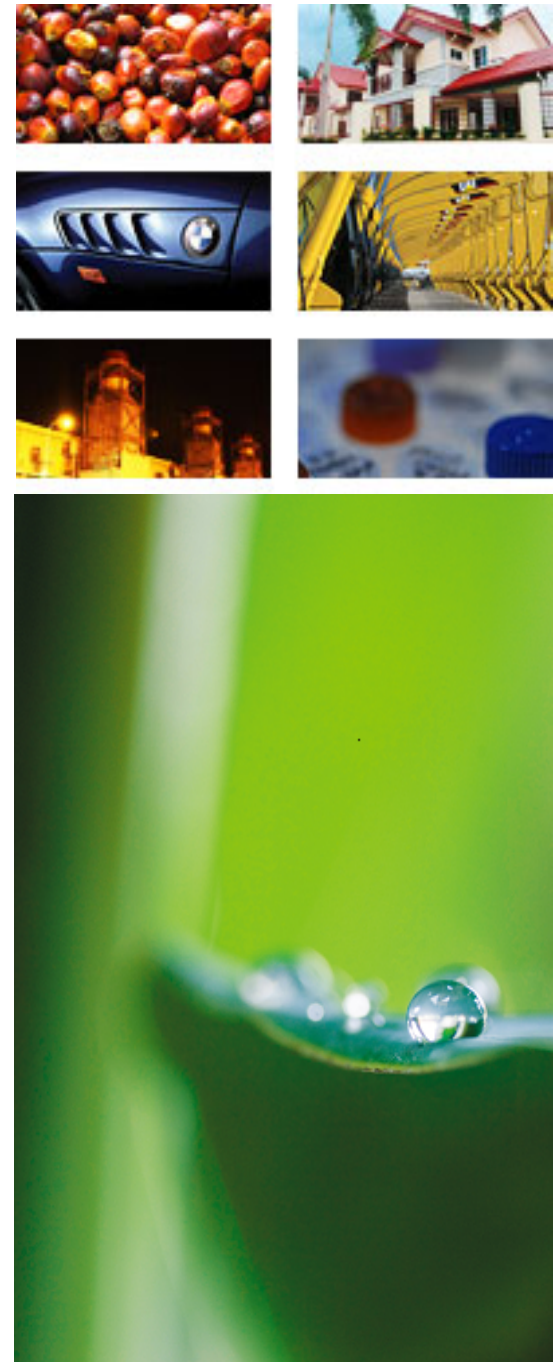


Recent Advances & Innovations of Palm Products in Food Applications

A presentation by

Dr. Mohd Suria Affandi Yusoff

R&D Centre
Sime Darby Plantation



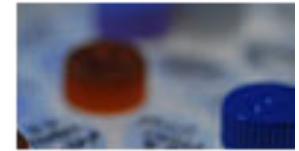
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1. Introduction

2. Advances in Palm Oil Processing Techniques

3. Advances in Palm Oil Products

4. Future Trends of Palm Oil



1.Introduction



Introduction to Palm Oil

- ❑ Yearly production approx. **3.7 MT/ha**
- ❑ Economic productivity ~ **20-25 years**
- ❑ **Versatile Oil** – cooking, frying, baking, confectionery, margarines, spreads
- ❑ **Stable Oil** – Not easily oxidized



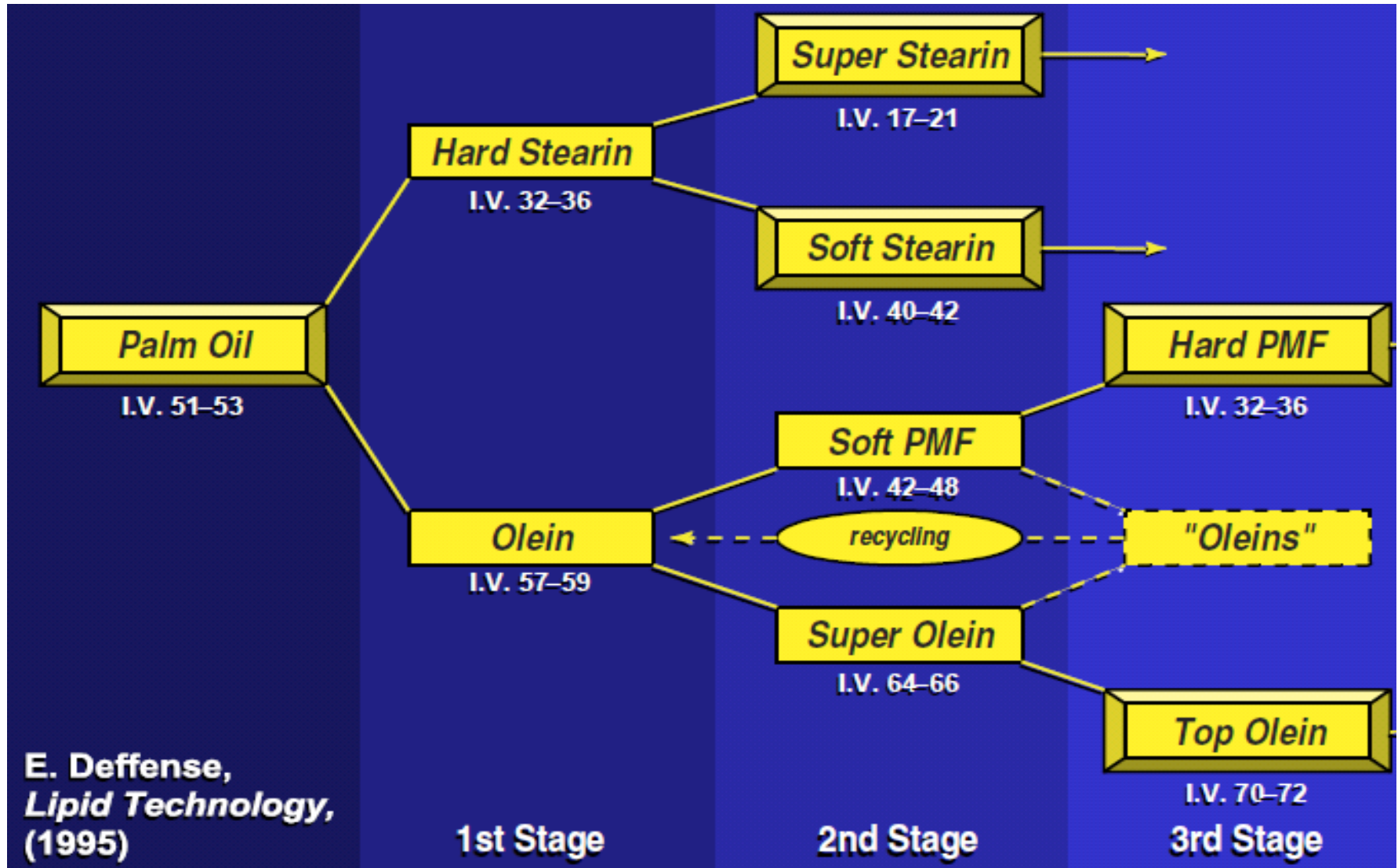
The Major Oils in Global Oils & Fats Market in 2009 (Million Tonnes)

