Common Wheat Flour Problems and Their Solutions

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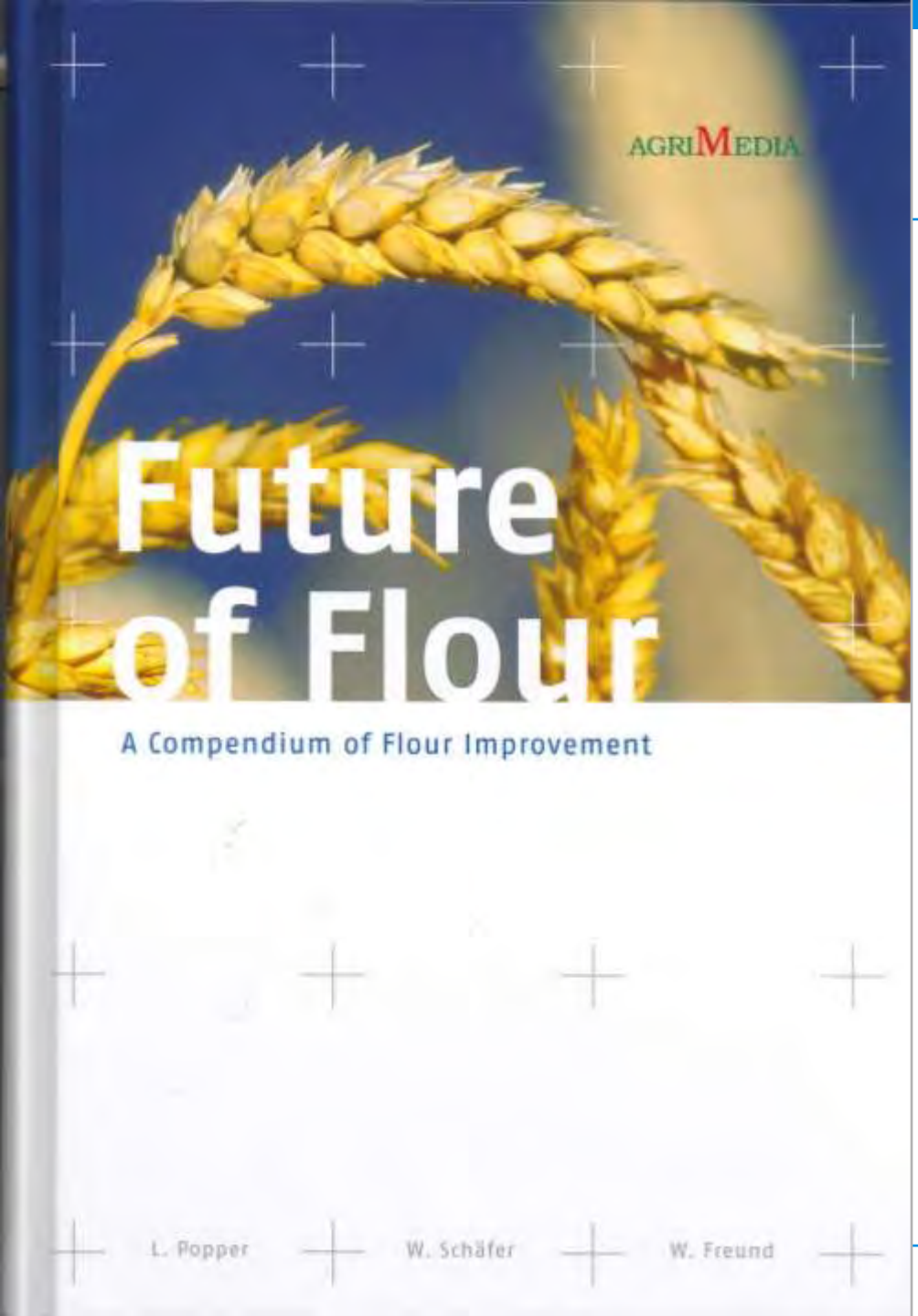

Future of Flour

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Application of Esterases in Baking

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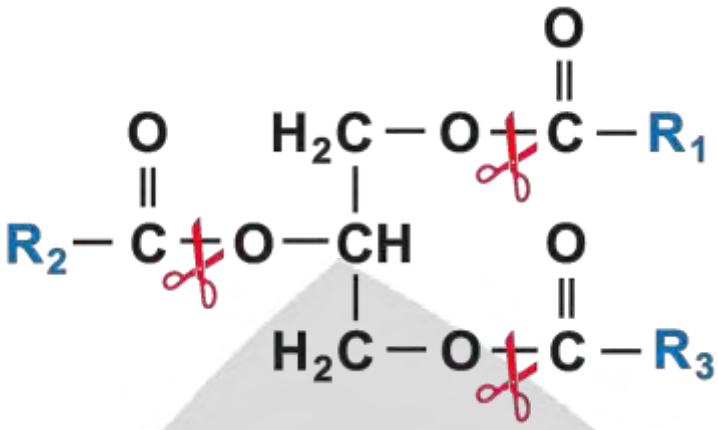
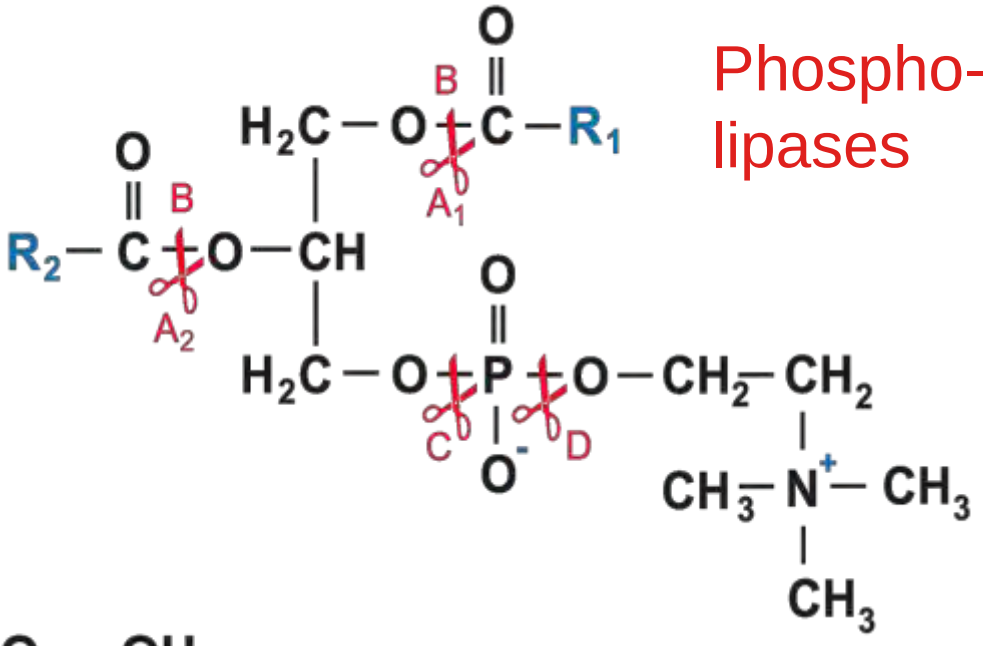
Esterases and Their Applications in Food

