder diseases and dissolve kidney stones.

Coconut oil was shown to reverse the increase in liver weight induced by paracetamol and similar changes were noted in serum liver enzymes and histopathological analysis of the liver.²⁷ This may be independent of anti-oxidant induction, as dietary ingestion of 15% coconut oil in rats for 8 weeks failed to show such an antioxidative effect.²⁸ Coconut oil appears to down regulate hepatic lipogenesis, which coincided with reduced activity of HMG-CoA and more activity of lipoprotein lipase (LPL).²⁹ A high concentration of coconut oil has been demonstrated to reduce incidence of renal lesions and /or mortality.³⁰

4. Reproductive effects

Coconut oil was reported to be associated with increased infant weight and length gain.³¹ Nursing mothers often take coconut oil 3-4 tablespoons a day (and Vitamin D) to increase milk production and nutrients.

Coconut oil was found to reduce oxidative stress in the testes of rats, resulting in significantly higher levels of testosterone.³² It was also found to reduce testosterone-induced benign prostate growth in rats.³³

5. Anti-osteoporosis

Coconut oil permits more calcium to be taken up by the body, hence it is very valuable in preventing osteoporosis. Free radicals are culprits in the development of osteoporosis, and the antioxidants in VCO assist in reducing these free radicals thus preventing their deleterious effects on the bone.³⁴ Studies has shown that VCO not only increases bone volume and structure, but also decreases bone loss due to osteoporosis.³⁴

6. Anti-obesity

Because of the energy-creating abilities of coconut oil and the fact it is a non-carbohydrate oil, it is no wonder that it is beneficial in losing weight. It helps burn fat and calories, decrease appetite, and especially helpful in losing stomach fats

Medium-chain triglycerides (TGs) have been used in many weight loss programmes for obese patients.³⁵ Dietary intake of medium-chain TGs results in incorporation of MCFAs into the TGs stored in adipocyte.^{36, 37} It has been hypothesized that incorporation of MCFAs into adipocyte TGs might enhance lipolysis, which contribute to decreased fat mass.^{37, 38}

It might seem ironical that eating coconut oil (a fat) will contribute to *fat* loss, but it is actually quite logical. The key to understanding this phenomenon lays in the multidimensional ability of the MCFAs to control a variety of physiological processes .For example, capric acid shows significant improvements in thyroid function, helps lower resting heart rate and assists the body in burning fat for energy.³⁹

Lei et al⁴⁰ provided a clue why MCFAs have fat-burning ability. They observed that in rats pretreated with caprylic acid, fat breakdown occurred at such a significant level that it mimicked the characteristics of fasting. Such changes they concluded, could contribute, in part, to weight loss in animals and humans associated with dietary medium-chain fatty acids.

One interesting feature of coconut oil is that it can reduce appetite. This may be related to the way the fatty acids in it are metabolized, because ketone bodies can have an appetite reducing effect.⁴¹ The fatty acids in coconut oil can significantly reduce appetite, which may positively affect body weight over the long term.^{42, 43}

7. Anti-Alzheimer's and anticonvulsant effects

Alzheimer's disease is the most common cause of dementia worldwide and occurs primarily in elderly individuals. Medium-chain triglycerides are being intensively studied as potential therapeutic agents in Alzheimer's disease.^{44, 45} In Alzheimer's patients, there appears to be a reduced ability to use glucose for energy in certain parts of the brain. Ketone bodies can supply energy for the brain and studies have speculated that ketones can provide an alternative energy source for these malfunctioning cells and reduce symptoms of Alzheimer.⁴⁶ Ketones are used by the brain as an important energy

source and have been shown to have possible therapeutic effects on people suffering from memory loss, such as Alzheimer's disease.⁴⁶ Studies showed that the fatty acids in coconut oil can increase blood levels of ketone bodies, supplying energy for the brain cells of Alzheimer's patients and relieving symptoms.⁴⁷ Additionally, unique phenolic compounds and hormones found in coconut oil may be able to prevent the aggregation of amyloid beta peptides, which are part of a leading theory about the etiology of Alzheimer's disease.

The postulation that coconut oil may be beneficial in seizures is based on its high content of ketones. Ketogenic diet has been reported to significantly reduce the mean percentage of seizures in children.⁴⁷ The mechanism of this effect is attributed to the high fat and limited carbohydrate content of ketogenic diet. Although coconut oil alone is not enough to prevent seizures, however some of its constituents are vital in reducing seizures that strike epileptic patients.⁴⁷

8. Anti-stress and anti-oxidant and anti-inflammatory effects

Oxidative stress is the steady state level of oxidative damage in a cells, tissues or organs caused by reactive oxygen species (free radicals and peroxide). This can affect a specific molecule or the entire organism. One of the biggest factors in oxidants stress is lipid peroxidation. Coconut oil has been proven to inhibit oxidative stress due to its ability to enhance the antioxidant defense system. The oil mops up free radicals and eliminates them from the body.⁴⁸ The antioxidant capacity of VCO has been attributed to phenolic compounds.⁴⁹

A study on the anti-stress and antioxidant effect of virgin coconut oil (VCO) *in vivo* showed that VCO was able to reduce immobility time and relieve oxidative stress in mice post-swim test. These results suggest the potential value of VCO as an anti-stress.⁵⁰ The medium-chain fatty acids (MCFAs) in coconut oil are particularly useful in stress reduction, and daily intake of MCFAs, such as those in coconut oil could assist in reducing the onset of stress-induced depression.⁵¹

The high levels of antioxidants in coconut oil have a positive effect on inflammation and arthritis.⁵² Coconut oil was shown to increase antioxidant enzymes as well as reduce the expression of inflammatory genes such as IL-6, COX-2 and iNOS.⁵³ The antioxidant and anti-inflammatory effects of virgin coconut oil was also demonstrated

in methotrexate-induced oxidative nephrotoxicity in rats.^{54, 55}

9. Anti-cancer effects

Ketones present in coconut oil endow it with significant cancer prevention and treatment properties. Multiplication and survival of cancer cells depend on the availability of glucose, and the energy in ketones is not available when needed. Thus ketones act as a barrier against cancer growth.⁵⁶ Both lauric acid palmitic acid, which are saturated fatty acids abundant in coconut oil have been shown to inhibit the HT29 colon cells more strongly than linoleic acid and other vegetable oils.⁵⁶

10. Effects on hormonal balance

Lauric acid in coconut oil has been shown to play a vital role in balancing hormones.¹⁴ Reduction in estrogen levels during menopause responds positively to HDL-cholesterol. Coconut oil has positive effect on HDLs and has been shown to increase the level of beneficial proteins that conserve estrogen in women during menopause.¹⁴

11. Other effects

Other pharmacological effects attributed to coconut oil include, treatment of dandruff and dry hair,⁶ antiulcerogenic,⁵⁹ analgesic,⁶⁰ wound healing⁶¹ and acceleration of metabolism.⁶²

CONCLUSION

Coconut oil is a staple food in many parts of the world and is known for its potential health benefits. Virgin coconut oil (VCO) is known for its high nutritional content like lauric acid (monolaurin), medium chain triglyceride and fatty acids, and polyphenols. It has lots of pharmacological properties such as antimicrobial, anti-ulcer, anticonvulsant, antioxidant, as well as reproductive, neurological and hepatoprotective effects. Coconut oil also has positive effect on blood pressure, wound healing, blood cholesterol, pain, and protection of hair and skin damage.

CONFLICT OF INTEREST

The authors declare no conflict of interest

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