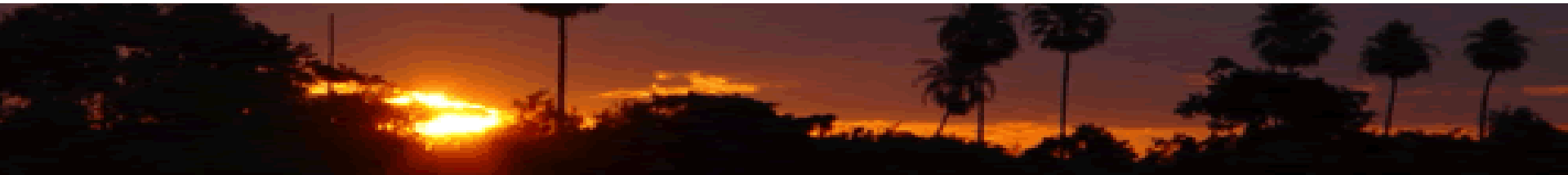
Methods for stabilising and concentrating human urine for use as a fertilizer

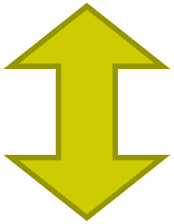
Marc A. Boncz

Edinéia L. Formagini, Felipe X.C. Arima, Paula L. Paulo



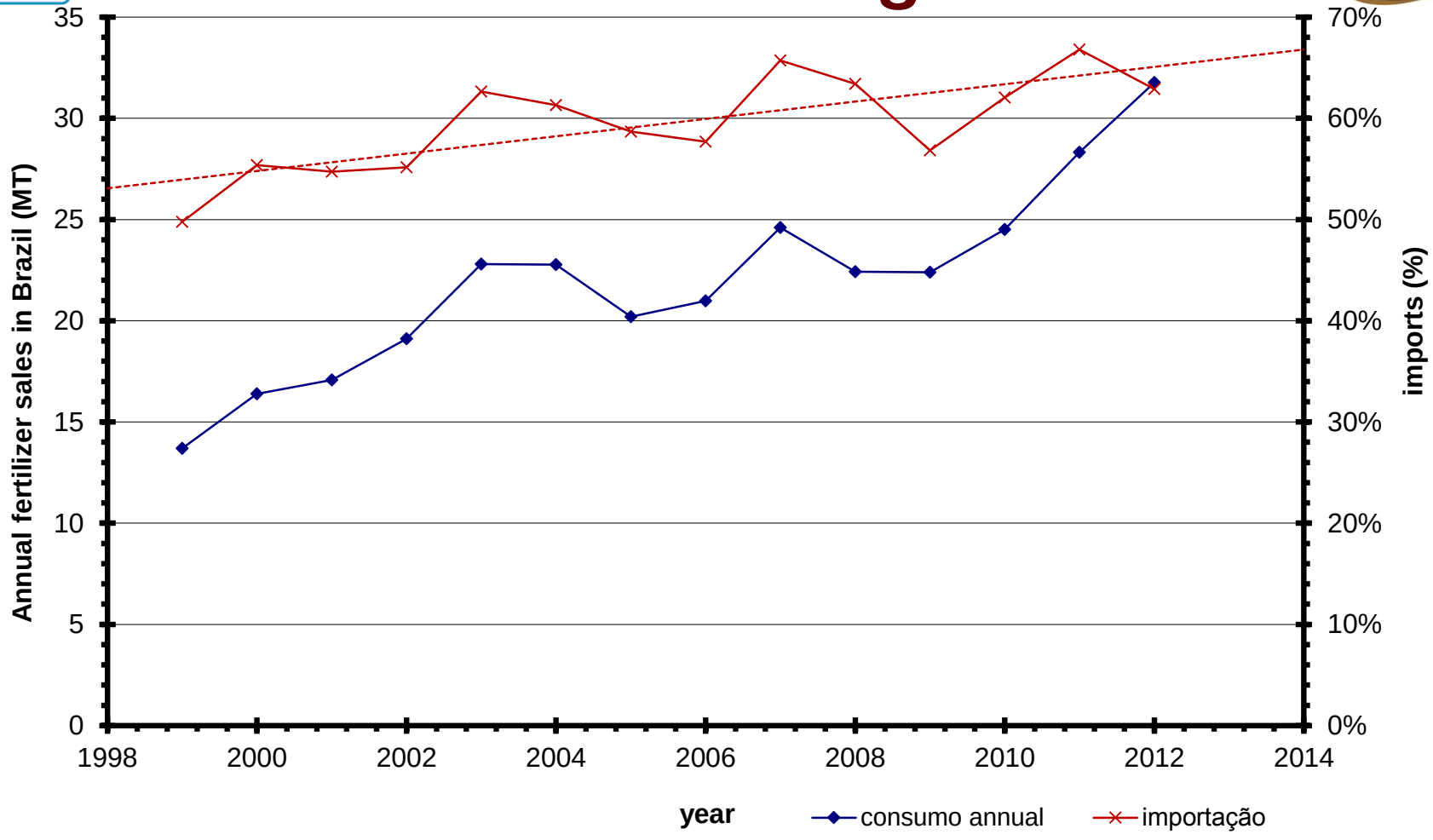
Introduction

- Agriculture in Brazil (and worldwide)
  - Still growing (population and biofuels!)
  - Growing dependency on mineral raw materials

