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A Review of Efficacy and Safety of Coconut Oil in Treating Skin Infections

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Abstract: Coconut oil has been hypothesized to have antimicrobial and antifungal activity. Medium-chain fatty acid constituents of coconut oil including lauric acid, capric acid, and others provide antimicrobial effect by disrupting bacterial, fungal, and viral cell membranes, leading to cell death. This review summarizes in vivo and in vitro studies of topical anti-infective properties of coconut oil and the medium-chain fatty acids contained within, and describes the proposed use of coconut products for dermal infections.

Keywords: Antimicrobial activity, Antifungal activity, Medium-chain fatty acid

I. INTRODUCTION

The scientific name of coconut is Cocosnucifera L. Coconut oil is a fatty oil that comes from the white pulp of the coconut referred to as the "tree of life" because of its many uses. Coconut oil has traditionally been used as a medicinal agent for cancer, diabetes, diarrhea, dry skin, and psoriasis and is used as an antibacterial, antifungal, and antiviral agent for the treatment of dermal infections.[1–3] Evaluation of Cocosnucifera L. as an anti-infective agent is very important due to the increased prevalence of antibiotic-resistant infectious microorganisms, and the dearth of novel antibiotics in the pipeline.

Coconut oil contain Median Chain Fatty Acid (MCFA).Fats with a chain length of 6 to 12 carbons are called medium chain triglycerides (MCTs). The antiviral, antibacterial, and antifungal properties of the medium chain fatty acids/triglycerides (MCTs) found in coconut oil have been known to researchers since the 1960s. Research has shown that microorganisms that are inactivated include bacteria, yeast, fungi, and enveloped viruses.

Medicinal properties of C. nucifera are attributed to 3 medium-chain fatty acids found in coconut fat: lauric acid, the most abundant fatty acid, capric acid, and caprylic acid.[3]Lauric acid is the most predominant MCFA found in coconut oil. Lauric acid is a mediaum chain fatty acid, which has the additional beneficial function of being formed into monolaurin in the human or animal body. Monolaurin is the antiviral, antibacterial and antiprotozoal monoglyceride used by the human or animal to destroy lipid-coated viruses such as HIV, Herpes, various pathogenic bacteria and protozoa.[1-5]

A. 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 newest high-value product, which is becoming a by-word in coconut producing countries is Virgin Coconut Oil (VCO). VCO, the purest form of coconut oil is essentially colorless and free from rancidity. 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%).[10]

B. Clinical Evidence

Studies have evaluated the antimicrobial activity of *Cocosnucifera L.* husk fiber, coconut oil, and lauric acid and monolaurin extracts.

1) *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 transepidermal 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(SCO Ring of Atopic Dermatitis) 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.[14]

2) *Comparative study of Virgin Coconut Oil (VCO) and virgin olive oils (VOO)in adult atopic dermatitis.:* Atopic dermatitis (AD) skin is dry and readily colonized by Staphylococcus aureus (SA). A double-blind, randomized controlled trial compared virgin coconut oil (VCO) to virgin olive oil (VOO) for efficacy in removing colonized Staphylococcus aureus in 26 patients aged 18 to 40 years with atopic dermatitis (AD). Both groups applied 5 mL of either VCO or VOO on the affected area twice daily and were instructed not to put any other emollients, creams, or oil-based products on the lesions.[7]The results concluded that the VCO and monolaurin's O-SSI reduction and in vitro broad-spectrum activity against SA (given clinical validity here), fungi, and viruses may be useful in the proactive treatment of AD colonization. No adverse effects to VOO or VCO were reported.[6]

