

GENETICALLY MODIFIED ENZYMES AND THEIR POTENTIAL IN THE FOOD INDUSTRY

Introduction.

Enzymes have been used in industrial processes for thousands of years.

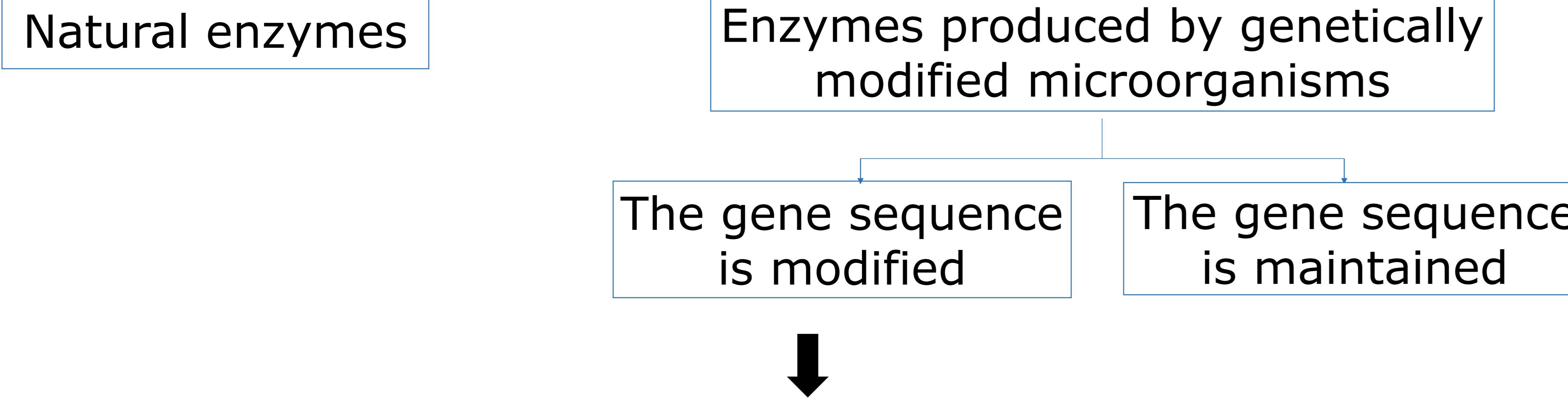
Enzymes do not adapt well to industrial processes, for this reason there is great interest in generating new enzymatic variants.

Aim.

Research and analysis of bibliographic information of the different genetically modified enzymes used in the food industry.

- Study the operation and application of food enzymes.
- Analyze main strategies for genetically modifying enzymes.
- Know a specific example of a genetically modified enzyme.
- Learn the main safety concerns and regulations

Origin of enzymes used in the food industry



Strategies for genetically modifying enzymes [1]

