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Perspective

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

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DESCRIPTION

Maintaining high standards of hygiene in food preparation environments is essential for preventing microbial contamination and ensuring food safety. Food contact surfaces, including cutting boards, countertops, knives and processing equipment, can serve as reservoirs for pathogenic microorganisms such as *Salmonella, Listeria monocytogenes*, *Escherichia coli*, and *Staphylococcus* aureus. If not properly sanitized, these surfaces can facilitate cross-contamination and lead to foodborne illnesses. This study aimed to evaluate the effectiveness of commonly used sanitizing agents in reducing microbial load on food contact surfaces within commercial and institutional kitchens in Caracas, Venezuela. The agents tested included sodium hypochlorite (chlorine-based sanitizer), Quaternary Ammonium Compounds (QACs), hydrogen peroxide, and peracetic acid, all of which are frequently used in the Venezuelan food industry due to their cost-effectiveness and accessibility.

The study was conducted in 15 foodservice establishments, including restaurants, school cafeterias, and small-scale food processors. Surfaces frequently used for raw and cooked food handling were sampled using sterile swabs before and after application of the selected sanitizing agents. Each sanitizer was prepared at manufacturer-recommended concentrations and applied according to standardized protocols, including contact time and rinsing procedures where applicable. The microbial load was determined by Total Viable Count (TVC), coliform count, and specific detection of *E. coli* and Staphylococcus aureus using selective media. Surface materials tested included stainless steel, plastic, and wood, reflecting the diversity of surfaces found in typical food preparation areas.

Initial analysis of unsanitized surfaces revealed alarmingly high microbial loads, especially on wooden cutting boards and plastic surfaces with visible wear and grooves. TVC ranged from 10^4 to 10^7 CFU/cm^2, with coliforms present on over 60% of the tested surfaces. *Staphylococcus aureus* was detected in 40% of pre-sanitized surfaces, often in areas associated with frequent handling or inadequate drying. Following sanitation, sodium hypochlorite and peracetic acid demonstrated the highest efficacy, with microbial reductions exceeding 4 log CFU/cm^2 on most surface types. Quaternary ammonium compounds were also effective, particularly on stainless steel, but less so on porous materials like wood. Hydrogen peroxide achieved moderate reductions, around 2 log CFU/cm^2–3 log CFU/cm^2, but its effectiveness was strongly dependent on the surface type and organic load.

The residual microbial presence after sanitization highlighted key challenges in real world sanitation practices. In several cases, the application of sanitizers was inconsistent, with contact times shorter than recommended or dilution errors observed during preparation. This suggests that even effective agents can underperform if protocols are not strictly followed. Observations also revealed that many workers lacked formal training in sanitation practices, relying instead on traditional knowledge or informal instruction. Interviews with food handlers indicated a perception that stronger odors or foaming implied better cleaning, leading to over-reliance on visible effects rather than microbiological efficacy.

The study also assessed cost-effectiveness and surface compatibility. While peracetic acid was the most efficient in microbial reduction, its higher cost and corrosive properties made it less favorable for frequent use on sensitive surfaces. Sodium hypochlorite, despite concerns about chlorine residues and skin irritation, remained the most popular due to its low cost and broad-spectrum antimicrobial action. Quaternary ammonium compounds were well received for their non-corrosive nature and minimal odor, but concerns about their reduced efficacy in the presence of organic matter persisted. Hydrogen peroxide, although environmentally friendly, required higher concentrations to be effective, reducing its economic advantage.

In conclusion, the evaluation of sanitizing agents on food contact surfaces in Venezuelan kitchens underscores the critical role of proper chemical selection, surface type consideration, and adherence to application protocols in ensuring food safety.

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Sodium hypochlorite and peracetic acid proved most effective in reducing microbial loads, especially on smooth, non-porous surfaces. However, the practical effectiveness of any sanitizer is ultimately dependent on correct usage, including adequate contact time and concentration. The findings suggest a pressing need for enhanced training programs for food handlers, focusing on hygiene education, standard operating procedures, and the microbiological rationale behind sanitation. Moreover, routine microbiological monitoring of food contact surfaces should be implemented as a quality control measure in all food establishments. Strengthening sanitation practices not only minimizes the risk of foodborne illness but also contributes to building consumer trust in the food system, particularly in regions facing economic and infrastructural challenges like Venezuela.