Oil	Production	Imports	Exports	Consumption
Palm	45.11	36.13	35.42	45.33
Soybean	35.94	9.08	9.21	35.86
Rapeseed	21.43	2.69	2.63	21.20
Sunflower	13.02	5.19	5.17	12.78
Palm Kernel	5.23	3.11	2.99	5.68
Cottonseed	4.86	0.15	0.16	4.67
Groundnut	4.12	0.19	0.18	4.11
Coconut	3.22	1.82	1.89	3.10
Total	132.74	58.35	57.66	132.42

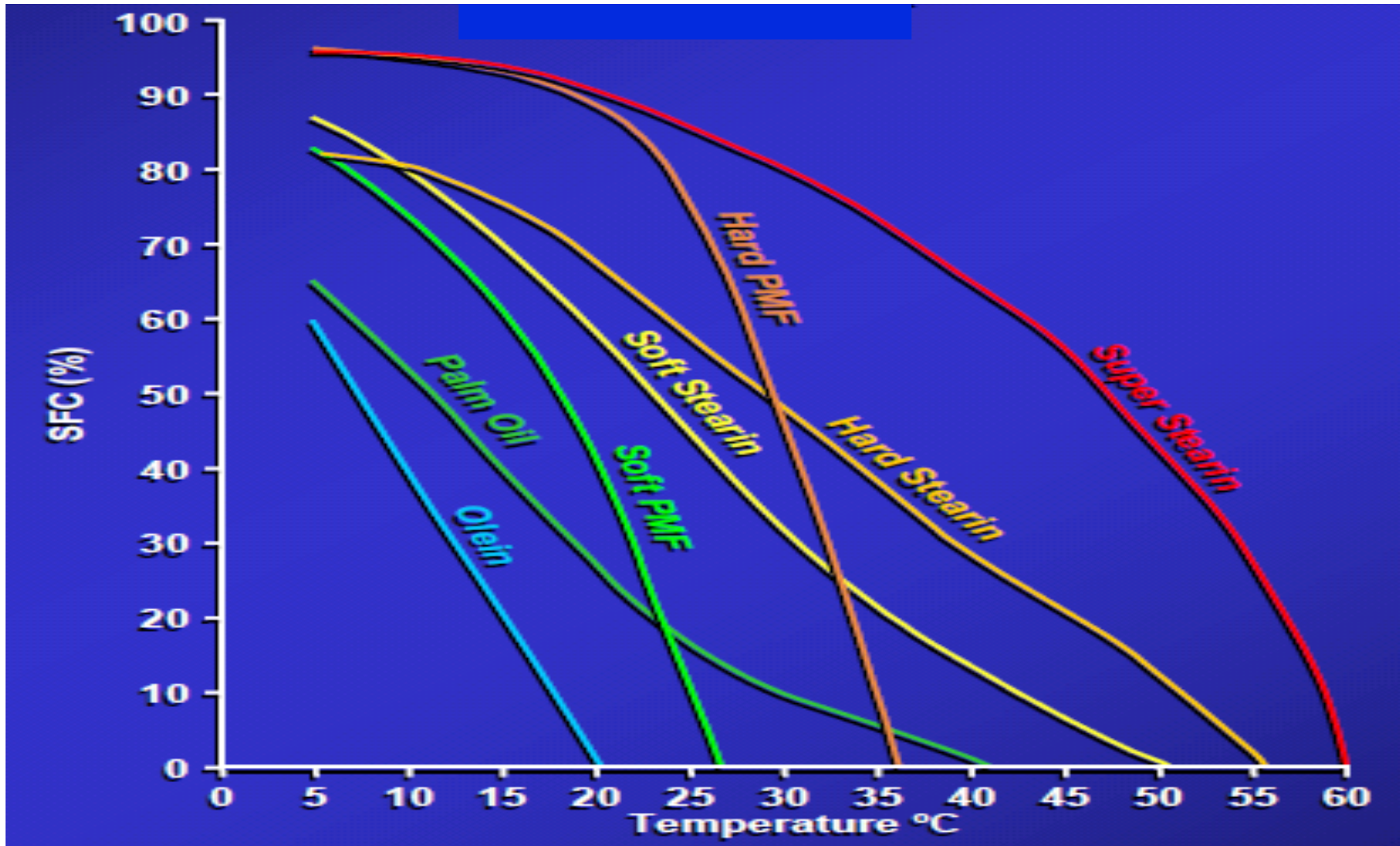
The Major Oils in Global Oils & Fats Market in 2009 (% market share)

