Processing characteristics and eating quality of beef made from hot water treated trim

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Canadian Meat Council – Technical Symposium
October 3rd, 2014
Background

- Post-harvest microbial interventions
  1) Hide interventions
  2) Carcass interventions
  3) Trim interventions

- what is the effect on processing and eating quality?
Objectives

Phase 1
- Effect of hot water pasteurization time on processing characteristics of beef trimmings

Phase 2
- Evaluation of processing characteristics and eating quality of beef made from hot water treated trim
Phase 1

Effect of hot water pasteurization time on processing characteristics of beef trimmings

- Not treated
- Control
- Hot water treated at 85° C
  - 20 s
  - 40 s
  - 60 s
Evaluation of beef trimmings and ground beef

- Processing yield
- Microbial evaluation
  - Total aerobic plate count (APC)
  - Lactic acid bacteria (LAB)
  - Coliforms, *Enterobacteriaceae*
- CIE $L^*$, $a^*$, $b^*$ colour during simulated retail display

Textural characteristics
- Cook yield
- Bind strength
- Texture profile analysis
Processing yield

![Graph showing the processing yield with different pasteurization gains/losses and time intervals.]
Aerobic Plate Counts

Approximately 1 log reduction at >40 sec
1) Redness is affected at 60s for 65/35

2) HWT does not impact colour stability over time
Bind Strength

60s resulted in a significant decrease in bind strength
Summary of Phase 1:

- Results show that 40s treatment provides a significant decrease in microbial counts while maintaining desirable processing characteristics.
Phase 2: Processing and eating quality

85:15

- C
- HW

65:35

- C
- HW

Stored and evaluated at 1, 7, 10, 14 days
Microbial evaluation

- Total aerobic plate count (APC)
- Lactic acid bacteria (LAB)
- Coliforms, *Enterobacteriaceae*

Odour evaluation

- Trained sensory panel evaluation
  - Odour quality
Processing of trimmings
Ground beef evaluation

Simulated retail display

1) Instrumental Color CIE $L^*a^*b^*$

2) Visual assessment - semi-trained panel
   a) Lean beef colour
      (1 = very bright red, 8 = tan to brown)
   b) % discolouration
      [1 = no discolouration (0%),
       6 = extensive discolouration (81-100%)]

3) Oxidative stability (TBARS)
Evaluation of cooked patties

Grilled from frozen – 71 °C internal

✓ Cook loss

✓ Dimensional changes
diameter and thickness change

✓ Textural and hydration properties
  Bind, TPA
  Expressible moisture

✓ Consumer acceptance evaluation
- HWT does not affect processing yield
Aerobic Plate Count

HWT reduced APC by 1 log compared to control
Enterobacteria

HWT resulted in up to 1 log lower counts over storage time
Colour of 85/15 patties

From trim stored for 1 d

From trim stored for 7 d
No effect of HWT on colour stability of 85/15 raw patties

From trim stored for 1 d

From trim stored for 7 d
Colour of 70/30 patties

From trim stored for 1 d

From trim stored for 7 d
No effect of HWT on colour stability of 70/30 raw patties.

Graph shows the redness and lean colour of patties stored for 1 and 7 days, with and without HWT treatment.
1) Hot water treatment has no effect on the oxidative stability over storage.
2) Regular fat patties have lower oxidative stability.
HWT does not affect cook yield

HWT has no effect on shrinkage of patties
Bind strength

- HWT tends to reduce bind strength of cooked patties
Beef odour evaluation - trained sensory panel

**Objective:** Determine impact of HWT on odour of raw trimmings and ground beef

- potential warmed over aroma?
- potential oxidative aromas?
- impact on spoilage aroma over time?
# Beef flavour lexicon

1) Bloody/serumy \((\text{cow blood})\)
2) Fat-like \((\text{cooked suet})\)
3) Metallic \((\text{ferrous sulfide})\)
4) Sour aromatics \((\text{buttermilk})\)
5) Sour/sweet aromatics \((\text{plain yogurt})\)
6) Spoilage \((\text{dimethyl disulfide})\)
7) Warmed over \((\text{re-heated, cooked ground beef})\)

