

Management of Technological Processes in Food Production and Safety with Biochemically Active Detergents

Tsitsino Sikharulidze^{*}, Qristine Lobjanidze^{*,**}, Lali Tabatadze^{**},
Ana Chabrava^{*}, Darejan Gulbani^{**}, Guram Aleksidze[§],
Anatoli Giorgadze^{§§}

^{*} Veterinary-Diagnostic Laboratory "SANA" of LTD Chirina, Tbilisi, Georgia

^{**} Faculty of Natural Sciences, Mathematics, Technologies and Pharmacy, Sokhumi State University, Tbilisi, Georgia

[§] Academy Member, National Academy of Sciences of Georgia, Tbilisi, Georgia

^{§§} Georgian Academy of Agricultural Sciences, Tbilisi, Georgia

Abstract. Modern technological processes are increasingly based on in-depth knowledge of the chemical transformations occurring in living systems. The paper discusses in detail the application of the surface-active detergents SINTEX and FOAM 42 in a chicken meat processing plant, their chemical mechanisms of action, potential chemical hazards and safety strategies in the context of MSDS, HACCP, ISO/IEC 17025 systems. The results of the study confirmed that properly selected and used in accordance with the technological process, biochemically active detergents play an important role in ensuring microbiological safety, reduce the risk of cross-contamination and contribute to the production of safe high-quality poultry products for consumers. © 2026 Bull. Georg. Natl. Acad. Sci.

Keywords: detergents, chicken meat products, food technology, food safety

Introduction

Physical, chemical, and biological components of environmental pollution pose a threat to the health of humans and other living organisms. Bioorganic compounds play an important role in nature as a source of energy, structural material, and molecular recognition elements in cellular processes. They are used in the food industry, medicine, agriculture, and various fields of industry. (Mtchedlishvili et al., 2024; Iremashvili et al., 2025; Sidamonidze et al., 2023; Pachulia et al., 2016).

Modern food production systems are undergoing rapid transformation, driven by both technological progress and growing consumer demands for product quality and safety. The development of modern science and industry is closely linked to a deep understanding of biological and chemical laws. Effective management of technological processes is impossible without understanding the molecular mechanisms that occur in living systems. (Fan et al., 2025; Sikharulidze et al., 2025). In this context, bioorganic technologies are considered as an interdisciplinary scientific basis that combines the

principles of organic chemistry, biochemistry and food technology, studying the structure, reaction mechanisms and functional interactions of biologically active organic compounds and ensuring their practical application in the management of technological processes, which is the most important tool for ensuring the safety and quality of food products. In the modern food industry, particular importance is placed on maintaining sanitary and hygienic conditions (Chandimali et al., 2025; Aung and Chang, 2014). Chicken processing plants are risky facilities, as protein and fat residues accumulate during technological processes, facilitating the growth of microorganisms. This problem cannot be effectively solved by chemical cleaning or water rinsing alone. Detergents are widely used for this purpose, and their proper use is critical to both product safety and consumer health.

Chicken meat processing is one of the highest-risk sectors of the food industry. During the production process, meat comes into intensive contact with technological equipment, work surfaces, and personnel, which increases the risk of both microbiological and chemical contamination (Hansson et al., 2025; Alexander et al., 2021). Compliance with sanitary and hygienic regimes is a necessary prerequisite for food safety, and the correct selection and use of detergents plays a special role in this process. In poultry farming, detergents (alkaline, acidic, and neutral) are used to clean kitchens, processing lines, tools, and work surfaces, as well as to remove bacteria and hydrocarbon residues. The specific action, application area, and proper selection of each detergent (anionic, cationic, neutral, and complex) ensure high hygiene standards, product safety, and process efficiency. SINTEX and FOAM 42 (foam detergents) are chemical/engineered solutions that ensure the highest hygiene standards in food processing environments. They are used in technological environments related to food products, including chicken and other meat processing plants, to remove organic residues (fat, proteins, blood) as well as

bacteria work surfaces, devices and equipment. A properly selected detergent ensures high hygiene standards, product safety and efficiency of technological processes. Surface cleaning is much more effective than cleaning with conventional cleaning fluids. The action of these detergents is based on bioorganic mechanisms (protein denaturation, fat emulsification). Safe use of detergents is possible only with strict compliance with MSDS, HACCP and food safety requirements. The aim of the paper is to discuss the use of SINTEX and FOAM 42 type (food-grade industrial) detergents in a chicken meat processing plant, the mechanisms of action, and safety requirements.

Materials and Methods

Equipment and instrumentation: Biochemically active detergents: SINTEX and FOAM 42, pre-prepared disposable cotton swabs in a disposable container (Fig. 1), gloves, thermal transport bag, pipettes, loops (Fig. 1), buffer solution NaCl 0.85% (Fig. 1), Endo agar, PCA agar, Baird-Parker Agar (BPA), thermostat 36.8°C and 41.5°C.

Research methodology: Samples were taken in accordance with the requirements of the ISO 17025 standard and in compliance with relevant national sanitary norms. Samples were taken on a surface area of 100 cm². The sampling procedure was carried out in accordance with the Georgian Sanitary Standards (Order No. 301/N, numbered: 2.3.4. 012-04), which determine the methods of hygienic control of surfaces, tools, inventory, containers and personnel.

