Surviving bacteria from mechanically-recovered poultry meat treated with high hydrostatic pressure

Josep Yuste and Montserrat Mor-Mur

Tecnologia dels Aliments (Ce.R.T.A.). Facultat de Veterinària. Universitat Autònoma de Barcelona. 08193 Bellaterra, Barcelona, Spain. Tel.: 34-93-5811446. Fax: 34-93-5812006. e-mail: ivppi@cc.uab.es

INTRODUCTION

High hydrostatic pressure treatment is a non-thermal process which can be applied as a food processing and preservation method (7). It has been tested in meat and poultry to improve microbiological quality and physico-chemical and sensory characteristics (8, 10, 11, 13). High pressure causes microbial inactivation, so it enhances the safety and extends the shelf-life of some food and food ingredients (1, 5, 10).

Mechanically-recovered poultry meat (MRPM) is a raw material with an elevated microbial contamination mainly introduced during manufacturing (3, 4). It is likely to become contaminated with bacteria of human origin because it undergoes extensive handling (3). Great amounts of this meat are produced and, since it shows excellent nutritional and functional characteristics, further processes to preserve it are being investigated as complement to refrigeration. This will make possible a better use of MRPM as ingredient in food products.

A great variety of microbial populations can be found in poultry and poultry-derived products. Psychrotrophic bacteria are cause for concern because they increase in numbers even though the products are stored at proper refrigeration temperatures and, eventually, spoil them (4). Strict sanitary measures should be taken to ensure low initial bacterial counts and to reduce access to pathogens.

OBJECTIVES

The aim of this study was to evaluate the lethal effect of high pressure processing on aerobic mesophilic populations of MRPM and to identify the surviving bacteria from pressurized MRPM.

MATERIALS AND METHODS

MRPM, provided by an industrial company, was manufactured from meat remaining on carcasses and retails originated in poultry processing and kept frozen until use.

For high pressure processing, the equipment used was a discontinuous isostatic press (ACB, Nantes, France). The time needed to achieve the treatment pressure was between 1 and 2 min, depending on the required pressure, and the decompression time was approximately 30 s. The pressure chamber and the liquid inside were cooled or heated to the treatment temperature with a constant flow of an ethanol-water mixture (3:1) or water, respectively. Vacuum-packaged samples of approximately 30 g were pressurized combining different values of pressure (350, 450 and 500 MPa), time (10, 15 and 30 min) and temperature (2 and 20°C).

Microbiological analyses were carried out as Yuste *et al.* (13) described.

For bacterial isolation and identification, 34 colonies were randomly selected from plate count agar (PCA) plates. First, these colonies were all Gram stained and tested for catalase and oxidase. Second, other tests were performed according to the type of bacterium. Indole, methyl red, Voges-Proskaüer (VP), Simmons' citrate, triple sugar iron, fermentation/oxidation (F/O), motility (SIM -sulphide, indole and motility- medium) and growth anaerobically for Gram-negative rods. Indole and motility (SIM medium) for Gram-positive sporeforming rods. Indole, VP, F/O and growth with 6% NaCl for Gram-positive cocci.

RESULTS AND DISCUSSION

Treatments at 20°C gave decreases in aerobic mesophilic bacterial counts slightly greater than pressurizations at 2°C (Table 1).

In general, the higher the treatment pressure the larger the microbial inactivation. Pressurizations at 500 MPa for 15 or 30 min at 20°C showed the best results, giving reductions of more than 2 log units. Carlez *et al.* (1) find reductions of 3 to 5 log units in minced beef muscle treated at 450 MPa for 20 min at 20°C. O'Brien and Marshall (8) report a reduction of 1,62 log units when pressurize ground chicken at 408 MPa for 10 min at room temperature.

In contrast to what it is observed in a previous study (12), the pressure of treatment seemed to affect mesophile counts of MRPM more than the pressurization time.

From 34 selected colonies growing on PCA, only 22 could be identified. When stained, some morphologically-changed microorganisms were observed. In some cases, bacteria grew with difficulties probably due to the damage caused by high pressure; some properties of these bacteria were modified, which caused irregular results in microbiological and biochemical identification tests.

It is known that Gram-negative bacteria are more sensitive to pressure than Gram-positive ones (10). But when colonies were identified, it was observed that microorganisms surviving the high pressure processing were Gram-negative rods, Gram-positive sporeforming rods and Gram-positive cocci (Table 2). O'Brien and Marshall (8) also isolate both Gram-negative and Gram-positive bacteria from pressure-treated chicken.

Gram-positive cocci seemed to be the most pressure-resistant microorganisms since they survived the treatment at 500 MPa. Ludwig and Schreck (6) also find cocci more resistant than rods and observe no correlation with the Gram type.

As food constituents and the food matrix itself probably perform a baroprotective effect and, therefore, increase the survival of bacteria exposed to high pressure (2, 9, 13), it is necessary to investigate how these factors influence the sensitivity of different genera to pressure.

CONCLUSIONS

Although high pressure processing decreases aerobic mesophilic bacterial counts, it is not enough to delay spoilage and improve the quality of MRPM. It is necessary combine pressurization with another treatment, such as the addition of some kind of preservative or a complementary physical process (7, 13).

Under certain treatment conditions, and depending on the type of product pressurized, Gram-negative rods, Gram-positive sporeforming rods and Gram-positive cocci can survive pressure treatment.

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Table 1. Aerobic mesophilic bacterial counts (log CFU/g) of pressurized MRPM.

		20°C	2°C
Reference sample		6,72	6,72
350 MPa	**10 min**	5,12	5,84
	15 min	4,83	5,11
	30 min	5,09	5,75
450 MPa	**10 min**	4,82	5,26
	15 min	5,07	5,54
	30 min	4,77	4,96
500 MPa	**10 min**	4,90	
	15 min	4,62	
	30 min	4,71	5,03

Table 2. Surviving bacteria from pressurized MRPM.

	Gram-negative rods	Gram-positive cocci	Gram-positive sporeforming rods
350 MPa	*Pseudomonas* spp. *Enterobacter* spp.	*Aerococcus* spp. *Enterococcus* spp. *Lactococcus* spp.	
450 MPa	*Pseudomonas* spp. *Escherichia* spp. *Yersinia* spp. *Enterobacter* spp. *Serratia* spp.	*Aerococcus* spp. *Enterococcus* spp. *Lactococcus* spp. *Staphylococcus* spp.	*Bacillus* spp.
500 MPa		*Aerococcus* spp. *Enterococcus* spp. *Lactococcus* spp.	