Inactivation of Campylobacter by Ozone treatment of Chicken Breast Fillets at Different Concentrations

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Abstract— **The effectiveness of different ozone concentrations in modified atmosphere packaging on standard skin-on chicken breast as a mean to reduce Campylobacter, a major pathogen found in poultry products was evaluated. Campylobacter jejuni/coli have been recognized as major cause of foodborne disease since the 1980s. They have been associated with human illness through the consumption of undercooked chicken. In four experiments, a total of 120 packs of chicken breast packed in modified atmosphere packaging (80% O_2 and 20% CO_2) were injected with 0, 10, 30 and 60 ppm ozone (O_3) at 5°C. The O_3 introduction was performed using a Teledyne generator Model 465L UV Photometric Ozone. While control packs (absence of O_3) indicated that Campylobacter level was 4 $\log_{10}$ cfu/g after 8 days, O_3 concentration of 10 and 30 ppm resulted in no significant drop in Campylobacter. However, a higher O_3 level of 60ppm showed a substantial 2.5 $\log_{10}$ cfu/g reduction. Ozone treatment at 60ppm appears to be an effective technique for reducing bacteria in breast fillets. It is proposed that the latter treatment could, in a modified atmosphere packaging, be used to reduce the contamination of chicken with campylobacter and improve shelf life.**

Keywords— **Ozone, Campylobacter, Chicken.**

I. INTRODUCTION

Campylobacter is one of the most common causes of food poisoning in the UK; it is prevalent in around 65.2% of chicken at retail (FSA, 2009). The Food Standard agency (FSA) has set in 2010 new targets to reduce campylobacter in UK produced chickens. A new banding approach is used; where samples are grouped into 3 bands (<100 cfu/g, 100- 1000 cfu/g and > 1000 cfu/g) for simplicity and to allow practical analysis when monitoring progress. In order to meet the FSA and consumers' demand of fresher and safer ready to eat products, the poultry industry is in need of innovative processing technologies. Ozone is a potent antimicrobial agent, very reactive form of oxygen, consisting of three oxygen atoms (O_3). It results from the rearrangement of atoms when oxygen molecules are exposed to high voltage electric discharge. It is a strong oxidant that rapidly breakdown to oxygen (O_2). The gas was reported to kill microorganisms by reacting with oxidizeable cellular components such as membrane phospholipids, intercellular enzymes and genomic material (Ramaswamy et al., 2007). This study aimed to investigate the effect of different ozone concentrations on the reduction of campylobacter in skin on chicken breast during the product shelf life.

II. MATERIALS AND METHODS

A total of 120 packs of standard skin-on chicken breasts packed in modified atmosphere (80% Oxygen and 20% Carbon Dioxide) on day of slaughter were collected from a local chicken processor and stored at 5°C for 6hrs. In four experiments, 30 packs were injected with O_3 at different concentrations 0, 10, 30 and 60 ppm using an O_3 generator (Model Teledyne 465L UV Photometeric Ozone, Enviro Technology Services, Stroud, Gloucestershire). Breast fillets from the 4 different batches were then sent for microbial analysis at 0, 2, 4, 6 and 8 days. The Campylobacter enumeration method was performed based on ISO/TS 10272-2 and as described by Central Science Laboratory (2009). A 1.0 ml aliquot from the BPW chicken rinse was inoculated onto 3 modified Charcoal Cefoperazone Deoxycholate Agar (mCCDA) plates in duplicate (a total of 6 plates), and 0.1 ml to duplicate mCCDA plates. 1.0 ml of the BPW chicken rinse was transferred to 9 ml ± 0.2 ml of Maximum Recovery Diluent to obtain a 10-1 dilution, and gently agitated for 5 to 10 seconds. 0.1 ml of the 10-1 dilution was inoculated to duplicate mCCDA plates. The inoculum was evenly spread across the surface of the plates. mCCDA plates were incubated microaerophilically at 41.5°C ± 1.5°C for 40 to 48 h. Suspect colonies were examined by oxidase, motility and morphology.

III.RESULTS AND DISCUSSIONS

The introduction of ozone at 10 ppm did not reduce campylobacter in skin-on chicken breast when compared to control as shown in figure 1. After, the concentration was increased to 30 ppm a slight decline in campylobacter levels was observed however it was not significant in comparison to 0 ppm. On the other hand, doubling the level of O_3 to 60 ppm had a substantial effect on campylobacter levels where more than 2 Log_{10} reduction was noticed.

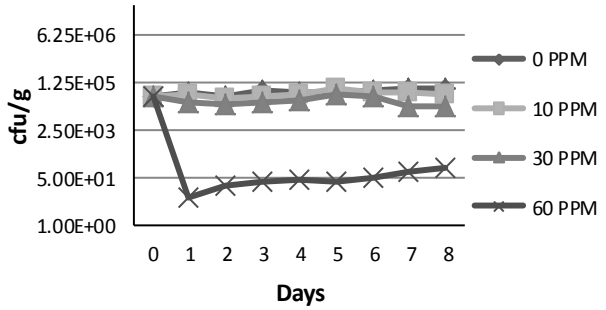

Figure 1: Effect of Ozone at different concentrations on Campylobacter in Skin-on breast fillets

Kim et al. (2001) emphasized that the presence of organic substances (cell debris, or faeces where viruses and bacteria are associated) with high ozone demand may compete with the gram negative bacteria for ozone. Hence it is expected to have a noticeable reduction when the chicken carcass is least contaminated or when higher O_3 levels are injected. The campylobacter reductions achieved in this study were monitored in bands of contamination as set by FSA as shown in table 1.

Table 1: Campylobacter enumeration in chicken breasts after ozone treatments

O_3 ppm	<100 cfu/g	100-1000 cfu/g	>1000cfu/g
0 ppm	0%	0%	100%
10 ppm	0%	0%	100%
30 ppm	0%	0%	100%
60 ppm	90%	10%	0%

IV. CONCLUSIONS

O_3 can be effective in reducing Campylobacter in chicken when the correct dose is used; in this study 60 ppm was significantly different (<0.001) compared to non-treated samples. Investigating the practicality of using this technology in the food industry could be another relevant intervention against campylobacter and food poisoning. However, further research on this technology would be required to examine the effect of O_3 on the quality of chicken.

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