24/11/15

Lipases in baking

Colloque AD BIOTECH « Les lipides du futur : Les lipases au cœur du développement scientifique et industriel »

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Harrys
100% Mie
NATURE
SANS CROÛTE
SANS ADDITIF
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CONTENT

CONTENT

FRENCH BREADMAKING PROCESS

- Classical direct process :

	% flour weight
FLOUR	100
WATER	60 -65
FRESH YEAST	1,5 – 2,5
SALT	1,8

MIXING (12-18 min)

1ST PROOFING (20- 30 min)

DIVISION – PUT INTO A BALL

RELAXING (10 min)

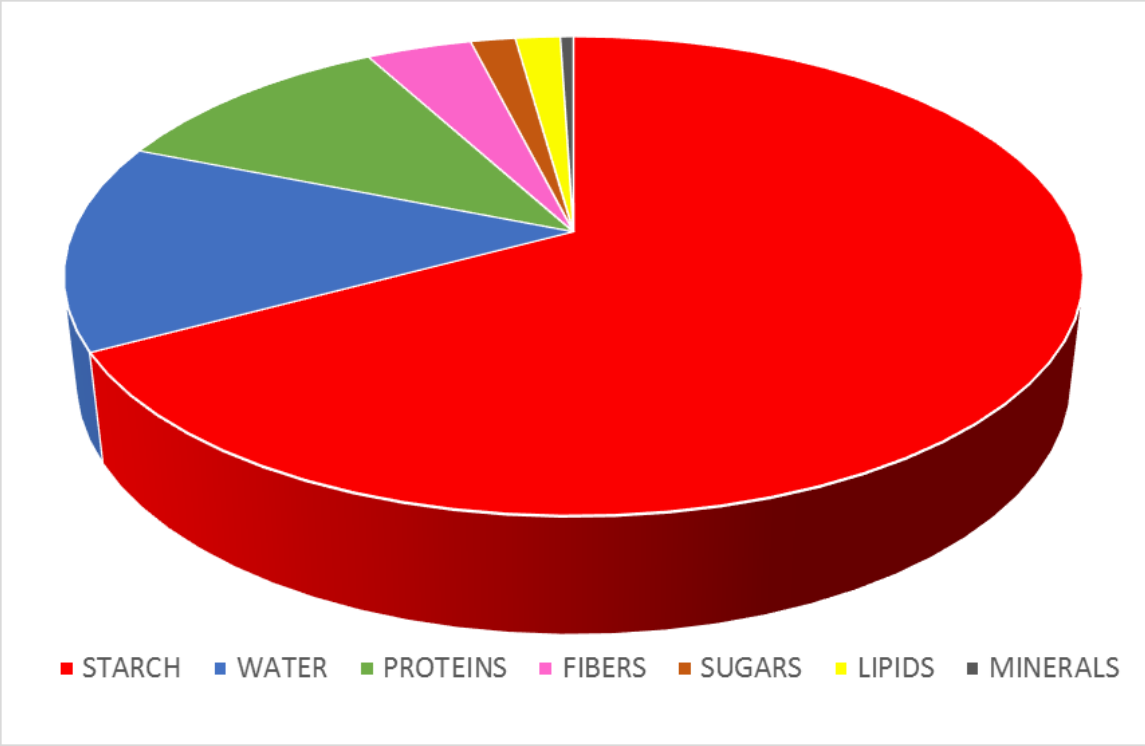
SHAPING

FINAL PROOFING (2h)

BAKING (20-25 min)

WHEAT FLOUR COMPOSITION

- T55 Wheat Flour :



	% total weight
STARCH	62 - 70
WATER	12 - 15
PROTEINS	10 - 13
FIBERS	3 - 5
SUGARS	1,5 - 2
LIPIDS	1 – 2,5
MINERALS	0,5 – 0,6

KEY COMPONENTS AND FUNCTIONAL PROPERTIES

- **Starch :**
  - Crumb formation by gelatinization
  - Crust formation and coloration with sugars produced by amylases hydrolysis

- **Insolubles proteins**
  - Gluten network formation and water-binding : viscoelastic network
  - Gaz retention and ovenspring

