

**ESSENTIALS OF COCONUT OIL****Lakshmi Gopal R.\*<sup>1</sup> and Blessy B.<sup>2</sup>**<sup>1</sup>Mar Dioscorus College of Pharmacy, Thiruvananthapuram.<sup>2</sup>Sree Krishna College of Pharmacy and Research Centre, Thiruvananthapuram.Article Received on  
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Pharmacy,  
Thiruvananthapuram.**1. ABSTRACT**

Coconut oil is produced by crushing copra, the dried kernel, which contains about 60 -65% of the oil. The oil has the natural sweet taste of coconut and contains 92% of saturated fatty acids (in the form of triglycerides), most of them (about 70%) are lower chain saturated fatty acids known as medium chain fatty acids (MCFAs). MCFAs are not common to different vegetable oils with lauric acid at 45-56%. Various fractions of coconut oil have medium chain triglycerides and are excellent solvent for flavours, essences, emulsifiers etc. These fatty acids are used in the preparation of emulsifiers, as drugs and also in

cosmetics. Its metabolism is different from that of the normal vegetable oils containing long chain fatty acids. Hence, it cannot be generalized as an oil similar in properties to that of a 92% long chain saturated fatty acids containing oil/fat. More studies are required to prove the good effects of coconut oil, medium chain triglycerides (MCT) and the fatty acids on humans especially on the ill effects on cardiovascular and other diseases. Coconut oil is consumed in tropical countries for thousands of years. Studies done on native diets high in coconut oil consumption show that this population is generally in good health. Coconut oil has a long shelf life and is used in baking industries, processed foods, infant formulae, pharmaceuticals, cosmetics and as hair oil. The review covers the production of coconut oil its chemistry, MCT and its applications taking a holistic approach on the good and bad effects of coconut oil reported in the literature.

**KEYWORDS:** Copra, Triglycerides.



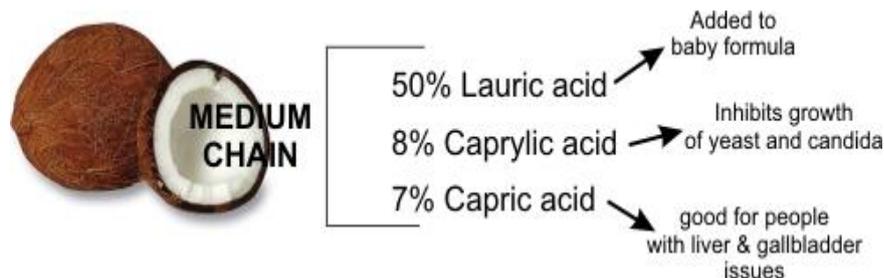
**Figure 1: Shows Health benefits of Coconut oil.**

## 2. INTRODUCTION

Coconut oil is an edible oil that has been consumed in tropical countries for thousands of years. As it has a long shelf life and a melting point of 76°F, it is used in baking industries. Coconut oil has >90% saturated fatty acids, hence is less attractive to consumers. Saturated fat is one that has no unsaturation or double bonds and tends to be solid at room temperature. Coconut oil is rich in short and medium chain fatty acids. Various fractions of coconut oil are used as drugs. Butyric acid is used to treat cancer, while lauric acid is effective in treating viral infections. Hence, the literature is reviewed in the greatness of Coconut oil. Coconut oil has a long shelf life and is used in baking industries, processed foods, infant formulae, pharmaceuticals, cosmetics and as hair oil. The oil has the natural sweet taste of coconut and contains 92% of saturated fatty acids (in the form of triglycerides), most of them (about 70%) are lower chain saturated fatty acids known as medium chain fatty acids (MCFAs). MCFAs are not common to different vegetable oils with lauric acid at 45-56%.

## 3. COCONUT OIL

Coconut oil has >90% saturated fatty acids. Saturated fat is one that has no unsaturation or double bonds and tends to be solid at room temperature. Coconut oil is rich in short and medium chain fatty acids.



Coconuts are very high in saturated fat- 92%. 65% of those saturated fats are called medium chain. Medium chain has very unique characteristics that put them in a different category of other fatty acids.

□

**Figure 2: Shows Medium Chain Fatty Acids.**

### 3.1 Biological Source

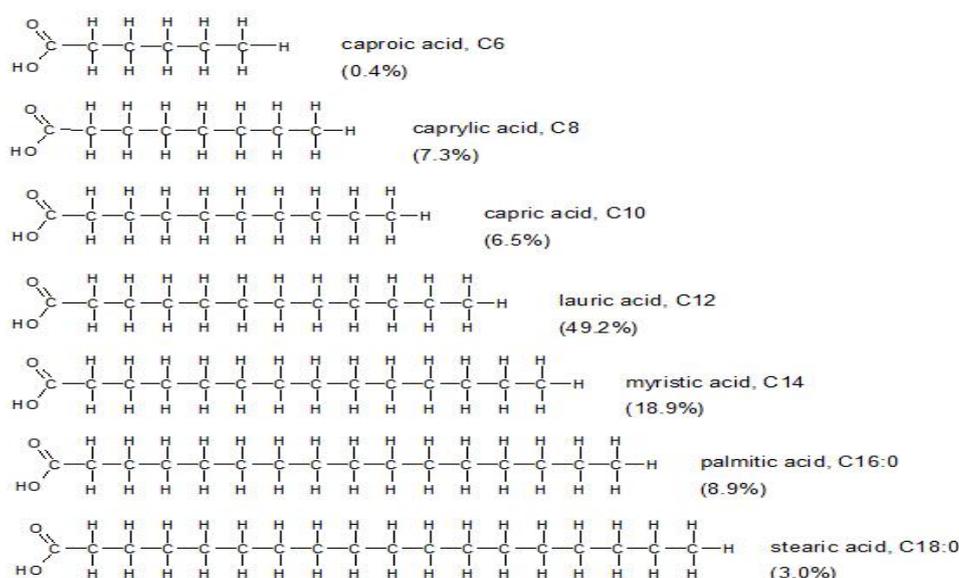
Coconut oil is the oil obtained from the *Cocos nucifera* belonging to the family Arecaceae

### 3.2 Chemical Constituents

The Coconut oil contains 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%.

