



## Addition of vinegar to extend the shelf-life of *cabeça de xara*

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### SUMMARY

*Cabeça de xara* is a ready-to-eat meat product (RTEMP), whose production is very characteristic in Alentejo, a region in the South of Portugal. It is a galantine usually moulded into parallelepiped shape made with various meats obtained from the Alentejano pig breed reared in the same region, namely deboned pork heads, tongue and connective tissue to which a number of condiments like salt, parsley, wine and pepper, are added. This work intended to test the feasibility of adding vinegar in order to increase the shelf-life of *cabeça de xara*, by reducing the contaminating microbiota responsible for spoilage, as well as controlling the pathogen *Listeria monocytogenes*. Three independent batches were produced and proximate composition, pH, water activity (aw), microbiological parameters and biogenic amines content evaluated. A sensory analysis was also performed throughout the storage period. No significant differences between control and vinegar samples was found regarding the proximate composition of *cabeça de xara*. As expected, pH is lower in the vinegar samples, however no differences in aw were observed between the two treatments. *L. monocytogenes* was present only in one batch in the control treatment from the first month on. However, it is inhibited by the addition of wine vinegar until the third month of storage, where *L. monocytogenes* is present but below the limit established in the 2073/2005 regulation. The presence of vinegar significantly decreased the content in biogenic amines, particularly cadaverine, putrescine and tyramine, throughout the storage period. Concerning sensory evaluation, no vinegar taste was reported by the panellists in a depreciating way.

### Adición de vinagre para prolongar la vida útil de la *cabeça de xara*

### RESUMEN

*Cabeça de xara* es un producto de carne listos para comer, cuya producción es muy característica en el Alentejo, una región de Portugal. Es una galantina que generalmente se moldea en forma de paralelepípedo. Se elabora con varias carnes obtenidas de la raza porcina Alentejana y criada en la misma región, cabezas de cerdo deshuesadas, lengua y tejido conectivo, a la que se le añade una serie de condimentos como sal, perejil, vino y pimienta. Este trabajo se pretende poner a prueba la viabilidad de añadir vinagre con el fin de aumentar la vida útil de la *cabeça de xara*, mediante la reducción de la microbiota contaminante responsables del deterioro, así como el control del patógeno *Listeria monocytogenes*. Tres lotes independientes fueron producidos y con composición proximal parecida, se evaluó pH, aw, parámetros microbiológicos y contenido de aminas biogénicas. El análisis sensorial se realizó también durante todo el período de almacenamiento. No se encontraron diferencias significativas entre las muestras control y vinagre en cuanto a la composición proximal de *cabeça de xara*. Como era de esperar, el pH fue menor en las muestras con vinagre, sin embargo se observaron diferencias en aw entre los dos tratamientos. *L. monocytogenes* estuvo presente desde el primer mes sólo en un lote, en el tratamiento control. Sin embargo, es inhibida por la adición de vinagre de vino hasta el tercer mes de almacenamiento, donde *L. monocytogenes* está presente pero por debajo del límite establecido en el Reglamento 2073/2005. La presencia de vinagre redujo significativamente el contenido de aminas biogénicas, en particular cadaverina, putrescina y tiramina, durante todo el período de almacenamiento. En cuanto a la evaluación sensorial, el sabor a vinagre fue evaluado por los panelistas de manera negativa.

### ADDITIONAL KEYWORDS

Ready-to-eat meat product (RTEMP).

Food safety.

*Listeria monocytogenes*.

Biogenic amines.

Sensory evaluation.

### PALABRAS CLAVE ADICIONALES

Listos para comer.

Seguridad alimentaria.

*Listeria monocytogenes*.

Aminas biogénicas.

Evaluación sensorial.

### INFORMATION

Cronología del artículo.

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### INTRODUCTION

*Cabeça de xara* is a ready-to-eat meat product (RTEMP) made of cooked pork meat by-products, mainly pork head, seasoned with several condiments. This type of product has a short shelf-life, usually between one and two months.

Vinegar is a natural antimicrobial ingredient, which has a known antimicrobial effect, dating back to ancient times for its preservative properties, as well as for its aroma. The fact that acetic acid is considered a *Generally Recognised As Safe* (GRAS) substance (Chang & Fang, 2007) has also contributed to the increasing interest in studies of its efficacy in reducing number of foodborne pathogens.

