CHANGES IN MICROFLORA AND MYOFIBRILLAR PROTEINS OF RAW CHICKEN BREAST INOCULATED WITH BIOPROTECTIVE CULTURES

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Background

Poultry is usually chill stored and distributed packed in oxygen semi-permeable films that simulate a low oxygen environment. Spoilage of poultry stored at low-temperature is mainly due to microorganisms belonging to the genus Pseudomonads and Acinetobacter [1]. Lactic acid bacteria (LAB) are part of the initial microflora that develops after meat is packed under vacuum or modified atmosphere, therefore under this conditions the microflora is able to change from putrefactive gram-negative bacilli to fermentative LAB [2]. This change produces a dramatic effect on the shelf life extension; which is even more severe in conditions of temperature abuse, commonly observed in the open markets of Mexico.

Selected LAB has been suggested as protective cultures because they prevent the growth of spoilage and pathogenic bacteria through several mechanisms like nutrient and oxygen competition, competition for adhesion sites, depression of pH and production of several metabolites like lactic and acetic acids, hydrogen peroxide, diacetyl and bacteriocins [3,4].

There are many reports regarding the inhibition of food spoilage organisms in fresh meat by addition of LAB [5,6,7] however, production of organic acids and the subsequent decrease in pH may well induce denaturation of meat proteins which are responsible of textural attributes and functional properties of muscle foods.

Objectives

To evaluate the effect of inoculation with bioprotective LAB on the microflora and myofibrillar proteins of raw chicken stored under temperature abuse conditions.

Methods

LAB cultures *L. lactis* ATCC 11454 and *S.carnosus* (Ch. H. MC-1-02055) were used as inoculum because of their capacity to growth on this substrate. Cultures were transferred into MRS media and incubated at 35°C for 24 hr until OD=1. Chicken breast was purchased from a local market, cut in cubes and portions of 100 g were inoculated by immersion during 10 minutes in a cell suspension added with 2.5% of sucrose, leaving a batch without inoculum as a control. Samples were vacuum packaged and stored at 10°C for eight days. Changes in pH, water holding capacity (WHC) expressed as ml of retained NaCl 0.6 N per 100g of meat subjected to centrifugation [8]. *L*, *a* and *b* color values were measured (Hunter Lab Color-Flex 45/0 system, USA), and SDS-PAGE myofibrillar profile [9, 10] were followed through the time of analysis.

In order to evaluate the effect of LAB inoculation on the growth of spoilage indicators as Pseudomonads and *Enterobacteriaceae*, samples were inoculated by immersion in a cell suspension consisting of a mixture of *L. lactis* or *S. carnosus* and *E. coli* ATCC 8739 or *P. fluorescens* C65 (10:1). Enumeration of Enterobacteriaceae and Pseudomonads were performed using RVB and GSP media, respectively. Analysis of covariance and Duncan's method were used to test differences

Results and Discussions

Samples were inoculated, vacuum packed and stored at 10°C during 8 days. Figure 1 shows the pH evolution of LAB inoculated and non-inoculated samples. As it can be seen the initial pH was close to 5.8 and it decreased during storage, changes were more noticeable for inoculated samples reaching values of 5.4 and 4.9 after 8 days for *L. lactis* and *S. carnosus*, respectively. Meanwhile, control samples had a reduction in 0.2 pH units, therefore pH was significantly different between non-inoculated and both LAB inoculated samples (Table 1), where samples inoculated with *L. lactis* had the lowest values.

WHC and color are related to the extent of protein denaturation and shrinkage of the myofibril [11]. It was observed a decrease in WHC (Figure 2) for all samples including those non-inoculated. Reduction in pH diminishes electrostatic repulsion forces between filaments and thus water retention. In addition, no significant differences were observed between non-inoculated control samples and those inoculated with *L. lactis* (Table 1). However, samples inoculated with *S. carnosus* had lower WHC even though their pH reduction was less marked, this might be an indicative of protein degradation. In addition the color parameters *L*, *a* and *b* increased during storage. Inoculation with LAB had a significant effect on *L* and *a* parameters although, *b* was not affected by LAB.

SDS-PAGE gel pattern of myofibrillar proteins (Figure 3) shows degradation of myosin heavy chain (MHC) in all samples, being more severe for the non-inoculated control samples. Actin did not show sings of degradation but several bands of low molecular (<30 kDa) were observed, those bands were more noticeable in samples inoculated with *S. carnosus* and might be related to reduction in WHC.

Population of *Enterobacteriaceae* and Pseudomonads (not shown) were lower for samples containing LAB. However, no significant differences were observed for *Enterobacteriaceae* populations between samples (see Table 1). Although, Pseudomonads population decreased by 2 log cfu when compared to control samples, also non-significant differences were detected between *L.lactis* and *S. carnosus*.

Conclusions

Inoculation with selected lactic acid bacteria might be a complementary method to increase shelf life of fresh chicken stored under temperature abuse conditions. However, protein degradation could reduce WHC during prolonged storage.

