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"Drugstore in a bottle" – Virgin Coconut Oil

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ABSTRACT

According to market statistics, the global functional food and nutraceutical market is growing industry, fuelled by consumer demand and advances in science as foods are now being examined intensively for added physiological benefits, which may reduce chronic disease risk or otherwise optimize health. It is these research efforts that have led to the global interest in the growing food category now recognised as functional foods. Nutraceuticals is the most active area of research in nutrition sciences today. There is renewed interest on traditional and indigenous health products and virgin coconut oil is a potent one as a nutraceutical. Focus on the benefits of virgin coconut oil in the present study from different studies will be useful to researchers in the fields of pharmaceuticals, nutraceuticals and cosmetics.

Introduction

Recently there is a trend towards producing coconut oil which does not have to go through the refining, bleaching and deodorizing (RBD) process. Rather than going through the normal dry process, this oil is obtained by wet processing which entails the extraction of the cream from the fresh coconut emulsion. This process is more desirable as no chemical or high heat treatment is imposed on the oil. VCO is directly extracted from coconut milk under controlled temperature; this type of extraction retains most of the biologically active components like vitamins, phytosterols and polyphenols (Kapila N , et al.,2008) The coconut oil produced through the wet method is known as Virgin Coconut Oil. The term virgin coconut oil refers to oil that is obtained from fresh, mature kernel of the coconut by mechanical or natural means with or without the use of heat and without undergoing chemical refining. (Villarino, Dy & Hizada, 2007)

Virgin coconut oil has many advantages, which include the health benefits from the retained vitamins and antioxidants, the antimicrobial and antiviral activity from the lauric acid components and through its easy digestibility from the medium chain fatty acids. It has also been traditionally used to enhance the beauty and promote the growth of our tresses, refine and moisturize our skin conditions as well as being used as ailments for minor illness such as diarrhoea and skin inflammations. The health benefits of virgin coconut oil, range from speeding up bodily metabolic system and providing immunity against a horde of commonly prevalent diseases.

Unlike the RBD coconut oil which is tailor made for cooking purposes, virgin coconut oil is marketed lately as functional oil. Since its first introduction, virgin coconut oil has captured the attention of vast majority of publics. Its beneficial properties are fast spreading. This paper presents an overview of the current status and recent trends of on-going research findings associated with virgin coconut oil up to date.

Biologically active substances

Recently considerable interests in the possible impact of consuming certain foods to fight against several diseases have appeared. The relevance of the positive consequences of clinical studies on VCO has been widely contributed by its bioactive components. It is believed that VCO is more beneficial than usually obtained copra oil since the mode of extraction retains more biologically active components such as Vitamin E and polyphenols (Nevin & Rajamohan, 2004).

Polyphenols

Numerous studies suggest that the consumption of foods containing dietary phenols may significantly contribute to human health (Naczk & Shahidi, 2004). Attempts have been made by few investigators to determine the phenolic content in VCO. Dia et al. (2005) determined the total phenolic content in VCO produced from different methods.The results revealed that VCO contained higher total phenolic content compared to refined coconut oil. *Marina et al.* (2009) conducted a study on commercial VCO in Malaysian and Indonesian markets, and confirmed that VCO samples were significantly higher in total phenolic compared to RBD coconut oil.

Marina et al. (2008) identified some of the phenolic acids in VCO to be protocatechuic, vanillic, caffeic, syringic, freulic, and p – coumarice acids. This study also suggested that the contribution of antioxidant activity in VCO could be due to phenolic compounds.

These phenolic compounds can act as free radical scavengers by virtue of their hydrogen donating ability, forming aryloxyl radicals (Dinkova – Kostova & Rao, 1999). In addition, phenolics have also been found interacting with the oxidative cascade preventing its outcome (Unnikrishnan & Rao , 1992), quenching oxygen and making it less available for oxidative reaction (Soudamini et al, 1992).

