

# Investigation of the effect of electric field on bacteria isolated from skin infection

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**Abstract.** Al-Salami RB, Mukhaifi EA, Al-Tamimi WH. 2024. Investigation of the effect of electric field on bacteria isolated from skin infection. *Biodiversitas* 25: 1320-1328. Nineteen bacterial isolates were obtained from twenty-six samples obtained from various patients with skin infections in the current study. These bacteria were identified by a genetic method depending on 16S rRNA and the molecular identification of *cna* and *fnbA* genes of *Staphylococcus aureus* isolates were detected, and an antimicrobial electric field was applied using various voltages and durations to target both Gram-positive and Gram-negative bacteria. The results showed that *Staphylococcus* sp. was the most dominant genera, followed its *Acinetobacter* sp. The high frequent species was *Staphylococcus aureus* (24%) followed by *Staphylococcus epidermidis* (21%), *Staphylococcus epidermidis* and *Staphylococcus argenteus* (10.5%), *Staphylococcus haemolyticus*, *Acinetobacter baumannii* and *Acinetobacter variabilis* (5.2%). Eleven new strains were identified and recorded in GenBank. A phylogenetic tree was also constructed based on 16S rRNA gene sequences of isolates to evaluate their close relationship and evolution between them. The bands of each amplified *cna* and *fnbA* gene were described at 192 bp and 191 bp respectively. The effect of the antimicrobial electric field showed an extremely high and significant decrease of the viable bacterial count of *S. haemolyticus* and *A. baumannii* after the exposure to an electric field of (1-5) V for 15 min, where the viable count of bacteria reduced sharply with percentage bacterial death (19-95%) and (16-100%), respectively, and from (66-100%) and (52-100%) after 30 min, respectively.

**Keywords:** 16S rRNA gene sequencing, antibiotic resistant, antimicrobial electric field, isolation, skin infection

## INTRODUCTION

The human skin is the largest organ and the basic barrier in the body. It is a vital component of the immune system, serving as the first line of defense against bacterial infections and protecting against thermal, mechanical factors, and harmful radiation. It not only blocks pathogens from entering the body from the environment but also provides a large-scale biological niche for a wide range of bacteria. The bacteria, along with their genetic components and environmental interactions, make up the human skin microbiome (Ibrahim et al. 2015).

Most commonly found are Firmicutes (24.4%), Actinobacteria (51.8%), Bacteroidetes (6.3%), and Proteobacteria (16.5%). The most prevalent genera are *Propionibacterium*, *Corynebacterium*, and *Staphylococcus*. Various skin infections may arise from any breach of this barrier or disturbance of skin homeostasis combined with the appearance of pathogens. Abnormal conditions such as humidity, temperature, pH, and the composition of antimicrobial peptides and lipids also lead to ecological dysbiosis (Yang et al. 2022). Dysbiosis is an unbalanced microbial community in a particular location of the body that might cause the onset or development of disorders McLoughlin et al. (2021). Many skin diseases like seborrheic dermatitis and atopic, acne, alopecia areata, and psoriasis may result from dysbiosis (Silverberg 2021). McLoughlin et al. (2021) showed that dysbiosis is an unbalanced microbial community in a particular location of

the body that might cause the onset or development of disorders. Many skin diseases like seborrheic dermatitis and atopic, acne, alopecia areata, and psoriasis may result from dysbiosis (Silverberg 2021).

One of the most prevalent conditions in both community and hospital settings is skin infection. These can occur in various ways, ranging from limited superficial infections that can be treated with antibiotics to severe infections in the deep tissue that lead to death if the patient stays without treatment (Lim et al. 2018). Cellulitis is a common skin disease encountered in medical emergencies in hospitals (Toh et al. 2023). It is an acute bacterial infection causing inflammation in both the deep dermis and the surrounding subcutaneous tissue appears as a poorly defined, warm, erythematous, edematous, and palpably sensitive area; the infection is not accompanied by an abscess or purulent discharge (Byrd et al. 2018).

Gram-positive bacteria, specifically *Staphylococcus aureus* and streptococcal species, are the most likely cause of soft skin tissue infections (SSTIs) (Silverberg 2021). Additionally, germs that are not pathogenic due to damage to the skin barrier might become virulent through skin injury (Zegadło et al. 2023). Antibiotic resistance is one of the most important public health challenges, and the emergence of antibiotic-resistant bacteria poses one of the biggest dangers to the healthcare sector. Deadly pathogenic multidrug-resistant bacteria (MDR) are becoming more prevalent every day and represent a serious threat to human health. Antibiotic resistance of this kind was previously