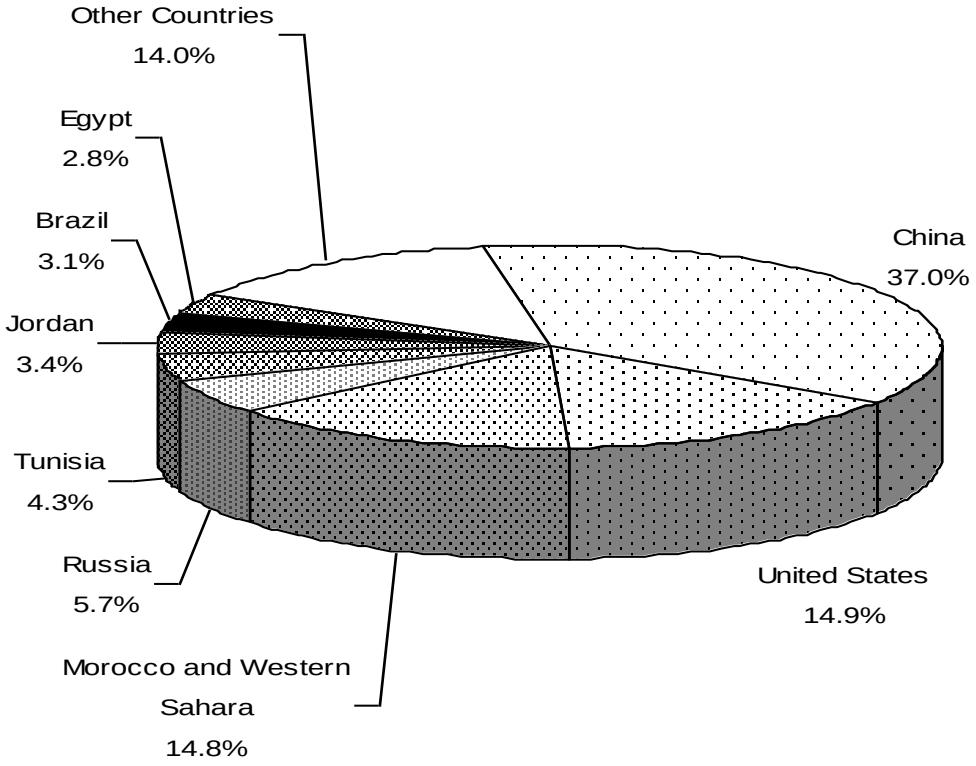


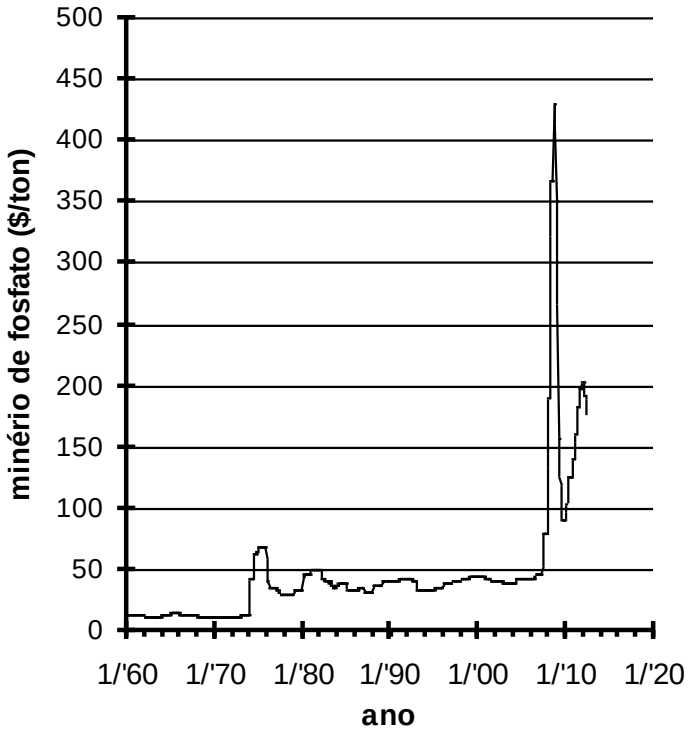
- Wastewater Treatment
  - Brazil: mainly UASB reactors
  - world: often still insufficient nutrient removal

