Run-time Optimization for Cooked Meat Products  
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Under NDA

### Background

EW Grobbel is a meat processor located in Detroit, MI. They produce raw and ready-to-eat (RTE) meat products for supermarkets, restaurants, and smokehouses. A problem with any meat product is the potential growth of microbial pathogens. Within RTE meats, the foodborne pathogen *Listeria monocytogenes* is a concern. There are serious public health and economic implications associated with *Listeria monocytogenes*. It causes over 1,600 illnesses a year through listeriosis. RTE meats are responsible for 90% of these illnesses (Sampedro et al., 2022). Furthermore, the USDA-ERS estimated that *Listeria monocytogenes* is a concern. There are foodborne pathogen *Listeria monocytogenes* as molds, yeasts, and fungi. EW Grobbel uses total plate counts as an indicator of pathogen risk.

### Design Alternatives

**Design A: Listeria Growth Study**
- Evaluated potential of *L. monocytogenes* growth
- Replicated plant conditions in laboratory setting
- Quantified growth at 5 timepoints up to 20 hours
- Utilized statistics to determine evidence of statistically significant growth

**Design B: Time Study**
- Equipment is time-consuming to clean
- Has a higher probability of microbial growth than other equipment in the RTE process
- Shift supervisor conducted the time study to detail the breakdown and sanitizing process
- Slicer: 3 Types of Cleaning Procedures for Weber 405 Slicer: Basic, Regular, and Interim
- Dicer: No procedure recommendations, company to design their own based on product characteristics
- Multivac: Cleaning procedure recommendations based on number of hours of use, otherwise based on product characteristics

**Design C: New Sanitations Methods**
- Provide alternative methods of cleaning to improve efficiency
- Draft new methods:
  - Dry Ice Blasting
  - SteraMist (Fog)
  - UV Light

### Recommendations

**Allowable run time for each product**
- Brisket: 20 hours
- Ham: 16 hours
- Turkey: 0 hours (Risk assessment)

**Continue current operations:**
- Continue current cleaning procedures
- Implement UV light technology into slicer components

**Adding 2nd shift:**
- General wipe down of equipment between shifts
- Implement SteraMist Environment System into the quick wipe down process

### Economics

- **Cost inputs**
  - Labor, overhead, sanitation supplies quantity, & production hr
- **Profit inputs**
  - Income, product produced, total cost, & production hr

**Step-by-step approach**
1. Estimated total cost of current and extended runtime
2. Estimated total profit of current and extended runtime
3. Determined economic impact of extended runtime past 8 hr

**Impact of extended runtime ($/run)**
- Ham: $337,480
- Beef brisket: $477,420

### Future Work

- Confirm TPC within limits for extended runtime of beef brisket and ham
- Risk assessment of turkey process
- Confirm efficacy of UV lighting

### Select References

USDA. (2009, October). Verification of less than daily sanitation within any specified period (UDSA, 2009). Regulations require sanitation corresponding to microbial risk established in the Hazard Analysis and Critical Control Points (HACCP) system. EW Grobbel does not have microbial growth data relative to the process to adhere to USDA regulations. This fact suggests a need for microbial growth data relative to the process or an analysis of current sanitation protocols and equipment used to verify the possibility of the extended runtime of the RTE process.

### Problem Statement

Optimize the run time of ready-to-eat meats based on microbial load and sanitation requirements at the EW Grobbel processing plant.

### Goals

- Optimize current cleaning practice efficiency
- Provide data to improve future sanitizing practices
- Increase total operational production runtime
- Provide data to inform 2nd shift addition

### Objectives

- Reduce sanitation time by 12 min
- Reduce total downtime by 18 min
- Justify EW Grobbel’s current cleaning practices of every ~8 hr

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**Table 1:** Mean Listeria Populations over 2-hour period at 51°F (Log CFU/g)

<table>
<thead>
<tr>
<th>Product</th>
<th>Hour 0</th>
<th>Hour 8</th>
<th>Hour 12</th>
<th>Hour 16</th>
<th>Hour 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Brisket</td>
<td>2.97 ± 0.07</td>
<td>3.04 ± 0.02</td>
<td>2.81 ± 0.01</td>
<td>3.03 ± 0.05</td>
<td>3.02 ± 0.06</td>
</tr>
<tr>
<td>Ham</td>
<td>2.99 ± 0.07</td>
<td>3.13 ± 0.05</td>
<td>3.05 ± 0.10</td>
<td>3.14 ± 0.08</td>
<td>3.13 ± 0.07</td>
</tr>
<tr>
<td>Turkey</td>
<td>2.98 ± 0.07</td>
<td>3.13 ± 0.05</td>
<td>3.17 ± 0.04</td>
<td>3.06 ± 0.12</td>
<td>3.15 ± 0.08</td>
</tr>
</tbody>
</table>

**Table 2:** Time Observation Sheet

<table>
<thead>
<tr>
<th>Step #</th>
<th>Step Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 3:** Implementation capacity decision matrix

<table>
<thead>
<tr>
<th>Dry Ice Blasting</th>
<th>SteraMist (Fog)</th>
<th>UV Light</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Worker Exposure &amp; Labor</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Cost Efficient</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ability to be part of daily cleaning</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Disinfecting Efficiency</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Time Efficient</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>2.08</td>
<td>3.91</td>
<td>3.94</td>
</tr>
</tbody>
</table>

- Conduct assessment of prospective approaches by analyzing case studies of plants that have implemented techniques in meat processing settings
- Dry Ice blasting is better suited for sporadic sanitation.
- SteraMist is better suited for overall sanitation of a whole room or superficial machinery cleaning.
- UV Light disinfection is better suited for machinery component disinfection or assembly line component disinfection.