

Antimicrobial Effect of Pectin with some antibiotics against staphylococcus aureus

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Abstract

Recently, alternative antibiotics originating from natural or biological sources have been used, which have fewer detrimental effects on people. In this work, we evaluated the bactericidal efficacy of pectin against *Staphylococcus aureus*. The inhibition of pectin against *Staphylococcus aureus* isolated from human skin infection sites was measured. This inhibitory action was tested using several antibiotic tablets such as linezolid 30 µg, vancomycin 5 µg, amikacin 30 µg, ceftriaxone 30 µg, and cefotaxime 30 µg, amoxicillin/clavulanic acid 30 µg. Pectin was utilized at a 100% concentration against the identified bacterial species. The inhibition zones were 16, 17, 14, 16, and 15 mm, respectively, compared to several of the antibiotics utilized in this investigation. Pectin was also utilized at varied concentrations (100%, 50%, 25%, and 12.5%) against five isolates of *Staphylococcus aureus*, yielding different inhibitory zones compared to several of the antibiotics used in this investigation. The (MIC) against *Staphylococcus aureus* was calculated, with the MIC of pectin reaching 50 µg/ml.

Keywords: Pctin; skin infection; *Staphylococcus aureus*; Antibiotics disc.

1. Introduction

Different parts of plants are rich sources of biologically active components, which has attracted attention throughout the decades [1]. Approximately 25% of the bioactive constituents in medicinal plants are utilized as pharmaceuticals [2]. Pectins constitute a category of intricate polysaccharides located in the cell walls of higher plants and constitute up to 30% of the dry mass of the primary cell wall [3]. Pectin contributes to the strength and structure of plant tissues, both as part of the primary cell wall and as a major component of the middle lamella, responsible for intercellular adhesion. It is a water-soluble polymer [4]. Natural pectin comes from a wide range of sources and is of industrial importance due to its thickening, coagulation, and emulsifying properties. It is also important in biomedical applications and the biomaterials industry due to its potential anti-inflammatory and immunomodulatory effects [5]. Varying pectin contents are found in fruit and vegetable raw materials such as pomegranates, lemons, apples, grapefruit, hawthorn, cocoa peels, sunflower heads, sugar beets, pumpkins, watermelons, pears, and potato pulp. Pectin isolated from citrus fruits and apples is among the most well-known and widely used in industry [7][6]. Pectin is the sole dietary fiber that demonstrates bactericidal properties against the most common pathogenic and opportunistic germs, inactivating therapeutic bacteria at elevated concentrations (>2%) and diminishing the antimicrobial efficacy of antibacterial penicillins. [8]. Pectin has antibacterial activity, a crucial property that has literally been rediscovered [9]. *Staphylococcus aureus* is a Gram-positive bacterium (stained purple by Gram stain) and one of the most important pathogens in hospitals. [10] *Staphylococcus aureus* is one of the most common human pathogens [11], causing a

wide range of conditions, from skin and superficial infections to serious systemic diseases. These infections include sepsis, endocarditis, and cutaneous and soft tissue infections (including impetigo, folliculitis, abscesses, cellulitis, and Staphylococcal Scalded Skin Syndrome), highlighting its complexity and role as a major cause of community-acquired and hospital-acquired bacterial infections in humans [12]. The skin is more susceptible to infection by *Staphylococcus aureus*, which causes skin ulcers and sometimes wound infections. These bacteria enter the bloodstream and penetrate deeply into tissues, causing serious infections [13]. Stable medical surgical wounds are the primary sites of infection in hospitalized patients. In these wounds, the system may host emerging bacteria, causing local damage, or they may spread to other parts of the body via the bloodstream. Localized skin infections with *Staphylococcus aureus* are either primary or secondary [14]. This study seeks to examine the impact of pectin on *Staphylococcus aureus* isolated from diverse skin infections at various anatomical locations on the human body and to compare it .

2. Materials And Methods

2.1 Collection of Samples

Clinical specimens from wound swabs from healthcare institutions in Salah Al-Din Governorate , Iraq were collected under aseptic precautions and transported by using Brain Heart Infusion Broth (BHIB) as the transport medium immediately to microbiology laboratory to be processed and examined. This study characterized all bacterial isolates of *S.aureus* using morphological, microscopic, biochemical assays.

