Salt Reduction in Processed Meats - achievements and challenges

Kerry Foods
Cyril Cunningham
2004 Salt reduction guidelines communicated to the Industry, (Kerry Foods had already engaged in a 10% reduction in our bacon products)

Requirements were applicable to our following categories

- Sausages
- Bacon
- Puddings
- Cooked Meats

Targets

- 2.2% in Sausages
- 3.3% in Rashers
- 2.5% in PPSCooked (cured) Meats
How was this going to affect...

- Our flavour
- Our Shelf life
- Our customers

Following debate and inquiry.....

- Inclusion and Action
Salt Reduction

- **Salt replacers**
  - Potassium Chloride
    - Originally discounted because it was felt that the preferred approach was to educate consumers away from salty flavours.
  - Milk Mineral Blends
    - Considered too high a cost in use
  - Flavour enhancers
    - MSG – considered to have a negative consumer image.
  - Yeast Extracts
    - Various types available, some with differing impacts on flavour

- **Effects on labelling**
  - Clean Labelling was a goal for us
  - We would strive to deliver flavour without unnecessary ingredients.

- **Eat healthy ranges**
  - Launched to deliver lower salt and lower fat options for consumers.
  - Small uptake relative to standard sausages and rashers
  - Significant growth in PPSCM
SAUSAGES
- Major sausage provider in ROI

- Flavour consistency was a major part of this success

- Any changes in flavour were viewed with caution

- All flavour impacts were to be assessed

- Texture would also be impacted
Perceived Saltiness

- High Salt 2.4%
- Medium Salt 1.9%
- Low Salt 1.4%
Samples were always initially judged in-house, with potentially favourable recipes going to commercial sensory panels for assessment.

These were assessed for various characteristics and compared to a control sample.
- **Star Diagram: Sample Control 744 & Trial 422**

**Consumer taste trials (Example)**

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<table>
<thead>
<tr>
<th></th>
<th>Test1</th>
<th>Test2</th>
<th>Control</th>
<th>Brand 1</th>
<th>Brand 2</th>
<th>Brand3</th>
<th>Brand 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>6.20</td>
<td>6.08</td>
<td>6.62</td>
<td>6.10</td>
<td>5.73</td>
<td>5.61</td>
<td>6.22</td>
</tr>
</tbody>
</table>

*Note: The table includes a legend indicating the level of significance for differences among brands.*
Star Diagram: Sample Control 744 & Trial 422

Significant differences are indicated by the following key:
*** = 0.1% significance level
** = 1% significance level
* = 5% significance level
? = 10% significance level

Control Sample 744 is significantly higher in salt, is slightly lower in white pepper and is higher in salt aftertaste. It is also significantly more greasy upon the lips and leaves the mouth greasier than 422.
PCA:
Overall Plot:
Salt Levels

Products towards this side of the plot are more meaty/porky in odour and flavour.

Products towards this side of the plot are more salty, have a stronger overall flavour and are less bready.

Products towards this side of the plot are higher in piggy and animal fat notes.

High Salt 2.4%
Medium Salt 1.9%
Low Salt 1.4%
Interaction between A: Salt and B: MSG

These two plots show the interaction between Salt and MSG, the plot on the left is with yeast included and the plot on the right is with yeast excluded.

With Yeast
Adding MSG at the low and middle salt level increases the overall flavour,
At the high salt level adding MSG decreases the overall flavour.

Without Yeast
When yeast is not included adding MSG at all of the salt levels reduces the overall flavour.
Sausages (Summary)

- Maintaining flavour profile while reducing salt has proved difficult
- Initial requirement to reduce salt to 2.2% achieved
- Taste Panel experiments are giving further direction
- Sausages currently contain <0.75g Na /100g
- Eat Healthy Sausages have a current level of 0.56g Na/100g
- We will continue to work toward the 0.55g level for the remainder of our sausages
RASHERS
The connective tissue membranes and cell membrane prevent the free movements of ions in muscular tissue.

The diffusion of salts is very slow in meat; it is more the question of days for salt to diffuse than hours (Ockerman et al., 1999; Vestergaard, Risum, & Adler-Nissen, 2004).

Offer and Knight (1988) mention the “tiger stripe”-type appearance caused by uneven distribution of brine just after the injections. The diffusion is normally accelerated by brine curing and subsequent tumbling for several hours.

Hamm (1981) and Offer and Knight (1988) pointed out that whole meat and a piece of meat behave in a different manner than chopped meat. In chopped meat the connective tissue is to a large extent disrupted and fibres and myofibrils are broken. Puolanne (1999) has calculated that during the normal chopping of cooked sausage batter the cutter knife smashes on average every point of the sausage batter at least once. Hence salt, water and phosphates are able to directly attach the filaments in every part of the batter.