- **Fibers (pentosans)**
  - Water absorption
  - Dough consistency

- **Lipids**

WHEAT FLOUR LIPIDS PROFIL

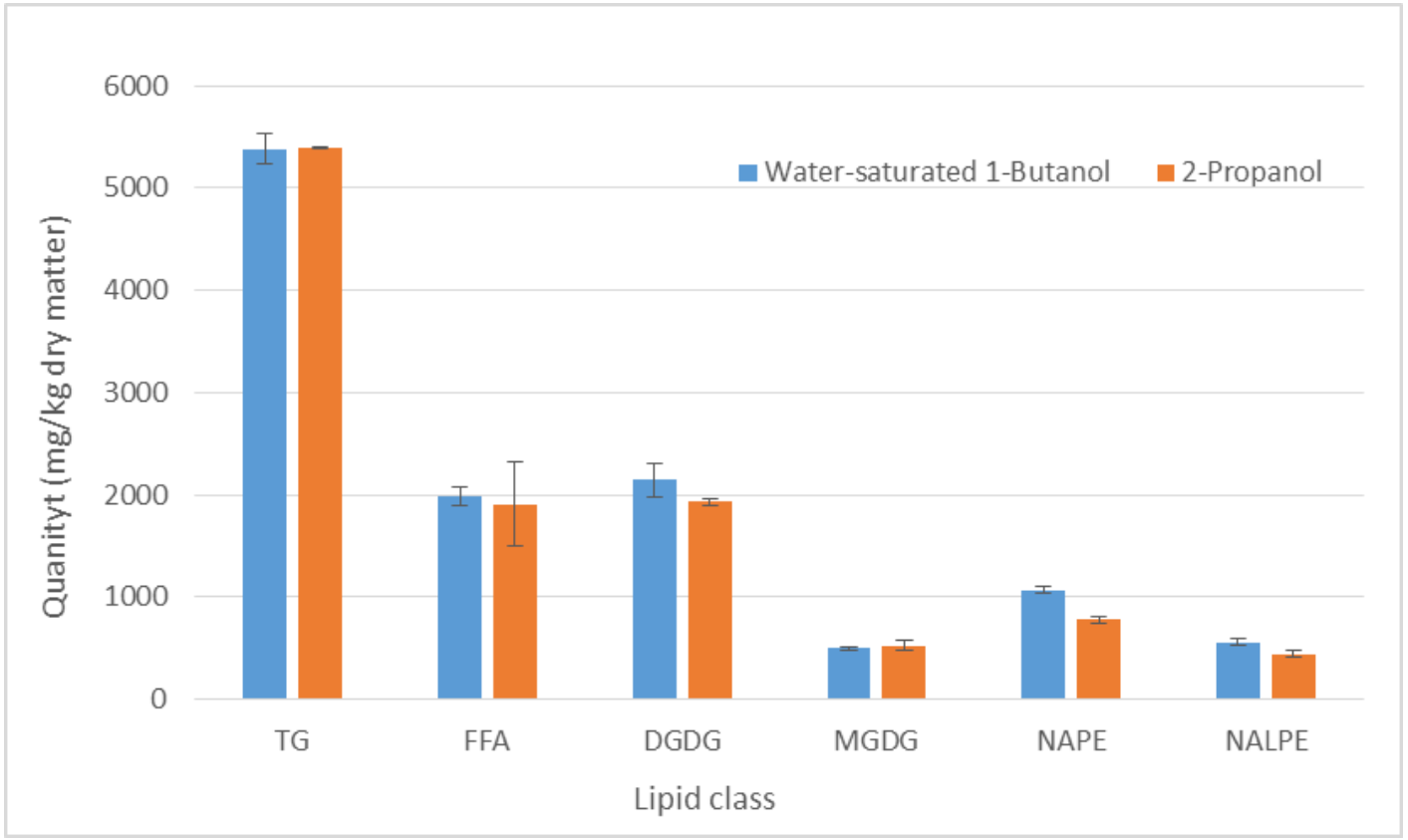
- **Depends on :**
  - Wheat (variety, agricultural practices,...)
  - Milling conditions
  - Age of flour

- **2/3 nonstarch-bound lipids**
  - Non-polar : triglycerides, free fatty acids
  - Polar : glyco and phospholipids , bound with proteins

  have more effect on breadmaking properties, increase loaf volume

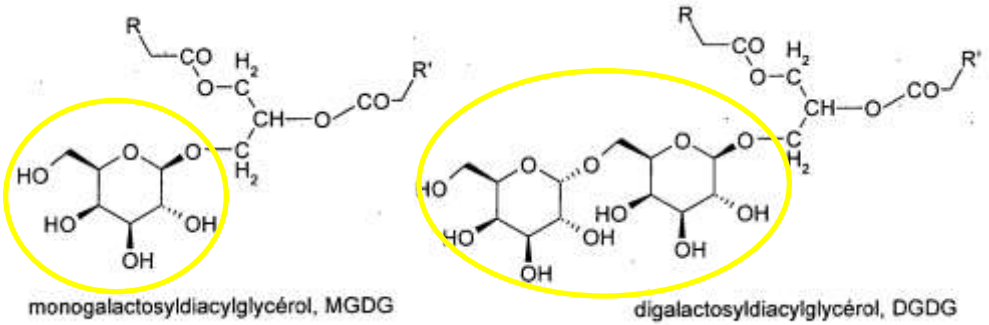
- **1/3 starch-bound lipids**
  - Lysophospholipids

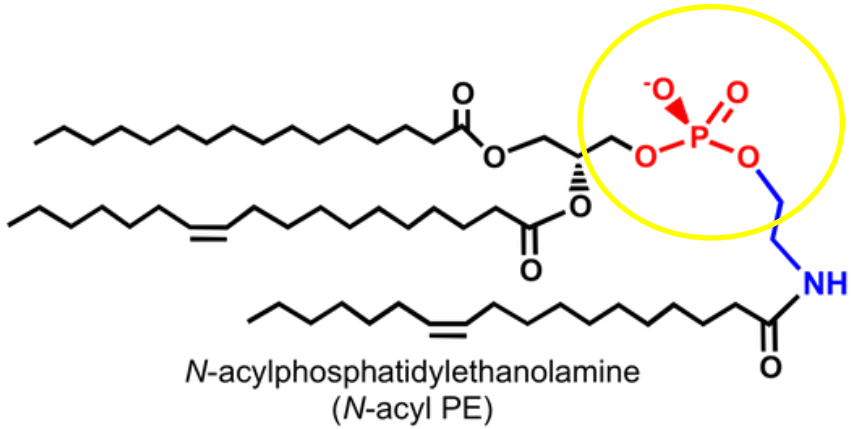
Lipid composition of a Dutch flour – 1,6% lipids on dm (2012)



