# MICROBIOLOGICAL SAFETY AND SENSORY QUALITY OF RAW PERISHABLE PRODUCTS AFTER HIGH PRESSURE PROCESSING

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***Abstract*— the trend for minimally processed products with a high benefit for health is continuing. Increasingly waiving of preservatives and process technology as gentle as possible is requested for the protection of the valuable ingredients. On the other hand the safety of the consumer is still the highest priority. This applies for raw meat products as well as for similar perishable products. There is a special need for such technologies relating to fishery products. These are of eminently high nutritionally use, but represent at the same time a high microbiological risk for the consumer. Therefore these products were chosen as models which can be transferred also for meat products with similar characteristics. To reduce the microbiological exposure innovative technological concepts based on high pressure technology can be used. Previous analysis of several foods including meat products revealed a bactericidal effect on the total aerobic plate count as well as on the amount of *Listeria monocytogenes* through high pressure processing. By increasing the pressure and holding time this effect can be intensified. The aim of this study was to analyse and evaluate the microbiological status of high pressure processed meat and fishery products during the storage period. For this purpose the products are processed with pressures between 200 and 700MPa with different holding times. During the shelf life the products were repeatedly analysed. The contamination of raw poultry sausages with *Listeria monocytogenes* was determined qualitatively as well as quantitatively. Sensory analyses also show changes in the sensory quality of the raw sausages.**

***Index Terms*—Food safety, Fishery Products, High Pressure Processing, Meat Products**

## I. INTRODUCTION

Short ripened raw poultry sausages, require reliable anti-microbial treatments to guarantee a product with a maximum possible microbiological safety to the consumer. Short ripened raw sausage neither undergo long ripening, nor drying processes, nor is the material being heat treated. The product just passes through an acidification process and a very short ripening period. Hence, this does not suffice to fully eliminate all potentially present health threatening microorganisms. Additionally, it is known that poultry products have to be evaluated more critical than those of beef or pork meat (BGVV 1997). In this regard, HARTUNG (2007) could confirm a considerable poultry meat contamination with *Listeria monocytogenes*, which is major jointly responsible for calling short ripened raw sausage a risk product. The same applies for fishery products. These products are perishable and represent a high microbiological risk. *Listeria monocytogenes* has been isolated from seafood on a regular basis since 1987 (Embarek 1994). Consumers demand safe meat products on the one hand and the fresh appearance of minimally processed food on the other. To comply with these demands, high pressure processing (HPP) can be set in during food production (HUGAS et al. 2002). The inactivation of microorganisms by HPP is dependent on the level of pressure, the duration of treatment and the food matrix (GARRIGA et al. 2004). Therefore a pressure-time-combination that allows an adequate reduction of pathogenic organisms has to be identified for each product. The objective of this study was also to determine a combination of pressure and holding time, at which the sensory quality of raw sausage and fishery products is preserved. In fresh meat products it is noted, that HPP over 200 MPa might lead to protein denaturation and according to that changes in colour and structure (CHEAH u. LEDWARD 1996; PFISTER et al. 2000).

## II. MATERIALS AND METHODS

Raw sausage made of poultry were manufactured following the traditional process. Thigh meat from turkey (*M. biceps femoris, M. gastrocnemius and M. peroneus longus*) without skin and bones was taken as raw material. The spiced sausage raw material was vacuum-packaged to 80 g each. After a ripening time of 3 days at + 15 °C the high pressure treatment was performed for 5 min at 300 MPa (B) respectively 500 MPa (D) and 500 MPa für 1 min (C). A control group was not pressure-treated (A). The sensory analysis (DIN 10952-1 (1978-10)) of six raw sausages each was performed by an examiner panel containing six skilled assessors on day 2 and 17 after HPP.
Additionally short ripened sausage raw material was produced with turkey meat, inoculated with *Listeria monocytogenes* (*L.m.*, field strain, serovar 1/2a) in a concentration of $10^3$ (L3) and $10^6$ (L6) CFU/g under defined conditions and vacuum-packaged. After a ripening time of three days at 15 °C HPP was performed for 5 min at

300 MPa (B) and 500 MPa (C) respectively and for 1 min at 500 MPa (D) and 700 MPa (E) respectively. A control group of the raw sausages stayed untreated. At day 1, 6, 9 and 16 after HPP a microbiological analysis of six sausages each was performed to give a *L. m.*-count (EN/ISO 11290-2).
Fresh catfish-filets were vacuum-packed and processsed for 1 and 5 min resp. at 200 MPa, 400 MPa and 600 MPa. The filets were stored at 4-7 °C. At day 1, 5 and 7 a microbiological analysis was performed to give the total aerobic plate count, *Enterobacteriaceae* and anaerobic growing *Lactobacillus*. Furthermore sensory analysis was performed by an expert panel. Microbiological tests with catfish-filets inoculated with *Listeria monocytogenes* will follow.

