

Cássia H. Barbosa^{1,2}, Mariana A. Andrade^{1,3}, Fernanda Vilarinho¹, Ana Sanches Silva^{4,5,6}, Ana Luísa Fernando^{2*}

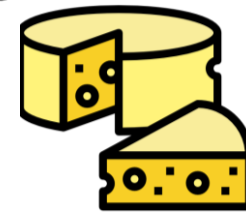
¹ Departamento de Alimentação e Nutrição, Instituto Nacional de Saúde Doutor Ricardo Jorge, Av. Padre Cruz, 1649-016 Lisboa, Portugal; ² METRICS, Departamento de Química, NOVA School of Science and Technology, Universidade NOVA de Lisboa, Campus de Caparica, 2829-516 Caparica, Portugal; ³ Universidade de Coimbra, Faculdade de Farmácia, Coimbra, Azinhaga de Santa Comba, 3000-548 Coimbra, Portugal; ⁴ REQUIMTE/LAQV, Rua D. Manuel II, Apartado 55142, Porto, Portugal; ⁵ Centro de Estudos de Ciências Animal (CECA), ICETA, Universidade do Porto, Porto, Portugal. ⁶ Associate Laboratory for Animal and Veterinary Sciences (AL4Animals), 1300-477 Lisboa, Portugal; *ala@fct.unl.pt



INTRODUCTION

Cheese Preservation

- Biodegradable films are increasingly applied for cheese preservation.
- Can reduce moisture loss, lipid oxidation, and microbial contamination.
- Whey protein-based films are biodegradable, transparent, and good carriers for bioactive compounds.



Cynara cardunculus L. (Cardoon)

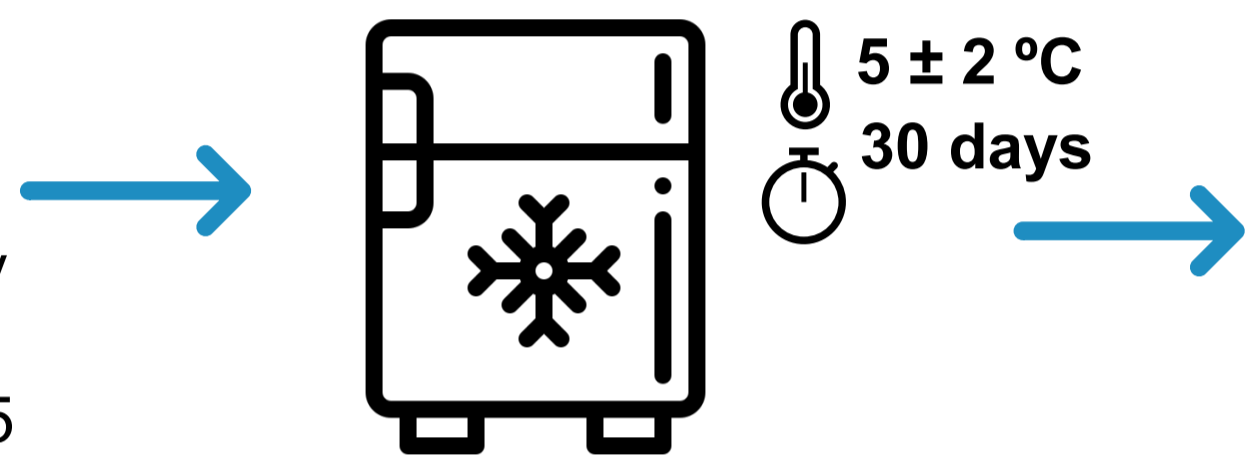
- Native to the Mediterranean region
- Is a multipurpose crop (e.g. food ingredient and biomass)
- Its flowers are used as milk clotting in the production of some cheeses
- Leaves are the main by-product and is rich in polyphenols with antioxidant and antimicrobial potential.



Aim: evaluation of the potential of whey protein-based films incorporated with cardoon leaf extract (0.5, 1.0, and 2.0 % w/v) to extend the shelf life of cheese to understand if it can be a substitute to natamycin.

