

Modeling studies on the level of inhibition using gamma-decalactone-enriched pectin films against *Bacillus subtilis*

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INTRODUCTION

Food safety challenge

Microbial contamination reduces the **shelf life** of fresh produce and contributes to significant food losses worldwide.

Gamma-decalactone (GDL) (C₁₀H₁₈O₂)

Naturally occurring compound with a characteristic **peach like aroma**, widely used in the food industry.

Recent studies suggest it may also possess

antimicrobial properties. While investigating the

basic mechanism of peach aroma toxicity in yeast cells, it was demonstrated that the lactone inhibits

H⁺-ATPase activity in microbial cells, resulting in changes to the cell membrane's integrity¹.

Edible films & coatings

Biodegradable pectin-based films enriched with natural compounds offer a sustainable alternative to **synthetic packaging**, providing both preservation and consumer appeal².

AIM

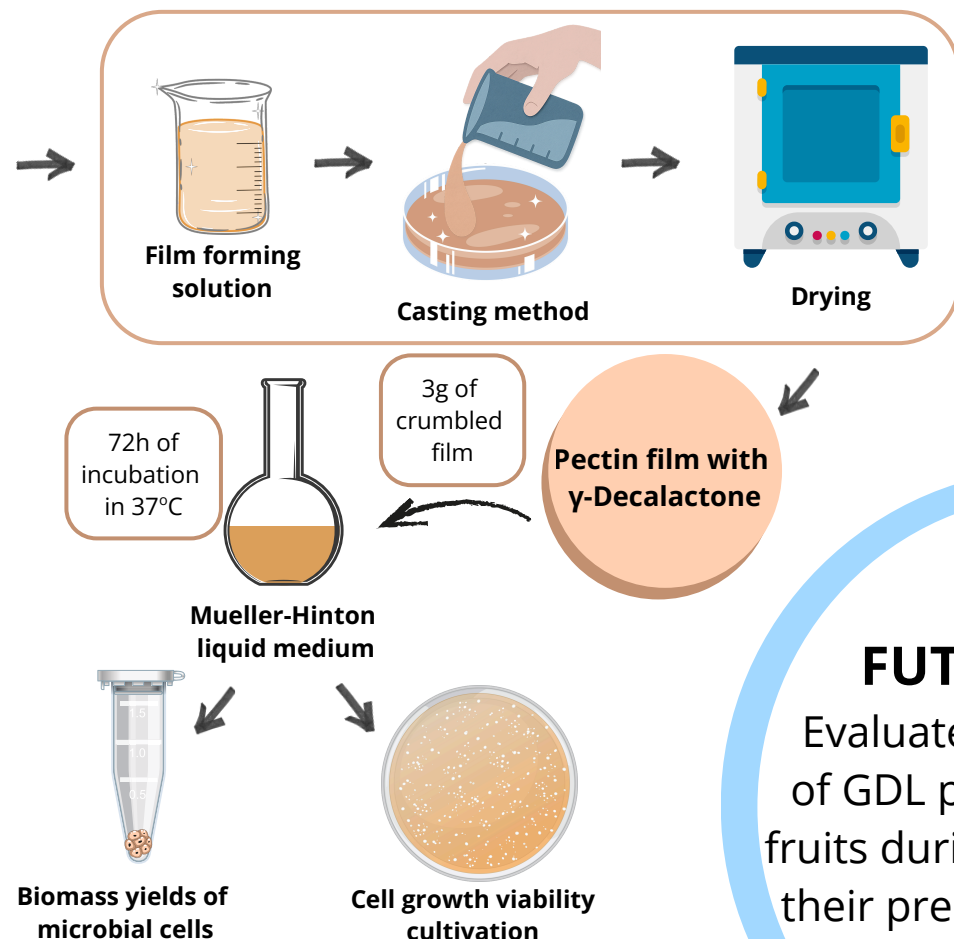
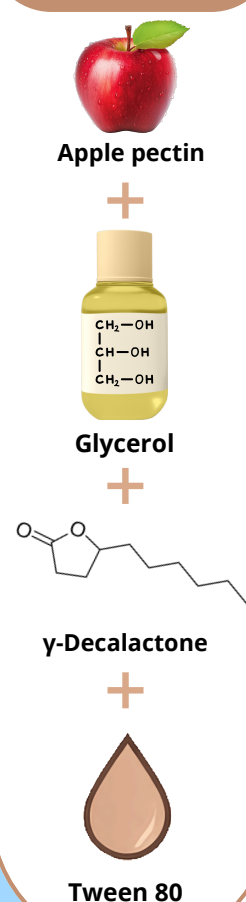
Evaluation of the **antimicrobial** activity of GDL added to edible pectin coatings used in fruit coating.



