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# Reuse of urine in agriculture Can pharmaceuticals cause a problem?

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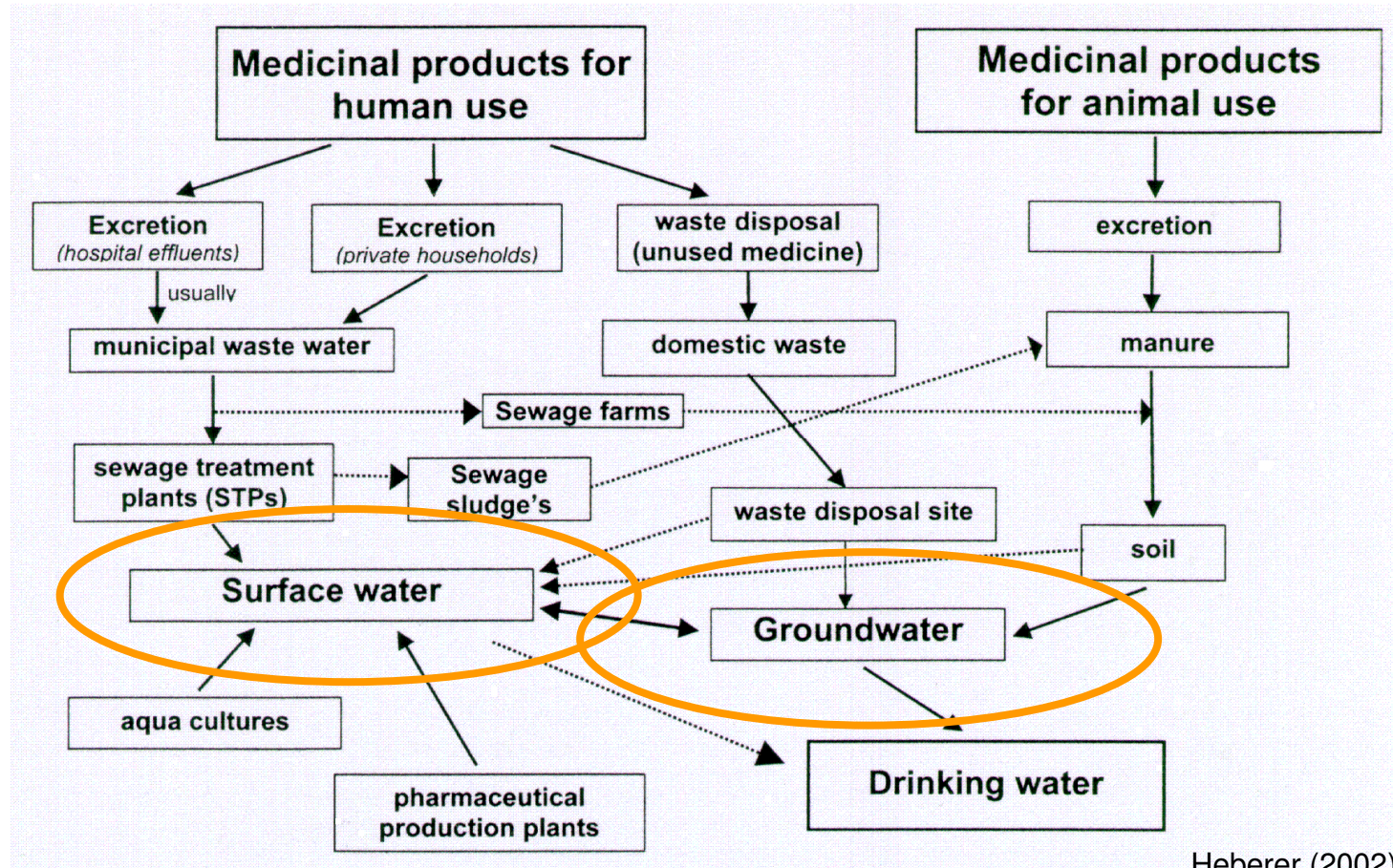


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# Introduction

- Pharmaceutical residues (PhaR) are found in the environment since decades: 1970, 1973, 1976...
- Large investigations started in 1990s when analyzing tools improved
- Took time until problem was realized
  - » First - major polluter expected: hospitals
  - » Now - major polluter detected: households
- Today's wastewater treatment plants (WWTP) are not able to hold back PhaR

