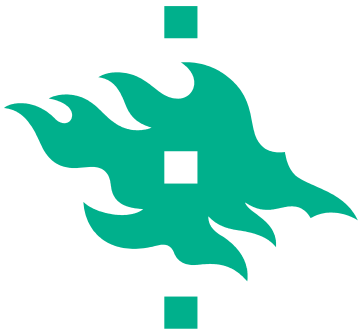




9th international oat conference

Structural, physicochemical and emulsion properties of oat proteins deamidated by protein-glutaminase

Zhong-qing Jiang, Loponen Jussi, Tuula Sontag-Strohm
and Hannu Salovaara
University of Helsinki

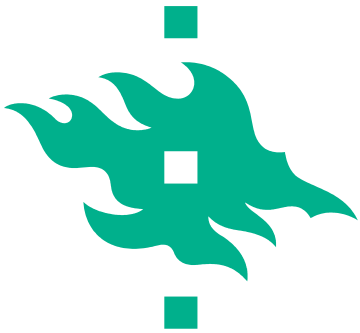


Background knowledge

Oat proteins – general knowledge

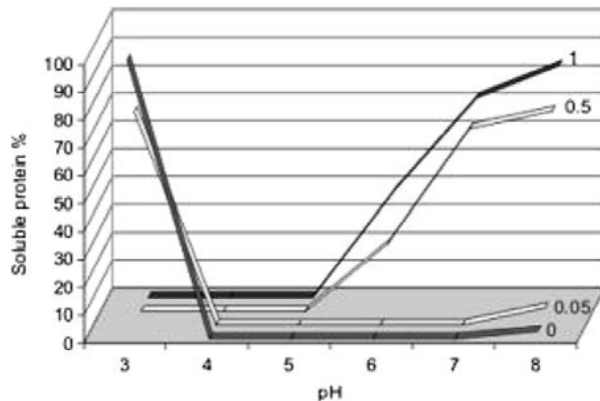
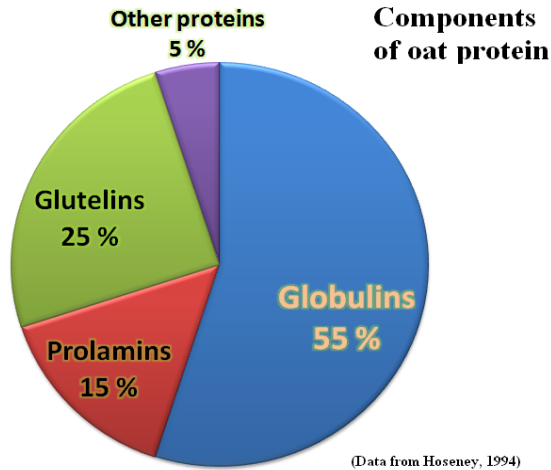
- Unique among cereal proteins
 - Concentration in grains:
15% to 20% (Mirmoghtadaie et al, 2008)
 - Good balance of amino acids
- Rarely applied in beverage food





Background knowledge

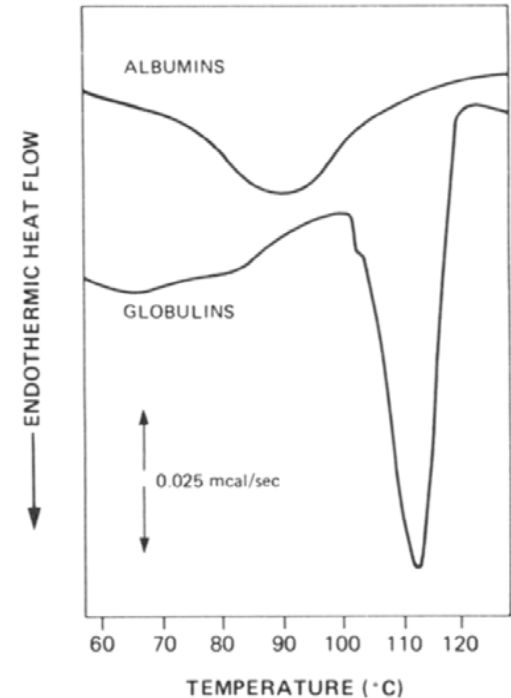
Oat globulins – Physicochemical properties



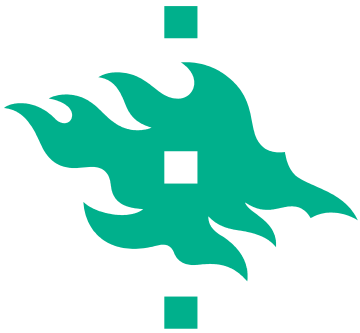
Solubility profile of oat globulin (Loponen et al., 2007)

Native oat globulin:

- Predominant in oat
- Poor water solubility
- Compact structure
- Hard to heat denaturize



Differential scanning calorimetric (DSC) thermograms of albumins and globulins from oats (Ma and Harwalkar, 1984)



Background knowledge

Existing commercial products:



0 h



24 h

Soya
Milk

Rice
Milk

Oat
Milk

Yes, you can:

“Shake before drinking”



No, you may not:

