



Enzymes in Flat Bread Application

....a clean label solution....



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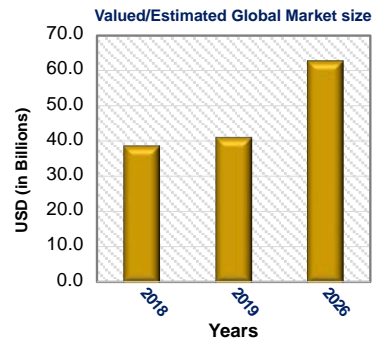
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Flat Bread Market is Expanding



Flatbreads Are The Oldest Of All Bread Products

Traditionally consumed in: Middle East, North/South Africa, Indian subcontinent, Central America, Mexico, China, and Europe



Expected to reach \$62.8 billion by 2026 with CAGR of 6.2%

<https://www.alliedmarketresearch.com/flatbread-market>

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Flat Bread Market is Expanding



Key Driving Factors For Increasing Demand Include

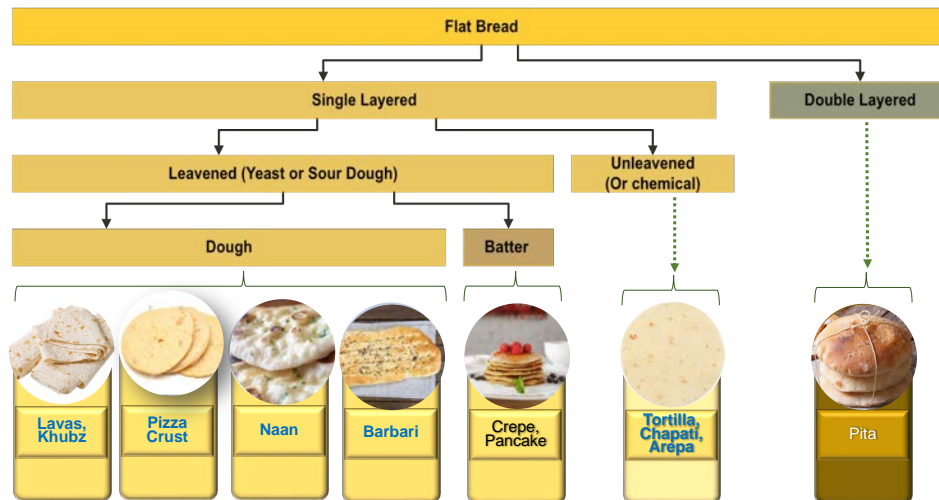
1. Innovative flavors: wide variety of fillings
2. Health deliverables (Better-for-you), Diabetic Friendly)
3. Small portion size of tacos
4. Varieties (e.g., Pita, Naan, Barbari, corn tortilla, flour tortilla, wraps, etc.)



Tortilla segment dominates the overall global market

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Classification of Flat Bread



Qarooni, J. (1996).

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Single Layer And Double Layer: A Process Difference

Single-layered flat bread

- Dough balls are baked immediately after sheeting
- Baking is at lower temperature
- Sheeting dough pieces are docked/grooved/pressed before baking



Double-layered flat bread

- Dough Balls are proofed after sheeting
- This allows dough to relax, aerate, and develop a thin skin.
- Baking at high temperature
- Top and bottom crust separate into two layers by
- Force from the steam from free water in the dough,
- Pressure from CO₂

Source: Garooni, J. (1996)

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Characteristics of Flat Bread



Quality of Flat Bread

Single Layered

- Smooth crust, or with uniform blisters
- Uniform edges with soft texture
- Excellent rollability/flexibility/foldability
- Resistance to cracking/breaking
- No zippering; no sticking

Double Layered

- A clean separation between top and bottom layers
- Fine and uniform crumb appearance
- Preferred crumb color creamy-white.
- Softness, Resistance to cracking/breaking
- Good tearing quality

