Food Applications of Palm Oil

A presentation by

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Introduction
Introduction to Palm Oil

- Yearly production PO approx. 5 MT/ha
- Economic productivity ~ 20-25 years
- **Versatile Oil** – cooking, frying, baking, confectionery, margarines, spreads
- **Stable Oil** – Not easily oxidized
1 tree = 2.5 round harvesting/mo
1 FFB = 30kg/bunch
1 FFB = 2800 – 3000 fruitlets
1 FFB = 25 – 35 mt/yr/hec
**Basic Facts**

- **Fruits per bunch:** 2800 to 3000
- **Bunch Weight:** 30 kg
- **Fruit size:** 5 cm
- **Fruit shape:** Oval
- **Fruit Color:** Yellowish Red
- **Fruitlet weight:** 10 gm
ANATOMY OF OIL PALM FRUIT

Mesocarp: Palm Oil (PO)

Kernel: Palm Kernel Oil (PKO)

Shell

Basic Facts

• Kernel per fruit: 5-8%
• Mesocarp per Fruit: 85-92%
• Oil per mesocarp: 20-50%
• Oil per bunch: 23-25%
<table>
<thead>
<tr>
<th>Fatty Acid Composition</th>
<th>Palm kernel oil</th>
<th>Palm oil</th>
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<tbody>
<tr>
<td>C12</td>
<td>47.6-50.0</td>
<td>0.2 -3.6</td>
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<tr>
<td>C14</td>
<td>14.6-18.6</td>
<td>1.0-2.5</td>
</tr>
<tr>
<td>C16</td>
<td>8.6-13.6</td>
<td>37.2-47.6</td>
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<tr>
<td>C18:0</td>
<td>2.0-3.8</td>
<td>4.4-13.3</td>
</tr>
<tr>
<td>C18:1</td>
<td>13.7-16.5</td>
<td>29.9-40.7</td>
</tr>
</tbody>
</table>
Palm Oil & Its Fractions


**1st Stage**
- Palm Oil
  - I.V. 51-53
- Hard Stearin
  - I.V. 32-36

**2nd Stage**
- Soft Stearin
  - I.V. 40-42
- Super Stearin
  - I.V. 17-21

**3rd Stage**
- Hard PMF
  - I.V. 32-36
- Soft PMF
  - I.V. 42-48
  - Recycling
- "Oleins"
- Super Olein
  - I.V. 64-66
- Top Olein
  - I.V. 70-72
<table>
<thead>
<tr>
<th></th>
<th>PKO</th>
<th>Palm Kernel Olein</th>
<th>Palm Kernel Stearin</th>
<th>PO</th>
<th>POO</th>
<th>POS</th>
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<tr>
<td>6:0</td>
<td>0.3</td>
<td>0.4</td>
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<tr>
<td>8:0</td>
<td>4.4</td>
<td>5.4</td>
<td>1.2 - 3.5</td>
<td>0.2</td>
<td>0.2</td>
<td>0.1 - 0.6</td>
<td>0.1</td>
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<tr>
<td>10:0</td>
<td>3.7</td>
<td>3.9</td>
<td>2.4 - 3.6</td>
<td>44.0</td>
<td>39.8</td>
<td>47.2 - 73.6</td>
<td>52.8</td>
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<td>12:0</td>
<td>48.3</td>
<td>41.5</td>
<td>55.6 - 58.6</td>
<td>1.1</td>
<td>1.0</td>
<td>1.1 - 1.9</td>
<td>0.8</td>
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<td>14:0</td>
<td>15.6</td>
<td>11.8</td>
<td>18.1 - 24.7</td>
<td>4.5</td>
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<td>4.4 - 5.6</td>
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<td>7.1 - 7.9</td>
<td>39.2</td>
<td>42.5</td>
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<td>0.4</td>
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<td>2.4</td>
<td>1.5 - 1.8</td>
<td>10.1</td>
<td>11.2</td>
<td>3.2 - 9.8</td>
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<tr>
<td>18:3</td>
<td>0.2</td>
<td></td>
<td>0.4</td>
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<tr>
<td>IV</td>
<td>17.8</td>
<td>25.5</td>
<td>4.1 - 9.6</td>
<td>53.3</td>
<td>58.0</td>
<td>21.6 - 49.4</td>
<td>35.9</td>
</tr>
</tbody>
</table>
Solid Fat Content (SFC) of Various Palm Fractions
Advances in Palm Oil Modification Techniques
Oil Processing