One of the most common applications of acetic acid in meat products is the prevention of the development of *Listeria monocytogenes*. This bacteria is resistant to the low pH values common in meat products, as well as to low temperatures (Xi et al., 2012).

The aim of the present work was to increase the shelf-life of *cabeça de xara*, by reducing the spoilage microbiota and controlling the food pathogen *Listeria monocytogenes*, using a natural antimicrobial agent.

## MATERIAL AND METHODS

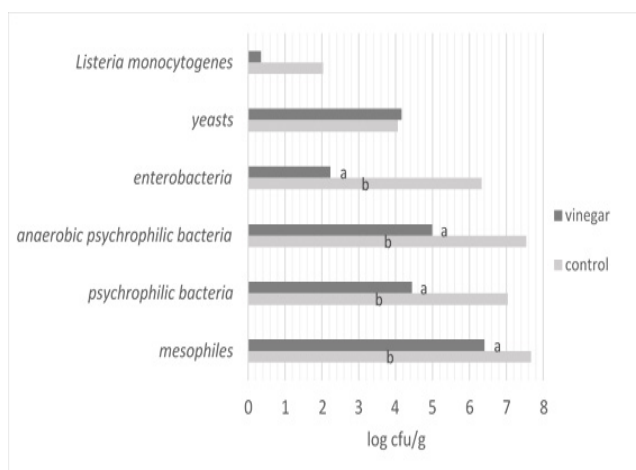
Two different treatments were compared, namely control and vinegar, during three months storage of *cabeça de xara*.

Vinegar treated *cabeça de xara* slices were submerged in a 50% aqueous white wine vinegar solution immediately before packing.

Three independent batches were produced. Two replicates per batch were analysed immediately after packing, and after one, two and three months storage. One-Way ANOVA was used for statistical analyses. Significant differences ( $P < 0.05$ ) were identified based on the Tukey Honest Significant Difference (HSD) test.

Microbiological analyses were performed according to the ISO standards as described before (Laranjo et al. 2015). pH was determined with a Crison 507 pH-meter (Barcelona, Spain) according to ISO 2917 (1999) and aw with a Hygroskop Rotronic DT (Zurich, Switzerland) equipped with a WA-40 probe at 25°C. Biogenic amines were analysed according to Roseiro et al. (2006). Sensory evaluation was done using a Quantitative Descriptive Analysis, as described by Laranjo et al. (2016).

## RESULTS



**Figure 1.** Microbiological counts after three months storage (Recuento microbiológico después de tres meses de almacenamiento).

The microbiota of *cabeça de xara* showed significant higher counts of mesophiles, psychrophiles, psychrophilic anaerobes, enterobacteria and *L. monocytogenes* in the control treatment (**Figure 1**). *L. monocytogenes* was inhibited by the addition of vinegar throughout storage (**Figure 1**). After three months storage *L. monocytogenes* counts are below the limit established in the EC 2073/2005 regulation (100 cfu g<sup>-1</sup>) for vinegar treated samples (EC, 2005).

The mean pH of the vinegar *cabeça de xara* (5.39) was much lower than the pH of the control treatment (5.93) ( $P < 0.05$ ). However, no significant differences between control (0.979) and vinegar (0.984) treatments regarding aw ( $P < 0.05$ ).

Significant differences were observed between treatments for most individual biogenic amines, with the exception of tryptamine,  $\beta$ -phenylethyamine, spermidine and spermine (**Figure 2**). Vinegar samples showed significantly lower contents in vasoactive amines throughout the storage period (**Figure 2**).

Panellists generally gave higher scores to the vinegar treated *cabeça de xara* (**Figure 3**). No significant differences were observed between control and vinegar *cabeça de xara* concerning, except for the attribute "off aromas" ( $P < 0.05$ ).