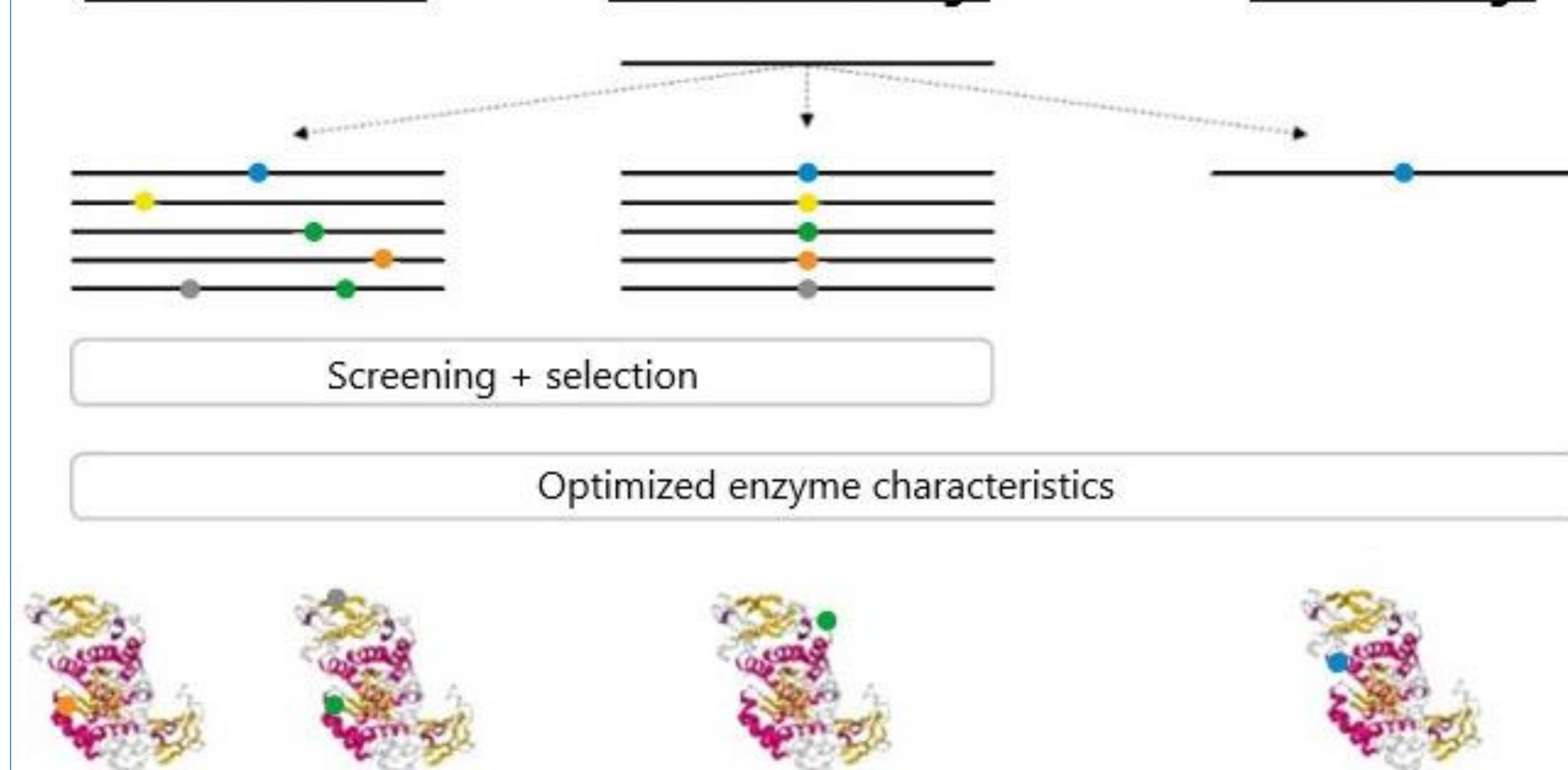


Figure 1. Strategies for genetically modifying enzymes [1].

Example 1: Site-directed mutagenesis

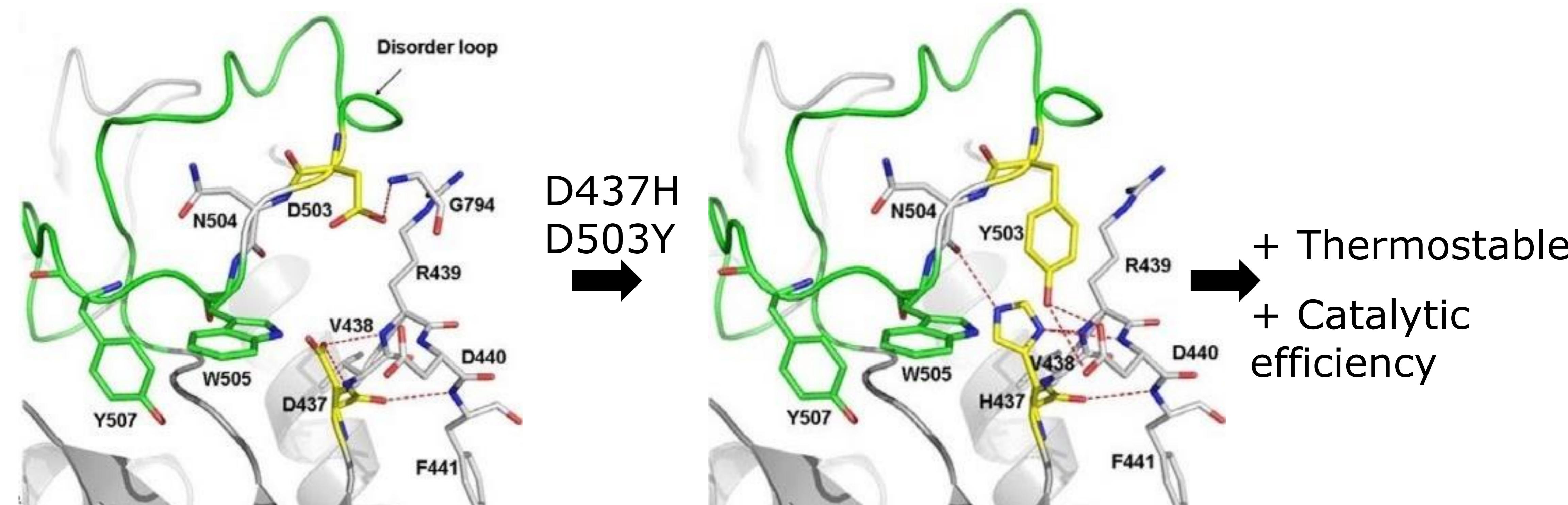


Figure 2. Wild-type pullulanase [2]. **Figure 3.** Mutant pullulanase [2].