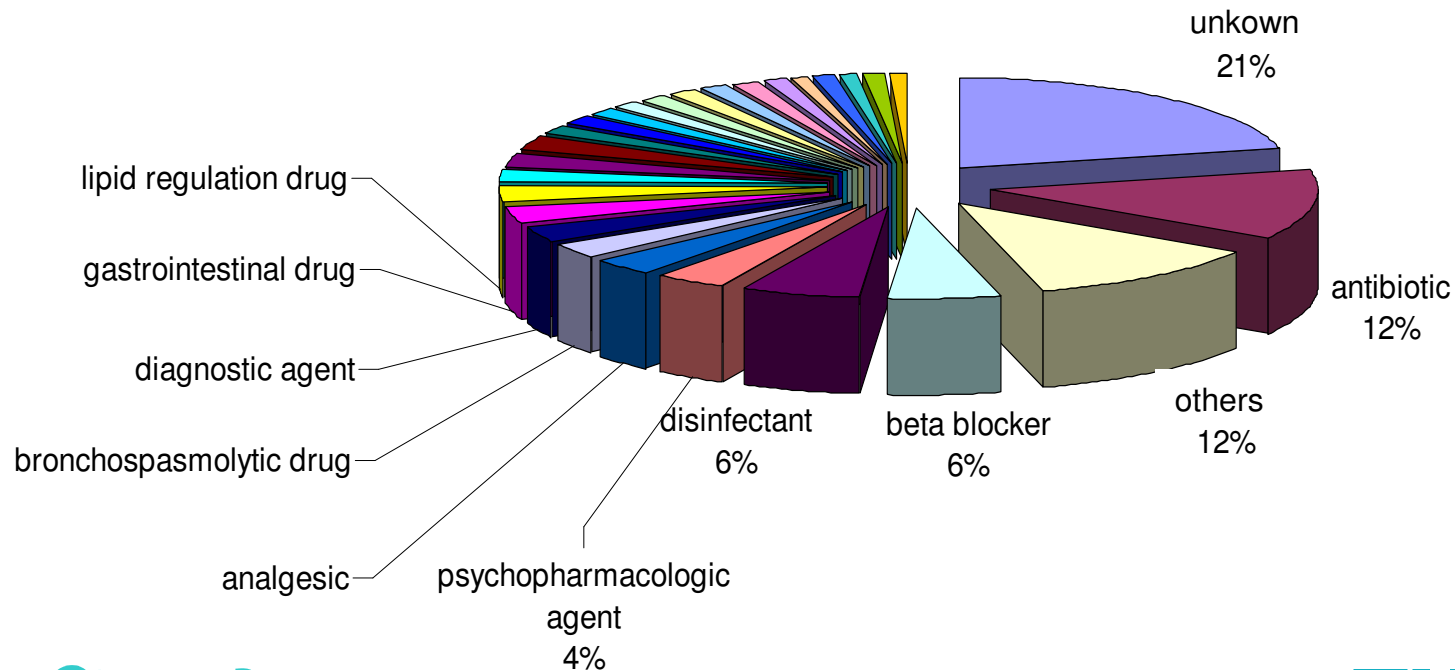
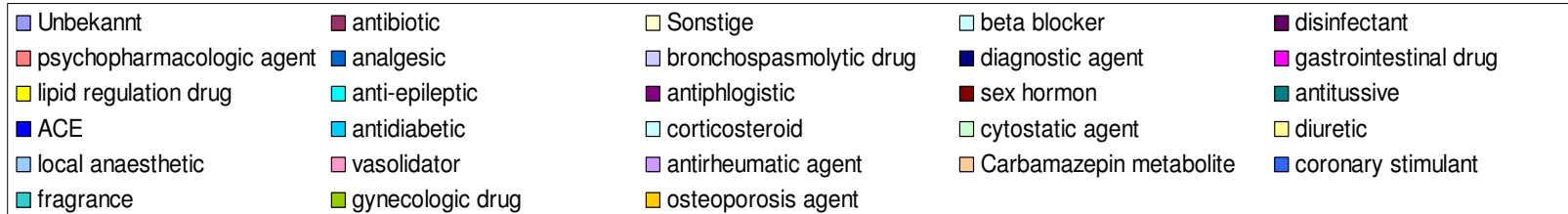
# Pathways of PhaR



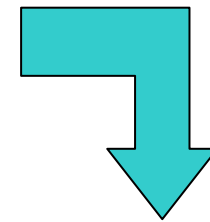
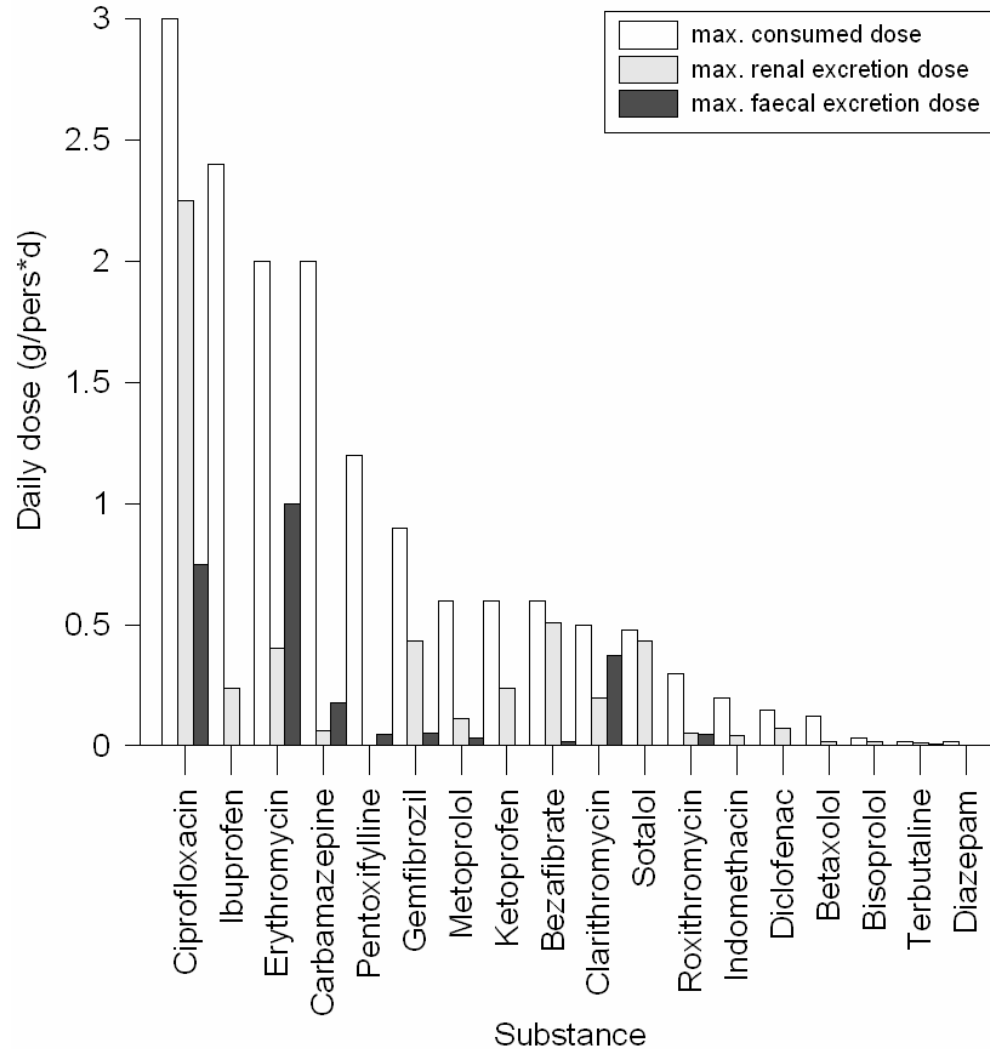
Heberer (2002)



