HYPERBARIC STORAGE EFFECT ON CAMPYLOBACTER CONTROL ON POULTRY

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I. INTRODUCTION

Hyperbaric storage is an emerging technology currently under investigation as an alternative to traditional refrigerated storage for various foods, including meat [1]. Typically, hyperbaric storage is employed in association with vacuum-packaging [2]. Poultry meat is recognized as a primary source of *Campylobacter* spp., a pathogen that has been identified as the leading cause of human gastroenteritis in the EU and elsewhere [3]. This study aims to: 1) evaluate the effectiveness of hyperbaric storage in reducing the survival of *Campylobacter* spp. in non-packaged poultry meat; 2) assess the impact of hyperbaric storage on the control of poultry meat spoilage microbiota, color and lipid oxidation.

II. MATERIALS AND METHODS

To assess the effect of hyperbaric storage on the survival of *Campylobacter* spp., samples of broiler breast steaks (BI), and neck skin (SI) were inoculated with a mixture of two strains of *Campylobacter jejuni* (NCTC 11168 and a wild strain 46E isolated from poultry carcass), to achieve approximately 6 log ufc/g. Non-inoculated samples [broiler carcass (CS), breast steaks (BS) and neck skin (SS] were submitted to hyperbaric storage (0.22 MPa, 100% O_2, 21°C, 12 hours) using the Hyperbaric chamber (HVM™, 6400, USA). Analysis was performed before and after hyperbaric storage. Total aerobic mesophilic bacteria, psychrophilic bacteria, *Enterobacteriaceae, Pseudomonas* spp., and *Campylobacter* spp. counts were determined in accordance with ISO Standards. TBARS and pH were assessed in broiler carcass (CS) and breast steaks (BS). L*a*b* color measurements were obtained for broiler carcass (CS), breast steaks (BS), and neck skin (SS) using a Konica Minolta CR-400/410 instrument with illuminant D65. These assays were repeated on three separate working days.

III. RESULTS AND DISCUSSION

The inoculated breast steaks exhibited a reduction in *Campylobacter* spp. of 0.55 log cfu/g, decreasing from 5.38 log cfu/g before storage to 4.84 log cfu/g after hyperbaric storage. Similarly, in the inoculated neck skin, a reduction of 1.33 log cfu/g was observed, from 5.87 log cfu/g to 4.54 log cfu/g after storage. These results from the inoculated samples highlight the potential effectiveness of hyperbaric storage with 100% oxygen, in reducing *Campylobacter* spp. contamination. Microbiological counts from non-inoculated samples are presented in Table 1. The effect of storage negatively impacted total aerobic mesophilic and psychrophilic bacteria, *Enterobacteriaceae*, and *Pseudomonas* spp. counts on carcass, breast steak and neck skin samples, probably due to the favorable temperature and to the lack of inhibitory effect of oxygen. Even in not inoculated samples the effect of hyperbaric storage resulted in a significant ($p<0.05$) decrease in *Campylobacter* spp. counts, in carcass and neck skin samples. These findings suggest an interesting potential of this preservation method in controlling *Campylobacter* spp., that deserves to be better understood to perceive what is the effect of the pressure and the atmosphere composition, and the indirect effect of the natural microbiota on the pathogen' behavior.

Table 1 – Microbiological analysis results of carcass, breast steak, and neck skin before and after hyperbaric storage (n=3).

Sample	Carcass					Breast Steak					Neck Skin				
Parameter (log cfu/g)	TA	PA	E	P	C	TA	PA	E	P	C	TA	PA	E	P	C
Before Storage	4.0^{a}	4.8^{a}	1.9^{a}	2.6^{a}	1.2^{a}	4.3^{a}	4.3^{a}	2.4^{a}	3.5^{a}	0.5	4.7^{a}	4.8^{a}	3.4^{a}	3.1^{a}	3.1^{a}
After Storage	5.7^{b}	6.4^{b}	4.4^{b}	5.9^{b}	0.2^{b}	7.2^{b}	7.5^{b}	5.7^{b}	6.7^{b}	0.3	7.3^{b}	7.4^{b}	7.1^{b}	6.7^{b}	2.7^{b}

TA: Total Aerobic Mesophilic; PA: Psychrophilic aerobic; E: *Enterobacteriaceae*; P: *Pseudomonas* spp.; C: *Campylobacter* spp.. Means followed by different letters in the same column are different ($p < 0.05$). Values below limit of detection (10 cfu/g) were considered 0, for statistical purposes.

The analysis of variance revealed that hyperbaric storage had no significant effect on the pH of breast steaks, (pH=5.9) observed before and after treatment. For carcasses, the effect of hyperbaric storage on pH was significant ($p < 0.001$), still small in dimension, from 5.9 before to 5.8 after storage. The color of the carcass remained unaffected by storage, with mean values of L*=63.98, a*=1.54, and b*=14.21. Similarly, the color of the breast steak (BS) was not impacted by hyperbaric storage, with values of L*=55.67, a*=2.65, and b*=11.74. TBARS in all samples were below the limit of detection (0.17 mg MDA/kg). These findings suggest that although hyperbaric storage may potentially induce a prooxidant effect due to the high oxygen exposure, the applied conditions did not lead to lipid oxidation, probably due to the short period of the exposure [1].

IV. CONCLUSION

The use of hyperbaric storage had a very slight impact on *Campylobacter jejuni*. Both inoculated breast steak and neck skin exhibited a reduction in *Campylobacter* spp. of 0.55 log cfu/g, and 1.33 log cfu/g respectively. In non-inoculated samples hyperbaric storage resulted in 1 log cfu *Campylobacter* spp./g reduction on carcasses. Even so, this could be beneficial to increase safety level and accomplishing Commission Regulation (EU) 2017/1495. Yet, the effect of the tested hyperbaric storage conditions favored the growth of the spoilage microbiota, that might negatively impact the quality of the products. The applied conditions did not lead to changes in color or lipid oxidation. These preliminary findings indicate the need for exploring a new approach with different binomial conditions to optimize and effectively increase *Campylobacter* control while preserving and adequate the shelf-life of poultry products.

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