

Review of Studies on Biological Activities and Medical Use of *Morinda citrifolia* (Noni)

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Abstract: In ancient times, folks tried somewhat to find suitable medications for the purpose of healing or using them against diseases. On account of lack of the medicine facilities as well as supplies, herbal medicine was used to a wide degree. One of the most beneficial fruit in the tropical areas which has been flourishingly planted is *Morinda citrifolia* L. which know as Noni, has been utilized as a remedy for >2000 years by Polynesians. The need of Noni increases due to importance of widely curative influences such as anticancer, antioxidant, antitumor, antibacterial, antiviral, antifungal, hypertensive, antiinflammatory and antimicrobial. A correlated literature review and crucially relevant approaches of Noni is achieved; for the purpose of not only reiewing the primary significance which justifies the Polynesians but also expressing the nutritional as well as remedial values of Noni.

Key words: *Morinda citrifolia* L., Noni, folk remedies, polynesians, therapeutic effects

INTRODUCTION

In the past two millennia, many of the South Pacific Islands have come under colonial control of the French Polynesians. In this process, the carried specially selected plants from their own islands. The most significant among these was the *Morinda citrifolia*, better known as Noni a highly popular and highly regarded as a traditional cure all for many ailments and seen as a magical remedy by the Pacific Islanders for centuries. Outside of their geographical location of origin, Noni is known by various names: mengkudu in Malaysia, nhau in Southeast Asia and known as nonu in Samoa and Tonga, nonon in Raratonga and Tahiti and Noni in the Marquesas Islands and Hawaii. The fruit of the *Morinda citrifolia* was a vital source of food for the early Polynesians who used it in times of famine. Australian aborigines were also fond of the fruit. People in Burma use the unripe fruit in their curries and eating the raw fruit with salt was a popular practice.

All parts of the fruit and plant are edible-seeds, leaves, bark and root-especially by those well-versed with the Noni. Noni does well on all the islands of French Polynseia and is particularly abundant on the island of Tahiti. The Noni plants can grow to heights of 15-20 feet have creamy white flowers and fruits, the size of potatoes are available throughout the year. Tahiti is considered the major producer of Noni due to suitable climatic and soil

conditions and general environment although, there have been concerns about contaminated Tahiti Noni fruit due to past nuclear testing in the vicinity. In the course of history, there has been much evidence of the wide use of herbs and other organic products by all cultures throughout the world as traditional folk medicine. Today, both medical researchers and scientists have been paying more attention to the field of traditional medicine and investigated the validity and efficacy of folk remedies.

More than 2000 years ago, Hippocrates advised that we should le food be the medicine and medicine be the food. This is still true today for it has been proven that we are what we eat.

Before the advent of modern medicine it was the traditional folk remedies that were widely used for the treatment of diseases and natural disasters. In this respect, *Morinda citrifolia* has been often recorded as a trusted folk remedy among the Pacific islanders from Tahiti to Fiji. Captain James Cook was recorded in the 1700's to have observed the fruit being eaten in Tahiti (Cheeseman, 1903). Seemann and Flora (1866) refer to an 1866 London article about Fijians using *Morinda citrifolia* fruit as a food item.

Other later documents have revealed the popular use of *Morinda citrifolia* in various places stretching from the Pacific Islands to Southeast Asia, Australia and India. In Roratonga, the local inhabitants were observed to be eating the fruit (Cheeseman, 1903) while other records

referee to the Australian Aborigine fondness for Noni (Maiden, 1889). There have also been observations of Samoans eating Noni as food while the people of Burma were seen to cook Noni curry or eat it as table fruit (Morton, 1992). In 1943, Merrill (1943) referred to *Morinda citrifolia* L. in a scientific publication on edible and toxic plants of the Pacific Islands as a plant that was consumed by the islanders. Abbott (1992) wrote of the versatility and popularity of Noni as a drink, food, medicine and even as a colorful dye (Abbott, 1992).

