The influence of cultivated cardoon and globe artichoke ethanolic leaf extracts on the shelf life of poultry meat

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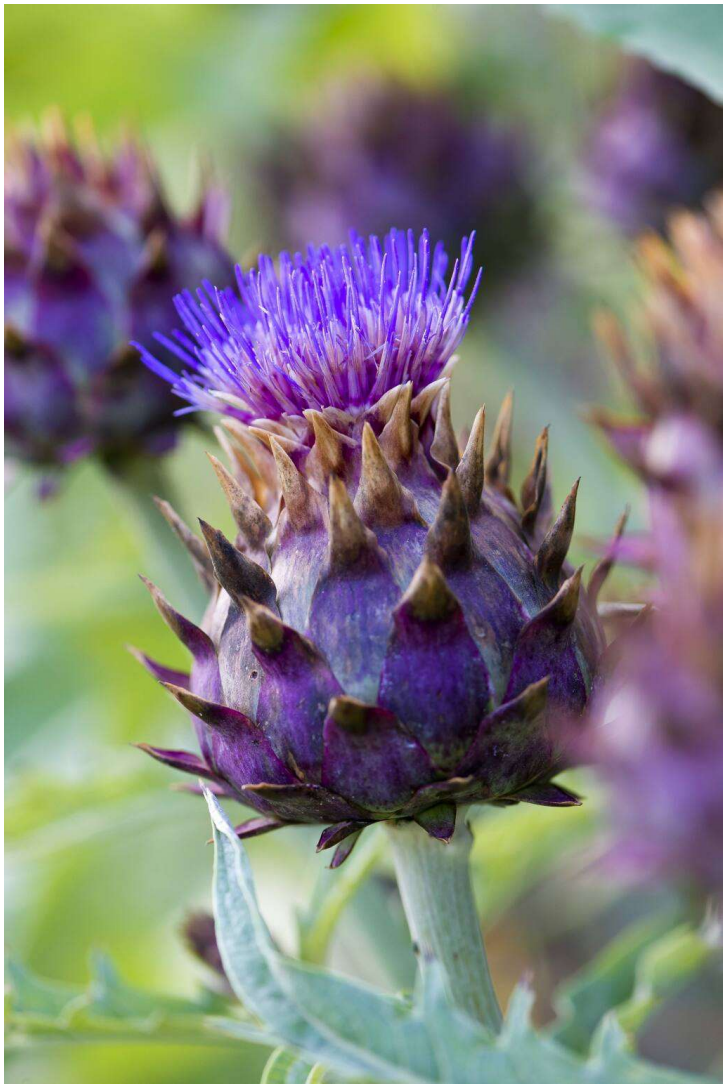


(Almeida & Simões, 2018; Barbosa et al., 2020; Conceição et al. 2018)

Introduction

Cynara cardunculus L. (Cardoon) – Asteraceae

- Cultivated cardoon (var. *altilis* DC.)
- Globe artichoke (var. *scolymus* (L.) Fiori)
- Wild cardoon (var. *sylvestris* (Lamk) Fiori)
- Herbaceous perennial plant
- Native to the Mediterranean region
- Can grow naturally in adverse climate conditions

Multipurpose crop:

Mediterranean cuisine → Fleshy stems and immature heads

Traditional medicine → High content in cynarin and silymarin

Biomass production → Solid Biofuel, Seed Oil, Biodiesel, and Paper Pulp

Introduction

Flower

- Cardoon flowers are rich in cardosin – Cardosins A and B
- Used as milk clotting in some cheeses produced in countries like Portugal, Spain and Italy
- In the EU, some are classified as Protected Designation of Origin (PDO) – quality and authenticity.
- E.g.: “Queijo Serra da Estrela”, “Queijo de Serpa”, “Queijo de Azeitão”

Leaves

- Main by-product – 60%
- Excellent source of bioactive compounds: chlorogenic acid and luteolin
- Antioxidant and antimicrobial properties
- Phytotoxic, cytotoxic, fungicidal activities

