UPDATES OF HALAL PRODUCTS AUTHENTICATION

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بسم الله الرحمن الرحيم

نحمده ونصلى على رسوله الكريم
Presentation Outlines

- Background
- Halal Authentication and Certification
- Global Challenges to Halal Analysis
- Updates of R & D on Analytical Methods for Halal Products Authentication
- Concluding Remarks
Background

Halal from 2 perspectives:

- **Islamic perspective** – Halal act and consumption is an obligation to every Muslim. The opposite is haram which is prohibited activity.

- **Industry perspective** – ‘Halalan Thoyyiban’ concept provides good business opportunities for everyone, Muslims or non-Muslims alike.
Islamic Perspective

- Halal is a Qur’anic term meaning ‘permitted, allowed or lawful’. Halal when used in relation to food and other consumer goods means ‘permissible for consumption and used by Muslims’

- Haram is the opposite of halal.

- Shubhah or Mashbooh, means doubtful or suspected

- Halal and haram are serious matters in Islam
Halal – permissible based on shariah rulings (religious, faith and spiritual)

Thoyyib – Good or Wholesome (quality, safety, hygeinic, clean, nutritious, quality, authentic - scientific)
Cont..

In the selection of food and drink, and other consumer products, Islam has laid down 3 very important guidelines:

• Whether the consumption of the products are halal (permitted) or haram (prohibited) by Allah S.W.T.

• Whether or not the materials are good and safe to be consumed or used by mankind (thoyyib)

• Whether the products are obtained through halal or haram means (e.g. source of finance)
Halal Industry Perspectives

- Halal food, pharmaceutical, health products, medical devices, toiletaries and cosmetics worth USD 2.1 trillion worldwide.

- Lucrative industry and huge opportunities for halal business - domestic and international trade

- Demand for halal food and other Islamic consumer goods is increasing

- Currently, ~1.8 – 2.0 billion Muslims
Organization of Islamic Countries (OIC)
The size of the Global Halal Food Market is projected at more than USD 640 billion in 2010.

Size of Global Halal Food Market (2004): USD 587.2 billion
Growth: 1.5% per annum
Market size by 2010: USD 641.5 billion
Global Halal Market 2005 ~ US$3.1 trillion/year

Non-Food (US$ 1.52 trillion)

Food (US$ 0.58 trillion)

Services (US$ 1.0 trillion)

Source: Third Industrial Master Plan
MARKET FOR HALAL PRODUCTS

- Approximately 67% of potentially Halal products are categorized as fast moving consumer goods (FMCG).
- "Potentially halal" market has been quantified as the target market that can potentially be captured.
- Food FMCG and primary meat together account for 62% of the market.

Global market for potentially Halal products, 2005** Percent
Food industry globally are looking at the 'halal' concept as a new tool for marketing.

To tap this lucrative market, the industry must understand and appreciate the religious and scientific basis of halal requirement.
Issues in Halal Industry

- Halal concept is simple; however, the industry is becoming more complex and sometimes confusing.

- Due to breathtaking technological development today and the diversification of sources acquired globally for consumer products processing and production, numerous number of processed products are available in the market.

- It is very challenging and increasingly difficult for Muslims to ensure the halal status of products in the market.

- This trend has raised concerns among Muslim consumers regarding new processed food and consumer products.
Food Adulteration

- Adulteration is an issue of major concern in the food, cosmetics and pharmaceutical trade and industries globally.
- Adulteration involving the replacement of high cost ingredients with lower grade and cheaper substitutes is a common phenomena in many of these industries.
- Adulteration of food products can be very attractive and lucrative for food manufacturers or raw material suppliers, e.g. recent melamine adulteration issue in baby foods.
Porcine-based Products Ingredients

- Pork is commonly found in many food products
- Lard could be effectively blended with other vegetable oils to produce shortening, margarines and other specialty food oils
- In some countries, food manufacturers choose to blend vegetable fats with lard to reduce production cost
- In other instances, adulteration with porcine products could be unintentional, e.g. use of emulsifiers such as E-471 or mono- and diglyceride from lard
# PRODUCTS

