

Developing new enzymes for the dairy industry

Udvikling af nye enzymer til
mejeriindustrien

Present options for obtaining new enzymes

- Search organisms at the genome level for genes encoding candidate enzymes
- Investigate extracts or secreted protein of microorganisms for desired activities
- Optimizing existing enzymes using protein engineering or enhanced evolution

A protein/enzyme 'pixi'

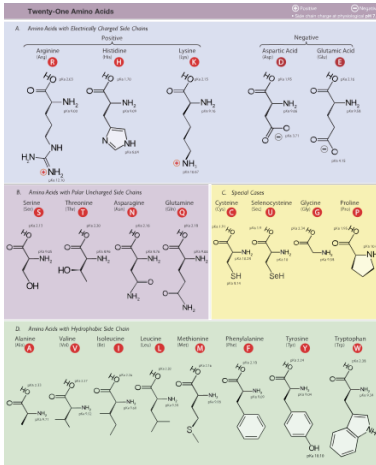
- What is a protein?
- What is an enzyme?

What is a protein?

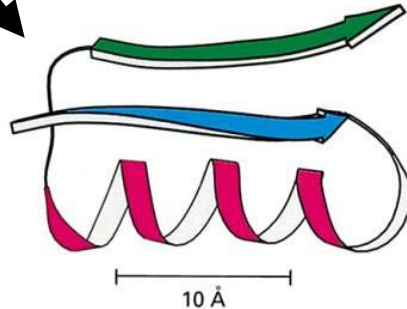
Primærstruktur

MATHPRILVGGTRLEDLIKSGATATFH...

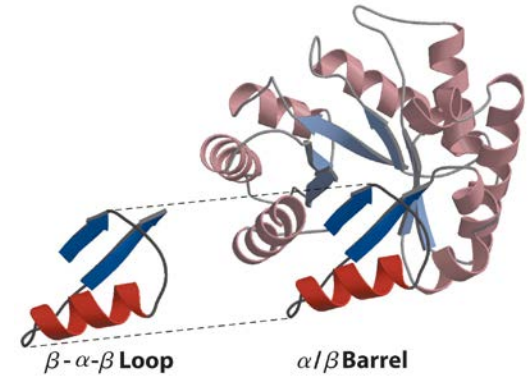
Met-Ala-Thr-His-....



Sekundærstruktur



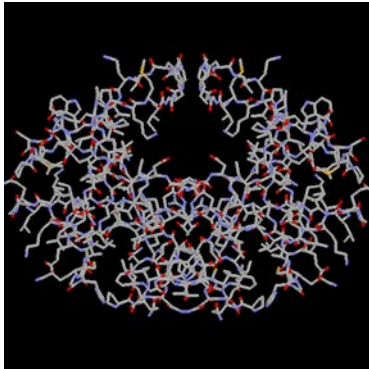
Tertiærstruktur



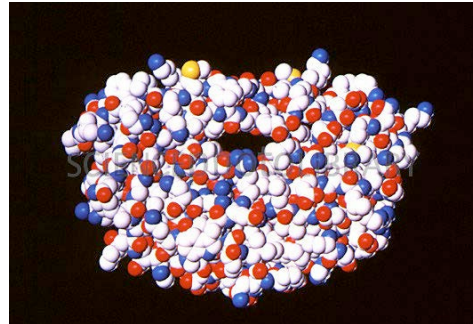
How does a protein look like in real life?

