



RESEARCH SPOTLIGHT

CLINOPTILOLITE

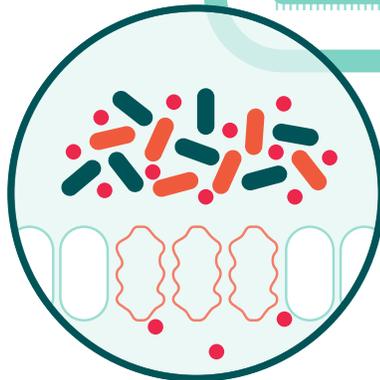
BINDS AND NEUTRALIZES C. DIFFICILE TOXINS



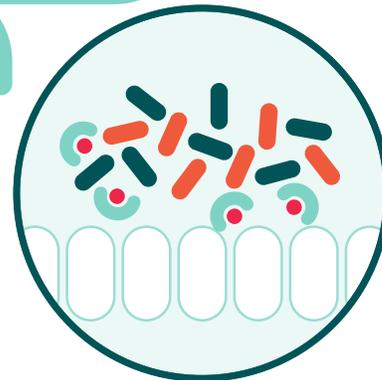
C. difficile



Clinoptilolite



**Without clinoptilolite,
C. diff toxins damage
intestinal epithelial cells.**



**Clinoptilolite binds
C. diff toxins to protect
intestinal epithelial cells.**

Purified natural clinoptilolite can counteract the pathophysiology that underlies recurrent *C. difficile*-induced diarrhea; it can adsorb *C. difficile* toxins A and B and neutralize their biological activity, and it binds bile acids which may promote restoration of the gut microbiome. Clinoptilolite is a natural zeolite mineral with high binding affinity and has been suggested as an option to neutralize toxins secreted by *C. difficile*.

Clostridioides difficile: Bacteria causing infection resulting in diarrhea due to the actions of two cytotoxic proteins secreted by the bacteria

Toxins A and B: Cytotoxic proteins secreted by *C. difficile* that bind to membrane receptors in intestinal cells and trigger the loosening of tight junctions and neutrophil infiltration



RESEARCH QUESTION

Can purified natural clinoptilolite bind *C. difficile* toxins A and B and neutralize their effects on intestinal epithelial cells?

METHODS

In vitro studies determined the ability of purified natural clinoptilolite to modulate the effect of *C. difficile* in Caco-2 cells (a model of small intestinal cells) including:

- Cell viability
- Binding of *C. difficile* to purified natural clinoptilolite
- Analysis of apical surface
- Integrity and permeability of monolayer as a marker of gut barrier integrity

RESULTS

Clinoptilolite did not affect the ability of cells to survive.

Binding of *C. difficile* to purified natural clinoptilolite was rapid for the first ten minutes then slowed by ~20-fold for 2 hours.

Clinoptilolite was able to effectively bind *C. difficile* toxins even in the presence of bile acids.

Incubation with clinoptilolite protected intestinal cells from absorbing *C. difficile* toxins and preserved the integrity of microvilli on brush border and epithelial barrier.

CONCLUSIONS

Purified natural clinoptilolite effectively bound *C. difficile* toxins A and B and protected intestinal cells from their cytotoxic actions. The binding capacity of clinoptilolite for toxins A and B was comparable or even slightly superior to some current therapeutic options.

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