American Journal of Pharmacological Sciences, 2017, Vol. 5, No. 2, 25-30
Available online at http://pubs.sciepub.com/ajps/5/2/2

DOI:10.12691/ajps-5-2-2

Various Pharmacological Aspects of *Cocos nucifera* - A Review

Babita Aggarwal[1], H. S. Lamba[2], Pankaj Sharma[2], Ajeet[3,*]

[1]School of Pharmaceutical Sciences, Jaipur National University, Jaipur, Rajasthan, India
[2]Department of Pharmaceutical Chemistry, H. R. Institute of Pharmacy, Ghaziabad, Uttar Pradesh, India
[3]Department of Pharmaceutical Chemistry, School of Pharmacy, Vishveshwarya Group of Institute, Greater Noida, Uttar Pradesh, India
*Corresponding author: ajeet_pharma111@rediffmail.com

Abstract Plant materials, derived from thousands of plant species from lichens to towering trees, represents substantial portion of the global market. When we think about the highly nutritious plant parts then we can't move beyond *Cocos nucifera.* Many scientists around the world have worked on *Cocos nucifera* and revealed too may bioactivities such as antimicrobial, antiinflammatory, antiparasitic, antidiabetic, antineoplastic, insecticidal, and leishmanicidal activities. In this review also, we focused on various pharmacological aspects of *Cocos nucifera*, with different extraction methods and isolated compounds.

Keywords: *Cocos nucifera, husk fiber, shell, pharmacological effects, extraction methods*

Cite This Article: Babita Aggarwal, H. S. Lamba, Pankaj Sharma, and Ajeet, "Various Pharmacological Aspects of *Cocos nucifera* - A Review." *American Journal of Pharmacological Sciences*, vol. 5, no. 2 (2017): 25-30. doi: 10.12691/ajps-5-2-2.

1. Introduction

Plant materials and herbal remedies, derived from around 70,000 plant species from lichens to towering trees, represents substantial portion of the global market. From time immemorial, the herbs have played a major role by providing us lead compounds for the isolation and synthesis of many conventional drugs.

Being a flowering plant, *Cocos. nucifera* belongs to angiosperm and represented in Magnoliophyta division which could be classified in two subclasses like Magnoliopsida and Liliopsida. Liliopsida class is monocotyledons while plants belonging to Magnoliopsida are dicotyledons. [1,2]

1.1. Traditional Health Benefits of Coconut

- Antimicrobial and antifungal treatment for skin like ring worms, psoriasis candidiasis, sore throat, sores, skin burns, sunburns, toothache and ulcer.
- Coconut oil acts as anti ageing regimen to keep skin soft and youthful, also used as oil massage to remove heel cracks and removing darkening of armpits.
- To treat scalp and hair problems from dandruff to baldness and graying of hairs.
- As an antidote against pesticide poisoning.
- To treat colitis, stomach acidity and kidney stones.
- As diuretics.
- Used for the treatment of urinary tract, kidney problems and gall bladder.
- Used for the treatment of catarrhal inflammation.
- Consumption of flesh of Coconut with Coconut milk and honey results in increased libido in both men and women.
- Used to treat measles.

1.2. Scientific Health Benefits of Coconut

1.2.1. Immune System Booster

- It is best for the immune system.
- It is also considered as a potent nutritional source which can boost energy and endurance, enhancing athletic and physical capacity.

1.2.2. Improvement to Digestion

- It has been found to improve digestion and absorption of nutrients including minerals, vitamins and amino acids
- Parasites such as tapeworms and lice can also be expelled out.

1.2.3. Antibacterial, Antiviral and Antifungal Action

- It contains antimicrobial lipids, caprylic acid and lauric acid, which are well known to possess antifungal, antibacterial and antiviral property.
- It helps strengthen the immune system through converting lauric acid into monolaurin which limits the activities of virus.
- Coconut also fights against bacteria such as listeria monocytogenes & heliobacter pylori that cause throat infections, gum disease, ulcers, pneumonia, gonorrhea and urinary tract infections.

- It is also used in to treat fungi and yeast infections such as ringworm, athlete's foot, thrush and candidiasis.