Increased demand for better quality oils

**Organoleptic/stability**
- Bland taste, no odor
- Light color (brilliant)
- High thermal stability
- High oxidative stability
- Long shelf life

**Functional Properties**
- Good melting profile
- Desired Plasticity
- Crystallisation kinetics

**OIL QUALITY**

**Refining**

**Modification**

**Nutritional Quality**
- Balanced FA composition (SFA/MUFA/PUFA, ω3-6)
- Low or no trans FA (< 1%)
- High natural antioxidants (tocopherols) and vitamins
Oil Refining: chemical vs physical
Refiner’s Challenge

EFFICIENCY

REFINING CONDITIONS

QUALITY

SUSTAINABILITY

REFINING TECHNOLOGY
Hydrogenation

- Adds hydrogen atoms into vegetable oil
- Reason: To **modify hardness** of the oil for various applications
- **Partial** hydrogenation or **Full** hydrogenation
- Partially hydrogenated fats widely used as confectionery fats
- **BUT** partial hydrogenation produces **trans fatty acids** (aka trans fats)
- **Trans fats** proven to raise cholesterol levels = **Unhealthy**
HYDROGENATION REACTOR

Headspace 1/3 of total volume

Heating / Cooling Coils 4.5m²/Ton

Top Stirrer Location to Oil Level very important!

Agitator 2 kWh/Ton

Hydrogen Sparge Ring
elaidic acid (trans unsat.) oleic acid (cis unsat.) stearic acid (saturated)
Trans-free Solutions...

- Fractionation to get harder fats
- Blending soft oil with harder fats
- Interesterification (IE) ~ Most recent development
Interesterification

- **Rearrangement of the fatty acids in the oil molecule**
  - *Reason:* To change melting point of the oil/fat

- **Versatile** ~ able to get wide range of fat profile by varying oil type and ratio

**2 ways of doing it:**

1. Chemical Interesterification (CIE)
2. Enzymatic Interesterification (EIE)
Chemical Interesterification (CIE)
Enzymatic Interesterification (EIE)
Enzymatic Interestesterification (EIE)

- Cost effective
- Milder reaction conditions
- Selectivity
- Clean & Safe
- “Green chemistry”

Rearrangement of the oil molecule via enzymes

EIE provide solutions to partial hydrogenation of soft oils and CIE.
## CIE vs. EIE

### CIE
- Randomised products.
- SFC relatively flat.
- Catalyst sensitive to moisture (sodium methoxide)
- Prone to side-products (soaps, methyl esters, partial glycerides)
- Requires post-processing (catalyst deactivation, washing, bleaching)
- Batch process

### EIE
- Specific (1,3-position) products.
- SFC steeper, i.e. better melting.
- Minimal side-products.
- Minimal post-processing.
- Continuous process.
3. Palm Oil in Food Products
Palm Oil Applications

Wide range of applications:

- Frying fat
- Cooking oil
- Margarine
- Spread
- Shortening
- Vanaspati
- Confectionery fat
Cooking & Frying Fats

- Palm olein **widely used as cooking oil** in tropical countries

- **Good cooking quality, clear & good oxidative stability**

- Palm olein with **cloud point 10 °C** is the preferred choice in most tropical countries

- Also widely used for **frying in food industry**

- **Good resistance** to gumming, oxidation, foaming, darkening, slower FFA increase, & smoking
Jomalina’s Guaranteed Quality (JGQ) frying oil is produced from premium quality (PQ) CPO. These PQ CPO are derived from specially selected and segregated palm fruits harvested from only a selective numbers of Sime Darby’s estates/mills. These fruits are then processed immediately with special handling.

- Applications are specially suited for instant noodle frying, deep frying (chips & crisp. etc) & tempura frying.

- Excellent resistance to deterioration during shipment. Maintaining the stability of the JGQ Oil. Longer shelf life and slower deterioration during frying.

