



Degradation of Storage Proteins in Different Cereals by Peptidases Induced by Germination

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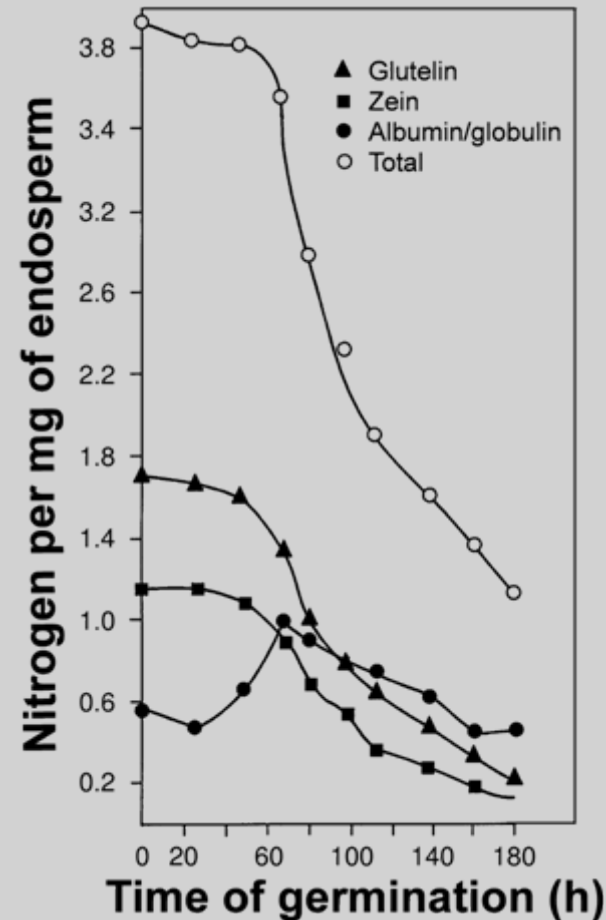
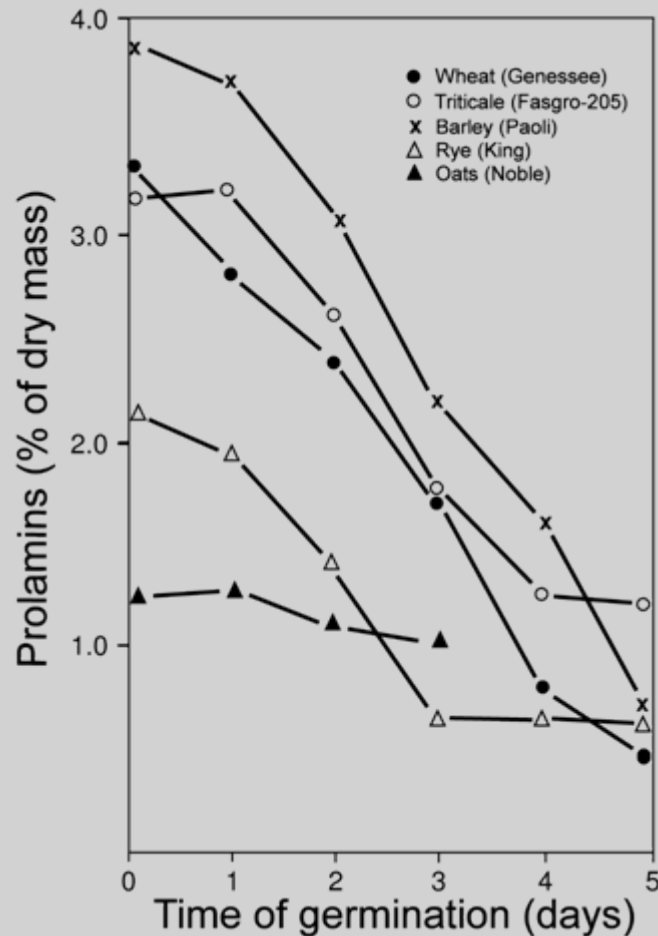
- **Previous studies**
- **Objectives**
- **Results**
 - **Degradation of storage proteins**
 - **Amylase and protease activities**
 - **Changes of folates**
- **Possible applications**
- **Conclusions**

Introduction



- **Degradation of storage proteins of wheat during germination has repeatedly been described in literature**
- **No systematic studies on the degradation of single protein fractions and types under the same conditions of germination**
- **No comparative studies including different cereal species regarding single protein fractions and types**
- **Very few information on how germination affects bioactive constituents such as vitamins and dietary fibre**

