

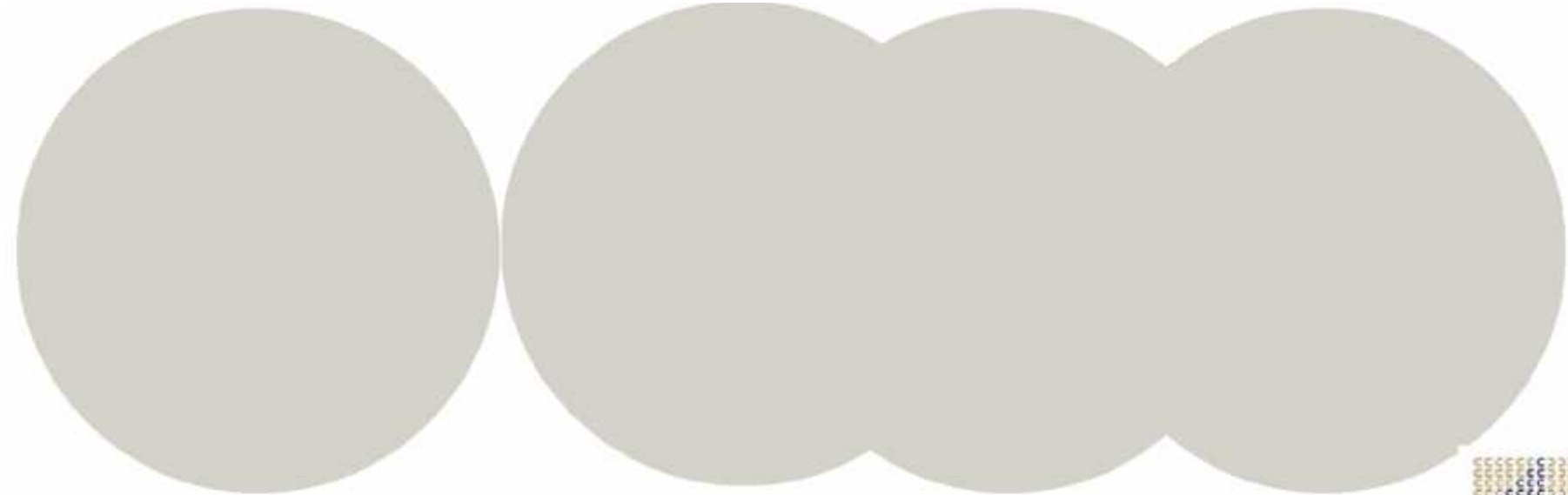
WHC in mushroom in relation to its material property

Conceptual process design of mushroom processing

Ekaraj Paudel*

Dr. Ruud Van der Sman

Prof. Remko Boom



WAGENINGEN UNIVERSITY
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Food Process
Engineering