Morinda citrifolia has been investigated within a variety of medical perspective use such as anti cancer and anti tumor activity, Analgesic activity, estrogenic activity, estrogenic activity, analgesic activity and pain killer activities. The main purpose of this study is to summarize these studies in specific groups and provide the comprehensive and classifying of researches that have done about this topic. In the tropical regions where *Morinda citrifolia* is widespread its curative properties are well known and most parts of *Morinda citrifolia* are used for the treatment of disease and sickness or for injury. This is confirmed by Elkins (1998), a Cook Island Maori who lectures on island plants who explains that it has been the tradition of Polynesians to use the Noni as a magical cure-all for a whole range of illnesses. In fact any Polynesian youngster will easily remember the instances when he/she had had some experience with Noni-using the root juice of Noni its blooms and the Noni fruit itself. The youngster would have been trained by his granny to extract Noni juice from the roots and the fruit as herbal medicines to be applied externally or ingested to cure one illness or another such as coughs, boils, skin diseases and cuts.

ANTIOXIDANT ACTIVITY

In vitro, *Morinda citrifolia* juice study showed a dose-dependent inhibition of both the Superoxide Anion free Radicals (SAR) and Lipid Hydroperoxide (LPO). A comparison was made of the SAR scavenging activity of *Morinda citrifolia* juice with these three antioxidants: vitamin C, pycnogeno and grape seed powder at a daily dose according to manufacturer's recommendations serving level or recommended by USRDA's. Under these experimental conditions, the SAR scavenging activity of *Morinda citrifolia* juice was observed to be 2.8 times that of vitamin C, 1.4 times that of pycnogenol and 1.1 times that of grape seed powder. As a result, *Morinda citrifolia* juice offers great promise to scavenge reactive oxygen free radicals (Wang and Su, 2001; Wang *et al.*, 2002).

In vivo animal studies, 10% *Morinda citrifolia* juice in the drinking water of female SD mice and male C57 B1-6

mice were used to show if *Morinda citrifolia* juice has the ability to stop the carcinogen, 7, 12-Dimethyl [a] Benzantracene (DMBA), from forming a reactive metabolite and binding to DNA. The 7 days later, *Morinda citrifolia* juice absorbed and intragastric administration of the carcinogen DMBA, proceeded with the animals scarified after 24 h. In both animals models, *Morinda citrifolia* could reduce the sum of DMBA-DNA adducts in the heart, lung, liver and kidneys compared with negative controls (Wang and Su, 2001).

Other studies showed that using the leaf, root and fruits' methanol extracts and ethyl acetate partition, antioxidant activity was measured using the Ferric Thiocyanate Method (FTC) and Thiobarbituric Acid test (TBA). The root methanol extract had comparable antioxidant activity with the positive control α -tocopherol and butylated hydroxytoluene. The ethyl acetate partition of all parts of the plant tested was like the positive control (Zin *et al.*, 2002). In the recent study, Mandukhail *et al.* (2010) conducted that due to the presence of antioxidant constituents in Noni this plants have antidyslipidemic effects in both triton (WR-1339) and high fat diet-induced dyslipidemic rat models to variable extents (Mandukhail *et al.*, 2010).

ANALGESIC ACTIVITY

Joseph Betz illustrated that the *Morinda citrifolia* fruit has analgesic and tranquilizing activities. One team from France led by Younos *et al.* (1990) experimented with the analgesic and sedative effects of extracts from the *Morinda citrifolia* plant which showed an important and crucial idea about dose-related, central analgesic activity in the treated mice. They mentioned that these results validate the traditional analgesic properties of this plant. The analgesic efficacy of the *Morinda citrifolia* extract is 75% as strong as morphine yet non-addictive and without side effects (Sang *et al.*, 2003).

