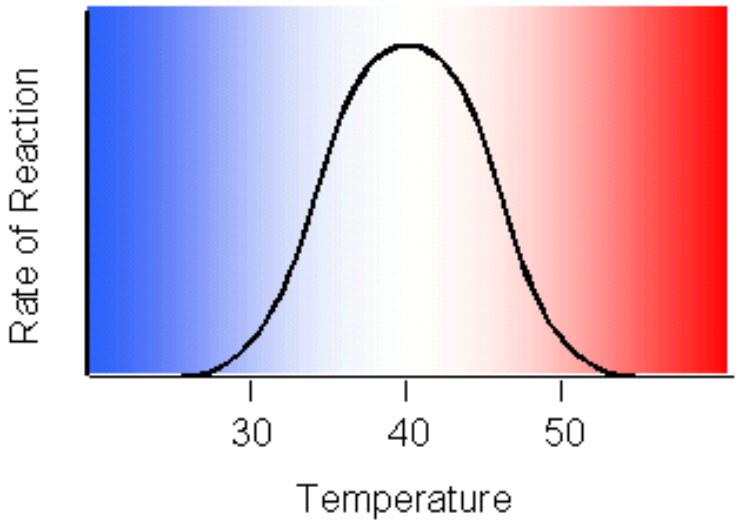
Factors Influencing Enzyme Activity

- Temperature
- pH
- Water activity
- Ionic Strength
- Chemicals
  - Chelating agents
  - Reducing agents

Temperature

- Enzymes function very slowly at sub-freezing temperatures
- Optimal activity in the 30-40C range
- Denature above 45C

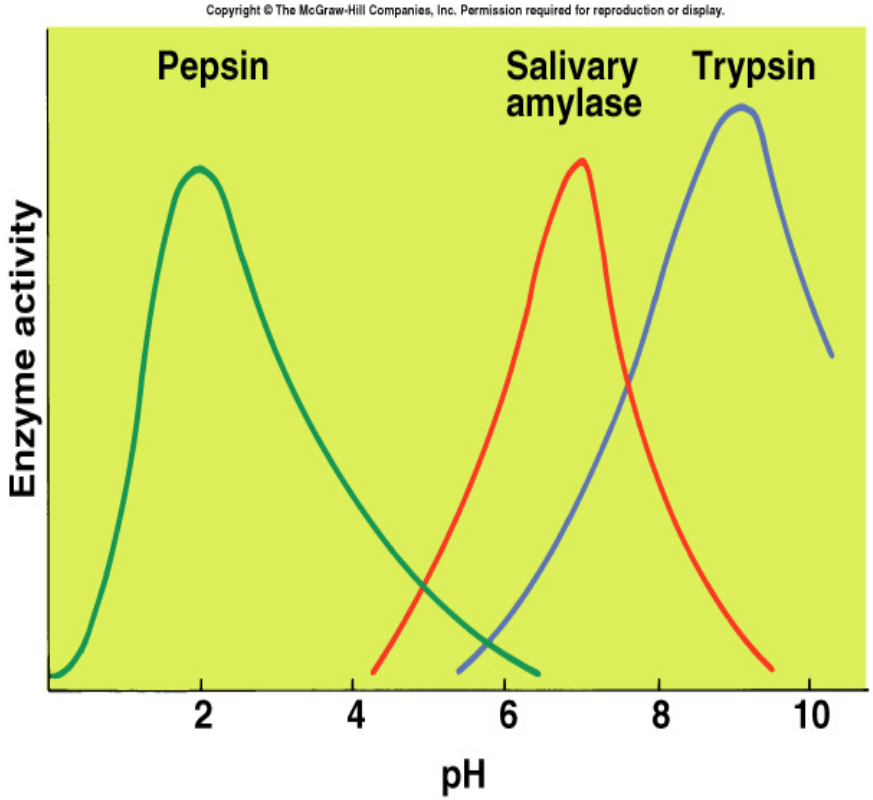


Temperature

- Freezing
  - Activity depends on the enzyme (0 to –10C)
  - Below –10C almost always decrease activity
- Factors involved in inconsistent behavior
  - Composition of medium
  - Rate and extent of freezing
  - Concentration effects
  - Viscosity
  - Changes in phase (crystallization of water, solidification of triacylglycerides)

pH

- Extremes generally inactivate enzymes
- pH optimum
- Maximum activities between pH 4.5 – 8.0
- Narrow pH range
- Exceptions
  - Pepsin: optimum pH is 1.8
  - Trypsin: optimum pH is 9.8



Water activity

- Dried foods
  - Restricted water activity
  - Susceptible to enzymatic spoilage
- The rate of enzymatic reactions in dried products is limited by the rate at which the substrate diffuses to the enzyme
- Heat stability