Oil	Production	Imports	Exports	Consumption
Palm	33.98	61.92	61.42	34.23
Soybean	27.08	15.56	15.97	27.08
Rapeseed	16.14	4.61	4.56	16.01
Sunflower	9.81	8.89	8.97	9.65
Palm Kernel	3.94	5.33	5.19	4.06
Cottonseed	3.52	0.26	0.28	3.52
Groundnut	3.10	0.33	0.31	3.10
Coconut	2.42	3.12	3.28	2.34
Total	100.00	100.00	100.00	100.00

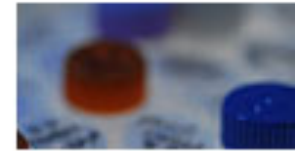
Palm Oil & Its Fractions



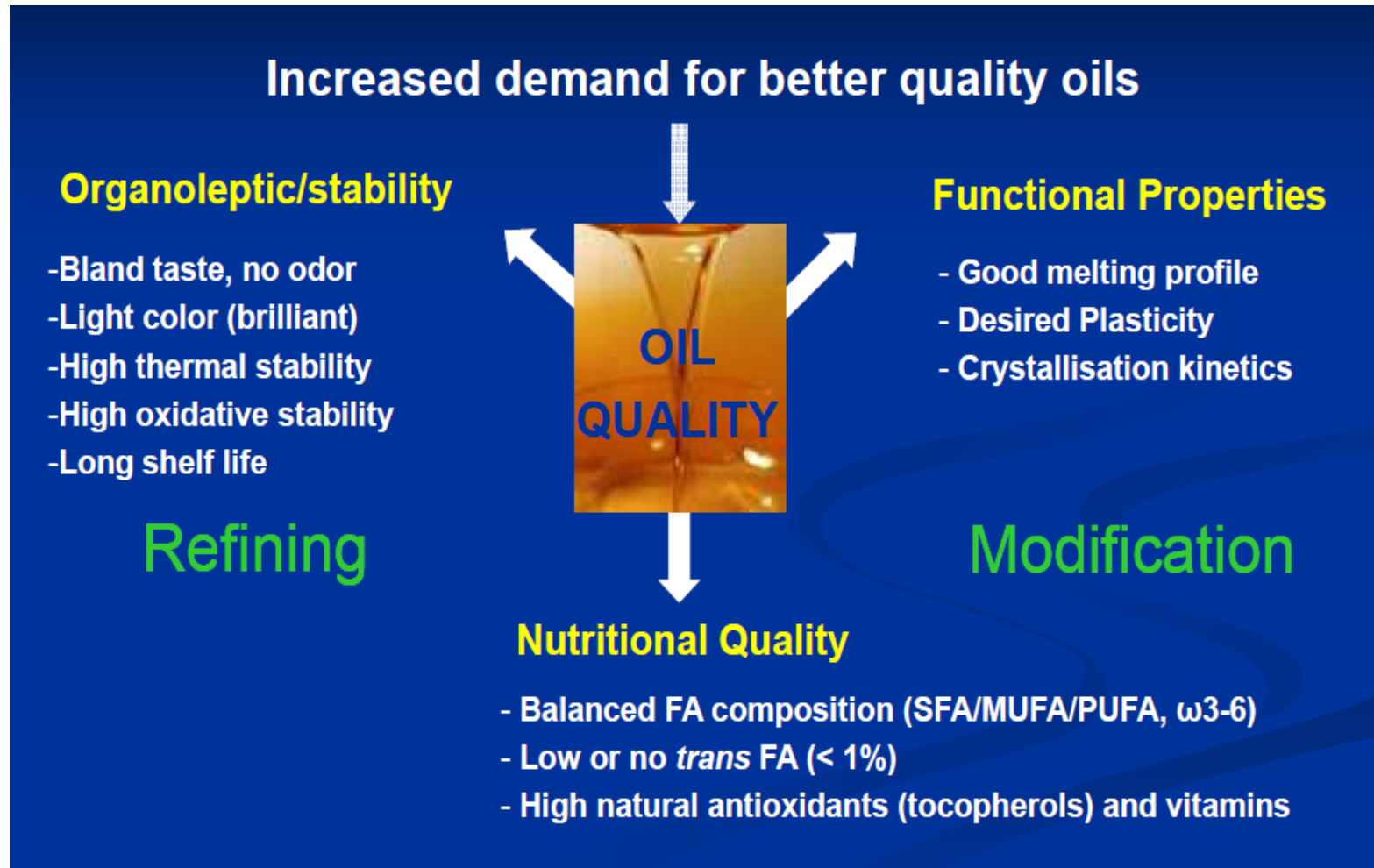
Solid Fat Content (SFC) of Various Palm Fractions



2. Advances in Palm Oil Processing Techniques



Oil Processing



Trends in Oil Refining

Refineries need to comply to more and more stringent environmental rules and at same time need to improve their efficiency on both operational cost and delivery of highest quality

- Trend:**
- maximum preservation of "nutritional" quality
 - less chemicals, more physical treatment
 - more sustainable, less energy (CO2 !)
 - less environmental impact: zero effluent /waste