Enzyme	Reaction Catalysed	Applications
Lipase (triacylglycerol lipase)	Splits fats and lipids into fatty acids and glycerol or other alcohols	Maturing of cheese; emulsifier production; interesterification of fats; baking
Phospholipase A_2	Hydrolyses phospholipids (lecithin)	Improvement of emulsifying power (e.g. egg yolk); degumming
Phospholipase A_1		
Lyso-phospholipase		
Galactolipase	Splits fatty acids off galactolipids	Improvement of emulsifying power; baking
Acetyl esterase	Splits off acetyl groups, e.g. from pectin or xylan	Baking; fruit juice
Pectin esterase	Splits methyl groups off pectin	Clarification of fruit juice; gel formation; stabilizing of fruit
Exo- and endonucleases	Splits nucleic acid between phosphate and nucleobase	Flavour; yeast extract
Feruloyl esterase	Splits off ferulic acid, e.g. from wheat xylans	Flavouring; baking
Coumaroyl esterase	Splits off cumaric acid, e.g. from wheat xylans	Flavouring; baking
Phytase	Removes phosphoric acid from phytate	Digestibility & bioavailability

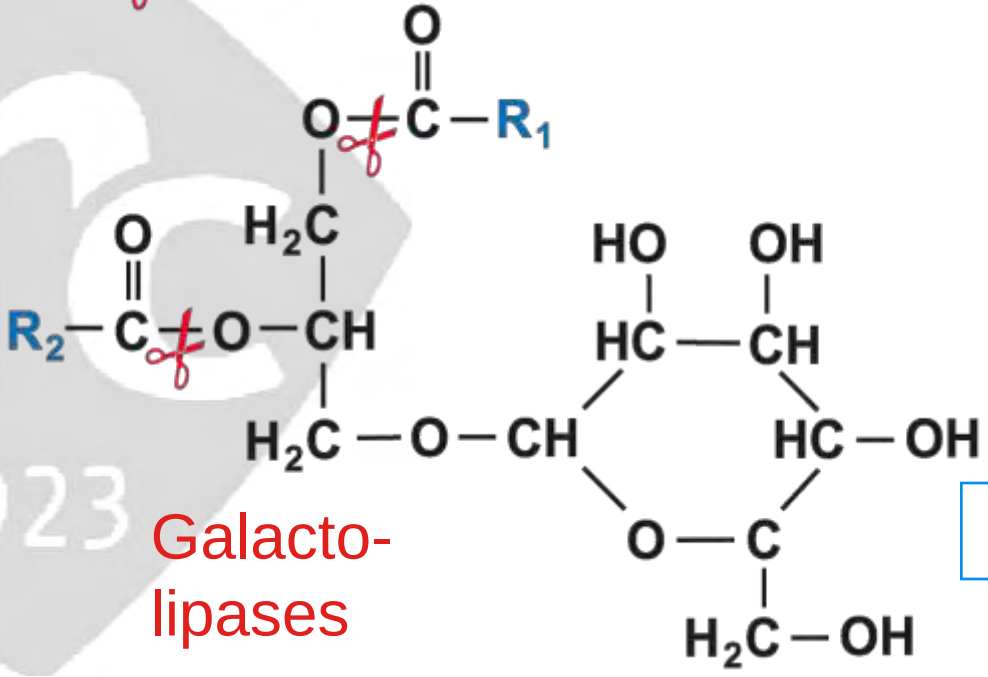
Action of Lipolytic Esterases



Lipases



Phospho-lipases



Galacto-lipases

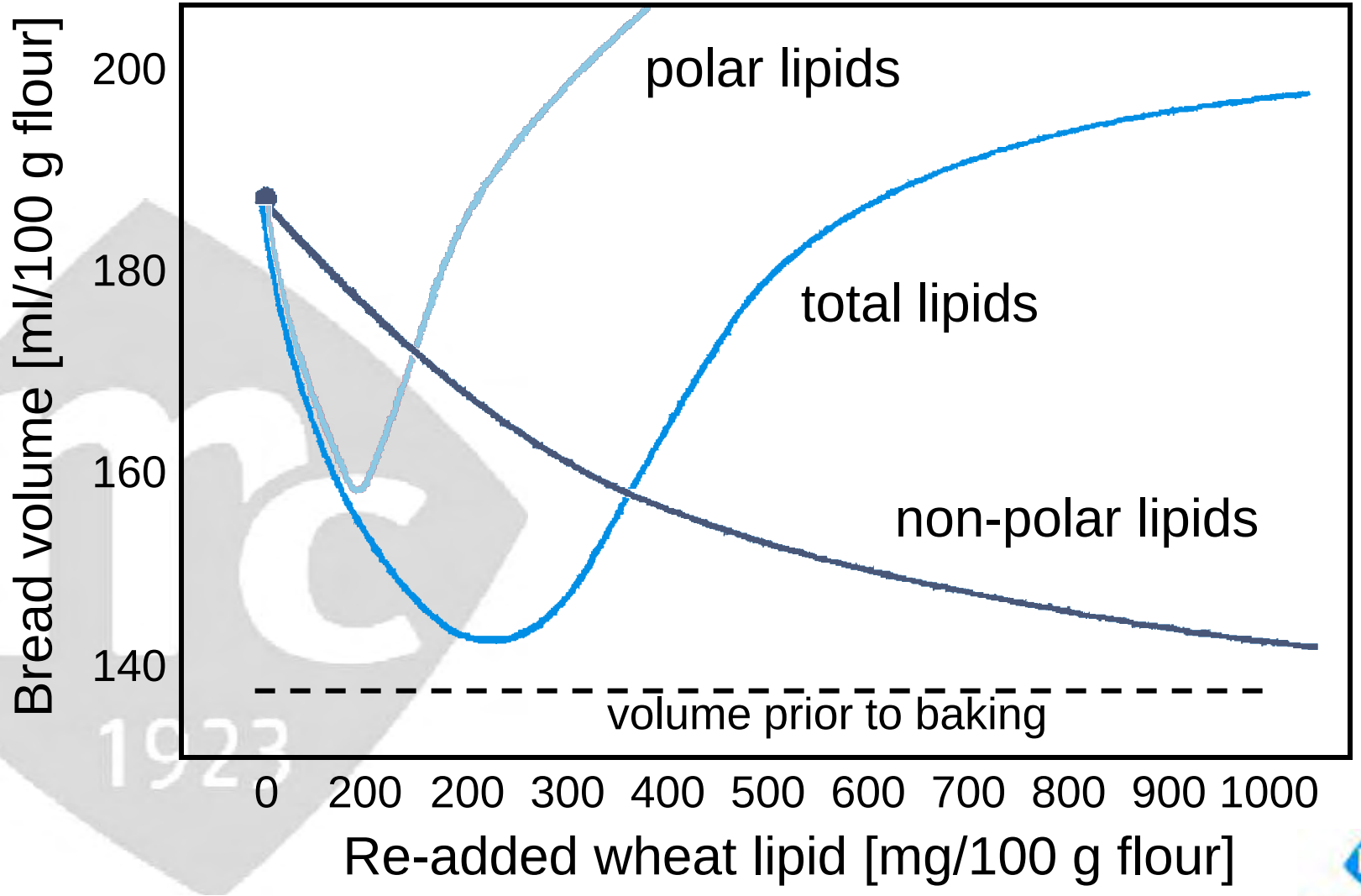
R_1, R_2, R_3= fatty acid residues

Lipids in Wheat Flour

Total lipids*			**1,280**
Non-polar lipids			**457**
Polar lipids			**823**
Phosphatides (lecithin)		**250**	
Phosphatidyl acid	**30**		
Phosphatidyl glycerol	**51**		
Phosphatidyl cholin	**27**		
Phosphatidyl ethanolamine	**traces**		
Phosphatidyl serine	**15**		
Lyso-phosphatidyl cholin	**117**		
Lyso-phosphatidyl ethanolamine	**10**		
Galactolipids		**249**	
Other polar lipids		**320**	

***mg/100 g wheat flour 0.405 % ash**

Effect of Wheat Lipids on Volume Yield of Defatted Wheat Flour



Modif. from MacRitchie & Gras, 1973

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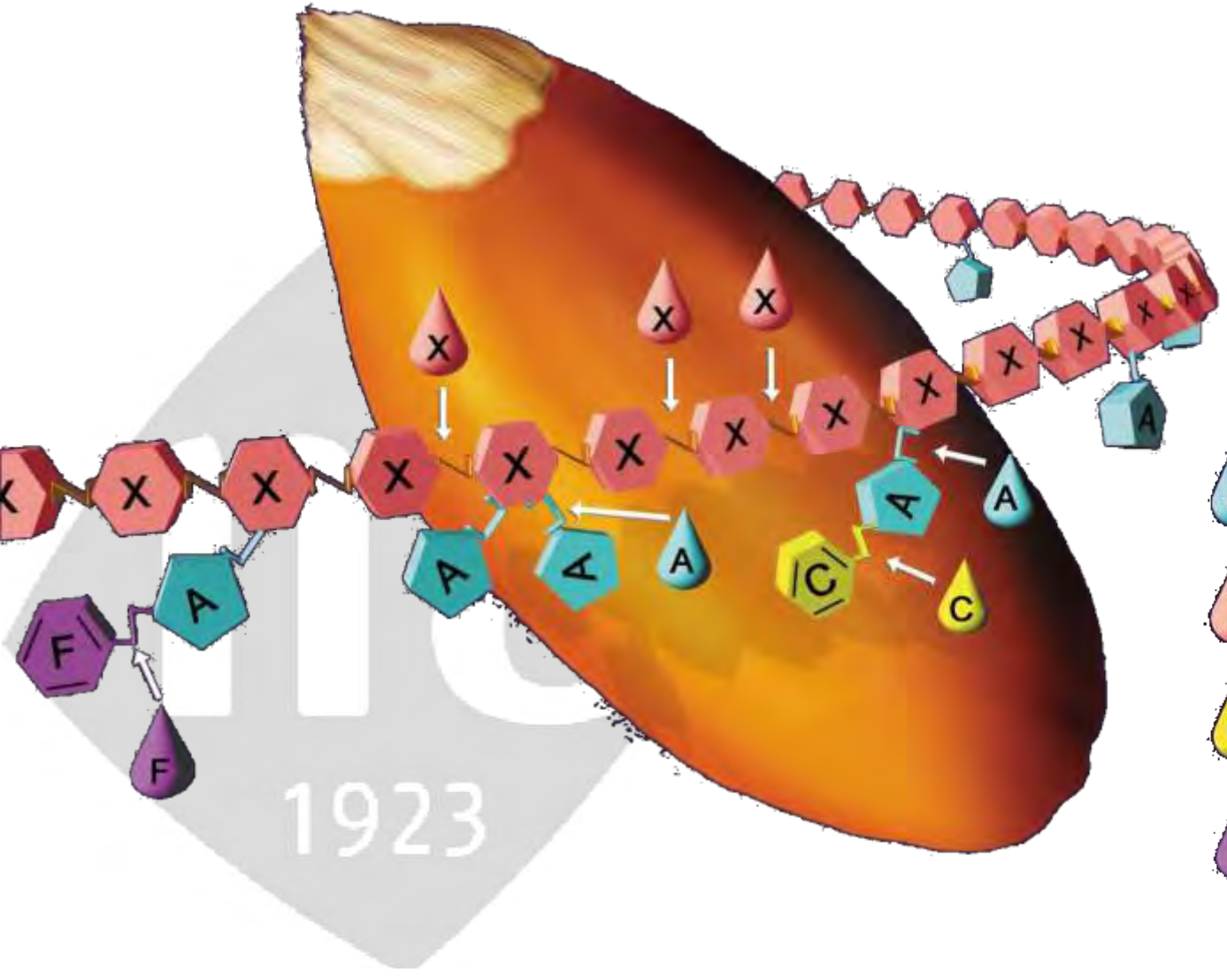
Action Sites of Feruloyl and Coumaroyl Esterase in Wheat Xylan



