

Antimicrobial activity of biopolymer against *Enterococcus faecalis*

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Abstract: The current study's objective was to examine any possible antibacterial activity of the biopolymer (Dextran) against clinical isolates of *Enterococcus faecalis*. All 30 strains of *E. faecalis* confirmed positive for resistance to vancomycin(VAN), whereas 24 strains (80%) tested positive for resistance to teicoplanin(TEC) in antimicrobial susceptibility testing. The minimum inhibitory concentration (MIC) had been detected by evaluating the antibacterial activity using the broth microdilution technique; the findings revealed that the MIC was between (25-50) mg/ml against isolates of *E. faecalis*. All experiments were done in triplicate.

Introduction:

Both humans and animals' digestive tracts are naturally colonized by Enterococci [1]. *Enterococcus faecalis* and *Enterococcus faecium* are two clinically prevalent isolates that cause nosocomial infections such as sepsis, endo-carditis, intra-abdominal, pelvis, skin infections, and UTI [2], [3] and [4]. There are limited choices for successful treatment and prevention of severe infections since *Enterococcus* species are resistant to a variety of antibacterial medications [5]. Consequently, microbial resistance is identified as one of the top five global issues [6], producing a pressing need for the creation of brand-new antibacterial drugs. Living bacteria known as probiotics colonize the host and have positive health effects. The most prevalent probiotic bacteria are Lactobacillus, Bifidobacterium, *Lactococcus*, *Streptococcus*, and *Enterococcus*, whereas *Saccharomyces* is a commonly used yeast species [7]. Enzymes, bacteriocins, amino acids, peptides, short-chain fatty acids, vitamins, anti-inflammatory compounds, antioxidants, exopolysaccharides, and immunomodulators are just a few of

the bioactive chemicals produced by probiotics [8]. Probiotic-containing foods and dietary supplements in the form of capsules, pills, liquid, and powder have been widely available throughout time ([9]; [10]). The benefits of probiotics include the variety of ways they regulate the host's immune system, stimulate the gut microbiota, increase the creation of digesting enzymes and bioactive components, and remove infections ([11]; [12]). Earlier researches have shown that a variety of pharmacological actions can be caused by the different functional groups in EPS, including those related to immune system modulation, anti-inflammatory, antioxidant, antiviral, and anticancer in a variety of animals [13].

Dextran is a neutral, highly biocompatible bacterial exopolysaccharide made up of straightforward, repetitive glucose subunits. Its biopolymeric nature is straightforward and distinctive, particularly water soluble, and free of any cellular toxicity associated with drug delivery markers. Additionally, it has a full capability for metabolism within the body, which lowers the risk of renal failure [14]. With a wide size range and anticancer, antifungal, and antibacterial capabilities, the biocompatible EPS may be utilized in a number of fields, including the food and biomedical. Dextran has additionally been suggested for usage in biodegradable film-forming agents and coatings ([15]; [16]). This study's objective was to assess dextran's antibacterial effectiveness against *Enterococcus faecalis*.

Materials and methods:

Microbial strains:

In the current investigation, 30 clinical strains of the *Enterococcus faecalis* bacteria were examined. They have been identified from various clinical samples in the Bacteriology Laboratory of Al-Hussein teaching hospital, Identified by the Vitek2 automatic system. The isolates had been maintained in the laboratory on TSA medium (Tryptone Soy Agar).

