Meat flavour
- What does the Consumer Like?

Linda Farmer
Agri-Food and Biosciences Institute,
Newforge Lane, Belfast BT9 5PX
Meat Flavour
- What does the Consumer Like?

- £££ €€€ $$$$ - all comes from the consumer!

- Beef
- Lamb

Consumer, sensory and instrumental studies to understand beef and lamb flavour
What does the consumer want from beef eating quality?
Prediction of overall acceptability of beef by tenderness and flavour

Grilled sirloin
German, Spanish and British consumers

Regression coefficients (P < 0.001)

<table>
<thead>
<tr>
<th>Consumer Country</th>
<th>Tenderness coefficient</th>
<th>Flavour coefficient</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>German</td>
<td>0.50</td>
<td>0.50</td>
<td>0.99</td>
</tr>
<tr>
<td>Spanish</td>
<td>0.40</td>
<td>0.59</td>
<td>0.99</td>
</tr>
<tr>
<td>British</td>
<td>0.40</td>
<td>0.59</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Oliver et al., Meat Science 2006
Consumer data from different countries (Meat Standards Australia)

Relative contribution of flavour liking (FL) and tenderness (TE) to satisfaction in grilled beef for different consumer countries

<table>
<thead>
<tr>
<th>FL &gt; TE</th>
<th>FL = TE</th>
<th>FL &lt; TE</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. Ireland</td>
<td>Australia</td>
<td>Japan</td>
</tr>
<tr>
<td>Ireland</td>
<td>France</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. Africa</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Rare, medium or well done beef - same effect
- Cooking method - flavour liking even more important for RST than GRL
Beef Eating Quality

Consumer perceptions

Production & processing factors

Precursors

Meat science

Collagen, proteolysis, sarcomeres

Mechanisms of formation

Odour compounds

Flavour

Appearance

Texture

Can we explain consumer liking?
Beef Eating Quality

Preference mapping

Meat science

Production & processing factors

Meat science

(Bio)chemistry

Sensory science

Odour compounds

Appearance

Texture

Preference mapping

Can we explain consumer liking?

Consumer perceptions
Understanding consumer perceptions of beef

Farmer et al., ICOMST 2010

Beef from range of production /processing methods

Consumer panels
Sensory profiling panels
Meat quality Measurements
pHu, shear force...
Chemical Measurements
Sugars, amino acids

Multivariate statistics
ANOVA, External and internal preference mapping, hierarchical cluster analysis
Understanding consumers

External preference map for grilled beef sirloin for principal components, PC1 and PC2
Understanding consumers

External preference map for grilled beef sirloin for principal components, PC1 and PC2

- Overall liking
- Juiciness
- Tenderness
- Aroma Liking
- Livery
- Chewy
- Crumbly
- Flavour Liking
- Tenderness
- Overall liking
- Aroma Liking
- BeefyAR
- BitterF
- SweetF
- SourF
- FattyAT
- OpenAP
- ContsAP
- PinkAP
- CardbAT
- LiveryAT

< PC1 (67%) >
< PC2 (16%) >
Understanding consumers

External preference map for grilled beef sirloin for principal components, PC1 and PC2

- **Overall liking**: Juiciness, Tenderness
- **Aroma Liking**: TemppH6, OpenAP
- **Flavour Liking**: BitterF, SweetF, FattyF, SourF
- **Tactile**: ChewyT, StringyT, LiveryAT, CrumblyT, RubberyT
- **Fat indices**: B7, B4, B12, B10, B3, B1, B13

Understanding the map:
- **PC1 (67%)**: TemppH6, B7
- **PC2 (16%)**: WBSF, pHu

**Note**: The map visualizes the relationship between different attributes and the perception of consumers regarding grilled beef sirloin.
Understanding consumers

External preference map for grilled beef sirloin for principal components, PC1 and PC2

- B7
- B12
- B13
- B10
- B3
- IMP
- Totalfat
- TotalSat
- TotalUnsat
- MUFA
- OpenAP
- pHu
- TemppH6
- C18-3c
- C18-2c
- WBSF
- OilyAP
- PinkAP
- ContsApp
- IMP
- CardbAT
- SourAT
- ChewyT
- StringyT
- SourF
- n-6
- PUFA
- B1
- B11
- B12
- B13
- B10
- B3
- IMP