MATERIALS & METHODS

Cheese wrapped with the whey protein-based film incorporated with cardoon leaves extract (0.5 %, 1.0% and 2.0%)



Microbial Contamination:

- Total viable counts
- Mould and yeast
- *Enterobacteriaceae*

Physicochemical Properties:

- Moisture Content
- pH and titratable acidity*
- Lipid oxidation – Thiobarbituric Acid Reactive Substance (TBARS)*

*Assessed only in the interior/paste of the cheese.

RESULTS & DISCUSSION

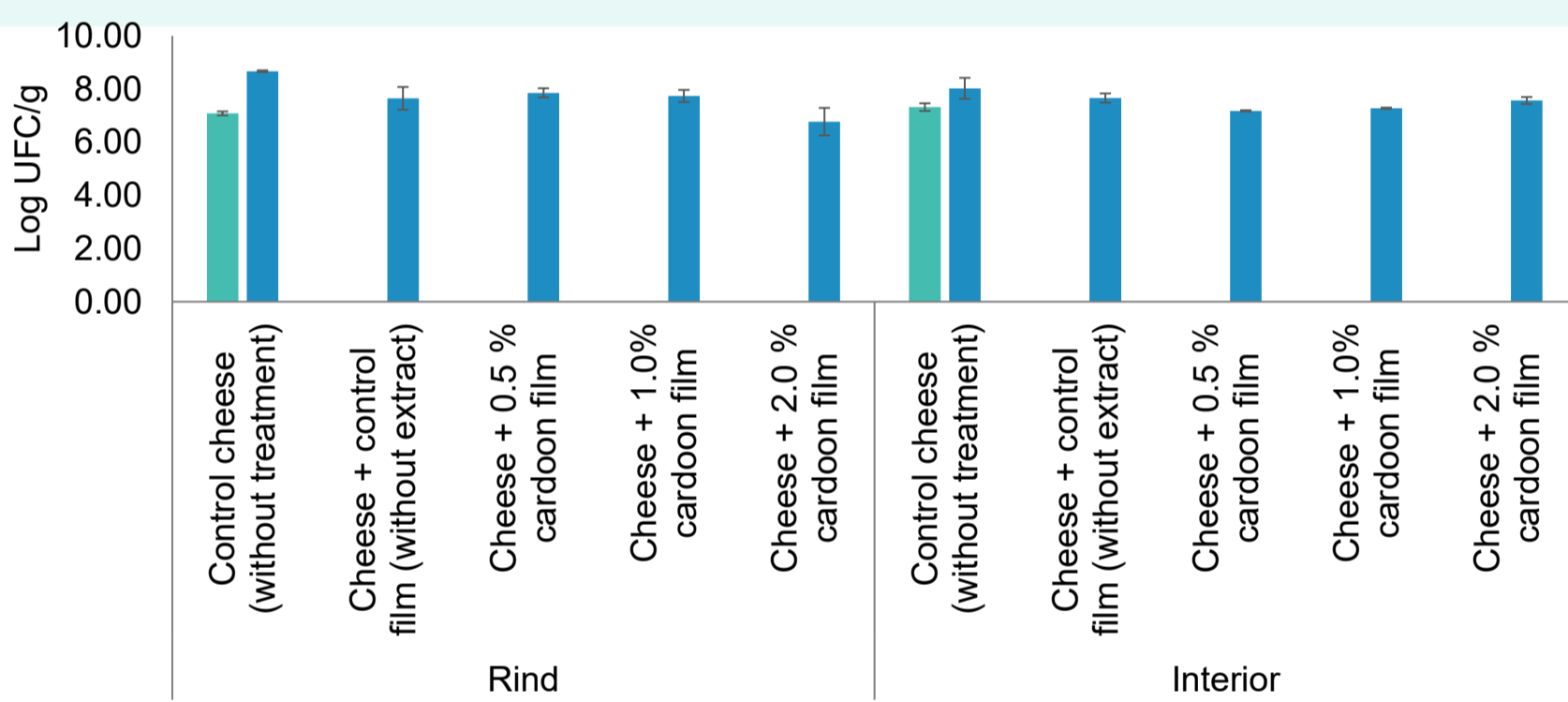


Figure 1 – Growth of total viable counts in cheese rind and interior/paste after 30 days of storage.

