71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

QUALITATIVE ANALYSIS OF VOLATILE COMPOUNDS IN BEEF BURGERS WITH DIFFERENT TYPES OF PACKAGING

Vanessa C. Francisco [1], Rainara M. Beletato [2], Henriette M. C. Azeredo [3], Márcia M.H. Haguiwara[4], Renata T.Nassu [1*]

[1] Embrapa Pecuária Sudeste. São Carlos – São Paulo, Brazil

[2] Faculdade de Ciências Farmacêuticas (FCFAr)/UNESP, Araraquara-São Paulo, Brazil

[3]Embrapa Instrumentação. São Carlos – São Paulo, Brazil

[4]Instituto de Tecnologia de Alimentos, Campinas, São Paulo, Brasil.

*Corresponding author email: renata.nassu@embrapa.br

I. INTRODUCTION

Beef burger is one of the most popular processed meat products worldwide, widely consumed for its practicality and flavour [1]. Packaging plays a critical role in preserving food, as it affects the chemical, microbiological, and sensory stability of the product [2]. Edible films made from onion and garlic present a promising alternative to traditional primary packaging [3]. Growing concerns about burger quality and shelf life have driven research into more effective packaging solutions. This study aims to evaluate the impact of different packaging types on the formation of volatile compounds, which can influence the aroma, flavour, and overall product quality during storage.

II. MATERIALS AND METHODS

The beef burgers were produced from sirloin tip (61.5%) and brisket (38.5%) beef cuts, with a total fat content of 7% 0.7% salt added. Aproximately 300 burgers made in one batch were processed and were divided into three treatments: control (no packaging), paper packaging, and onion and garlic-based edible film packaging. The analyses were at the beginning of the experiment (T0) and every 30 days until 120 days. The burgers were cooked while frozen in an oven preheated to 180 °C for 13 minutes and ground in a food processor. One g of the grounded sample was weighed In a glass flask with a capacity of 60 mL, and the extraction of volatile compounds was performed by the technique of microextraction in solid phase (SPME) using a carboxen/polydimethylsiloxane (CAR/PDMS) fiber as stationary phase. Gas chromatography coupled to mass spectrometry (GC-MS) was used to separate and identify volatile compounds in the samples using a DB-5 MS column. The oven temperature started at 40 °C, increasing 4 °C min-1 to 180 °C, 10 °C min-1 to 280 °C, remaining at this temperature for 5.3 min. Helium (He) was used as carrier gas. The compounds were identified through their spectra and compared with those of the NIST library database. For volatile compounds identification confirmation, a solution n-alkane (C7-C30) was injected into the equipment under the same conditions as the samples to obtain the programmed linear retention temperature index (LTPRI) of volatile compounds. Experimental identification was performed by comparing the LTPRI and mass spectra with literature reports, with a minimum similarity of 85%. A qualitative analysis was applied to analyze the obtained data.

III. RESULTS AND DISCUSSION

A total of 103 volatile compounds were identified among the treatments and classified according to the chemical class as carboxylic acids (n=7), alcohols (n=11), aldehydes (n=19), ketones (n=15), aromatic compounds (n=3), sulfur compounds (n=12), ester (n=10), ether (n=4), furans (n=5), hydrocarbons (n=11), lactone (n=1), pyrazines (n=2) and terpenes (n=3). A PCA was created to show the variations between each treatment based on individual volatile compounds (Figure 1). The first principal component (PC1) described 33.18%, and the second principal component (PC2) described 18.00% of the total variation, totalling 51.18%. The graph shows a separation between the samples, indicating that the treatments applied significantly impacted the chemical composition of the burgers. Onion T90 and Onion T120 are strongly associated with sulfur-containing compounds such as diallyl sulfide, diallyl disulfide, and allyl methyl sulfide [4], indicating that the treatment with onion edible film coating favoured the release or formation of sulfur compounds, which are characteristic of onion and garlic, in the coated burgers. Control T90 and Control T120 are close to compounds such as carboxylic acids and esters (butanoic acid, hexanoic acid methyl ester and carbonic acid dimethyl ester), indicating that these compounds may be related to storage time. Paper T30, Paper T60, Paper T90, Control T30 and Control T60 are associated with aldehydes such as pentanal, 2-

methylpropanal, 3-methylbutanal, 2-methylbutanal and the ketones 2-pentanone and 2,3-butanedione, these compounds may be indicators of lipid oxidation or degradation, a typical process during storage [5].

