**Introduction**

Palm Oil is without doubt the most fractionated oil. Multi-step dry fractionation gives rise to soft fractions (Oleins, Superoleins and Topoleins) that are used as salad, cooking and frying oils, and to hard and specialty fats. Palm Oil is principally made of triunsaturated TAG’s (SSS), disaturated TAG’s (SUS) and monounsaturated TAG’s (SUU). Limitations due to insolubility (closely linked to polymorphism) make the separation difficult, as co-crystals are formed at each fractionation step. On the other hand, the hard and soft palm fractions can be easily produced from Palm Olein through a single separation step, using a multi-step fractionation technique.

**Objectives**

GOAL: Highlight the insolubility phenomenon involved in the dry fractionation process of Palm Oil.

Several liquid and solid fractions are selected: « Liquid Route »

Physico-chemical characteristics are examined in order to establish relationships between melting/polymorphic properties and chemical composition.

**Palm Oils:**
- Large range of FAME and IV (GLC) (depending on origin).
- No relationship between IV and CP.
- Large range of TAG’s composition (HPLC).
- SSC: 8-10%; SUS: 44-49%; SUU: 38-42%; UUU: 6-8%.
- DSC: LMP and HMP. Total melting \( \Delta H_f \) : 72.9 (+/-4.6) J/g.

**Palm Stearins:**
- Stearin from Filter-press: IV 33.8; 35.6.
- Stearin from Vacuum Filter: IV 46.8.
- TAG’s composition (HPLC).
- Differences between Filter-press and Vacuum Filter. FF: SUS 33%; SUU 47-49%; SUU 17-19%; UUU 1-2%.
- DSC: total melting \( \Delta H_f \) : 12.6 J/g.

**Palm Oleins:**
- Series of Oleins, Superoleins and Topolein with increased IV.
- Better relationship between IV and CP.
- DSC: Only LMP. « HMP » shoulder is nevertheless observed for lower IV oleins (higher CP). Three sub-peaks in LMP for oleins, two for superoleins and one for topolein. Total melting \( \Delta H_f \) : 64.0 (+/-2.8) J/g (64.0 J/g for Topolein).

**Palm Mid Fractions:**
- Two Soft PMF and one Hard PMF.
- DSC:
  - Soft PMF’s: LMP + HMP shoulder. Hard PMF: LMP and HMP.
  - DSC :
    - Hard PMF: LMP + HMP shoulder. Total melting \( \Delta H_f \) : 12.6 J/g.
    - Hard PMF: LMP + HMP shoulder. Total melting \( \Delta H_f \) : 12.6 J/g.

**Conclusions:**

**Palm Oils:** Two main populations of insoluble co-crystals: LMP = sub-\( \delta_2 \), sub-\( \alpha \); \( \beta_2 \), \( \beta_1 \); HMP = \( \beta_1 \), \( \beta_2 \); \( \beta_1 \). LMP = UUU + SUS; HMP = SUS + SSS.

**Palm Stearins:** Three main populations of insoluble co-crystals: LMP = sub-\( \delta_2 \), sub-\( \alpha \); \( \beta_2 \), \( \beta_1 \); HMP = \( \beta_1 \), \( \beta_2 \); \( \beta_1 \). LMP = UUU + SUS; HMP = SUS + SSS.

**Palm Oleins:** One main population of insoluble co-crystals with sub-populations: LMP = sub-\( \delta_2 \), sub-\( \alpha \); \( \beta_2 \), \( \beta_1 \); \( \beta_2 \). LMP = UUU + SUS + SUS.

**Palm Mid Fractions:** Soft PMF: One main population of insoluble co-crystals with sub-populations: 3 or 2 (SUS + SUS and UUU) + HMP shoulder (SUS + SSS). Hard PMF: Two main populations of insoluble co-crystals: LMP (SUS) + HMP (SUS + SSS).

**Methods:**
- FAME and iodine Value: AOCS Ce 1e-91 and Cd 1c-85.
- Cloud and Doping point: TAG’s composition.
- DSC: Mettler HPLC, Melting, Cooling 25 C/min., Heating 5 C/min.