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A Review on the Role of Coconut Oil in Dermatitis Diseases

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ABSTRACT

Background: Coconut oil, or copra oil is obtained from the nut/kernel of matured coconuts garnered from the Cocosnucifera. Coconut oil is an edible oil derived from the kernels of harvested mature coconuts harvested from the coconut palm. In recent decades, this oil has risen to the status of a health food superstar in the health food industry. Celebrities are welcoming its use, nutritionists are promoting it, and patients are praising it for its many benefits.

Purpose: This oil has been linked to a range of health advantages. These include improvements in skin care, hair care, stress management, losing weight & cholesterol level management, immune modulatory effects, cardiovascular applications, and, most recently, Alzheimer's disease. However, for several years, coconut oil was demonised, and consumers were led to believe that it was harmful to their health because it would clog arteries and cause heart disease. The tide has shifted, and in recent years, increased awareness of the favourable health advantages of coconut oil has emerged.

Conclusion: The usage of coconut oil, particularly crude coconut oil, is increasingly popular; however some individuals are still doubtful. This present review makes an attempt to provide a scientific assessment of the medicinal qualities of this oil.

1. Introduction

Coconut oil, or copra oil that is obtained out of the nut/kernel of matured coconuts garnered from the *Cocosnucifera*.

For generation sequatorial countries have used coconut from the tree *Cocosnucifera*, Family Aracaceae as an essential part of their nutriment and livelihood. In Philippines, it is commonly known as the "Tree of Life" (Kappally, Shirwaikar & Shirwaikar, 2015). There is a dilemma over the use of coconut oil because many people believe that saturated fats that are present in coconut oil make it bad for health as it can clog the arteries and cause cardiac infarction; however, many researchers suggest that coconut oil has many good properties like balancing the level of cholesterol in the blood, it also safeguards the arteries by lowering coagulation plugs. The name 'virgin' has been used recently to mark the values associated with health in coconut oils (Verallo-Rowell, Dillague & Syah-Tjundawan, 2008). There is a lot of controversy for its use in human nutrition, primarily because of high ratio of free fatty acids. However, many scientific clinical studies have been reported for its positive effect on human body (Natalia, 2017). Many public-figures are using it, dietetics advocating it, and patients applauding its many virtues. This oil is associated with a number of health benefits (Marinaa, Che Mana & Amin, 2009).

VCO production which at present is mainly done on a small scale or village level is rising rapidly and has potential of increasing the market income of coconut farms by 5 to 8 fold. Asian Pacific Coconut Community (APCC) and representative countries are moving up the use of VCO for health and rising livelihoods of smallholder coconut processors. But the major concern lies on the quality of the finished product so as to meet with the standards and fit for human use (Bawalan & Chapman, 2006). In history, it has been used to intensify the allure and improve the growth of our hairs, refine and dampen our skin conditions and also secondary ailments like diarrhoea and skin inflammations. It was reported by Lans (2007) that *Cocosnucifera* was used to treat gastrointestinal problems and minor wounds , injuries, and inflamations as an "ethonomedicine". Also the lauric acid i.e. a medium chain fatty acid, shows anti-obesity properties (Mansor et al., 2012).

Dermatitis is a chronic inflammatory skin disease affecting both children & adults and has become increasingly pruritic (Chew, 2019). It is complex, recurrent relapsing, incendiary disease, characterized by xerosis, abrasions, eczematous and pruritus (Valdman-Grinshpoun,

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Ben-Amitai & Zvulunov, 2012). Dermatitis is diagnosed on the basis of the constellation of medical findings, such as itchiness, facial and extensor eczema in neonates and children, chronicity of dermatitis and flexural eczema in adults (Leung, Boguniewicz, Howell, Nomura & Hamid, 2004).

