



Health benefits of coconut oil, coconut sugar and coconut water consumption R&D updates

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In Sri Lanka, coconut groves are mentioned in early inscriptions as well as in literary works dating to about the 2nd century AD and that its nuts were eaten when tender. However no mention is made of the use of coconut oil ⁽¹⁾.

When looking at health benefits of a substance, *in-vitro* studies involving isolated cells or tissues in the laboratory may give some idea of the basic mechanisms involved. While animal studies are easy to perform under controlled conditions, the final answer lies in human studies. When trying to look for the effect of a food substance on our health, the proof of the pudding as they say is in the eating! Epidemiological studies involving a well defined population are a time tested method. These can be either retrospective- looking back

or better still prospective – following a group over a long period of time. Another method is interventional study in the form of a controlled clinical trial – feeding a test food which can be short term or long term. Such studies need to be planned with extreme care as clinicians are very skeptical and will make every effort to find fault in study design to criticize findings that are not in consonance with generally accepted views.

Sound incontrovertible evidence to prove the efficacy of such claims is in most cases lacking. Such claims are based on the chemical compounds present in the form of a controlled clinical trial. Coconut oil (CO) or their derivatives following digestion and absorption. Coconut oil contains 96.5% fat with about 0.42% protein and 0.56% carbohydrate. Small amounts of phospholipids

and antioxidants in the form of polyphenolic compounds are also found. Many of the health benefits of CO are attributed to the fatty acid composition of the fat in CO. Over 90% of the fat in coconut oil is saturated. What most people still do not know is that though saturated, medium chain triglycerides (MCTs) account for two thirds of the fat in CO. These MCTs containing predominantly lauric, capric and caprylic acids are handled differently by the body when compared to long chain saturated fatty acid containing triglycerides (LCTs) derived from animal fats. MCTs do not require bile salts for their digestion and monoglycerides and medium chain fatty acids (MCFAs) derived from digestion of MCTs in coconut oil are absorbed intact across the intestinal barrier, enter the portal vein and pass directly to the liver. This allows for much quicker absorption and utilization of fatty acids derived from MCTs compared to LCTs. MCFAs are easily oxidized lipids and are not stored in adipose tissue unlike long chain fatty acids (LCFAs). Oxidation of MCTs provides 8.3 calories per gram, while LCTs provides 9.2 calories per gram. The predominant fatty acid in CO is lauric acid. Interestingly, large amounts of Lauric acid are found in human breast milk and in the secretion from the glands in the skin.

Coconut Oil and Heart Disease

The various pathological mechanism that have been proposed as possible contributors in the development of Atherosclerosis and Ischaemic heart disease(IHD) leading to heart attacks are the result of a block in an artery supplying blood to the heart muscle and is thought to result from a combination of cholesterol plaque formation related to elevated bad cholesterol fractions (LDL) in the blood, inflammation of the arterial wall or thrombogenesis resulting in the formation of a clot at the site. CO or substances contained in it are now thought to influence all of these. We should no longer have too many hang ups about concentrating on what happens to only cholesterol when consuming a dietary substance in relation to I.H.D.

Coconut Oil Fuels Your Metabolism

We tend to think that eating too much fat is associated with obesity. Obesity, Type 2 diabetes and Metabolic Syndrome are on the rise in South Asian countries where coconut oil is a major component of the diet. Medium chain tryglyceride (MCT) oils composed entirely of caprylic (75%) and capric acids (25%) are widely used in sports nutrition to reduce and control weight and increase performance, in intravenous formulas and in infant formulas. Both animal and human trials have suggested a greater satiating effect of MCTs compared with LCTs⁽²⁾. But the problem with all of them is that the synthetic MCTs used contained predominantly caprylic and capric acids while CO has mainly lauric. Thus one cannot conclusively say CO fuels our metabolism and

helps combat obesity. If this is so, is CO less likely to cause obesity? A small (20 subjects) short term 4 week Malaysian study showed that VCO in a dose of 30 ml/day had a beneficial effect in reduction of waist circumference especially in males without any deleterious effect to the lipid profile⁽³⁾. Waist circumference is an accepted clinical measure of overweight and obesity particularly the abdominal obesity common in South Asian populations. Interestingly, previous studies have also shown that women respond less readily to MCTs feeding than men.

