

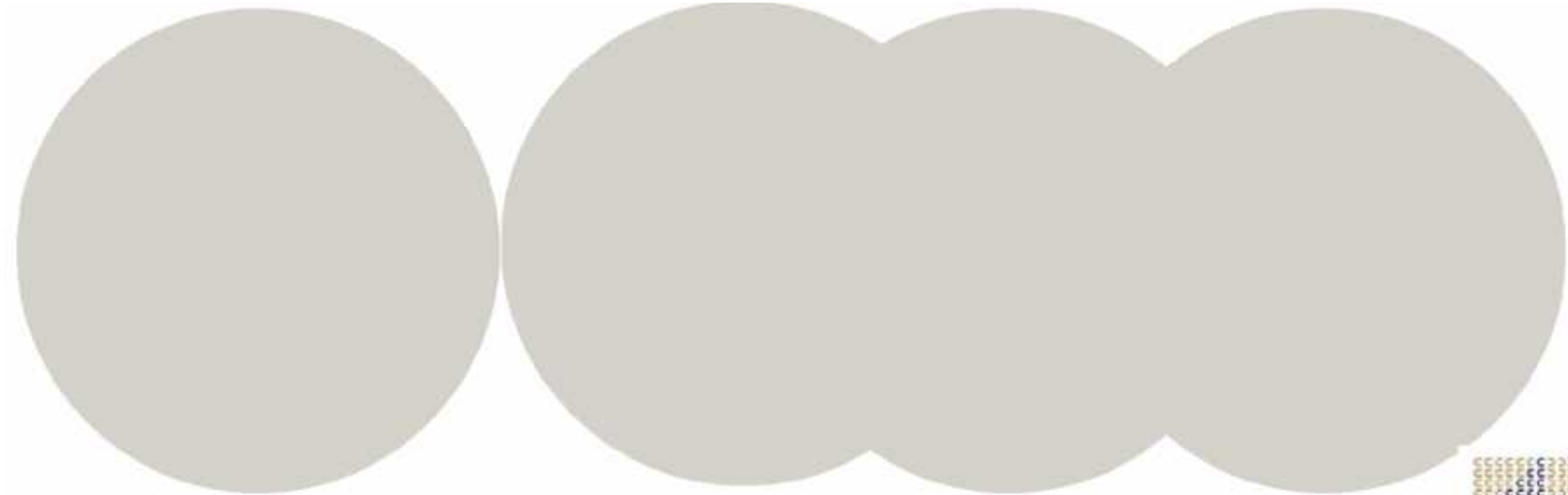
# *WHC in mushroom in relation to its material property*