Examples: Protein Degradation During Germination

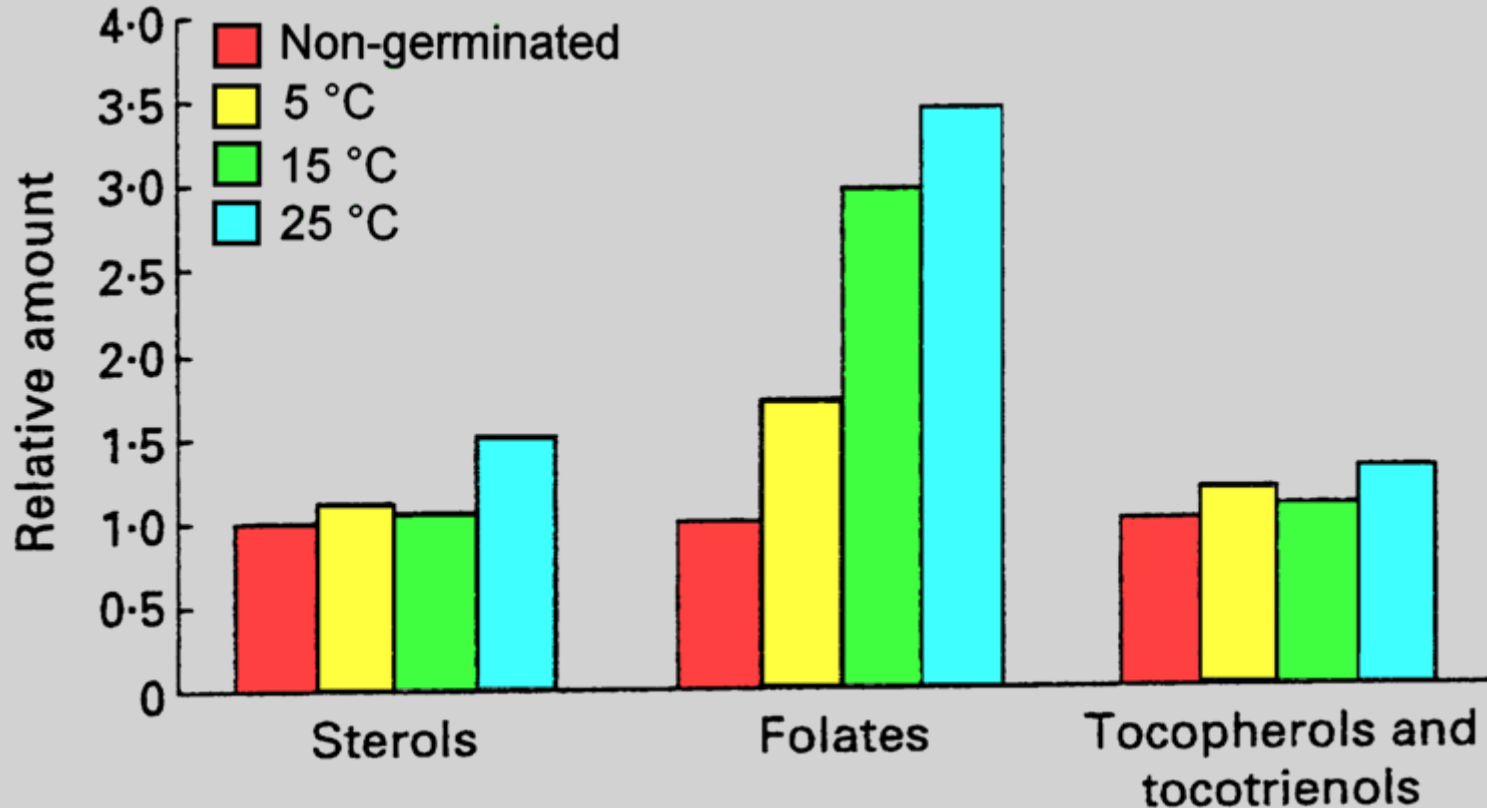


Amount of protein decreases by 20 to 80 % depending on the species

Example: Bioactive Constituents



Effect of 6 day germination of rye on the levels of bioactive constituents



In particular the concentration of folates is increased by germination

Objectives



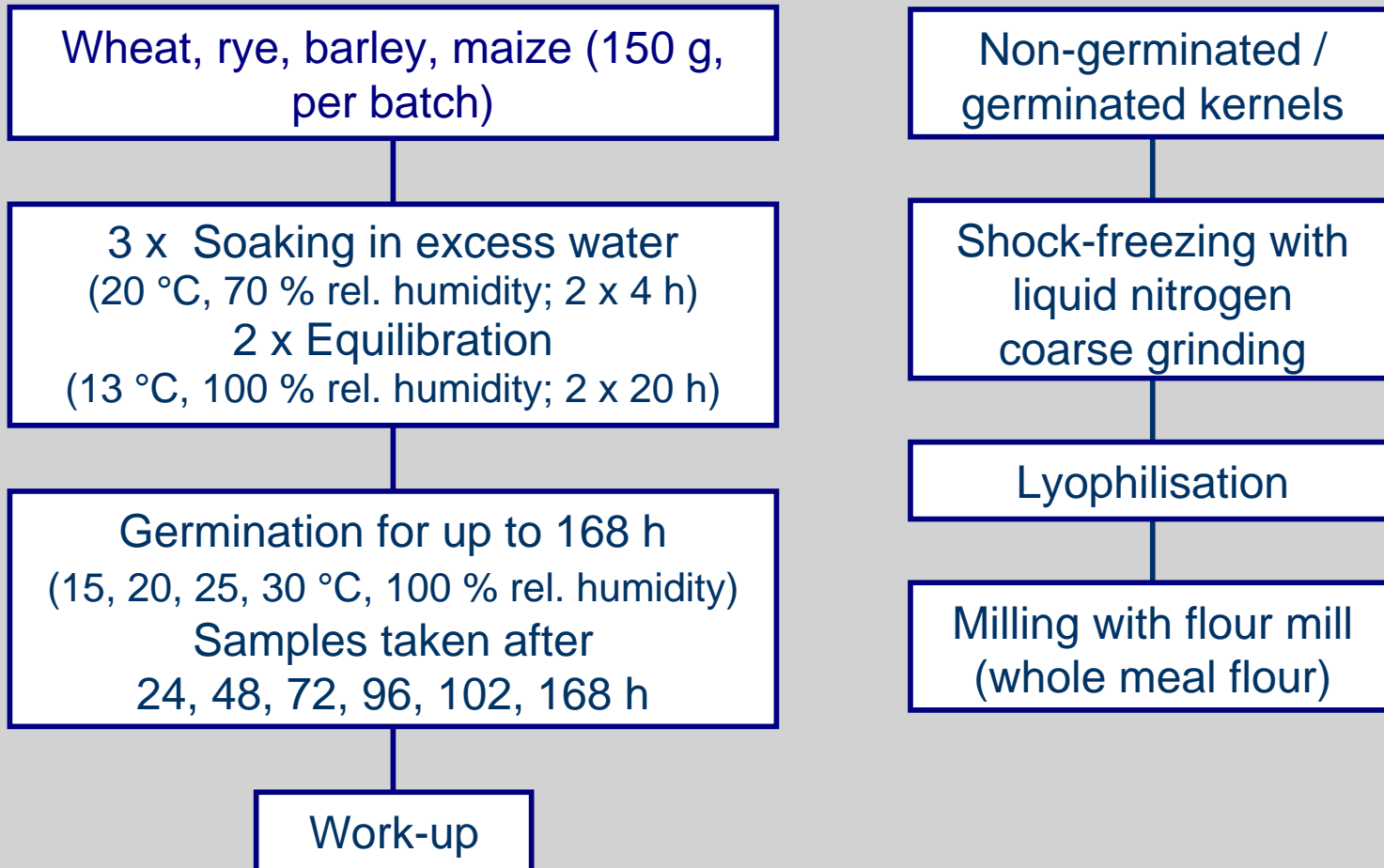
- **To monitor the degradation of protein fractions and single protein types in wheat, rye barley and maize during germination**
- **To monitor how germination affects enzyme activities**
- **To increase the amount of folates in wheat by germination and subsequent fermentation**
- **To use germinated wheat as an ingredient in the production of bread with increased folate content**

Germination



Germination

Work-up



Course of the Germination (Wheat cv. Tommi)



