INTERNATIONAL CONFERENCE ON SUSTAINABLE AGRICULTURE
ICSA2008

A sustainable biorefinery resource based on rapeseed meal

-Current challenges and developments of bio-diesel research in China

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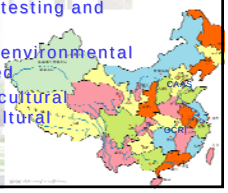
Oil Crops Research Institute
Chinese Academy of Agricultural Science

National laboratories and research centers

- National oilseed crops improvement center
- National research center of rapeseed technology and engineering
- Key open laboratory of the agricultural ministry for genetic improvement of oilseed crops
- Center of the agricultural ministry for testing and inspection of oilseed products
- Center of the agricultural ministry for environmental risk assessment of transgenic rapeseed
- Processing engineering center of agricultural products of China's Academy of Agricultural Sciences



Introduction

◆In the modern world, sustainable development has become one of the most important issues.

- The rapid development of world economy
- Traditional mineral reserves, such as petroleum oil, natural gas and coal, are becoming exhausted,
- Energy sources and environmental problems became more and more urgent .

◆Exploring of alternative sustainable resources is rapidly gained recognition.

- According to Chinese governmental renewal energy policy, consumption of bio-diesel in China would be around 0.2 million tons in 2010 and 2 million tons in 2020.

◆Bio-refineries would play a dominant role for maintaining modern civilization in the future.

- Renewable bio-fuel and bio-material, such as bio-diesel and biobased resins and plastics

Motivation for Biorefinery

- **Alternative bio-resources of mineral reserves**

  petrolium, coal

- **Improving environmental quality**
  - Smog, acid rain, waste disposal
  - Global climate change

- **Economic development of countryside**
  - Modulating and optimizing Chinese agriculture framework
  - Increasing feedstock prices
  - Improving farmer incomes

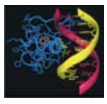
Techniques and products of biorefinery

Crop science
- genomics
- metabolics
- enzyme engineering

Feedstocks
- crops
- waste
- residue

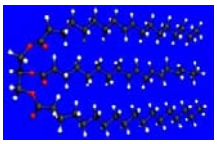
Conversion processes
- Enzyme/chemical hydrolysis
- Fermentation
- Bioconversion
- Chemical conversion
- Gasification
- Pyrolysis co-firing

Products
- Plastics, resins, foams, phenolic resins, solvents, cleaning fluids, chemical intermediates, adhesives, fatty acids, carbon black, paints, coatings
- Renewable fuels: Ethanol, Bio-diesel
- Power: electricity heat



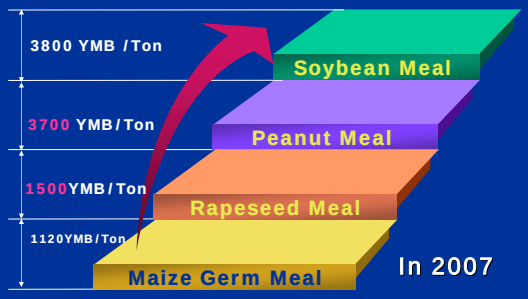
Oil-crop biorefinery

- Oil-crops are very important raw material of bio-refineries
- High content of oil (20-60%) and protein (~40%)
- Products of bio-refinery from oil-crops
  - Bio-diesel
  - Bio-based resins and plastics



Main oil crops in China

- Chinese oil crops include soybean, rapeseed, peanut, sunflower, sesame, flax, etc.
- The planting area of oil crops is about 24.7 million ha.
- The yield of oilseeds is about 44.27 million tons / year, about 15% of total yield in the world
- High energy efficiency crops (oil content 20-60%)



Price of difference oilcrops meal

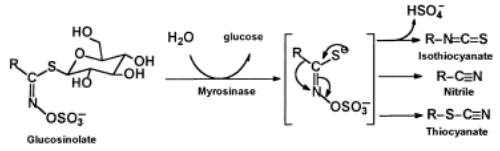
Oilseed Rape in the World

Rape oilseed accounts for approximately 10 percent of global oil-seed production, taking second place behind soya beans. China, Canada, Australia and Europe are the main rape-growing regions in the world. They produce two-thirds of the global harvest.

Why choice Rapeseed meals

- Rapeseed cultivation is widely developed for oil production.
- In China, the output of rapeseed meal is more over 7 million tons in 2006 to 2007
- Defatted rapeseed meals with 30–45% of protein content
- Rapeseed meals are low cost, and are usually used for the supplementation of animal feed.
- Rapeseed meals contain toxic metabolites which are not favorable for the growing of animals.

Toxic components in rapeseed meal



◆Glucosinolates are biologically inactive, but their hydrolysis produces a number of goitrogenic and toxic compounds.
◆Other antinutritional factors: sinapine and tannins
◆High in fiber and phytic acid

Why choice *Bacillus natto*

今日の話題

微生物産生高分子を利用した生分解性吸水性ポリマー
納豆菌のγ-グルタミン酸架橋体は自重の5,000倍の吸水率をもつ

高吸水性樹脂はイオン性基をもつ高解質ポリマーをわずかに架橋したもので，自重の数百倍から1,000倍という10％。放射線照射線量20 kGyのとき自重の5,000倍に達し[1]，新たな機能性素材として応用が期待されている。

