



Department
for Environment
Food & Rural Affairs

The UK Food Authenticity Programme

FOOD FRAUD ANALYTICAL TOOLS CONFERENCE
27 February, 2014
FERA

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Department For Environment, Food and Rural Affairs, UK

Overview

- Overview of Programme
 - Drivers for programme, aims, how it is run
- Breadth of funded projects
 - Methodologies, authenticity issues
- Case studies
 - Programme successes
- Current work
 - Main focus
- Audience involvement
 - Challenges and priorities for Q&A session

Legal basis for food labelling

- Underlying principle of Food Law
 - Regulation (EC) No 178/2002-General Food Law, Art 8
- Food Information for Consumers
 - General labelling requirements
 - Legal/customary name, treatment, QUID, method of production
 - Tightens origin claims and veg oil description
- Vertical Directives
 - Sugars, honey, milk, jams, chocolate and fruit juice
- EC Regulation No. 1224/2009 (Art 58)
 - Species and geographic origin indication for fish products
- UK Regulations
 - Meat Product Regulations
- Regulations (EC) No 5009/2006 & 5010/2006
 - Geographic indication (PDO, PGI, TSG)
- EC Marketing Regulations
 - Poultrymeat, olive oil, dairy products

Misdescription of food

Basmati adulterators in UK pay heavy price

Local Court Slaps Fine Of £8,000 On Two Cos

'Wild' fish found to be farmed

Ten per cent of samples wrongly labelled



Food labelling remains 'disturbing' a year after horse-meat scare



TAKEAWAY CHICKEN INJECTED WITH PORK

Burgers scandal: Meat found to contain 80% horsemeat found in latest sample

New tests reveal highest level of contamination found in the ongoing investigations

MARTIN HICKMAN

TUESDAY 05 FEBRUARY 2013

Fake vodka and Basmati rice seized in UK in food fraud crackdown

Aims of the programme

- Activities aimed at developing and disseminating tools to detect misdescription which helps to:
 - Protect the consumer from food fraud
 - Supports enforcement of food labelling and standards legislation
 - Supports development of food labelling and standards policy
 - Businesses comply with the law on food description
 - Protect the food industry from economic fraud
 - Promote competitiveness and resilience across the food chain

Work areas

➤ Research

- Wide variety of food commodities and methods investigated
- 140 project funded in total
- Feasibility studies, method development, validation, evidence gathering, project evaluation, horizon scanning

