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

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Malaysian Palm Oil Board
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OVERVIEW OF MALAYSIAN PALM OIL INDUSTRY
Malaysian Palm Oil Industry

- World’s largest exporter and second largest producer of palm oil
- Oil palm cultivation in 2011: 5.00 mil. Ha
- Palm oil (crude) production in 2011: 18.91 mil. T
- Export earnings in 2011: RM 83.4 billion (USD 27.8 billion)
- Malaysian palm oil exported to more than 150 countries.
Overview of The Malaysian Palm Oil Industry

DEVELOPMENT OF OIL PALM INDUSTRY

Exports of Malaysian Palm Oil

Major Export Market of Malaysian Palm Oil

Total export of palm oil and products (2011)

- Export Quantity: 24.27 million tonnes
  (Palm oil: 18.01 million tonnes)

Export earnings: RM83.4 billion (USD 27.7 billion)
Two Unique Oils from Oil Palm

Lembaga Minyak Sawit Malaysia
## 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
Components of Crude Palm Oil

- Triglycerides
- Diglycerides
- Monoglycerides
- Free Fatty Acids
- Minor components (Phytonutrients)

Approximately 99% of crude palm oil is composed of triglycerides, diglycerides, monoglycerides, and free fatty acids. Minor components, including phytonutrients, account for approximately 1% of the oil.
PALM OIL FOR FOOD APPLICATIONS
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

• 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
Palm Based Interesterified (IE) Fats

- Hard stock or fat blend for: Margarine, Shortening, Spread, pastry fats

- Advantages of IE fats hard-stock
  - Rapid crystallization
  - Right melting properties & good plasticity
  - Eliminate/reduce post-hardening problem
  - Free of TFA (Trans Fatty Acid)
  - Healthy Formulation – low SAFA solid fat (29.5% SAFA)
  - Solid fat content between 15% to 30% at usage temperature is desirable to provide structure
Margarines and Spreads

- Basically an emulsion of water-in-oil

- 3 main types: Table margarine, industrial margarine & pastry margarine

- Palm oil and its fraction impart very high stability to margarine compared to other vegetable oil

- Semi-solid characteristic of palm oil is an important advantage as it does not require hydrogenation which can produce trans fatty acids.
Shortenings and Vanaspati

**Shortening**: Palm oil and palm oil fraction produce shortenings of excellent quality with diverse applications - bread, cakes, pastries, icing, cream and sweets.

- **Desirable M.P range**: 34-44°C

- **Vanaspati**: Vanaspati/vegetable ghee is 100% vegetable fat. Used as a substitute for butter fat.

- Widely used in India, Pakistan & Middle East Countries

- **Trans-free vanaspati** - palm oil blended with soft oils.
Palm based Vanaspati: Its Economic Advantage

<table>
<thead>
<tr>
<th>Type</th>
<th>Price (MYR)</th>
<th>Convert to INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm based Vanaspati (1 kg)</td>
<td>MYR 7.60</td>
<td>INR 135</td>
</tr>
<tr>
<td>Ghee Blend (Milk Fat &amp; Palm Fat)</td>
<td>MYR 20.30</td>
<td>INR 350</td>
</tr>
<tr>
<td>Pure Ghee (1 kg)</td>
<td>MYR 30.00</td>
<td>INR 517</td>
</tr>
</tbody>
</table>

Approximate price in Malaysian market
SMART BALANCE

- A successful blend of palm oil and soft oil to meet AHA (1:1:1) health requirement
- No hydrogenation and *trans*-fatty acid in the formulation
- Suitable for cooking and baking
- Suitable for temperate climate
- Gained substantial market share in the United States
Novel Frying Oil from Palm: NoveLin

Premium Cooking Oil

- IV > 60
- Good Cold Stability (0 C for more than 5 hours)
- Suitable for temperate climate
- High content of natural antioxidants (extended frying time)
- Blend of palm olein and soft oil
- Free of Trans Fatty Acid
Confectionary Fats

Palm and Palm Kernel - suitable as raw material with unique properties. Used in:

- Cocoa butter substitute
- Coatings
- Cream filling & icing/frostings
- Caramels, toffees and fudges
Other Food Applications

- Palm-based coconut milk
  - Better long term stability compared to coconut milk
- Palm-based Mayonnaise & Salad Dressing
  - Super olein blended with soft oil
Dairy Product Substitutes

Palm-based Cheese Analogue – palm oil and palm kernel oil fractions can substitute milk fat in cheese analogue.

Palm-based Ice Cream – palm oil is suitable due to its narrow plastic range with high solid at low temperature.
PALM OIL FOR NON-FOOD APPLICATIONS

- Oleochemicals
- Biodiesel
Value Added Oleo Derivatives

• Increased economic returns by shifting from production of basic oleochemicals to oleo derivatives
• Incentives provided by the Malaysian government to go downstream or to JV with overseas partners

• Five product sectors identified
  - Surfactant
  - Biolubricant
  - Biopolyol
  - Agrochemicals
  - Glycerol derivatives
Methyl Ester Sulphonate (\(\alpha\)-SME)

- \(\alpha\)-SME is an anionic surfactant - active ingredient in detergent and cleaning products
- Equivalent to Linear Alkyl Benzene Sulphonates (LABS) – most common petrochemical based surfactant used worldwide
- Current detergent products in the market contain LABS as the active ingredient
Environmental Friendly Palm Based Products

Personal Care Products
Environmental Friendly Palm Based Products

- Palm Based Grease and Food Grade Grease
- Agrochemical: Palm-Based Water-Based Insecticide
- Palm-Based Printing Ink
Environmental Friendly Palm Based Products
(polyols & polyurethanes)
Biodiesel Industry in Malaysia

