# EFFICACY OF POTASSIUM BASED ORGANIC ACID SALTS AGAINST SPOILAGE BACTERIA AND CONTROL OF *LISTERIA MONOCYTOGENES*

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## I. INTRODUCTION

The incidence of *Listeria monocytogenes* in processed meat products ranged from 1.8-4.1% [1]. Traditionally lactic, acetic acid, or their sodium salts were regarded as primary meat safety solutions. However, market trends of low sodium options have pushed the industry to look for alternate solutions. Highly effective potassium based acetic acid salts (Provian® K) is a very effective solution to meet this need [2]. The objective of this research was to investigate the effect of Provian® K on the growth of spoilage microorganisms (*Lactobacillus sakei* and *Carnobactrium divergens*) and control of *L. monocytogenes* on frankfurters.

## II. MATERIALS AND METHODS

A total of 2000 frankfurters for thirteen different treatment formulations (0.25-0.75% Provian® K, 1.25%-3.5% potassium lactate/sodium diacetate blend, 0.06-0.16% sodium acetate and 1.17-3.25% potassium lactate) and control (no antimicrobials) were inoculated in pairs with *L. monocytogenes* (serotype 1/2a, 1/2b, 4a and 4b) or *C. divergens* or *L. sakei*. Uninoculated samples were used for detecting the level of natural contamination. Following bacterial attachment, the frankfurters were vacuum packaged and stored at 4 or 7°C and sampled up to 120 days. At each sampling, frankfurters were homogenised, stomached, and plated onto selective medium and incubated at 35°C for 48 h. Failure of antilisterial capacity was assessed at 2 log CFU/g outgrowth and spoilage threshold was considered as 6 log CFU/g and treatment performances was compared using one-way ANOVA. Data were fitted to modified Gompertz model to calculate growth rate (μmax; log/day), lag time (day) and estimate day of spoilage. Statistical analysis and model building was carried out using JMP Pro version 15.1.0 (SAS Institute Inc., NC, US), with significance set at $P<0.05$.

## III. RESULTS AND DISCUSSION

Inoculation level of ca. 3 log CFU/g for all bacteria strains was achieved on day 0 for all the treatments. For *L. monocytogenes*, the control treatment exhibited fastest outgrowth >2 log CFU/g by 21 days of storage at 4°C. The 0.75% Provian® K treatment significantly ($P<0.05$) controlled *L. monocytogenes* outgrowth (<2 log CFU/g) for 120 days of storage. At 4°C, Provian® K exhibited slowest lag time and μmax of (20 day; 0.05 log/day) compared to control (9 day; 0.13 log/day). Fig. 1 represents the populations of *L. monocytogenes* in frankfurters stored at 4 ˚C with highest concentrations of the sample formulations.

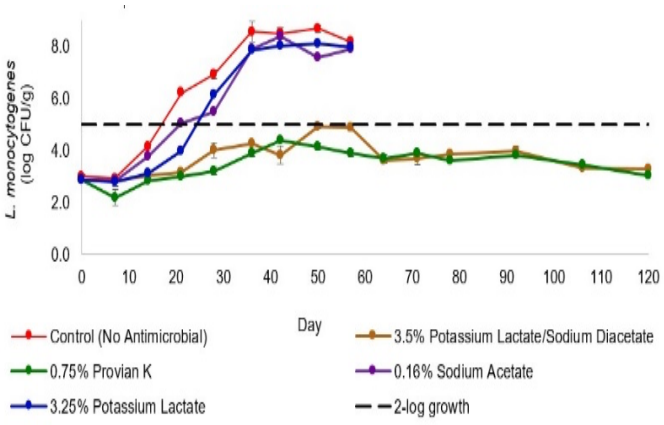


Figure 1. Populations of *L. monocytogenes* in frankfurters at 4 ˚C.

Likewise for spoilage bacteria, 0.75% Provian® K showed optimal performance across both temperatures of 4°C and 7°C (Table 1). For *L. sakei*, controls spoiled at 24 and 10 days, while 0.75% Provian® K provided significant *($p\leq0.0032$)* extension of 11 and 3

days at 4 and 7°C, respectively. Similar trends were observed for *C. divergens,* Provian K (0.75%) significantly enhanced shelf-life compared to control *(p≤0.0001)* at these storage temperatures, imparting 14 and 13-days shelf-life extension at 4 and 7°C, respectively. Uninoculated samples stored at 4°C did not spoil (<2 log CFU/g) within the 120 days of sampling, ensuring low background loads of bacteria.

Table 1. Time (days) to end of shelf life (lactic acid bacteria at 6 log CFU/g) at 4 and 7˚C.

| Treatment | Days to 6 logs for *C. divergens* | | Days to 6 logs for *L. sakei* | |
|---|---|---|---|---|
| | 4˚C | 7˚C | 4˚C | 7˚C |
| Control | 12.7±0.02$^{A}$ | 5.10±0.28$^{A}$ | 24.2±0.18$^{A}$ | 10.0±0.07$^{A}$ |
| 0.75% Provian® K | 28.5±0.62 $^{B}$ | 18.3±0.57$^{B}$ | 35.1±1.03$^{B}$ | 11.4±0.08$^{B}$ |
| 3.5% Potassium Lactate/ Na Diacetate | 26.2±1.5 $^{B}$ | 14.8±0.63$^{C}$ | 33.7±0.02$^{C,D}$ | 11.9±0.17$^{B}$ |
| 0.16% Sodium Acetate | 13.2±0.34 $^{A}$ | 6.80±0.44$^{A,D}$ | 30.6±0.42$^{D}$ | 12.7±0.10$^{C}$ |
| 3.25% Potassium Lactate | 14.1±0.97 $^{A}$ | 8.30±0.28$^{D}$ | 36.3±0.79$^{B}$ | 13.6±0.11$^{D}$ |

Data depicted is the mean±standard deviation. Values indicated by different letters are significantly different (P≤0.05).

## IV. CONCLUSION

Provian® K exhibited superior antimicrobial efficacy against both *L. monocytogenes* and spoilage microorganism in processed meat at a 3 to 5 times lower use level compared to potassium lactate-based preservatives, providing meat processors with very cost-efficient antimicrobial solutions.

## REFERENCES


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2. Heintz, E., Van Lent, H. J., Vega, L., Glass, K., (2018). The inhibitory effect of a sodium free powder preservative on the growth of *Listeria monocytogenes* and Lactic acid bacteria in turkey ham applications. Meat and Muscle Biology 1:2.