### 3.3 Fatty Acid Composition of Coconut Oil

□ Fatty acid designations follow a schematic of the number of carbons in the side chain followed by the number of double bonds; a 14:2 designation is a 14 carbon chain with two double bonds.



**Figure 3: Shows Fatty Acid Composition.**

#### 4. HEALTH BENEFITS OF COCONUT OIL

##### 4.1 The Lauric Acid In Coconut Oil Can Kill Bacteria, Viruses And Fungi, Helping To Stave Off Infections

Almost 50% of the fatty acids in coconut oil is the 12-carbon Lauric Acid. When coconut oil is enzymatically digested, it also forms a monoglyceride called monolaurin. Both Lauric acid and monolaurin can kill harmful pathogens like bacteria, viruses and fungi.

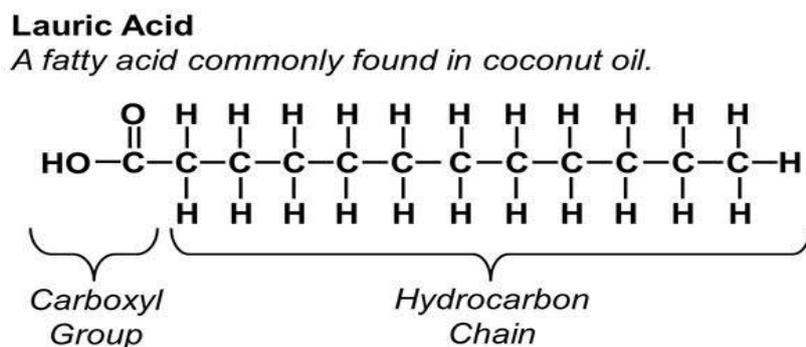


Figure 4: Shows structure of Lauric acid.

##### 4.2 The Fatty Acid In Coconut Oil Are Turned Into Ketones, Which Can Reduce Seizures

Coconut oil can help with epilepsy in several ways. Coconut oil is rich and medium chain fatty acids, on research says it is helpful in preventing seizures in epilepsy with much lower side effects as compared to prescription drugs. Coconut oil is great anti-inflammatory and thus can help with brain inflammation caused by epileptic seizures. Coconut oil is known to improve general brain health too and prevent gastrointestinal tract from side effects of drugs used in the treatment.

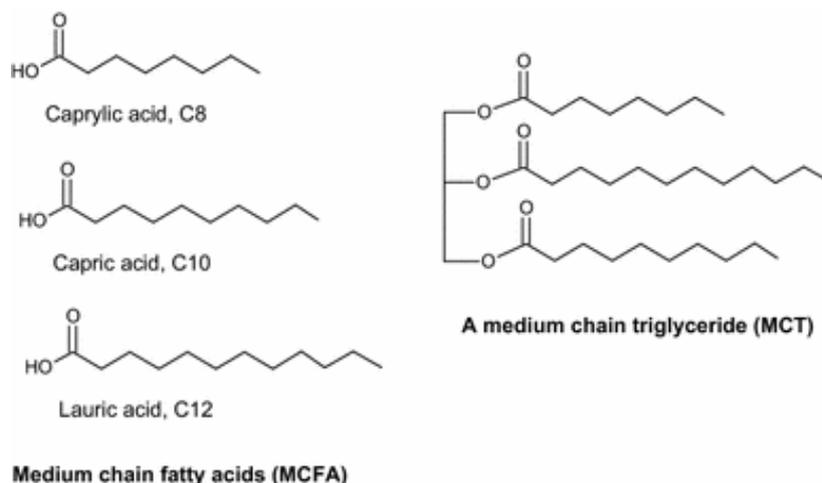
##### Precautions

- There are certain things to be kept in mind before taking up your dose of coconut oil.
- Allergic conditions towards the oil must be noted in order to avoid any complication.
- Pregnant and lactating women must stick to fewer amounts as it is not a condition where you can take risks.

##### 4.3 Coconut Oil Contains A Unique Combination Of Fatty Acids With Powerful Medicinal Properties

Coconut oil doesn't contain your average run-of-the-mill saturated fats like you would find in cheese or steak. No, they contain so-called Medium Chain Triglycerides (MCTs) – which are

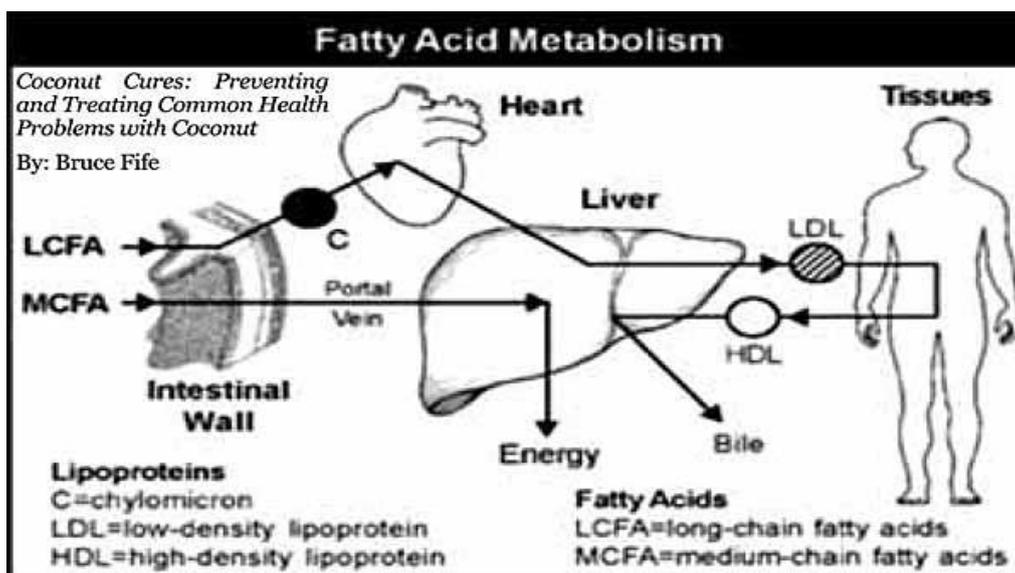
fatty acids of a medium length. Most of the fatty acids in the diet are so-called long-chain fatty acids, but the medium-chain fatty acids in coconut oil are metabolized differently. They go straight to the liver from the digestive tract, where they are used as quick source energy or turned into so-called ketone bodies, which can have therapeutic effects on brain disorders like epilepsy.