Example: germination at 25 °C



non-germinated



48 h



72 h



96 h



102 h

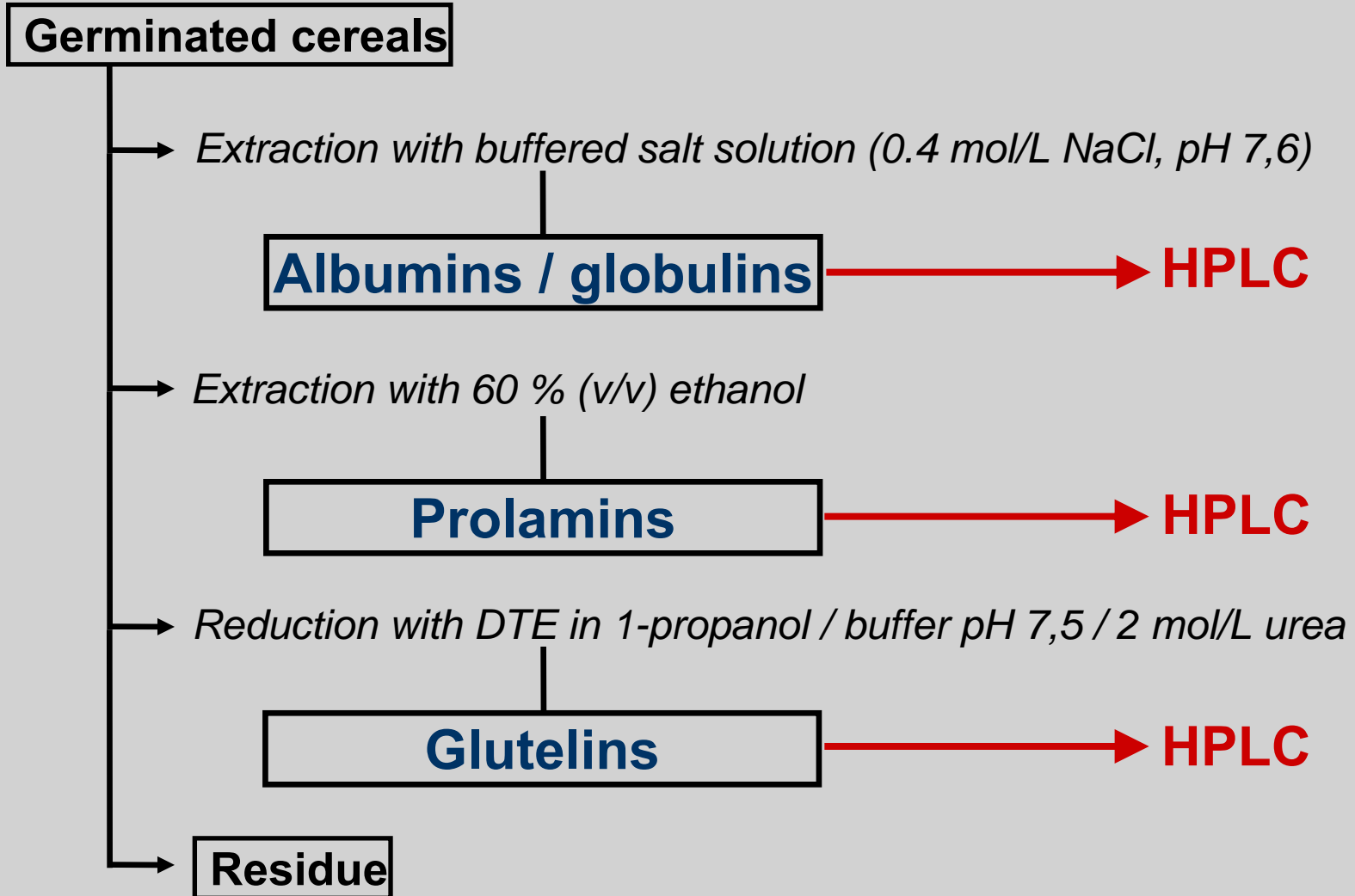


102 h

Protein Degradation



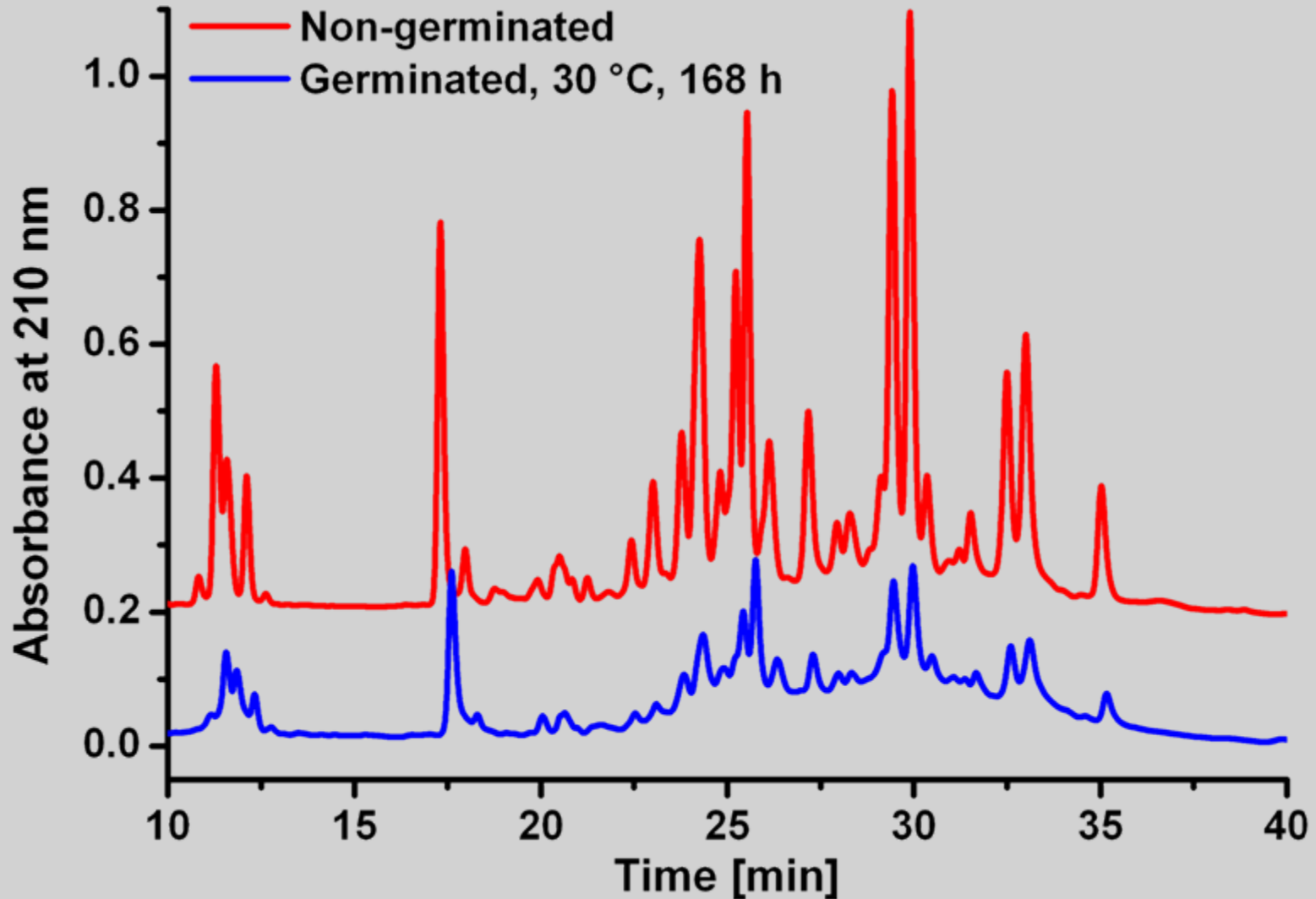
Extraction-/HPLC-Method according to Wieser (1998)