In collaboration between University of Illinois, College of Medicine and Henan Medical University, Wang and Su (2001) examined the analgesic properties of *Morinda citrifolia* juice in animal models. *Morinda citrifolia* juice was utilized for its analgesic properties by the twisted method animal model which is a simple and reliable method to test the analgesic effect of *Morinda citrifolia* juice. Mice were placed in four groups namely: control group, 5, 10 and 20% *Morinda citrifolia* juice groups. *Morinda citrifolia* juice was given in the drinking water for 10 days. The control group has only drinking water. A chemical named antimony potassium tart rate was given by intraperitoneal injection which caused twisting due to pain. In the first 15 min, the

number of twists was indication of the degree of pain. The number of twists was compared between the control and *Morinda citrifolia* juice groups using Student's t-test. There was an 82.30, 74.53 and 64.29% reduction in the number of twists in the 20, 10 and 5% *Morinda citrifolia* juice groups, respectively compared to the control. Clearly, the analgesic effect of *Morinda citrifolia* juice on mice showed a dose dependent manner. The analgesic effects of each *Morinda citrifolia* juice group were statistically important compared with that in the control group ($p < 0.01$), respectively (Wang *et al.*, 2005). In the recent research, Rodriguez *et al.* (2012) evaluated the effect of Noni juice in different analgesic models. Their results demonstrated that the Noni juice was effective in reducing the number of contortions induced by the acetic acid in a dose-dependent manner. Just the highest dose of the juice increased significantly the time of reaction in the hot plate and in the tail immersion test. In sum their result suggested that the analgesic effect of Noni juice is basically peripheral.

IMMUNOLOGICAL ACTIVITY

Peter (2007) discovered that the making of Tumor Necrosis Factor-Alpha (TNF- α) an endogenous tumor promoter could be inhibited by an alcohol extract of *Morinda citrifolia* fruit at different concentrations. Hirazumi *et al.* (1994) suggested that *Morinda citrifolia* ppt has a polysaccharide-rich substance that inhibits the growth of tumors. It does not have important cytotoxic effects in adapted cultures of lung cancer cells but can activate peritoneal exudates cells to provide high toxicity when co-cultured with the tumor cells indicating that *Morinda citrifolia*-ppt may hold back tumor growth by activating the host immune system. *Morinda citrifolia*-ppt was also found to have the ability of stimulating the release of some mediators from murine effector cells including TNF- α , Interleukin-1 beta (IL-1 β), IL-10, IL-12, Interferon-Gamma (IFN- γ) and Nitric Oxide (NO) (Hirazumi and Furusawa, 1999).

Recently, Nayak and Mengi (2010) tested the effects of the *Morinda citrifolia* extracts on lymphocytes were assessed by *in vitro* (MTT assay) and *in vivo* (cell mediated immune response) techniques. Results of the MTT study indicated that the hydroalcoholic (0.5 and 1.0 mg mL⁻¹) and aqueous extracts (0.5 and 1.0 mg mL⁻¹) significantly ($p < 0.05$) increased *in vitro* splenocyte proliferation to the extent of 43.6, 54.5, 32.7 and 36.4%, respectively. Moreover, the hydroalcoholic (200 mg kg⁻¹) and the aqueous (200 mg kg⁻¹) extracts significantly ($p < 0.05$) increased the cell-mediated immune response to the extent of 33.52 and 18.56%, respectively.

ANTIFUNGAL ACTIVITY

Morinda citrifolia fruit extract has an antifungal effect on *Candida albicans* and inhibitory effect with different concentrations and contact times. Doses above 40 mg mL⁻¹ might be helpful for clinical applications. The results of this study suggest the potential application of *Morinda citrifolia* fruit extract as an antifungal agent. In the present study, results indicate a strong potential therapeutic value of *Morinda citrifolia* fruit extract against *in vivo* candida infections. Oral therapeutic products derived from *Morinda citrifolia* fruit extract should be safe for use in clinical applications. This is supported by reports indicating that in spite of wide consumption of *Morinda citrifolia* fruit by different people for centuries, no serious side effects have been observed or reported (Jainkittivong *et al.*, 2009).

