



CHEMICAL CHARACTERISATION AND CLASSIFICATION OF FATS

- Technology and main properties -

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Barcelona, 28 March 2008



WP 1 - Characterisation and Classification of Feeding Fats

- ✧ OBJECTIVE: achieving a correct classification of fats resulting as a co-product or by-product of fats industrial chain or of food chain
- ✧ 7 Partners (UBAR, SSOG, SLU, UNIBO, UAB, CSIC, SILO)
- ✧ More than 100 man/month

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WP 1 - Characterisation and Classification of Feeding Fats

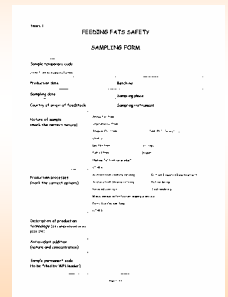
WP 1 was splitted in 4 different subtasks:

- SUB 1: Individuation of feedstocks
- SUB 2: Classification of feedstocks (technology, chemical composition)
- SUB 3: Evaluation of degradation products
- SUB 4: Evaluation of contaminants

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WP 1 - Characterisation and Classification of Feeding Fats Sample arrival in SSOG



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WP 1 - Characterisation and Classification of Feeding Fats Sample melting and homogenisation



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WP 1 - Characterisation and Classification of Feeding Fats Preparation of sub-samples



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Feeding Fats Safety



WP 1 - Characterisation and Classification of Feeding Fats Samples ready for delivery

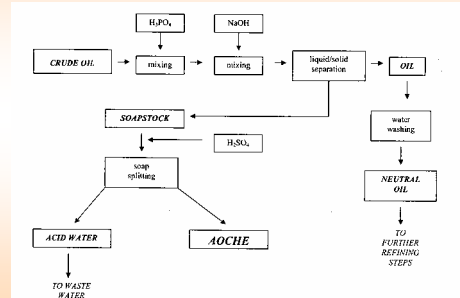


- * 124 collected samples
- * 868 sub-samples prepared and distributed
- * sub-sample size 100 ml <V <1000 ml

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AOCHE Acid Oils from CHEMical refining



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AOCHE



Main properties

- Mixture of Fatty Acids and Triglycerides
- High acid values
- Selection possibility (Olive, Tropical, Seed, Animal) in terms of FA composition and IV
- Low peroxide value
- Low trans FA content
- Low polymer content
- No problems with PBDEs
- No problems with Dioxins and PCBs

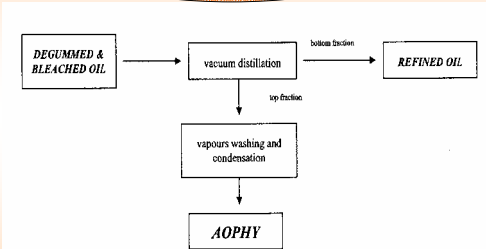
Main drawbacks

- Secondary oxidation products
- Possible problems with PAH

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AOPHY Acid Oils from PHYSICAL refining



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AOPHY



Main properties

- High concentration Fatty Acids, no glycerides, high unsaponifiable
- Very high acid values
- Selection possibility (Olive, Tropical, Seed, Animal) in terms of FA composition and IV
- Important sources of vitamin E
- Low peroxide value
- Low trans FA content
- Polymers practically absent
- No problems with PBDEs
- No problems with Dioxins and PCBs

Main drawbacks

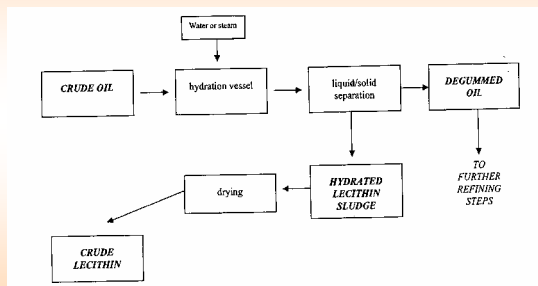
- Secondary oxidation products
- Possible problems with PAH (mainly for tropicals)

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LECI

LECithins



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LECI

Main properties

- Mixture phospholipids + triglycerides
- Product with a number of interesting functional properties
- No problems with PBDEs
- No problems with PAHs
- No problems with Dioxins and PCBs