- Package it in transparent bottles
- Further process it

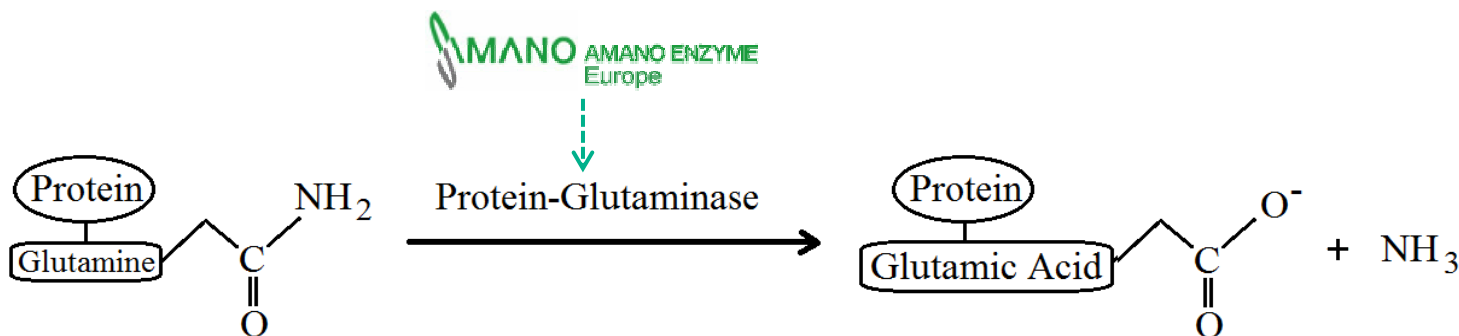


How to improve?



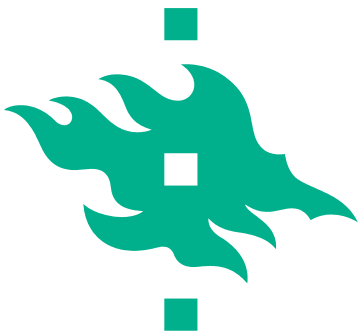
Background knowledge

A Novel Enzyme: Protein-glutaminase



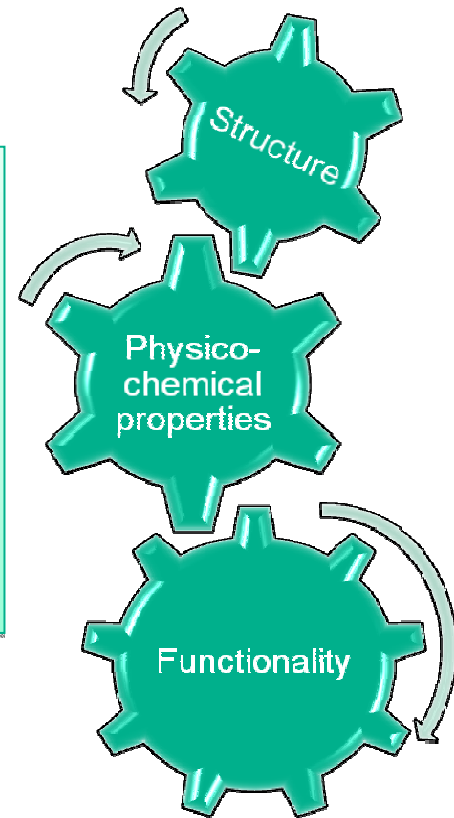
Protein-glutaminase deamidation of food proteins

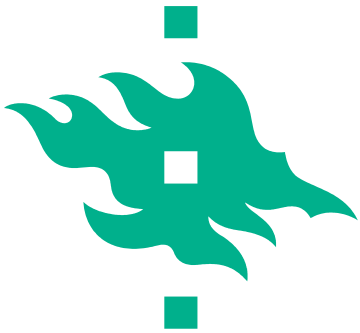
Protein	Solubility ^a	Structure	Emulsifying property	References
Maize α -zein	Increased	More flexible	Improved	Yong et al, 2004
Wheat gluten	Increased	More flexible	Improved	Yong et al, 2006
Skim milk protein	Increased	- ^b	Improved	Miwa et al, 2010



Aims of this study

- 1) Improve the **functionality** of **oat proteins**;
- 2) Test the performance of **protein-glutaminase** on **oat proteins**;
- 3) Study the relationship between the **structural**, **physicochemical** and **functional** properties of the modified oat proteins.

