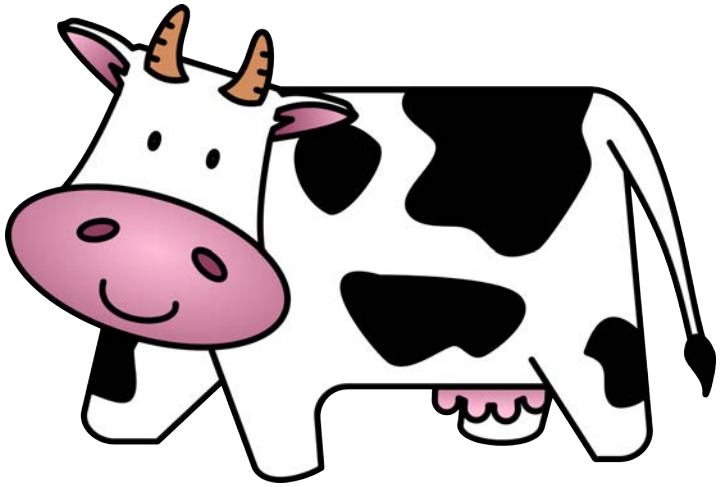
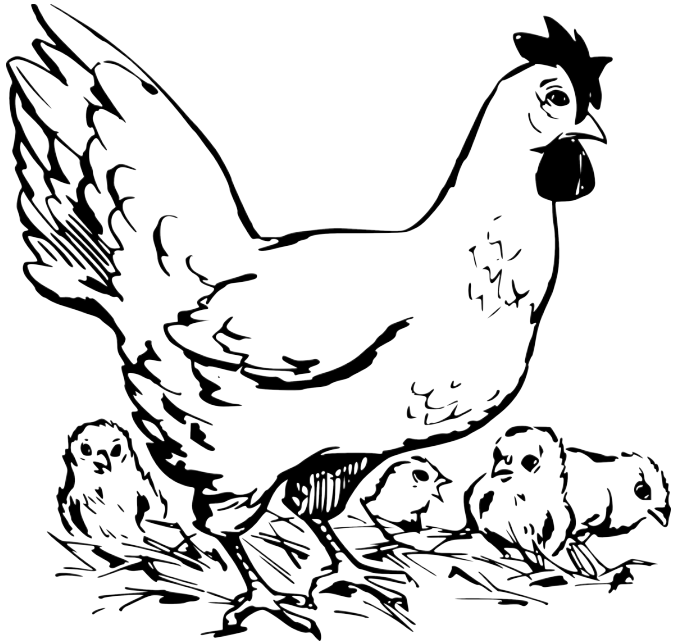
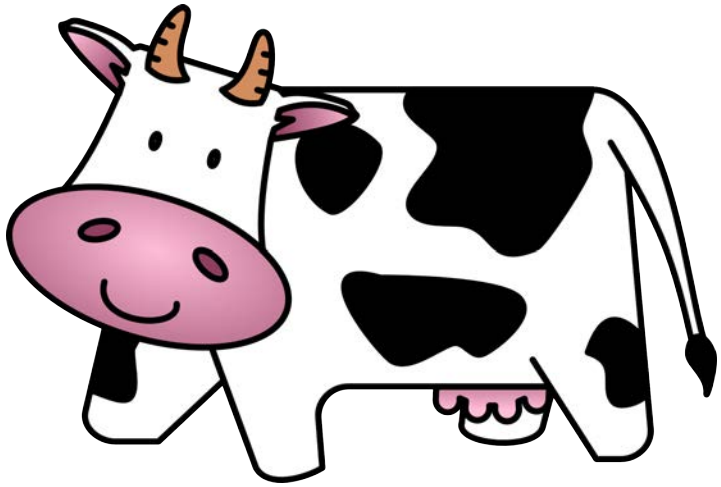

HILTON CHICAGO - FEBRUARY 25 - 27, 2018
BAKINGTECH 2018
SUSTAINABILITY-SUCCESS THROUGH PEOPLE
PRODUCTS AND PRODUCTIVITY
Enzymes Past, Present & Future
John Del Campo
REPCO

