Shelf-life extension of squid and shrimp skewers through the application of vinegar solutions

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MICROBIOTEC 21 Webconference

CATÓLICA ESCOLA SUPERIOR DE BIOTECNOLOGIA PORTO

Introduction

Seafood is regarded as a great source of nutrients, indispensable to a healthy diet, ranging from proteins and fatty acids to vitamins and minerals (Wu et al., 2019). Due to this, there is increasing demand for new, fresh, pre-cooked and ready-to-eat seafood products (Møretrø et al., 2016).

The application of non-toxic, edible preservatives as a coating to extend shelf life and inhibit bacterial proliferation has been the focus of several recent studies (Rezaei & Shahbazi, 2018). In addition, these coatings have the potential to retard the spoilage of the product, retaining the hedonic characteristics of fish, like smell, texture, and flavor (Rezaei & Shahbazi, 2018).

This work was developed under the scope of the ValorMar project (https://valormar.pt) and focused on using natural compounds-based treatments to inhibit bacterial proliferation and spoilage, of squid and shrimp skewers, throughout five days of product storage under refrigeration conditions.

Methodology

Sample treatment

A vinegar solution (50% v/v) was tested, applied through both immersion and pulverization.

Immersion

- Complete submersion of the product in 550 ml of vinegar 50% (v/v) solution
- 5 minutes
- Sampling

Pulverization

- Use a conventional dispenser to spray the solution on the product.
- 3 to 4 sprays per face of the product.
- Sampling

Figure 1 – Vinegar solution application to the product by immersion and pulverization.

Sampling

Random portions of the product were selected (25 g) and homogenized in 225 g of sterile buffered peptone water (Biokar Diagnostics, Beauvais, France), according to standard microbiological methods. Each sample was analyzed in triplicate.

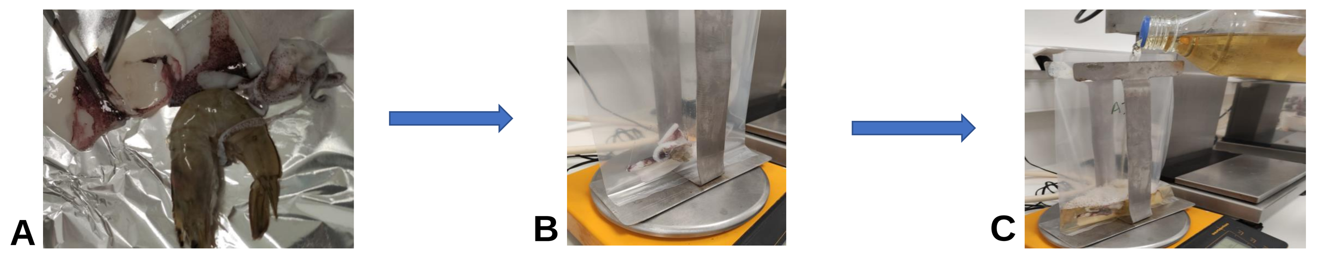

Figure 2 – Sampling technique. Selection of random portions of product (A), Weight 25 g of product (B), Suspension in Buffered Peptone Water (C)

The effects on bacterial loads were analyzed in comparison with untreated samples or treated with water, from the same batch, immediately after reception (day zero) and after two and five days of refrigerated storage. Enumeration of Total Viable Counts, *Enterobacteriaceae, Pseudomonas* spp. and lactic acid bacteria was performed at appropriate incubation conditions (according to ISO standards), but also at 11 ºC (since it is a refrigerated product).

Results and discussion

Microbial growth and inhibition

Bacterial inhibition was observed after treatment with vinegar for both immersion and pulverization techniques throughout the storage time, but significant differences ($p \leq 0.01$) were only detected for immersed samples after two days of storage. With the exception of lactic acid bacteria, this behaviour was observed for all the microbiological parameters at both temperatures tested.

