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Enhanced Disinfection of Food Surfaces Using Combined SDS and Organic Acid Treatments: Efficacy Against *Escherichia coli* O157:H7 and *Staphylococcus aureus*

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ABSTRACT

Escherichia coli O157 and *Staphylococcus aureus* are significant foodborne pathogens that present challenges for effective removal from surfaces in food processing and healthcare environments. This study aimed to investigate the bactericidal effects of combined treatments using sodium dodecyl sulfate (SDS) with lactic acid and citric acid, alongside factors such as temperature and exposure time, to reduce *E. coli* O157:H7 and *S. aureus* on various surfaces. Bacterial strains were treated with varying concentrations of SDS, lactic acid, and citric acid at different temperatures over a range of exposure times. The bactericidal effectiveness of the combinations was first assessed in suspension, and the most effective combinations were selected for testing on ceramic, stainless steel, and plastic surfaces. Additionally, the impact of NaCl on SDS efficacy was evaluated. The results demonstrated that bacterial sensitivity varied between pathogens and surface types. *E. coli* O157:H7 and *S. aureus* showed enhanced sensitivity to SDS combined with lactic acid at higher temperatures, with the optimal combination of SDS 1% + 0.05% lactic acid at 45°C providing significant log reductions on surfaces. The optimized SDS–lactic acid combinations achieved up to a 6.24 log reduction in *E. coli* O157:H7 and a 4.5 log reduction in *S. aureus*, with complete inactivation observed on stainless steel and ceramic surfaces. The addition of NaCl notably reduced the bactericidal activity of SDS. Among surface types, stainless steel required the least contact time for bacterial removal, followed by ceramic and plastic, which necessitated longer exposure. In conclusion, combined solutions of SDS and an organic acid, particularly at elevated temperatures, are effective in reducing pathogenic bacteria on various surfaces. The SDS and lactic acid combination at 45°C is recommended as a potential disinfection method for *E. coli* and *S. aureus* on food and healthcare surfaces.

1- Introduction

Escherichia coli (*E. coli*) O157:H7 is a strain of *E. coli* that can cause severe foodborne illness in humans. It is often associated with contamination in food processing facilities, particularly those handling raw meats and produce [1]. The bacterium can contaminate surfaces and equipment in these facilities, leading to the potential for widespread foodborne outbreaks if proper sanitation measures are not implemented. E. coli O157:H7 produces toxins that can cause symptoms such as severe abdominal cramps, diarrhea (often bloody), vomiting, and in some cases, kidney failure, especially in vulnerable populations such as children and the elderly [2].

Staphylococcus aureus (*S. aureus*) is a bacterium commonly found on the skin and in the noses of healthy individuals. While it is generally harmless in these locations, it can cause various infections if it enters the body through cuts, wounds, or mucous membranes [3]. In food processing environments, *S. aureus* can be a concern due to its ability to produce heat-stable toxins that can withstand cooking temperatures. Contamination of food can occur through improper handling or cross-contamination, leading to foodborne illness [4].

E. coli O157:H7 and *S. aureus*, with their significant prevalence and morbidity rates, stand as prominent foodborne pathogens. The transmission of these bacteria often occurs through direct contact of food products with contaminated surfaces during various stages of food processing. Traditional sanitation methods employed in food facilities may not consistently eradicate these pathogens, thus prompting the exploration of novel disinfection strategies adaptable to food processing environment [5].

Preventing contamination in food processing plants requires strict adherence to hygiene protocols, including thorough cleaning and disinfection of surfaces and equipment, proper handwashing practices, and adequate cooking temperatures to kill any bacteria present in the food [6]. Using disinfectants to eliminate *E. coli* and *S. aureus* from surfaces in food processing facilities is a critical measure to ensure food safety and prevent contamination [7]. Various types of Chemical disinfectants are employed for this purpose, including substances such as chlorine, hydrogen peroxide, chloramine, acids, alkalis, and other disinfectants. They are commonly used for surface disinfection and equipment sanitization in food industries [8].

Sodium dodecyl sulfate (SDS), an anionic surfactant, has demonstrated remarkable efficacy in disrupting bacterial membranes and denaturing proteins. Recognized as Generally Recognized as Safe (GRAS) by the U.S. Food and Drug Administration (FDA) for use as a multipurpose food additive, SDS has garnered attention for its potential as a disinfectant in the food industry. Various studies have investigated the synergistic potential of SDS when combined with other substances, highlighting its effectiveness in controlling pathogens [9].

