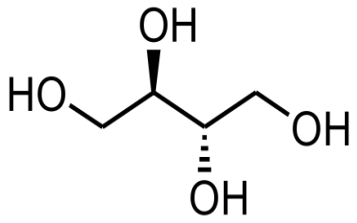
Produktion von Erythritol aus Stroh

Robert Mach

Institut für Verfahrenstechnik, Umwelttechnik und Technische Biowissenschaften

Erythritol – physikalische und chemische Eigenschaften

- C4 Polyol
- Hitzestabil
- Säurestabil
- Nicht-hygroskopisch
- mäßig wasserlöslich
- erzeugt hohen osmotischen Druck
- Positive Löslichkeitsenthalpie



Erythritol – ein gut geeigneter Süßstoff

- 70 – 80% Süßkraft von Saccharose
- Reiner Süßgeschmack, kaum Nachgeschmack
- Sehr geringe abführende Wirkung
- Extrem geringer Energiegehalt (< 0,2 kcal/g)
- Keine Wirkung auf den Blutzuckerspiegel
- Nicht kariös
- Nicht toxisch (LD_{50}[rat] 13 g/kg)

Erythritol – Vorkommen & Produkt

- Natürliches Vorkommen:

Früchte (zB Trauben, Melonen, Birnen)

Seegras

Pilze

Fermentierte Produkte (zB Sojasauce, Sake)

- Weltmarkt:

2006: 20.000 t $4,5/kg

2011: 23.000 t

Erythritol – derzeitige Herstellungsverfahren

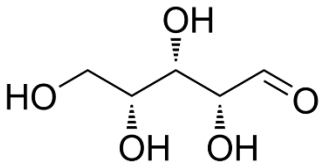
- Fermentation osmotoleranter Hefen, zB hochmutierte *Candida magnoliae* or *Torula corallina* Stämme

- Ausbeuten von ca. 40% (w/w) auf Glukose

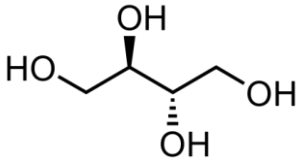
- Häufigstes Substrat: Glukoselösung 40% (w/v)