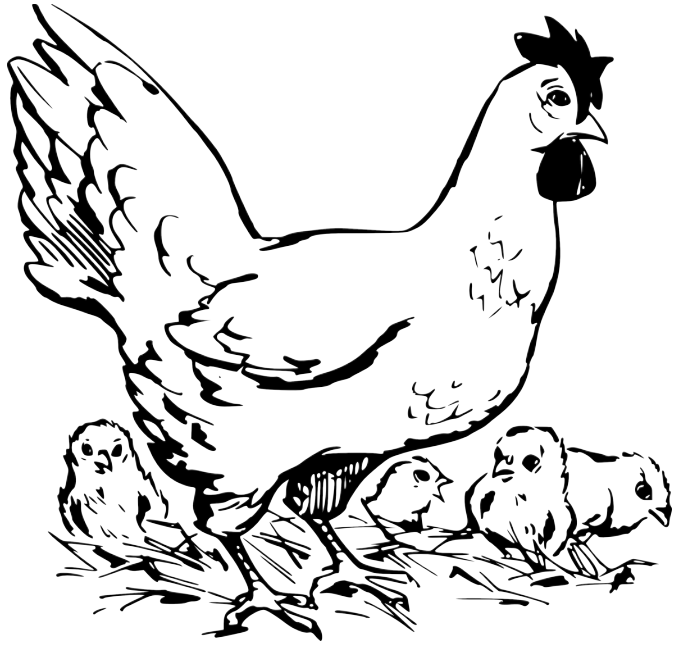
Cows and Chickens





50 Cows and 20 Ate Chickens





What is an Enzyme?

- Protein
- Reaction catalyst
- Very specific in substrate and product
- Reaction rate depends on several factors
- Enzyme names end in “-ase”

Reaction Factors

- Temperature
- pH
- Amount of substrate(s)
- Amount of enzyme added
- Water activity
- Inhibitors
- Time

Lock and Key model

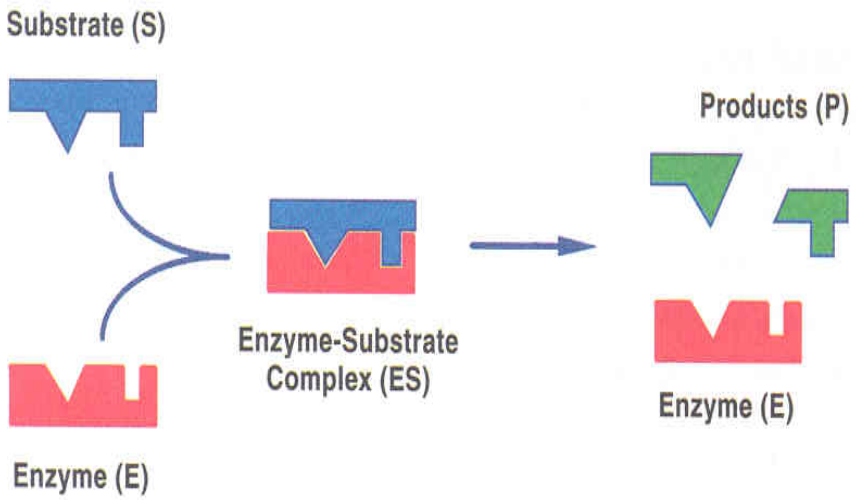
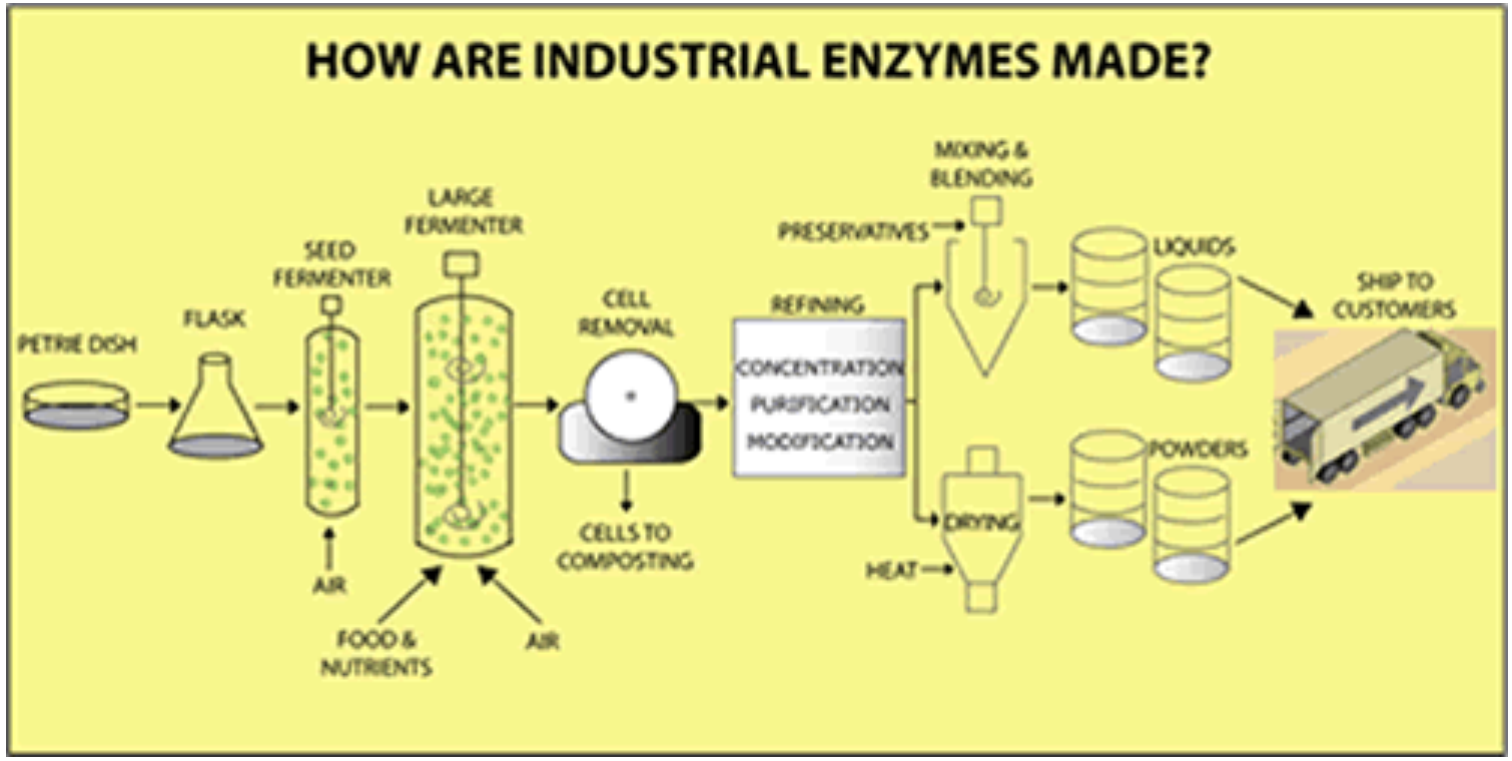