1.2.4. Skin and Hair Care

- Coconut oil is widely used for healthy growth of hair.
- Traditionally it is used to treat baldness, dandruff and head lice.
- Coconut oil is also used topically for wounds and burns to lubricate skin and to protection from infections.
- It reduces symptoms of psoriasis, eczema, and dermatitis.
- It helps to soften the skin and relieve flaking and dryness.
- Prevents wrinkles and age spots.
- Coconut is also used as a protective agent against the damaging effects of UV radiation from the sun.

1.2.5. Prevents from Heart Disease

There is a misconception about coconut oil that being high in saturated fats, that it can cause heart diseases. In fact, recent researches have shown that the saturated fats found in coconut oil is a type of unique fat molecule which is known as medium-chain fatty acids (MCFA) that actually prevents heart diseases. The medium-chain fatty acids found in coconut oil increases the HDL level while lowering the LDL in the blood thus improving the ratio of HDL to LDL which is the basis for heart disease risks. The p-Coumaric acid in coconut oil prevents the formation of arterial plaque by preventing the stickiness of the blood platelet reducing the risk of damaging the arteries and preventing the development of atherosclerosis and lowering the blood pressure.

1.2.6. Weight Loss

Coconut oil contains medium-chain fatty acids which are readily burned into energy which prevents the formation of fats; actually this process relieves the pancreases of stress, increasing the body metabolism, there by burning more energy that results in weight reduction. This likewise reduces the symptoms of pancreatitis also. Coconut oil is easy to digest which helps the thyroid and the enzyme system to function properly as well. A study was performed on women who were given coconut oil as supplement for 12 weeks as compared to those given with soybean oil have indicated that women who took 30 milliliters of coconut oil daily have lower body mass index and reduced waist line also.

1.2.7. Antioxidant and Anti-cancer

- Virgin coconut oil naturally contains Tocopherol, p-Coumaric acids and Ferulic acid which are known as potent antioxidants.
- The antioxidants in coconut helps protect the body from free radicals which are primary reason behind premature aging, degenerative disease and cancer also.
- Traditionally it is also used to protect the body against colon, and breast cancer.

1.2.8. Other benefits to health

- Relieves diabetes by improving insulin secretion and utilization of blood glucose
- Relieve chronic fatigue syndrome.
- Relieves benign prostatic hyperplasia (prostate enlargement).
- Reduces epileptic seizures.
- Active against urinary, kidney and bladder problems.
- Prevents liver disease.
- Improves the absorption of calcium and magnesium which is beneficial for osteoporosis prevention.
- Relieves in pain and irritation caused by hemorrhoids.

(All the above given information about traditional and scientific benefits of *Cocos nucifera* have been taken from website http://www.medicalhealthguide.com/articles/coconut.htm assessed on 5th June 2017).

Many researchers have worked on *Cocos nucifera* and revealed too may bioactivities such as antimicrobial, antiinflammatory, antiparasitic, antidiabetic, antineoplastic, insecticidal, and leishmanicidal activities. [3]

There are some more bioactivities other than specified earlier in this review which are biocidal activity, anti-biofilm activity, healing process etc. [3]

Cocos nucifera Linn. is the well known drug in Indian System of medicine for their potential phytochemical and therapeutic values. Keeping in view the potential of these plants, an effort is made to accumulate bioactivities related to *Cocos nucifera*.

2. Literature Review

In the year 2017, Rukmini J N *et. al.* had performed *in-vitro* experimental study on *Streptococcus mutans* to evaluate the antimicrobial efficacy of tender coconut water in its natural state. For this purpose they used fresh tender coconut water and pasteurized tender coconut water as sample, whereas dimethyl formamide as negative control, and 0.2% chlorhexidine as the positive control. They found that, with the tender coconut water, there was no zone of inhibition. Actually it was found with positive control (0.2% Chlorhexidine) [4].