Different presentations of protein
structure

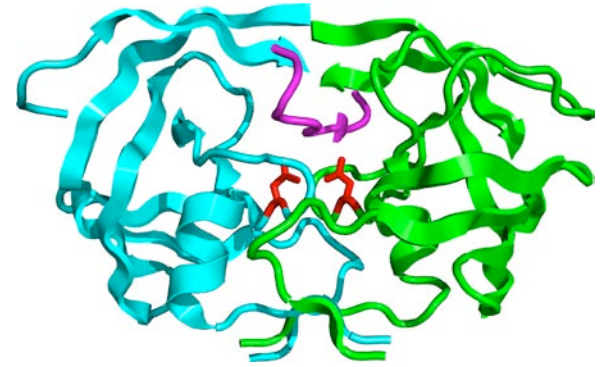
'Wire'



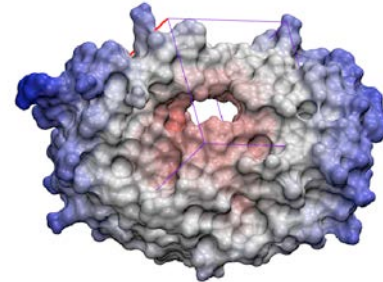
'Space filling'



'Ribbon'



'Surface'

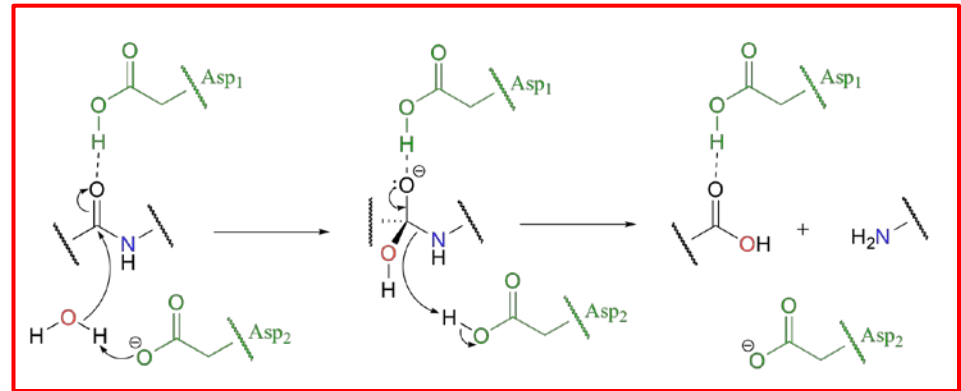
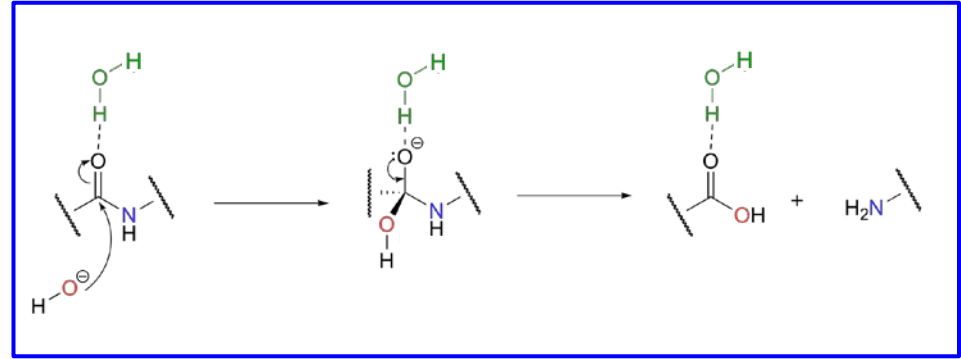
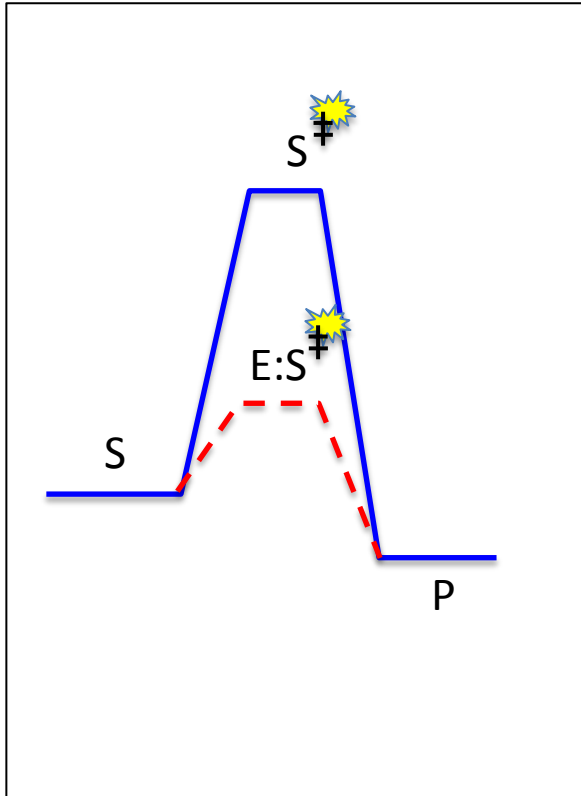