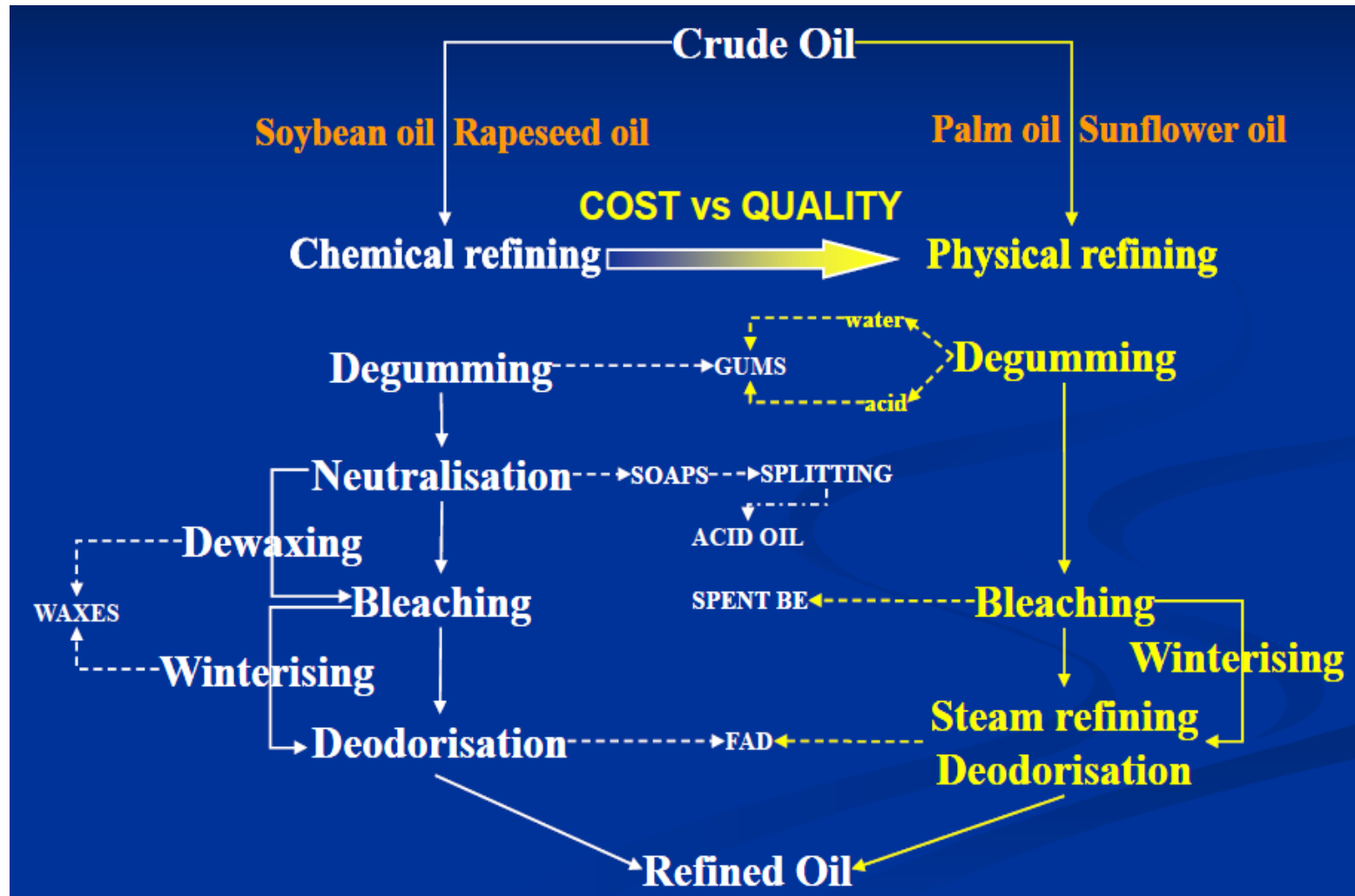
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More BIO, ECO, GREEN ...

