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Biodegradable Innovative Packaging: A Sustainable Solutions for Food Shelf Life Extension

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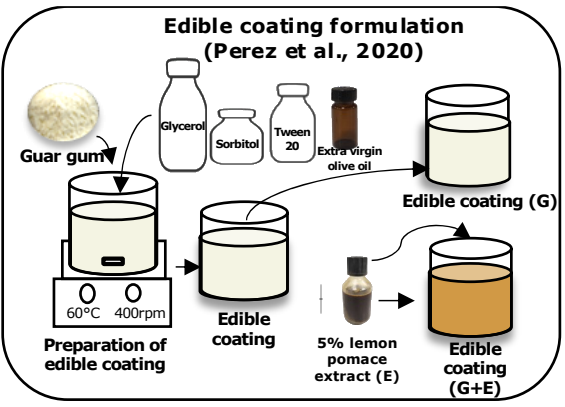
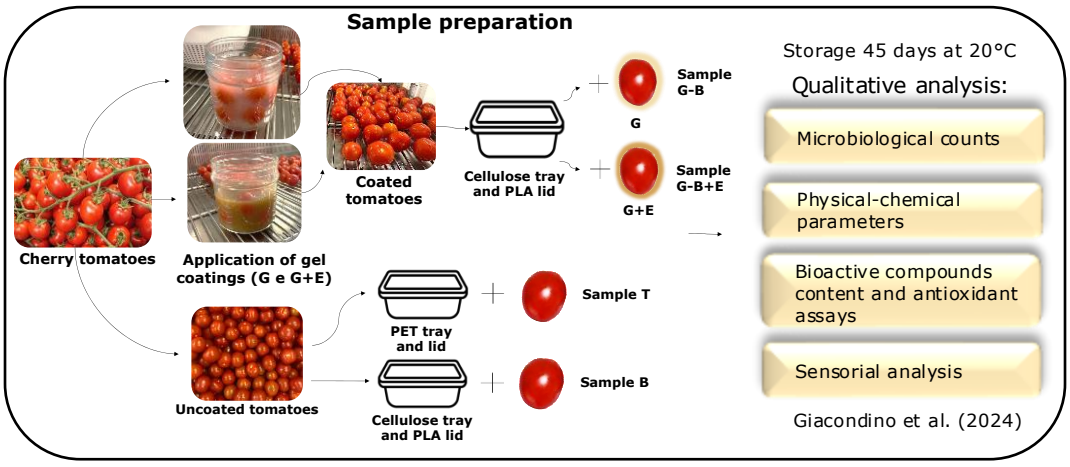
INTRODUCTION

Nowadays, food industry is looking for solutions that can combine maintaining product quality and extending shelf life. Tomato (*Solanum lycopersicum* L.) fruits are on the basis of the Mediterranean diet; their climacteric nature makes them susceptible to rapid spoliage. Among the potential methods to control the shelf life of cherry tomatoes, biodegradable packaging materials and edible gel coatings are an interesting sustainable option to replace conventional plastic polymers, which are widely used for packaging fresh produce. Furthermore, bioactive compounds could be added to coatings through extraction from agri-food by-products as a sustainable way to improve and reduce food waste and limit environmental impact. This approach could contribute to extending the shelf life of the fruit and enhance the use of a by-product extract with a green approach (Naeem et al., 2018).

MATERIALS AND METHODS





RESULTS

Table 1 Antioxidant characterization of lemon pomace extract.

E	TPC (mg GAE mL^{-1})	7.73± 0.09
	TFC (mg CE mL^{-1})	3.19 ± 0.0
	ABTS (mmol TE L^{-1})	13.19± 5.02
	DPPH (mmol TE L^{-1})	3.24± 0.16
	Eriocitrin (mg L^{-1})	879.35±18.98
	Esperidin (mg L^{-1})	332.56±21.00

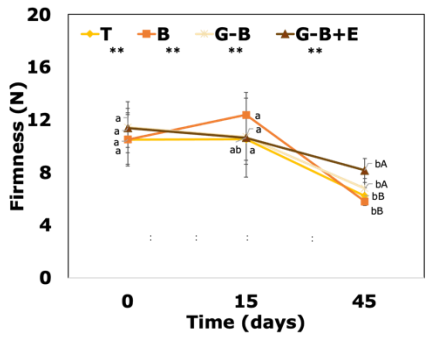


Figure 3 Changes in cherry tomatoes firmness during storage.*

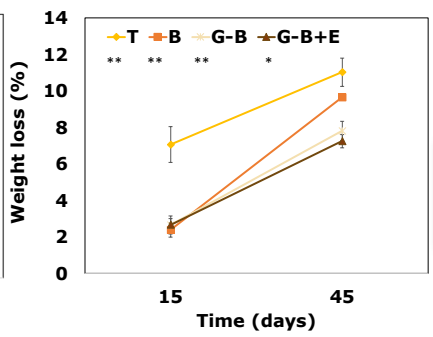


Figure 4 Changes in cherry tomatoes weight loss during storage

Total microbial count (Log CFU g^{-1}):
- G-B and G-B + E (around 2.8)
- B and T (3.0–3.25).

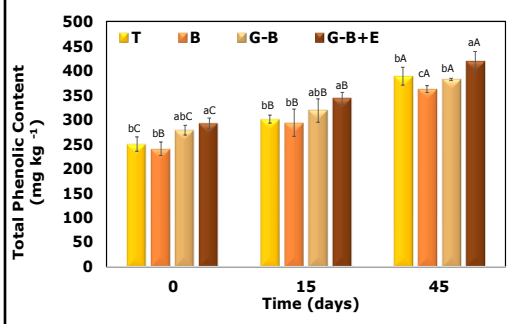


Figure 1 Total Phenolic Content of cherry tomatoes during storage.*

- G-B+E showed a significant increase in phenol content.