Conceptual process design of mushroom processing

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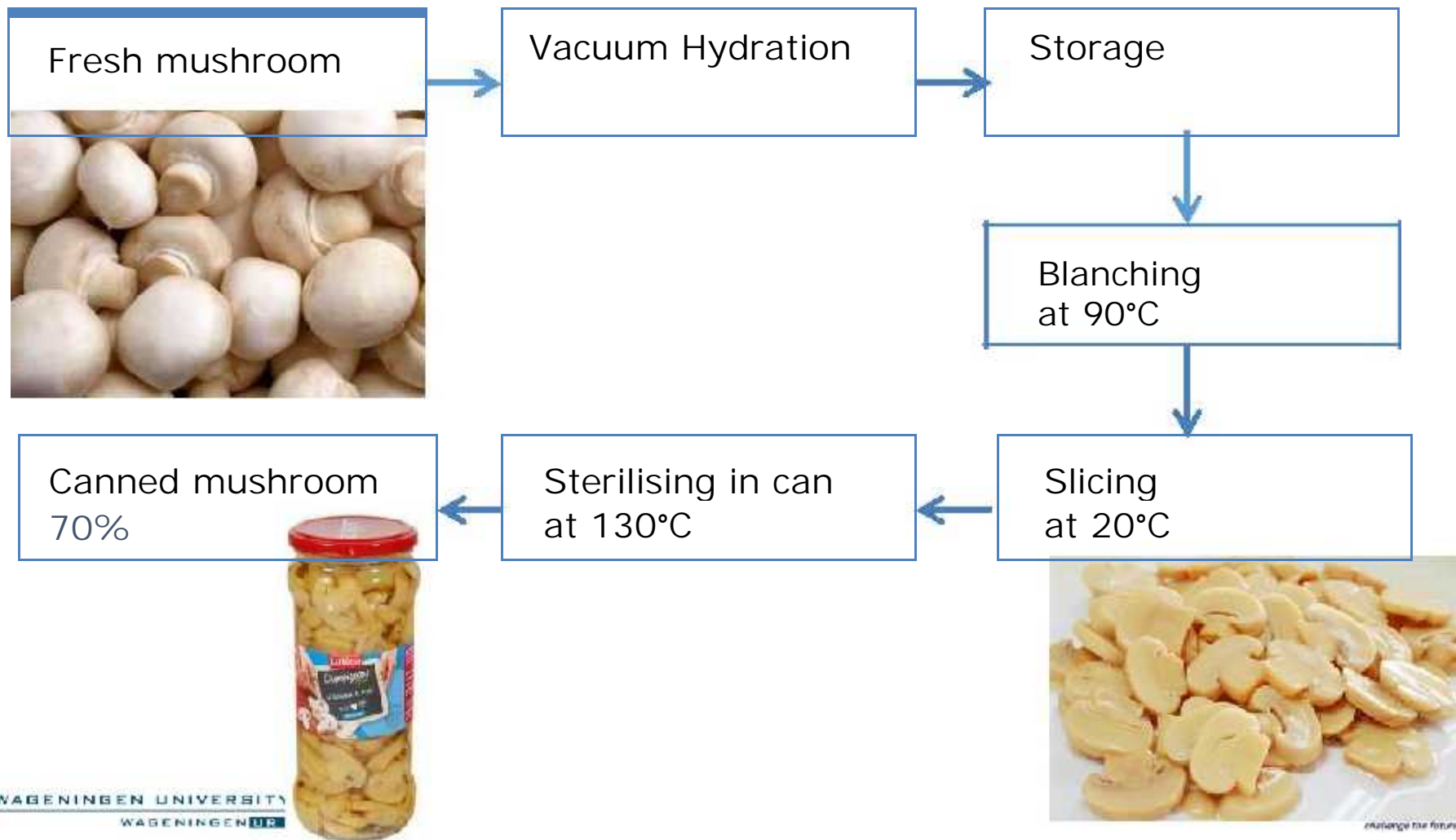
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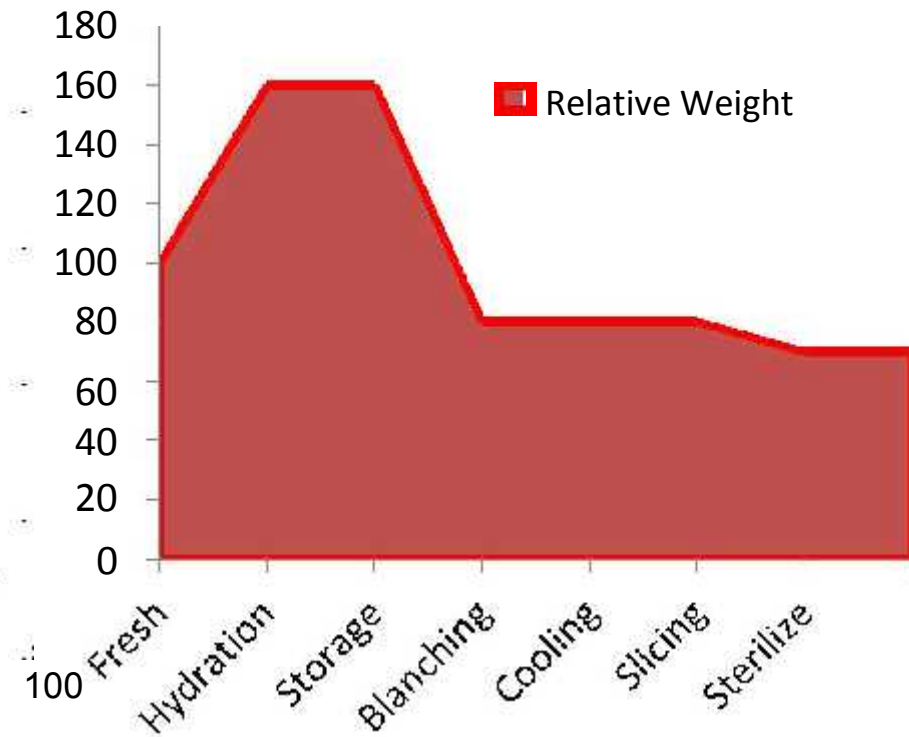
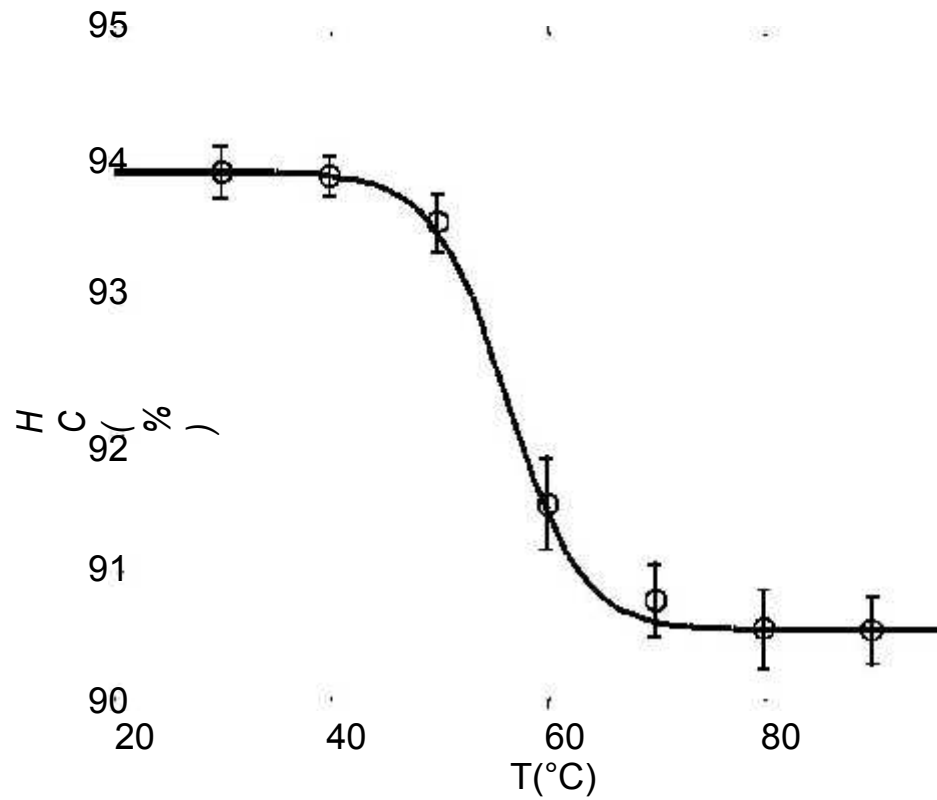
- Project background
- WHC loss in mushroom
- Theory and modelling
- Results
- Conclusion

