Mechanism of Water Transport in Meat during the Roasting Process

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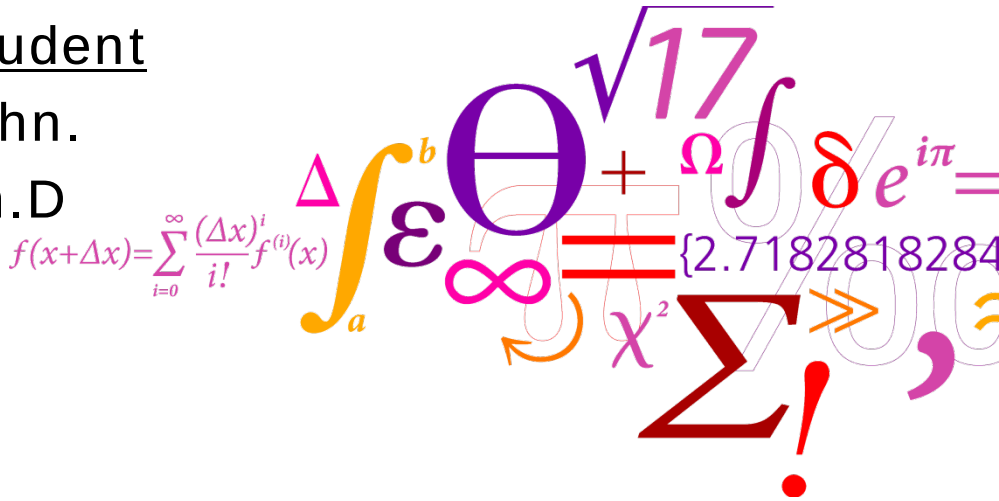
Aberham Hailu Feyissa,PHD student

Jens Adler-Nissen, Prof, dr.techn.

Krist V.Gernaey, Assoc.Prof,Ph.D



Food Production Engineering

DTU Fødevareinstituttet

Roasting process

- *Quantitative*
  - quality, safety
  - minimize loss
  - upscale
  - process control

