ESSENTIAL OILS FOR THE INHIBITION OF *LISTERIA MONOCYTOGENES* IN FOOD APPLICATIONS

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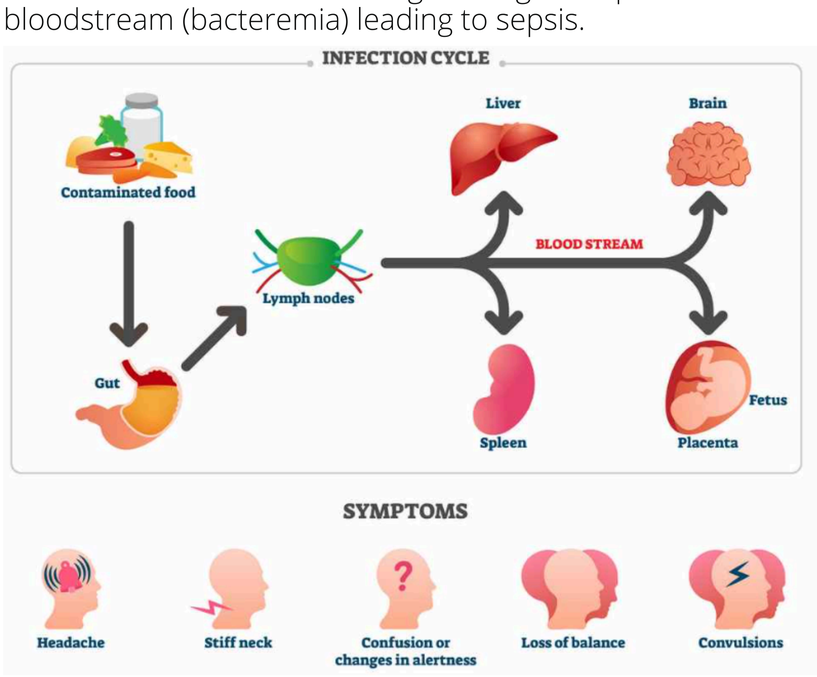
INTRODUCTION

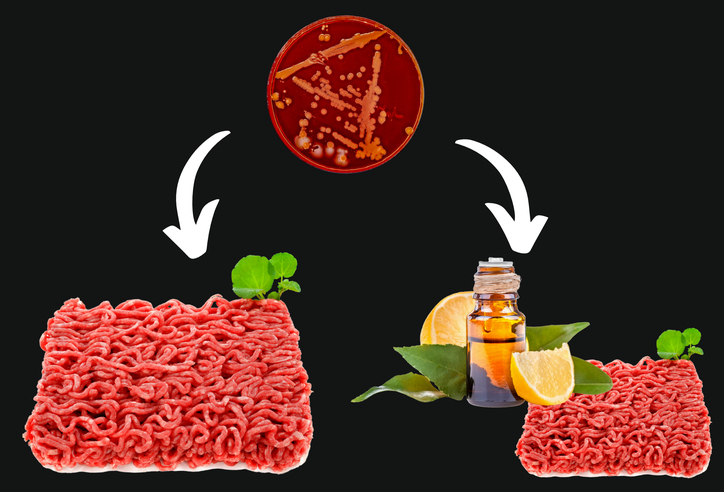
Worldwide, **14.8 cases of listeriosis per million people** are estimated annually (EFSA, WHO combined estimates). Although relatively rare, it has one of the highest **mortality rates (20–30%)** among foodborne illnesses. Estimated cost per case (medical + productivity loss) ranges from **€10,000 to €150,000,** depending on severity.

HOW LISTERIA KILLS?

Unlike many bacteria, *Listeria* survives stomach acid and bile salts. The bacteria invade the gut lining and spread into the bloodstream (bacteremia) leading to sepsis.



EXAMPLE IN MEAT:

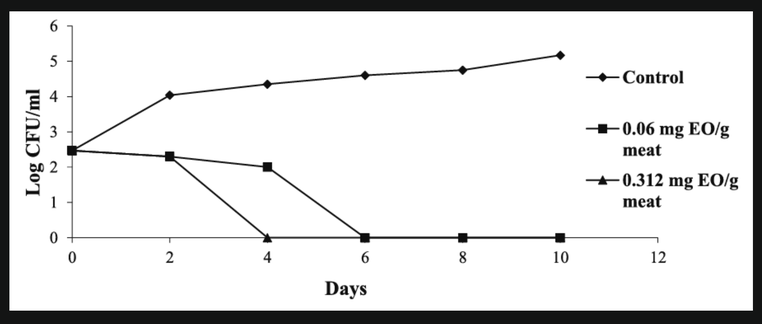


Infected minced meat

Control

Infected minced meat with Lemon Essential oil (EO)