Nov, 2014

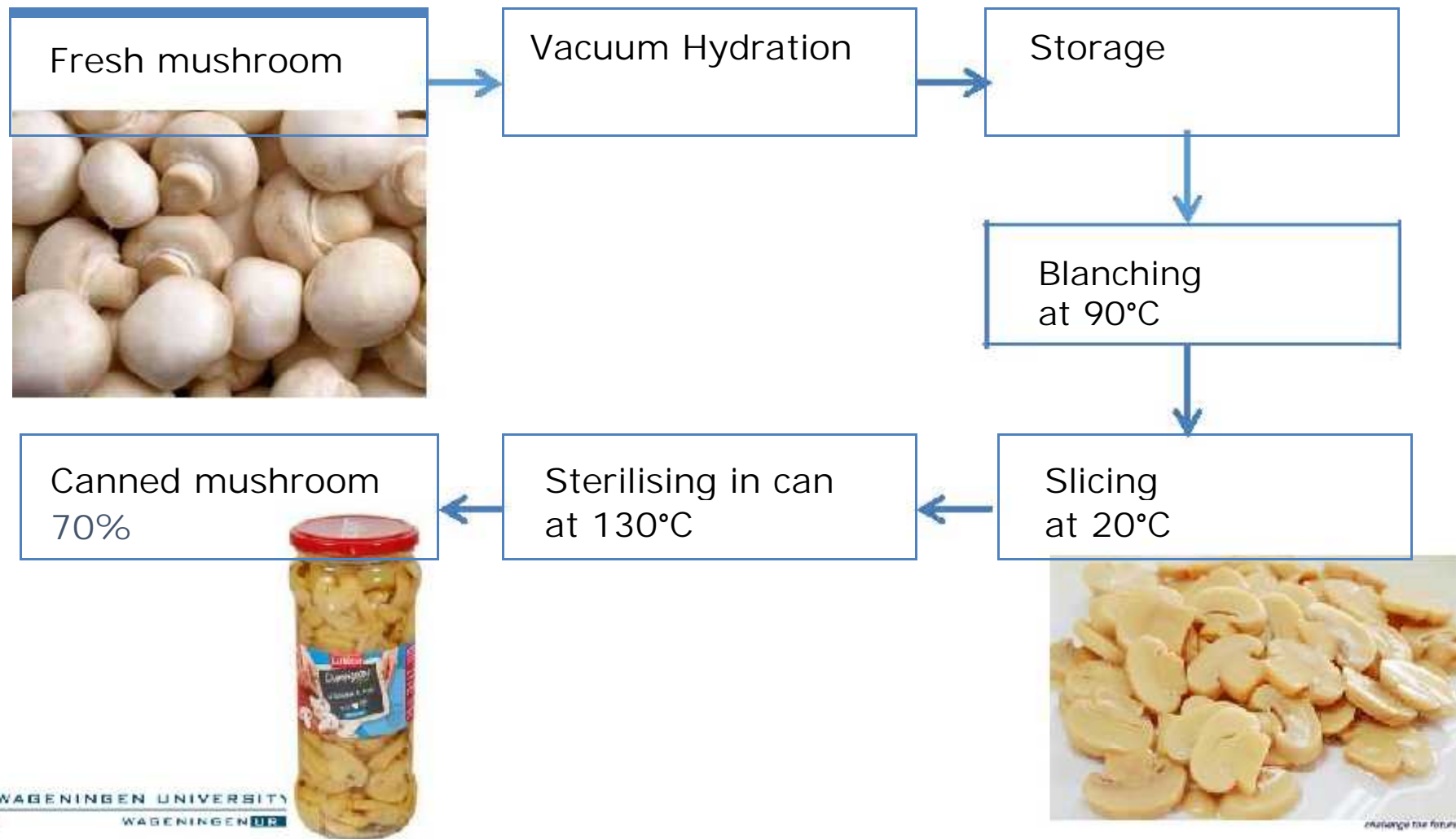


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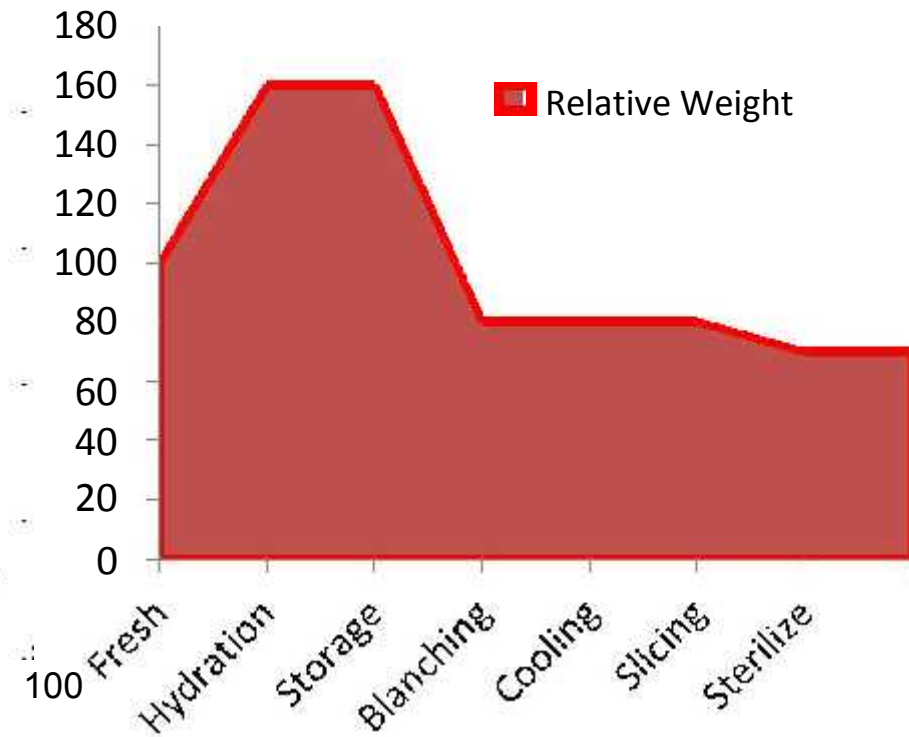
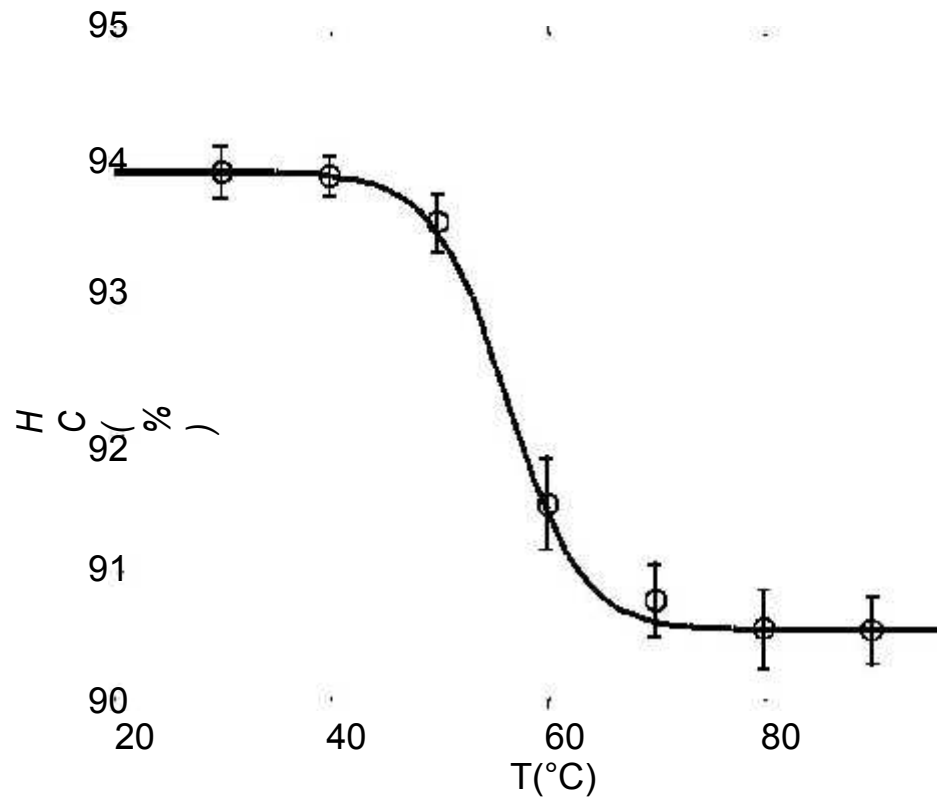
- Project background
- WHC loss in mushroom
- Theory and modelling
- Results
- Conclusion

Background

Canned mushroom: production process



Thermal processing shrink mushroom



....and Why?

Protein Denaturation

S. Zivanivic and R. Buescher
Anantheswaran RC et. al (1986);
Beelman RB (1973);
Lin Zhimin (2001);
Eby et al (1975);
Gormley TR and Walshe PE(1986)

Effect of Processing on Yield, Co
of Canned Mushro

R. C. ANANTHESWARAN, S. K. SAST
A. OKEREKE, and M. KON

ELSEVIER

Influence of canning proced
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A.M. Vivar-Quintana, M.L. Gon

Department of Bionotechnology and Food Science, Univ

Received 13 August 1998, revised



BEELMAN
& Industry
, PA 16802

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R. GORMLEY AND P. E. WALSHE

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D. L. EBY, F. J. McARDLE and R. B. BEELMAN
Department of Science, The Pennsylvania State University, University Park, PA 16802

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MUSHROOM HARVEST STORAGE OF THE CULTIVATED MUSHROOM (*Agaricus bisporus*)
AND ITS INFLUENCE ON QUALITATIVE PROTEIN CHANGES
RELATED TO CANNED PRODUCT YIELD

Objectives

- Describe the WHC loss in mushroom during thermal processing with the Flory Rehner's theory

Theory

WHC definition and understanding

Synonyms: water hydration capacity, water absorption, water-imbibing, water-binding etc.

