Health benefits of virgin coconut oil

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Introduction

Virgin coconut oil is extracted directly from fresh coconut meat. There are several techniques being used which can be classified generally into: (1) drying the freshly grated coconut meat at low temperature, no higher than 60^{0}C, followed by pressing to extract the oil, (2) by extracting the coconut milk from the freshly grated coconut meat, followed by the addition of enzyme or aging for several hours, or by mechanical process using continuous centrifuge.

To safeguard the quality of virgin coconut oil (VCO), it is important that moisture level must be kept at the minimum. Philippine National Standard for Virgin Coconut Oil specifies moisture and volatile matters content at 0.2% maximum. Additionally, it describes the oil as colorless, sediment free, with natural fresh coconut scent, and free from rancid odor or taste.

Coconut oil, although the most stable oil being highly saturated, still has about 10% unsaturated fatty acids which are susceptible to peroxidation that brings about rancidity. Apart from making the product unpalatable, rancidity produces adverse reactions such as stomachache, or skin irritations when used externally. Thus the emphasis on adherence to moisture content limits.

Coconut oil

Coconut is a versatile and unique plant. It is very resilient and can withstand any type of weather or natural calamites. It bears fruit all year round. Studies show that every coconut cultivar has its own unique characteristic that may explain for the variances in the percent composition of fatty acids like the lauric fatty acid in the oil. This is attributed to several factors such as location and varietal differences (Laurels *et al.* 2000) as well as age of the nuts (Balleza) and Sierra 1976; Pham 1994 and 1996), time of the year the nuts are harvested, and age of copra before expelling. Ten to 13-

Table 1: Proximate analysis of the coconut kernel at different ages

Constituents	Age in months							
	8	9	10	11	12	13	14	15
Oil	26.67	41.67	58.27	66.84	71.80	71.45	66.29	67.04
Protein	10.67	9.93	8.31	8.03	7.61	7.61	7.62	6.23
Crude Fiber	3.98	5.20	5.92	4.56	3.22	3.29	3.34	2.87
Carbohydrates	38.45	34.93	31.91	34.38	34.19	37.26	41.59	44.91
Ash	6.14	4.90	3.77	3.45	2.26	2.03	2.07	1.76

Ref: Sierra, Z.N. and C.F. Balleza. 1972. Proximate Analysis of the Coconut Endosperm at Progressive stages of development. National Institue of Science and Technology. Annual Report 1971-1972:3.

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month old nuts have the highest oil content as shown in Table 1.

Coconut oil as saturated oil is mostly small and medium chain triglycerides (MCTs) as opposed to other saturated fats like animal fats which are long chain triglycerides (LCTs). When ingested, MCT is readily burned in the body and dissipated as energy unlike LCT which goes to the circulatory system before it is finally being used as energy. The process leaves fatty deposits in the tissue.

Aside from being LCT, most vegetable oils are polyunsaturated. Coconut oil contains less than 10 per cent unsaturate. It is the most stable oil and does not require further processing to make them stable. In contrast, LCT needs to be partially hydrogenated to make them stable. However, clinical studies show partial hydrogenation produce *trans* fatty acids that cause elevation in cholesterol (Enig 1990).

Clinical studies done at the New England Deaconess Hospital (NEDH), a Harvard medical school affiliate, show that coconut oil is neutral in its effects on blood lipids and will not cause an increase in cholesterol or cause cardivascular disease (Norton *et al.*, 2004). Coconut oil even increased the High Density Lipoprotein (HDL) or the so called "good cholesterol", reducing the risk for coronary heart disease.

A preliminary study on the effects of coconut oil on HIV+AIDS gave very encouraging results with subjects' viral load dramatically reduced and immune system enhanced as reflected in the CD4/ CD8 count (Dayrit *et al.*).

In animal experiments conducted using coconut oil or its derivative monolaurin, monolaurin removed the bacterial drug resistance of *Sireptococcus aureus* to Penicillin G. (Ontengco *et al.*, 1998; Gamboa and Carandang 1998). Coconut oil prevented sepsis cause by *E-coli* endotoxin shock (Lim-Navarro *et al.*, 1994), inhibited the actions of some mutacarcinogenic substances (Sylianco *et al.* 1992). Monolaurin is generally recognized as safe and can be tolerated in relatively high dose (Lazo and Dayrit 1998).

