

Improvement of flatbread processing and quality by enzymes

Lutz Popper, Head R & D

Flatbread feeds the world

Bagebröd, Sweden; Bannock, Scotland; Bolo do caco, Madeira, Portugal; Borlengo, Italy; Farl, Ireland and Scotland; Flatbrød, Norway ; Flatkaka, Iceland; Focaccia, Italy; Ftira, Malta; Lagana, Greece; Lefse, Norway; Lepinja, Croatia, Serbia; Lepyoshka, Russia; Pita, Hungary; Flatbrød, Norway; Podplomyk, Poland; Pane carasau, Sardinia; Piadina, Italy; Pita, Greece; Pită/Lipie/Turtă, Romania; Pissaladière, France; Pizza, Italy; Podplomyk, Poland; Posúch, Slovakia; Pärlenka, Bulgaria; Rieska, Finland; Somun, Lepina, Bosnia and Herzegovina; Spianata sarda, Sardinia; Staffordshire oatcake, England; Tigella, Italy; Torta, Spain; Torta al testo, Umbria, Italy; Torta de Gazpacho, Spain; Tunnbröd, Sweden; Yemeni lahoh; Barbari, Iran; Bataw, Egypt; Bazlama, Turkey; Gurassa, Sudan; Harsha, Morocco; Khebz, Levant; Khubz, Arabian Peninsula; Lahoh, Northern Somalia, Djibouti, Yemen; Lebanese Bread, Lebanon; Muufo, Somalia; Malooga, Yemen; M'lawi, Tunisia; Chapati, Swahili coast, Uganda; Markook, Levant; Matzo, Israel; Murr, Israel; Pita, Eastern Mediterranean, Turkey and Middle East; Sangak, Iran; Taftan, Iran; Khubz, Arabian Peninsula; Yufka, Dürüm, Turkey; Lavash, Armenia; Matnakash, Armenia; Pogača, Balkans and Turkey; Shotis Puri, Georgia; Tonis Puri, Georgia; Afghan bread or Nan, Afghanistan; Aloo paratha, India and Pakistan; Akki rotti, India; Aparon, Philippines; Bánh, Vietnam; Bakarkhani, Indian subcontinent; Bhatura, Indian subcontinent; Bing, China; Chapati, Indian subcontinent; Chili paratha, India; Chikkolee, India; Dhebra, India; Gobi paratha, India and Pakistan; Jolada rotti, India; Obi Non, Afghanistan and Uzbekistan; Kaak, Pakistan; Kabkab, Philippines; Kachori, Indian subcontinent; Khanom buang, Thailand; Kiping, Philippines; Kothu parotta, India; Kulcha, Indian subcontinent; Laobing, China; Luchi, India and Bangladesh; Makki di roti, India and Pakistan; Mughlai paratha, India and Bangladesh; Pathiri, India; Naan, Indian subcontinent and Central Asia; Paratha, Indian subcontinent; Parotta, India and Sri Lanka; Phulka, Indian subcontinent; Piaya, Philippines; Poli, India; Puri, Indian subcontinent; Ragi rotti, India; Roti, Indian subcontinent; Roti prata, Singapore; Roti canai, Malaysia and Indonesia; Rumali roti, Indian subcontinent; Sanchuisanda, China; Sheermal, Indian subcontinent and Iran; Shelpek, Kazakhstan; Tapansha, Taba nan, Kazakhstan; Taftan, Indian subcontinent and Iran; Tandoor-nan, Central Asia; Frybread, United States; Pan de semita, Mexico; Johnnycake, North America and Caribbean; Tortilla, Mexico, Central and South America; Tortilla de Rescoldo, Chile (modif. from Wikipedia)