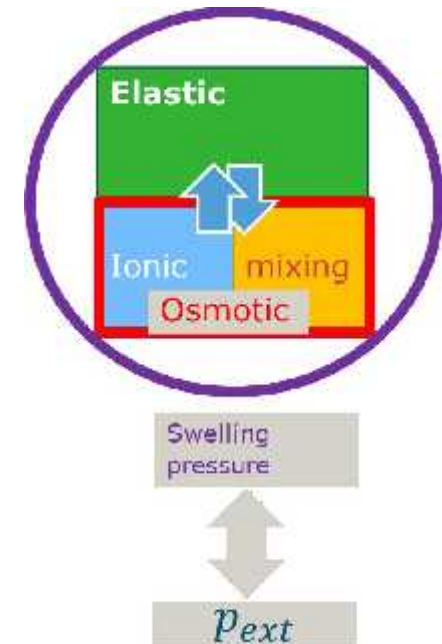
Water Holding Capacity (WHC) – The ability of meat to retain its inherent moisture even though external pressures (like gravity, heating, centrifugation, pressing) are applied to it. This characteristic can be measured by drip loss, but other methods can be used as well (Honikel and Hamm, 1994; Honikel, 1998).

The ability of meat to retain both inherent water and added water is de-fined as water-holding capacity (WHC) (Grau and Hamm, 1956).

Water holding capacity: Flory Rehner's theory

- WHC: Ability to hold water under applied external force
- FR theory: WHC expressed as swelling of polymer
- Driving force for dewatering: $-\Pi$

$$\Pi = \Pi^+ - \Pi^-$$

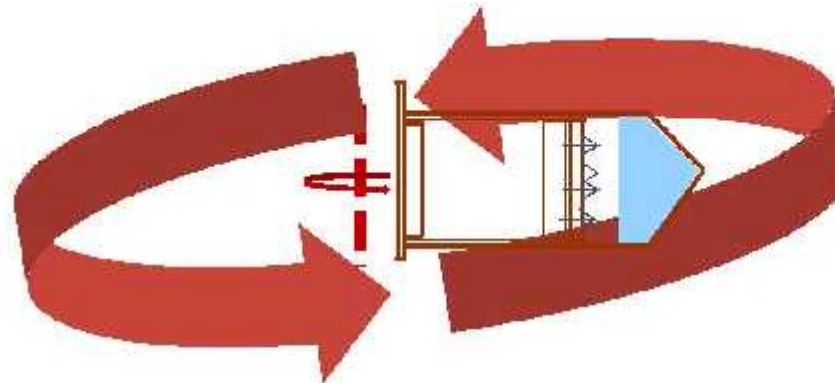


WHC-determination: centrifugation

- Sample centrifuged at various speed till equilibrium ($\pi = \Pi$)



$$\Pi = \pi + \pi - \pi$$



Centrifugation technique

The swelling contributions

$$p_{ext} = \Pi_{sw} = \Pi_{mix} + \Pi_{ion} - \Pi_{elas}$$

$$\Pi_{mix} = \frac{RT}{V_w} \left[\ln(\phi_w) + \left(1 - \frac{1}{N_{eff}}\right)(1 - \phi_w) + \chi_{eff}(1 - \phi_w)^2 \right] \text{ Flory Huggin's Theory}$$

$$\Pi_{ion} = \frac{RT}{v_w} \log(a_{w,ion})$$

$$\Pi_{elas} = \frac{RT}{v_w} N_c \phi_0 \left[\frac{1}{2} \left(\frac{\phi}{\phi_0}\right) - \left(\frac{\phi}{\phi_0}\right)^{2/3} \right]$$