# 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  
of m

A.M. Vivar-Quintana, M.L. Gon  
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R. GORMLEY AND P. E. WALSHE

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D. L. EBY, F. J. McARDLE and R. B. BEELMAN  
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www.shutterstock.com - 84500394  
MUSHROOM HARVEST STORAGE OF THE CULTIVATED MUSHROOM (*Agaricus bisporus*)  
AND ITS INFLUENCE ON QUALITATIVE PROTEIN CHANGES  
RELATED TO CANNED PRODUCT YIELD

# Objectives

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- 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.

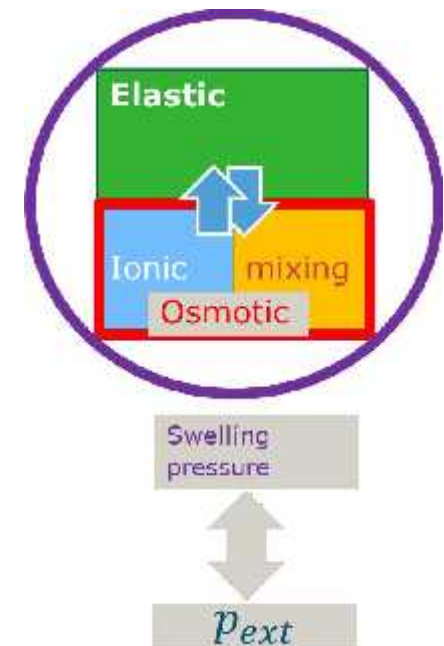
**Water Holding Capacity (WHC)** – The ability of meat to retain its inherent moisture even though external pressures (like gravity, heating, centrifugation, pressing) are applied to it. This characteristic can be measured by drip loss, but other methods can be used as well (Honikel and Hamm, 1994; Honikel,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