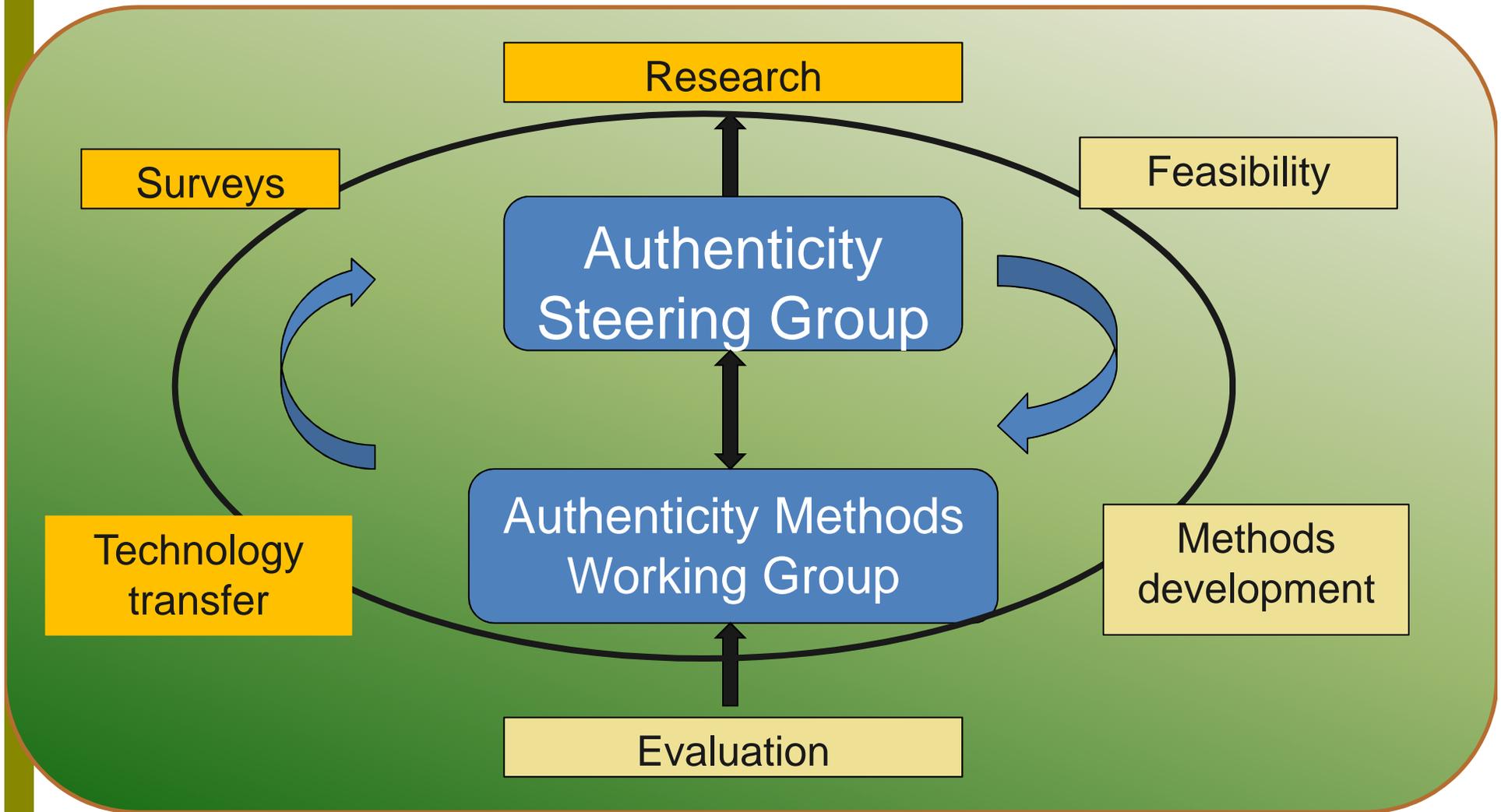
➤ Knowledge Transfer

- Publication of reports, SOPs, journal articles, general publicity/ dissemination (to food enforcement officers)
- Method transfer to public analysts in official control labs - including EU-wide, 14 to date
- Challenge exercises, inter-laboratory trials

➤ Surveys/investigations

