

"*Jatropha Curcas* L.: The Biodiesel Source for Tomorrow?"

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Jatropha Seminar, November 20-21, 2006, Jakarta, Indonesia

EUROPE HEATS UP • GERMANY'S ODD COUPLE

NewsweekInternational.com

Newsweek

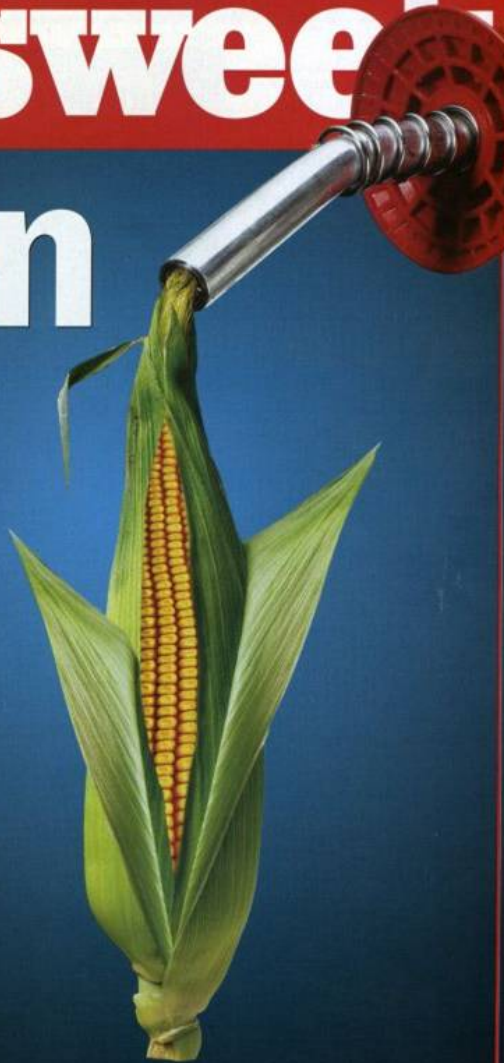
August 8, 2005

Green Gold

After Years of Hype, Biofuels Are Starting To Fill the World's Gas Tanks

PLUS

Amory Lovins On How to Eliminate Oil



Newsweek:

August 8, 2005



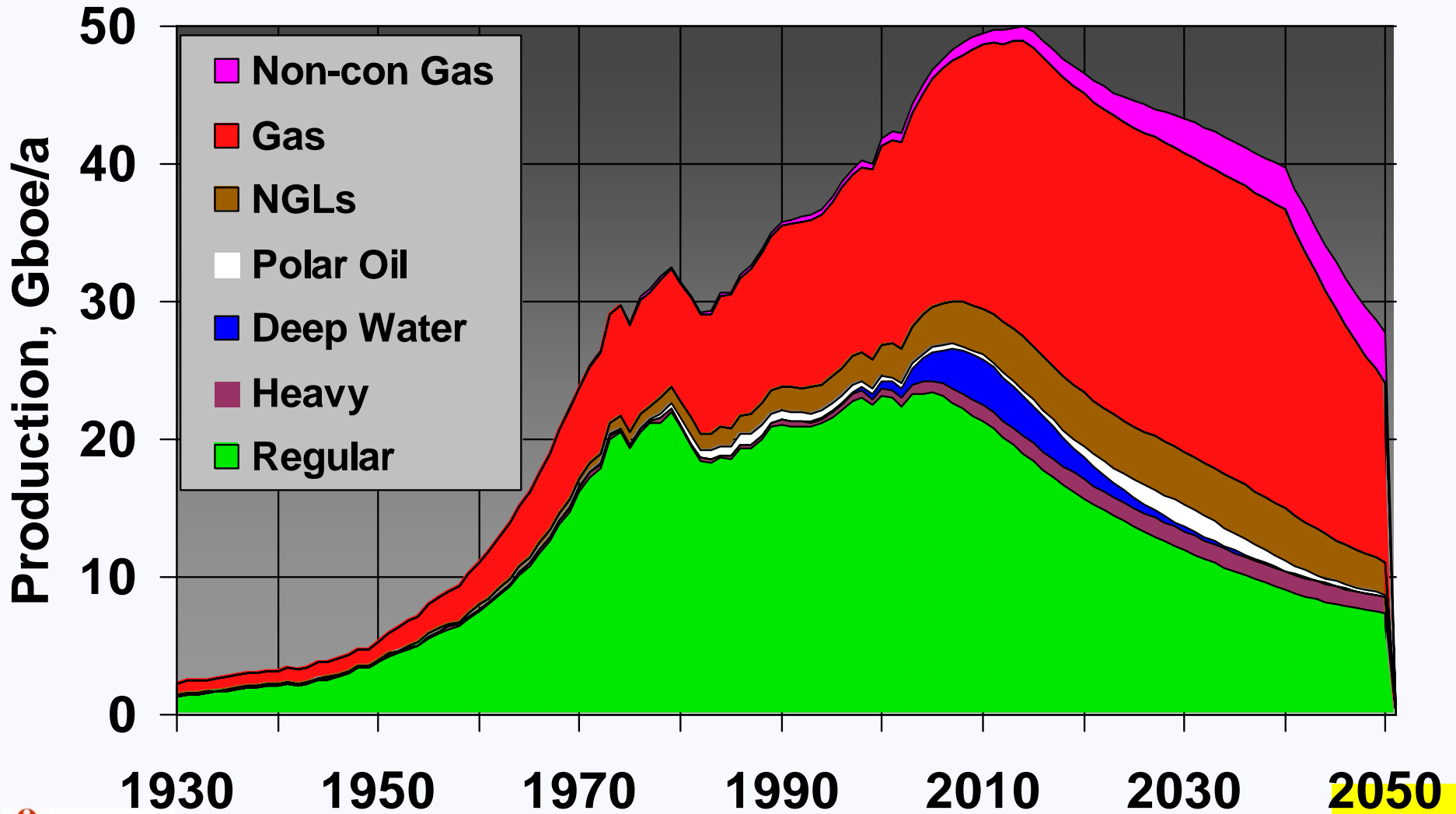
Albania Lek 600	France €4.00	Germany €4.00	India ₹ 75.00	Italy €4.00	Japan ¥ 500
Austria €4.50	Germany €4.00	Gibraltar £ 3.75	Latvia €4.00	Lebanon L.L. 15,000	Malaysia RM 11.20
Belgium €4.00	Germany €4.00	Greece €4.00	Lithuania €4.00	Malta Lm 1.75	Mexico MXN 11.20
Bulgaria BGN 4.00	Hungary Ft 500.00	Denmark Kr 36.00	Luxembourg €4.00	Malta Lm 1.75	Norway NOK 11.20
Croatia HRK 20.00	Denmark Kr 36.00	Cyprus €2.25	Malta Lm 1.75	Poland (incl. tax) PLN 11.20	Portugal (incl. tax) €4.00
Czech Republic CZK 100.00	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	Romania Lei 15.00	Russia €4.00
Cyprus €2.25	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	Russia €4.00	South Africa R 11.20
Danish Kr 36.00	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	South Africa R 11.20	Spain €4.00
Denmark Kr 36.00	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	South Africa R 11.20	Sweden SEK 36.00
Denmark Kr 36.00	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	South Africa R 11.20	Switzerland SF 6.20
Denmark Kr 36.00	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	South Africa R 11.20	Turkey TL 100,000 YTL 4.00
Denmark Kr 36.00	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	South Africa R 11.20	Ukraine €4.00
Denmark Kr 36.00	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	South Africa R 11.20	United Kingdom £ 2.25
Denmark Kr 36.00	Denmark Kr 36.00	Denmark Kr 36.00	Malta Lm 1.75	South Africa R 11.20	U.S. Dollars \$ 3.25



