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THERAPEUTIC PROPERTIES OF NONI (*Morinda citrifolia*) AND ITS PRODUCTS

S. Senthilkumar*, K. Deepa, T. Suganya, M. Janakarajan, J. Muralidharan and P. Vasanthakumar

Department of Animal Nutrition,
Veterinary College and Research Institute, Namakkal- 637 002,
Tamil Nadu Veterinary and Animal Sciences University (TANUVAS)
E-mail: annsenthil@gmail.com (**Corresponding Author*)

Abstract: Noni (*Morinda citrifolia)* is a drought tolerant tree, which grows in adverse climatic conditions (20-45^0 C). There are about 160 phytochemical compounds identified in this plant which is having the explored benefits such as anti-viral, anti-fungal, anti-bacterial, anti-nematode, anti-cancer and in the treatment of arthritis, diabetes, asthma, hypertension and pain.

Keywords: Noni, phytochemicals, health benefits, therapeutic properties.

Introduction

Noni, commonly known as **great morinda**, **Indian mulberry**, **Nunaa** (in Tamil) is a drought tolerant tree and in any type of degraded and unfertile land, particularly performs better in sandy loamy soil. The tree has attained significant economic importance worldwide in recent years through a variety of health and cosmetic products made from its leaves and fruits. Fetid oil obtained from seeds is used as insecticide or insect repellent in Hawai. Leaves are used as livestock fodder and to feed silkworms in India. The fruit is used as pig food in Puerto Rico.

Chemical composition of noni.

Among phytochemical compounds have been identified in the noni plant, and the major components are phenolic compounds, organic acids and alkaloids. Of the phenolic compounds, the most important reported are anthraquinones (damnacanthal, morindone, morindin, etc.), and also aucubin, asperuloside, and scopoletin. The main fatty acids are caproic and caprylic acids, while the principal alkaloid is xeronine (Heinicke, 1985).

The complete physico-chemical composition of the fruit has not yet been reported and only partial information is available on noni juice. The fruit contains 90% of water and the main components of the dry matter appear to be soluble solids, dietary fibers and proteins. The

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fruit protein content is surprisingly high, representing 11.3% of the juice dry matter, and the main amino acids are aspartic acid, glutamic acid and isoleucine.

Physico-chemical composition of noni fruit

Noni fruit is rich in carbohydrates and dietary fiber and a good source of protein with low total fats. Noni have higher level of vitamin C and substantial amounts of niacin (vitamin B3), iron and potassium. Vitamin A, calcium and sodium are present in moderate amounts.

pH-value	-	3.72
Dry matter	-	9.87±0.4%
Total soluble solids (1Brix)	-	8
Protein content	-	2.5%
Lipid	-	0.15%
Glucose	-	11.970.2 g/l
Fructose	-	8.270.2 g/l
Minerals	-	8.4%
Potassium	-	3900 mg/l
Sodium	-	214 mg/l
Magnesium	-	14 mg/l
Calcium	-	28 mg/l
Vitamin C	-	100 - 158 mg/100 g

The chemical composition (per cent) of noni fruit pulp is as follows:

Moisture - 43.2 per cent, lipids - 3.2 per cent, crude protein - 8.32 to 9.13 per cent and crude fibre - 33 per cent and total sugars-1.8 mg/g (Desai, 2010). The composition (per cent) of noni juice extract waste (NJEW) contain per cent crude protein – 12.6, ether extract – 1.1, Neutral Detergent Fibre (NDF) – 60.9, Acid Detergent Fibre (ADF) 43.1, Acid Detergent Lignin (ADL) - 19.1, Hemicellulose – 17.8, Cellulose – 24.1, Non-structural carbohydrates – 16.7 and Gross energy –15.4 MJ/kg (Aregheore, 2005).

Phenolic compounds have been found to be the major group of functional micronutrients in noni juice: damnacanthal, scopoletin, morindone, alizarin, aucubin, nordamnacanthal, rubiadin, rubiadin-1-methyl ether and other anthraquinone glycosides have been identified in noni (Wang and Su, 2001). Damnacanthal is an anthraquinone that has been characterized recently and has some important functional properties (mainly anti-carcinogenic). Scopoletin is a coumarin that was isolated in 1993 at the University of Hawaii and has been found to have analgesic properties as well as a significant ability to control serotonin levels in the

body. Other researchers have shown that scopoletin may also have anti-microbial (Duncan *et al*., 1998) and anti-hypertensive effects (Solomon, 1999). Different Hawaiian teams reported the presence of a novel component, proxeronine, in the noni: it would be the precursor of xeronine, an alkaloid that is claimed to combine with human proteins, improving their functionality. These authors attribute most of the beneficial effects of noni to xeronine. Nonetheless, neither the chemical characterization of this alkaloid has been published nor the method used to assess its content. About 51 volatile compounds have been identified in the ripe fruit (Sang *et al*., 2001), including organic acids (mainly octanoic and hexanoic acids), alcohols (3-methyl-3-buten-1-ol), esters (methyl octanoate, methyl decanoate), ketones (2-heptanone), and lactones [(E)-6-dodeceno-glactone] (Farine *et al*., 1996).

