PALM OIL: A Versatile Ingredient for Food and Non-food Applications

Datuk Dr. Choo Yuen May
Director-General MPOB

1 July 2013

PRESENTATION OUTLINES

1. Introduction to Oil Palm
2. Nutritional Attributes of Palm Oil
3. Palm Oil for Food Applications
4. Palm Oil for Non-Food Applications
5. Conclusion
OVERVIEW OF THE MALAYSIAN OIL PALM INDUSTRY

THE OIL PALM
OIL PALM – MOST PRODUCTIVE OIL CROP

THE OIL PALM FRUITS

Basic Information
- Fruits per bunch: 1000 to 3000
- Bunch Weight: 15-25kg
- Fruit size: 5 cm
- Fruit shape: Oval
- Fruit Color: Yellowish Red
- Fruitlet weight: 10 grams
- Oil per bunch: 23-25%

Mesocarp: crude palm oil
Palm kernel: crude palm kernel oil
Shell
PERFORMANCE OF THE MALAYSIAN OIL PALM INDUSTRY

WORLD PRODUCTION OF PALM OIL (MILLION TONNES) – 2012

TOTAL: 53.67 MILLION TONNES

<table>
<thead>
<tr>
<th>Country</th>
<th>Production (Million Tonnes)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>26.90</td>
<td>50.1%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>18.79</td>
<td>35.0%</td>
</tr>
<tr>
<td>Others</td>
<td>7.98</td>
<td>14.9%</td>
</tr>
</tbody>
</table>

Source: Oil World Annual 2013
WORLD EXPORT OF PALM OIL (MILLION TONNES) – 2012

TOTAL: 40.78 MILLION TONNES

- Malaysia, 17.58 (43.1%)
- Indonesia, 19.09 (46.8%)
- Others, 4.11 (10.1%)

Source: Oil World Annual 2013

MALAYSIA: CPO PRODUCTION Vs PLANTED AREA

CPO Production ('000 Tonnes) vs Planted Area (Million Hectares)

Source: MPOB

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Lebih Rm30 untuk Malaysia • MPOB, Peta 30 Kedua
OIL PALM – THE MOST PRODUCTIVE OIL CROP

Average Oil Yield (t/ha/year)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Soybean</th>
<th>Sunflower</th>
<th>Rapeseed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.40</td>
<td>0.57</td>
<td>0.73</td>
</tr>
<tr>
<td><strong>Oil Palm</strong></td>
<td>4.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Oil Crops Production (Mn T) % of total production

<table>
<thead>
<tr>
<th>Crop</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil palm*</td>
<td>59.39</td>
<td>41.8</td>
<td>24.4</td>
<td>14.8</td>
<td>2009: 15.88 mil. tonnes</td>
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<tr>
<td>Soybean</td>
<td>41.8</td>
<td>29.8</td>
<td>17.4</td>
<td>10.5</td>
<td>2010: 16.66 mil. tonnes</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>24.4</td>
<td>10.5</td>
<td>5.9</td>
<td>5.9</td>
<td>2011: 17.99 mil. tonnes</td>
</tr>
<tr>
<td>Sunflower</td>
<td>14.8</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>2012: 17.58 mil. tonnes</td>
</tr>
</tbody>
</table>

Source: Oil World Annual 2013
* Combined tonnage of palm oil and palm kernel oil

Palm Oil Exports to Major Destination

<table>
<thead>
<tr>
<th>Year</th>
<th>China</th>
<th>Pakistan</th>
<th>EU</th>
<th>India</th>
<th>USA</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>4,027</td>
<td>1,769</td>
<td>1,892</td>
<td>1,354</td>
<td>859</td>
<td>5,980</td>
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<tr>
<td>2010</td>
<td>3,483</td>
<td>2,135</td>
<td>2,064</td>
<td>1,170</td>
<td>1,028</td>
<td>6,784</td>
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<tr>
<td>2011</td>
<td>3,982</td>
<td>1,821</td>
<td>2,006</td>
<td>1,668</td>
<td>1,055</td>
<td>7,461</td>
</tr>
<tr>
<td>2012</td>
<td>3,502</td>
<td>1,343</td>
<td>2,221</td>
<td>2,640</td>
<td>1,029</td>
<td>6,841</td>
</tr>
</tbody>
</table>

Total:
- 2009: 15.88 mil. tonnes
- 2010: 16.66 mil. tonnes
- 2011: 17.99 mil. tonnes
- 2012: 17.58 mil. tonnes

The Malaysian palm oil is exported to more than 150 countries worldwide.

