A VALIDATION STUDY TO DEMONSTRATE THE REDUCTION OF PATHOGENIC BACTERIA IN A NON-HEATED DRY FERMENTED SALAMI

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I. INTRODUCTION

A process validation study was conducted to the effect of a starter culture on the levels of pathogenic bacteria *Salmonella spp*., *Escherichia coli* 0157:H7 and *Listeria monocytogenes* inoculated into a fermented and dried Italian type salami and assessed during production. The study was designed to fit USDA (United States Department of Agriculture), FSIS (Food Safety and Inspection Service) combined with the protocol employed by Goodfellow [1].

II. MATERIALS AND METHODS

A Salami batch was prepared following the recipe presented in Table 1. SafePro® B-LC-007 (*Pediococcus acidilactici*, *P. pentosaceus*, *Staphylococcus carnosus*, *S. xylosus*, *L. sakei*, *Debaryomyces hansenii*), a starter culture from Chr. Hansen, was used following manufacturer recommended dosage.

Table 1 Pure pork salami recipe

Raw material / ingredient	Quantity (%)
Boneless pork shoulder 21% fat	95.27
NaCl	2.58
Dextrose	1.57
White pepper ground	0.13
Cracked black pepper	0.18
Garlic	0.02
$NaN0_2$	0.014
$NaN0_3$	0.005
SafePro® B-LC-007	0.21?
Filtered water	0.021

After preparation the salami raw batter was inoculated with a cocktail of 5 pathogenic strains (Table 2) of each of the 3 pathogenic bacteria. Targeted initial concentration in each of the pathogenic bacteria cocktail was 10^7 cfu/g.

Table 2 Pathogenic strains used in the study

E. coli O157:H7	*Salmonella* spp.	*L. monocytogenes*
FSIS 063-93 (USDA meat/poultry)	*S.* cubana G2:z29	WP986C
FSIS 413-95 (USDA meat/poultry)	*S.* enteriditis GFP-108	FSIS 1263
GFP-85	*S*. newport c2:eh:1,2	ATCC 35152
ATCC 35150 (human disease)	*S*. senftenberg (DLI isolate)	ATCC 15313
ATCC 700599 (salami)	*S*. bredeney ATCC 10728	ATCC 19115

Salami were then stuffed into 78 mm fibrous casing. Fermentation took place at 30°C with a relative humidity (RH) above 90% until reaching pH 4.9. Drying took place at 20°C / 84-89% RH for 24h and then at 14°C / 81-86% RH until reaching a water activity (a_w) between 0.92 and 0.90.

Samples were taken at five times being raw batter (0 days), after fermentation (22 hours), mid-drying (14 days), end of drying (28 days) and end of extended drying (37 days). Three salami samples were used to measure *Salmonella spp*., *Escherichia coli* 0157:H7 and *Listeria monocytogenes* concentrations. In addition, pH and temperature of the salami were continuously recorded during the first 24h of the process. Finally, pH, water activity, protein content and moisture of the salami were checked at various times.

III. RESULTS AND DISCUSSION

Initial pH of the salami was 5.97. SafePro® B-LC-007 is a fast acidifying culture and pH post fermentation after 14 hours was 5.19 with a pH decline to 4.84 after 20h. Other results from physico-chemical analyses are presented Table 3.

Table 3 Results of the physico-chemical analyses performed during the test

Analyses	Mid dry (14^{th} day)	Final dry (28^{th} day)	Extended dry (37^{th} day)
pH*	4.50	4.23*	4.27*
Water activity (a_w)	0.947	0.915	0.899
Moisture: Protein ratio	NM[+]	1.52:1	1.30:1

* pH measured in 10% slurry (dilution in distilled water)
[+] NM= Not measured

After 37 days of processing, a > 5 log reduction was achieved for every pathogenic bacteria inoculated in the batter (Table 4).

Table 4 The $\log_{10}$ cfu/$_g$ reduction in the pathogenic bacteria for fermented and dried salami processed with SafePro® B-LC-007

Pathogenic bacteria	Final dry	Extended dry
Salmonella spp.	5.70	5.70
E. coli 0157:H7	4.92	5.02
L. monocytogenes	5.06	5.24

IV. CONCLUSION

Based on the results of this validation study it has been demonstrated that the use of the fast acidifying starter culture SafePro® B-LC-007 containing a *P. acidilactici* protective strain can be used to produce a safe fermented and dried salami which meets the required bacterial reduction criterion from USDA/FSIS.

REFERENCES

1. Goodfellow S.J., Brown W.L. (1978). Fate of *Salmonella* inoculated into beef for cooking. Journal of Food Protection Vol 41, 8: 598-605.