Calculated

Estimated

Calculation of mixing pressure

- Mixing pressure was computed from the composition of blanched mushroom (Sman, 2013)¹

$$\Pi_{mix} = \frac{RT}{V_w} \left[\ln(\phi_w) + \left(1 - \frac{1}{N_{eff}}\right) (1 - \phi_w) + \chi_{eff} (1 - \phi_w)^2 \right]$$

$$\frac{1}{N_{eff}} = \frac{\sum_{i \neq w} \phi_i / N_i}{\sum_{i \neq w} \phi_i}$$

$$\chi_{eff} = \frac{\sum_{i \neq w} \phi_i \chi_{iw}}{\sum_{i \neq w} \phi_i}$$

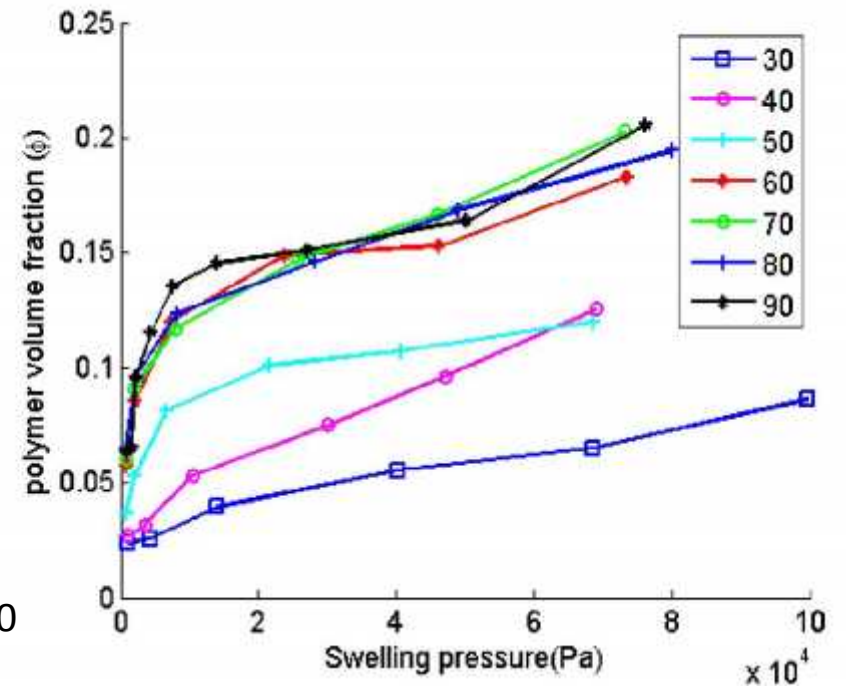
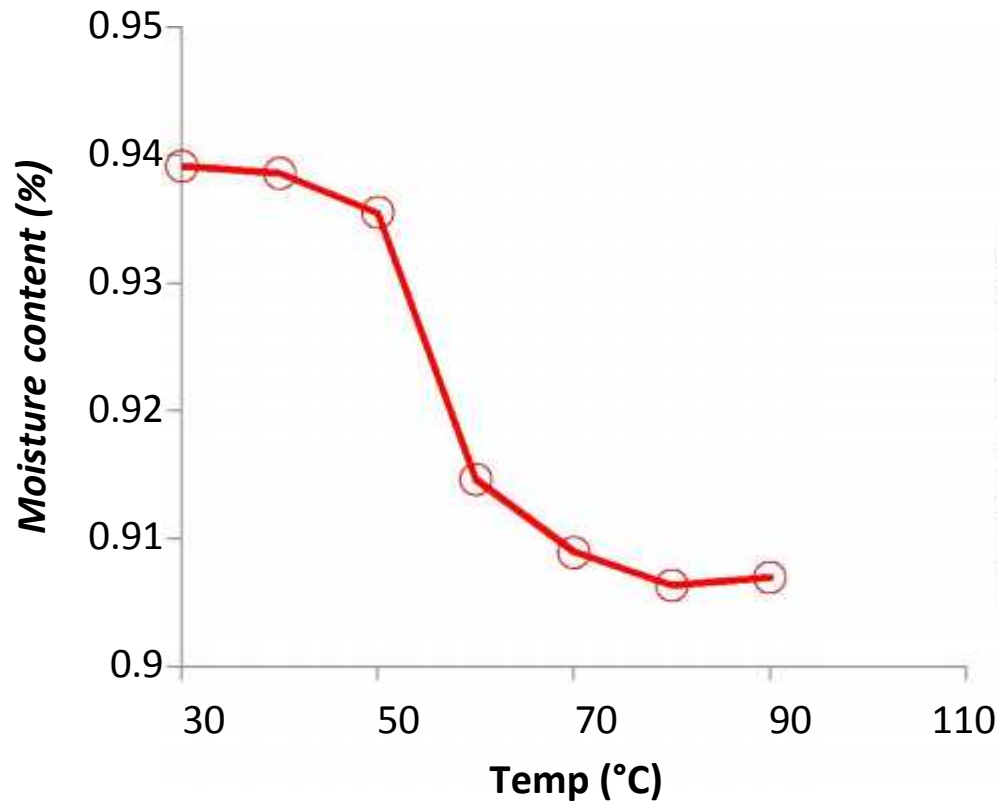
Components	χ_{iw}	$1/N_i$
Mono - saccharides	0.27	0.16
Di- saccharides	0.53	0.84
Polymers	0.8	0
Proteins	0.8-1.4	0

