Isotope Analysis to support food authenticity

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AHDB Agriculture & Horticulture DEVELOPMENT BOARD

Funded by farmers and the industry

Up to the minute market information

BPEX

Pigs

EBLEX

Beef and lamb

HGCA

Cereals and oilseeds

HDC

Horticulture

POTATO COUNCIL

Potatoes

DairyCo

Dairy

MLC SERVICES LTD

Commercial services to meat industry

Outline

- 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

Isotope ratio	Fractionation	Information
$^{2}H/^{1}H$	evaporation, condensation, precipitation	geographical
$^{13}C/^{12}C$	C3 and C4 plants	diet (geographical proxy)
$^{15}N/^{14}N$	trophic level, marine and terrestrial plants	diet (geographical proxy)
$^{18}O/^{16}O$	evaporation, condensation, precipitation	geographical
$^{34}S/^{32}S$	bacterial	geographical (marine)
$^{87}Sr^{86}Sr$	Radiogenic decay of ^{87}Rb	geographical

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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)

Hypotheses

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

Pilot study (2008)

- 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

Pilot study (2008)

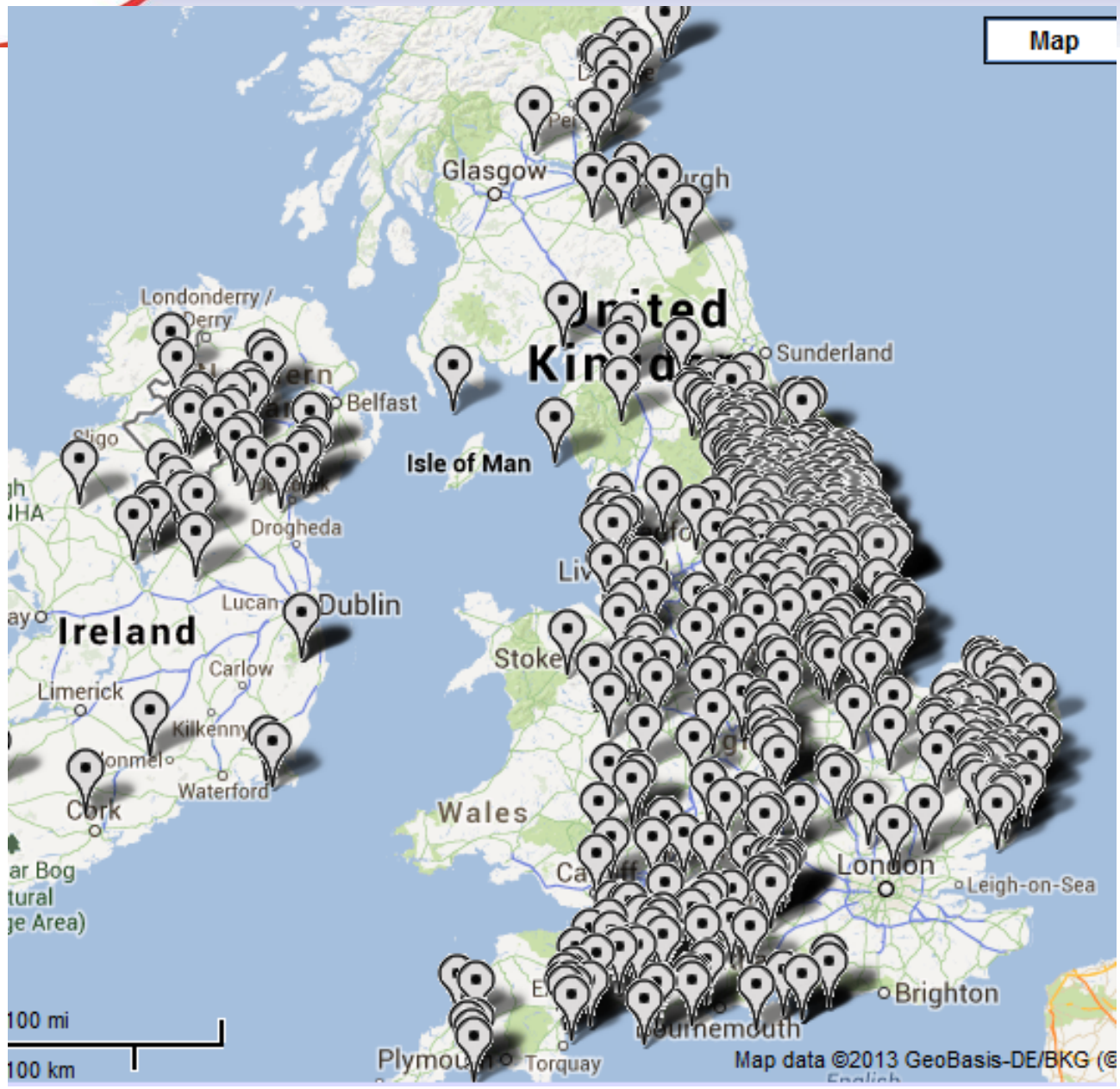
- Results:
  - 8 test samples correctly identified (including matching samples from same farm)
  - Correctly identified 2 samples as non-British
  - Correctly questioned the origin of 3 samples: ‘probably not British’
  - Misidentified 2 of the 15 test samples as British:
    - a bacon sample processed in the UK
    - a fresh Danish pork sample
- Lessons learned
  - Larger reference set needed
  - Control needed over sample selection for reference database