Arabinose

Xylose

Coumaric acid

Ferulic acid

α-L-Arabinofuranosidase

Endo-1,4-ß-xylanase

Coumaric acid esterase

Ferulic acid esterase

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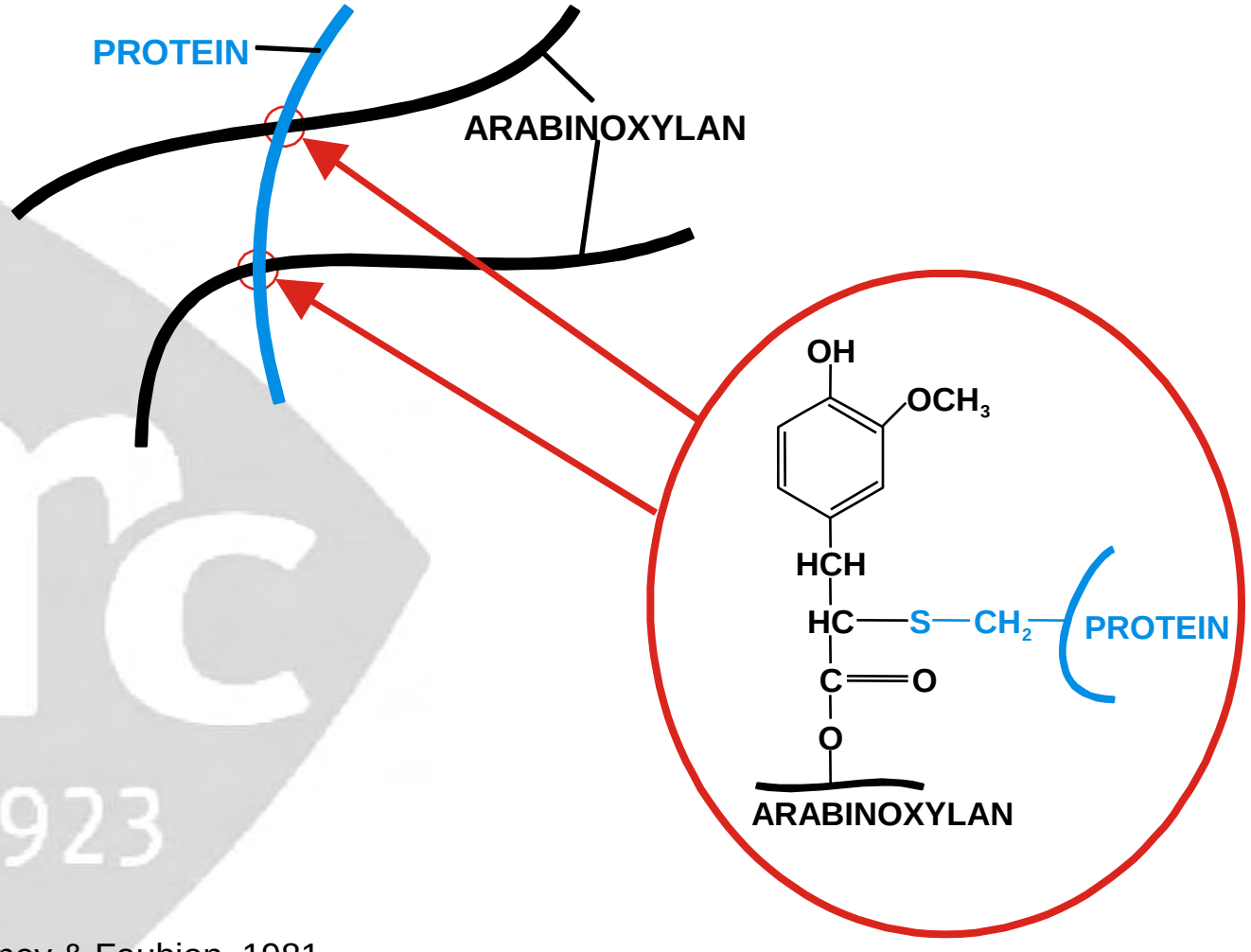
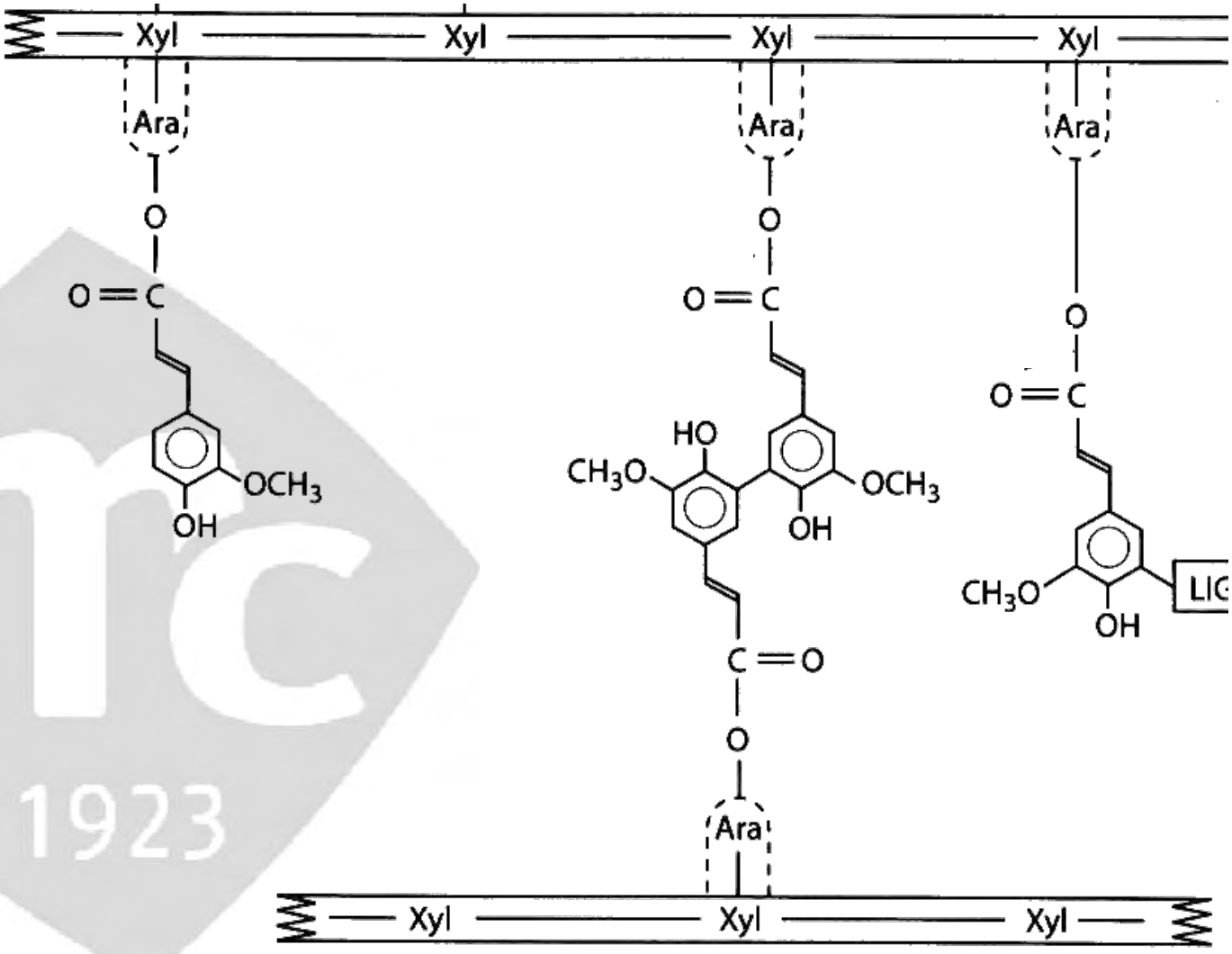
Cross-Linking of Gluten and Hemicellulose