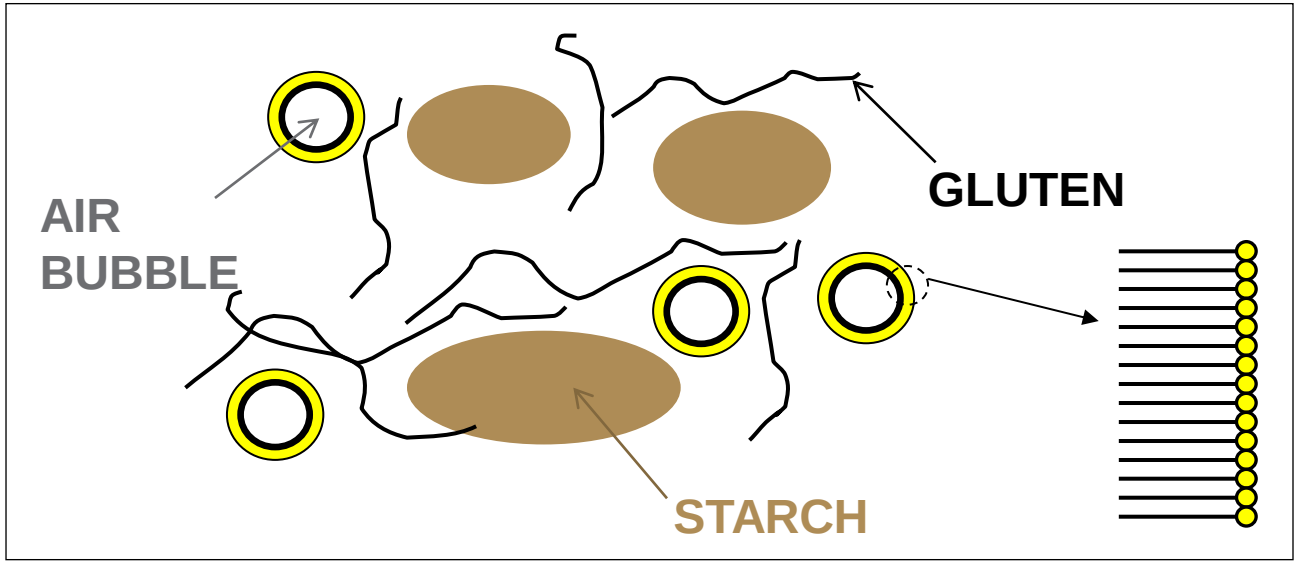
Schaffarczyk *et al.*, 2014

POLAR LIPIDS FUNCTIONNALITY IN BAKING PROCESS





IN THE DOUGH



Stabilization of gaz/water interface in alveolation structure

Better gaz retention

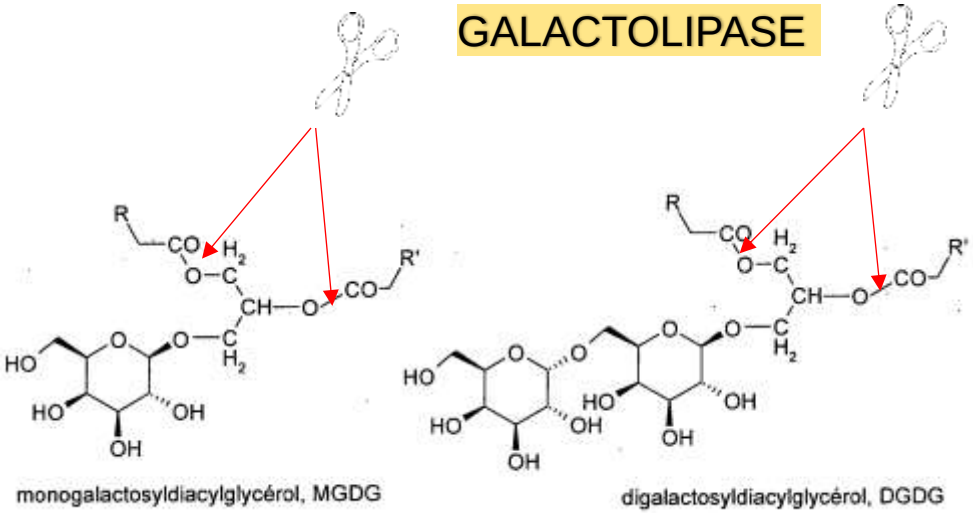
Increase Loaf volume

CONTENT

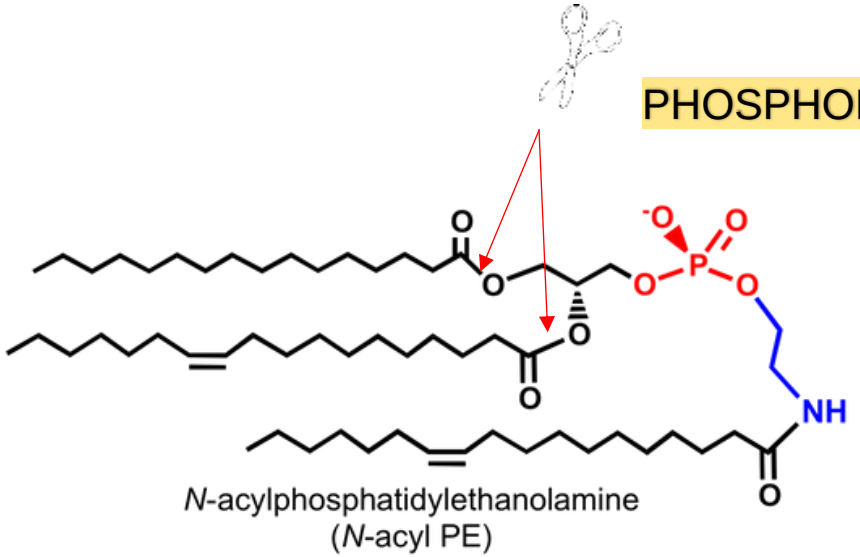
LIPASE ACTION IN DOUGH

- Most of commercial lipases are produced from GMO microorganisms :
  - Submerged fermentation production