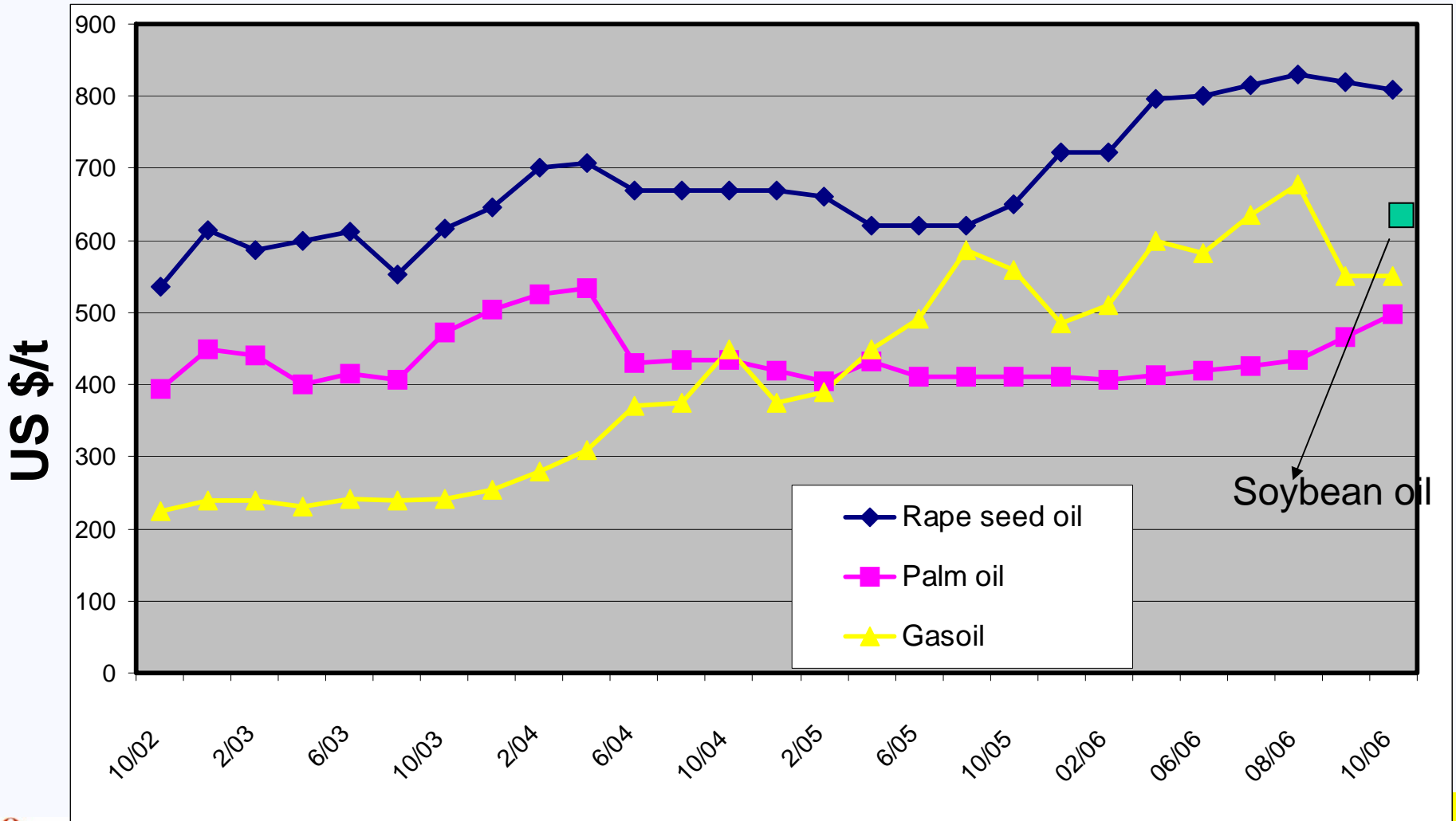
Jakarta, November 20-21, 2006



Peak Oil



Vegetable Oil /Mineral Oil Prices



Triacylglycerides

Vegetable oils, animal fat, microbial oils



Transesterification

Biodiesel:

Fatty Acid (M)ethyl Esters
from natural origin



Esterification

Fatty Acids

Hydrolysis, veg. oil refinement, soap stock



Biodiesel Chronicle in Europe

- 1985 First Pilot Plant for RME in Austria
- 1988 Creation of Word „Biodiesel“
- 1991 First Industrial Scale RME Production Plant in Austria
- 1991 First Biodiesel Production Plant in Germany
- 1992 First Biodiesel Plant in Czech Republic
- 1992 Biodiesel Activities Starting in Italy
- 1993 First Demonstration Plant in France
- 1994 FAME Fuel Specifications in Austria
- 2003 European Directive for the Promotion of Biofuels
- 2004 EU-Specifications for Biodiesel
- 2005 ff Biodiesel Activities in all European Countries



Biofuels Activities of IFC, Uni Graz

- Development of biodiesel process technologies
- Alternative feedstocks for biodiesel production
- Alternative uses for biodiesel and side products
- Research on analysis and characterization of fats and oil derivatives
- Development of specifications
- Training and seminars on biodiesel analysis and quality management
- Research on second generation biofuels: BTL....