Introduction

Cardoon's leaves have excellent properties

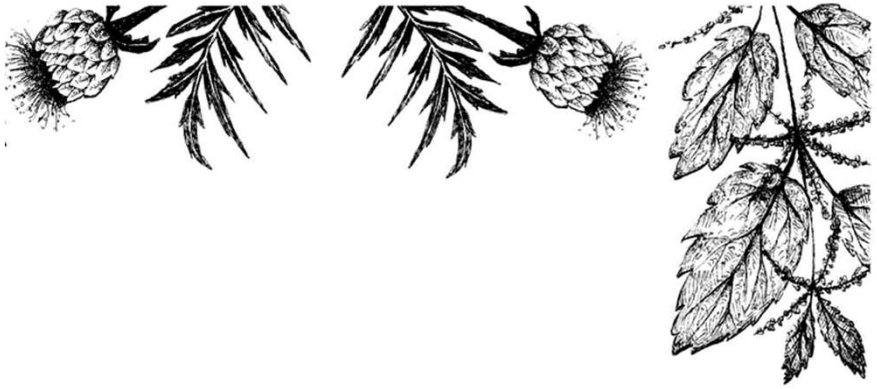
Explore their possibilities of use

Circular economy and sustainability of the planet

Potential to be exploited as a bio-refinery:

- Biomass
- Active compound in food packaging
- Natural food additives

Production of high value bio-based products.



Objectives

Evaluate the capability of cultivated cardoon leaves and globe artichoke leaves ethanolic extracts to preserve poultry meat stored under refrigeration for 15 days.

Materials and Methods

➢ **Preparation of the Samples**

Samples / Solvents

- Cultivated Cardoon (var. *altilis* DC.) leaves
- Globe Artichoke (var. *scolymus* (L.) Fiori) leaves
- Ethanol

1% (w/w) cultivated cardoon leave extract
1% (w/w) globe artichoke leave extract

+

Ground fresh poultry meat

Solid-Liquid Extraction

- Grind the sample
- Grounded sample mixed with solvent in a 1:10 ratio (w/v)
- Shake in the compact stirrer for 30 minutes
- Centrifuged for 15 minutes at 6000 rpm, at 10 °C
- Supernatant evaporated until dryness in a rotary evaporator at 35 °C

Stored under refrigeration (5 ± 2°C) for 4, 8, 11 and 15 days.

Materials and Methods

➢ **Physicochemical Characterization**

- Moisture
- pH
- Titratable acidity
- Colour
- Total volatile basic nitrogen (TVB-N)

➢ **Lipid Oxidation**

- Thiobarbituric Acid Reactive Substances (TBARS)

➢ **Microbiological Growth**

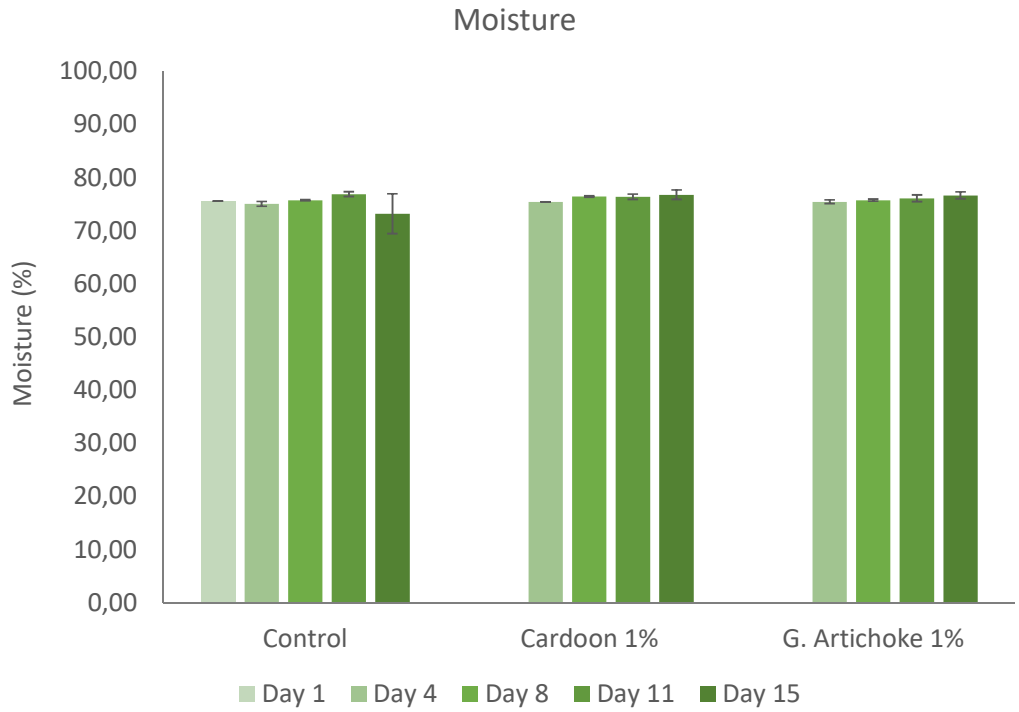
- Total mesophilic microorganisms
- Total psychrotrophic aerobic microorganisms
- Enterobacteriaceae