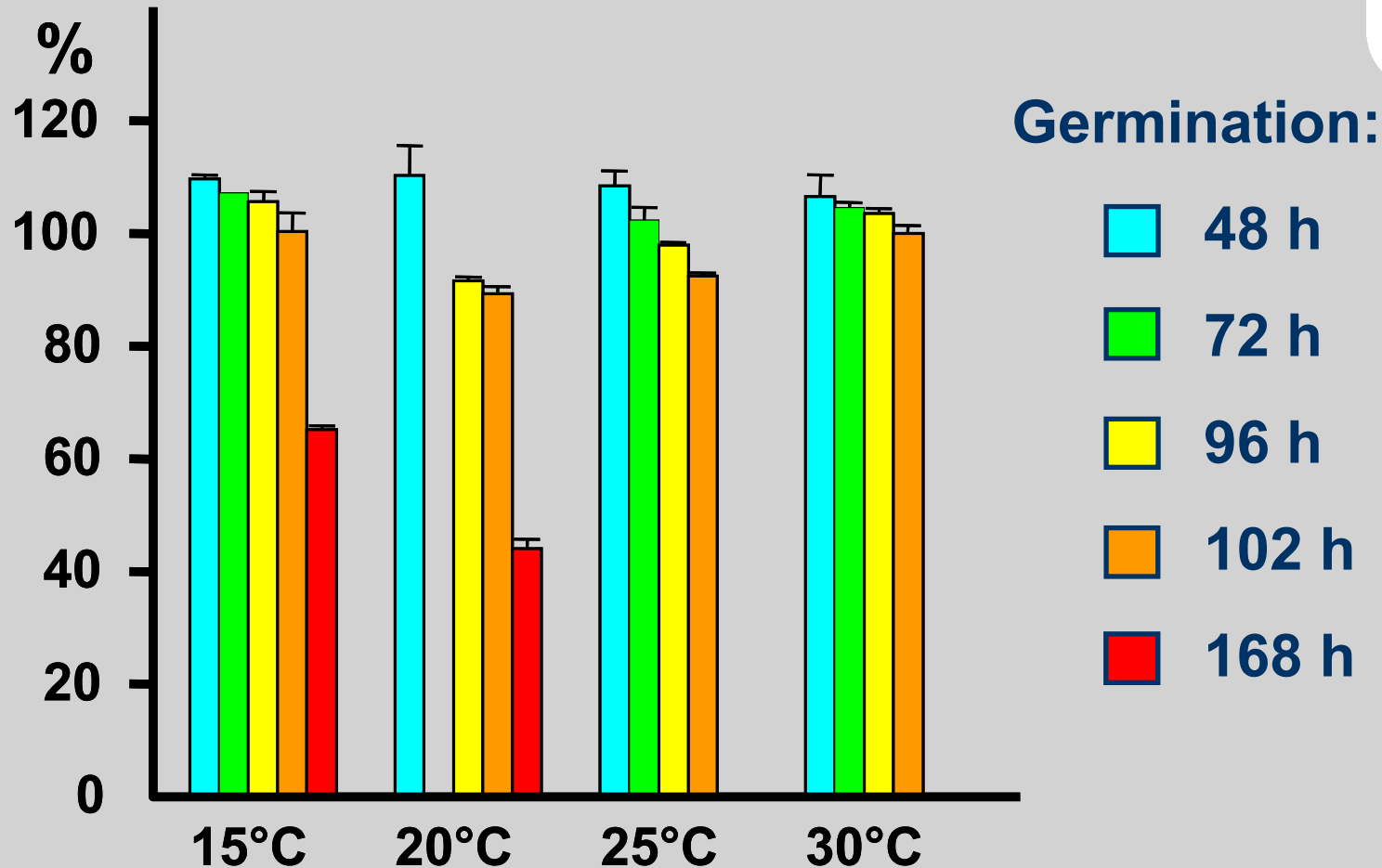
Example: Germination of Wheat at 30 °C



HPLC-pattern of gliadins

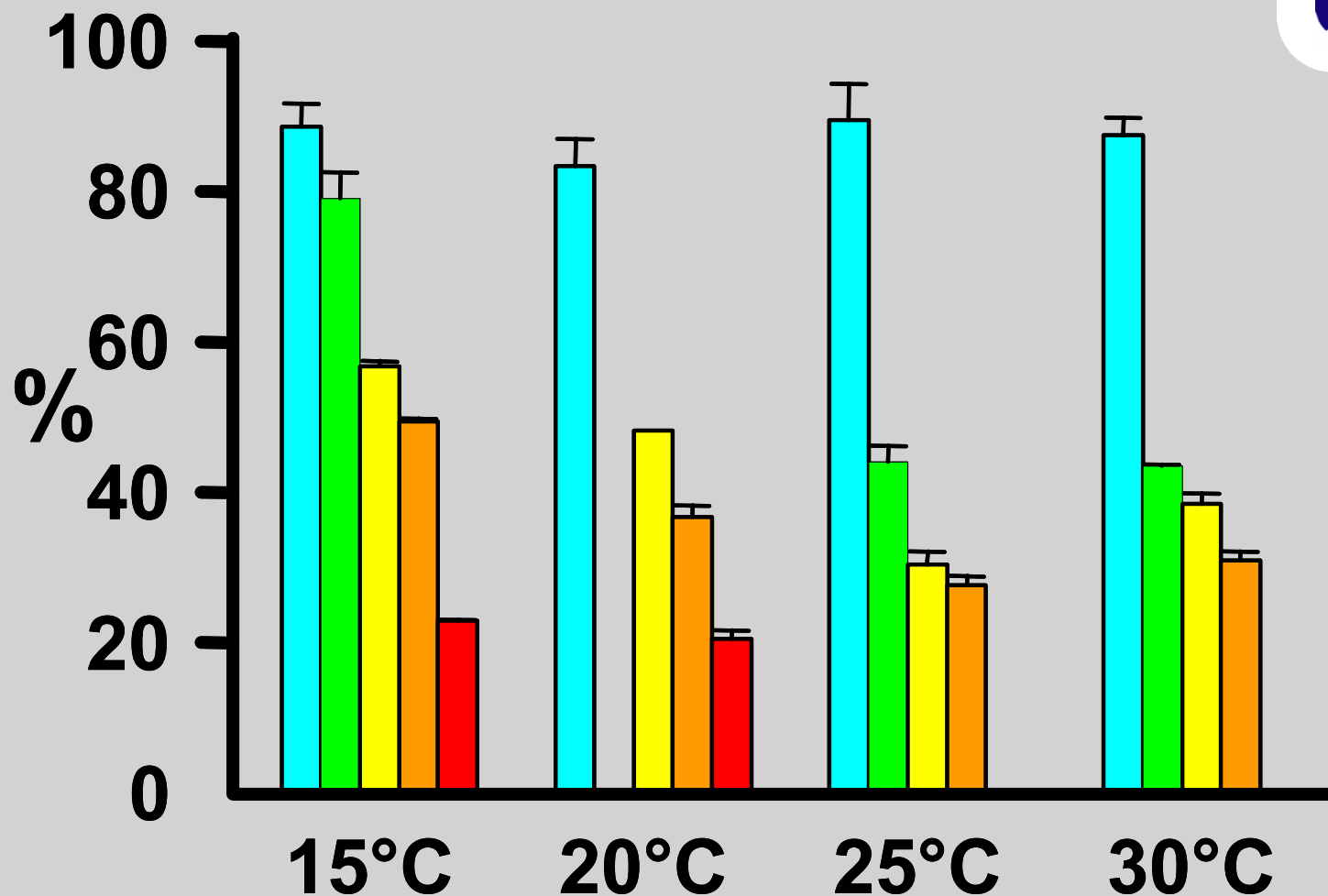


Wheat: Degradation of Total Gliadins



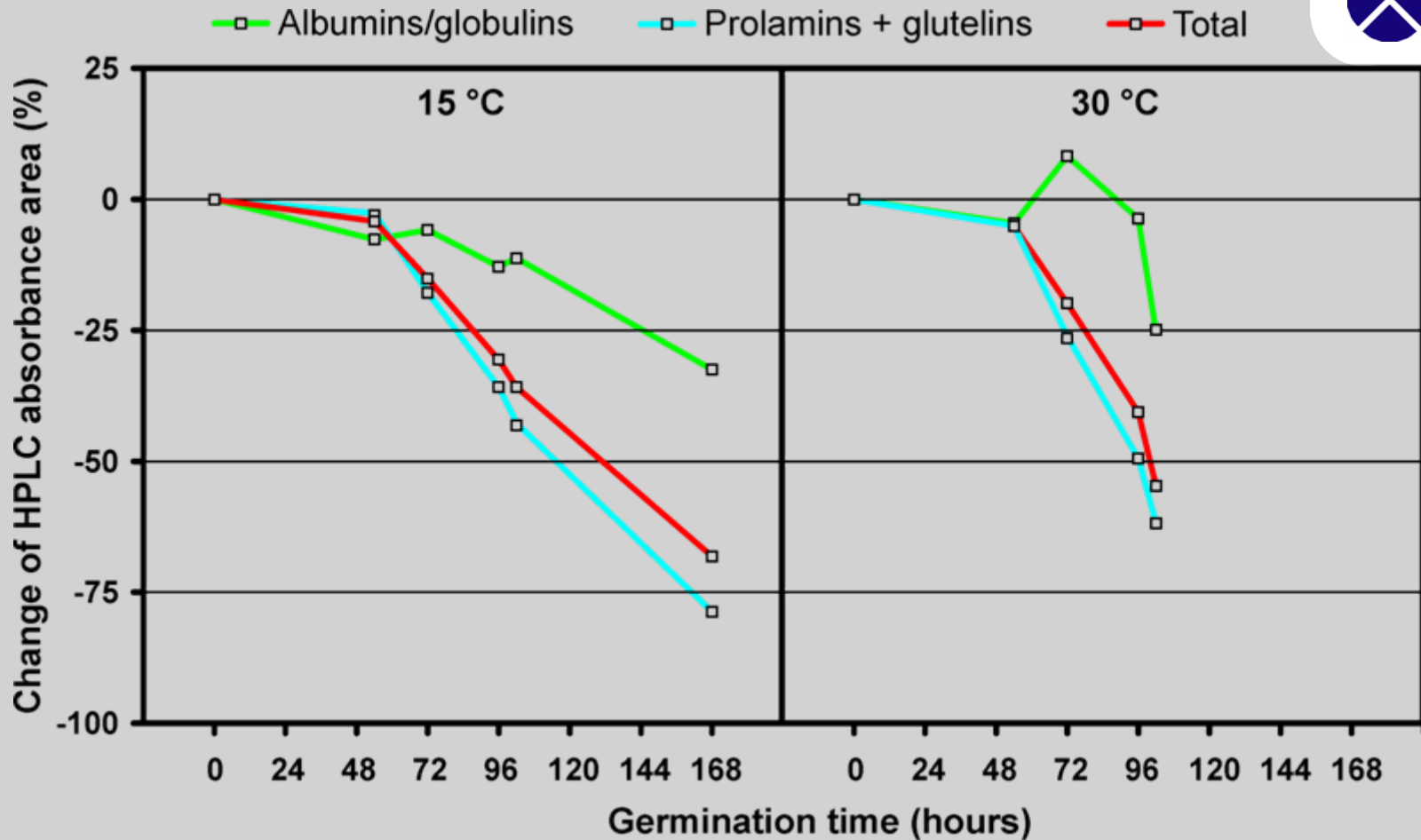
Initial increase because of partially hydrolysed glutenins that are soluble in 60 % ethanol