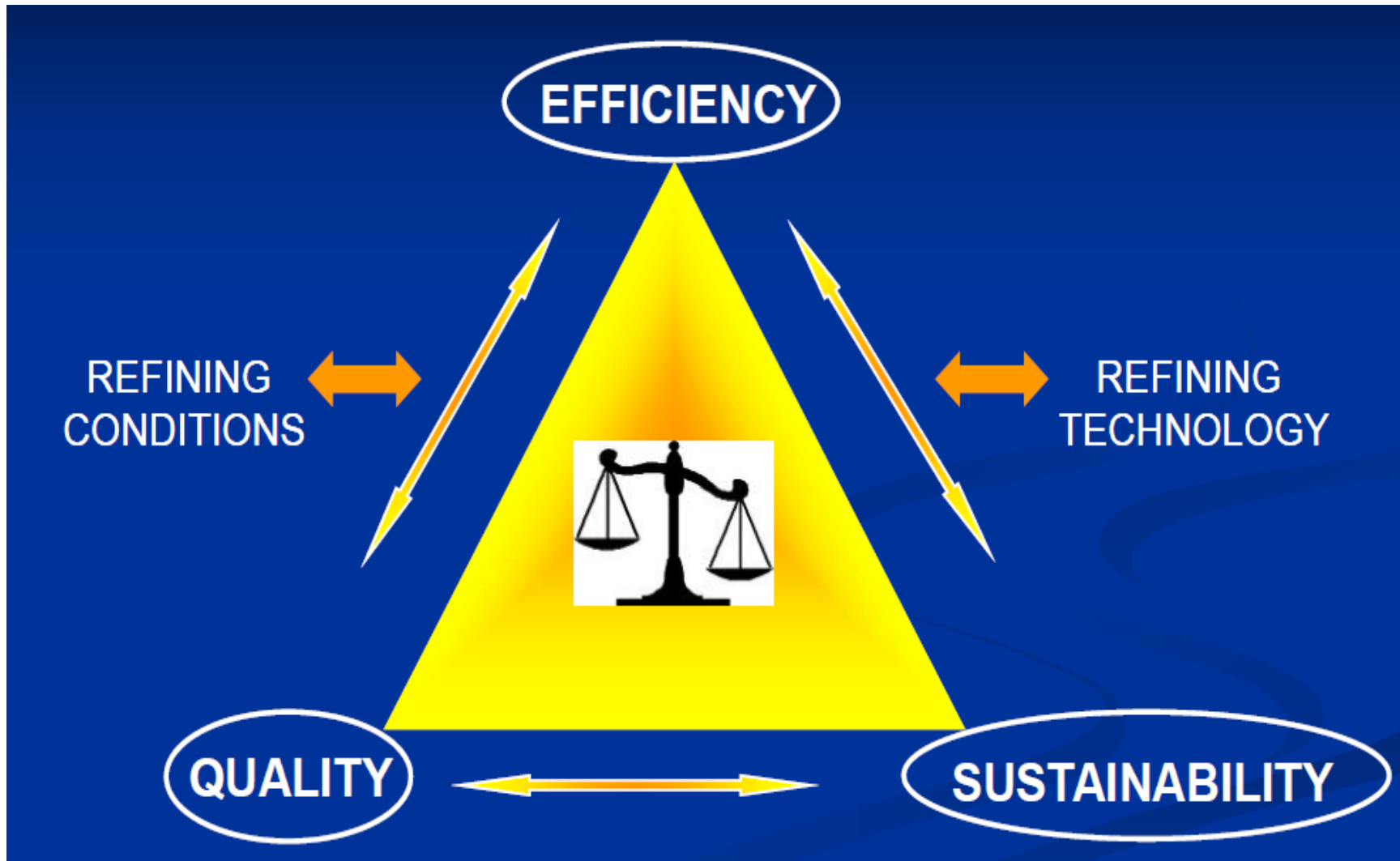


ECOLOGICAL <=> ECONOMICAL

Oil Refining : chemical vs physical



Refiner's Challenge



Hydrogenation

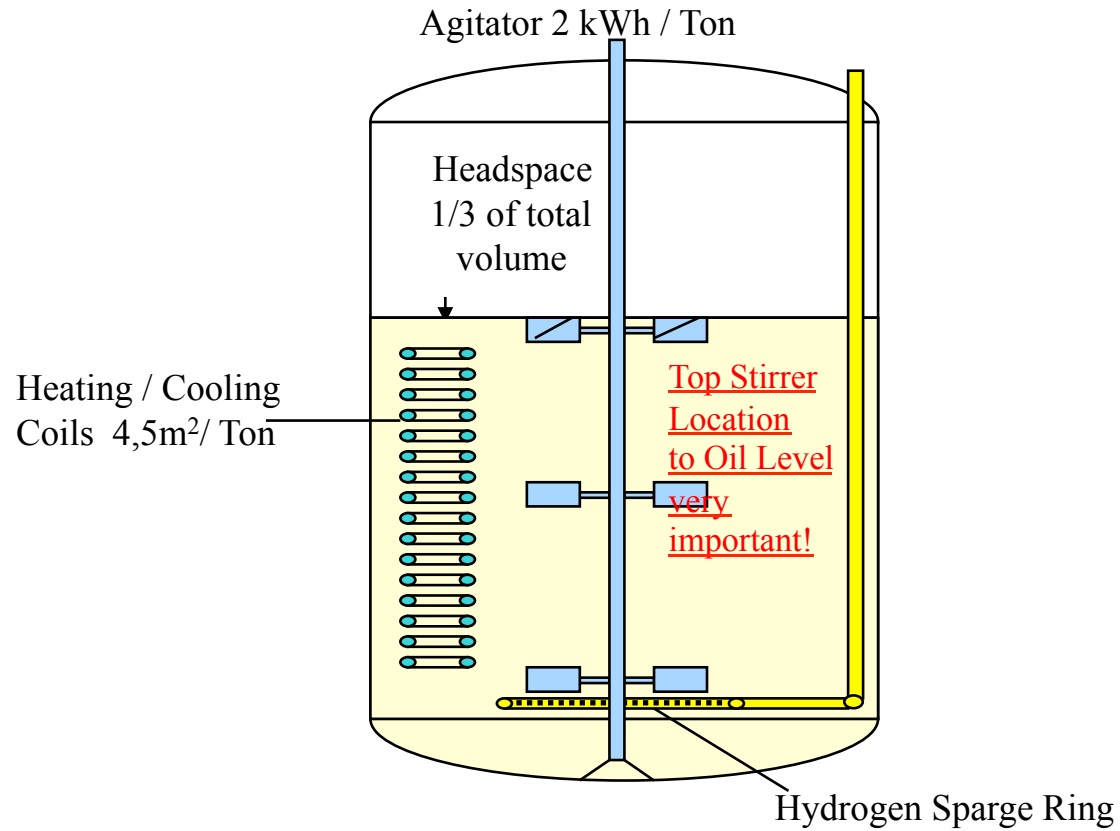
- ❑ Adds hydrogen atoms into vegetable oil
- ❑ Reason: To **modify hardness** of the oil for various applications
- ❑ **Partial** hydrogenation or **Full** hydrogenation
- ❑ Partially hydrogenated fats widely used as confectionery fats
- ❑ BUT partial hydrogenation produces **trans fatty acids** (aka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

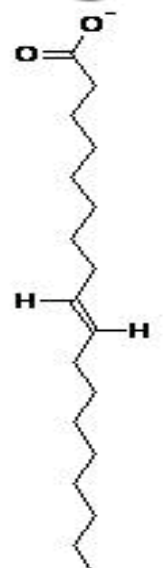
Nutrition Facts			
Serving Size 1 cup (228g)			
Serving Per Container 2			
Amount Per Serving			
Calories	250	Calories from Fat	110
% Daily Value*			
Total Fat	12g		18%
	Saturated Fat 3g		15%
	Trans Fat 1.5g		
Cholesterol	30mg		10%
Sodium	470mg		20%
Total Carbohydrate	31g		10%
	Dietary Fiber 0g		0%
	Sugars 5g		
Protein	5g		
Vitamin A			4%
Vitamin C			2%
Calcium			20%
Iron			4%

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

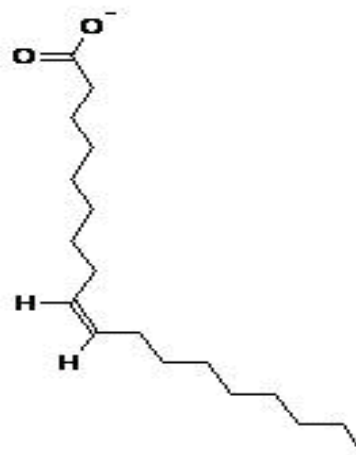
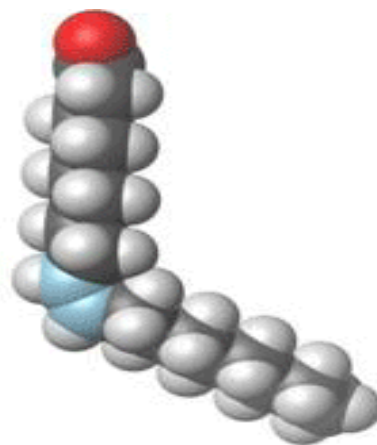
	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