Flour quality for flatbread – as diverse as flatbread

Typical specifications for various flatbread flours

Property	Dim.	Flatbread type					
		Baladi	Chapatti	Naan	Paratha	Tortilla	Yufka
Extraction rate	%	77-85	72-100	72-82	72-85	75-78	72-76
Ash	%	0.8-1.1	0.5-1.5	0.5-1.0	0.5-1.1	0.55-0.60	0.55
Protein	%	8.5-11	9-12	9-12	10-11	10-11	> 12.5
Wet gluten	%	23-25	25-30	25-30	27-30	30	30-35
Falling Number	s	300-350	250-350	250-350	250-350	350	n.sp.
Farinograph WA	%	55-63	72-78	52-65	62-65	56	> 58
Alveograph P/L	-	0.5-1.0	0.4-1.0	0.5-1.0	0.4-1.0	0.7	1.0-1.6
Alveograph W	10 ⁻⁴ J	150-250	180-300	220-300	180-300	280	300-350

n.sp. - not specified

Arabic flatbread: Attributes of flour, dough and bread

e.g. for baladi, pita, Lebanese bread, kubus, khubz, خبز

- Made from high extraction (> 80 %) flour mostly from hard wheat
- High water absorption
- Mixing and processing tolerance
- Machinability of the dough
- Puffed upon baking → can be used for fillings or as wrap
- Flexible, but strong enough for folding
- Softness and duration of freshness of the bread



Enzymes for Arabic bread

Properties and effects

■ Alpha-amylase improves

- fermentation
- flavour and colour formation
- dough handling properties / extensibility: release of water from starch → gluten softening
- eating properties: crumb more “juicy”
- duration of softness (shelf-life) → rollability

■ Proteases

- useful in case of very short gluten structures
- may limit the flexibility of the final product
- rather L-cysteine is used for gluten softening → only weakens the interaction of the protein chains, not their strength.

■ Hemicellulase

- releases water from the pentosans → softening of the pentosan-gluten network → formability of the dough
- affects the crumb structure → finer or coarser, depending on enzyme dosage and type

■ Lipoxygenase

- comes as enzyme active (soy-) bean flour
- improves whiteness of the crumb
- enhances eating properties (shorter bite)

Unleavened flatbread

e.g. chapatti, shabaati, safati, roti, poori, phulka, yufka

- Made from whole meal flour (atta)
- Oil may be added into the dough
- Baked on iron pan (called tava or sac) or
- Deep-fried (like poori)
- Flexible, but strong enough for folding (yufka: crispy)
- Softness and duration of freshness of the bread



Indian roti. Credit: Obaid Raza

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„Thick“ flatbread with more volume and crumb

e.g. naan, nan, نان 馕 (nang), barbari, snowshoe naan

- Made from flat dough from white or whole meal flour
- Milk or yoghurt may be used to improve taste and volume (naan)
- Baking methods differ:
 - naan is made in tandoor ovens (for baking, the dough pieces are stuck to the inner sidewalls of the oven)
 - barbari is baked in open-fire stone ovens
- Bread should be soft and easy to break, but not too elastic and dry
- Shelf-life is increasingly important



Enzymes for “thick” flatbread

Properties and effects

■ Alpha-amylase improves

- fermentation
- flavour and colour formation
- eating properties: crumb more “juicy”
- duration of softness (shelf-life)

■ Maltogenic alpha-amylase

- prolongs shelf-life (more efficiently than standard alpha-amylase)
- does not affect does processing properties, bread structure or appearance

■ Hemicellulase

- releases water from the pentosans → dough softening → formability of the dough

■ Glucose oxidase

- stabilizes dough pieces
- achieves dryer dough surfaces → reduced stickiness
- effect increases upon resting time

Paratha

also named parotha, parotta, porotta, parontay, palata, farata



- Made from white or wholemeal flour
- Layered dough
- Butter fat or oil separates layers
- Bread must be well layered and easy to break, without being crumbly
- Sold by small street vendors → prolonged resting time at elevated temperatures →
- Stabilization of the dough required

Enzymes for parathas

Properties and effects

■ Alpha-amylase, hemicellulase

- Due to the prolonged resting time at unfavourable conditions, these enzymes are rarely added to flour for parathas because they would cause excessive softening and stickiness

■ Lipase

- Stabilization of dough pieces for long resting times
- Risk for off-flavour formation with butter or oil is small because the fat is added only after dough resting

