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Pharmacological activity of Cocos nucifera L. during different stages of maturation: Brief Outline

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ABSTRACT
The coconut tree, Cocos nucifera L., is grown for a variety of reasons, the most important of which are its nutritional and therapeutic properties. Coconuts are delicious, exotic fruits that grow on coconut palms. Every part, including the fruits, wood, and leaves, has a purpose. As a result, the trees are abundantly grown in many parts of South India. All of the components are utilised. It is a one-of-a-kind source of many nutrients, and as a result, it has a wide range of pharmacological properties, including anti-inflammatory, anti-bacterial, anti-neoplastic, anti-diabetic, and so on.It takes a year for coconuts to grow from flowers to mature nuts. During this time, the coconut fruit goes through four nutritional stages. (1) Even before the nuts are ripe. Green coconut milk has the advantage of being completely sealed in a hygienic container, so it is used in place of medicated sterile water or with salt to rehydrate in the event of fever or gastroenteritis. (2) After the green stage, the nuts begin to ripen-the outside slowly turns brown and the inside begins to develop a thin white pulp or layer of pulp-this is edible and has a similar texture to the nuts. Have a soft-boiled egg. (3) When the nuts stay on the tree, it continues to mature, the outside hardens, the inner layer of the fleshy thickens and hardens, and the milk turns into tasteless water. At this stage, the ripe pulp can be crushed. (4) In the case of coconut what is allowed on the tree will mature completely and then fall to the proper surface and begin to germinate. This forms the final supply stage. As the coconut germinates, white spongy balls develop inside the shell, absorbing liquid and tough meat.

KEY WORDS: Coconut, Cocos nucifera, Pharmacological activity, Different stages of coconut

I. INTRODUCTION:

Cocos nucifera (L.) is a plant that belongs to the Arecaceae family. Coconut trees are commonlyconnected with tropicalregions of the world and coasts of Southeast Asian countries like Malaysia, the Philippines, and Indonesia. The coconut palm& fruit is thought to have been initially introduced in India&southernfringe, including Sri Lanka, the Maldives, and the Laccadives, before spreading to East Africa andother tropical regions. Its natural habitat is along sandy beaches with moderately acidic to alkalinesands, as well as clean or clay sands.[1]

Coconut plants thrive in warm, humid environments, althoughthey can also live in temperatures below 21°C for brief periods of time. This tree is amonocotyledonous. The coconut palm tree is monoecious, which means it has both male and femaleflowers in the same spadix (inflorescence). The spadix is 1-1.5 metres long and is linked to theflowers with 40-60 spikelet branches. The coconut palm treeleaves are feather-shaped and haveleaflets. The fruit is a fibrous drupe with a thin and hard exterior skin, a thicker layer of fibrousmesocarp, endocarp, white endosperms, and a liquid-filled interior. Coconut water is a thick, sweet, and slightly acidic drink made from coconuts. The immature carp has a spherical to elongated shapeand is usually green or bronze in colour. (Chan and Craig, 2006).[2]

The coconut tree, Cocos nucifera (L.) (Arecaceae), is the most widely distributed fruit plant on theplanet. Medicinal plants have been utilised therapeutically by humans throughout history, andminerals, plants, and animals have traditionally been the primary suppliers of medications.Anti-helminthic, anti-inflammatory, anti-nociceptive, antioxidant, antifungal, antibacterial, andanticancer actions are among the biological effects of C. nucifera components. Other effectsdocumented include antihypertensive, anti-inflammatory, antimicrobial, antioxidant, cardioprotective,antiseizure, cytotoxicity, hepatoprotective, vasodilation, nephroprotective, and anti-osteoporosis.Because each component of

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C. nucifera has various ingredients, the plant& pharmacological effectsdiffer depending on which part is studied.[3]

COCONUT INFLORESCENCE:

ANTI DIABETIC AND ANTI-OXIDANT ACTIVITY:

Cocos nucifera has been used to cure a variety of diseases in traditional medicine around the world.The study was done in Cocos nucifera flower extract to check anti-diabetic and antioxidant propertiesin STZ-induced diabetic rats. The levels of blood glucose, glycosylated haemoglobin, urea, uric acid and creatinine were all considerably lowered after 30 days of oral treatment of Cocos nucifera flower extract (300 mg/kg b.w/day) to diabetic rats. Treatment with the fruit extract restored the alteredlevels of serum amino transferases and alkaline phosphatase. The extract administration reversed thediabetic rat's apparent drop in plasma protein levels, bringing them back to near-normal levels. Aftertreatment with the extract, the level of glycogen content, as well as the changed activities of glycogensynthase and glycogen phosphorylase, improved. After extract treatment, antioxidant capabilityimproved. The study suggests that the floral extract is harmless and has anti-diabetic and antioxidant properties.[4]