Several studies have investigated the use of sodium dodecyl sulfate (SDS) in combination with other compounds to enhance antimicrobial efficacy. For instance, a study examined the effects of a 0.5% SDS and 5% lactic acid combination on controlling *Listeria monocytogenes* in vacuum-packed frankfurter sausages over a 90-day period. The findings suggested that this combination could serve as an alternative method for controlling *Listeria spp.* in processed meats [10]. Another investigation focused on the combined effects of levulinic acid and SDS in reducing *Salmonella* Typhimurium and *E. coli* O157 on lettuce and chicken skin, concluding that this solution effectively reduces intestinal pathogens on fresh produce and poultry [11]. Similarly, a 3% levulinic acid and 2% SDS foam was studied for its potential to eliminate *Salmonella spp*. from cage walls and poultry carcasses, achieving a 4-log reduction in bacterial counts [12]. The antimicrobial effects of various SDS concentrations, alone or with other compounds, have also been explored across a range of food matrices, including minced beef [13], eggshells [14], and food-related surfaces [15].

Despite documented synergistic effects, there remains a paucity of data elucidating the influence of environmental factors on the bactericidal activity of SDS. Hence, this study aims to explore the synergistic effects of SDS in combination with various environmental factors, including temperature, salt concentration, acidity, and exposure duration, on *E. coli* O157 and *S. aureus* in normal saline and on diverse surfaces pertinent to food industries.

2- Materials and Methods

2-1 Bacteria

E. coli O157 (ATCC 43895) and *S. aureus* (ATCC 25923) were procured from the culture repository of the Department of Food Hygiene, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz. Bacterial identification was confirmed through biochemical assays and PCR techniques.

2-2 Preparation of Bacterial Suspensions

Bacterial suspensions were prepared by inoculating a colony from fresh agar plate cultures into Trypticase Soy Broth (TSB) and incubating at 37°C for 20 hours. The process was repeated twice, and aliquots (100 µl) of the bacterial suspensions were collected for viable counting.

2-3 Primary Treatments of Bacteria with Individual Parameters

To assess the sensitivity of each strain, bacterial suspensions were subjected to various concentrations of SDS, citric acid, lactic acid, and NaCl solutions, targeting a bacterial concentration of $1x10^6$ CFU/mL (Table 1). Subsequently, the suspensions were treated for predetermined durations (0, 10, 20, 30, 40, and 60 min) at different temperatures, and viable counts were enumerated before and after each treatment.

Table 1 Concentration and temperatures used in the individual treatments of *E. coli* O157:H7 and *s. aureus*

Treatment	Concentration

SDS (%)	**Different concentrations were used depending on the test conditions (from 0.007 to 3%)**				
Citric acid (%)	**Different concentrations were used depending on the test conditions (from 0.07 to 0.5)**				
Lactic acid (%)	**Different concentrations were used depending on the test conditions (from 0.03 to 0.5)**				
NaCl (%)	**0**	**1.5**	**2**	**3**	**4**
Temperature (Centigrade)	**4**	**25**	**35**	**45**	**55**

2-4 Combined Treatment of Bacterial Suspension (single, two, and three parameters)

Based on the sensitivity profiles obtained from primary treatments, selected concentrations of SDS, citric acid, and lactic acid were employed in combination treatments (Table 2). The bactericidal efficacy of these combinations was evaluated, and the most effective combination was further assessed for its activity against the tested bacteria on ceramic, stainless steel, and plastic surfaces.

Table 2. Parameters tested on *E. coli* O157:H7 and *S. aureus* during single and combined treatments

Factors		**Range**
		Time: 0, 10, 20, 30, 40, 60 minutes
***E. coli* O157:H7**		
Single factor treatments	**SDS**	**1%, 1.5%, 2%, 2.5%, 3%**
	Citric acid	**0.07%, 0.1%, 0.2%, 0.3%, 0.5%**
	Lactic acid	**0.05%, 0.1%, 0.2%, 0.5%**
	NaCl	**1.5%, 2%, 3%, 4%**
Double factor treatments	**SDS+ Citric acid**	**1%+0.07% 1.5%+ 0.1% 3%+ 0.2%**
	SDS+ Lactic acid	**1%+0.07% 1.5%+ 0.2% 3%+ 0.3%**
	SDS+ Temperature	**1%+ 4°C, 25°C, 35°C, 45°C, 55°C**
	SDS+ NaCl	**3%+ 1.5%, 2%, 3%, 4%**
Three factor treatments	**SDS+ Citric acid+ Temperature**	**SDS1%+ Citric acid 0.07%+ Temperature 45°C**
	SDS+ Lactic acid+ Temperature	**SDS1%+ Lactic acid 0.05%+ Temperature 45°C**
S. aureus		
Single factor treatments	**SDS**	**0.02%, 0.01%, 0.007%**
	Citric acid	**0.08%, 0.3%, 0.4%, 0.5%**
	Lactic acid	**0.03%, 0.05%.1%, 0.5%**
	NaCl	**1.5%, 2%, 3%, 4%**