Microbiological analysis: The study was conducted in laboratory conditions at the “Blu-Bu” meat processing plant and included the impact of the use of biochemically active detergents (SINTEX and FOAM 42): Evaluation of microbial bacterial growth and development during the pre- and post-washing and disinfection stages with detergents; Evaluation of the biochemical effect of detergents, i.e. how surfactants and enzymatic additives affect organic residues and bacterial counts.

Samples are taken in accordance with the requirements of the ISO 17025 standard, which ensures: representativeness of the sample; accuracy of the test results; validity and repeatability.

Sampling method. Specified surface area: 100 cm²; the surface sample was placed in a sterile disposable container; the containerized swabs were transferred to tubes containing NaCl peptone buffer solution, which ensures sample transport and preservation of bacterial activity; the samples were incubated for 18-24 hours, then transferred to designated microbiological agars (e.g., Endo agar, BPA) for determination of bacterial activity.

Research process model: samples are taken before washing and disinfection (baseline); samples are taken after washing and disinfection (after treatment); Comparative analysis shows the change in the number of bacteria, which allows to assess the effectiveness of the detergent and the degree of cleanliness of the surfaces; data recording and documentation; all samples are documented: time of collection, place, person, tools used, buffer composition; the procedure ensures compliance with ISO 17025 requirements in terms of sample management.

Results and Discussion

As part of the research, the effectiveness of washing and disinfection in terms of microbiological cleanliness at a chicken processing plant was evaluated. The study was conducted before washing and disinfection and after the use of biochemically active detergents (SINTEX and FOAM 42), and the results were compared. The following microorganisms were detected in the samples taken before washing and disinfection (Table 1): *Staphylococcus aureus*, *Escherichia coli*, *Proteus vulgaris*, which indicates microbiological contamination of work surfaces and the environment. According to the results of microbiological research (Table 2), incomplete cleaning was observed when using a 3% Santex solution, since *Staphylococcus aureus* is a gram-positive cocci, which is characterized by a

thick peptidoglycan layer, which gives it the ability to firmly attach to the surface, and is also characterized by high resistance to various chemicals. Due to these characteristics, *S. aureus* is considered one of the most critical targets in food production. However, none of the above microorganisms were detected after treatment with a 5% SINTEX solution, which confirms the high efficiency of the detergent and the complete elimination of microbial contamination. Similar results were observed after the use of FOAM 42 (Table 3), where none of the studied microorganisms were found. When using FOAM 42 detergent, it was found that the washing and disinfection process carried out on surfaces under the conditions of a 3% working solution ensured the elimination of only *Proteus vulgaris*, while *Staphylococcus aureus* and *Escherichia coli* were partially preserved, which indicates insufficient biocidal activity of the detergent at this concentration, while when using a 5% solution, complete removal of all studied microorganisms and complete restoration of microbiological purity were observed, which confirms that the disinfection efficiency of FOAM 42 increases directly proportionally with increasing concentration of active substances. A comparative analysis of the results shows that SINTEX and FOAM 42 effectively reduce and practically completely suppress the presence of pathogenic and conditionally pathogenic microorganisms, which plays an important role in fulfilling the requirements of food safety, hygiene standards and the HACCP system, as well as ISO 22000. In addition, after the completion of the cleaning and disinfection process, a complete rinsing of disinfectant residues from the treated surfaces is carried out, followed by additional control of the possible presence of allergens by strip testing of disinfectant residues (Fig. 5).

This stage is an additional safety mechanism that ensures the minimization of product contamination and compliance of the final products with international hygiene and food safety standards.

Table 1. Microbiological analysis before washing-disinfection

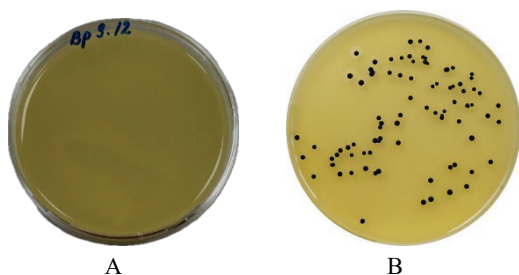
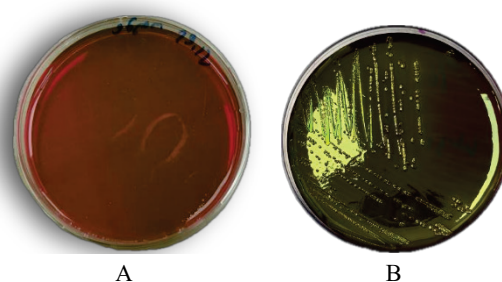
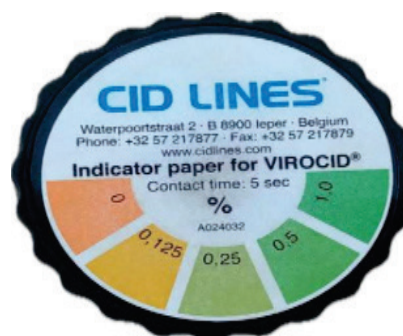
Microorganism	Research before washing-disinfection
<i>Staphylococcus aureus</i>	It turned out
<i>Escherichia coli</i>	It turned out
<i>Proteus vulgaris</i>	It turned out