HEPATOTOXICITY EFFECT

The effect of the acetone extract of Cocos nucifera inflorescence (CnAE) on acetaminophen-induced hepatotoxicity was examined in the blossoming inflorescence ofCocos nucifera, a primary element of various traditional medicine formulations. The extract has 222.6gallic acid equivalent/g and 120.8 g quercetin equivalent/g of total phenol and flavonoid content respectively. The LD50 was greater than 5000 mg/kg b.w. The antioxidant activity was determinedusing three different methods on acetaminophen-induced liver damage were studied. The researchersdiscovered that pre-treatment with CnAE significantly lowered serum alanine amino transferase, aspartate amino transferase, and alkalinephosphatase levels, as well as liver superoxide dismutase,reduced glutathione, glutathione-S-transferase, and glutathione peroxidise levels. Malon-di-aldehyde level also decreased by the extract. The findings suggested that phenolic-rich CnAE could be apromising alternative candidate for preventing acetaminophen-induced hepatotoxicity and oxidativestress.[5]

Image: Cocos nucifera L

Image: Cocos nucifera L Sprout

COCONUT WATER:

The benefits of coconut water, such as healing disease and using it as a food source, are due to itspharmacological activity, which can be defined as any physiological or biochemical changes in thebody caused by certain levels of coconut water consumption. Recent investigations on coconut waterrevealed that it possesses

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numerous pharmacological activities, including anti-inflammatory, anti-bacterial, antioxidant, renal protecting, and cardiac protective properties.[6]

ANTI-INFLAMMATORY ACTIVITY:

Coconut water was found to have anti-inflammatory action against the inflammation generated byacetic acid in a rat paw oedema model in a study by Rao and Najam, (2016)[7] .Coconut water has an anti-inflammatory impact due to the presence of flavonoids and abscisic acid (ABA), which helps tosuppress the creation of prostaglandins (Kumar et al, 2013)[8]. In addition, Mahayothee et al., (2016) [10]found that young coconut water improved the percent inhibition of edema in the second phase ofinflammation, which they ascribe to the presence of salicylic acid. Coconut waters anti-inflammatoryproperties may be attributed to its sugar, vitamins, minerals, and cytokinin components, according toYong et al, (2009).[9]

ANTI-FUNGAL ACTIVITY:

Rajmohan et al, (2017) conducted research on the antifungal activity of green coconut water (Cocos nucifera (L.) against Candida albicans. According to the findings, green coconut water has antifungal properties against Candida albicans. The effect, however, varies depending on the proportion of greencoconut water. The greatest concentration of green coconut water to prevent C. albicans development was 1000 g/mL, followed by 500 g/mL and 250 g/mL, according to this study. As a result, largeramounts of green coconut water extract can be used in anti-fungal medications to treat candidiasis. [11]

ANTI-OXIDANT ACTIVITY:

The study of antioxidant activity done on this species was found to be documented by Santos etal.,(2013), in which the evaluation of antioxidant activities was done by comparing four varieties ofcoconut such as green dwarf, yellow dwarf, red dwarf and Malaysian yellow with two industrializedcoconut water and lyophilized water of green dwarf variety. The results indicated that all varietiesshows positive effects against the free radical DPPH and among the four varieties of coconut, thegreen dwarf variety showed the best antioxidant activity as well as containing the highest levels oftotal phenols and vitamin C. The results demonstrated that TCW treatment of CCl4 female ratsresulted in normal antioxidant levels, demonstrating the effectiveness of TCW antioxidant activity in combating CCl4-induced oxidative stress. [12]

RENAL PROTECTIVE ACTIVITY:

An experiment conducted by Gandhi et al., (2013) utilising a Wistar rat model shown significantkidney protective effect of coconut water. The rats were split into three groups and fed three differentdiets. Group I was given a conventional diet, Group II was given 0.75 percent ethylene glycol in their drinking water to assist develop nephrolithiasis, and Group III was given coconut water in addition tothe ethylene glycol. After 7 weeks, the number of calcium oxalate crystals in Group III animals had decreased, while Nephrolithiasis had formed in Group II animals. Coconut water also caused thelevels of creatinine and urea in group III animals to drop, lowering lipid peroxidation as a result. [13]