Double factor treatments	**SDS+ Citric acid**	**0.01%+ 0.4%** **0.01%+ 0.08%**
	SDS+ Lactic acid	**0.01%+0.1%** **0.007%+ 0.05%**
	SDS+ Temperature	**0.007%+ 4°C, 25°C, 35°C, 45°C, 55°C**
	SDS+ NaCl	**0.02%+ 1.5%, 2%, 3%, 4%**
Three factor treatments	**SDS+ Citric acid+ Temperature**	**SDS0.007%+ Citric acid 0.08%+ Temperature 35°C**
	SDS+ Lactic acid+ Temperature	**SDS0.007%+ Lactic acid 0.05%+ Temperature 35°C**

***Note.* SDS: Sodium dodecyl sulfate.**

2-5 Preparation of Stainless Steel, Ceramic, and Plastic Coupons

Small coupons of stainless steel (5×5 cm/grade 304), anti-acid ceramic, and high-density polyethylene cutting boards, typical materials used in food processing, were prepared. Prior to experimentation, the coupons underwent washing, sterilization, and sterility confirmation [16].

2-6 Treatment of Coupons by the Best Combination Solutions

Bacterial biofilms were established on the coupons by immersing sterilized coupons in bacterial suspensions and incubating at 25°C for 48 hours under static conditions. Biofilm formation was confirmed visually and by quantitative recovery using swab sampling and sonication, followed by viable plate count enumeration, followed by treatment with the selected disinfectant solutions. The efficacy of the solutions in reducing bacterial populations on the respective surfaces was assessed at predefined intervals [17].

2-7 Statistical Analysis

All experiments were performed in triplicate. Data analysis was performed using one-way and two-way repeated measures ANOVA followed by LSD post hoc test, employing SPSS 16.0. Statistical significance was determined at $P \leq 0.05$.

3- Results

3-1 Single Treatments

Significant effects of time, concentration, and their interaction were observed on the population dynamics of *E. coli* O157:H7 and *S. aureus* when subjected to SDS, citric acid, lactic acid, and NaCl. Notably, *E. coli* O157:H7 exhibited relative resistance to SDS, whereas *S. aureus* displayed heightened sensitivity. Citric acid and lactic acid demonstrated superior bactericidal effects compared to NaCl, with lactic acid exhibiting greater efficacy than citric acid against both bacterial strains. One-way ANOVA revealed that SDS concentrations of 1%, 1.5%, 2%, and 2.5% had no significant effect on *E. coli* O157:H7 reduction over time ($P > 0.05$). However, 3% SDS significantly decreased the bacterium counts (Figure 1-A).

For *S. aureus*, treatment with 0.007% SDS showed no significant reduction ($P > 0.05$), while 0.01% and 0.02% SDS significantly reduced counts ($P < 0.001$) (Figure 2-A). Two-way ANOVA confirmed that both SDS concentration ($P < 0.001$) and time ($P < 0.05$) affected *S. aureus* counts.

One-way ANOVA showed that 0.07% and 0.2% citric acid had no significant impact on

E. coli O157:H7 reduction ($P > 0.05$), but 0.3% and 0.5% citric acid significantly reduced counts ($P < 0.001$) (Figure 1-B). For S. aureus, only 0.4% and 0.5% citric acid led to significant reductions ($P < 0.001$) (Figure 2-B).