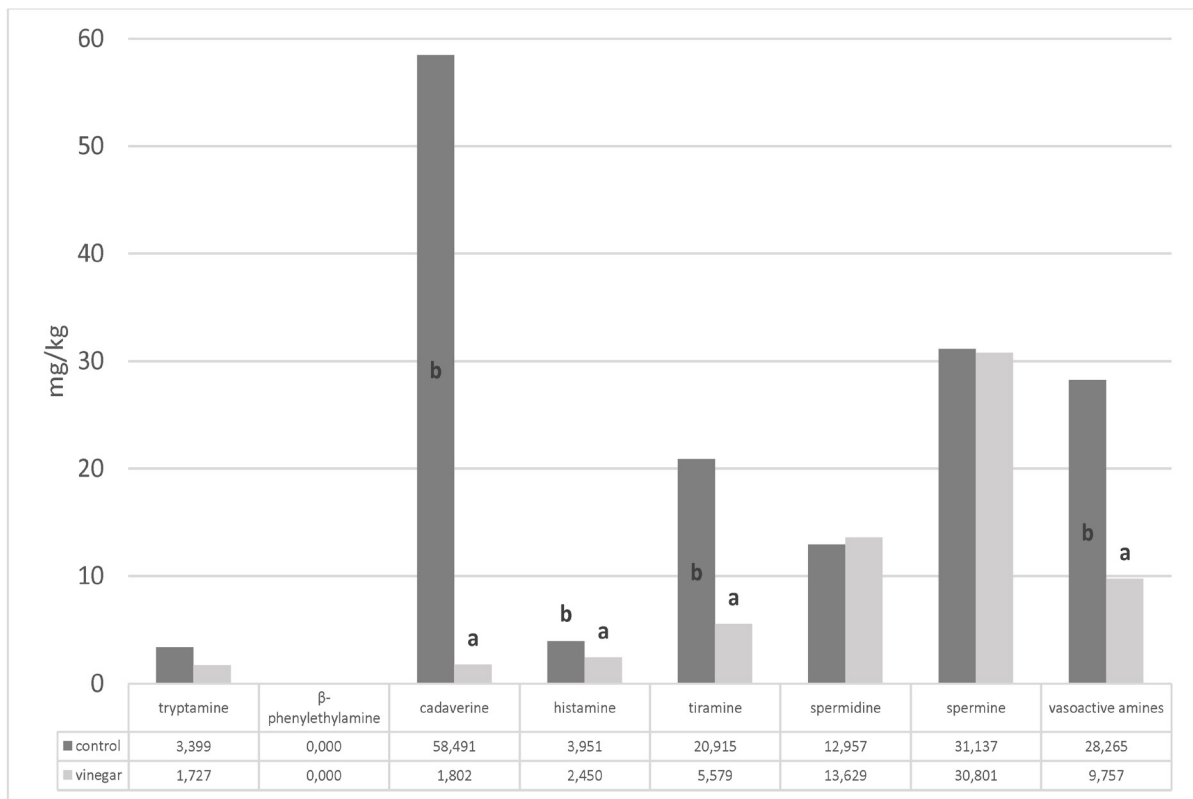
## DISCUSSION

Considering the results of the end product throughout its shelf-life, the vinegar treated *cabeça de xara* showed lower microbial counts, probably due to the lower pH values. Furthermore, vinegar inhibits the growth of microorganisms with decarboxylase activity and consequently, the presence of vinegar significantly decreased the content in biogenic amines, particularly cadaverine, putrescine and tyramine, throughout the storage period.

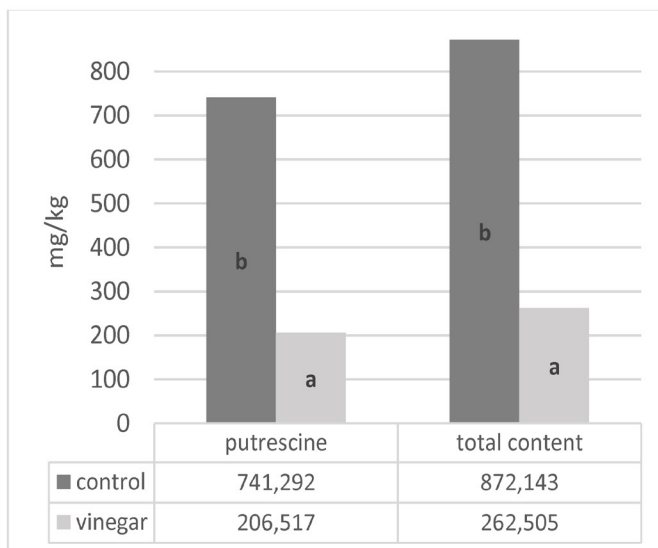
Regarding sensory evaluation, no vinegar taste was reported by the panellists in a depreciating way. Moreover, the products with vinegar are more succulent and more fibrous, since the acidity partially denatures muscle tissues, so that the more fibrous tissues (such as connective tissue) will be the only ones to remain unaltered. However, these products were valorised by the panellists, maybe because of the antimicrobial action of vinegar and its inhibiting action over tissue enzymes, which led to a lower production of secondary metabolites responsible for unpleasant aromas and flavours. On the other hand, the similar values given by the sensory panel to *cabeça de xara* with and without vinegar for the attribute "salt perception", indicate that panellists have a good training level.