Table 2. Microbiological analysis after using SINTEX

Microorganism	Research using SINTEX	
	3%	5%
<i>Staphylococcus aureus</i>	It turned out	Not found
<i>Escherichia coli</i>	Not found	Not found
<i>Proteus vulgaris</i>	Not found	Not found

Table 3. Microbiological analysis after using FOAM 42

Microorganism	Research using FOAM 42	
	3%	5%
<i>Staphylococcus aureus</i>	It turned out	Not found
<i>Escherichia coli</i>	It turned out	Not found
<i>Proteus vulgaris</i>	Not found	Not found

**Fig. 1.** (A) Disposable loop; (B) Disposable cotton swab; (C) NaCl tubes.**Fig. 2.** (A) BPA agar without inoculation; (B) BPA agar with colony development.**Fig. 3.** (A) Endo agar without inoculation; (B) Endo agar with colony development.**Fig. 4.** (A) PCA AGAR without inoculation; (B) PCA AGAR with colony development.**Fig. 5.** Strip test.

Conclusion

The results of this study revealed that significant microbiological contamination occurred on work surfaces and in the technological environment before washing and disinfection in a chicken meat processing plant. The samples taken revealed both pathogenic and conditionally pathogenic microorganisms, including *Staphylococcus aureus*, *Escherichia coli*, *Proteus vulgaris*, and others, which indicates the presence of hygiene risks and potential food safety hazards. The study conducted after the use of biochemically active detergents SINTEX and FOAM 42 showed that the above-mentioned microorganisms were not fully detected.

These results indicate the high efficiency of the aforementioned detergents, which is likely due to their chemical composition, the combined action of surfactants and possible enzymatic components, which effectively destroy organic residues and reduce the possibility of microbial survival. The obtained data comply with the requirements of international and local standards, including the principles of sampling and research validity of ISO/IEC 17025, as well as the Georgian Sanitary Rules and Norms (Order No. 301/N), which provide for microbiological control of the industrial environment. The standardized sampling methodology used in the study (taking a swab from a 100

cm² surface, incubation and plating on selective agar plates) ensured the reliability and comparability of the results. It is noteworthy that both detergents showed identical effectiveness against all studied microorganisms, which indicates their applicability in supporting both preventive sanitary measures and HACCP ISO 22000 and critical control points of the system. This fact is especially important in chicken processing plants, where the risk of spreading salmonella, staphylococcus, and other gram-negative bacteria is high. Studies are conducted after each wash and disinfection, which aims to constantly monitor the effectiveness of cleaning and hygiene standards.

ბიოქიმია

ტექნოლოგიური პროცესების მართვა სურსათის წარმოებასა და უსაფრთხოებაში ბიოქიმიურად აქტიური დეტერგენტებით

ციცინო სიხარულიძე*, ქრისტინე ლობჯანიძე**, ლალი ტაბატაძე**, ანა ჩაბრავა*, დარეჯან გულბანი**, გურამ ალექსიძე§, ანატოლი გიორგაძე§§

* შპს „ჩირინას“ ვეტერინარულ-დიაგნოსტიკური ლაბორატორია „სანა“, თბილისი, საქართველო

** სოხუმის სახელმწიფო უნივერსიტეტი, საბუნებისმეტყველო მეცნიერებათა, მათემატიკის,

ტექნოლოგიებისა და ფარმაციის ფაკულტეტი, თბილისი, საქართველო

§ აკადემიის წევრი, საქართველოს მეცნიერებათა ეროვნული აკადემია, თბილისი, საქართველო

§§ საქართველოს სოფლის მეურნეობის მეცნიერებათა აკადემია, თბილისი, საქართველო

თანამედროვე ტექნოლოგიური პროცესები სულ უფრო მეტად ეფუძნება ცოცხალ სისტემებში მიმდინარე ქიმიური გარდაქმნების სიღრმისეულ ცოდნას. ნაშრომში დეტალურადაა განხილული ზედაპირულად აქტიური SINTEX და FOAM 42 დეტერგენტების გამოყენება ქათმის ხორცპროდუქტების გადამამუშავებელ საწარმოში, მისი ქიმიური მოქმედების მექანიზმები, შესაძლო ქიმიური საფრთხეები და უვნებლობის სტრატეგიები MSDS, HACCP, ISO/IEC 17025-ის სისტემების კონტექსტში. კვლევის შედეგებმა დაადასტურა რომ სწორად შერჩეული და

ტექნოლოგიური პროცესის შესაბამისად გამოყენებული ბიოქიმიურად აქტიური დეტერგენტები მნიშვნელოვან როლს ასრულებენ მიკრობიოლოგიური უსაფრთხოების უზრუნველყოფაში, ამცირებენ ჯვარედინ კონტამინაციის რისკს და ხელს უწყობენ მომხმარებლისთვის უსაფრთხო პროდუქტის წარმოებას.

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