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Directive 2003-30 of the European Commission

EC Directive for the Promotion of Liquid Biofuels:
2003/30/EC, May 2003

Indicative Market Shares:

2 % by 2005

5.75 % by 2010

Annual report by the 25 member states on activities
to reach the goal

Installation of national regulations; tax release



Biofuels in the European Union Vision for 2030 and Beyond (June 2006)

Target for 2030: Biofuels share: 25 % (109 mill. t/a)
4 – 13 % of total agricultural area

*„Biofuels and their raw materials are traded on world markets. In view of increasing our security of supply, a fully self-sufficient approach to meeting the EU’s needs is neither possible nor desirable. The Commission should pursue a **balanced approach** in encouraging both domestic production and imports.“*

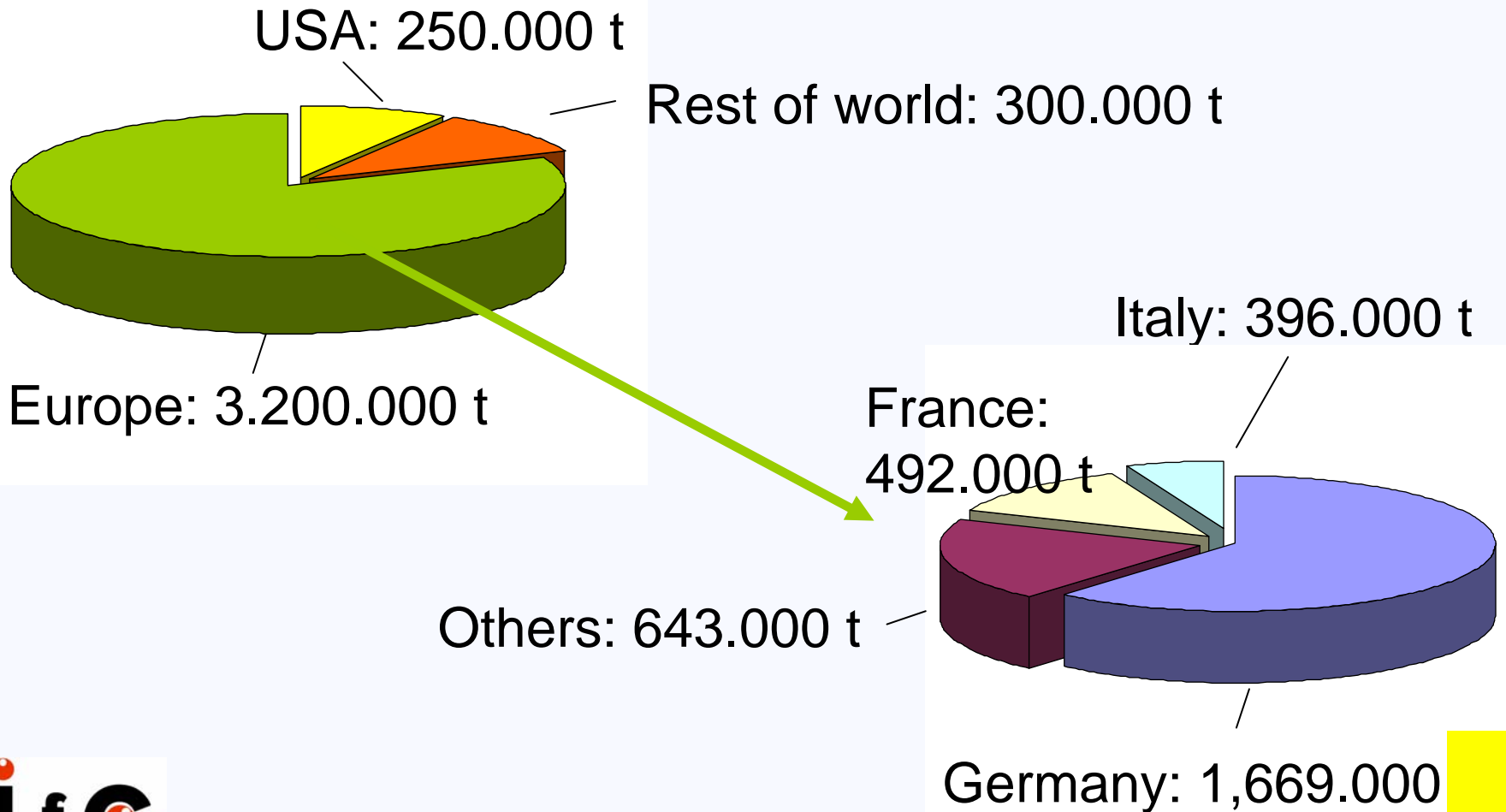


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2005 Biodiesel Production Worldwide

3.75 mill. tons p.a.



