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The Application of *Morinda citrifolia* (noni) as An Alternative Herbal Product in Dentistry

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Abstract

Morinda citrifolia, also referred to as noni, is a plant used to treat a variety of diseases. Noni fruit helps treat bacterial infections because of its antifungal, antibacterial, analgesic, anti-inflammatory, antioxidative, and immunomodulatory properties. The noni plant has been used in dentistry more often in recent years. It is effective as a mouth rinse for periodontal diseases, an irrigant in endodontics, and an agent that inhibits caries, and it is increasingly preferred over synthetic alternatives due to its reduced side effects and greater cost-effectiveness.

Keywords: Dentistry, *M. citrifolia*, noni fruit

What is already known on this topic?

- Noni has been documented in the literature for its various applications in different fields, including medicine and healthcare.
- There is emerging interest in exploring its potential uses in dentistry, but the existing studies remain limited.

What does this study add on this topic?

- This manuscript provides an overview of noni's reported applications, with a specific focus on its potential uses in dentistry.
- It summarizes the existing literature on noni's role in dentistry and identifies gaps where further research could contribute to the field.
- By highlighting these areas, the study offers a perspective on how noni could be further investigated to expand its applications in dental practice.
- Additionally, the study emphasizes that noni's natural composition and absence of harmful side effects make it a preferable alternative to synthetic products, further supporting its potential use in various fields.

INTRODUCTION

Throughout history, plants have consistently served as prevalent sources of medicines, either in traditional formulations or through the extraction of active compounds. The extensive chemical diversity in secondary plant metabolites, primarily tailored to animal physiology, positions them as promising reservoirs for novel therapeutic candidates across various diseases. Natural products in mouth rinses, toothpaste, local delivery agents, and regenerative materials are increasingly preferred over synthetic alternatives due to their reduced side effects and greater cost-effectiveness.[1,2] The increasing resistance to antibiotics and chemotherapeutic drugs has led to a rise in the use of herbal, animal, and other natural products in treating dental diseases.[3]

Morinda citrifolia, commonly known as noni, is utilized in various diseases with therapeutic effects that are popular in the field of medicine today. It is also known as Indian Mulberry, a small tree cultivated in Southeast Asia, Hawaii, and Australia, and is used in the treatment of various acute and chronic illnesses.[4-6] Noni comprises chemical components such as betalains, indoles, glucosinolates, and organosulfides. Due to its phytochemical content, noni demonstrates antioxidant effects, regulates endocrine functions, modulates enzyme activities, induces immune responses, affects DNA and RNA, and possesses antibacterial functions.

The noni herb has become a widely used dietary supplement in Asia, Europe, and America today.[7,8] Noni fruit is available in capsule, tablet, liquid, and powder forms, and it is known to treat infections, diabetes, hypertension, and other diseases. Considering the health benefits of noni, the European Commission of Health and Consumer Protection has recognized it as a novel natural product, leading to its utilization in

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various countries in response to the increasing demand for natural products.[9]

Additionally, the immunomodulatory effect of noni fruit is supported by in vivo and in vitro results.[5,10-12] A review of the literature revealed that juice prepared from ripe noni fruits was utilized in the studies. In recent years, there has been an increase in the utilization of the noni plant in dentistry. It is employed as an irrigant in endodontics, a caries-inhibiting agent, and as a mouth rinse for periodontal diseases. [13-16] Research findings have demonstrated the antifungal, antibacterial, analgesic, anti-inflammatory, antioxidative, and immunomodulatory effects of noni fruit and its use in bacterial infections.[10,17-19]

ANTI-INFLAMMATORY EFFECT OF *MORINDA CITRIFOLIA*

Noni fruits contain some active ingredients, including iridoids and phenolic compounds, coumarins, and flavonoids. Plant secondary metabolites called phenolic compounds are well-known for having anti-inflammatory and antioxidant characteristics.[20]

Lee et al[21] showed that 5 compounds in noni fruit juice, namely asperulosidic acid, rutin, nonioside A, (2E,4E,7Z)-deca-2,4,7-trienoate-2-O-β-D-glucopyranosyl-β-D-glucopyranoside, and tricetin, inhibited lipopolysaccharide-induced inflammatory response in RAW 264.7 macrophages. They determined that the anti-inflammatory effects were mediated through the IKKα/β, I-κBα, and NF-κB p65 signaling pathways that activate inducible nitric oxide synthase and cyclooxygenase-2 and regulate nitric oxide production.