Literature

[1] Jay, J.M. (1994) Microbiología de los alimentos. Ed. Acribia, S.A., Spain. 90-92.
[2] Hugas, M. (1998) *Meat Sci.* **49** No. Suppl. 1 S-139-150.
[3] Stiles, M. E. (996) *Ant. Van Leeuw.* **70**, 473-478.
[4] Vandenbergh, P. A. (1993) *FEMS Microbiol. Rev.* **12**, 221-238.
[5] Guerrero I., Mendiolea R., Ponce E. & Prado A. (1995) *Meat Science* **40**: 1-15.
[6] Goff, J. Bhunia, A., Johnson, M. (1996) *J. Food Prot.* **59** (11),1187-1192.
[7] Escalona H, Gallardo F., Guerrero I. & Ponce E. (1994) *J. Muscle Foods*, **5**:335-341.
[8] Price, J. F. & Schweigert, B.S. (1971) The Science of meat and meat products, W.F., Freeman and Co., San Francisco
[9] Morgassian, S.S. & Lowey, S. (1982) Methods in Enzymology Ed. S. P. Colowick & O. Kaplan, Academic Press, Inc. N.Y. **vol. 85**:55-73.
[10] Laemmli, V.K. (1970) *Nature* **227**,680-685.
[11] Klont, R., Brocks, L., & Eikelenboom, G. (1998) *Meat Sci.* **49** No. Suppl., 1 S-219-229.

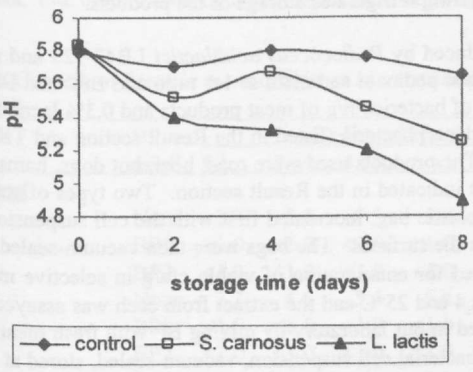

Fig. 1 pH evolution of poultry samples stored at 10°C

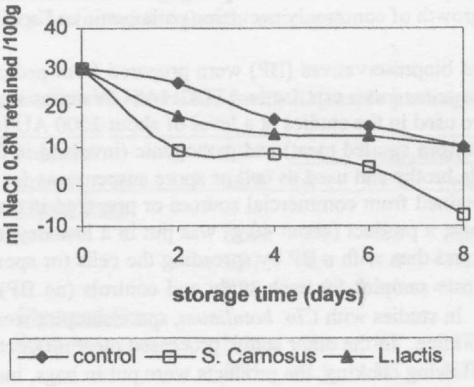

Fig. 2 WHC of poultry samples stored at 10°C

Table 1. Means for pH, color parameters and microbial populations of poultry inoculated with bioprotective LAB and stored at 10°C during eight days

	pH	WHC	Pseudomonads population	*Enterobacteriaceae* population	color *L*	*a*	*b*
control	5.76^{A}	19.2^{A}	4.65^{A}	5.56^{A}	53.55^{B}	9.65^{A}	26.85^{A}
S. carnosus	5.55^{B}	10.0^{B}	2.72^{B}	5.04^{A}	54.67^{A}	9.00^{B}	27.63^{A}
L.lactis	5.34^{C}	17.7^{A}	2.94^{B}	5.03^{A}	52.44^{C}	9.96^{B}	27.21^{A}

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

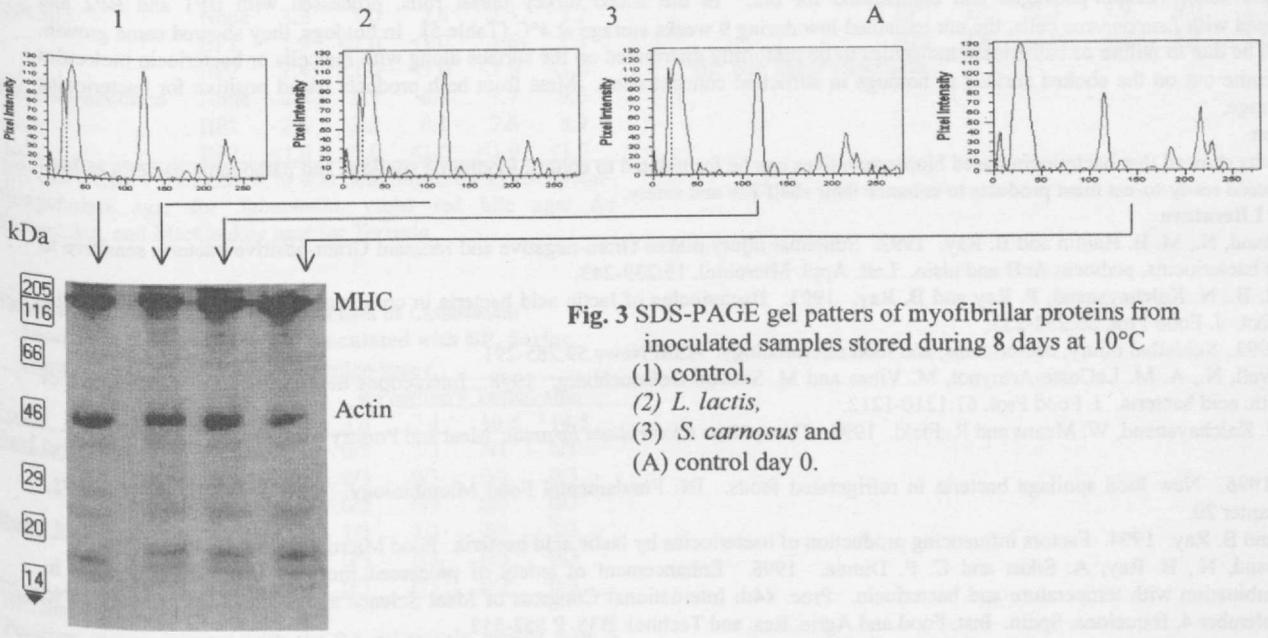

Fig. 3 SDS-PAGE gel patters of myofibrillar proteins from inoculated samples stored during 8 days at 10°C
(1) control,
(2) L. lactis,
(3) *S. carnosus* and
(A) control day 0.