Nidhi Tyagi *et. al.* 2015 has investigated the effect of ethanolic as well as aqueous extract of Cocos nucifera endocarp on blood glucose concentration. They found 17.2 mg (CNAE) in ethanolic extract and 21.4 mg (CNEE) in aqueous extract. They also found the total present flavonoid contents as 23.71 mg (CNAE) and 37.57 mg (CNEE) in respective extracts. Streptozotocin induced diabetes was used by them to study the effect on blood glucose level. They said that ethanolic extract of *Cocus nucifera* posses some greater extent of antidiabetic potential than aqueous extract. [5]

Elizabeth Abidemi Balogun *et. al.* in 2014, Dwarf Red variety of *Cocos nucifera* was evaluated for antimalarial and toxicity activity of the methanolic extract of the husk fibre. This husk fibre was exhaustively extracted with hexane, ethyl acetate and methanol successively. These were screened for flavonoids, phenols, tannins, glycosides, alkaloids, steroids, triterpenes, phlobatannins and

anthraquinones. They also evaluated their toxicity in rats for selected hematological parameters. As a result of analysis they found alkaloids, tannins, steroids, phenol, saponins, glycosides and anthraquinones. They also declared significantly increased in urea, creatinine, cholesterol, bilirubin concentrations and high-density lipoprotein-cholesterol in serum, whereas it reduced albumin concentration significantly at higher doses as compared to controls. [6]

The extracts of five Nigerian varieties of *Cocos nucifera* were evaluated *in vitro* for antimalarial and toxic potentials by J. O. Adebayo *et. al.* in 2013. He found that alkaloids, tannins, and flavonoids were present in ethyl acetate extract fraction and was active against Plasmodium falciparum. This was also active *in vivo* against Plasmodium berghei, with more than 50% reduction in parasitaemia.[7]

Viju, N. *et. al.* in 2013 extracted the coconut husk which was screened for anti-biofilm activity with the help of various methodologies. The marine biofilm set on acrylic sections has been used to develop various microbes such as Alteromonas sp., Pseudomonas sp. and Gallionella sp. [8]

J O Adebayo *et. al.* in 2012 tested extracts from husks of 4 different varieties of *Cocos nucifera*, which were evaluated for their antiplasmodial activity, cytotoxicity and hemolytic activities *in vitro*. It was found that hexane extract was active against the blood forms of Plasmodium falciparum which is a human malaria parasite maintained in continuous culture. Selectivity indices of <10 was observed in most of the extracts, but hexane extract of coco mestico had a selectivity index of 35, which reveals non-toxic attitude of extract. [9]

Dry distilled extract of Endocarp of *Cocos nucifera* L. was evaluated by R K Singla et. al. in 2012 for antimicrobial activity using a method known as Kirby bauer agar diffusion. They used P. aeruginosa, E. coli strains, S. aureus & B. subtilis, and 4 fungal strains which are A. oryzae, C. albicans, R. oligosporus and A. flavus. They found extract as potential growth inhibitor of B. subtilis and Aspergillus species. At all concentrations this extract was found inactive against R. oligosporus. [10]

Bidkar J S, et. al. in 2011 evaluated the inhibitory action of Cocus nucifera shell ash against Oral Microflora: They collected samples of mouth rinse and tartar from male and femal population. They revealed that the organisms were susceptible much more to the stock. [11]

Z. A. Zakaria *et. al.* in 2011 carried out his investigation against antinociceptive and anti-inflammatory activities for oil of virgin coconut. They used different concentrations diluting with Tween 80 for various *in-vivo* model systems. They found dose-dependent antinociceptive activity significant for acetic acid-induced writhing test. They also revealed that vergin coconut oil also exhibited significant antinociceptive activity in all phases of the formalin and hot-plate tests. Z. A. Zakaria *et. al.* also clearly mentioned that this virgin coconut oil does not exhibited its activity for chronic conditions as a case of cotton-pellet-induced granuloma test, but its action against carrageenan-induced paw edema test stands positive.[12]

Taiwo Adesola Akinyele *et. al.* in 2011 treated n-hexane and crude aqueous extracts of husk of Cocos nucifera for special Vibrio species and some bacterial which generally include in food and wound infections. They found 0.6–5.0 mg/mL minimum inhibition concentration for aqueous extract and 0.3–5.0 mg/mL for n-hexane extracts. [13]