Results

- **Physicochemical Characterization**
- Moisture

  - Some food products shelf life is directly impacted by the water exchange between the food and the environment they are in.

✓ No significant differences were observed among samples or among days.

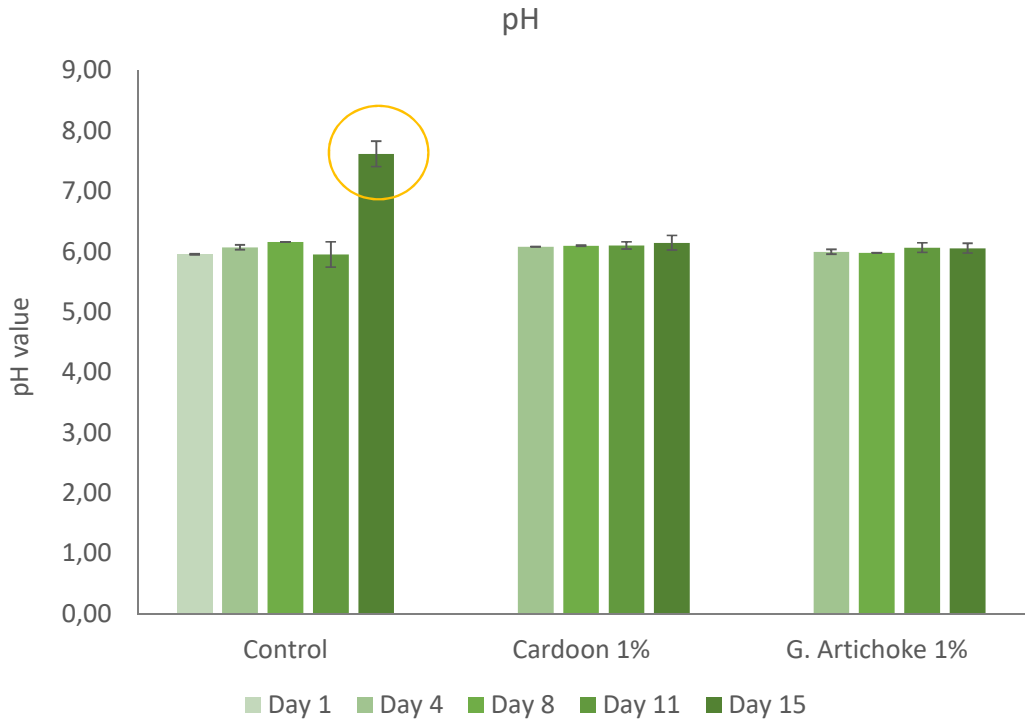


Results

➢ **Physicochemical Characterization**

➢ pH

- pH is an indicator of food stability.
- Food spoilage increases pH.
- The pH of the control sample increased throughout the storage days.
- In the case of samples with extract, there was a small tendency to increase throughout the storage days, but with no significant differences ($p < 0.05$).