**Figure 5: Shows Medium Chain Fatty Acids.**

#### 4.4 Coconut Oil Can Improve Blood Cholesterol Levels and May Lower Your Risk of Heart Disease

Coconut oil reduces triglycerides, total and LDL cholesterol increases HDL and improves blood coagulation factors and antioxidant status. This improvement in cardiovascular risk factors should theoretically lead to a reduced risk of heart disease over the long term.



**Figure 6: Shows Fatty Acid Metabolism.**

#### **4.5 Coconut Oil Can Increase Your Energy Expenditure, Helping You Burn More Fat**

The medium chain triglycerides (MCTs) in coconut oil can increase energy expenditure compared to the same amount of calories from longer chain fats. One study found that 15-30 grams of MCTs per day increased 24 hour energy expenditure by 5%, totaling about 120 calories per day.

#### **4.6 Coconut Oil Can Kill Your Hunger**

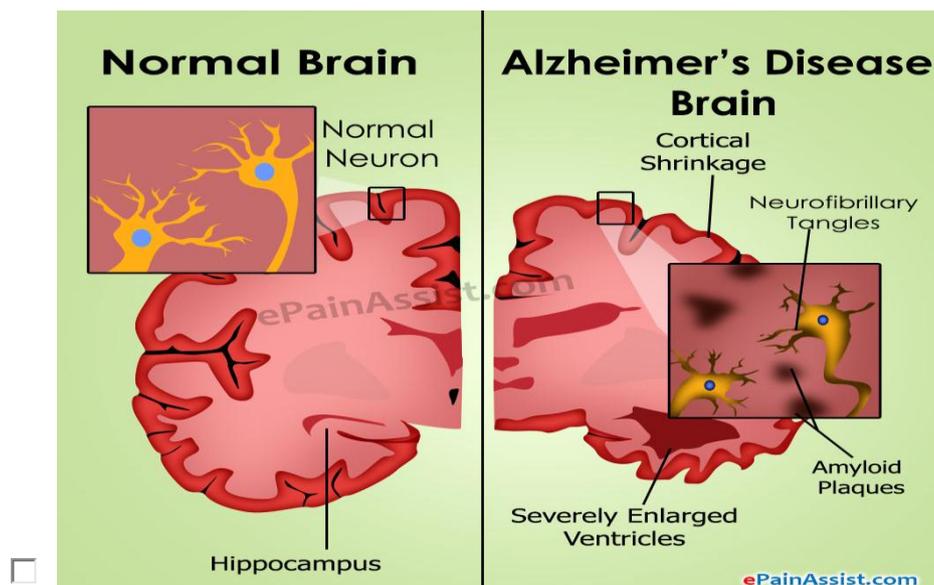
One of the interesting feature of coconut oil is that it can reduce your hunger. This may be related to the way the fatty acids in it are metabolized, because ketone bodies can have an appetite reducing effect. The findings in which varying amounts of medium and long chain triglycerides were fed to 6 healthy men, the men eating the most MCTs ate 256 fewer calories per day, on average. Another study involving 14 healthy men discovered that those who ate the most MCTs at breakfast ate significantly fewer calories at lunch. These studies were small and only done for a short period of time. If this effect were to persist over the long term, it could have a dramatic influence on body weight over a period of several years. The fatty acids in coconut oil can significantly reduce appetite.

#### **4.7 Coconut Oil Can Protect Hair Against Damage, Moisturize Skin And Function As A Sunscreen**

Coconut oil can improve the moisture and lipid content of the skin. Coconut oil can also be very protective against hair damage and one study shows effectiveness as sunscreen, blocking about 20% of the sun's ultraviolet rays. Coconut oil can be applied topically as well, studies showing it to be effective as a skin moisturizer and protecting against hair damage. It can also be used as mild form of sunscreen and as a mouthwash.

#### **4.8 Coconut Oil Can Boost Brain Function In Alzheimer's Patients**

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 researchers have speculated that ketones can provide an alternative energy source for these malfunctioning cells and reduce symptoms of Alzheimer's disease. Consumption of medium chain triglycerides led to immediate improvement in brain function in patients with milder forms of Alzheimer's disease. 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.



**Figure 7: Shows Alzheimer's Disease.**

#### 4.9 Coconut Oil Can Help You Lose Fat

Given that coconut oil can reduce appetite and increase fat burning, it makes sense that it can also help you lose weight. Coconut oil appears to be especially effective in reducing abdominal fat, which lodges in the abdominal cavity and around organs. This is the most dangerous fat of all and is highly associated with many Western diseases. Waist circumference is easily measured and is a great marker for the amount of fat in the abdominal cavity.

#### 4.10 Antioxidant Property of Coconut Oil

Coconut oil which has great anti-oxidant properties. One capable of preventing other medical complications that manifest as a result of the oxidative stress. It contains polyphenols and phenolic acids that have great anti-oxidative properties. Coconut oil increases levels of antioxidant enzymes like glutathione that significantly reduced oxidative stress in the kidney, liver, and heart.