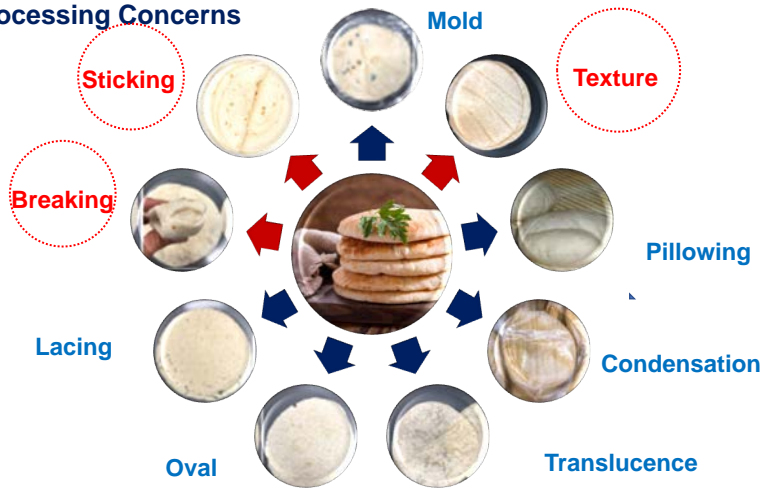
Scoring system is preferred method to evaluate flat bread



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Flat Bread/Tortilla – Quality Concerns

Formulation/Processing Concerns



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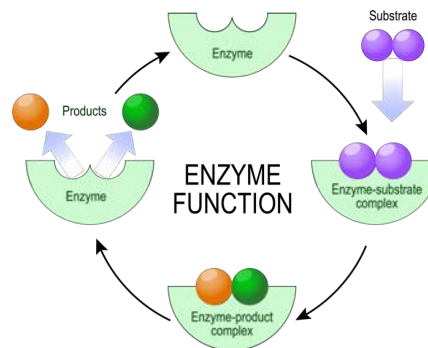
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What Are Enzymes

Enzymes Basics

- Enzymes are proteins that function as biocatalysts
- Most of the enzymes are derived from microbial sources
- They are produced by fermentation
- It is the protein/enzymes produced during fermentation is added to the formulation **Not the microorganism**
- Enzymes speed up reactions
- Once the reaction is complete, enzymes are free and can be reused



Source: Yi Zhang et AL., 2019

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Enzymes in Bakery

Enzyme Type	Substrate	Function in Tortilla
Amylases	Starches	Modification of gelatinized starch
Pentosanases	Hemicellulose, Xylan	Modification of Pentosan
Proteases	Proteins	Prevent strong gluten network;
Oxidases	Proteins	Improves gluten strength
Transglutaminase	Proteins	Improves gluten strength
Lipases/phospholipases	Lipids	Help to generate emulsifier like structure
Phytase	Phytic acid	It breaks down phytic acid present in bran
Asparaginases	Asparagine	Removes precursor of acrylamide

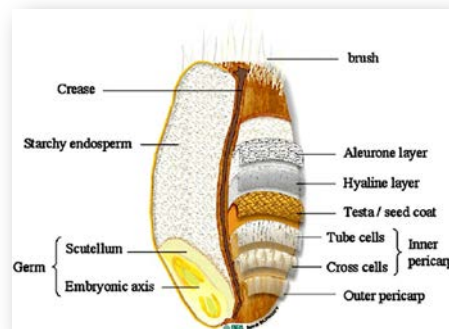
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Wheat Grain : Major Ingredient

Mature Wheat Grain has following major components			
1	Pericarp (Outer Layer)	Bran (14-16%)	Phenolics, Vitamins and minerals
2	Endosperm	White flour (81-84%)	80% Starch, 10% Protein, Minor % NSP, Lipids
3	Germ	Embryo (2-3%)	Vitamins, minerals, oil



1) Protein; 2) Starch, 3) NSP (Non-Starch Polysaccharides), 4) Lipids

Heinze et al., 2017

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Proteins

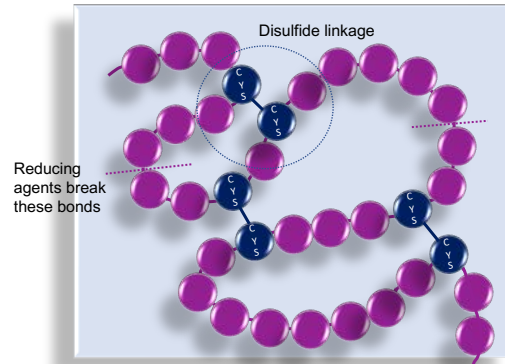
Gluten a major protein in wheat flour

Gluten protein is made with amino acids linked together with peptide bonds

Gluten is subdivided into :