- Cost saving as JGQ palm oil/olein can be used directly without re-refining on arrival at the destination point.
## Product Specification

<table>
<thead>
<tr>
<th></th>
<th>JGQ Palm Olein</th>
<th>Palm Olein (PORAM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFA (palmitic) % max</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>M &amp; I % max</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>IV (Wijs) min</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>SMP °C max</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Colour (Lovibond 5 1/4” cell) max</td>
<td>1.5R 15Y</td>
<td>3.0R 30Y</td>
</tr>
<tr>
<td>PV meq O₂/kg max 2 packing</td>
<td>1.0(arrival)*</td>
<td>1.0 (packing)</td>
</tr>
</tbody>
</table>

* Subject to control of packing material and voyage
Margarines & Spreads

- Water-in-oil emulsion with **spreadability**, **stability** and **mouthfeel**

- **3 main types**: (1) Table margarine, (2) industrial/baking margarine, (3) pastry margarine

- Other margarine types: stick, whipped soft, pourable, low-fat spreads

- Table margarine: Palm olein suitable as liquid component; Palm stearin suitable as solid component

- Palm oil **imparts plasticity** to margarine. Good working properties. **Good crystallisation** properties
Pastry Margarine (KEMPUFF 39)

Product Characteristics
- Good in plasticity & easy handling
- Flavored & colored
- High in solid profile
- Its normally in the slab form with various sizes

Application
- Formulated for preparation of Danish Pastry, Puff Pastry and croissant
- As a laminating (roll in) fat in dough to give layer effect to the end product

Functionality
- Impart good layering to puff pastries & croissant
- Contribute taste & richness to the food
- Provide tenderness to croissant & puff pastries
- Improve volume of croissant & puff pastries
Cake and Cream Margarine (IM39)

Product Characteristics
• This margarine is a high quality bakery fat specially formulated and texturized to give good creaming volume for cakes & cookies.
• It also can be used in wide range of temperatures and does not oil out on exposure to normal storage temperatures of up to 40°C.

Application
• Cakes, Cookies, Cake decoration creams, Bakery filling creams, Coffee Roasting and Asian type of bread like Paratha, Capati, Lebanese bread and etc.

Functionality
• Improves volume and softness of the cakes
• Increases taste and gives pleasant mouth feel
• Contribute softness and an aroma for cookies

Contact details
Shortenings

- Various types: **frying, baking, icing & filling shortenings**
- Desirable melting range: **34-44 °C**
- Palm oil is preferred due to tendency to **promote β’ crystals** (the preferred type of fat crystal for good mouthfeel)
- IE fats with palm oil gives **good SFC profile** for shortenings
Bakery Shortening (AP40)

Product Characteristics
• It's specially formulated and texturised to give good creaming properties over a wide range of temperatures.
• It does not oiling out on exposure of normal room temperature of up to 40°C.

Application
• Icing cream, Filling creams, Cakes and Bread, biscuits, crackers and other bakery products.

Functionality
• Act as lubricant for dough mixing, handling, proofing
• Promote bread volume
• Cohere gluten strand and shorten it
• Impart desirable eating
• Give good cream volume for icing cream
Specialty Animal Fat Replacer (SAFaR)

Product Characteristics
• Vegetable based fat to imitate the function of animal fats

Application
• Beef sausages, burger patties, chicken nuggets, pepperoni, meat balls

Benefits
• Cholesterol free as it’s 100% vegetable based
• Free from pathogenic and spoilage microbes
• Improve product shelf life
• Cost effective when the meat price is higher
Milk Fat Replacer (MFR)

Product Characteristics
• Palm oil based vegetable shortening as replacement for dairy milk fat.
• Texturized for easy handling.