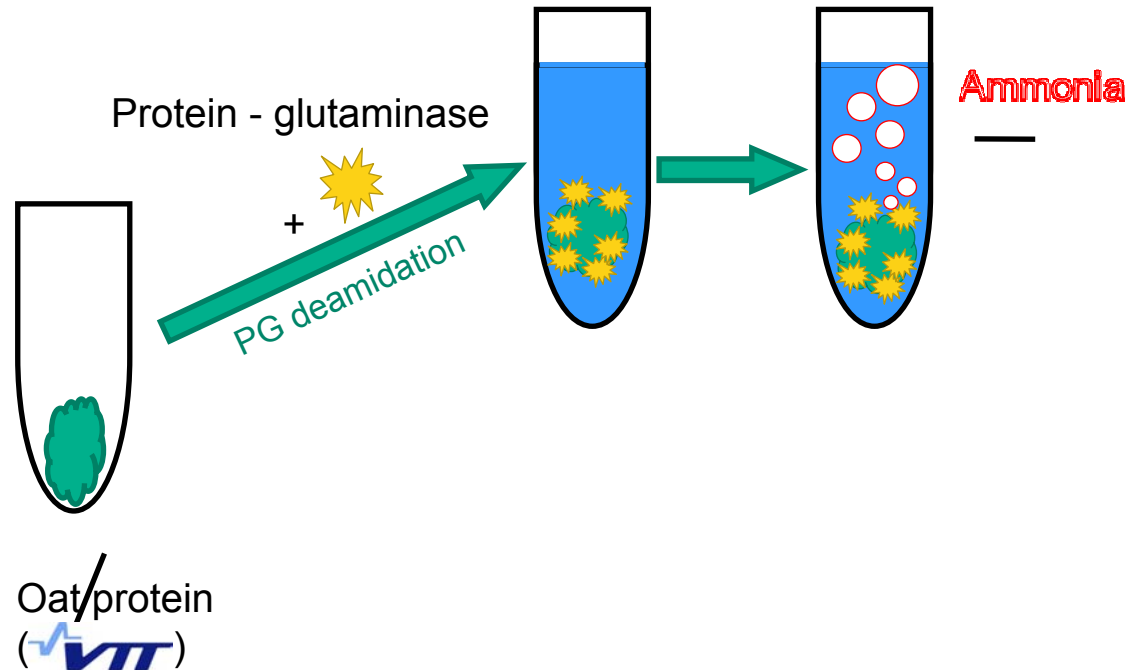


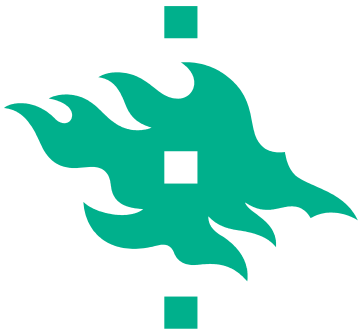


Research methods

Deamidation degree and enzyme kinetics test

- Deamidation on oat protein



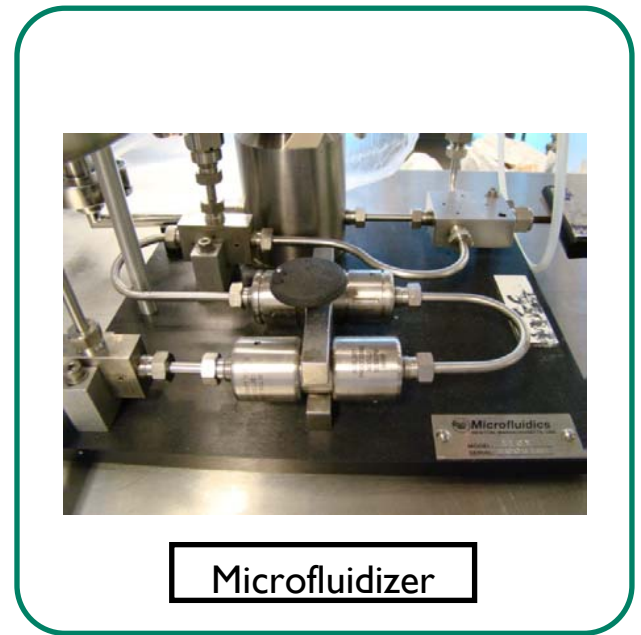
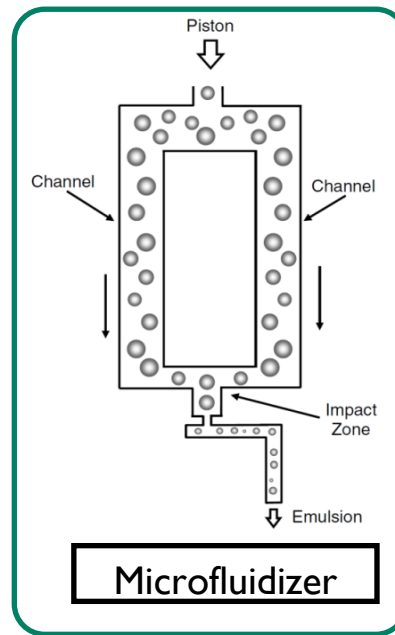
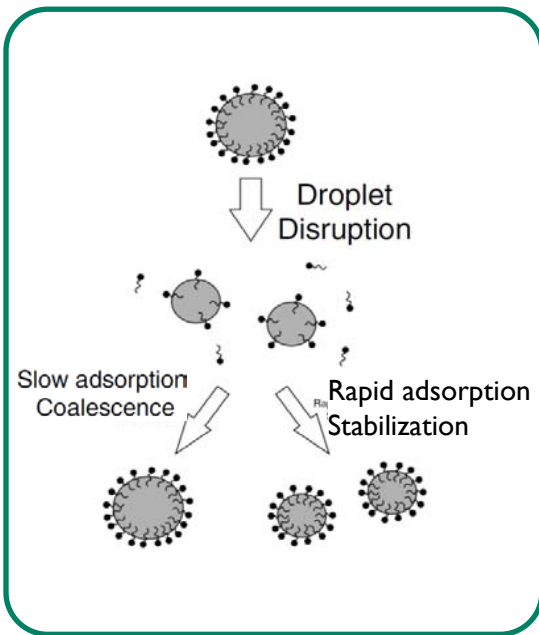


