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REVIEW ARTICLE

Review on *Morinda Citrifolia*

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ABSTRACT

Morinda citrifolia is a fruit bearing tree in the coffee family rubiaceae. *Morinda citrifolia*, commonly known as great morinda, Indian mulberry, nunaaki (Tamilnadu, India), dog dumpling (Barbados), Mengkudu (Indonesia and Malaysia), Apatot (Philippines), Kumudu (Bali), pace (Java), beach mulberry, cheese fruit or noni (Hawaii). Polynesian healers have used noni fruits for thousands of years to help treat a variety of health problems such as diabetes, high blood pressure, aches, pains, burns, arthritis, inflammation, tumors, effect of aging, parasitic, Viral and bacterial infections.

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1. Introduction

Scientific name: *Morinda citrifolia*

Kingdom: Plantae

Family: Rubiaceae

Order: Gentianales

Higher classification: Morinda

Rank: Species

Morinda citrifolia is a fruit bearing tree in the coffee family, Rubiaceae. Its native range extends across Southeast Asia and Australia, and the species now cultivated throughout the tropics and widely naturalized.

Noni or Indian Mulberry, the fruit of the *Morinda citrifolia* tree, is actually a species of the coffee family - and like coffee, it is a stimulator, but not in the way you would imagine. Native to Southeast Asia and Australasia, the noni fruit has been particularly well revered in Hawaii, where it is a part of many traditional medicinal remedies. Many of the medicinal benefits though, are largely attributed to the fact that the noni plant is a source of phytonutrients - which have anti-inflammatory, anti-viral, and anti-bacterial compounds, known to boost the immune system as well as

repair cellular damage. In India, ancient ayurvedic texts mention noni, or ashyuka in Sanskrit, as a remedy to stimulate internal cleansing by treating parasitic infections of the stomach and for asthma, as well as an external remedy to treat joint pains and for the skin ailments and as an anti-ageing solution. Traditional healers in the Pacific Islands have been using noni for centuries, as a general wellness tonic - to cure almost any ailment. Today, noni is also considered to be a treatment for Cancer and HIV, though the U.S. based Food and Drug Administration (FDA) says it requires further scientific evidence before approving the medicinal value of these claims. The potato-sized noni fruit itself is not pleasant in taste, and does give off a slightly strong odor, so it is more commonly taken in the form of juice. For those who don't have access to the fresh fruit, juices are available by the bottle. However as the juice is quite bitter, producers will often sweeten it for sale, so it is always advisable to check the quantity of sugar added in the ingredients, before purchasing. The beneficial properties decrease with added sugar and processing. Although the fruit eaten as is provides the best remedy, the juice is the most practical option for most people. When you drink it, it helps with diabetes, high blood pressure, headaches, stomach ailments, heart disease, gastric ulcers, circulation problems, to stimulate menstruation, lowering cholesterol, fever, cough and cold, relieve high blood pressure, arthritis, AIDS, cancers, and poor digestion, stroke, weight loss, and any sort of infection. It is even considered to be an excellent treatment for senility and depression. noni tea contains antioxidants and works as an anti-ageing treatment. It is also beneficial for digestive issues, and works as a cure for diarrhea, nausea, vomiting, food poisoning, and intestinal worms. The preparation of the tea, however, is unlike the juice, and has higher sugar content - so can actually be harmful for those with diabetes and liver problems. Some also say noni tea used externally is also beneficial for preventing greying for those with darker hair, as well as a hair-loss treatment. Wrapping noni leaves around affected areas can cure arthritis, sore and swollen joints, stomachache and headache. A mixture of raw fruit and leaves is a cure for skin infections such as boils, and bruising. In the Polynesian Islands, root preparations were used to heal sting-ray and jellyfish wounds. The bark was also traditionally used as an aid for mothers giving birth. However, since noni is a stimulant, it does cleanse the body, in order to heal it. This means though that if one has weak liver or kidneys, it is advisable to refrain from taking noni internally. This also applies for those taking blood-thinning medications or anti-water-retention pills. Pregnant women should not take noni.



Fig 1: *Morinda citrifolia*

Nutritive Constituents:

Fat, Protein, Carbohydrate, Glucose, Fructose, Galactose, Arabinose, Rhamnose, Ascorbic acid, Thiamin, Riboflavin, Niacin, Beta-carotene, Potassium, Sodium, Magnesium, Iron, Calcium, Phosphorous.