3) *The Antimicrobial Activity of Liposomal Lauric Acids Against* Propionibacterium acne**:** A mixed in vitro and *in vivo* study examined the antibacterial activity of lauric acid against Propionibacterium acnes and other skin flora. P. acnes is the main causative organism of acne vulgaris, a disease that affects between 50% and 95% of adolescents at some point in their lives and 40 million people in the United States.[9] Current treatments, such as benzoyl peroxide (BPO), have undesirable side effects including burning, drying, irritation, and erythema.[10]S. aureus, Staphylococcus epidermidis, and P. acnes were co-cultured with either BPO or lauric acid. Following incubation of agar plates containing P. acnes and either BPO or lauric acid, the minimum inhibitory concentration (MIC) against each organism for BPO were 15.6, >100, and 62.5 mcg/mL, respectively, compared to 0.9, 3.9, and 3.9 mcg/mL, respectively, for lauric acid. Lauric acid was bactericidal to P. acnes at concentrations over 60 mcg/mL. In the in vivo portion, BALB/C mice ears were injected intradermally with 1 X 107 colony forming units (CFU) of P. acnes. After 24 hours, significant swelling was observed in the P. acnes injected ear. Inflamed ears were then treated with intradermal injections and epicutaneous applications of lauric acid. After 1 day ear inflammation thickness was significantly reduced ($P<0.05$), as were P. acnes CFU ($P<0.0005$). TUNEL assays (Terminal deoxynucleotidyl transferased UTP nick end labeling, a method that identifies DNA fragmentation that results from abnormal apoptosis or cellular DNA damage) reveal that lauric acid was not toxic to keratinocytes.[9]

4) *Formulation and Antimicrobial Studies of Coconut (Cocosnucifera Linne) Oil:* Coconut oil obtained from the nuts of *Cocos*nucifera was formulated into creams inorder to standardize its use and present it in an elegant form. Using the fusion method, oil in water (o/w) creams were formulated in concentrations of 5 to 40% w/w of oil. The release of active ingredients from creams was investigated using cream challenge and skin inoculation tests, whereby creams were exposed to various spots on skin inoculated with Ps. aeruginosa ATCC 7853, E.coli ATCC 9637, P.vulgaris (clinicalisolate), B.subtilis ATCC607and C. albicans ATCC 10231. In addition A. niger (clinical isolate) and S. aureus ATCC 13709 were used for antimicrobial screening. The stability of creams was also evaluated using a standard method. The results showed that active ingredients of the coconut oil were released from the creams; this was shown from the good antimicrobial activity of the cream confirming that all formulation ingredients were compatible and did not interfere with activity of the oil. The creams were also found to be stable, as a result of their ability to withstand shock and maintain their physical characteristics.[13]
heemergnce of antimicrobial resistance, coupled with the availability of fewer antifungal agents with fungicidal actions, prompted this present study to characterize Candida species in our environment and determine the effectiveness of virgin coconut oil as an antifungal agent on these species. In 2004, 52 recent isolates of Candidaspecies were obtained from clinical specimens sent to the Medical Microbiology Laboratory, University College Hospital, Ibadan, Nigeria. Their susceptibilities to virgin coconut oil and fluconazole were studied by using the agar-well diffusion technique. Candida albicans was the most common isolate from clinical specimens (17); others were Candida glabrata (nine), Candida tropicalis (seven), Candida parapsilosis (seven), Candida stellatoidea (six), and Candida krusei (six). C. albicans had the highest susceptibility to coconut oil (100%), with a minimum inhibitory concentration (MIC) of 25% (1:4 dilution), while fluconazole had 100% susceptibility at an MIC of 64 µg/mL (1:2 dilution). C. krusei showed the highest resistance to coconut oil with an MIC of 100% (undiluted), while fluconazole had an MIC of >128 µg/mL. It is noteworthy that coconut oil was active against species of Candida at 100% concentration compared to fluconazole. Coconut oil should be used in the treatment of fungal infections in view of emerging drug-

5) *Used as a moisturizer for mild to moderate xerosis:* Xerosis is a common skin condition (1) characterized by dry, rough, scaly, and itchy skin, (2) associated with a defect in skin barrier function, and (3) treated with moisturizers. People in the tropics have effectively used coconut oil as a traditional moisturizer for centuries. Recently, the oil also has been shown to have skin antiseptic effects. This study aimed to determine the effectivity and safety of virgin coconut oil compared with mineral oil as a therapeutic moisturizer for mild to moderate xerosis. 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. 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. [15]

II. 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. Abbreviations: CA: capric acid, CFU: colony forming units, DB: double blind, FA: fatty acid, LA: lauric acid, MBC: minimum bactericidal concentration, MIC: minimum inhibitory concentration, MRSA: methicillin resistant Staphylococcus aureus, MSSA: methicillin sensitive Staphylococcus aureus, RCT: Randomized controlled trial, spp: species, VCO: virgin coconut oil, VOO: virgin olive oil

A. Conflict of Interest

Authors would hereby like to declare that there is no conflict of interests that could possibly arise.

