HIGH PRESSURE PROCESSING OF COOKED POULTRY SAUSAGES: INACTIVATION OF ENTEROBACTERIA AND LACTIC ACID BACTERIA

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Background.

In recent years, consumer requires safe, fresh-like, nutritional and novel foods. So, there is a particular interest in evaluating the challenge of any new technologies, with high pressure treatment being one of the most extensively studied, to manufacture minimally-processed food products.

High pressure processing inactivates microorganisms and induces few changes in nutrient content, taste and odour *(Mertens, 1993; Cheftel, 1995)*. It is, therefore, a promising food preservation method. With regard to microbial inactivation, pressurization affects the cell membrane, which is the primary site of pressure damage, and also causes modifications in morphology and biochemical reactions, protein denaturation and inhibition of genetic mechanisms *(Hoover* et al., *1989)*.

After cooking, when casing is removed and then sausages are packaged, they are handled and usually recontaminated. So, pasteurization after packaging is essential to guarantee a good microbiological quality during chill storage. Heat processing applied at present could be replaced with high pressure processing.

Objectives.

To compare the bactericidal effect of pressurization with that of heat treatment on enterobacteria and lactic acid bacteria and to determine whether high pressure processing is a valid alternative method.

Methods.

Cooked poultry sausages were provided by an industrial company in six-unit vacuum packages and kept at 2 °C until processing. The AOAC official methods of analysis *(McNeal, 1990)* were applied to determine sausage composition. Two pressure treatments (500 MPa for 5 or 15 min at 65 °C) and one heat treatment (80-85 °C for 40 min) were assayed. Samples were stored at 2 °C for 18 weeks. The complete experiment was performed twice. The equipment used for high pressure processing was a discontinuous isostatic press (ALSTOM, Nantes, France). The time needed to achieve the treatment pressure was about 120 s and the decompression time was approximately 30 s. The pressure chamber and the liquid inside were held at the appropriate temperature by circulating hot water. Sausage packages were allowed to reach the treatment temperature in this chamber before pressurization. After processing, they were cooled in running tap water for 30 s. Counts of enterobacteria and lactic acid bacteria were determined 1 day and 3, 6, 9, 12, 15 and 18 weeks after treatment. Twenty-five grams of sausages were homogenized in 225 mL of peptone water (Oxoid, Basingstoke, UK) for 1.5 min in an electromechanical blender and decimal dilutions were also prepared with peptone water. Violet red bile glucose agar (VRBGA; Biokar Diagnostics, Beauvais, France) and MRS agar (Biokar Diagnostics) were used to enumerate enterobacteria (incubation at 37 °C for 24 h) and lactic acid bacteria (incubation at 30 °C for 72 h), respectively. When the *most probable number* procedure was applied, glucose buffer brilliant green bile broth (EE broth; Oxoid) and MRS broth (Biokar Diagnostics) were used; tubes were incubated at 37 °C for 24 h and at 30 °C for 72 h, respectively. To confirm microbial growth, a loopful of these media was transferred to VRBGA or MRS agar plates *(Peeler* et al., *1992)*, which were incubated at the aforementioned conditions.

Results and discussion.

Proximate composition of sausages was: total solids, 35.3% (± 0.13); fat, 15.5% (± 0.14); total nitrogen, 2.3% (± 0.04); ash, 3.3% (± 0.01).

Counts of enterobacteria in untreated samples were 6 log CFU/g (the highest point) at 9 weeks of storage, and then gradually decreased (Table 1). Pressurization proved very effective: insignificant or no growth was detected independently of the treatment and the point of storage. Heat treatment inactivated enterobacteria similarly to pressure treatment.

Regarding lactic acid bacteria, in untreated sausages almost 8 log CFU/g were already found after 6 weeks of storage (Table 2). Bacterial load consisted mostly of such spoilage bacteria, which exerted a competitive inhibition that is reflected by gradual decreases in enterobacterial counts. Pressure treatment caused great inactivation; an initial decrease of more than 3.5 log units was observed; counts did not reach 1 log CFU/g in any pressurized sausages throughout the study. These low numbers confirm the ability of high pressure processing to markedly delay spoilage. *Carlez* et al. *(1994)* found *Lactobacillus* spp. highly pressure-sensitive; these bacteria were not detected during 22 days at 3 °C.

Pressurization at 65 °C greatly improved the microbiological quality of sausages. In a previous study *(Yuste* et al., *1999)*, such treatment was effective to reduce plate counts of mesophilic and psychrotrophic bacteria and to keep them low during chill storage. *Patterson and Kilpatrick (1998)* also combined high pressure with mild heating to treat poultry and UHT milk and found it more lethal against *Escherichia coli* O157:H7 and *S. aureus* than either treatment alone.

Conclusions.

- High pressure processing for short time at mild temperature is an excellent method to enhance the safety and extend the shelf-life of cooked poultry sausages.
- Pressurization can replace heating as a pasteurization treatment of cooked sausages after packaging.

Pertinent literature.

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Table 1. Enterobacterial counts[1] (log CFU/g) of pressurized (500 MPa / 65 °C) and heat-treated (80-85 °C / 40 min) cooked poultry sausages stored at 2 °C for 18 weeks.

	Day 1	Week 3	Week 6	Week 9	Week 12	Week 15	Week 18
Untreated	3.51	4.64	5.38	6.02	5.62	5.23	5.01
Pressurized (5 min)	n.d.[2]	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Pressurized (15 min)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Heat-treated	n.d.	n.d.	0.35	n.d.	n.d.	n.d.	n.d.

[1] n = 4
[2] n.d.: nondetected growth

Table 2. Lactic acid bacterial counts[1] (log CFU/g) of pressurized (500 MPa / 65 °C) and heat-treated (80-85 °C / 40 min) cooked poultry sausages stored at 2 °C for 18 weeks.

	Day 1	Week 3	Week 6	Week 9	Week 12	Week 15	Week 18
Untreated	4.05	6.06	7.74	7.90	7.98	8.20	8.15
Pressurized (5 min)	2.01	1.39	2.07	1.97	1.48	1.99	1.40
Pressurized (15 min)	0.35	n.d.[2]	0.48	0.98	0.50	0.93	n.d.
Heat-treated	0.35	n.d.	0.30	n.d.	0.68	0.30	n.d.

[1] n = 4
[2] n.d.: nondetected growth