A BIOPROTECTIVE CULTURE FOR SLICED AND VACUUM-PACKED MEAT PRODUCT

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Background

Nowadays there is a need for pré-prepared and ready-to-eat food products, specially the sliced meat products. However, the slicing process increases the surface that become exposed to the microbial contamination which can reduce its quality and shelf life (*6*). The vacuum-packages using a plastic with low oxygen permeability has been used to increase the shelf-life of meat products by controlling the undesirable psychrotrophic bacteria development. The microaerobic conditions suppresses the growth of the spoilage bacteria such as *Pseudomonas* and *Achromobacter* species, but it allows the growth of anaerobic facultative bacteria such as *Lactobacillus* and *Leuconostoc* species that present a minor spoilage potential. The storage temperature is another very important factor, since as the temperature rises it can increase the microbial development. Many alternative methods have been studied for the improvement and maintenance of the meat quality and its products. The bioprotective cultures could be an additional obstacle, being added to the others with the objective to extend the shelf-life as well as to offer a more safety meat products to the population besides the consumer's tendency for the best quality products, the more natural, the chemical additive free and nutritionally healthy foods.

Objective

The objective of this work was to evaluate the *Lactobacillus alimentarius* utilization on the shelf-life of the sliced and vacuum-packaged chicken-Bologna, storage at 8°C during 8 weeks.

Methods

The Bactoferm B-2 (Chr. Hansen) culture was suspended in sterilized distilled water and left to rest for 20 minutes. The final concentration of *Lactobacillus alimentarius* in the suspension was approximately 10^9 UFC·g^{-1}. Right after sliced, the inoculum suspension was sprayed on the chicken-Bologna resulting in approximately 10^7 UFC·g^{-1}. After spray application the chicken-Bologna was vacuum-packed in 250 g portions and stored for 8°C (±1°C) for 8 weeks. The control samples (without inoculum spray) were maintained in the same conditions as the treated samples. Samples treated or not with *Lactobacillus alimentarius* were analysed on the day of application. Hereafter, the samples were analyzed every week. The samples were analyzed for total coliform (2), mold and yeast counts, lactic acid bacteria (8), psychrotrophic microorganisms and Gram-negative counts (2). For each repetition a 250g packing was used as a sample and the analysis was made in duplicates. The samples pH was carried out using a DIGIMED potentiometer equipped with a combined glass electrode (*8*), at the same time as the microbiological analysis were determined.

Results and Discussion

The inoculated samples presented high levels of lactic acid bacteria count (around 10^7 UFC·g^{-1}) at the beginning of the storage period (Figure 1) due to the *Lactobacillus alimentarius* application while the non-inoculated ones showed only 10^2 UFC·g^{-1} at this time period. On the other hand, by the third week of storage, the non-inoculated samples reached 10^7 UFC·g^{-1} value, an increase of approximately 6,5 logarithmic cycles, while in the inoculated samples this increase was of only one logarithmic cycle during the whole storage period. It was recommended the addition of 10^7 UFC·g^{-1} of the Bactoferm (*1*) to achieve a greater *Lactobacillus alimentarius* efficiency. A high number of *Lactobacillus alimentarius* is recommended since it competes with the spoilage microorganisms for nutrients (3). The lactic acid bacteria are divided into two groups: the homo and the heterofermentative species. The heterofermentative bacteria can produce gas and a different kinds of organic acids, particularly the acetic acid. Consequently the heterofermentative acid lactic bacteria are undesirable in meat products because they can affect negatively its sensorial qualities. However, the homofermentative acid lactic bacteria such as *Lactobacillus alimentarius*, are characterized by its ability in fermenting the carbohydrates to only lactic acid (5). The *Lactobacillus alimentarius* can growth and can have a continuous activity at 2°C (*3*). This can be confirmed in our experiment once the psychrotrophic counts (Figure 2) were high at day zero in the inoculated samples, while the non-inoculated samples increased its counts during the storage period, reaching 10^7 UFC·g^{-1} by the third week. The psychrotrophic growth inhibition was observed when *Lactobacillus alimentarius* was added, since the non-inoculated samples had a 6,30 logarithmic cycles increase during the whole storage, while in the inoculated samples was this increase was of just 1 logarithmic cycle. Furthermore, the inoculated sliced chicken Bologna showed significantly lower Gram negative counts (Figure 3) and completely inhibited the total coliform microorganisms (Figure 4) when compared to the non-inoculated ones, during the whole storage period. The total coliform counts inhibition in the inoculated samples can be explained by the pH lowering at the first three weeks (Figure 5), while in the non-inoculated samples the pH started to decrease by the third week, reaching a close value thereafter. Among various microorganism species, the mold and yeast are favored by the mild acidic conditions, using the acids as a substratum for the metabolism (4). We observed that the mold and yeast development in the sliced chicken Bologna treated with *Lactobacillus alimentarius* did not differ significantly from the control samples during the storage period (Figure 5). Therefore, the acid lactic production of the bacteria contributed to the development of mold and yeast. The inoculated sliced chicken Bologna presented values significantly lower for the Gram negative bacteria counts since the first week of storage (Figure 3) and the total coliform counts (Figure 4) were inhibited during the whole storage period. These results show that the *Lactobacillus alimentarius* indeed caused inhibition in the development of the undesirable microorganisms in sliced chicken Bologna. An inhibition in the indigenous coliform development during the storage period of fresh coarse chopped sausages, when *Lactobacillus alimentarius* was added in the mince preparation was observed (1). Besides the nutrient competition, the acidification observed by the *Lactobacillus alimentarius* could