L. monocytogenes in control beef grew by ~3–4 log, whereas in lemon oil-treated beef the count was over 2 log lower than control.
In fact, with the highest concentration of lemon oil, *Listeria* was effectively held over 2.5 log below the control level for the entire storage and never exceeded ~10^3–10^4 CFU/g



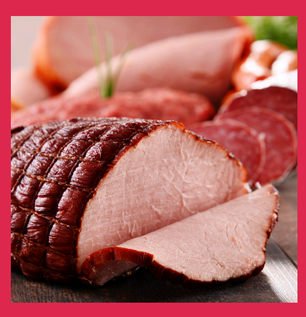
Reference: Citrus Lemon Essential Oil: Antioxidant and Antimicrobial Activities with Its Preservative Effect Against L. monocytogenes in Minced Beef – Anis Ben Hsouna et al. (2017)

CHEMICAL PRESERVATIVES

1 SODIUM NITRITE (NANO2)

Inhibits microbial growth by interfering with iron-sulfur proteins in bacterial cells.

POTENTIAL FORMATION OF NITROSAMINES (CARCINOGENIC COMPOUNDS)

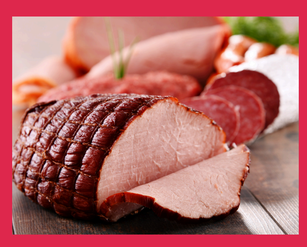


2 SODIUM BENZOATE (E211)

Disrupts bacterial cell membrane function, especially in acidic environments.

3 NISIN (E234)

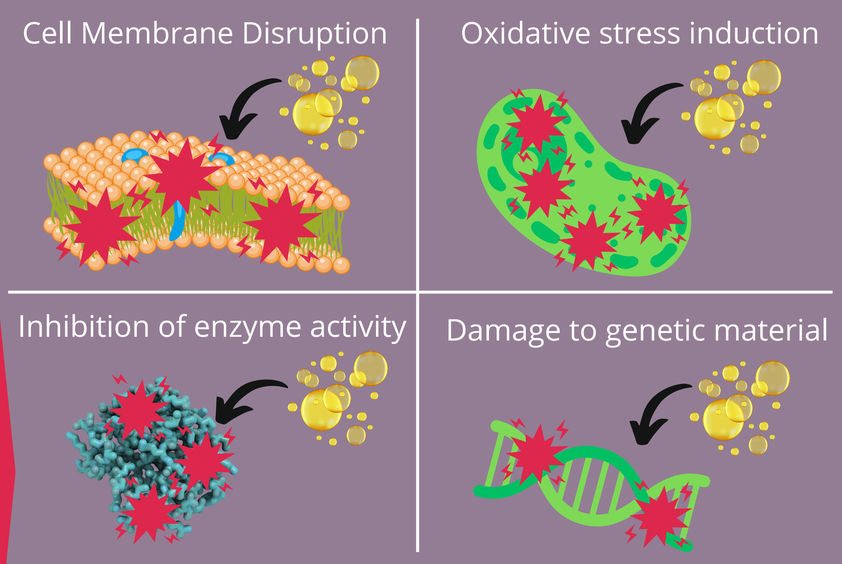
A natural bacteriocin that disrupts bacterial cell wall synthesis. Highly effective against Listeria.



NEED FOR NATURAL ALTERNATIVES

- Consumer demand for **"clean label"** and natural ingredients.
- Concerns over long-term health risks, allergies, and chemical residues.
- Environmental impact of synthetic preservatives.

MECHANISM OF ACTION OF ESSENTIAL OILS

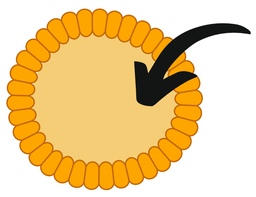


EXAMPLE IN CHEESE:

Infected soft cheese

Control

Infected soft cheese with Lemongrass Essential oil (EO) 5.0 mg/mL



Lemongrass oil was encapsulated in liposomes to create a **controlled-release system.** The release of EO was designed to be triggered by listeriolysin O – a toxin enzyme that L. monocytogenes secretes.

At 28 days *L. monocytogenes* was undetectable or significantly reduced (several log CFU reduction) in the EO-liposome treated cheeses relative to controls.

Reference: Inhibitory Effect of Liposome-Entrapped Lemongrass Oil on the Growth of L. monocytogenes in Cheese – H. Y. Cui et al. (2016)

CONCLUSION

- Essential oils are effective natural antimicrobials against Listeria monocytogenes in various food products.
- Oregano, thyme, cinnamon, clove, and lemon oils show strong inhibitory effects, reducing *Listeria* by up to 2–5 log CFU in meat, dairy, and fresh produce.
- Encapsulation techniques (nanoemulsions, liposomes) enhance stability, control release, and minimize sensory changes.
- Low concentrations (0.3–0.5%) can achieve safe and effective inhibition without compromising flavor.
- Essential oils are a promising clean-label alternative to chemical preservatives for improving food safety.

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