- Use these and other methods in surveys of the UK market to detect misdescription
- Pilots, UK-wide, targeted risk-based investigations
- Co-ordination with other surveillance activities (FSAs imported food surveillance)

How the programme is set up



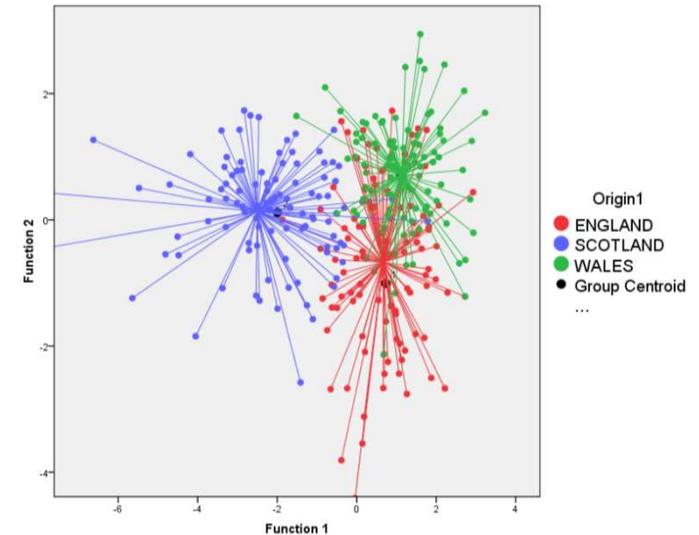
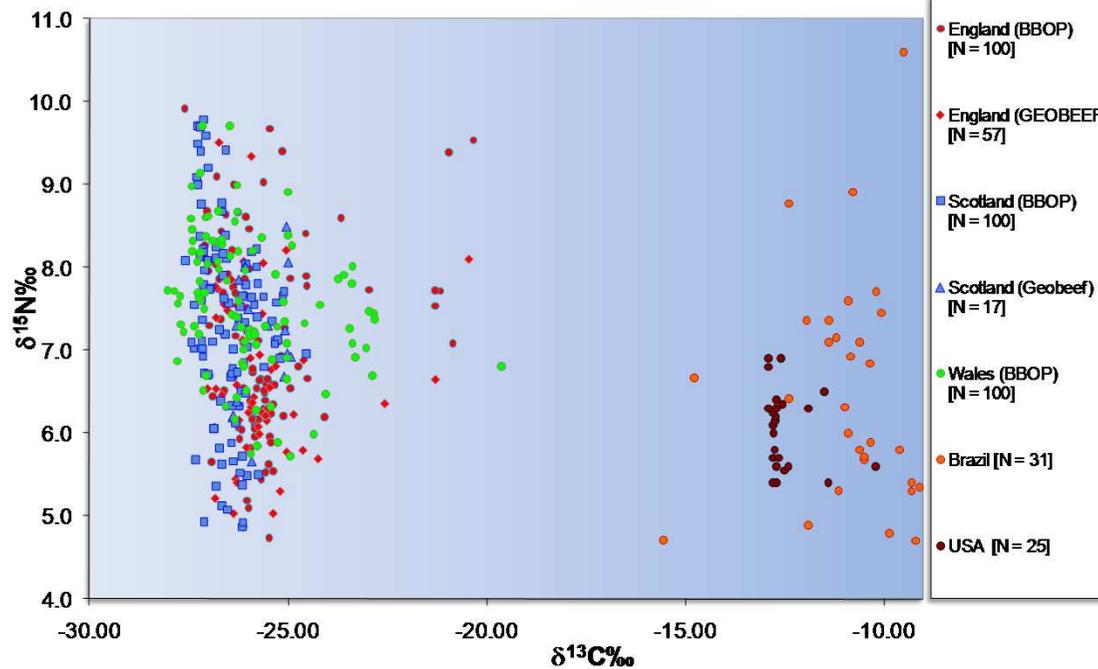
Main methodologies developed