HYDROGENATION REACTOR

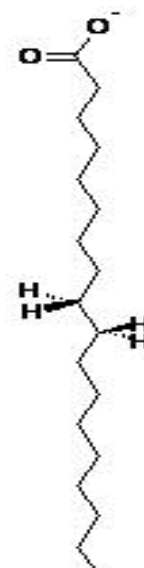




elaidic acid
(trans unsat.)



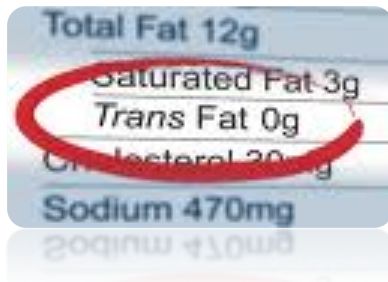
oleic acid
(cis unsat.)



stearic acid
(saturated)

Trans-free Solutions...

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



Interesterification

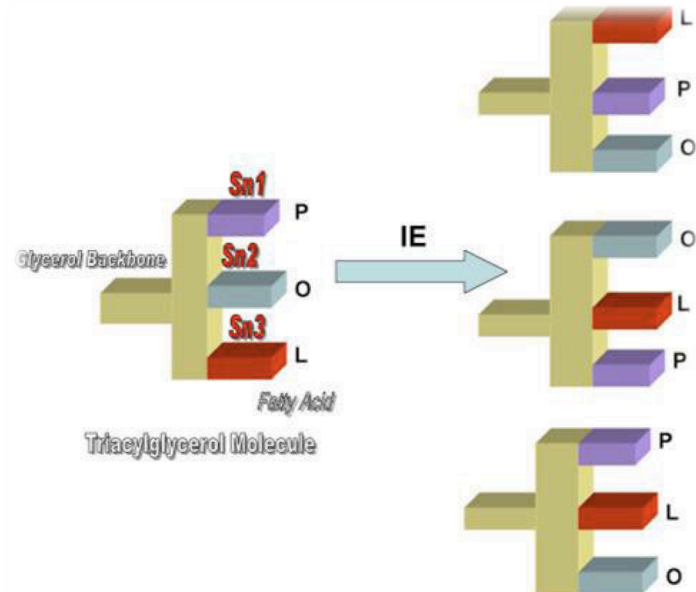
- ❑ **Rearrangement of the fatty acids in the oil molecule**

Reason: To change melting point of the oil/fat

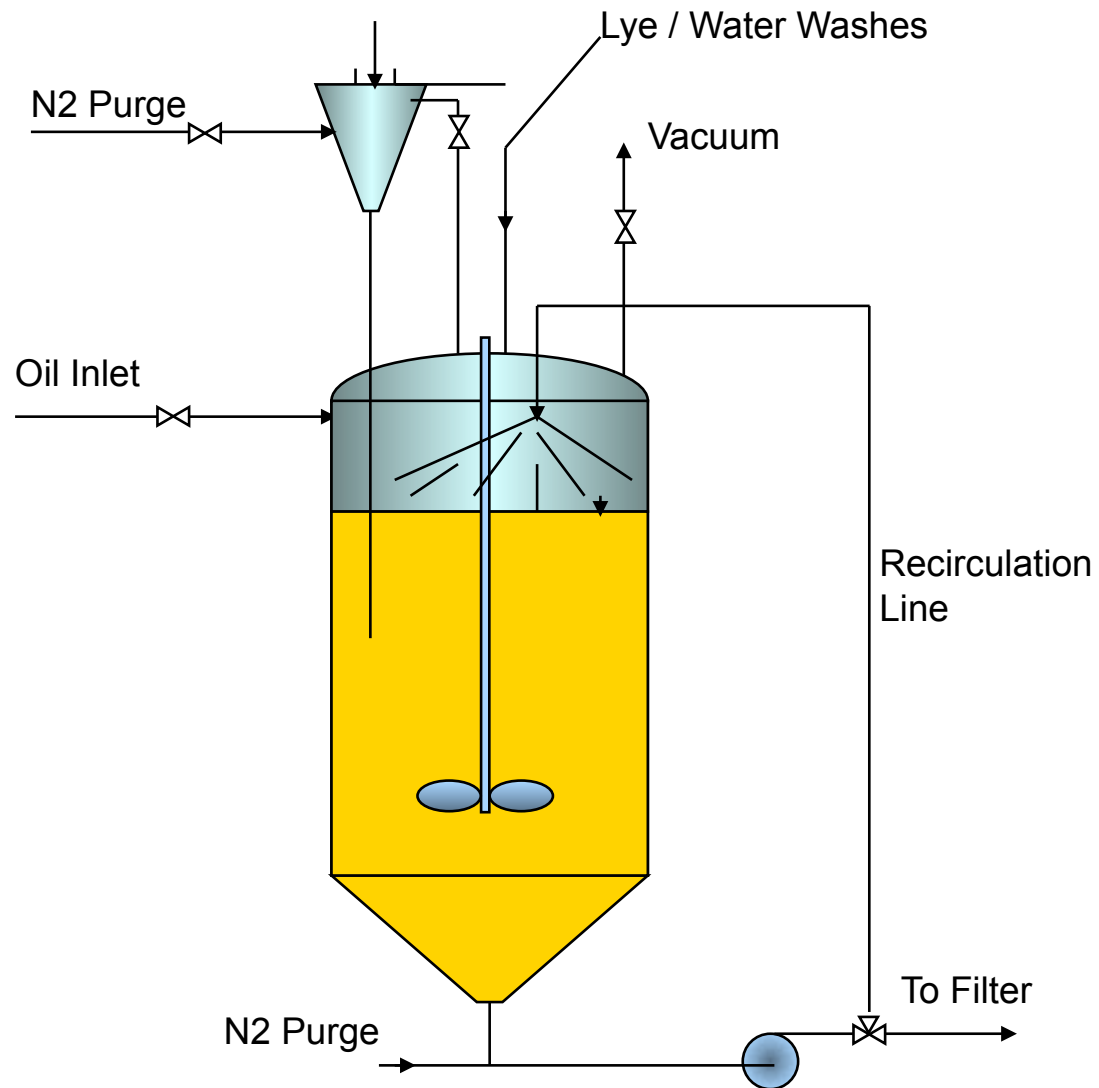
- ❑ **Versatile** ~ able to get wide range of fat profile by varying oil type and ratio