Raw Material Sources for Today's Biodiesel Production, Worldwide

Rapeseed 68 %

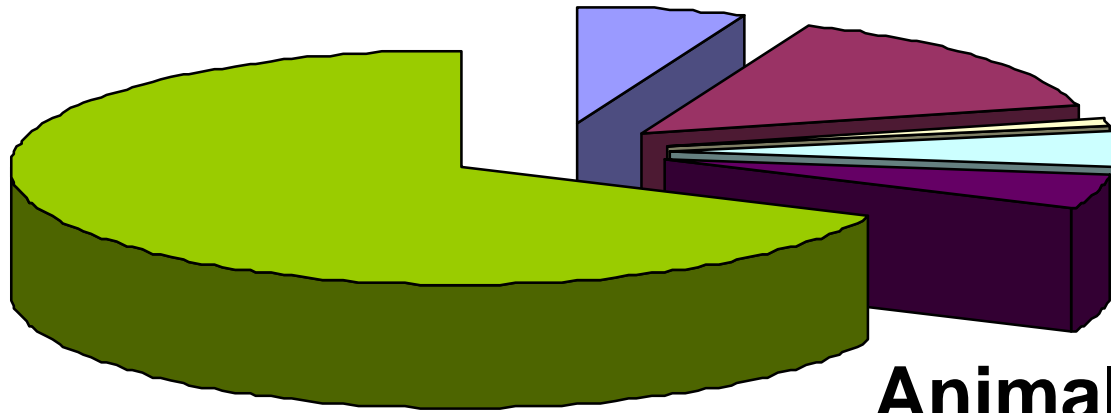
Palm 6 %

Soybean 15 %

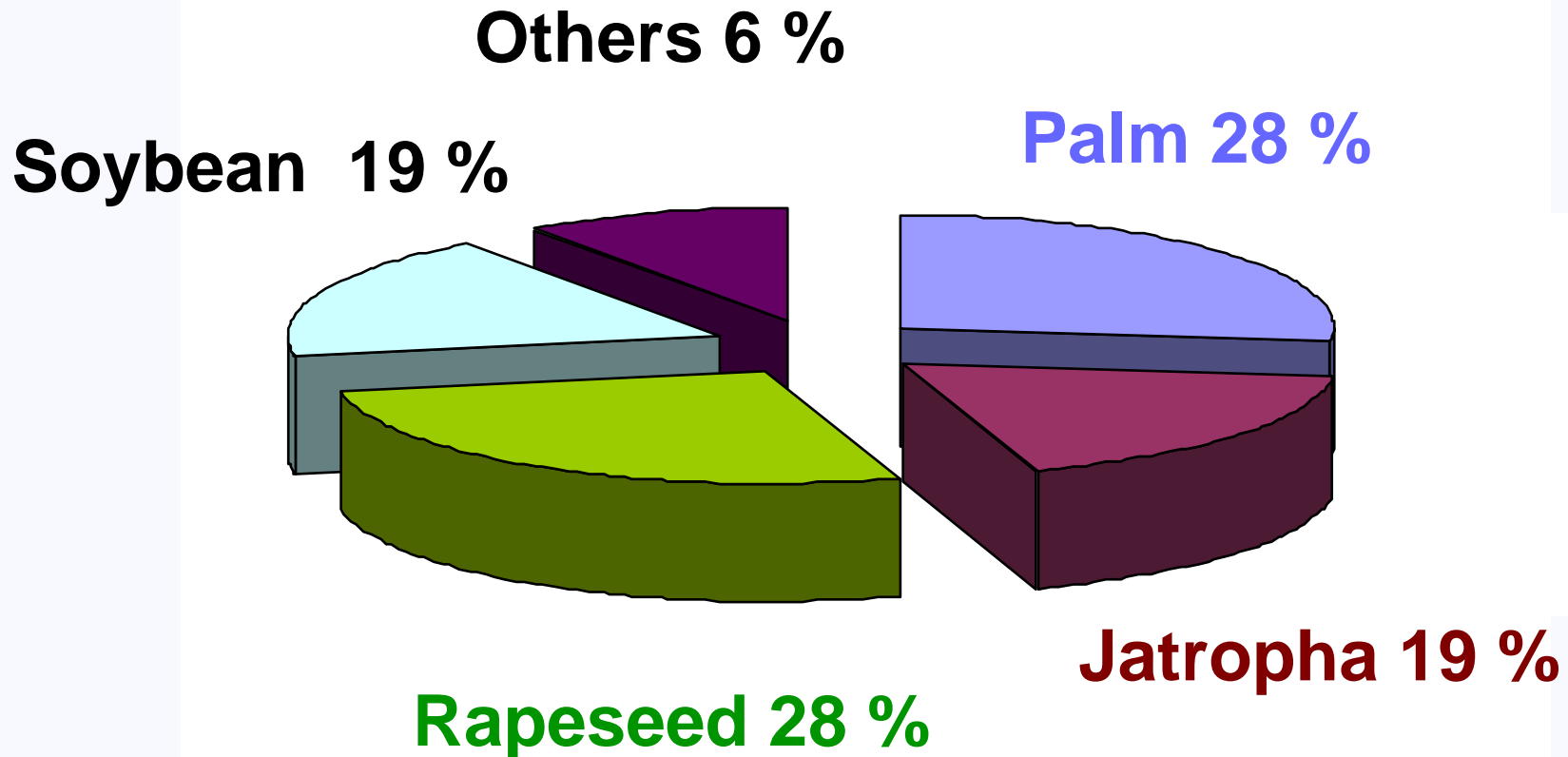
Sun 1 %

UFO 5 %

Animal Fat 5 %



Raw Material Sources for Tomorrow's Biodiesel Production, Worldwide ???



New Feedstocks for Biodiesel Production

- Vegetable food oils: palm, soybean, sunflower
- „New“ seed oils: cuphea, crambe.....
- Single cell oils: yeast, funghi, algae
- Genetically modified seed oils
- Non-edible seed oils
 - Jatropha curcas, Castor oil
 - Used frying oil
- Animal fat: tallow, grease
- Waste oils and fat, soap stock, trap grease