M. Komala Sivakumar *et. al.* in 2011 carried out studies to observe the antibacterial potential of *Cocos nucifera* Linn. bark and root against urinary tract infection. They used E. coli, P. aeruginosa, S. aureus and K. pneumonia as their test samples with Amikacin as standard drug. Along with antibacterial action, they also exhibited some test like ash values and antibiotic susceptibility tests, which reveals the positive attitude root and bark of plant against urinary tract infection. During this study they observed that aqueous extract of root is more effective as compared to alcoholic. [14]

Abdulelah H. Al-Adhroey *et. al.* in 2011 studied White flesh extract of *Cocos nucifera* (coconut) to evaluate the antimalarial usage in Malaysian folk medicine. They evaluated different extract doses of different concentrations such as 50, 100, 200 and 400 mg/kg in vivo against Plasmodium berghei. Standard drugs used were Chloroquine (20 mg/kg) and pyrimethamine (1.2 mg/kg). They revealed that extract contained few phytochemical constituents which are safe on oral administration toxologically. They also said that extract significantly reduces the parasitaemia. Whereas they also found the extract with significantly increased the survival time. [15]

Hemanth Sairam Pattigadapa *et. al.* in 2011said that various parts of coconut tree is used in the treatment of cancer, indomethacin-induced ulceration. Even coconut water intake reduces diastolic blood pressure. They evaluated fresh coconut water with dilution 1:1 (coconut water: distilled water) for cardiac activity on the isolated frog heart. It was found that concentrated sample showed good response when compared to the diluted coconut water. [16]

C.T.C. Costa *et. al.* in 2010studied the anthelmintic activity of the liquid extracted of the bark of the green coconut and its extract in butanol, on mouse intestinal nematodes. They determined chemical composition of the extract and its butanol extract by phytochemical tests. They also revealed that a dose of 1000 mg/kg of butanol extract showed 90.70% efficacy in reducing the mouse worm. Authors also revealed the presence of saponnins, triterpens and condensed tannins. [17]

Andrzej K. Bledzki *et. al.* in 2010 studied the potential of barley husk and coconut shell. They also studied thermal degradation characteristics of fibres. They used scanning electron microscopy for particle morphology and particle size study. To determine importance of end-use properties of composites they study surface chemistry. [18]

Obidoa Onyechi *et. al.* in 2010 They study the phytochemical constituents of the endosperm of *Cocos nucifera* L. They cut endosperm, washed, dried and milled with the help of laboratory mill. They found the presence of terpenoids, alkaloids, glycosides, resins, and steroids. They also said that acidic compounds and flavonoids were not observed. They said that the alkaloids, steroids and terpenoids are well known to have antioxidant properties. [19]

Girish R. Bankar *et. al.* in 2010 Aim of the study: They undertake study of ethanolic extract of *Cocos nucifera*

Linn. endocarp for vasorelaxant activity on rat aortic rings (isolated) and deoxycorticosterone acetate salt-induced hypertensive rats for antihypertensive effects. It was further characterized by HPLC. It was observed that extract significantly reduces the mean systolic blood pressure in salt-induced hypertensive rats. Further they revealed that the vasorelaxant and antihypertensive effects of extract is possible through nitric oxide production and endothelium-dependent manner. [20]

Intahphuak S *et. al.* investigated pharmacological properties of coconut oil in 2010. They said they observed anti-inflammatory, antipyretic and analgesic effects. These activities were tested through various models such as ethyl phenylpropiolate-induced ear edema in rats, and carrageenin- and arachidonic acid-induced paw edema. They also observed a moderate analgesic effect as well as an antipyretic effect on the acetic acid-induced writhing effect and yeast-induced hyperthermia respectively. [21]

In 2009, Sebastian Rinaldi *et. al.* revealed that tea from the husk fiber is generally and widely used to serve against inflammatory disorders. They evaluated crude extract and *Cocos nucifera* fractions to test the anti-inflammatory and antinociceptive activities. They also showed that their different samples significantly develop central antinociceptive and peripheral activity but with lesser effect on supra-spinal regions. They observed inhibition of the antinociceptive effect after administration of the opioid antagonist, naloxone (5 mg/kg), which clearly shows that its extract and fractions may be act mediated through opioid receptors. Further, they also show that these extract and fractions may inhibit rat paw edema induced by histamine, and serotonin. [22]

