

# Morinda citrifolia: A Fruit to Future Endodontics

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## ABSTRACT

The aim of this article is to review *Morinda citrifolia* in the field of endodontics. Herbal medicaments have been used as remedies for various illnesses and diseases for centuries. Furthermore, it has been a topic of interest in dentistry for many years. *Morinda citrifolia* juice (MCJ), also commonly known as “Noni,” a tropical fruit, has a wide range of uses in endodontics and in the eradication of endodontic pathogens without any potential side effects. A literature review is conducted using electronic databases, such as “PubMed,” “Google Scholar,” and “Scopus,” using keywords “Herbal Medicine” and “*M. citrifolia*.” Furthermore, an advanced or refined search was carried out using the keywords “Endodontics,” “Root canal Therapy,” “Irrigation,” “Herbal Endodontics,” and “Endodontic Disinfection.” The MCJ can be used as an endodontic irrigant along with ethylenediaminetetraacetic acid (EDTA) as an adjuvant to sodium hypochlorite and chlorhexidine (CHX) due to its better smear layer removal properties and antimicrobial activity. It also does not have any major side effects as compared with sodium hypochlorite and CHX. It also helps in caries prevention and control, which is the main crux for the requirement for endodontic treatment. Further studies on MCJ on the endodontic aspect of dentistry can alter the chemical aspect of endodontic therapy in the near future. The MCJ, due to its advantages compared with sodium hypochlorite and CHX, can be used in the field of endodontics.

**Keywords:** Chlorhexidine, *Morinda citrifolia*, Noni, Sodium hypochlorite.

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## INTRODUCTION

A successful endodontic treatment depends on the removal of microbes from the root canal system, which leads to the prevention of reinfection. The root canals are usually shaped with hand and rotary instruments under constant irrigation to remove the inflamed and necrotic tissues, microbial biofilms, and other debris from the root canal space.<sup>1</sup> This goal can be accomplished using mechanical

instrumentation and chemical irrigation, with medication of the root canal system between treatment sessions.<sup>2</sup>

One should completely understand the microbiology involved in the endodontic pathologies. Endodontic microbiology, such as *Prevotella*, *Porphyromonas*, *Actinomyces* spp., *Propionibacterium propionicum*, *Parvoimonas micra* (previously called *Peptostreptococcus micros* or *Micromonas micros*), *Streptococcus* species, and *Enterococcus faecalis* are most often opportunistic pathogens. They have the ability to invade and penetrate the dentinal tubules, making them very difficult to remove from the canal space. The longer the duration of root canal infection, the greater the number of facultative anaerobes. The root canal system with necrotic pulp provides space for microbial colonization and affords the microorganism a warm, nutritious, and anaerobic environment, protected from host defenses due to the lack of microcirculation in the necrotic pulp. Biofilms around the bacteria help in resisting the destruction of these opportunistic microorganisms by making them 1000 times more resistant to phagocytosis, antibodies, and antimicrobial agents. This is attributed to the protective barrier provided by the extracellular matrix. Biofilms also participate in gene exchange through horizontal gene transfer, leading to the spread of antibiotic resistance genes between different clinically relevant species, and thus, the microorganisms have the ability to survive chemomechanical preparation. Hence, ideal intracanal irrigants are those that possess a good antimicrobial property to enhance the outcome of the instrumentation procedures.<sup>3-5</sup>

Various irrigation activation systems, such as sonic and ultrasonic systems have also been used to increase the efficacy of sodium hypochlorite in cleaning the canal system along with lateral canals and provide an improved penetration of hypochlorite into the biofilms to eradicate the endodontic microbes. The use of herbal plant extracts for the eradication of microbes has been a topic of interest due to the drawbacks of sodium hypochlorite and CHX. Herbal extracts, such as *M. citrifolia*, Green tea, Triphala, *Azadirachta indica*, and Aloe vera have been used as irrigants in various studies. These studies have proved that herbal plant extracts eliminate microbes causing dental pathologies, thus proving its efficacy as an antimicrobial for oral infections.<sup>6-10</sup>

With the increasing popularity of traditional and holistic/alternative medicines due to their natural origin, easy availability, efficacy, safety, and fewer side effects,

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the aim of this review is to enlist and describe the MCJ in endodontic treatments.

