

Enzyme Enabled Tortilla Fresh Keeping

ENZYME SCIENCE FOR CLEAN-LABEL FRESHKEEPING

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Why Tortillas, Why Now

A \$57 billion category by 2033

Tortillas are the fastest growing flatbread category, expanding worldwide at significant CAGR (TIA).

Fresh-baked softness, every time

Consumers expect softness, rollability and foldability across a shelf life measured in weeks to months.

Clean label pressure is rising

Manufacturers need freshness solutions that read well on the ingredient panel.

Staling is inevitable, “enzymes are the answer”

A biophysical certainty met with a “**targeted, clean way to fight it**”.

Wheat Tortilla Model Employed in this Study

1. Mix Dry Ingredients

Wheat flour, salt, sugar, DC etc.
Ambient Temperatures • Short duration low speed

2. Add Shortening & Water

Add shortening and **short duration low**.
Then add water
Mix short duration low • long duration high

3. Divide & Round

Divide and round the dough
X g pieces

Enzymes functions

Enzymes functions

Enzymes functions

4. Rest time

Rest the dough pieces
5-min at Ambient Temperatures

5. Hot Tortilla Press

375°F lower / 325°F top plate
2.25 sec • 700 psi

6. Griddle Bake

Electric griddle at max heat, 375°F
30 sec × 3 sides

Enzymes functions

Enzymes inactivation significant

Starch

Gelatinization (°C)

Wheat

53-64

Starch gelatinization sets the temperature window that drives texture and staling.

Corn Tortilla Model Employed in this Study

1. Mix Dry Ingredients

Corn masa (pH 8.5-9.5), maltose, minors
Ambient Temperatures • short duration low speed

Enzymes functions

2. Add Water

Blend to uniform masa dough
Ambient Temperatures • medium duration low until blended

Enzymes functions

3. Rest Dough

No relaxation time required
0 min • Ambient Temperatures

Enzymes functions

4. Divide & Round

Portion and round the masa
X g • rest 5 min • Ambient Temperatures

Enzymes functions

5. Cold Press Machine

Press at ambient temperature
3 sec • Ambient Temperatures

Enzymes inactivation significant

6. Griddle Bake

Electric griddle at max heat, 400°F
30 sec • flip 35 sec • flip 10 sec

Starch

Gelatinization (°C)

Corn

61-72

Starch gelatinization sets the temperature window that drives texture and staling.

Fresh Keeping Challenges in Tortillas: Two Aspects

Staling mediated spoilage

- Firmer, leathery texture
- Cracking and breaking on fold or roll
- Reduced extensibility over days of storage
- Driven by starch, moisture and protein changes
- Gradual, begins the moment baking ends

This Talk Focus on Mitigating this Aspect

Microbial spoilage

- Mold growth over storage time
- Controlled by preservatives and mold inhibitors
- Separate shelf-life driver from texture
- Addressed by different tools (e.g., propionates, SHIELD-type inhibitors)
- Not the focus of enzyme softening solutions

Please meet us!

Defining staling: a tortilla's condition after 8 weeks in storage



**After 8 weeks, a tortilla
produced without clean label
enzyme technology**



**Which factor primarily
drives this phenomenon?**

Starch Retrogradation Primarily Determines Freshness

Starch is a common entity in tortilla ingredients

1. Freshness driver

Retrogradation is a key aspect of flat bread fresh keeping

2. Enzyme strategy

Modifying starch to impede retrogradation through enzymes is a relevant strategy

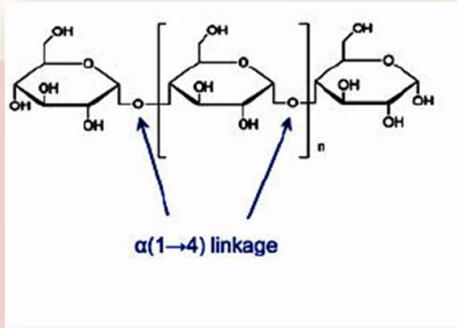
3. Enzyme toolbox

Several starch acting enzymes are prevalent

Starch Retrogradation Primarily Determines Freshness

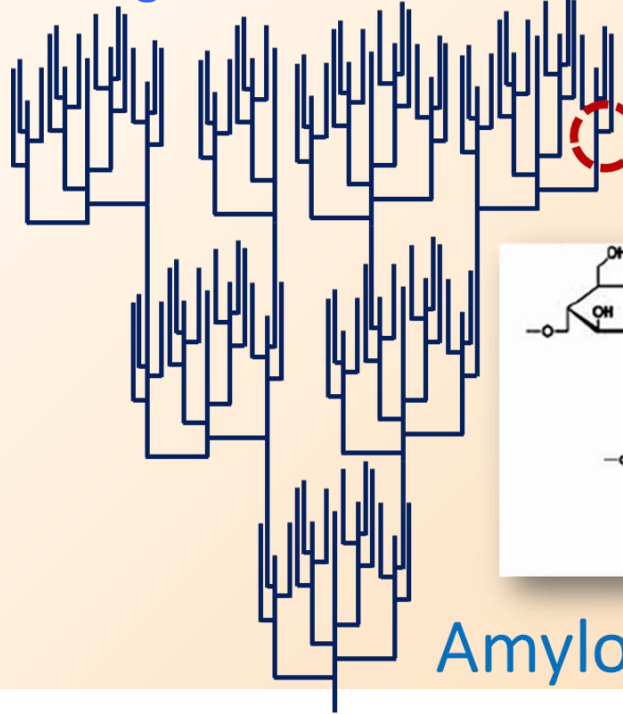
The principal building blocks that structure starch

