DIFFERENT ULTIMATE pH RANGES EFFECTS ON AGED BEEF VOLATILE ORGANIC COMPOUNDS

Cecylyana L. Cavalcante[1], Beatriz G. Lopes[2], Taciana V. Savian[2], Milagros M. C. Gonza[1], Carlos E. C. A. Freire[1], Carolina S. Moreira[1], Jair S. S. Pinto[1], and Carmen J. Contreras-Castillo[1*]

[1] Department of Agri-food, Food and Nutrition, University of São Paulo/ESALQ, Piracicaba, SP, Brazil

[2] Department of Exact Sciences, University of São Paulo/ESALQ, Piracicaba, SP, Brazil

*Corresponding author email: ccastill@usp.br

I.   INTRODUCTION

The pH of meat is an important quality parameter, as it causes changes in the biochemical processes that occur post-mortem [1], as well as altering various physicochemical and sensory characteristics. However, there is little information regarding the influence of ultimate pH (pHu) of meat on production of volatile organic compounds (VOCs). These compounds are associated with the aroma and flavour present in beef [2], being an important factor to be evaluated. Therefore, this study aimed to evaluate volatile organic compounds of Longissimus lumborum muscles from non-castrated male Nellore cattle (Bos indicus) with different pHu ranges, during refrigerated storage.

II.   MATERIALS AND METHODS

This study was carried out using a randomized design, with 9 treatments of three pHu ranges (high, intermediate, normal) in their respective beef aging times (3, 14 and 28 days). Muscles (Longissimus Lumborum) were used from non-castrated Nellore bulls (Bos indicus); aged between 36 to 42 months old and slaughtered in a commercial slaughterhouse. The pHu classifications were as follows: 5.40 – 5.79 (normal); 5.80 – 6.19 (intermediate) and > 6.20 (high). The muscles were portioned into 2.5 cm steaks, packaged and stored for a period of up to 28 days, under cooling to 2 ºC (±1 °C). To analyse volatile organic compounds (VOC), the steaks were grilled until reaching an internal temperature of 71 °C, weighed, crushed, and separated into glass vials. VOCs were extracted from the headspace using the solid phase microextraction technique (HS/SPME), with a 75 µm fibre of carboxen/polydimethylsiloxane (CAR/PDMS) (Supelco, Bellefonte, USA). For the adsorption of the compounds, the samples (5 g of meat and 1.25 g of anhydrous sodium sulphate) were kept in the vial in a water bath at 60 ºC (±1 °C), with the addition of 1 µL of 1,2-dichlorobenzene (13.06 µg/kg – internal standard), and the fibre was exposed for 45 min. After extraction, the VOCs were desorbed in the gas chromatograph injector coupled to the mass spectrometer (GC-MS Shimadzu QP2010 Plus, Japan) for analysis. Compounds were identified by comparing mass spectra with libraries Wiley 8 and FFNSC 1.3 and confirmed with the Linear Retention Index (LRI) of each VOC. An analysis of variance of the results was performed. The k-means clustering algorithm, which determines the distance between two points using Euclidean distance was used to group treatments according to the number of clusters and to detect similarities between them. Using within-cluster sum of squares (WSS), the optimal number of clusters was found. Analyses were performed with the statistical software R (R core team, 2021) [3].

III.   RESULTS AND DISCUSSION

A total of 34 volatile organic compounds were identified in this study, including aldehydes, hydrocarbons, alcohols, ketones and other chemical classes. Most of the identified compounds are formed from lipid oxidation and degradation [4]. Aldehydes were the most representative chemical

class in all treatments; in particular, hexanal was highly abundant, and had higher concentrations in normal pHu meat. This will be investigated in more detail in future works.
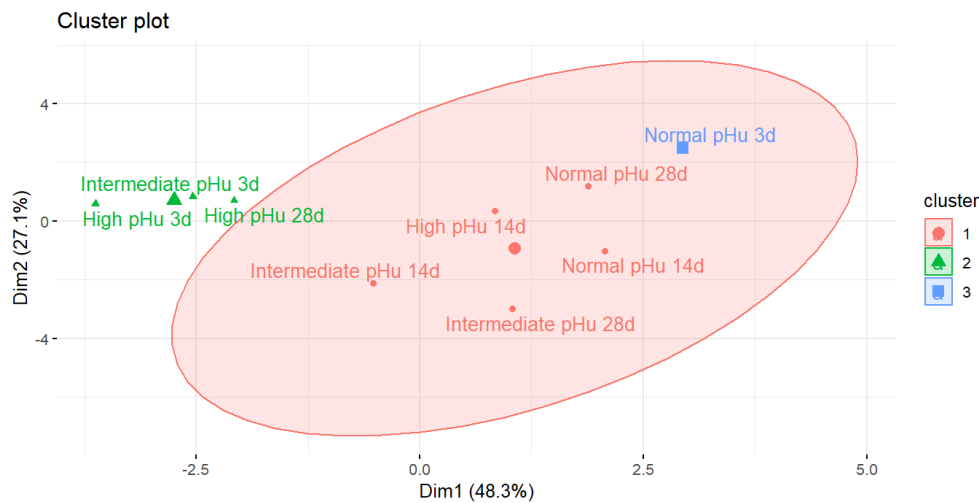

Figure 1. Visualization of clusters by the k-means algorithm for treatments according to the Volatile Organic Compounds.

The effects that the different treatments had was investigated using cluster analysis, which resulted in treatment groupings (Fig 1). Cluster analysis showed that 75.4% of the data variability was explained in the first two dimensions. The samples that were normal pHu and treated at 3 days of maturation showed a higher average, forming a group of their own. A second observation was the samples involving all the three pHu ranges at 14 days of aging; these clustered into a larger and closer group, and we conclude that the treatments at this maturation time resemble each other qualitatively and quantitatively.

IV.   CONCLUSION

This study preliminarily demonstrated that the aging process is subject to pHu influences, and therefore there will be variability in the composition of volatile organic compounds, and consequently in the flavour of the meat samples in some degree of greater or lesser intensity.

ACKNOWLEDGEMENTS

REFERENCES

1. Lomiwes, D., Farouk, M. M., Wu, G., & Young, O. A. (2014). The development of meat tenderness is likely to be compartmentalised by ultimate pH. Meat Science 96: 646–651.
2. Ba, H. Van, Park, K., Dashmaa, D., & Hwang, I. (2014). Effect of muscle type and vacuum chiller ageing period on the chemical compositions, meat quality, sensory attributes and volatile compounds of Korean native cattle beef. Animal Science Journal 85: 164–173.
3. R Core Team (2021). R: A language and environment for statistical computing. Vienna: R Foundation for Statistical Computing, 2021.
4. Sohail, A., Al-Dalali, S., Wang, J., Xie, J., Shakoor, A., Asimi, S., Shah, H., & Patil, P.(2022). Aroma compounds identified in cooked meat: A review. Food Research International 157: 111385.