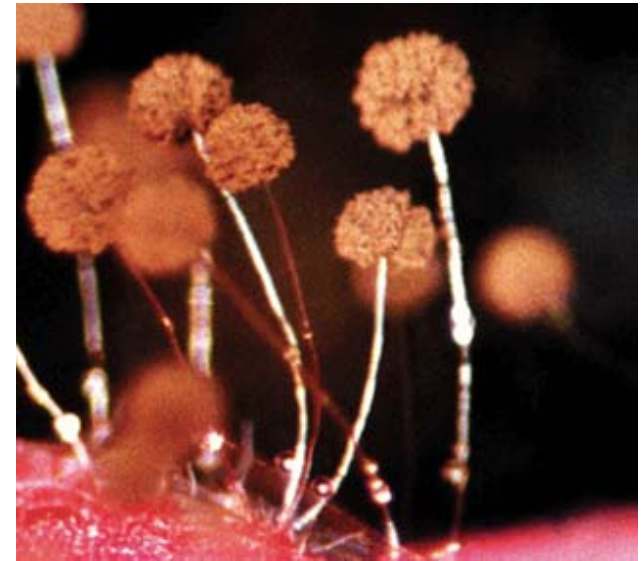
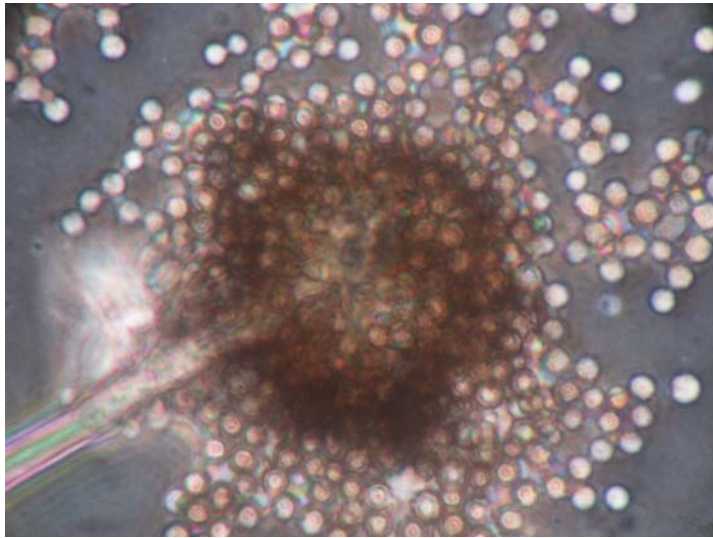


THE IMPORTANCE OF ASPERGILLI IN BIOTECHNOLOGY



Piet W.M. van Dijck

Aspergillus Systematics in the Genomic Era – an International Workshop

Utrecht, April 12-14 2007

DSM Food Specialties

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THE IMPORTANCE OF ASPERGILLII IN BIOTECHNOLOGY

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DSM Nutritional Products, Delft, The Netherlands

The use of *Aspergillus* species for fermentation purposes goes back millennia. Old Chinese recipes have been found that describe the use of fungal cultures – now we know that this is *A. oryzae* – for the production of koji. Takamine took this process to the US around the beginning of the last century to produce amylase and glucoamylase for beer brewing. In particular *A. niger* and *A. oryzae*, have since long been used in biotechnology for the production of citric acid and enzymes for the food and feed industry. Commercial production of citric acid started in 1919 at Citrique Belge (Tienen)(now DSM) by surface fermentation of *A. niger* on beet molasses. Although still in use citric acid and other organic acids today are primarily produced by submerged fermentations. *A. niger* also turned out to be an excellent producer of pectinases. This also started as surface fermentations but to date most companies use submerged fermentation technologies to produce their enzymes. The three major fermentation industries, DSM, Novozymes and Danisco Genencor all employ *Aspergillus* as their most important production organism. For DSM this is *Aspergillus niger*, for Novozymes it is *Aspergillus oryzae*, and Genencor uses both organisms.

With the development for recombinant technology both *Aspergillus niger* and *A. oryzae* have been developed into important host to overproduce enzymes and pharmaceutical proteins.

Aspergillus oryzae

- Well-known producer of enzymes
- Extended history of safe use: production of koji with *A. oryzae* dates back millenia
- Safe organism but some strains can produce toxic metabolites, such as cyclopiazonic acid and/or β -nitropropionic acid
- Taxonomically closely related to *A. flavus*, but no aflatoxin producer
- Good host for recombinant production of enzymes and (therapeutic) proteins
- Genome has been sequenced – see presentation Machida

JOKICHI TAKAMINE, Japanese father of the US Biotech Industry

- Born in 1854 in Japan and died in 1922 in New York
- Takamine patented taka-diastase, fungal α -amylase for brewing in 1894, the first microbial commercial enzyme



Aspergillus niger (1)

- Well-known production organism of citric acid and other organic acids
- Citric acid production with *A. niger*: > 1.000.000 ton annually; a real commodity
- First production facility: Citric Belge (Tienen), now DSM
- Also a well-known over-producer of enzymes, in particular starch-degrading enzymes and plant cell-wall degrading enzymes, such as pectinases, (hemi) cellulases, xylanases etc.
- Safe organism but some strains have the potential to produce ochratoxin A.

Aspergillus niger (2)

- Genome has been sequenced – see presentation Van Peij
- Good host for recombinant production of enzymes and (therapeutic) proteins

Citric acid production in surface culture



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Citric acid production in surface culture (2)



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A. NIGER CAN GROW AND PRODUCE CITRIC ACID IN SUBMERGED CONDITIONS



Kluyver and Perquin (1932)
On the methodology of research
on fungal metabolism.
Biochem. Z. 266: 68-81

Citric acid production in submerged fermentation



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DSM – NOVOZYMES – GENENCOR

DSM 

novozymes 

 Genencor International®
A Danisco Company

- *Aspergillus niger*
- *Aspergillus oryzae*
- *A. niger* and *A. oryzae*