Wheat: Degradation of Glutenins



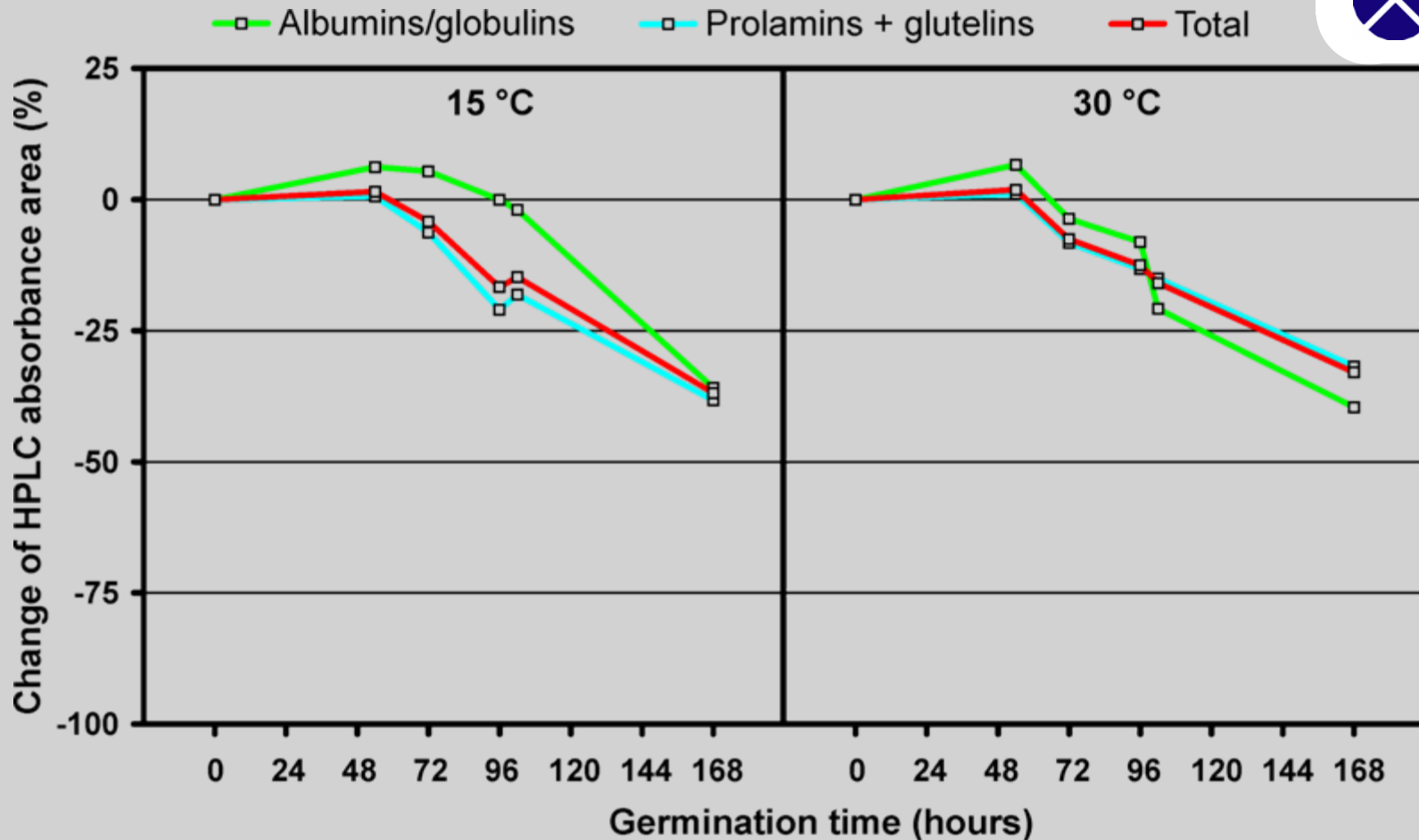
Germination: ■ 48 h ■ 72 h ■ 96 h ■ 102 h ■ 168 h

Protein Degradation in Rye



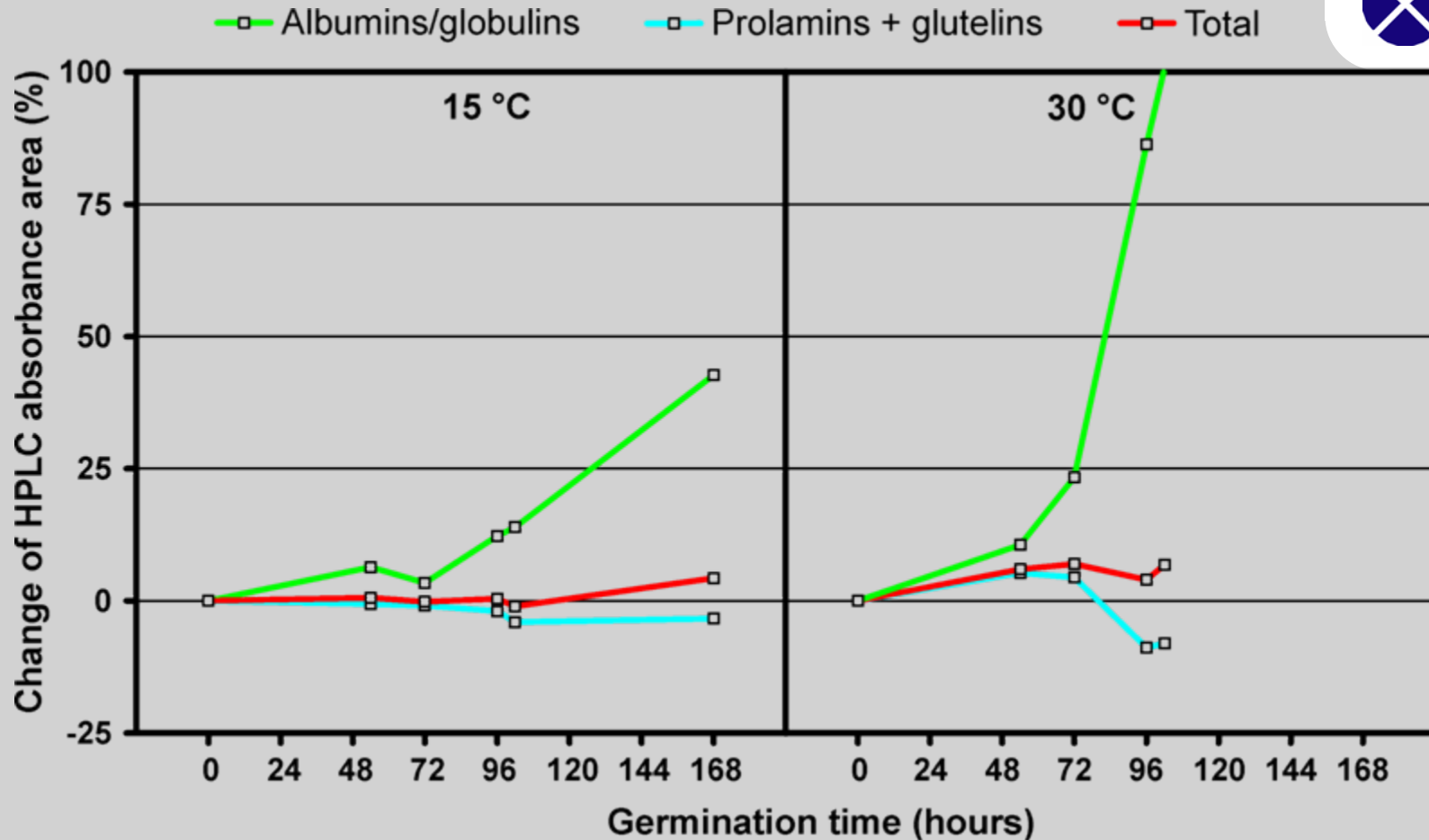
Storage proteins: - max. 80 % degraded
- 15°C stronger than 30°C