TENDER COCONUT WATER:

PREVENTS OXIDIZED STRESS:

TCW can lower systolic pressure, triglycerides, and free fatty acids, according to Bhagya et al. Micefed a high-fructose diet and given TCW had lower MDA levels, a measure of lipid peroxidation, andhigher antioxidant enzyme activity. Tender coconut water therapy can significantly minimize theonset of oxidative stress and increase the antioxidant status in mice fed a fructose diet, according tothe findings of this study. [14]

ANTIOXIDANT ACTIVITY:

TCW may boost antioxidant enzyme levels, and Muhammad et al [15] found that coconut water vinegarreduced acetaminophen-induced liver damage by restoring antioxidant activity and reducinginflammation. The administration of TCW 450 mL/day for 30 days enhanced SOD and GPx levels in traditional gold miners exposed to mercury, according to Zulaikhah et al. According to a study by Agbafar et al., coconut water can boost SOD and GPx levels. Coconut water also contains L-arginine, which has antioxidant action and lowers the formation of free radicals, as well as ascorbicacid, which reduces lipid peroxidation in rats.

LIPID PEROXIDATION ACTIVITY:

(Reduces MDA levels) Signs of lipid peroxidation include MDA levels. The content of organic andinorganic ions in tender coconut water plays an important role in the antioxidant system of thehuman body can normalize cell function, increase antioxidant activity, increase bone formation, increase hemoglobin, gene expression,

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amino acid metabolism and fat. TCW can also be used toprotect the heart and prevent peroxidation. Zulaikhah et al. proved that the administration of 450mL/day of TCW 30 days lowers MDA levels in traditional gold miners exposed to mercury. [16]

ANTI-IFLAMMATORY ACTIVITY:

Coconut water& anti-inflammatory properties may be explained by the fact that it inhibitsprostaglandin production, hence lowering inflammation and pain. The study findings suggest thatcoconut water has analgesic and anti-inflammatory actions that are time-dependent. Thermalnociception in hot plate and tail immersion tests, as well as chemical nociception in formalin-induced paw licking and acetic acid-induced writhing tests, were used to demonstrate the analgesicproperty. The anti-inflammatory impact was assessed using the same carrageenan-induced pawoedema test paradigm. Coconut water has anti-inflammatory properties. Coconut water has anti-inflammatory properties. [17]

CARDIO PROTECTIVE ACTIVITY:

High levels of HDL, according to epidemiological research, can help avoid heart disease (cardiovascular illnesses) such ischemic stroke and myocardial infarction. In a rat model of experimental myocardial infarction, Anurag and Rajamohan discovered that coconut water has acardioprotective effect. A major biological activity of coconut was demonstrated in rat's utilizingan experimental model of isoproterenol-induced myocardial infarction. TCW supplementation protected these rats from myocardial infarction and reduced mitochondrial lipid peroxidation. [18]

INCREASE HAEMOGLOBIN LEVEL:

Tender coconut water reduces parasitaemia index and increases haemoglobin levels in mice injectedwith Swiss PBA, but the effect in humans is unknown and needs to be investigated further. [19]

TENDER COCONUT

ANTIOXIDANT ACTIVITY

The activity of the natural antioxidant to reduce the DPPH free radical will be measured by decrease in the absorbance of U.V visible spectrum at 517nm wave length, and the Gallic acid which is a good antioxidant was used as the positive control and reference to the IC_{50} values of the sample. IC_{50} value is the antioxidant concentration of the sample that shows 50% inhibition activity of DPPH free radicals and it is indicated in mg/L. So if lesser concentration of the sample is needed for half (50%) maximum inhibitory action, the sample has higher antioxidant activity, meaning that $IC50_{value}$ is inversely proportional to the antioxidant activity. Antioxidant activity of fresh young coconut was 448.4±34.6 mg/L. But the antioxidant activity of standard Gallic acid was 4.3180±0.1171 mg/L, which has considerably higher antioxidant activity than of coconut mesocarp. [21]

COCONUT:

Because it is a one-of-a-kind source of many nutrients, it has a wide range of pharmacological properties, including anti-inflammatory, anti-bacterial, anti-neoplastic, anti-diabetic, and so on.coconut kernels include a variety of micronutrients that are beneficial to illness prevention and health maintenance.