<table>
<thead>
<tr>
<th>Pharmaceutical and Medical Products.</th>
<th>Food products</th>
<th>Other Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Capsules</td>
<td>• Animal shortening</td>
<td>• Brushes</td>
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<tr>
<td>• Tablets and pastilles</td>
<td>• Calcium stearate</td>
<td>• Leather product</td>
</tr>
<tr>
<td>• Micro-encapsulation</td>
<td>• Gelatine</td>
<td>• Shoes and sports shoes</td>
</tr>
<tr>
<td>• Suppository</td>
<td>• Lard</td>
<td>• Jackets</td>
</tr>
<tr>
<td>• Gelatine sponge</td>
<td>• Pancreatin (pancreatic extract)</td>
<td>• Wallets</td>
</tr>
<tr>
<td>• Surgical powder</td>
<td>• Pepsin</td>
<td>• Sling bags</td>
</tr>
<tr>
<td>• Gelatine dressing</td>
<td>• Sodium stearoyl lactylate</td>
<td>• Handbags</td>
</tr>
<tr>
<td>• Plasma substitute</td>
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</tr>
</tbody>
</table>
Examples of Haram Ingredients in Cosmetics

- Placenta from human and animals
- Lard
- Gelatin and collagen (from pork or animal - not slaughtered according to Shariah law)
- Emulsifiers (from lard or animal fat - not slaughtered according to Shariah law)
- Enzymes (from non-halal sources)
- Hazardous chemicals/ingredients
Halal Authentication & Certification

- Food (or any other products) is only halal if the entire value chain, from farm to plate, is processed, handled and stored in accordance to Shariah or Halal Standards and Guidelines.

  E.g - *Malaysia Standard MS1500:2004 Halal Food: Preparation, Handling, Packaging and Storage - General Guidelines*


  *Codex Alimentarious – Codex General Guidelines for *Use of the Term Halal (CAC GL-24/1997)* – Secretariat of the Joint FAO/WHO Food Standard Programme originally based on JAKIM’s Guidelines*
Halal Standards in Malaysia

<table>
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<th>Standard</th>
<th>Description</th>
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<tr>
<td>MS 1500:2004</td>
<td>HALAL FOOD – PRODUCTION, PREPARATION, HANDLING AND STORAGE – GENERAL GUIDELINES (FIRST REVISION)</td>
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<tr>
<td>MS 1900:2005</td>
<td>QUALITY MANAGEMENT SYSTEMS - REQUIREMENTS FROM ISLAMIC PERSPECTIVES</td>
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<tr>
<td>MS 2200:2008</td>
<td>ISLAMIC CONSUMER GOODS - PART 1: COSMETIC AND PERSONAL CARE - GENERAL GUIDELINES</td>
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HALAL CERTIFICATION PROCESS IN MALAYSIA

Application/Document Approval/Fee

Premise Inspection /Audit /Sample

Report Writing

Panel Committee

Issuance of Halal Certificate

Monitoring and Enforcement /Sample
Certificate of Authentication

Halal

Manufactured/distributed by:

Have complied with the HALAL requirements according to Islamic Law.
Global Challenges to Halal Analysis

- More stringent monitoring system is needed by Halal Authorities.
- Analytical techniques become a major challenge for authentication of halal products.
- Reliable state-of-the-art scientific methods are required for analysis of non-halal components (e.g., porcine origin) in halal products.
- Competent scientists and scientific methods are needed.
Analysis should be able to reliably identify origin of food components