Volatile constituents:

Acids: Acetic, 2-methyl propanoic, Butanoic, 2-methylbutanoic, Hexanoic, 3-methylpropanoic, Benzoic, Glucuronic, Caproic, Caprylic, Heptanoic, Okadaic, Octanoic, Hexanadioic, Nonanoic, Decanoic, Undecanoic, Lauric, Myristic, Palmitic, Linoleic, Elaidic, Oleic, (Z,Z,Z)-8,11,14-eicosatrienoic

Alcohols: 1-Butanol, 3-Methyl-3-buten-1-ol, 3-Methyl-2-buten-1-ol, 1-Hexanol, Benzyl alcohol, Eugenol, (Z,Z)-2-5-Undecadien-1-ol

Esters: Methyl hexanoate, Methyl 3-methylthio-propanoate, Ethyl hexanoate, Methyl octanoate, Ethyl octanoate, Methyl decanoate, Ethyl decanoate, Methyl palmitate, Ethyl palmitate, Methyl elaidate, Methyl oleate

Ketones: 3-Hydroxy-2-butanone, 2-Heptanone

Lactones: (E)-6-Dodecano-y - lactone, (Z)-6-Dodeceno-y - lactone

Miscellaneous compounds:

Hexanamide, Limonene, (Ethylthiomethyl) benzene, Scopoletin, Vomifoliol, Aucubin, Asperuloside

All of the above volatile components are readily vaporizable at a relatively low temperature. Because this is so, any process involving exposure of the open, ripe fruit to either heat or air (such as in drying the fruit or pasteurizing its juice) will result in a loss of many of these constituents.

Anthraquinones: Noni fruit contains a concentration of anthraquinones, including one novel anthraquinone, damnacanthal.

Noni ppt: Ripe noni fruit yields a unique polysaccharide-rich substance known as noni-ppt.

Xeronine- elusive constituent of noni: In 1985, researcher Ralph Heinicke of the University Of Hawaii declared the existence in noni of a novel substance he dubbed Xeronine. According to Heinicke, xeronine is a miracle ingredient responsible for the purported cure-all properties of noni. Also according to Heinicke, xeronine is almost impossible to detect. While much marketing hay has been made of Heinicke's findings by one multi-level marketing group which sells diluted noni juice of Tahitian origin, his work has yet to be corroborated. In a 1999 review of noni in Economic Botany, the authors dismissed Heinicke's claims as suspect. No independent laboratory has identified or quantified xeronine in any noni product.

Activity of Ripe Noni Fruit and its Constituents:

1-Hexanol-antiseptic; Acetic acid - bactericide, fungicide; Asperuloside - anti-inflammatory, laxative; Aucubin - antioxidant, bactericide, laxative; Benzoic acid - antiseptic, bactericide, fungicide; Benzyl alcohol - anesthetic, antiseptic; Caprylic acid - candidacide, fungicide; Damnacanthal - cathartic; Eugenol - analgesic, anesthetic, anti-inflammatory, antiseptic, cancer-preventive; Glucuronic acid - detoxicant; Limonene - anticancer, antitumor, hypercholesterolemic; Linoleic acid - ant arteriosclerotic, cancer-preventive, hepatoprotective; Myristic acid - cancer-preventive; Noni-ppt - antitumor,

immunomodulatory; Oleic acid – cancer-preventive; Palmitic acid – antifibrinolytic; Scopoletin – analgesic, antiedemic, anti-inflammatory.

2. Pharmacological activities

Preclinical investigations:

Effect on lung and colon cancer:In a recent study reported six known chemical compounds and two new compounds isolated from roots of the plant showed significant inhibitory effects on the proliferation of human lung and colon cancer cells.

Effect on esophageal cancer:Reported in an in-vivo and in-vitro studies that black or red raspberries, strawberries, blueberries, noni, wolfberry, inhibits the development of cancer by signifying that the all possesses both preventative and curative effects on rat esophageal cancer induced by N-nitroso methyl benzylamine.