## III. RESULTS AND DISCUSSION

The results, demonstrated in Figure 1 and 2, showed, that HPP had a germ-inactivating effect on *L.m.* in the analysed raw sausages. This is also in agreement with other authors (LUCORE et al. (2000), MORALES et al. (2006) and GARRIGA et al. (2004)). After a treatment with 500 MPa for 5 min and 700 MPa for 1 min an efficient germ-reduction could be achieved: These treatment variants resulted in a *L.m.*-inactivation of almost 100 % at day 1 after HPP in the raw sausages inoculated with $10^3$ and $10^6$ CFU/g, respectively. After a treatment with 500 MPa for 5 min, *L.m.* was under the limit of detection (2 log) in L3C during the whole storage-time, in L6C just at day 1 after HPP, so especially for contamination rates which can be seen under present practical conditions (HARTUNG 2007) this treatment-variant is suitable to control risks associated with *L.m.* effectively. After HPP with 300 MPa for 5 min, the microbiological status was inadequate. During the 16 days of storage after HPP the *L.m.*-count of all raw sausages increased ($p < 0.05$) except for L3C. The increase of the germ-content was slower in the pressure-treated than in the untreated sausages, but L6B also reached at day 16 after HPP *L.m.*-counts similar to L6A and L3A of over 8 log CfU/g.

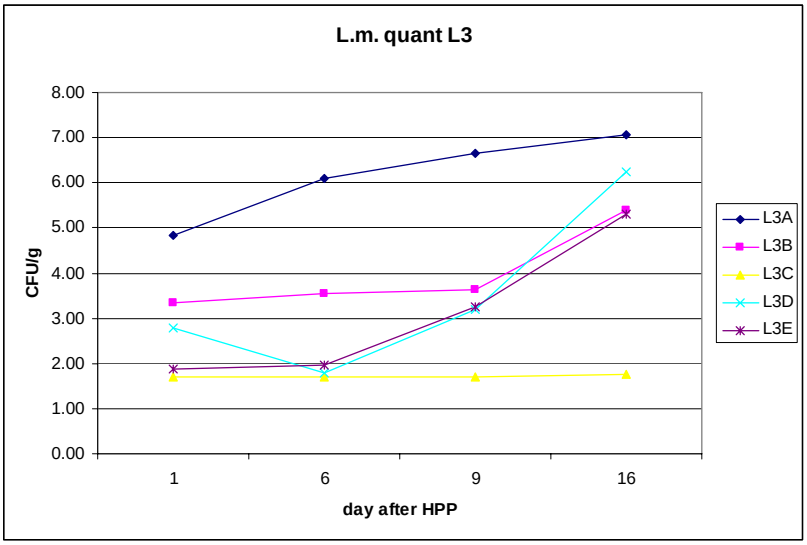


Figure 1*:* Mean *quantitative lg-counts of Listeria monocytogenes in short ripened raw poultry sausage in the samples inoculated with $10^3$ KBE/g L.m. (L3) for the different treatment variants (A = untreated, B = 300 MPa 5 min, C = 500 MPa 5 min, D = 500 MPa 1 min, E = 700 MPa 1 min, n = 6) for a storage-time of 16 days after HPP, n= 6*

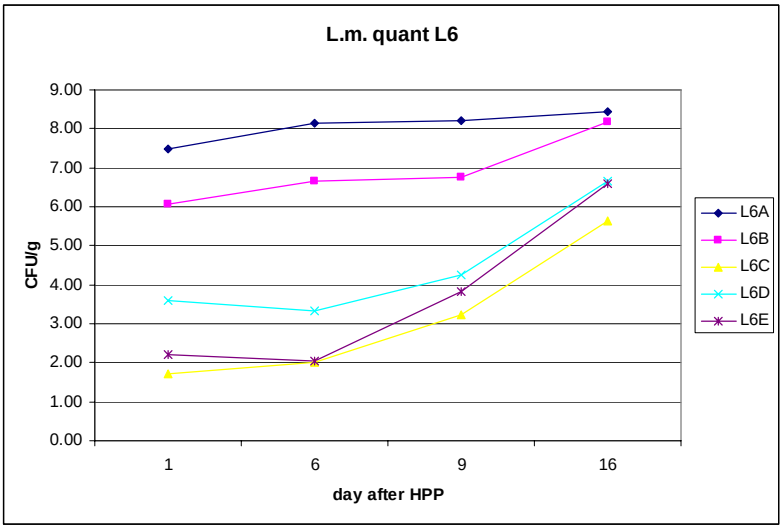


Figure 2: Mean *quantitative lg-counts of Listeria monocytogenes in short ripened raw poultry sausage in the samples inoculated with $10^6$ KBE/g L.m. (L6) for the different treatment variants (A = untreated, B = 300 MPa 5 min, C = 500 MPa 5 min, D = 500 MPa 1 min, E = 700 MPa 1 min, n = 6) for a storage-time of 16 days after HPP, n = 6*