2.2 Bacterial Isolates and Identification

2.2.1 Microscopical Identification

The microscopic examination results of *S. aureus* bacteria showed Gram-Positive bacteria with a Purple color, in the form of Cocci, and as single cells or in pairs likes grapes shapes[14] .

2.2.2 Biochemical test:

Biochemical experiments were employed to identify the ideal biochemical parameters for each isolate, as referenced in [15,16]. Confirmatory assays were additionally conducted utilizing the Vitek_2 compound system.

2.2.3 Preparation of Substances:

Pectin was acquired in powdered form from Himedia.

2.2.4 Preparation of the Solution:

The solution was prepared by precisely measuring 100 mg of the chemical with a delicate balance. Pectin was incorporated into 5 ml of sterile distilled water (autoclaved) or dimethyl sulfoxide (DMSO) within a sterile vial. The vial was gently agitated or a magnet was employed to mix the fluid until the pectin was entirely dissolved (pectin is water-soluble, though prolonged gentle shaking may be necessary). The liquid was filtered through a 0.22 micron by Syringe filter in a sterile environment such as a sterilization chamber or a laminar flow hood. This inhibits the existence of any bacterial contamination. The material was thereafter immersed in a water bath at 62°C for 10 minutes to yield a basic solution, which was then utilized to derive various concentrations [17].

2.2.5 Estimation the Minimum Inhibitory Concentration Method (MIC) of pectin:

A suspension of bacterial isolates, 24 hours old, was prepared following incubation at 37°C for 24 hours. A standard McFarland tube (0.5) was utilized to assess the turbidity of the bacterial suspension prior to growing on Mueller-Hinton agar (MHA) medium. Bacterial isolates were grown on Mueller-Hinton agar using sterilized cotton swabs. Subsequent to this, suitable wells were formed in the media on the culture plate utilizing a sterile ceramic apparatus. Twenty microliters of the solution at varying concentrations was dispensed into each well, followed by incubation of the plates for 24 hours at 37°C [18].

2.2.6 Antibiotic Sensitivity Test:

The antibiotic disc, as illustrated in Table (1), was positioned on the plate of the Mueller-Hinton agar medium (MHA) with sterile forceps, following the streaking of the bacterial inoculum. Cultured plates were subsequently incubated overnight at 37°C for 24 hours, resulting in the formation of an inhibitory zone. The bacteria's resistance and sensitivity to antibiotics were assessed by monitoring inhibition on the plate and measuring the inhibition zone with a ruler, with the area quantified in millimeters [19]. The area of inhibition diameter was measured and the results were compared with the standard tables given in (CLSI 2024).

Table1: Antibiotic discs used

<i>Antibiotics</i>	<i>conc µg/ml</i>	<i>Synthetic company</i>
<i>Amikacin AK</i>	30µg	
<i>Amoxicillin/clavunic acid AMC</i>	30µg	
<i>Vancomycin VA</i>	5µg	Bioanalyse/ Turkey
<i>Linezolid LZ</i>	30µg	
<i>Ceftriaxoen CTR</i>	30µg	
<i>Cefotaxime CTX</i>	30µg	

3. Results and Discussion:

3.1 Inhibitory Effect of 100% Pectin Compared to Some Antibiotics

Table 2 and Figures (1), (2) demonstrate the effect of 100% pectin on *Staphylococcus aureus*. The inhibition zones were 14, 15, 16, 17, and 16 mm, respectively, compared to some antibiotics Figures (3) The amoxicillin/clavulanic acid antibiotic showed inhibition zones of (21, 20, 13, 0, 10 mm) and the bacterial isolates showed a clear effect when compared to the antibiotics used in this study, as we find that the effect of pectin was almost equal for both the vancomycin antibiotic, which gave inhibition zones of (14, 15, 14, 13, 14 mm) respectively, and ceftriaxone with inhibition zones of (16, 18, 0, 15, 13 mm), and cefotaxime (17, 18, 11, 10, 0 mm), as it gave a result almost similar to these antibiotics, while high inhibition zones appeared for both the antibiotics amikacin (21, 18, 10, 21, 19 mm) and linezolid (26, 24, 19, 16, 19 mm).