  - Aspergillus species
  - Aspecific lipases
- Action on Flour lipids during Mixing and proofing
- Action 1 : Hydrolysis of Triglycerides and polar lipids ester bonds : production of endogenous surfactants

GALACTOLIPASE



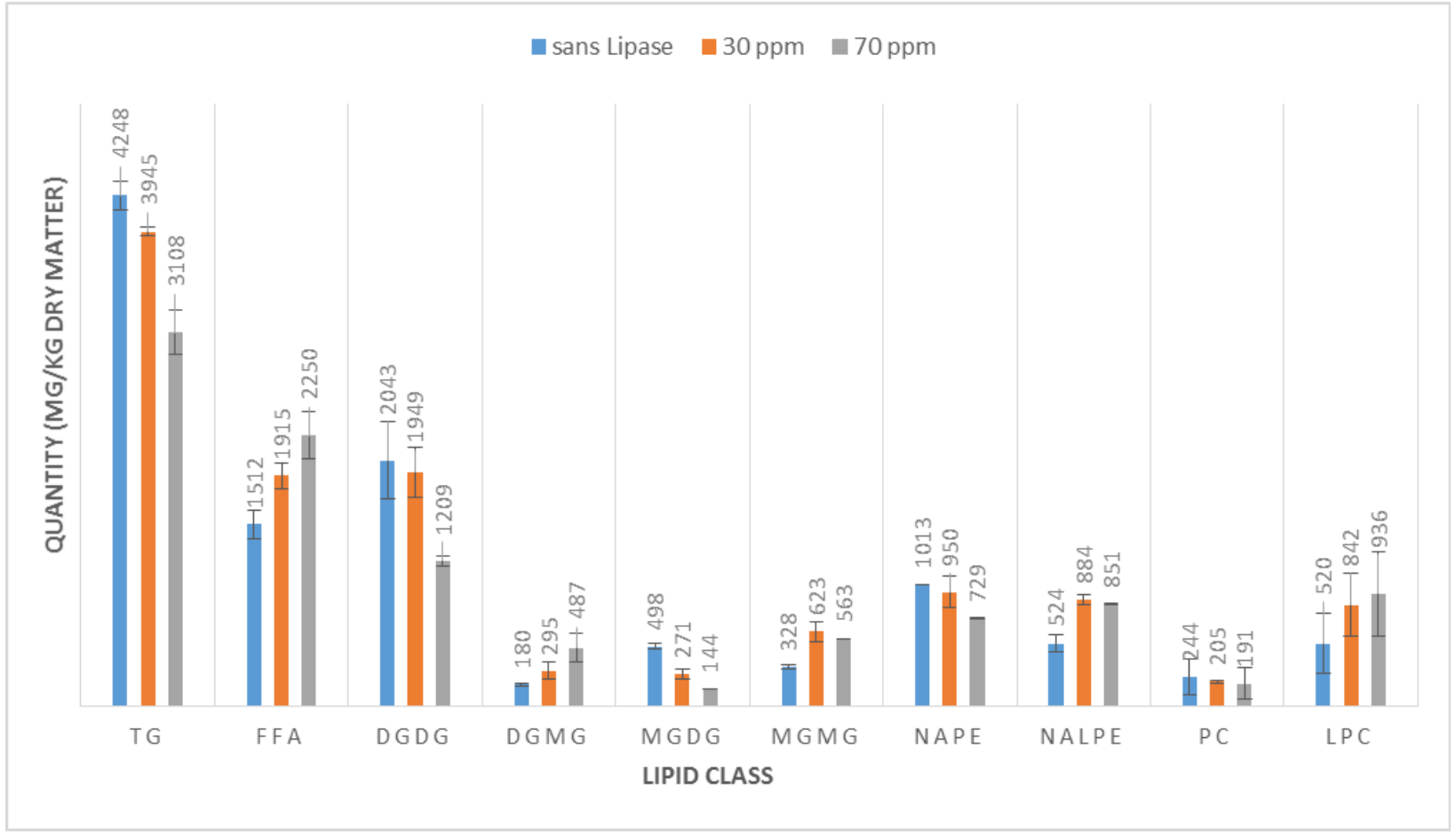
PHOSPHOLIPASE



LIPASE ACTION IN DOUGH

- Action 1 : Hydrolysis of Triglycerides and polar lipids

Concentration of Lipids from wheat dough after 58 min proofing (30°C) with addition of lipase from Asp. Oryzae