Effect on breast cancer :The effects of Tahitian Noni Juice (TNJ) were tested on mammary carcinogenesis in MMTV-neutransgenic mice. Reported TNJ treatment did not affect mammary tumor latency, multiplicity and metastatic incidence. But TNJ showed significant diminution in tumor weight, size and longer tumor repetition times in mice. Overall, it was observed that, a mouse equivalent of dose for humans (<3OZ/Day) remarkably inhibited the growth of mammary gland cancer. Investigated the effect of noni juice on Ehrlich ascites tumors bearing Balb-c mice, concluded that noni juice may be useful in the treatment of breast cancer either on its own or in combination with doxorubicin. This is because of the effect of noni juice on Ehrlich ascites tumors bearing Balb-c mice, which produced significantly smaller, short and long diameters of the tumor tissues in each treated group compared to those in control group either alone or with doxorubicin.⁴⁸ Reported the anti-growth effect of TNJ in one hundred and sixty female Sprague-Dawley rats. TNJ was found successful in reducing number of palpable tumors per group significantly in all the groups in which 3%, 5%, and 10% TNJ was administered. TNJ also found to significantly reduce the multiplicity and malignancy of lesions, and the survival rate of animals when compared with positive controls at different time points.

Effect on colorectal cancer:Damnacanthal is able to suppress cancer in colorectal tumor genesis by the findings that damnacanthal exhibited cell growth arrest as well as caspase activity induction. Result suggests that damnacanthal having potent antitumorogenic activity in human colorectal cancer cells.

Effect on cervical cancer:Noni juice and cisplatin, either alone or in combination was able to induce apoptosis through the mitochondrial pathway on HeLa and SiHa cells. However, cisplatin showed slightly higher cell killing when compared to noni juice while their combination showed additive effects. This result suggests that Noni juice can be used as a chemo adjuvant in the treatment of cervical cancer.

Antitumor activity:

Noni juice has been found to improve survival time and produce curative effects when noni-ppt (noni-ppt obtained

from noni juice) was combined with sub-optimal doses of the standard chemotherapeutic agents like cisplatin, doxorubicin, 5-fluorouracil and vincristine. Their result suggests that noni-ppt is a good supplemental agent in cancer treatment.²⁹ Reports of 10% concentration of noni juice in growth media induce vessel degeneration and apoptosis within a few days. They also found that 10% noni juice in media was an effective inhibitor of capillary initiation in explants from human breast tumors.

Chemo protective effect:

Evaluate the chemoprotective effect of ethanolic extract of *M. citrifolia* (EEMC) fruits by simultaneous administration orally at the dose of 100 and 200 mg/kg b.wt. in rats. Cisplatin 5.0 mg/kg was administered through i.p. route to induce nephrotoxicity. They determined serum biochemical parameters like serum creatinine, protein and urea as indicators of kidney damage. In result both doses has shown significant nephroprotective activity, which was confirmed by histopathological study.

Effect on cardiovascular system:

Noni fruit has the ability to prevent arteriosclerosis related to the oxidation of low density lipoproteins (LDLs). They state that this beneficial effect could be due to presence of lignans.

Anti-psychotic activity:

Acute treatment of *M. citrifolia* (1, 3, 5, 10 g/kg, p.o) significantly decreased apomorphine induced cage climbing behavior and climbing time in mice in a dose dependent manner. Similar significant inhibition of methamphetamine-induced stereotypy behavior and climbing time in mice was observed dose dependently. The 7 and 21 days treatment of TNJ in drinking water at 50 and 100% v/v significantly improved the apomorphine induced climbing behavior and climbing time in mice. These results suggest that TNJ has potential effect in the treatment of psychiatric disorders.

Anti-depressant activity:

A number of scientists have investigated the potential action of some plants i.e. *Hypericum perforatum*, *Ginkgo biloba*, *Apocynum venetum*, *Valeriana officinalis*, *Melissa officinalis* and *M. citrifolia* for the treatment of depression and anxiety.⁵⁵ Additionally recent studies showed *M. citrifolia* as an inhibitor of MAO-A and MAO-B.

Effect on cognitive function:

Another study investigated the effects of fruit juice on stress-induced impairment of cognitive function in mice using Morris water maze. They suggested that noni juice protect brain from stress-induced impairment of cognitive function and reported this protective effect may be related to improvement in stress-induced decrease in blood vessel density in the hippocampal dentate gyrus.

Effect on nervous system:

Researchers evaluated the protective effect of noni juice on brain damage caused by ischemic stress in mice focused on the effect of fruit juice on the development of the post-ischemic glucose intolerance as a cerebral protective mechanism. This mechanism may provide the neuronal protective effect of Oral Noni Juice (ONJ) against ischemic stress as derived from the above results.

Effect on Alzheimer's disease:

Evaluation of neuroprotective effect of noni juice against scopolamine induced memory loss in mice indicated that oral administration of noni juice developed reversible impairment of retention in step down latency inhibitory test. From the above result, authors assumed that noni juice offers a protective effect against oxidative damage induced by scopolamine by maintaining the activities of superoxide dismutase (SOD) and concluded that noni juice might be a potential therapeutic alternative in either the prevention or the treatment of alzheimer's disease.