# Overview about pharmaceutical groups

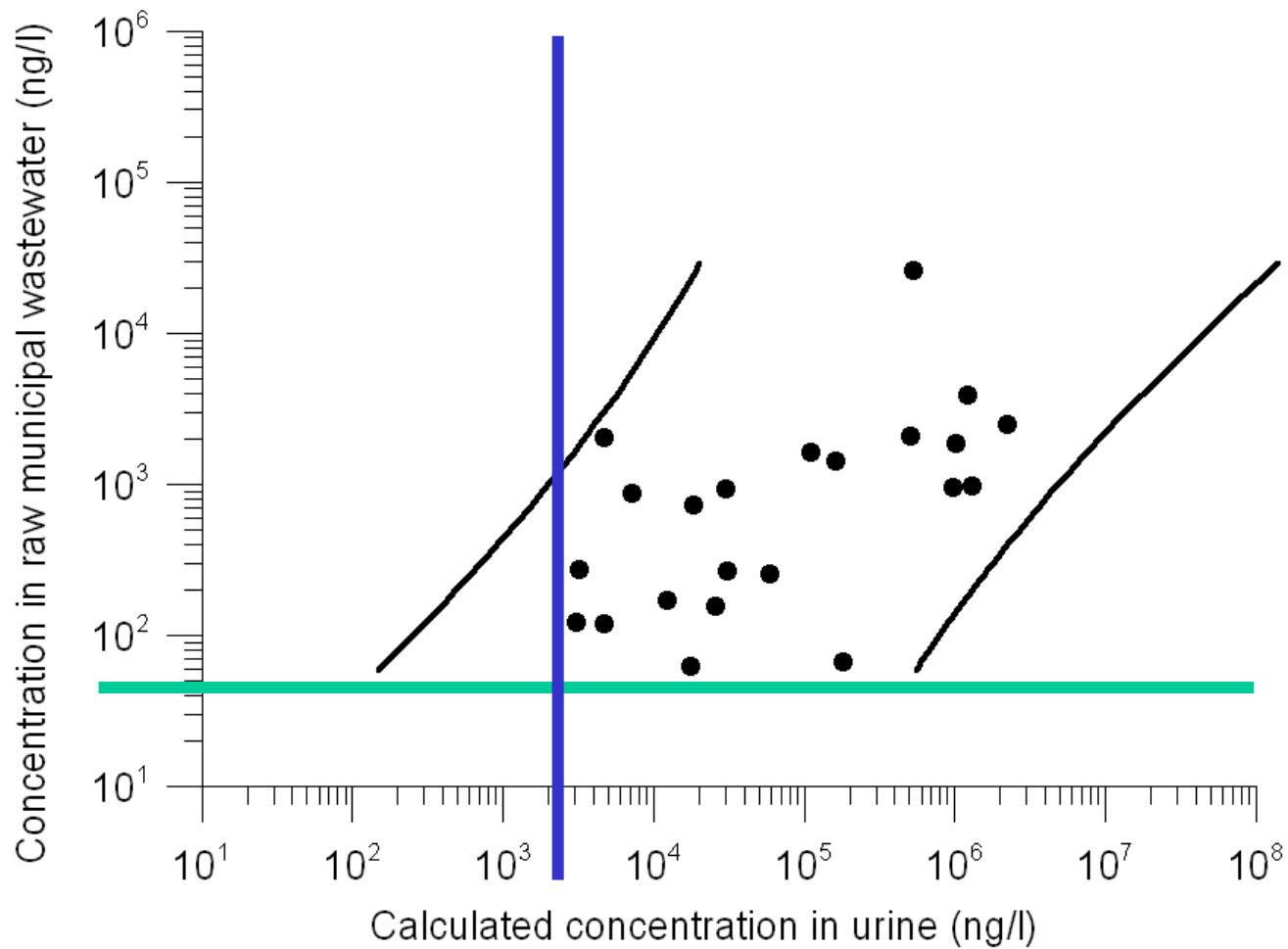


# Discharge of PhaR

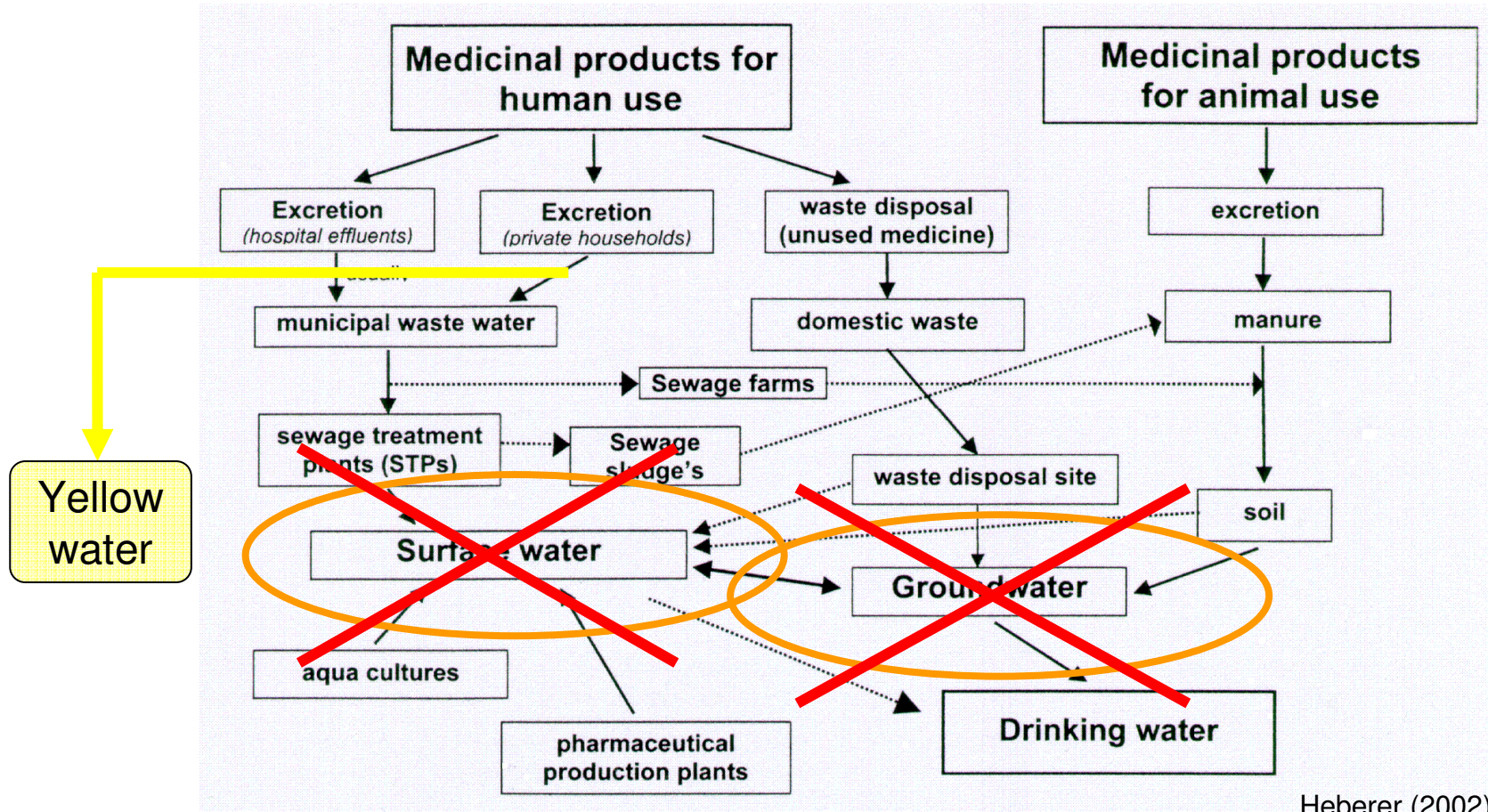


Mainly  
via urine

# Concentrations of PhaR