METHODS

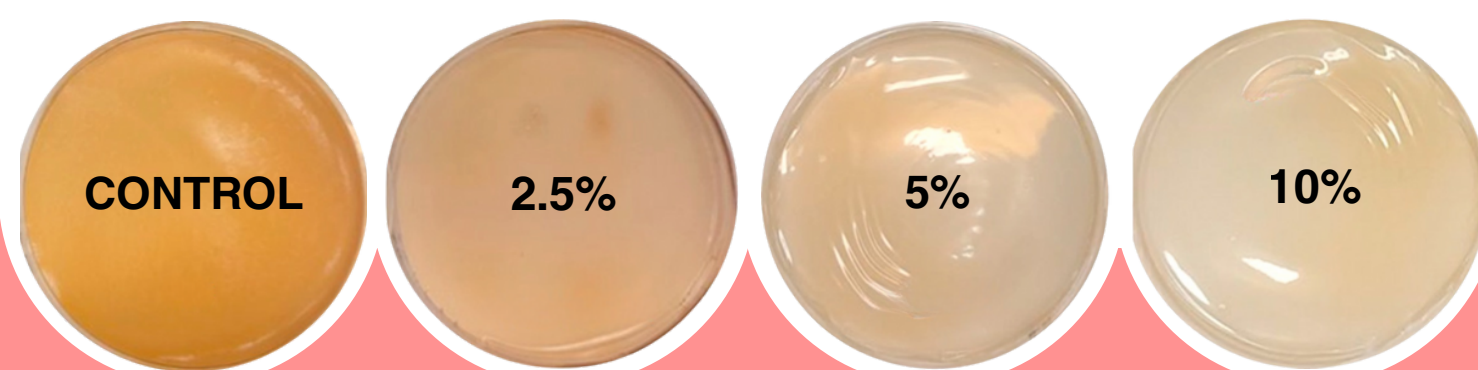
MATERIALS

ACTIVE PACKAGING FILMS



RESULTS & DISSCUTION

Photographs of apple pectin films: control and with added GDL



Biomass yields of microbial cells growing on Mueller-Hinton with the addition of pectin films with a varied GDL concentration.

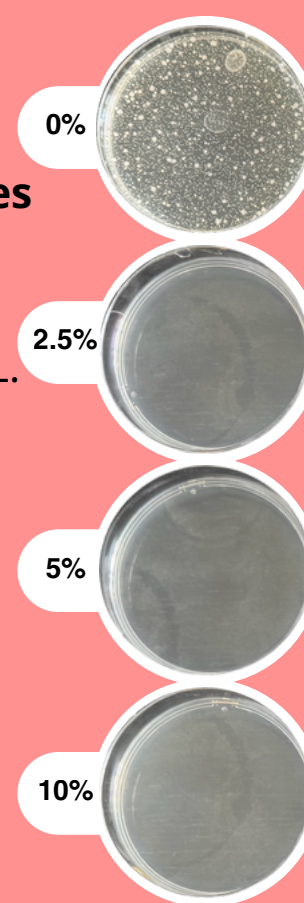
Type of Medium	Biomass Yield (g d.w./dm ³)	
	48 h	72 h
Without film	4.56 ± 0.23	6.09 ± 0.14
AP	6.23 ± 0.11	7.55 ± 0.27
AP_2.5GDL	3.02 ± 0.45	3.87 ± 0.31
AP_5GDL	0	0
AP_10GDL	0	0

Cell growth viability cultivated on media with film containing different concentrations of GDL.

Type of Medium	Viability Indicator (log CFU/mL)	
	48 h	72 h
Without film	6.81 ± 0.10	8.09 ± 0.17
AP	7.91 ± 0.21	9.17 ± 0.04
AP_2.5GDL	5.62 ± 0.05	7.13 ± 0.41
AP_5GDL	0	0
AP_10GDL	0	0

The **biomass yield** results above indicate that adding a **lactone**-containing coating to the culture medium inhibits microorganism growth. Media with the addition of coatings with a lactone concentration of 2.5% were characterised by an almost **two times lower cell biomass yield** than the control medium (containing a coating without the lactone). For *B. subtilis* bacteria, complete cell inhibition was already observed in media with the addition of 5% GDL.

It is **hypothesized** that lactones may inhibit H⁺-ATPase activity in microbial cells, leading to altered cell membrane integrity. It is also likely that hydrophobic interactions with the acyl chains of cell membrane phospholipids occur, leading to increased permeability disturbances. According to numerous reports, lactones **lower intracellular pH**, leading to accelerated cell death.



CONCLUSION

Incorporating **gamma-decalactone (GDL)** into pectin-based films effectively inhibited the growth of *Bacillus subtilis*. The results confirm GDL as a promising **natural antimicrobial agent** for edible films, combining food safety benefits with enhanced sensory appeal.

This approach offers a sustainable strategy for **extending the shelf life of fresh produce** and reducing food waste.

FUTURE WORK

Evaluate the effectiveness of GDL pectin films on real fruits during storage to verify their preservation potential.

REFERENCES

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- Kozakiewicz, G.; Małajowicz, J.; Karwacka, M.; Ciurzyńska, A.; Szulc, K.; Żelazko, A.; Janowicz, M.; Galus, S. The Effects of Gamma-Decalactone on the Physicochemical and Antimicrobial Properties of Pectin-Based Packaging Films. *Materials* 2025, 18, 3831.