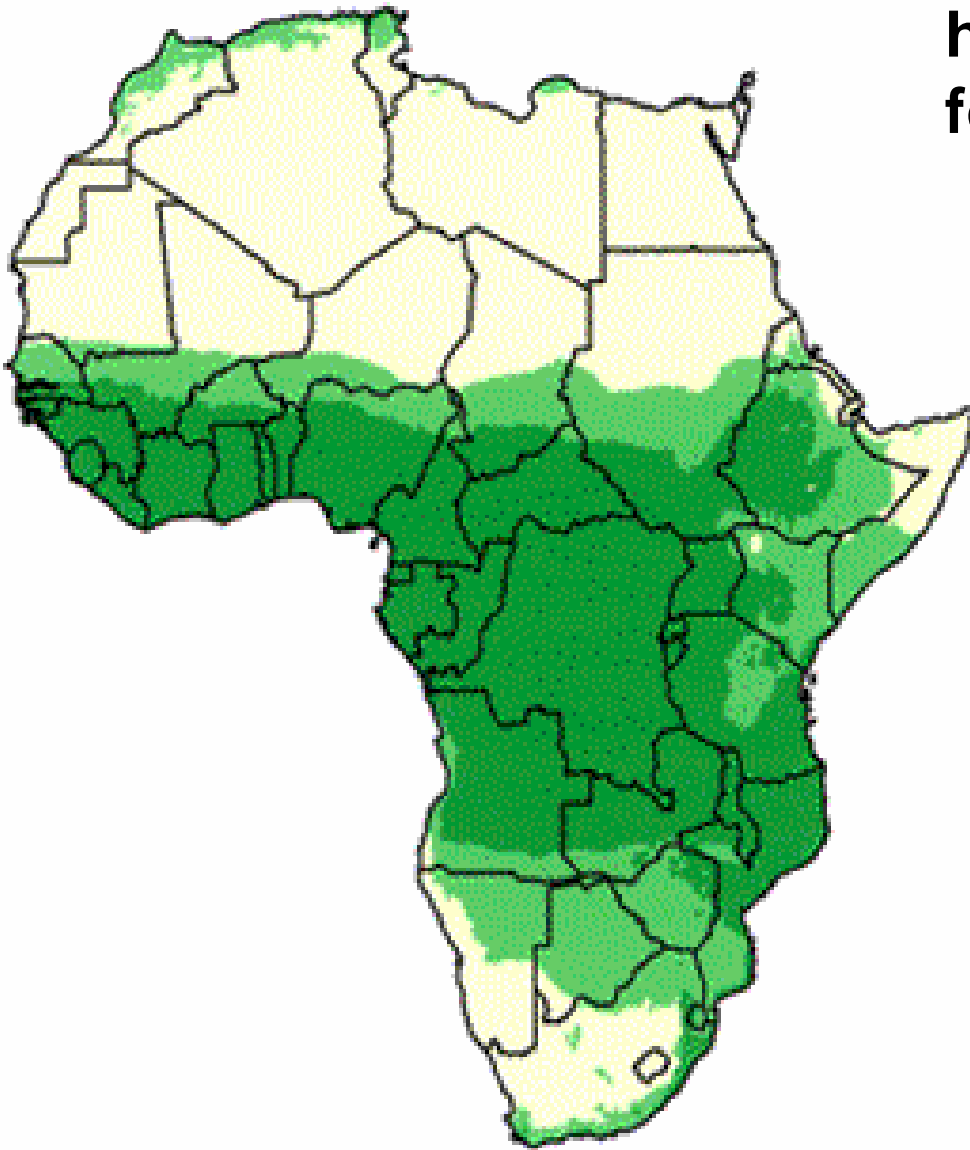




***Jatropha curcas* L**
The Biodiesel Crop in the Future???



**Over 50% of Africa's land
has the right climate
for growing Jatropha**



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Jatropha Production in India

Goal for 2006/07:

5 % of mineral diesel replacement

2.2 mill ha plantations

2.6 mill. t of biodiesel

Available areas: 13.4 mill ha



Jatropha Production in India

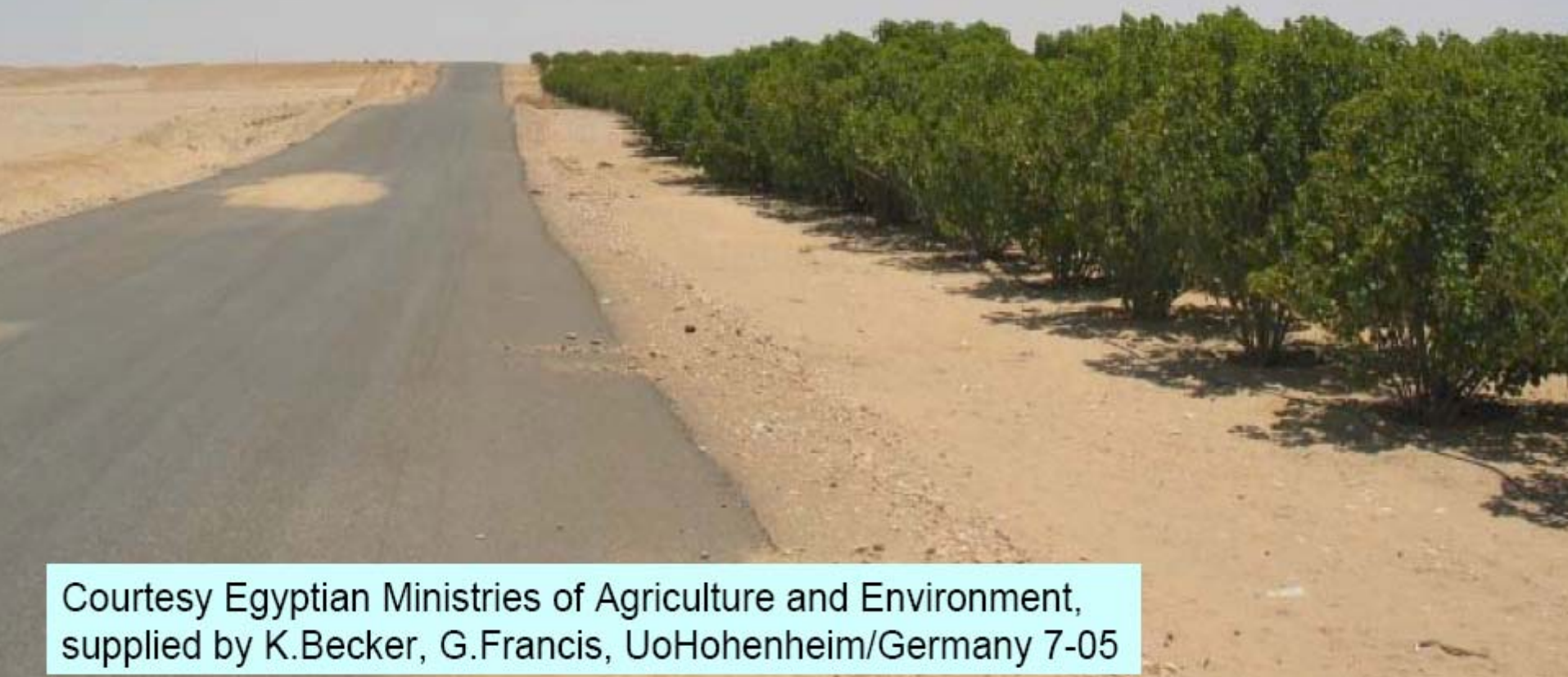


**K.Becker, Uni Hohenheim: Jatropha Plantation in Gujarat
India – Aug/Sept 2004**

Reforestation of Desert or Degraded Land

LUXOR, Egypt 2005

(Slight Irrigation - 200 mm p.a. - by Sewage Water)



Courtesy Egyptian Ministries of Agriculture and Environment,
supplied by K.Becker, G.Francis, UoHohenheim/Germany 7-05