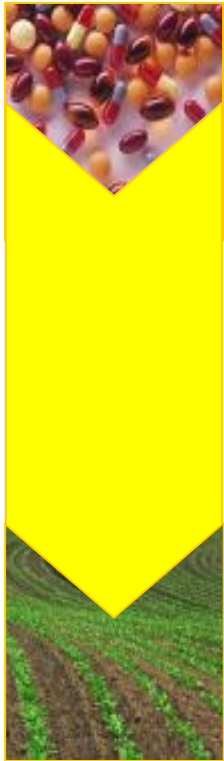
# Pathways of PhaR



Heberer (2002)

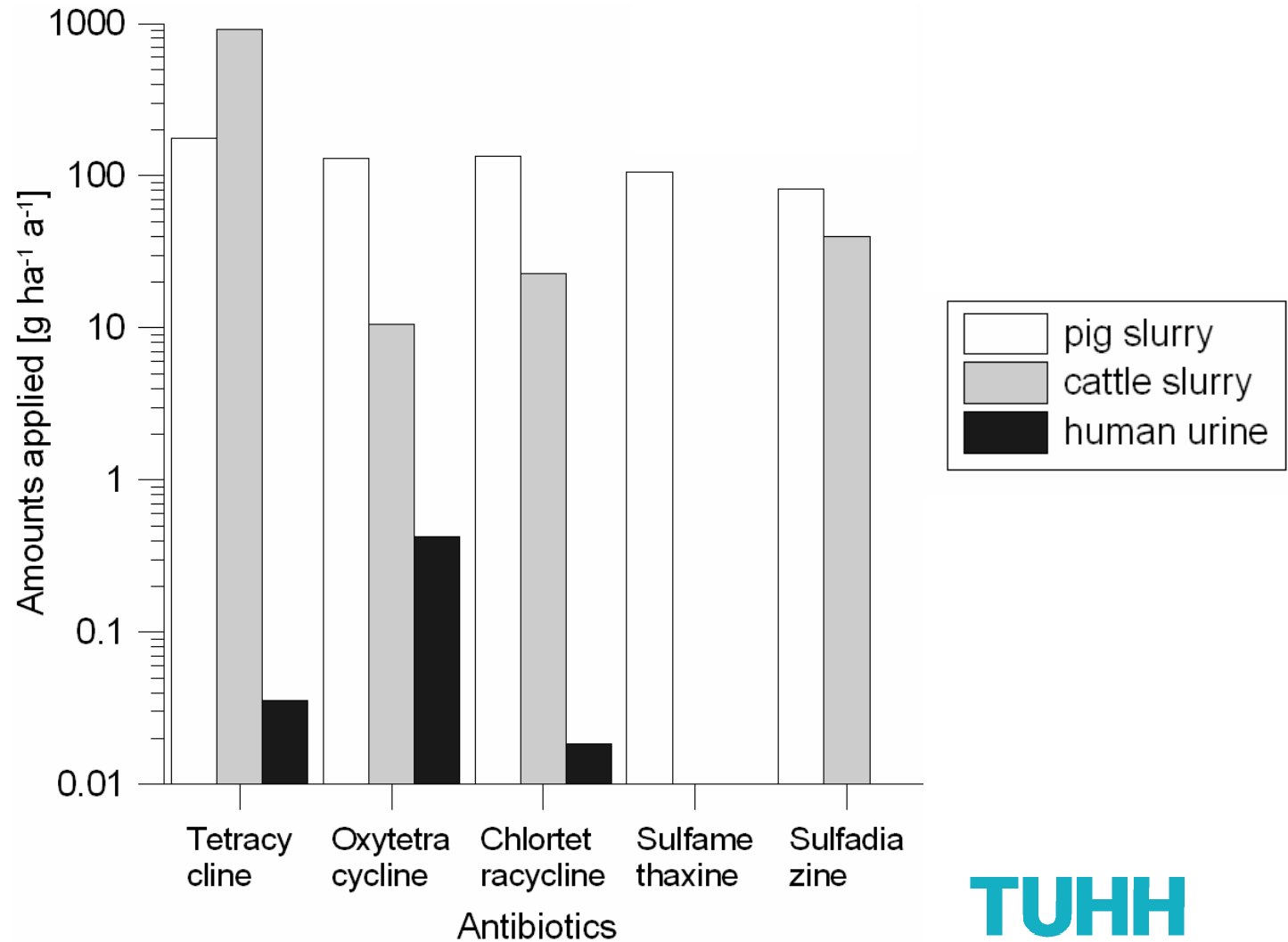
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# Pharmaceuticals in agricultural soils

