Review paper

The potential effects of Pomegranate on Bacteria and Viruses: A review

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ABSTRACT

The Pomegranates have been known for their numerous health benefits, including antioxidant, anti-inflammatory, anti-bacterial and anti-viruses properties. Research indicates that pomegranates and their extracts may serve as natural alternatives due to their potency against a wide range of bacterial and viral pathogens. The characterization and effect of pomegranate were investigated from different extract water, ethanol, methanol, acetic acid and petroleum ether. Pomegranate has a vital role in the prevention of cancer, viral diseases, diabetes, bacterial infections, ultraviolet radiation-induced skin damage and infant brain ischemia due to synthesizing putative active molecules such as Gallic acid, Ellagic acid, Punicalin, Punicalagin, Anthocyanins, and Flavanols compounds. In this mini-review, we debate the antimicrobial and antiviral effects of pomegranate.

1. Introduction

Punica granatum are utilized by local people as the part of their meal. Peoples supposed to consume Punica granatum arial part and throw its peel as waste. Punica granatum is also well known by different local name like dalim, anar, and pomegranate1. It belongs to the family of Puniceae. Punica granatum L., an ancient, mystical, and highly distinctive fruit, is the pre-dominant member of two species comprising the Puniceae family. Punica granatum are widely available in Mediterranean basin and Southern Asia in warm environment 2. The chief production of pomegranates is carried out at Alicante and Murcia provinces of India 3. Different part of pomegranate like bark, leaves, immature fruits, and fruit rind have some medicinal importance 3. Various investigations were carried out to determine antioxidant, anticarcinogenic, and anti-inflammatory properties of pomegranate constituents 3,4. Numerous studies showed the role of pomegranate in prevention of cancer, cardiovascular disease, diabetes, dental conditions, erectile dysfunction, bacterial infections, male infertility, Alzheimer’s disease, arthritis, and obesity using various extract of this plant 5-7. In this mini review, we attempted to summarize the
antimicrobial and anti-viral properties of pomegranate.