Wound healing activity:

M. citrifolia leaf extract was found to possess wound healing activity. Observations showed decrease in lipid peroxide level in *M. citrifolia* treated group which may be because of the presence of β -carotene, flavonol and iridoid glycosides that are antioxidant in nature is reported.⁶⁰

Immunostimulant activity:

Immune enhancing properties of *M. citrifolia* fruit enable the plant to exhibit immunostimulant activity on T and B lymphocytes as reported.

Hepatoprotective activity:

Acute liver injury induced by carbon tetrachloride (CCl₄) in female Sprague-Dawley (SD) rats was found reversed by noni juice. In the placebo group, administered CCl₄ with drinking water which was induced liver damage in rats. While in control group, pretreatment with 20% noni juice in drinking water + CCl₄ markedly decreased hepatotoxic lesions. Concluded noni juice have liver protective effect from extrinsic toxin exposure.

Anti-oxidant activity:

Evaluated the beneficial effects of Noni juice on antioxidant, hematological and biochemical changes caused by N-Methyl-N-Nitrosourea (NMU) induced mammary carcinogenesis in Sprague-Dawley rats. Results showed that noni juice treatment significantly increased antioxidant enzymes level such as catalase, SOD and significantly decreased lipid peroxidation level in NMU challenged group when compared to NMU control group. Noni juice also showed a preventive effect against anemia, lymphocytosis and neutrophilia when compared to NMU control group. They concluded that noni juice have liver and kidney protective effect in NMU induce carcinogenesis and could be useful to treat mammary gland in humans and animals.⁶³ The antioxidant properties of ethanol and ethyl acetate extracts of root, fruit and leaf of *M. citrifolia* assessed by ferric thiocyanate method (FTC) and thiobarbituric acid methods (TBA) which indicated that the root extract showed higher activity than the fruit or leaf extracts.

Anti-inflammatory activity:

Bradykinin induced inflammatory response was inhibited and rapid collapse in rat paw edema were pretreated either by oral or i.p administration with noni juice extract. This effect may be a result of interference with the B2 receptor mediated mechanism by which bradykinin induces rat paw edema.⁶⁵ Another study concludes that *M. citrifolia* juice selectively inhibits cyclo-oxygenase enzymes (COX-1 and COX-2) involved in breast, colon and lung cancer and shows anti-inflammatory activity.

Anti dyslipidemic activity:

In an evaluation of antidyslipidemic effect of aqueous ethanolic extracts of different parts of *M. citrifolia* viz. fruits, leaves and roots, concludes the mechanism of antidyslipidemic effects of fruits, roots and leaves of *M. citrifolia* through various pathways i.e. inhibition of biosynthesis, absorption and secretion of lipids. The results indicate that noni can be used as a potential medicine for cardiovascular diseases.

Anti lipidemic activity:

The effect of noni seed oil on serum lipid levels in normal lipidemic and hyper lipidemic mice were evaluated and found a reduction in total cholesterol and triglyceride levels in both models are reported.

Effect on GIT:

Noni juice inhibits gastric emptying by stimulation of cholecystokinin (CCK) secretion which occurs simultaneously with an increase in plasma CCK cholecystokinin 1 (CCK1) receptors that are involved in the noni induced inhibition of gastric emptying.⁶⁹ Scopoletin is a phyto constituent present in noni fruit found to be effective as a potential preventive and therapeutic agent for gastro-esophageal inflammatory diseases through its anti-secretory and prokinetic activities including an inhibitory activity on serotonin, free radicals, and cytokine-mediated inflammation.

Anti-microbial activity :

Powder form of various extracts of noni leaves increases the growth inhibition activity of *E. coli*, *Staphylococcus aureus*, *Candida albicans* and *Aspergillus niger* in a dose dependent order. The overall result indicates the use of solvent extracts of noni leaves is effective in the treatment of infectious disease.

Antifungal activity:

Methanolic extract of the dried noni fruit exhibited maximum percentage of inhibition against Trichophyton mentagrophytes (79.3%), while approximately 50% activity was recorded against Penicillium, Fusarium and Rhizopus species.

Antiviral activity:

1-methoxy-2-formyl-3-hydroxyanthra quinone isolated from noni roots suppressed the cytopathic effect of HIV infected MT-4 cells, without inhibiting cell growth and removal of endothelium.