Antibacterial and Anti-inflammatory Actions of Coconut Oil

Monolaurin derived from the digestion of coconut fat is thought to be an antiviral, antibacterial, and antiprotozoal monoglyceride used by the humans or animals to destroy lipid coated viruses such as HIV, herpes, cytomegalovirus, influenza, various pathogenic bacteria including *Listeria monocytogenes* and *Helicobacter pylori*, and protozoa such as *giardia lamblia*. This may account for the presence of lauric acid containing MCTs in CO as well as in human breast milk and sebum. Some studies have also been done using coconut oil but for those interested I would like to refer to an excellent review by DebMandal & Mandal⁽⁴⁾. In a very recent *in-vitro* study VCO itself did not inhibit the growth of *Clostridium difficile* leading cause of hospital-acquired antibiotic-associated diarrhea worldwide, but lipolysed C.O., and MCFAs most powerfully lauric acid killed the *C. difficile*⁽⁵⁾. This study does not necessarily rule out the possibility of CO or VCO acting *in vivo* as an antibacterial agent.

In a review we have speculated as to whether the low incidence of *H. pylori* infection in Sri Lanka compared to that in other South Asian countries may be linked to the fact that the main fat in the Sri Lankan diet is coconut and that monolaurin and lauric acid released by pre-gastric lipase is responsible⁽⁶⁾.

Anti-ulcerogenic Action of Coconut Oil

In one small study, coconut milk in a dose of 2ml/ day daily was able to produce a 54% reduction in the mean area of indomethacin induced ulcers in rats, whereas coconut water produced only a 39% reduction. The response to CO was comparable to sucralfate a conventional cytoprotective agent⁽⁷⁾. Based on this finding one could argue that the prevalence of gastric ulcer could be expected to be lower in a country like Sri Lanka where coconut milk forms a major part of the daily diet. No studies are available to either support or refute this argument.

Coconut Oil in Arthritis

It has been claimed that Rheumatoid Arthritis (RA), the type associated with inflammation may result from an overactive immune system and that the antibacterial



and anti viral actions of CO or more particularly VCO may help in the treatment of RA. No clinical trials have been done.

Adjuvant induced arthritic experimental model has been used extensively for studying immunoinflammatory processes of arthritic diseases in humans, in particular RA, as well as for screening and testing novel anti-arthritic agents. A recent study showed that the inhibitory effect of polyphenolic extract from VCO was better than that of standard drug indomethacin⁽⁸⁾. It is unclear what the equivalent quantity of VCO is and whether giving VCO itself will produce the same result firstly in the rat and then whether it is worth doing clinical trials.

Coconut Oil in Alzheimer's Disease

Recent anecdotal evidence has touted the use of VCO as having major benefits in lessening the cognitive deficits associated with Alzheimer's disease (AD). This is one area which has led to a booming popularity in the use of coconut oil following the appearance of the YouTube(R) video. Unfortunately, there are neither clinical trials to date nor are there animal studies. However, there is evidence to suggest that MCTs may be beneficial in AD. The brain cells of patients with AD have been shown to be unable to use glucose as their energy source. The only other available energy option for brain cells is ketone bodies which are normally available only in the fasting state. Medium chain triglycerides when metabolized by the liver yield ketone bodies. A small clinical trial of a synthetic MCT caprylidene "Axona" consisting of capric acid derived from coconut or palm kernel oil has been shown to significantly improve cognitive function in AD patients⁽⁹⁾. This preparation is expensive and has led to people switching to CO or VCO but these have mainly lauric acid with caprylic and capric acid comprising only 21%. No studies have been done using lauric acid. In 2014, one group reported that CO attenuates the effect of β -amyloid on cortical neurons and improves cell survival *in vitro*⁽¹⁰⁾. β -amyloid is thought to be the toxic agent in AD. Another study in rats by Maric *et al* showed that the amount and type of fat consumed affected the inflammatory response in the brain with a high fat diet containing coconut showing

the best anti-inflammatory response⁽¹¹⁾. One cannot directly conclude that this action is due to the MCTs in VCO as there are reports of studies that suggest that dietary polyphenolics may benefit Alzheimer's disease by modulating multiple disease-modifying modalities, both β -amyloid-dependent and independent mechanisms⁽¹²⁾. We are still waiting for a well controlled clinical trial of coconut oil in the treatment of A.D.