explain its contribution for the inhibition of coliform development since the pH reduction was about 1,4 units (Figure 5). In this manner, the nutrient competition and the oxide-reduction potential of the food could have an important role in the microbial inhibition produced by lactic acid bacteria (7). By the third week, the control samples began to show some alterations such as the vacuum loss in the packings and a white exsudate, besides the acidic odour and flavor. These alterations increased in the control samples during the storage period. By the fifth week of storage, the control samples had lost the vacuum totally. The unpleasant odour of the vacuum-packed products can be originated by the indigenous heterofermentative acid lactic bacteria growth on meat product, which can produce gases and acetic acid, losing the sensorial characteristics. The addition of bioprotective culture can suppress these alterations (3) as it was observed in this work. The Bactoferm B-2 culture predominated the bacterial flora, suppressing the growth of those microorganisms that caused undesirable alterations in the vacuum-packed sliced chicken Bologna.

Conclusions

The application of *Lactobacillus alimentarius* (Bactoferm B-2 culture) contributed for the biopreservation of the vacuum-packed sliced chicken Bologna by acting as a natural hardle to the development of undesirable microorganisms, reducing or inhibiting the spoilage microorganisms, maintaining unaffected the sensorial characteristics and prolonging its shelf life. Therefore, it can be considered as an additional safety factor with a great potential to improve the microbial quality of the meat products. However, it never should be considered as a substitute for the good manufacture practices, but as another barrier for the microbial growth to improve the quality maintenance of the meat products.

Acknowledgments

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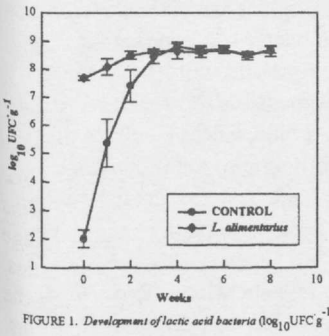

FIGURE 1. *Development of lactic acid bacteria* ($log_{10}UFC\,g^{-1}$) *in sliced chicken Bologna, vaccum-packed and stored at 8°C.*

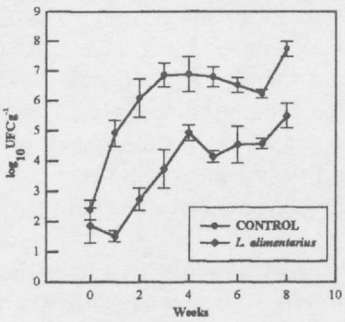

FIGURE 3. *Gram negative bacteria development* ($log_{10}UFC\,g^{-1}$) *in sliced chicken Bologna, vaccum-packed and stored at 8°C*

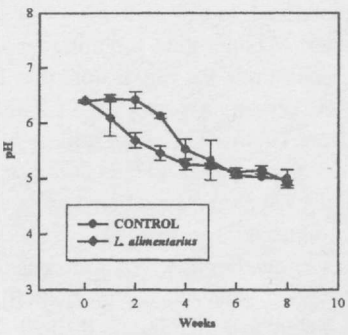

FIGURE 5. *pH determination in sliced chicken Bologna, vaccum-packed and stored at 8°C.*

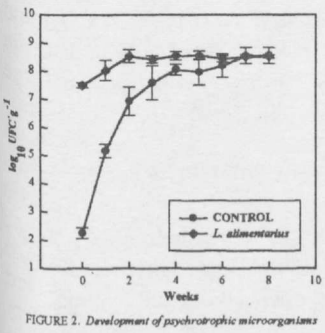

FIGURE 2. *Development of psychrotrophic microorganisms* ($log_{10}UFC\,g^{-1}$) *in sliced chicken Bologna, vaccum-packed and stored at 8°C.*

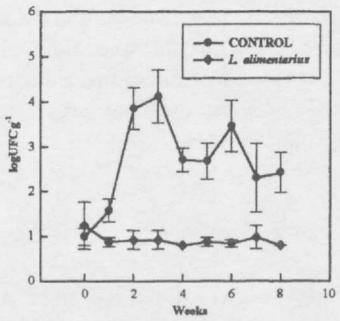

FIGURE 4. *Total coliform development* ($log_{10}UFC\,g^{-1}$) *in sliced chicken Bologna, vaccum-packed and stored 8°C.*

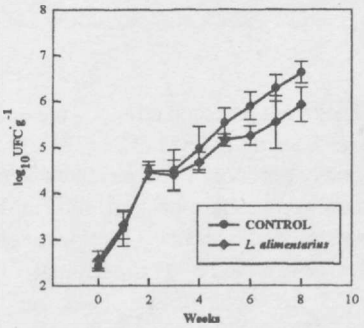

FIGURE 6. Molds and yeasts development ($log_{10}UFC\,g^{-1}$) in sliced chicken Bologna vaccum-packed and stored at 8°C.