Source: MPOB
Palm Fruit

Palm Oil and Its Fractions

Crude Palm Oil

RBD Palm Oil

RBD Palm Olein

RBD Palm Stearin

Palm Kernel Oil

RBD Palm Kernel Olein

RBD Palm Kernel Stearin

RBD Palm

RBD Palm

Crude Palm Kernel Oil

Crude Palm Oil
### Fatty Acid Composition of Palm Oil Versus Palm Kernel Oil

<table>
<thead>
<tr>
<th>Fatty acid</th>
<th>Palm oil</th>
<th>Palm kernel oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>C6:0</td>
<td>ND</td>
<td>ND – 0.8</td>
</tr>
<tr>
<td>C8:0</td>
<td>ND</td>
<td>2.4 – 6.2</td>
</tr>
<tr>
<td>C10:0</td>
<td>ND</td>
<td>2.6 – 5.0</td>
</tr>
<tr>
<td>C12:0 (lauric)</td>
<td>ND – 0.5</td>
<td>45.0 – 55.0</td>
</tr>
<tr>
<td>C14:0 (myristic)</td>
<td>0.5 – 12.0</td>
<td>14.0 – 18.0</td>
</tr>
<tr>
<td>C16:0 (palmitic)</td>
<td>39.3 – 47.5</td>
<td>6.5 – 10.0</td>
</tr>
<tr>
<td>C16:1</td>
<td>ND – 0.6</td>
<td>ND – 0.2</td>
</tr>
<tr>
<td>C18:0</td>
<td>3.5 – 6.0</td>
<td>1.0 – 3.0</td>
</tr>
<tr>
<td>C18:1 (oleic)</td>
<td>36.0 – 44.0</td>
<td>12.0 – 19.0</td>
</tr>
<tr>
<td>C18:2</td>
<td>9.0 – 12.0</td>
<td>1.0 – 3.5</td>
</tr>
<tr>
<td>C18:3</td>
<td>ND – 0.5</td>
<td>ND – 0.6</td>
</tr>
</tbody>
</table>

**ND**: Not-detected

### COMPOSITION OF CRUDE PALM OIL

- **Triglycerides** ~ > 90%
- **Diglycerides** ~ 2 – 7%
- **Monoglycerides** ~ < 1%
- **Free Fatty Acids** ~ 3-5%
- **Minor components** (Phytonutrients) ~1%

~99% ~1%
NUTRITIONAL ATTRIBUTES OF PALM OIL

85% of world's palm oil production is used as food

Nutritional research is a major thrust area for MPOB

Positioning palm oil as a superior functional and nutritive oil is our goal
• Great strides have been made over the last 25 years in elucidating a number of the health benefits of palm oil and its fractions

• This has resulted in –
  - over 200 publications in high impact peer reviewed journals
  - collaborative projects undertaken at both local and international centres of excellence


<table>
<thead>
<tr>
<th></th>
<th>CHD</th>
<th>Palm Vitamin E</th>
<th>Carcinogenesis</th>
<th>Red Palm Oil</th>
<th>Palm Flavonoids</th>
<th>Other Studies</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA / Canada</td>
<td>39</td>
<td>24</td>
<td>10</td>
<td>4</td>
<td>-</td>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>Europe</td>
<td>6</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Australia</td>
<td>11</td>
<td>4</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Asia / Middle East</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>Africa</td>
<td>4</td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Malaysia</td>
<td>13</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>Malaysia MPOB</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>Malaysia Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>50</td>
<td>22</td>
<td>15</td>
<td>6</td>
<td>6</td>
<td>190</td>
</tr>
</tbody>
</table>
OUTCOMES OF PALM OIL NUTRITIONAL RESEARCH

• The Food and Agriculture Organisation (FAO) and World Health Organisation (WHO) have endorsed palm oil as meeting food standards under Codex Alimentarius Commission (CAC) Programme.