Schaffarczyk *et al.*, 2014

LIPASE ACTION IN DOUGH

- **Action 2 : Promote gluten aggregation**

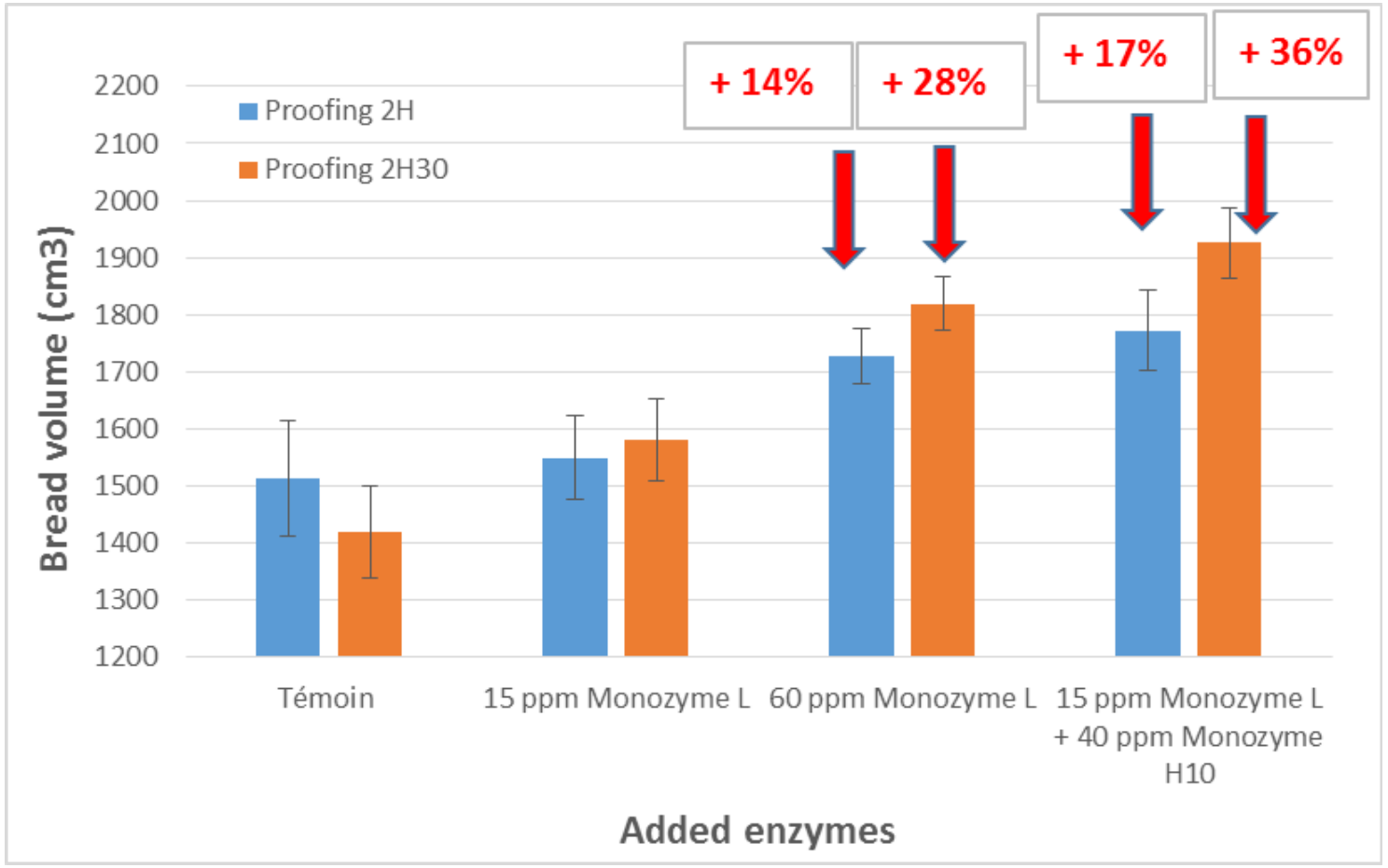
  - By ionic interactions (*Stauffer et al , 2005*)

  - Lipo-proteic complex and co-oxydation (*Daniels et al,1971*) with polyunsaturated fatty acids and wheat lipoxygenase action (*Hoseney, 1994*)

LIPASE ACTION ON BREAD

- Improves holding strength and gaz cell stabilization
- Increases loaf volumes

Bread volume evolution with lipase and fungal xylanase addition in BIPEA french bread recipee (Moulins Soufflet french flour, 3 rep.)