Sensitive and robust enough to be applied to complex food/products matrices

Analysis based on certain identified biomarkers
- oil/fat-based
- protein-based
- DNA-based
- metabolites-based
Updates of R & D on Analytical Methods for Halal Products Authentication
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<th>Food samples</th>
<th>Issue</th>
<th>Detection limit of adulterant</th>
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<tbody>
<tr>
<td>Cake formulation</td>
<td>Lard adulteration in shortening</td>
<td>4% (w/w) level</td>
<td>Syahariza et al. (2005)</td>
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<td>Chocolate</td>
<td>Lard addition</td>
<td>3% (w/w) level</td>
<td>Che Man et al. (2005)</td>
</tr>
<tr>
<td>Biscuits</td>
<td>Lard adulteration</td>
<td>4% (w/w) level</td>
<td>Syahariza (2006)</td>
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<tr>
<td>Edible oil</td>
<td>Lard characterization</td>
<td>NR</td>
<td>Guillen and Cabo (1997)</td>
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<tr>
<td>Meat</td>
<td>Lard mixed with other meat</td>
<td>NR</td>
<td>Che Man et al. (2001)</td>
</tr>
<tr>
<td>Meat</td>
<td>Pork identification</td>
<td>NR</td>
<td>Al-Jowder et al. (1997)</td>
</tr>
<tr>
<td>Animal Fats</td>
<td>Lard mixture</td>
<td>1% (w/w) level</td>
<td>Jaswir et al. (2003); Rohman and Che Man (2010)</td>
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<td>Cod liver oil</td>
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<td>Gelatin</td>
<td>Differentiation of bovine and porcine</td>
<td>NR</td>
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<td>Vegetable oils</td>
<td>Lard adulteration</td>
<td>1%</td>
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## Liquid Chromatography

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<td>HPLC</td>
<td>Meat products</td>
<td>Detection of pork and lard</td>
<td>1% in beef, 3% in mutton</td>
<td>Saeed et al., 1989</td>
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<td>Meat products</td>
<td>Detection of lard</td>
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<td>Rashood et al., 1995</td>
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<td></td>
<td>Meat</td>
<td>Detection of meat adulteration</td>
<td>10% meat</td>
<td>Wissiack et al., 2003</td>
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<td></td>
<td>Edible oil</td>
<td>Contamination of lard</td>
<td>NR</td>
<td>Marikkar et al., 2005</td>
</tr>
<tr>
<td></td>
<td>Gelatine</td>
<td>Differentiation of gelatine sources</td>
<td>NR</td>
<td>Norakasha et al. (2009)</td>
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<tr>
<td></td>
<td>Animal fats</td>
<td>Lard presence</td>
<td>NR</td>
<td>Dugo et al. 2006</td>
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## Gas Chromatography

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<tbody>
<tr>
<td>GC-FID</td>
<td>Lard</td>
<td>Animal fats (tallow and buffalo)</td>
<td>10% (in buffalo, 5% in tallow)</td>
<td>Farag et al. (1983)</td>
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<td>Vegetable oils</td>
<td>2% (w/w) lard</td>
<td>Marikkar et al. (2005)</td>
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<td>GC-MS</td>
<td>Pork</td>
<td>Cooked meat</td>
<td>NR</td>
<td>Wittasinghe et al. (2001)</td>
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<tr>
<td>GCxGC-MS-TOF</td>
<td>Lard</td>
<td>Animal fats</td>
<td>NR</td>
<td>Chin et al. (2009)</td>
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<td></td>
<td></td>
<td>Animal fats</td>
<td>NR</td>
<td>Indrasti et al. (2010)</td>
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## Electronic Nose

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<tr>
<td>Edible oil</td>
<td>Detection of lard</td>
<td>1%</td>
<td>Che Man et al. (2005)</td>
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<td>Meat</td>
<td>Detection of pork</td>
<td>1%</td>
<td>Juliana et al. (2010)</td>
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<td>Edible oil (VCO)</td>
<td>Detection of adulteration</td>
<td>NR</td>
<td>Marina et al. (2010)</td>
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<td><strong>Food samples</strong></td>
<td><strong>Issue</strong></td>
<td><strong>Detection limit of adulterant</strong></td>
<td><strong>References</strong></td>
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<tr>
<td>Ghee, butter</td>
<td>Adulteration of goat body fat</td>
<td>10% (w/w) level</td>
<td>Lambelet, 1983</td>
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<td></td>
<td>Adulteration of cow and buffalo ghee by pig</td>
<td>10% (w/w) level</td>
<td>Lambelet <em>et al.</em>, 1980</td>
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<tr>
<td></td>
<td>Detection of lard and randomized lard in RBD palm oil</td>
<td>10% (w/w) level</td>
<td>Kowalski, 1989</td>
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<tr>
<td>Edible oil</td>
<td>Detection of lard and randomized lard in RBD palm oil</td>
<td>10% (w/w) level</td>
<td>Marriker <em>et al.</em>, 2001</td>
</tr>
<tr>
<td></td>
<td>Adulteration of RBD palm oil with lipase catalyzed interesterified lard (ERLD)</td>
<td>10% (w/w) level</td>
<td>Marriker <em>et al.</em>, 2002</td>
</tr>
<tr>
<td></td>
<td>Detection of lard in selected food product deep fried in lard</td>
<td>10% (w/w) level</td>
<td>Marriker <em>et al.</em>, 2003</td>
</tr>
<tr>
<td>Sunflower oil</td>
<td>Monitoring lard, tallow and chicken fat adulteration in Canola oil</td>
<td>10% (w/w) level</td>
<td>Marriker <em>et al.</em>, 2002</td>
</tr>
<tr>
<td></td>
<td>Lard adulteration</td>
<td>NR</td>
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## DNA Based Methods