### TABLE 2. DEFINITIONS AND REFERENCES FOR BEEF FLAVOR ATTRIBUTES

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Definition</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal hair</td>
<td>The aromatics perceived when raw wool is saturated with water.</td>
<td>Caproic acid (hexanoic acid) = 12.0 (aroma)</td>
</tr>
<tr>
<td>Beef identity*</td>
<td>Amount of beef flavor identity in the sample.</td>
<td>Swanson’s beef broth = 5.0 (aroma and flavor)</td>
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<td></td>
<td></td>
<td>80% lean ground beef = 7.0 (aroma and flavor)</td>
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<tr>
<td></td>
<td></td>
<td>Beef brisket = 11.0 (aroma and flavor)</td>
</tr>
<tr>
<td>Bitter*</td>
<td>The fundamental taste factor associated with a caffeine solution.</td>
<td>0.01% caffeine solution = 2.0 (flavor)</td>
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<tr>
<td></td>
<td></td>
<td>0.02% caffeine solution = 3.5 (flavor)</td>
</tr>
<tr>
<td>Bloody/serumy*</td>
<td>The aromatics associated with blood on cooked meat products. Closely related to metallic aromatic.</td>
<td>USDA choice strip steak = 5.5 (aroma and flavor)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beef brisket = 6.0 (aroma and flavor)</td>
</tr>
<tr>
<td>Brown/roasted*</td>
<td>A round, full aromatic generally associated with beef suet that has been broiled.</td>
<td>Beef suet = 8.0 (aroma and flavor)</td>
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<tr>
<td></td>
<td></td>
<td>80% lean ground beef = 10.0 (aroma and flavor)</td>
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<tr>
<td>Burnt</td>
<td>The sharp/acid flavor note associate with over-roasted beef muscle, something over-baked or excessively browned in oil.</td>
<td>Alf’s red wheat Puffs = 5.0 (aroma and flavor)</td>
</tr>
<tr>
<td>Chemical</td>
<td>The aromatics associated with garden hose, hot Teflon pan, plastic packaging and petroleum based product such as charcoal liter fluid.</td>
<td>Zip-Loc sandwich bag = 13.0 (aroma)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clorox in water = 6.5 (flavor)</td>
</tr>
<tr>
<td>Cocoa</td>
<td>The aromatics associated with cocoa beans and powdered cocoa and chocolate bars. Brown, sweet, dusty, often bitter aromatics.</td>
<td>Hershey’s cocoa powder in water = 3.0 (flavor)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hershey’s chocolate kiss = 7.5 (aroma), 8.5 (flavor)</td>
</tr>
<tr>
<td>Cooked milk</td>
<td>A combination of sweet, brown flavor notes and aromatics associated with heated milk.</td>
<td>Mini Babybel original Swiss cheese = 2.5 (flavor)</td>
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<td></td>
<td></td>
<td>Dillon’s whole milk = 4.5 (flavor)</td>
</tr>
</tbody>
</table>

Adhikari et al, 2011
Objective 1: Determine impact of HWT on consumer acceptability of cooked ground beef patties

- 9-point hedonic scale
- overall acceptability, appearance, colour, flavour, juiciness, texture, aftertaste
Odour evaluation - results

1) No development of ‘warmed over’ aroma
2) Significantly more spoilage development in control
Odour evaluation - results

Spoilage over time – Control more significant at day 10 & 15
Consumer evaluation

Objective 2: Determine impact of HWT on consumer acceptability of raw beef patties

- 9-point hedonic scale
- overall acceptability, colour

Result:
- HWT does not impact acceptability of raw beef patties
Consumer evaluation - results

Hot water treatment DOES NOT affect the consumer acceptability for cooked ground beef patties.
Putting it all together... Focus groups

Objective: Investigate consumer attitudes towards the process of HWT of beef

Take home message...
- if purpose of process is to improve safety, it is acceptable
- frozen burgers presented during sessions were well received by all groups
Conclusions

- Hot water treatment of beef trimmings has no effect on:
  - Processing yield
  - Colour stability of ground beef patties
  - Oxidative stability of product stored up to 7 days or ground beef displayed in a retail cabinet
  - Cooking characteristics (cook loss, shrinkage)
  - Textural properties of cooked patties
  - Visual acceptability of raw beef patties
  - Acceptability of cooked beef patties
Take home message...

Hot water treatment of beef trimmings is an effective way to improve the microbiological safety of ground beef without detrimental effect on quality.
Thank you!

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