L.M.B. Oliveira *et. al.* in 2009 evaluated the efficacy of *Cocos nucifera* fruit against sheep gastrointestinal parasites. They performed in vitro and in vivo tests of ethyl acetate extract with different concentrations based on egg hatching and larval development tests. They found 100% efficacy in egg hatching and 99.77% in larval development. [23]

Moumita Chakraborty *et. al.* in 2008 prepared some methanolic extract of *Cocos nucifera* L. mesocarp, and evaluated them against some biological activities with help of DPPH, FRAP and deoxyribose assays. They found the mesocarp extract as a potential source for therapeutic purposes. While performing antimicrobial activity, they used Staphylococcus aureus, Bacillus subtilis, Escherichia coli and Pseudomonas aeruginosa. Furthet they revealed that extract shows a potent anti-staphylococcal activity. After analysis with the help of HPLC and UV/ESI–MS they found some chemical structures responsible for bioactivity such as three tentative isomers of caffeoylshikimic acid, 5-O-caffeoylquinic acid and dicaffeoylquinic acid. [24]

In 2008, Pallavi Srivastava *et. al.* evaluated oil of *Cocos nucifera* against burn wound healing. They also compared the burn wound healing effect of the combination of this "oil and silver sulphadiazine" with silver sulphadiazine itself. To evaluate the efficacy of burn wound healing properties they observed some parameters such as epithelialization period and percentage of wound contraction. They observed that they found significant improvement in burn wound contraction from the combination of *Cocos nucifera* oil and silver sulphadiazine along with significantly reduction in period of epithelialization. [25]

P.R. Koschek *et. al.* in 2007 investigated the fractions from aqueous extracts of the husk fiber against in vitro anti-tumor activities. They evaluate cytotoxicity for leukemia cells with the help of 3-[4,5-dimethylthiazol-2-yl]-2,5-diphenyltetrazolium bromide (MTT) assay. According to him extract showed antitumor activity against the leukemia cell line K562. They screened different fractions of extract with the help of Amicon membranes and found molecules with varying weights, like, for fraction A from 1-3 kDa, for fraction B from 3-10 kDa and more than 10 kDa for fraction C. They also found extracts active against Lucena 1, which is a multidrug-resistant leukemia cell line. [26]

Sueli Rodrigues *et. al.* in 2007 evaluated the coconut shell as a possible source of phenolic compounds as upon investigation it was found with a composition similar to wood . They treated coconut powder to different toasting temperatures and after that the phenolic compounds were extracted with the application of ultrasound. It has been generally used as a low cost alternative in substitution against solvent reflux extraction. They performed experiments according to a factorial experimental planning and evaluated some parameters through response surface methodology, such as; effects of toasting time, toasting temperature and extraction time. They found high amounts of phenolic content extracted from coconut shell with this extraction technology. [27]

Z A Zakaria *et. al.* in 2006 performed experiments to evaluate the potential of *Cocos nucifera* as antipyretic, wound healing and anti-inflammatory agents. They used fresh juice of *Cocos nucifera* was directly used while they also used aqueous kernel extract obtained after 72 h of soaking of 1:2 (w/v) fresh kernel in 2:1 (v/v) chloroform: methanol. They revealed that fresh juice and aqueous kernel extract exhibited significant antipyretic and anti-inflammatory activities and promoted wound healing. [28]

Gargi Dey et. al. in 2005 works for identification of few phenolic metabolites in *Cocos nucifera*. They used HPLC/UV system to analyze all soluble and wall-associated phenolics in leaf tissues and mesocarp. They revealed that alkaline hydrolysis of the mesocarpic and leaf tissues yielded a major phenolic compound as 4-hydroxybenzoic acid. They also said that Other phenolic compounds were also identified such as ferulic acid, vanillic acid, 4-coumaric acid and 4-hydroxybenzaldehyde. [29]