## LITERATURE REVIEW

The MCJ, also known as “Cheese plant”, “Indian Mulberry”, or popularly known as “Noni”, grows widely throughout the Pacific and is one of the most significant sources of traditional medicines among Pacific island societies. This small evergreen tree or shrub is native to South-eastern Asia (Indonesia) and Australia, and now has a pantropical distribution. All parts of the plant have traditional and/or modern uses including roots and bark (dyes and medicine); trunks (firewood and tools); and leaves and fruits (food and medicines). The medicinal applications, both traditional and modern, cover a vast array of conditions and illnesses.<sup>7,11</sup>

## CHEMISTRY

A number of major components have been identified in the noni plant, which include 6 $\alpha$ -hydroxyadoxoside, 6 $\beta$ , 7 $\beta$ -epoxy-8-epi-splendoside, americanin A, scopoletin, octoanoic acid, terpenoids, alkaloids, anthraquinones, bistosterol, carotene, flavone glycosides, linoleic acid, alizarin, acubin, L-asperuloside, caproic acid, caprylic acid, ursolic acid, rutin, and proxeronine, which are responsible for its antibacterial properties.<sup>12,13</sup>

## MEDICINAL APPLICATIONS

*Morinda citrifolia*, popularly known as noni, has been an important medicinal plant for many centuries throughout the South Pacific and has been used in folk remedies by Polynesians for over 2,000 years. It is a small shrub and its potential therapeutic properties remain vastly unknown.<sup>14,15</sup>

Pharmacological investigations have demonstrated that the roots of *M. citrifolia* possess an antihypertensive action and that an alcoholic extract has an *in vitro* antispasmodic effect. The MCJ has a broad range of antibacterial, antifungal, antiviral, antitumor, antihelminthic, analgesic, antihypertensive, anti-inflammatory, and immune-enhancing effects.<sup>16-18</sup>

In traditional medicine, *M. citrifolia* fruit juice has been used to treat various illnesses including arthritis, diabetes, muscle aches, menstrual cramps, cardiac diseases, cancers, gastric ulcers, vascular diseases, and drug addiction.<sup>7,12,13</sup> It has been reported that *M. citrifolia* inhibits pathogenic bacteria, such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Proteus morgani*, *Bacillus subtilis*, *Escherichia coli*, *Helicobacter pylori*, *Salmonella* species, and *Shigella* species. This might be attributed to the presence of secondary metabolic phenolic compounds, such as acubin, L-asperuloside, alizarin, and anthraquinones including

scopoletin. Saludes et al<sup>20</sup> demonstrated that a crude acetonitrile extract of the dried fruit was bactericidal against *P. aeruginosa*, *B. subtilis*, *E. coli*, and *Streptococcus pyogenes*. Ethanol and hexane extracts of *M. citrifolia* leaves inhibit 89 to 95% of *Mycobacterium tuberculosis* species. Other studies have reported a significant antimicrobial effect on various strains of *Salmonella*, *Shigella*, and *E. coli*.<sup>16,19-21</sup>

Methanol extracts of *M. citrifolia* fruits show a significant activity against *Trichophyton mentagrophytes* and *S. aureus*.<sup>18</sup> *Morinda citrifolia* has also been proven to have an antihelminthic effect along with its antibacterial and fungicidal action.<sup>22-27</sup>

However, in older pharmacological studies, it was found that the individual compounds from noni were tested to have an antitumor activity. The fruit juice of *M. citrifolia* is rich in polysaccharides and carotene, which have been reported to have an antitumor activity. These antioxidants interact with the tumor cells leading to the destruction of tumor cells by an inhibition of tumor necrotizing factor-alpha, which is an endogenous tumor promotor. The anticancer agents in MCJ are 6-D-glucopyranose pentaacetate, anthraquinones, alizarin, epigallocatechin gallate, monoterpenes, and terpenoid compounds, such as beta-carotene and ursolic acid. It was found that damnacanthol and alizarin, an anthraquinone which is isolated from the roots of noni using chloroform extract, has been found to be a new inhibitor to the functioning of ras and helps to suppress the expression of activated ras-expressing tumors.<sup>16,18,27-30</sup>

## REVIEW RESULTS

The use of MCJ as an endodontic irrigant might be of interest to patients and endodontic professionals as a part of the growing trend to seek natural remedies as a part of dental treatment.<sup>17,21,22</sup>

### As a Caries Prevention Agent

Progression of dental caries is governed by acidogenic and aciduric Gram-positive bacteria, such as *Streptococcus mutans*, lactobacilli, and actinomycetes, which convert sucrose to organic acids, particularly lactic acid that dissolves the calcium phosphate present in teeth and eventually leads to decalcification and tooth decay. *Streptococcus mutans* adheres on enamel and dentin, creating an acidic environment leading to cavitation. Ripe *M. citrifolia* fruit juice was used to study the inhibitory effect against caries-causing microorganisms using disk diffusion bioassay and evaluating the minimum inhibitory concentration. *Morinda citrifolia* fruit juice showed zones of inhibition and minimum inhibitory concentrations at 125 and 62.5  $\mu$ g respectively, against predominant caries-causing bacteria, i.e., *S. mutans* and *Streptococcus mitis*.