Amylose

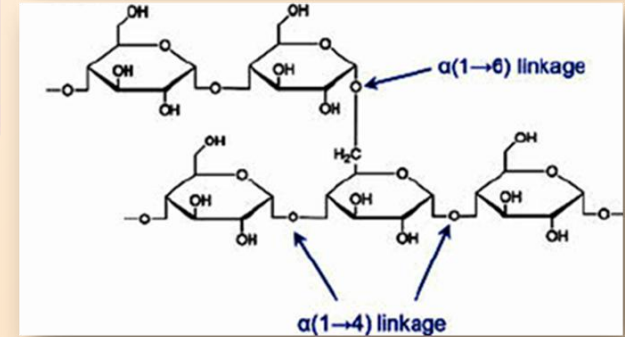


Average chain length: ~2000 DP

~25% of flour starch



Average chain length: ~25 DP

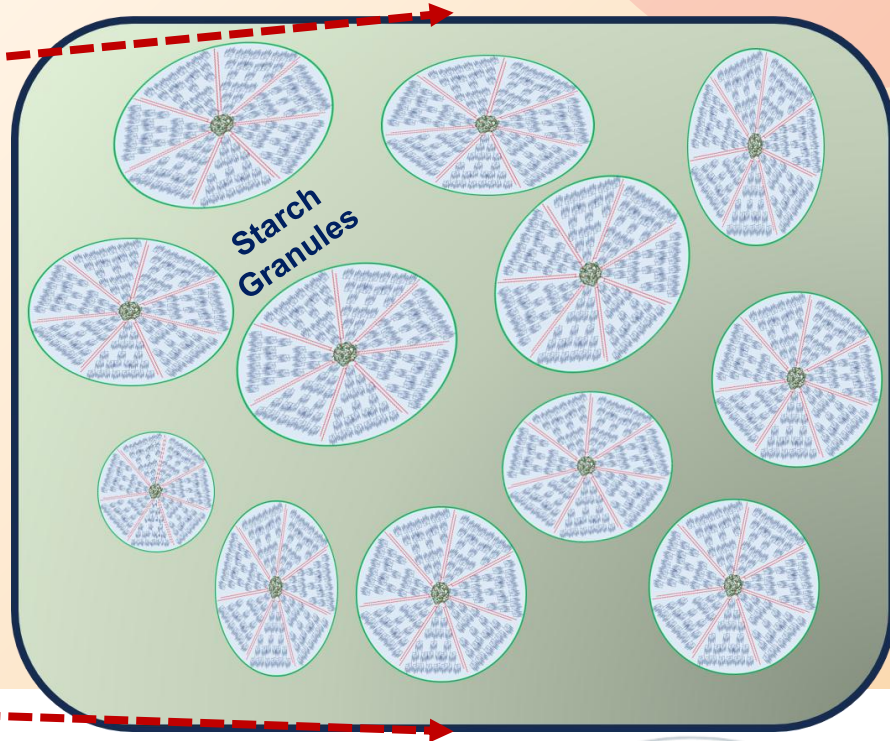


Amylopectin

~75% of flour starch

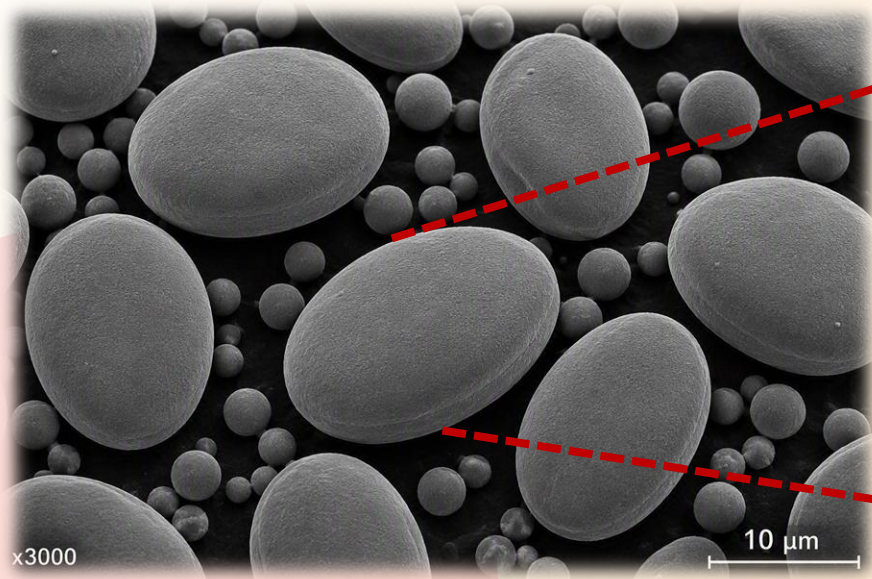
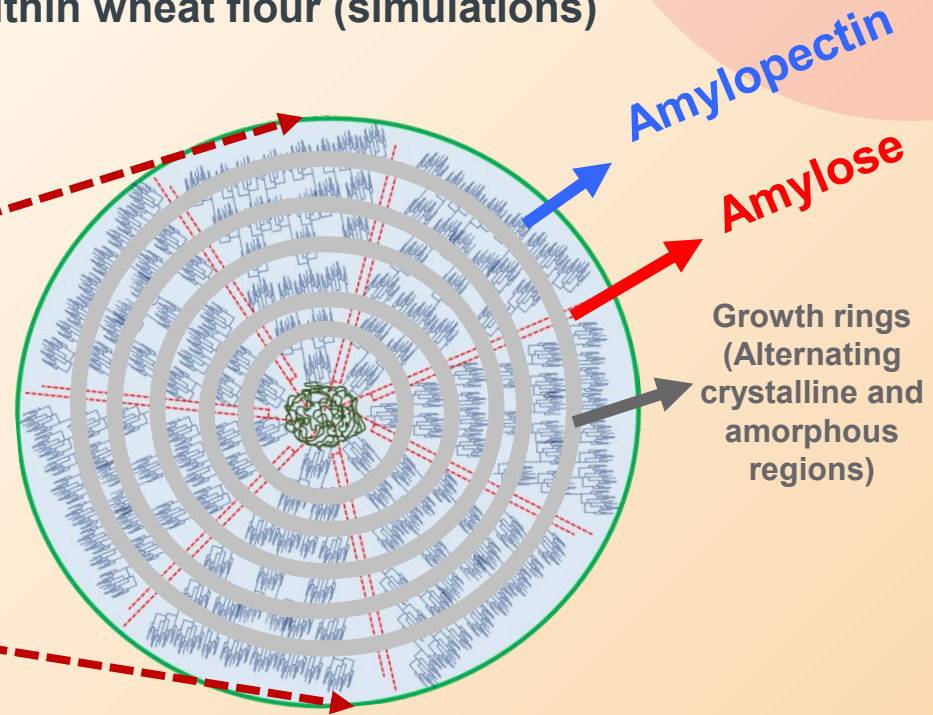
Starch Retrogradation Primarily Determines Freshness

Starch granules as present within wheat flour (simulations)