Application
• Dairy milk fat, cheese, ice cream

Benefits
• Cholesterol free as its 100% vegetable based
• Consistency in quality
• Cost effective
Vanaspati

- Vegetable ghee to substitute butterfat (ghee)
- Widely used in India, Pakistan & Eastern Mediterranean countries
- In the past, hydrogenated fats used
- Now, **trans-free vanaspati** from palm stearin blended with soft oils is used
- IE of palm stearin and palm olein able to give softer texture than hydrogenated vanaspati
Vanaspati
Red Palm Oil/Olein

- Palm olein with high amounts of β-carotenes
- Deep reddish colour cooking oil
- Widely accepted in Japan for healthful benefits
Red Palm Superolein

Properties
- Natural vegetable liquid oil
- Bright red colour
- Natural beta-carotene
- Source of pro-vitamin A and vitamin E

Benefits
1. **Colourant** which enhances food presentation
2. Improves product **shelf life**
3. Adds **nutritional value** to foodstuffs

- Clean labelling
- Easy dosing and mixing

Contact details
jomasales@simedarby.com
Red Palm Superolein: a Natural Colourant

- Visual appeal of a product has an effect on our appetite
- When Red Palm Superolein is added to food products, it produces a yellow to red colour.
- Examples of applications: soups, potatoes, margarines, dressings, mayonnaise, seasoning, cheese, bakery products etc

Visual impact of Red Palm Super Olein in a refined vegetable oil blend

0%  1%  2%  3%  4%  5%  100%
Confectionery Fats (CBE, CBS, CBX)
Confectionery Fats (CBE, CBS, CBX)

- Cocoa butter ~ mainly **POP, POS, SOS**-type triglycerides
- Palm Oil ~ **high in POP**
- Palm oil fraction ~ **Palm Mid Fraction (PMF)** has enriched POP content
- Used as CBE to blend with other exotic fats (illipe, shea fats)
- **Palm kernel oil** ~ Used as lauric-type CBS
- Also can be blended with other lauric oils
Cocoa Butter Substitute (KC35)

Product Characteristics
• A superior quality cocoa butter substitute made from hydrogenated and fully refined vegetable oils and fractions. It has excellent sharp melting profile
• It is a hydrogenated lauric fat, and trans free.

Application
• As total replacer of cocoa butter in compound, for solid and hollow moulding, enrobing and couverture.

Functionality
• Having brittle texture
• Have good glossiness and have excellent mouthfeel profile
• Good demoulding properties to the end product
Coating Fat (CF38)

Product Characteristics
- A high quality lauric coating fat based on hydrogenated and fully refined vegetable oils and fractions.
- It has an excellent heat resistance and it’s specially formulated for warmer climates.
- It also has an excellent microbiological properties, shows good stability against oxidation and it's free from lipases

Application
- As total replacer of cocoa butter in compound chocolate coating for biscuits, wafers, nougats, nuts and raisin
- Suitable for manufacture of glazes, icing, caramels, toffees, fillings and cream
- Milk fat replacer for nondairy creamer, caramel and toffee

Functionality
- Non tempering fat
- Glossy and good mouthfeel
- Non tempering and excellent heat resistance
Soft Confectionery Fat

Product Characteristics
• A soft confectionery fat made from non lauric fat and non hydrogenated fat.
• It also stable and does not oiling out during storage

Application
• Compound chocolate spread
• Compound filling in chocolate or

Functionality of the soft confectionery fat
• The product remains soft at wide temperature range and after baking.
• No waxy taste and has excellent mouthfeel
• Chocolate spread remain soft at wide temperature range
Minor Components in Palm Oil

Vitamin E (Tocopherols & Tocotrienols)

- **Fat-soluble vitamin & antioxidant**
- Tocotrienol sources not many. Palm oil is one of them.
- **600-1000 ppm** in crude palm oil
- Partial loss in conventional refining processes. Concentrated in **palm fatty acid distillate (PFAD)**
- PFAD used as a source to extract vitamin E
4. Future Trends of Palm Oil
Future Trends of Edible Oil

- Addressing **global health concerns**
- Consumer perception on **healthful products** on the rise
- **High-value products** for premium market

| Countries with Highest Per Capita Expenditure on Consumer Health 2009 | US$ |
|---------------------------------------------------------------|=-----|
| Japan                                                         | 200  |
| Norway                                                        | 185  |
| United States                                                 | 160  |
| Switzerland                                                   | 139  |
| Finland                                                       | 111  |
| Australia                                                     | 111  |
| Denmark                                                       | 110  |
| Sweden                                                        | 108  |
| Belgium                                                       | 107  |
| Singapore                                                     | 103  |
Future Trends of Edible Oil
Thank you