Fig. 1-4. Schematic representation of an enzymatic reaction. Blue = substrate, red = enzyme.

Enzyme sources

- Bakery enzymes come from microorganisms, either fungi or bacteria
- They are neither animal or plant, but fall under the class called microorganisms

Enzyme production



Protease

- Degrade complex proteins into smaller pieces
  - Softening and conditioning the gluten.
  - Provide greater extensibility; improve machining properties.
  - Will reduce mixing requirements.
- Used to replace l-cysteine in “natural” improvers
- Release water for moister crust
- Excess? Sticky, wet, hard to handle doughs; often weak.
- Recent improvements enable better performance with fewer drawbacks
- Generally, but not necessarily non-GMO

α-amylase

- Cleaves starch at interior alpha-1,4-gylcosidic linkages
- Works on damaged starch granules, converts to sugars
- Optimal pH is between 5 and 6
- **Fungal:** *Aspergillus oryzae*. Optimal temperature is 122 F. Inactivated at 149 F.
- **Bacterial:** *Bacillus subtilis.* Optimal temperature is 158 F. Inactivated at 185 F.
- Generally non-GMO
- Both types are relatively inexpensive

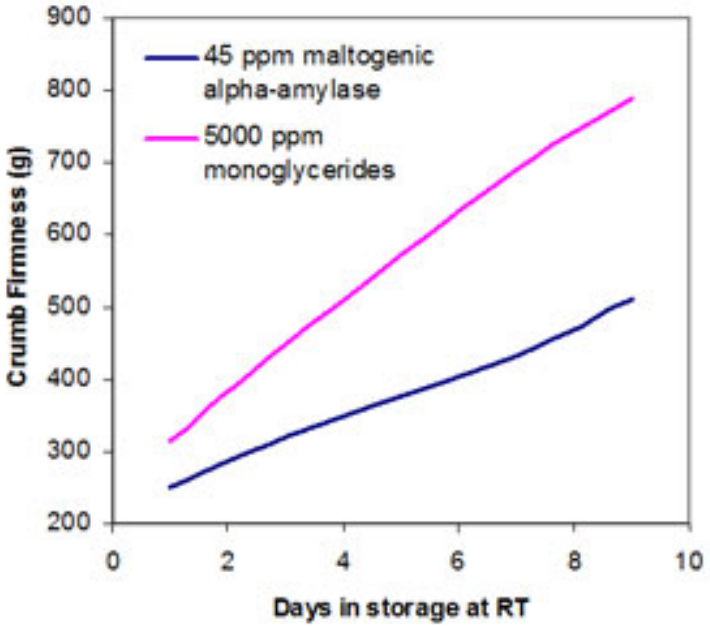
Glucoamylase

- Converts starch granules to glucose
- Enhances crust color
- Both GMO and non-GMO versions available
- By providing additional glucose assists performance of sugar oxidases