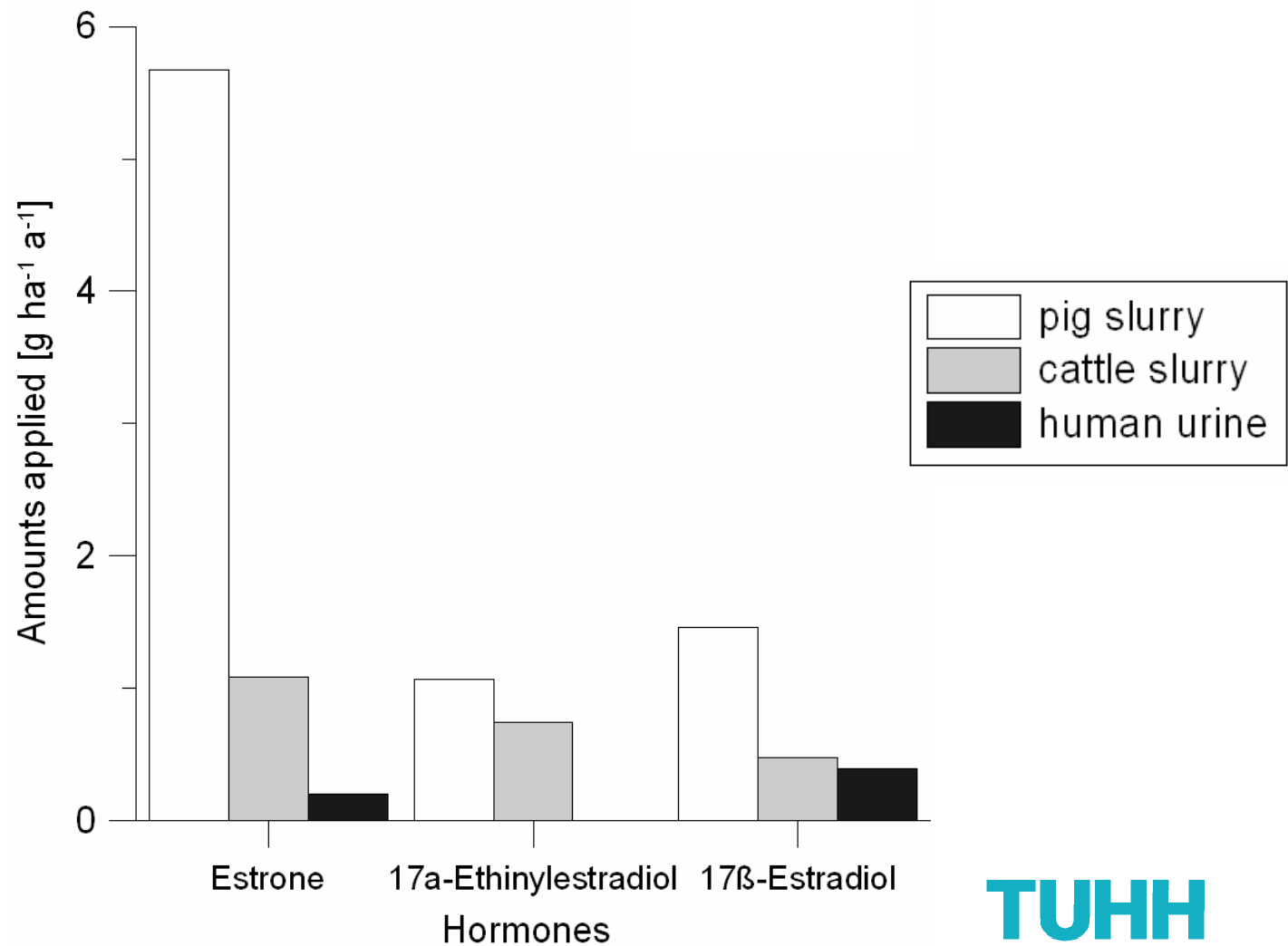


- 20 substances found in soil
  - » Applied through sewage sludge and manure
  - » Below 40cms depths: nothing detected
  - » Degrade after application
- Plants
  - » Found in each part, highest amounts in side roots, then roots.
  - » Also in grain of wheat (when 0.5 mg/kg DM by manure application)

