

# FOOD ENZYMES AND THEIR APPLICATIONS

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# Importance of enzymes in the food industry

- Naturally present – may inactivate them
  - Polygalacturonase
- Naturally present – may activate them
  - Pectin methyl esterase
- Used as indicators of proper processing
  - Alkaline phosphatase
- Used to measure another compound in the food
  - Glucose oxidase

# Importance of Enzymes in Foods

- Starch
  - Amylase
- Milk
  - Lactase
  - Lipases
- Fresh vs. canned pineapple
  - Bromelain breaks down gelatin in “Jello”
- Meat tenderizer – uses bromelain, ficin, or papain
- Blanching of vegetables – catalase and peroxidase
- Cloudy vs. clear apple juice –pectin methyl esterase
- Apples – polyphenol oxidase (PPO)
- Onions – allinase acts on sulfur compounds

# Important food enzymes –Glycosyl hydrolases - Amylases

I. Glycoside hydrolases : Break bonds with the help of water

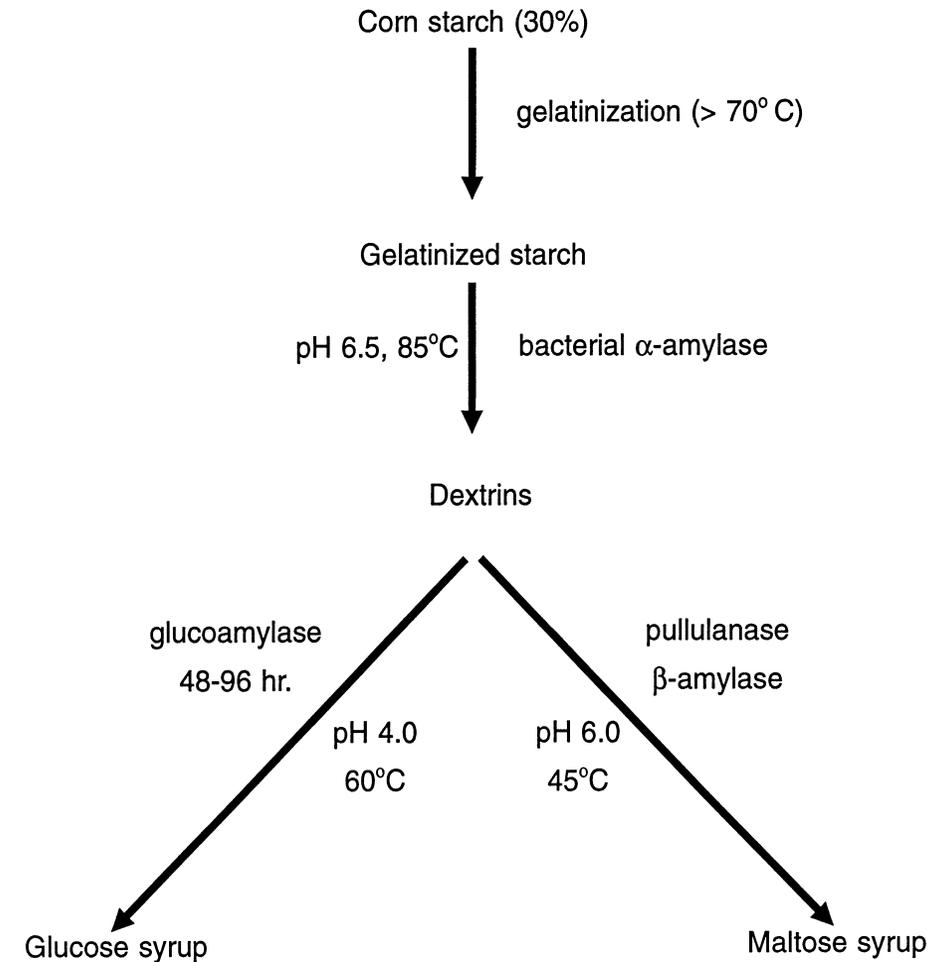
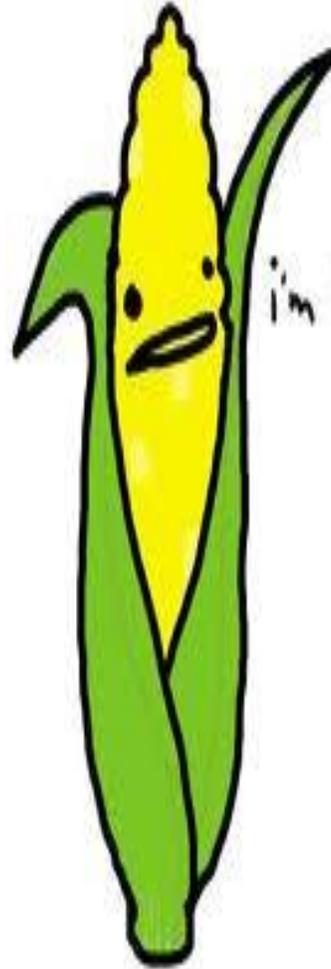
A) Starch hydrolyzing enzymes (glycosidic bonds)