< PC1 (67%) >

< PC2 (16%) >
Understanding consumers

External preference map for grilled beef sirloin for principal components, PC1 and PC2

a lot of information ...
Focusing on flavour

Flavour, odour and aftertaste only
Using flavour and aroma terms only
- trained panel and consumers
Using flavour and aroma terms only
- adding classes of volatiles
Using flavour and aroma terms only
- adding classes of volatiles and precursors

Consumer flavour liking is associated with Maillard products and precursors.
**BEEF**

**Consumer flavour liking is linked to:**

- “sweet flavour”
- “Maillard” odour compounds
- Sugars and amino acids in raw meat

**Consumer liking is INVERSELY related to:**

- “sour” or “bitter” flavour, “cardboard aftertaste”
- High pHu, lipid-derived volatiles
1. Seven treatment study
   (as for beef)

2. Gender and age study
External preference map - lamb loin
Gender and age study

• Effect of age and gender on eating quality

• Treatments
  - Ewe and ram lambs
  - Ram lambs mixed with ewe lambs or not
  - Slaughter dates from 5 to 11 months

• Not focusing on treatments today …

… What can we learn about consumers?
Understanding consumer perceptions of lamb flavour

Lamb from different age/gender groups

Consumer Panels

Sensory profiling panels

Loin samples grilled

Multivariate statistics
REML, external and internal preference mapping, hierarchical cluster analysis
Lamb loin - flavour and aftertaste
(external preference map)
Lamb loin - flavour and AT attributes
(internal preference map - flavour liking)

PC1 (15.5%)
PC2 (12.5%)

LikingFL

CG1 (29)
CG2 (55)

RU9.75
RM9.75
E7.25

RU7.75
RM7.75
RU6.5
RU8.5
RM8.5

RU10.75
RM10.75

E10.75
E5.5
E7.25

RU5.5
RM5.5

Lamb loin - flavour and AT attributes
(internal preference map - flavour liking)

Consumers form two main cluster groups with differing likings...
Cluster groups for flavour liking

- CG1 (n=29) like lamb flavour, especially older lambs
- CG2 (n=55) like most lamb flavour, dislike 7.75 mo lambs
Consumers can differentiate dates of slaughter on aroma alone!
Cluster groups for aroma liking

- CG1 (n=68) like lamb aroma, do not differentiate
- CG2 (n=13) like most lamb aroma, differentiate
- CG3 (n=5) like the lamb aroma others don’t!
LAMB

Consumer liking of flavour is linked to:

- “sweet flavour”, “roast lamb flavour”
- Sugars, n-3 fatty acids
- Other precursors > ongoing studies

Consumer liking of flavour is INVERSELY related to:

- “bitter”, “sour”, “musty”, “ram” flavours
- WBSF, n-6 fatty acids
Conclusions

Consumer liking for flavour can be linked to:

- Sensory profiling attributes
- Precursors
- Odour compounds
- Meat quality measurements

Consumers are discerning!

- Can differentiate as well as trained panels
- Not all alike > different markets?

Consumer liking for flavour can be explained ...
Flavour formation

Base cause
- Age/maturity?
- Breed/genetics?
- Diet
- Marbling, IMF
- pHu
- pH/T decline
- Ageing
- Muscle
- Cooking method
- Contamination

Formation pathways
- Proteolysis
- Glycolysis
- ATP / IMP breakdown
- Pentose phosphate pathway
- Lipid oxidation
- Impact of pro-oxidants and antioxidants

Flavour precursors
- Amino acids
- H₂S
- Sugars
- Fatty acids
- Nucleotides
- Carotenoids

Flavour perception
- ODOUR
- VOLATILES
- TASTE (including UMAMI)
- FLAVOUR
- RELEASE

FLAVOUR as perceived by the consumer
Flavour perception

Flavour formation

Base cause
- Age/maturity?
- Breed/genetics?
- Diet
- Marbling, IMF
- pHu
- pH/T decline
- Ageing
- Muscle
- Cooking method
- Contamination

Formation pathways
- Proteolysis
- Glycolysis
- ATP / IMP breakdown
- Pentose phosphate pathway
- Lipid oxidation
- Impact of pro-oxidants and antioxidants

Flavour precursors
- Amino acids
- H₂S
- Sugars
- Fatty acids
- Nucleotides
- Carotenoids

Flavour
- Odour volatiles
- Taste (including umami)
- Flavour release

Flavour as perceived by the consumer
Thanks!

- My colleagues
  - Terence Hagan, David Farrell, Octavio Oltra, Alan Gordon, Yuka Devlin, many others ....

- Dunbia and InvestNI for funding much of this work

- You for listening!