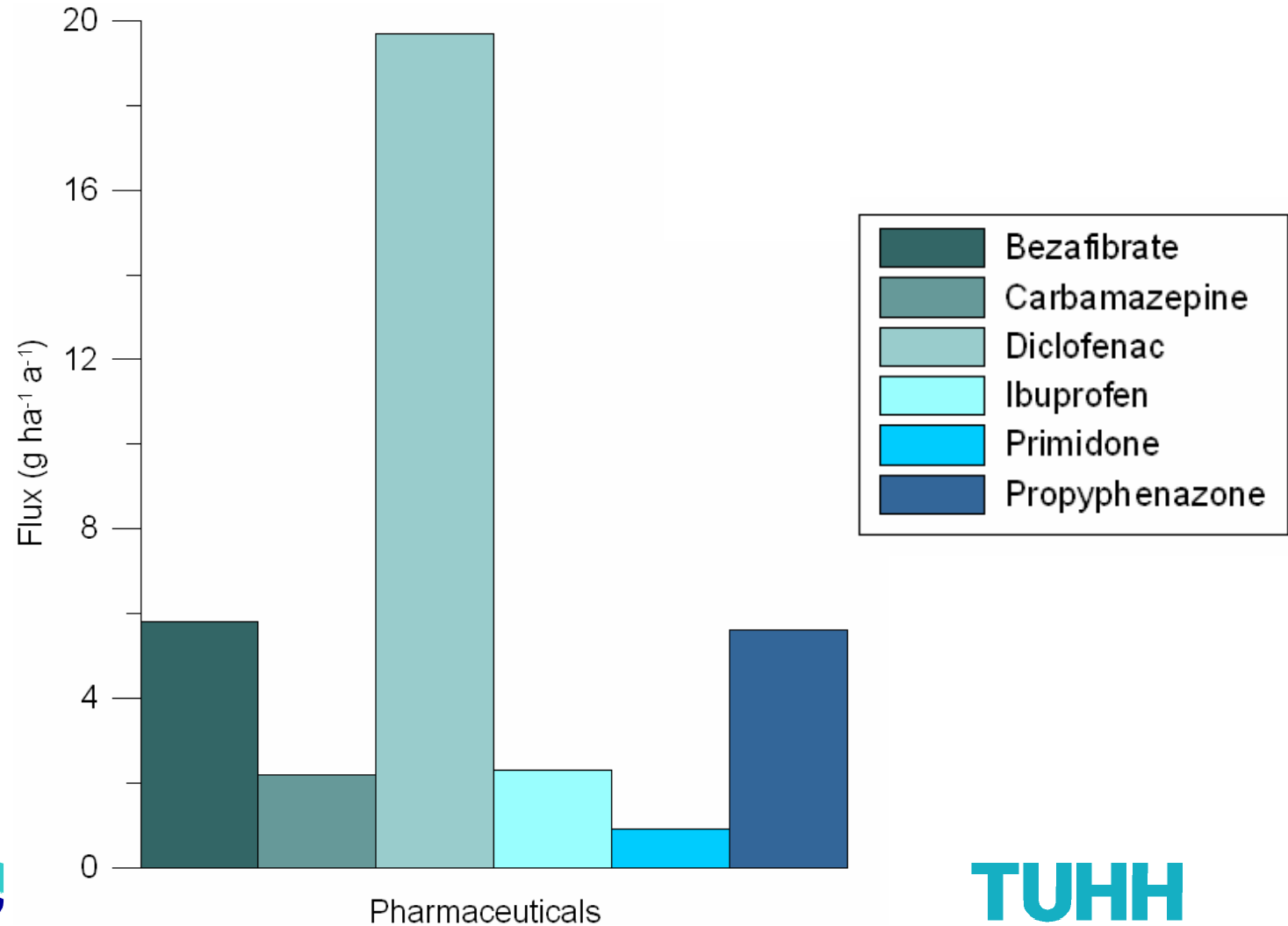
# Antibiotics



# Hormones

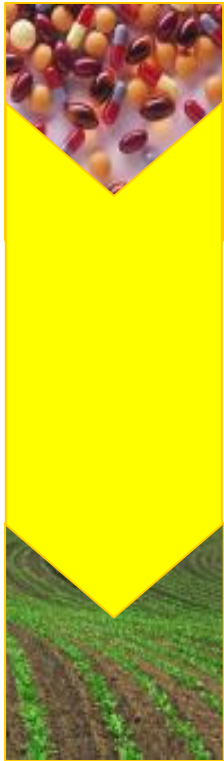


## Other pharmaceuticals



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## Fertilization on urine base depends on...



- Source of urine
- Amount / Nutrient composition: max.  $20 \text{ m}^3 \text{ ha}^{-1} \text{ a}^{-1}$
- Storage over some time – change of pH
- Technique of application
- Timing of fertilization
- Type of crop / crop rotation

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## Conclusion

- Urine can be field applied in a dosage of about  $20 \text{ m}^3 \text{ ha}^{-1} \text{ a}^{-1}$ .
- Hormones' and antibiotics' fluxes show higher values in animal manure than in urine.
- Certain aspects not finally discussed.
- Source separation is a promising option to save water bodies and groundwater from pollution.