Ketogenic diets and MCTs have also been known to be of benefit in intractable epilepsy. The main component of such diets is caprylic acid. There are, however, no reports on the use of coconut oil treatment in chronic epilepsy.

Coconut Oil Fights Cancer

Many people claim that consuming CO or more particularly VCO help reduce the incidence of cancer. This is based on two main lines of thinking. The first is that the major fatty acid in coconut, lauric acid and its derivative monolaurin are bactericidal and by this action spare the body's immune system to enable it to cope better in cancer surveillance. The second argument is that coconut contains phenolic anti oxidants which can protect against cancer. However, there are no epidemiological studies that link an observed difference in prevalence of any specific cancer type to consumption of CO.

An animal study at the University of Tennessee in Knoxville observed a protective effect of coconut oil of the liver from alcohol injury. Rats were fed diets containing 10% coconut oil or corn oil for 120 days. Compared to the corn oil group, the coconut oil group exhibited significantly higher blood ethanol concentration, longer half life of ethanol, and lower rates of ethanol elimination. Plasma carnitine levels were also higher in the coconut oil group. Authors concluded that coconut oil protects liver from alcohol injury by retarding ethanol metabolism, and carnitine may be involved⁽¹³⁾.

The Exquisite Taste of Coconut

We all know that one thing that attracts tourists to our part of the world are the culinary delights many of which contain coconut which confers an exquisite taste to the foods made with it. Until recently only five basic tastes were recognized. Namely five basic tastes: sweetness, sourness, saltiness, bitterness, and umami or glutamate tastes. Fat has been identified as a basic quality sporadically over time, most notably by Aristotle. It is only now that evidence is emerging from animal and human studies to suggest that a sixth fatty acid taste is also present in the mouth cavity for the oral detection of fat. Given fat's prominence in foods, its numerous physiological roles, and its potential threats to health, this is not surprising. It is thought that the sensation of fat taste is due to free fatty acids and there is debate as to whether these can be released in the mouth in

adequate concentrations by an enzyme lingual lipase or have to be present in the free form in the food and also as to which fatty acids are the most powerful. In a small study published in 2013, participants chewed fixed amounts of almonds, coconut, walnuts, almond butter, and olive oil (stimuli that vary in physical state and fatty acid composition) for 1 min at the rate of 1 bite/s and expectorated. They showed that based on their previous electro-physiological studies, the concentrations of free fatty acids generated were sufficient to initiate taste signals were present in the oral cavity and that in the case of coconut the main free fatty acid was lauric acid⁽¹⁴⁾. The unique taste of coconut is, however, likely to be a complex process involving taste, smell, genetic and even acquired characteristics.

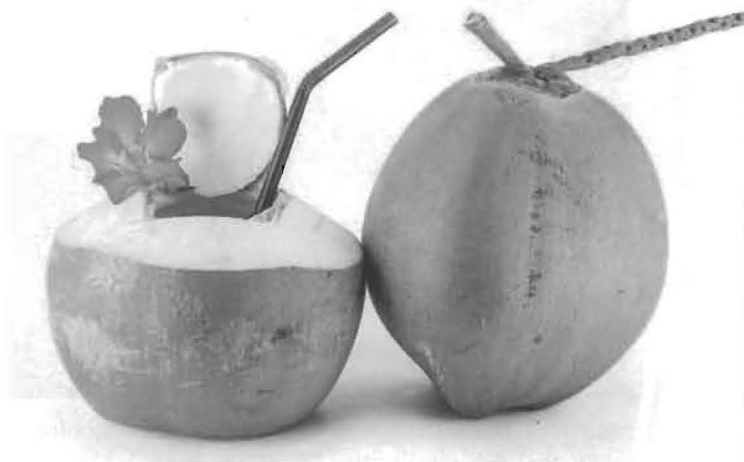
How Safe is it to Reuse Coconut Oil in Deep Frying?