Virgin coconut oil

Virgin coconut oil (VCO) differs from commercial coconut oil in the way it is processed. The latter is produced from copra or dried coconut meat and undergoes refining process to make the oil edible. The refined oil produced is called RBD (Refined, Bleached and Deodorized) coconut oil which is largely used as cooking oil. Virgin coconut oil production does not subject the oil to refining process since the oil produced is already edible. In effect, the term *Virgin* refers only to the process and not on the chemical properties which are essentially the same in both RBD oil and VCO. Their effect on health would likewise be the same, given the same medium chain fatty acid (MCFA) compositions.

Innovations have been made regarding the presentation or packaging of VCO for the consuming public. Apart from being sold in bottles of various sizes, it now comes in capsules of 500mg. Likewise, flavors such as banana, sweet corn, jackfruit, have been added in some cases. Questions have arisen with respect to the addition of flavors suggesting the product would be no longer qualify as VCO because of the additive.

The use of flavors as additive does not change the chemical properties of VCO. It only makes the coconut flavor, a welcome innovation for those who can not tolerate the coconut smell. However, it should be borne in mind that substance used as additive to VCO must be food grade adhering to international standards set by the institutions like Codex, United States Food and Drug Administration (U.S. FDA). Additives should not be reactive to cause any change in the chemical properties of VCO nor diminish its potency as nutraceutical product.

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.

The word nutraceutical refers to any substance that has nutritional value and at the same time pharmacological effects. A classical example of nutraceutical substance is mother's milk which provides an infant with the necessary nutrients for growth and development as well as serves to boost the immune system because of its antiviral antimicrobial and other protective properties.

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.

The U.S. FDA has given *phytosterols* GRAS (Generally Recognized As Safe) status. *Phospholipids* are important emulsifiers and essential constituents of all living cells. *MCT* is a good source of energy not only to the sick and convalescent and healthy individuals but also to pre-term infants. *Polyphenols* are known to help metabolism of certain amino acids in colon cells. *Phytochemicals* are linked to cancer prevention; *mono-* and *diglycerides* as antimicrobial and antiviral substances particularly against lipid coated organisms; *flavonoids (isoflavones)* and other *polyphenols, stanols* for preventing/curing some chronic diseases.

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.

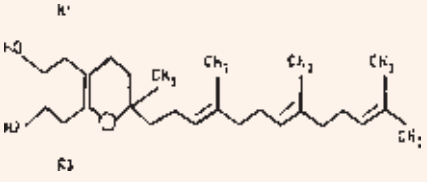

Fig. 1. Tocopherol structure

b. *Tocotrienols*

This biologically active substance synonymous with tocopherols is collectively called tocols. 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.

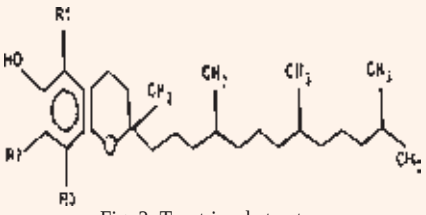

Fig. 2. Tocotrienol structure

Some studies show that tocotrienols are better than tocopherols as antioxidants. Tocopherols are normally found in seeds and green parts of the plant while tocotrienols are found in germ and bran fraction. There were reports on the hypocholesterolemic, antithrombotic, and antitumor properties of trienols which are beneficial for the prevention and/or treatment of many disease (Theirault *et al.* 1999).

It has antioxidant activity. They may also have anti-atherogenic, anticarcinogenic and immunodulatory actions. Recent studies have shown that tocotrienols are effective and better inhibitors of both lipid peroxidation and protein oxidation than alpha tocopherols.

For their possible anti-atherogenic activity, they inhibit LDL oxidation, suppression of HMG-CoA reductase activity and inhibition of platelets aggregation.

c. *Phytosterols*

Plant sterols are plant compounds with chemical structures similar to that of cholesterol. Studies show that concentrated phytosterol extracts

have lessened the discomfort of prostatic hyperplasia. 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.

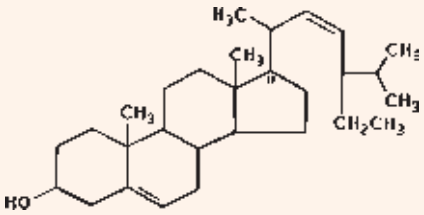

Fig. 3. Stigmasterol (a phytosterol)

d. *Phytostanols*

They are saturated phytosterols. It has been identified to have cholesterol lowering activity. Studies have shown that phytostanols appear to inhibit the absorption of dietary cholesterol and the reabsorption (via the enterohepatic circulation) of endogenous cholesterol from the gastrointestinal tract. It is believed that phytostatnols displace cholesterol from bile micelles.