特集●21世紀の食糧問題を考える

展望

砂漠の緑化
—高分子を利用した緑化—

原　敏夫
九州大学大学院農学研究院

納豆の糸に放射線を照射して合成できるPGA架橋体は自重の5,000倍の水を吸収する。しかも土中の微生物により炭酸ガスと水に分解されるグリーン・プラスチックである。このエコ対応型生分解性吸水樹脂を活用したヘドロ・シードペレットと，砂漠にあり余るほど豊富にある太陽エネルギーを利用して新規節水農業が砂漠でできないだろうか。

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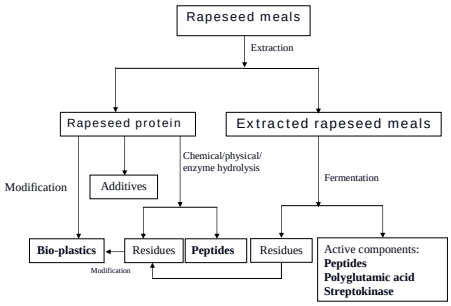
Our approach and technology



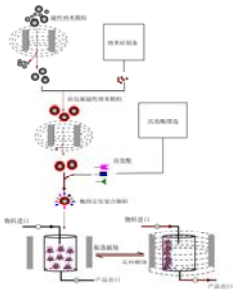
Research progress

	unfermented rapeseed meals	fermented rapeseed meals	unfermented rapeseed dregs	fermented rapeseed dregs
glucosinolates (μ mol/g)	**65.86**	**1.12**	**59.80**	**1.16**
isothiocyanates（mg/g）	**4.89**	**0.24**	**3.08**	**-**
oxazolidone（mg/g）	**3.04**	**0.19**	**1.94**	**-**

detection limit: 0.01mg/g

The content of glucosinolates, isothiocyanates and oxazolidone of fermented rapeseed meals and dregs

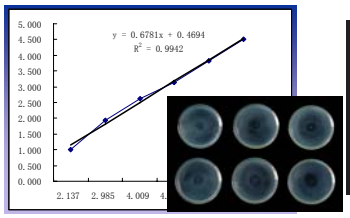
Research progress



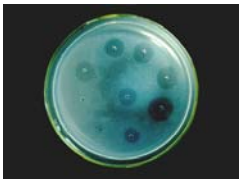
High efficient conversion technology based on nano-immobilized enzyme

Research progress

Standard curve of urokinase activity

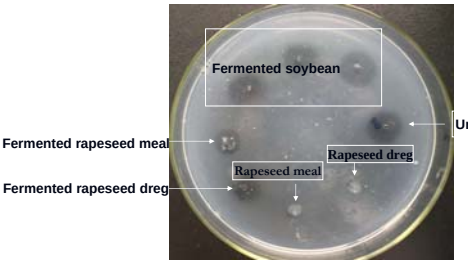


x-axis is area of clear zone. y-axis is natural logarithm of urokinase activity



different natto *Bacillus* strains.

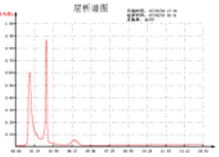
Research progress



nattokinase of fermented rapeseed meals

Research progress

Peptides



Polyglutamic acid

Patent

Research progress

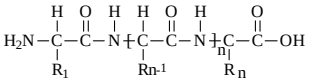
Ultrafiltration was used based on different molecular weight for separation and purification

Polyglutamic acid
MW ⩾ 100 k D

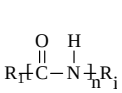
Nattokinase MW ≈ 27.7 k D

Peptide MW < 10k D

Protein-plastic



Protein



Polyamide (Nylon)

molecular formula

Protein-plastic

Protein-plastic modified from rapeseed meals

Summary

- Rapeseed is blooming as one of the most important the alternative bio-resources material of bio-refinery and bio-diesel.
- It is very important to research processing technique for increasing the value of the byproducts, such as meals .
- High efficient conversion, integration and low cost green techniques were developed in our institute.
- The sustainable development of oilseed production is important for the food security and even energy security in the future. Meanwhile, it is highly related to the livelihoods of nearly 400 millions famers in china

Call for Scientific Exchanges and Cooperation

- High efficiency, high-throughput and low cost green processing techniques for bio-fuel.
- Processing technique for increasing the value of the byproducts, such as (protein and glycerol).
- Breeding, genetic and metabolic engineering research for high yield of seed production and high oil contents.
- Study on plant physiology and plant pathology in order to improve cultivation techniques for the lower input costs and labor-saving

Acknowledgements

1. High throughput quantification and in-situ determination of ultra-trace phytoestrogenic compounds in Arabidopsis and its relative crops and their applications in the study on the mechanism of pathogenic resistance, National Natural Science Foundation of China (90717101), 2008-2009.
2. High efficient conversion technology of rapeseed peptides based on nano-immobilized magnetic enzyme, National High Technology Research and Development Program of China (863 Program: 2007AA10Z328), 2007-2010.
3. Key techniques of green conversion of plant lipid and theirs products, National High Technology Research and Development Program of China (863 Program: 2007AA100703), 2007-2010.
4. Analyzing of core metabolic pathway for high oil-content of rapeseed. National High Technology Research and Development Program of China (863 Program: 2007AA10Z328), 2007-2010.
5. Production of phytosterol ester using immobilized whole cell enzyme by using solvent-free system. Innovative Foundation of Hubei province, 2007-2010.
6. Key technique acquisition for sustainstable biorefinery of novel bio-energy oil crops, supported by State Administration of Foreign Experts Affairs (20084200029), 2008
7. Study on functional and active components of fermented rapeseed meal and highly efficient and continued techiques for isolation, purification and enrichment in biorefinery, Research Foundation of the Director General of Oil Crops Research Institute, Chinese Academy of Agricultural Sciences, 2006-2008.


Thank you for your attention