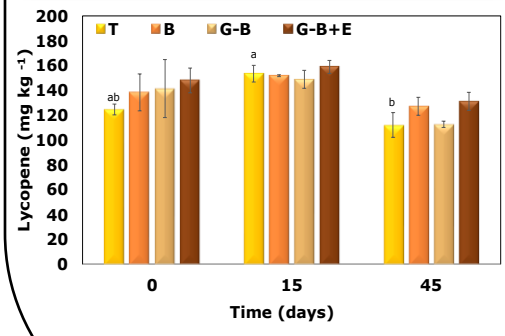


Figure 2 Lycopene content of cherry tomatoes during storage.*

- Coated tomatoes showed less changes in firmness and weight loss.

Table 2 Antioxidant activity and organic acid content of cherry tomatoes during storage*

Time (days)	T	B	G-B	G-B+E	Sign.
		ABTS (μmol TE 100 g^{-1} *FW*)			
0	139.93±7.98^{bAB}	136.82±7.83^{bB}	148.43±9.35^{bB}	189.35±5.41^{aA}	**
15	126.02±9.06^{bB}	117.52±0.42^{bC}	149.65±6.43^{bB}	160.01±2.29^{aB}	**
45	157.82±2.89^{bA}	193.59±2.75^{aA}	200.98±0.38^{aA}	198.99±3.84^{aA}	**
Sign.	*	**	**	**	
		DPPH (μmol TE 100 g^{-1} *FW*)			
0	53.50±4.28^{A}	52.3±3.97	53.99±3.98	56.73±1.78	ns
15	49.24±0.66^{AB}	44.9±5.00	49.71±5.43	54.92±2.97	ns
45	41.68±2.37^{bB}	53.18±2.2^{a}	58.20±3.27^{a}	54.27±1.00^{a}	**
Sign.	*	ns	ns	ns	
		Citric Acid (mg 100 g^{-1} *FW*)			
0	419.57±14.58^{A}	398.06±14.58^{A}	432.21±15.63^{A}	420.83±8.03^{A}	ns
15	397.58±7.50^{A}	355.87±1.18^{B}	382.66±0.35^{B}	371.39±1.58^{B}	ns
45	75.33±3.48^{cB}	100.36±3.06^{abC}	114.24±7.04^{aC}	98.73±1.68^{bC}	**
Sign.	**	**	**	**	
		Ascorbic acid (mg 100 g^{-1} *FW*)			
0	20.45±0.43	20.63±0.33^{A}	19.32±0.48	19.14±0.22^{A}	ns
15	18.70±1.05	18.00±0.07^{B}	18.13±3.41	17.13±0.27^{B}	ns
45	19.53±0.00^{a}	17.60±0.41^{abB}	20.51±3.56^{a}	10.51±0.11^{bC}	*
Sign.	ns	*	ns	**	

- At time 0, the antioxidant assay and the total polyphenol content present r = 0.883 while at time 45 r= 0.908 for lycopene and r=0.933 for citric acid content.

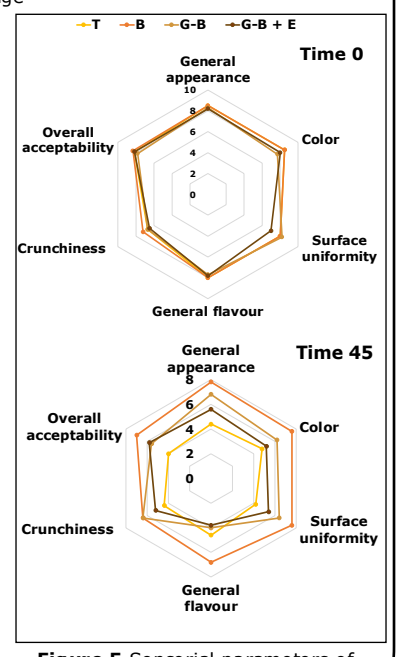


Figure 5 Sensorial parameters of cherry tomatoes.

- Samples T packed in PET showed a sensory unacceptability (<4.5) after 45 days.

*Small and capital letters show significant differences as assessed by Tukey's post hoc test.

CONCLUSION

Both the tested combinations of edible gel coating + bio-based packaging proved to be effective in maintaining the overall quality of cherry tomatoes for 45 days, offering a promising approach to reduce plastic polymer use. The lemon pomace extract resulted to be a valid bioactive additive for coated cherry tomatoes up to 45 days.

REFERENCES

Giacondino, C.; De Bruno, A.; Puntorieri, D.; Pizzimenti, M.; Piscopo, A. Impact of Antioxidant- Enriched Edible Gel Coatings and Bio-Based Packaging on Cherry Tomato Preservation. Gels 2024, 10, 549.

Naeem, A.; Abbas, T.; Ali, T.M.; Hasnain, A. Effect of antioxidant and antibacterial properties of guar gum coating containing spice extracts and its application on tomatoes (*Solanum lycopersicum* L.). Food Measure 2018, 12, 2725–2734.

Pérez, D.A.; Gómez, J.M.; Castellanos, D.A. Combined modified atmosphere packaging and guar gum edible coatings to preserve blackberry (*Rubus glaucus* Benth). FSTI 2020, 27, 353-365.

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