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<th>References</th>
</tr>
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<tbody>
<tr>
<td>Food products</td>
<td>Pork identification</td>
<td>NR</td>
<td>Che Man et al., 2007</td>
</tr>
<tr>
<td>Meat</td>
<td>Detection of pork and lard (qualitative)</td>
<td></td>
<td>Aida et al., 2005</td>
</tr>
<tr>
<td></td>
<td>Detection of pig derivatives</td>
<td></td>
<td>Aida et al., 2007</td>
</tr>
<tr>
<td></td>
<td>Pork adulteration</td>
<td>0.001 ng</td>
<td>Che Man et al. (2008) Patent</td>
</tr>
<tr>
<td></td>
<td>Characterization of porcine muscle protein</td>
<td>10g/kg</td>
<td>Chen et al., 1998</td>
</tr>
<tr>
<td></td>
<td>Detection of pork meat</td>
<td>NR</td>
<td>Montiel-Sosa et al., 2000</td>
</tr>
<tr>
<td>Meat</td>
<td>Detection of pork</td>
<td>NR</td>
<td>Fadila et al. (2010)</td>
</tr>
<tr>
<td></td>
<td>Pork adulteration</td>
<td>0.0001ng</td>
<td>Che Man et al. (2010) Patent</td>
</tr>
<tr>
<td></td>
<td>Pork adulteration</td>
<td>NR</td>
<td>Murugaiah et al. (2009)</td>
</tr>
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NR = not reported
<table>
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<tr>
<th>Food samples</th>
<th>Issue</th>
<th>Detection limit of adulterant</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat products</td>
<td>Detection of pork</td>
<td>NR</td>
<td>Ayob et al., 1989</td>
</tr>
<tr>
<td>Raw ground beef</td>
<td>pork adulteration</td>
<td>1 %</td>
<td>Martin et al., 1998</td>
</tr>
<tr>
<td>Meat and feed products</td>
<td>Pork quantification</td>
<td>0.5 – 0.05 %</td>
<td>Chen and Hsieh, 2000</td>
</tr>
</tbody>
</table>
Development of Analytical Techniques for Halal Products Analysis in HPRI

- Molecular Biology techniques (DNA, ELISA)
- Fourier Transform Infrared (FTIR) spectroscopy
- Electronic Nose (E-nose) technology
- Differential Scanning Calorimetry (DSC)
- Chromatography (e.g. GC-FID, GC-ToF-MS, HPLC, GCMS)
- Biopotential Telemetry EEG & ECG
Molecular Biology Techniques

(i) DNA-based technique

- DNA technique is a favorite approach for species identification because DNA is relatively stable even after processing.
- We develop method for species identification from pork samples using conventional and RT-PCR analysis.
Conventional PCR

- RFLP
- Species Specific
Restriction Enzyme Analysis of PCR Amplified Cytochrome b Gene (sausages) (Che Man, et al 2005)

M-1Kb DNA ladder
A1, A2 and A3- chicken sausages of different brands
D1, D2 and D3- beef sausages of different brands
K1 and K2- pork sausages of different brands
P1 and P2- unknown products
Real-time PCR