1.1. Extraction of Coconut Oil

Coconut meat of fresh and mature kernel is used for extraction of Virgin coconut oil. Different types of coconut oil can distinguished based on steps used for extracting fat from the crude drug:

- Virgin coconut oil (crude oil) is obtained by crushing fresh and ripe coconuts to obtain the oil. One of simplest precaution to collect oil is that it should not contain caustic solvents or other fading or odor control agents (Villarino, Dy & Lizada, 2013). Also, innate sensory properties and a high content of bio-active compounds is retained (Arunimaa & Rajamohan, 2013).
- Oil produced by pressing coconut flesh (Refined oil) and then subjected to additional processing such as bleaching, refining, and deodorizing. This results in tasteless and odorless oil product with a higher smoke point (Marina, Che Man, Nazimah & Amin, 2009).

Some other officially accepted methods for the extraction of virgin coconut oil are as follows:

- WET METHOD
- DRY METHOD

WET METHOD - The wet method can further be divided into three alternatives that help in the destabilization of the coconut oil emulsion (1) chilling, thawing and freezing technique (2) enzymatic methods and (3) fermentation or any of them can be used in combination.

Chilling, freezing and thawing technique - In this technique the emulsion of coconut milk is allowed to centrifuge at about 2000 to 5000 rpm up to 6 minutes. Centrifugation is followed by chilling at freezing at 10°C and -4°C. Thrawing at 40°C continues as a next step until coconut cream reaches the room temperature (Nevin & Rajamohan, 2009; Mansor et al., 2012). The insoluble solids would be eliminated in these steps so as to yield high quality virgin coconut oil. Centrifugation would ensure the coconut oil is packed in globules to crystallize at a lower temperature.

Fermentation - Water at 30, 50 and 70°C is first mixed to grafted coconut meat in different ratios i.e. 1:1, 1:2 and 1:3 followed by inoculation with *Lactobacillus platarum* followed by settling of mixture for at least 2-6 hours. In order to destabilise the coconut milk emulsion, *L. platarum* is added to aid in its quick breakup and release of oil. The pH of the mixture is altered to achieve so. At the last the fermented milk is centrifuged to harvest the Virgin Coconut Oil (Agarwal & Bosco, 2017; Suryani et al., 2020).

Enzymatic extraction - Enzymatic extraction of coconut oil is mainly done by the use of enzymes *Celluclast, Termamyl, Viscozyme, Neutrase y Protease* which are selected on the basis of Preliminary experiments. The coconut oil milk is treated with the enzymes, keeping pH levels into considerations because an increase in pH has negative effect on the enzymatic extraction of coconut oil yield thus decreasing the efficiency (Sant'Anna, Freitas & Coelho, 2003).

DRY METHOD - In this method the kernel is heated under specific conditions of temperature and pressure to remove moisture along with prevention of microbial invasion & sweltering. Separation of coconut copra is done & the coconut meat is pulverized, followed by hydraulic extraction at law temperature (<50°C) (Bawalan & Chapman, 2006).

1.2. Chemical Constituents of Virgin Coconut Oil

In the nineteenth century it was figured out that coconut oil is different from other marketed fats and oils as it is composed principally of medium chain triglycerides. Gas Liquid Chromatography is used to determine the composition of fatty acids in VCO including saturated fats such as Lauric acid(45%-52%), Palmatic acid (7%-10%), Caprylic acid(5%-10%), Myristic acid (16%-21%), and Palmitoleic acid (in traces). Some of the unsaturated fatty acids are Linoleic acid(1%-3%), Oleic acid(5%-8%), and Linolenic acid(up to 0.2%). Virgin Coconut oil should be rancidity free, colourless and have the specific coconut odour and the specifications that should match with the standard specifications as mentioned in the table (Kappally, Shirwaikar & Shirwaikar, 2015).

Sterols-Plant organisms synthesize structural and functional analogues of cholesterol. Sterol portions in coconut oil i.e. β-sitosterol, stimgasterol & campesterol with average contents approximately 8, 13 and 39% respectively have anti-tumor and hypocholesterolemic effects (Natalia, 2017; Carandang, 2008).

