SENSORY QUALITY OF BEEF PATTIES INOCULATED WITH STRAINS OF *CARNOBACTERIUM MALTAROMATICUM* WITH POTENTIAL AS BIOPRESERVATIVES

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Abstract – Biopreservation is the use of naturally occurring microorganisms and/or their inherent antimicrobial compounds to extend shelf life and to enhance the safety of foods. The aim of the present study was to perform a sensory evaluation of beef patties inoculated with strains of *C. maltaromaticum* with potential as biopreservatives. Three different strains of *C. maltaromaticum* (CM_824, CM_827 and CM_829) isolated from vacuum packaged beef with long shelf life were selected for this study. An untrained panel was requested to make a sensory evaluation of raw and cooked beef patties 8 and 10 days after inoculation with the selected strains at 10^4 and 10^6 UFC/g and storage in high O_2 atmosphere. This preliminary study permitted to evaluate the effect of three *C. maltaromaticum* strains on the sensory quality of beef patties. Strain CM_827 did practically not change the sensory attributes of beef patties. Samples inoculated with strain CM_824 and CM_829 received the worst scores for several of the tested descriptors. Therefore, further research on the biopreservative capacity of *C. maltaromaticum* should be conducted with strain CM_827.

Key Words – biopreservation, *Carnobacterium maltaromaticum*, sensory analysis.

I. INTRODUCTION

Biopreservation is a powerful and natural tool to extend shelf life and to enhance the safety of foods by applying naturally occurring microorganisms and/or their inherent antimicrobial compounds of defined quality and at certain quantities [1].
Carnobacterium maltaromaticum is a lactic acid bacterium (LAB), and many LAB associated with meat are known for their bactericidal or bacteriostatic activity against other strains, species or genera of bacteria. Some *C. maltaromaticum* strains have been reported to produce class I and II bacteriocins, in addition to circular bacteriocins [2]. Bacteriocin production, however, is not a pre-requisite for the biopreservative efficacy of *Carnobacterium* [3]. In this way, the presence of certain LAB adapted to a low temperature could extend the shelf life of meat and improve the microbial stability and safety of this product. Nevertheless, undesired effects of *Carnobacterium* on food quality have been reported, e.g., the production of a malty/chocolate like aroma due to 3-methylbutanal from the catabolism of leucine [4]. The aim of the present study was to perform a sensory evaluation of beef patties inoculated with potential biopreservative strains of *C. maltaromaticum* isolated from vacuum packaged long shelf life beef.

II. MATERIALS AND METHODS

Carnobacterium maltaromaticum strains: three different strains of *C. maltaromaticum* (lab. ref. CM_824, CM_827 and CM_829) isolated from vacuum packaged beef with long shelf life were selected for this study according to their genetic profile (genes coding for the 16S ribosomal RNA).
Samples: commercial bovine meat preparation (89 % beef, water, 0.9 % vegetal fibers (bamboo), salt, silicium dioxide, ascorbic acid, sodium acetate and sodium citrate) for the production of beef patties, displaying a shelf life of 8 days, was supplied by a meat plant located in the Walloon region of Belgium. Three meat preparation batches were made, and each batch was inoculated (1 % v/w) with a suspension of the selected strains of *C. maltaromaticum* at 10^6 or 10^8 UFC/mL physiological saline to achieve a final concentration of 10^4 and 10^6 UFC *C. maltaromaticum*/g meat. After

inoculation, portions of 90 g of meat were molded into 2 cm thick beef patties. The beef patties were packaged in PP/EVOH/PP trays (oxygen permeability of 4 $cm^3/m^2 \cdot 24$ h) sealed with a polypropylene film (52 µm thick, oxygen permeability of 110 $cm^3/m^2 \cdot 24$ h) containing a modified atmosphere – 80 % O_2:20 % CO_2 –, and stored up to 10 days at +4 °C (5 days) and +8 °C (5 days).

