Physico-Chemical and Pharmacological Prospective of Roghan-e-Narjeel (Coconut Oil)

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Abstract

Roghan-e-Narjeel (coconut oil) is extracted from dried Maghz-e-Narjeel (coconut kernels) which is derived from coconut (*Cocos nucifera L.*) tree. It is used extensively in tropical countries especially India, Srilanka and Philippines. The oil contains 92% of saturates consisting of medium chain fatty acids in the form of triglycerides containing lauric acid in large amount, and about 8% of unsaturates consisting of oleic and linoleic acids as triglycerides. The oil is colourless and has odour typical of the coconuts. It plays an important role in the treatment of ischemic heart disease, infections (viral, bacterial, fungal, protozoal), wounds and obesity. These effects of oil can be attributed to the presence of lauric acid, capric acid and caprylic acid. The aim of this review paper is to highlight the physico-chemical and pharmacological properties of Roghan-e-Narjeel (coconut oil) according to modern as well as unani aspect.

Keywords: Roghan-e-Narjeel, lauric acid, anti-hyperlipidemic activity, anti-microbial activity, healing activity.

Introduction

Roghan-e-Narjeel (coconut Oil) also known as coconut butter, is an edible oil extracted from dried Maghz-e-Narjeel (coconut kernels) which contains about 60-65% of the oil and derived from coconut (*Cocos nucifera L.*) tree[1,2]. Coconut oil is one of the primary sources of energy, in tropical countries like India, Srilanka, Philippines, and Indonesia [3]. There are commonly four varieties of coconut oil available in the market. Firstly *pure coconut oil* is extracted from dried coconut kernels (copra) by compression in a mill either by bullock or by power. It is crude, unrefined and without any additives. It has multiple uses such as edible oil, massaging oil, hair oil, cosmetic usage, medicinal and industrial purpose. Secondly is *refined coconut oil* obtained by mechanically and chemically refining, bleaching and deodorizing the crude coconut oil to make it thin, colorless, odourless and without any type of particle (like protein) suspended in it, for getting only pure saturated fats. Thirdly is *virgin coconut oil* (VCO) derived from coconut milk extracted from freshly shredded coconut meat and not from copra by processes like fermentation, centrifugal separation and enzymatic action. It is laden with medium chain triglyceride (MCT). It has remarkable anti-oxidants and anti-microbial properties. This is the most respected and trusted variety. Lastly is *organic coconut oil* that has extracted from coconut palms prepared only on organic manure without involving any chemical, synthetic fertilizers or insecticides in its extraction or processing. This is another well respected variety. This form mainly used in cosmetic area [4].

Physico-chemical Properties

It has a long shelf life. The oil has the natural sweet taste of coconut. Coconut oil is insoluble in water. At temperature above its melting point it is completely miscible with most of the non-hydroxylic solvents such as light petroleum, benzene, carbon tetrachloride etc. In alcohol, coconut oil is more soluble than most common fats and oils[2]. Among the most stable of all vegetable oil, coconut oil is slow to oxidize and thus resistant to rancidity. Unrefined coconut oil melts at 20-25^{0}C and smokes at 170^0 (350^{0}F), while refined coconut oil has a higher smoke point of 232^{0}C (450^{0}F) [5]. Coconut oil is a triglyceride consisting 92% saturated fatty acids, most of them (about 70%) are lower chain saturated fatty acids known as medium chain fatty acids (MCFAs), 6% monounsaturated fatty acids and 2% polyunsaturated fatty acids. Out of its saturated fatty acids, 45-56% coconut oil is primarily lauric acid, 16.8% myristic acid and 8.2% palmitic acid.It's only monounsaturated fatty acid is oleic acid while it's only polyunsaturated fatty acid is linoleic acid[2,5]. Physico-chemical Characteristics of unrefined, refined and virgin Coconut Oil are described in Table-1[2].

Table-1 Physico-chemical Characteristics of Coconut Oil

Physico-chemical Characteristics	Virgin coconut oil from wet coconut	Unrefined coconut oil from copra	Refined coconut oil
Appearance	Colourless	Slight brownish	Colourless
Odour	Coconut smell	Coconut smell	Odourless
Melting point ^{0}C	24	24	24
Moisture %	<0.1	<0.1	<0.1
Iodine value (cg 12/gm)	12-15	12-15	10-12
Peroxide value (meq.02/kg.)	0-1	0-1	0-1
Saponification value (mg KOH/g)	245-255	245-255	250-255
Phospholipids (%)	0.1	0.1	0.0
Unsaponifiable matter (%)	--	0.42	0.19
Tocopherols (mg/Kg)	150-200	150-200	4-100
Phytosterols (mg/Kg)	--	400-1200	--
Total phenolics (mg/Kg)	640	618	20
Fatty Acid Composition Relative (%)			
Saturates	92.0	92.0	92.0
Monounsaturates	6.0	6.0	6.0
Polyunsaturates	2.0	2.0	2.0