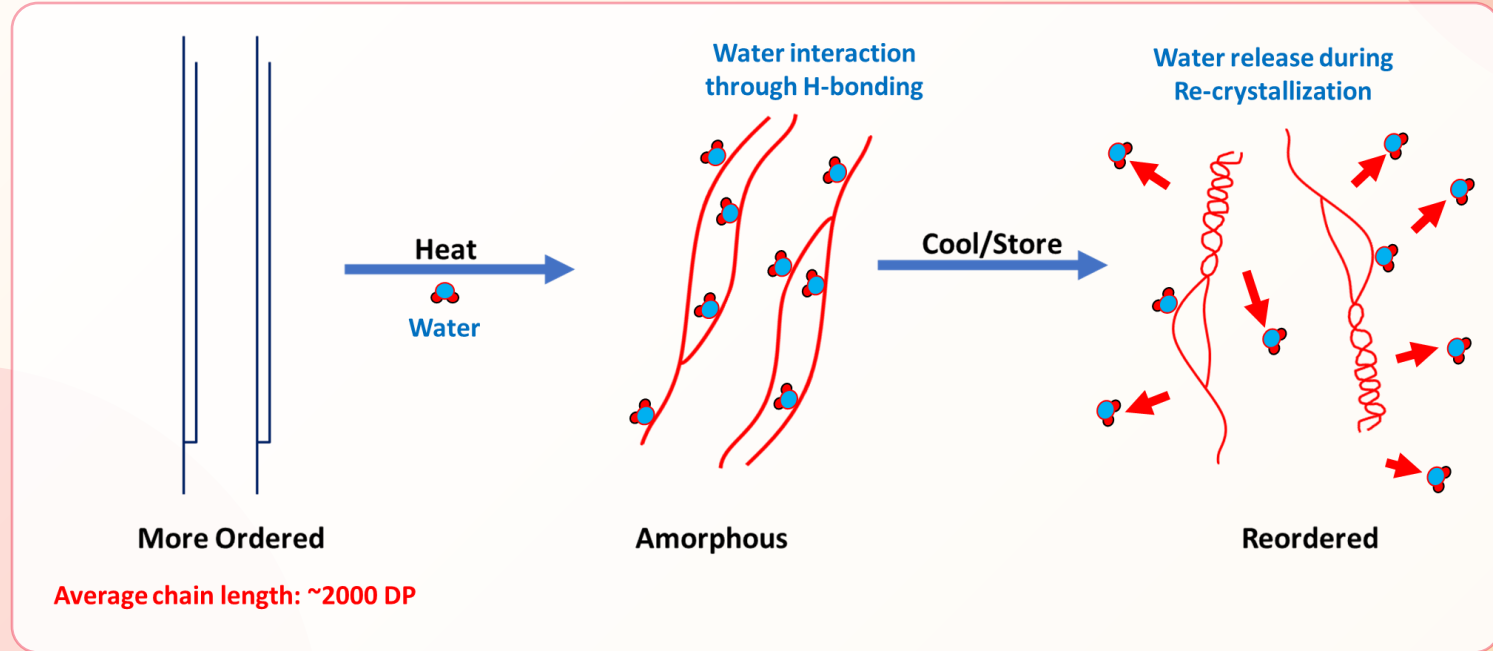


Starch Retrogradation Primarily Determines Freshness

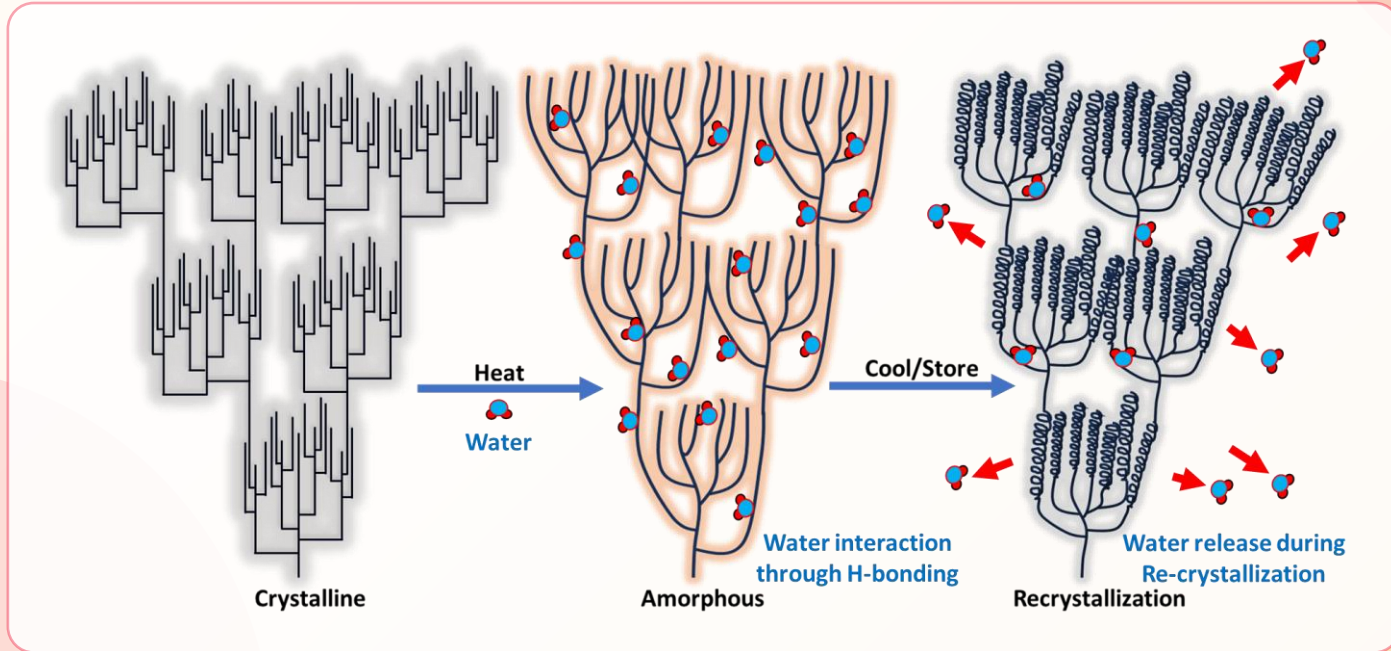