■ Glucose oxidase

- Stabilization of dough pieces
- Drying of dough surfaces → reduced stickiness
- Increasing effect upon resting time
- Little or no risk of oxidative off-flavour (caused by hydrogen peroxide) because
 - butter / oil is only added for baking
 - the parathas are consumed fresh

Wheat tortillas

Latin American flatbread



- Made from hard wheat flour (~75-80 % extraction, ~10-12 % protein)
- No yeast, but sodium bicarbonate for opaque appearance
- Dough pieces rolled or hot-pressed
- Tortillas used for wraps → rollability is important
- Increasing sales in supermarkets → shelf-life matters
- Bright colour requested
- Good separation of upper and lower layer → ballooning



Corn flour tortillas

- Flour from nixtamalized corn
- No yeast, no proofing
- Plastic dough → pieces are rolled or (hot) pressed

Wheat flour tortillas

- White wheat flour
- No yeast, no proofing
- Elastic dough → hot press

In-store tortilla bakery (1)

Limited shelf-life (softness) required



In-store tortilla bakery (2)

Limited shelf-life (softness) required



Wheat tortillas

Ballooning

- Not to be mistaken for Arabic bread: Mexican wheat tortillas after baking



Enzymes for wheat tortillas

Properties and effects

■ Protease

- Elastic → plastic dough properties

■ Lipase

- Volume yield is not required
- However, triacyl lipase supports bleaching by lipoxygenase (intrinsic or added)

■ Lipoxygenase

- From enzyme active (soy-) bean flour
- Improves whiteness

■ Glucose oxidase

- Has been reported to brighten tortillas.
- Effect seems to depend largely on flour properties (pigments)

■ Hemicellulase

- Releases water from pentosans → improves extensibility
- Effects gluten crosslinking with pentosans → improves duration of flexibility

■ Alpha-amylase

- Water release improves extensibility
- Partial starch break-down retards staling

■ Maltogenic alpha-amylase

- Prolongs shelf-life more efficiently than standard alpha-amylase
- Does not affect does processing properties, bread structure or appearance
- Responds to market requirements