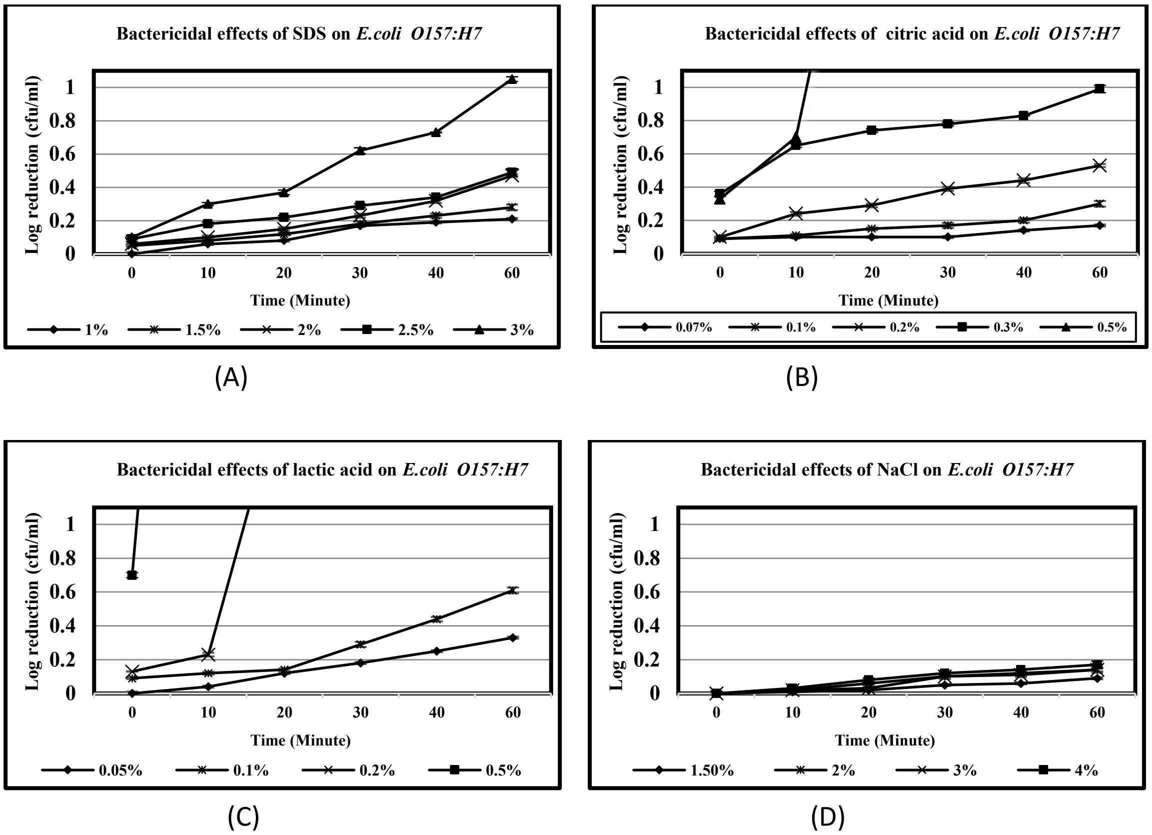


Figure 1 – Bactericidal effect of different concentrations (A) SDS, (B) citric acid, (C) lactic acid, (D) NaCl on the reduction of *E. coli* O157:H7 population during time

Treatment with 0.2% lactic acid led to a 5.97 log reduction in *E. coli* O157:H7 after 30 minutes, while 0.5% lactic acid completely inactivated *E. coli* O157:H7 in 10 minutes (Figure 1-C) and caused a 5.92 log reduction in *S. aureus* (Figure 2-C).