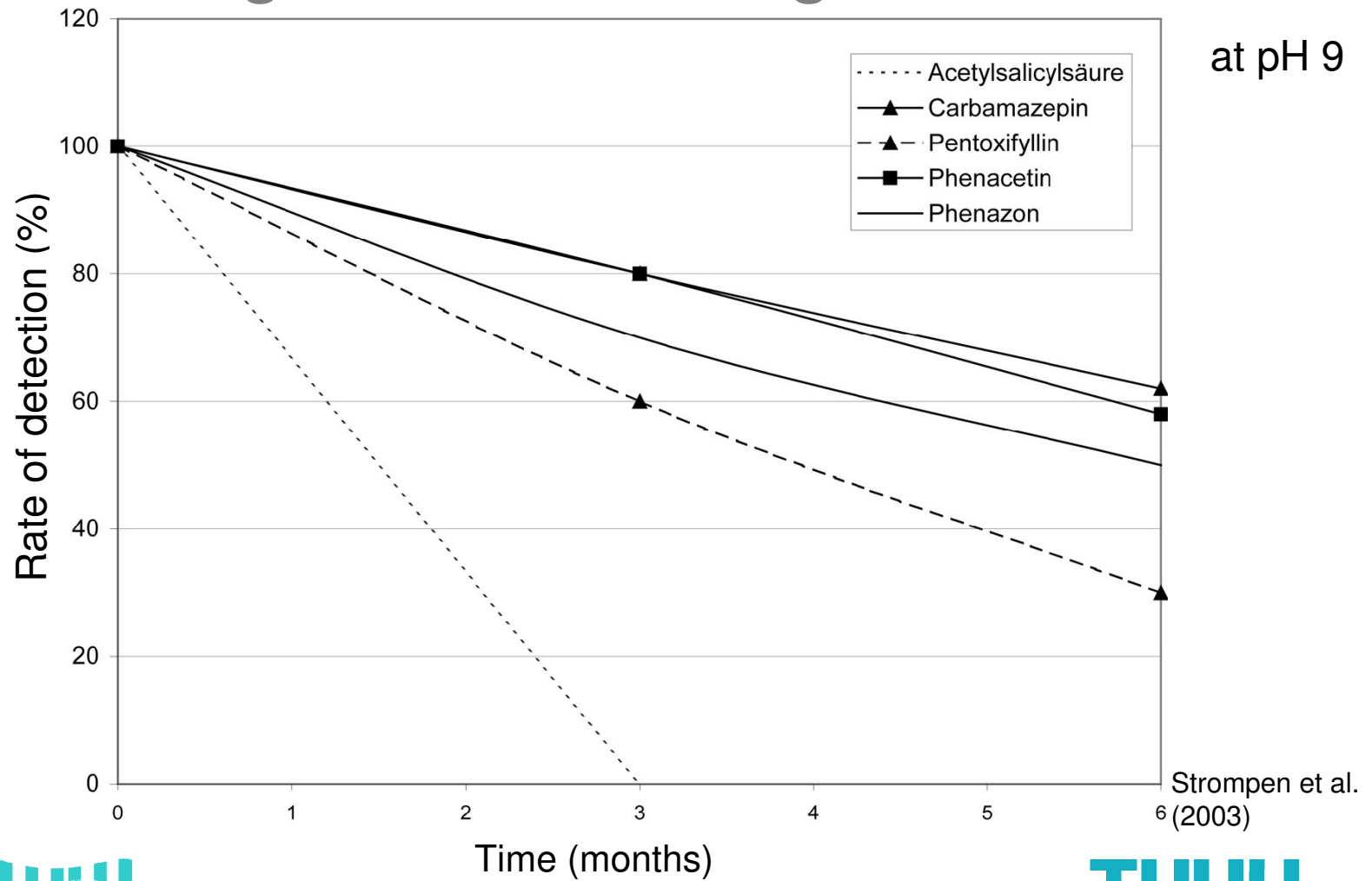
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Thank you!

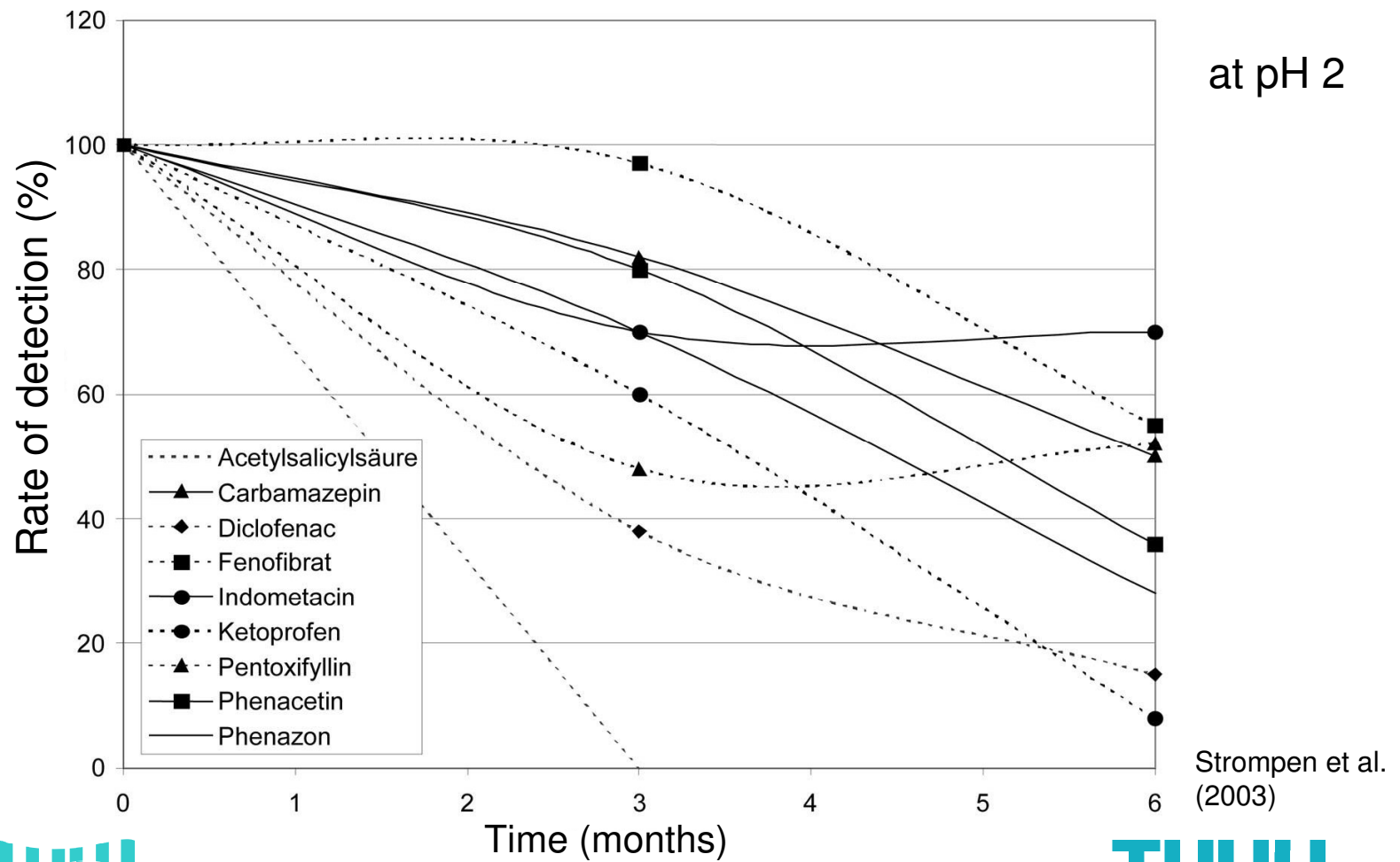
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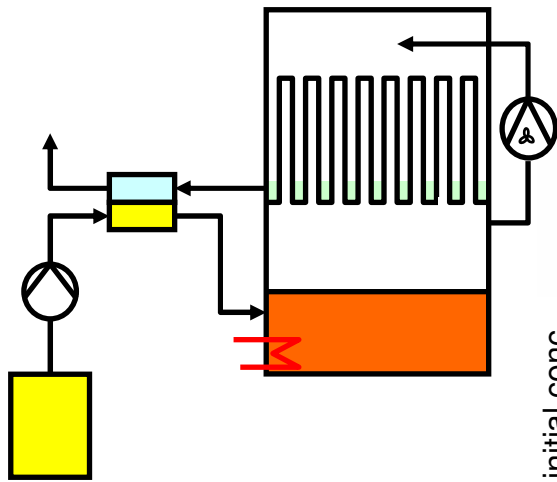
# Degradation in storage tank



