

El potencial de l'oli reciclat per la producció de biodiesel

PhD candidate Laura Talens Peiró,
Dr. Gara Villalba Méndez,
Dr. Xavier Gabarrell i Durany

Grup de recerca de Sostenibilitat i Prevenió Ambiental
SosteniPrA UAB-IRTA

12 de Juny de 2008
IV Jornades Internacionals de Biodièsel

Outline

- Introduction - Research group SosteniPrA
(Sostenibilitat i Prevenció Ambiental)
- What is the used cooking oil (UCO)?
- Aim of the study
- Potential production of biodiesel
- Conclusions
- Future research

SosteniPrA (Sostenibilitat i Prevenció Ambiental) is a research group of the **Institute of Environmental Science and Technology (ICTA)**. Presently, **SosteniPrA** has **22 researchers**, **8 doctors** and **2 members of PAS**. SosteniPrA aims to study systems and services versus environment, **optimize cycles and close material cycles**.

- ✓ **Methodologies:** **Life cycle analysis (LCA)**, eco-design, ecoefficiency, material and energy flow analysis, **exergy analysis** applied at different levels: process, local, regional, and national.
- ✓ Applied to prioritized sectors such as **biomass**, agriculture, the chemical industry, **waste re-use**, urban systems, and industrial products → **UCO for the production of biodiesel.**

Used Cooking oil (UCO) is the waste generated after frying and cooking food with fresh vegetable oil (fish, potatoes, etc..). UCO is classified by the European waste catalogue EC/532/2000 with CER number 200125.

Chemically UCO is composed by 92% triglycerides, 6% free fatty acids and 2% mono- and di-glycerides.



During frying oils can raise 160-200°C. For economical reasons, the same fat is used during continuous and repeated frying. Frying performed for several days, in household the frying fat may be several weeks.

During the frying process:

- It is increased the free fatty acids content
- Change its colour to dark brown or even red
- Increase the tendency of fat to foam



Even though the chemical changes, UCO is suitable for biodiesel production.

The aim of the study is to **account for the potential production of biodiesel from UCO in Area A.**

Area A is located in the east part of Catalonia and includes **221 municipalities** in 19 counties.

Area A has a population of **over 6 million inhabitants** (85% population in Catalonia).

Catalonia has **13.42% agro-industry** and **17.35% HORECA** of Spain.

Area A concentrates **76% of the total** industry and HORECA consuming vegetable oil.



Vegetable oil are consumed by:

Industry and HORECA (HOtels, REstaurants and CAtering) have to submit yearly reports of the amount of UCO generated to the department of environment following EC/532/2000 with CER number 20 01 25:

20 Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

20 01 separately collected fractions (except 15 01)

20 01 25 edible oil and fat

UCO is collected by authorised waste management companies.

Citizens (in households) are not obligated to separate UCO from other household wastes. UCO from households is collected from recycling centres.

Potential production of biodiesel

1. **Account for the present consumption of fresh vegetable oils.** Using data from Spanish Ministry of Agriculture, food and fishery (MAPA).
2. **Account for the amount of UCO generated.**
 - Data for industry and HORECA taken from yearly reports.
 - Data for households obtained by surveys.
3. **Account for potential amount of biodiesel.** Amount of UCO required to produce 1 ton of biodiesel.

Consumption of fresh vegetable oil in tonnes (2005)

| | Area A | Catalonia |
|------------|---------|-----------|
| Industry | 27,400 | 37,240 |
| HORECA | 112,100 | 144,437 |
| Households | 84,029 | 98,546 |
| Total | 223,529 | 280,224 |

→ Households consume 35 % of the total vegetable oil.

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- Households consume 35 % of the total vegetable oil.
- Area A consumes approximately 80% of the consumption in Catalonia.

Generation of UCO in tonnes in Area A (2006)

| | Present (tonnes) | Potential (tonnes) |
|---------------------|---------------------|-----------------------|
| Industry and HORECA | 4,580 | 4,580 |
| Households | 120 | 25,200 |
| Total | 4,700 | 29,780 |

CER number 20 01 25

- Industry and HORECA manage 2-3 % of their vegetable oil consumption as CER number 20 01 25.
- Households, 30% of the vegetable oil consumption is generated UCO.