2 ways of doing it:

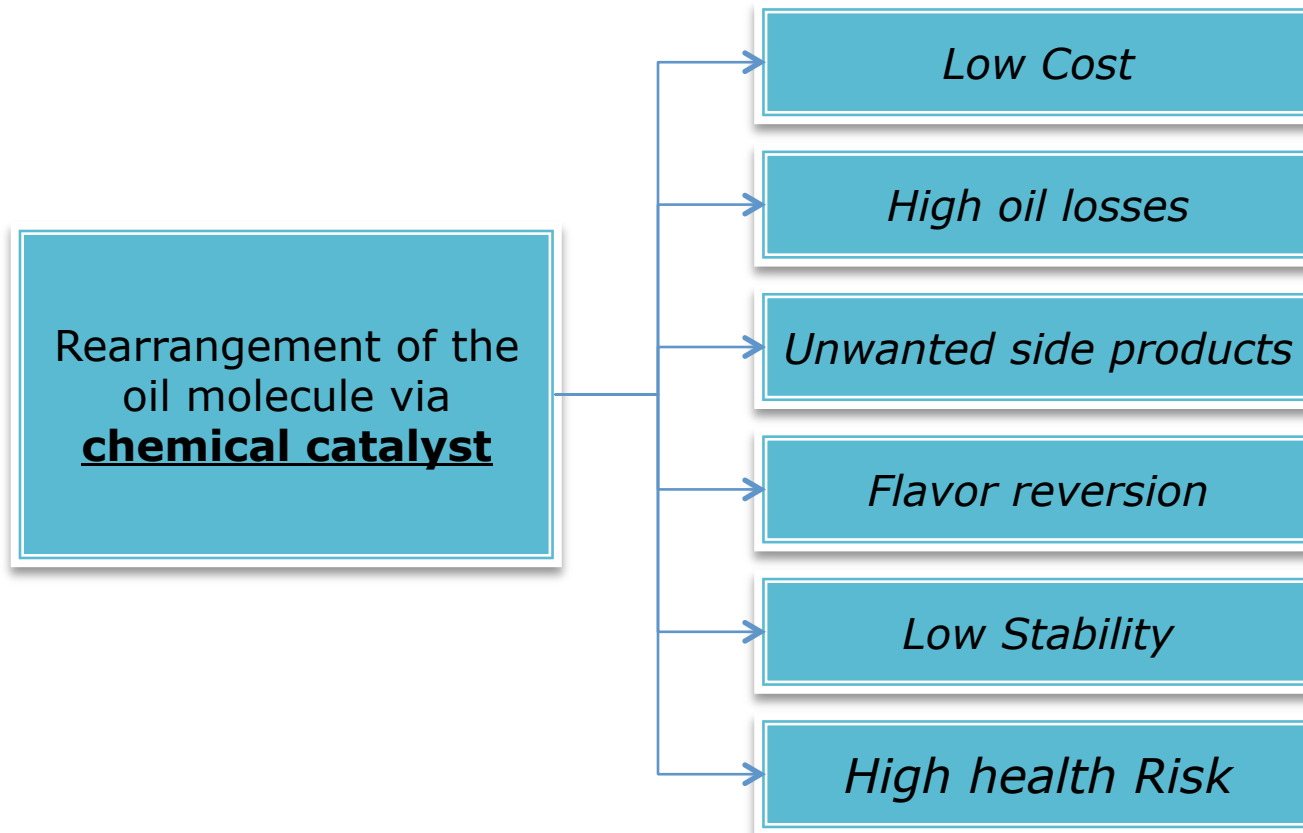
1. Chemical Interesterification (CIE)
2. Enzymatic Interesterification (EIE)



Chemical Interesterification (CIE)



Chemical Interesterification (CIE)



Enzymatic Interesterification (EIE)