Protein Degradation in Barley



Storage proteins: - max. 40 % degraded
- 15°C = 30°C

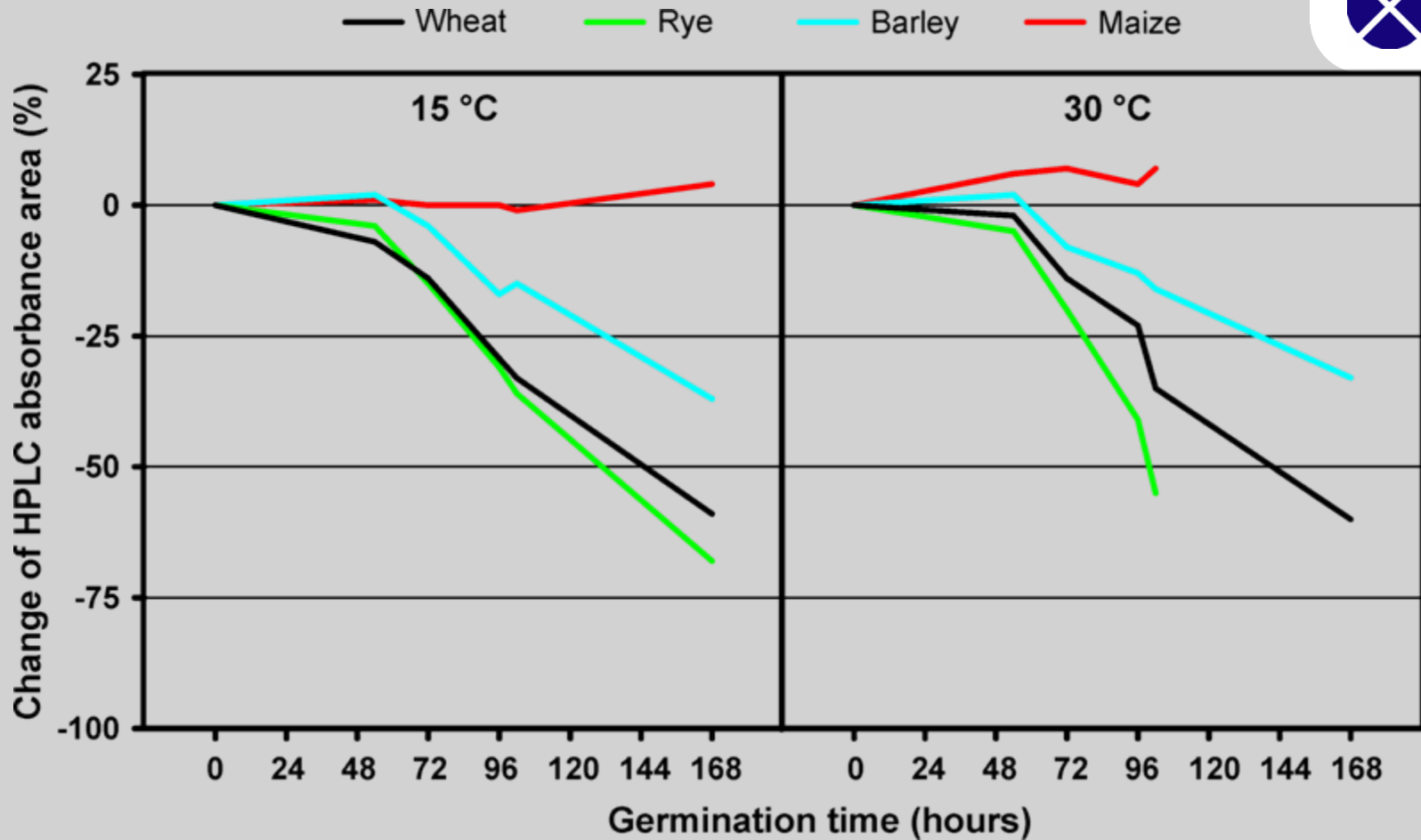
Protein Degradation in Maize



Storage proteins: NO degradation (solvent?)

Alb/Glob: increase (degraded storage proteins)