#### 4.11 Coconut Oil For Piles

Hemorrhoids are swollen veins in the anus and lower rectum. They are fairly common and can cause symptoms like itching, bleeding, and discomfort. Coconut oil has numerous properties and health benefits that can help treat hemorrhoids. It has strong anti-inflammatory properties. The oil's powerful analgesic (or pain-relieving) properties can help to reduce discomfort caused by the hemorrhoids, while its antibacterial properties allow the hemorrhoids to heal faster. Coconut oil may also aid in relieving constipation thanks to a

laxative effect. Since constipation or straining during bowel movements is a common cause of hemorrhoids, this can help to treat and prevent them.

#### **4.12 Coconut Oil For Pain**

In an acetic-acid, formalin, and hot plate pain tests coconut oil (either fermented or regular) exert dose-dependent pain-reducing effects.

### **5. Inflammation and Immunology**

One study using *in vivo* inflammation tests in rats noted that while coconut oil ingestion exerted anti-inflammatory effects in an acute inflammation model (carrageenan-induced paw edema) it failed to have any significant effect chronically (cotton-pellet-induced granuloma test).

A rat study assessing IL-6 release from adipocytes (basal or epinephrine stimulated) comparing coconut oil against both sunflower oil and olive oil noted that ingestion of coconut oil and olive oil were not associated with an epinephrine-induced increase in IL-6 (although coconut oil was consistently higher than olive oil) while sunflower oil was low initially and increased IL-6 secretion in response to epinephrine. These localized anti-inflammatory effects may be related to the one human study noting a reduction in waist circumference independent of overall weight changes with coconut oil, as waist circumference is related to low-grade chronic inflammation. A human study assessing serum IL-8 after a test meal noted that while fish oil and linseed had differential effects, that cakes enriched with coconut oil had no significant effect. Ingestion of coconut oil, relative to other dietary fatty acids, may be associated with anti-inflammatory effects although they do not appear to be of remarkable magnitude.

### **6. Coconut Oil Can Protect Organ Function**

Coconut oil may help to clear up and heal urinary (UTI) and kidney infections. The MCT's in the oil work as a natural antibiotic by disrupting the lipid coating on bacteria and killing them. A 2014 study showed that Virgin coconut oil protects against liver damage. At least in Albino rats.

## 6.1 Interactions with Organ System

### • ORAL CAVITY

Decoction obtained from coconut tree roots appear to have traditional usage as mouthwash or gargle, which may be related to the low toxicity in general and potential anti-infective properties secondary to lauric acid. Coconut (husk fiber) has demonstrated anti-bacterial properties against various strains of oral bacteria which may be related to the glycolipid sucrose monolaurate, which has been noted to reduce oxidative of *Streptococcus* mutants at 0.05% and reduced dental plaque in vitro and has shown these properties in a human study (although to a lesser degree of efficacy) using coconut soap on dentures, where there were protective effects against denture stomatitis. The husk fiber of coconut appears to have anti-bacterial effects in the oral cavity; the oil component may (demonstrated elsewhere) although usage in the oral cavity is not common which may be related to the fiber being chewed and oil ingested. Another application is using it like mouthwash in a process called oil pulling, which can kill some of the harmful bacteria in the mouth, improve dental health and reduce bad breath.



Figure 8: Shows Oil Pulling.

### • Liver

In response to paracetamol-induced liver injury, 10mL/kg of coconut oil was able to outright reverse the increase in liver weight induced by paracetamol (the reference drug, Silymarin

from milk thistle at 100mg/kg, was also effective) while 1-5mL/kg were wholly ineffective; similar changes were noted in serum liver enzymes and histopathological analysis of the liver. This may be independent of anti-oxidant induction, as dietary ingestion of 15% coconut oil in rats for 8 weeks has failed to show such an antioxidative effect. Coconut oil appears to down regulate hepatic lipogenesis in rats after 45 days of 8% dietary inclusion which coincided with reduced activity of HMG-CoA and more activity of lipoprotein lipase (LPL). This decrease in LPL has been noted with coconut water (although the reduction in HMG-CoA was absent) whereas the water portion appears to be associated with increased HMG-CoA reductase activity but increased bile acid efflux, resulting in a net hypocholesterolemic effect and in fat-fed rats 40mL/kg bodyweight is comparable to 0.1mg/kg Lovastatin for cholesterol reduction. The oil may have protective effects at higher doses (preliminary evidence) while in rats some beneficial effects on lipid synthesis and degradation (less synthesis, more degradation) are noted with chronic ingestion of both coconut oil and water.

## 7. Interactions with Aesthetics

- **Hair**

Coconut oil appears to be a traditionally applied hair remedy in India alongside amla oil and mustard oil.

It is known to penetrate hair follicles when directly applied and appears to be more protective of physical damage (from combing techniques *in vitro*) relative to both mineral oil and sunflower oil as assessed by protein losses and when applied directly to hairs; these protective effects were noted on normal and bleached by not boiled hair follicles and was more protective when applied prior to the stressor rather than after and have been confirmed in humans as assessed by the hair breakage index (HBI) where coconut oil for 16 weeks was associated with less physical hair damage. Studies that are conducted on isolated hair follicles or strands note increased moisture resorption with coconut oil relative to mineral oil secondary to reducing moisture loss which may be related to an oil coating of the hair. In usage of coconut oil as a shampoo, it does not appear to have any ocular irritant properties (in case shampoo reaches the eye).