ANTIDEPRESSANT ACTIVITY

Among the population of developed and developing countries, major depressive disorder or clinical depression is a serious concern. Statistics show that lifetime prevalence estimates are from a low of about 3% of the population (Japan) to 17% (USA) while the average prevalence rate is between eight percent and 12% (Deng and West, 2011). In the US, the annual-prevalence rate estimation is 6.6% (Kessler *et al.*, 2003). Sad to say, the treatment of clinical depression remains a significant public health concern as its treatment several modalities. Psychotherapy and pharmacological approaches are the most significant while the most popular anti-depressant drugs are Monoamine Oxidase (MAO) inhibitors. Monoamine oxidase enzymes disintegrate the monoamine neurotransmitters such as dopamine, serotonin, epinephrine and norepinephrine (Dowrick, 2009). MAO inhibitors are used as they are able to prevent the catalysis of the amine-based neurotransmitters. While these inhibitors have been widely utilized to treat a wide range of health disorders there are unfortunately several significant related toxicities like hypertensive reaction and other more extensive negative side effects such as weight gain and daytime sedation (Remick and Froese, 1990).

The aim of all these studies which are about antidepressant effects of Noni is to find the ideal and safer treatments. Examples of antidepressant plants include *Hypericum perforatum*, *Ginkgo biloba*, *Apocynum venetum*, *Valeriana officinalis* and *Melissa officinalis* (Shirai *et al.*, 2005).

Morinda citrifolia has the distinction of a long and credible history of use to treat diseases and ailments such as cancer, colds, diabetes, flu, anxiety, hypertension, pain

and other health disorders (Wang *et al.*, 2002, McClatchey, 2002). Noni fruit has also been found to be an effective remedy for treating anxiety and depression and Noni fruit juice is well tolerated even at high doses (West *et al.*, 2009).

It has been recorded that Noni juice has been popularly used among the rural population of the Pacific islands to treat anxiety and depression (Pande *et al.*, 2005) and consumption of Noni juice has been proven to lead to mood improvements among postmenopausal women (Langford *et al.*, 2004a, b).

Deng and West (2011) conducted several experiments on the antidepressant effects of Noni fruit and investigated the antidepressant effects of Noni fruit and its bioactive principles in terms of the Monoamine Oxidase (MAO) A and B bioassays for the first time. Their results indicate that Noni fruit is a natural MAO-A and MAO-B inhibitor, bringing about a synergistic effect from multiple active components. These results indicate an *in vitro* rationale for the traditional uses of Noni fruits as a natural remedy for the treatment of depression and anxiety and a help to improve a sense of well-being. This study indicates the possible *in vitro* mechanism that brings about Noni's antidepressant and antianxiety effects. There should therefore be more animal and/or clinical investigation done.

ANTIINFLAMMATORY ACTIVITY

Noni fruits various rich with active components such as phenolic compounds, particularly coumarins, flavonoids and iridoids (Potterat *et al.*, 2007). Phenolic compounds are plant secondary metabolites are antioxidants and have antiinflammatory activities, similar to flavonoids, particularly quercetin and kampferol derivatives as previously mentioned for their *in vitro* and *in vivo* anti-inflammatory properties (Morikawa *et al.*, 2003; Blonska *et al.*, 2004; Wang *et al.*, 2008) which are natural antioxidants that can inhibit different enzymes related with making of radical oxygen species (Pietta, 2000). The coumarin group which is another group of polyphenols, particularly scopoletin and esculetin are significant for their anti-oxidant properties and free radicals-scavenging activities (Ng *et al.*, 2003; Arthur, 1990) as well as anti-inflammatory activities in different models (Tubaro *et al.*, 1988; Silvan *et al.*, 1996). There have been an increase of research done recently on the antiinflammatory activity of iridoids such as lamiide (Delaporte *et al.*, 2002), ipolamiide (Schapoval *et al.*, 1998), genipin (Koo *et al.*, 2004), scrovalentinoside (Bas *et al.*, 2007) and hydrolyzed aucubin (Park and Chang, 2004) that explored their antiinflammatory activities in different models.