• As a balanced vegetable oil, palm oil is a source of energy, it is free of cholesterol and trans fatty acids and packed with health-inducing carotenoids and vitamin E.

Palm oil contains almost equal amounts of unsaturated and saturated fats. In the body, it behaves more like a monounsaturated fat and has no adverse impact on cholesterol levels.
Palm olein and olive oil have similar beneficial effects on blood cholesterol

Choudhury N, Tan L, Truswell S. 1995 AJCN

Ng et al. 1992 AJCN

Voon et al. 2011 AJCN

Palm olein and olive oil have similar beneficial effects on blood cholesterol
Palm olein is comparable with sunflower oil on lipid profile

Wood et al. 1993 J Nutr Biochem

Palm olein is comparable with groundnut oil on lipid profile

Ghafoorunissa et al. 1995 Lipids
PALM OIL PHYTONUTRIENTS

Vitamin E (Tocotrienols, tocopherols)

Squalene

Carotenoids

Phytosterol

Lecithin

Coenzyme Q10

VALUE ADDITION THROUGH PALM PHYTONUTRIENTS

Tocotrienols

- Antioxidant properties
- Cholesterol lowering properties
- Anti-cancer activities
- Neuroprotective properties
- Immune regulation
VITAMIN E CONTENT IN FATS AND OILS

<table>
<thead>
<tr>
<th>Fat/Oil</th>
<th>Tocopherols</th>
<th>Tocotrienols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm Kernel Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coconut Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olive Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cocoa Butter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peanut Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybean Oil</td>
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<td></td>
</tr>
<tr>
<td>Sunflower Oil</td>
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<td></td>
</tr>
<tr>
<td>Cottonseed Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm Oil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


COMMERCIAL PRODUCTS

[Image of commercial products]
Carotenoids
Pro-vitamin A—solution to vitamin A deficiency
• Anti-cancer effects
• Anti-oxidant
• Stimulation of the immune system
• Cardiovascular protection
• Prevention of cataract

Palm Phytonutrients: Red Palm Oil/Olein
• Palm Oil/Olein with high content of α and β-carotenes
• The only vegetable oil containing both natural carotene and tocotrienols
• Suitable for shallow frying and salad dressing
BENEFITS OF CAROTENE IN RED PALM OIL

• Improves vitamin A and anti-oxidative status
• Reduces prevalence of Bitot’s spot

Bitot’s Spot
(A sign of Vitamin A deficiency)

INCREASED PLASMA VITAMIN A LEVELS IN SCHOOL CHILDREN AFTER 5 MONTHS SUPPLEMENTATION OF CAROTENE FORTIFIED BISCUITS

Stuifbergen et al. 2001 EJCN
Applications of Red Palm Oil

The Colourful World of Phenolics
BIOLOGICAL ACTIVITIES OF OIL PALM PHENOLICS

- Antioxidant
- Anti microbial
- Anti atherogenic
- Anti cancer
- Anti diabetic
- Anti hypertensive
- Anti inflammatory
- Memory enhancing
- Anti obesity
- Anti spasmodic
- Anti thrombotic
- Anti allergenic
- Anti ulcer

In vitro, whole animal and microarray studies

confirmed

PALM OIL FOR FOOD APPLICATIONS
ADVANTAGES OF PALM OIL IN FOOD APPLICATIONS

- High Nutritional Value
- Genetically Modified Organism (GMO) Free
- Free of Trans-Fatty Acid
- Cholesterol Free
- Competitive Price
- High Stability
- Anti-Oxidant Property

