

The Antibacterial Potential of Essential Oils for Eggshell Sanitization and Preservation of Quality

Torlak Licker*

Department of Pharmacognosy and Natural Products, Faculty of Pharmacy, Pharos University in Alexandria, Alexandria 21648, Egypt

Introduction

Eggs are an essential part of the human diet, widely consumed across cultures for their high nutritional value. However, the porous nature of eggshells makes them vulnerable to contamination by various microorganisms, including harmful bacteria such as *Salmonella* and *Escherichia coli*. These bacteria can pose significant health risks to consumers, making the proper sanitization of eggshells critical for food safety. Traditionally, eggshell sanitization has relied on chemical disinfectants, but there has been growing concern regarding the potential health risks of chemical residues and their environmental impact. As a result, there is increasing interest in the use of natural alternatives for eggshell sanitization, with essential oils emerging as a promising option.

Essential oils are aromatic compounds derived from plants, known for their diverse biological properties, including antibacterial, antifungal, and antiviral effects. Due to their natural origin and antimicrobial activities, essential oils have gained attention as potential alternatives to synthetic chemicals in food safety applications, including the sanitization of eggshells. This article explores the antibacterial potential of essential oils for eggshell sanitization and their role in preserving the quality of eggs [1].

Description

The eggshell serves as the first line of defense against environmental contaminants, protecting the egg's contents from microbial invasion. However, eggs are often exposed to a variety of potential contaminants during production, collection, transport, and handling. *Salmonella* spp., *E. coli*, and other pathogenic microorganisms are frequently found on the surface of eggs, making sanitization a crucial step in maintaining food safety. Without proper sanitization, these microorganisms can lead to foodborne illnesses when the eggs are consumed raw or undercooked. Eggshell sanitization aims to reduce the bacterial load on the surface of the egg, preventing microbial contamination while maintaining the egg's quality and shelf life. While several methods are employed for eggshell sanitization, including washing, disinfecting with chemicals, and ultraviolet light treatment, these approaches can have limitations in terms of effectiveness, safety, and environmental impact. Consequently, there is an increasing demand for more sustainable and natural alternatives that are both effective and environmentally friendly. The antimicrobial action of essential oils is primarily attributed to their active compounds, such as phenols, terpenes, and aldehydes, which can disrupt the cell membranes of bacteria, leading to cell lysis and death. The ability of essential oils to inhibit bacterial growth has made them of particular interest in food safety applications, including the preservation and sanitization of perishable products like eggs [2].

The antibacterial properties of essential oils are primarily attributed to the

chemical constituents present within the oils. These compounds interact with the bacterial cell membrane, disrupting its integrity and leading to leakage of intracellular contents, which eventually causes bacterial cell death.

Cell membrane disruption: Many essential oils, especially those containing phenolic compounds, can disrupt the integrity of bacterial cell membranes. This leads to the leakage of vital cellular components, causing loss of function and eventual cell death.

Inhibition of enzymatic activity: Some essential oils inhibit bacterial enzymes that are essential for cell metabolism and growth. For example, carvacrol and thymol, two key compounds found in thyme and oregano oils, have been shown to interfere with the enzymatic activity of bacterial cells, preventing their replication.

DNA Damage: Certain essential oils, such as those from cinnamon and oregano, have been shown to cause DNA damage in bacterial cells, interfering with their ability to replicate and function.

Antioxidant activity: Essential oils also possess antioxidant properties that can help prevent bacterial oxidative stress. By neutralizing free radicals, essential oils can reduce oxidative damage in bacterial cells, further enhancing their antimicrobial activity [3].

The application of essential oils in eggshell sanitization has gained attention as a natural, non-toxic alternative to chemical sanitizers. Studies have demonstrated that essential oils, due to their strong antibacterial properties, can effectively reduce bacterial contamination on eggshells, offering a promising solution for enhancing food safety without leaving harmful chemical residues. Tea tree oil, derived from the *Melaleuca alternifolia* plant, is known for its broad-spectrum antimicrobial activity. It contains compounds like terpinen-4-ol and -terpineol, which have been shown to inhibit the growth of *Salmonella* and *E. coli*. Research has shown that applying diluted tea tree oil to eggshells can significantly reduce bacterial contamination while maintaining the egg's structural integrity and quality. Oregano oil contains the active compound carvacrol, which exhibits strong antibacterial and antifungal properties. It has been shown to reduce bacterial contamination on eggshells, particularly *Salmonella* and *Listeria monocytogenes*. Oregano oil also has antioxidant properties that may help in preserving the quality of eggs during storage by reducing oxidative degradation. Cinnamon oil, with its high content of cinnamaldehyde, is known for its potent antimicrobial effects. Studies have indicated that cinnamon oil can significantly reduce bacterial load on eggshells, particularly *Salmonella* spp. and *E. coli*. Additionally, cinnamon oil's antioxidant properties may help preserve egg quality by reducing lipid oxidation and preventing rancidity. Lavender oil, derived from *Lavandula angustifolia*, is another essential oil with known antibacterial properties. It contains linalool and linalyl acetate, which exhibit activity against a range of bacteria. Lavender oil can help reduce bacterial contamination on eggshells while contributing to a pleasant aroma, making it a popular choice for food safety applications [4,5].

