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Antimicrobial Properties of *Cocos nucifera*: A Review

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Abstract

Coconut is known as the "wonder food" and is regarded as perfect diet because it contains almost all essential nutrients needed by the human body. The various products of coconut include tender coconut water, copra, coconut oil, raw kernel, coconut cake, coconut toddy, coconut shell and wood based products, coconut leaves, coir pith etc. Coconut is a unique source of various natural products for the development of medicines against various diseases and also for the development of industrial products. Almost all the parts of the palm have medicinal properties such as antibacterial, antifungal, antiviral, antiparasitic, antidermatophytic, antioxidant, hypoglycemic, hepatoprotective and immunostimulant property. The various medicinal properties of coconut and its products are summarized in this paper.

Keywords: coconut, antimicrobial properties

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Introduction

Plants have always played a major role in the treatment of human and animal diseases. Medicinal plants can be used in different forms: (i) as raw materials for extraction of active compounds or (ii) for extraction of abundant but inactive constituents which can be transformed by partial synthesis into active compounds as such as extracts or as traditional preparations (Mukherjee, 2008).

Coconut is a drupe borne by the coconut palm (*Cocos nucifera)*, a member of the monocotyledonous family Palmae. It is known as the "wonder food" and is regarded as perfect diet because it contains almost all essential nutrients needed by the human body. Coconut palms are grown in more than 80 countries of the world, with a total production of 61 million tonnes per year (FAO, 2010). India is the third largest coconut producing country, having an area of about 1.78 million hectares under the crop. In India, the four south Indian states namely Kerala, Tamilnadu, Karnataka and Andhra Pradesh account for around 90% of the coconut production in the country (NMCE, 2007). Coconut is a very versatile and indispensable fruit for most people under the tropical belt. It is a complete food is rich in calories, vitamins, and minerals. It is nourishing, strengthening and fattening food. It has high oil content. The protein is of high quality and contains all amino acids essential for the growth and maintenance of the body. It is rich in K, Na, Mg and S. The energy value of the dried coconut is 662 calories per 100 g (Bakhru, 2000). The nutrient content of nuts varies by species, but in general they provide rich sources of vegetable protein, monosaturated and polyunsaturated fatty acids, dietary fiber, vitamins E & K, folate, magnesium, copper, selenium and potassium. Nuts are also naturally low in saturated fatty acids and sodium (O'Neil *et al*, 2012). Nuts also provide phenols, phytosterols, flavanoids, proanthocyanidins, resveratrol and arginine; these bioactive compounds, coupled with micronutrients such as vitamin E and selenium, serve as antioxidants and are anti-inflammatory (Bolling *et al.*, 2010).

All parts of coconut tree besides being used as food and commercially, are also rich in medicinal properties. Most of the parts of coconut tree such as endosperm, coconut oil, tender coconut water, inflorescence and root are being used in the Ayurvedic medicine for the treatment of several clinical conditions. In view of its utilitarian value of the entire tree it is often referred as *Kalpavriksha* (Pushpan *et al.*, 2013).

It is the unique source of various natural products for the development of medicines against various diseases and also for the development of industrial products. The parts of its fruit like coconut kernel and tender coconut water have numerous medicinal properties such as antibacterial, antifungal, antiviral, antiparasitic, antidermatophytic, antioxidant, hypoglycemic, hepatoprotective and immunostimulant property. Coconut water and coconut kernel contain microminerals and nutrients, which are essential to human health, and hence coconut is used as food by the peoples in the globe, mainly in the tropical countries (Deb Mandal and Mandal 2011).

Anti-bacterial activity of coconut

The antibacterial activities of coconut endocarp extracts using methanolic and aqueous extracts showed a strong activity against *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Micrococcus luteus* (Singla *et al.*, 2011). The antimicrobial property of coconut shell showed strong antibacterial activity on *Ecsherichia coli* and *Salmonella typhi* (Verma *et al.*, 2012). The antibacterial potentials of crude aqueous and n-Hexane extracts of the husk of *Cocos nucifera* against forty-five strains of *Vibrio* pathogens and twenty-five other bacterial isolates those normally implicated in food and wound infections were studied. The aqueous extract was active against 17 of the tested bacterial and 37 of the *Vibrio* isolates; while the n-Hexane extract showed antibacterial activity against 21 of the test bacteria and 38 of the test *Vibrio* species (Akinyele *et al.*, 2011).

Tender coconut water is given to cholera patients because of its saline and albumen content (Effiong *et al.*, 2010). It is generally used to treat urinary infection and diarrhea. Three

peptides lower than 3kDa were purified and identified from green coconut water by using reversed phase-high performance liquid chromatography (RP-HPLC), showing molecular masses of 858Da, 1249Da and 950Da. These peptides have remarkable potential to contribute in the development of novel antibiotics from natural sources (Mandal *et al.*, 2009).Bacterial isolates obtained from fermented toddy were checked for the activity against *B. cereus*, *Listeria monocytogenes* and *E. coli* which are common food borne pathogens that infect the gastro intestinal tract. The results showed that two of the ten isolates could inhibit the indicator organisms, however, at different inhibition levels (Krishnamoorthy and Arjun 2012).