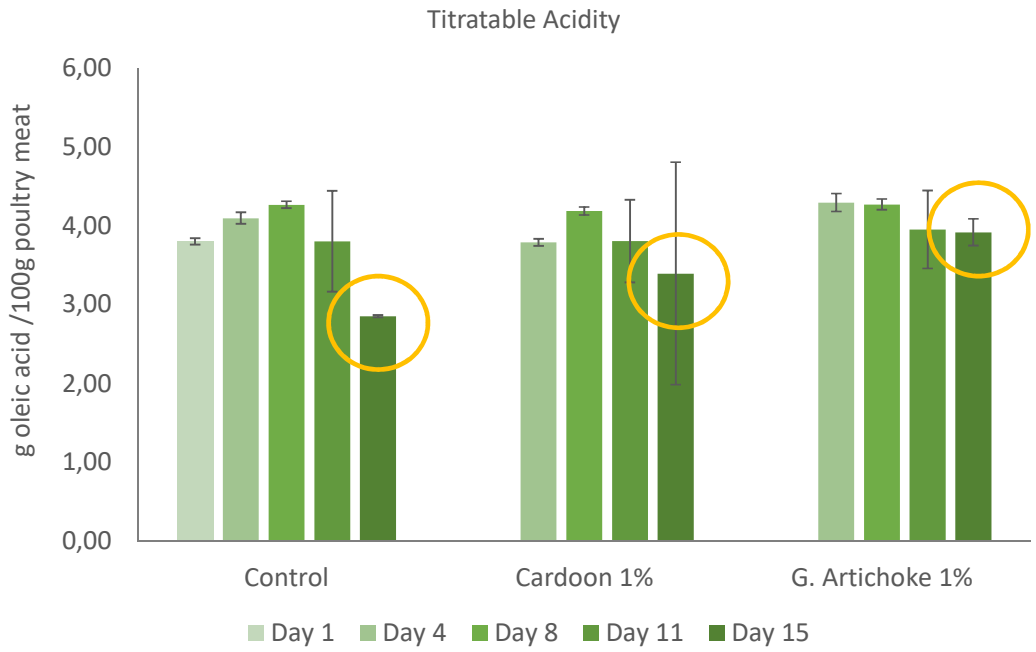
✓ Comparing the control sample with the extract samples, the most significant difference ($p < 0.05$) was observed on day 15.

✓ There are no significant differences among extract samples ($p < 0.05$).

Results

- **Physicochemical Characterization**
- Titratable Acidity

- Acidity is an indicator of food stability.
- Food spoilage reduces acidity values.

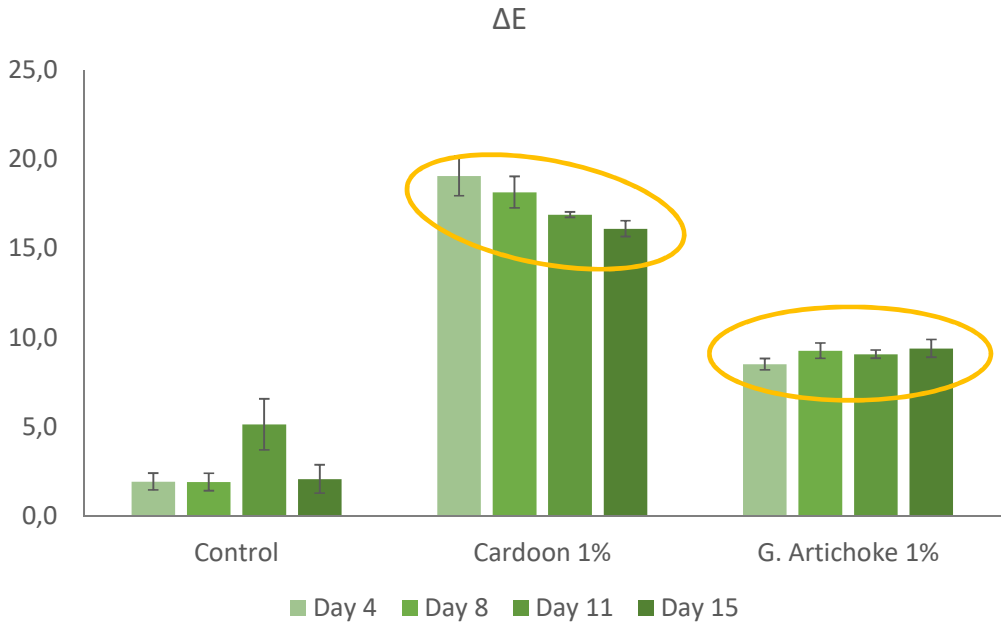


✓ After 15 days of storage, the control sample presented a lower acidity value compared to the samples with extract, which was consistent with the pH results.

Results

- **Physicochemical Characterization**
- Colour

- Colour is one of the main factors used to evaluate meat quality.
- During the storage period of the meat, its colour must remain unchanged



Colour difference $(\Delta E) = \sqrt{(L^*_C - L^*)^2 + (a^*_C - a^*)^2 + (b^*_C - b^*)^2}$

✓ After 15 days of storage, the colour change was smaller in the presence of Globe Artichoke 1% extract.

