




Improving Feed with Exogenous Enzymes


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Presentation

- Novozymes 
- Meat and feed enzymes market
- Enzymes and enzyme classes
- Current and future applications
- Final remarks
- Questions ?

- Coffee 



Novozymes

- **Market leader in all industries, where present**
- **Sales USD ~1bn**
- **Strong profitability and high generation of cash flow (2005 EBIT margin 19.2%, free cash flow DKK 991million)**
- **More than 4400 employees**
- **Main production in USA, China and Denmark**
- **More than 600 products sold in 130 countries**
- **More than 4300 active patents**
- **12-13% of sales invested in R&D**
- **In the feed industry we have a strong partner in DSM NP**

Strong pipeline to support sales growth

12-13% of sales invested in R&D, ~800 people, >100 individual projects



Technical enzymes

Detergent:
New, improved cleaning and fabric care properties, new concepts, improved dish washing products

Other technical:
New technologies and improved processes for starch and fuel ethanol, bioprocesses

New industries:
Digestion disorders



Food enzymes

Improved dough products, non-bread products.

New concepts for brewing.

Food specialties – dairy products, oils & fats



Feed enzymes

Phosphorus release, improved cereal utilisation, vegetable protein, aquaculture

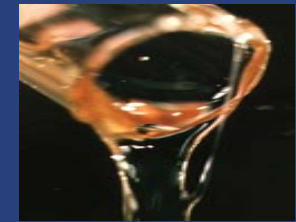


Microorganisms

Institutional & Household cleaning:
Odour reduction, oil & grease degradation

Plant care:
Biofungicides, growth enhancement, expand application of existing products

Waste treatment:
Ammonia and nitrite control, colour removal, hydrocarbon degradation



Biopolymer and Pharma proteins

Hyaluronic acid and potentially other biopolymers

Antimicrobial peptides

New technology for antibody production

Cell cultures substrates

Approx. 85% of R&D resources

~ 5% of R & D resources

Up to 10% of R&D resources



World meat market

- Meat market is $\sim 275 \times 10^6$ tonnes.
- Static consumption pattern in the EU.
- Growth rate in feed ingredients is $\sim 2-3\%$.
- 10 kg per capita increase for 1×10^9 people equals the need for 40×10^6 tonnes more feed.



World population growth I

- Today we are $\sim 6.7 \times 10^9$ people on this planet.
- Growth according to: $N = N_0 \times e^{(k t)}$
- Annual growth $k = \sim 1.36 \%$.
- In 15 years ($t=15$): $\sim 8.2 \times 10^9$ people.
- 1.5×10^9 more people that needs food.