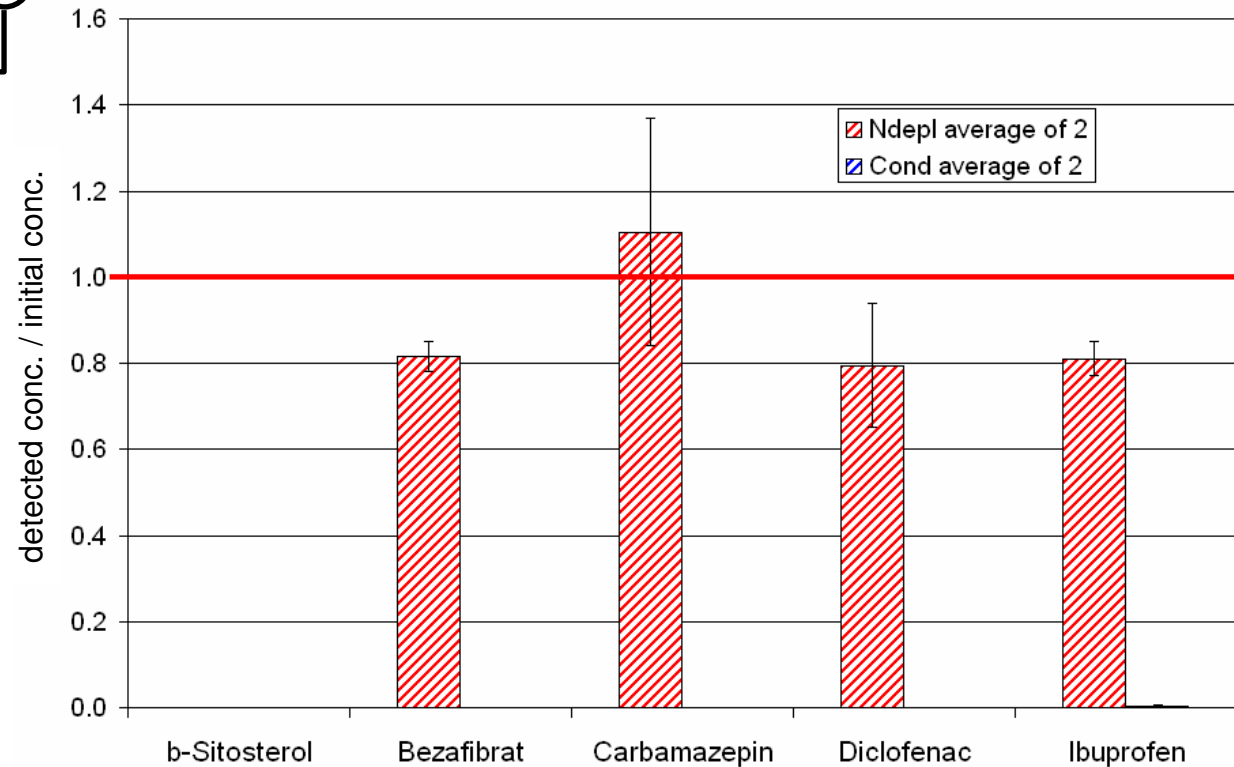
# Degradation in storage tank



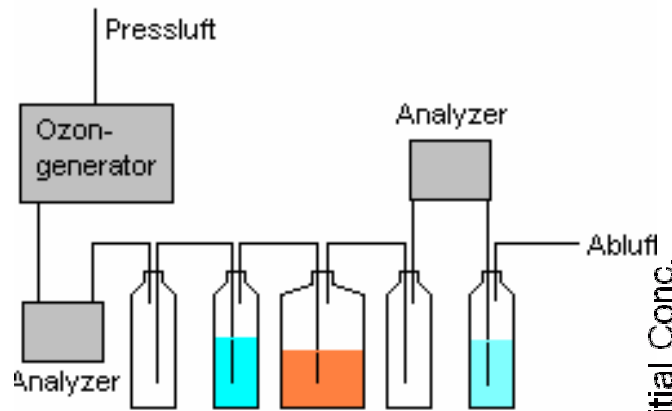
# Treatment of urine – steam stripping



Results of:  
Tettenborn, F. (2006)



# Treatment of urine - ozonisation



Results of:  
Tettenborn, F. (2006)