- *Water transport*
  - *prediction of large rise at center (??)*

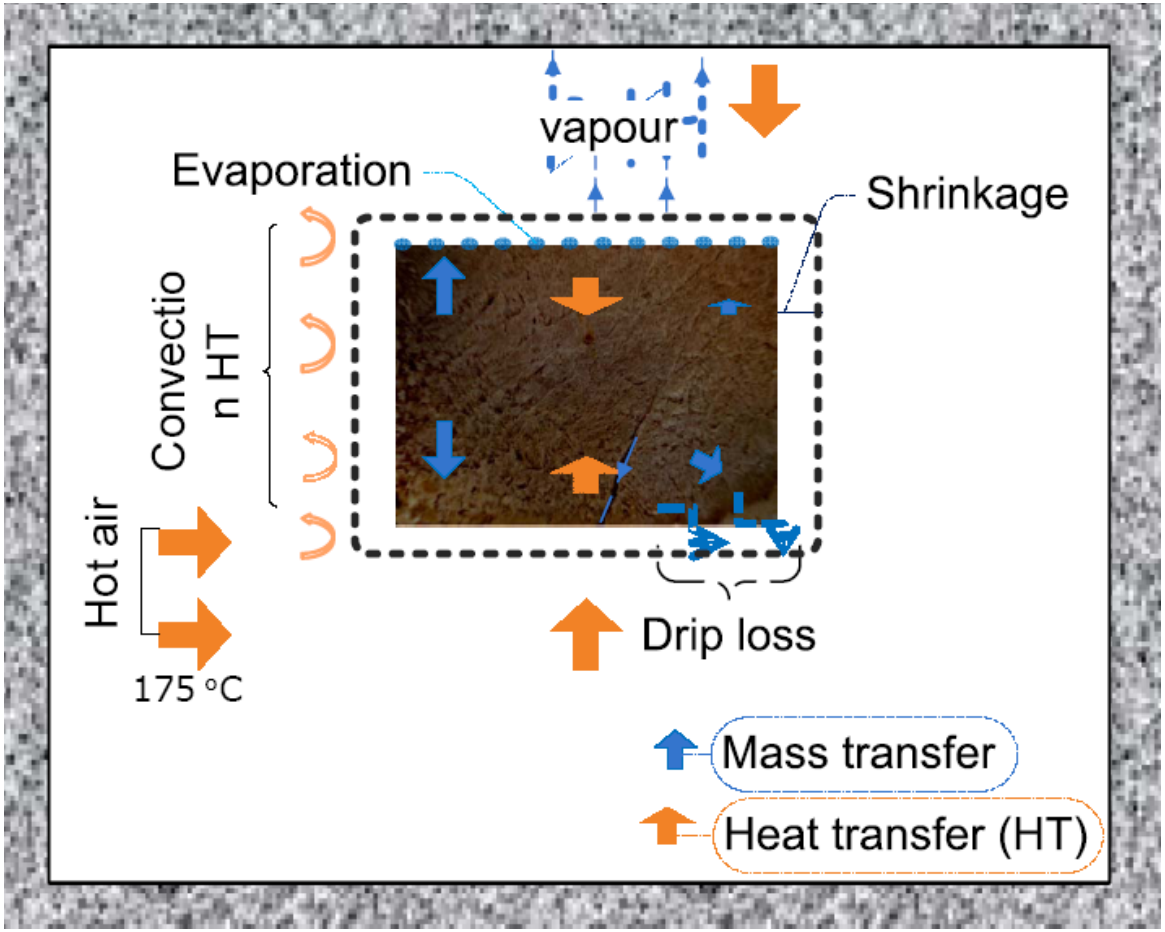


Figure 1. Transport processes during oven-convection roasting

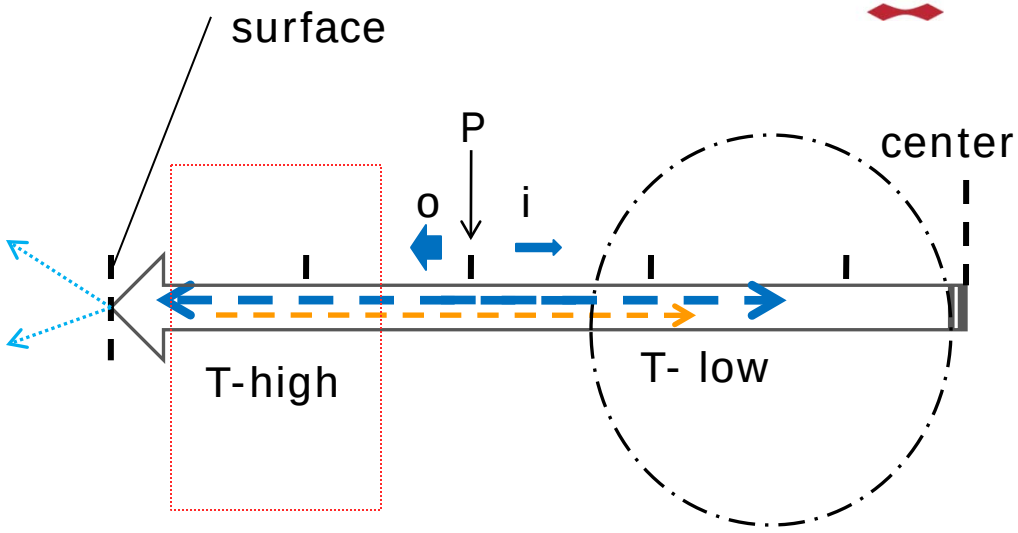
Mechanism of water transport

1. *Pure diffusion (often used)*
   - Concentration gradient
2. *Convective*
   - T⇧
     - Denaturation
     - WHC ⇩
     - Shrinkage (protein network)
   - Pressure gradient-velocity
   - Microstructure
     - Permeability(K)
   - Elastic modulus (E)

Figure 2.Change of microstructure during roasting

(cross-sectional view)

