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Perspective

Comparative Evaluation of Sanitizing Agents in Reducing Microbial Load on Common Food Contact Surfaces

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DESCRIPTION

Ensuring the cleanliness of food contact surfaces is fundamental to maintaining food safety, particularly in commercial and institutional food handling environments. In regions such as Ethiopia, where foodborne illness continues to pose a public health challenge, the routine use of effective sanitizing agents is essential to prevent microbial cross-contamination. This study was designed to assess and compare the effectiveness of commonly available sanitizing agents sodium hypochlorite, vinegar (acetic acid), Quaternary Ammonium Compounds (QACs), and ethanol in reducing microbial load on typical food contact surfaces. Stainless steel, plastic and wooden surfaces were selected for testing as they are widely used in food preparation settings ranging from restaurants to community kitchens and street food vendors. The evaluation was carried out under conditions simulating real-world kitchen practices in urban and semi-urban areas of Addis Ababa.

Sterile swab samples were collected from surfaces artificially contaminated with a cocktail of common foodborne pathogens, including *Escherichia coli*, *Salmonella spp.*, and *Staphylococcus aureus*, each inoculated at approximately 10^5 CFU/cm^2. Sanitizers were applied using cloth wiping, as this method is typical in local food establishments. The sanitizers were used at concentrations generally practiced by food handlers: sodium hypochlorite (200 ppm), vinegar (5% acetic acid), ethanol (70%), and a commercial QAC formulation at recommended dilution. Contact times were standardized to five minutes across all tests to ensure consistency. After application, swab samples were taken again from the treated surfaces, and the microbial load was enumerated using plate count techniques on selective media.

The results revealed significant differences in the effectiveness of the sanitizers based on both the type of agent and the surface material. Sodium hypochlorite and ethanol demonstrated the highest overall reduction in microbial load, consistently achieving 3.5 log to 4.5 log reductions across all surface types. QACs performed well on non-porous surfaces such as stainless steel and plastic but were less effective on wood, likely due to absorption and uneven distribution of the agent. Vinegar, while widely used in household settings, showed the least effectiveness, achieving less than 2 log reduction in most cases, and its performance was especially limited on wooden surfaces. Among the surfaces tested, stainless steel had the lowest post-treatment microbial count, indicating ease of sanitation, while wooden boards retained higher levels of microbes due to their porous and fibrous nature, which shelters microorganisms and resists thorough sanitization.

Observations during the experiment indicated that improper application techniques, such as incomplete coverage and insufficient wiping pressure, further compromised sanitizer effectiveness. Additionally, the presence of organic matter such as food residues was found to reduce the efficiency of all sanitizers, especially chlorine and QACs. Ethanol maintained relatively high performance even in the presence of organic debris, pointing to its suitability in high-risk or fast-paced environments where complete cleaning is not always possible. Worker interviews conducted during site visits suggested that sanitizer selection in food establishments was more often driven by affordability and availability than by proven effectiveness. Many handlers admitted to diluting sanitizers based on visual judgment, often resulting in suboptimal concentrations.

The cost analysis of each sanitizing agent revealed that while vinegar was the cheapest option, its low effectiveness makes it unsuitable as a standalone sanitizer for commercial operations. Sodium hypochlorite offered a cost-effective balance between price and efficacy, though concerns over corrosion and chlorine odor may limit its use on sensitive equipment. QACs, though slightly more expensive, offered the advantage of leaving residual antimicrobial activity on surfaces, which could be beneficial in high-contamination zones. Ethanol, despite being highly effective, is often more costly and prone to rapid evaporation, making it less practical for low-resource settings unless used strategically.

In conclusion, the comparative study underscores the importance of selecting appropriate sanitizing agents based on both surface type and usage context. Sodium hypochlorite and

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ethanol emerged as the most effective sanitizers for reducing microbial loads on a variety of food contact surfaces, with QACs also proving useful for non-porous applications. Vinegar, while commonly used, does not provide sufficient microbial control for commercial food safety needs. The findings also emphasize the critical need for training food handlers on proper sanitation practices, including correct dilution, application technique, and surface compatibility. In resource limited settings like Ethiopia, improving awareness and access to scientifically validated sanitizers is a practical and impactful step toward reducing foodborne disease risk. Incorporating these insights into local public health policies and food safety regulations can contribute to safer food environments and improved consumer protection.