Main methodologies applied:

- **Stable isotope ratio analysis (SIRA)** – geographic origin, production method,
- **DNA-methods** – used for species/variety identification e.g. meat breeds, fish species, crop/plant varieties (wheat, potato, fruit types)
- **Proteomics** – identifies peptide biomarkers in complex samples; searched against databases (known protein sequences) to identify protein origin (e.g. Detect Meat type/species, collagen/gelatine)
- Traditional methods – **immunoassays** (serum, plasma meat binders), **microscopy** (MSM), **Nitrogen** content
- Others - **Metabolomics** – low molecular weight compounds in cells/tissues (metabolite patterns), **metagenomics**, **lectin chips**



SIRA Verification of Geographic Origin



Results from 'British Beef Origin Project' Dr S Kelly, Fera

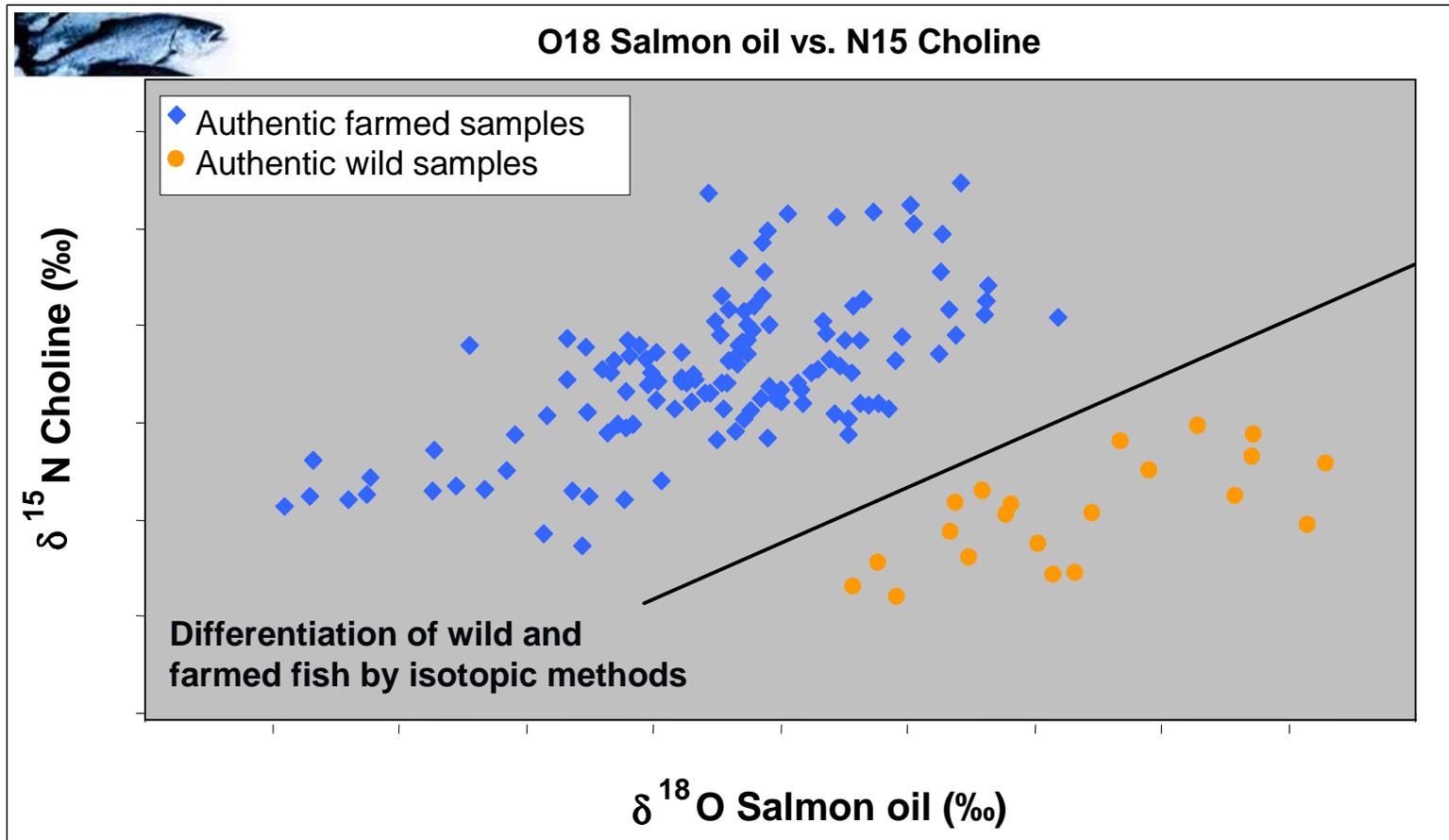
Production/geographic origin	Technique
Organic vegetables	$^{15}\text{N}/^{14}\text{N}$ IRMS
Corn-fed chicken	$^{13}\text{C}/^{12}\text{C}$ IRMS
Wild and farmed salmon, seabass and seabream	$^{13}\text{C}/^{12}\text{C}$, $^{18}\text{O}/^{16}\text{O}$, $^{15}\text{N}/^{14}\text{N}$ +Fatty acid profile
Geographic origin of beef	N, O, C, Sr isotopes, multi-element
Geographic origin of poultry	As above

Wales or Scotland? 95.0%
 $[\delta^2\text{H}]$, $[\delta^{13}\text{C}]$, $[\delta^{15}\text{N}]$, [Mg], [P], [Ca], [Sr], [Mn], [Fe], [Cu], [Li], [Ru], [Cd], [Sn], [Tb]

England or Scotland? 91.0%
 [Rb], [Sr], [Mg], [P], [K], [Ca], [Na], [Cd], [Sm], [Pt]

England or Wales? 70.8%
 $[\delta^{15}\text{N}\text{‰}]$, [Na], [Rb], [Ti], [Fe], [Tm], [W], [Re]

SIRA: Production Origin - Wild vs Farmed



Results from Q01031 Dr. M LEES, Mr F THOMAS, Eurofins

- **Databases - expensive, authentic and representative samples, data sharing**

DNA Analysis - methods and commodities

Issue	DNA Technique
Rice varieties Potato varieties Origin of tea Olive varieties	Microsatellites Simple sequence length polymorphism (PCR-SSLP)
Fruit species in jams and pulps Rice varieties Olive varieties Cattle and pig breeds	Single Nucleotide Polymorphisms (SNPs)
Durum wheat pasta Quantitative meat and fish species GM soya Meat species Meat in vegetarian foods	Real time PCR
Differentiation of meat tissues, CNS, offal	Methylation events - PCR
Fish species Meat species	Restriction fragment length polymorphism (PCR-RFLP) Single strand conformation polymorphism (PCR-SSCP)
Mandarin in orange juice	PCR heteroduplex analysis