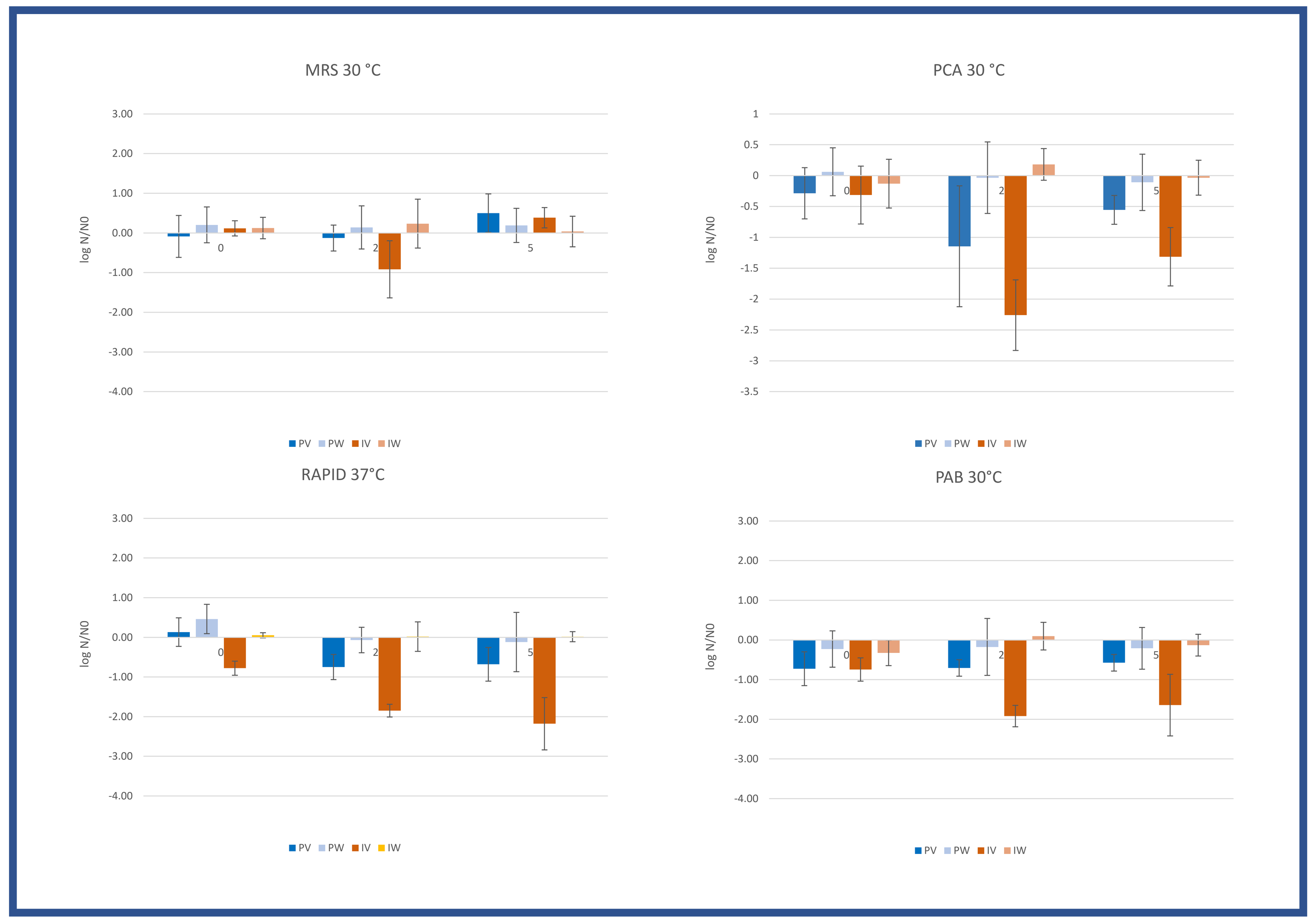

Figure 3 – Bacterial inhibition at incubation conditions according to each ISO standard for Pulverization with vinegar 50% v/v (PV); Pulverization with water (PW); Immersion in vinegar 50% v/v (IV); Immersion in water. (IW). N0 – Bacterial count in control samples. N – Bacterial growth at each sampling point.