Phytochemicals

Noni fruit contains phytochemicals such as

- lignans - a group of phytoestrogens
- oligo- and polysaccharides - long-chain sugar molecules that serve a prebiotic function as dietary fiber fermentable by colonic bacteria, yielding short chain fatty acids with numerous potential health properties
- flavonoids - phenolic compounds such as rutin and asperulosidic
- iridoids - secondary metabolites found in many plants
- trisaccharide fatty acid esters, "noniosides" - resulting from combination of an alcohol and an acid in noni fruit
- free fatty acids - most prominent in noni fruit are caprylic acid and hexanoic acid, responsible for unique pungent (cheese-like) aroma of ripe noni fruit
- scopoletin - may have antibiotic activities
- catechin and epicatechin
- beta-sitosterol - a plant sterol with potential for anti-cholesterol activity
- damnacanthal - a potentially toxic anthraquinone, putatively an inhibitor of HIV viral proteins
- alkaloids - naturally occurring amines from plants.

Various parts of the tree (leaves, flowers, fruits, bark and roots) serve as tonics and to alleviate fever, to treat eye and skin problems, gum and throat problems as well as constipation, stomach pain, or respiratory difficulties. Noni seed oil is abundant in linoleic

acid that may have useful properties when applied topically on skin, e.g., anti-inflammation, acne reduction, moisture retention.

Biological activity of Noni

1. Anti-microbial effects

The anti-microbial effect of noni due to relatively large amounts of sugars that are not fermented when fruits are stored in closed containers at ambient temperature. Noni inhibits the growth of certain bacteria, such as Staphylococcus aureus, Pseudomonas aeruginosa, Proteus morgaii, Bacillus subtilis, Escherichia coli, Helicobacter pylori, Salmonella and Shigella. It might be due to the presence of phenolic compounds such as acubin, L-asperuloside, alizarin, scopoletin and other anthraquinones. (Locher *et al*., 1995).

Ethanol and hexane extracts of noni have an antitubercular effect since they inhibit by 89–95% the growth of Mycobacterium tuberculosis (Saludes *et al*., 2002). The major components identified in the hexane extract were E-phytol, cycloartenol, stigmasterol, b-sitosterol, campesta-5,7,22-trien-3-b-ol, and the ketosteroids, stigmasta-4-en-3-one and stigmasta-4-22-dien-3-one. Furthermore, they showed that the anti-microbial effect is highly dependent on the stage of ripeness and on processing, being greater when the fruit is ripe, without drying.

2. Anti-cancer activity

The ethanol precipitable fraction (ppt) of noni juice, corresponding to a polysaccharide- rich substance composed of glucuronic acid, galactose, arabinose, and rhamnose, has been found to have immunomodulatory and anti-tumor effects against Lewis lung carcinoma (LLC). On cell models, noni-ppt seems to stimulate the production of T-cells, thymocytes and macrophages that produce cytokines, which are important mediators of tumor cytostasis and cytotoxicity. Noni-ppt also appears to stimulate the release of several mediators from murine effector cells such as cytokines, which slow down the cell cycle in tumors, increase the response of cells to other immunized cells that fight tumor growth, and have a potent macrophage activator activity, suspected of playing a role in the death of tumors (Hirazumi and Furusawa, 1999).

3. Anti-oxidant properties

The ethyl acetate extract of noni fruit have strong inhibition of lipid oxidation comparable to the same weight of pure *a*-tocopherol and butylated hydroxy toluene (BHT). The superoxide anion radicals (SAR) scavenging activity of noni juice was shown to be 2.8 times higher than that of vitamin C, 1.4 times that of pycnogenol (PYC). (Wang and Su, 2001).

4. Anti-inflammatory activity

Noni juice has a selective inhibition effect on some cyclo-oxygenase enzymes (COX-1 and COX-2) involved in breast, colon and lung cancer, and also in anti-inflammatory activity (Su *et al*., 2001). The inhibition of the activity of these enzymes by noni juice was comparable with that of commercial traditional non-steroidal inflammatory drugs such as aspirin, indomethacins and celebrexs.

5. Analgesic activity

Noni root extract (1600 mg/kg) showed significant analgesic activity in the animals, similar to the effect of morphine (75% and 81% protection using noni extract and morphine, respectively), and it also proved to be non-toxic (Younos *et al*., 1990).

6. **Cardiovascular activity**

Noni fruit preventing arteriosclerosis, a disease related to the oxidation of low density lipoproteins (LDL). This beneficial effect could be due to the presence of lignans,phenylpropanoid dimers (Kamiya *et al*., 2004).

Side effects of noni

- Some side effects include diabetic shock if one does not adhere to the sugar levels and calorie information provided when purchasing the product.
- Noni Juice can occasionaly cause constipation.

Conclusion

The *Morinda citrifolia* plant especially its fruit, has been used for centuries in folk medicine. The most important compounds identified in noni fruit are phenolics, such as damnacanthal and scopoletin, organic acids (caproic and caprylic acid), vitamins (ascorbic acid and provitamin A), amino acids such as aspartic acid, and minerals. Another compound named xeronine, supposedly an alkaloid, has been reported.

On the other hand, scientific studies have opened some interesting doors. The main proven functional properties of noni fruit are related to the control of several diseases. In vitro research and limited experiments with lab animals have shown that noni has anti-microbial, anti-cancer, antioxidant, anti-inflammatory, analgesic and cardiovascular activity. Market interest in this fruit suggests a bright future, although more studies are needed to identify the nutritional and functional compounds it contains and explain their mechanisms of action in order to determine the real potential of this fruit and the technological processes that preserve these properties.

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