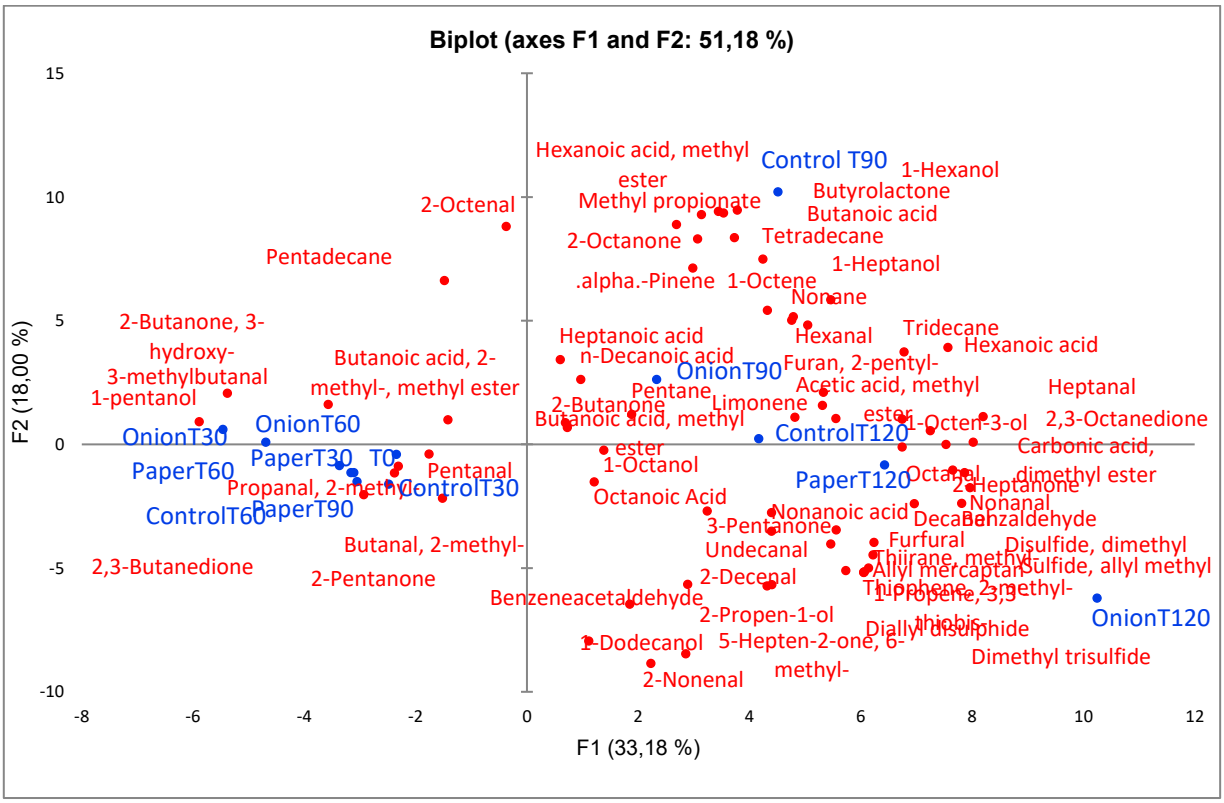


Figure 1. Principal component analysis (PCA) of volatile compounds present in beef burgers stored for 0, 30, 60, 90 and 120 days, in different types of packaging (control, paper and onion/garlic film).

IV. CONCLUSION

The treatment with the onion and garlic film resulted in a distinct volatile compound profile, with some compounds appearing exclusively in this treatment, such as allyl mercaptan and diallyl disulfide, contributing to the pungent flavour and characteristic aromas of onion and garlic. The presence of the edible film also influenced the formation of other volatile compounds, including carboxylic acids, furans, and terpenes, suggesting that the coating altered chemical interactions during storage. Thus, using edible onion and garlic films is a promising approach for enhancing the sensory characteristics of meat products during storage.

ACKNOWLEDGEMENTS

The current research was funded by the São Paulo Research Foundation (FAPESP – grants 2023/03583-9 and 2023/11177-0) and financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

REFERENCES

1. Angioletti, B. L., Hoffmann, T. G., Santos, S. P. D., Meinert, C., Bertoli, S. L., Prudêncio, E. S., & de Souza, C. K. (2024). Improving beef burger quality during cold storage: effect of Aloe vera gel, packaging, and temperature. Brazilian Journal of Food Technology, 27, e2024033.
2. Suvarna, V., Nair, A., Mallya, R., Khan, T., & Omri, A. (2022). Nanomateriais antimicrobianos para embalagens de alimentos. Antibióticos, 11(6), 729.
3. 1. Azeredo, H. M. C., Otoni, C. G., & Mattoso, L. H. C. (2022). Edible films and coatings – Not just packaging materials. Current Research in Food Science, 5, 1590–1595.
4. Lanzotti, V. (2006). The analysis of onion and garlic. Journal of chromatography A,1112(1-2), 3-22.
5. Lorenzo, J. M., Pateiro, M., Domínguez, R., Barba, F. J., Putnik, P., Kovačević, D. B., ... & Franco, D. (2018). Berries extracts as natural antioxidants in meat products: A review. Food Research International, 106, 1095-1104.