Antimicrobial property of coconut leaf extracts against *Acinetobacter* spp., *B. cereus*, *E. coli*, *S. typhi*, *Shigella dysenteriae*, *S. aureus*, *Aspergillus flavus and A. niger* were investigated. The results showed that the leaf extract were active against all the organisms except *S. aureus* and *A. flavus* (Ifesan *et al.*, 2013). The phytochemical screening of coconut flowers demonstrated the presence of alkaloids, flavonoids, phenols, phytosterols, tannins, aminoacids and carbohydrates (Dyana and Kanchana, 2012). These phytochemicals present in coconut flowers have well known curative activity against several human pathogens. Antibacterial properties of aqueous and methanolic extracts of 26 medicinal plants used in Mexico to treat gastrointestinal disorders were studied. The results showed that coconut being one of the plants which possessed a strong bactericidal activity against tested species (Alanis *et al.*, 2005).

The effects of oil-pulling against oral microorganisms in biofilm models using different edible oils were investigated. The study proved that oil-pulling using coconut oil exhibited antimicrobial activity against *S. mutans* and *C. albicans* which are considered to be the predominant microorganisms found in dental caries (Thaweboon *et al.*, 2011). Owing to the high Lauric acid content in coconut flour, it has used as a medication for oral sores (Taheri *et al.*, 2010). Husk fibers extract of coconut was proved to have potential cure for oral diseases (Alviano *et al.*, 2008).

Lauric acid is a natural compound that is the main acid in coconut oil and also resides in human breast milk. Studies have been done to prove the potentiality of lauric acid against many harmful pathogens. Batovska *et al.*, in 2009 worked on antibacterial activity of medium chain fatty acids and their 1- monoglycerids. In the study they have reported that among all monoglycerides, monolaurin displayed the greatest anti bacterial activity towards various Gram positive strains. The antimicrobial property of lauric acid against *Propionibacterium acnes* both *in vitro* and *in vivo* was studied. The *in vitro* studies proved that lauric acid inhibited the growth of *P. acnes*, and did not have much effect on resident flora of skin. The cytotoxicity effect of lauric acid reported that higher concentrations of lauric acid also did not affect viability of the cells, instead killed the acne causing bacteria. (Nakatsuji *et al.*, 2009).

Anti-fungal activity

Heating the coconut shells gives oil that is used against ringworm infections in the popular medicine of India. The alcoholic extract of ripe dried coconut shell has antifungal activity against *Microsporum canis*, *M. gypseum*, *M. audouinii*, *Trichophyton mentagrophytes*, *T. rubrum*, *T. tonsurans* and *T. violaceum*. The extract showed antifungal activity against all dermatophytes tested with twice the concentration needed against *Epidermophyton flocossum* (200 ug/ml. The activity was mainly attributed to the high content of phenolic compounds (Venkataraman *et al.*, 1980). An extensively study carried out by Ogbolu *et al.*, (2007) revealed that the anti- fungal activity of coconut oil against 6 *Candida* sp. obtained from clinical settings. They further reported that coconut oil was active against species of Candida at 100% concentration compared to fluconazole.

Antiviral activity

Coconut oil is very effective against a variety of viruses that are lipid-coated. The

medium chain fatty acids in coconut oil destroy the viruses by disrupting their membranes, interfering virus assembly and maturation (Arora *et al.,* 2011). Coconut oil as an anti- HIV medication was administered to 15 HIV positive patients at different concentrations for 6 months. By the end of three months 50% of the patients showed reduced viral load and by the end of 6th month, eight patients showed reduced viral load and favorable CD4/ CD8 count (Conrado 2000). Extraction of polyphenols from husk fiber was done and the extract was checked for antimicrobial and antiviral activities. The selective antibacterial activity of *C. nucifera* against *S. aureus* and Herpes Simplex Virus - 1(HSV-1) suggests that this plant may be useful for topical application in wound healing (Esquenazi *et al.,* 2002).

Antiprotozoan activity

The antihelmintic assay was performed on chironomus larvae by Mariselvam *et al.,* 2013. The crude extract of the coconut inflorescence not only confirmed inactivation of helminthes, but also caused death in the shorter time as compared to standard drug albendazole. The *in vitro* leishmanicidal effects of coconut husk extracts on *Leishmania amazonensis* were evaluated. These results showed that extract of coconut husk at 10 µg/ml was a strikingly potent leishmanicidal substance which inhibited the growth of both promastigote and amastigote developmental stages of *L. amazonensis* after 60 min, presenting no *in vivo* allergenic reactions or *in vitro* cytotoxic effects in mammalian systems.

A combination of specially prepared extracts of onion (*Allium cepa*) and coconut was tested against the organisms causing gastrointestinal infection in animals. The sheep with gastrointestinal helminthic infection were fed with extract for 8 days containing each 60 g coconut and onion extract. The results showed that the worm stages disappeared from the feces and were also not found 9 and 20 days after the end of the feeding with the extract (Mehlhorn *et al.,* 2011).

Conclusion

Coconut has a potent antimicrobial activity against various microflora. Besides being antimicrobial in nature, coconut and its products have other health benefits such as improving heart health, digestion, management of diabetes mellitus and some other diseases. The utilization of coconuts on a regular basis can be encouraged. Food formulations with coconut and its products can be made commercially viable and popularized as a functional food. Drugs and supplements can be formulated with coconut products for prophylactic and therapeutic purposes.

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