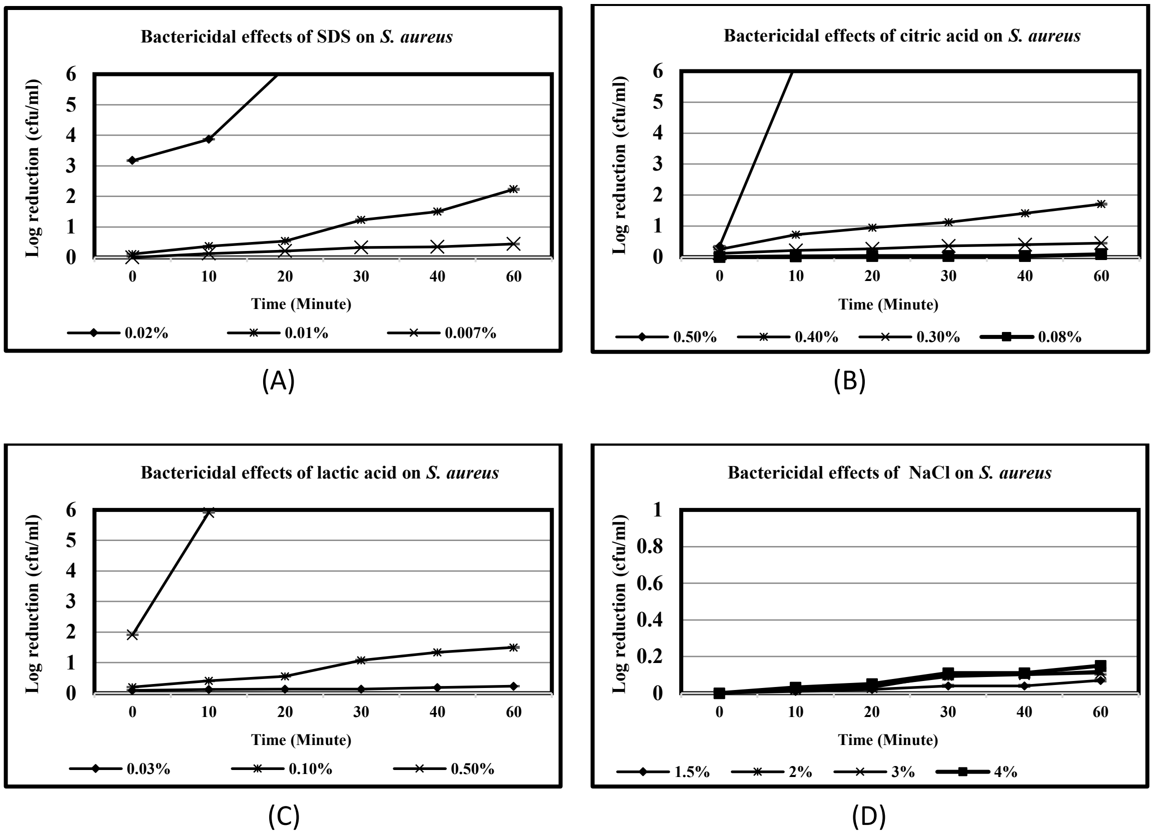
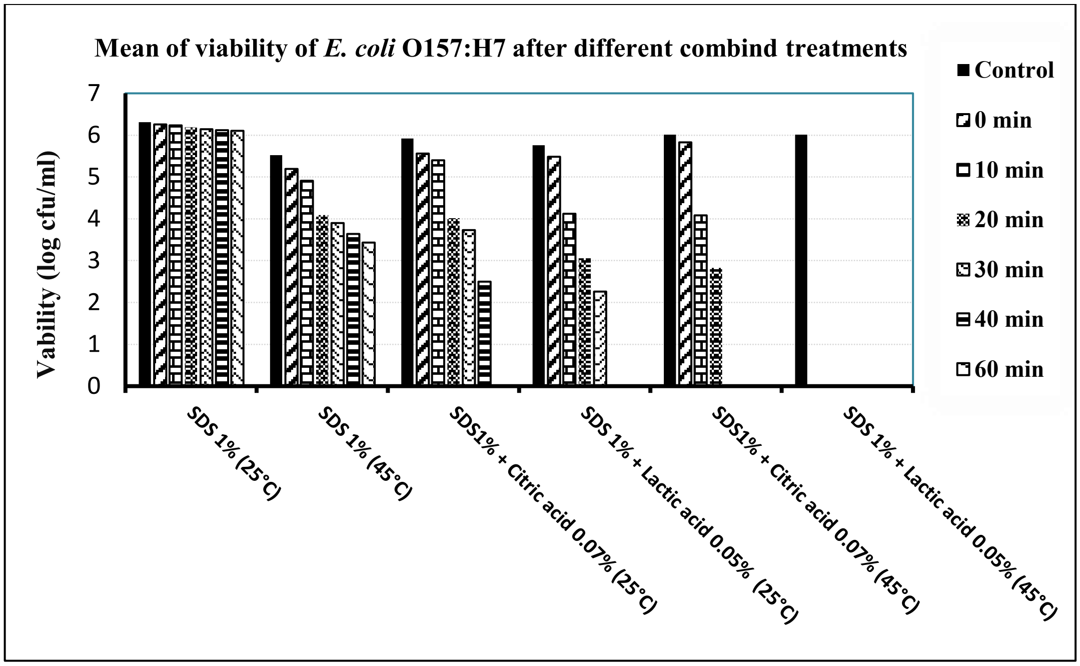


Figure 2- Bactericidal effect of different concentrations (A) SDS, (B) citric acid, (C) lactic acid, (D) NaCl on the reduction of *S. aureus* population during time

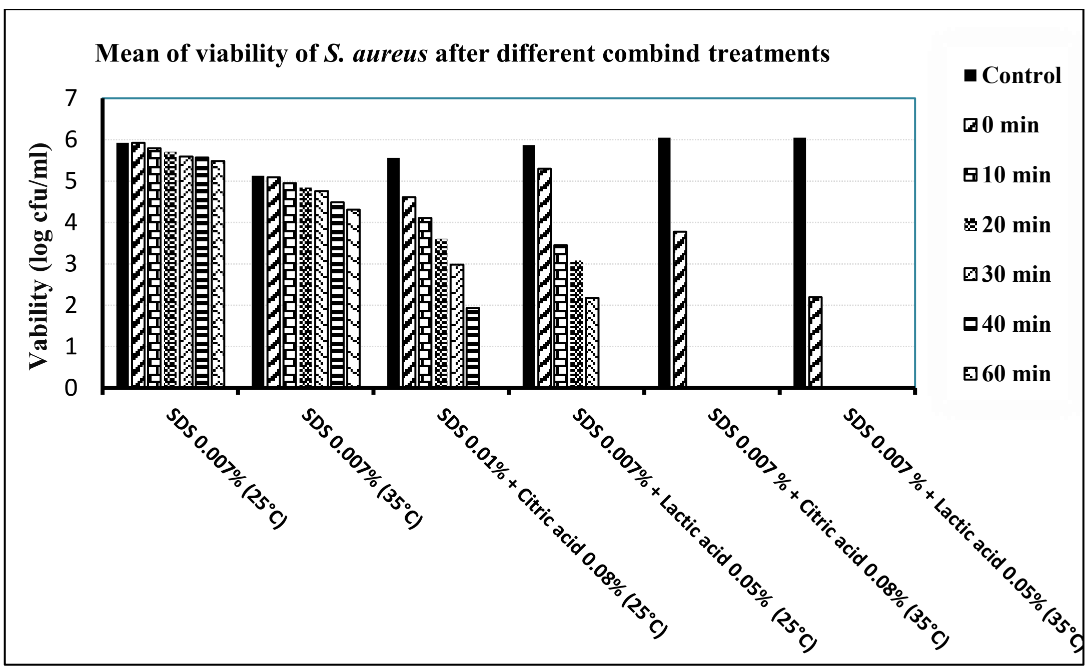
One-way ANOVA indicated a significant effect of 0.1% lactic acid over time ($P < 0.001$). Two-way ANOVA confirmed significant effects of concentration ($P < 0.001$), time ($P < 0.01$), and their interaction ($P < 0.01$) on *S. aureus* counts. One-way ANOVA indicated that various NaCl concentrations had no significant effect on *E. coli* O157:H7 or *S. aureus* counts over time ($P > 0.05$) (Figure 1-D and 2-D).

