

# Evaluation Of Natural Essential Oil Coatings (Thyme And Cinnamon) For Enhancing Storability Of Cherry Tomato And Lemon

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**Abstract:** *Postharvest Losses Of Fruits Such As Cherry Tomato And Lemon Are A Significant Issue Due To Microbial Spoilage And Rapid Physiological Deterioration. The Use Of Chemical Preservatives, Though Effective, Raises Concerns Regarding Food Safety And Environmental Impact, Necessitating The Development Of Natural Alternatives. This Study Evaluates The Effectiveness Of Thyme And Cinnamon Essential Oil Coatings In Enhancing The Storability And Quality Of Cherry Tomato And Lemon. The Oils Were Applied Using An Emulsifier-Based Coating Method, And Treated Fruits Were Stored Under Ambient Conditions With Periodic Assessment Of Physical Appearance, Microbial Growth, And Shelf Life. The Results Revealed That Both Essential Oils Significantly Reduced Microbial Spoilage And Delayed Deterioration Compared To Untreated Samples. Among The Treatments, Thyme Oil Exhibited Superior Antimicrobial Activity And Better Retention Of Fruit Firmness And Overall Quality. This Study Demonstrates That Natural Essential Oil Coatings Are A Promising, Cost-Effective, And Sustainable Alternative To Synthetic Preservatives For Improving Postharvest Fruit Quality And Extending Shelf Life.*

**Keywords:** *Thyme Oil, Cinnamon Oil, Cherry Tomato, Lemon, Spoilage, Postharvest Preservation, Delay Fruit Deterioration, Antimicrobial Activity, Essential Oil Coating, Storability.*

## I. INTRODUCTION

Fruits such as cherry tomato (*Solanum lycopersicum*) and lemon (*Citrus limon*) are highly perishable due to their high moisture content and susceptibility to microbial infection. Postharvest losses caused by fungi and bacteria significantly reduce their market value and shelf life. Traditionally, chemical preservatives have been used to control spoilage; however, their continuous use raises concerns regarding food safety, environmental pollution and human health. The use of Natural plant-based essential oils or their components as natural preservatives can overcome these problems. Essential oils, namely thyme oil (*Thymus vulgaris*) and cinnamon oil (*Cinnamomum zeylanicum*) possess strong antimicrobial and antioxidant properties due to the presence of bioactive compounds like thymol, carvacrol, and cinnamaldehyde. The application of these essential oils as edible coatings can form a

protective barrier on fruit surfaces, reducing moisture loss, delaying ripening, and inhibiting microbial growth. This study focuses on evaluating the effectiveness of thyme and cinnamon oil coatings in enhancing the storability of cherry tomato and lemon under postharvest conditions.

## II. REVIEW OF LITERATURE

This study investigated cinnamon-based edible coatings to extend tomato shelf life. Tomatoes treated with varying concentrations of cinnamon extract were analyzed for quality parameters such as firmness, pH, colour, and total soluble solids. The 15% cinnamon coating showed results comparable to chitosan treatment, significantly preserving quality and extending shelf life. The findings highlight cinnamon coating

as a promising natural preservation method (N.K. Mukhtar et al., 2024).

The antimicrobial potential of cinnamon oil incorporated into chitosan edible coating was evaluated on fresh-cut potatoes. Cinnamon oil exhibited strong antibacterial activity against major foodborne pathogens with low MIC values. Coatings containing 0.2% cinnamon oil effectively reduced microbial counts, minimized weight loss, and maintained firmness during storage. The study demonstrates the effectiveness of cinnamon oil coatings in improving food safety and shelf life (Sarengaowa et al., 2022).

This review examined the use of lemon and cinnamon essential oils as natural fruit preservatives. Both oils demonstrated strong antimicrobial activity against common spoilage organisms such as *Botrytis cinerea*. Their effectiveness varied depending on concentration and application method. The study highlights their potential as GRAS-approved alternatives to synthetic preservatives while noting possible impacts on fruit quality attributes (Freche E. et al., 2022).

This study explored the synergistic antimicrobial effects of essential oil combinations against *Leuconostoc citreum*. Cinnamon, oregano, and thyme oils showed strong activity, with combined oregano and thyme oils exhibiting enhanced inhibitory effects. The combination significantly reduced bacterial growth in tomato juice compared to individual treatments. These findings support the use of essential oil combinations in natural food preservation (Lee S. et al., 2020).

