EFFECT OF SODIUM LACTATE ON THE HEAT RESISTANCE OF *LISTERIA MONOCYTOGENES* IN A MEAT PASTE

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INTRODUCTION

Listeria monocytogenes has long been recognized as a foodborne pathogen that had produced serious outbreaks associated with foods from animal origin, like milk and meat products [2]. The prevalence of *L. monocytogenes* in foodborne outbreaks involving processed food has been attributed to some of its characteristics, like the ability to grow at refrigeration temperatures and its high resistance to thermal processing.

Novel approaches have been used to improve the sensorial quality of cooked meat products, among them, sous-vide processing and the use of new additives in cooked meat. Sous-vide cooking has been attaining acceptance for the superior quality of the sensorial properties of the foods processed in such a manner. However, it has been pointed out the microbial risk implied in sous-vide processing as a consequence of the low cooking temperatures utilized, frequently below 70°C.

Sodium lactate (NaL), a GRAS food ingredient, has been successfully applied to retain water and to enhance the sensorial quality of cooked meat. More recently several studies have also investigated the action of NaL as an antimicrobial agent during the storage of processed meats [1]. The effect of lactate salts on *L. monocytogenes* has been described as delaying the growth in different substrates [5], and reducing the recovery of injured cells in broth[4]. On the other hand it has also been reported that sodium salts used as curing agents can increase the thermal resistance of *L. monocytogenes* in pork meat [6]. Therefore, our interest was to study the survival of *L. monocytogenes* under different NaL concentratons during the cooking of meat.

AIM

The aim of this work was to determine the effect of sodium lactate on decimal reduction times of *Listeria monocytogenes* in a meat paste at different low cooking temperatures.

MATERIALS AND METHODS

Experimental design

Decimal reduction times (D times) for *L. monocytogenes* were determined at 55°C, 58° and 60°C in a meat paste with 2.4 % and 4.8% of added NaL and without (control). Determinations of D times were repeated twice.

Culture

L. monocytogenes V7 was grown in an overnight culture at 35°C in 100 ml of Brain Heart Infusion broth. Cells were resuspended in 2.5ml of saline solution (0.85%) after centrifugation at 2800 rpm for 30 min. (Sorvall R3C3, Dupont) for inoculation.

Preparation of Meat Paste and Inoculation

A semitendinosus muscle (1.5-2kg) into a cook-in pouch (Grace. S. A., Argentina) was submerged for 1-2 min. in a boiling water bath. Raw meat from the center of muscle was then aseptically taken and ground in a food processor (Moulinex, France). Sodium lactate (food grade) as 60% w/v solution (Farmesa, Argentina) was added to the meat paste to give a 2.4% or 4.8% concentration and mixed in a Stomacher (Lab Blender 400, Seward). Resuspended cells of *L. monocytogenes* (2ml per 100g of meat paste) were added and further mixed to give an initial inoculum of approximately $\log_{10}$ 7 CFU/g. The meat paste (1g) was then transferred to sterilized screw cap tubes (10 x 13mm) and the tubes were sealed with Teflon.

Thermal Processing

Sealed screw cap tubes were completely submerged into a circulating water bath controlled to 0.1°C with a thermostatic controller (MS, Lauda). The temperature in the samples was measured by means of a type T thermocouple placed into a tube with uninoculated meat paste, and recorded in a data logger (Hydra, Fluke Mfg, USA). A set of tubes, three per sampling time, was taken out of the water bath and immediately immersed in an ice-water bath. The first set of tubes (zero time) was withdrawn from the bath when temperature had reached 0.1°C below the tested temperature.

Viable Count

Viable counts of *L. monocytogenes* were done by inoculation of decimal dilutions into CASO agar (Merck, Germany). Plates were incubated at 35°C for 48-72h.

RESULTS AND DISCUSSION

Decimal reduction times obtained are shown in table 1. In the range of extremely low cooking temperatures (55°C-60°C) the effect of raising NaL concentration in the meat paste was demonstrated to be an increase in the thermal resistance of *L. monocytogenes*. At 55°C this effect was more obvious; the mean D time was increased a 36% between the controls (0%) and samples with 2.4% NaL, in comparison with a 9.2% increase when a NaL was elevated from 2.4% to 4.8%. At 58°C and at 60°C these increases were also notable but of less size; they were a 24%

and 9.7% at 58°C and, of a 18% and 7.7% at 60°C when NaL was raised from 0% to 2.4% and from 2.4 to 4.8% respectively. Some authors [1] have estimated that a thermal processing equivalent to 4D is enough to eliminate the potential natural contamination with *L. monocytogenes*. Taking into account the data collected it could be considered, as an example, that at 58°C such a treatment should be of 10 min when there is no NaL in the meat paste, and of 12.4 and 13.6 for a 2.4% and 4.8% NaL concentration respectively. The increment of thermal resistance in meat observed in this study is in agreement with a previous report [4] that described that NaL increased the thermal resistance of *L. monocytogenes* in a culture broth at 60°C. It is apparent from the data obtained that for this strain of *L. monocytogenes* the effect of NaL would not be significant at temperatures over 60°C. However, it is noted that the strain used in this study is not particularly high heat resistant.

Other factors have been reported to elevate the thermal resistance of *L. monocytogenes* like, the rate of heating, presence or absence of a thermal shock, atmosphere, etc. Therefore, it could be speculated that a sum of factors like, for example, a high heat resistant strain, presence of NaL, and a low heating rate would give a situation where *L. monocytogenes* could survive more intense cooking processes. An effective thermal process should consider all those factors to eliminate any risk of surviving *L. monocytogenes* cells.

CONCLUSION

Sodium lactate should be considered as capable of increasing the thermal resistance of *L. monocytogenes* in a meat paste particularly when low cooking temperatures are applied as a way to preserve the sensorial quality of food products, i.e., in sous-vide processing.

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Table 1. Decimal reduction times of *Listeria monocytogenes* in a meat paste with different concentrations of sodium lactate.

Temperature	Sodium Lactate Concentration	D time	r^2	Mean D time
55°C	0%	9.3	0.78	10.4
		11.5	0.95	
	2.4%	13.8	0.92	14.2
		14.6	0.95	
	4.8%	14.8	0.82	15.5
		16.2	0.85	
58°C	0%	2.5	0.87	2.5
		2.4	0.97	
	2.4%	3.0	0.79	3.1
		3.2	0.88	
	4.8%	3.4	0.78	3.4
		3.4	0.93	
60°C	0%	0.9	0.78	1.1
		1.2	0.95	
	2.4%	1.2	0.94	1.3
		1.5	0.92	
	4.8%	1.3	0.96	1.4
		1.5	0.85	