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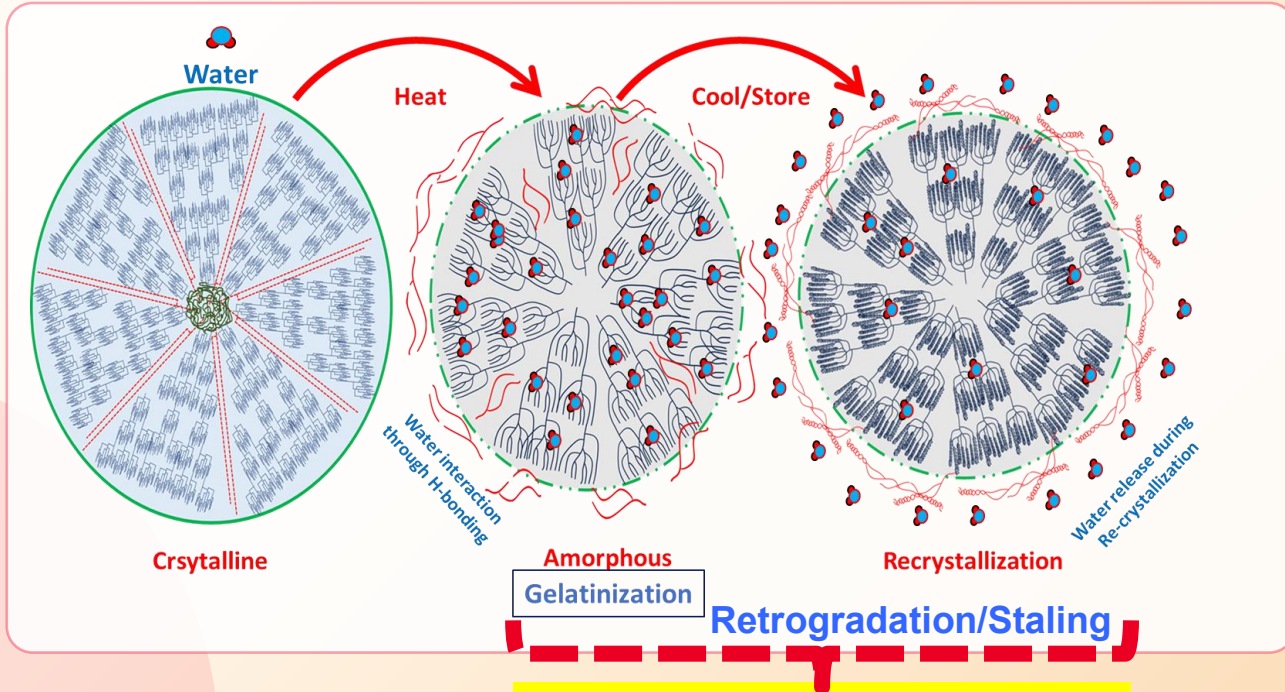
Amylose Transformation (drives early staling within hours)