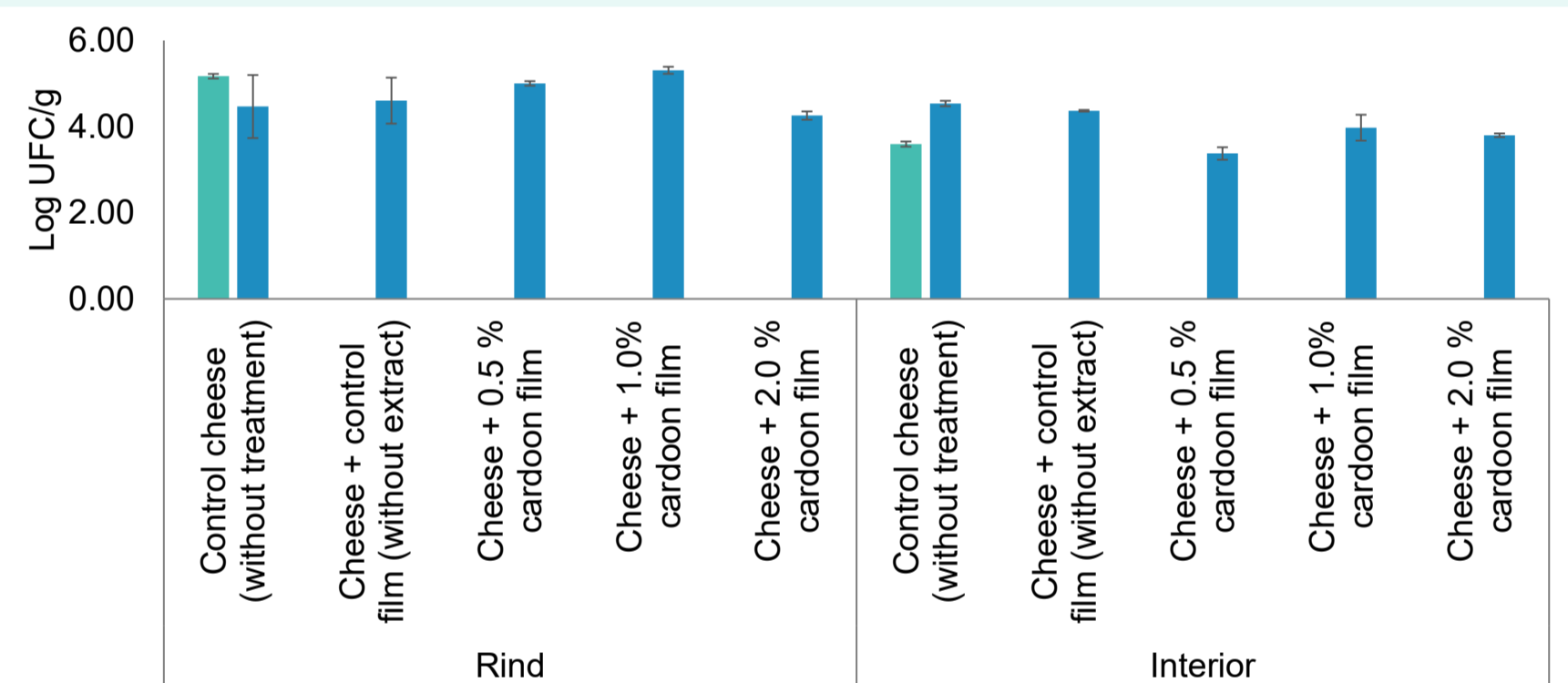


Figure 2 – Growth of *Enterobacteriaceae* in cheese rind and interior/paste after 30 days of storage.