The fatty acid composition of the oil is: α-tocopherol, 5; and β-tocopherol, 6ppm: it also contains α-, β and γ-tocotrienol, 5, 1 and 19 ppm, respectively. The fatty acid composition of the oil is: caproic,<1: caprylic, 5-9; capric, 6-10; lauric, 44-52; myristic, 13-19; palmitic, 8-11; stearic, 1-3; oleic, 5-8; and linoleic, <3%. [6] Several derivatives have been obtained from these fatty acids and their uses are given in Table-2. [6]

Table -2 Applications of Derivatives of Coconut Oil Fatty Acid

Derivative	Application
Ethyl caproate	Synthetic flavours
Amyl caproate	Synthetic flavours
Allyl caproae	Synthetic flavours
Ethyl caprylate	Perfumery intermediate
Amyl caprylate	Perfumery intermediate
Butyl caprylate	Perfumery intermediate
Barium caprylate / caprate	Stabilizer for PVC
Allyl	Sweet banana / pineapple odour
Amyl caprate	Arrachcognac odour
Amylase caprate	Dip type coatin for food products
Butyl caprate	Apricot odour
Capryl caprate	Chemical pruning activity on plants
Lauryl alcohal	Detergent base
Sodium lauryl sulphate	Cosmetics and toiletries
Sodium lauryl ether sulphate	Shampoo
Iso propyl myristate	Cosmetics

Temperament (*Mizaj*)

Hot 2^0 & Wet 2^0 [7]

Therapeutic Dosage (*Miqdar-e-Khurak*)

2-3 Tola. [7]

Method of Uses *(Tarkeeb-e-Istemalat)*

Roghan-e-Narjeel (coconut Oil) is used for oral administration (Brah-e-Dahn) as well as topical application in the form of a paste (Zamad) and ointment (Marham) [6,7,8].

Pharmacological actions *(Af'aal)*

Dafe-e-Da-us-sadaf (Anti-psoriatic) [9]

Dafe-e-Kharish (Anti-pruritic) [9]

Qatil-e-Kirm-e-Shikam (Antihelminthic) [8]

Muqavvi-e-Bah (Aphrodiasiac) [7]

Muqavvi-e-Qalb (Cardiac Tonic) [5,10]

Muqavvi-e-Mana'at (Immunomodulator) [1,10]

Musakkin (Sedative) [7]

Murattib (Moisturizer) [9]

Mundamil-e-Qurooh (Wounds Healer) [9]

Nafey-e-Shaheeqa (Pertusis Reliever) [8]

Anti-microbial activity [1,11]

Anti-bacterial activity [1,11]

Anti-viral activity [1,11]

Anti-fungal activity [1,11]

Anti-protozoal activity [1,11]

Anti-septic activity [9]

Therapeutic uses (*Mahall-e-Istemalat*)

Roghan-e-Narjeel (Coconut Oil) is specially suggested in the treatment of Da-us-sadaf (Psoriasis), Nar-e-Farsi (Eczema), Hekah (Pruritis), Quba (Ring worm), Namla (Herpes), Busoor-e-Labniyya (Pimples) and Busoor-e-Jild (Skin Rashes) [7,8,9]. It is also used in Amraz-e-Qalb (Heart Diseases), Amraz-e-Sha'ar (Hair Diseases) like hair's falling, graying and lusturelessness. It is also used in Ziabitus (Diabetes), Deedan-e-Am'aa (Intestinal worms) particularly in Habb-ul-Qara (Tape Worm) and Aujaaye Baridah (cold pains) [7,8,10].

Scientific Studies

Few scientific studies are illustrated below regarding Roghan-e-Narjeel (Coconut Oil).

Anti-oxidant Activity

Newin et at (2005) studied VCO is capable of increasing antioxidant enzymes when supplemented with diets in rats[12].

Kapila et al (2009) compared the antioxidant activities of coconut oil extracted under hot and cold conditions. The coconut oil extracted under hot conditions (HECO) contained more phenolic substances than the coconut oil extracted under cold conditions (CECO). However, high temperatures used in the hot extraction of coconut oil favor the incorporation of more thermally stable phenolic antioxidants into coconut oil. Therefore, the consumption of HECO may result in improvement of antioxidant related health benefits compared with the consumption of CECO [13].

