BIOPROTECTIVE ACTION OF *Lactococcus lactis subsp lactis* IN RELATION TO THE CONCENTRATION OF THE CARBON SOURCE AND ITS EFFECT ON pH AND WATER HOLDING CAPACITY

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Background

Poultry is frequently contaminated with spoilage and pathogenic microorganisms [1]. This condition is even more severe under temperature-abused conditions due to improper or inefficient refrigeration; conditions commonly observed during processing and storage of meat and meat products. Selected lactic acid bacteria (LAB) have been suggested as protective cultures because they prevent the growth of spoilage and pathogenic bacteria by nutrient competition, depression of pH, and production of lactic acid, peroxide, diacetyl and bacteriocins. Those bioprotective LAB can reduce the undesirable changes brought about by spoilage microorganisms, even under conditions of temperature abuse commonly observed in the open markets and home storage in tropical countries as Mexico [2,3,4]. However, the ability of LAB to grow and exert the antagonistic effect depends on several factors as the type and concentration of the carbon source, among others. Meat is low in carbohydrates and must be added to ensure the bioprotective activity of LAB [5,6].

Objective

The aim of this work was to evaluate the bioprotective action of *Lactococcus lactis* in presence of 2.5 and 5% of sucrose as a carbon source in raw chicken meat stored under temperature abuse conditions.

Methods

Chicken *Pectoralis* muscle meat was obtained from a local slaughterhouse, skin and bone were removed and meat was cut into 100g portions. Then samples were inoculated by immersion in a cell suspension consisting Chicken *Pectoralis* muscle meat was obtained from a local slaughterhouse, skin and bone were removed and meat cut into 100g portions of *L. lactis* subs *lactis* ATCC 11454 (~10^8cfu/mL) mixed with indicators, *Escherichia coli* ATCC 8937 (~10^8cfu/mL), *Pseudomonas fluoresens* C65 (~10^9cfu/mL), or *Listeria innocua* ATCC 33090, (10^8cfu/mL) and added with 2.5% or 5% of sucrose. Controls were prepared as before but without addition of LAB. Samples were vacuum packaged and stored at 10°C for 8 days and analyzed for *total coliforms*, *Pseudomonads*, and *Listeria.* Finally, the effect of sucrose concentration on pH and water holding capacity (WHC) were evaluated only in samples inoculated with *L. lactis.* Analysis of covariance and Duncan's method were used to test differences.

Results and discussion

Populations of coliforms, *Pseudomonads* (Table 1) and *Listeria* (Figure 1) increased approximately in 1 log in numbers during storage for control samples that were inoculated with each indicator microorganism. Inoculation of *L. lactis* caused a reduction in numbers of *coliforms* and *Pseudomonas* by 1.6 log cfu/cm^2, according to the sucrose concentration. Bacterial reduction was more evident in samples containing 5% sucrose. Additionally, *L. lactis* ATCC 11454 produce the bacteriocin nisin that caused an immediate reduction in numbers of *Listeria* from 5.5 to below 3 log cfu/cm^2 as can be seen in Figure 1.
Figure 2 shows the evolution of pH and WHC in samples inoculated with L. lactis ATCC11454 added with 2.5 and 5% sucrose. A significative reduction in these parameters was observed and related to the amount of sucrose as presented in Table 1.

Conclusions

Inoculation with *Lactococcus lactis* subsp *lactis* improved food safety by inhibiting undesirable microorganisms under temperature abuse conditions. The inhibitory activity of *L. lactis* was more effective when 5% of sucrose was added. However, excessive pH reduction diminished WHC and therefore the whole meat quality. Hence, carbohydrate concentration must be regulated to encourage both the bioprotective activity of selected LAB without affecting meat functionality.

Pertinent literature

[1] Lüke F.K. (2000) *Meat Sci.***56**:105-115.
[2]]Stiles, M. E. (1996) *Ant. Van Leeuw.* **70**, 473-478.
[3] Vandenbergh, P. A. (1993) *FEMS Microbiol. Rev.* **12**, 221-238
[4] Hugas, M. (1993) *Eurocarne*, **15**: 47-53
[5] McMullen, L.M. y Stiles, M.E. (1996), *J. Food Prot.* Supl. 64-71
[6] Aymerich, M.A. and Hugas, M. (1998), *Eurocarne*, **72**: 39-51.