What is an enzyme?

- An enzyme is a protein.
- An enzyme catalyses a chemical reaction – it makes the reaction proceed faster.
- The enzyme cannot make ‘more’ product from the same amount of reactant – it cannot change the equilibrium of the reaction.

What is an enzyme?

Reaction energy ($\Delta G'^{\circ}$)



What is enzyme design?

OPEN ACCESS Freely available online



In Silico Prediction of Mutant HIV-1 Proteases Cleaving a Target Sequence

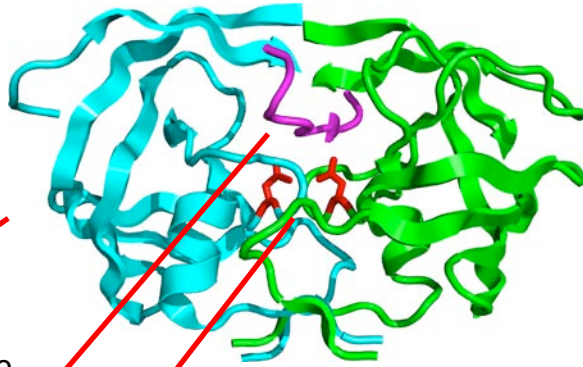


Jan H. Jensen¹, Martin Willemoës², Jakob R. Winther², Luca De Vico^{1*}

¹ Department of Chemistry, University of Copenhagen, Copenhagen, Denmark, ² Department of Biology, University of Copenhagen, Copenhagen, Denmark

