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Carnobacterium maltaromaticum as a bioprotective culture against spoilage bacteria in ground beef (#330)

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Introduction

Meat is susceptible to the development of spoilage bacteria, including *Brochothrix* spp.and *Pseudomonas* spp., that alter the quality characteristics and reduces the shelf life during chilled storage. *Carnobacterium* spp. are lactic acid bacteria, usually found as part of the natural microbiota of chilled meat and have bioprotective potential. This study aimed to evaluate the effect of *Carnobacterium maltaromaticum* (C) as a bioprotective culture against *Brochothrix thermosphacta* (B) and *Pseudomonas fluorescens* (P) in ground beef.

Methods

C: pool of three C strains (C_824, C_827 and C_829), isolated from vacuum packaged meat were used.

Spoilage bacteria: pool of three B (ATCC 11509; s109 and s153) isolated from beef) and P (ATCC 13525) were used.

Samples: ground beef was purchased from a local cutting plan in Belgium. Meat was inoculated (with concentrations ~6 log and ~4 log, respectively, for C and spoilage bacteria) according to the following treatments and homogenized for 10 min. Treatment 1-Blank (sterile deionized water as inoculum); 2-C; 3-B; 4-C+B; 5-P; 6-C+P. Beef patties (80 g) were packaged in MAP (66% O_2/30% CO_2/residual 4%N_2)in PP/EVOH/PP trays (ES-plastic dimensions: 187 × 137 × 50 mm, oxygen permeability: 4 cm^3/m^2 at 24 h bar, 23°C and 0% RH) and sealed with a PET/PP film (Wipak, O_2 permeability: 8.4 cm^3/m^2 at 24 h bar, 23°C and 0% RH). Samples were stored for 3 d at 4°C followed by 4 d at 8°C (to simulate a temperature abuse at retail).

Analysis: microbiological analysis was carried out at 0, 3 and 7 d of storage. P was counted on *Pseudomonas* Agar Plate added with CFC supplement incubated at 25°C for 24h; B on STAA added with STAA supplement incubated at 25°C for 24 h; and C was estimated by the difference of counts on PCA, incubated at 25 °C for 24 h, and the other media; instrumental color was evaluated using a colorimeter CR-400 (Konica Minolta), CIE L*a*b*, D65, 8 mm diameter aperture, 2° observation) and pH using a Knick 765 pHmeter.

Statistical analysis: the effects of treatment, storage time and their interaction were analyzed using Multi-Way ANOVA and means were compared by Tukey´s test ($P<0.05$).

Results

There was significant interaction between treatment and time for B and P count ($P < 0.05$) (Table 1). C was effective in inhibiting B growth in ground meat during storage. At day 7, the count of B in C+B was 2.3 log CFU/g lower than in B. Regarding P growth, the results showed a slight, but significant inhibition (0.7 log CFU/g) of P in C+P compared to P. This can be explained by the structural barrier that P has as a Gram negative bacteria, serving as protection from metabolites of Gram positive bacteria as C [1], corroborating previous results of LAB against pathogenic strains [2].

At 7 d, patties inoculated with C (C, C+B and C+P) showed lower pH than other treatments. However, pH value differences were lower than 0.2, confirming that *Carnobacterium* is not a strong acid producer (Fig. 1) [3].

Storage time affected all color parameters, increasing lightness, whereas decreasing redness and yellowness of meat. Treatments affected only the lightness and yellowness of the product. Nevertheless, small differences in instrumental color values are likely due to intrinsic characteristics of the product itself than to the influence of the treatments (Fig. 1).

Conclusion

In conclusion, C showed a bioprotective effect for both spoilage bacteria without affecting the quality characteristics of ground beef. It supports the C potential for extension of the shelf life of fresh meat.