Herstellung in Trichoderma reesei

Pentosen



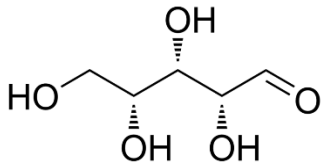
Erythritol



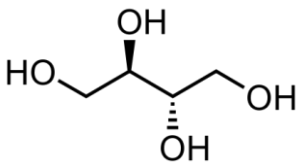
Herstellung in Trichoderma reesei

Einstufiger Ganzzellkatalyseprozess

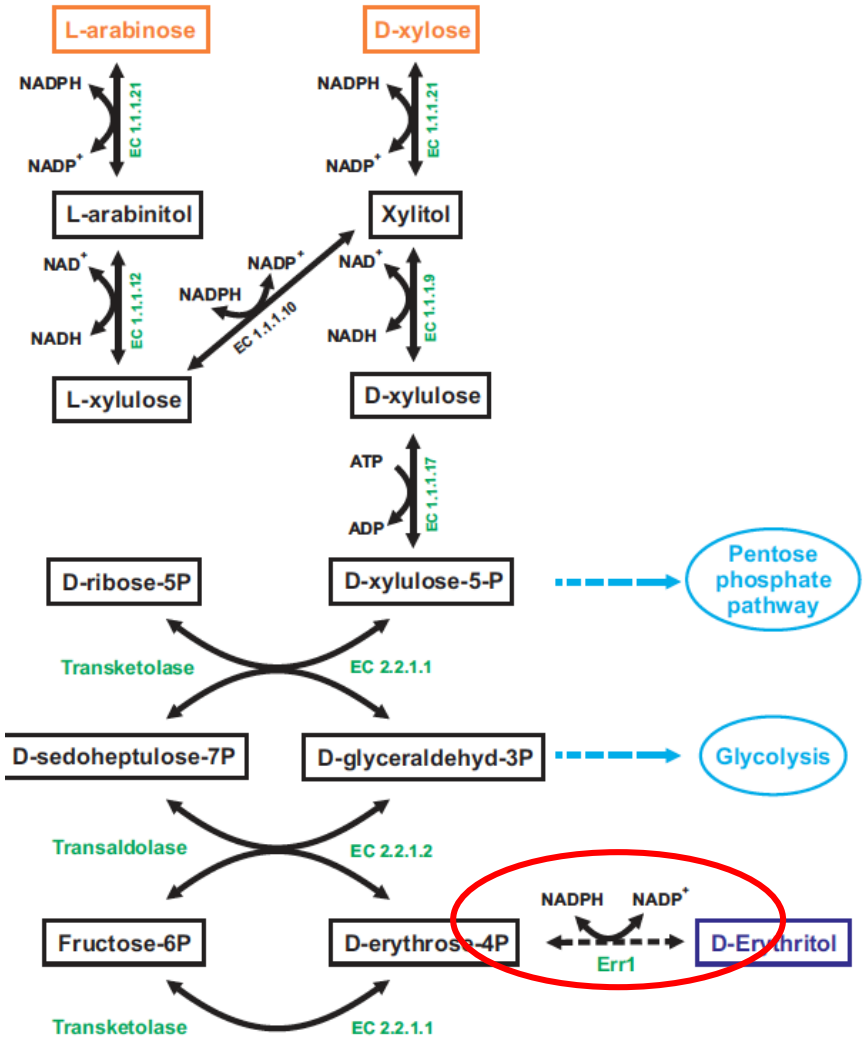
Pentosen



Erythritol



Modifizierter Syntheseweg in T. reesei



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ORIGINAL ARTICLE Open Access

Characterization of erythrose reductases from filamentous fungi

Birgit Jovanović, Robert L Mach and Astrid R Mach-Aigner*

Abstract

Proteins with putative erythrose reductase activity have been identified in the filamentous fungi *Trichoderma reesei*, *Aspergillus niger*, and *Fusarium graminearum* by in silico analysis. The proteins found in *T. reesei* and *A. niger* had earlier been characterized as glycerol dehydrogenase and aldehyde reductase, respectively. Corresponding genes from all three fungi were cloned, heterologously expressed in *Escherichia coli*, and purified. Subsequently, they were used to establish optimal enzyme assay conditions. All three enzymes strictly require NADPH as cofactor, whereas with NADH no activity could be observed. The enzymatic characterization of the three enzymes using ten substrates revealed high substrate specificity and activity with D-erythrose and D-threose. The enzymes from *T. reesei* and *A. niger* herein showed comparable activities, whereas the one from *F. graminearum* reached only about a tenth of it for all tested substrates. In order to proof in vivo the proposed enzyme function, we overexpressed the erythrose reductase-encoding gene in *T. reesei*. An increased production of erythritol by the recombinant strain compared to the parental strain could be detected.

Keywords: *Trichoderma reesei*; *Aspergillus niger*; *Fusarium graminearum*; Erythrose reductase; Erythritol

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RESEARCH ARTICLE Open Access

Erythritol production on wheat straw using *Trichoderma reesei*

Birgit Jovanović*, Robert L Mach and Astrid R Mach-Aigner

Abstract

We overexpressed the *err1* gene in the *Trichoderma reesei* wild-type and in the cellulase hyperproducing, carbon catabolite derepressed strain Rut-C30 in order to investigate the possibility of producing erythritol with *T. reesei*. Two different promoters were used for *err1* overexpression in both strains, a constitutive (the native pyruvat kinase (*pki*) promoter) and an inducible one (the native β-xylosidase (*bxl1*) promoter). The derived recombinant strains were precharacterized by analysis of *err1* transcript formation on D-xylose and xylan. Based on this, one strain of each type was chosen for further investigation for erythritol production in shake flasks and in bioreactor experiments. For the latter, we used wheat straw pretreated by an alkaline organosolve process as lignocellulosic substrate. Shake flask experiments on D-xylose showed increased erythritol formation for both, the wild-type and the Rut-C30 overexpression strain compared to their respective parental strain. Bioreactor cultivations on wheat straw did not increase erythritol formation in the wild-type overexpression strain. However, *err1* overexpression in Rut-C30 led to a clearly higher erythritol formation on wheat straw.

Keywords: Erythritol; Erythrose reductase; *Trichoderma reesei*; Wheat straw; Lignocellulose

Kontakt:

Prof. Dr. Robert Mach
Inst. of Chemical Engineering
FB Biochemische Technologie
robert.mach@tuwien.ac.at