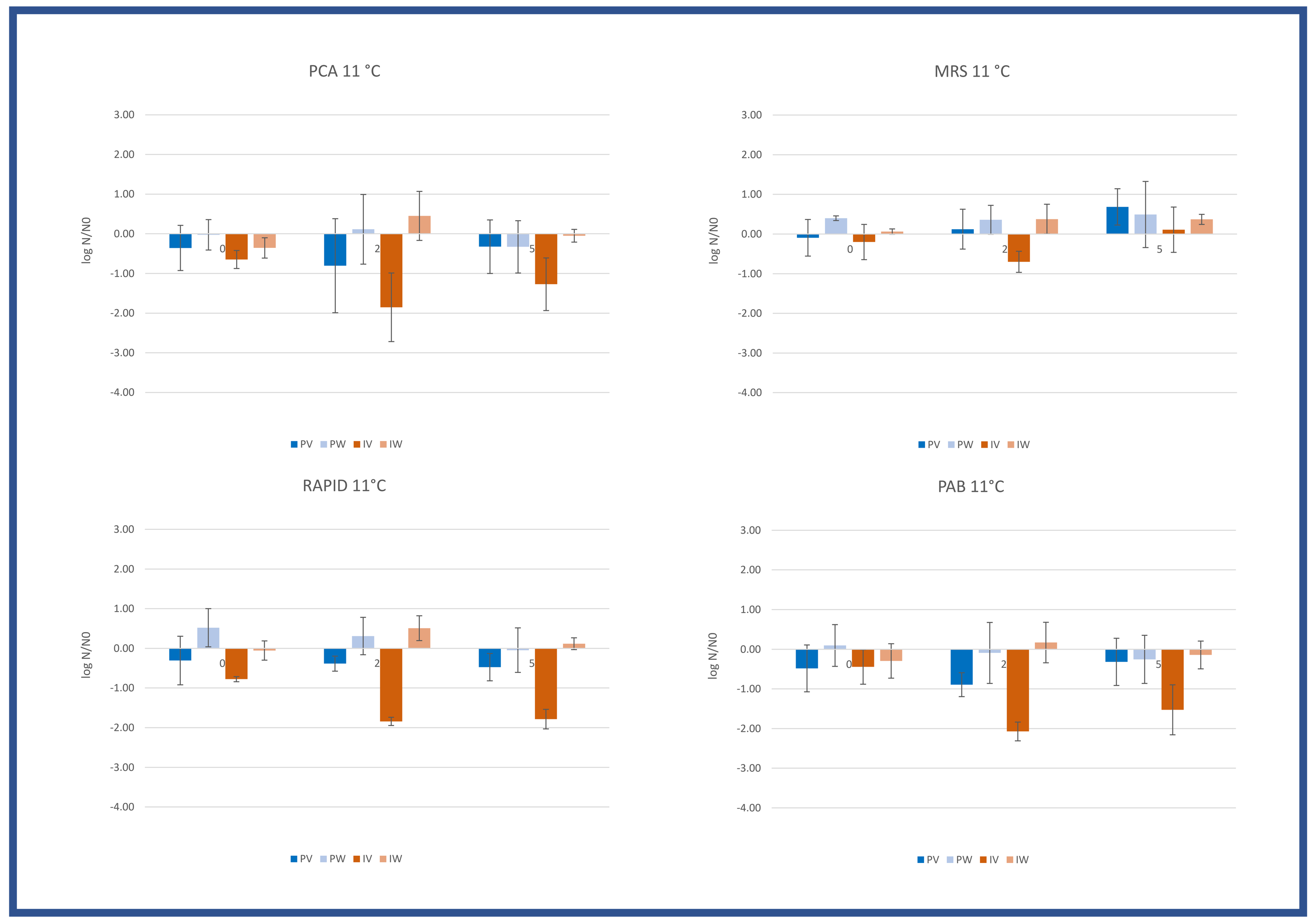

Figure 4 – Bacterial inhibition at 11 ºC for Pulverization with vinegar 50% v/v (PV); Pulverization with water (PW); Immersion in vinegar 50% v/v (IV); Immersion in water. (IW). N0 – Bacterial count in control samples. N – Bacterial growth at each sampling point.

Results and discussion

Sensorial Changes

Clear signs of spoilage were observed for control samples:

- Squid flesh developed a yellowish tonality, turned soft and sponge-like and had white slime in its surface. Shrimps darkened considerably and had black spots on their flesh. The intensity of color reduced significantly during storage, having the intensely purple external surface of squid turned to a mild gray.

Also, an extremely unpleasant odor was developed during storage, resulting in a completely undesirable product.

In vinegar treated samples, squid meat maintained its original colors. The intense purple coloration of squid exterior surface was maintained.

In addition, no changes in texture were detected, being observed resistance to cut and consistency in squid. No slime was observed.

No dark spots were observed in shrimp and maintenance of lively colors was achieved. Regarding odor, no vinegar scent was noticed, and product smell was similar to what was found in the first day of sampling.