Acknowledgements

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References

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Notes

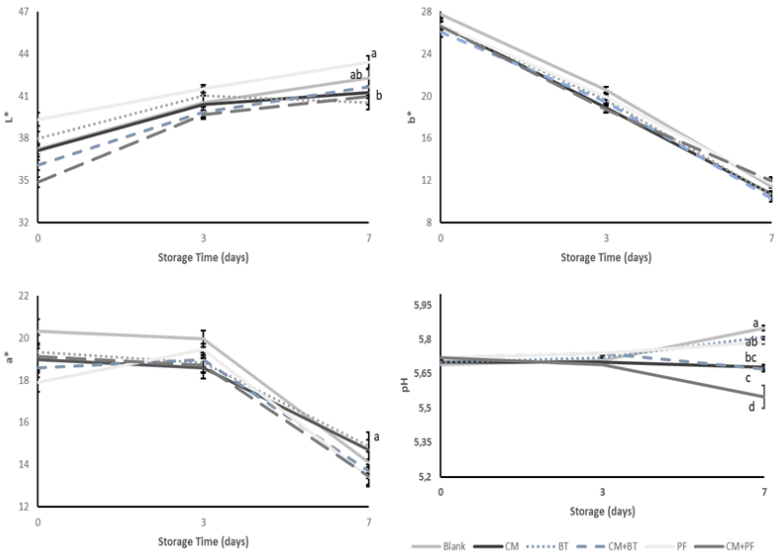

Fig 1. Color and pH of ground beef inoculated with C. maltaromaticum and spoilage bacteria
Different lowercase letters indicate significant differences among treatments

Treatment	Storage time (days) 0	3	7	P
	Carnobacterium spp. (mean ± S.E.)			
Blank	3.6 ± 0.04cC	4.5 ± 0.02bB	6.7 ± 0.09abA	< 0.001
CM	6.2 ± 0.03aB	5.6 ± 0.09aC	7.3 ± 0.06aA	< 0.001
BT	3.6 ± 0.04cC	4.3 ± 0.12bB	5.6 ± 0.26cA	< 0.001
CM+BT	5.6 ± 0.00bB	5.4 ± 0.04aC	7.3 ± 0.07aA	< 0.001
PF	3.6 ± 0.14cB	3.3 ± 0.18cB	7.4 ± 0.06aA	< 0.001
CM+PF	5.7 ± 0.00bA	5.5 ± 0.05aA	6.1 ± 0.35bcA	0.174
P	< 0.001	< 0.001	< 0.001	
	BT (mean ± S.E.)			
Blank	2 ± 0bC	3.4 ± 0.08cB	6.7 ± 0.01bA	< 0.001
CM	2 ± 0bC	3.1 ± 0.08dB	5.5 ± 0.06cA	< 0.001
BT	3.7 ± 0.01aC	3.9 ± 0.03bB	7.2 ± 0.02aA	< 0.001
CM+BT	3.7 ± 0.04aB	3.9 ± 0.04bB	4.9 ± 0.12dA	< 0.001
PF	2.5 ± 0.23bC	3.3 ± 0.04cdB	6.7 ± 0.01bA	< 0.001
CM+PF	2.3 ± 0.17bC	4.3 ± 0.08aB	5.5 ± 0.07cA	< 0.001
P	< 0.001	< 0.001	< 0.001	
	PF (mean ± S.E.)			
Blank	2.6 ± 0.04eC	2.9 ± 0.04bB	6.1 ± 0.03aA	< 0.001
CM	2.9 ± 0.03cB	2.9 ± 0.09bB	3.9 ± 0.01dA	< 0.001
BT	2.8 ± 0.04dC	3.8 ± 0.12aB	4.8 ± 0.03cA	< 0.001
CM+BT	3.2 ± 0.04bB	3.2 ± 0.02bB	3.9 ± 0.04dA	< 0.001
PF	4.1 ± 0.03aB	3.9 ± 0.03aB	5.5 ± 0.27bA	< 0.001
CM+PF	4.1 ± 0.03aC	3.7 ± 0.03aB	4.8 ± 0.02cA	< 0.001
P	< 0.001	< 0.001	< 0.001	

Table 1. Count of Carnobacterium maltaromaticum and spoilage bacteria in ground beef
*abcdDifferent lowercase letters indicate significant differences in column (treatment effect)**ABCDifferent uppercase letters indicate significant differences in a row
(time effect)

Notes