- **Skin**

A topical irritation assessment noted that, of 480 persons with active skin diseases, only 5 persons (0.9%) appeared to have a response to coconut oil (15 $\mu$ L of a 5% potassium cocoate solution applied via patch) and in 12 persons known to have an allergic response to cocamido

propyl betaine a 100% solution of coconut oil failed to exert an allergic reaction. This lack of effect has been noted in animal studies, and elsewhere in humans where both isolated lauric acid and coconut oil were not associated with significant allerginity in persons confirmed to be allergic to coamidopropyl betaine. There appears to be low allergenicity and immune reactivity of coconut oil and its components when topically applied to the skin, suggesting it can be useful for those with sensitive or reactive skin.

In persons with xerosis (dry and itchy skin) which is normally treated with moisturizers, coconut oil applied topically was as effective as the active control of mineral oil in reducing symptoms of skin dryness moisturizing effects has been noted in adults with atopic dermatitis to a potency greater than that of olive oil (control group for blinding purposes) with reductions in the objective-SCORAD severity index (46.8% reduction from baseline) after 5mL oil application to infected areas twice daily; for those adults that were positive for *Staphylococcus aureus* infection (readily colonizes atopic dermatitis) only 1 out of 20 remained positive after coconut oil application for 4 weeks. Coconut oil appears to have moisturizing properties on skin and may also have these effects in atopic dermatitis, where it may also have additive anti-bacterial effects.

Glycerol monolaurate (one lauric acid fatty acid bound to glycerol), sometimes referred to as Lauricidin, is as effective as a 70% isopropyl alcohol mixture (when lauricidin itself is at 1.5%) in eradicating the bacteria *Serratia marcescens* when applied to the hands *Staphylococcus aureus* in atopic dermatitis has also been reduced with coconut oil applied topically, Coconut oil, as a component of hand wash, can exert an anti-microbial property which is thought to be related to the monolaurate content.

## 8. Sexuality and Pregnancy

### • Benefits to Child

It is thought that coconut oil can promote neonatal growth in part due to topical absorption of fatty acids, and in part due to tactile kinesthetic stimulation.

In neonates given an oil massage with either coconut oil or mineral oil (with another control group) four times daily starting on the second day of life (massage given by trained professional) and continued until a month of life (continued up until this point by mother), the coconut oil group appeared to be associated with increased infant weight and length gain

relative to the controls. Neurobehavioural outcomes were unaffected by either coconut oil or mineral oil.

Massages of coconut oil to the newborn appear to have preliminary evidence to suggest improved weight gain.

## 9. NUTRIENT NUTRIENT INTERACTION

- **CLA**

Conjugated Linoleic Acid (CLA) is a fatty acid touted to reduce fat mass, but seems highly unreliable at doing so.

CLA-induced fat loss in mice is augmented when paired with coconut oil relative to being paired with soybean oil and also in mice fed fat-free diets, one other study has noted that pairing CLA with coconut oil trended to outperform coconut oil alone but this was insignificant; in isolated fat cells measuring biomarkers of lipolysis, they appear to be synergistic.

Appears to be synergistic in regards to anti-obesity effects with CLA, but due to the lack of human evidence for the combination and the known species differences with CLA these results should be taken with caution.

- **Vitamin E**

A study using topical vitamin E (succinate) noted that, with using a coconut oil product (Myritol 318; the medium chain triglycerides of coconut oil) as a base, that absorption was enhanced by approximately 50% relative to other oils tested; 61.2% of vitamin E reached solubility with Myritol 318, which was higher than walnut (43.4%), olive (42.6%), sesame (40.1%), soy (39.6%), sunflower (39.4%), safflower (36%), and canola (24%) and these trends followed for circulating levels of free tocopherol following topical administration in mice. This has been noted with another branded formulation of coconut oil MCTs (Henkel) suggesting that the MCTs per se influence absorption rather than branded products.

Medium chain triglycerides in coconut oil may enhance vitamin E topical absorption relative to other fatty acids; coconut oil has a naturally occurring Vitamin E content.

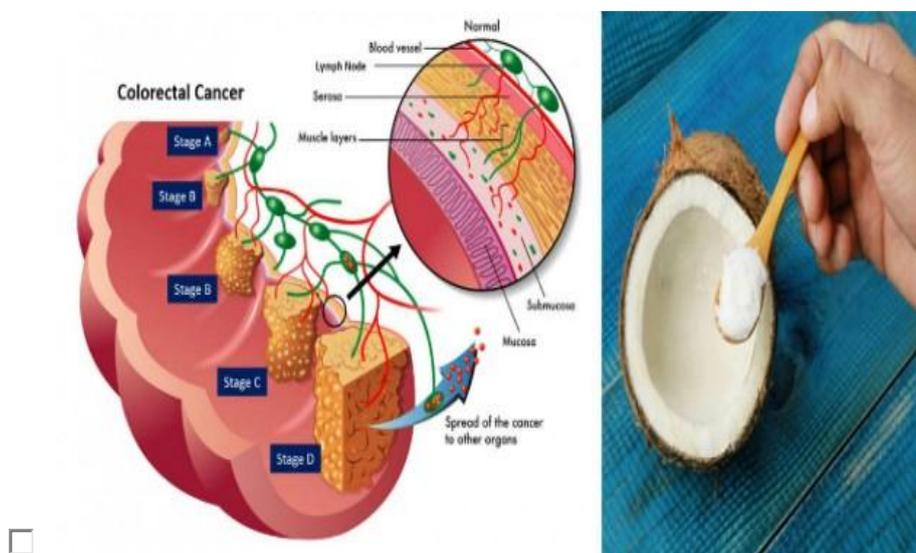
### 9. Coconut Oil Balance The Hormones

Hormone disruption can cause a litany of problems in men and women. Coconut oil can help in maintaining an important balance of hormones because the lauric acid it contains. A 2012 study conducted in the Philippines has suggested that coconut oil may be an excellent fat to consume during menopause and also may have a positive effect on estrogen levels

### 10. COCONUT OIL USED IN CANCER

This coconut oil benefit can occur in two ways:

1. When we digest coconut oil, ketones are produced. Now these ketones contain energy that the body can utilize but tumor cells can't. Tumor cells depend on glucose for energy. That's why it's believed that a ketogenic diet could be a possible component of helping cancer patients recover.
2. As the MCT's digest the lipid walls of bacteria, they also can kill a specific bacteria that has been known as increasing the risk of stomach cancer, helicobacter pylori. Even in studies where cancer is chemically induced, the introduction of coconut oil prevents cancer from developing!