HIV protease

An example of protein design

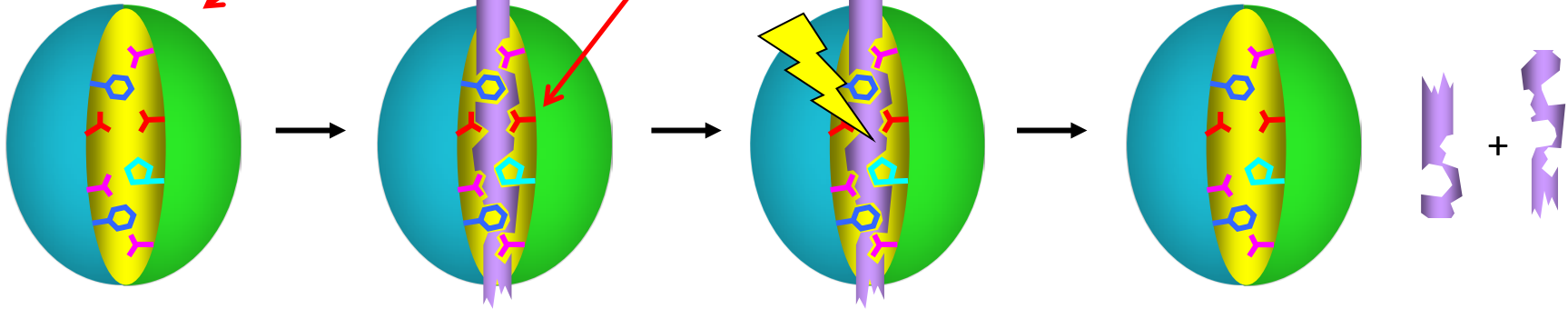


Protease

Substrate

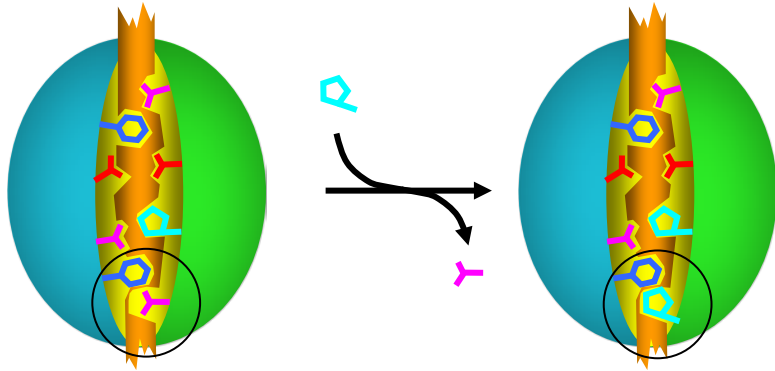
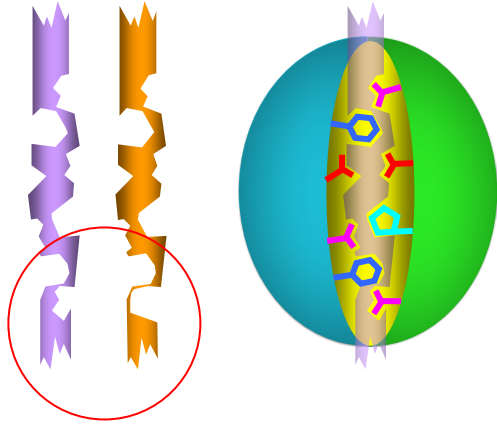
Important catalytic residues

Products

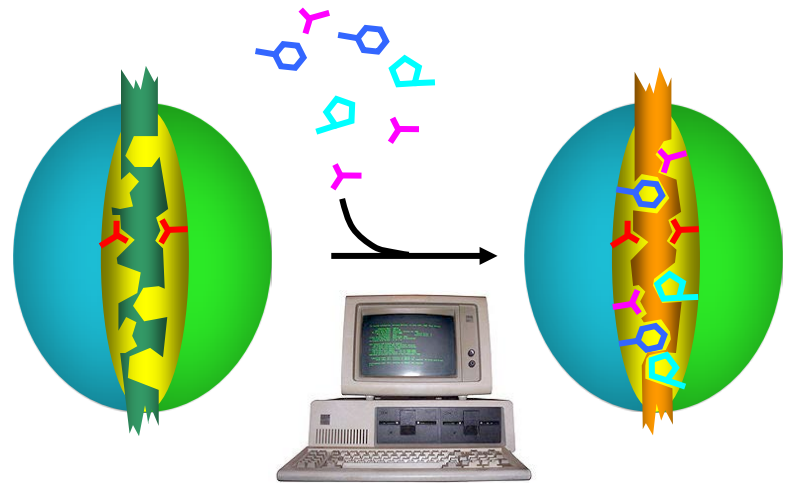
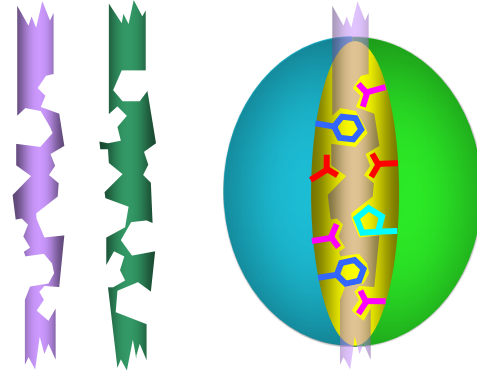