The sensory analysis of the pressurized short ripened sausages is important to detect considerable changes of texture. This is of great relevance for producer and consumer. The effect of HPP on the sensory properties is product dependent and should not be seen in comparison to conventional heat sterilisation (MATSER et al. 2004), which always has a greater influence on the product quality. The results of the sensory analysis of six raw sausages by six trained assessors on day 2 after HPP (Fig. 3) demonstrated that the untreated sausages were considered best, followed by the sausages treated with 300 MPa for 5 min. A treatment with 500 MPa caused great sensory abnormalities compared to A. This could be seen especially in the categories “appearance of cut”, “color”, and “consistence”. In C and D dry-rim-development and a glossy surface because of pressure induced protein-denaturation could be detected. The single components of these sausages, especially fine tendons, could be seen well in the smooth surface, so the composition was rated worse. Correlating to increasing pressure and holding time the color got lighter, caused by beginning denaturation of myoglobin (CHEAH u. LEDWARD 1996; PFISTER et al. 2000).

With sight on the consistency of the raw sausages, HPP-treatment higher than 300 MPa caused firmness; C and D were gummy, crumbly and not spreadable any more. These changes were also caused by protein denaturation (CHEFTEL u. CULIOLI 1997; HUGAS et al. 2002). On the other hand, the consistence of B was even softer than without high pressure treatment. Accordingly to MORALES et al. (2006), SERRA et al. (2007) and YOUSTE et al. (2001), taste and odour were not influenced by HPP. During the storage time the results of the sensory analysis got worse in each case (Fig. 4).

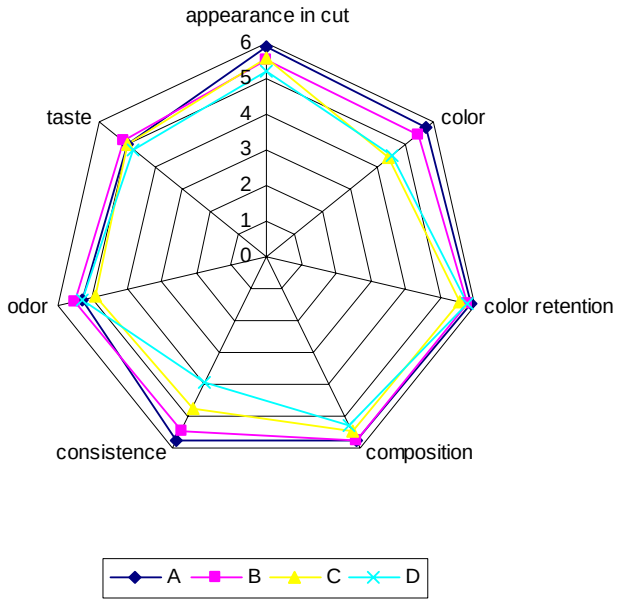


Figure 3: *Mean results of the sensory analysis at day 2 after HPP for the different treatment variants (A = untreated, B = 300 MPa 5 min, C = 500 MPa 1 min, D = 500 MPa 5 min), n = 6*

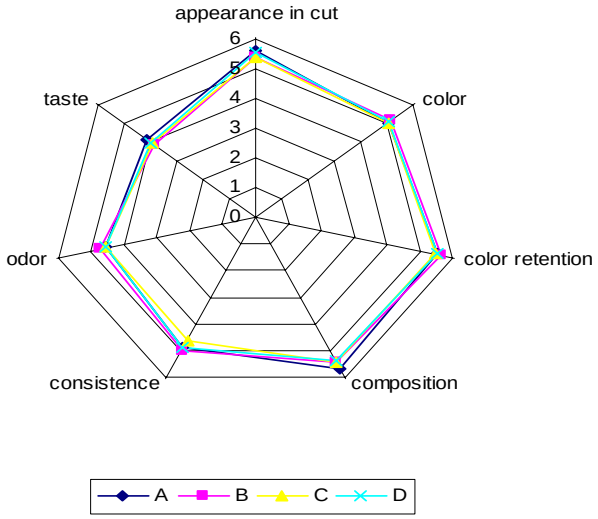


Figure 4: *Mean results of the sensory analysis at day 17 after HPP for the different treatment variants (A = untreated, B = 300 MPa 5 min, C = 500 MPa 1 min, D = 500 MPa 5 min), n = 6*

The results of the microbiological analyses and the sensory analyses of the fishery products will be interpreted in relation to the possibility of extended shelf life without loss of quality or safety for the consumer.

## IV. CONCLUSION

For the consumer the high pressure processing of short ripened sausages made of poultry meat, especially the treatment with 500 MPa for 5 min provides an applicable health-related safeness. The treatment with 300 MPa for 5 min produced acceptable sensory results for the raw poultry sausages.

The ongoing tests with fish products will show if the high pressure treatment will have similar effects on the microbiological and sensory quality of fishery product. Therefore the inoculation with *Listeria monocytogenes* will be performed.


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