ACTIVE PACKAGING BASED ON PP OR PLA AND ESSENTIAL OILS: Antimicrobial and antioxidant properties

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Context and objectives

Active packaging are intended to extend shelf-life or improve the packaged food, therefore are designed to deliberately incorporate components that would release or absorb substances into or from the packaged food[1]. Renewable and biodegradable polymers as well as natural additives are currently considered sustainable alternatives for food packaging applications, reducing environmental negative issues associated with packaging wastes after their useful life. Poly (lactic acid) (PLA) is one of the most commercially available biopolymers for use in food packaging [2]. Essential oils (EOs) have shown the most promising action for its antimicrobial and antioxidant properties [3]. The objective of the present work was to develop active PP and PLA based films by incorporating different EOs (thyme, oregano, lemon, grapefruit). Antimicrobial and Antioxidant capacity of the developed films were investigated to select the best formulation for food packaging applications.

Materials and Methods

Film preparation

EOs
- Thyme
- Oregano*
- Lemon
- Grapefruit

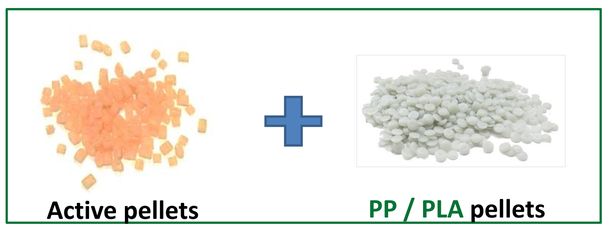
*PLA-oregano films were not feasible

Microporous pellets

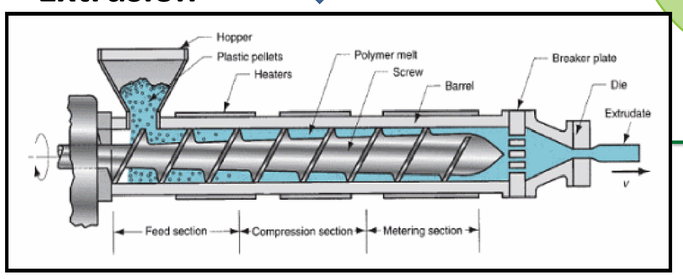
PP

PLA

Preparation of active pellets



Extrusion



Processing of active films

Active films

Film characterization

✓ Antimicrobial activity

The antimicrobial activity of the processed films against different types of microorganisms (*Listeria monocytogenes, Escherichia coli, Saccharomyces cerevisiae* and *Aspergillus niger*) was analyzed by *in vitro* tests in vapor phase. Results were expressed as percentage of inhibition.

✓ Antioxidant capacity

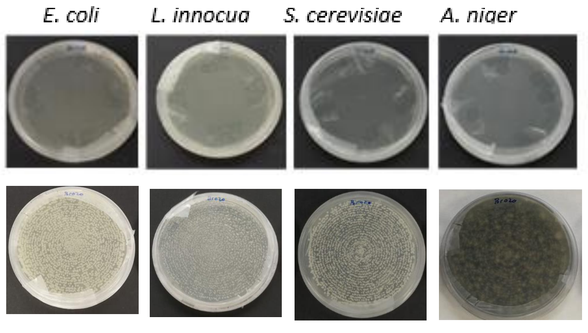
The free radical scavenging capacity of PP and PLA active films was evaluated using DPPH method [4]. 30 cm^2 of each film was immersed in 50 ml of two different food simulants: A (10% ethanol) and B (3% acetic acid). Samples were stored for 10 days at 25°C. Results were expressed as percentage of inhibition of DPPH.

Results

Antimicrobial activity

EOs	PP				PLA			
	E. coli	*L. innocua*	*S. cerevisiae*	*A. niger*	*E. coli*	*L. innocua*	*S. cerevisiae*	*A. niger*
Thyme	*	*	*	*	***	***	***	***
Oregano	*	*	*	*	n.a	n.a	n.a	n.a
Lemon	***	***	***	***	***	***	***	***
Grapefruit	***	***	***	***	***	***	***	***

*Very strong inhibition activity, ** Moderate inhibition activity, *** No inhibition.



Some images of the culture plates used to test PP and PLA-thyme active films, showing different inhibition degrees, given as an example

Antioxidant activity

	PP		PLA	
	Antioxidant capacity (%)		Antioxidant capacity (%)	
EOs	Simulant A	Simulant B	Simulant A	Simulant B
Thyme	59a	52a	41b	39a
Oregano	61a	52a	n.a.	n.a.
Lemon	39b	44b	31b	39a
Grape fruit	42b	42b	48a	37a

All the samples exhibited inhibition towards the DPPH free radical. Among PP active films, PP+EO thyme and PP+EO oregano showed the highest antioxidant capacity in both simulants, with values always greater than 50% of inhibition. For PLA active films, PLA+EO grapefruit showed the higher antioxidant activity for simulant A, equal to 48%; no differences were found among all the samples in simulant B.

Conclusions

- Only those films based on PP containing oregano and thyme EOs were effective against every microorganism tested. The rest of the references based on PP and those based on PLA, did not show antimicrobial activity against the reference tested microorganisms
- Both PP and PLA active film with EO showed good antioxidant properties against DPPH. Further analysis will be done to confirm results in vivo.

ACKNOWLEDGMENT

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REFERENCES

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