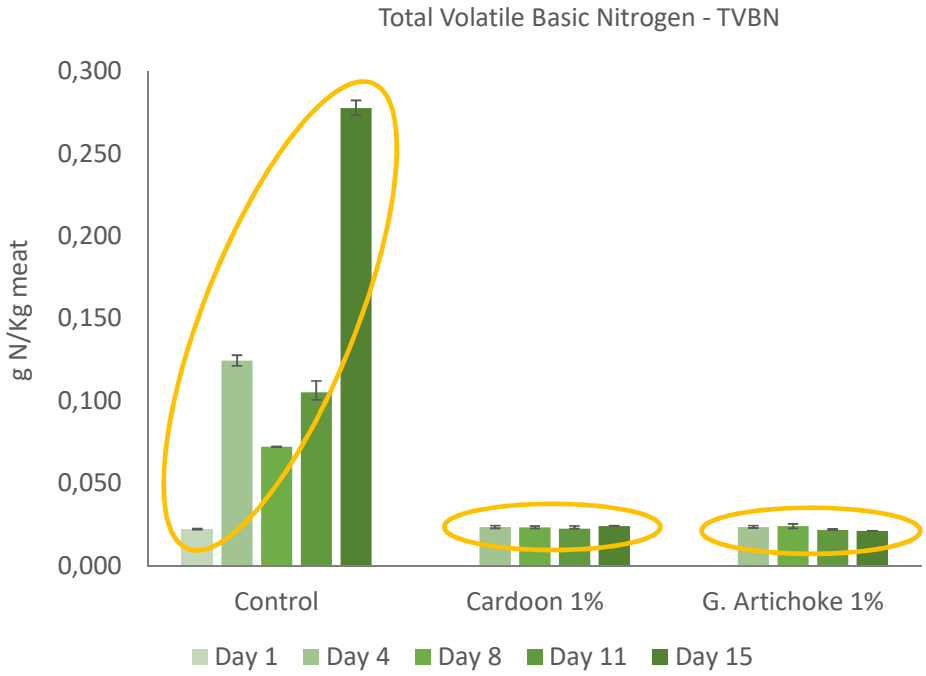
Results

➢ **Physicochemical Characterization**

➢ Total volatile basic nitrogen (TVB-N)

- As a result of spoiling mechanisms, the degradation of proteins and other nitrogen containing substances leads to the formation of organic amines, also known as total volatile basic nitrogen (TVB-N).

- The chemicals TVB-N are toxic and are responsible for significant colour and flavour modifications in meat and meat products.