Adapted from Hoseney & Faubion, 1981

Interaction of Feruloyl Side-Chains in Arabinoxylan



Modif. from Williamson *et al.*, 1998

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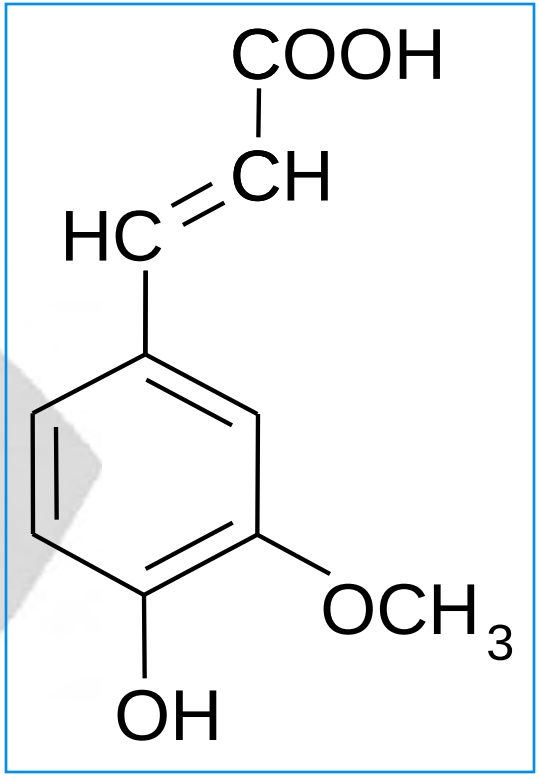
Significance of Ferulic Acid

3-Metoxy-4-hydroxy cinnamic acid (trans)

Biological function

- *Integrity*
- *Form*
- *Plasticity*
- *Thermal stability*
- *Adhesion*



Industrial significance

- *Antioxidant*
- *Absorbs UV light*
- *Antimicrobial*
- *Vanillin*
- *Flavor precursor*
- *Links polymers*