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

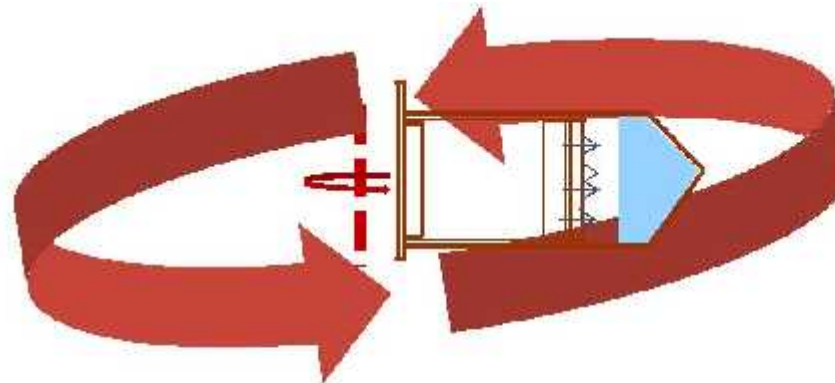


# WHC-determination: centrifugation

- 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)<sup>1</sup>

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

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

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

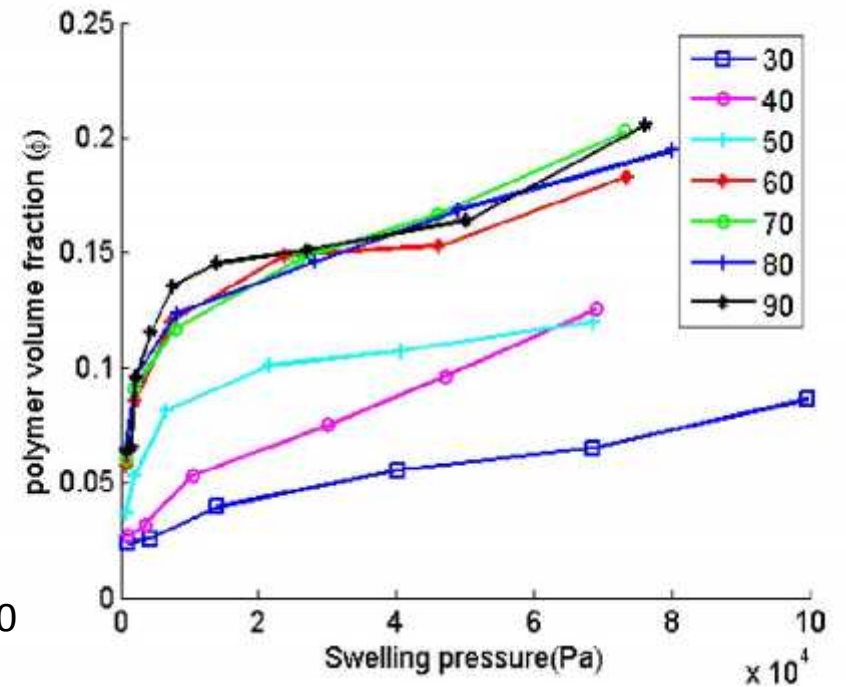
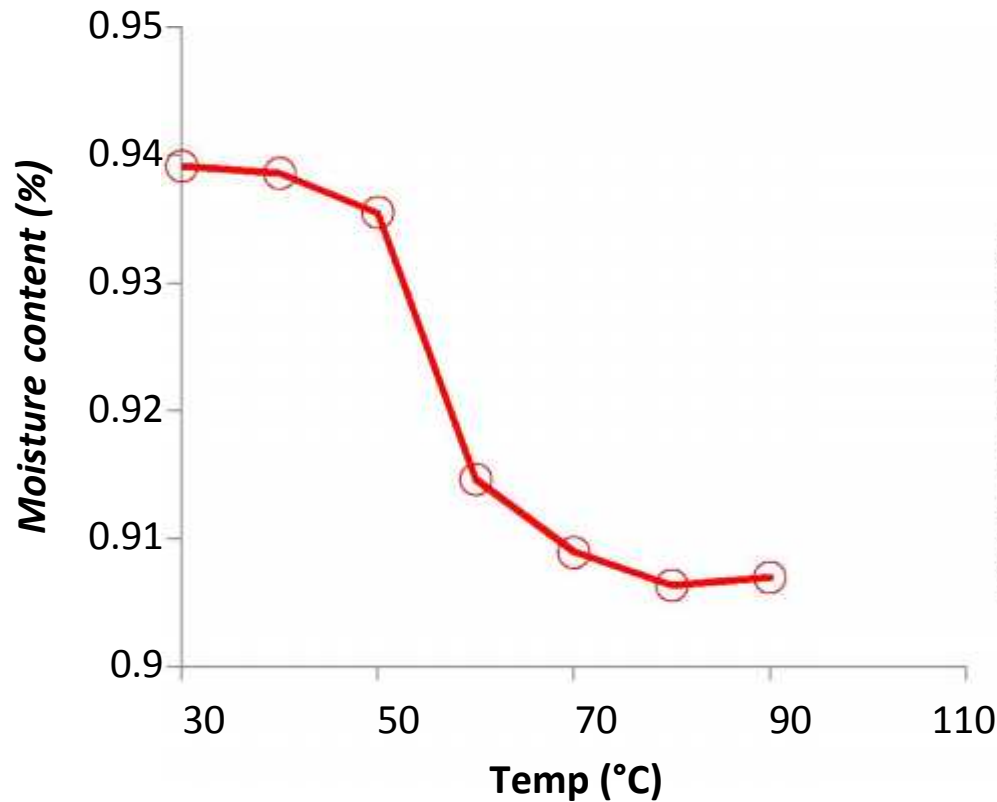
Components	$\chi_{iw}$	$1/N_i$
Mono - saccharides	0.27	0.16
Di- saccharides	0.53	0.84
Polymers	0.8	0
Proteins	0.8-1.4	0

