CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Naomi L. Epps

Project Number
31090

Project Title
Breaking the Bond: The Optimum Temperature for Lactase Activity

Abstract

Objectives/Goals
My objectives are to find the temperature at which the enzyme lactase has the fastest rate of reaction breaking the glycosidic bond in lactose ("milk sugar") resulting in glucose and galactose. This is called the "optimum temperature" for lactase activity. In addition, I want to find the temperature at which lactase is destroyed (denatured) by heat.

Methods/Materials
Using a glucose meter, I measured glucose concentrations in milk samples, 10 minutes after adding a controlled amount of lactase (2,555 FCC units of Nature's Way Lactase made from aspergillus fungus) to a controlled amount of non-fat milk (300 ml). I varied the temperature of the milk/lactase samples from 35 degrees F to 180 degrees F. I tested each sample 6 times in rapid succession, at temperatures throughout this range and I calculated the standard error. In total, I took 108 glucose concentration measurements.

Results
My data shows that heat speeds up the reaction rate of lactase activity as it breaks the glycosidic bond in the double-sugar, lactose, resulting in the two single-sugars of glucose and galactose. The reaction rate increases from 35 degrees F up to the range of 125 to 135 degrees F where it drops off dramatically. So by definition, 125 to 135 degrees F is the "optimum temperature" (range) for lactase activity. At temperatures higher than this range, the enzyme quickly becomes denatured and therefore unable to break down the milk sugar.

Conclusions/Discussion
It should be noted that this data is specific to this particular fungal enzyme in the particular substrate (non-fat milk) tested. However, given the findings, since the human body's internal temperature is about 99 degrees F, it may be more efficient to add lactase to milk at 125 degrees F rather than ingesting lactase as a dietary supplement. Also, it is important not to heat this lactase beyond 125 degrees F because it will quickly lose its effectiveness. In other words, don't add this lactase to your hot chocolate if you are lactose intolerant because it won't break down the milk sugar!

Summary Statement
My project is to determine the "optimum temperature" for a commercially made lactase enzyme to break down milk sugar and to consider the implications for lactose intolerant people.

Help Received
My sister, Wendy, taught me the chemistry, my brother, Brenden showed me the glucose meter, my mom helped with the experiment, my dad helped with the calculations, my sister, Melody, and friend, Mimi, helped with Excel, my sister, Helena, proofread, and my teacher, Ms. SB, helped with APA format.