Yeast and Genetic Engineering

Scientists working with E. coli bacteria established many of the techniques for recombinant DNA and genetic engineering using the small-scale methods of the research laboratory. For centuries before the rise of molecular biology, people in cultures all over the world were using yeast and other microbes to produce food and medicines. Bread, wine, beer, poultices, yogurt, cheese all owe their flavor and punch to microbes.

Louis Pasteur established the modern field of microbiology for purely a commercial reason: something was turning wine into vinegar. He established that bacterial contaminants were taking the alcohol, produced by yeast fermentation and turning the alcohol into vinegar. By established pure cultures, he identified the bacterial culprit, which is still used today to manufacture vinegar, when that IS the desired product, and he established methods for minimizing contamination of the wine microbes (yeast consortium) so that the quality of wine produced could remain high). In Germany at around the same time, Koch was establishing similar methods to identify microbial agents that cause human disease (Koch's postulates).

So even more than 100 years ago, commercial and medical interests found similar pathways to success. Biotechnology recognizes this opportunity; basic research and commercial R&D discoveries often move from one sector to the other. Consumer science and "pure" research are often no longer widely different.

The knowledge that DNA is the same chemical in all living things and that the genetic code is identical across many species has made it possible to manufacture human hormones in bacterial cultures. Safety regulations for use of E.coli for recombinant DNA work stipulated highly specialized monitoring and construction for scale-up of these bacterial fermentations. Then chemical engineers and recombinant DNA researchers realized that yeast, which were already grown in large scale for food and beverage consumption and for production of chemicals, could be used with less new regulation, since yeast were already determined safe to handle in large quantities. Once vectors for moving DNA fragments through yeast were constructed, manufacturers began using yeast as providers of human proteins.

Yeast are eukaryotes like us, and have the same modification enzymes as in our cells. This feature made yeast a better living factory for human proteins. Researchers had found that many desired human proteins lost activity after synthesis in bacterial hosts, and traced this problem to the lack of post-translational modification of the protein e.g., no carbohydrate chains added, because the bacteria do not naturally have those modification enzymes.

So, the chemical engineering for growing large quantities of yeast were already established, yeast can modify proteins the same way as human cells and large-scale yeast culture was already established as safe, while having continued regulation and monitoring.

So, studying yeast enzymes is not just for the low skills student, but for all students from the aspiring millionaire to the public-service minded!