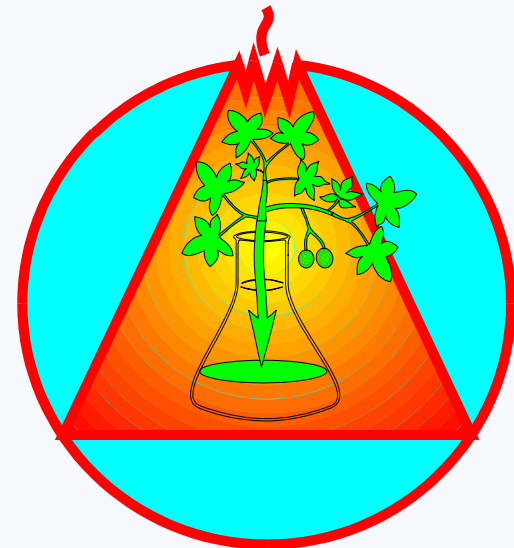
Gübitz, Mittelbach, Trabi

Biofuels and Industrial Products from *Jatropha curcas*



Symposium on Biofuel
and Industrial Products
from *Jatropha curcas*
and other Tropical Oil Seed
Plants

Managua / Nicaragua
23 - 27 February 1997



Biomass Project within an Austrian Development Help Project in Nicaragua

1990 – 2000

Evaluation of *Jatropha curcas* L. as
energy plant

Cultivation of 1.000 ha

„The biofuel part, however, suffers from the development of fossil fuel prices, which makes the production of diesel from physic nut uneconomical at the moment.“



Jakarta, November 2







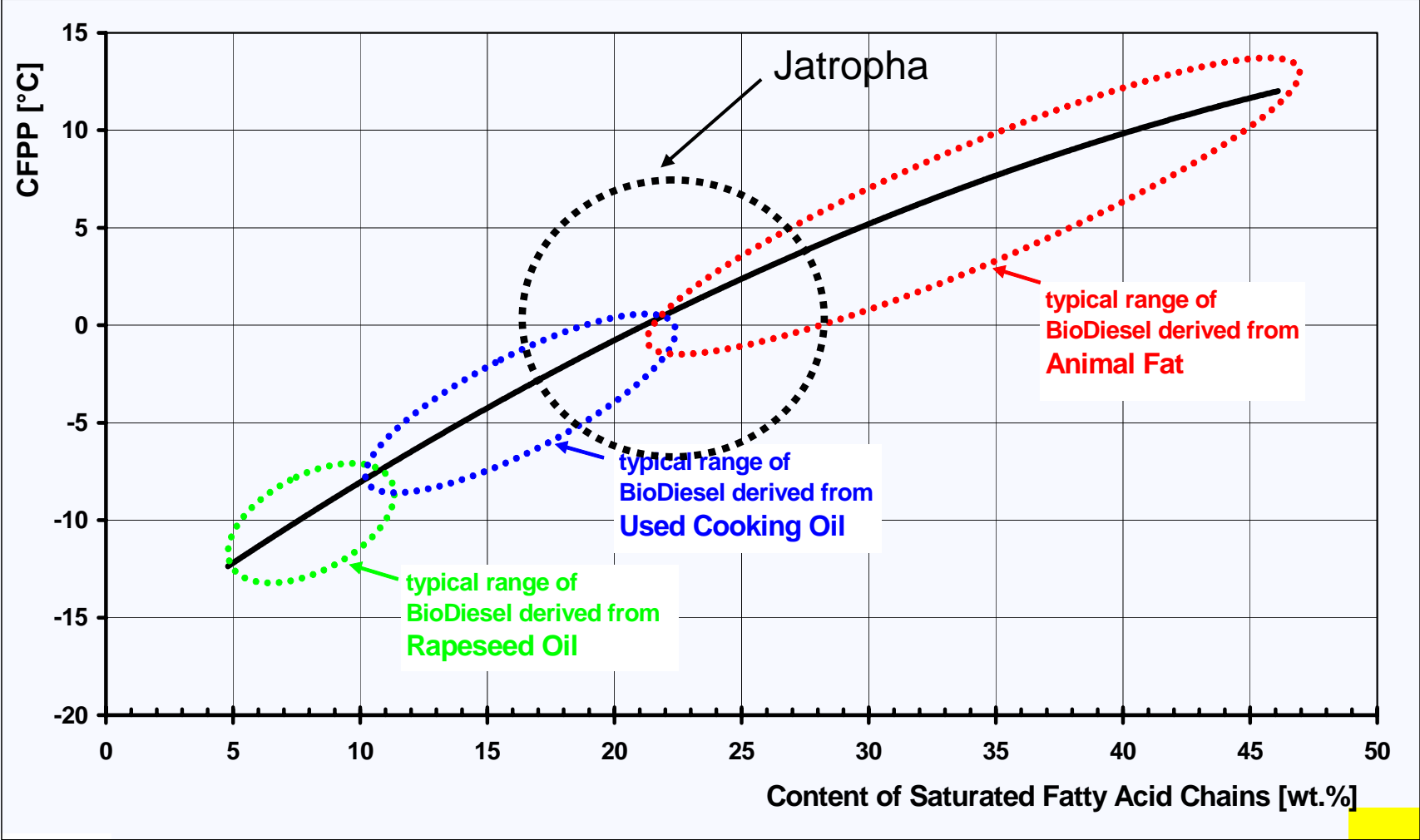
Biodiesel from Oil of *Jatropha Curcas* L.

FAME from

Fuel Parameter	Rape Seed	Jatropha curcas
Cetane Number	49 - 62	51 - 59
CFPP [°C]	-19 - -8	-3
Iodine Number	104 - 120	95 - 107
Oxidation Stability [h]	7	3



CFPP of B100 vs. Saturated Fatty Acids



Source: BDI, 2005

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Toxic Principles of *Jatropha Curcas* L.