Gliadins : plasticizer: contribute to dough viscosity and extensibility

Glutenin contribute to strength, elasticity, resistance to extension



Source: ABL_FB_014

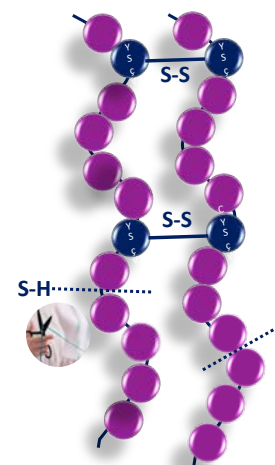
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1:- Enzyme: Proteases/Dough Relaxers

Reducing Agents

- Reduces the size of glutenin polymers
- Weaken the gluten matrix
- Reduce dough elasticity
- Improves water absorption
- Improve softness, dough machinability and handling
- Reduces mixing time ,also called mixed-time reducers



Source: ABL_FB_014

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Proteases/Dough Relaxers

- Protease improve softness, dough machinability and handling
- Reduces mixing time and improves water absorption
- “Cleaner” replacement for L-cysteine or sodium metabisulfite



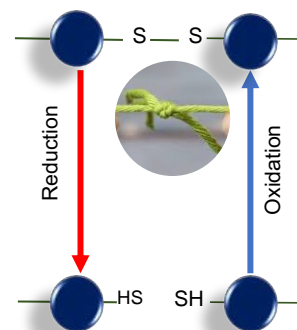
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2:- Enzyme : Glucose Oxidase (GO)/ Dough Strengtheners

- Strong gluten matrix is created by disulfide linkages
- GO indirectly oxidize SH into SS
- By decreasing the levels of SH groups
 - Gliadin–glutenin crosslinking is developed
- This leads to the dough strengthening



Source: Lagrain et al. 2012

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3:- Enzyme : Transglutaminase (TG)/Dough Strengtheners

- Mainly in gluten free flat bread or with protein (e.g., soy flour) supplementation (Chapati/Roti)
- It helps to develop linkage between amino acid (Glutamine and Lysine)
- Due to these cross-links high molecular weight polymers are formed
 - Improves the protein network
 - Increases water holding capacity
 - Viscoelastic and thermal properties



Source: Basman, 2002

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Starch Gelatinization: Starch Water Interaction

Gelatinization

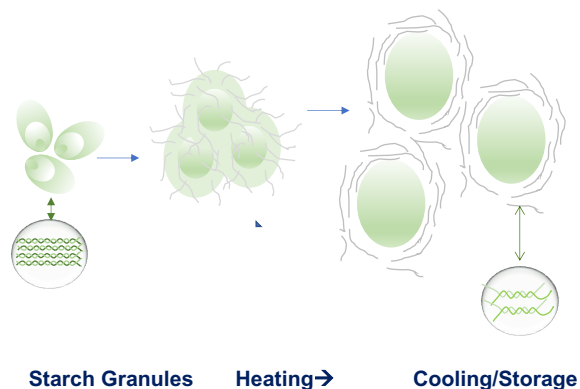
- In the presence of water and heat starch absorb water and swells up; loses its crystalline structure, viscosity increases

Pasting

- Pasting follows gelatinization and involves granular swelling amylose molecule
- Total disruption of starch molecule

Retrogradation

- After gelatinization starch tend to regain its crystalline structure



Lagrain et al., 2012

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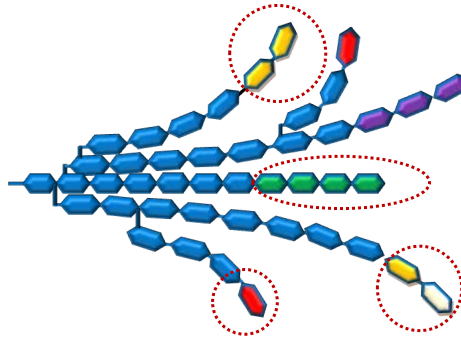
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5:- Enzyme : Amylases As Antistaling Agents

Oligomers: DP = 2; DP = 3; DP = 4.....