- SYBR Green
  *UPM Patent
  **Commercialised Products - HaFYS™

- TaqMan Probe
  *UPM Patent

- Molecular Beacon
BRIEF DESCRIPTION OF TECHNOLOGY
(Description of Process)

Total DNA Extraction

Primers and probe Design

Real-time PCR

Specificity Test

Sensitivity Test
SYBR Green Assay
Specificity test on pork primer designed against other meat species (beef and chicken).
Sensitivity test of pork primer with 10-fold serial dilutions

Detection - 0.001ng of pork DNA. This is an essential discovery in terms of Halal identification of food products.
Specificity of the assay

Amplification plot of porcine-specific TaqMan real time PCR assay on different raw meat species. Note that only porcine DNA give rise to positive amplification resembled by the increased of fluorescence intensity. Assay cross-tested against non-targeted meat species show no amplification which confirmed the specificity conferred by the recent developed assay.
Sensitivity of the assay

Amplification plot of porcine-specific TaqMan real time PCR assay on a serial 1:10 diluted porcine DNA. It is showed that the ability of the assay to detect as low as 0.0001 ng porcine DNA in water. The high sensitive assay is important as a minute amount of pork in food products is prohibited for Muslim.
Real-Time PCR Halal Testing Methods

• The methods developed have the potential to be used for Halal authentication process.

• The methods were highly sensitive and detected the presence of 0.001ng (SYBR Green) and 0.0001ng (TaqMan) of pork template DNA when assessed using dilutions of DNA in water.

• These dedicated Real-Time PCR Halal Testing Methods developed which are rapid, specific and cheap offer huge market potential.
About the HaFYS™ Technology

The components of the system are:

1. Portable real-time PCR analyzer
2. Disposable Test module (lyophilized PCR reagents)
3. DNA extraction kit (optional)
HaFYS™ - Portable PCR

• **Analyzer**
  - Fully automated system for rapid DNA & RNA analyses
  - Sample preparation included
  - Simple one touch operation
  - Light weight and field deployable

• **Test Module**
  - Pocket-sized, sealed cartridge (biohazard friendly)
  - Months to years storability at ambient temperatures
Advantages of the HaFYS™ Technology

1. Rapid (< 1 hour) and capable of multiplexing (optional)
2. Portable ("Go Anywhere" - in the field or in the lab)
3. Easy to operate by unskilled operators
4. Direct (w/o DNA extraction)/indirect (with DNA extraction) PCR testing
5. Relatively cheap – affordable
6. Reliable for animal speciation
Typical Real-Time PCR and HaFYS™ PCR

Previously: A Complicated and Tedious Procedure Taking 6-54 hours, Performed only in Special Laboratories

With HaFYS™: A Simplified Procedure Taking About 1 Hour and Doable Anywhere, Indoors or Outdoors
Making the Complex Simple

• Usual PCR = Many Steps = Hours to Days

- Collect Sample
- Place in Test Module
- Insert into Analyzer
- One Button to Start
- Yes/No Results
- Easy, Fast, Anywhere

HaFYS™ Simplicity

One Step, One Button, ~ One Hour

- Take Sample
- Transport
- Prep Sample
- PCR
- Results
Red line: Internal control; blue line: beef sample (Negative Result)
Red line: Internal control; blue line: Cat food containing pork (Positive Result)
Red line: Internal control; blue line: no-template control
Unprecedented PCR Technology

- Automatic Sample Preparation
- Ruggedized Design (few moving parts)
- Portable
- Fully Automated Operation
- Self-Contained Test Module
- Novel Optical Detection
- Rapid Results
- Remote Communications -- Optional
Launching of HaFYS™
FTIR SPECTROSCOPY
Fourier Transform Infrared (FTIR) Spectroscopy

- FTIR spectroscopy provides a highly effective choice.
- It is a fast and non-destructive technique, sensitive, and free of chemical preparation.
- FTIR gives a valuable information about the presence of molecular bonds or functional groups.
- Using computer and its advance chemometrics software, FTIR can be easily manipulated the spectral information.
- FTIR has been used for analysis of lard in mixed with body fats of lamb, cow, and chicken; lard in cake and chocolate formulations as well as in cream cosmetics formulations; differentiation of gelatin sources etc.
FTIR SPECTRA OF LARD AND OTHER OILS