Anti-hyperlipidemic Activity

Newin *et al* (2007) showed the VCO lowered total cholesterol, triglycerides, phospholipids, low density lipoprotein (LDL), very low density lipoprotein (VLDL) and increased high density lipoprotein (HDL) [14].

Vessby (1994) reported the monounsaturated fatty acids such as oleic acid are as effective in reducing serum total and low density lipoprotein cholesterol levels as polyunsaturated fatty acids such as linoleic acid [5].

In 1989 Mendis *et al* reported undesirable lipid changes when young adult Sri Lankan males were changed from their normal diets by the substitution of corn oil for their customary coconut oil. Although the total serum cholesterol decreased 18.7 per cent from 179.6 to 146.0 mg/dl and the LDL cholesterol decreased 23.8 per cent from 131.6 to 100.3 mg/dl, the HDL cholesterol decreased 41.4 per cent from 43.4 to 25.4 mg/dl (putting the HDL values below the accept-able lower limit) and the LDL/ HDL ratio increased 30 per cent from 3.0 to 3.9.

Ahrens and colleagues (1957) had shown that adding coconut oil to the diet of hypercholesterolemics lowers serum cholesterol from 450 mg/ dl to 367 mg/dl. This is hardly a cholesterol raising effect [15].

Hostmark *et al* (1980) compared the effects of diets containing 10% coconut fat and 10 % sunflower oil on lipoprotein distribution in male wistar rats. Coconut oil feeding produced significantly lower levels ($p = <0.05$) of pre-beta lipoproteins (VLDL) and significantly higher ($p = <0.01$) alpha-lipoproteins (HDL) relative to sunflower oil [15].

Anti-viral Activity

Hierholzer and Kabara (1982) showed virucidal effects of monolaurin (a disease-fighting fatty acid derivative produced when the lauric acid in coconut oil is used by the body) on enveloped RNA and DNA viruses was done in conjunction with the Center for Disease Control of the US Public Health Service with selected prototypes or recognized representative strains of enveloped human viruses. The envelope of these viruses is a lipid membrane [15].

Kabara (1978) and others have reported that certain medium-chain fatty acids such as lauric acid and their derivatives like mono-glycerides (monolaurin) can have adverse effects on various micro-organisms including bacteria, yeast, fungi, and enveloped viruses that are inactivated by disrupting the lipid membranes of the organisms (Isaacs and Thormar 1991; Isaacs *et al* 1992).

Some of the viruses inactivated by these lipids, in addition to HIV, are the measles 1), vesicular stomatitis virus (VSV), *isna virus, and cytomegalovirus* (CMV) [15].

Anti-microial Activity

It is reported by Kabara (1972) that in vitro Lauri Acid and Capric Acid were active against all gram-positive and gram-negative organisms and Candida. Minimum Inhibitory Concentration ranges for lauric acid were 0.062–2.249 micromoles/ml, and were 1.45 and 5.8 micromoles/ml for capric acid [16].

Oyi et al (2010) reported that VCO in water emulsions killed S. aureus was by 6 hrs, *Ps. eruginosa*by 48 hrs, *Candida* or *A. niger* by 7 days in vitro [16].

Healing Activity

Nevin et al (2010) reported that VCO-treated wounds healed much faster due to higher collagen and anti-oxidant enzymes activities. It was also observed histopathologically, that there is increase in fibroblast proliferation and nevovascularization in VCO-treated wounds [17].

Moisturizing activity

Agero et al (2004) reported that Coconut oil is as effective and safe as mineral oil when used as a moisturizer in xerosis (dry & rough skin). A randomized double-blind controlled clinical trial was conducted on mild to moderate xerosis in 34 patients with negative patch-test reactions to the test products. These patients were randomized to apply either coconut oil or mineral oil on the legs twice a day for 2 weeks. Quantitative outcome parameters for effectivity were measured at baseline and on each visit with a Corneometer CM825 to measure skin hydration and a Sebumeter SM 810 to measure skin lipids. Both oils showed effectivity through significant improvement in skin hydration and increase in skin surface lipid levels. Subjective grading of xerosis by the investigators and visual analogue scales used by the patients showed a general trend toward better (though not statistically evident) improvement with coconut oil than with mineral oil, therefore Coconut oil is superior to mineral oil in dry skin [18].