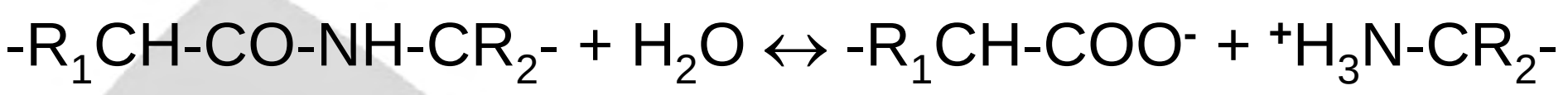
Bakery process

Effect of Feruloyl Esterase from *Streptomyces werraensis* on the Alveogram

	Resting time 28 min					Resting time 120 min					
%	P	L	W	P/L	Ie	P	L	W	P/L	Ie	Idp
0.00	102	100	351	1.02	59.6	81	123	334	0.66	60.3	4.8
0.02	101	101	349	1.00	59.9	83	122	329	0.69	59.0	5.6
0.04	106	88	333	1.20	60.4	85	115	324	0.66	58.8	3.2
0.08	100	110	364	0.91	59.1	79	132	325	0.60	58.2	10.6
0.12	95	113	351	0.84	58.5	74	136	309	0.55	57.1	11.8
0.14	94	126	374	0.75	58.7	71	140	309	0.51	57.9	17.3
0.16	88	133	359	0.66	57.9	68	149	307	0.46	56.8	14.4
0.20	81	130	320	0.62	57.1	63	145	268	0.44	55.6	15.8

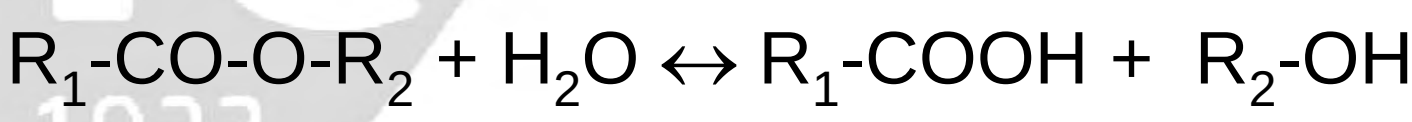
Reaction Schemes of Protease and Lipases

Protease



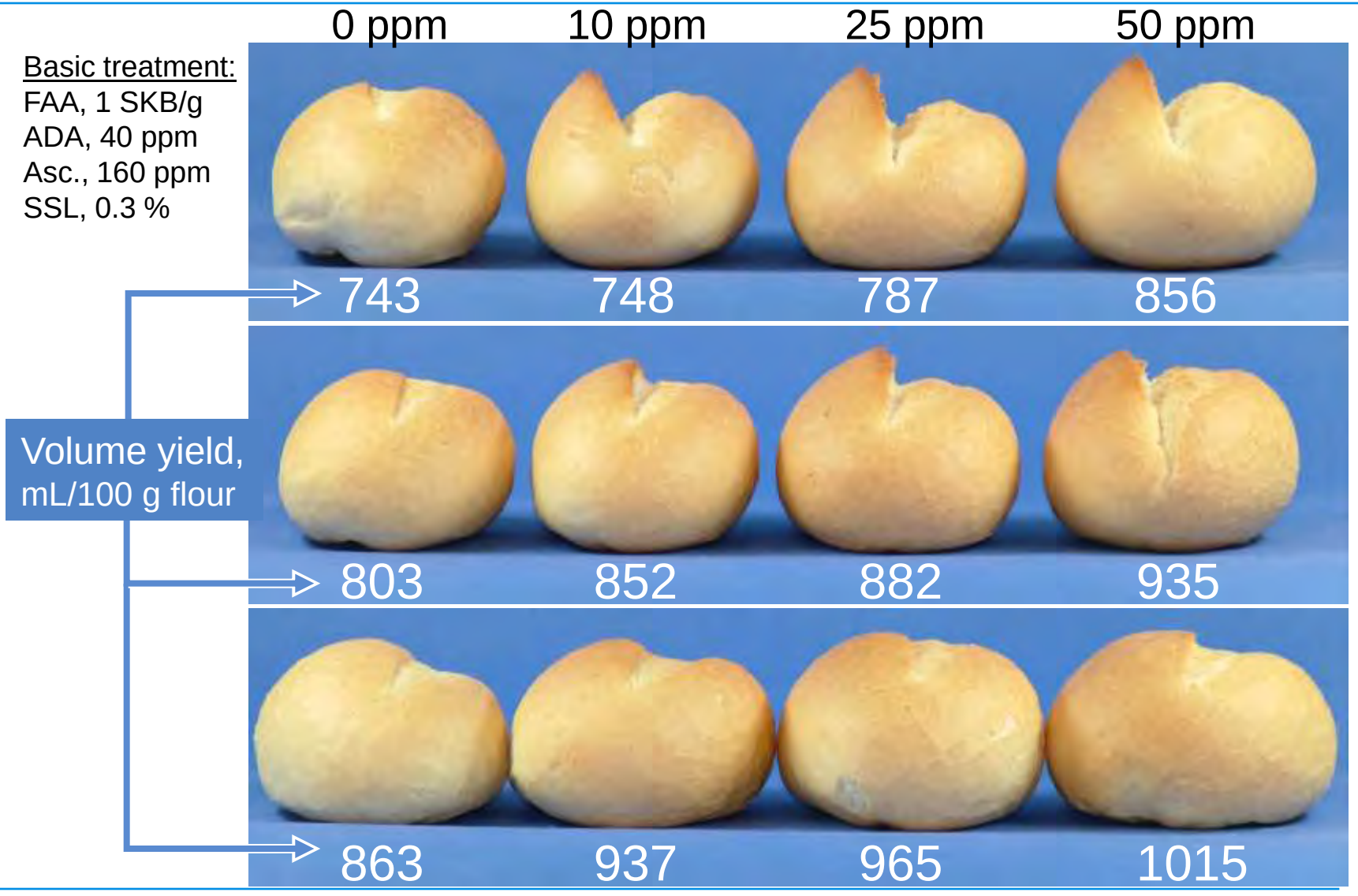
$$-R_1CH\text{-}CO\text{-}NH\text{-}CR_2\text{-} + H_2O \leftrightarrow -R_1CH\text{-}COO^- + {}^+H_3N\text{-}CR_2\text{-}$$

