Hygeia.J.D.Med. October 2015 –March 2016 ISSN 2229 3590
Hygeia:: journal for drugs and medicines
October 2015
Open Access www.hygeiajournal.com
Research article section: Medicinal Natural Products
A Half Yearly Scientific, International, Open Access Journal for Drugs and Medicines
DOI:10.15254/H.J.D.Med.7.2015.149 Review Article

COCONUT OIL – A REVIEW OF POTENTIAL APPLICATIONS

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Key words: coconut oil, Applications

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Received: 14 April 2015,
Revised: 30 May 2015,
Accepted: 25 July 2015,
Available online: 8 October 2015

ABSTRACT

Coconut oil is an edible oil obtained from the kernel of harvested mature coconuts of the coconut palm .In recent years this oil has attained superstardom in the health food world. Celebrities are adopting its use, nutritionists advocating it, and patients acclaiming its many virtues. A number of health benefits have been attributed to this oil. These include benefits in skin care, hair care, stress relief, weight loss and cholesterol level maintenance, immunomodulatory effects, cardiovascular uses, and more recently in Alzheimer's disease .However for several years, coconut oil was demonized and consumers were made to believe that coconut oil is deleterious to health as it would block the arteries and cause heart disease. The tide has turned and in recent times recognition of the positive health effects of coconut oils have emerged stronger. The use of coconut oil, especially virgin coconut oil is in vogue, though some people still remain skeptical. This article attempts to scientifically review the therapeutic benefits of this oil.

1. INTRODUCTION

For thousands of years tropical countries have used coconut from the tree *Cocos nucifera*, Family Aracaceae (*palm* family) as an integral part of their diet and livelihood. Known as "*kalpa vriksha*", in Sanskrit, this interprets as the palm which supplies all the necessities of life. The coconut is known as "*pokok seribu guna*" in Malaysia, translating as a tree of a thousand uses. In Philippines, it is commonly known as the "Tree of Life". All parts of the coconut palm are useful, with significant economic value[1, 2]. *Coconut oil* or *Copra oil* is an edible oil extracted from the kernel of mature coconuts of the coconut palm[3]. In recent years this oil has attained superstardom in the health food world. Celebrities are adopting its use, nutritionists advocating it, and patients acclaiming its many virtues. Yet, despite the growing popularity, some people are skeptical. Its many health benefits sounds too good to be true.

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Hygeia journal for drugs and medicines, 2229 3590
Researcher id: J-6280-2015

Health care professionals and physicians have exhibited reluctance to use coconut oil as a health food. Saturated fats have been condemned for so many years, that they find it hard to change their opinions even when faced with evidence to the contrary. The newest high-value product, which is becoming a by-word in coconut producing countries is Virgin Coconut Oil (VCO). There is no industry standard definition for "virgin coconut oil" as there is in the olive oil industry for "virgin" and "extra virgin" olive oil. Natural or mechanical means are used to obtain the oil. Heat may or may not be used for extraction. The oil is not subject to chemical refining, bleaching or de-odorising so that the nature of the oil remains unaltered, and further processing is not required for human consumption[4]. VCO, the purest form of coconut oil is essentially colorless and free from rancidity. Unlike natural coconut oil, it is endowed with the natural antioxidant, Vitamin E which prevents the peroxidation reaction. The aroma of the fresh coconut can vary from mild to intense depending on the method employed for oil extraction. VCO differs from natural coconut oil in the process of extraction. While the latter is extracted by cold milling or cold compression of copra (another name for dried coconut kernels), the former is extracted from coconut milk obtained from fresh coconuts[5]. Further processes such as fermentation, and centrifugal separation, refrigeration, and enzyme action, enables the separation of the oil from water or moisture. In some cases, micro-expelling is used i.e. boiling the fresh coconut oil, followed by evaporating the water / moisture or by direct cold compression of fresh dried coconut meat[6].

VCO mainly consists of medium chain triglycerides (MCT), which are resistant to peroxidation. They differ from animal fat which consists of long chain saturated fatty acids and is the one main risk factor for cardiac complication[7]. Medium chain fatty acids (MCFA) differ from long chain fatty acids in that they actually help to protect against heart disease. MCFA have been reported to lower the risk of both atherosclerosis and heart disease. MCFA is reported to be primarily responsible for the special and beneficial effects of VCO[8]. The best known dietary sources of MCFA are include coconut and palm kernel oils.