Tocols-α-tocopherol(α-T) is the most dominant among to tocopherols in the coconut oil. Its share is estimated at 0.20 to 1.82% of the total tacols i.e. 40.20mg/100g. Other tocopherols such as β, γ & Δ-tocopherolin the oil are 0.1, 0.2 and 0.4%, respectively and have anti-aging, anti-thrombotic, hypocholesterolemic and anti-tumor activity (Carandang, 2008). These tocopherols obstruct Low Density Lipoprotein oxidation and supress HMG-CoA reductase activity and also inhibit the platelet aggregation

to show atherogenic activity (Wallace, 2018). Other than these there is presence of fractions of tocotrienols, with highest quantity of α-tocotrienol (α-T3) in an extent limit from 1.1 to 2.99% (Natalia, 2017). Tocopherols consist of a saturated phytyl side chain whereastocotrienols consist of an unsaturated isoprenoid side chain containing three double bonds. Presence of monolaurin in VCO shows antimicrobial activity (Peedikayil, Sreenivasan & Narayanan, 2015).

Flavonoids and other polyphenols- Simple phenol, phenolic acids, hydroxyl cinnamic acid and its derivatives are included (Carandang, 2008). The dominant phenolic acids that persist in VCO in increasing order of concentration are caffeic acid, syringicacid, p-coumaric acid, vanillic acid, and ferulic acid (Wallace, 2018). Flavonoids are polyphenolic compounds consisting of 15 carbon atoms i.e. two benzene rings joined together by a propane. The skeleton is represented by C6-C3-C6 system. One of the flavonoid i.e. Rotenone is used topically for treatment of head lice, scabies, and other ectoparasites. Anti-platelet, anti–allergic, anti- inflammatory, antitumor, and antioxidant activities of flavonoids are major topics of interest (Sant'Anna, Freitas & Coelho, 2003).

1.3. Problems Originated from Dermatitis

Dermatitis is a general term for skin inflammation. It mainly leads to the skin look dry, turgid and reddish. Depending on the type of dermatitis causes may vary. Dermatitis symptoms may include-rashes, abscesses, dry or cracked skin, itchiness, pain with stinging or burning, redness, swelling etc. (Glatz et al., 2018).
Some major skin related problems are as follows:

1.3.1. Acne

Acne is usually caused at the adolescence age, but now a days a huge number of people of over 25 years of age are found with acne (Glatz et al., 2018). Initial pathologic condition involves microcomedo along with follicular burst of comedo, that starts an inflammatory response. This leads to the formation of cysts, pustules, and/or papules. Generally, the clinical appearance and morphologic indication of acne varies with age. However, there occurs a significant overlap amongst the age categories (Goulden, Stables & Cunliffe, 1999). Onset frequencies of different types of acne are as follows:
Neonatal acne - 0 to 6 weeks of age
Infantile acne - 3 to 6 months
Acne vulgaris - At teenage
Adult acne - 25 to 44 years of age

1.3.2. Ageing

Modification of basal connective tissue characterizes the normal skin which can undergo calculable effects on global skin biophysical characteristics. Patients appear aged prematurelyin case of accelerated ageing process due to alterations in dermal elastic fibers. There is change in orientation of cutaneous lines from nearly isotropic to greatly anisotropic formation (White, 1998). Features such as wrinkling, loss of flexibility, laxity, and coarse-textured appearance greatly characterize the skin ageing. The single biggest culprit in aging skin is sunlight exposure. With time, fibers in the skin called elastin are deteriorated by the sun's ultraviolet (UV) rays. The skin sags, stretches, and loses its ability to snap back after stretching due to deterioration of elastin fibers. Bruising, tearing and longer healing time are other ill-effects of ageing. Sun damage will not show a young age, but it will show its effects in the later stages of the life.

1.3.3. Inflammation

In dermatology, skin inflammations are the most frequently encountered problem. The problems can manifest themselves in a variety of ways, ranging from minor rashes accompanied by skin irritation and redness to chronic conditions such as dermatitis (eczema), rosacea, seborrheic dermatitis, and psoriasis. Acute skin inflammation is distinguishable from chronic skin inflammation. The difference between them is a matter of timing, says Elbuluk. Time of acute inflammation is around six weeks or less and can arise from many skin issues, like acne, allergic reactions and sunburns. On the other hand chronic inflammation is indefinite and may go beyond 8 weeks. The host skin's internal defence system consists of three main components: (1) a acquired immunity, (2) congenital immunity, and (3) barrier among others. Because none of the disorders in the above-mentioned layers can cause a normal immune response to specific infectious agents or internal/external injury, one of the disorders in the above-mentioned layers can induce an inflammatory skin disease with a distinct manifestation that partially mimics the actual defensive response against infections & risks (Pailler-Mattei, Debret, Vargiolu, Sommer & Zahouani, 2013).