To conclude, both safety and sensory characteristics of the product were improved with the vinegar treatment, thus enabling the shelf-life of *cabeça de xara* to be extended from two to three months with the use of vinegar.

A



B



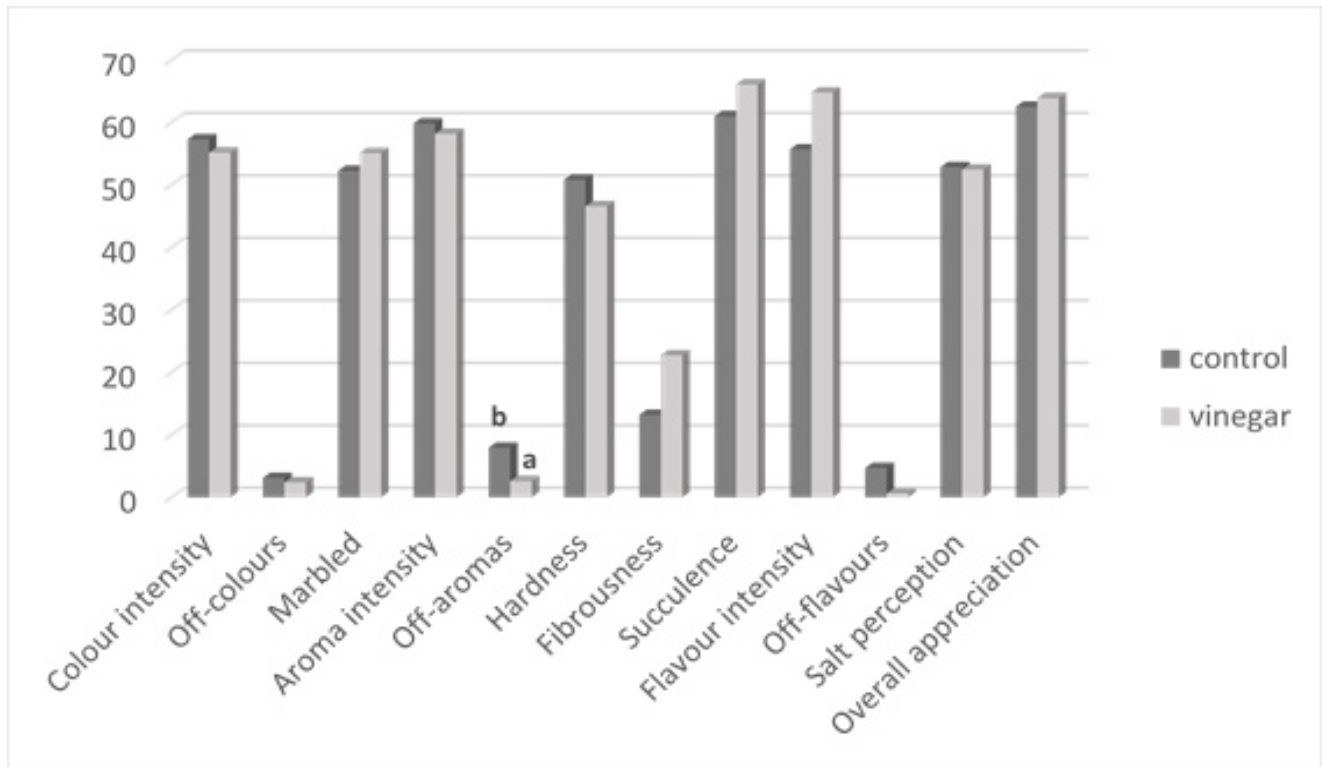
**Figure 2. Biogenic amines content after three months storage** (Contenido de aminas biogénicas después de tres meses de almacenamiento).

To our knowledge, this is the first report on the physicochemical, microbiological and sensory characteristics of a traditional meat-based product with these specific characteristics.

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**Figure 3.** Sensory analysis after two months storage (Análisis sensorial después de dos meses de almacenamiento). Data for sensory analysis after three months storage are not shown, because *L. monocytogenes* counts were above the limit for control samples. (Los datos de análisis sensorial después de tres meses de almacenamiento no se muestran, porque los recuentos de *L. monocytogenes* estaban ácima de los límites en las muestras control).

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