Improvement of softness and shelf-life of wheat tortillas

Industrial production requires prolonged shelf-life



Reference

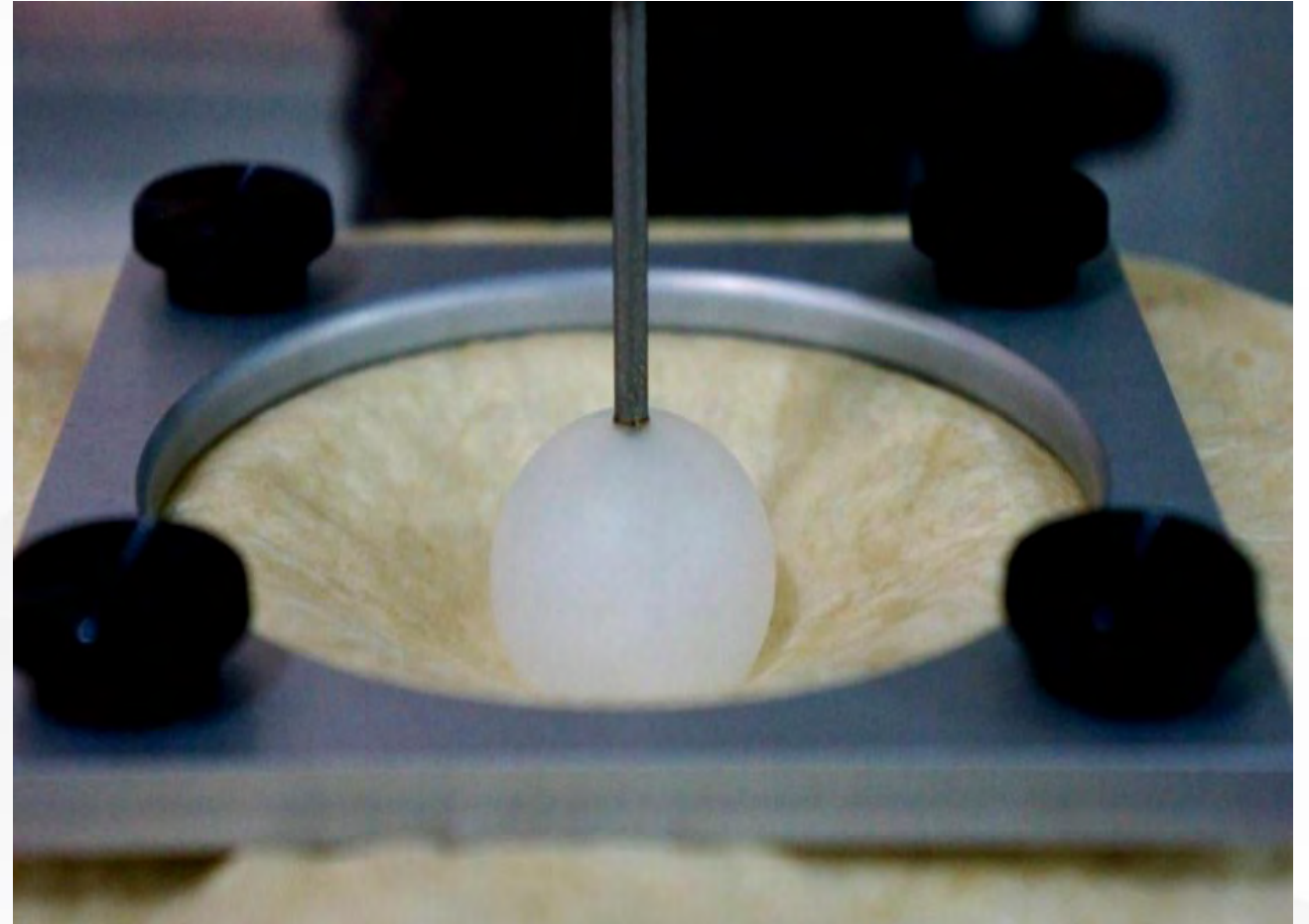
Flexizyme, 100 ppm

- Industrially produced tortillas are sold in supermarkets →
- Prolonged storage time in shelf and at home (hamster purchases)
- Tortillas are used as wraps →
- Have to stay soft and rollable for weeks or months
- Mold formation avoided by preservatives (propionate)