The effectiveness of oregano and thyme essential oils as alternatives to sulfur dioxide in grape preservation was evaluated. Preharvest application significantly reduced decay, weight loss, and enzymatic deterioration while maintaining fruit quality during storage. The oils also improved firmness, appearance, and biochemical properties, demonstrating their potential as eco-friendly postharvest treatments (El-Abbasy U.K. et al., 2023).

This review highlights the role of essential oils in controlling postharvest fruit spoilage. Essential oils, with or without edible coatings, exhibit strong antimicrobial activity against pathogens responsible for fruit deterioration. The study emphasizes their potential as sustainable alternatives to synthetic fungicides while addressing challenges related to consistency and application methods (Magri A. et al., 2023).

Postharvest fungal diseases, particularly caused by *Alternaria alternata*, significantly reduce tomato quality and yield. This study evaluated aqueous extracts of cinnamon and clove, along with their active compounds cinnamaldehyde and eugenol, for antifungal activity. Complete inhibition of mycelial growth and spore germination was observed with 5% clove extract and combined treatments. The antifungal effect was mainly attributed to eugenol. These findings suggest that botanical extracts can effectively control postharvest diseases and reduce reliance on synthetic fungicides (Carmello C.R. et al., 2025).

Food spoilage by yeasts and moulds remains a major issue, especially in acidic and low water activity foods where bacteria cannot grow. This study highlights the potential of plant-derived essential oils (EOs) as natural preservatives. EOs were found to inhibit yeast and mould growth by extending lag phases and reducing colony formation. Despite

their strong aroma, synergistic combinations can minimize sensory impacts. The findings support essential oils as safe, effective, and consumer-accepted alternatives to chemical preservatives (Burt S, 2011).

The antifungal activity of plant extracts and essential oils was evaluated against major spoilage fungi. Oregano essential oil exhibited strong inhibition against *Fusarium*, *Aspergillus*, and *Penicillium* species. Combined treatment with refrigeration and oregano oil or rosemary extract significantly improved tomato quality during storage. The study suggests that integrating natural extracts with storage techniques enhances postharvest preservation (Ibrahim F.A.A. et al., 2014).

This study assessed the effectiveness of thymol and carvacrol combined with commercial wax coatings on lemons. The treatment significantly reduced microbial load and decay during storage, showing results comparable to synthetic fungicides. Additionally, fruit quality parameters such as weight loss, firmness, and colour were maintained. Essential oil coatings demonstrated potential as natural alternatives for postharvest preservation (Castillo S. et al. (2014).

This work has been aimed at studying the effect of red thyme oil (RTO, *Thymus vulgaris L.*) on the shelf-life and *Penicillium* decay of oranges during cold storage. RTO vapours significantly reduced ( $P \leq 0.05$ ) the percentage of infected wounds, the external growth area and the production of spores in inoculated orange fruit stored for 12 days at 7 °C in a polypropylene film selected for its appropriate permeability. Among the RTO compounds, p-cymene and thymol were the most abundant in packed boxes at the end of cold storage. The RTO vapours did not affect the main quality parameters of the oranges, or the taste and odour of the juice. The results have shown that an active packaging, using RTO vapours, could be employed, by the citrus industry, to extend the shelf-life of oranges for fresh market use and juice processing (Pinto L. et al., 2021).

This study evaluated the application of essential oil components such as carvacrol, eugenol, and thymol in controlling lemon postharvest decay. Carvacrol at low concentration (100 µL/L) showed the most effective reduction in fungal incidence without affecting fruit quality. Higher concentrations and combinations were less effective. The results highlight carvacrol as a promising eco-friendly alternative to synthetic fungicides (Gutiérrez-Pozo et al., 2023).

This study evaluated the antifungal activity of thyme essential oil in controlling postharvest decay in table grapes. The treatment significantly reduced fungal growth and decay incidence while maintaining fruit quality during storage. Thyme oil effectively preserved firmness and reduced weight loss compared to untreated samples. The results suggest that thyme essential oil can serve as a natural alternative to chemical fungicides in postharvest management (Abdollahi M. et al., 2012).