Main Research project

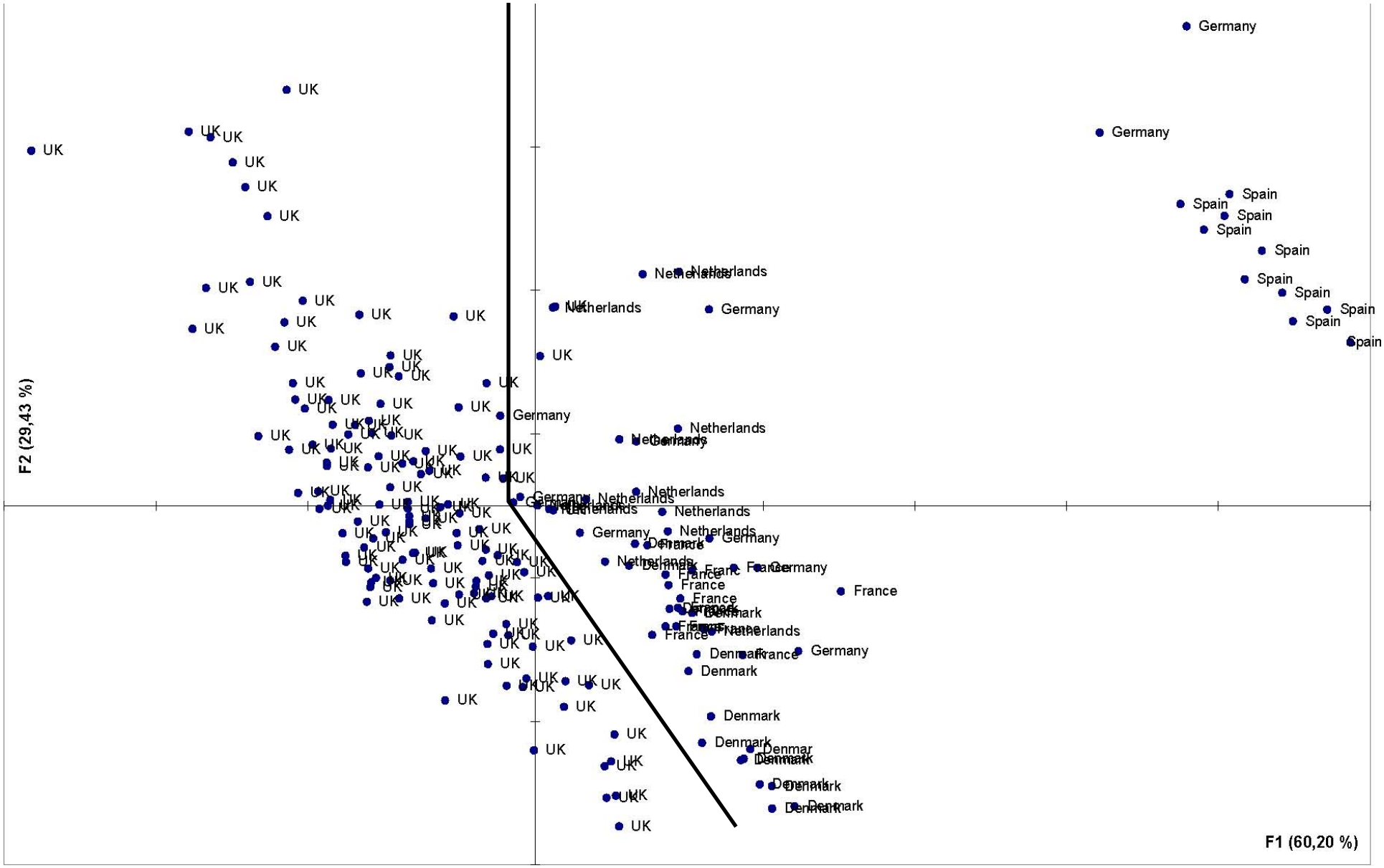
- Objectives
  - Comprehensive evaluation of stable isotope analysis for origin verification of pork and pork products
  - Establishing a reference database
  - Test the use of the reference database

The current database

- About 400 locations covering England, Scotland and Ireland.
- About 80 known non-UK samples


Map
Glasgow
Londonderry / Derry
Belfast
Sligo
Isle of Man
Drogheda
Dublin
Ireland
Carlow
Limerick
Kilkenny
Waterford
Cork
Sunderland
Stoke
Wales
London
Leigh-on-Sea
Brighton
Torquay
100 mi
100 km
Map data ©2013 GeoBasis-DE/BKG (©