Esterase



$$R_1\text{-}CO\text{-}O\text{-}R_2 + H_2O \leftrightarrow R_1\text{-}COOH + R_2\text{-}OH$$

Effect of Dosage and Proof Time on Baguette Rolls with Alphamalt EFX Super



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Effect of Proof Time on Baguette Rolls with Alphamalt EFX Super (50 ppm)

1.5 h, normal proof, no EFX Super	1.5 h, normal proof	2 h, over-proof 1	2.5 h, over-proof 2

Basic treatment:
FAA, 1 SKB/g
ADA, 40 ppm
Asc., 160 ppm
SSL, 0.3 %

Volume yield, mL/100 g flour

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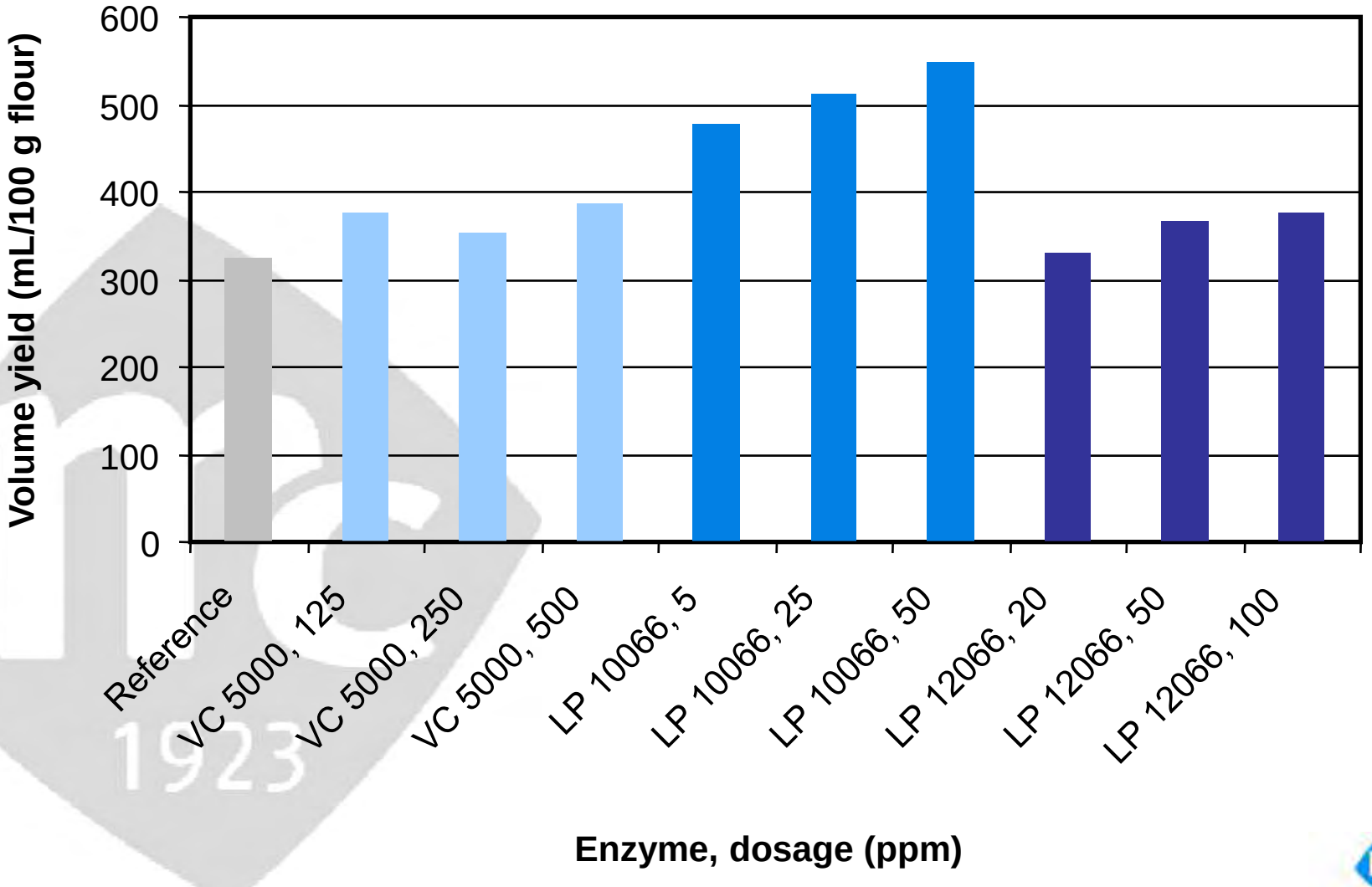
Steamed Bread with Lipolytic Enzymes



