



Using Colocynth Extract as an Antibacterial Against Tooth Decay

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Abstract

The past few decades have witnessed the emergence of drug-resistant germs, which has contributed to the search for bioactive substances effective against these microbes. Plant-derived phytochemicals, which can be taken from any part of the plant, including the root, stem or flower, have shown beneficial therapeutic properties. *Citrullus colocynthis's* ethanolic extract has been observed to have inhibitory effects on *Streptococcus mutans*. This literature review aimed to explore the use of herbal products and their secondary metabolites in the treatment of dental caries. The studies included in our review were all conducted either in the laboratory or inside the body to determine the extent of the effect of this plant on bacteria. The number of original studies using different extracts of *Citrullus colocynthis* was 6, with the highest concentration being (16.384 mg/mL) and the lowest MBC (1.5 mg/mL) aqueous and ethanolic extract, respectively. In contrast, the lowest MIC was 0.37 mg/mL for the aqueous extracts, and the highest was 1 mg/mL for the ethanolic extract. We concluded in the current study that further research is needed on this topic to investigate the

potential safety of using the extract both internally and externally, given the emergence of bacteria resistant to known antibiotics.

Introduction

Bitter apple, Colocynth, or *Citrullus colocynthis*, is a native of Asia and the Mediterranean region and a member of the Cucurbitaceae family. With lobular tendrils, alternating leaves, and tiny yellow monoecious flowers, it is a wild, herbaceous, non-tough, angular, perennial vine. *Citrullus colocynthis* has shown promise in treating mouth ulcers and preventing the growth of the tooth decay-causing bacterium *Streptococcus mutans*.

Antimicrobial Features

Inhibition of *Streptococcus mutans*:

Citrullus colocynthis's ethanolic extract has been observed to have inhibitory effects on *Streptococcus mutans*, with minimum bactericidal concentration (MBC) and minimum inhibitory concentration (MIC)

values of 3.12 and 1.56 mg/ml, respectively. This means that the bacterium, a major cause of dental caries, can be effectively inhibited and destroyed by the plant extract [1].

Broad antimicrobial effect:

A potent antimicrobial effect has been observed against a variety of bacterial isolates, including Gram-positive and Gram-negative bacteria, with colocynth extracts. The high percentages of inhibition indicated the effectiveness of the ethanolic and aqueous extracts [2].

Therapeutic potential for mouth ulcers:

Broad antimicrobial effects: Although studies on mouth ulcers are not well-documented, bitter melon's general antibacterial properties suggest possible advantages in treating infections that cause mouth ulcers [3,2].

Cytotoxicity and Safety:

The results of the cytotoxicity tests indicate that the survival rate of cells is significantly reduced at higher concentrations (5 mg/ml and 10 mg/ml), suggesting potential toxicity. However, the survival rate is higher at lower dosages (1.25 mg/ml and 2.5 mg/ml), suggesting safer levels of use for therapeutic purposes [1].

Because *Citrullus colocynthis* has long been used to treat infectious diseases, pharmacologists are now more interested in the active compounds that confer their therapeutic qualities. In addition, the plant exhibits various biological and pharmacological properties, including antioxidant, anti-inflammatory, anticancer, antibacterial, and antidiabetic effects [4]. In Book Three of the Canon of Medicine, Persian scholar Ibn Sina (980-1032) provided an excellent example of oral disorders and toothaches, while in Book Two, she listed medicinal plants that were used to treat toothaches [5,6]

Previous studies have suggested that the colocynth extract group saw more noticeable adverse effects, despite a study finding statistically significant differences in inflammation levels, inflammatory cell infiltration, and morphological changes of pulp tissue cells [7].

Numerous analgesic, anti-inflammatory, and antibacterial properties have been demonstrated in one study by aqueous extracts of roots, stems, fruits, and seeds at various stages of ripening. However, this same study assumes the presence of side effects when using the extracts at 100 or 200 mg/kg/day in mice. Severe lesions were detected, revealing the effects of seed and pulp extracts on the kidneys, small intestine, and liver [8].

Another study suggested that the extract of *Colocynthis* taken from the bark did not show an inhibition zone in the plate against any type of bacteria isolated from the mouth, including *Streptococcus mutans*, which causes tooth decay [9].

Another study examined various doses of the extract within the body to assess cytotoxicity, and the findings showed that at 400 mg/kg, minor morphological alterations were observed in the liver cells [10].