3-2 Combined Treatments

Combination treatments incorporating SDS, citric acid, and lactic acid demonstrated enhanced bactericidal effects against *Escherichia coli* O157; H7 and *Staphylococcus aureus*. Optimal combinations exhibited strong antimicrobial activity, with temperature significantly influencing treatment outcomes. The addition of NaCl to the SDS solution resulted in a marked reduction in its bactericidal efficacy (data not shown); therefore, NaCl was excluded from subsequent combined treatments.



(A)



(B)

Fig 3- Bactericidal effects of combined treatments on (A) *E. coli* O157:H7 and (B) *S. aureus*

Figure 3-A presents the treatment results of *E. coli* O157:H7 using SDS alone or in combination with lactic or citric acid at 25°C and 45°C over time. The data show that SDS 0.1% combined with lactic acid 0.05% at 45°C provided the most effective bacterial reduction, followed by the combination of SDS 0.1% with citric acid 0.07% at the same temperature.

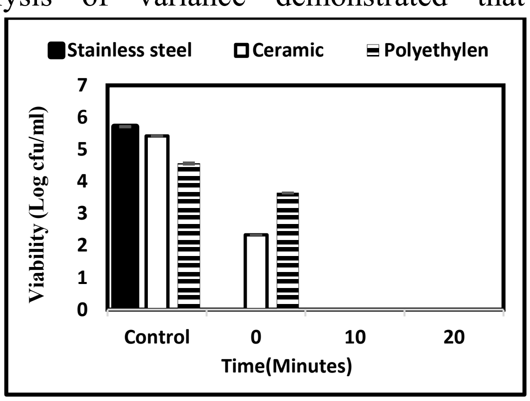
A one-way analysis of variance indicated a significant reduction in bacterial load for both combinations over time. Specifically, the SDS 1% + 0.05% lactic acid + 45°C combination resulted in a log reduction of 6.24 immediately post-inoculation, while the SDS 1% + 0.07% citric acid + 45°C combination achieved a log reduction of 6.30 after 30 minutes. Consequently, the SDS 1% + 0.05% lactic acid + 45°C combination was selected for surface applications.

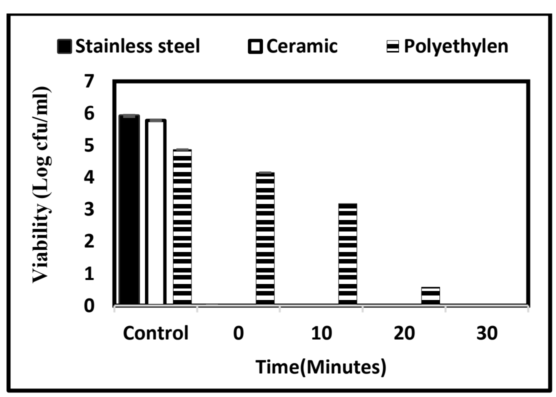
Figure 3-B illustrates the treatment results for *S. aureus* using SDS alone or in combination with lactic or citric acid at 25°C and 35°C over time. Results revealed that SDS 0.007% combined with lactic acid 0.05% at 35°C yielded the most effective reduction of S. aureus. Additionally, the combination of SDS 0.007% and citric acid 0.08% at the same temperature was highly effective. A two-way analysis of variance demonstrated that concentration, time, and the interaction between these factors significantly impacted the logarithmic count of *S. aureus* ($P < 0.001$). Ultimately, the SDS 0.007% + 0.05% lactic acid + 35°C combination was chosen for surface applications.

3-3 Surface Treatments

The selected disinfectant solutions effectively eradicated *E. coli* O157:H7 and *S. aureus* from stainless steel, ceramic, and plastic surfaces, with varying efficacy observed across different materials and temperatures.