Lab Scale

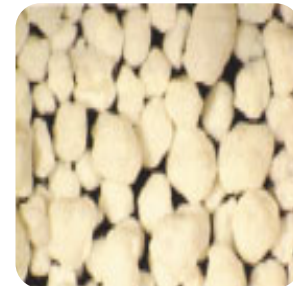
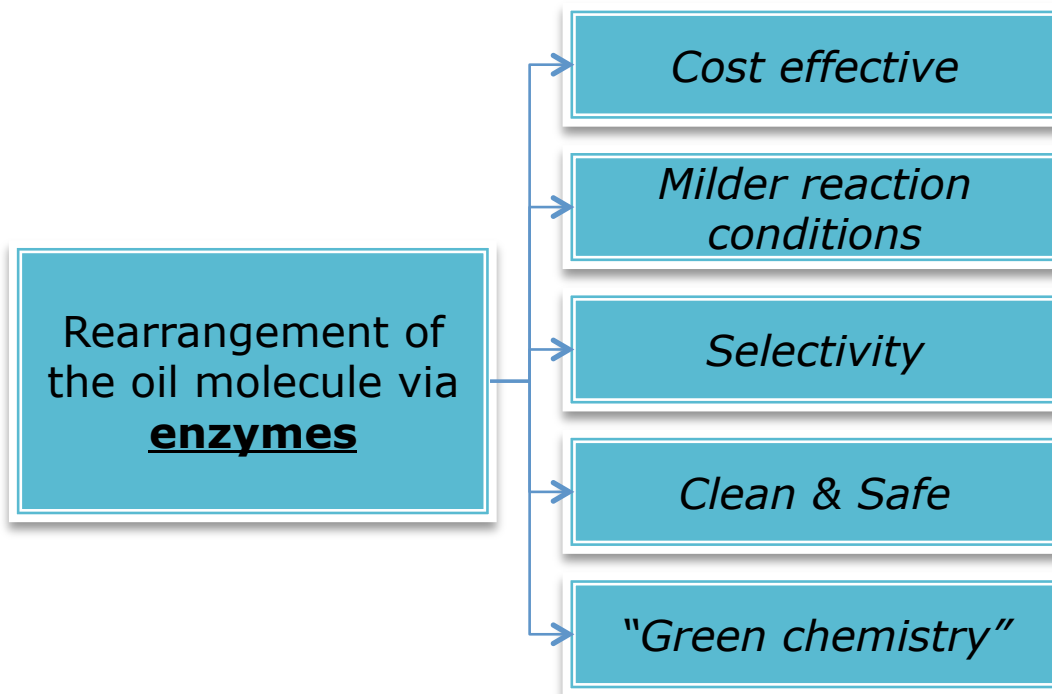


Pilot Plant



Plant

Enzymatic Interesterification (EIE)



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.
- Expensive enzymes.
- Minimal side-products.
- Minimal post-processing.
- Continuous process.

3. Advances in Palm Oil Products



Palm Oil Applications

Wide range of applications :

Spreads

Margarines

Baking fat

Frying fat

Cooking oil

Confectionery fat



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



เมยเทียม (Margarine)

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



ကုတ်ဆီ (Shortening)

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



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





Red Palm Oil/Olein

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



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

Confectionery Fats (CBE, CBS, CBX)



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)**

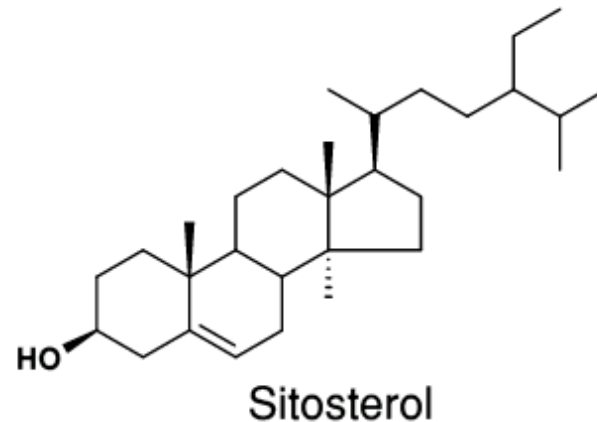
- ❑ PFAD used as a source to extract vitamin E



Minor Components in Palm Oil

Phytosterols

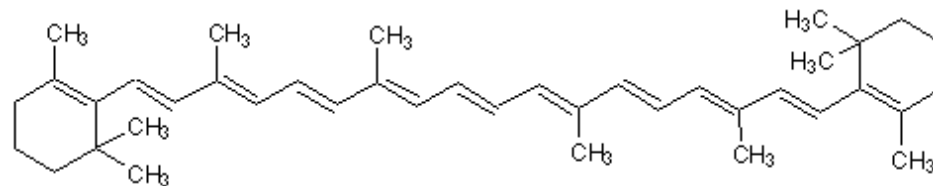
- ❑ **300-600 ppm** in CPO
- ❑ Helps **lower cholesterol**
- ❑ Used in nutraceuticals, pharmaceuticals, cosmetics, food beverages



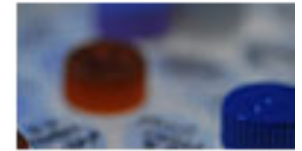
Minor Components in Palm Oil

Carotenoids (Vitamin A)

- ❑ Natural **fat-soluble pigment & antioxidant**
- ❑ Up to **700 ppm** in palm oil
- ❑ Crude palm oil rich in **beta-carotene**. Rich reddish colour
- ❑ Removed/destroyed during conventional refining
- ❑ Now, Red Palm Olein available from new processing techniques to retain beta-carotene

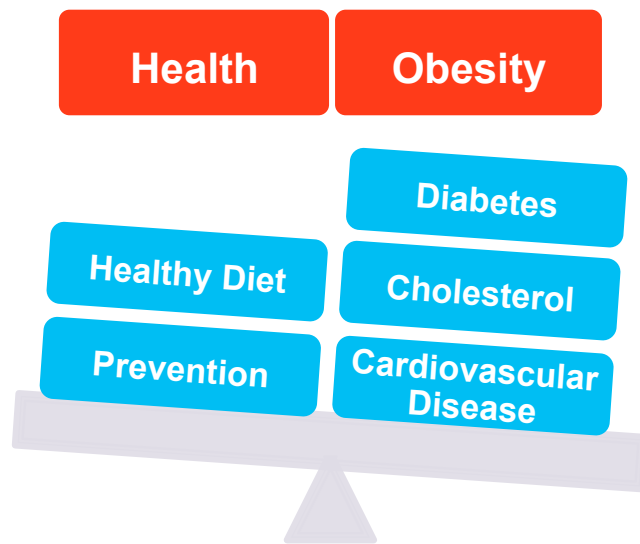


4. Future Trends of Palm Oil



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

- ❑ **Enzyme**-assisted processing techniques
- ❑ **Functional** oils (EIE oils/fats, DAG, MLCT)
- ❑ Consumer **lifestyle**



Future Trends of Edible Oil





Thank you