A previous in vitro study demonstrated that the ethanolic extract exhibited inhibitory activity against certain types of bacteria at various temperatures, whereas the aqueous extract showed no inhibitory effect at the different temperatures and concentrations tested [11]. In our current review, we focused on the effect of this plant on the bacteria that cause tooth decay, considering the concentrations used in previous studies and their potential side effects.

Method

Originally published articles were reviewed, which carefully examined and collected important data about *C. colocynthis* from the best published research available in Google Scholar, PubMed, and Scopus (Embase) from 2019 to 2025. Reviews and studies that used it as an antibacterial in general were excluded. Original articles that used it in specific cases and concentrations were taken. The studies included in our review were all conducted either in the laboratory or inside the body to determine the extent of the effect of this plant on bacteria. Using the keywords, 53 papers were identified that relate to our current topic. We conducted a detailed study of the methods for examining the effect of *Citrullus colocynthis* on bacteria that cause tooth decay, whether used alone or in combination with another substance, as well as the concentration used.

Results

Tale 1. Number of previous studies.

| Studies | Google Scholar | PubMed | Scopus |
|---------|----------------|--------|--------|
| 5 | 5 | 3 | 2 |

Tale 2. Concentrations in previous studies.

| extract | Concentrations | | study |
|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------|
| ethanolic extract | 3.12 MBC mg/mL | 1.56 MIC mg/mL | [1] |
| aqueous extracts ethanolic extract | 1.5 1.5 mg/mL MBC | 0.37 0.75 mg/mL MIC | [12] |
| Aqueous ethanolic methanolic extracts | 8000 2000 4000 µg/ml MBC | 4000 1000 2000 µg/ml MIC | [13] |
| The powder of the dried plant was prepared, then hydrodistilled for three hours to obtain the pure essential oil | Sterile endodontic pressure syringes were used to fill the canals with C.colocynthis essential oil. Both medications continued to be inserted into the root canals up to the point when they were extruded from the access cavity. | | [14] |
| Ethanolic extract inhibited the growth of <i>Lactobacillus acidophilus</i> | 16384 µg /ml | | [15] |
| Aqueous extract inhibited the growth at the concentrations of <i>Lactobacillus acidophilus</i> | 16384 and 8192 µg/ml MBC. | | |
| The ethanolic and aqueous extracts inhibited <i>Streptococcus mutans</i> growth | 16384 and 8192 µg/ml µg/ml MBC. | | |

Discussion

One of the most prevalent chronic diseases affecting people is tooth decay, which is caused by the bacterium *Streptococcus mutans*. Some types of bacteria also cause infections in the area around the gums. Because herbal extracts include anti-inflammatory and anti-bacterial properties, it is vital to

investigate methods of treating oral health issues. Aqueous or ethanolic extracts of *Citrullus colocynthis* have been extensively investigated in numerous studies. In a comparative study examining the effect of *Citrullus colocynthis* essential oil and $\text{Ca}(\text{OH})_2$ on *Enterococcus faecalis*, the former demonstrated higher activity against it than $\text{Ca}(\text{OH})_2$ during the initial contact period of the first week [14]. Various studies have mentioned the use of colocynth as an anti-inflammatory, antibacterial, and even a pain-relieving agent [16-18].

It has been used alone or in combination with another compound. A previous study used a simple, environmentally friendly, and effective method. It used zinc nitrate and extracts of bitter melon (*Citrullus colocynthis*) as biofuels that inhibit the growth of pathogenic Gram-negative and Gram-positive bacteria, including methicillin-resistant *Staphylococcus aureus* (MRSA) and *Pseudomonas aeruginosa* [19].

Another study suggested that the inhibitory effect of aqueous and ethanolic extracts of colocynth on *Streptococcus mutans* was similar, meaning that only very high concentrations had antibacterial effects [15].

The number of original studies using different extracts of bitter melon and the concentrations shown in the table was 6 the highest concentration was (16.384 mg/mL) and the lowest (1.5 mg/mL), while some sources cited in the introduction showed that aqueous extracts showed no effect on bacteria, in addition to the side effects of using the extract inside the body. We need more studies on this matter to investigate the safety of using the extract, both internally and externally.

Conclusion

Citrullus colocynthis exhibits encouraging antimicrobial activity, particularly against *Streptococcus mutans*, which may aid in treating mouth ulcers and controlling tooth decay. However, due to the potential cytotoxic consequences, care should be taken when using the employed concentration. To fully comprehend its effectiveness and safety in oral health applications, further research is needed.

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