LIPASE ACTION ON BREAD

- Effect of lipase and xylanase addition in BIPEA French Bread recipee

  (Proofing 2H30 at 25°C)

Standard = 20 ppm ascorbic acid	Std + 15 ppm Monozyme L	Std + 60 ppm Monozyme L	Std + 15 ppm Monozyme L + 40 ppm Monozyme H10

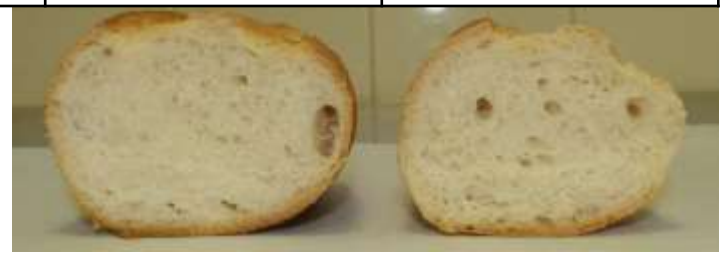
LIPASE ACTION ON BREAD

- Effect of lipase addition in African breadmaking process (dough T° = 30°C, proofing 1H45 and 2H30 at 32°C)

1H45 proofing time

+ 10%

	Standard Correction + 12 ppm Monozyme L	Standard Correction
Volume (cm3)	1191	1083



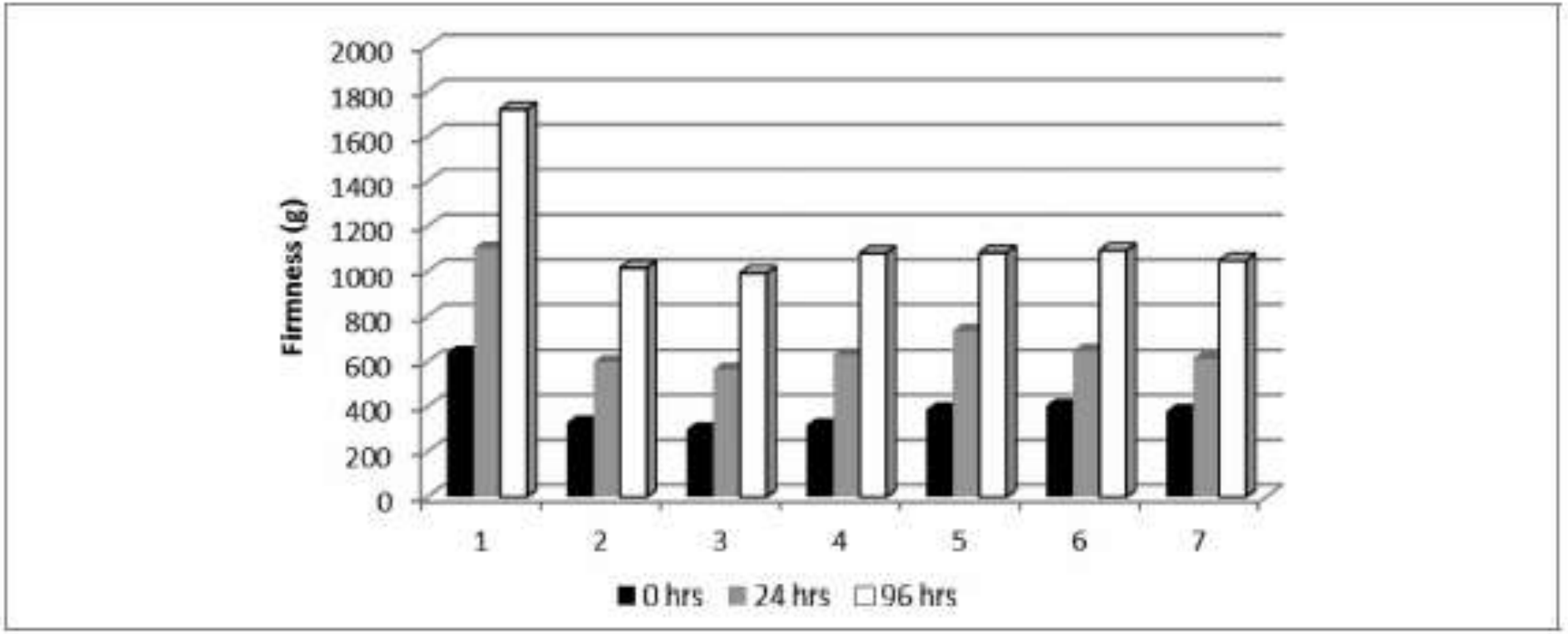
	Standard Correction + 12 ppm Monozyme L	Standard Correction
	1377	1200

2H30 proofing time

+14%

LIPASE ACTION ON BREAD

- Effect on crumb firmness



-Crumb firmness (g) of fresh (0 h) and stored (24 and 96 h) control bread (sample 1) or bread that contained increasing levels of lipase (samples 2–7; lipase units/kg flour of 250, 500, 1000, 1500, 10000, and 20000, respectively, with 1 lipase unit being the amount of lipase enzyme releasing 1 μmole titratable butyric acid per min at 30 °C, pH 7.0 [Olesen and others 2000]). Graphical representation of data from Olesen and others (2000). The data show a decrease in initial firmness (0 h) upon lipase addition (samples 2 to 7) compared to the lipase-free recipe (sample 1), but no additional effect on the firming rate since forces measured up to 96 h after baking increase equally for all (lipase-free and lipase containing) samples.

