Impact of Overcrowding Sous Vide Water Baths on the Thermal Process of Pork Loins

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Jessica Wu
Overview

● Literature Review
  ○ Sous Vide
  ○ Public Health Significance
● Methods
● Statistics & Results
● Discussion
  ○ Limitations
● Conclusion & Recommendations
● Knowledge Translation
● Future Research Ideas
● Acknowledgements
● References
Literature Review
Sous Vide Cooking

“A process where vacuum-packaged foods are immersed in a temperature controlled water bath (or steam oven)”

– BCCDC (2016)
Sous Vide Pasteurization

- Total time required = CUT + Holding Time

- CUT (Come-up time)
  - Period of time food will take to reach to a specific internal core temperature

- Holding Time
  - Time (after CUT) in which food is held longer at a specific temperature to achieve required log reduction
    - 7 log reductions of *Salmonella* spp. for poultry
    - 6.5 log reductions of *Salmonella* spp. for all other foods
Public Health Significance
Microbiological Hazards

Pathogens of concern:

- *Clostridium botulinum*
- *Clostridium perfringens*
- *Bacillus cereus*
- *Salmonella* spp.
- *Escherichia coli*
- *Staphylococcus aureus*
- *Listeria* spp.
- *Vibrio* spp.
Potentially Hazardous Food: “food in a form or state that is capable of supporting the growth of disease-causing microorganisms or the production of toxins”

– Section 1 (1) of FPR

Potentially hazardous food is prescribed as a health hazard

– Section 2.1 (1) (b) of FPR
EHO Roles

- Should be well informed about sous vide practices
- Inspection
  - Assess food safety and sanitation plans
  - Observe and identify improper sous vide practices
  - Assess time and temperature records
- Education
Overcrowding Water Baths

- Uneven heat distribution
  - Cold spots
- Prolongs time required to achieve full sous vide pasteurization
- Problem if food is taken out earlier
Methods
Methods

Preparation
Methods

Preparation

Cooking

Normal Condition
**Methods**

**Preparation**

**Cooking**

Overcrowded Condition

Top view

Side view

14
Methods

Preparation  Cooking  Data Collection
American Meat Institute Process Lethality Determination Spreadsheet

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Statistics, Results & Discussion
Table 1. Descriptive statistics for $\log_{10}$ reductions achieved in 31 minutes in pork loins cooked under normal and overcrowded conditions.

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<thead>
<tr>
<th></th>
<th>Normal Condition</th>
<th>Overcrowded Condition</th>
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<tr>
<td>Mean</td>
<td>8.75 $\log_{10}$ reductions</td>
<td>1.76 $\log_{10}$ reductions</td>
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<tr>
<td>Median</td>
<td>8.25 $\log_{10}$ reductions</td>
<td>0.58 $\log_{10}$ reductions</td>
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<td>Standard deviation</td>
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<td>0.04 $\log_{10}$ reductions</td>
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<td>Maximum</td>
<td>21.07 $\log_{10}$ reductions</td>
<td>7.93 $\log_{10}$ reductions</td>
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<td>Count</td>
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Statistics & Results

Inferential statistics results:

1. The mean log reductions of *Salmonella* spp. in pork loins cooked under normal conditions at 31 minutes is statistically greater than 6.5 log reductions.

2. The mean log reductions of *Salmonella* spp. in pork loins cooked under overcrowding conditions at 31 minutes is statistically less than 6.5 log reductions.

3. There is no difference in the mean log reductions of *Salmonella* spp. between the pork loins placed on the bottom, middle and top layers of an overcrowded water bath at 31 minutes.
Discussion

• Normal conditions
  • Achieved at least 6.5 log reductions

• Overcrowded conditions
  • Did not achieve at least 6.5 log reductions

→ Experimental findings agree with the recommendation outlined in the guidelines
Discussion

Figure 1. Cross-sectional diagram of log reductions achieved in pork loins cooked under overcrowded conditions at 31 min.

\[ \mu_{\text{top}} = 2.791 \text{ log reductions} \]
\[ \mu_{\text{middle}} = 0.998 \text{ log reductions} \]
\[ \mu_{\text{bottom}} = 1.499 \text{ log reductions} \]
Limitations

● Sample size
  ● Budget and time constraints
● Setting of experiment
● Equipment used
Conclusion & Recommendations

- Overcrowding sous vide water baths does have an impact on the thermal process of pork loins.
  - Food products cooked under overcrowded conditions will require a longer cook time
- EHOs and operators should become familiarized with proper and improper sous vide practices
- Inconclusive that inadequate water circulation will cause cold spots → further research using more samples is recommended
Knowledge Translation

1. Inform guidelines
2. Knowledge enhancement
Future Research Ideas

1. Determine effects of overcrowding in steam ovens
2. Determine maximum optimal food to water bath volume ratio to define overcrowding in sous vide
Acknowledgements

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● Fred Shaw

BCCDC:
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● Sion Shyng
Any questions?
References


References


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