- $\alpha$ -amylase
  - Hydrolyses  $\alpha$ -1-4 glycosidic bonds within starch
  - Results in dextrans, maltose and maltotriose
- $\beta$ -amylase
  - Hydrolyses  $\alpha$ -1-4 glycosidic bonds from the non-reducing end of starch, results in maltose
- Glucoamylase
  - Hydrolyses  $\alpha$ -1-4 and  $\alpha$ -1-6 glycosidic bonds in starch, hydrolyze all the way to glucose
- Pullulanase
  - Hydrolyses  $\alpha$ -1-6 glycosidic bonds in starch

# Application of food enzymes: Corn syrup production

Using a cocktail of enzymes starch can be converted to a glucose syrup (dextrose) or Maltose syrup

- Start with  $\alpha$ -amylase to break amylose and amylopectin to smaller units
- Then use glucoamylase to break down to glucose
- If maltose is desired use  $\beta$ -amylase and pullulanase



# Application of food enzymes: Baking and Brewing

## Baking

- $\alpha$ -amylases are important to “dextrinize” the disrupted starch granules (rupture during milling) and the dextrans are then hydrolyzed to maltose by  $\beta$ -amylase  $\rightarrow$  gives fermentable sugar for yeast to produce  $\text{CO}_2$   $\rightarrow$  essential for rising of the bread
- On baking there is further action of the amylases on the gelatinized starch  $\rightarrow$  plays an important role in the final texture and quality of bread, addition minimize staling

## Brewing

- During mashing (milled barley malt and water at  $50^\circ\text{C}$ ) amylases hydrolyze starch to give maltose for yeast to utilize and produce  $\text{CO}_2$  and ethanol

# Important food enzymes –Glycosyl Hydrolases - Others

## B) Invertase (sucrase)

- An enzyme that hydrolyzes the glycosidic bond between glucose and fructose in sucrose
  - Results in invert sugar (free Glc and Fru)
  - Popular in the confectionary industry because invert sugar is sweeter than sucrose and has less tendency to crystallize → Popular in soft candy fillings

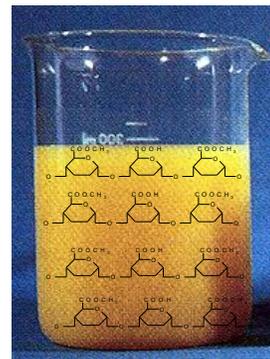
## C) Lactase

- An enzyme that hydrolyses the glycosidic bond between galactose and glucose in lactose
  - Increases sweetness and solubility of the sugar
  - Done in the dairy industry to minimize crystallization in ice cream and to produce lactose free products

# Important food enzymes –Glycosyl Hydrolases - Others

## II. Pectinases

- Occur widely in fruits and vegetables and are responsible for the degradation of pectic substances
  - Pectin methyl esterase
    - Hydrolyze the methyl ester linkages of pectin
    - Causes loss of cloud in citrus juice (big problem)
    - Converts colloidal pectin to non-colloidal pectin
    - We add this enzyme when juice clarity is desired



PME →