2. CHEMICAL PROPERTIES AND CHEMISTRY

In the 1920s and 1930s it was discovered that coconut oil differed from other fats and oils in that it was found to be composed predominantly medium chain triglycerides. The composition of Fatty acids in VCO as determined by Gas Liquid Chromatography include Saturated fats : Lauric acid (45% to 52%) , Myristic acid (16% to 21%), Palmitic acid (7% to 10%), Caprylic acid (5% to 10%), Capric acid (4% to 8%), Stearic acid (2% to 4%), Caproic acid (0.5% to 1%) and Palmitoleic acid (in traces) and Unsaturated fats : Oleic acid (5% to 8%) , Linoleic acid (1% to 3%) and Linolenic acid (up to 0.2%). VCO is colourless, free of rancidity and has a specific fresh natural coconut aroma and the specifications which should meet by the Virgin Coconut Oil listed in the Table 1[9].

3. THERAPEUTIC BENEFITS

Virgin coconut oil (VCO) has been consumed worldwide for various health-related reasons and some of its benefits have been scientifically evaluated.

Table.1: Specifications of Virgin Coconut Oil

Properties	*Specifications*
Moisture and volatile content	0.20% max
Free fatty acids(Expressed as lauric acid)	0.20% max
Peroxide value	3.0 meq/kg oil max
Food additives	None permitted
Matter volatile at $105^{O}C$	0.20% max
Heavy metal	Mg/kg max
Iron(Fe)	5.0
Copper(Cu)	0.40
Lead(Pb)	0.10
Arsenic(As)	0.10

3.1. Antioxidant and Antistress Activity

A study carried out by Yeap SK *et al* evaluated the antistress and antioxidant effects of virgin coconut oil *in vivo.* VCO reduced lipid peroxidation and increase the activity of SOD in the serum of mice undergoing the forced swim test and the brains of mice subjected to chronic cold restraint[10]. VCO has been reported to be rich in polyphenols and these contribute to the increased antioxidant enzyme levels, which in turn reduces inflammation and lipid peroxidation in VCO-treated mice. Restoration of brain antioxidant levels hinders further neuronal damage thereby preventing subsequent monoamine depletion[11]. The potential of VCO to prevent exercise- and chronic cold restraint stress-induced damage and to restore the antioxidant balance was demonstrated and this was attributed to the polyphenols and medium-chain fatty acids present in VCO. In another study on the comparative effect of VCO with copra oil, olive oil and sunflower oil on endogenous antioxidant status and paraoxonase-1 activity in ameliorating the oxidative stress in rats, findings revealed that dietary VCO improved the antioxidant status as compared to the other three oil- fed groups, as was evident from increased catalase, superoxide dismutase, glutathione peroxidase and glutathione reductase activities in tissues[12].

3.2. Hepatoprotective activity

Several studies[10, 11] have reported the antioxidant activity of VCO. Oxidative stress induced by the generated free radicals plays a lead role in the development of hepatic toxicity[13]. A study was conducted on hepatoprotective activity of VCO on 2, 4-Dichlorophenoxyacetic acid (2, 4-D) induced liver damage in rats[14]. Rats treated with 2, 4-D showed a significant liver damage with increased serum transaminases and alkaline phosphatase enzymes activities, hepatic lipid peroxidation and liver free fatty acids. Serum total protein, albumin, hepatic superoxide dismutase and glutathione peroxidase enzymes activities were significantly reduced. Inflammation and necrosis were observed in liver sections of treated rats. VCO oil treated animals showed an improvement in hepatic antioxidant enzymes, serum transaminases activities and liver free fatty acids levels which was confirmed by histopathological examination, thereby establishing the hepato protective activity of VCO[15].

3.3. Anti-inflammatory, analgesic, and antipyretic activities of VCO

A study conducted by Intahphuak et *al*, evaluated the_anti-inflammatory, analgesic, and antipyretic effects of VCO in rats using ethyl phenyl propiolate-induced ear edema and carrageenan and arachidonic acid-induced paw edema. VCO was found to possess moderate anti-inflammatory effects.

Through reduction of the transudative weight, granuloma formation, and serum alkaline phosphatase activity, VCO exhibited an inhibitory effect on chronic inflammation. In acetic acid-induced writhing, the model for analgesic activity and for yeast-induced hyperthermia for antipyretic activity, VCO showed a moderate analgesic and antipyretic effect[16].