DNA -SNP genotyping – breeds identification

- **Project Goals:**
 - To develop a robust, accurate, affordable method of **verifying meat from traditional cattle and pigs breeds sold in the UK.**
- **Specific breeds included:**
 - Cattle: Aberdeen Angus, Welsh Black, Hereford, Red Poll
 - Pig: Hampshire, Gloucester Old Spot (TSG), Berkshire, Welsh, Oxford Sandy & Black
 - Wild Boar:
- Challenging – breeds closely related – not discrete units – look for small genetic differences
- **The resulting application:**
 - Should ideally be able to be undertaken by UK Public Analysts
 - Work underway to modify method to a simpler platform and reduce number of SNPs

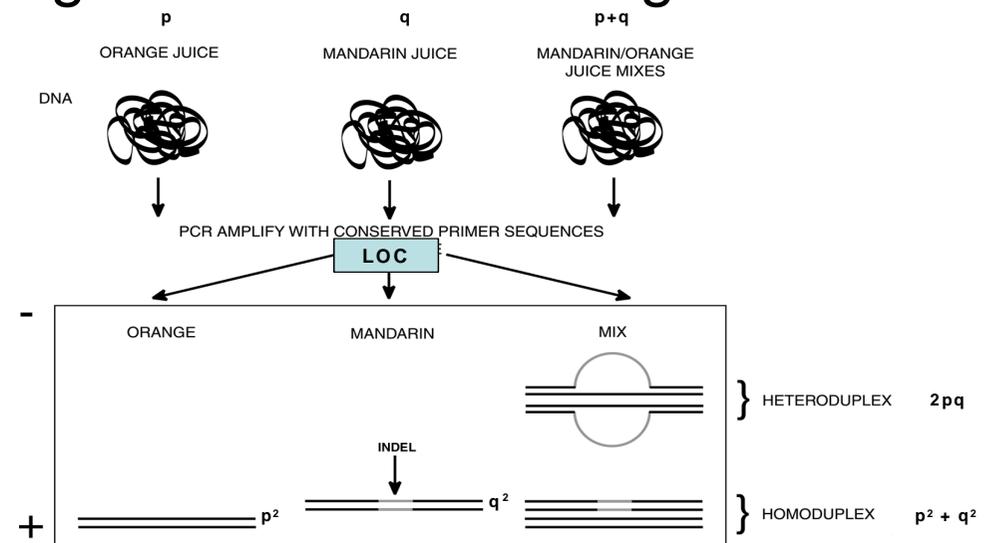


DNA - PCR Heteroduplex analysis- orange juice adulteration

- Project to develop a DNA based method to detect orange juice adulteration with mandarin juice or grapefruit juice
- Successfully developed a heteroduplex analysis assay for quantitative detection of mandarin juice in orange juice.
- Transferred to CE chip for detection. The test can reliably detect 10% mandarin juice in orange juice.
- Followed up with a PA training course and challenge exercise



Image from Q01114 Dr. A Knight LFI



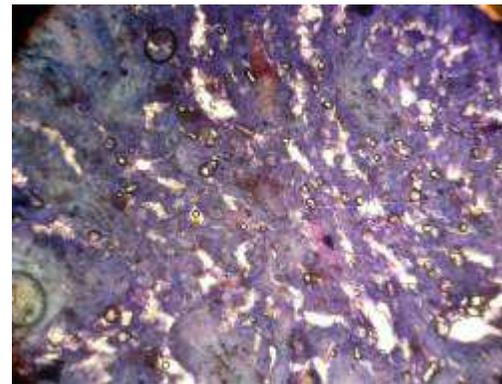
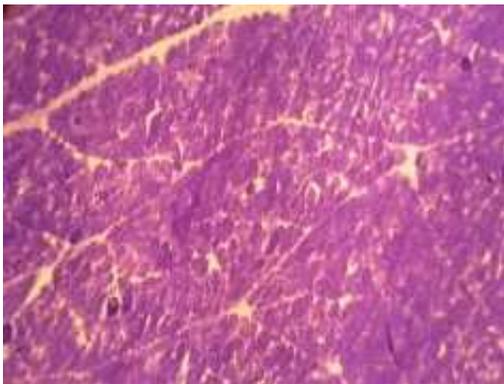
Proteomics

Issue	Technique
Identify and quantify meat species (QUID)	Proteomics- LC-MS
Offal detection and speciation in meat (lung, liver, heart, kidney)	Proteomics- LC-MS
-Gelatine species	Proteomics – LC-MS/MS