VERSATILE FOOD APPLICATIONS OF PALM OIL

- Traditional Foods
  - Cooking oil
  - Industrial Frying Fats
  - Margarine
  - Shortening
  - Vegetable Ghee
  - Confectionery Fats
  - Ice Cream
  - Filled Milk
- Non-Dairy Food Products
  (Cheese analogue, Creamer)
- As a source of pro Vitamin A and E
PALM OIL AS A COOKING OIL

• The unique fatty acid composition and natural antioxidants confer:
  – Good oxidative stability – long shelf life
  – Excellent thermal stability – perfect for shallow and deep frying
• Most other vegetable oils need to be partially hydrogenated to increase stability
• Palm oil is trans free

CURRENT FACTS ON TRANS-FATTY ACIDS (TFA)

• TFA contributes to increased risk of cardiovascular disease.

• WHO/FAO (2003-2009) Recommendation– TFA should be limited to < 1% of total daily energy in human diet.

• In most EU countries and North America- 2% TFA limit in dietary oils/fats
**CHRONIC PALM OLEIN STUDIES: PALM OLEIN VS TRANS FATS**

Trans fat increased total cholesterol, LDL cholesterol and lipoprotein (a) and decreased HDL cholesterol compared to the palm olein diet.

**PALM OIL-BASED TRANS-FREE MARGARINE FORMULATIONS**

- Cake margarine
- Filling with ease
- Fluidized margarine
- Soft margarine
- Slab margarine
- General purpose margarine
- Pastry margarine
- Shortening
PALM OIL IN GHEE SUBSTITUTES
(TRANS-FREE FAT VEGETABLE GHEE)

Palm Oil in Dairy Products Substitutes

- Evaporated Milk/Condensed Milk
- Palm-based mozzarella analogue
- Non-dairy Creamer/Whiteners
SPECIALTY FATS/CONFECTIONARY FATS

OTHER FOOD APPLICATIONS

- Palm based Coconut Milk
  - better long term stability compared to coconut milk

- Palm based Mayonnaise and Salad Dressing
OTHER FOOD APPLICATIONS

Palm-based Cheese Analogue

- palm oil and palm kernel oil fractions can substitute milk fat in cheese analogue.

OTHER FOOD APPLICATIONS

Palm-based Ice Cream

– palm oil is suitable due to its narrow plastic range with high solid at low temperature.
Palm oil applications in foods & baking sectors

PALM OIL FOR NON-FOOD APPLICATIONS
PALM OLEOCHEMICALS
DOWNSTREAM PRODUCTS

- MES-Based detergents/cleaning products
- Transparent soap
- Personal care products

POLYOLS – POLYURETHANES
ENVIRONMENTAL FRIENDLY PALM BASED PRODUCTS

Palm Based Grease and Food Grade Grease

Agrochemical: Palm-Based Water-Based Insecticide

Palm-Based Printing Ink

PALM BIOFUEL
Biodiesel Industry in Malaysia

- Malaysia has undertaken R&D on palm-based biofuels since 1981
- Home-grown palm biodiesel production technologies, including winter grade biodiesel have been successfully commercialised
- Palm biodiesel is used locally in Malaysia’s B5 programme and also exported
- Palm biodiesel meets the international standards (EN 14214 and ASTM D6751)

PALM BIODIESEL

Summer-Grade Palm Biodiesel
Pour point +15°C

Winter-Grade Palm Biodiesel
Pour point –21°C
PALM BIODIESEL PLANT IN MALAYSIA

Normal-grade Palm Biodiesel Plant
60,000 TPA

Winter-grade Palm Biodiesel Plant
30,000 TPA

PALM OIL FOR NON-OIL BIOMASS APPLICATIONS
VALUE ADDITION THROUGH BIOMASS UTILIZATION

**Abundance of Oil Palm Biomass**

- Production of syngas (gasification)
- Production of bio-oils (pyrolysis)
- Production of Palm bioethanol
- Palm biomass synthetic diesel (CDP)

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**2ND GENERATION BIOFUELS**

**EMERGING FIELD FROM PALM BIOMASS**

- Production of syngas (gasification)
- Production of bio-oils (pyrolysis)
- Production of Palm bioethanol
- Palm biomass synthetic diesel (CDP)
PALM OIL MILL EFFLUENT BASED BIOGAS PLANT