**Figure 9: Shows Coconutoil in Cancer.**

### 11. COCONUT OIL CAN PREVENT INSULIN RESISTANCE

Insulin resistance is the precursor to type 2 diabetes. The term refers to when the body's cells refuse to respond to insulin and therefore, can no longer take in glucose for energy. The pancreas dutifully pumps out more insulin to compensate and creates a cycle of overproduction. The MCT's in coconut oil help balance the insulin reactions in the cells

because of ketones our bodies produce when we consume it. These ketones take off the strain on the pancreas by giving the body a consistent energy source that is not dependent on glucose reactions.

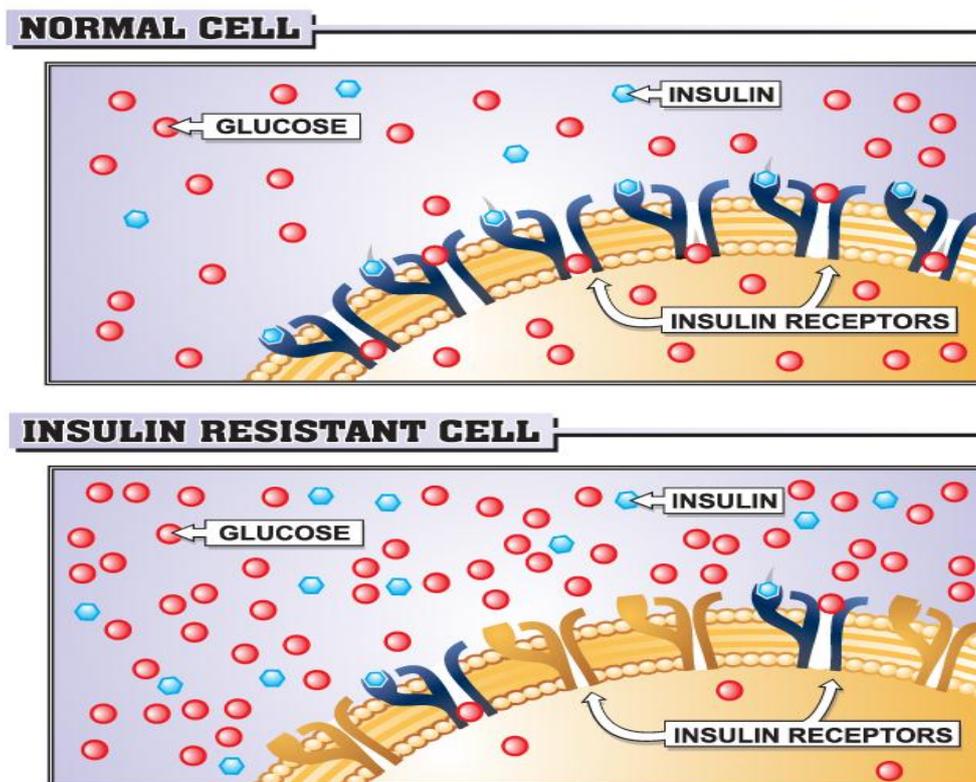


Figure 10: Shows Insulin Resistance.

## 12. COCONUT OIL IMPROVES DIGESTION

Coconut oil improves digestion by helping the body to absorb fat-soluble vitamins, calcium, and magnesium. If coconut oil is taken at the same time as omega-3 fatty acids, it can make them doubly effective. Coconut oil can also help improve bacteria and gut health by destroying bad bacteria and Candida. Candida imbalance especially can decrease stomach acid which causes inflammation and poor digestion.

## 13. COCONUT OIL GIVES YOUR PANCREAS A BREAK

The MCT's of coconut oil are super easy to digest and as such, they don't need pancreatic enzymes to be broken down. Taking coconut oil actually eases the metabolic strain on the pancreas. In fact, super fat is so easy to digest that it has been known to improve the symptoms of gallbladder disease too. You can improve gallbladder and total body health simply by replace other longchain fats with coconut oil.

#### **14. COCONUT OIL CAN HELP YOU BUILD AND MAINTAIN MUSCLE**

The MCT's in coconut oil are good for upping your body's energy expenditure and burning calories. Here's yet another way this wonder-stuff can help you look better naked. It's great for building muscle! MCTs found in coconut are also used in popular muscle building products like Muscle Milk. But many supplements use processed forms of MCT's. By eating actual coconut oil, you'll benefit from getting your MCT's in their natural and most effective form. Add 3 tablespoons of coconut oil to a muscle building shake daily.

#### **15. COCONUT OIL IMPROVE MEMORY**

The MCT's found in coconut oil improved the memory problems their older subjects were experiencing. All patients in the study saw a marked improvement in their recall ability after taking the fatty acid. It's thought that this is due to MCT's being absorbed more easily in the body. As they can be accessed in the brain without the use of insulin, they are able to more efficiently fuel brain cells.

#### **16. COCONUT OIL FOR THYROID**

Both indirect and direct benefits of coconut oil for thyroid function and health make it an outstanding supplement to any diet. It turns out that coconut oil may also nourish the thyroid for improved functioning, but it's not necessarily a replacement for your prescription thyroid medication. Coconut oil is a suitable substitute for polyunsaturated fats that may suppress the thyroid.