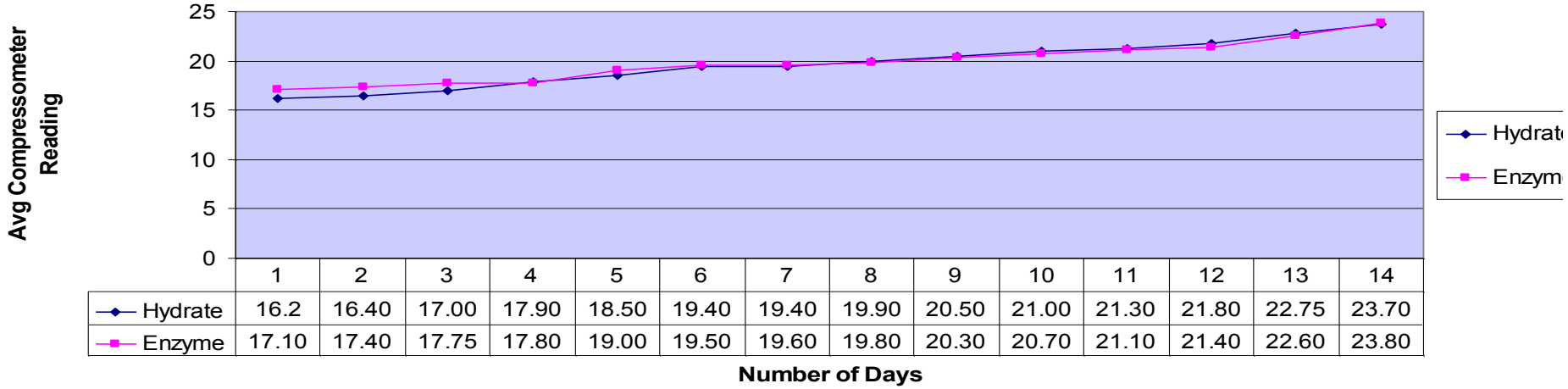
Maltogenic Amylase

- Extends shelf life by reducing crumb staling
- Modifies amylopectin in starch after gelatinization
- Reduces and slows recrystallization of structure baking crumb soft and flexible
- Minimal risk of overdose
- First patented in 1983, emerged in the early 1990's
- Patent expires in March 2018
- Use genetically modified microorganisms

Maltogenic Amylase



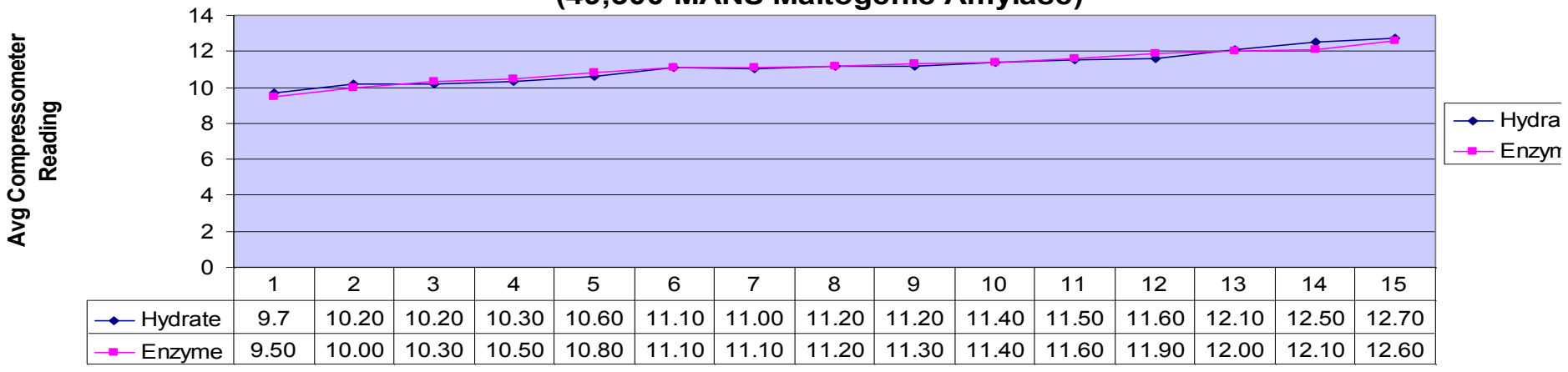
Enzyme vs .75 % Double Strength Hydrated Monoglyceride White Bread no ESL Enzyme



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hydrate	16.2	16.40	17.00	17.90	18.50	19.40	19.40	19.90	20.50	21.00	21.30	21.80	22.75	23.70
Enzyme	17.10	17.40	17.75	17.80	19.00	19.50	19.60	19.80	20.30	20.70	21.10	21.40	22.60	23.80

Number of Days

Enzyme vs .75 % DS Hydrated Monoglyceride White Bread with ESL Enzyme (49,300 MANU Maltogenic Amylase)



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hydrate	9.7	10.20	10.20	10.30	10.60	11.10	11.00	11.20	11.20	11.40	11.50	11.60	12.10	12.50	12.70
Enzyme	9.50	10.00	10.30	10.50	10.80	11.10	11.10	11.20	11.30	11.40	11.60	11.90	12.00	12.10	12.60

Number of Days

Maltotetrahydrolase

- Anti staling similar to maltogenic amylase along with -
- Improved eating quality of the crumb
- Not inhibited by sucrose
- Better crust hinging
- Improved foldability of flatbreads