- for on & off grid application
- digester and covered lagoon technology
- steam and electricity applications
- co-firing in biomass boiler and diesel genset to reduce the utilization of the palm shell and diesel
- capable to generate about 1 - 2 MW from 60 t/hr POM

FURTHER APPLICATIONS OF OIL PALM BIOMASS

PROPERTIES OF OPT, OFF & EFB FIBRE BUNDLES
- Fibre quality
- Fibre morphology
- Fibre properties
- Usable fibre fractions

OIL PALM BIOMASS

BOARD OF VARIOUS KINDS
- MDF
- Plywood
- Moulded particleboard
- Sawn lumber

OTHER PRODUCT TYPES
- Oil palm heart
- Carbon products
- Carboxymethyl cellulose
- Fine chemicals

PAPER PULP & PAPER PRODUCTS
- Chemical pulp
- Semi-mechanical pulp
- Mechanical pulp
- Moulded paper products
- Soilless planting medium

FIBRE REINFORCING COMPOSITES
- Agrolumber
- Plastic composite
MALAYSIAN PALM OIL INDUSTRY: SUSTAINABILITY INITIATIVES

1. Code of Good Nursery Practice for the Oil Palm Nurseries
2. Code of Good Agricultural Practice for the Oil Palm Estates and Small Holdings
3. Code of Good Milling Practice for Palm Oil Mills
4. Code of Good Refining Practice for Palm Oil
5. Code of Good Crushing Practice for Palm Kernel Crushers
6. Code of Good Practice for the Handling, Transport and Storage of Products from the Oil Palm
BENEFITS OF LIFE CYCLE ASSESSMENT (LCA) STUDY

- To identify the potential environmental impacts associated with the production of the product under study.
- To gauge the GHG emissions of the product.
- To suggest mitigation measures to reduce or overcome the environmental hotspots.
- To contribute to the sustainable development of the oil palm industry by identifying and addressing environmental hotspots.

MPOB Life Cycle Assessment (LCA) Programme

- **Upstream** – LCA of
  - Oil palm
  - Oil palm seed processing

- **Midstream** – LCA of
  - Crude palm oil
  - Refined palm oil
  - Palm kernel oil and palm kernel cake

- **Downstream** – LCA of
  - Biodiesel
  - Cooking oil
  - Alpha-sulfonated methyl ester
  - Margarine and shortening
  - Palm-based soap

- **Overall LCA of handling and transportation**
**GHG EMISSIONS OF MAJOR VEGETABLE OILS**

<table>
<thead>
<tr>
<th>GHG EMISSION</th>
<th>Refined Palm Oil (MPOB Study)*</th>
<th>Refined Rapeseed Oil**</th>
<th>Refined Soybean Oil**</th>
</tr>
</thead>
<tbody>
<tr>
<td>tonne CO₂eq/ tonne oil</td>
<td>1.11</td>
<td>1.35</td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>0.63 (Biogas capture)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:**


**Mortimer, ND; Evans, AKF; Mwabonje, O and Whittaker, CL (2010) Comparison of the GHG benefits resulting from use of vegetable oils for electricity, heat, transport and industrial purposes. North Energy Associates Ltd, February 2010**

**CONCLUSION**
CONCLUSIONS

- Palm oil is a very important food source and provides needed energy to the world population.
- It has a wide range of applications in the food industry without the presence of trans fat.
- The unique fatty acid composition of palm oil makes it a nutritious yet functional oil in various food applications.
- Palm oil behaves like unsaturated oils e.g. olive oil, sunflower oil and groundnut oil.

CONCLUSIONS

- Evidence has been obtained to suggest that dietary palm oil reduces the risk parameters to cardiovascular diseases.
- The phytonutrients are additional health benefits to the oil.
- The unique composition of palm oil also offers potential for use in non-food applications.
- The steady supply of quality Malaysian palm oil will help meet the increasing global demand for oils and fats.
EVENT OF THE YEAR

www.mpob.gov.my

THANK YOU

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