Noni exhibits anti-inflammatory effects by inhibiting inflammatory cytokines such as Interleukin-1 beta (IL-1ß), tumor necrosis factor-alpha (TNF-α), IL-6, IL-8. Due to its ability to inhibit inflammation without side effects, noni is believed to reduce the use of nonsteroidal anti-inflammatory drugs.[10] Additionally, it has been shown to play a role in the inhibition of matrix metalloproteinase-9 (MMP-9) and acts as a bradykinin receptor antagonist, which plays a significant role in inflammation. [22] Matrix metalloproteinases are molecules primarily responsible for degradation in the periodontium, and it is also believed that their effects can be reduced by noni.

ANTIBACTERIAL PROPERTIES OF *MORINDA CITRIFOLIA*

In the study conducted by Masuda et al,[23] it was demonstrated that the extract of *M. citrifolia* inhibits MMP through its anti-inflammatory effect, leading to a reduction in gingival inflammation. Additionally, it has been shown to exhibit antibacterial effects on periodontopathogens.

Kamran et al[24] demonstrated that the use of *M. citrifolia* as mouthwash exhibited superior antiplaque effectiveness compared to chlorhexidine. Additionally, as a herbal alternative, it showed a significant decrease in inflammatory cytokines such as TNF-α, IL-α, and IL-β along with a more positive subjective experience, including improvements in taste, reduction in mouth dryness and burning sensation, and a feeling of freshness. Noni has the potential to inhibit the production of TNF-α.[25] Its bioactive constituents, such as flavonoids and polyphenols, are responsible for regulating the production of of IL-α and IL-β, thereby reducing the intensity of the inflammatory response.[26-28]

A study involving patients with both periodontitis and type 2 diabetes was carried out by Shashikumar et al.[29] It was found that bleeding on probing, gingival index, and plaque index scores significantly decreased in the group using noni mouthwash as an adjunct compared to the group undergoing only non-surgical periodontal treatment.

In a study conducted on gingivitis patients, the effect of noni-containing mouthwashes on the gingival index was similar to that of chlorhexidine. The authors suggested that noni extract should be considered superior to other mouthwashes due to its comparable efficacy to chlorhexidine, coupled with minimal side effects, cost-effectiveness, and high efficacy.[30]

An in vitro study examining the antibacterial effects against *Fusobacterium nucleatum* growth in root canal irrigation demonstrated that ethanol extract of noni fruit possesses antibacterial effects against *F. nucleatum*.[31]

As an intracanal irrigant, *M. citrifolia* performed similarly to sodium hypochlorite (NaOCl) combined with ethylenediamine tetraacetic acid. *Morinda citrifolia* is one of the oldest fruits proposed as a potential substitute for NaOCl as an intracanal irrigant.[32] According to an in vivo study conducted by Chandwani et al[33] with primary teeth, *M. citrifolia* juice may be a natural intracanal irrigant that can be used as an alternative to NAOCl.[33]

Due to its antibacterial effect, it is also utilized in irreversible hydrocolloid impression materials. Noni extract reduces microbial contamination in dental impressions and does not compromise the quality of the material.[15]

Research has been conducted on the impact of herbal remedies that prevent dental caries, a significant health issue. It has been reported that phytochemicals present in *M. citrifolia* exhibit inhibition on oral *Streptococci*.[14] Noni is easily accessible, safe to use, and has been reported to be antibacterial, although its anti-caries properties have not been conclusively proven.[14]