Sensory analyses: an untrained panel of 7 to 12 members was requested to make a sensory evaluation of raw and cooked samples, 8 and 10 days after inoculation, by scoring each descriptor (appearance, odor, color, tenderness, flavor and juiciness) from 1 (= dislike) to 5 (= like). Cooked samples were grilled (frying top Tecnoinox FTL35E/6/0) until they reached an internal temperature of +75 °C.

Statistical analysis: Results are expressed as mean ± standard deviation (SD). Experimental data for each response variable was analyzed by ANOVA using the GLM procedure. Whenever necessary, Tukey tests were performed.

III. RESULTS AND DISCUSSION

After 8 days of storage (5 days at +4 °C and 3 days at +8 °C), non-inoculated raw samples (blank) were perceived as having the best appearance and color ($P < 0.05$). The appearance of the samples inoculated with strain CM_827 was similar to the blank. Samples inoculated with strain CM_827 at 10^4 UFC/g received better scores for the three evaluated descriptors than samples inoculated with strains CM_824 and CM_829. However, the inoculated samples did not differ statistically (Figure 1).

Beef patties inoculated with *C. maltaromaticum* at 10^6 UFC/g received scores comparable to those of beef patties inoculated with *C. maltaromaticum* at 10^4 UFC/g. In this case, blank was also perceived as having the best color ($P < 0.05$) (Figure 2).

After 8 days of storage and cooking, non-inoculated beef patties received higher scores than inoculated beef patties, but no statistical difference was observed with samples inoculated with *C. maltaromaticum* at 10^4 UFC/g (Figure 3).

Samples inoculated with the strain CM_829 at 10^6 UFC/g received the worst scores for all studied descriptors. For appearance, odor and flavor, beef patties inoculated with the strain CM_829 differed from blank ($P < 0.05$). Samples inoculated with strains CM_824 and CM_827 received scores comparable to the blank. (Figure 4).

After 10 days of storage (5 days at +4 °C and 5 days at +8 °C), samples inoculated with the strain CM_827 at 10^4 UFC/g received the highest scores, but no statistical difference was found between the analyzed samples (Figure 5). Regarding samples inoculated with *C. maltaromaticum* at 10^6 UFC/g, they all received scores lower than the blank, except for beef patties inoculated with strain CM_827, that had a better appearance than the other samples. However, the differences were not statistically significant (Figure 6).

Figure 1. Mean ± SD values of sensory analysis of raw patty samples inoculated with 10^4 UFC *C. maltaromaticum*/g after 8 days of storage (5 days at +4 °C and 3 days at +8 °C)

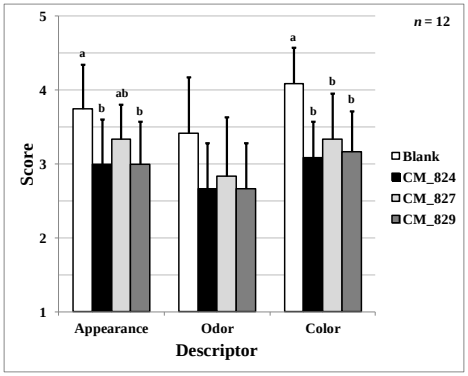


Figure 2. Mean ± SD values of sensory analysis of raw patty samples inoculated with 10^6 UFC *C. maltaromaticum* /g after 8 days of storage (5 days at +4 °C and 3 days at +8 °C)

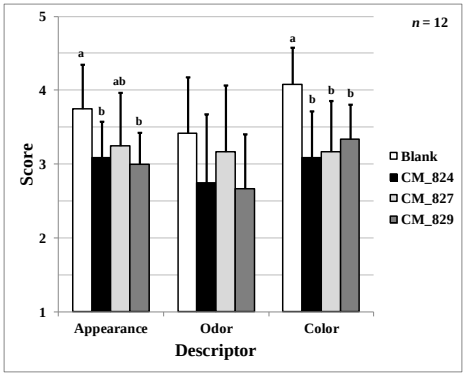


Figure 3. Mean ± SD values of sensory analysis of cooked patty samples inoculated with 10^4 UFC *C. maltaromaticum*/g after 8 days of storage (5 days at +4 °C and 3 days at +8 °C)