Medium Chain Triacylglycerol

Coconut oil is rich in medium chain triacylglycerol (MCT). Extensive review has been made by Che Man and Marine (2006) and Marten, Pfeuffer and Schrezenmeir (2006) on MCT. Being rich in MCT, consumption of coconut oil is associated with increase in triacylglycerol but incorporation if structured lipid and other functional substances may improve the lipid profile.

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Lauric Acid

Coconut oil is also rich in lauric acid; a fatty acid with strong antimicrobial property which inhibited various pathogenic bacteria such as *Listeria monocytogenes*(Wang & Johnson, 1992).

Tocotrienols

The biologically active components in VCO such as tocotrienols (which have been reported as having more potent antioxidant properties than even alpha – tocopherol[Serbinova et al., 1991; Serbiinova & Packer, 1994]), flavonoids and other polyphenols are responsible for the antioxidant properties observed in this oil.

Fatty Acids

VCO contains a high proportion of four saturated fatty acids and the high level of HDL cholesterol in VCO treated animals compared to the non VCO treated group could be attributed to the presence of these fatty acids(Cox et al., 1995).The main fatty acids found in VCO include lauric (47%), myristic (19%), palmitic (9%), caprylic (8 %), oleic (6 %) and stearic (3%) acids. Fatty acids such as oleic and stearic acids have been shown to attenuate inflammation (Zakaria et al, 2010).

The nature of the fatty acid present in the dietary oil have a role in modulating hepatic lipid metabolism (Clarke S.D., 2004) and the fatty acids in coconut oil are preferentially utilized for energy production and are less implicated in the accumulation of body fat (Tsuji H, et al.,2001)

Freulic Acid

Freulic acid belongs to phenoxy carboxylic acid family (Graf E, 1992). Toda et al (1991) have proven that freulic acid has the ability to scavenge the superoxide radical and suppress the lipid peroxidation induced by superoxide anion.

Nutraceutical properties

The word nutraceutical refers to any substance that has nutritional value and at the same time pharmacological effects. Virgin Coconut oil contains biologically active substances which have been identified to provide nutraceutical / health benefits. This article discusses some studies that probe the pharmacological effects of these biologically active substances to human health. Coconut oil has been widely used throughout history for its medicinal value and has served man as important food for thousands of years (Ghazali et al , 2009).

Cardio – Protective Effect

The effects of consumption of VCO on various lipid parameters was conducted by Nevin and Rajamohan (2004). The findings indicated that triglycerides in serum and tissues were significantly lower in VCO treated animals compared to copra oil and control animals. High density lipoprotein (HDL) cholesterol in VCO fed animals was increased while low density lipoprotein (LDL) cholesterol level were significantly decreased compared to copra oil. Polyphenol fraction of VCO was found to be more beneficial than polyphenol fractions of copra and ground nut oils in preventing the copper induced oxidation of LDL as indicated by low thiobarbituric acid reactive substance (TBARS) and reduced carbonyl formation.

Antithrombotic Effect

VCO has significant antithrombotic effect over copra oil. (Nevin and Rajamohan, 2007). A coconut oil based diet high in saturated fatty acid (HSAFA) – diet lowers postprandial t – PA (tissue plasminogen activator) antigen concentration, and this may favourably affect the fibrinolytic system and the Lp(a) (lipoprotein –a) concentration compared with the high mono and polyunsaturated fatty acid (HUFA) – diet. The proportions of dietary saturated fatty acids more than the percentage of saturated fat energy seem to have a beneficial influence on Lp(a) levels. (Muller et al, 2003).

In a recent study, the influence of VCO on blood coagulation factors, , lipid levels and LDL oxidation in cholesterol fed Sprague – Dawley rats were investigated by Nevin and Rajamohan (2008). The lipid levels and thrombotic risk factors as indicated by platelets, fibrin and fibrinogen levels which were lower in rats fed VCO compared to copra oil and comparable to copra oil and sunflower oil.