- Protein denaturation affects χ_{eff} via an effect on $\chi_{1,p}$

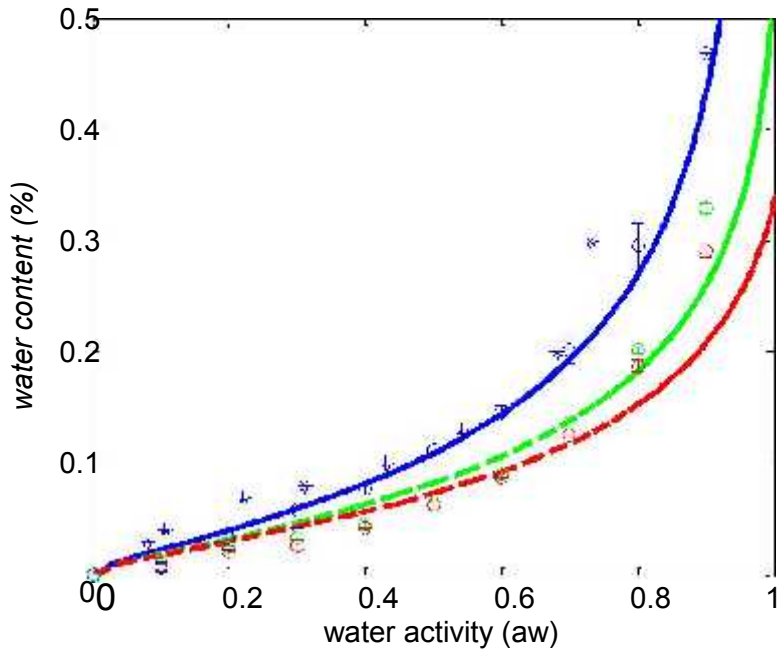
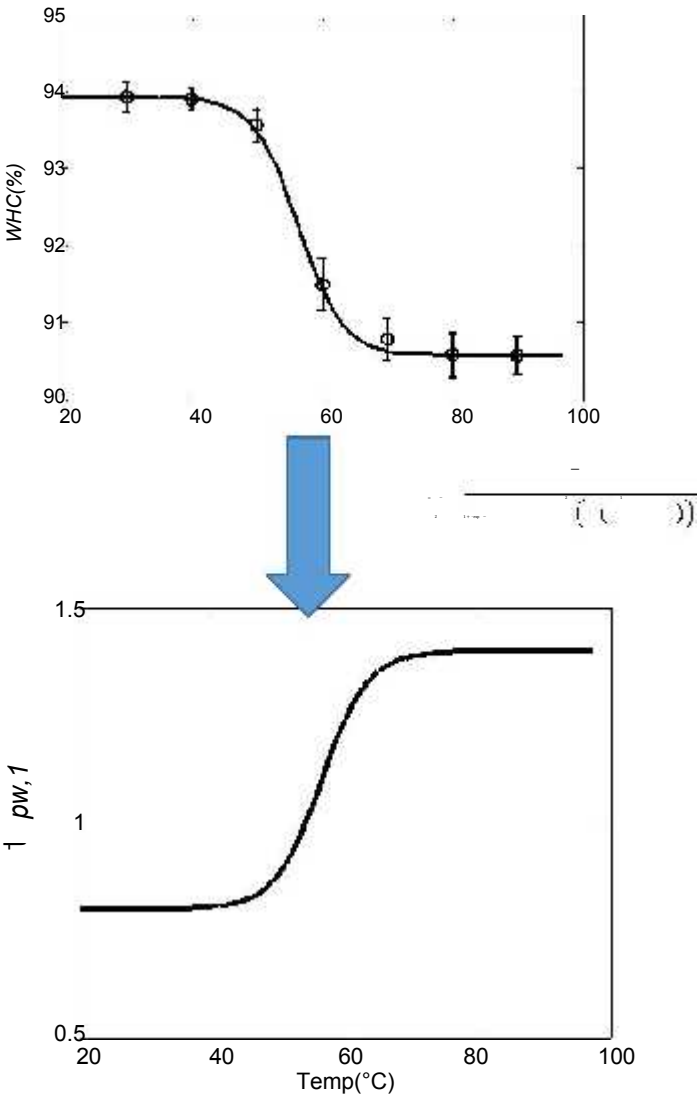