Research methods

Preparation of emulsion

- Homogenization

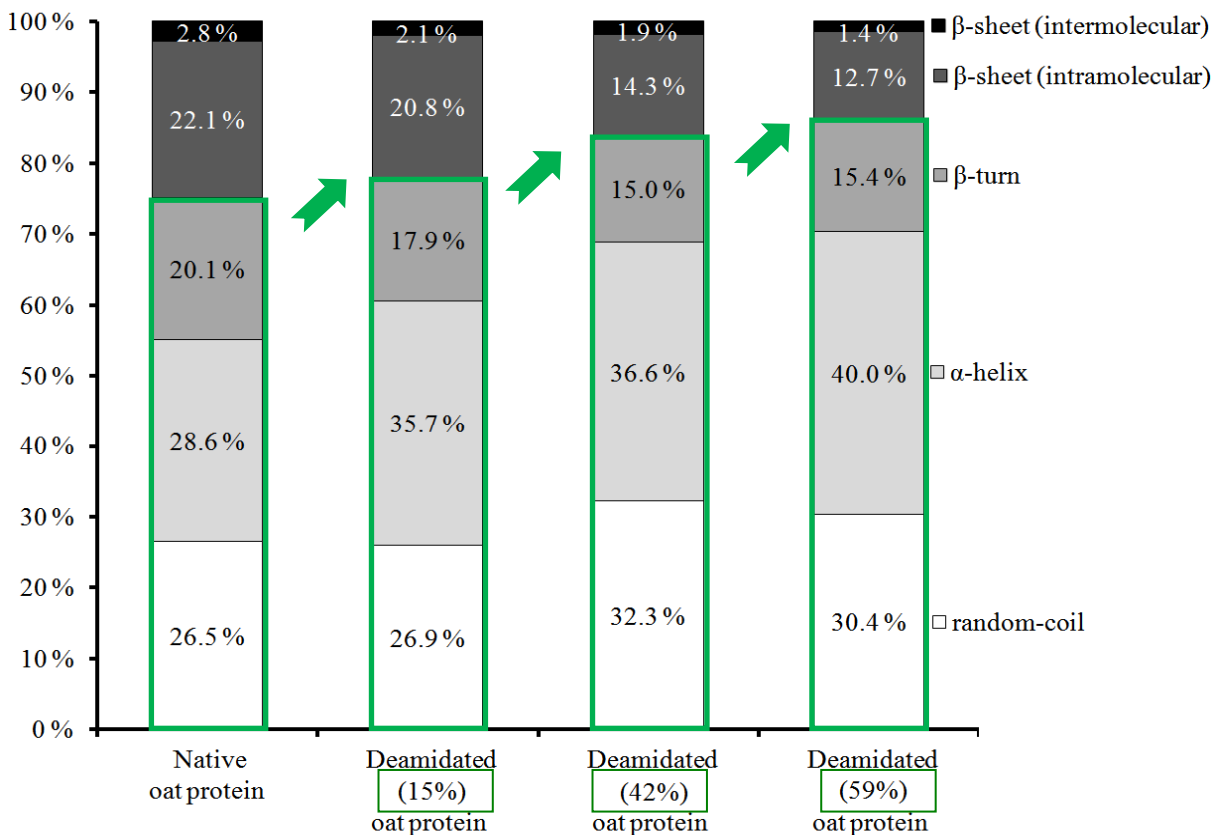
by microfluidizer at 600bar for 10 min





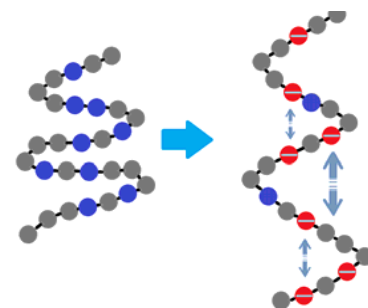
Results

Protein structure – FT-IR analysis results



Conformational flexibility

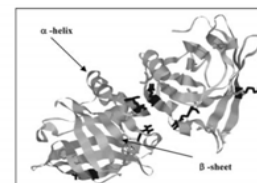
Protein secondary structure:



Compact

“unzipped”

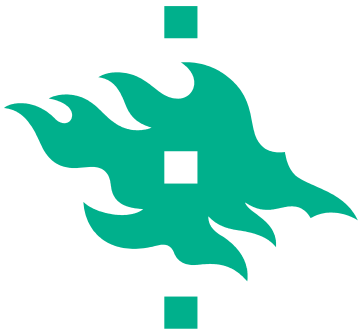
Amino acid Gluta



1.0

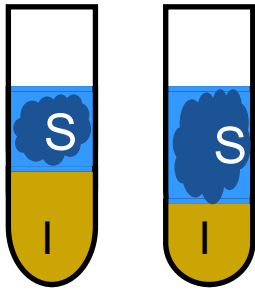
absorption (a.u.)