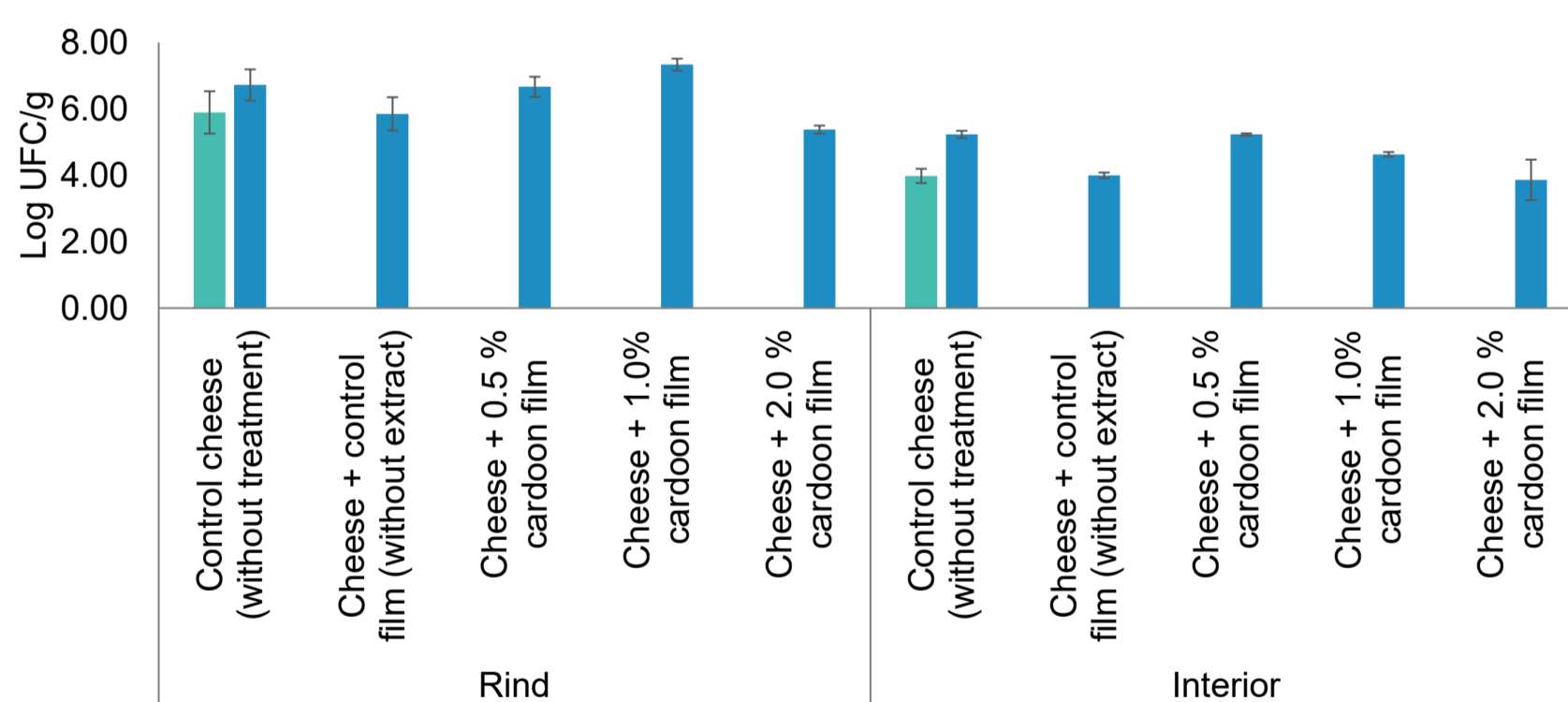


Figure 3 – Growth of moulds and yeast in cheese rind and interior/paste after 30 days of storage.