1. Lard
2. Beef fat
3. Chicken fat
4. Mutton fat
5. Cod liver oil
6. Canola oil
7. Corn oil
8. Extra virgin olive oil
9. Grape seed oil
10. Palm oil
11. Pumpkin seed oil
12. Rice bran oil
13. Sesame oil
14. Soybean oil
15. Sunflower oil
16. Walnut oil
17. Virgin coconut oil

Absorbance

Wavenumbers (cm⁻¹)

2922 (-CH₂-asymmetric)
2853 (-CH₂-symmetric)
2952 (-CH₃)
3007.1 (cis C=CH)
1743.5 (-C=O)
1417.6 (cis C=CH)
1464 (-CH₂-)
1377 (-CH₃)
1655 (cis C=C)
1157.6 (C-O)
1116.8 (C=O)
1097.3 (C=O)
1031.9 (C=O)
1065.7 trans CH=CH
721.6 (cis CH=CH)
Peak identifications

3007,1 cm\(^{-1}\) → unsaturated CH
2922 cm\(^{-1}\) → CH\(_2\) stretching
2852,7 cm\(^{-1}\) → CH\(_3\) stretching
1743 cm\(^{-1}\) → carbonyl group (-C=O)
1465 cm\(^{-1}\) → CH\(_2\)bending
1377,7 cm\(^{-1}\) → CH\(_3\)bending
1160,7 cm\(^{-1}\) → overlapping CH\(_2\)
1117,3 and 1097 cm\(^{-1}\) → oleic acid group
962 cm\(^{-1}\) → bending vibration of cis olefinic disubstituted
721,7 cm\(^{-1}\) → overlapping CH\(_2\)

Sources: Pavia et al (2001); Guillen and Cabo (1997)
PCA OF LARD AND OTHER OILS

1 = lard; 2 = beef fat; 3 = chicken fat; 4 = mutton fat; 5 = cod liver oil; 6 = canola oil; 7 = corn oil; 8 = extra virgin olive oil; 9 grape seed oil; 10 = palm oil; 11 = pumpkin seed oil; 12 = rice bran oil; 13 = sesame oil; 14 = soybean oil; 15 = walnut oil; 16 = sunflower oil; 17 = virgin coconut oil
CLUSTER ANALYSIS OF LARD AND OTHER OILS

1 = lard; 2 = beef fat; 3 = chicken fat; 4 = mutton fat; 5 = cod liver oil; 6 = canola oil; 7 = corn oil; 8 = extra virgin olive oil; 9 grape seed oil; 10 = palm oil; 11 = pumpkin seed oil; 12 = rice bran oil; 13 = sesame oil; 14 = soybean oil; 15 = walnut oil; 16 = sunflower oil; 17 = virgin coconut oil
Discriminant analysis of lard in mixture with body fats of lamb, cow, and chicken (Che Man, 2009)
Component peak location of FTIR for average of three spectra of bovine gelatins (1) and average of three spectra of porcine gelatins (2).
Discriminant Analysis Plot for FTIR Analysis of Gelatin

Cooman’s plot for two classes of gelatin: porcine gelatin and bovine gelatin.
Cont…

- FTIR technique combined with chemometric analysis was able to detect and quantify the level of lard adulterated in food samples
- Fast and non-destructive technique, and free of chemical preparation
- Offers rapid (results in 2 min), simple, accurate, reliable, and environmental friendly technique
Electronic Nose
Electronic nose analysis

Array of electronic chemical sensors

Appropriate pattern recognition system

Recognizing odors

Principle component analysis (Data interpretation)

Raw / Processed meats sample
SAW detector response vs time. Pure RBD palm olein (pink) overlay with RBD palm olein adulterated with 5% lard (black) (Che Man et al, 2005)
Rapid Detection of Haram Meat (pork) by Electronic Nose

VaporPrint™

Pork  Chicken  Beef  Mutton

Typical chromatograms of four different types of meat. Pork showed more aromatic compound corresponding to the number of peaks.
VaporPrint™

CORN OIL

PEANUT OIL

PALM OLEIN

COCONUT OIL

SESAME OIL

LARD
The different meat samples were separated along the first PC described 86% of the peak variation and showed four defined groups: beef and mutton with high positive scores; chicken meat with low positive score; and pork with high negative scores along PC1.
Cont…

- E-nose is an interesting alternative choice which offers easier operation, rapid determination (1 min), and give reliable results.