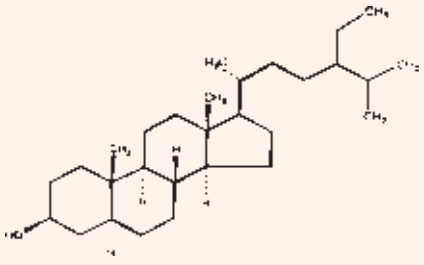

Fig. 4. Phytostanol structure

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. Consequently, the exertion of cholesterol in the feces leads to decreased serum levels of this sterol thus reducing risk of heart disease. Phytostanols do not appear to affect the absorption on bile acids.

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 cathechins. Animal experiments also indicate anticarcinogenic activity for several specific catechins.

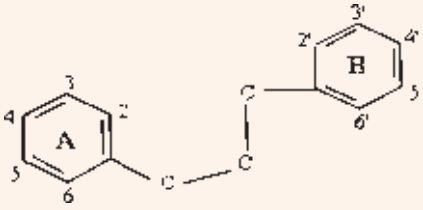

Fig. 5. Flavonoids structure

Phenolic compounds could affect carcinogenesis through a number of mechanisms. These compounds may scavenge carcinogens or free radicals. They may also block generation of reactive oxygen species. Phenolic compounds may also reduce cellular proliferation through the modulation of protein kinase C activity. Few phenolics may possess bioantimutagenic properties.

Flavonoids are polyphenolic compound possessing 15 carbon atoms; two benzene rings joined by a linear three carbon chain. The skeleton below can be represented as the C_6-C_3-C_6 system.

Rotenone, a flavonoid, has been used topically for treatment of head lice, scabies, and other ectoparasites, but the dust is highly irritating to the eyes (conjunctivitis), the skin (dermatitis), and to the upper respiratory tract (rhinitis) and throat (pharyngitis).

Interest on 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 iriglycerides 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.

$CH_3(CH_2)_{14}C(O)O\text{-}C_lH_2$
$CH_3(CH2)_{14}C(O)O\text{-}C_lH$
$(CH_3)_{3+}NCH_2CH_2OP_l(O)\text{-}CH_2$
O-

Fig. 6. Lecithin

Lecithin is the best known member of the phosphatide group. It supplies *choline,* which is necessary for liver and brain function (an important component of bile) that helps the body to utilize fats and cholesterol properly. Triglyceride is a *non-polar, fat-soluble* molecule while phosphatide is *polar* and *water-soluble.* The fatty acid part of the molecule is *fat soluble,* and the phosphate group is *water soluble.*

g. *Medium Chain Triglycerides (MCT)*

Medium Chain Triglyceride has been known for its nutritional and

medical benefits and has been recognized as a multipurpose nutrient supplement. MCT is liquid at room temperature and has a bland odor and taste. Composed of C8, C10 and C12 medium chain fatty acids, MCTs are low molecular weight and highly soluble in biological fluids. These properties make MCT unique in that they are not metabolized through the intestinal walls like other fats but in the liver. MCT is not deposited as fat but instead is burned into energy (Kaunitz).

Premature born infants given MCT-enriched diets increased their fat and mineral absorptions to same level as in a normal term infants. Studies even showed that infants with diarrhea can tolerate high MCT diets (Kamen 2001).

For weight reduction, intake of MCT-rich diets 30 min before meals results into a significant decrease in calorie intake. Other studies show that MCT added to the diet converts most of the energy from the diet thus promoting weight loss.

Since MCT is directly transported to the liver several symptoms of adverse reaction such as vomiting, diarrhea, anorexia has been reported.

$R_1COOC_lH_2$
R_2COOC_lH
R_3COOCH_2

Triglyceride structure

R1. R2, R3 are medium fatty acids (C8, C10 and C12 chains)

Unique properties of MCT lead to more opportunities for innovation. Some of these are :

1. MCT as flavour carrier. MCT being colorless and flavorless does not interfere with the flavor it is carrying. It can substitute propylene glycol, triacetin, mineral oil and benzyl alcohol.
2. For confectioneries : MCT easily metabolizes and converts to energy. It does not deposit as fat in the body.
3. Reduce calorie foods : MCT easily metabolizes and converts to energy. It does not deposit as fat in the body;

MCT provides wellness for individuals suffering from short bowel syndromes, childhood epilepsy, aptic fibrosis, those that have undergone by pass surgery, for premature babies (Babayan and Rosenau 1991). As energy-dense foods, these are very good for people who need high energy in their diets to supply their energy requirement (Megremis 1991).

Observation/Recommendations

So much information but less data were documented. Most of the studies were on the MCT or its monglycerides form. There is a need to establish and quantify the biologically active substances present in VCO even if present in small amounts. To further support claim more clinical studies must be conducted.

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