Antiatherosclerotic Effect

Chlamydia pneummoniae, is suspected of playing a role in artherosclerosis by provoking an inflammatory process that result in the oxidation of lipoproteins with induction of cytokines and production of proteolytic enzymes, a typical phenomenon in artherosclerosis.(Enig MG, 2010) Some of the pathogenic gram – negative bacteria with an appropriate chelator have been reported to be inactivated or killed by lauric acid and monolaurin as well as capric acid and monocaprin (Enig MG, 2010)

All members of the HSV family are reported to be killed by the fatty acids and monoglycerides (MG) from saturated fatty acids renging from C – 6 to C – 14. (Eckarstein V et al, 2002), which include approximately 80 % of the fatty acids in virgin coconut oil. Monolaurin is not formed in the body unless there is a source of lauric acid in the diet, and coconut oil is a rich source of monolaurin.

Hypolipidemic Effect

VCO is capable of reducing lipid peroxidation contents (Nevin and Rajamohan, 2007). The study conducted by Arunima S and Rajamohan (2012) indicated that dietary VCO beneficially modulates the hepatic lipid metabolism, by regulating the synthesis and degradation of lipids as compared to other dietary oils like copra oil, olive oil and sunflower oil. This beneficial effect of VCO over other oils may be due to the difference in absorption, transport and catabolism of its constituent fatty acids as well as the higher amounts of biologically active unsaponifiable minor components present in VCO.

Antibacterial Activity

The most abundant and potent MCFA in VCO is lauric acid. The MCFAs and their derivatives e.g., MGs are effective in destroying a wide assortment of lipid – coated bacteria by disintegrating their lipid membrane. For instance, they can be effective against bacteria that can lead to stomach ulcers, sinusitis, dental cavities, food poisoning and urinary tract infections.

Monoglycerides, especially Monolaurin, has been used to protect intravenously administrable oil – in – water emulsion compositions against growth of *Escherechia coli (E.coli), Pseudomonas aeruginosa (P. aeruginosa), Staphylococcus aureus (S. aureus) and Candida albicans (C. albicans).* The compositions can be medicaments containing lipophilic drugs, especially Propofol, and / or total intravenous nutritional compositions. (Daftary GV et al, 2008)

Emulsions of 1.25mM monocaprin in citrate – lactate buffer at pH 4 to 5 caused a > 6- to 7- $\log_{10}$ reduction in viable counts of *Salmonella spp., E. Coli* in 10 min and *Clostridium jejuni* was also more succeptible to monocaprin emulsions at low pH (Thormar H et al , 2006). Thus, like many other important medicinal plants having antibacterial property (Mandal et al ,

2007 and 2010) VCO rich in both monoaurin and monocaprin is also excellent against different pathogenic bacteria causing several life – threatening infections to humans.

Antidermatophytic Activity

The traditional use of coconut oil as a lotion in many parts of the world is well founded. Monolaurin has statistically significant *in – vitro* broad spectrum sensitivity against gram – positive and gram – negative bacterial isolates from superficial skin infections (Carpo BG et al , 2007). VCO and monolaurin have been suggested for proactive treatment of atopic dermatitis colonization due to their *in – vitro* broad – spectrum activity against S. *aureus* (Verallo – Rowell et al, 2008). Its selective antibacterial effects (Eckarstein v et al, 2002) make it useful for tropical aplications.

Antiviral Effect

The MCFA in coconut oil primarily destroy these organisms by disrupting their membranes, interfering virus assembly and maturation. Monoaurin acts by solubilizing the lipids and phospholipids in the envelope of the virus, causing the disintegration of the virus envelope (Arora R et al , 2011).

Antifungal Effect

The antimicrobial spectrum of monolaurin is broad including fungal species such as *Aspergillus sp., Penicillium s., Cladosporium sp., Fusarium sp., Alternaria sp., C. albicans, Fonsecaea pedrosoi* and *Cryptococcus neoformans (*Esquenazi D et al , 2002).