- It is possible to detect any adulteration with the characteristic aroma fingerprint of each sample (1% detection level).

- This electronic nose could fulfil the need for rapid detection of lard adulteration in food.
Differential Scanning Calorimetry
Differential Scanning Calorimetry

- Thermoanalytical technique for monitoring changes in physical or chemical properties of material by detecting heat changes
- Thermogram profile show the presence of lard in food sample
- Relatively simple, accurate and minimum amount of sample needed
DSC-Thermogram of different animal fats and DSC cooling thermogram of RBDPO adulterated with genuine lard (increasing proportion).

ALD PROFILE (Marikkar et al. 2001)

ALD PROFILE (Sample Pre-Fried In Lard)

AOO PROFILE (Sample Pre-Fried In Palm Olein)
(ii) Protein-based technique

• ELISA is used to determine the level of antibodies in a sample and useful because they are specific and are relatively simple to perform.

• We developed method for detection of pig derivatives qualitatively in the food samples using ELISA technique

• The analysis yielded excellent results for detection of pig derivatives in samples
ELISA Results

<table>
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<tr>
<td>A</td>
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A1- positive control;
B1 and C1- negative controls;
D1- mutton,
E1- beef;
F1- chicken meat,
G1, H1, A2 and B2-pork;
C2- mutton fat;
D2- beef fat;
E2- chicken fat;
F2, G2, H2, A3- lard;
B3, C3 and D3- chicken sausages with different brands;

E3, F3 and G3- beef sausages with different brands;
H3 and A4- pork sausages with different brands;
B4 and C4- unknown sausages;
D4, E4 and F4- unknown casings;
G4, H4, A5 and B5- bread with different brands;

C5 and D5- biscuits with different brands;
E5- homemade biscuit with 1% lard;
F5- homemade biscuit with 50% lard;
G5- homemade biscuits with 100% lard.
Chromatography (GC)

Gas chromatography (GC)  High Performance liquid chromatography (HPLC)
Animal FAME – GC-FID

Pig

Sheep

Cow

Chicken
Animal FAME - 2D (GC x GC)

Pig

Cow

Sheep

Chicken
### Lard FAME profiles and other animal fats by GC×GC-TOF-MS

<table>
<thead>
<tr>
<th>Formula</th>
<th>FAME compound</th>
<th>Composition (%)</th>
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</thead>
<tbody>
<tr>
<td>C18:3 n3t</td>
<td>Methyl trans-9,12,15-octadecatrienoate</td>
<td>6.754  4.684</td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
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<tr>
<td>C20:3 n3t</td>
<td>Methyl 11,14,17-eicosatrienoate</td>
<td>0.116  0.127</td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
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<tr>
<td>C20:2 n6</td>
<td>Methyl 11,14-eicosadienoate</td>
<td>0.268  0.030</td>
<td>nd</td>
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Conclusions

- Halal and haram issues are serious matters for Muslims but also provide good business opportunities for everyone.
- Properly processed and halal certified consumer products are pertinent to capture the lucrative global halal market.
- R & D and application of new methods for halal analysis and authentication is much needed to uphold the credibility of halal certification programs.
- It is hoped that scientific advances on analytical techniques on halal products authentication would contribute to the integrity of Halal certification and further supporting halal trade and industry.
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  - Akasha
  - Juliana
  - Aida
  - Farijah
  - Fadhilah
  - Salwani
  - Salehan
  - Nazrim
واعلم
وصلى الله على سيدنا محمد وعلى
أله وصحبه وسلم
والحمد لله رب العالمين
THANK YOU