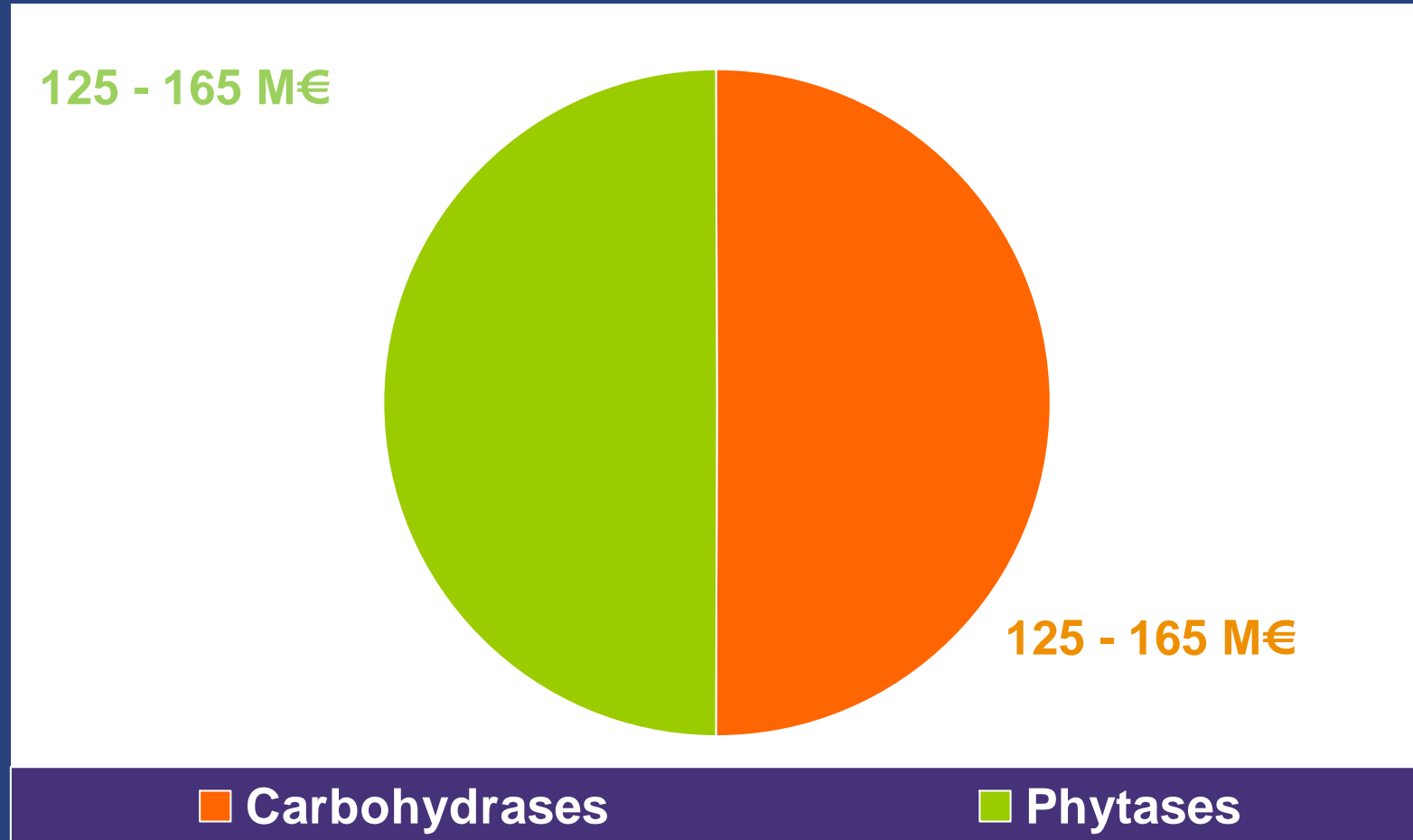


How to feed the planet

- Global warming
- Reduction in fresh water resources
- Reductions in arable land area
- Competition: Biofuel vs Cereals for food/feed?



World market for phytases and carbohydrases





Current feed enzymes

Important enzymes

- Phytases
- Xylanases
- β -Glucanases
- "Pectinases"

Alternative enzymes

- Proteases
- Amylases
- Lipases

Six basic enzyme classes

- **Oxidoreductases** – 22 subclasses
 - the oxidation of one compound with the reduction of another
- **Transferases** – 9 subclasses
 - entire groups of atoms are moved from one molecule to another
- **Lyases** – 7 subclasses
 - separation of two parts of a molecule with the formation of a double bond in one of them
- **Isomerases** – 6 subclasses
- **Ligases/Synthetases** – 6 subclasses
 - catalyze the linkage of two molecules, generally utilizing ATP as the energy donor
- **Hydrolases** – many subclasses



Current and future applications I

Enzymes in feed processing

- Liquid and fermented feed
 - Cold or warm applications
- Extrusion cooking
 - Amylases used already
 - Cellulases, xylanases
- Upgrading of feed ingredients
 - Vegetable protein sources – ANF, fibre
 - Upgrading of industrial by-products, e.g. DDGS



Current and future applications II

Enzymes in animal feed

- Liquid and fermented feed
- Formation of pre-biotics in situ
 - From by-products added to the feed
 - From major fibre components present in e.g. cereals
- Increased P digestion >65 %
- Proteases for efficient protein utilisation
 - Solubilisation
 - Peptide formation



Final remarks

Many challenges

- Increased production efficacy
- Sustainable production
- What about quality
- What about quantity
- GMO crops



Thank you for your kind attention

Questions - please