Table 1. Means for pH, WHC and microbial populations of poultry meat stored at 10°C during 8 days. Control samples were inoculated with an indicator bacteria (*E. coli* ATCC 8937, *P. fluoresens* C65 or *Listeria innocua* ATCC 33090); samples treated with a mixture of *L. lactis* ATCC 11454 an indicator bacteria.

	pH		WHC		Pseudomonads		Coliforms log cfu/cm^2		Listeria	
Sucrose	2.5%	5%	2.5%	5%	2.5%	5%	2.5%	5%	2.5%	5%
Control	5.67^a	5.52^a	19.2^a	15.2^b	5.59^a	5.16^b	6.11^b	6.5^a	5.77^b	6.24^a
L.lactis	5.35^b	5.04^b	10^c	5.7^d	4.1^c	3.56^d	5.54^c	4.76^d	4.86^c	3.11^d

Means with different subscripts are significantly different ($p<0.05$)

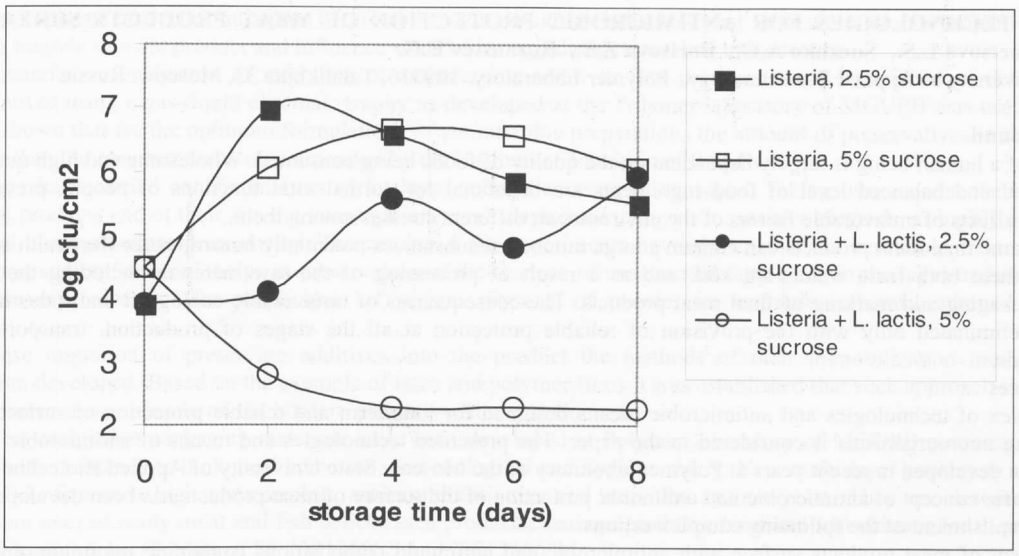

Figure 1. Growth of Listeria in poultry inoculated with *L. lactis* ATCC11454 and *Listeria innocua* ATCC 33090 with 2.5 and 5% of sucrose and stored at 10°C.

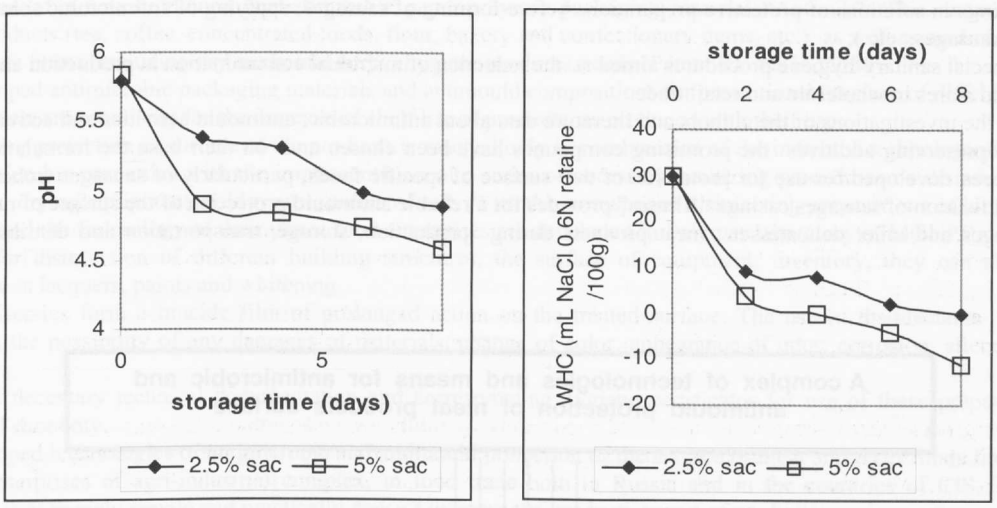

Figure 2. Evolution of pH and WHC of poultry inoculated with L. lactis ATCC 11454 with 2.5 and 5% of sucrose and stored at 10°C