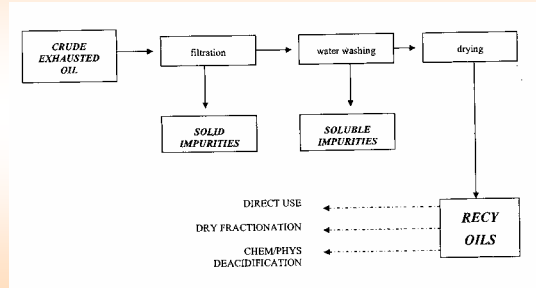
Main drawbacks

- FFA not standardised
- Humidity not standardised
- Very high viscosity (honey-like)
- High secondary oxidation products

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RECI RECIcled cooking oils



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RECI

Main properties

- Wide variety of different materials
- Mainly consisting of glycerides and fatty acids in different amounts
- No problems with PBDEs
- No problems with PAHs (in general)
- No problems with Dioxins and PCBs

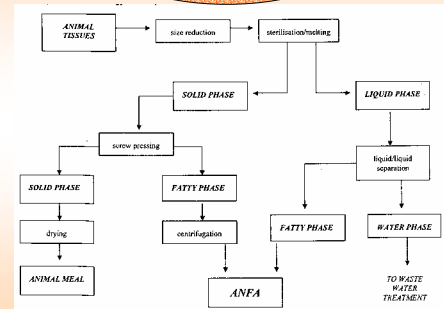
Main drawbacks

- Highly degraded products
- Actually forbidden for feed uses
- Important concentration of polymers
- Weak production chain
- Accidental contamination may occur

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ANFA ANimal Fats



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ANFA

Main properties

- Mainly consisting of glycerides
- Wide range of acid values
- Wide range of Iodine Values
- Low peroxide values
- Generally low secondary oxidation
- Low polymer content
- No problems with PBDEs
- No problems with PAHs (with exceptions !)
- No problems with Dioxins and PCBs

Main drawbacks

- Weak production chain – some unwanted materials can come inside !
- Lack of classification
- Low concentration of natural antioxidants
- Possibility of accidental contamination
- Poor standardisation state

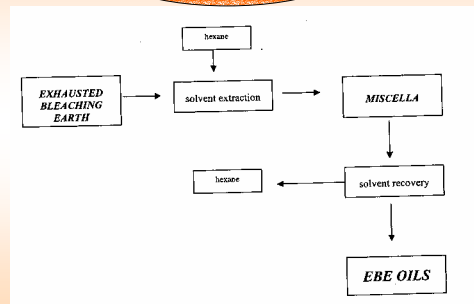
DEVELOPMENT POLICY

Presentation of Rafael Codony at EFPR meeting - Do not forget conclusions !!

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EBE oils from Exhausted Bleaching Earths



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EBE

Main properties

- Mainly consisting of glycerides
- No problems with PBDEs
- No problems with PAHs
- No problems with Dioxins and PCBs

Main drawbacks

- High polymer content
- Actually forbidden for food and feed uses
- Dark, viscous, smelling products
- Very low quantities available
- Weak production chain

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FISH
FISH oils

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    graph TD
      A[FISH/FISH TISSUES] --> B[soln reduction]
      B --> C[sterilisation/bleaching]
      C --> D[SOLID PHASE]
      C --> E[LIQUID PHASE]
      D --> F[sieve pressing]
      F --> G[SOLID PHASE]
      F --> H[FATTY PHASE]
      G --> I[drying]
      I --> J[FISH MEAL]
      H --> K[concentrating]
      K --> L[FISH]
      E --> M[liquid/solid separation]
      M --> N[FATTY PHASE]
      M --> O[WATER PHASE]
      O --> P[TO WASTE WATER TREATMENT]
  
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FISH

Main properties

- Mainly constituted of triglycerides
- Variable values for FFA
- FAME composition rich in polyunsaturated
- Low peroxide values
- No problems with PAH

Main drawbacks

- High secondary oxidation products
- Presence of polymers
- Strong smelling product
- Sometimes the fishy taste is transferred to the meat
- Contamination risk for PBDEs
- Contamination risk for PCBs and Dioxines

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HYBY
Hydrogenated BY-products