Thus, *M. citrifolia* was proved to have an inhibitory effect on caries-causing organisms.<sup>10</sup>

### As an Intracanal Medicament

Intracanal medicaments help in reducing the bacteria remaining even after chemomechanical instrumentation and can provide an environment conducive to periapical tissue repair. *Morinda citrifolia* gel, along with herbal and CHX gels, was evaluated as an intracanal medicament against *E. faecalis* after their inoculation in extracted teeth by microbiological assessment after a period of 21 days. Results proved that *M. citrifolia* gel had a better antimicrobial activity and showed second best inhibition after CHX gel against *E. faecalis*. In another study, *M. citrifolia* gel exhibited good inhibition up to the 5th day of application of the gel when colony-forming units (CFUs) were evaluated at days 1, 3, and 5. This proves that *M. citrifolia* gel can be used as an intracanal medicament due to its good antibacterial properties, which can be enhanced with sufficient contact time of the gel with the bacteria.<sup>12,31</sup>

The antifungal activity of MCJ was evaluated by Jainkittivong et al.<sup>32</sup> The *M. citrifolia* fruit juice was tested against *Candida albicans* at different concentrations and at different contact times. This was done using broth dilution tests and cultures. The minimum fungicidal concentration of extract against *C. albicans* was 40 mg/mL at a 90-minute contact time or with 50 mg/mL at a 15-minute contact time. Thus, this proves that *M. citrifolia* fruit extract had an antifungal effect on *C. albicans*, and the inhibitory effect varied with concentration and contact time. Furthermore, a similar study performed by Barani et al.<sup>33</sup> proved that *M. citrifolia* fruit extract had an antifungal effect on *C. albicans*, and the inhibitory effect varied with concentration.<sup>34</sup>

### As an Endodontic Irrigant

Cleaning is one of the main objectives of root canal preparation. Thorough cleaning removes microorganisms, permits a better adaptation of filling materials, and enhances the action of intracanal medicaments. The choice of an irrigant is of great importance because they might vary in their effectiveness to act as lubricants during instrumentation and flush debris, smear layer, and bacteria out of the canal. Different chemical formulations of irrigants have different reactions with pulp, necrotic tissues, and microorganisms. *In vivo* studies on irrigation of MCJ in deciduous teeth assessed the administration of NaOCl and MCJ and their effectiveness against the bacterial colonies. It was concluded that there is a significant reduction in CFU in both types of drugs. Although there is no significant difference between both drugs, due to its lesser toxicity and

significant antimicrobial activity, it can be regarded as an intracanal irrigant.<sup>15</sup>

The MCJ is the first juice alternative to sodium hypochlorite in the irrigation of root canals.<sup>35,36</sup> According to Murray et al.,<sup>14</sup> 6% *M. citrifolia*, along with EDTA, has shown effective smear removal than 5.25% sodium hypochlorite. When MCJ is to be used as an endodontic irrigant, a flush of EDTA, followed by a final flush of MCJ, is recommended. The CHX was not very effective at removing smear layer, and the mixing of CHX and MCJ created one of the least effective irrigating solutions. The mixing of CHX and MCJ appears to inactivate the smear layer removal properties of the combined solution; this suggests that these solutions neutralize each other rather than enhancing the removal of smear layer. The use of MCJ as an endodontic irrigant might be advantageous because it is a biocompatible anti-oxidant and not likely to cause severe injuries to patients that might occur through NaOCl accidents. Preclinical and clinical trials are needed to evaluate the biocompatibility and safety before MCJ can be conclusively recommended as an intracanal irrigating solution, but according to *in vitro* observations, the effectiveness of MCJ when used with a rinse of EDTA appears promising.<sup>35</sup>

Furthermore, 6% MCJ followed by a final flush of 17% EDTA, which is regarded as an effective solution, does not affect the microhardness of root canal dentin.<sup>13</sup> The shear bond strength of resin sealers was also not affected when *M. citrifolia* was used as an irrigant than CHX; thus, it can be used as a better alternative to that of CHX.<sup>37</sup>

### CONCLUSION

The MCJ can be used as an endodontic irrigant and medicament due to its better smear layer removal properties and antimicrobial activity. It also does not have any major side effects as compared with sodium hypochlorite and CHX. It also helps in caries prevention and control, which is the main crux for the requirement endodontic treatment. Further studies of MCJ on the endodontic aspect of dentistry can alter the chemical aspect of endodontic therapy in the near future.

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