- Detects species- and tissue-specific peptide markers
- Advances in mass spectrometry and separation/purification have increased the ability to detect small amount of proteins in complex mixtures.
- Quantify using known amounts of marker peptides labelled with stable isotopes
- Markers can be used to develop a simpler transferable method, e.g. ELISA, western blot - limitations

Other methods - Microscopy MSM

- MSM needs to be labelled separately on ingredients list for meat products and can't count towards meat content.
- Various approaches tried to enable identification of MSM in meat products or raw material – to look for a marker.
- Funded project that successfully uses a simple light microscopy and staining protocol to assess the loss or modification of muscle fibre structure in recovered meat samples for chicken, pork and turkey.
- Also considered other structural aspects of meat, such as dispersed protein and connective tissue.



Images from Q01101 Dr. K Groves, LFI

mechanically separated chicken under high pressure

Case study 1– fish species

- Need for a simple method for raw and processed fish identification
- Developed DNA-based method to give a fingerprint for major species
- Transferred to a simple platform for analysis
- Training course in the method, challenge exercise
- Survey of fish species in catering sector in 2008, 10% of fish were not the species claimed

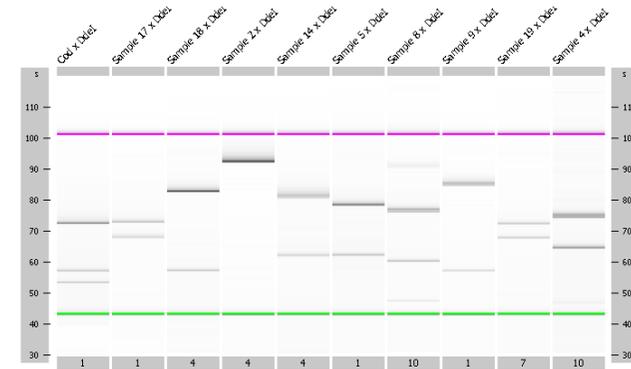


Image from Q010969Dr. S Garrett Campden BRI



Food Standards Agency
Monday 19 April 2010

Safer food, better business

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Survey on fish species in the catering sector
Thursday 4 December 2008
Food Survey Information Sheet 07/08

- Public analysts now routinely using method



Case study 2- chicken injection powders

- Chicken preparations with added water used in catering sector. Hydrolysed pork and beef proteins (derived from bones and skin i.e. gelatine) can be used to hold in high levels of added water.
- Legal to use but need to be accurately labelled including species origin.
- Detected by looking for species DNA. Intelligence that DNA was denatured so undetectable.
- Used newly developed proteomic method to look at peptides in injection powders. Collagen sequence database interrogated. Identified beef and pork peptides present, powders mislabelled as only from poultry source.
- Report published and advice to consumers issued, followed up with discussions with other member states and Commission.
- Experimental method – funded further work to develop the method and run International inter-laboratory validation
- Now being used in imported foods analysis for chicken preps.



less, skinless, without inner filets, with added water



Recent/current work

Focus on:

- Simplifying methods for uptake and up-skilling labs

e.g. Breed authentication, DNA training courses

- Validation

e.g. offal and serum in meat products, meat binding agents, gelatine speciation, EU –wide /international validation

- Feasibility studies

e.g. spectral imaging, for basmati rice & durum wheat adulteration, oil speciation

- Enforcement

e.g. Updating N factors

- Geographic origin

e.g. Beef origin, Fish geographic traceability

- Supporting innovation through industry-led technology with TSB

- Seeking co-funding and funding partnership projects (EU-wide)



Thank You

Current and past contractors

LGC

Campden BRI

Leatherhead Food Research

Fera

Trace Forensic Network

Gen-Probe

NIAB

Tepnel

Premier Foods

Nottingham Trent University

Royal Holloway University

Institute of Food Research

Eurofins

PA labs

University of York

Programme Adviser: Sandy
Primrose



This afternoon's session – setting the future direction

Gather your views on

- **Current methods – are these fit for purpose?**
- **What are the emerging food authenticity challenges** for UK industry, enforcers, consumers?
- **What technical solutions are needed** to meet these challenges, new/emerging technologies ?
- **What are the barriers?**
- **Where do priorities need to focus?**

- Over coffee and lunch....please capture your thoughts on challenges, technical R&D needs, barriers and solutions on post-its provided and put them up on boards.

We will present a summary of these for discussion this afternoon in the panel Q&A session.