2. Antimicrobial Properties

The antimicrobial activities of pomegranate extracts have been widely studied against several highly pathogenic and sometimes antibiotic-resistant organisms. The antimicrobial activity of the pomegranate against clinical isolates strains of pathogenic of S. aureus and E. coli were studied by Pagliarulo C et al. The antibacterial activity of different extracts of pomegranate fruit against S. aureus and E. coli determined with the agar-diffusion method. It has been found that the crude and purified peel extracts have high antibacterial activity, which formed a large zone inhibition (15-30 mm) against both the test microorganisms at concentration of 2, 4, 8 mg/disc, while the crude juice extracts of pomegranate at concentration of 10 mg/disc have not demonstrated clear zone against E. coli. However, the concentration of 20 mg/disc led to formation of a clear inhibition zone of 13 mm, against both S. aureus and E. coli. Purified juice of pomegranate at concentration of 4 mg/d demonstrated a lower antibacterial activity, forming an inhibition zone of 10 mm against S. aureus and 8 mm against E. coli. The MBC (The minimum bactericidal concentration: was defined as the minimum extract concentration that killed 99% of bacteria in the initial inoculums) of pomegranate crude juice extracts was 160 µg/µl against both clinically isolated microorganisms tested in this study. Differently from the juice extracts, the peel pomegranate extracts exhibited the following antimicrobial activity: MIC 30 µg/µl and MBC70 µg/µl against E. coli; and MIC 20 µg/µl and MBC 50 µg/µl against S. aureus. Sydney et al. also reported antibacterial activity of pomegranate extract against Clostridium difficile. It has been found that pomegranate extract exhibits in vitro activity against Clostridium difficile. This research was the first data of antimicrobial in vitro activity for pomegranate extract against toxigenic C. difficile. The antibacterial activity of extracts of pomegranate fruit on C. Difficile determined with the agar-diffusion method, it has been found that all the C. difficile strains tested had MICs at 12.5-25 µg/ml GAE level range, so the use of pomegranate extract is very important to prevention of C. difficile disease or colonization. There was other studied that talked about the activity of pomegranate extract against Alicyclobacillus acidoterrestris DSM 3922 vegetative cells and spores in apple juice. This bacteria is leading to spoilage of fruit juices and acidic food products through produce taint compound and their spores can survive during thermal pasteurization, in other words their spores were not killed by pasteurization. The counts (log CFU/ml) of A. acidoterrestris vegetative cells in the apple juice at difference concentration were studied. It has been found that the count of vegetative cells in apple juice at different concentrations of pomegranate extract (PE) were decreased during time, the count of vegetative cells in apple juice without pomegranate extract was approximately 7.36 log CFU/mL at the 24 hour while the count of vegetative cells in apple juice with different concentration of pomegranate extract were tested and results were as follow: at concentration 10 µg/ml of pomegranate extract was 4.34 log CFU/mL, at concentration 20 µg/ml of pomegranate extract was 4.19 log CFU/mL, and at concentration 40 µg/ml of pomegranate extract was 4.10 log CFU/mL. The inhibitory activity of PE against spores was evaluated in relation to sporulation media. PDA, BATA, BAA and MEA have been used for sporulation. A. acidoterrestris spores in the apple juice with different concentrations of PE (2.5-40 mg/mL) were tested. The extract of PE inhibits the germination of spores from all sporulation media in the apple juice when compared to the control spores due to its role in the destruction of cell wall and membrane of bacteria and the effect on the cell division. Gullon et al showed antibacterial activity of the pomegranate peel flour (PPF) against Pseudomonas aeruginosa, Salmonella sp, Listeria monocytogenes and Listeria innocua bacterial strains. Antimicrobial activity of pomegranate extracts was tested using a microdilution assay. The antimicrobial activities of pomegranate extracts, expressed as minimum inhibitory concentrations (MIC) and minimum bactericidal concentration (MBC), were evaluated. It has been found that the growth of Salmonella sp and L. monocytogenes were inhibited
by a concentration (MIC) 50 mg/mL of PPF, while the MIC of PPF against *L. innocua* was 20 mg/ml and against *P. aeruginosa* was 40 mg/ml. Regarding MPC of PPF for *Salmonella* sp and *L. monocytogenes* were 60 mg/mL, for *P. aeruginosa* was 50 mg/ml and *L. innocua* was 30 mg/ml. Türkyılmaz et al. has reported antimicrobial activity of PJ (Pomegranate juice) against *B. megaterium* and *B. subtilis*. It has been found that the pomegranate extract has high antibacterial activity against *B. subtilis* and *B. megaterium* with the inhibition zone (16.0 mm) and (14.4 mm), respectively. The antimicrobial mechanisms (Figure 1) of phenolic compounds involve the reaction of phenolics with microbial cell membrane proteins and/or protein sulphhydryl groups that yield bacterial death due to membrane protein precipitation and inhibition of enzymes such as glycosyltransferases. Food-borne diseases and urinary tract infections are conventionally treated on the Indian Sub-continent using Pomegranate peel extracts (PoPx), while ellagitannins, punicalagin, ellagic acid and gallic acid as natural antimicrobial agents have been widely exploited against *S. aureus* and *E. coli* for their ability to precipitate membrane proteins and inhibit enzymes such as glycosyltransferases.

3. **Antiviral properties**

Influenza virus continues to be a major cause of morbidity and mortality each year with 31,000 deaths reported yearly in the US, despite access to vaccines. However, frequent recombination events and viral evolution necessitate the change in vaccine composition requiring administration of new vaccines yearly. Researchers have shown that pomegranate polyphenols were virucidal against influenza A virus, suppressed the replication of the virus in host cells, and inhibited agglutination of chicken red blood cells caused by the virus using real-time polymerase chain reaction, a plaque assay, and a median tissue culture infective dose 50% hemagglutination assay. Anti-influenza viricidal activity has also been associated with other flavonoid compounds.

The pomegranate has been used in phage amplification assays as a viricidal agent. In addition, pomegranate extract has been reported to have microbiocidal effects on HIV-1. *Table 1* displayed various studies of pomegranate toward different bacterial strains.

![Figure 1 Depicted how pomegranate does impact bacterial cell.](image-url)
4. Conclusion

We discussed in this review the antimicrobial activity of pomegranate against bacterial and viruses with mechanisms of action including vital growth bacteria, effect on bacterial cell signaling, reductions in viral infectivity and binding to host cell receptors, and structural damage to viruses, and this review support potential benefit of pomegranate extracts in food preservation and decontamination. This application could be particularly useful in lesser developed countries where food sanitation can easily be compromised. Results of the studies on antibacterial benefits of pomegranate extracts against bacteria hold promise toward using them in the alternative medicine. Additional trials should be conducted to confirm the benefits.

Conflict of interest

The authors declare no conflict of interest.
References


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