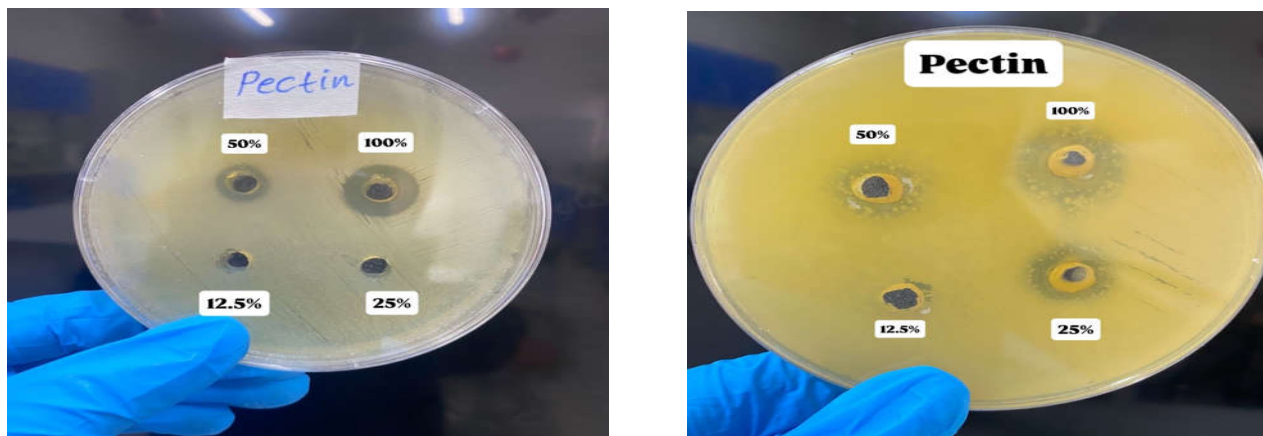


Figure 1.2: Pectin concentrations 100%, 50%,25%,12.5% toward Staphylococcus aureus .



Figure 3: Antibiotic sensitivity for (S.aureus) bacteria .

Table 2: Inhibition effect of pectinat concentration 100% in comparison to certain antibiotics
Bacterial Isolates Inhibition Zone 100%

<i>Pectin</i>	S.ureus(1) 16mm	S.aureus(2) 17mm	S.aureus(3) 14mm	S.aureus(4) 16mm	S.aureus(5) 15mm
<i>Antibiotics Inhibition Zone</i>					
<i>AK (30μg)</i>	20	18	10	21	19
<i>AMC(30μg)</i>	21	20	13	0	10
<i>VA(5μg)</i>	14	15	14	13	14
<i>LZ(30μg)</i>	26	24	19	16	19
<i>CTR(30μg)</i>	16	18	0	15	13
<i>CTX(30μg)</i>	17	18	11	10	0

3.2 Minimum inhibitory concentration (MIC) of pectin

From the results that conducted in table Table 3 indicate that the (MIC) of pectin for most Staphylococcus aureus isolates is 50 μg/ml.

Pectin, a non-ionic, heterogeneous polysaccharide, has garnered heightened interest as a paramount prevalent natural polysaccharides globally. Pectin is distinguished by its remarkable membrane-forming capacity, biological efficacy, Ease of use, biodegradability, biocompatibility, ease of use,

non-toxicity , and affordability [20] [21]. The oligosaccharides in pectin demonstrate many functional activities, including immunomodulation, anticancer effects, antioxidant capabilities, and antibacterial qualities. [22] Pectic oligosaccharides (POSSs) derived The out layer of several fruits and veggist have unique antimicrobial capabilities. (POSSs) obtained from citrus peels and Apple pomace demonstrate significant antibacterial properties against Gram-positive organisms such as *Staphylococcus aureus* [23].

Table 3: The Minimum inhibitory concentration MIC (mm) of pectin .

Isolates *MIC (μg/ml) with Stock (100,50,25,12.5) of pectin*

	Stock 100	50	25	12.5
<i>Staph.aureus(1)</i>	+	+	+	-
<i>Staph.aureus(2)</i>	+	+	-	-
<i>Staph.aureus(3)</i>	+	-	-	-
<i>Staph.aureus(4)</i>	+	+	-	-
<i>Staph.aureus(5)</i>	+	+	-	-

4- Conclusion

Through our study of fruit pectin on *Staphylococcus* bacteria isolated from skin infections and surgical wounds in humans, and comparing it with a selection of antibiotics, we observed a varying Inhibitory The effect of this extract regards antibiotics. The inhibitory impact of this extract closely resembled that of other antibiotics utilized in this study.

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