Amylopectin Transformation (governs late staling over days)



Bringing It Together: How Starch Granules Transform during Baking



Retrogradation/Staling

What can slow this down and preserve freshness?

Starch Retrogradation Determines Freshness

Starch modifying enzymes relevant for antistaling mechanisms

Enzyme 1

**Maltotetraogenic
Amylases**

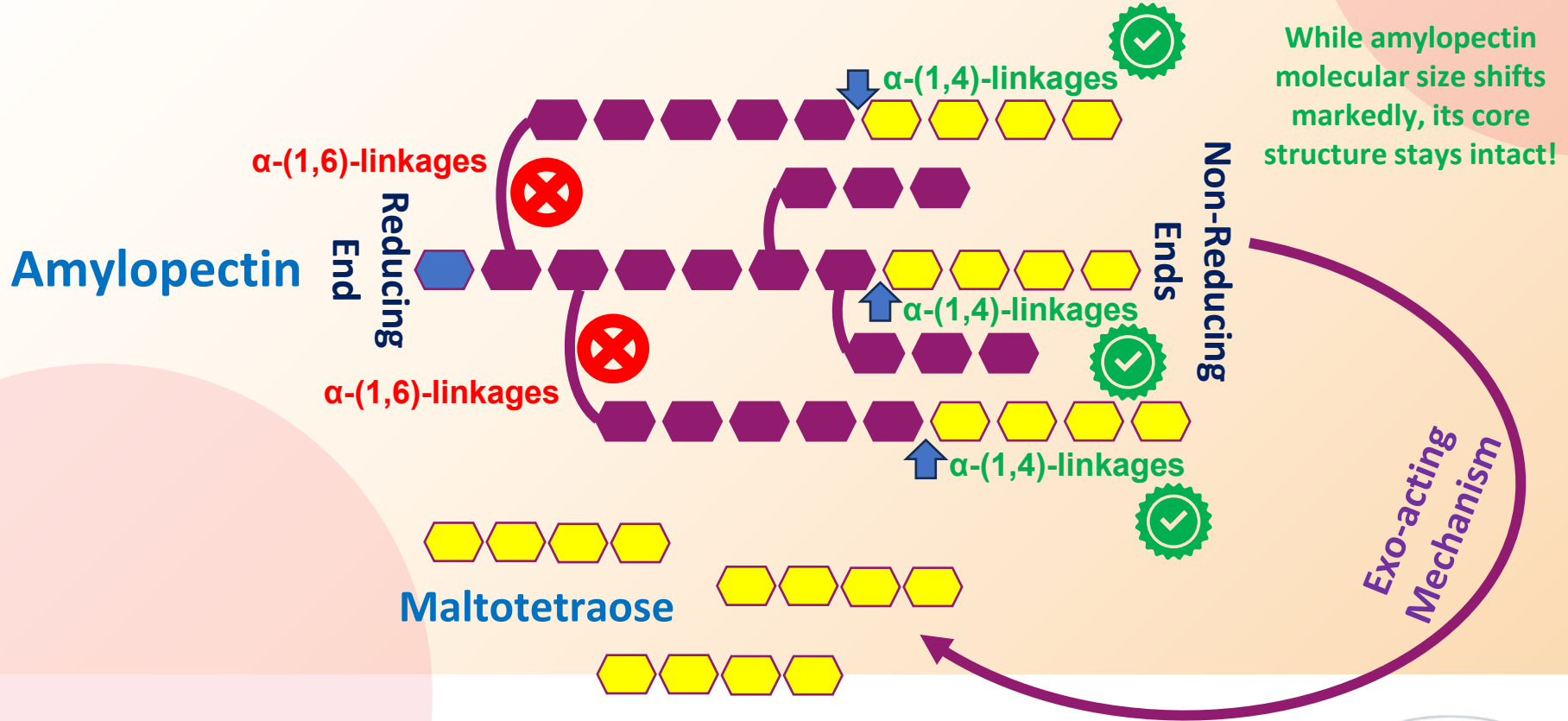
Enzyme 2

Maltogenic Amylases

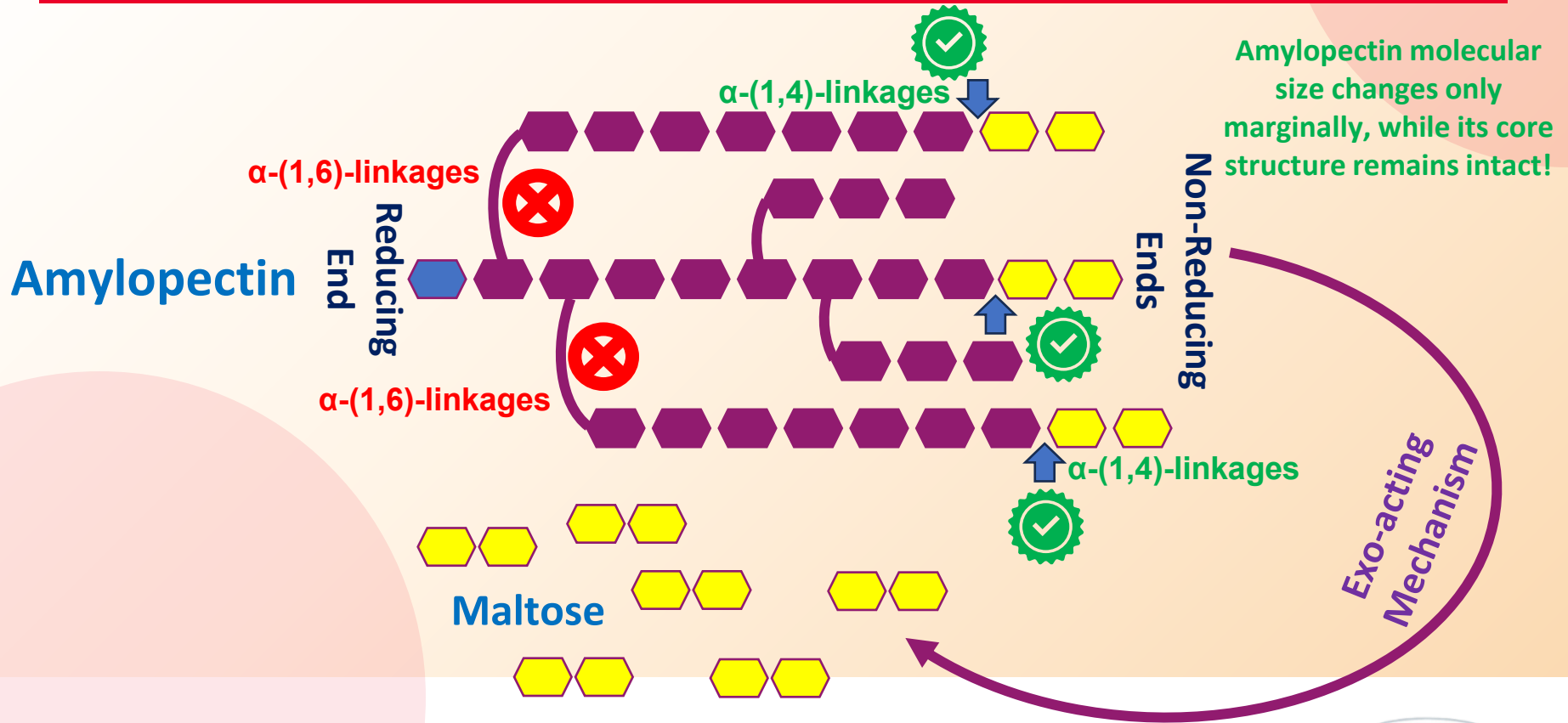
Enzyme 3

α -Amylases
With optimal temperature
tolerance levels

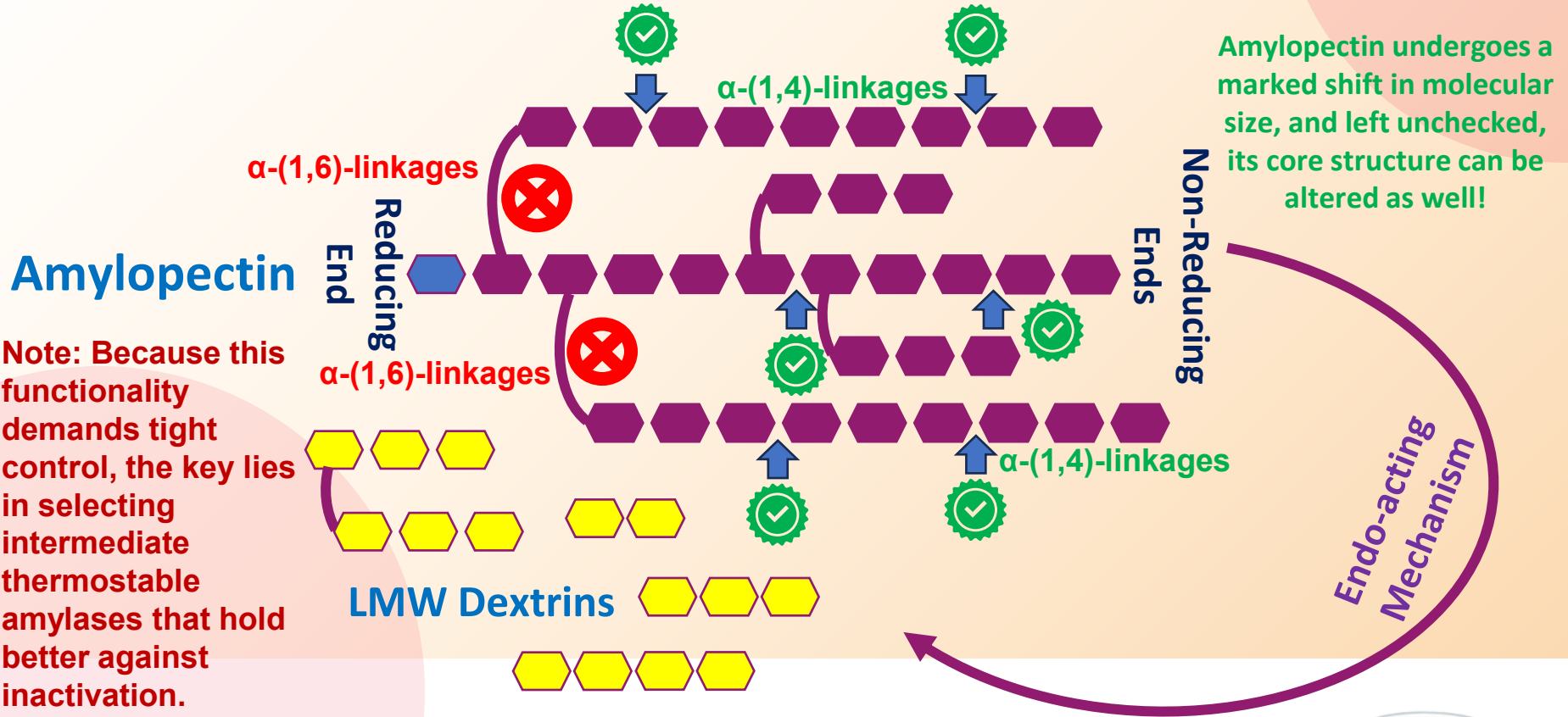
Maltotetraogenic Amylase



Maltogenic Amylases



α -Amylases

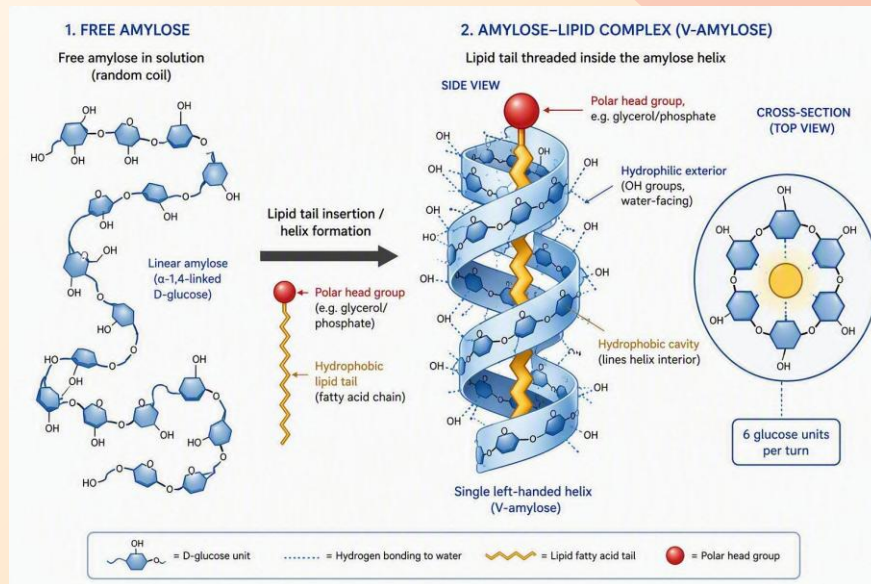


Trilipase functionality likewise engages starch pathways to limit staling

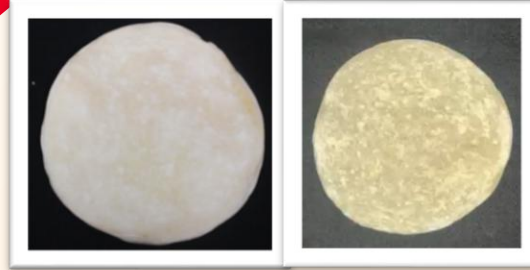