Example 2: Directed evolution

Four rounds of DNA shuffling and subsequent → 7 mutations → + Thermostable

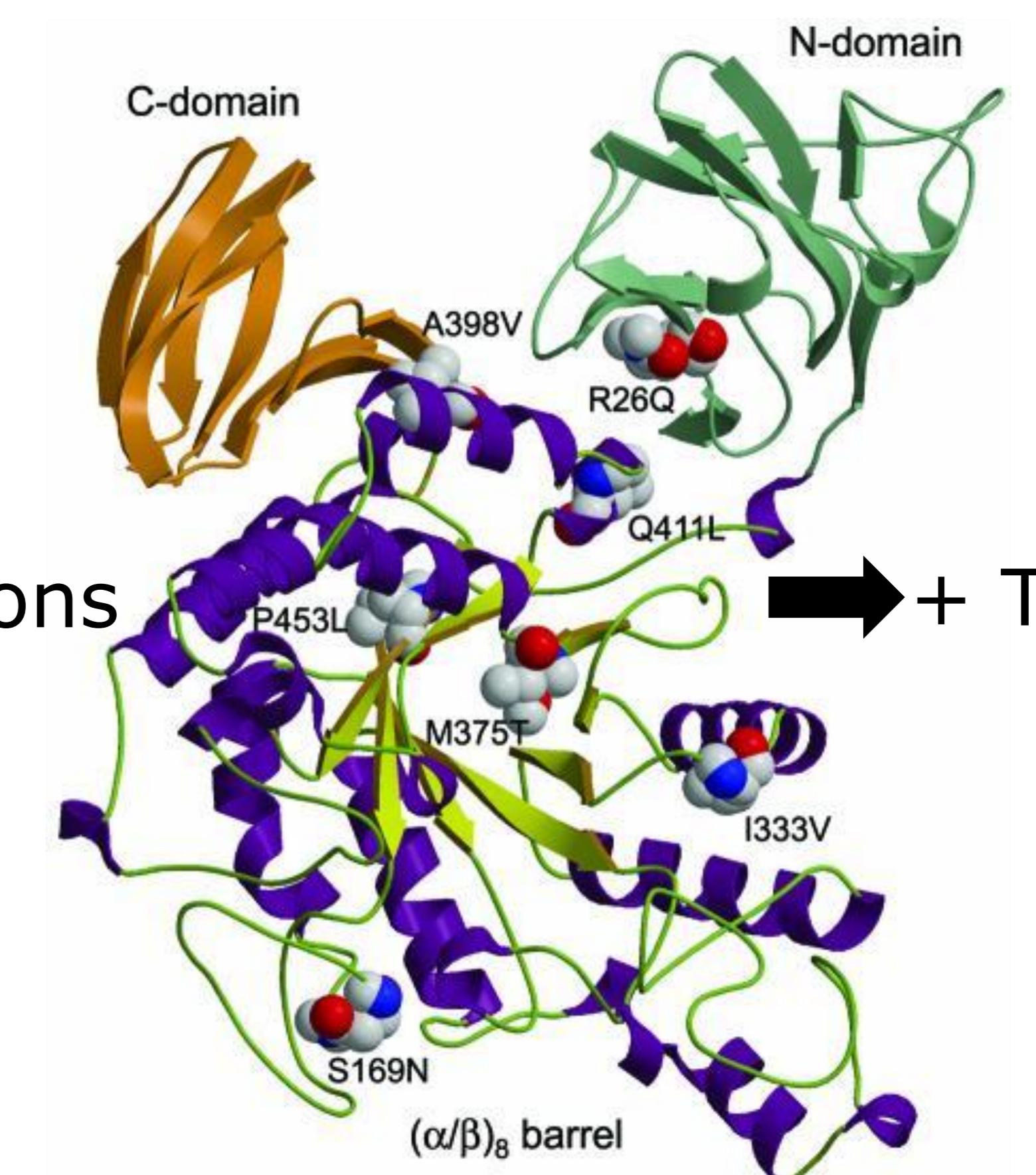


Figure 4. Mutant maltogenic amylase [3].

Conclusion.

The field of enzymology can be very promising for the future. Obtain enzymes with extraordinary properties improve food production. The main strategies for genetically modifying are site-directed mutagenesis, directed evolution and semi-rational design. The quality and quantity of hydrogen bonds, enhancing hydrophobic interactions, and avoiding bulky side chains can increase thermostability. If the structure becomes very rigid, the catalytic activity may decrease.

- References.**
- [1] Deckers M, Deforce D, Fraiture MA & Roosens NHC. 2020. Genetically Modified Micro-Organisms for Industrial Food Enzyme Production: An Overview. *Foods*. 9(3): 326.
 - [2] Duan X, Chen J & Wu J. 2013. Improving the thermostability and catalytic efficiency of *Bacillus deramificans* pullulanase by site-directed mutagenesis. *Appl. Environ. Microbiol.* 79(13): p.4072-4077.
 - [3] Kim YW, Choi JH, Kim JW, Park C, Kim JW, Cha H, Lee SB, Oh BH, Moon TW & Park KH. 2003. Directed Evolution of *Thermus* Maltogenic Amylase toward Enhanced Thermal Resistance. *Appl. Environ. Microbiol.* 69(8): p.4866-4874.