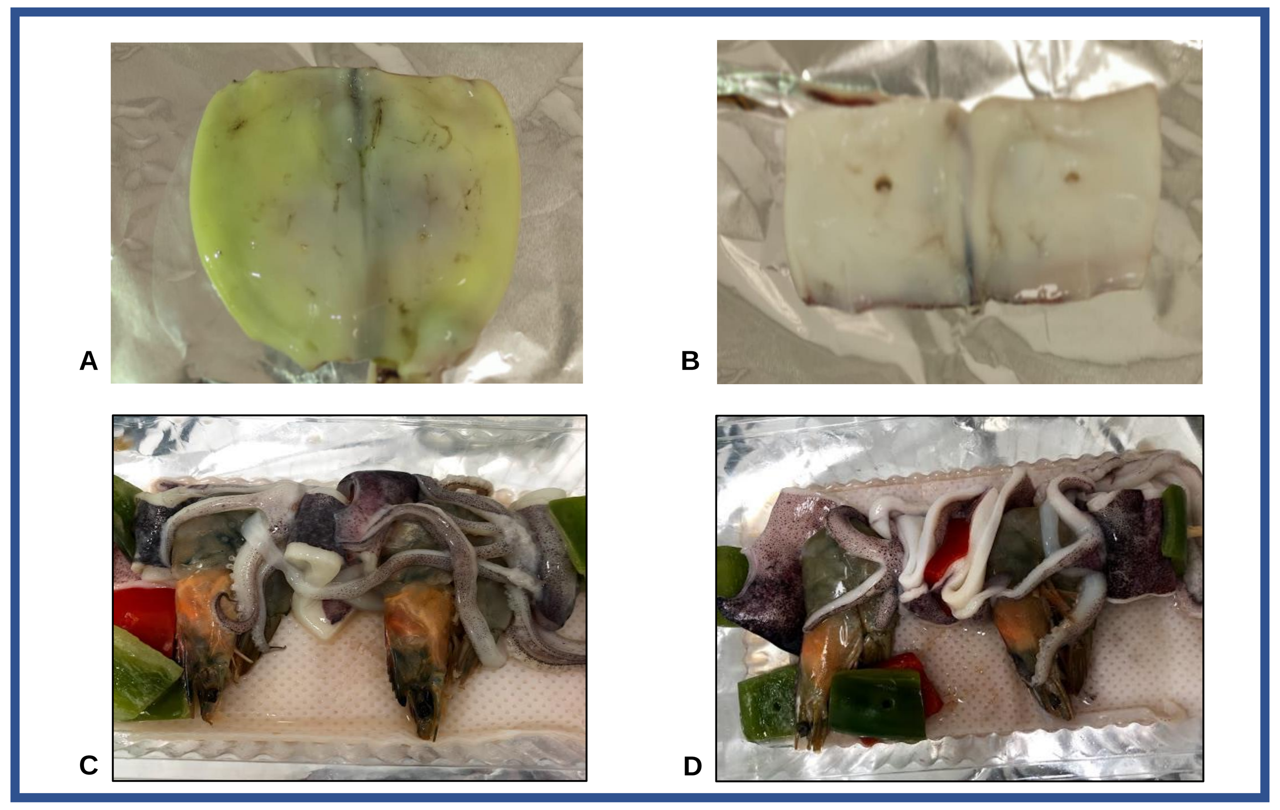

Figure 5 - Control sample after 5 days of storage (A, C), vinegar-immersed sample after 5 days (B, D)

Conclusion

The application of an edible vinegar-based solution to the product by immersion and pulverization resulted in growth inhibition, at both temperatures, of total viable microorganisms, *Pseudomonas* spp. and *Enterobacteriaceae*, but not of LAB, during two days of storage. Additionally, the deteriorative progress of the product was delayed, allowing the maintenance of good appearance, texture and smell after five days of storage. Although more experimental tests are required, this preliminary study demonstrated that vinegar solutions could be regarded as an all-natural approach to prevent bacterial growth in such perishable squid and shrimp skewers.

Acknowledgements

This work was carried out and funded within the project VALORMAR with reference 24517 (10/SI/2016 - I&DT Empresarial Programas Mobilizadores), supported by the European Regional Development Fund (ERDF) and by the European SocialFund (ESF). The authors thank the scientific collaboration under the *Fundação para a Ciência e Tecnologia* (FCT) project UIDB/50016/2020. Financial support for author J. Barbosa was provided by a post-doctoral fellowship SFRH/BDP/113303/2015 (FCT).

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