Phospholipases

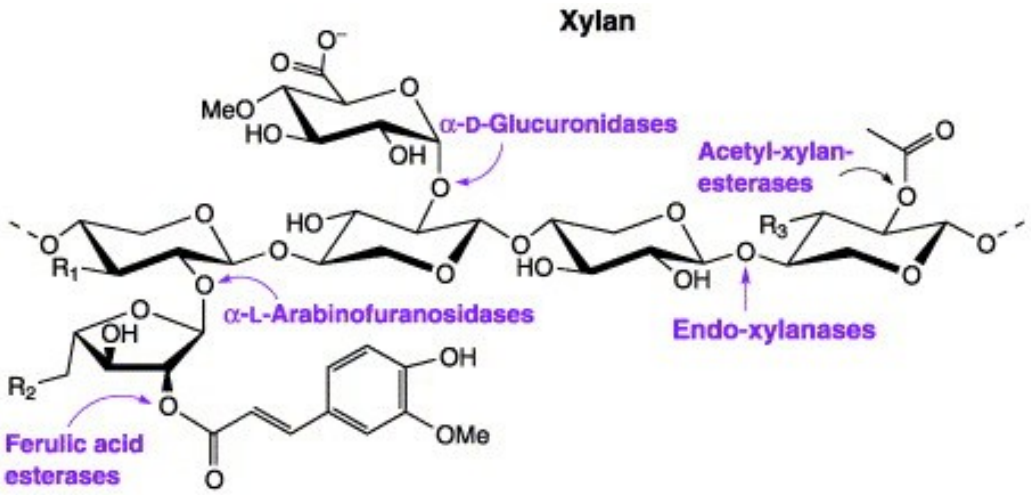
- Strengthen yeast raised doughs by converting fat present in wheat flour to emulsifiers similar to DATEM and SSL
- Genetic technology for production was first introduced in 1984
- Most common type is phospholipase A2, because they turn phospholipids in flour into LysoPhospholipid (= higher polarity) and Galactolipids into lysogalactolipids (= higher polarity)….
- A recent patent expiration has opened the door to more competition, and more product offerings

Dual specifity of lipases

- Lipases generally act on the polar lipids naturally present in wheat flour to improve dough strength and loaf volume. An improvement was made to enable reaction with non-polar lipids as well as polar lipids resulting in further improved dough tolerance and loaf volume.

Xylanase, Hemicellulase, Pentosanase

- Convert insoluble arabinoxylans etc., detrimental to loaf quality, to more desirable soluble starch gels
- Improved extensibility, better processing, improved loaf volume.