0.5

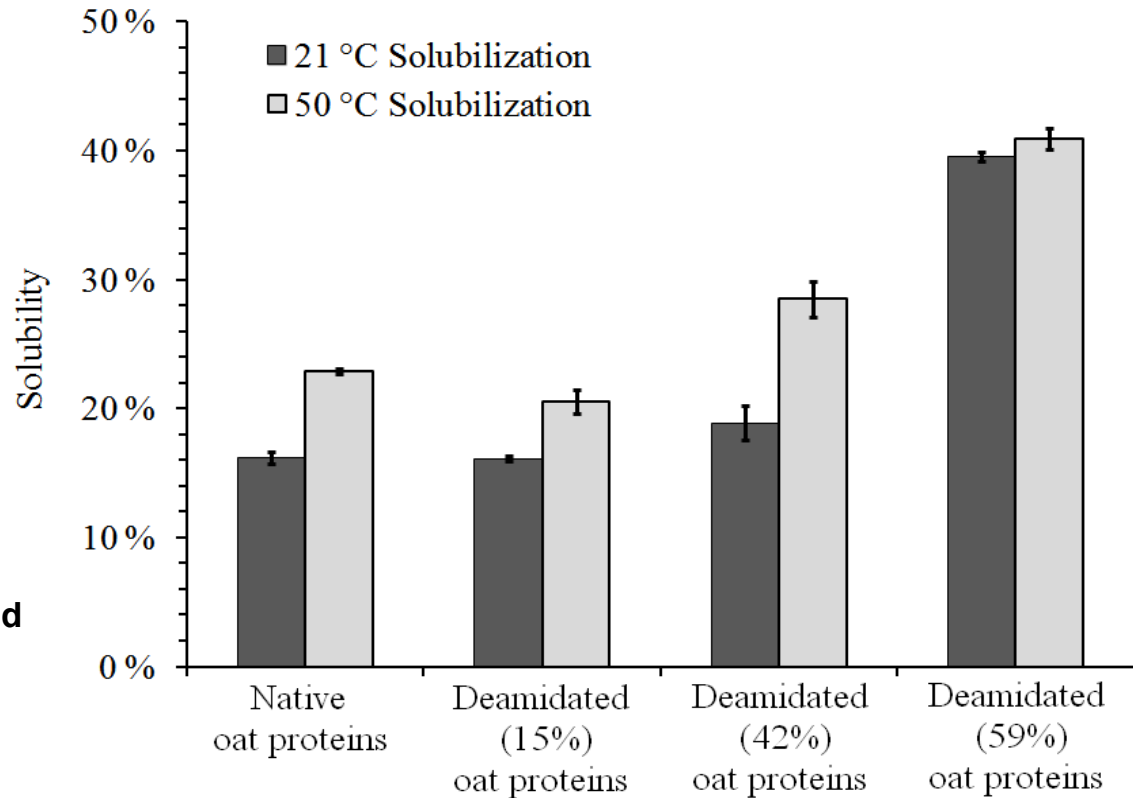


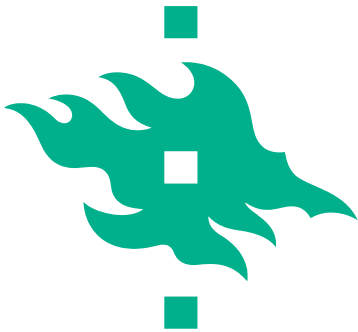
Results

Protein solubility test results



Water solubility of native and deamidated oat proteins:

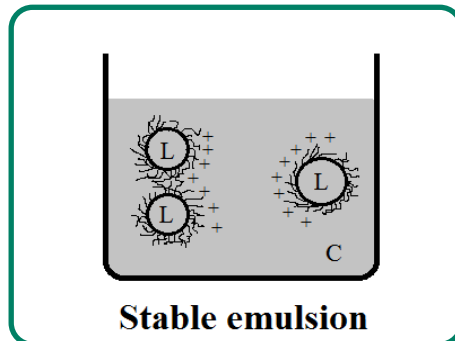
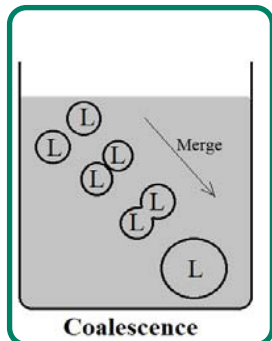
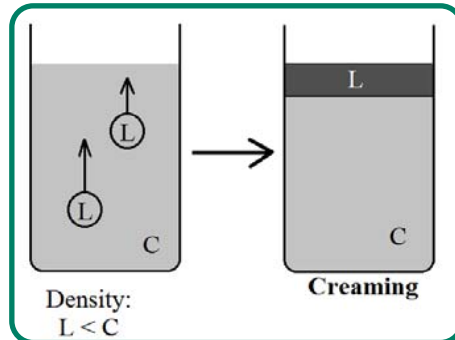
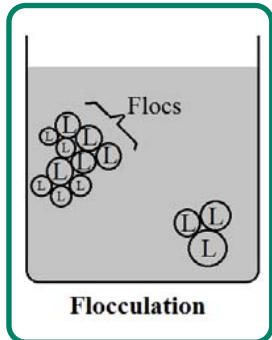




Results

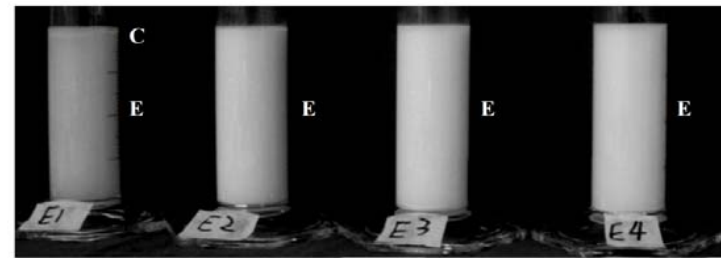
Emulsion stability

Mechanisms of emulsion stability / instabilities:

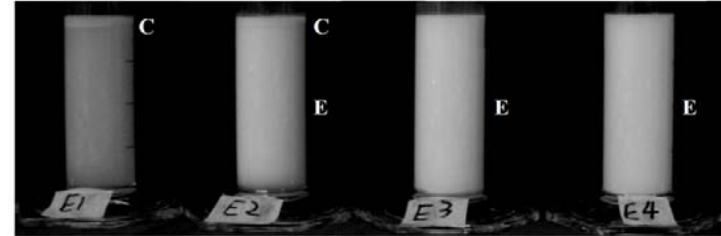


HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

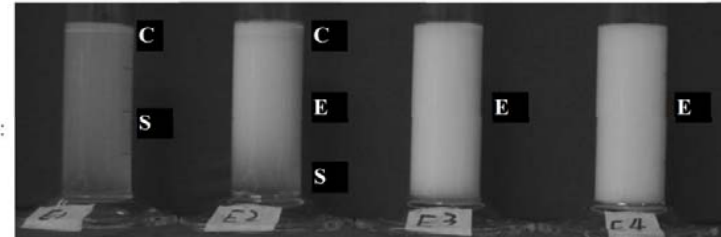
2 h:



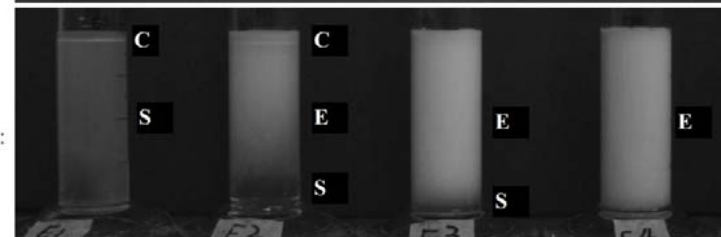
1 day:



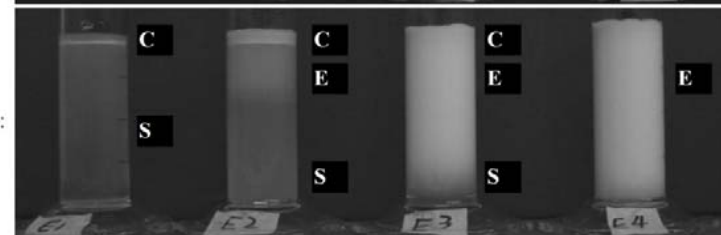
7 days:



15 days:

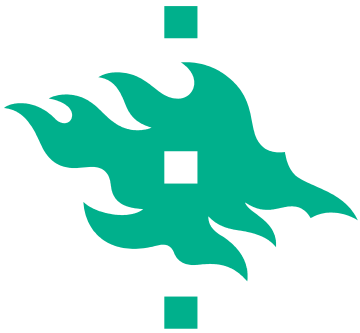


30 days:



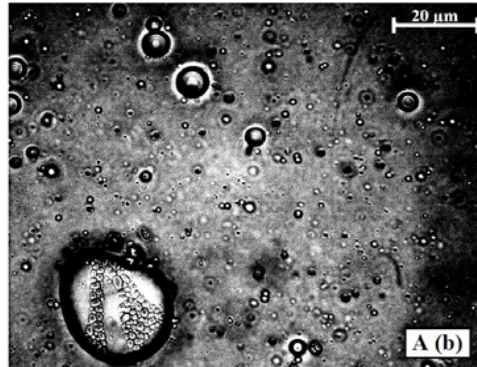
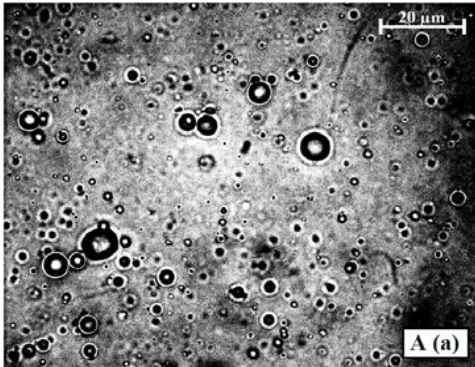
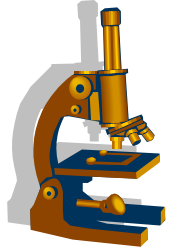
Native DD = 15% DD = 42% DD = 59%

Deamidation degree

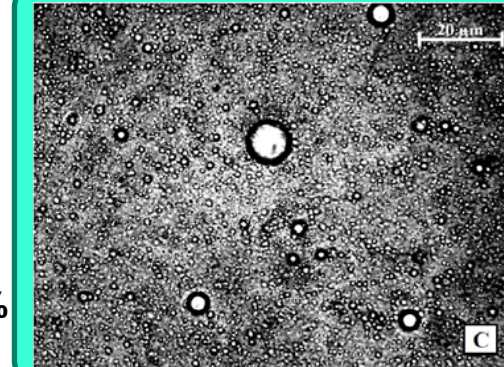


Results

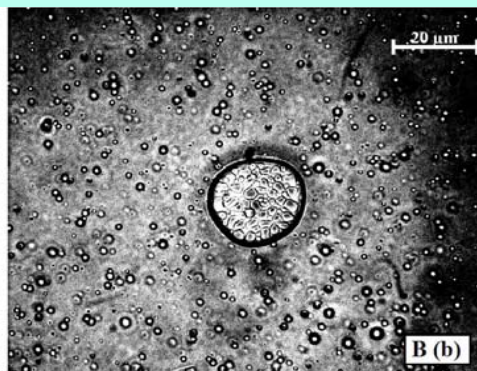
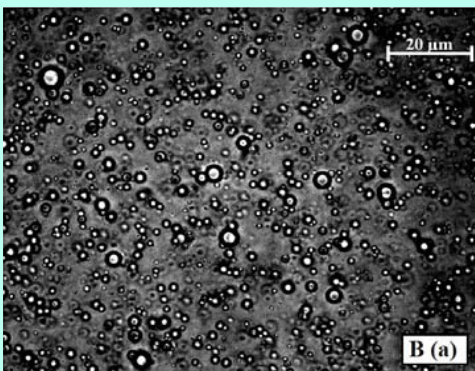
Microphotograph – Effects of deamidation degree (DD)