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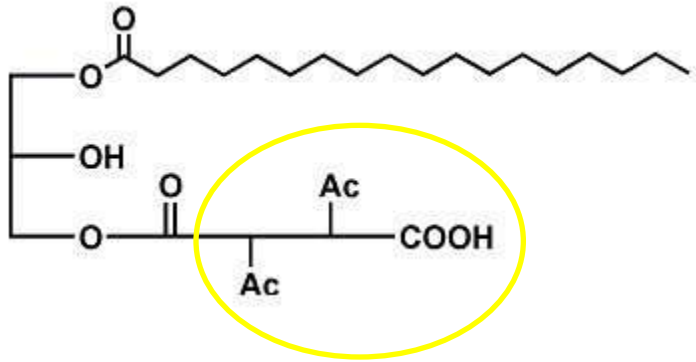
LIPASE BENEFITS IN BAKING

E472 - diacetyl tartaric acid ester of mono and diglycerides replacement



- Clean label tendancy (processing aids)
- Cost reducing : -30 to 40%
- Logistical economy (ppm vs % on flour weight)

General improvment of french bread aspect

- E472 non authorized in baguette (french regulation « pain courant français »)
- Improve bread regularity and stability (ex : unproofed frozen process)

LIPASE BENEFITS IN BAKING

- Synergy with other enzyme activities/ingredients

  - Fungal alpha-Amylase (yeast activation and crust colour)
  - Xylanases (dough machinability and bread volume)
  - Glucose-oxydase / Acide ascorbique (dough strenght and bread volume)

Baguettes baked after
2 weeks at -18°C storage
(frozen shaped unproofed dough)

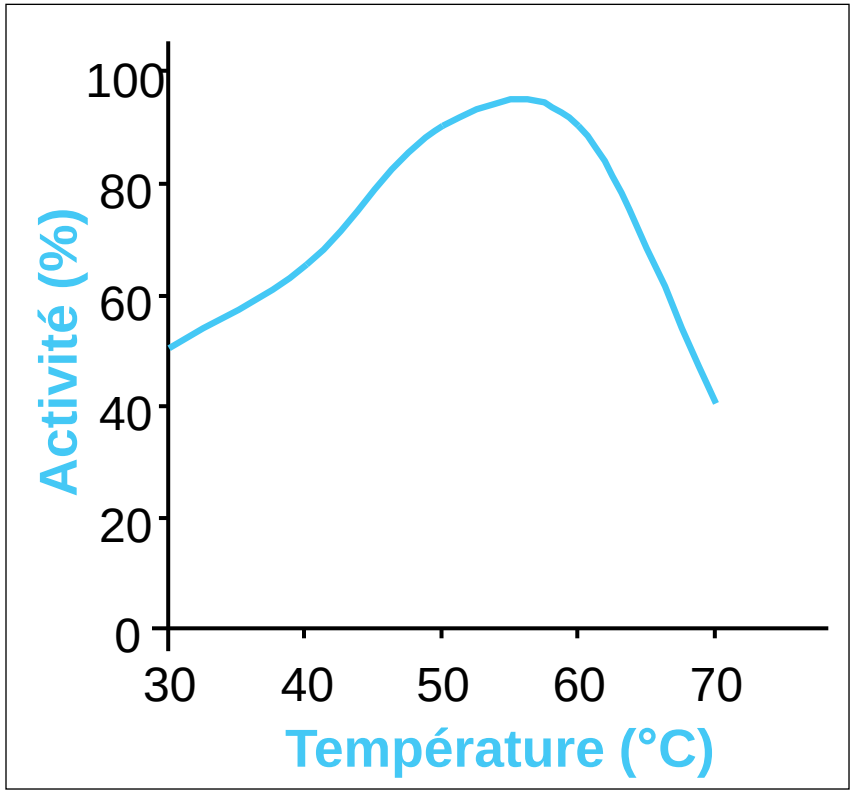
Trial	1	2	3	4
Composition	100 ppm ascorbic acid + 1% gluten	100 ppm ascorbic acid + 1% gluten + 5 ppm Monozyme A54 + 70 ppm Monozyme H10 + 8 ppm Monozyme L	100 ppm ascorbic acid + 5 ppm Monozyme A54 + 100 ppm Monozyme H10 + 8 ppm Monozyme G0 10 000 + 8 ppm Monozyme L	20 ppm ascorbic acid
Volume (cm3)	1058	1126	1168	997

LIPASE OBJECTIONS IN BAKING

Sensibility to pH and temperature

- Need to adapt dosage depending on the final application

- Ex 1 : dough temperature = 16-17°C in frozen dough process
- Ex 2 : Sourdough bread with pH dough between 4 and 4,5 whereas classical dough have a pH around 5,5.



Risk of oxidation in recipee with butter

- Bring rancid taste in viennoiserie (croissant , brioche)