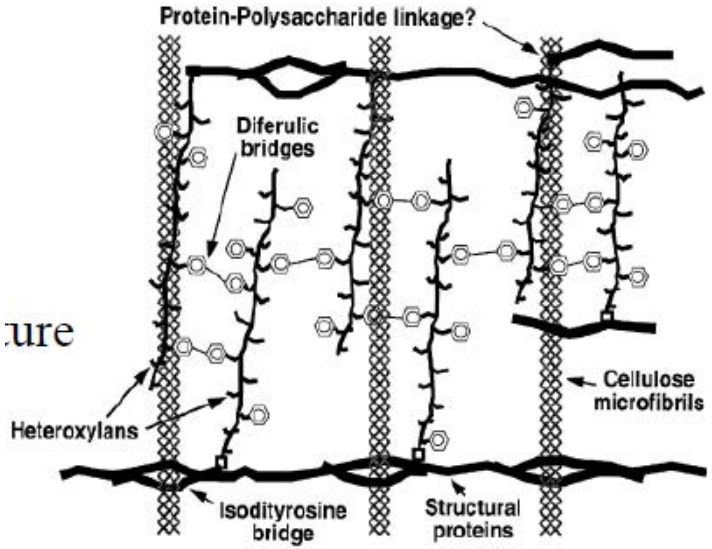


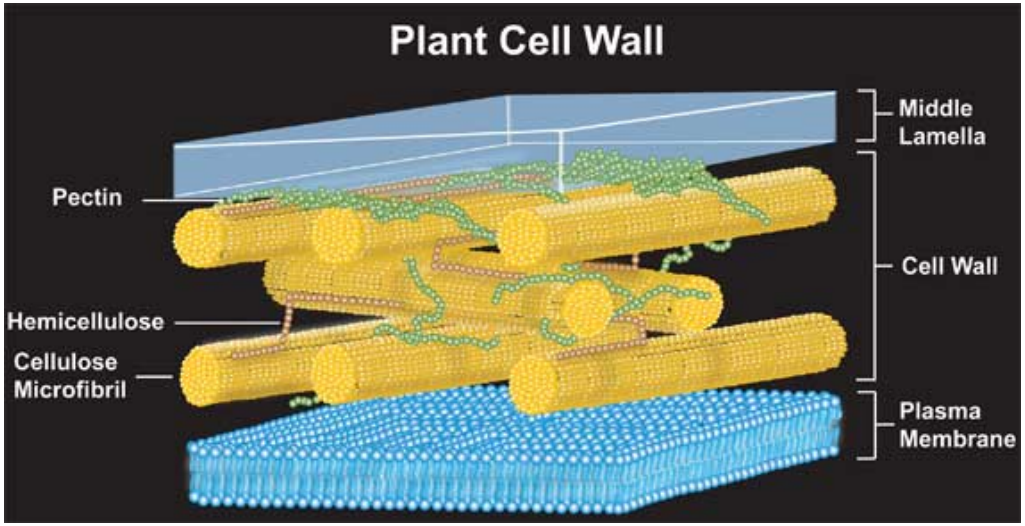
Xylanase, Hemicellulase, Pentosanase

- Release bound water.
- Enhance crust dryness, reduce flakiness and improve hinging
- Enhance anti-staling properties of maltogenic amylases
- Non-GMO versions available

Cellulase

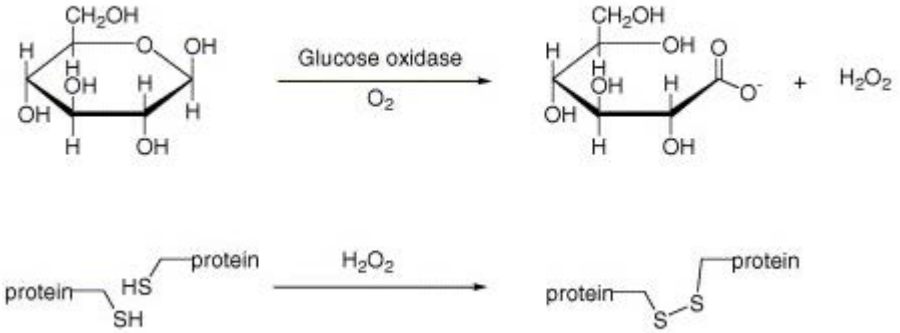
Converts cellulose fibrils to starch that can be further converted to sugars

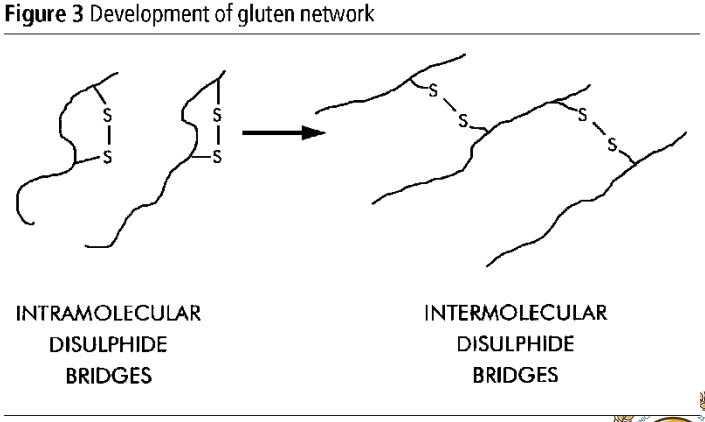




Glucose or Hexose Oxidases

- Use certain sugars to create oxidizers (H_2O_2)
- H_2O_2 links disulphide bonds of gluten
- Strengthens gluten network to give greater volume. Became prominent with the need for removal of Potassium Bromate and ADA