Intro: nutrients for agriculture



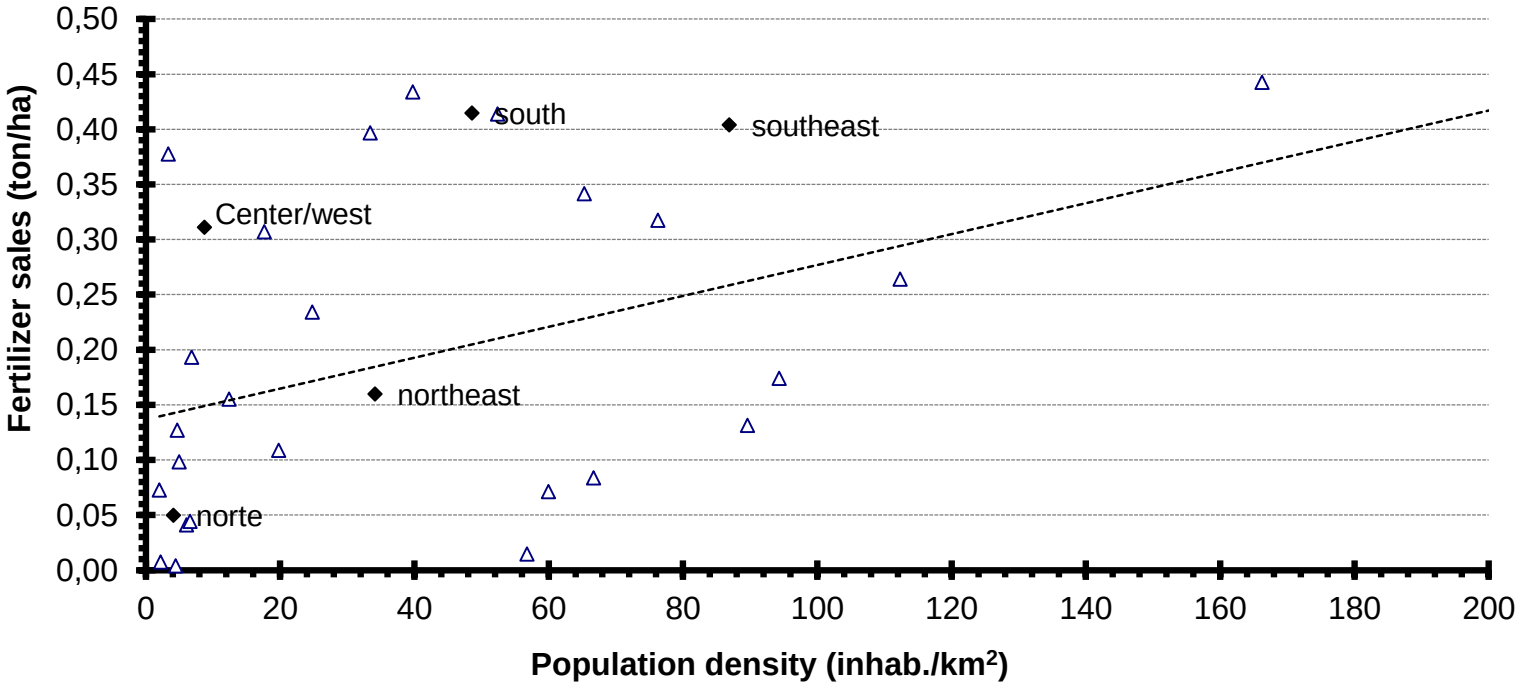
Intro: nutrients for agriculture





Introduction: potential of urine

- Quantity available much smaller than demand
- Higher demand in more densely populated areas



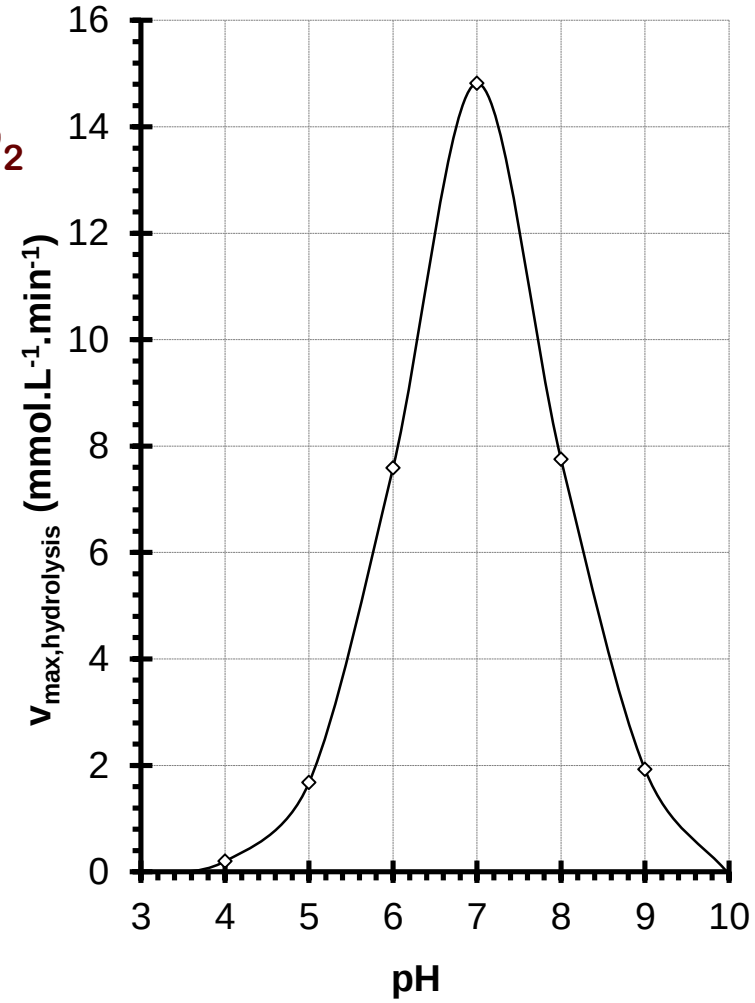
Main problem: instability of urea

- **Urea hidrolysis:**

  $H_2N\text{-}CO\text{-}NH_2 + H_2O \rightarrow 2\ NH_3 + CO_2$

  $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$

  - **Enzymatic process**
    - **Faster at pH≈7**
  - **Problems:**
    - **Loss of Nitrogen**
    - **Smell**
    - **Increase of pH**