Comparison: Wheat – Rye – Barley- Maize

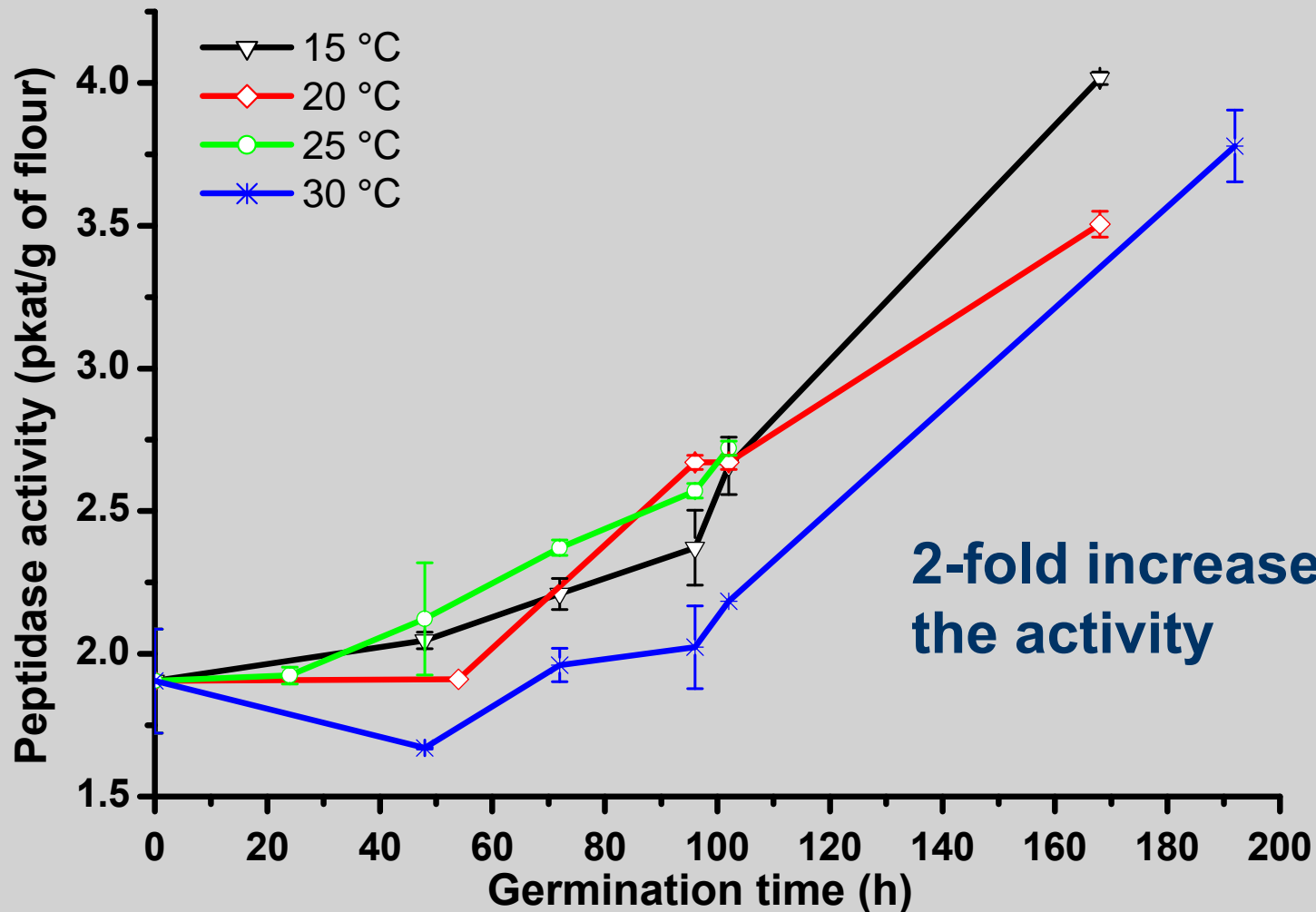


Total proteins: - rye \approx wheat > barley > maize
- 15 °C \approx 30 °C

Peptidase Activity: Wheat cv. Tommi



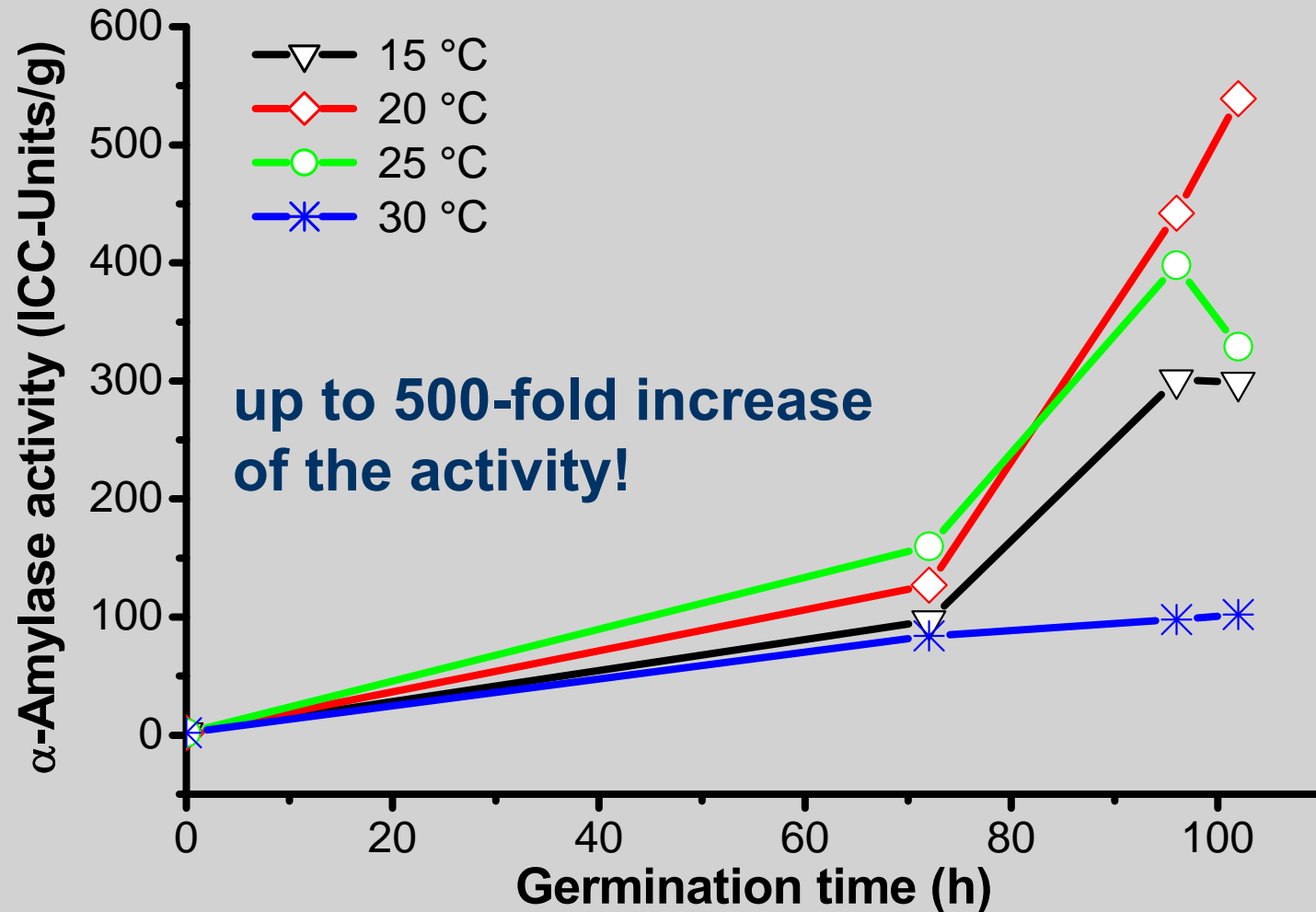
Substrate: azocaseine, pH = 4.5



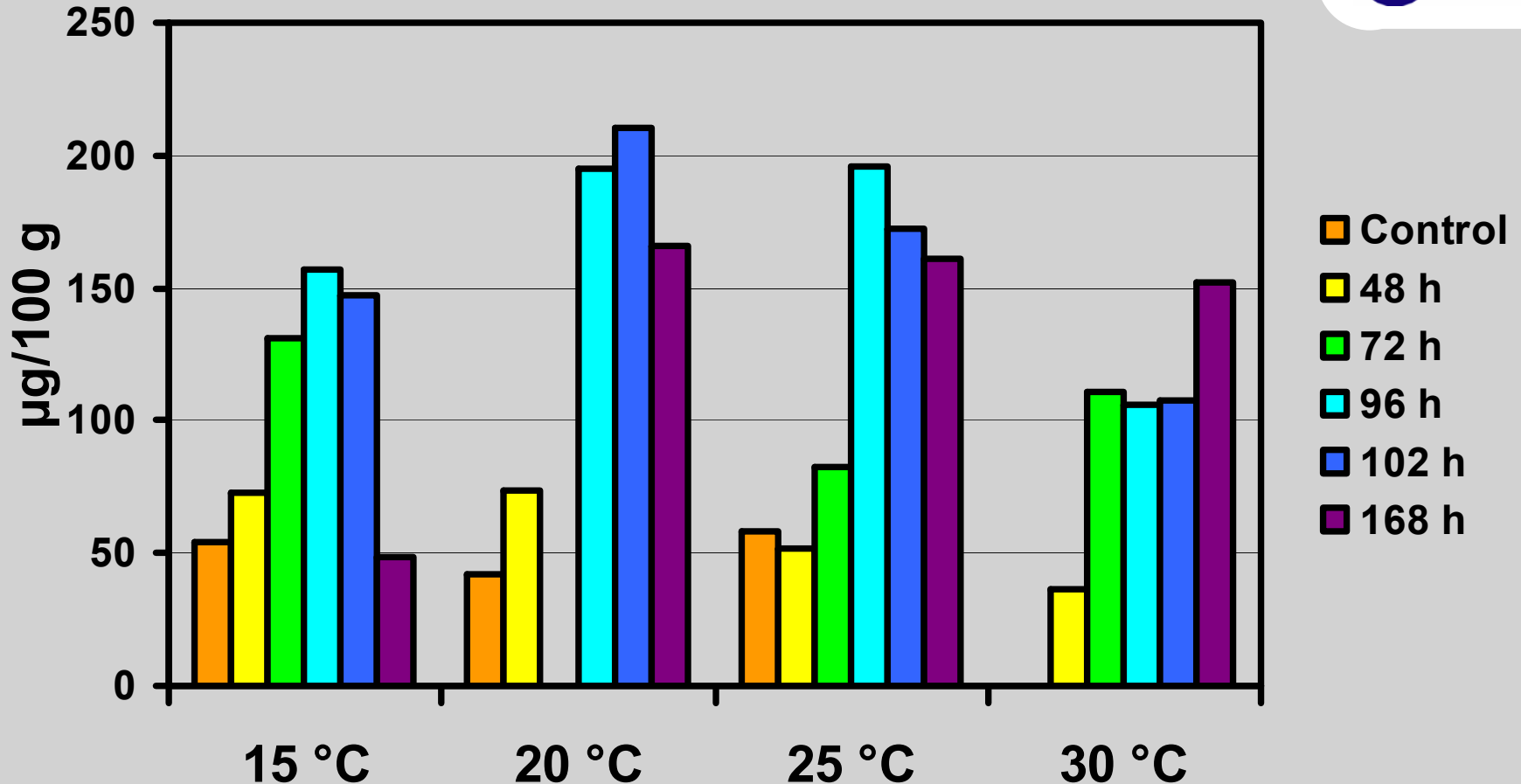
α -Amylase Activity: Wheat cv. Tommi



Determination according to ICC Standard No. 108



Total Folates as Affected by Germination



→ At 20 to 25 °C and 96 to 102 h of germination the highest concentration of total folate is obtained (4-fold increase)

Possible Applications



- **Preparation of gluten-free food ('detoxification'), e.g. wheat starch, beer, non-alcoholic drinks**
- **Oral therapy of coeliac disease ('PEP-Pill'), e.g. as prophylactic dietary supplement or medicament for preventing intestinal damage**
- **Preparation of total protein hydrolysates for amino acid analysis, seasonings or hypoallergenic foods**
