



Leader in flour applications.

The Potential of Enzymes to Improve the Price/ Performance Ratio of Flour

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Properties of High Quality Bread Wheat

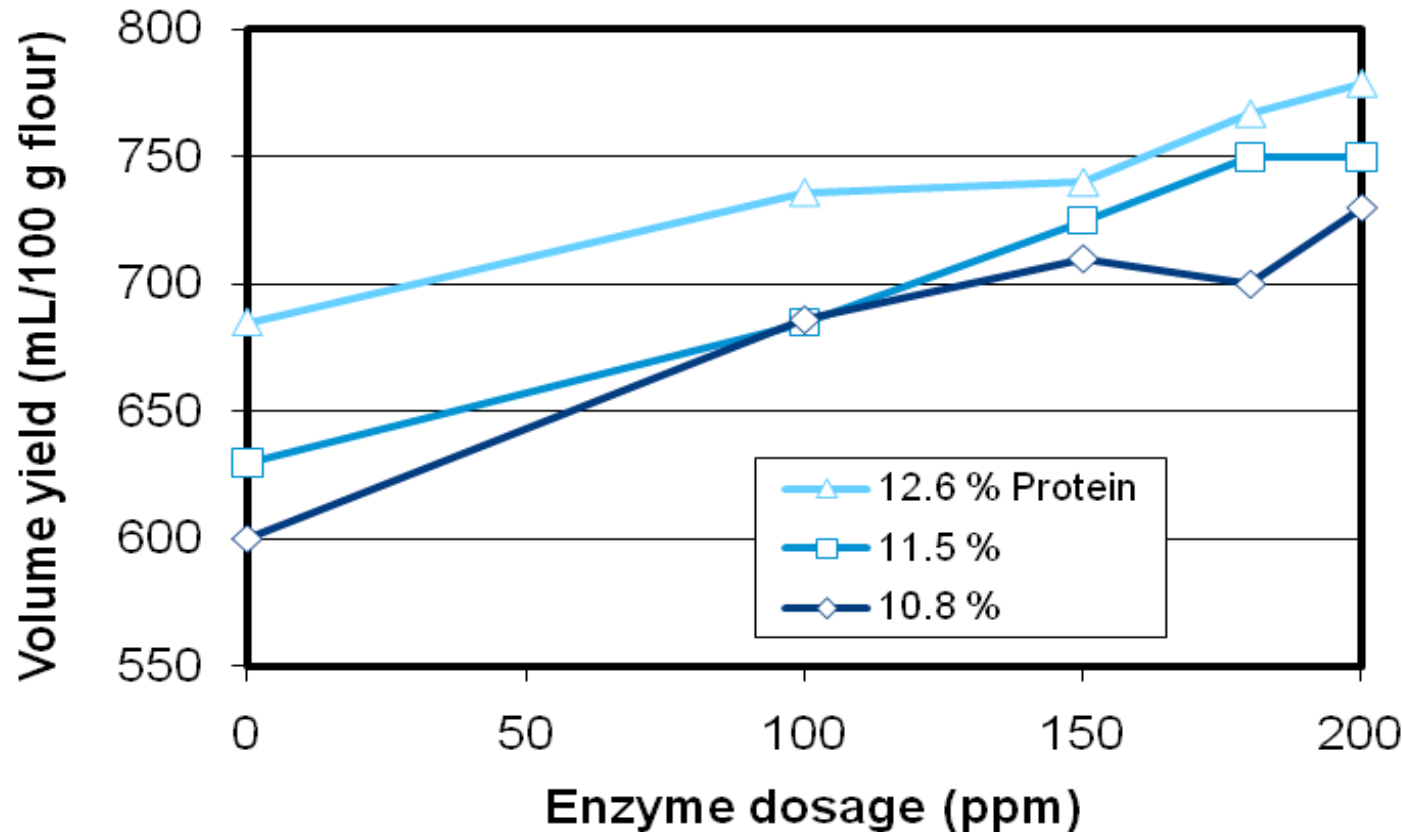
- ◆ **Good milling yield**
- ◆ **High protein**
- ◆ **Good protein quality**
- ◆ **No damage (frost, sprout, insects, molds)**
- ◆ **Superior baking properties**
- ◆ **Limited availability**
- ◆ **High price**

Gluten Quality ↔ Flour Quality

◆ Parameters affecting gluten quality

- ◆ Wheat variety
- ◆ Growing & harvest conditions
- ◆ Transport & storage conditions
- ◆ Milling
 - Yield, bran separation
 - Air classification
- ◆ Flour treatment
 - Vital wheat gluten addition
 - Maturing / softening agents
 - Enzymes
 - Emulsifiers
 - ...