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

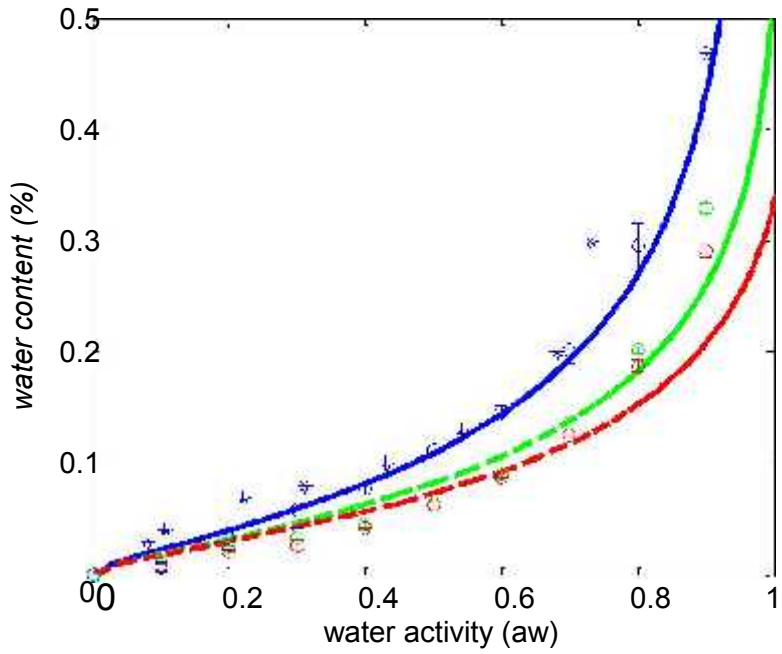
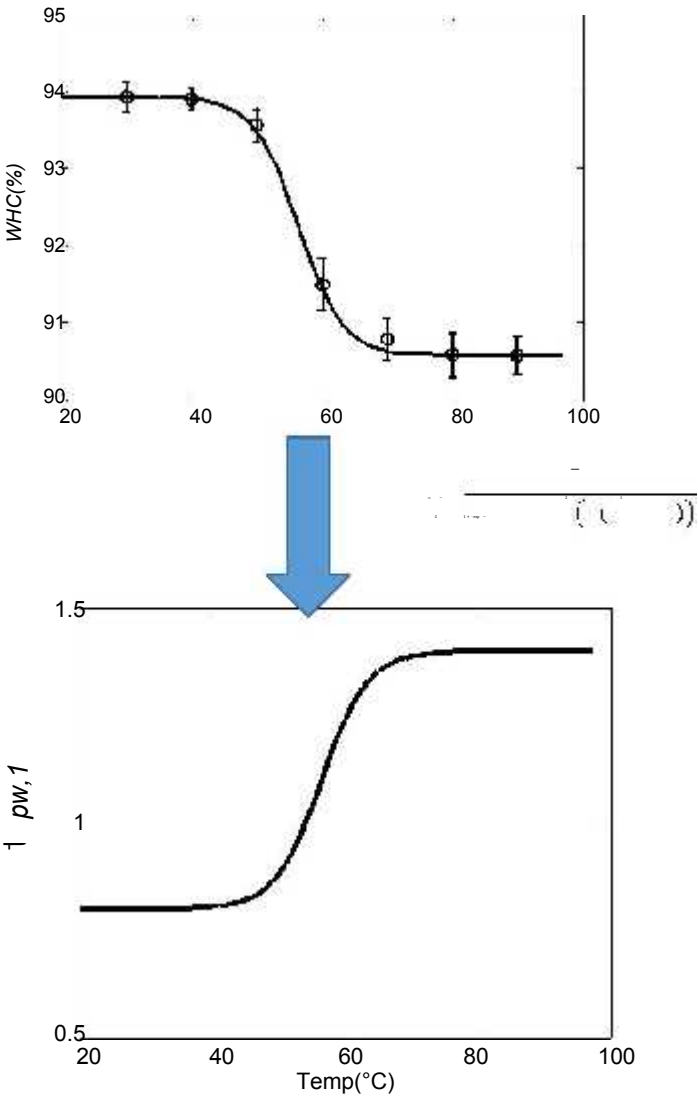