- **Application in bread making to produce bread with increased concentration of bioactive constituents, e.g. folates**

Possible Applications



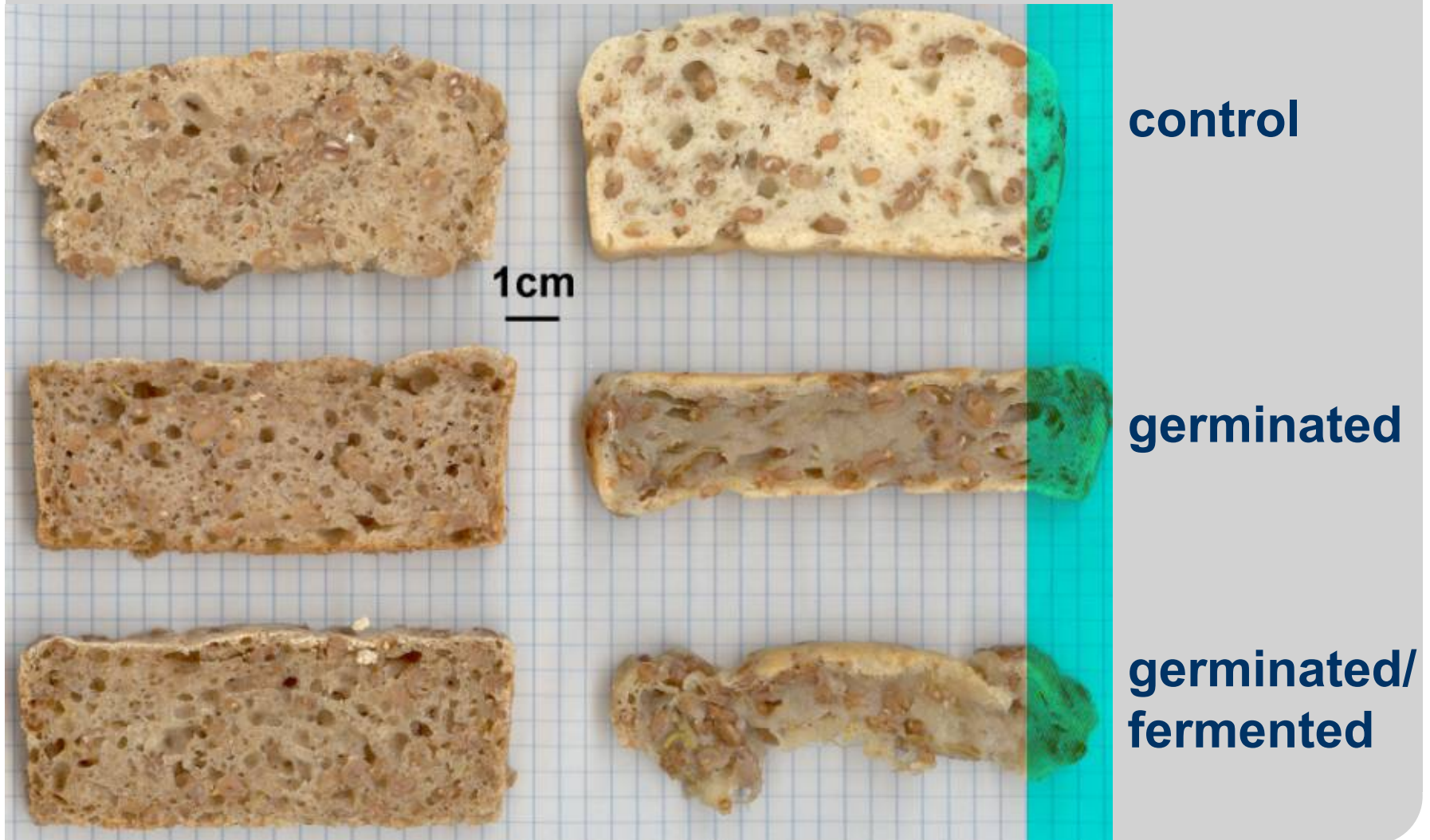
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Initial Studies on Folate-Enriched Bread



Sourdough

Yeasted dough



Bread Enriched in Folates



Control

Folate-enriched

***Concentration of
total folates
(in dry matter)***

20 $\mu\text{g}/100\text{g}$

42 $\mu\text{g}/100\text{g}$

Conclusions



- **Protein degradation during germination:** in wheat glutenins are degraded first followed by gliadins. After 168 h 65 % of the total protein is degraded. Rye is comparable to wheat. In barley protein hydrolysis is weaker than in rye and stronger than in maize.
- **Amylases are strongly activated by germination, whereas peptidases are weakly affected**
- **Folates: in wheat 4-fold increase by germination**
- **Germination can be used as a tool to prepare bread enriched in folates**

Thanks to



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Thank you!