It has been indicated by earlier researches reported that chronic inflammations related to oxidative stress are involved in various diseases such as cancer, diabetes, asthma and autoimmune diseases. Strategies have been improved to reduce the inflammation and oxidation status to effectively treat these diseases and for this many natural products with biological active molecules have the potential to help prevent or treat some of these diseases (Fulop *et al.*, 2010).

ANTIBACTERIAL ACTIVITY

Phytochemically analyzing *Morinda citrifolia* fruit juice has revealed the existence of several compounds including saponins, tannins, alkaloids and triterpenoids. Rivera and Boucher (2011) have reported on the testing of antibacterial activity of *Morinda citrifolia* fruit juice against *Mycoplasma pneumoniae*, *Mycoplasma penetrans* and *Mycoplasma fermentans*.

The most significant antibacterial activity of *Morinda citrifolia* fruit juice is against mycoplasmas tested ($p < 0.05$). It is a pioneering report of antibacterial activity of *Morinda citrifolia* fruit juice as opposed to medically essential mycoplasmas compared with other microorganisms. All mycoplasmas will innately resist all beta-lactams and glycopeptides due to lack of cell wall. Sulfonamides, trimethoprim, polymixins, nalidixic acid and rifampin are also not active. Linezolid is the prototype agent of the oxazolidinone class. These agents are significantly less active against *M. pneumoniae* than the other agents that decrease proteins synthesis (Kenny and Cartwright, 2001).

The compound (1, 8 dihydroxy-2-methyl-3, 7 dimethoxyanthraquinone) in *Morinda angustifolia* indicates the significant antimicrobial activity against *Bacillus subtilis*, *Escherichia coli*, *Micrococcus luteus*, *Sarcina lutea*, *Candida albicans* and *Saccharomyces sake*. The 70% ethanolic extract with a minimal bactericidal concentration of 5 mg mL^{-1} was mentioned by Koffi *et al.* (2010) as the most active against *in vitro* growth of *Vibrio cholerae* O:1. The antibacterial properties of *Morinda citrifolia* can be enormously advantageous in managing cholera.

Seven anthraquinones extracted from *in vitro* cultured roots of *Morinda royoc* L. were investigated for their antimicrobial activity against seven yeast and seven bacterial strains. It showed a minimum inhibitory concentration value of $15.6 \text{ microg mL}^{-1}$ against all species of *Candida* tested and exhibited inhibition of the growth of oxacilin-resistant *Staphylococcus aureus*. However, Kandaswamy *et al.* (2010) indicated that the propolis and *Morinda citrifolia* fruit juice affected *Enterococcus faecalis* in dentine of extracted teeth.

Rivera and Boucher (2011) reported that the antibacterial effect of *Morinda citrifolia* fruit juice on mycoplasmas clinical isolates and type strain. The for the antimicrobial effects of fruit juice could be the pH value (3.5) which exhibited different biological activities such as therapeutic benefits in healing of wounds, inhibition of xanthine oxidase and scavenging of superoxide anions and toxics and antioxidants properties (Ozsoy *et al.*, 2009).