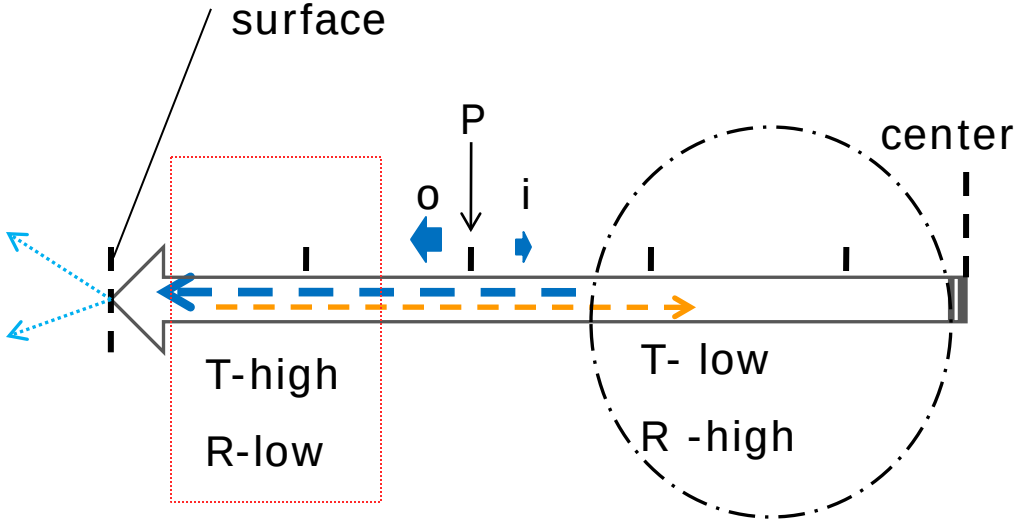
Case-1



Case-2

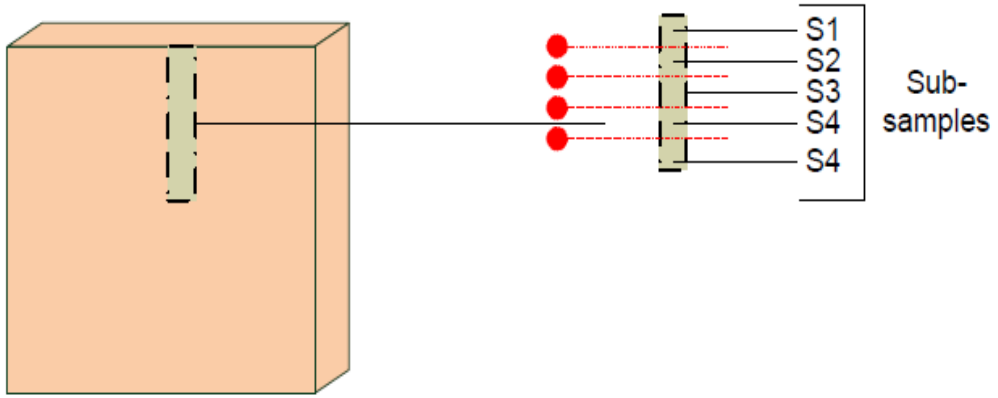
R- resistance to flow

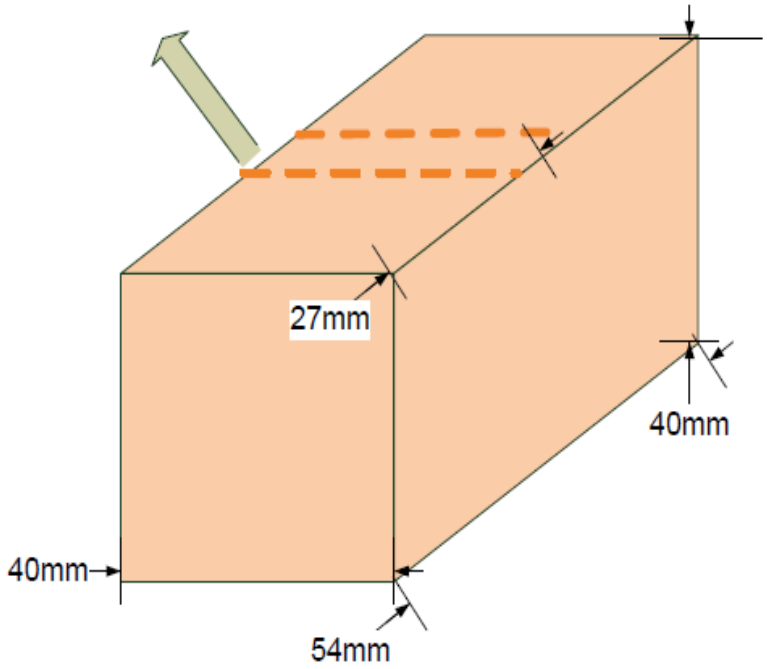
Low K – high R



Method

- Sample-pork meat (*Longissimus-dorsi*)
- Oven (175 ˚C)
- Local water content
  - *Liquid nitrogen + freezer*
  - Sub-samples *(local)*
  - Oven drying
- Overall shrinkage
  - *Dimensions & mass*

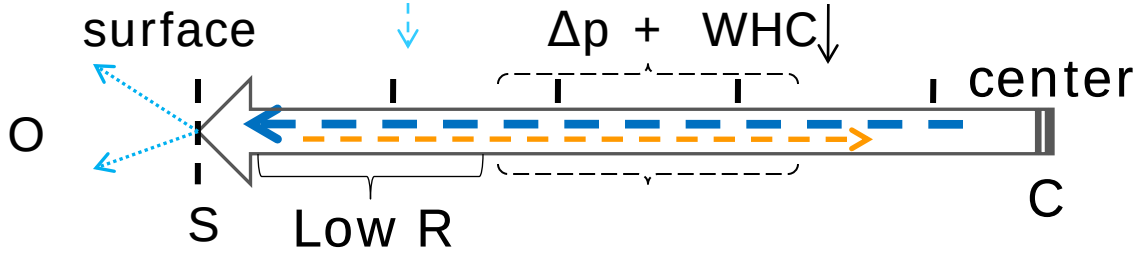




Local water content

Table 1 Local water content (kg of H_2O per kg of sample)