Hypoglycemic activity:

Fermented noni juice used to investigate the hypoglycemic activity in diabetes-induced rats. On the 20th day, after treatment in diabetic experimental animals, showed significant decrease in fasting glucose from an excess of 300 mg/dl (day 3) to 150 mg/dl (day 20). It can be assumed that *M.citrifolia* either potentiates the action of insulin directly or that it increases peripheral tissue sensitivity to the storage hormone.

Smooth muscle stimulatory activity:

Reported that the dried fruit has smooth muscle stimulatory activity and histaminergic effects based on tests conducted for biological activities in animal and anti-microbial studies.

Spasmolytic activity:

Noni plant root extract possess antispasmodic, vasodilator and cardio depressant activities which are mediated through

blockade of calcium channel as well as release of calcium from intracellular calcium which may make clear the use of *M. citrifolia* in diarrhea and hypertension.

Anti-osteoporotic activity:

Isolated seven anthraquinones from an ethanolic extract of the roots of *M. citrifolia*. Reported all the isolated components were found to inhibit osteoclast tartrate resistant acid phosphatase (TRAP) activity and bone resorption including the inhibitory effects on osteoclastic bone resorption in osteoporotic rats. Finally they suggested all the components have positive therapeutic effect against osteoporosis.

Immunomodulatory effect:

In *in-vitro* study, TNJ and fruit juice concentrate potently activated the cannabinoid 2 (CB2), but inhibit the cannabinoid 1 (CB1) receptors in a concentration-dependent manner. But *in-vivo* studies reported decreased the production of IL-4 and increased the production of IFN- γ . These results suggested that noni juice modulates the immune system via activating of the CB2 receptors and suppressing of the IL-4 but increasing the production of IFN- γ cytokines.

Nephroprotective activity:

Fruit juice can modify renal function and catecholamine contents in doxorubicin induced nephrosis, it was reported that noni juice reduced plasma cholesterol; doxorubicin induced impaired renal function in rats along with compensatory increase in renal dopamine content. But no beneficial effects on renal function were observed when fruit juice was administered with doxorubicin.

Bone protective effect:

Investigation on roots of *Morinda officinalis* reports its protective effect against bone loss in sciatic neurectomized and ovariectomized osteoporotic rats, which is due to the present of anthraquinone (1,3,8-trihydroxy-2-methoxy-anthraquinone 2-hydroxy-1-methoxyanthraquinone and rubiadin) in the plant.

3. Clinical investigations

Safety study:

Some researchers conducted safety study of noni fruit juice on ninety six healthy volunteers where different quantities of fruit juice were administered daily in the order 0 ml (placebo), 30 ml, 300 ml, or 750 ml. It was found that 300 ml significantly reduced the adverse events like headache, cough, nausea, menstrual cramp, nasal discharge and vomiting, upper respiratory and urinary tract infections.

Anticancer activity:

Consume 1 to 4 oz of TNJ daily may reduce the cancer risk in heavy cigarette smokers by blocking carcinogen DNA binding is suggested. In another one month clinical trial on 68 current smokers, supplemented with two ounces of TNJ (n=38) or placebo (n=30) twice a day for 30 days which resulted in protection from oxidative damage induced by cigarette smoke and thereby reduced cancer risk related to smoking.

Antioxidant activity:

in heavy smokers Evaluated the antioxidant activity of TNJ in double-blind and placebo controlled clinical trial with 285 current heavy smokers for 30 days. Reported TNJ International Journal of Chemistry and Pharmaceutical Sciences

lowered free radicals viz. superoxide anion radicals (SAR) and lipid hydroperoxide (LOOH) levels significantly and observed no significant reductions in SAR or LOOH levels in the placebo group.

Noni protect Malondialdehyde (MDA)-DNA adducts in heavy smokers:

In one month clinical trial on 203 people, placebo-controlled trial, found TNJ reduced the amount of MDA caused DNA damage by 53%, and concluded TNJ is able to reduce the MDA-DNA adduct level at a tremendously significant level. The result suggests that it may reduce cancer risk in current smokers.

Effect on cholesterol and triglyceride level in heavy smokers:

Conducted one month clinical trial double-blind and placebo controlled in 132 heavy smokers with cholesterol level more than 190 mg/dl. Authors are reported TNJ decreases total cholesterol and triglyceride levels in current smokers. So they concluded that drinking TNJ may prevent heart disease.