Phorbol esters:

mainly in the oil; esters of tigliane diterpenes
tumor promotion, cell proliferation, activation of blood platelets, lymphocyte mitogenesis, inflammation

Curcin:

mainly in the oil cake; Ribosome-inactivating protein

Non-toxic varieties found in Mexico



Separation of 6 New Compounds

3 kg of seed oil
Separation on silica with SPE

Column chromatography on silica: 3.52 g

2 x column chromatography

HPLC separation C8 reversed-phase HPLC [Spherisorb]

Final purification with HPLC

Isolation of compounds: 1-7 mg each



Identification of 6 New Compounds

Methods:

MALDI-TOF MS

NMR techniques including

- 1H-1H correlation (COSY)

- 1D and 2D total correlation (TOCSY)

- distortionless enhancement by polarization (DEPT)

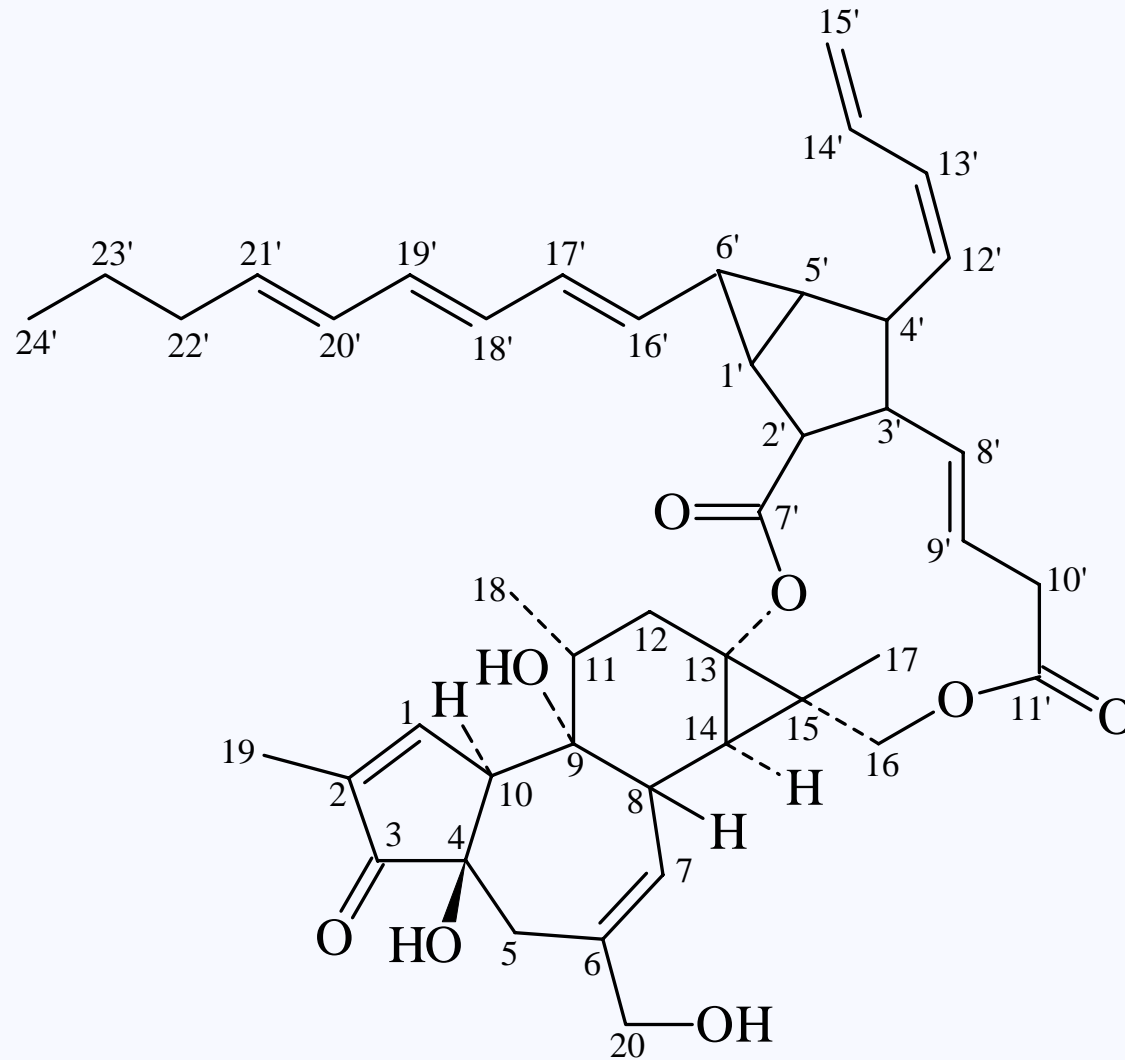
- heteronuclear multiple quantum/bond coherence (HMQC/HMBC)

- gradient-enhanced nuclear Overhauser effect

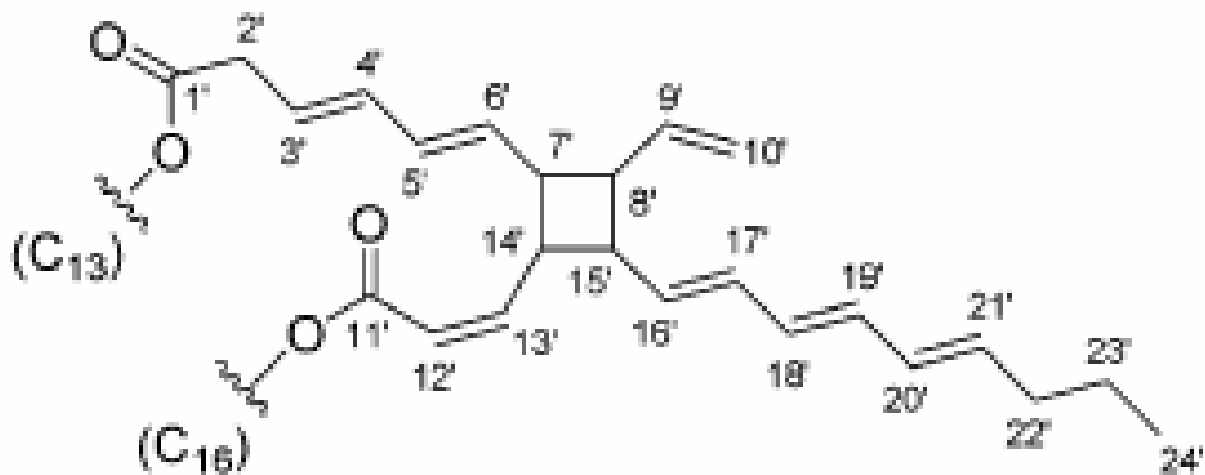
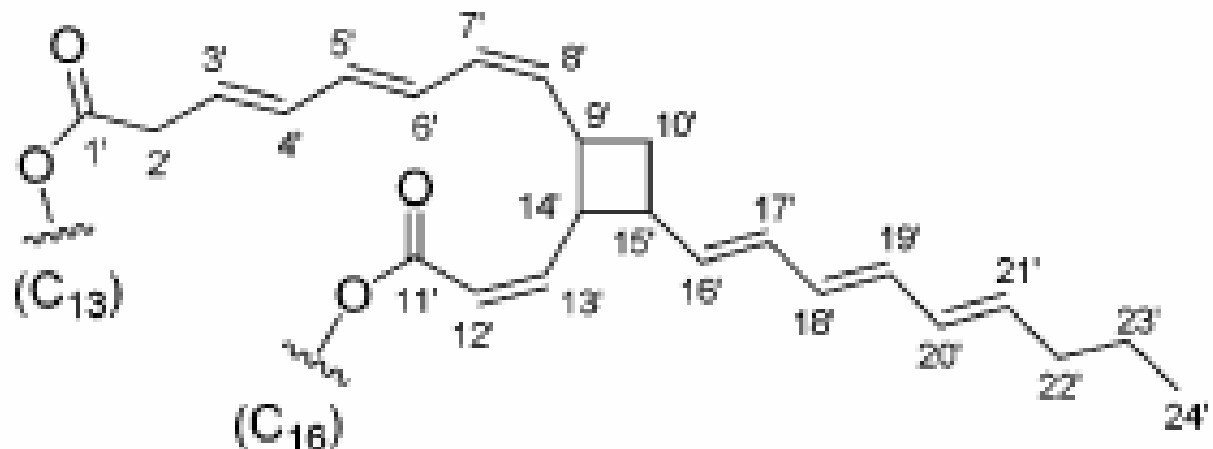
W.Haas, H.Sterk, M.Mittelbach: *J. Nat. Prod.* **2002**, *65*, 1434-1440