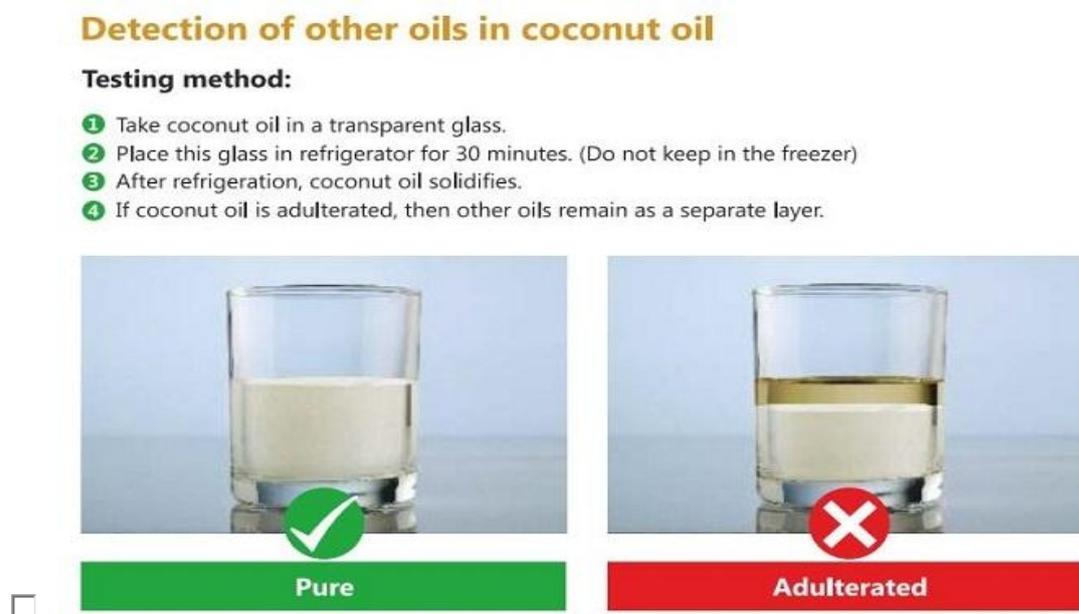
#### **17. COCONUT OIL HEALTH BENEFITS AND USES**

1. It has been shown to increase absorption of calcium and magnesium.
2. Internally as part of the protocol to help remineralize teeth.
3. Is an immediate source of energy when eaten that isn't stored as fat.
4. Can help speed weight loss when consumed daily.
5. It can help improve sleep when taken daily.
6. When used in food, it may support healthy thyroid function.
7. Some studies show that it can help improve insulin levels when consumed regularly.
8. Topically, it help skin heal faster after injury or infection because of its beneficial fats.
9. When used consistently on skin it can help get rid of cellulite.
10. Some evidence shows that the beneficial fats in coconut oil can help with depression and anxiety.
11. When taken regularly, it can boost hormone production.

12. Can relieve the pain of hemorrhoids when used topically.
13. Some studies show it can boost circulation and help those who often feel cold.
14. Internally during pregnancy to help provide baby necessary fats for development (especially when taken with Fermented Cod Liver Oil).
15. There are entire books dedicated to the potential of saturated fats like coconut oil to help avoid Alzheimer's.

### 18. ADULTERANTS IN COCONUT OIL

Use of refined coconut oil can be detected by again checking for FFA. Even the best quality coconut oil will have FFA not less than 0.4. Refining brings FFA down to 0 also. So, if the FFA is abnormally low, it means it has refined coconut oil.



**Figure 11: Shows Adulteration in Coconut oil.**

### 19. REFINED COCONUT OIL

Excess of FFA (Free Fatty Acids) in Coconut Oil can be chemically removing by neutralizing with a base, this is called refining. Coconut Oil extracted from second quality copra or that is solvent extracted from coconut oil cake is refined. This refined oil passes all the chemical parameters of food safety, but consumer is deprived of its taste, aroma and quality. We sell our coconut oil cake to a major solvent extractor in Kerala. I just asked him, were do you sell the coconut oil, he said it is finding major demand among re-packers. Re-packers buy inferior quality coconut oil and mix it with refined coconut oil to balance FFA. Surprisingly refined coconut oil is cheaper than just filtered coconut oil.

## 20. VIRGIN COCONUT OIL

Virgin coconut oil (VCO) differs from commercial coconut oil in the way it is processed. To safeguard the quality of virgin coconut oil (VCO), it is important that moisture level must be kept at the minimum. Since the process of VCO extraction involves no or little heating only if required, biologically active substances, which are normally lost during the refining process, remain intact in the oil. The presence of these biologically active substances in VCO spells the difference between RBD oil and VCO. These substances which are present in minute quantities provide nutritional and health benefits, especially in preventing or minimizing chronic diseases, apart from the protection already derived from MCFAs.

Biologically active substances naturally occur in plants. When the oil is extracted from oilseed, most of these substances are present in the oil. One of the most stable biologically active substances is the fatty acid in the triglyceride form, unless high heat and lipase enzyme are added. For methods of virgin coconut oil production that require long incubation such as the enzymatic and aging of coconut milk, intermittent mixing is needed to prevent anaerobic condition that can lead to formation of aldehydes or ketones which cause unacceptable flavor and aroma as well as react with the biologically active substances.

### 20.1 Biologically active substances

As plant product, coconut oil contains biologically active substances which have been identified to provide nutraceutical/ health benefits. Although studies may take years to probe the pharmacological effects of these substances, there is growing interest worldwide on the role of these biologically active substances to human health. Tocopherols, which are already known as antioxidants, have a role in the prevention of certain chronic diseases like coronary heart disease and cancer. Tocotrienols, said to be better antioxidant than tocopherols, are effective in treating many diseases. Phytosterols have been known to lower blood cholesterol, specifically the LDL “bad” cholesterol.

#### a. Tocopherols

Tocopherols are antioxidants that have saturated phytyl side chain. The amount of tocopherols in coconut oil is low as compared to other vegetable oils.