Daniela S. Alviano et. al. in 2004 studied the aqueous extract of the husk fiber of *Cocos nucifera* L. against free radical scavenging and analgesic properties. They used acid-induced writhing response, Tail flick and hot plate assays and some acute toxicity tests. They revealed that it does not induce any significantly acting dermic or ocular irritation. They performed DPPH photometric assay which positively results in free radical scavenging properties. [30]

Ricardo R. Mendonça-Filho *et. al.* in 2004 works for identification of polyphenolic rich extract from the husk fiber of *Cocos nucifera* Linn. presents antiviral and antibacterial bioactivities. They evaluated *Cocos nucifera* on Leishmania amazonensis *in vitro* for leishmanicidal effects. They said that findings from this research provide

new perspectives on development of drug against leishmaniasis. They revealed that the extract of *Cocos nucifera* is a remarkably potent leishmanicidal substance which is able to inhibit the growth of both amastigote and promastigote developmental stages of L. amazonensis. [31]

Gargi Dey *et. al.* in 2003 reported extraction and identification for phenolic acids which could be present in the dried mesocarpic husks of mature coconut fruit. They found phenolic content of the husk material as 13 mg/g dry wt. 4-HBA and ferulic acid contents were identified and analysed in the husk fractions. They said that mesocarpic husk materials can be an alternative source of 4-HBA. [32]

Daniele Esquenazi et. al. in 2002 performed decoction of *Cocos nucifera* L. husk fiber for treatment of arthritis and diarrhea. They revealed that water extract from coconut husk fiber and fractions showed antimicrobial activity against Staphylococcus aureus. They also suggested that crude extract and a fraction contained catechin showed inhibition against acyclovir resistant herpes simplex virus. They revealed that there were not a single fraction found which could be active against the fungi Candida albicans, Cryptococcus neoformans and Fonsecaea pedrosoi.

S. Venkatraman et. al., (1980) had evaluated coconut shell for its anti-fungal activity of alcoholic extract against *Microsporum canis, M. gypseum, M. audouinii, Trichophyton mentagrophytes, Epidermophyton flocossum* etc. They found id active at a dose of 100 µg/ml, but it was 200 µg/ml for *E. flocossum.*

3. Conclusion

After studying about the traditional and novel uses and bioactivities of *Cocos nucifera,* it was observed that it has tremendous activities in various pharmacological aspects. This also tends to promote us identify some more and novel uses of *Cocos nucifera*. Hence we can conclude that it has numerous un-revealed aspects left behind which are still waited to be discovered.

References

[1] Singh Y. N., "Traditional medicine in Fiji: some herbal folk cures used by Fiji Indians". Journal of Ethnopharmacology, 15, 57-88, 1986.

[2] Yartey J., Harisson E. K., Brakohiapa L. A., Nkrumah, F. K., "Carbohydrate and electrolyte content of some home available fluids used for oral rehydration in Ghana". Journal of Tropical Pediatrics, 39, 234-237, 1993.

[3] Selvaraj Mohana Roopan, "An Overview of Phytoconstituents, Biotechnological Applications, and Nutritive Aspects of Coconut (*Cocos nucifera*)".

[4] Rukmini J. N., Manasa S., Rohini C., Sireesha L. P., Ritu S., Umashankar G. K., "Antibacterial efficacy of tender coconut water (*Cocos nucifera* L) on Streptococcus mutans: An in-vitro study". J Int Soc Prevent Communit Dent, 7,130-134, 2017.

[5] Nidhi Tyagi, Vikas Hooda, Anjali Hooda and Sachin Malkani, "Evaluation of antidiabetic potential of ethanolic and aqueous extract of *Cocos nucifera* endocarp". World Journal of Pharmacy and Pharmaceutical Sciences, 4(7), 1112-1120, 2017.

[6] Elizabeth Abidemi Balogun, Sylvia Orume Malomo, Joseph Oluwatope Adebayo, Ahmed Adebayo Ishola, Ayodele Olufemi Soladoye, Lawrence Aderemi Olatunji, Olatunji Matthew Kolawole, Stephen Olubunmi Oguntoye, Abiola Samuel Babatunde, Oluwole Busayo Akinola, "In vivo antimalarial activity and toxicological effects of methanolic extract of *Cocos nucifera* (Dwarf red variety) husk fibre". Journal of Integrative Medicine, 12(6), 504-511, 2014.