As depicted in Figure 3-A, the disinfectant solution completely removed *E. coli* O157:H7 from stainless steel upon application. On polyethylene, approximately a 1-log reduction was observed, while a 3-log reduction was noted on ceramic surfaces immediately after treatment. No bacterial presence was detected on any of the three surfaces after 10 minutes. Statistical analysis indicated that time, surface type, and the interaction between time and surface significantly influenced *E. coli* O157:H7 populations ($P < 0.001$).





(A) *E. coli O157:H7* **(B) *S. aureus***

Fig 4- Viable population of (A) *E. coli O157:H7* and (B*) S. aureus* after treatment by the selected solution on different surfaces

To remove *S. aureus* from plastic, stainless steel, and ceramic surfaces, the optimal solution (SDS 0.007% + 0.05% lactic acid + 35°C) was applied, as shown in Figure 4-B. The disinfectant completely eliminated the bacterium from stainless steel and ceramic surfaces immediately after use. On polyethylene, the solution achieved reductions of approximately 1, 2, and 4.5 log in bacterial counts after 0, 10, and 20 minutes, respectively. *S. aureus* was undetectable on all three surfaces after 30 minutes. Statistical analysis revealed that time, surface type, and their interaction significantly affected *S. aureus* populations ($P < 0.001$).

4- Discussion

Sodium dodecyl sulfate (SDS) has garnered considerable interest as an effective disinfectant in food processing and healthcare settings due to its detergent properties, including high solubility, foaming capability, and ease of rinsing from surfaces [16]. Recent research has focused on enhancing the antimicrobial effectiveness of SDS through combination with other agents, particularly organic acids, to improve its efficacy against foodborne pathogens [17]. Previous studies have demonstrated that combining SDS with organic acids can maintain strong bactericidal activity even with low concentrations, making it a practical solution for the food industry where biofilms and resistant pathogens like Escherichia coli O157 and Staphylococcus aureus can pose persistent risks [18-20].

This study investigated the bactericidal effects of combined SDS, lactic acid, and citric acid treatments on *E. coli* O157 and *S. aureus* across multiple surfaces. Our findings indicate that specific combinations, particularly SDS 1% + 0.05% lactic acid at 45°C and SDS 0.007% + 0.05% lactic acid at 35°C, yielded significant bacterial reductions, with variations in efficacy depending on surface type and temperature. These results underscore the value of optimizing disinfectant concentration, temperature, and contact time for effective microbial control.

The enhanced activity of SDS when combined with organic acids can likely be attributed to a synergistic interaction that disrupts bacterial cell membranes. SDS, a surfactant, can weaken the outer cell structures, allowing acids like lactic and citric acid to penetrate and destabilize cellular integrity more effectively [21]. This mechanism is supported by previous research demonstrating the effectiveness of surfactant-organic acid combinations against pathogens on food processing surfaces and in healthcare environments [12]. Our results align with these studies and suggest that SDS-organic acid combinations are promising disinfectants, particularly at elevated temperatures.

Temperature was a significant factor in enhancing the bactericidal effect of SDS combinations. Higher temperatures (45°C) consistently yielded more substantial bacterial reductions than lower temperatures (25–35°C), supporting the hypothesis that temperature increases fluidity of bacterial membranes, allowing disinfectants to penetrate more effectively [22]. This insight is especially relevant for applications in settings where thermal treatment can be safely applied, as it reduces required contact time and concentration, potentially minimizing the environmental and operational costs of disinfection.

The results also indicated a marked reduction in SDS's bactericidal efficacy when combined with NaCl. This finding is consistent with studies showing that ionic interactions between salts and surfactants can alter micelle formation, potentially reducing SDS's ability to disrupt cell membranes [23]. This suggests that the formulation of SDS-based disinfectants should avoid salinity to maximize efficacy. Electrostatic interactions may hinder SDS's ability to penetrate bacterial membranes when NaCl is present, as was also noted by previous research on the reduced bactericidal effect of SDS in the presence of salt [15]. Thus, the use of deionized or distilled water in SDS-based disinfectant preparation is recommended to avoid any reduction in SDS effectivene Given that NaCl is commonly present in industrial and food processing environments, this interaction may be an important consideration for practical applications of SDS-based disinfection protocols.

In terms of surface materials, stainless steel and ceramic responded well to the disinfectant solutions, with complete bacterial removal achieved within minutes. In contrast, plastic surfaces, specifically polyethylene, required longer exposure times for similar reductions. This difference may stem from the inherent properties of plastic, which can include surface irregularities or hydrophobic characteristics that reduce disinfectant effectiveness. These findings suggest that disinfection protocols may need to account for material-specific adjustments, such as increased contact time or higher disinfectant concentrations for plastic surfaces. Our findings indicate that the selected SDS + lactic acid combination was highly effective across different surface types, with the exception of polyethylene and other porous materials, where longer exposure was needed to reach complete bacterial elimination. This is consistent with studies showing that surface roughness and porosity can protect bacteria by providing microsites that reduce exposure to disinfectants. In practice, this suggests that while SDS + lactic acid is an effective solution for stainless steel and similar surfaces, enhanced exposure or alternative formulations might be required for plastics and ceramics in environments where complete pathogen elimination is critical.

