Reuse of urine in agriculture
Can pharmaceuticals cause a problem?

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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

- Medicinal products for human use
  - Excretion (hospital effluents)
    - Municipal waste water
  - Excretion (private households)
    - Domestic waste
      - Sewage farms
      - Sewage sludge's
      - Surface water
        - Aqua cultures
      - Pharmaceutical production plants
    - Waste disposal site
      - Soil
      - Drinking water
- Medicinal products for animal use
  - Excretion
    - Manure
Overview about pharmaceutical groups

- Antibiotic (12%)
- Beta blocker (6%)
- Bronchospasmolytic drug (6%)
- Diagnostic agent (6%)
- Disinfectant (6%)
- Lipid regulation drug (5%)
- Gastrointestinal drug (4%)
- Psychopharmacologic agent (4%)
- Unbekannt (21%)
- Others (12%)
Discharge of PhaR

Mainly via urine
Concentrations of PhaR
Pathways of PhaR

Medicinal products for human use
- Excretion (hospital effluents)
- Excretion (private households)
  - municipal waste water
  - sewage treatment plants (STPs)
  - Sewage sludge's
  - surface water
  - aqua cultures
  - pharmaceutical production plants

Medicinal products for animal use
- waste disposal (unused medicine)
  - domestic waste
  - sewage sludge's
  - waste disposal site
  - drinking water

Yellow water

Heberer (2002)
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

Amounts applied [g ha\(^{-1}\) a\(^{-1}\)]

- **Tetracycline**
- **Oxytetracycline**
- **Chlortetracycline**
- **Sulfamethazine**
- **Sulfadiazine**

- Pig slurry
- Cattle slurry
- Human urine

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Hormones

Amounts applied [g ha\(^{-1}\) a\(^{-1}\)]

- Estrone
- 17α-Ethinylestradiol
- 17β-Estradiol

pig slurry

- cattle slurry
- human urine

TUHH
Other pharmaceuticals

Flux (g ha\(^{-1}\) a\(^{-1}\))

- Bezafibrate
- Carbamazepine
- Diclofenac
- Ibuprofen
- Primidone
- Propyphenazone

Pharmaceuticals
Fertilization on urine base depends on...

- Source of urine
- Amount / Nutrient composition: max. 20 m³ ha⁻¹ a⁻¹
- Storage over some time – change of pH
- Technique of application
- Timing of fertilization
- Type of crop / crop rotation
Conclusion

- Urine can be field applied in a dosage of about 20 m³ ha⁻¹ 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.
Thank you!

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Degradation in storage tank

at pH 9

Strompen et al. (2003)
Degradation in storage tank at pH 2

Strompen et al. (2003)
Treatment of urine – steam stripping

Results of:
Tettenborn, F. (2006)
Treatment of urine - ozonisation

Results of:
Tettenborn, F. (2006)