Gluten Replacement with Enzymes Only?



**German A-wheat,
breakfast rolls,
40 ppm ascorbic acid,
Alphamalt A 6003
(amylase, xylanase)**

- ◆ Enzymes have always been able to compensate for the lack of protein content in baking!
- ◆ Most enzymes have a pronounced effect on dough rheology.

Effect of Basic Flour Treatment on Fino Bread Baking Results



ELCO C 100K: Ascorbic acid, 100 %
Alphamalt A 15140: Amylase, 140,000 SKB/g
Alphamalt HC 13045: Hemicellulase
Alphamalt Gloxy 14080: Glucose oxidase
Alphamalt EFX Mega: Carboxyl esterase



Reference

**ELCO, 50 ppm
A 15140, 10 ppm**

**ELCO, 50 ppm
A 15140, 10 ppm
HC 13045, 30 ppm**

**ELCO, 40 ppm
A 15140, 10 ppm
HC 13045, 30 ppm
Gloxy 14080, 20 ppm
EFX Mega, 10 ppm**

“Gluten Enhancement” in Fino Bread – Trial Parameters

Ingredients	Quantity (g)
Wheat flour ⁽¹⁾	1000
Water	560
Salt	5
Yeast, instant	15
Fat	26
Sugar	40

⁽¹⁾ Ash 0.54 %, protein 11.3 % d.b., wet gluten 26.2 %, Falling no. 444 s, water absorption 55.9 %, stability 5.2 min, softening (12 min) 53 FU

Process parameter	Value
Mixer type	Spiral kneader
Mixing time (min), slow	3
fast	6
Dough piece weight (g)	60
Fermentation time (min)	70
Proofing time (min)	100
Baking temperature (°C)	220
Baking time (min)	12

- ◆ Reference treatment: ascorbic acid, α -amylase, hemicellulase
- ◆ MC treatment: Powerzym 24123 (ascorbic acid, α -Amylase, hemicellulase, carboxyl esterase, glucose oxidase)

“Gluten Enhancement” in Fino Bread – Results

Property	Powerzym 24123	Reference
Dough properties	Extensible, stable	Extensible, slightly sticky
Oven rise	normal	normal
Baking volume (mL/100 g)	854	623
Appearance	Good color, round shape, fine and soft crumb	Less color, flat base



Powerzym Reference



Powerzym Reference



Grist Cost Optimization with a Gluten Enhancer Compound Containing Enzymes

Background Information

- ◆ **The EMCEgluten Enhancer Range** aims at replicating and surpassing the functionality of vital wheat gluten
 - ◆ Structure and stability
 - ◆ Water binding properties
- ◆ **The product is an enzyme system imparting**
 - ◆ Dry dough properties & good machinability
 - ◆ Fine texture
 - ◆ Good volume
- ◆ **The goal is to maintain and enhance baking performance by replacing vital wheat gluten, or improving the performance of low gluten flour or composite flours**

EMCEgluten Enhancer - Applications

- ◆ **Replacing vital wheat gluten**
- ◆ **Enhancing weak flours**
- ◆ **Improving hard- and soft wheat blends**
- ◆ **Improving baking properties of composite flours from wheat and non-wheat flour, e.g. cassava, corn or other crops**
- ◆ **Increasing stability, water absorption, volume yield**
- ◆ **Maintain or improve rheological data**
- ◆ **Optimizing costs**

Comparison of EMCEgluten Enhancer 21 and 22

Normal proof

Basic treatment: 40 ppm ELCO C-100 (ascorbic acid), 100 ppm Alphamalt VC 5000



0.3 % EMCEgluten Enhancer 21

control

0.3 % EMCEgluten Enhancer 22

Comparison of EMCEgluten Enhancer 21 and 22

Over-proof

Base treatment: 40 ppm ELCO C-100 (ascorbic acid), 100 ppm Alphamalt VC 5000



0.3 % EMCEgluten Enhancer 21

control

0.3 % EMCEgluten Enhancer 22

Application – Grists from Hard and Soft Wheat

- ◆ **Blending hard and soft wheat varieties could lead to:**
 - ◆ Reduction of the protein content
 - ◆ Decreased water absorption
 - ◆ Impaired stability
 - ◆ Impaired volume