[7] Adebayo J. O., Balogun E. A., Malomo S. O., Soladoye A. O., Olatunji L. A., Kolawole O. M., Oguntoye O. S., Babatunde A. S., Akinola O. B., Aguiar A. C. C., Andrade I. M., Souza N. B., Krettli A. U., "Antimalarial Activity of *Cocos nucifera* Husk Fibre: Further Studies". Evidence-Based Complementary and Alternative Medicine.

[8] Viju N., Satheesh S., Vincent S. G. P., "Antibiofilm activity of coconut (*Cocos nucifera* Linn.) husk fibre extract". Saudi Journal of Biological Sciences, 20, 85-91, 2013.

[9] Adebayo J. O., Santana A. E. G., Krettli A. U., "Evaluation of the antiplasmodial and cytotoxicity potentials of husk fiber extracts from *Cocos nucifera*, a medicinal plant used in Nigeria to treat human malaria". Human and Experimental Toxicology, 31(3), 244-249, 2012.

[10] Singla R. K., Jagani H., "Investigation of Antimicrobial Effect of Dry Distilled Extract of *Cocos nucifera* Linn Endocarp". Webmed Central Pharmaceutical Sciences, 3(8), WMC003671, 2012.

[11] Bidkar J. S., Poojari S. K., Dama G. Y., Bidkar S. J., "An Inhibitory Study on Oral Microflora of Homo sapiens by the Water Extract of Cocos Nucifera Shell Ash". International Journal of Pharma Research & Development, 3(2), 171-174, 2011.

[12] Zakaria Z. A., Somchit M. N., Mat Jais A. M., The L. K., Salleh M. Z., Long K., "In vivo Antinociceptive and Anti-inflammatory Activities of Dried and Fermented Processed Virgin Coconut Oil". Med Princ Pract, 20, 231-236, 2011.

[13] Taiwo Adesola Akinyele, Omobola Oluranti Okoh, David Ayinde Akinpelu, Anthony Ifeanyi Okoh, "In-Vitro Antibacterial Properties of Crude Aqueous and n-Hexane Extracts of the Husk of *Cocos nucifera*". Molecules 16, 2135-2145.

[14] Komala Sivakumar M., Mohammed Moideen M., Ruby Varghese, Sampath Kumar K. P., "Antibacterial potential of root and bark of *Cocos nucifera* linn. Against isolated urinary tract infection causing pathogens". International Journal of Pharma and Bio Sciences, 2(4), 489-500, 2011.

[15] Abdulelah H. Al-Adhroey, Zurainee M. Nor, Hesham M. Al-Mekhlafi, Adel A. Amran, Rohela Mahmud, "Evaluation of the use of *Cocos nucifera* as antimalarial remedy in Malaysian folk medicine". Journal of Ethnopharmacology, 134, 988-991, 2011.

[16] Hemanth Sairam Pattigadapa, Ramesh M., Praneeth Sagar C.H., Bhaskar Rao U., Lakshman G., Ankaiah M., Balu Naik J., "Cardiotonic Activity Of Coconut Water (*Cocos nucifera*)". Recent Research in Science and Technology 3(4), 155-157, 2011.

[17] Costa C. T. C., Bevilaqua C. M. L., Morais S. M., Camurça-Vasconcelos A. L. F., Maciel M. V., Braga R. R., Oliveira L. M. B., "Anthelmintic activity of *Cocos nucifera* L. on intestinal nematodes of mice". Research in Veterinary Science, 88, 101-103, 2010.

[18] Andrzej K. Bledzki, Abdullah A. Mamun, Jürgen Volk, "Barley husk and coconut shell reinforced polypropylene composites: The effect of fibre physical, chemical and surface properties". Composites Science and Technology 70, 840-846, 2010.

[19] Obidoa Onyechi, Joshua, Parker Elijah, Eze Nkechi J., "Phytochemical Analysis of *Cocos nucifera* L.". Journal of Pharmacy Research, 3(2), 280-286, 2010.