Immunomodulator Activity

Winarsi et al (2008) reported that the VCO enriched with zinc increased Tc cells, Th cells, IL-2, but maintained the number of neutrophils and NK cells, while the IgG level changed from equivocal to negative in candidiasis patient [19].

Anti-diabetic Activity

It is reported by Girotti et al (1984) that Virgin coconut oil (VCO) has been shown to possess insulinotropic effects shown in isolated perfused mouse islet with hypolipidemic effects[20]. Further studies by Siddalingaswamy et al (2011) on diabetic rat with force fed with 2ml alcoholic extracts of commercial coconut oil (CCO), CEVCO and HEVCO for 21 days. The results indicated HEVCO reduced blood glucose and lipids viz total cholesterol (TC), triglycerides (TG), High density lipoproteins (HDL), Low and Very Low Density Lipoprotein (LDL+ VLDL) and thiobarbutyric acid reactive substances (TBARS) increased the antioxidant status by elevating activities of antioxidant enzymes such as superoxide dismutase (SOD), catalase, glutathione peroxidase (GSH-Px), glutathione (GSH) concentration and decresed lipid peroxidation in liver than CEVCO. These beneficial effects may be due to increased polyphenolic and other antioxidants content present in HEVCO [21].

Kabra *et al* (2012) reported that *Cocos nucifera* flower extract (CNFE) and coconut oil (CO) at a dose of 300 mg/kg body weight for 15 days, suppressed the elevated blood glucose and lipid levels in alloxan induce diabetic rats. These findings indicated that the *Cocos nucifera* flower extract and coconut oil possess antihyperlipidemic effect in addition to anti-diabetic activity. The hypoglycemic activity of coconut oil seen in

this study could be due to the fatty acids present in the oil [22]. It is reported by Maedler *et al* (2003) that monosaturated fatty acids improved β-cell secretory function by preventing β-cell apoptosis, decrease β-cell proliferation and impairment of β-cell function [23].

Anti-obesity Property

Liau *et al* (2011) reported that VCO is safe and effective in reducing visceral adiposity in obese, though healthy men. An open label pilot study was conducted over 20 obese but healthy volunteers with intake of VCO for four weeks. Result has been concluded that only waist circumference was significantly reduced with a mean reduction of 2.86 cm or 0.97% from initial measurement ($p=0.02$). Waist reduction was seen in only males ($p<0.05$) [24].

Another study by Assuncao *et al* (2009) showed that dietary coconut oil elevates High Density Lipoprotein (HDL) levels and reduces abdominal obesity in women. This randomized double-blind clinical trial involved 40 obese women, aged 20-40 years, presenting waist circumference(WC) >88cm (abdominal obesity). Groups received daily dietary supplements comprising 30 ml of either soyabeen oil (Group S; n=20) or coconut oil (Group C; n=20) over a 12- week periods. After 12- week, group C presented a higher level of HDL (48.7+/- 2.4 vs. 45+/-5.6; P=0.01) and a lower LDL: HDL ratio 2.41+/- 0.8 vs. 3.1 +/- 0.8; P=0.04). Reductions in BMI were observed in both groups but only group C exhibited a reduction in WC (P=0.005) [25].

Anti-Cancer Activity

Lim-Sylianco (1987) published a 50-year literature review showing the anti-cancer effects of coconut oil [26]. Cohen *et al* (1986) showed that coconut oil was by far more protective than unsaturated oils in chemically induced cancers of the colon and breast, for example 32% of corn oil eaters got colon cancer whereas only 3% of coconut oil eaters got the cancer. Animals fed unsaturated oils had more tumors. This shows the thyroid-suppressive and hence, immuno-suppressive effect of unsaturated oils [27].

Antithrombotic Property

VCO has significant antithrombotic effect over copra oil [14]. A coconut oil based diet high saturated fatty acid diet lowers postparendial t-PA (tissue plasminogen activator) antigen concentration, and this may favorably affect the fibrinolytic system and the Lp-a (lipoprotein-a) concentration compared with the high mono polyunsaturated fatty acid diet. The proportions of dietary saturated fatty acids more than the percentage of saturated fat energy seem to have a beneficial influence Lp-a (lipoprotein-a) levels [28].

Conclusion

Coconut oil has many health benefits, which includes hair care, skin care, stress relief, cholesterol level maintenance, weight loss and boosted immune system. These benefits of oil can be attributed to the presence of lauric acid, capric acid and caprylic acid. The oil is known to have antioxidant, antiviral, antibacterial, antifungal antiprotozoal, antihyperlipidemic effects and excellent healing & moisturizing properties. However, more research is needed to clearly understand the many good effects of the oil.

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