Antimicrobial susceptibility testing:

Following the instructions of CLSI versions 2018, the diffusion technique (Kirby-Bauer) had been used to evaluate the antibiotic susceptibility. VAN (30 µg), VAN (5 g), and TEC (30 µg) have been antimicrobial disks which it performed in this investigation. Following an 18–24 hrs incubation period at 37°C, inhibitory zones scored and analyzed in accordance with CLSI

guidelines. In this investigation, resistance and intermediate susceptibility were both reported. The Clinical and Laboratory Standards Institute's guidelines were applied to determine the MIC of *E. faecalis* isolates against a range of antibiotics using agar dilution (CLSI, 2018). Essentially, Mueller-Hinton Agar plates (Difco in the United States) had been applied with VAN(30 µg), VAN (5 µg), and TEC (30 µg), would then infected with bacteria solution equivalent to 0.5 McFarland standard. The plates seem to have been then incubated for 18 to 24 hours at 37°C. Isolate had been categorized as susceptible or resistant predicated on the CLSI document M100-S27's suggested endpoint values (Wayne, PA, USA).

Antimicrobial activity of dextran against E. faecalis:

Dextran's antimicrobial activity against *E. faecalis* isolates had been assessed using the microdilution technique in 96-well flat-bottom microplate plates on the basis of minimum inhibitory concentration (MIC) values. Dextran has given by Pharmacosmos A/S Denmark. Three copies of each experiment were performed. At a concentration of 200 mg/ml, a pure dextran stock solution was made. The first column of the 96-well microplate received 125 µl of sterile culture medium nutrient broth, followed by the addition of 125µl of dextran solution, which had mixed with the medium. Following a 1:100 nutrient broth dilution of the standardized *E. faecalis* suspension (equal to 0.5 Mcfarland standard), 25µl of the modified *E. faecalis* suspension had been applied to all growth control wells. For 24 hours, covered microplates were incubated at 37° C. Subsequently, all wells received 30 µl of 0.015% resazurin dye, which was then incubated for 4 hours to examine color change. The column without resazurin (blue) color change throughout incubation has been used to compute the MIC value.

Results and Discussion:

A total of 30 strains that were identified in 2022 from patients at the Al-Hussein teaching hospital had been used for this investigation. *Enterococcus faecalis* had been detected using the VITEK method, and all strains showed catalase-negative.

Testing for antimicrobial susceptibility All 30 *E. faecalis* strains appeared resistant to vancomycin, whereas 24 strains (80%) had been resistant to teicoplanin, according to the susceptibility profiles of the two drugs.

Dextran's antimicrobial effectiveness against *E. faecalis* was measured using (MIC) values. The MIC against isolates of *E. faecalis* had been found to be between (25-50) mg/ml, in accordance with the results. Dextran's MIC found to be 25 mg/ml against 19 *E. faecalis* isolates from urinary tract infection patients (UTI), 50 mg/ml against 11 *E. faecalis* isolates from wound infections.

Similar to Shakeri, *et al.* (2023) [17], their study assessed the antibacterial efficacy of curcumin-encapsulated PU/dextran membranes against the gram-positive bacterium *S. aureus*..

When made of chitosan and oxidized dextran, the ideal hydrogel should have built-in antimicrobial qualities that help hasten wound healing by minimizing problems at the wound site. Surface antibacterial assays had all been also used to assess the antibacterial activities against Gram-positive bacteria *S. aureus* and Gram-negative bacteria *P. aeruginosa*. [18].

Comparable research has been done by Bucak, *et al.*(2021) [19] in order to determine whether glycodendritic polyamine dextran G2.5 exhibits antibacterial activity in an in vitro experiment and, *E. coli* produced the lowest MIC, at a concentration of 1%. Additionally, at MICs equivalent to 2%, *S. aureus* and *L. monocytogenes* growth was suppressed.

The oxidized dextran/chitosan hybrid hydrogels with polydopamine nanoparticles has shown antibacterial properties to guard the wound against infections [20].

Conclusions:

Our findings suggested that dextrana might be used in conjunction with antibiotic therapy to boost its effectiveness in the management of several disorders brought on by bacterial infections that are resistant to common antibiotics. These results had indicated dextran's potential as a bioactive antibacterial compound source for the management of antibiotic-resistant *E. faecalis*. Even so, in order to ascertain their toxicity and pharmacokinetic and pharmacodynamic properties, additional tests are required for drug development.

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