Modelling and curve fitting

WHC in the heat treated sample

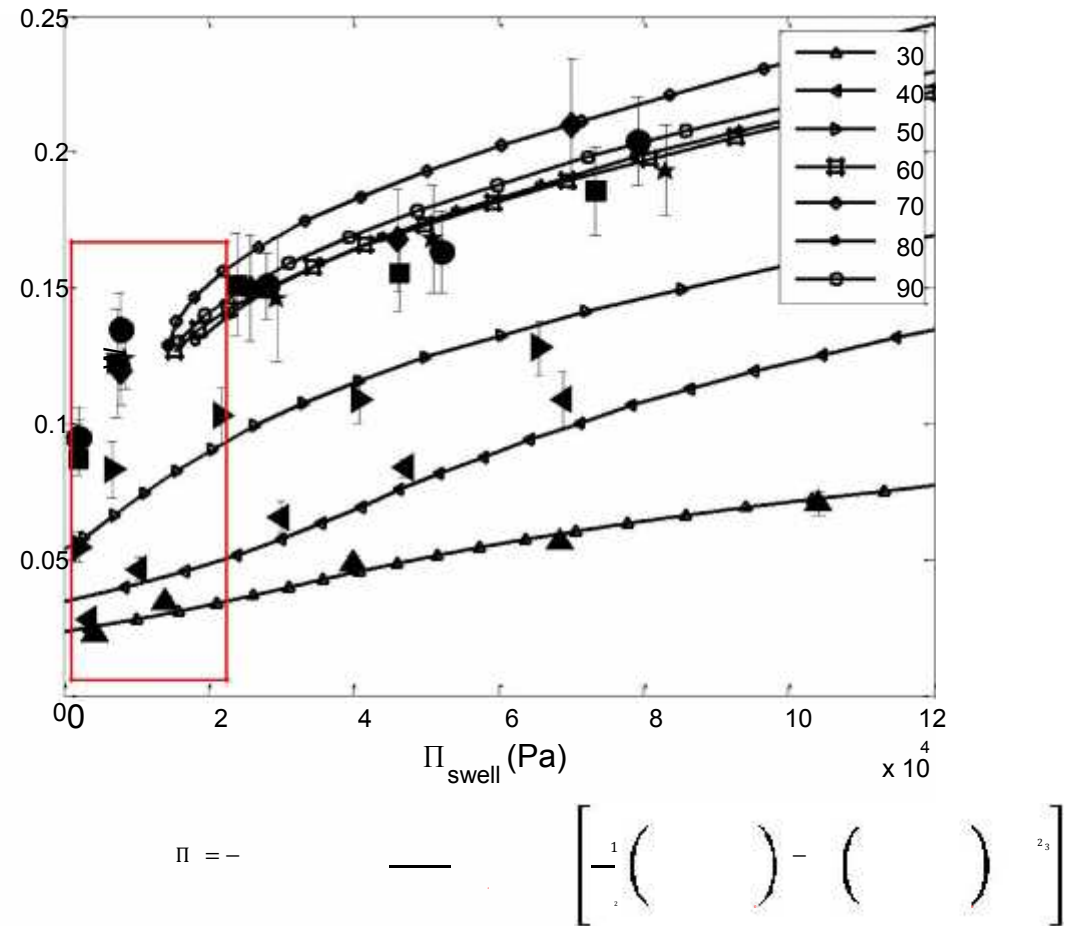
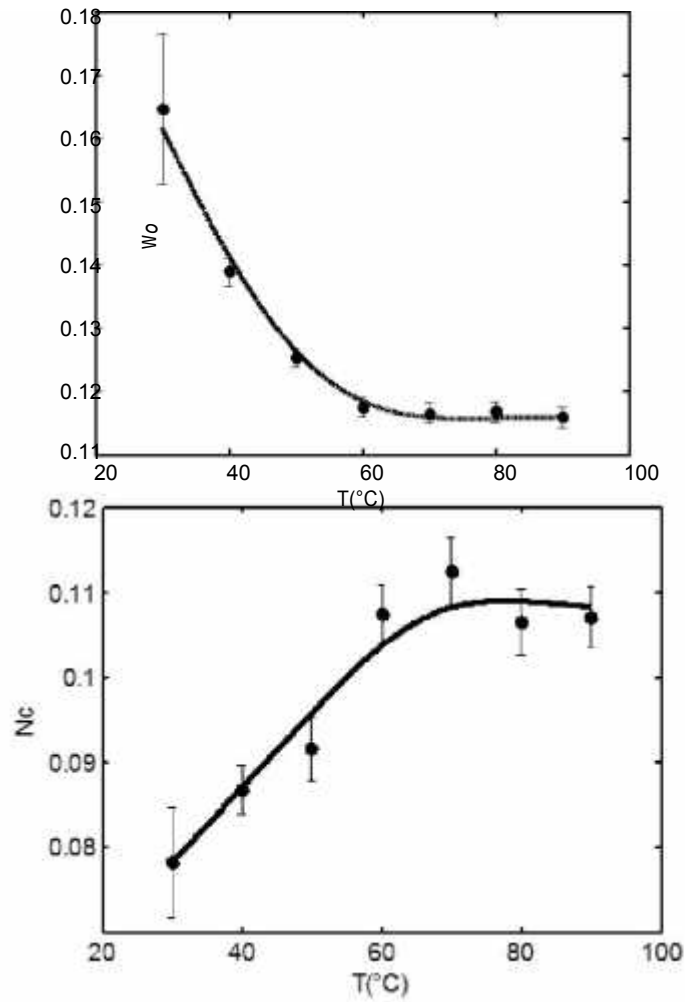