1.3.4. Pigmentation Disorders

Skin color is highly specific and the changes among the individuals are regulated by various genes. The size and number of melanosomes differentiates the different skin colors (White, 1998). Abnormalities due to migration of melanocytes from the neural chest to the skin during embryogenesis can be a result of pigmentation disorders. In addition, impairment of melanosome transfer to the surrounding keratinocytes, an alteration in melanin synthesis and a defective degradation or removal of melanin may lead to abnormal skin pigmentation [25].

1.3.5. Bacterial and Fungal Infections

Colonization of *Staphylococcus aureus* frequently occurs in infected eczema skin. *S. aureus* colonization on atopic skin could lead to chronic inflammation, dysfunction of skin barrier and result in dry and flaky skin (Mansor et al., 2012). Fungal infections may also lead to scaly and degraded skin.

2. Mechanism of Action

2.1. Dermatitis

In THP-1 cells, VCO has the ability to regulate pro-inflammatory molecules such as interleukin-6, interferon-gamma, interferon-alpha, interleukin-8, interleukin-5, and TNF-a. To deliver effective immune function that is a part of innate immunity, a vital role is played by monocytes and macrophages. Proinflammatory cytokines that are chargeable for inflammation, delirium, damage of tissue & cell expiry of cell are TNF- α and interleukins (IL). One of the mostly considered pro-inflammatory cytokine is TNF-α which can cause pathogenesis of a large number of inflammatory diseases (Varma et al., 2019). This in turn demonstrates TNF- α production induced by LPS in THP-1 cells which is significantly decreased by VCO. A cell membrane protein, Involucrin, is produced in the initial stages of keratinocyte terminal differentiation. Enhancement in skin barrier activity is there due to greater level of involucrin expressed in the epidermis. VCO increases the level of involucrin in the skin, as well as the expression of microRNA (mRNA) in the epidermis, both of which contribute to the improvement skin barrier function. VCO increase the involucirin level & also increases regulated the m-RNA level of expression in HaCaS cells that can thereby promote the formation of cell envelope & cohesion. Monocyte-produced cytokines such as interferon-gamma (IFN-gamma), interleukin-12 (IL-12), and interleukin-10 (IL-10) play an important role in the pathogenesis of infection and numerous inflammatory disorders. VCO inhibit IFN-γ on LPS stimulus and also affect reduction of TNF-α. As a result, the topical application of VCO has anti-inflammatory effect by limiting the amounts of various cytokines such as Tumor necrosis factor (tnf, IFN-, IL-6, IL-5 & IL-8 in the skin, as well as improving the performance of the skin barrier. Because of this, skin problems marked by permeability barrier malfunction, particularly those associated with diminished epidermal protein expression, such as dermatitis and eczema, can be completely cured with VCO (Karagounis, Gittler, Rotemberg & Morel, 2019).

Conclusion

From the above discussion it is concluded that coconut oil has several health benefits including skin related problems i.e. acne, ageing, pigmentation disorder, inflammation etc. Its topical use on skin can also effect bacterial and fungal growths on the outer skin that may lead to dry and flaky skin. VCO can be extracted by wet and dry methods. THP-1 cells can be induced to produce pro-inflammatory cytokines such as Tumor necrosis factor, IFN-a, IL-8, IL-4, & IL-6, which can be controlled by VCO. It also increases the involucirin level that leads to enhanced skin barrier function.

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Authorship Contribution

Pavas Sharma: Conceptualization
Durga Chauhan: Methodology, investigation
Suijt Bose: Resources
Rakesh Kumar: Data curation, supervision
Rajesh Kumar: Writing - Original Draft
Amit Mittal: Writing - Review & Editing, administration.

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Conflict of Interest

The authors declare no conflict of interest.

Declaration

It is an original data and has neither been sent elsewhere nor published anywhere.

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