Lipases and fresh keeping

Polar lipid–starch interaction lowers initial firmness and slows staling.

- Lipases generate amylose-lipid complexes during heating; these complexes slow retrogradation and extend freshness.
- Reaction products — free fatty acids and “lyso”lipids — curb amylopectin retrogradation.



Staling Addressed! The state of a tortilla held for 8 weeks in storage



Tortilla made using clean label enzyme technology, shown at 8 weeks!

Staling in tortillas is markedly delayed by the right enzyme combination



Defining staling: a tortilla's condition after 8 weeks in storage



Control Tortillas

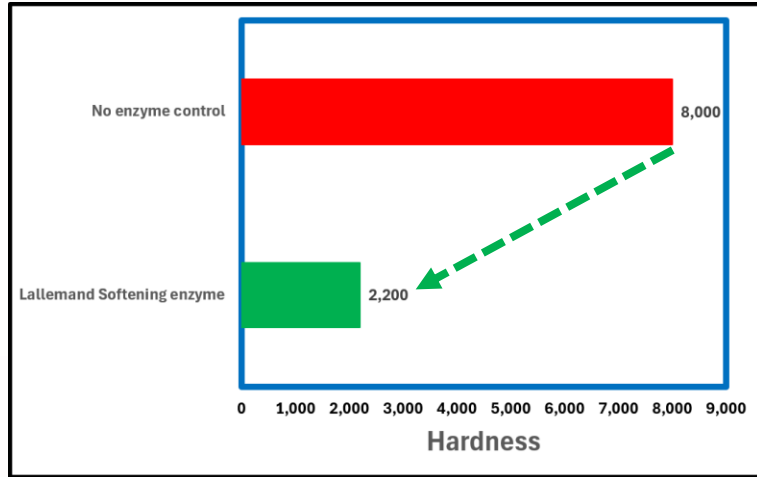


**Tortilla Softening from Lallemand
Built on Clean Label Technology**



Staling in tortillas is markedly