Assumptions and verification



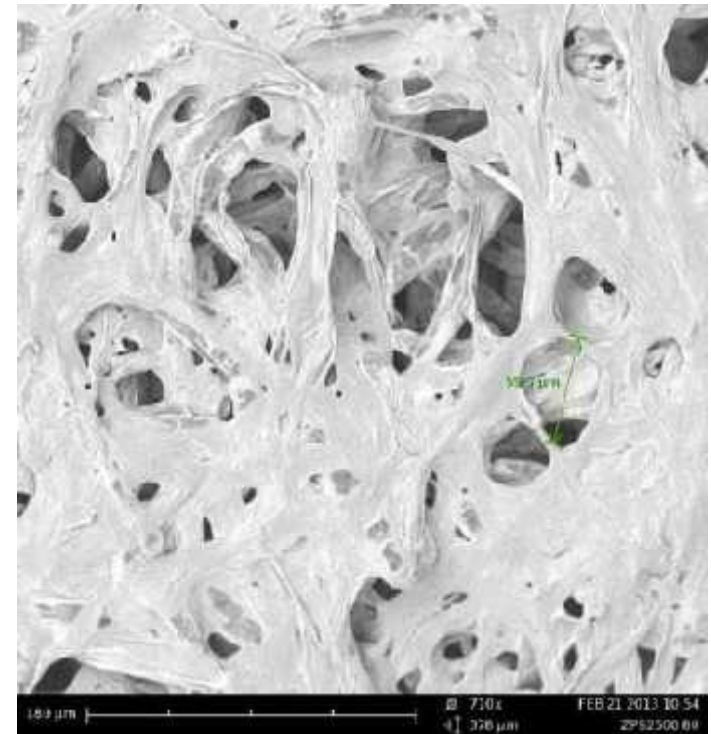
Sorption isotherm of freeze dried mushroom (30, 60 and 90C)

The fitting



Summary and Conclusion

- Describes the water contained in the gel phase
- Need a consideration for water contained in the capillaries





Thank you for your kind attention



WAGENINGEN UNIVERSITY
WAGENINGENUR

contact: ekaraj.paudel@wur.nl