- ◆ **The addition of EMCEgluten Enhancer compensates for about the 100-fold quantity of added soft wheat, i.e. 0.05-0.1 % EMCEgluten Enhancer makes up for 10% soft wheat**

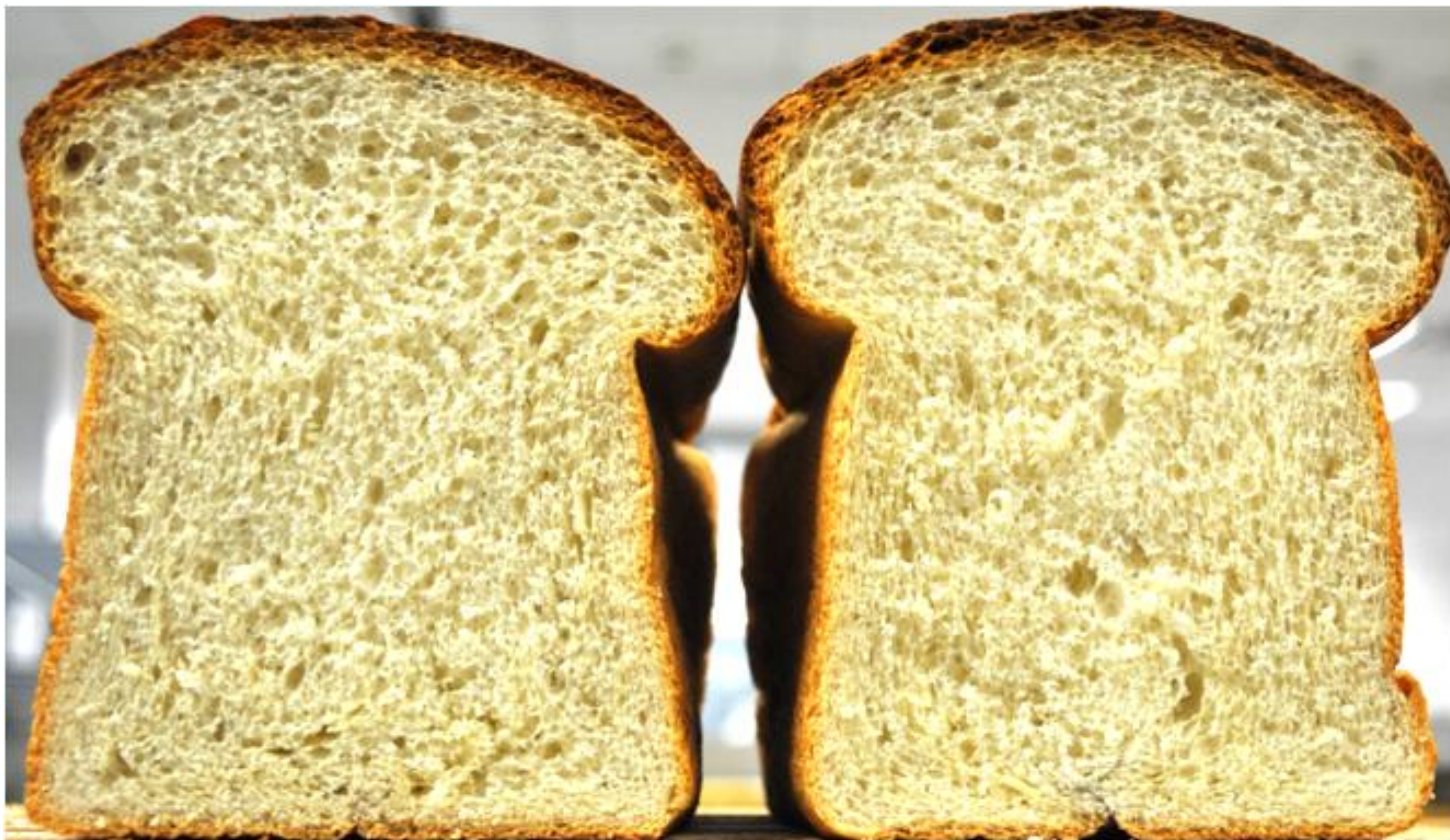
Application – Hard- and Soft Wheat Mixtures

Effects of EMCEgluten Enhancer 22 (GE 22)