# Modelling and curve fitting

# WHC in the heat treated sample



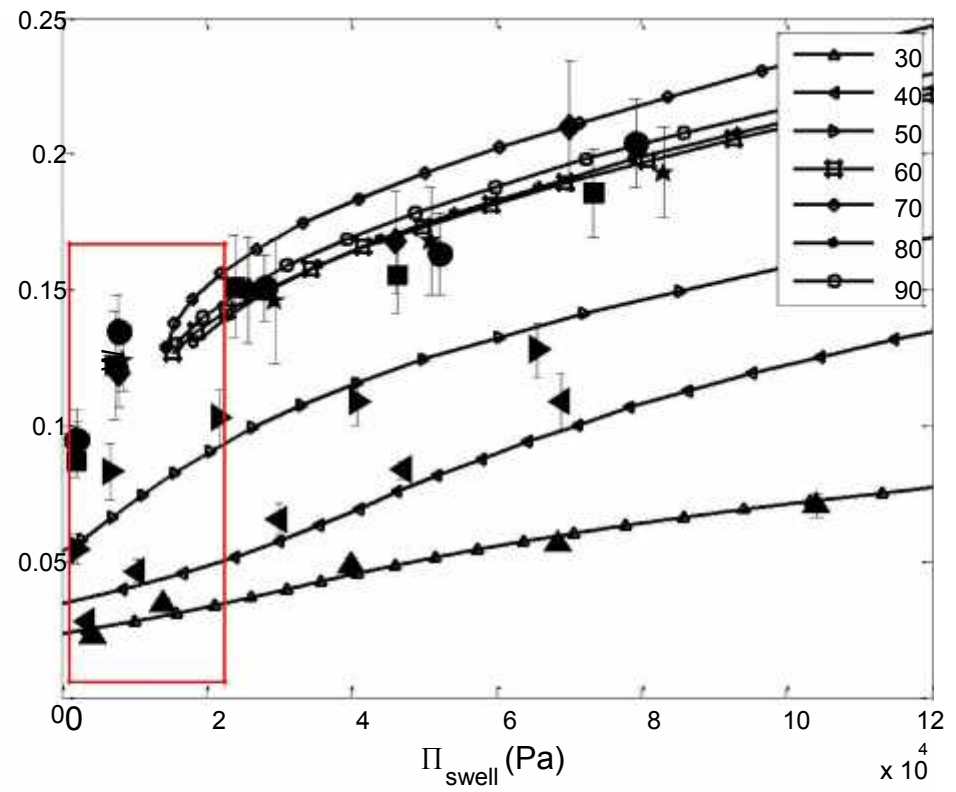
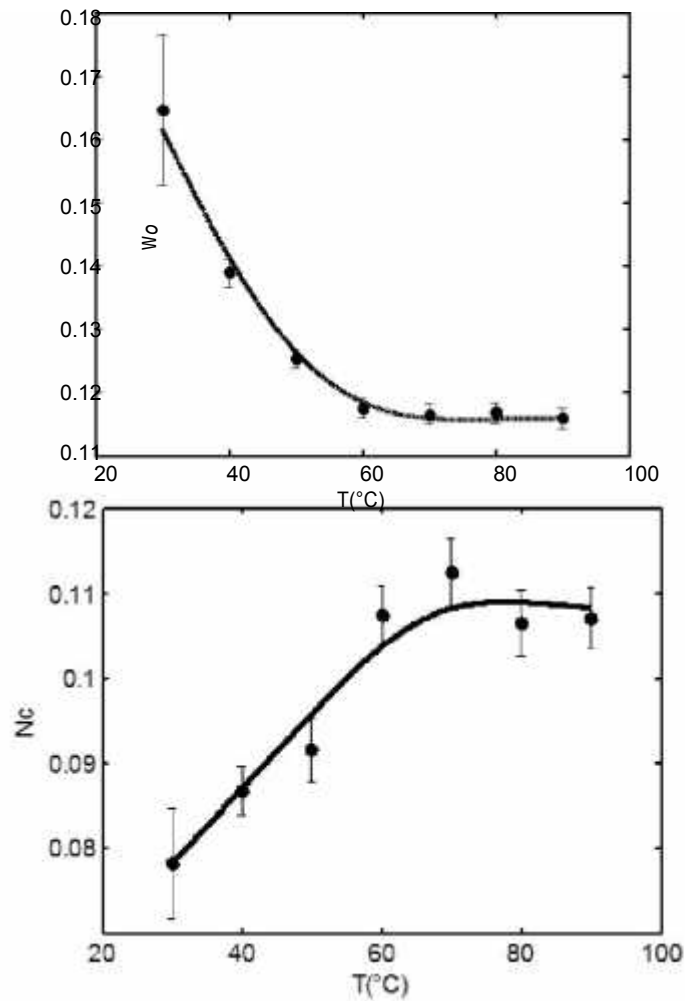
# Assumptions and verification