In addition, Offer and Knight (1988) concluded that the endomysial connective tissue acts as a mechanical restraint to swelling. They also stated that if myofibrils are exposed to large excess of salt solution, especially in the presence of polyphosphates, myosin molecules formed by depolymerisation of the thick filament will tend to be extracted, and this will not result in swelling.

Wilding et al. (1986) also claim that endomysial sheath acts as a restraint to myofibrillar swelling.
Salt requirements for this product are different to the other meat product categories because of the distribution issues.

This can cause problems especially when salt distribution is not assisted by some mechanical means, and time is not available to allow this distribution.

Nevertheless, we continued to work towards a solution for our rasher products

We are currently on average, below the salt levels required by FSAI
Denny Salt Results

Sample no.

% NaCl

Std Deviation = 0.31

Linear (%NaCl)

Std Deviation = 0.27
Rashers – Normal Curves

\[ \phi_{\mu,\sigma^2}(\chi) \]

- $\mu = 0, \sigma^2 = 0.2$ (light blue)
- $\mu = 0, \sigma^2 = 1.0$ (red)
- $\mu = 0, \sigma^2 = 5.0$ (purple)
- $\mu = -2, \sigma^2 = 0.5$ (green)

$x$-axis: $-5$ to $5$

$y$-axis: $0.0$ to $1.0$
3 - sigma Rule (68 – 95 – 99.7)

From Wikipedia
If we worked to MAX level of 1.3g Na (3.25% salt equivalent)

For Wiltshire type/Traditional cure Bacon this 3 Sigma rule creates problems

- Most of the Wiltshire process involves salt distribution by immersion
- This is not a very effective way of getting good distribution at lower salt levels.
- SD of 0.5 can be common
- Therefore, for a maximum level of 1.3g Na, the average salt will have to be 2.25%, with levels of 1.25% occurring every 40 packs
- This can be considered too low for safety
COOKED HAMS & PPSCM*

* Pre Packed Sliced Cooked (cured) Meats
Currently a major provider of PPSCM to the ROI Market

Main products are Hams of various styles, and Luncheon type sausages (*Sliced Luncheon Roll, Ham & Chicken Roll, Pork Onion & Tomato Roll*)

Hams are a different proposition to Sausages
- Whole Muscle generally
- Salt more difficult to distribute
- Mechanical action normally required
Reducing salt could have two main effects in our Hams

- Salt soluble protein extraction, with subsequent bind and texture issues
- Flavour

What we did

- For bind and salt soluble protein extraction.
  - Adjusted meat preparation techniques to enhance extraction at meat surface.
  - Adjusted phosphate levels when present, to deliver comparable product
  - Adjusted processing techniques to deliver comparable bind, bite and mouthfeel.

- For Flavour
  - Product succulence had a major part to play in salt perception
  - As slightly higher level of free water on the slices gave a more immediate salty taste than a dryer product with the same salt level.
  - Again, this was achieved by modifying the production process to deliver this effect.
Initial reduction levels were easier to achieve, and did not involve additional ingredients.
- This was assisted by the fact that most of our products involve a degree of massaging to distribute the brine more effectively.

Future reductions may require salt replacing ingredients.

Kerry Foods are currently at, or below, the initial 2010 targets of 2.5g salt or 1g sodium/100g for all our sliced hams.
- Salt Levels in our Deli Style Hams (a major line) is 2.25%
- We have been able to achieve sodium levels of less than 0.67g/100g in our Eat Healthy and Waifos ham ranges.
- Salt levels in our cooked Luncheon type products have been reduced to 1.7% (0.67g Na/100g).
Kerry Foods involved in FSAI and FSA reduction programs

Meat products:
- Sausages reduced by 25%
- Bacon reduced by 20%
- Cooked cured meats – at or below target levels

Dairy products:
- Processed Cheese reduced by 10% (All added salt has now been removed)
- Yellow fat spreads reduced by 6% - main brand,
  - process in place for all brands to achieve 5% reduction by year end

Sandwiches:
- “Healthy Ways” < 2g salt per sandwich
- 75% of std range < 2.4g salt per sandwich
How much salt have we removed?

- Given our starting point in 2003 and our current position today…
  - We have removed the equivalent of over 100 tonnes of salt from Irish diets
  - This is probably enough salt to create a 3 inch wide strip of salt from here to Drogheda, Navan or Kildare.

- However:
  - 4g reduction per day, Pop 4 million…
  - Equivalent to 4m x 0.004kg/day
  - = 16,000kg/day
  - 5,840 tonnes salt reduction per annum (16 x 365)

- We still have a way to go, and will continue on our journey
Thank You