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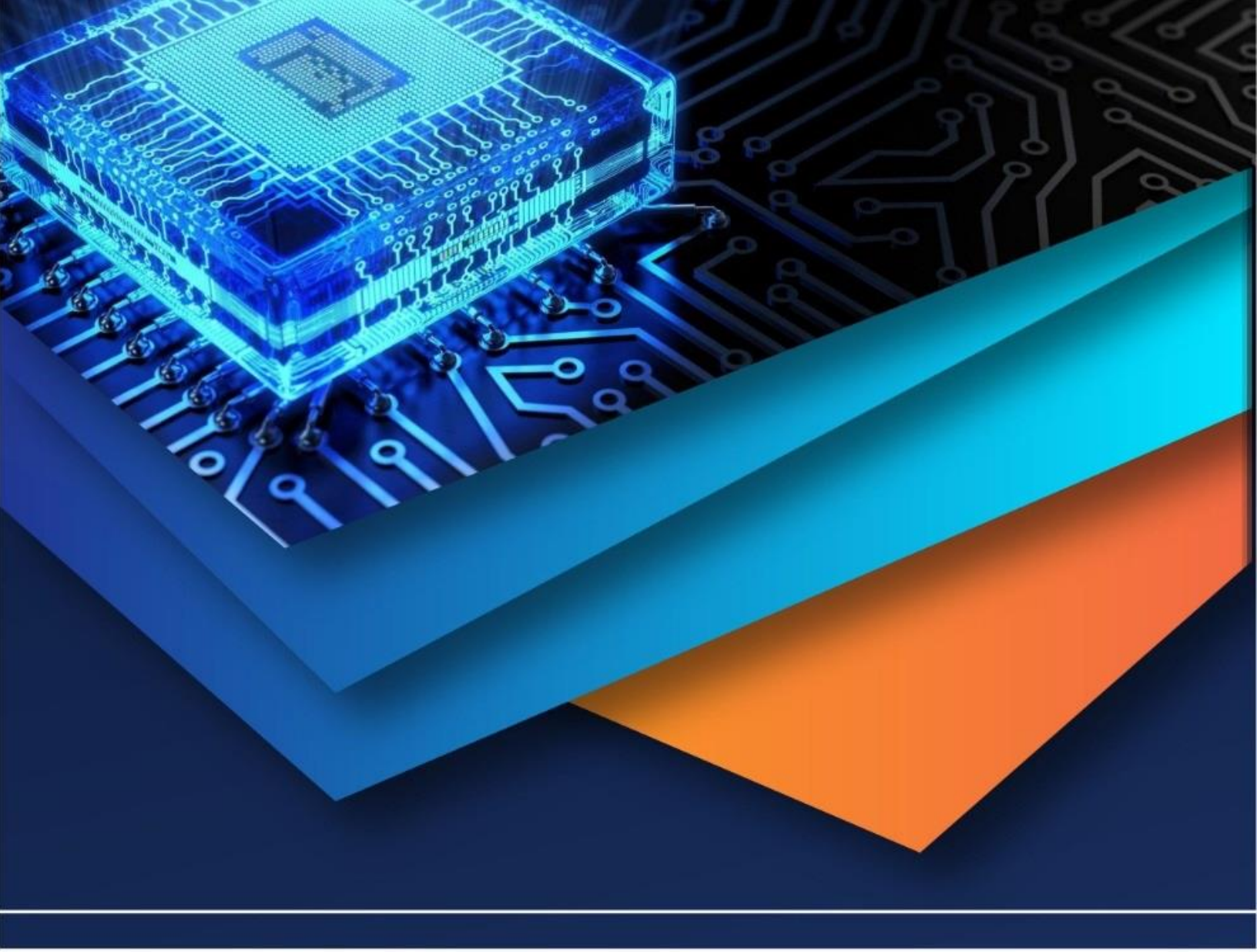

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