delayed by the right enzyme
combination

In corn tortillas, staling is markedly postponed by softening enzymes



- Nixtamalization pre-gelatinizes masa starch — more accessible to enzymes
- Maltogenic amylase markedly delays staling in corn tortillas
- Starch retrogradation drives texture loss; enzymes control it
- Short shelf-life need = fast, cost-effective freshness win

Corn tortillas represent a promising application area for maltogenic amylases, offering a scientifically sound and cost-effective approach to retard staling and improve consumer-perceived freshness.

Conclusions and Perspectives

1

Impeding starch retrogradation can be a key strategy in long term fresh keeping of tortillas.

2

Multiple starch degrading enzymes could be sought for tortilla softening solutions.

3

Maltogenic amylase functionality alone is not enough for optimal performance in wheat flour tortilla applications.

4

Maltogenic and optimized α -amylase combinations with Maltotetraogenic amylase functionality is significantly relevant in long term tortilla softening.

5

More softening benefits can be achieved by adding lipase component

6

Optimized level of “endo-amylase” type functionality (that release a moistness-supporting levels of oligosaccharides in dough system) is relevant for considering enhances tortilla softening.

Corn tortillas represent a promising application area for maltogenic amylases, offering a scientifically sound and cost-effective approach to retard staling and improve consumer-perceived freshness.