VCO has been used in the treatment of *Candida* infections full stop after inections Ogbolu et al (2007) compared the susceptibilities of the *Candida* isolates to VCO and fluconazole using the agar – well diffusion technique and found that *C. albicans* had 100 % susceptibility to coconut oil at a minimum inhibition concentration (MIC) of 25 % (1:4 dilution), while fluconazole had 100 % susceptibility at an MIC of 64 µ gm / mL (1:2 dilution). Capric acid caused the fastest and most effective killing of the *C.albicans* strains while lauric acid was the most active at lower concentrations and after a longer incubation time *C. krusei* showed the highest resistance to coconut oil with an MIC of 100 % (undiluted), while fluconazole had an MIC of > 128 µ g / mL.

Immunostimulatory Effect

The virgin coconut oil enriched with zinc increased Tc cells, Th cells, IL – 2, but maintained the number of neutrophil and NK cells, while the IgG levels changed from equivocal to negative in Candidiasis patient. (Winarsi H et al , 2008)

Antioxidant Activity

The antioxidant activity in VCO was reported to be high in VCO compared to refined coconut oil (Dia *et al* , 2005 and 2009a). The results also indicated that VCO with the highest total phenolic content also possessed the highest antioxidant activity. The effect of the different processing methods on antioxidant capacity of VCO was studied by Marina *et al* (2008). The VCO produced through fermentation had the strongest scavenging effect on DPPH and the highest antioxidant activity based on β – carotene – linoleate bleaching method. However, VCO produced through chilling method had the highest reducing power. Very high correlations were found between total phenolic content and each of scavenging activity and reducing power.

Nevin and Rajamohan (2006) determined the antioxidant status of rats fed VCO. The results indicated that the activities of catalase (CAT) and superoxide dismutase (SOD) which were mutually supportive team of defence against reactive oxygen species (ROS) and preventing lipid peroxidation, were increased in VCO. The lipid peroxide levels were significantly less in the heart, liver and kidney of VCO fed animals when compared to the other oil fed groups. Compared to groundnut and copra oils, VCO feeding was found to increase the total glutationine (GTN) content, a sensitive indicator of antioxidant status.

Enteral and Parenteral Nutrition

VCO, just like coconut oil, is also known for its high MCT. MCT is unique due to its physiochemical properties such as having shorter chain length and smaller molecules compared to long chain triglyceride (LCT), making them more rapidly absorbed and hydrolysed in the body. MCT has been used in the clinical area for enteral and parenteral nutrition in diverse medical conditions for treatment of patients suffering from fat malabsorption (Che Man & Marina, 2006).

Pro – fertility Agent

Studies have shown that excessive ethanol ingestion induces hypoandrogenism and hypogonadism in males with low testosterone levels (Iturraga et al., 1995; Ren et al.,2005). In fact, research with animals has consistently demonstrated an association between both acute and chronic alcohol consumption.

Dosumu et al (2010) explored the effect of virgin coconut oil on oxidative stress, testosterone and gonadotrophic hormones in alcohol induced testicular injury. In this investigation, tMDA levels were elevated in the alcohol – only treated group, suggesting a state of oxidative stress in the testes. However, the administration of VCO with alcohol ameliorated these effects. Hence, this could also account for the significant increase in testosterone levels observed in the groups treated with VCO when compared with the alcohol only treated groups. The studies of Maneesh et al., (2006) have suggested that increased oxidative stress caused damage to testosterone secreting Leydig cells and supporting Sertoli cells as well as impairing the HPG axis. In addition, Calvin et al (1981) suggested that the metabolic pathway of testosterone synthesis requires protection against peroxidation and will be affected by a decrease in the activity of antioxidants. It is therefore logical to believe that substances that could ameliorate these effects will also boost testosterone synthesis ans release.

The antioxidant properties demonstrated by VCO may account for its ability to decrease oxidative stress and prevent tissue damage in the testes as well as protect the metabolic pathway of testosterone against peroxidation thereby preventing the suppression of testosterone as observed in the alcohol only treated group.

