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## Synergistic and Antagonistic Effect of Avocado (*Persea americana*) Leaves, Pulp and Seed Extracts with Antibiotics against Bacteria

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### Abstract

Antimicrobial resistance (AMR) is an increasing worldwide health concern, jeopardizing treatment efficacy and resulting in significant mortality. With standard antibiotics like ciprofloxacin and vancomycin becoming less effective, this study investigates the possibility of avocado extracts, which include antibacterial components, as an alternative treatment for *Escherichia coli* and *Staphylococcus aureus*. The study determined the optimal concentration of avocado seed, leaf, and pulp extract exhibiting the strongest antibacterial activity. Agar plates inoculated with *Staphylococcus aureus* and *Escherichia coli* were prepared. The identified avocado extract concentration was combined with dissolved antibiotics and placed in wells on the agar plates for diffusion. The study evaluated the interaction between avocado extracts and antibiotics against *E. coli* and *S. aureus*. Clindamycin and penicillin exhibited synergistic effects with avocado leaf and pulp against *S. aureus* but antagonistic effects against *E. coli*. Vancomycin and ciprofloxacin demonstrated antagonistic effects against *E. coli* but synergistic effects against *S. aureus*. Avocado seed extract showed varying effects, with synergistic activity against *E. coli* in combination with penicillin and antagonistic activity against *S. aureus* when combined with ciprofloxacin. Overall, the results suggest that avocado extracts can influence the efficacy of antibiotics, but the specific interactions vary depending on the antibiotic and bacterial species. Future research should consider exploring Gram-positive bacteria beyond *Staphylococcus aureus*, such as MRSA, *Enterococcus faecalis*, *Streptococcus pyogenes*, *Clostridium difficile*, and *Streptococcus pneumoniae*. Moreover, studying Gram-negative bacteria other than *E. coli*, such as *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Haemophilus influenzae*, *Salmonella enterica*, and *Acinetobacter baumannii*, is suggested. Future researchers could use different methods to study the synergistic effect of avocado extract and antibiotics, such as the checkboard technique or time-kill assays. They could also test specific phytochemicals and consider using the Factorial Inhibition Concentration Index (FICI).