The antimicrobial effects of cinnamon essential oil vapour were investigated on fresh produce. The treatment significantly inhibited microbial growth and reduced spoilage organisms. Additionally, the application helped in maintaining quality parameters such as firmness and visual appearance. The study highlights cinnamon oil vapour as an effective

natural preservative for extending shelf life of fresh fruits and vegetables (Tzortzakakis N.G., 2007).

This study examined the application of essential oils in edible coatings for fresh-cut fruits. Essential oils such as cinnamon and clove showed strong antimicrobial activity against spoilage microorganisms. The coatings effectively reduced microbial growth and maintained sensory quality. The results demonstrate that essential oil-based coatings can enhance safety and extend shelf life of minimally processed fruits (Raybaudi-Massilia R.M. et al., 2009).

The study reviewed the antimicrobial properties of various plant essential oils including thyme and cinnamon. These oils exhibited strong inhibitory effects against foodborne pathogens and spoilage microorganisms. The research emphasizes their potential use as natural food preservatives and their role in improving food safety and shelf life (Viuda-Martos M. et al., (2008).

This study investigated the synergistic antimicrobial activity of essential oil components such as thymol and carvacrol. The combination of these compounds enhanced antimicrobial effectiveness against various pathogens. The results suggest that combining essential oils can improve their efficiency while reducing required concentrations, making them suitable for food preservation applications (Gutierrez J. et al., 2008).

### III. METHODOLOGY

Fresh, mature, and uniform-sized cherry tomatoes and lemons were collected from a local market. The fruits were washed with tap water, rinsed with sterile distilled water, and air-dried before treatment. Essential oils (thyme and cinnamon) were prepared were prepared at concentrations of 0.3 - 0.5% and emulsified using 0.1% Tween-80 to ensure proper mixing. The fruits were divided into three groups: control (untreated), thyme oil-treated, and cinnamon oil-treated.

The fruits were coated with respective essential oil formulations by spraying method and allowed to dry. All samples were stored under ambient conditions and observed at regular intervals (7, 14, 21, and 28 days).

Microbial analysis was carried out by isolating spoilage organisms from infected fruits using standard microbiological techniques. Antimicrobial activity of essential oils was tested using agar well diffusion method.

Parameters such as fruit appearance, firmness, microbial growth, and shelf life were recorded and compared with control samples.

### IV. RESULTS

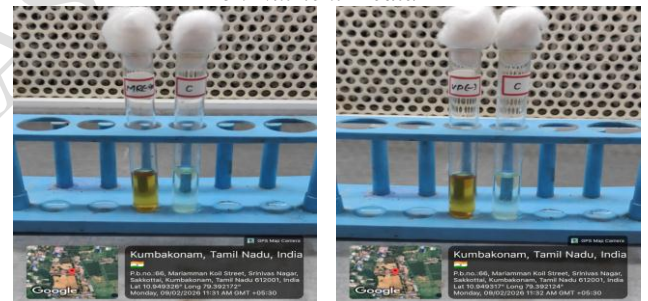
The effect of postharvest application of thyme oil and cinnamon oil on tomato and lemon fruits was evaluated by observing changes in weight loss, physical appearance, microbial and overall storability at weekly intervals (7th, 14th, 21st, and 28th day) and compared with untreated control fruits.

Treated fruits showed improved appearance, with better color retention, reduced shriveling, and maintained firmness throughout the storage period. Weight loss was considerably lower in treated fruits compared to untreated samples, indicating reduced moisture loss and delayed deterioration. Among the treatments, thyme oil was more effective in controlling microbial growth, minimizing weight loss, and preserving overall fruit quality, followed by cinnamon oil.

In contrast, untreated fruits exhibited rapid spoilage, weight loss, poor appearance, and reduced shelf life. Overall, essential oil treatments improved the appearance, reduced weight loss, and significantly extended the storability of the fruits.