- Malaysia has undertaken R&D on palm-based biofuels since 1982
- 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 Plants in Malaysia

Normal-grade Palm Biodiesel Plant
60,000 TPA

Winter-grade Palm Biodiesel Plant
30,000 TPA
New Biodiesel Co. Ltd., Surat Thani, Thailand
Palm Biodiesel

Summer-Grade Palm Biodiesel
Pour point +15°C

Winter-Grade Palm Biodiesel
Pour point –21°C
Non-Oil Biomass Applications
Potential Biofuel / Renewable Energy Feedstocks from the Palm Oil Industry

- Crude Palm Oil
- Biofuel / Biodiesel
- Oil Palm Fronds
- Fuel for CHP
- FRESH FRUIT BUNCH
- Palm Biomass
- Oil Palm Trunk
- POME
- Biogas

10% oil
90% biomass
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

Ponding system of POME treatment
Further Applications of Oil Palm Biomass

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

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

**OIL PALM BIOMASS**

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

**FIBRE REINFORCING COMPOSITES**
- Agrolumber
- Plastic composite

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

## REGIONAL DISTRIBUTION OF PROJECTS

<table>
<thead>
<tr>
<th>Region</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>
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<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>
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<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>-</td>
<td>3</td>
<td>-</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>-</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Malaysia - MPOB - Others</td>
<td>13</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>36</td>
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<tr>
<td></td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>91</strong></td>
<td><strong>50</strong></td>
<td><strong>22</strong></td>
<td><strong>15</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
<td><strong>190</strong></td>
</tr>
</tbody>
</table>
Palm Olein and Olive Oil Have Similar Effects on Blood Lipids

- Numerous human studies including one conducted at the University of Sydney, comparing the health effects of palm olein and olive oil (both high in oleic acid) have shown that palm oil (olein) and olive oil have similar beneficial effects on blood cholesterol.

*OO = Olive Oil
PO = Palm Olein
Palm Oil Phytonutrients

- Vitamin E (Tocotrienols, tocopherols)
- Squalene
- Carotene
- Lecithin
- Phytosterol
- Polyphenols
- Co-Q10
Phytonutrients from Palm Biodiesel

For every 1 tonne of methyl esters burnt as fuel, we also burn away:

- 0.6 kg Carotenoids
- 0.8 kg Vitamin E
- 0.5 kg Phytosterols
- 0.4 kg Squalene
- 0.05 kg Coenzyme Q
- 0.06 kg Phospholipids
CPO Methyl Esters (Palm Biodiesel)

Short Path Distillation

Distilled Methyl Esters (Palm Biodiesel)

Feedstock for value-added oleochemicals products

Micronutrients Concentrate Containing Carotenes, Vitamin E, Phospholipids (Lecithin), Sterols, Coenzyme Q and Squalene

SFE / SFC / Crystallisation

Carotenes
Vitamin E
Sterols
Squalene
Coenzyme Q
Phospholipids (Lecithin)
Phytonutrients from Palm Biodiesel

- Palm Vitamin E (up to 95% concentration)
- Carotenes (up to 95% concentration)
- Coenzyme Q (0.3% concentration)
  - concentrated by 300 folds
- Sterols (up to 95% concentration)
- Squalene (up to 50% concentration)
- Phospholipids (0.1% concentration)
Tocotrienols
- Antioxidant properties
- Cholesterol lowering properties
- Anti-cancer activities
- Neuroprotective properties
- Immune regulation

Carotenoids
- Pro-vitamin A – solution to vitamin A deficiency
- Anti-cancer effects
- Anti-oxidant
- Stimulation of the immune system
- Cardiovascular protection
- Prevention of cataract
- Prevention of macular degeneration
Commercial Products

Tri.E TOCOTRIENOLS

TOCOVID SupraBio™

NEW IMPROVED ABSORPTION

50mg 60 Soft Gels
PATENT PENDING
Fighting Blindness with Palm Carotenes
Benefits of 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)
Applications of Red Palm Oil
The Colourful World of Phenolics
Value Addition through Palm Phenolics
Water-soluble Phytonutrients from Palm Oil Mill Effluent

PHENOLICS (2.4%)
- Vitamins
- Fruit acids
- Fruit sugars

A tremendous opportunity to leverage on the 45mil tons of POME produced annually in Malaysia

Waste to Wealth to Health
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
Value Addition through Palm Phenolics: Shikimic Acid

- OPP contains 1% shikimic acid
- Substrate for synthesising tamiflu
- Current source is star anise from China
- An opportunity for the oil palm industry to enter shikimic acid market
- Oil palm phenolics- largest potential source of shikimic acid in the world
SUSTAINABILITY
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**
LCA

- LCA (mineral soils) completed, reviewed by independent review panel and published in Journal of Oil Palm Research (JOPR) and International Journal of LCA.

- Data also submitted to Joint Research Centre, European Commission and to Environmental Protection Agency, United States for consideration in computation of GHG emissions reduction savings concerning palm biodiesel.
<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 CO$_2$eq/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>
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</tr>
</tbody>
</table>
CONCLUSION
• The unique composition of palm oil contributes towards its versatility and stability, making it the oil of choice for various applications

• MPOB will continue to intensify R&D efforts into improving and developing new applications for palm oil.

• The steady supply of quality Malaysian palm oil will help meet the increasing global demand for oils and fats

• The future direction of the Malaysian palm oil industry is very much dependent on the trade relations it shares with buyers around the world

• This shared future requires efforts from Malaysia and its trading partners to cooperate on a win-win formula for best economic returns

Conclusion
Palm Oil - Nature’s Gift to Malaysia
Malaysia’s Gift to the World

THANK YOU

www.mpoob.gov.my