Hard-/ Soft wheat	100	90/10	80/20	70/30	60/40	50/50
Protein (NIR)	14.8	14.6	14.5	14.2	13.9	13.7
WA Farinograph (%)	64.6	64.1	63.7	63.2	62.7	62.1
Addition GE 22 (%)	0	0.05	0.1	0.2	0.25	0.3
WA Farinograph (%)	64.6	64.5	64.4	64.3	64.3	64.1
Stability Farinograph (min)	20:19	20:04	19:45	19:02	19:05	19:43

Application – Hard- and Soft Wheat Mixtures

**Basic treatment:
300 ppm Powerzym S + 50 ppm Alphamalt Gloxy 12082**



80/20, basic treatment

**70/30, basic treatment
+ 0.1% EMCEgluten Enhancer 22**

Application – Vital Wheat Gluten Replacement

- ◆ **Vital wheat gluten is used in different applications**
 - ◆ It can be used to strengthen weak flours
 - ◆ It is often used in sandwich bread at 2-8 %, or
 - ◆ in regional specialties like Easter bread, which may contain >10% vital gluten
- ◆ **Vital wheat gluten prices are volatile and availability varies**
- ◆ **1 % Vital wheat gluten can be replaced with 0.1 % of EMCEgluten Enhancer**
- ◆ **Economical benefits when vital wheat gluten prices are high**
- ◆ **Savings in logistics and storage cost, because only 10% of quantity is needed**

EMCEgluten Enhancer – Product Examples

Product	Ingredients	Mode of operation
EMCEgluten Enhancer 21	Enzymes, vegetable fiber, hydrocolloids	Basic version with guar gum for water absorption
EMCEgluten Enhancer AS	Enzymes, vegetable fiber, ascorbic acid	Dispensation with guar gum, increased fiber, ascorbic acid for stability
EMCEgluten Enhancer 22	Enzymes, vegetable fiber, ascorbic acid	Adapted enzyme system for increased volume, enhanced crumb structure
EMCEgluten Enhancer P	Enzymes, vegetable fibers, ascorbic acid	Price optimized

EMCEgluten Enhancer –Summary of Advantages

- ◆ **Increased water binding capacity**
- ◆ **Optimized dough stability**
- ◆ **Uniform crumb structure**
- ◆ **Enhanced baking performance for composite flours**
- ◆ **Higher flexibility in gristing / raw material choice**
- ◆ **Cost savings**
 - ◆ Replacement of gluten at 10% of the dosage
 - ◆ Usage of cheaper raw materials possible
 - ◆ Increased yield by using cassava etc.
 - ◆ Logistics and storage capacity (only 1/10 to be shipped and stored)

Replacement of Strong Wheat

Example: Wheat from the U.S.

***Triticum aestivum* - soft wheat**

About 100 varieties in 5 classes, distinguished by:

- ◆ **Wheat plant appearance**
- ◆ **Grain hardness →**
 - Hard *soft wheat* (referred to as “Hard Wheat”)
 - Soft *soft wheat* (referred to as “Soft Wheat”)
- ◆ **Grain color**

Replacement of Strong Wheat U.S. Wheat Classes

◆ HRW (Hard Red Winter)



- ◆ High protein (12%)
- ◆ Bread flour
- ◆ 40% export

◆ HWW (Hard White Winter)



- ◆ High protein (12%)
- ◆ Noodle / pasta flour
- ◆ Captive use

◆ HRS (Hard Red Spring)



- ◆ Very high protein (14%)
- ◆ Bread flour
- ◆ 20% export
- ◆ Includes DNS (Dark Northern Spring)

◆ SW (Soft White)



- ◆ Low protein ($\leq 10\%$)
- ◆ Flour for corn-flakes, noodles, biscuits
- ◆ 20% export

◆ SRW (Soft Red Winter)