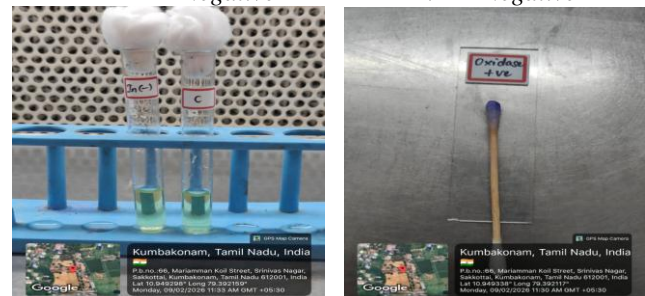


Figure 1: Isolation of Organism from Infected Fruit Sample on Nutrient Media



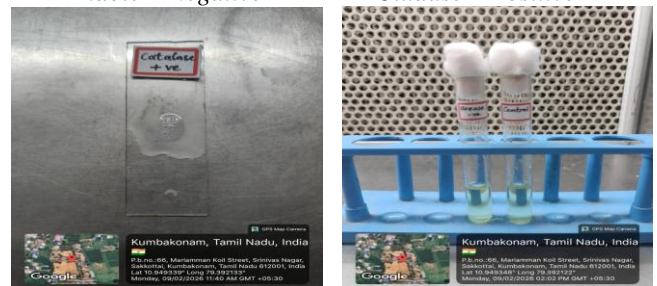
MR - Negative

VP - Negative



Indole - Negative

Oxidase - Positive



Catalase - Positive

Urease - Negative

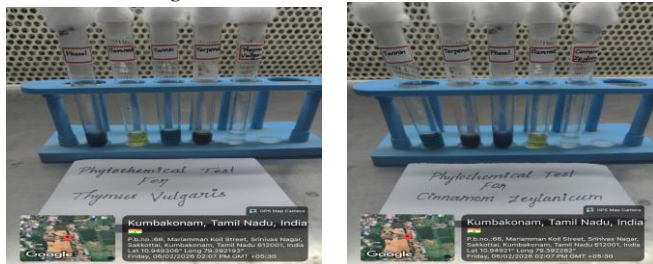
Figure 2: Biochemical Analysis of Organism

S.No	Biochemical Characters	Results
1	Gram staining	-ve
2	Motility	Motile
3	Methyl Red test	-ve
4	Voges Proskauer	-ve
5	Indole test	-ve
6	Urease test	-ve
7	Oxidase	+ve
8	Citrate utilization	+ve

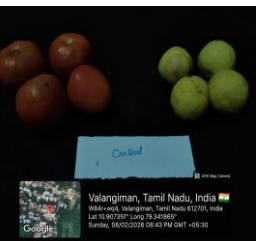
Table 1: Biochemical Test Characteristics of Organism



Thyme Oil Emulsion Cinnamon Oil Emulsion  
Figure 3: Essential Oils emulsions



Thymus vulgaris  
Cinnamom zeylanicum  
Figure 4: Phytochemical Analysis of Essential Oils

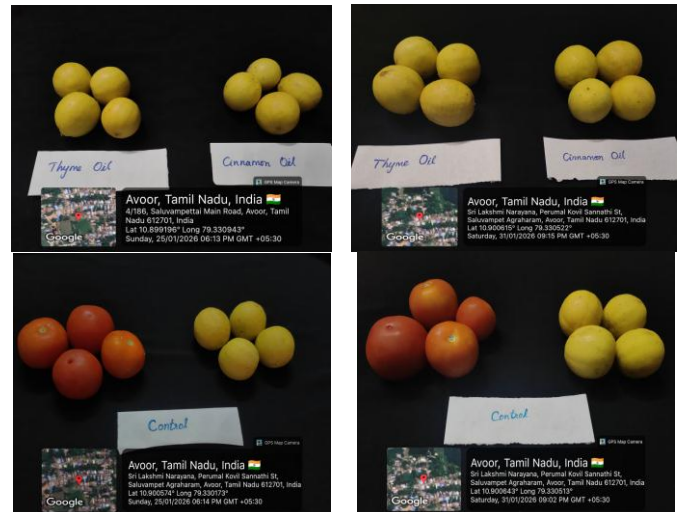


Phytochemical tests	Thymus vulgaris	Cinnamomum zeylanicum
Flavonoids	+ve	+ve
Phenolics	+ve	+ve
Tannins	-ve	-ve
Terpenoids	+ve	+ve