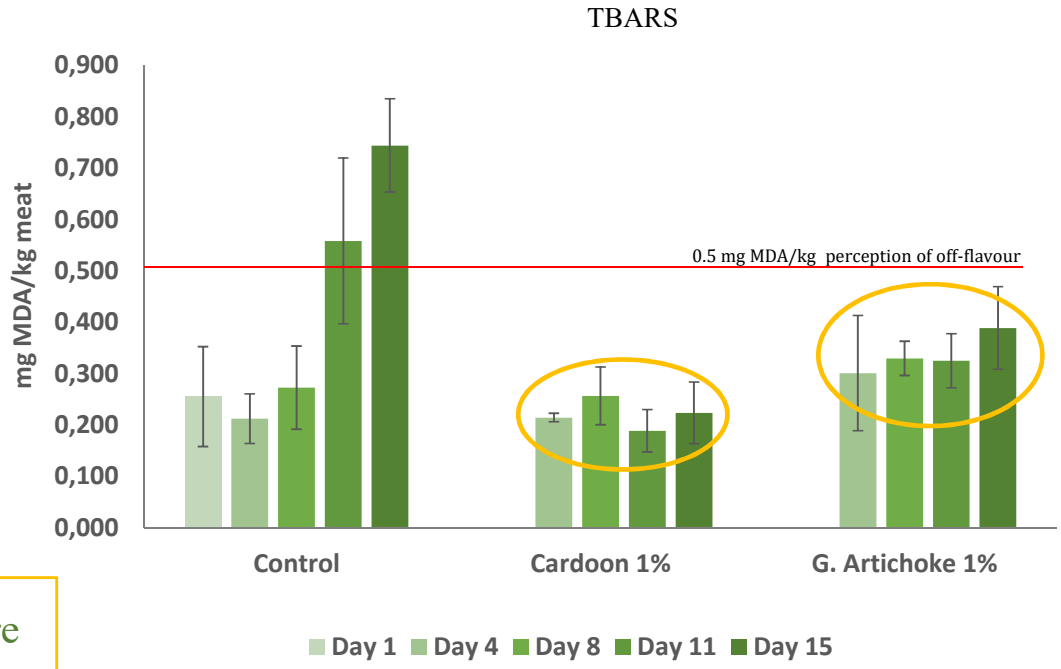


✓ The TVB-N significantly increased ($p < 0.05$) for the control sample during storage. This was not observed in the extract samples.

Results

- **Lipid Oxidation**
- Thiobarbituric acid reactive substances (TBARS)

- Lipid oxidation states as one of the primary causes of food spoilage. It is a natural occurrence that causes off flavours, loss of nutritional value, texture, and colour changes, leading to a decreased shelf life and consumer rejection of these foods



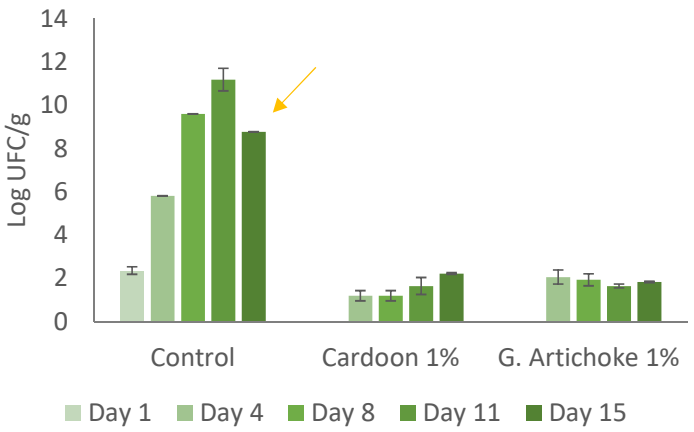
✓ Cultivated Cardoon and Globe Artichoke leaf extracts were effective in delaying the lipid oxidation of poultry meat.

✓ Cultivated Cardoon leave extract showed greater antioxidant activity than the Globe Artichoke leave extract

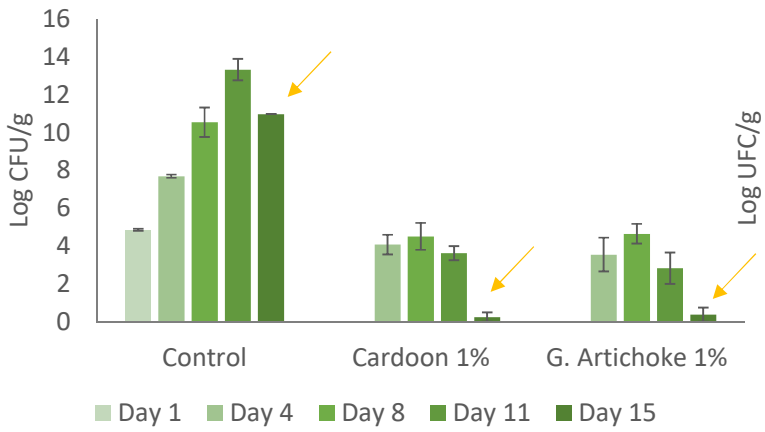
Results

➢ Microbiological Growth

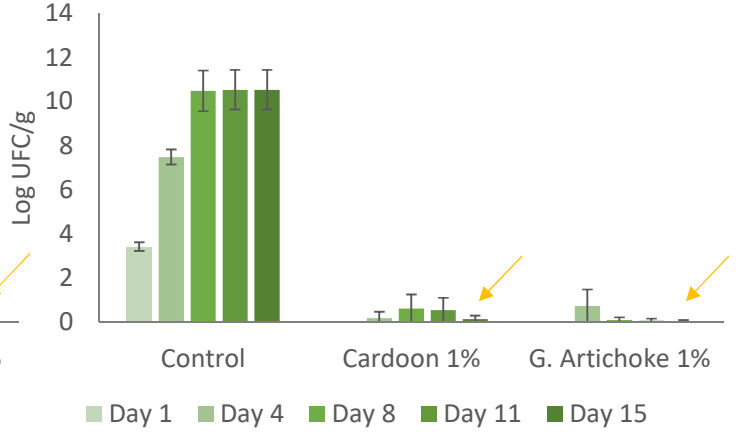
Enterobacteriaceae



Total Mesophilic Aerobic microorganisms



Total Psychrotrophic Aerobic microorganisms



- The control sample presented microbial growth due to the poultry's natural degradation.