3.4. Wound Healing Effect

Wound healing is a complex process where the skin or other body tissue repairs itself after injury. The oil of *Cocos nucifera* has been reported to be an effective wound healing agent[17]. Nevin *et al* studied the effect of topical application of virgin coconut oil on skin components and antioxidant status during dermal wound healing in young rats. In their study, animals were treated for 10 days with VCO, 24 hours after creation of the wound. VCO's healing activity was evaluated by monitoring time for complete epithelization in addition to various parameters of the wound's granulation tissue. Solubility pattern of collagen, glycohydrolase activity and granulation tissue histopathology were also studied. Animals treated with VCO showed much faster wound healing activity, indicated by a decreased time in complete epithelization and higher levels of various skin components. The significant increase of Pepsin-soluble collagen and glycohydrolase activities observed indicated higher collagen cross- linking and its turnover. They concluded that the wound healing activity of VCO may be a cumulative effect of various minor biologically active components present within [18].

3.5. Effect on Dermatitis

Atopic dermatitis (AD) is a chronic skin disease characterized by features of defective epidermal barrier function and inflamed cutaneous layer. In this condition trans epidermal water loss (TEWL) is increased and the ability of the stratum corneum to hold water is impaired. This leads to decreased skin capacitance and hydration. A study by Evangelista *et al* investigated the topical effect of VCO on SCORAD index, trans epidermal water loss, and skin capacitance in mild to moderate pediatric atopic dermatitis using a randomized controlled trial design. A total of 117 patients included were evaluated at baseline, and then at 2, 4, and 8 weeks respectively. The results concluded the superiority of VCO over mineral oil among pediatric patients with mild to moderate AD [19].

3.6. Use as an Ocular Rewetting Agent

Dry eye is a symptom caused by the lack of quality /quantity of tears or defect on the ocular surface area. That leads a condition of discomfort, visual disturbance; tear film instability, increased osmolality of the tear film and inflammation of the ocular surface, which ameliorate the damage to the ocular surface. Among all the therapeutic option for dry eyes, artificial tears is the mainstay for the initial management of dry eye patient. Due to the complexity of tear film, it is difficult to manufacture tears that would be similar to that of the human eye. Several brands of artificial tears are commercially available, that would consist of Hydroxypropyl methyl cellulose, Poly vinyl alcohol, sodium hyaluronate and oil based tears. A previous study showed that liposomal spray applied on closed eye lid had increased the thickness of lipid layer and also significantly increased the tear film stability. On account of this study Dept. of Optometry and vision science at Malaysian University evaluated the usage of VCO as a supplement for tear film.

A pilot study was carried out on the efficacy of VCO as an ocular rewetting agent on Rabbit eyes. VCO was found to be safe in the dry eye and its anti-inflammatory property was attributed to be responsible for its significant beneficial effect in the management of dry eyes[20].

3.7. Effect on Alzheimer's disease

In the neurological disorder Alzheimer's disease (AD), memory loss and cognitive decline occurs because of death of brain cells. The neurodegenerative disease starts as mild dementia getting progressively worse**.** In the brain, the lipid macromolecule, cholesterol is utilized as an antioxidant, for structural scaffolding of the neural network, as an electrical insulator (to prevent ion leakage), and as a functional membrane component. Cholesterol is utilized in the wrapping and synaptic delivery of the neurotransmitters and also plays an important role in the formation and functioning of synapses in the brain. Several studies[21] have proven the lack of cholesterol in the brains of AD patients. In contrast, a positive correlation (better memory function and reduced dementia) was observed between high cholesterol levels and longevity in a population above 85 years old . A study appearing in the American Journal of Cardiology in February 2011 suggested that a diet with adequate amounts of saturated fat is essential to maintain HDL high cholesterol levels. Those with deficiencies and suffering from neurological disorders needed to consider a diet that is high in saturated fat. The saturated fat of coconut oil provides the brain with an alternate source of energy in ketones. Ketones are high energy fuels that nourish the brain. Fasting /starvation can trigger the production of ketones. Ketones are also formed by the conversion of medium chain fatty acids in certain foods. Coconut oil is nature's richest source of these medium chain triglycerides (MCTs) [22]. A study done in 2004 took MCTs from coconut oil and put them into a drink that was given to Alzheimer's patients while a control group took a placebo. They observed significant increases in levels of the ketone body beta-hydroxybutyrate (beta-OHB) 90 minutes after treatment. When cognitive tests were administered, higher ketone values were associated with greater improvement in paragraph recall with MCT treatment relative to placebo across all subjects[23].