Table 2: Phytochemical Tests of Essential Oils

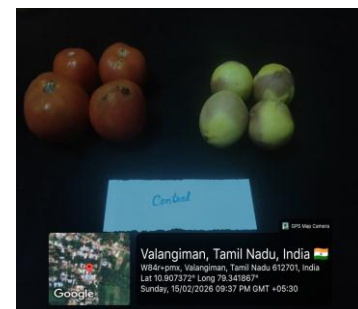
Day 1:

Day 7:



Day 14:

Day 21:



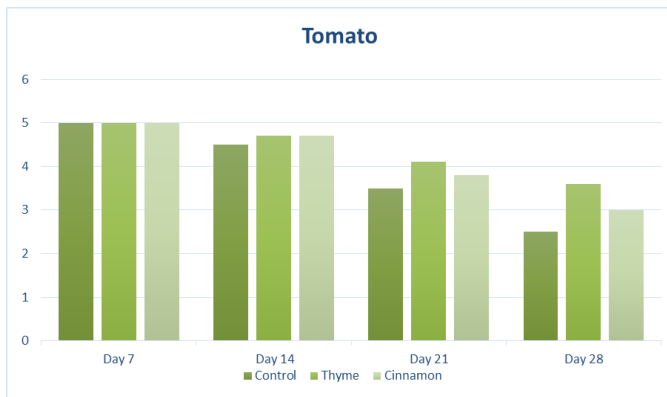
Day 28:



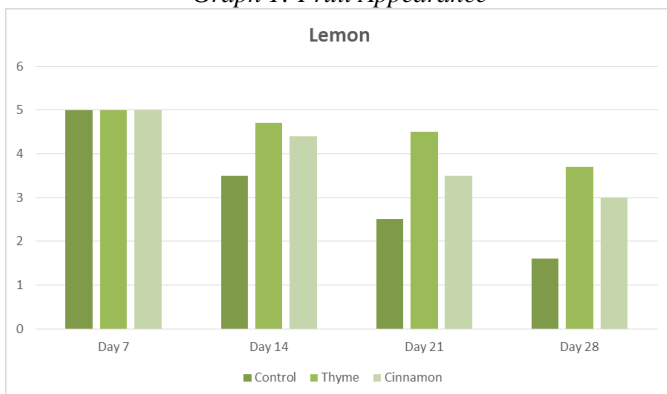


Figure 5: Treated and Untreated Fruits with Emulsion

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Graph 1: Fruit Appearance



Graph 2: Weight loss

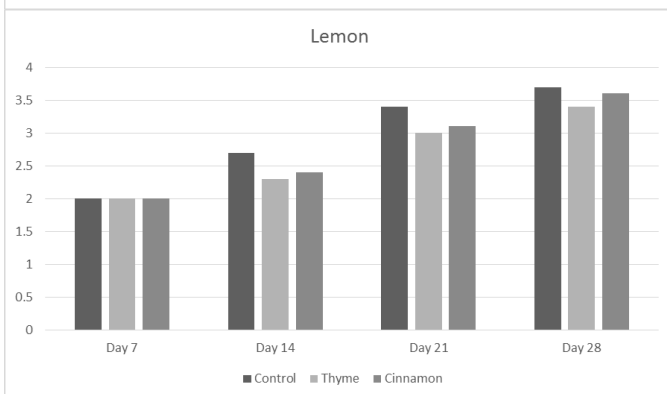
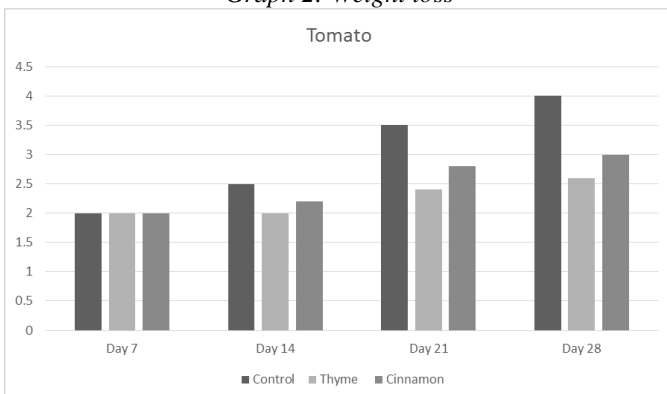


Figure 7: Antibacterial Activity of Essential Oils

S.No	Tested Organism	Essential Oils	Zone of Inhibition
1.	<i>Pseudomonas aeruginosa</i>	<i>Thymus vulgaris</i>	18mm
		<i>Cinnamomum zeylanicum</i>	15mm
		Control	

Table 3: Antibacterial Activity

## V. DISCUSSION AND SUMMARY

The study confirms that natural essential oil coatings are effective in reducing postharvest losses of cherry tomato and lemon. The antimicrobial properties of thyme and cinnamon oils play a crucial role in inhibiting spoilage microorganisms.