- ◆ Low protein (10%)
- ◆ Flour for flat bread, biscuits
- ◆ 20% export

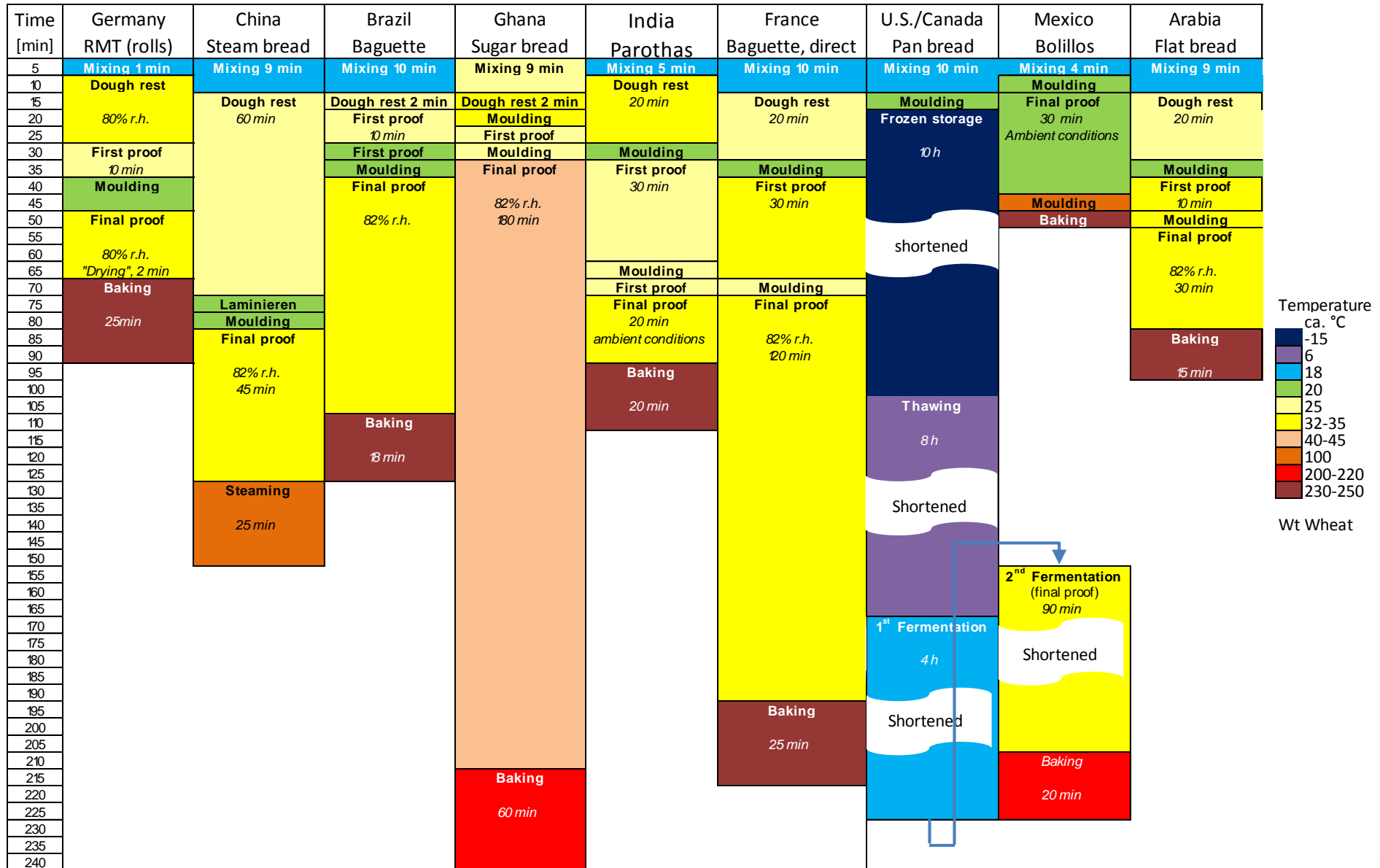
Role of Strong Wheat in Bread Flour Grists

- ◆ **Raises protein level**
- ◆ **Increase of water absorption**
- ◆ **Improves dough stability and tolerance**
- ◆ **Enhances volume yield**

Challenges Associated with Strong Wheat

- ◆ **Availability**
- ◆ **Logistics**
- ◆ **High wheat cost**

Comparison of Baking Procedures by Time and Temperature



Challenge High Wheat Cost

Example: U.S. vs. French Wheat

- ◆ French wheat at 188 €/t = 256 \$/MT (06/2014, €/\\$=1.3634)
- ◆ HRW at 232 €/t = 316 \$/MT
- ◆ Theoretical yield: 80% → 125 t wheat for 100 t flour

HRW in grist	(%)	0	10	20	30
French wheat	(\$/MT flour)	320.40	288.36	256.32	224.28
HRW	(\$/MT flour)	0.00	39.54	79.08	118.62
Total cost	(\$/MT flour)	320.40	327.90	335.40	342.90
Surplus	(\$/MT flour)	0.00	7.50	15.00	22.50

