Isotope Analysis to support food authenticity

Kim Matthews
IFST Food Auditing Conference
16 October 2013
Funded by farmers and the industry

Up to the minute market information

- BPEx
- EBLEX
- HGCA
- HDC
- Potato Council
- DairyCo

Pigs
Beef and lamb
Cereals and oilseeds
Horticulture
Potatoes
Dairy

Commercial services to meat industry
• Introduction – potential for stable isotopes
• Pilot study
• Establishing and testing the database
• Addition of Irish samples
• Effect of curing and packing
• Sausages
• Some possible questions
• Conclusion
Introduction

• The industry has generally good tracing systems through assurance schemes
• New analytical techniques present opportunities to strengthen existing systems
• Stable Isotope Reference Analysis has been proven in other food sectors by comparing the isotope profile of samples with a reference database
• BPEX wanted to know if this could be applied to the tracing of British pork and pork products
### Isotopic tracers and geographical origin

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<th>Isotope ratio</th>
<th>Fractionation</th>
<th>Information</th>
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<td>geographical</td>
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SIRA results

- The ratio of the heavy isotope to the light is determined
- Expressed as permil (‰)
- Usually shown as a variance from a standard set by the AEA
  - eg hydrogen and oxygen usually expressed as variance from SMOW (standard mid-ocean water)
Combining several elements and their isotopes – H (hydrogen/deuterium), C (carbon), N (nitrogen), S (sulphur) - could give a more accurate indicator of origin

Using multivariate statistical techniques a probability % of matching the reference dataset can be achieved
BPEX Research

- Pilot study to examine “proof of concept” (2008)
- Reference Database covering England, Scotland and known non-UK samples (2009/10)
- First field trial (2010)
- Decision to enhance analytical technique by extracting isotopes from lipids
- Expanded the coverage of the GB Reference database and to include Ireland (2010/11)
- Specific studies
  - Curing and packing
  - Sausages
- Further field trials and implementation
• Samples sent:
  – 3 reference pork samples
  – 1 feed and 1 water sample
  – 15 test samples

• Cautions:
  – Small reference set (Agroisolab’s own reference set)
  – Sample selection by processors
Results:
- 8 test samples correctly identified (including matching samples from same farm)
- Correctly identified 2 samples as non-British
- Correctly questioned the origin of 3 samples: ‘probably not British’
- Misidentified 2 of the 15 test samples as British:
  - a bacon sample processed in the UK
  - a fresh Danish pork sample

Lessons learned
- Larger reference set needed
- Control needed over sample selection for reference database
Objectives

- Comprehensive evaluation of stable isotope analysis for origin verification of pork and pork products
- Establishing a reference database
- Test the use of the reference database
The current database

- About 400 locations covering England, Scotland and Ireland.
- About 80 known non-UK samples
PCA plot using C, S and N
First Field Trial

- 5 known samples identified as consistent with database (“definitely British”)

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<th>Probability of UK origin</th>
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<tr>
<td>LN4</td>
<td>99.9</td>
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<td>DE65</td>
<td>99.9</td>
</tr>
<tr>
<td>IP28</td>
<td>98.2</td>
</tr>
<tr>
<td>CA8</td>
<td>99.1</td>
</tr>
<tr>
<td>DG11</td>
<td>99.7</td>
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- Second field trial all 3 known samples correctly identified
Issues arising

- From field trials
  - Processed products (added water and curing agents)
  - Packaged products (gas)
- Sausages
- Unusual feeds
  - Co-products
  - Organic
Isotopic signatures used following first field trial

- Hydrogen D/H
- Hydrogen D/H\textsubscript{org}
- Carbon $^{13}\text{C}/^{12}\text{C}$
- Carbon $^{13}\text{C}/^{12}\text{C}\text{_{lipid}}$
- Nitrogen $^{15}\text{N}/^{14}\text{N}$
- Sulphur $^{33}\text{S}/^{32}\text{S}$
Sausages and ingredients

- Sausage mix 40% meat
- Pork Trim
- Ripon Pinhead Rusk
- Pork belly Trim

$^{13}C/^{12}C$ [%] v.s. PDB
• Testing regime to support and direct audit activity
• 4 cycles per year of 30 retail samples
• Plus samples to supplement database
How does the system operate?

- Red Tractor / UK origin pork purchased
- Test against database gives probability of match
- Data passed to BMPA / Red Tractor
- Backwards trace to source farms requested for very low probabilities
- Test sample directly compared with likely source farms (or near matches)
- Any action is for the Assurance Scheme
- Audit of tracing information at next scheduled visit
• Stable isotope analysis can be used for origin verification of pork and processed products
• A system is in place for fresh pork in English retailers
• Limitations
  – Ireland
  – Sausages (<90% meat content)
  – Adjustment needed for cured and packed product
For more information


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• Longhand Data Limited
• Agro-isolab
• QMS
• NIMEA
• Abattoirs