Electrolytes and Ionic Strength

- Ions may be required components in the active site
- Cation requirements of enzymes is sometimes specific
- Salting in
- Salting out

Chemicals

- Chelating agents
- Reducing agents
- Alterations of substrates

Enzymes in Food Processing

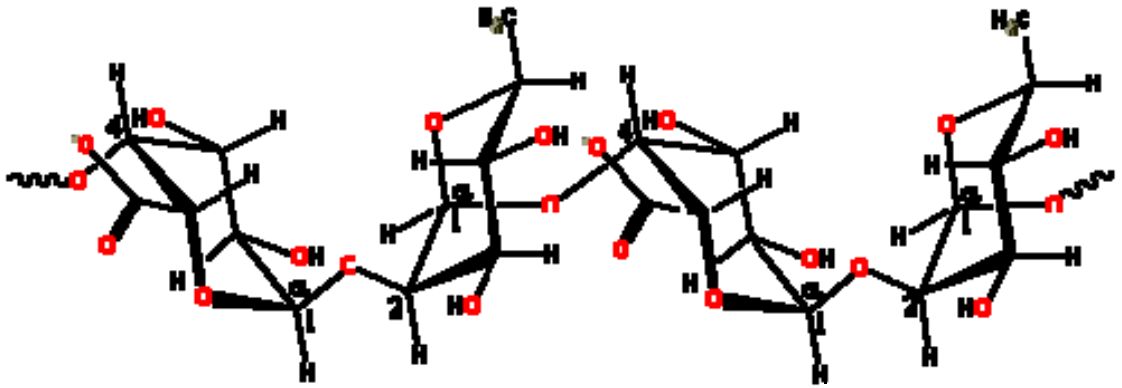
- Polyphenoloxidase
- Pectic enzymes
- Amylases
- Lipolytic enzymes
- Lipoxygenase
- Peroxidase
- Ascorbic acid oxidase
- Antioxidant enzymes

Polyphenoloxidase

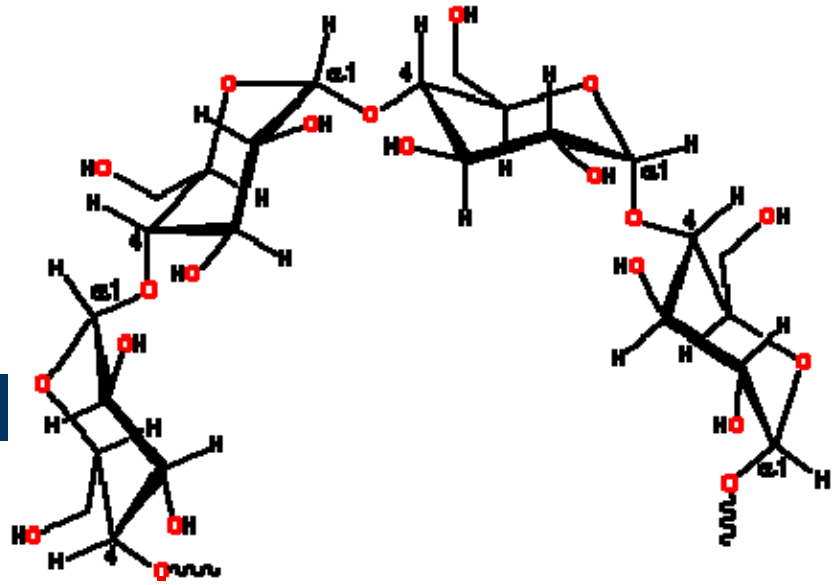
- Enzymatic browning
- Cut surfaces of fruits and vegetables
- Catalyze 2 types of reactions
- Active between pH 5-7
- Cu cofactor
- Inhibition

Pectic Enzymes

- Pectic lyases: high-methoxyl pectins
  - Split glycosidic bonds adjacent to methyl ester
- Structural elements
  - Changes in texture
  - Processing aids