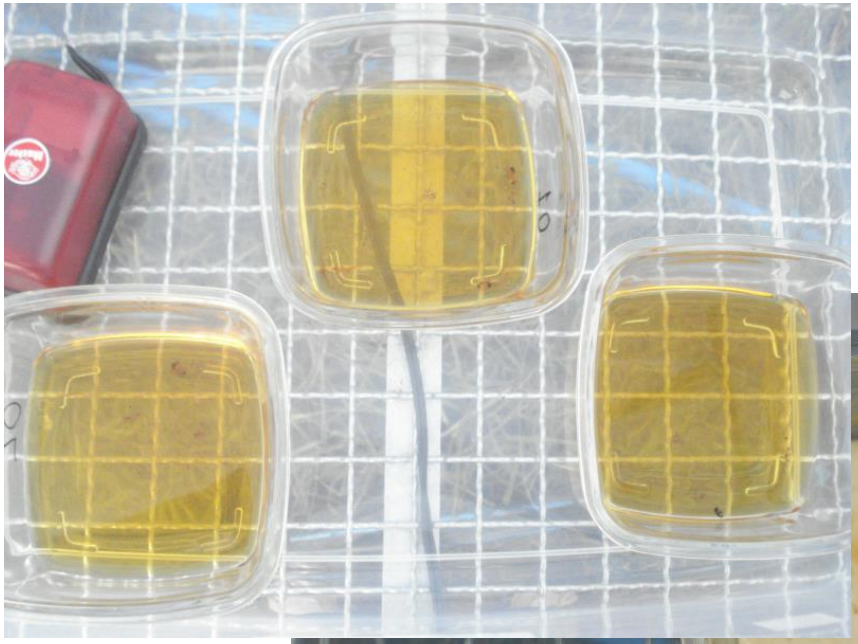
Objectives

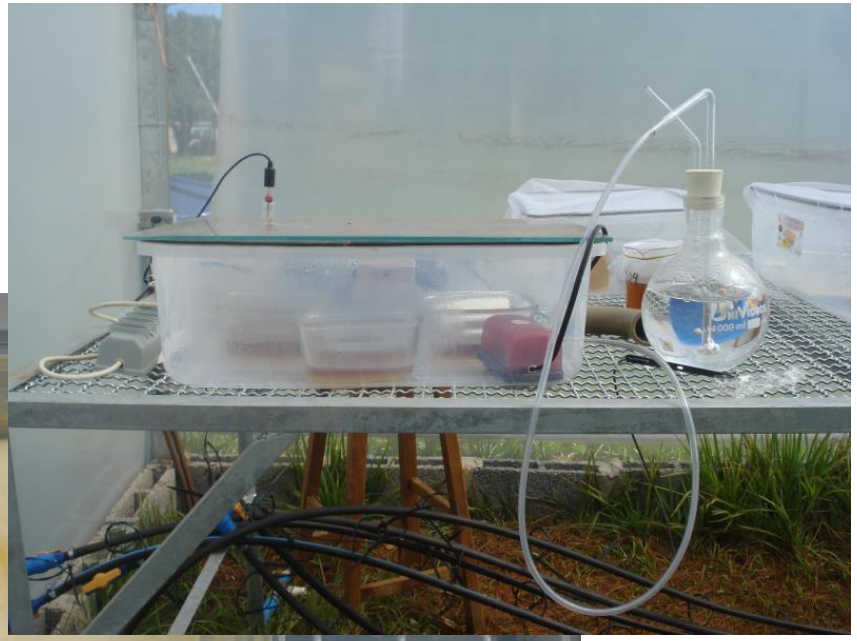
- stabilizing human urine for use as a fertilizer
  - Conservation of nutrients contained
    - impeding mainly urea hydrolysis
  - Volume reduction
    - Reduction of transportation costs