[20] Girish R. Bankar, Pawan G. Nayak, Punit Bansal, Piya Paul, Pai K. S. R., Rajeev K. Singla, Varadaraj G. Bhat., "Vasorelaxant and antihypertensive effect of *Cocos nucifera* Linn. endocarp on isolated rat thoracic aorta and DOCA salt-induced hypertensive rats". Journal of Ethnopharmacology, 134(1), 50-54, 2011.

[21] Intahphuak S., Khonsung P., Panthong A., "Anti-inflammatory, analgesic, and antipyretic activities of virgin coconut oil". Pharm Biol. 48(2), 151-157, 2010.

[22] Sebastian Rinaldi, Davi O. Silva, Fabiana Bello, Celuta S. Alviano, Daniela S. Alviano, Maria Eline Matheus, Patricia D. Fernandes, "Characterization of the antinociceptive and anti-inflammatory activities from *Cocos nucifera* L. (Palmae)". Journal of Ethnopharmacology 122, 541-546, 2009.

[23] Oliveira L. M. B., Bevilaqua C. M. L., Costa C. T. C., Macedo I. T. F., Barros R. S., Rodrigues A. C. M., Camurc¸a-Vasconcelos A. L. F., Morais S. M., Lima Y. C., Vieira L. S., Navarro A. M. C., "Anthelmintic activity of *Cocos nucifera* L. against sheep gastrointestinal nematodes". Veterinary Parasitology, 159, 55-59, 2009.

[24] Moumita Chakraborty, Adinpunya Mitra., "The antioxidant and antimicrobial properties of the methanolic extract from *Cocos nucifera* mesocarp". Food Chemistry, 107, 994-999, 2008.

[25] Pallavi Srivastava, Durgaprasad S., "Burn wound healing property of *Cocos nucifera*: An appraisal". Indian J Pharmacol, 40(4), 144-146, 2008.

[26] Koschek P. R., Alviano D. S., Alviano C. S., Gattass C. R., "The husk fiber of *Cocos nucifera* L. (Palmae) is a source of anti-neoplastic activity". Brazilian Journal of Medical and Biological Research, 40, 1339-1343, 2007.

[27] Sueli Rodrigues, Gustavo A.S. Pinto, "Ultrasound extraction of phenolic compounds from coconut (*Cocos nucifera*) shell powder". Journal of Food Engineering, 80, 869-872, 2007.

[28] Zakaria, Z. A., Reezal I., Jais A. M. M., Somchit M. N., Sulaiman M. R., *et al*., "The anti-inflammatory, anti-pyretic and wound healing activities of *Cocos nucifera* (MATAG Types) fresh juice and kernel extract in experimental animals". J. Pharmacol. Toxicol., 1,516-526, 2006.

[29] Gargi Dey, Moumita Chakraborty, Adinpunya Mitra, "Profiling C6–C3 and C6–C1 phenolic metabolites in *Cocos nucifera*". Journal of Plant Physiology 162, 375-381, 2006.

[30] Daniela S. Alviano, Karen F. Rodrigues, Suzana G. Leitão, Marcio L. Rodrigues, Maria Eline Matheus, Patrıcia D. Fernandes, Angelo R. Antoniolli, Celuta S. Alviano. "Antinociceptive and free radical scavenging activities of *Cocos nucifera* L. (Palmae) husk fiber aqueous extract". Journal of Ethnopharmacology, 92, 269-273, 2004.

[31] Ricardo R. Mendonça-Filho, Igor A. Rodrigues, Daniela S. Alviano, André L. S. Santos, Rosangela M. A. Soares, Celuta S. Alviano, Angela H. C. S. Lopes, Maria do Socorro S. Rosa., "Leishmanicidal activity of polyphenolic-rich extract from husk fiber of *Cocos nucifera* Linn. (Palmae)". Research in Microbiology, 155, 136-143, 2004.

[32] Gargi Dey, Ashish Sachan, Shashwati Ghosh, Adinpunya Mitra, "Detection of major phenolic acids from dried mesocarpic husk of mature coconut by thin layer chromatography". Industrial Crops and Products, 18, 171-176, 2003.