	Enzyme	Products Produced
1	α -Amylase	Maltose/ Oligosaccharides
2	β -amylase	Maltose
3	Maltogenic amylase	Maltose and Maltodextrins
4	Amylo-glucosidase	Glucose
5	Maltotetraose (G4) producing amylase	Malto-oligosaccharides



Source: ABL_FB_004

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Enzyme Systems in Flat Bread

Typical features of staling

- Loss of freshness/softness
- Hardness
- Loss of foldability
- Breaking

Enzyme based systems

- Slow down staling /retrogradation

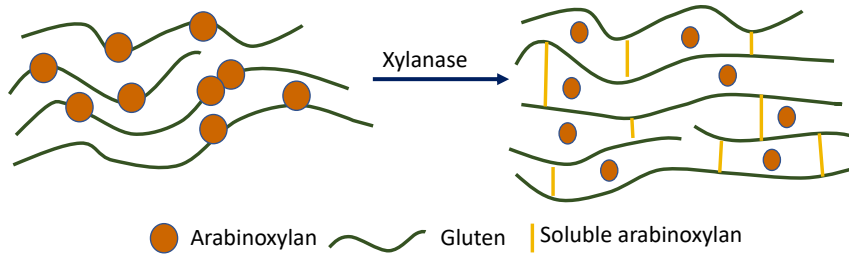


Retrogradation (staling) is a major concern in baked products...

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4:- Enzyme: Xylanase



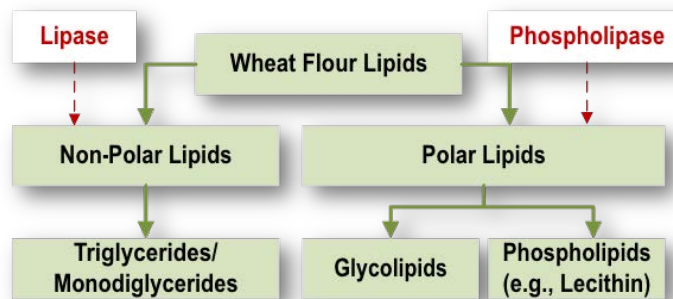
- Xylanases hydrolyze the xylan
- Xylan breakdown releases water for distribution to starch and gluten
- Dough becomes softer and easier to process
- Reduces mixing time

Source: Simsek, S. (1991)

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6:- Lipases/Phospholipases



- Natural wheat lipids comprise 2% to 3% of wheat flour
- Typically stuck to starch granules or proteins in the dough.

Source: ABL_FB_020

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Lipases & Phospholipases

Lipase enzymes break ester bonds in lipids

Lipase

- **Broad substrate specificity**
- Modify triglycerides and polar lipids
- **Help as anti sticking agent**
- Improved dough rheology and stability

Phospholipase

- **1,3-Specific, hydrolyze polar lipids**
- Improved dough consistency and stability
- Reduction in dough stickiness



<https://www.bakingbusiness.com/articles/58977-ero-tin-lipase-enzymes-can-provide-clean-label-emulsification>

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Enzyme Formulation/Application – Critical Factors

1. **Enzyme Concentration (Units/g or Dilution levels)**
2. Accurate weighing [Added at very low concentration (ppm)]
3. Enzymes deactivation temperature
4. Enzyme application rate (Enzyme Overdose)
5. Enzyme synergy (Enzymes are mostly used in combinations to give synergistic effects)
6. Diluent