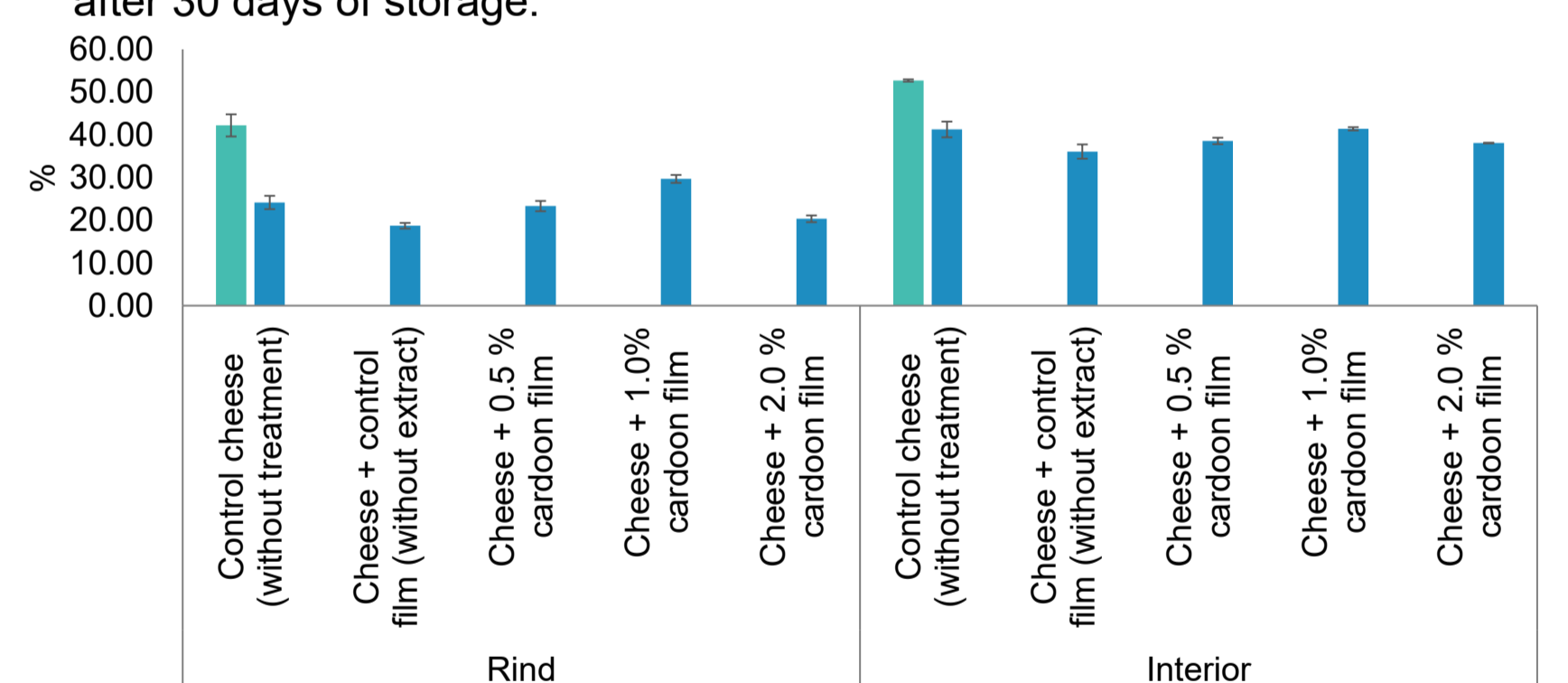


Figure 4 – Moisture content in cheese rind and interior/paste after 30 days of storage.