Statistical analysis confirmed that concentration, time, and temperature, along with their interactions, significantly influenced the bactericidal outcomes. These points to the importance of fine-tuning these variables to maximize treatment efficacy. Such optimization is particularly relevant for industrial applications, where minimizing treatment time while ensuring safety standards is crucial.

The outcomes of this study have practical implications for industries where surface contamination by *E. coli* O157:H7 and *S. aureus* poses a risk. The identified SDS-organic acid combinations at specific temperatures offer a cost-effective and efficient means of achieving high-level disinfection, particularly for surfaces in food processing and healthcare settings. Future research could extend these findings by examining the efficacy of these combinations on other resistant pathogens, and on different surface types, including glass and rubber, to better understand the breadth of these treatments.

5- Conclusions

In conclusion, our findings demonstrate the efficacy of SDS combined with organic acids, particularly at elevated temperatures, in achieving significant bacterial reductions. These results provide a foundation for developing optimized disinfection protocols tailored to specific pathogens and surfaces, contributing to improved hygiene and safety across various applications.

6- Acknowledgements

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مقاله علمی_پژوهشی

ضدعفونی کارآمد سطوح غذا با استفاده از درمان ترکیبی SDS و اسید های آلی: اثربخشی در برابر *اشریشیا کولای* O157:H7 و *استافیلوکوکوس اورئوس*

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چکیده

اشریشیا کولای O157:H7 و *استافیلوکوکوس اورئوس* پاتوژن های مهمی هستند که از طریق مواد غذایی منتقل شده و چالش هایی را برای حذف موثر از سطوح در محیط های فرآوری مواد غذایی و سایر مراکز بهداشتی ایجاد می کنند. این مطالعه با هدف بررسی اثرات ضد باکتریایی تیمارهای ترکیبی با استفاده از سدیم دودسیل سولفات (SDS)با اسید لاکتیک و اسید سیتریک، در کنار عواملی مانند دما و زمان در معرض قرار گرفتن این دو باکتری بر روی سطوح مختلف انجام شد. ابتدا سویه‌های باکتریایی با غلظت‌های مختلف SDS ، اسید لاکتیک و اسید سیتریک در دماهای مختلف در محدوده‌ای از زمان‌های مواجهه متفاوت تیمار شدند. سپس اثر باکتری‌کشی ترکیبی تیمارها ابتدا در سوسپانسیون ارزیابی شد و مؤثرترین ترکیب ها برای آزمایش بر روی سطوح سرامیکی، فولاد ضد زنگ و پلاستیک انتخاب شدند .علاوه بر این، تأثیر NaCl بر اثربخشی SDS مورد ارزیابی قرار گرفت. نتایج نشان داد که حساسیت باکتریایی بین پاتوژن ها و انواع سطح متفاوت است. هر دو سویه باکتری حساسیت افزایش یافته ای به SDS همراه با اسید لاکتیک در دماهای بالاتر نشان دادند، با ترکیب بهینه اسید لاکتیک 1٪ SDS + 0.05٪ در ٤٥ درجه سانتی گراد کاهش قابل توجهی در تعداد باکتری در سطوح ایجاد شد. ترکیب بهینه شده SDS و لاکتیک اسید تا ٦/٢٤ لوگ کاهش در تعداد باکتری *ایکولای* O157: H7 و ٤/٥ لوگ کاهش در تعداد *استافیلوکوکوس اورئوس* روی سطوح فولادی ضد زنگ و سرامیکی ایجاد کردند. افزودن NaCl به طور قابل توجهی فعالیت باکتری کشی SDS را کاهش داد. در میان انواع سطوح، فولاد ضد زنگ به کمترین زمان تماس برای حذف باکتری نیاز داشت و به دنبال آن سرامیک و پلاستیک، که مستلزم قرار گرفتن در معرض طولانی‌تری بودند. در نتیجه، محلول های ترکیبی SDS و یک اسید آلی، به ویژه در دماهای بالا، در کاهش باکتری های بیماری زا در سطوح مختلف موثر هستند. ترکیب SDS و اسید لاکتیک در دمای ٤٥ درجه سانتیگراد به عنوان یک روش بالقوه ضد عفونی برای *اشریشیا کولای* و *استافیلوکوکوس ارئوس* روی سطوح مواد غذایی و مراقبت های بهداشتی توصیه می شود.