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



# The fitting

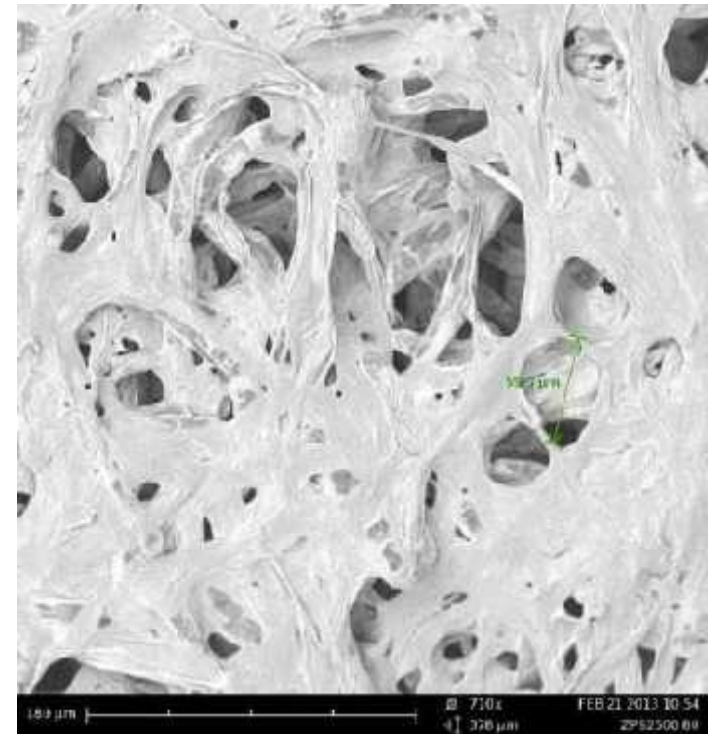


$$\Pi = - \left[ \frac{1}{2} \left( \begin{matrix} \phantom{0} \\ \phantom{0} \end{matrix} \right) - \left( \begin{matrix} \phantom{0} \\ \phantom{0} \end{matrix} \right) \right]^{2_3}$$

# Summary and Conclusion

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





Thank you for your kind attention



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