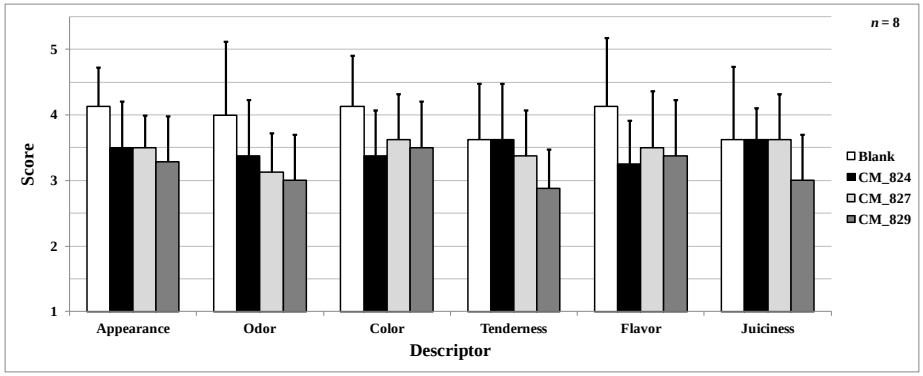


Figure 4. Mean ± SD values of sensory analysis of cooked patty samples inoculated with 10^6 UFC *C. maltaromaticum*/g after 8 days of storage (5 days at +4 °C and 3 days at +8 °C)

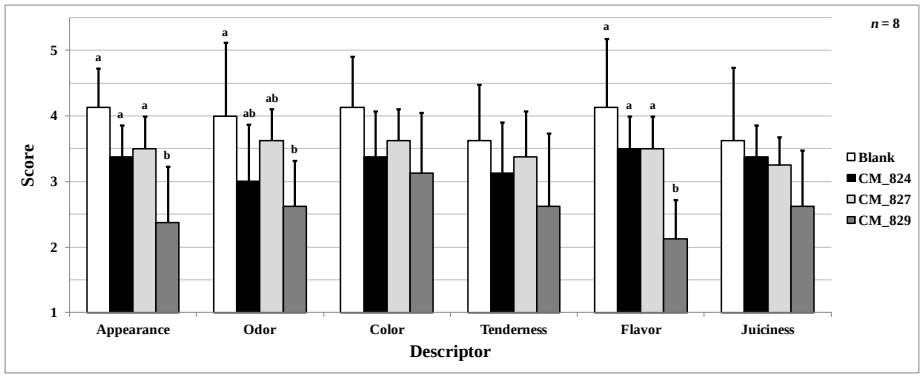


Figure 5. Mean ± SD values of sensory analysis of raw patty samples inoculated with 10^4 UFC *C. maltaromaticum*/g after 10 days of storage (5 days at +4 °C and 5 days at +8 °C)

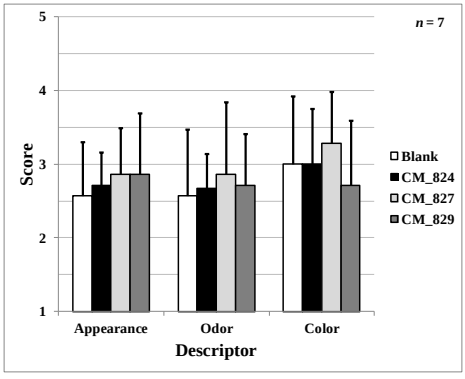
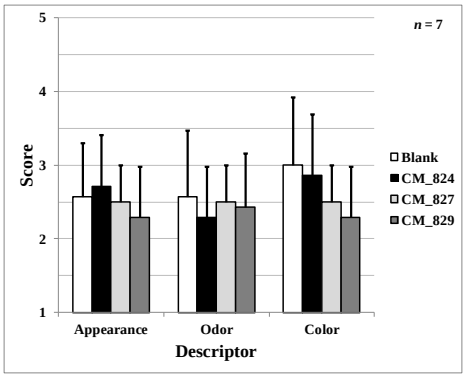


Figure 6. Mean ± SD values of sensory analysis of raw patty samples inoculated with 10^6 UFC *C. maltaromaticum*/g after 10 days of storage (5 days at +4 °C and 5 days at +8 °C)



Since after ten days of storage the beef patties were three days beyond the commercial self life, only appearance, odor and color were evaluated for cooked samples. A decrease in the sensory quality was observed during the last three days of storage. Most of the cooked samples inoculated at 10^4 UFC/g had a score between 3.0 and 3.5 after seven days of storage. After ten days of storage, most of the scores dropped to between 2.5 and 3.0 (Figure 7).