DHPB: Hirota et al. 1998



Novel Class of Cyclobutan Mojety



Detoxification Experiments with the Seed Oil

Oil Refinement

- Degumming
- Deacidification
- Bleaching
- Desodorization

W.Haas, M.Mittelbach, *Industrial Crops Prod.* 2000

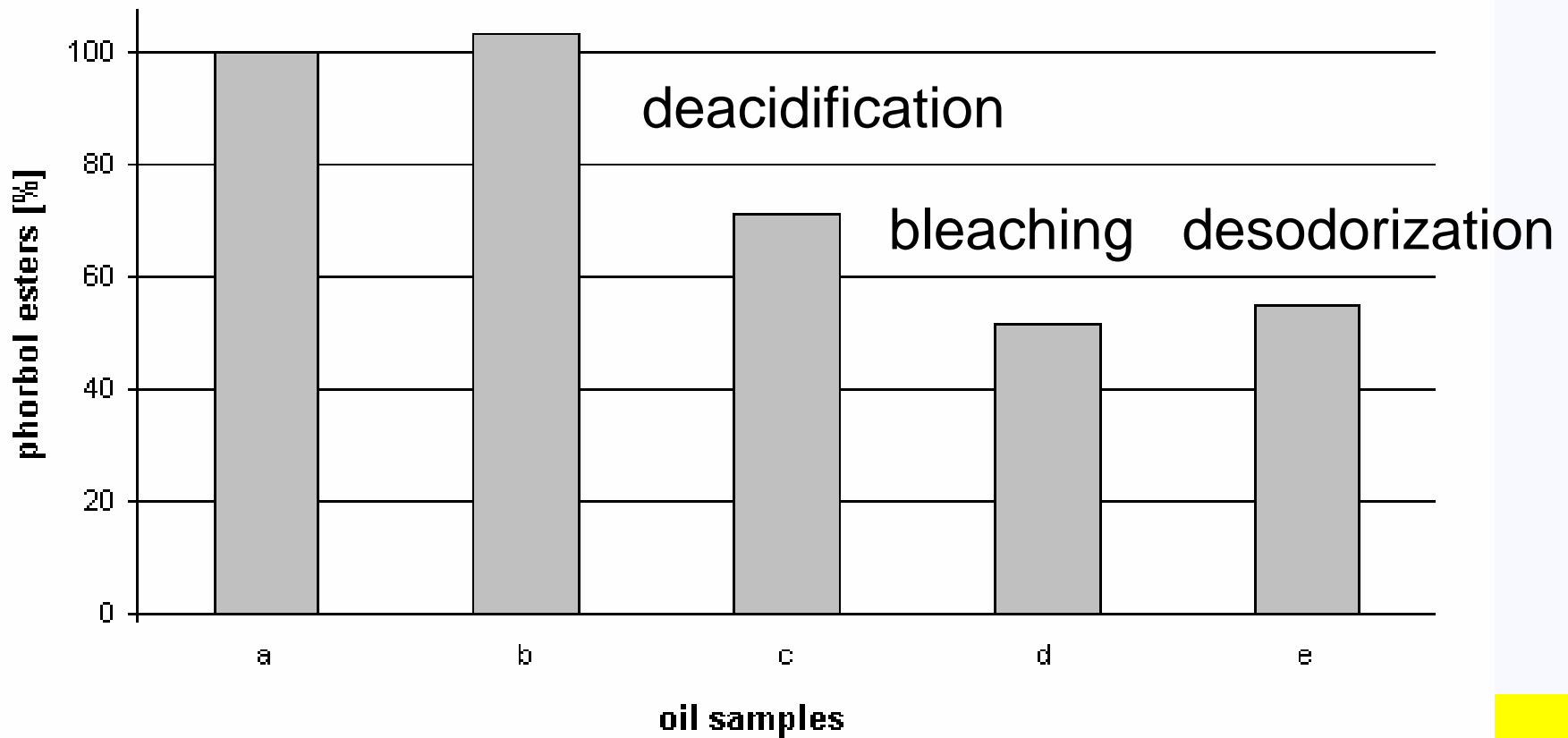


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Detoxification During Refinement

Untreated degumming



Summary

- Oil from *Jatropha curcas* L. is an excellent source for biodiesel production
- Fuel properties are almost similar to those of rapeseed oil ME
- Non-edible oil ideal for utilization in Asian countries
- Oil must be produced in specified plants
- Quick assay for toxic compounds is necessary
- Detoxification of oil cake would improve the economy



Research on non-toxic varieties

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biodiesel



The Comprehensive Handbook

Martin Mittelbach
Claudia Remschmidt

Third edition 2006

340 pages

Publisher: Martin Mittelbach

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