LIPASE OBJECTIONS IN BAKING

- French Regulation on enzymes used in food

ARRETE DU 19 octobre 2006 , état au 12 décembre 2013, ANNEXE I C

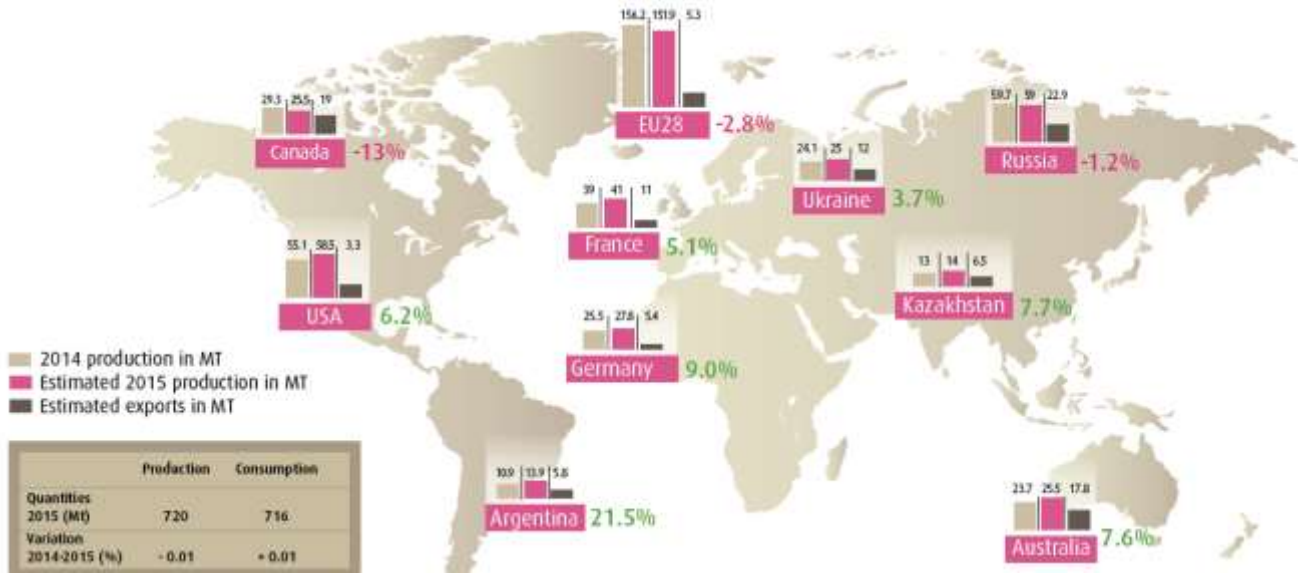
PROCESSING AIDS	FOODSTUFF	CONDITIONS OF USE
Lipase d'une souche recombinée MStr 115 d'Aspergillus oryzae porteuse du gène codant pour la lipase de Fusarium oxy- sporum.	Biscuiterie, viennoiserie, pâtisserie. Panification (à l'exception du pain de tradition française) et panification spéciale.	Modification des interactions triglycérides/gluten.
Lipase issue d'une souche génétiquement modifiée d'Aspergillus oryzae (AL) contenant le gène codant pour l'enzyme de Humicola lanuginosa (Thermomyces lanuginosus).	Biscuiterie, viennoiserie, pâtisserie, panification (à l'exception du pain de tradition française) et panification spéciale.	Modification des interactions triglycérides/ gluten.
Lipase issue d'une souche génétiquement modifiée d'Aspergillus oryzae (LH) contenant le gène modifié codant la lipase de Thermomyces lanuginosus.	Panification (à l'exception du pain de tradition française) et panification spéciale, biscuiterie, pâtisserie et viennoiserie.	Hydrolyse des triglycérides.
Lipase produite par la souche d'Aspergillus niger modifiée génétiquement LFS-54 contenant un gène codant la lipase de Fusarium culmorum.	Panification (à l'exception du pain de tradition française) et panification spéciale. Viennoiserie, biscuiterie, pâtisserie.	Modification des interactions triglycérides / gluten.
Lipase issue de la souche de Pichia angusta B14-CBSsynt modifiée génétiquement contenant un gène synthétique codant la lipase de Fusarium heterosporum.	Panification (à l'exception du pain de tradition française). Viennoiserie.	Modification des interactions triglycérides/gluten.
Lipase de Rhizopus oryzae FLP-1.	Biscuiterie, viennoiserie, pâtisserie. Panification (à l'exception du pain de tradition française) et panification spéciale.	Modification des interactions triglycérides-gluten.
Phospholipase A2 d'Aspergillus niger modifié génétiquement PLA 54 (DS 35496).	Biscuiterie, viennoiserie, pâtisserie. Panification (à l'exception du pain de tradition française) et panification spéciale.	Hydrolyse des phosphoglycérides ou phospholipides du gluten.
Phospholipase A2 de pancréas de porc.	Viennoiserie.	Hydrolyse des phosphoglycérides ou phospholipides du gluten.

CONCLUSIONS

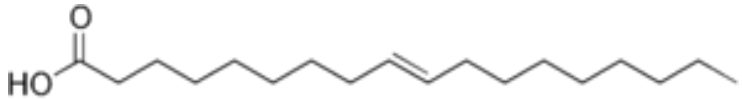
- WHEAT VARIABILITY IS A KEY FACTOR IN WHEAT FLOUR QUALITY CONTROL

- LIPASE A NEW TOOL TO CORRECT AND MAINTAIN FLOUR QUALITY REGULARITY

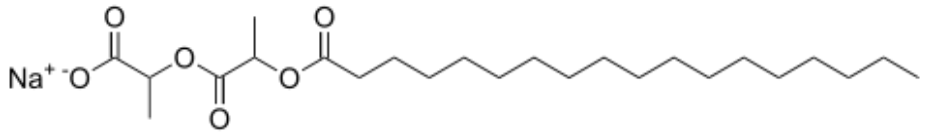
- A « YOUNG » ENZYME IN BAKING , WITH A GREAT POTENTIAL TO REPLACE ALSO OTHERS EMULSIFIERS (E471, E481) USED FOR SHELF-LIFE IMPROVMENT



	Production	Consumption
Quantities 2015 (Mt)	720	716
Variation 2014-2015 (%)	- 0.01	+ 0.01



trans-Oleic acid



Thank you for your attention

GROUPE soufflet

NOUS VALORISONS LES POTENTIELS DE LA TERRE