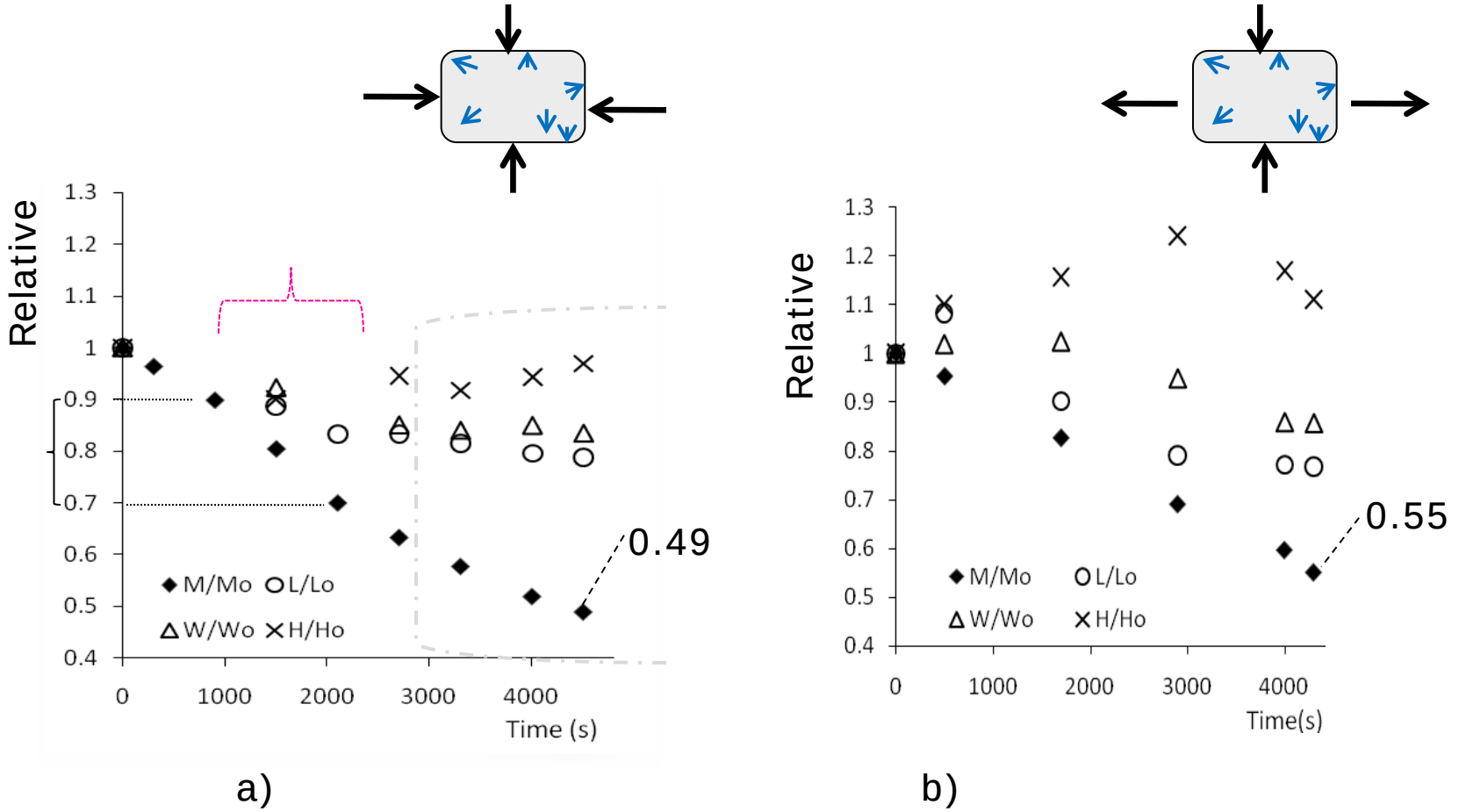
t, in min	Position(mm) from surface to center				
	(0-4) *Surface*	(4-8)	(8-12)	(12-16)	(16-20) *center*
0	Mean = 0.746 Std.dev = 0.0034				
8	0.720	0.730	0.740	0.730	0.740
11	0.701	0.716	0.727	0.737	0.745
15	0.690	0.720	0.730	0.730	0.740
20	0.646	*0.727*	*0.744*	0.741	0.736
25	**0.705**	*0.706*	*0.727*	0.732	0.736
30	0.693	0.712	0.719	0.716	0.734
35	0.659	0.618	0.665	0.667	0.681



If flux

CS > SO

shrinkage and mass loss as function of time



a) b)

Figure 3 a) meat sample shrinking in 3 directions; b) meat sample shrinking in x and y-direction and expanding in the z direction (height).

- Conclusion
  - Emerging mechanistic understanding of water transport is helpful to develop better model.
  - A large rise of the water content was not observed in contrary to what was predicted before.

- ACKNOWLEDGEMENT
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Thank you for your attention!