USE OF *MORINDA CITRIFOLIA* IN WOUND HEALING

The healing potential of *M. citrifolia* was assessed using topical ointments formulated with noni leaf extract, as well as

through oral administration of leaf ethanol extract and fruit juice. Across all approaches, a hastened healing process was noted, evidenced by decreased wound contraction and reduced re-epithelialization time, indicating noni's therapeutic efficacy in wound healing.[34-36]

Kongpuckdee et al[37] developed a topical bioadhesive gel using aqueous *M. citrifolia* fruit extract (AMFE) to treat oral inflammatory ulcers. The study results reported that daily application of 10% AMFE gel provided superior ulcer healing efficacy and a significantly faster ulcer healing process compared to twice daily application of a topical gel containing 10% AMFE or 0.2% chlorhexidine.

OSTEOGENIC ACTIVITY OF *MORINDA CITRIFOLIA*

Boonanantanasarn et al[38] investigated the regenerative potential of lyophilized leaf extract of *M. citrifolia* in the periodontal ligament of premolars and molars. The findings indicate that aqueous noni leaf extract effectively stimulated cellular proliferation, protein synthesis, alkaline phosphatase (ALP) activity, and in vitro matrix mineralization, thereby exhibiting osteoinductive properties and contributing to periodontal tissue regeneration. Shalan et al[39] demonstrated that noni is rich in catechins, which play a role in bone regeneration, inhibit resorption, reduce bone loss, and enhance collagen production.

Hussain et al[40] found that noni fruit juice increases the osteogenesis of bone marrow mesenchymal stromal cells (BMSC) by activating the primary osteogenic transcription factor Runx2 gene transcription. Additionally, noni fruit juice can increase BMSC proliferation and promote osteogenesis by increasing the activity of osteogenic biomarkers, such as osteocalcin and ALP. They also investigated if noni improved results on bone regeneration. Comparing the femur that got BMSC exposed to noni transplantation to the control femur that received BMSC alone, they showed higher quality bone growth in the BMSC-exposed femur by computed tomography and histological analysis. In terms of vascularization, noni was also beneficial. The findings indicate that bone regeneration can be facilitated by noni transplantation on BMSC, and this treatment modality may be helpful for patients whose bone quality is low.[40]

ANTIOXIDANT ROLE OF *MORINDA CITRIFOLIA*

Studies have shown that fruits and vegetables are important dietary sources of antioxidants and that consuming them can help prevent oxidative damage and lipid peroxidation caused by free radicals.[41,42]

Wang et al[43] demonstrated that soaking *M. citrifolia* fruit in drinking water for a week could inhibit the production of 12-dimethylbenz(a)anthracene (DMBA)-DNA (DMBA-DNA) adducts. The findings imply that *M. citrifolia* may have a preventative impact on cancer by preventing the production of carcinogen-DNA adducts and through the antioxidant activity of dietary supplements containing *M. citrifolia*.

In an in vitro study, individuals who consumed noni juice on an empty stomach once daily for 30 days were found to have confirmed antioxidant properties of noni when examining oxidative markers in the blood after 30 days. Additionally, it was observed that noni exhibited effects under conditions of oxidative stress induced by heavy smoking.[44]

CONCLUSION

Morinda citrifolia, also referred to as noni, is a plant used to treat a variety of diseases. Due to its rich phytochemical content, noni possesses antibacterial, antioxidant, and anti-inflammatory properties. The application of noni in dentistry has grown within the past several years. In periodontal conditions, it is used as a mouthwash, an irrigating agent in endodontics, and an anti-caries agent. It has been discovered that using noni mouthwash in combination with non-surgical periodontal treatment significantly improves periodontal clinical parameters. It might be an effective agent for periodontal disorders and other dental treatments because of its anti-inflammatory, antibacterial, and regenerative qualities and its low risk of adverse effects.

Availability of Data and Materials: The data that support the findings of this study are available on request from the corresponding author.

Peer-review: Externally peer-reviewed.

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