Research over the last 10 years has shown that the fatty acid-derived toxin 4-hydroxy-trans-2-nonenal (HNE) – “trans fat” accumulates in high amounts in polyunsaturated vegetable oils that have been reheated or used for long periods of time. Once absorbed in the body, these Trans fats reacts with DNA, RNA and proteins affecting basic cellular processes and are thought to be associated with increased risks of cardiovascular disease, stroke, Parkinson's disease, Alzheimer's disease, Huntington's disease, various liver disorders and cancer. Thus on a teleological basis it is argued that coconut oil containing over 90% saturated fatty acids are more stable and unlikely to generate trans fats. While this is so, reheating may affect other constituents of CO. An animal study has shown that reheating results in loss of antioxidant activity in rats fed reheated oil and that this can cause a genotoxic and pre-neoplastic changes in the liver.⁽¹⁵⁾ This study calls in to question the common practice of reuse of CO & VCO. More work needs to be done on the effects of exposure of CO and VCO to high temperatures and the possible effects of reused oil on health in humans.

Coconut Water

Coconut water (CW) has long been known as a thirst quencher and is now gaining popularity in the west. The biochemical profile of coconut water varies as the coconuts mature. Reductions in the concentration of potassium, calcium, magnesium, chloride, osmolarity, an increase in the concentration of fructose and glucose, and a reduction in the concentration of sucrose have all been reported. If the shell is not damaged the contents are sterile and the osmolarity similar to that of human plasma so it can be directly infused as an intravenous replacement fluid taking due care of its high potassium content.

Numerous medicinal properties of tender coconut water (TCW) have been reported, including its ability



to dissolve kidney stones, as an antidote for mineral poisoning etc. Recent studies with TCW indicated it is a rich source of cardio-protective factors such as L-arginine, magnesium, potassium, calcium and vitamin C. Claims have been made that these substances may be responsible for beneficial effects.

As far back as 2003, TCW was shown to protect against carbon tetrachloride induced liver damage in female rats. The authors attributed this to the antioxidant activity of TCW⁽¹⁶⁾. The same group from Kerala, showed that TCW has lipid lowering effect similar to the drug lovastatin in rats fed fat-cholesterol enriched diet⁽¹⁷⁾.

Antioxidant and antithrombotic activity of TCW⁽¹⁸⁾.

In a 2012 study it was shown that in male fructose fed hypertensive rats, TCW could prevent and reverse high blood pressure by inhibiting lipid peroxidation, up regulation of antioxidant status and improving insulin sensitivity⁽¹⁹⁾. A Brazilian study has confirmed that the antioxidant potential of coconut water from four varieties (green dwarf, yellow dwarf, red dwarf and yellow Malaysian) was efficient in protecting against oxidative damages induced by hydrogen peroxide in cell culture and they attributed it to phenolic compounds and ascorbic acid⁽²⁰⁾. Tender coconut water has also been shown to inhibit stone formation and protect against impaired renal function and development of oxidative stress in the kidneys of male rats treated with ethylene glycol⁽²¹⁾. In Alloxan induced diabetic rats, mature coconut water (MCW) significantly attenuated hyperglycemia and oxidative stress⁽²²⁾. Once again the problem is that such small animal studies have not led to clinical studies aimed at confirming these claims in a human situation.

Coconut Sugar

Coconut palm sugar (CPS) is produced from the



nectar of coconut flower buds is a caramel-colored sugar that has similarities to brown sugar. The main carbohydrate in CPS is sucrose and The Phillipine food and Nutrition Institute Study reported on their website, a small study that the Glycemic index of CPS was 35 compared to a value of 60 for table sugar. Such a very low value and is questionable due to the fact that the sucrose content of CPS is similar to that of unrefined cane sugar, and the authors have suggested that a long term interventional study be done to validate this result. (23)

Coconut sugar contains a fiber called Inulin, which may slow glucose absorption and explain why CPS has a lower glycemic index than regular table sugar even though the sucrose content is not much different in the two.

According to the Phillipine Department of Agriculture, coconut sugar contains several nutrients, most notable of these are the minerals Iron, Zinc, Calcium and Potassium, along with some short chain fatty acids, polyphenols and antioxidants that may also provide some health benefits (24). However, there is no published evidence to substantiate any of these claims.

Thus coconut oil is the oil for all ailments. When taken in moderation CO is probably not harmful and may well have some health benefits but much work needs to be done to prove its clinical efficacy. ■

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