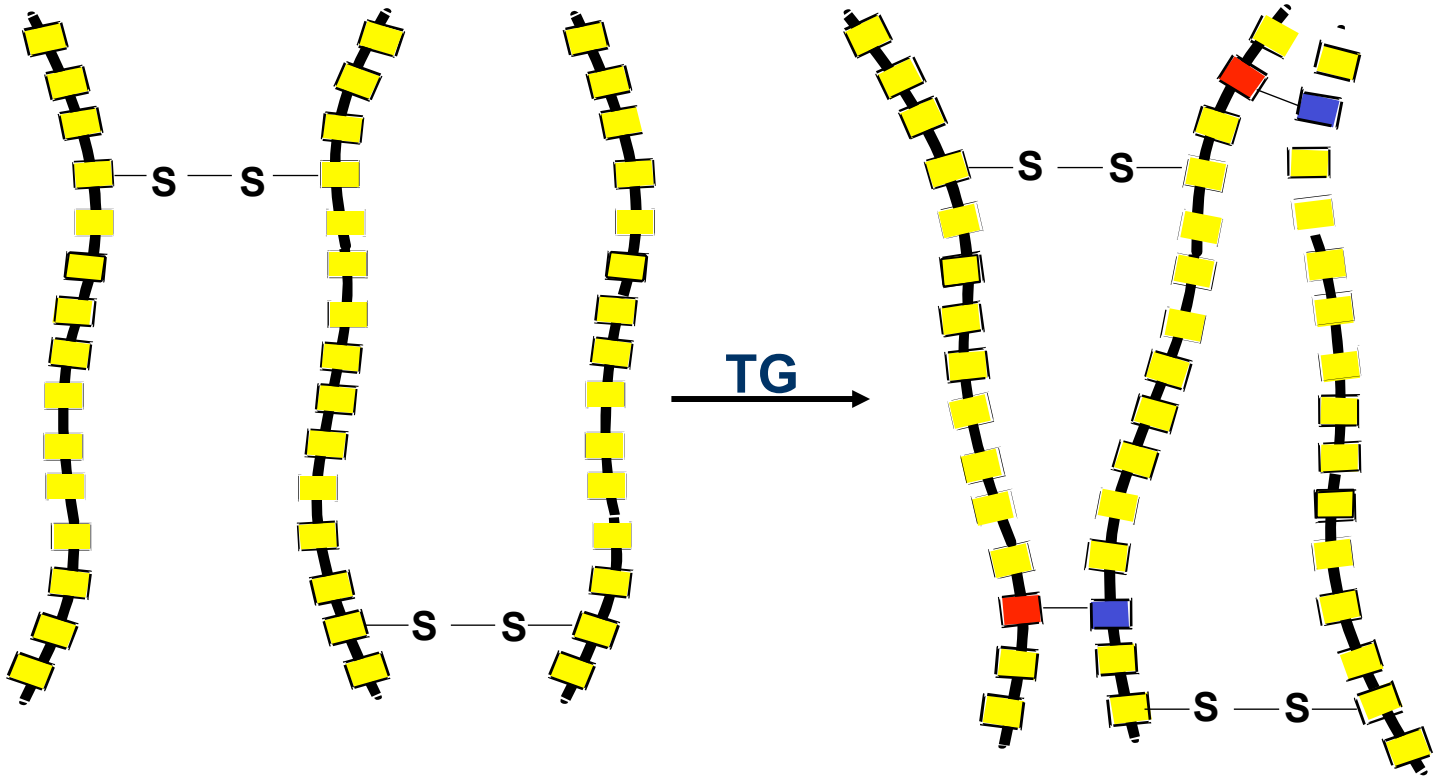


BAKINGTECH 2018
SUSTAINABILITY-SUCCESS THROUGH PEOPLE
PRODUCTS AND PRODUCTIVITY

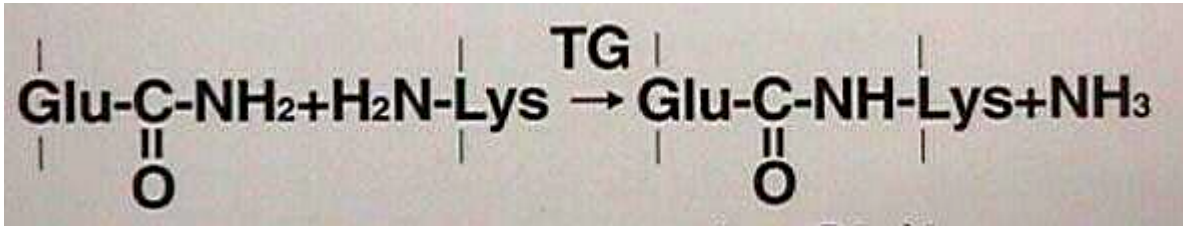
Glucose or Hexose Oxidases

- Improved dough strength, stability, and tolerance
- Reduced dough stickiness and increased
- dough absorption
- Increased loaf volume
- Generally slower acting than ascorbic acid or ADA
- Do not work in continuous mix systems
- Non-GMO versions available