GASTROKINETIC ACTIVITY

Morinda citrifolia is often employed a carminative to stimulate appetite and relieve heartburn (Farnsworth and Bunyapraphatsara, 1992). Antiemetic actions and the prokinetic of Noni fruit extract were first discovered by Chuthaputti *et al.* (1996) on the intestinal transit being delayed by apomorphine (a potent agonist of dopamine D2 receptor) in mice and on the emesis caused by apomorphine in dogs. The report shows that watery extract of Noni fruit at the dose equivalent to crude drug 10-20 g kg⁻¹ body weight and at the dose equivalent to crude drug 40 g kg⁻¹ body weight might contain a weak antidopaminergic agent responsible for its prokinetic in mice and researchers can see the antiemetic effect in humans, respectively. There are a lot of current pharmacological evaluations of an aqueous Noni fruit extract in rat models showing that the fruit juice and its active component: scopoletin prevented the creation of acid reflux esophagitis with equal potency to the standard antisecretory agents (ranitidine and lansoprazole) by way of its anti-inflammatory and antisecretory properties as well as its prokinetic activity that activates both intestinal transit and gastric emptying (Mahattanadul *et al.*, 2011). On the other hand there is little information on its effect on the GI motor function in human subjects or its possible gastrokinetic action. Two well-known forms of Noni fruit extract are an ethanol maceration and an aqueous decoction which are used in traditional medicine therefore, the sum of scopoletin in Ethanol Noni Fruit Extract (EFE) and an Aqueous Noni Fruit Extract (AFE) was explored to examine its *in vivo* Gastric Emptying Rate (GER) and Intestinal Transit Rate (ITR) in rats. This was to identify a connection between the scopoletin content and prokinetic activity of both fruit extracts. The effect of AFE at an administered dose calculated according to the prokinetic dose of scopoletin administered to rat models was then explored on the GI motor function in human subject by measuring the *in vivo* GI absorption of rantidine (a putative indicator of GI motility). The gastrokinetic action of the fruit extract was clarified by measuring its contractile response on the isolated rat gastric fundus strip. Pharmacological analysis was chiefly in relation with the stimulation of muscarinic or serotonin (5-HT3 and 5-HT4) receptor.

WOUND HEALING ACTIVITY

Plants throughout the world have the remarkable ability to manage and treat wounds. There are many plants that have been used in traditional healing by various cultures throughout the world in human history to treat wounds, burns and ailments. Natural agents, through a process of multiple mechanisms heal by regenerating damaged and lost tissue. Known as phytomedicine such traditional healing is both effective and safe. The main reason which has motivated scientists to examine these plants is to determine potential wound healing properties of various life-sustaining constituents in plants. There are a lot of phytopharmaceutical laboratories that now focus on the identification of various plants and their active agents that have been used in traditional healing. The value of these plants; lies in their bioactive photochemical constituents that have a physiological action on the human body such as alkaloids, essential oils, flavonoids, tannins, terpenoids, saponins and phenolic constituents.

Scientists are constantly testing and examining various extracts from herbs and plants as the essential way to discover new and effective drugs. Although, the literature has provided evidence of research done on antibacterial, antiinflammatory and wound healing qualities of many plants there is still much left to be investigated. From the point of pharmacology, much research has been done on various plants that seem to have different ways of healing wounds based on molecular mechanism and a priority is to validate the traditional claims and develop safe, effective and universally acceptable herb-based drugs for the treatment of wounds.

The three stages of wound healing are: inflammation, proliferation and remodeling (Guo and Dipietro, 2010). The proliferative phase is characterized by angiogenesis, collagen deposition, granulation tissue formation, epithelialization and wound contraction. In angiogenesis, endothelial cells create new blood vessels. In fibroplasia and granulation tissue formation, fibroblasts develop and form a new, temporary extracellular matrix by excretion of collagen and fibronectin. The major component supporting and strengthening extracellular tissue is collagen which is high in hydroxyproline and used as a biochemical marker for tissue collagen (Kumar *et al.*, 2006). In epithelialization, epithelial cells grow and spread across the wound area. Wound contraction occurs when the fibroblasts contract. Platelets release growth factors and other cytokines (Lawrence and Diegelmann, 1994). Chronic wounds are wounds that fail to heal despite