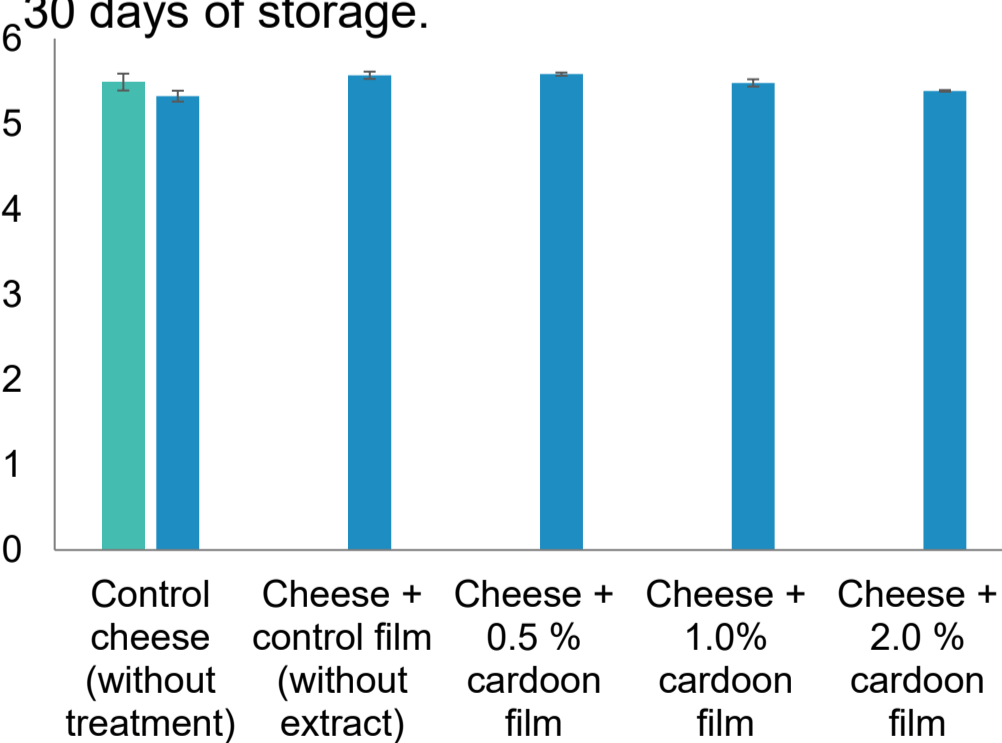


Figure 5 – pH in cheese interior/paste after 30 days of storage.

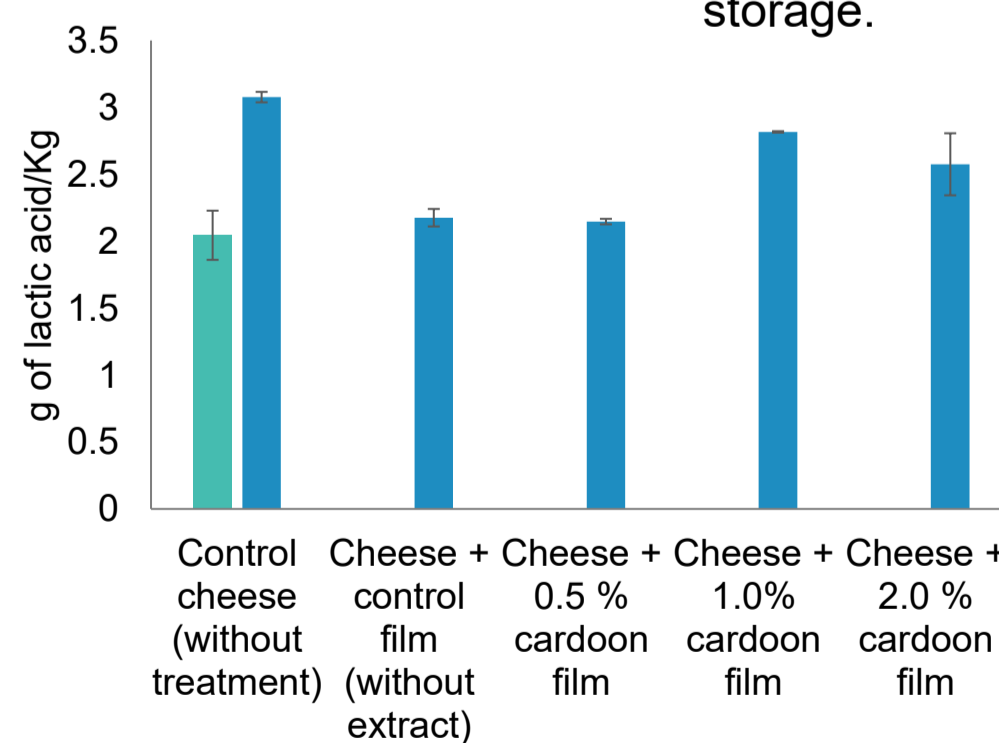


Figure 6 – Titratable acidity in cheese interior/paste after 30 days of storage.