Case studies:

Reported on two case studies of gastric cancer patients being treated with noni juice.

Case 1: Doctor advice a male patient aged 69 years, to do surgery otherwise he would die within few months. But the patient ignored doctor's advice and he became in capacitated within two months as his body weight dropped from 165 to 79 pounds. He started to take homemade noni juice and he is improved within a month and continued 6 months after that he stopped noni juice. Seven years he has not got any gastric problem but in biopsy examination showed histology similar to his original cancer not increased so the patient again started noni juice after that outcome was not reported.

Case 2: A patient was 64 years old with gastric cancer, examined in gastrectomy, reported the cancer had spread to 17-28 lymph nodes and he was given 5 years to live. After that started to consume homemade noni juice and he lived 16 years more, he died at age 80 of malnutrition due to gastric cancer.

Effect in hypertension:

One month open label clinical trial on 10 people by daily administrating of 4 oz. of TNJ, Reported noni juice significantly decreased the high blood pressure, especially systolic high blood pressure.

Effect on cholesterol in non-smokers:

One month pilot study on 10 non-smoking hypercholesteromic subjects, who are not currently taking cholesterol medications, consuming 4 ounces of TNJ daily for 30 days; lowered the average pre-test total cholesterol from 184.4 to 182.4, at the end of the trial it increased the HDL/ LDL from 0.36 to 0.37. Concluded that noni juice has the potential to lower cholesterol through the mechanisms of inhibiting HMG-CoA reductase and hepatic/intestinal ACAT enzymes, acting as a dual inhibitor of both enzymes.

Effect of leaf extract in skin protection:

Noni leaf extract protected the skin against UV induced redness and swelling (erythema). Study suggests that leaves

are safe for topical use and may be useful in mitigating UVB-induced injury to the skin.

Effect on skin care regimen:

Six week clinical trial of noni based skin care regimen on 49 women, (age 38 to 55 years). Where in the subjects applied three formulations of noni i.e. noni juice, noni seed oil and noni leaf juice to the face and neck. Result shows significant reductions in lateral canthal fine lines and wrinkles and also stated that improved skin elasticity and firmness. There was no evidence of skin irritation was present in any participant at any time during the trial. Finally they concluded the trial results validate traditional uses of the noni plant to improve skin health.

Effects on serum lipid profile :

A study reported that drinking 29.5 to 188 ml of noni juice per day reduces cholesterol, triglycerides, and hs-CRP. Also a decrease in LDL and homocysteine, as well as increase in HDL, among the noni juice drinkers were observed.

Ant diabetic activity :

Lowering glucose levels under fasting and postprandial conditions are reported when type-2 diabetes patients habitually consumed noni juice as a combination therapy (noni and oral hypoglycemic agents).

Effect on osteoarthritis:

In three month open level intervention trial (82 osteoarthritis patients) administered 3 oz of TNJ per day, reported significant improvements in symptoms such as pain and mobility.

Effect on menopause:

A three-month intervention pilot study by administering two ounces of TNJ. Reported TNJ possess anti-osteoporosis effect and also improved mood, energy and attenuated hearing loss.

Immune boosting & antioxidant:

In two month pilot study TNJ found to increase adaptive immune system activity by 32% and innate immune system activity by 30% while decreasing oxidative stress in the body 19%.

Effect in endurance:

In a placebo-controlled, three week trial on 40 peoples, result revealed that TNJ increased the staying power by 21% and increased antioxidant activity by 25% when compared to placebo which showed no effect. Same researchers conducted drug screening test on six healthy adult volunteers (5 males and 1 female), consumed each volunteer 124 ml of TNJ. Reported no unlawful drugs or their metabolites of TNJ are present in the urine samples collected from both male and female volunteers.

Effect on gingivitis/periodontitis:

Another study reports that the combination of good oral hygiene together with local and systemic treatment with noni juice is a promising tool for the treatment of gingivitis and periodontitis.

4. Conclusion

The approach of treatment based on allopathic drugs is common, but such types of treatment may be quick but cause adverse side effects on health. However, the knowledge of medicines based on natural products is increasing considerably and their usage has far more International Journal of Chemistry and Pharmaceutical Sciences

benefits. In this vista, noni and its constituents represent a key pivotal role in treatment and disease prevention through modulation of various cellular pathways. This review article demonstrates some general health-promoting effect of noni and its active compound through antioxidant, anti-inflammatory, antimicrobial, and anticancerous activities. Further studies on its different types of ingredient are required to know the proper mechanism of action in health management.

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