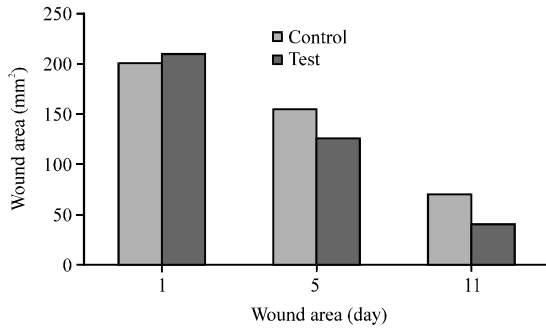


Fig. 1: Activity of wound-healing activity among males rates administered with extract from Noni leaf compared with control (excision wound model, n = 6). Each bar represents mean±SE. *p<0.002 versus control (nonparametric Mann-Whitney U-test)

adequate and suitable care. Such wounds are complicated and hard to manage (Falanga, 2005). Although, recent studies have shown treatment of chronic wounds through debridement, irrigation, antibiotics, tissue grafts and proteolytic enzymes there are however, significant disadvantages and undesirable side effects.

An essential rise in the wound-healing activity was reported in animals treated with the Noni extract compared with others that received the placebo control treatments. Figure 1 and 2 show the result of the ethanolic extract of Noni on wound-healing activity in rats. In this case, the animals administered extract exhibited an extra speedy decline in the size of the wound (Fig. 1) and a shortened time to epithelialization (Fig. 2) in comparison with the rats in the control which were given only plain water.

In this case, the ethanol extract of Noni is the main reason for the sharp increase in the rate at which wound contracted as well as the rate of epithelialization and weight of the granulation tissue. Toward the final part of the proliferation process there is the creation of granulation tissue which is mainly made up of fibroblasts, collagen, edema and new small blood vessels. The increase in dry granulation tissue content of wounds in animals treated with extract results in an increase in collagen content. It is possible that the presence of various constituents in Noni extract promotes collagen formation during proliferation stage of wound healing:

Injury → Wound healing started → Inflammation (Neutrophils, Macrophages, Lymphocytes)

→ *Morinda citrifolia* → Proliferation → (Fibroblast, Collagen, Epithelial cells, Endothelial cells) → Remodeling (Maturation)

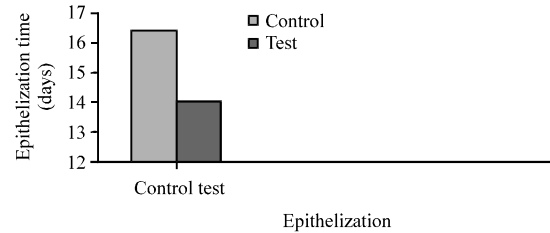


Fig. 2: Epithelialization time: comparison between male rats treated with noni leaf extract-those in the control group (excision wound model, n = 6). Each bar represents mean±SE. *p<0.002 versus control (nonparametric Mann-Whitney U-test)

WOUND HEALING: PHYTOCHEMICAL CONSTITUENTS OF NONI AND THEIR ROLE

It is possible that the compounds such as triterpenoids and alkaloids in Noni may be largely responsible in the healing of wounds; however, in order to be able to specifically identify the active compound (s) responsible there is a need to have more additional phytochemical studies. It is suggested that flavanoids and triterpenoids help wounds to heal faster because of their antimicrobial property and astringency which also positively influence the process of epithelialization (Scortichini and Rossi, 1991; Tsuchiya *et al.*, 1996). In the research done earlier and in other reports of research done using other plants, the existence and role of the same phytochemical constituents in promoting wound-healing activity in rats was established (Nayak and Mengi, 2010).