#### b. Tocotrienols

This biologically active substance synonymous with tocopherols is collectively called tocots. Like in tocopherols, natural tocotrienols are also present in various forms, alpha, beta, gamma

and delta tocotrienols. They differ from tocopherols in the chemical nature of the side chain. Tocopherols have a saturated phytyl side chain while tocotrienols have an unsaturated isoprenoid side chain possessing three double bonds. Their presence have been identified in coconut oil.

It has antioxidant activity. They may also have anti-atherogenic, anticarcinogenic and immunodulatory actions.

### **c. Phytosterols**

Plant sterols are plant compounds with chemical structures similar to that of cholesterol. Phytosterols help lower cholesterol levels, reduce symptoms of an enlarge prostate, improve control of blood sugar among diabetics, reduce inflammation among patients with autoimmune diseases such as rheumatoid arthritis and lupus.

### **d. Phytostanols**

They are saturated phytosterols. It has been identified to have cholesterol lowering activity. The cholesterol-lowering activity of phytostanols appears to block the absorption of dietary cholesterol and the reabsorption of endogenous cholesterol from the gastrointestinal tract via the enterohepatic route.

### **e. Flavonoids and other polyphenols**

Phenolic compounds include simple phenols, phenolic acids, hydroxycinnamic acid and its derivatives, and flavonoids. The most biologically active phenolic substances are thought to be the flavonoids, the proanto-and-cyanins, and the catechins.

Flavonoids is focused on their roles or potential beneficial effects on human health as antiviral, anti-allergic, antiplatelet, anti-inflammatory, antitumor, and antioxidant activities.

### **f. Phospholipids**

Phospholipids, the second major class of lipids besides triglycerides found in all life forms, are the prime building blocks of life known for its emulsifying and wetting properties to ensure proper digestion and absorption of fatty foods. One of the most common phosphatides is lecithin commonly found in the brain, lung, and spleen.

## CONCLUSION

Coconut oil is consumed in tropical countries for thousands of years. Studies done on native diets high in coconut oil consumption show that this population is generally in good health. Coconut oil has a long shelf life and is used in baking industries, processed foods, infant formulas, pharmaceuticals, cosmetics and as hair oil. The oil contains 92% of saturates consisting of medium chain fatty acids in the form of triglycerides, and about 8% of unsaturates consisting of oleic and linoleic acids as triglycerides. The oil has a small amount of unsaponifiable matter (< 0.5%), is colourless and has a odour typical of the coconuts. The oil has small amounts of tocopherols and tocotrienols and phytosterols. The oil is known to have antiviral and antibacterial effects and excellent healing properties. It gets easily absorbed in the body and is a nature mimic of the human breast milk fat and hence used in infant formulae. With all these good quality attributes, the side effects of the oil has also been reported especially in cardiovascular diseases due to the presence of less of unsaturated fatty acids in the triglycerides of the oil. It is hypothesized that due to lower amount of PUFA, there is a possibility of atherogenicity development during long term usage of the oil. However, more research is needed to clearly understand the many good effects of the oil.

## REFERENCES

1. DebMandal M, Mandal S. Coconut (*Cocos nucifera* L.: Areaceae): in health promotion and disease prevention. *Asian Pac J Trop Med.*, 2011.
2. Assunção ML, et al. Effects of dietary coconut oil on the biochemical and anthropometric profiles of women presenting abdominal obesity. *Lipids*, 2009.
3. Poppitt SD, et al. Fatty acid chain length, postprandial satiety and food intake in lean men. *Physiol Behav*, 2010.
4. Zakaria ZA, et al. In vivo antinociceptive and anti-inflammatory activities of dried and fermented processed virgin coconut oil. *Med Princ Pract*, 2011.
5. Ackermann D, et al. Waist circumference is positively correlated with markers of inflammation and negatively with adiponectin in women with metabolic syndrome. *Nutr Res.*, 2011.
6. Myhrstad MC, et al. Effect of the fat composition of a single high-fat meal on inflammatory markers in healthy young women. *Br J Nutr.*, 2011.
7. Antimicrobial Effect of Coconut Flour on Oral Microflora: An in vitro Study.
8. Alviano WS, 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.

9. Barnabé W, et al. Efficacy of sodium hypochlorite and coconut soap used as disinfecting agents in the reduction of denture stomatitis, *Streptococcus mutans* and *Candida albicans*. *J Oral Rehabil*, 2004.
10. Gode V, et al. Quantitative measurement of the penetration of coconut oil into human hair using radiolabeled coconut oil. *J Cosmet Sci.*, 2012.
11. Rele AS, Mohile RB. Effect of mineral oil, sunflower oil, and coconut oil on prevention of hair damage. *J Cosmet Sci.*, 2003.
12. Hargrave KM, et al. Influence of dietary conjugated linoleic Acid and fat source on body fat and apoptosis in mice. *Obes Res.*, 2004.
13. Hargrave KM, Azain MJ, Miner JL. Dietary coconut oil increases conjugated linoleic acid-induced body fat loss in mice independent of essential fatty acid deficiency. *Biochim Biophys Acta*, 2005.
14. Ippagunta S, et al. Dietary conjugated linoleic acid induces lipolysis in adipose tissue of coconut oil-fed mice but not soy oil-fed mice. *Lipids.*, 2011.
15. Trevithick JR, Mitton KP. Uptake of vitamin E succinate by the skin, conversion to free vitamin E, and transport to internal organs. *Biochem Mol Biol Int.*, 1999.
16. Trevithick JR, Mitton KP. Topical application and uptake of vitamin E acetate by the skin and conversion to free vitamin E. *Biochem Mol Biol Int.*, 1993.
17. Babayan, V.K. and John R. Rosenau. Medium Chain Triglyceride Cheese. *Food Technology*, February, 1991; 111 to 114.