ANTI HYPERTENSIVE ACTIVITY:

Using the deoxy corticosterone acetate (DOCA) salt-induced hypertension paradigm, the antihypertensive effect of an ethanolic extract of C. nucifera endocarp (EEC) was demonstrated. In DOCA salt-induced hypertensive rats, EEC treatment lowered mean systolic blood pressure from 185.34.7 to 145.66.1 mm Hg. The direct activation of the nitric oxide/guanylate cyclase pathway, as well as stimulation of muscarinic receptors and/or the cyclooxygenase pathway, was thought to be responsible for this impact. The presence of phenolic chemicals and flavonoids in the extract used is responsible for these activities [22]. C. nucifera should be investigated further for its possible application in the treatment of cardiovascular disorders in light of these findings. Using the Kirby-Bauer disc, antibacterial activities of ethanolic dry-distilled and aqueous extracts of coconut endocarp were compared to those of gentamicin and ciprofloxacin against methicillin-resistant Staphylococcus aureus (MRSA), methicillin-sensitive S. aureus, Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumonia, A The endocarp extracts were found to have potent antibacterial action against B. subtilis, P. aeruginosa, S. aureus, and M. luteus, but no effect on E. coli. [23]

CARDIO PROTECTIVE EFFECT:

Caprylic acid (C-8:0), capric acid (C-10:0), lauric acid (C-12:0), myristic acid (C-14:0), palmitic acid (C-16:0), stearic acid (C-18:0), oleic acid (C-18:1), and linoleic acid (C-18:1) make up the fatty acids in coconut (C-18:2). It is high in

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medium chain saturated fatty acids (MCFAs), which can be absorbed directly from the colon and transferred straight to the liver to be quickly digested for energy production. MCFAs do not participate in cholesterol manufacturing or transport. [24]

HYPOLIPIDEMIC EFFECT:

VCO has the ability to reduce the amount of lipid peroxidation in the body. Coconut protein has a hypolipidemic impact due to its high L-arginine concentration [25]. Aside from the content in coconut, it can help maintain normal lipid parameters in tissues and serum by trapping reactive oxygen species in aqueous components such as plasma and interstitial fluid of the arterial wall, inhibiting LDL oxidation, reversing cholesterol transport, and lowering cholesterol absorption in the intestine [26].

ANTI PROTOZOAL ACTIVITY:

After 60 minutes, the extract of C. nucifera, which is high in polyphenols, showed significant leishmanicidal action by reducing the growth of promastigote and amastigote at the developmental stages of Leishmanialamazonensis. C. nucifera has long been used to treat trichomoniasis in traditional Mexican medicine. [27]

ANTI DIABETIC EFFECTS:

The coconut kernel protein has potent anti-diabetic activity through reversal of glycogen levels, activities of carbohydrate metabolizing enzymes and the pancreatic damage to the normal levels due to its effect on pancreatic$_{\beta}$-cell regeneration by means of arginine. [28]

HEPATOPROTECTIVE ACTIVITY:

Histopathological investigations of liver showed no fatty infiltration or necrosis, as seen in CCl4-intoxicated rats, indicating that TCW has a hepatoprotective effect. [29]

COCONUT SPROUT:

CARDIO PROTECTIVE EFFECT:

This study looks into the cardioprotective effects of dietary coconut sprout (Cocos nucifera Linn.) on isoproterenol-induced myocardial infarction in rats. Male Sprague Dawley rats were fed coconut sprouts (50, 100, and 200 mg/100 g body weight) orally for 45 days, and the Gumieniczek A. To induce cardiotoxicity, isoproterenol (20 mg/100 g body weight) was given twice at a 24-hour interval. The activity of cardiac marker enzymes was considerably increased in the serum but decreased in the heart in isoproterenol-treated rats, indicating myocardial damage. Rats fed coconut sprouthad a significant reduction in these effects. Coconut sprouts were also used to boost anti-oxidant status and minimise oxidative stress in the heart. The shape of heart tissue .According to histological examination, these rats were practically normal. Based on these studies, coconut sprout appears to have significant cardioprotective and antioxidant properties.[30]

ANTIULCER:

The diversity of strong new bioactive chemicals found in plant-derived secondary metabolites and derivatives is astounding. Luteolin, a promising flavone belonging to the flavonoids family, is found in fruits, vegetables, and a variety of medicinal plant and tree species, and has a variety of pharmaceutical properties including antioxidant, antiviral, diuretic, anti-inflammatory, antimicrobial, anticancer, anti-ulcer, antispasmodic, anti-allergic, anti-secretary, anti-angiogenic, anti-proliferative, and others. The tree species Cocos nucifera L. (Arecaceae) is generally known as 'Kalpa vriksha.' The study's goal is to isolate a promising anti-ulcer bioactive molecule, characterise it, run bioassays on it, and assess its anti-ulcer activity in a cell line model in vitro. Using a silica gel column and thin layer chromatography, researchers were able to separate, isolate, and purify a promising bioactive component from coconut sprouts.The isolated fraction was subsequently characterised by UV-Vis, Fourier Transform Infrared spectrophotometer (FTIR) analysis, and structure elucidation using Nuclear Magnetic Resonance (NMR) and Mass Spectrometry (MS). The extracted bioactive ingredient from Cocos nucifera L. sprouts has been identified as luteolin, a flavone molecule, based on spectral data.[31]

ANTI BACTERIAL ASSAY:

Methanol and aqueous extracts of fresh coconut sprouts were used to conduct the antibacterial research. Staphylococcus aureus, Escherichia coli, Salmonella typhi, Klebsiella pneumonia, and Shigellaflexneri were tested at different quantities of extracts from the samples (50g, 75g, and 100g). A well diffusion method employing Mueller-Hinton agar media was used to conduct the antibacterial assay. A positive control of streptomycin was utilised. Bacterial growth was monitored by incubating the plates at 37°C. The antibacterial assay revealed a zone of inhibition around the well after 24 hours. For all of the samples, triplicates were kept. In vitro anti-inflammatory assay (albumin denaturation inhibition) the reaction mixture was generated using fresh and dried sample extracts in various concentrations (methanol and aqueous) and a 1 percent aqueous solution of bovine albumin fraction.The typical medicine was diclofenac sodium (10 mg). The sample extracts and standard

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were heated to 510C for 20 minutes after being incubated at 370C for 20 minutes. The turbidity was measured using a UV Spectrophotometer at 660 nm after the samples were cooled. The experiment was repeated three times [32]

ANTIOXIDENT ACTIVITY:

The conventional approach was used to determine the hydrogen peroxide (H_2O_2) scavenging activity. Fresh and dried coconut sprout were extracted with methanol and aqueous extract in concentration ranging from 100 to 500g.0.1 ml of each concentrations extract was dissolved in 3.4ml of 0.1M phosphate buffer (Ph 7.4) and combined with 0.6ml of 43mol hydrogen peroxide solution. The absorbance of the reaction mixture was measured at 230 nm using UV spectrophotometer. As a control phosphate buffer without hydrogen peroxide solution was utilized. It was calculated and recorded how much inhibition there was. As a control ascorbic acid was employed. [33]

II. CONCLUSION:

Cocos nucifera is a widely distributed plant with significant pharmacological properties and lowtoxicity. Furthermore, medical usage of C. nucifera benefits the environment because this plant isfrequently utilised in the food business, and using rejected plant components reduces waste andpollution. The plantpharmacological effects vary depending on which portion of the plant or fruit isused. Antioxidant activity was found in abundance in the endocarp and coconut water constituents.Antibacterial, antiparasitic, and anti-inflammatory properties were also found in the fibre. Coconut water appears to have antioxidant activity and protective effects onthe kidney and heart, as well as a hypoglycaemic effect. The investigations on C. nucifera have some limitations that must be acknowledged. First, theresearch has concentrated on the effects of various plant parts without demonstrating the processesthat underpin these actions. Second, in order to undertake clinical trials, formulations based on plantparts must be produced.Future study into C. nucifera should be encouraged, given its wide range of pharmacological effects.To develop safe phytotherapies, the major goals should be to isolate particular chemicals, define themechanisms involved in pharmacological actions, and evaluate probable harmful effects.A number of variables may hinder such research. The chemical composition of the researchedsubstance can be influenced by geographical and seasonal changes between countries and areas. Toensure the reproducibility of results, established processes for collecting samples and measuring substances should be used.

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