Reaction – cleavage of substrate

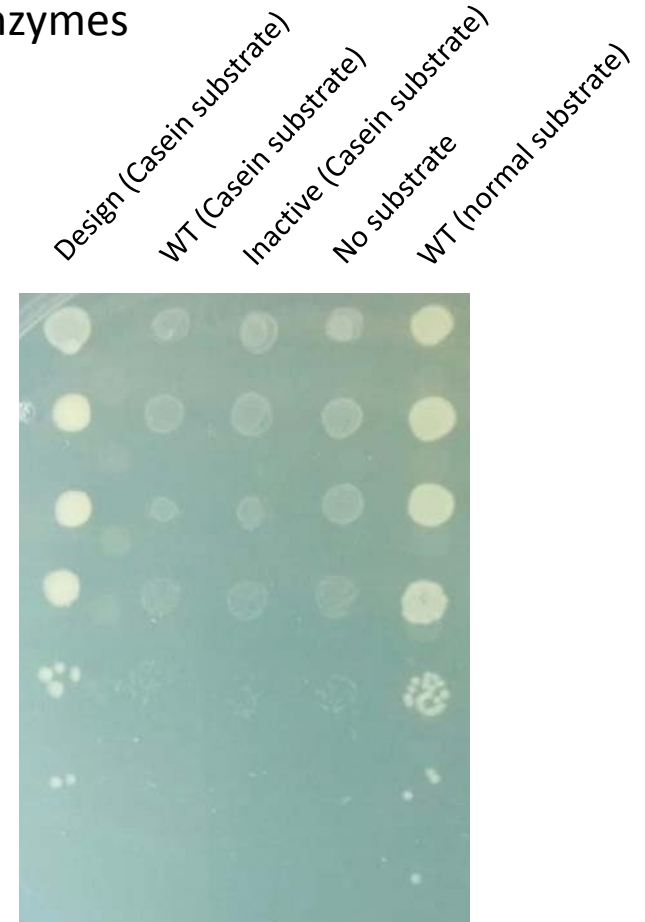
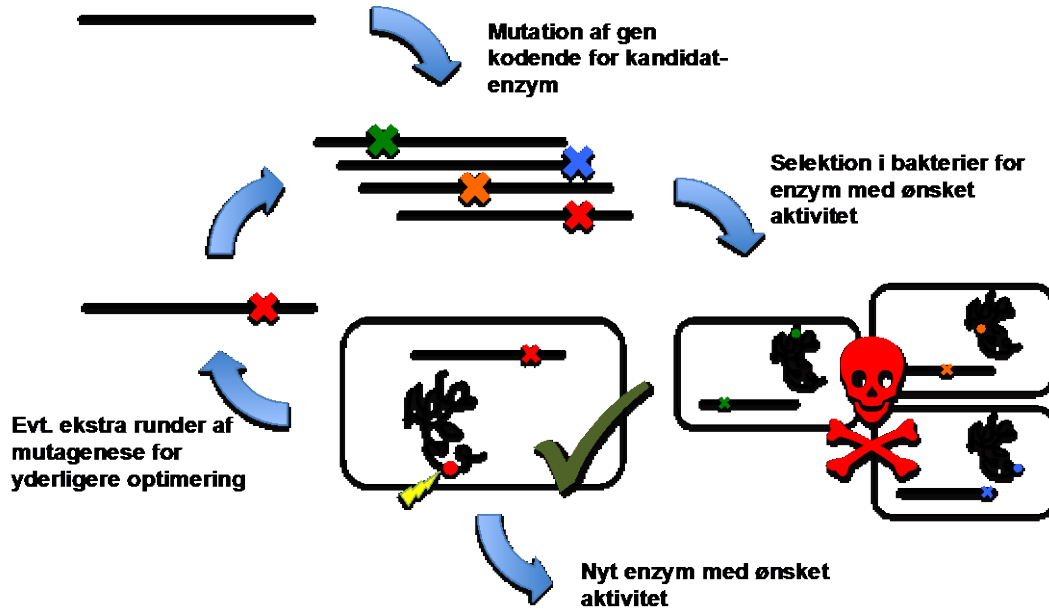
Engineering (1980-)