Technological Properties of EMCEgluten^{Plus} Baguette

- ◆ **Compound for upgrading flour, based on hydrocolloids and enzymes**
- ◆ **Dosage 0.01 – 0.5% on flour**
- ◆ **Hydrocolloids**
 - Water binding, cross-linking, texturization
- ◆ **Glucose oxidase**
 - Stabilized the gluten network
 - Water binding, drying of dough surfaces
- ◆ **Transglutaminase**
 - Strengthens the gluten protein
- ◆ **Carboxyl esterase (triacyl lipases, phospholipase, galactolipase)**
 - Create baking-active lipids
 - Dough stabilization
 - Increase volume yield
 - Create a fine, regular crumb structure

Flour Evaluation According to BIPEA

	Insuffisant				Excell				
	1	4	7	10	7	4	1		
PETRISSAGE									
LISSAGE								× 0.5	
COLLANT DE LA PÂTE								× 0.5	
CONSISTANCE								× 0.5	
EXTENSIBILITE								× 0.5	
ELASTICITE								× 0.5	
RELACHEMENT								× 0.5	
POINTAGE									
DETENTE-RELACHEMENT								× 1	
FACONNAGE									
ALLONGEMENT								× 0.5	
DECHIREMENT								× 0.5	
ELASTICITE								× 0.5	
COLLANT DE LA PÂTE								× 1	
APPRET									
ACTIVITE FERMENTAIRE								× 0.5	
PÂTE-DECHIREMENT								× 0.5	
MISE AU FOUR									
COLLANT DE LA PÂTE								× 1	
TENU DE LA PÂTE								× 2	
CARACTERISTIQUES DU PAIN									
SECTION								× 1	
COULEUR								× 2	
EPAISSEUR								× 0.5	
CROUSTILLANT								× 0.5	
COUPS DE LAME									
DEVELOPPEMENT								× 1	
REGULARITE								× 1	
DECHIREMENT								× 1	
VOLUME									
VOLUME MOYEN								× 1	
MASSE MOYENNE								× 1	
CARACTERISTIQUES DE LA MIE									
COULEUR								× 1	
TEXTURE								× 1	
SOUPLESSE								× 1	
ELASTICITE								× 1	
COLLANT								× 1	
ALVEOLAGE									
REGULARITE								× 1	
EPAISSEUR								× 1	
ODEUR									
								× 1	

NOTE PÂTE #25

NOTE PAIN #100

NOTE MIE #100

NOTE TOTALE #300

NB: La grille doit être remplie avec la lettre 'x'. Ne mettre qu'une seule croix par ligne.



Source : ARVALIS-institut du végétal

Replacement of Strong Wheat Baking Trials with EMCEgluten^{Plus} Baguette

Basic treatment: ascorbic acid, amylases, hemicellulases, lipases

HRW		30%	20%	10%	0%
EMCEgluten ^{Plus} Baguette (ppm on flour)		0	250	450	650 (+ 30 ppm AA)
Dough	Elasticity	Good	Good	Good	Good
	Extensibility	Good	Good	Good	Good
	Stability	Good	Good	Good	Reduced
Bread appearance	Shape	Good	Good	Good	Good
	Cut	Good	Good	Slightly irregular	Slightly irregular
Volume (ml)	1:30 h	1050	1100	1100	1100
	2:00 h	1250	1250	1300	1225



◆ Fermentation: 1:30 h

◆ Hearth oven

HRW

30%

20%

10%

0%



 **Fermentation: 2:00 h**

 **Hearth oven**

HRW

30%

20%

10%

0%



◆ Fermentation: 2:00 h

◆ Convection oven

HRW

30%

20%

10%

0%



Cost Savings by Reduction of Strong Wheat

HRW in grist	(%)	30	20	10	0
French wheat	(\$/MT flour)	224.28	256.32	288.36	320.40
HRW	(\$/MT flour)	118.62	79.08	39.54	0.00
EMCEgluten ^{Plus} Baguette	(ppm)	0	250	450	650
	(\$/MT flour)	0.00	4.43	7.98	11.52
Ascorbic acid	(ppm)	0	0	0	30
	(\$/MT flour)	0.00	0.00	0.00	0.53
Total cost	(\$/MT flour)	342.90	339.83	335.87	332.45
Savings	(\$/MT flour)	0.00	3.07	7.02	10.44