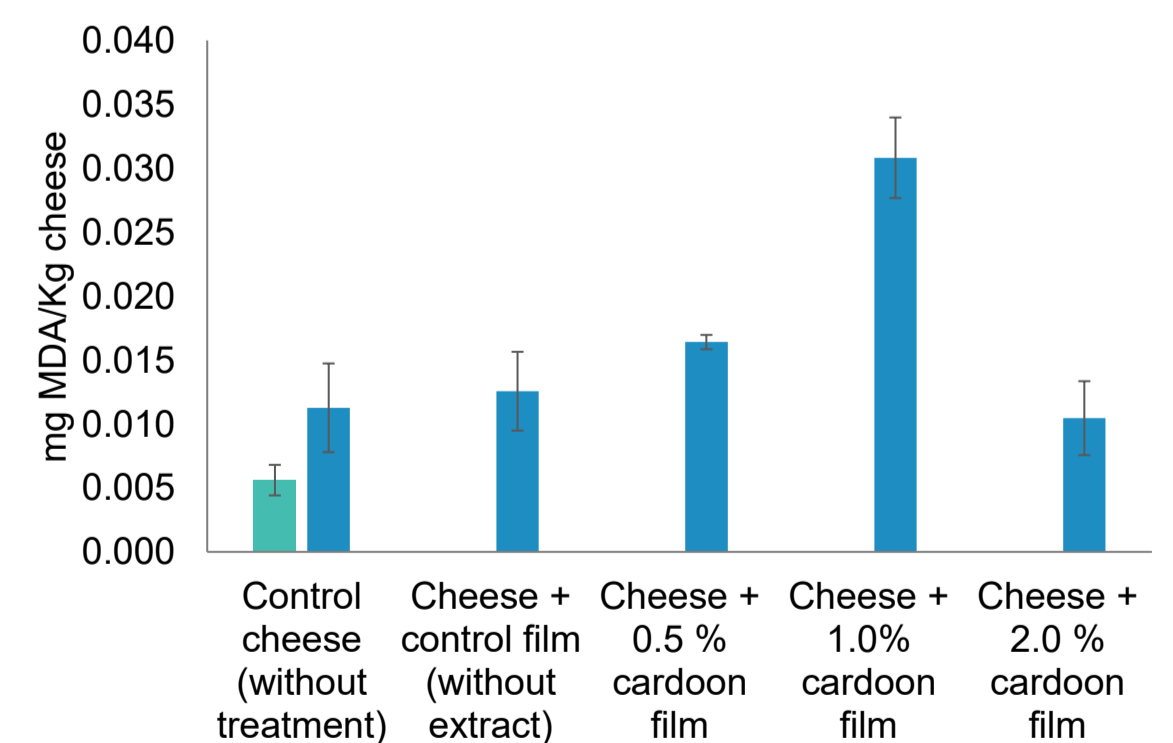


Figure 7 – Lipid oxidation in cheese interior/paste after 30 days of storage.

CONCLUSIONS

The film with 2.0% cardoon extract incorporated was the most effective film. It suppressed microbial growth, in both rind and interior of the cheese, as it presented lower counts of total viable counts, moulds and yeasts, and *Enterobacteriaceae* compared to the control film. TBARS increased for all samples, but values can be considered low as the cheese may not be oxidated yet since they did not exhibit rancid smell. The incorporation of cardoon-based extracts into whey protein films demonstrated antimicrobial and antioxidant properties, contributing to improved cheese preservation during refrigerated storage. This sustainable approach reduces reliance on synthetic preservatives while valorising agro-industrial by-products.

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