ANTI HIV ACTIVITY

In an endeavor to figure out the problem of the rapid reproduction of the HIV-1 virus and continual low level viral creation in latent T cell infections create drug-resistant viral strains, Kamata *et al.* (2006) examined 504 bioactive compounds to isolate those with inhibitory effects. It was discovered that a part of Noni root, the damnacanthal could inhibit viral protein induced cell death. The methylanthraquinone has been emerged from the root of Noni have the antiviral HIV (Ali *et al.*, 2000). In a study, Selvam *et al.* (2009) tested antiviral activity and cytotoxicity of Noni. They concluded that fruit juice of *Morinda citrifolia* exhibited a displayed marked cytotoxic activity in lymphocyte (MT-4) cells (CC50: 0.19 mg mL⁻¹). The 50% effective concentration for inhibition of HCV subgenomic replicon replication in Huh 5-2 cells by *Morinda citrifolia* was 0.98 µg mL⁻¹.

NONI AND BLOOD PRESSURE

The first research about Noni's related to a health situation was suggested by Dang-Van-Ho from Vietnam. He indicated that a 'total root extract' proved to be effective without side effects in treating 58 patients, resulting in an 81% success rate (Wang *et al.*, 2002). Additionally, Youngken (1921) studied Thai and Indian *Morinda citrifolia* demonstrated the fine details of the root and stem structures (Pawlus and Kinghorn, 2007). Anesthetized dogs were intravenously treated with water-soluble part of the root and blood pressure was found to be reduced by a significant 26 min. Other reports by Ettarh and Emeka (2004) suggested that *Morinda lucida* L. Is commonly used in Africa in the treatment of diabetes and malaria there is a related species of *Morinda citrifolia* which is not Noni but a tree from Africa that bears red fruit growing in Nigeria as well as the Congo basin. He examined how leaves from the Noni plant when applied to the aortic rings of rats produced a vase-relaxing effect on aortic smooth muscle with and without endothelium. The endothelium effect is caused by the endothelium release of nitric oxide, prostacyclin and Endothelium-Derived Hyperpolarizing Factor (EDHF). In aortas without endothelium, the leaf solution has the direct effect on smooth muscle cells as it lowered the intracellular calcium but this effect was not derived from Noni (Elkins, 1998).

NONI AND OSTEOPOROSIS

Osteoporosis may be related to conductive hearing loss resulting from the movement of back middle ear bones because of osteoporosis which has been attributed to functional and structural changes that are a natural outcome aging in postmenopausal women (Rosenberg, 2009).

Langford *et al.* (2004a, b) indicated that juice from the Noni of Tahiti may improve bone remodeling and vary hearing at the 8000 Hz, sensorineural range. Seo *et al.* (2008) tested the effect of administering a Noni sister species, *Morinda radix* extract to sciatic neurectomized mice with amazing results. It was found that the extract indicated there was significant inhibition of reduction in the thickness the hind limbs, tibia failure load, bone mineral density of the tibia and tibia phosphorus and calcium contents as well as an increase of serum osteocalcin levels. This non-Noni extract therefore is a suppressor of bone resorption and also responsible for improving the formation of bone *in vivo* in mice (Eriksson *et al.*, 2005).

CONCLUSION

There have been many studies that support the positive effects of Noni juice as an immunostimulant, in the reduction in tumor growth, normalizing cellular functions and increasing the regeneration of tissue. It has a powerful ability to purify blood and contributes to total homeostasis xeronine which can control the form and integrity of some proteins that act independently to particular activities of cells. This effect will come about after eating as a result, the most active compound of Noni may not be present in uneaten forms of the fruit or other parts of the plant. A few practitioners consider that xeronine is the most significant element from a Noni fruit juice precursor compound. Moreover, the enzymatic reactions that result from taking the juice on an empty stomach, according to Heinicke (1985), help to stimulate set cellular repair (Elkins, 1998). On the other hand there are lots of diseases and symptoms which are treated by *Morinda citrifolia* including abrasions, arthritis, bladder infections, bladder infections, diabetes, menstrual irregularities, kidney disease, high blood pressure, gastric ulcers, fractures, constipation, chronic fatigue syndrome, burns, intestinal parasites and gingivitis.

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