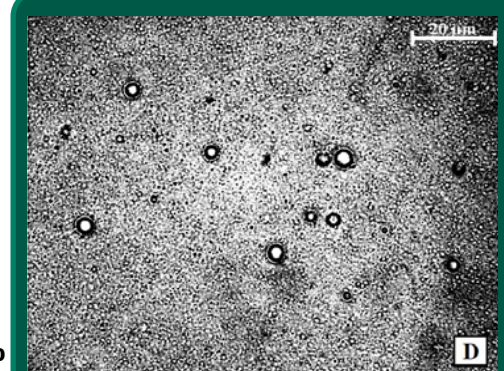
Native



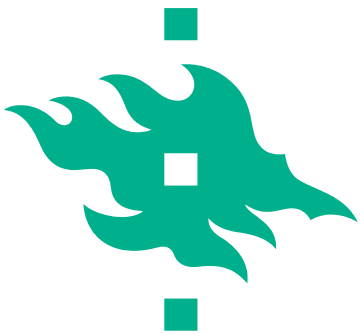
DD = 42%



DD = 15%

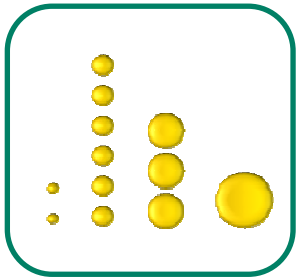


DD = 59%

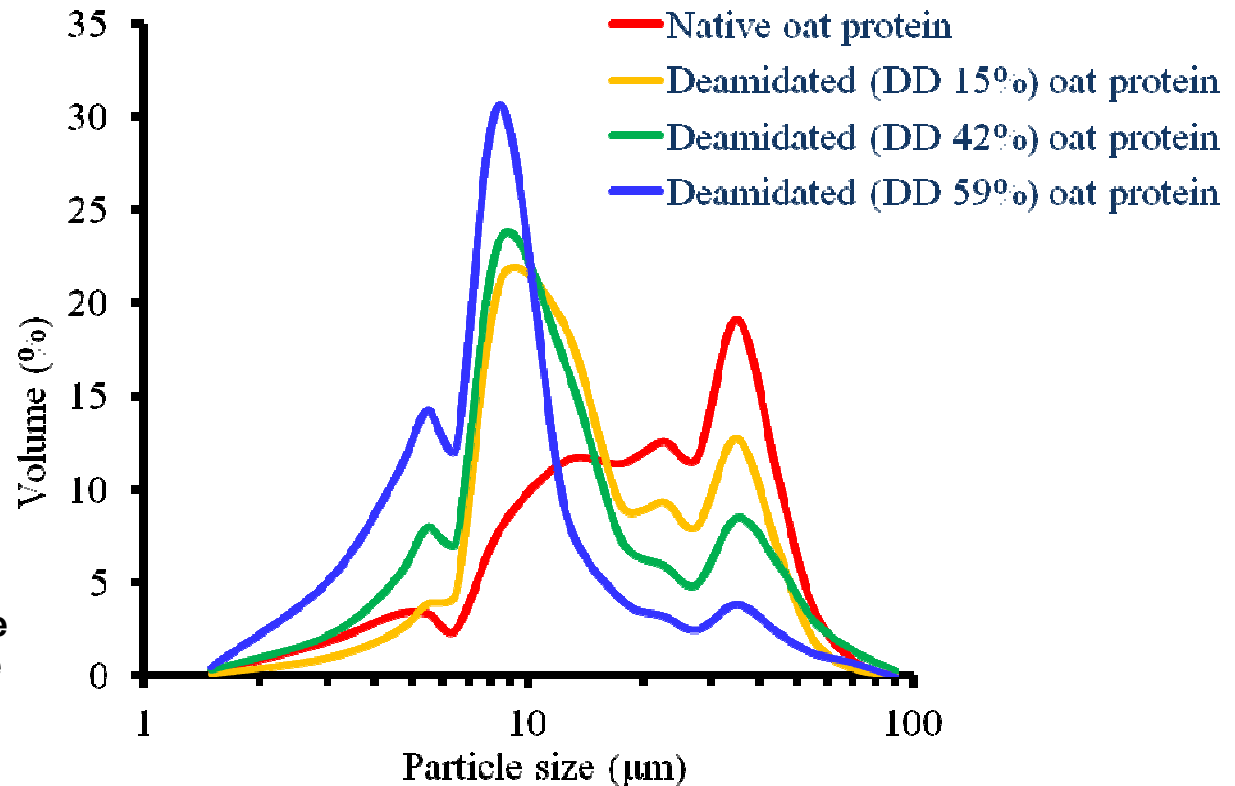


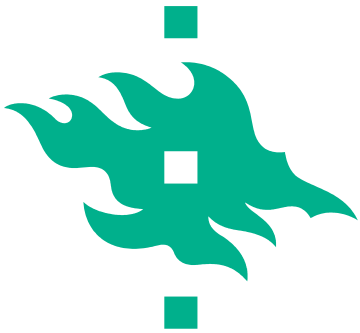
Results

Emulsion quality – emulsion droplet size distribution



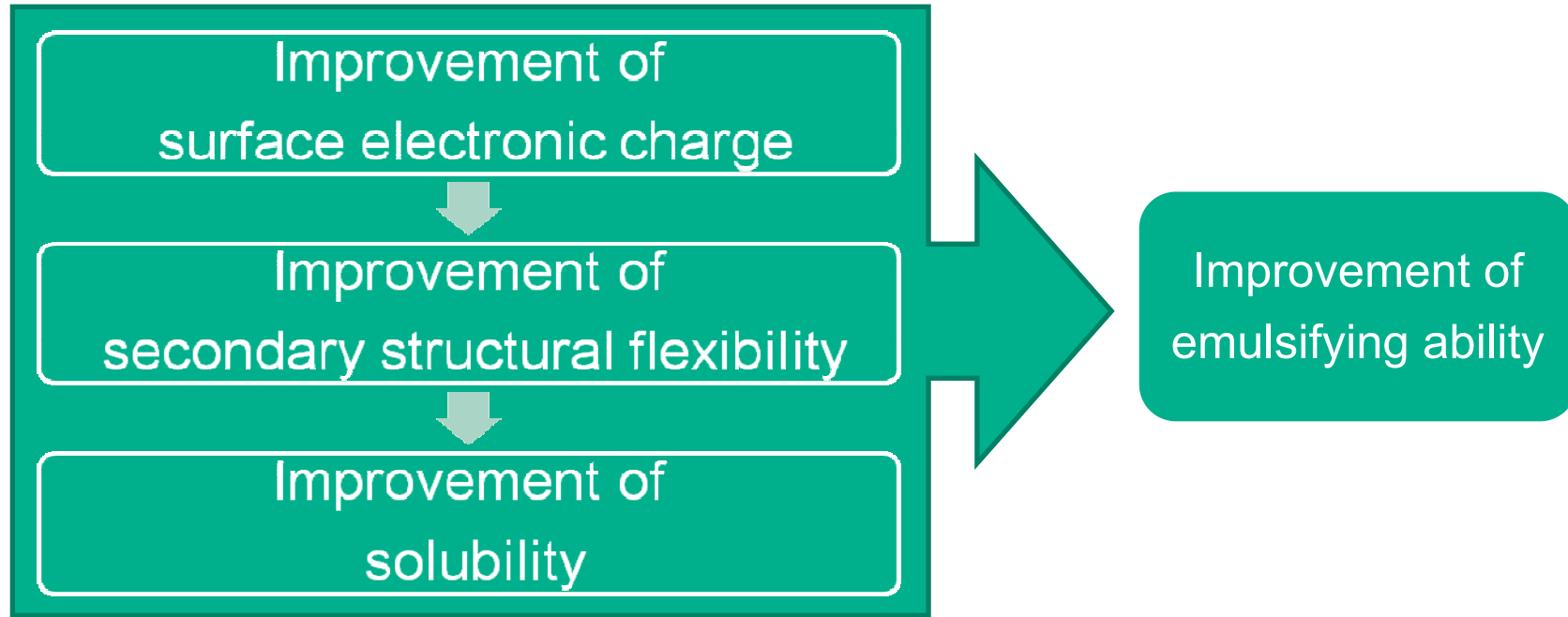
Particle size distribution of the emulsions stabilized by native and deamidated oat proteins:

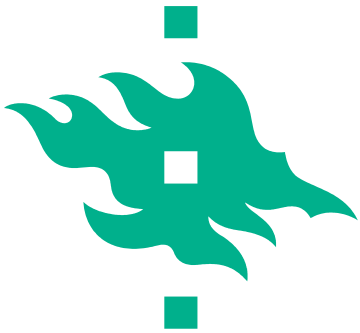




Discussion

Protein-glutaminase deamidation on oat proteins caused its:





Conclusion:

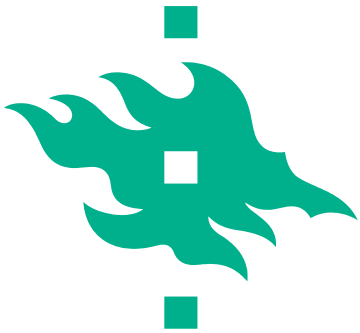
- **Protein-glutaminase:**

- Worked **efficiently** with the oat proteins
- Did **not hydrolyze** the oat proteins
- - Deamidation **improved the structural flexibility** of the oat proteins
- - Deamidation **improved the solubility** of the oat proteins at neutral conditions
- - Deamidation **improved the emulsifying ability** of the oat proteins
- Is **potential** for applications and further investigations



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- Yamaguchi S. 2001. Protein-glutaminase from *Chryseobacterium proteolyticum*, an enzyme that deamidates glutaminy residues in proteins - Purification, characterization and gene cloning. *European Journal of Biochemistry* 268(5):1410-21.



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University Lecturer Dr. Tuula Sontag-Strohm
and Professor Dr. Hannu Salovaara

And

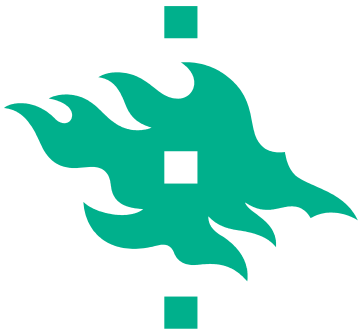
University Lecturer Dr. Päivi Tuomainen, University Technician Mrs. Outi Brinck,
Mr. Ossi Knuutila, Professor Dr. Laura Alakukku

Thanks for Amano Enzyme Inc.



And Technical Research Centre
of Finland .





End

THANKS FOR YOUR ATTENTION

QUESTIONS ARE WELCOME AND APPRECIATED



Poster shown in P21