Conclusion

Essential oils offer a promising, natural alternative to traditional chemical disinfectants for eggshell sanitization. Their broad-spectrum antibacterial properties make them effective in reducing bacterial contamination, while their natural origin and eco-friendly profile make them an attractive option for sustainable food safety practices. Essential oils like tea tree, thyme, oregano, lavender, and cinnamon have demonstrated significant potential in enhancing eggshell sanitization, reducing bacterial loads, and preserving egg

*Address for Correspondence: Torlak Licker, Department of Pharmacognosy and Natural Products, Faculty of Pharmacy, Pharos University in Alexandria, Alexandria 21648, Egypt, E-mail: lickker@edu.com

Copyright: © 2025 Licker T. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Received: 30 December, 2024, Manuscript No. jefc-25-163040; **Editor assigned:** 01 January, 2025, PreQC No. P-163040; **Reviewed:** 15 January, 2025, QC No. Q-163040; **Revised:** 20 January, 2025, Manuscript No. R-163040; **Published:** 27 January, 2025, DOI: 10.37421/2472-0542.2025.11.525

quality during storage. However, further research is necessary to optimize the application of essential oils for eggshell sanitization, including determining the ideal concentrations, contact times, and potential interactions with other food safety measures. Additionally, the scalability of essential oil-based sanitization methods for commercial egg production needs to be assessed to ensure their practicality and cost-effectiveness in large-scale operations. By harnessing the antibacterial potential of essential oils, the food industry can take a significant step toward more sustainable, safer, and healthier food practices. In addition to their antibacterial effects, essential oils can help preserve the quality of eggs during storage. Quality attributes such as egg freshness, texture, and nutritional content are highly susceptible to degradation due to microbial growth and oxidative reactions. Essential oils, by inhibiting bacterial growth and preventing oxidation, can extend the shelf life of eggs, ensuring that they remain fresh and safe for consumption over a longer period.

Acknowledgement

None.

Conflict of Interest

There is no conflict of interest by author.

References

1. Bermudez-Aguirre, D. and B. A. Niemira. "Effect of nisin, EDTA, and abuse temperature on the growth of *Salmonella Typhimurium* in liquid whole egg during refrigerated storage." *Food Res Int* 174 (2023): 113568.
2. Moradi, Mehran, Rahim Molaei and Jonas T. Guimarães. "A review on preparation and chemical analysis of postbiotics from lactic acid bacteria." *Enzyme Microb Technol* 143 (2021): 109722.
3. Raafat, Karim M. and Amal G. Omar. "Phytotherapeutic activity of curcuminol: Isolation, GC-MS identification, and assessing potentials against acute and subchronic hyperglycemia, tactile allodynia, and hyperalgesia." *Pharmaceutical Biol* 54 (2016): 1334-1344.
4. Saraiva, Cristina, Ana Catarina Silva, Juan García-Díez and Beniamino Cenci-Goga, et al. "Antimicrobial activity of *Myrtus communis* L. and *Rosmarinus officinalis* L. essential oils against *Listeria monocytogenes* in cheese." *Foods* 10 (2021): 1106.
5. Aouadhi, Chedia, Ahlem Jouini, Karima Maaroufi and Abderrazak Maaroufi. "Antibacterial effect of eight essential oils against bacteria implicated in bovine mastitis and characterization of primary action mode of *Thymus capitatus* essential oil." *Antibiotics* 13 (2024): 237.

How to cite this article: Licker, Torlak. "The Antibacterial Potential of Essential Oils for Eggshell Sanitization and Preservation of Quality." *J Exp Food Chem* 11 (2025): 525.