Anti – osteoporotic Effect

Osteoporosis is a chronic systemic skeletal disease characterized by a low bone mass and loss of bone tissue and micro-architecture. The bone becomes weak and fragile with a consequent increase in the fracture incidence. (Baron R & Hesse E, 2012).Many studies have shown that oxidative stress plays a role in the pathogenesis of osteoporosis while several risk factors for osteoporosis such as smoking, hypertension and diabetes are associated with high levels of oxidative stress (A. Salim et al., 2004; Galli F et al., 2005). Oxidative stress also suppresses bone formation by inhibiting osteoblast differentiation and decreasing the survival of these cells (Mody N et al., 2001 ; Bai c X et al., 2004).

The results of the study conducted by Abujazia M A et al (2012), showed significant improvement in the bone antioxidant status after VCO supplementation by a significant increase in

the levels of glutathione peroxidase in the VCO supplemented group compared to the comtrol groups, with an increased trend of SOD levels. The positive effect on the antioxidant enzymes was supported by a low of MDA in the supplemented group. In the same way, the significant increase in the levels of GPX and SOD in the ovariectomised – control rats represented the endogenous release of antioxidant enzymes, in response to oxidative stress and the high free radical activity in the bone.

Anti – Diabetic Effect

Lauric acid, present in coconut oil has been shown to possess insulin tropic properties in isolated perfused mouse islet model but not proven in diabetic animals.(Girotti. A. W. and Thomas.I. P 1984). In addition lauric acid with insulinotropic properties may have synergistic effects in combination with polyphenols in reducing blood sugar. (Ellman GL, 1958).

Better hypoglycaemic effect was observed in hot extracted virgin coconut oil (47 %) than cold extracted virgin coconut oil (39 %) with same lauric acid content suggests the vital role of polyphenol in protecting the pancreatic the pancreatic beta cells from apoptosis which is possible in diabetic condition due to enhanced formation of ROS . Better hypoglycaemic effects of cold extracted virgin coconut oil than ordinary coconut oil could be due to available bioactive molecules retained by manual processing.(Nevin and Rajamohan, 2006)

Siddalingaswamy et al.(2011) conducted a study to find the effects of hot extracted and cold extracted VCO in diabetic rats. The results of this study indicated hot extracted VCO reduced blood glucose and lipid via total cholesterol, triglycerides, VLDL,LDL and thiobarbutyric acid reactive substance (TBARS) increased the antioxidant status by elevating activities of antioxidant enzymes such as superoxide dismutase, catalase, glutathione peroxisase, glutathione concentration and decreased lipid peroxidation in liver than cold extracted VCO.

Weight Loss Effect

Medium chain fatty acids and triglycerides with these fatty acids metabolizes fast and may assist in preventing obesity and stimulate weight loss in diabetic obese patients.(Nevin and Rajamohan, 2004). VCO rich in medium chain triglycerides metabolizes quickly thus accumulation of fat is inhibited. (Nevin and Rajamohan, 2004 ; Evans, J.L, 2007)

Other functions

VCO is also known for its antinociceptive , anti-inflammatory and hepato-protective activities (Zakaria et al., 2010). The antinociceptive activity of VCO was observed at the peripheral and central levels while the anti – inflammatory activity was seen only against the acute, but not chronic, model of inflammation. This oil was also effective in attenuating the paracetamol induced hepatotoxicity via modulation of the cytochrome P 450 drug metabolism pathway and HCL / ethanol induced gastric ulcer.

The superior moisturizing property of VCO renders it to be more effective in in the treatment of atopic dermatitis compared to virgin olive oil. (Verallo – Rowell et al., 2008).

Conclusion

Presently, virgin coconut oil is gaining wide popularity in the scientific field and among the public. The positive outcomes from previous clinical studies conducted on VCO further enhance its reputation as highly valuable oil. Since its first appearance, VCO has gained wide attraction among the public and scientific community as functional food oil. Some studies pertinent to VCO have been described in this review article. Recent focus on the benefit of VCO has been on its uses in the pharmaceuticals, nutraceuticals, cosmetics and industrial fields. However further studies are necessary in order to obtain a more complete evaluation of the therapeutic potential and safety profile of the oil.

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