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Summary of Bakery Enzymes



Flour Improvers:
Fungal- α amylase

Dough Rheology
Protease, Xylanase, Lipase


Dough Strengtheners:
Glucose Oxidase,
Transglutaminase

Shelf-life
Maltogenic Amylase,
Xylanase Phospholipase

Texture
Protease, Xylanase, α -amylase,
Transglutaminase

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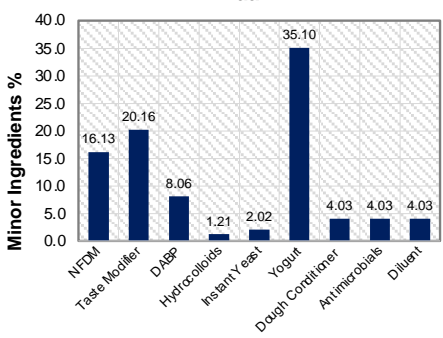
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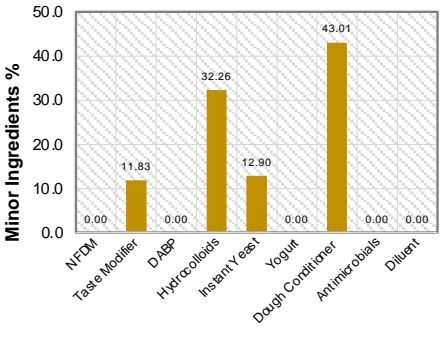
Prototype Formulations

	Naan	Pita
Flour	100	100
Water	55	85

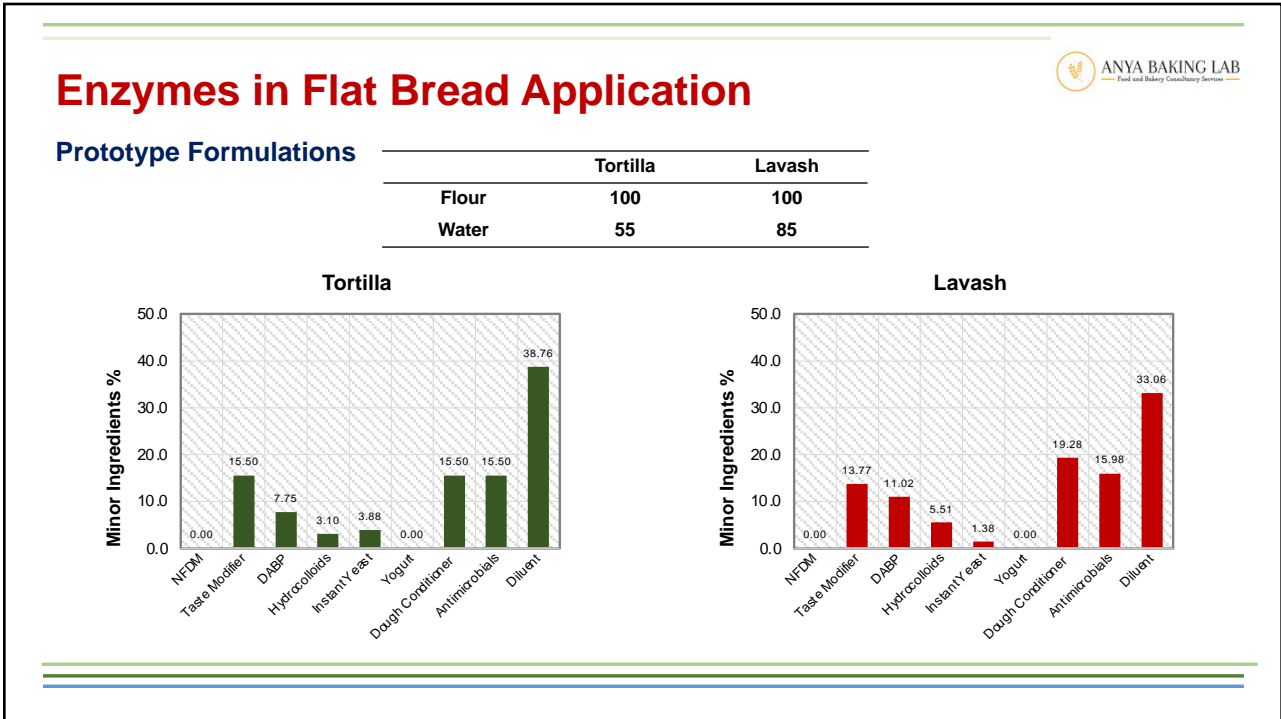
Naan



Pita



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Thank You

Anya Baking Lab

Consulting Services |Leavened & Flat Breads (Tortilla, Naan, Pita, Lavash)

- Product Innovation & Process Design ;
- Ingredient application works (Enzymes, Emulsifiers, Antimicrobials, Cost Optimization; Ingredient procurement and optimization ; Collaborative research studies;
- Analytical Lab support: Shelf-life Studies, Texture analysis, Flour Analysis , Dough Rheology, Starch characterization, Microbiology

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