Transglutaminase



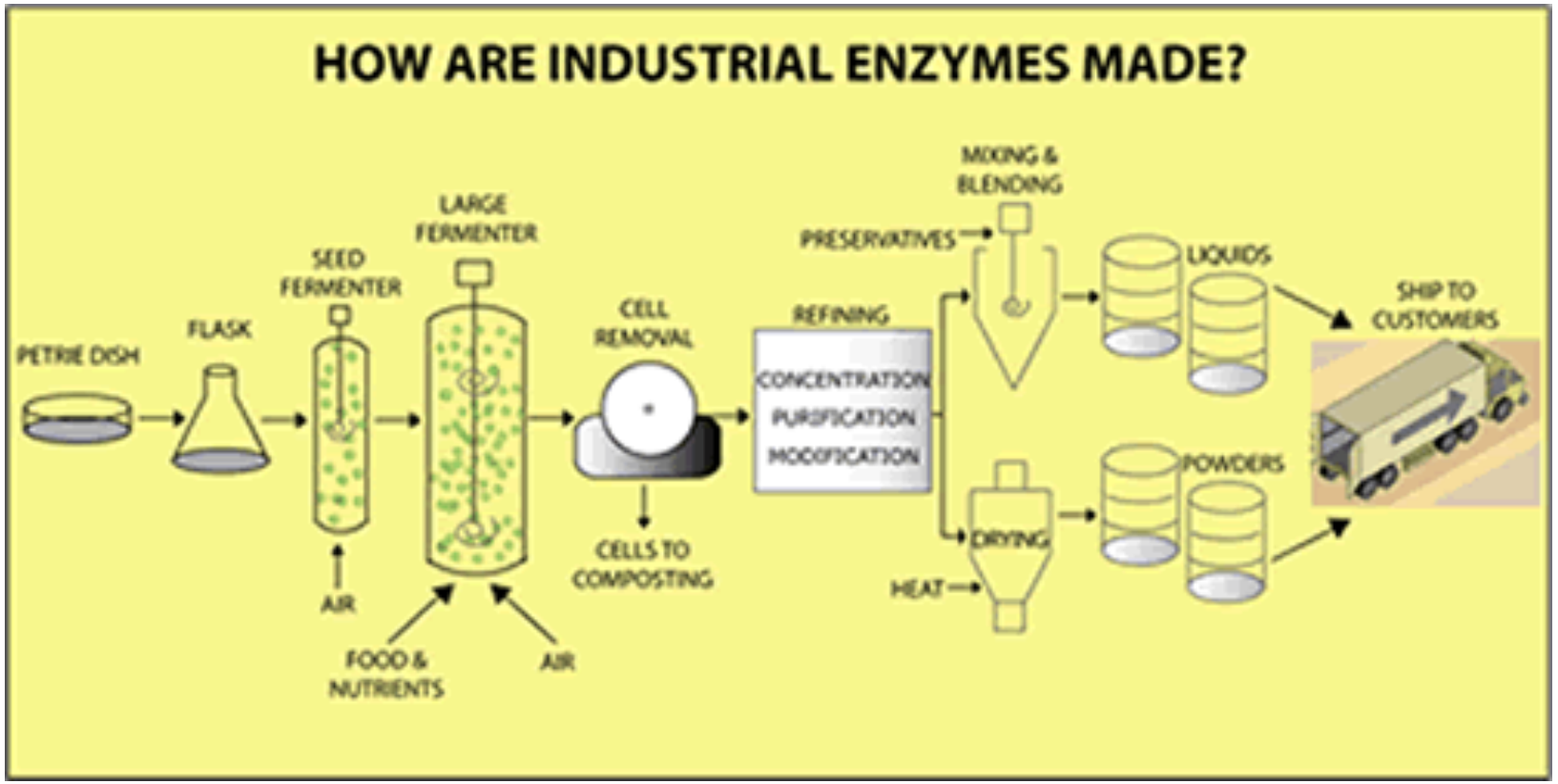
Action of Transglutaminase



glutamine lysine

Forms crosslinks between
glutamine and lysine in proteins

GMO Free vs Non-GMO



NON-GMO PROJECT VERIFIED PRODUCTS LIST

The Product Verification Program uses a process that combines on-site facility audits, document-based review and product testing to verify compliance with the standard at every level of the supply chain, from manufacturing facilities to ingredient suppliers. For a product to be verified and bear the seal, it must undergo a process through which any ingredient at high risk for GMO contamination — soy or corn, for example — has been proven to meet the standard through avoidance practices and testing.

AMERICAN SOCIETY OF BAKING ASB

BAKINGTECH 2018
SUSTAINABILITY-SUCCESS THROUGH PEOPLE
PRODUCTS AND PRODUCTIVITY

Available classical enzymes

- Protease
- α-amylase– fungal and bacterial
- Glucoamylase
- Glucose oxidase
- Xylanase, hemicellulose and cellulase
- Transglutaminse

Classical (Non GMO) Enzymes

AMERICAN SOCIETY OF BAKING
ASB

BAKINGTECH 2018
SUSTAINABILITY-SUCCESS THROUGH PEOPLE
PRODUCTS AND PRODUCTIVITY

Key Ingredient Lists

- Whole Foods Product Lists
- Panera Bread No No List
- Non-GMO Project Verified Lists
- UMRI and USDA Certified Organic Lists
- FDA Generally Recognized as Safe
- Canadian Approved Enzymes

Some enzyme benefits in bread

- Cleaner and more simplified labeling
- Stable and often lower formulation costs
- Improved volume
- Improved dough strength and tolerance
- Improved loaf structure
- Greater extensibility
- Increased absorption
- Tighter crumb structure
- Enhanced browning
- Frozen dough stability
- Longer shelf-life thru staling reduction

AMERICAN SOCIETY OF BAKING
ASB

BAKINGTECH 2018
SUSTAINABILITY-SUCCESS THROUGH PEOPLE
PRODUCTS AND PRODUCTIVITY