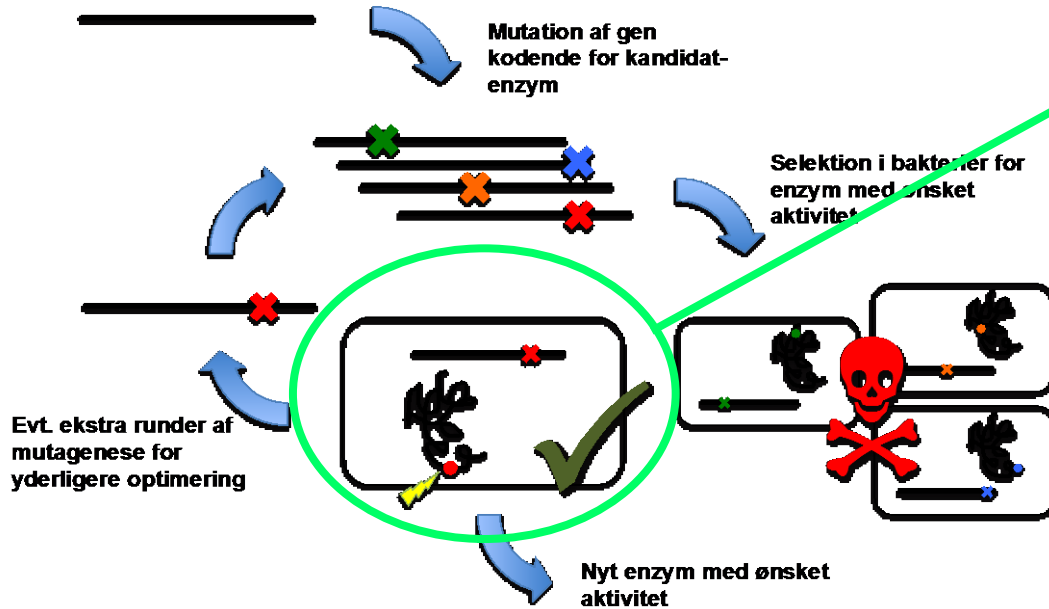
Design (2010-)



Combined design and molecular evolution to give new enzymes



Selektion af mutationer for forbedrede design-enzym



Examples of design projects currently in progress in the Linderstrøm-Lang Center for Protein Science

- Re-design of HIV protease to a chymosin-like protease (Chr. Hansen)
- Re-design of an alpha-N-acetylgalactosaminidase for chymosin-independent precipitation of casein (Chr. Hansen)
- Design of highly specific molecules for detection of Carbon nanotubes in lung tissue (National Research Centre for Environmental Health)
- Design of tools for protein structure design (Shafer-N)
- Synthetic biological designs (Schafer-N)
-

Examples of design projects currently in progress in the Linderstrøm-Lang Center for Protein Science

- Re-design of HIV protease to a chymosin-like protease (Chr. Hansen)
- Re-design of an alpha-N-acetylgalactosaminidase for chymosin-independent precipitation of casein (Chr. Hansen)
- Design of highly specific molecules for detection of Carbon nanotubes in lung tissue (National Research Centre for Environmental Health)
- Design of tools for protein structure design (Shafer-N)
- Synthetic biological designs (Schafer-N)
-

Nyt enzym

- til forbedring af kvaliteten af fedtfattige mælkeprodukter



Af ph.d.-studerende Dennis K. Hansen, Caspar Elo Christensen, Professor Jakob R. Winther og Lektor Martin Willemoës, Sektion for Biomolekylære Videnskaber, Biologisk Institut, Københavns Universitet