3.8. Effect on blood pressure elevation

Hypertension or elevated blood pressure is the main risk factor for cardiovascular complications such as coronary heart disease, atherosclerosis, and stroke. Many studies to prevent the elevation of blood pressure have been carried out.

Badlishah Sham Nurul-Iman *et al* carried out a study on Effect of VCO on prevention of blood pressure elevation and Improves Endothelial Functions in rats fed with repeatedly heated palm oil. This study explored the effects of virgin coconut oil (VCO) in male rats fed repeatedly with heated palm oil on blood pressure, plasma nitric oxide level, and vascular reactivity. In their study elevation of blood pressure was created by the repeated feeding of heated palm oil. On overheating, the free radicals that were generated induced oxidative stress within the blood vessel, affecting the NO level in the endothelial cells. In male rats, supplementation with repeatedly heated palm oil VCO was found to prevent blood pressure elevation and to also decrease nitric oxide deactivation. In addition, VCO did not influence relaxation but decreased vasoconstriction of the endothelium[24].

3.9. Immunomodulatory effect

In 1966, Jon Kabara discovered that Medium Chain Fatty Acids (MCFA's) of virgin coconut oil are incredible for antimicrobial properties that kill harmful viruses, bacteria, fungi, and parasites. When MCFA's are digested, they break down into free fatty acids and monoglycerides [25] .Lauric Acid, Capric acid, and Caprylic acid are the important medium chain fatty acids present in coconut oil that possess antimicrobial activity. Their monoglyceride form, monolaurin, monocaprylin, and monocaprin hinder microbes from terrorizing the immune system. Individually, these fatty acids act on microbes in different ways. Some may kill a particular organism that causes fungal infections but may not be as useful on other microbes. Unitedly, however they act as a highly powerful defence against diseases. Monolaurin (monoglyceride form of lauric acid) is considered to have the best antiviral, antifungal, and antibacterial effect[26].

3.10. Effect on blood sugar control

A study on Insulinotropic potency of lauric acid: a metabolic rationale for medium chain fatty acids (MCFA) in TPN formulation by Garfinkel M et al proved that the effect of MCFA on insulin secretion depends upon its chain length. Among all MCFA capric acid (C10) and lauric acid were observed to display the most potent effects on insulin secretion[27]. Another study proved that, as compared to other oils, coconut oil in the diet enhanced insulin action and improved binding affinity [28].

3.11. Effect on weight loss

A study conducted on the effect of dietary medium- and long-chain triacylglycerols (MLCT) on accumulation of body fat in healthy humans by Kasai M *et al* proved that a daily intake of MLCT diet could cause a reduction in body weight and body fat accumulation. Volunteers in a double-blind study for 12 weeks, consumed daily at breakfast, test bread, with 1.7 g MCFA, bread made with long-chain triacylglycerols (LCT) was consumed by the control group. A significant decrease of body weight and amount of fat, with a significant decrease in serum total cholesterol was observed in the test group[29]. In another study on the effect of dietary supplementation with coconut oil on the biochemical and anthropometric profiles of women with abdominal obesity (waist circumferences (WC) >88 cm) the intake of dietary supplement with VCO was observed to decrease the amount of abdominal fat[30].

4. CONCLUSION

People of traditional cultures of the South Pacific Islands, Asia, Africa and the Central America have used coconut oil for generations in traditional coconut-based diets. These people suffer very much lower rates of obesity, heart disease, cancer, diabetes, arthritis and other health problems than those in North America and Europe who don't eat coconut-based food at all. Till very recently, coconut oil was demonized and consumers were made to believe that coconut oil is deleterious to health as it would clog arteries and cause heart disease. The tide has turned and in recent times recognition of the positive health effects of coconut oils has emerged stronger and coconut oil, especially virgin coconut oil is being extolled for its beneficial properties.

While coconut oil definitely never really deserved its bad reputation, there is need for more research on the many claims attributed to this oil.

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Shijna Kappally, Arun Shirwaikar and Annie Shirwaikar. Coconut oil – a review of potential applications. *Hygeia.J.D.Med.7* (2) October 2015; 34-41
Available from http: //www.hygeiajournal.com / Article ID-Hygeia.J.D.Med/149/15.
DOI: 10.15254/H.J.D.Med.7.2015.149.