Shelf-life of wheat tortillas

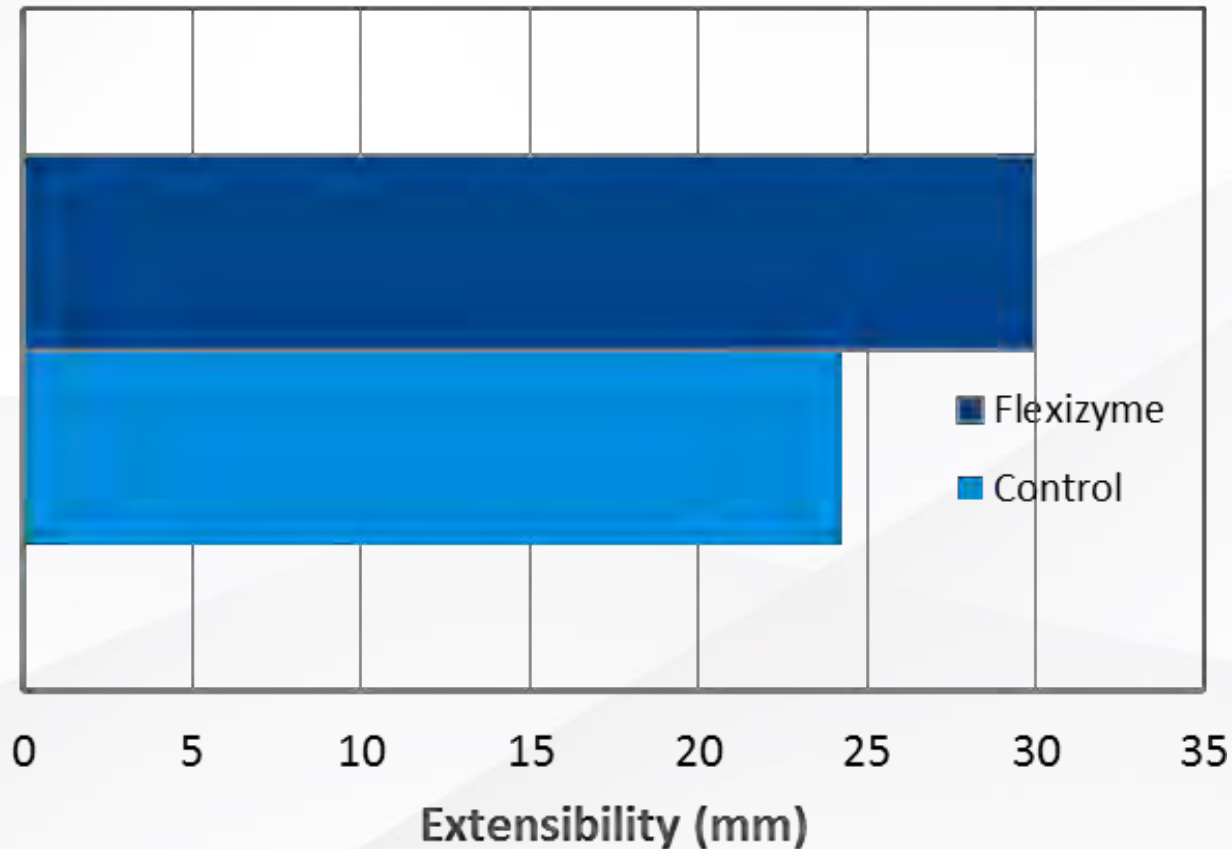
Flexibility test

- Texture Analyser
- Tortilla burst rig
- Spherical probe (1", 25.4 mm)
- Deformation: 30 mm
- Probe speed: 1 mm/s



Shelf-life of wheat tortillas

Flexibility after 4 weeks storage



- Tortillas only have a very limited crumb layer and the time for enzyme action is very short. →
- Do enzymes have an effect on flexibility?
- Result: An enzyme system containing maltogenic amylase improved the flexibility.

Shelf-life of wheat tortillas

Tendency of breakage after 2 weeks storage at room temperature

- The improvement of flexibility by enzyme systems based on maltogenic amylases also becomes obvious in application trials.



Pizza bases

Italian flatbread



(1) Manual shaping



(3) Hot press

Pizza bases are produced from (mostly) soft wheat flour (~0.6 % ash) either by

- (1) manual rolling and shaping of dough pieces to disks (home, restaurants),
- (2) multi-roller forming of dough pieces into disks (industrial),
- (3) hot-pressing of dough pieces to disks (restaurants, industrial), or by
- (4) cutting disks from continuous dough sheets (industrial).

→ (1) and (2) require particularly extensible and plastic dough

Enzymes for pizza bases

Properties and effects

- **Alpha-amylase improves**

- fermentation
- flavour and colour formation
- dough handling properties / extensibility: release of water from starch → gluten softening

- **Maltogenic amylase**

- Shelf-life improvement of pre-baked thick (American style) pizza crusts

- **Lipases**

- Dough stability and volume for thick (American style) pizza crusts

- **Proteases**

- useful in case of very short gluten structures

- **Hemicellulase**

- releases water from the pentosans → softening of the pentosan-gluten network → formability of the dough

- **Glucose oxidase**

- Reduces surface stickiness → improved processing

Conclusions

Enzymes in flatbread processing...

- ... improve the processing properties of the dough
- ... can be used in long and short processes
- ... can be used to strengthen or soften the dough
- ... improve the appearance and the eating properties
- ... prolong the duration of softness and foldability

World Flour Day – March 20

- Initiated by the FlourWorld Museum to honor flour, along with the farmers, millers, bakers – in fact the entire flour processing industry.
- The National Day Calendar certified March 20 as official World Flour Day. In the northern hemisphere, spring starts, and with it, the planting season. In the southern hemisphere, autumn starts, and the grain harvest comes to an end. March 20 – a day to be thankful!
- How will you celebrate the World Flour Day? We are curious to hear about your ideas! Please send a description to contact@worldflourday.com.