A similar loss of quality was observed for samples inoculated with *C. maltaromaticum* at 10^6 UFC/g (Figure 8), except for beef patties inoculated with strain CM_829, which received low scores after 7 days of storage.

Figure 7. Mean ± SD values of sensory analysis of cooked patty samples inoculated with 10^4 UFC *C. maltaromaticum*/g after 10 days of storage (5 days at +4 °C and 5 days at +8 °C)

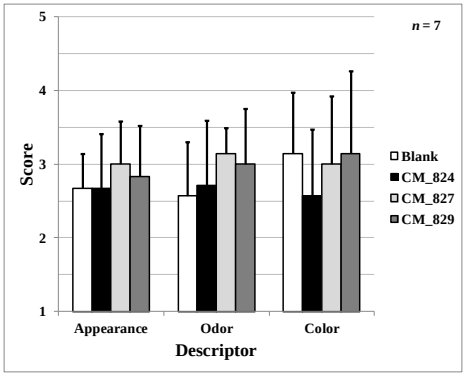
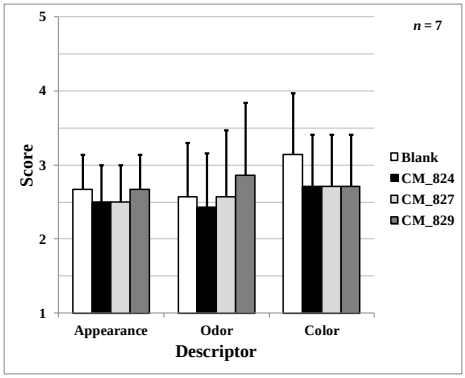


Figure 8. Mean ± SD values of sensory analysis of cooked patty samples inoculated with 10^6 UFC *C. maltaromaticum*/g after 10 days of storage (5 days at +4 °C and 5 days at +8 °C)



IV. CONCLUSION

This preliminary study permitted to evaluate the effect of three *C. maltaromaticum* strains on the sensory quality of beef patties. Strain CM_827 did practically not change the sensory attributes of beef patties. Therefore, further research on the biopreservative capacity of *C. maltaromaticum* should be conducted with the strain CM_827.

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REFERENCES

1. Ghanbari, M., Jami, M., Domig, K.J. & Kneifel, W. (2013). Seafood biopreservation by lactic acid bacteria – A review. LWT - Food Science and Technology: 54, 315-324.
2. Tulini, F. L., Lohans, C. T., Bordon, K. C., Zheng, J., Arantes, E. C., Vederas, J. C. & de Martinis, E. C. (2014). Purification and characterization of antimicrobial peptides from fish isolate *Carnobacterium maltaromaticum* C2: Carnobacteriocin X and carnolysins A1 and A2. International Journal of Food Microbiology: 173, 81-88.
3. Laursen, B. G., Bay, L., Cleenwerck, I., Vancanneyt, M., Swings, J., Dalgaard, P. & Leisner, J. J. (2005). *Carnobacterium divergens* and *Carnobacterium maltaromaticum* as spoilers or protective cultures in meat and seafood: phenotypic and genotypic characterization. Systematic and Applied Microbiology: 28, 151-164.
4. Afzal, M. I., Delaunay, S., Paris, C., Borges, F., Revol-Junelles, A. M. & Cailliez-Grimal, C. (2012). Identification of metabolic pathways involved in the biosynthesis of flavor compound 3-methylbutanal from leucine catabolism by *Carnobacterium maltaromaticum* LMA 28. International Journal of Food Microbiology:157, 332-339.