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    graph TD
      A[DISTILLED FATTY ACIDS] --> B[hydrogenation]
      C[H2] --> B
      D[catalyst] --> B
      B --> E[filtration/catalyst removal]
      E --> F[HYBY]
  
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HYBY

Main properties

- Mixture of distilled and hydrogenated fatty acid (one case of hydrogenated oil)
- Low oxidation parameters (both)
- Presence of trans fatty acids
- No polymers
- High melting point
- Can be handled as a powder
- No problems with PBDEs
- No problems with PAHs
- No problems with Dioxins and PCBs

Main drawbacks

- Non balanced fatty acids distribution

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FACS
Fatty Acid Calcium Soaps

1. Direct neutralisation of free fatty acids with slaked lime, according to the following reaction:

$$R-COOH + Ca(OH)_2 \rightarrow (R-COO)_2 Ca + H_2O$$
2. By double exchange reaction of fatty acids sodium/potassium salts with calcium chloride:

$$R-COOH + NaOH \rightarrow R-COONa + H_2O$$

$$R-COOH + KOH \rightarrow R-COOK + H_2O$$

$$2 R-COONa + CaCl_2 \rightarrow (R-COO)_2 Ca + 2 NaCl$$

$$2 R-COOK + CaCl_2 \rightarrow (R-COO)_2 Ca + 2 KCl$$
3. By direct saponification of an oil or fat with slaked lime:

$$2 \text{ triglyceride} + 3 Ca(OH)_2 \rightarrow 3 (R-COO)_2 Ca + 2 C_3H_5O_3 \text{ (glycerol)}$$

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FACS

Main properties

- Calcium soaps of fatty acids
- Feed with functional properties (rumen by-pass)
- FA composition can be designed as required
- Low oxidative profile
- Can be handled as a powder
- No problems with PBDEs
- No problems with Dioxins and PCBs

Main drawbacks

- Difficult classification and choice of analytical procedures
- Potential problems with PAHs (depending on the starting material)

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MIX
Miscellaneous products

1. Refined vegetable oils
2. Hydrogenated oils with very high *trans* fatty acids content
3. Fatty acid mono- and diglycerides

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MIX

Main properties

- High tech products with functional properties
- High quality
- High added value
- No problems with PBDEs
- No problems with Dioxins and PCBs

Main drawbacks

- Difficult classification and choice of analytical procedures
- Potential problems with PAHs, for mono- and diglycerides only (depending on the starting material)

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Feeding Fats Safety

Classifying the Feeding Fats

Means:

- Understanding which fat is going to be used
- Predicting/take advantage of special properties
- Knowledge of potential problems
- Choice of proper analytical procedures for evaluation
- Correct evaluation of trading price

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Feeding Fats Safety

Classifying the Feeding Fats - a proposal -

Eur. J. Lipid Sci. Technol. 106 (2007) 673-681 DOI 10.1002/ejlt.200700015 673

Classification of feeding fats by FT-IR spectroscopy

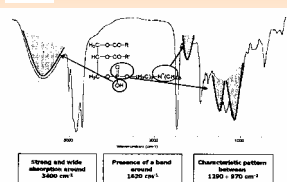
Classification of feeding fats by FT-IR spectroscopy

In this paper, a technique useful for the classification of different food oil co- and by-products of potential use for feed preparation is shown. The proposal is based upon a Fourier transform infrared evaluation of different classes of compounds, and its elaboration was carried out starting from the knowledge of the chemical composition of each feedstock category. Using this technique, a sure classification of fatty acid calcium soaps, fully hydrogenated fatty acids, lecithins, acid oils from chemical refining, acid oils from physical refining and fish oils can be easily done. The remaining categories of animal fats, fried oils and oils recovered from exhausted bleaching earth can be differentiated by using one or two additional chemical tests. The scope of this paper is to provide a quick, easy and non-expensive tool for a correct classification of feedstock, in order to allow the choice of correct and applicable analytical tests for the evaluation of the quality and of the composition of each sample.

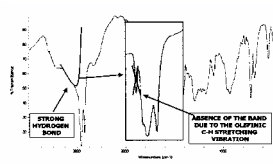
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Feeding Fats Safety

From the FT-IR spectrum



To feedstock classification



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