↙ - On the 15th day the count was decreasing, indicating that the microorganisms had nothing left to degrade and began to die.

✓ Cultivated Cardoon 1% and Globe Artichoke 1% leaf extracts efficiently inhibited microbial growth.

Conclusions

- *Cynara cardunculus L.* leaf extracts (cultivated cardoon and globe artichoke) were shown to be an antioxidant and antibacterial agent to increase the shelf life of poultry meat.

- The concentration of 1% of leaf extracts was applied and efficiently maintained the quality and stability of the poultry meat during the 15-day refrigerated period compared to the control.

- Both extracts (cultivated cardoon 1% and globe artichoke 1%) were effective in maintaining constant pH, level of acidity and moisture content.

- The addition of *C. cardunculus* to poultry meat significantly reduced microbial growth compared to control samples, minimizing the release of volatile basic nitrogen at the end of the assay (day 15).

Conclusions

- During storage time, the samples with extract successfully reduced the lipid oxidation of poultry meat (compared to the control samples).

- The colour of extracts can be a limitation due to the greenish-yellow colour that is seen in the meat, although it was more evident in the sample with the cultivated cardoon extract.

Future Perspectives

- To assess the toxicity of these natural extracts to determine whether they may be used as food additives.
- To define the bioactive(s) compound(s) that should be used to standardize the cardoon extracts and their amount to guarantee the quality and effectiveness of these extracts.
- To apply cardoon extracts to other food matrices (e.g. fish products) in order to evaluate their ability to extend food shelf life.
- Determination of the antimicrobial and antifungal activity of the extracts against other microorganisms.
- Evaluation of the effect of the extract on food as food additive and as active compound in food packaging.

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References

- Almeida, C.M., Simões, I., 2018. Cardoon-based rennets for cheese production. Appl. Microbiol. Biotechnol. https://doi.org/10.1007/s00253-018-9032-3
- Andrade, M.A., Ribeiro-Santos, R., Costa Bonito, M.C., Saraiva, M., Sanches-Silva, A., 2018. Characterization of rosemary and thyme extracts for incorporation into a whey protein based film. LWT 92, 497–508. https://doi.org/10.1016/j.lwt.2018.02.041
- Barbosa, C.H., Andrade, M.A., Vilarinho, F., Castanheira, I., Fernando, A.L., Loizzo, M.R., Silva, A.S., 2020. A new insight on cardoon: Exploring new uses besides cheese making with a view to zero waste. Foods 9, 564. https://doi.org/10.3390/foods9050564
- Barbosa, C.H.; Andrade, M.A.; Vilarinho, F.; Fernando, A.L.; Silva, A.S. Active Edible Packaging. Encyclopedia 2021, 1, 360–370. https://doi.org/10.3390/encyclopedia1020030
- Conceição, C., Martins, P., Alvarenga, N., Dias, J., Lamy, E., Garrido, L., Gomes, S., Freitas, S., Belo, A., Brás, T., Paulino, A., Duarte, M.F., 2018. Cynara cardunculus: Use in Cheesemaking and Pharmaceutical Applications, in: Technological Approaches for Novel Applications in Dairy Processing. InTech. https://doi.org/10.5772/intechopen.76530
- Erkan, N., Ayranci, G., Ayranci, E., 2008. Antioxidant activities of rosemary (Rosmarinus Officinalis L.) extract, blackseed (Nigella sativa L.) essential oil, carnosic acid, rosmarinic acid and sesamol. Food Chem. 110, 76–82. https://doi.org/10.1016/j.foodchem.2008.01.058
- Yoo, K.M., Lee, C.H., Lee, H., Moon, B., Lee, C.Y., 2008. Relative antioxidant and cytoprotective activities of common herbs. Food Chem. 106, 929–936. https://doi.org/10.1016/j.foodchem.2007.07.006


Thank you!