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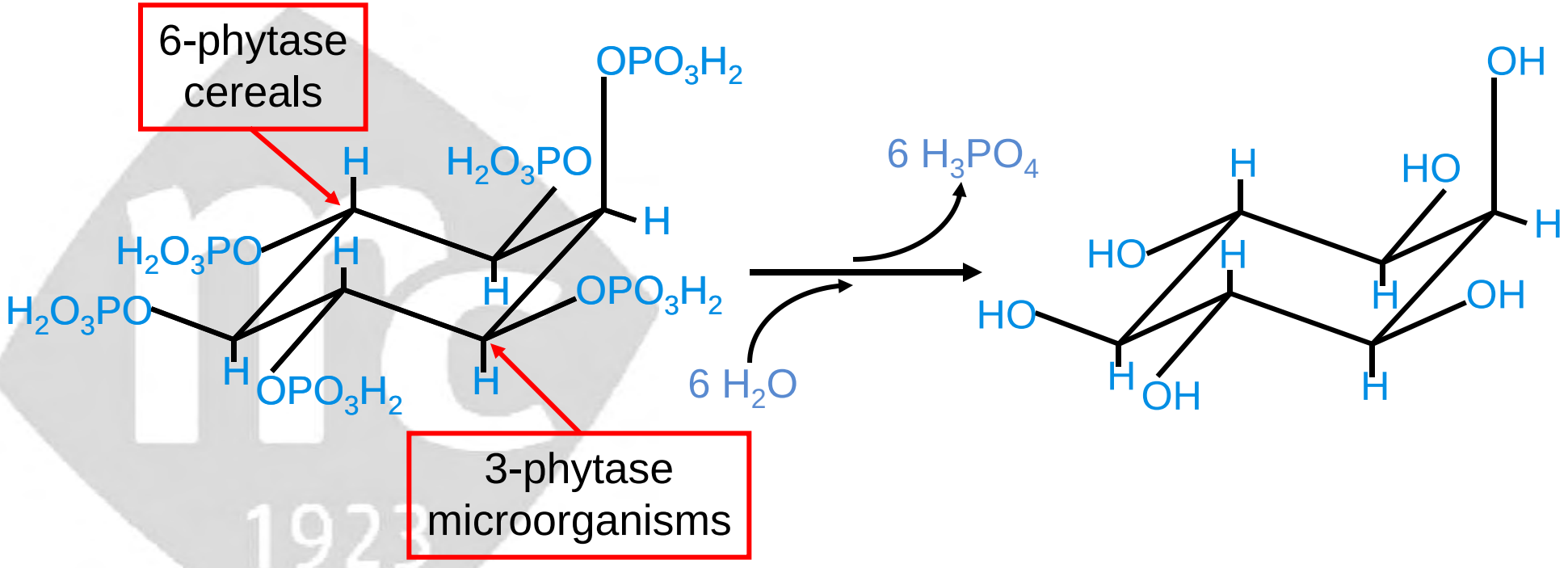
Properties of Phytic Acid

- Strong binder of metal ions
- Inhibition of microorganisms
- Inhibition of enzymes

Action of Phytases on Phytate

Phytate **Myo-inositol**



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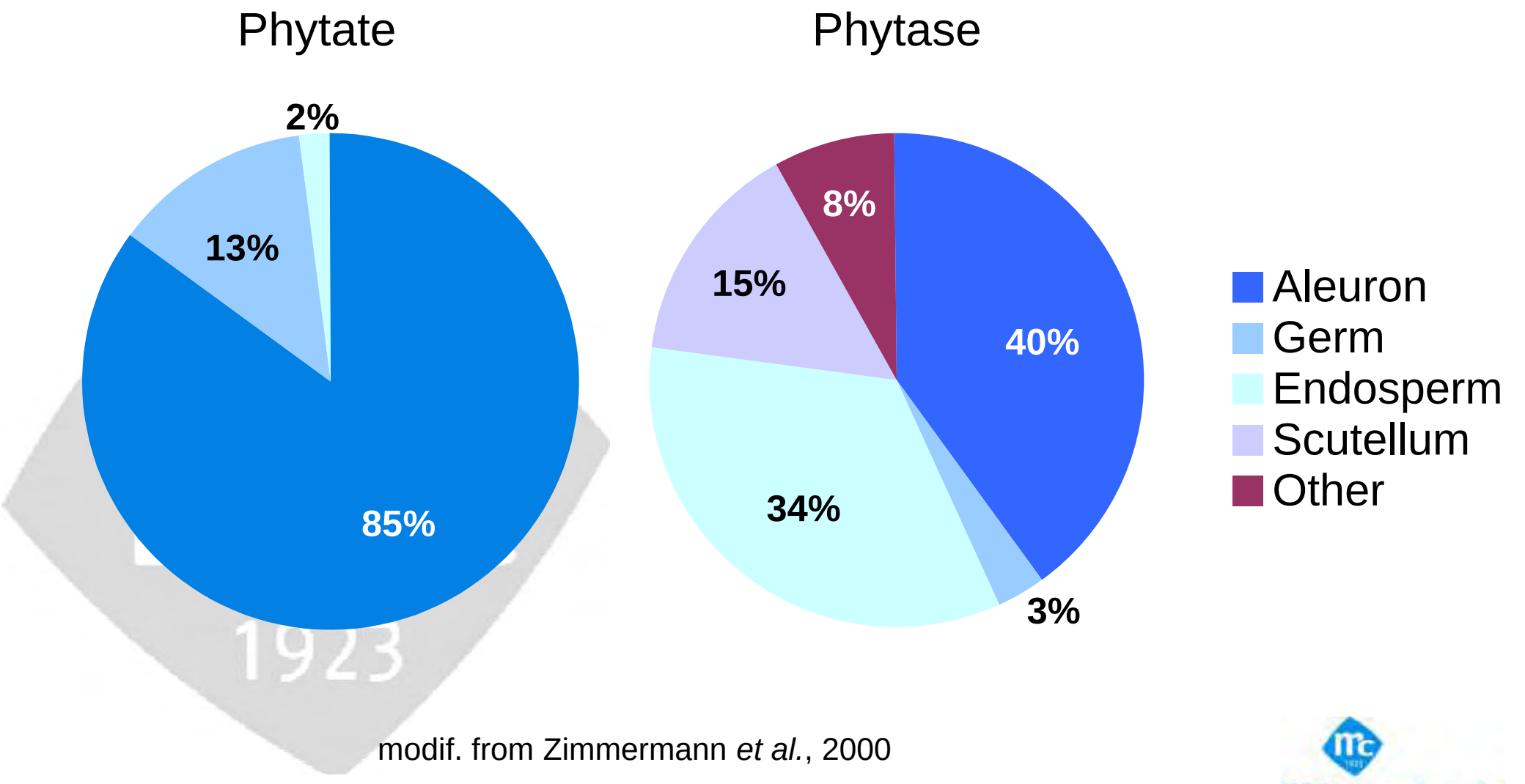
Distribution of Phytate and Phytase in Wheat



modif. from Zimmermann *et al.*, 2000

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Effects of Microbial Phytase in Baking

- Equilibration of natural fluctuation of phytase content in wheat
- Improvement of iron & mineral bioavailability
- Enhances yeast and sour dough fermentation
- Improves dough stability
- Increases volume yield

Thank You!

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