Thyme oil showed better performance due to its higher antimicrobial potency, which can be attributed to the presence of thymol and carvacrol. The coatings also helped in maintaining fruit quality by reducing moisture loss and delaying ripening. These findings suggest that essential oil-based coatings can serve as a safe, eco-friendly, and economical alternative to chemical preservatives in postharvest management.

## REFERENCES

- [1] Abdollahi, M., Rezaei, M., & Farzi, G. (2012). A novel active packaging system based on thyme essential oil for the control of postharvest decay in table grapes. *Journal of Food Engineering*, 111(3), 341–347.
- [2] Burt, S. (2011). Essential oils: Their antibacterial properties and potential applications in foods. *International Journal of Food Microbiology*, 94(3), 223–253.
- [3] Carmello, C. R., et al. (2025). Antifungal activity of cinnamon and clove extracts against *Alternaria alternata* in tomato. *Journal of Plant Pathology*, 107(2), 145–156.

- [4] Castillo, S., et al. (2014). Antifungal coatings based on essential oils to improve postharvest quality of citrus fruits. *Postharvest Biology and Technology*, 95, 13–20.
- [5] El-Abbasy, U. K., et al. (2023). Preharvest application of oregano and thyme essential oils for improving grape quality during storage. *Agronomy*, 13(12), 3075.
- [6] Freche, E., et al. (2022). Application of lemon and cinnamon essential oils as natural preservatives in fruits. *Food Chemistry Reviews*, 4(2), 210–225.
- [7] Gutiérrez-Pozo, A., et al. (2023). Effect of essential oil components on postharvest decay and quality of lemon fruits. *Postharvest Biology and Technology*, 198, 112345.
- [8] Gutierrez, J., Barry-Ryan, C., & Bourke, P. (2008). The antimicrobial efficacy of plant essential oil combinations and their interactions with food ingredients. *Food Microbiology*, 25(5), 760–769.
- [9] Ibrahim, F. A. A., et al. (2014). Antifungal activity of plant extracts and essential oils against postharvest spoilage fungi in tomatoes. *Journal of Food Safety*, 34(3), 234–241.
- [10] Lee, S., et al. (2020). Synergistic antimicrobial effects of essential oil combinations against spoilage bacteria in tomato juice. *Food Microbiology*, 86, 103312.
- [11] Magri, A., et al. (2023). Essential oils as natural alternatives to synthetic fungicides in postharvest fruit preservation. *Plants*, 12(5), 1023.
- [12] Mukhtar, N. K., et al. (2024). Effect of cinnamon edible coating on shelf life and quality of tomatoes. *Journal of Food Processing and Preservation*, 48(1), e17345.
- [13] Pinto, L., et al. (2021). Application of red thyme oil vapour for controlling postharvest decay in citrus fruits. *Food Packaging and Shelf Life*, 29, 100689.
- [14] Raybaudi-Massilia, R. M., Mosqueda-Melgar, J., & Martín-Belloso, O. (2009). Antimicrobial activity of essential oils on fresh-cut fruits. *Food Control*, 20(2), 135–141.
- [15] Sarengaowa, et al. (2022). Antimicrobial activity of cinnamon oil incorporated edible coatings on fresh-cut potatoes. *Food Control*, 135, 108781.
- [16] Tzortzakis, N. G. (2007). Maintaining postharvest quality of fresh produce with volatile compounds. *Innovative Food Science & Emerging Technologies*, 8(1), 111–116.
- [17] Viuda-Martos, M., Ruiz-Navajas, Y., Fernández-López, J., & Pérez-Álvarez, J. A. (2008). Antifungal activity of citrus essential oils. *Food Control*, 19(12), 1130–1138.