PCA plot using C, S and N



First Field Trial

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

Post code area	Probability of UK origin
LN4	99.9
DE65	99.9
IP28	98.2
CA8	99.1
DG11	99.7

- Second field trial all 3 known samples correctly identified

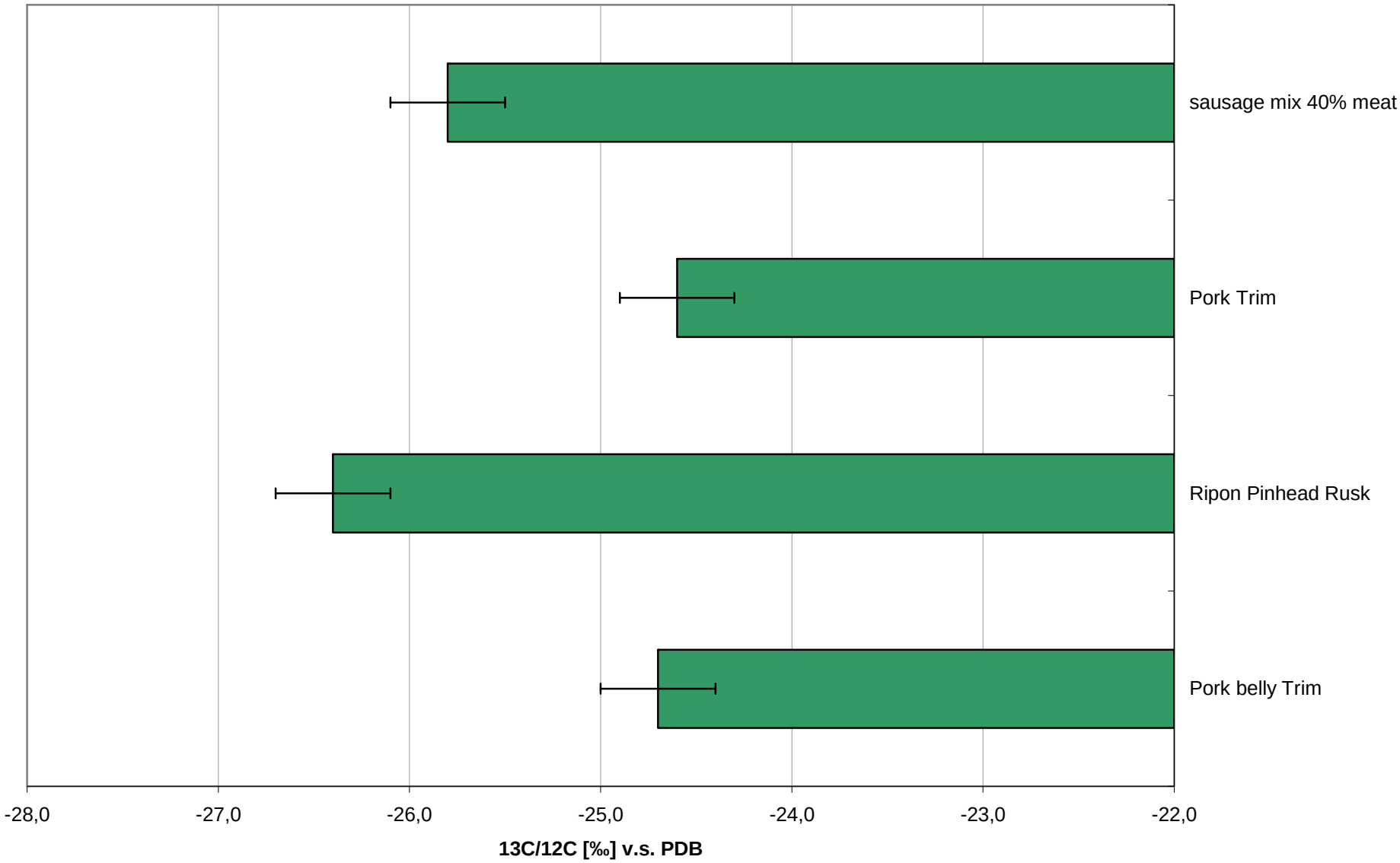
Issues arising

- 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_{org}
- Carbon $^{13}C/^{12}C$
- Carbon $^{13}C/^{12}C_{lipid}$
- Nitrogen $^{15}N/^{14}N$
- Sulphur $^{33}S/^{32}S$

Sausages and ingredients



Practical application

- 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

Conclusions

- 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

http://www.bpex.org.uk/downloads/303141/303188/BPEX%20Isotopes.pdf

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http://www.bpex.org.uk/R-and-D/R-and-D/Isotopes.aspx

Thanks to…

- Longhand Data Limited
- Agro-isolab
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- Abattoirs

Thank You