Potentiality of UCO, biodiesel and its by-products (2006)

To produce 1 ton of biodiesel are required 1.17 tonnes of UCO *

| | |
|---------------------------|--------|
| Potential amount of UCO | 29,780 |
| Production of biodiesel | 25,370 |
| Production of by-products | |
| Glycerol | 2,490 |
| Fertiliser | 564 |

* Talens Peiró, L.; Villalba Méndez, G.; Gabarrell, X. Exergy analysis of integrated waste management in the recovery and recycling of used cooking oils. Environmental Science & Technology. Manuscript ID: es071972a.R2. (In Press 2008)

Potentiality of UCO, biodiesel and its by-products (2006)

To produce 1 ton of biodiesel are required 1.17 tonnes of UCO *

| | | |
|---------------------------|--------|--|
| Potential amount of UCO | 29,780 | → In Catalonia, only from households 29,760 tonnes |
| Production of biodiesel | 25,370 | |
| Production of by-products | | |
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Other indicators:

Energy balance

Potential production of **biodiesel** will produce **943,000 GJ**.

| Energy consumed by the management of UCO | In GJ |
|--|--------|
| Electricity and 100% diesel | 34,770 |
| Electricity and 100% biodiesel | 34,430 |
| Electricity and 100% biodiesel* | 29,760 |

Exploiting further the capacity of the collecting vans (minimum amount transported 0.6 metric tones) and using 100% biodiesel

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Other indicators:

Land use

1.14 tonnes of rapeseed biodiesel → 1 ha per year **

25,370 tonnes of UCO biodiesel → 22,200 ha per year



which represents the 2.4 % of the total agricultural land for industrial and edible crops in Catalonia (925,000 ha).

** Mittelbach, M and Remschmidt, C., Biodiesel; the comprehensive handbook. First Edition ed. 2004: Martin Mittelbach, Am Blumenhang 27, A-8010 Graz, Austria.

- ✓ The **potential production of biodiesel in area A** could increase from 4,700 to **25,370 tonnes** by exploiting further the collection of UCO in households.
- ✓ **In Catalonia**, the amount of UCO generated **from households** can lead to a **potential production** of biodiesel of **29,200 tonnes**.
- ✓ The **surveys** show that for exploiting further the UCO is required to **increase the number of collecting points in cities**. Citizens find necessary also to distribute **specific containers** for **collecting oils in households**.
- ✓ **Further studies** are required to **account for the UCO generated by industry and HORECA and managed as 20 01 25**.

- ✓ The present **energy consumed** by the management of UCO is **4% of the final energy produced**. It can be further reduced to **29,760 GJ** if the capacity of the collecting vans is further exploited.
- ✓ Exploiting further **the production of biodiesel from UCO** avoids **using 22,200 ha per year**.

Papers published

1. [Life cycle assessment of a Brassica Carinata bioenergy cropping system in southern Europe.](#) Biomass and Bioenergy, Volume 31, Issue 8, August 2007, Pages 543-555. Carles M. Gasol, Xavier Gabarrell, Assumpció Anton, Miquel Rigola, Juan Carrasco, Pilar Ciria, M.L. Solano, Joan Rieradevall.
2. [Exergy analysis applied to biodiesel production.](#) *Resources, Conservation and Recycling, Volume 51, Issue 2, August 2007, Pages 397-407.* Laura Talens, Gara Villalba, Xavier Gabarrell.
3. [Integrated Assessment of forest bioenergy systems in Mediterranean basin areas: The case of Catalonia and the use of participatory IA-fous groups.](#) *Renewable and Sustainable Energy Reviews, Volume 12, Issue 5, June 2008, Pages 1451-1464.* Neus Puy, David Tàbara, Jordi Bartrolí Molins, Jordi Bartrolí Almera, Joan Rieradevall.
4. [Feasibility assessment of poplar bioenergy systems in the southern Europe.](#) *Renewable and Sustainable Energy Reviews, In Press, Corrected Proof, Available online 11 February 2008.* Carles M. Gasol, Sergio Martínez, Miquel Rigola, Joan Rieradevall, Assumpció Anton, Juan Carrasco, Pilar Ciria, Xavier Gabarrell.
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Projects

Estudio e integración de herramientas de sostenibilidad (SUSTOOL). Acción Integrada Hispano-italiana. Ministerio de Educación y Ciencia. Referencia: HI2006-0175. Enero 2007 hasta diciembre 2008.

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Thank you for your attention!

Laura Talens Peiró PhD candidate,

laura.talens@uab.cat

SosteniPrA UAB-IRTA

www.sostenipra.cat