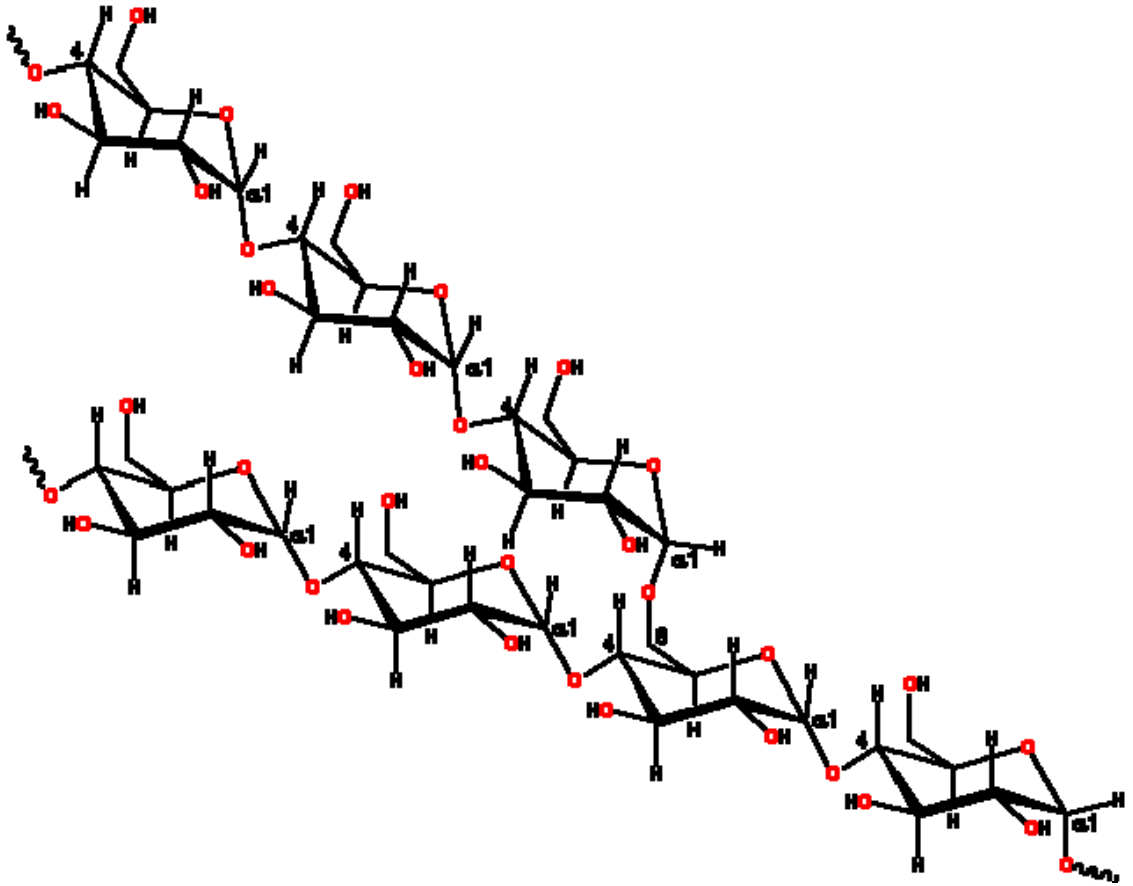


Amylases



- Hydrolyze starch
- Alpha-amylase – endoenzyme hydrolyzes α-1,4 glucan linkages in random manner
  - Yields dextrins and oligosaccharides
  - Liquefying enzyme
    - Decrease viscosity
    - Increase of reducing power
    - Loss of colored complex with I_2

Amylases



Amylases

- β-amylase --> Exoenzyme
  - Attacks only the end units
  - Removes maltose units only from non-reducing end
  - Stops 2-3 glucose molecules from branch point
    - Limit dextrins
- Gluco-amylase --> glucose
- Pullulanase β 1,6 link (debranching)

Amylases

- Provide sugars for fermentation
- Reducing sugars
- Alter texture, mouth-feel, sweetness, moistness

Lipolytic enzymes

- Lipase
  - Breaks fatty acid off triacylglyceride
  - Produce flavor in cheese making
    - eg butyric acid or caproic acid
- Phospholipases
  - Reacts with glycerophospholipids
  - 4 ester functions can be hydrolyzed

Lipoxygenase

Food	pH optimum	Peroxidation specificity[1]	
		9-LOOH(%)	13-LOOH(%)
Soybean, L-1	9	5	95
Soybean, L-2	6.5	50	50
Pea L-2	6.5	50	50
Peanut	6	0	100
Potato	5.5	95	5
Tomato	5.5	95	5
Wheat	6	90	10
Cucumber	5.5	75	25
Apple	6	10	90
Strawberry	6.5	23	77
Gooseberry	6.5	45	55

Changes in quality

- Color
  - Bleaching of carotenoids
    - Xanthophyll, lycopene
  - Loss of chlorophyll
- Flavor
  - Off-flavors
- Texture
  - Favorable effects on wheat flours
  - Control SS-SH balance & hydrophobic bonding
- Nutritional
  - Destruction of Vit A
  - Destruction of essential fatty acids

Peroxidases

- Blanching indicator
- Heme: Iron cofactor
- Oxidative deterioration of Vit C
- Bleaching of carotenoids
- Decoloration of anthocyanins
- Peroxidative deterioration of fatty acids
  - Off-flavor

Others

- Ascorbic acid Oxidase
  - L-ascorbic to DHA
- Catalase