Materials and Methods

- Fresh urine collection + characterization
  - pH, TN, NH_3, P, K, TS, VS, FS
- Addition of stabilizing compounds
  - acids, NaOH, limestone, ashes or a mixture
- Determination of initial weight
- Storage in temperature controlled room or greenhouse – with and without forced ventilation ($\rightarrow$ determination of evaporation)
- Parameters followed:
  - Weight, TN, NH_3, P, K, TS

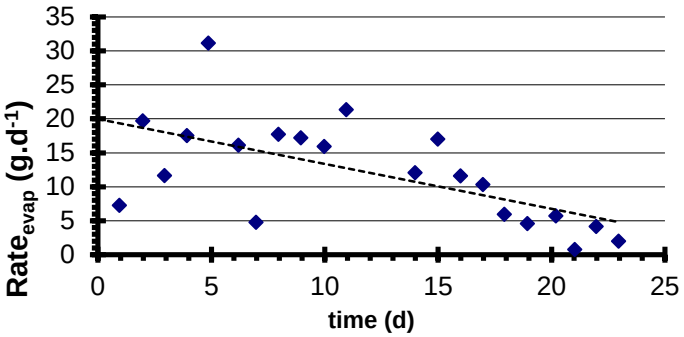
Materials and Methods

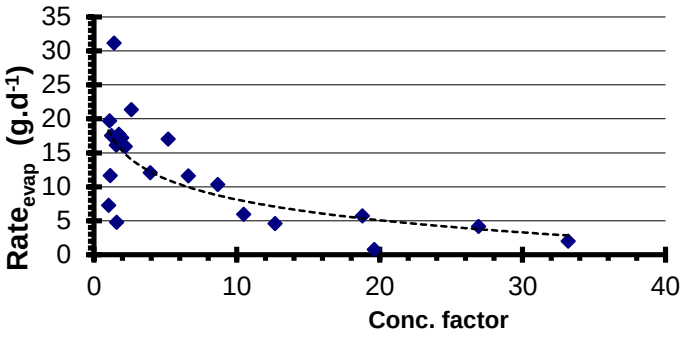


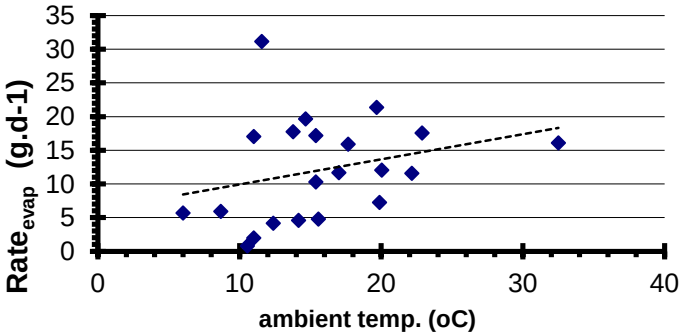


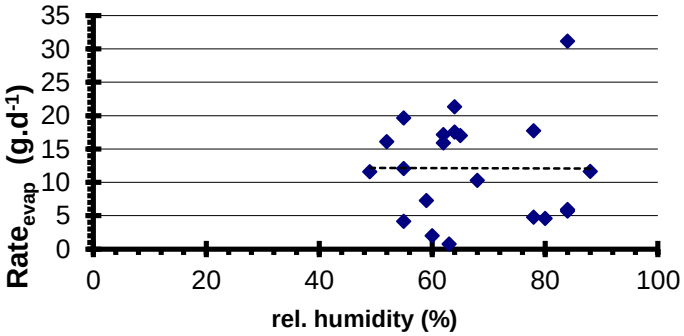
Results: evaporation

- Slightly slower when compared to water
- Influenced mainly by the TS contents

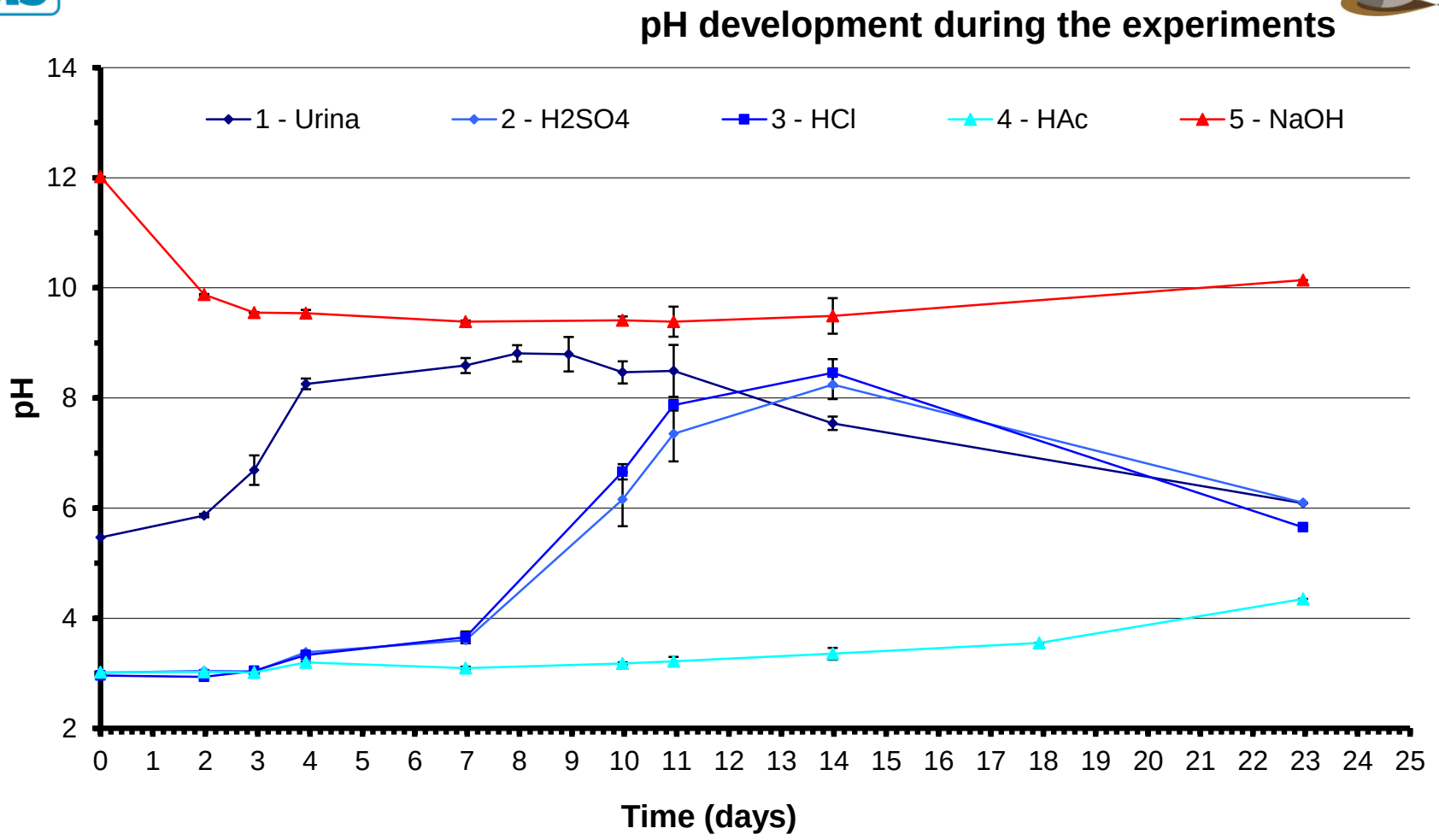




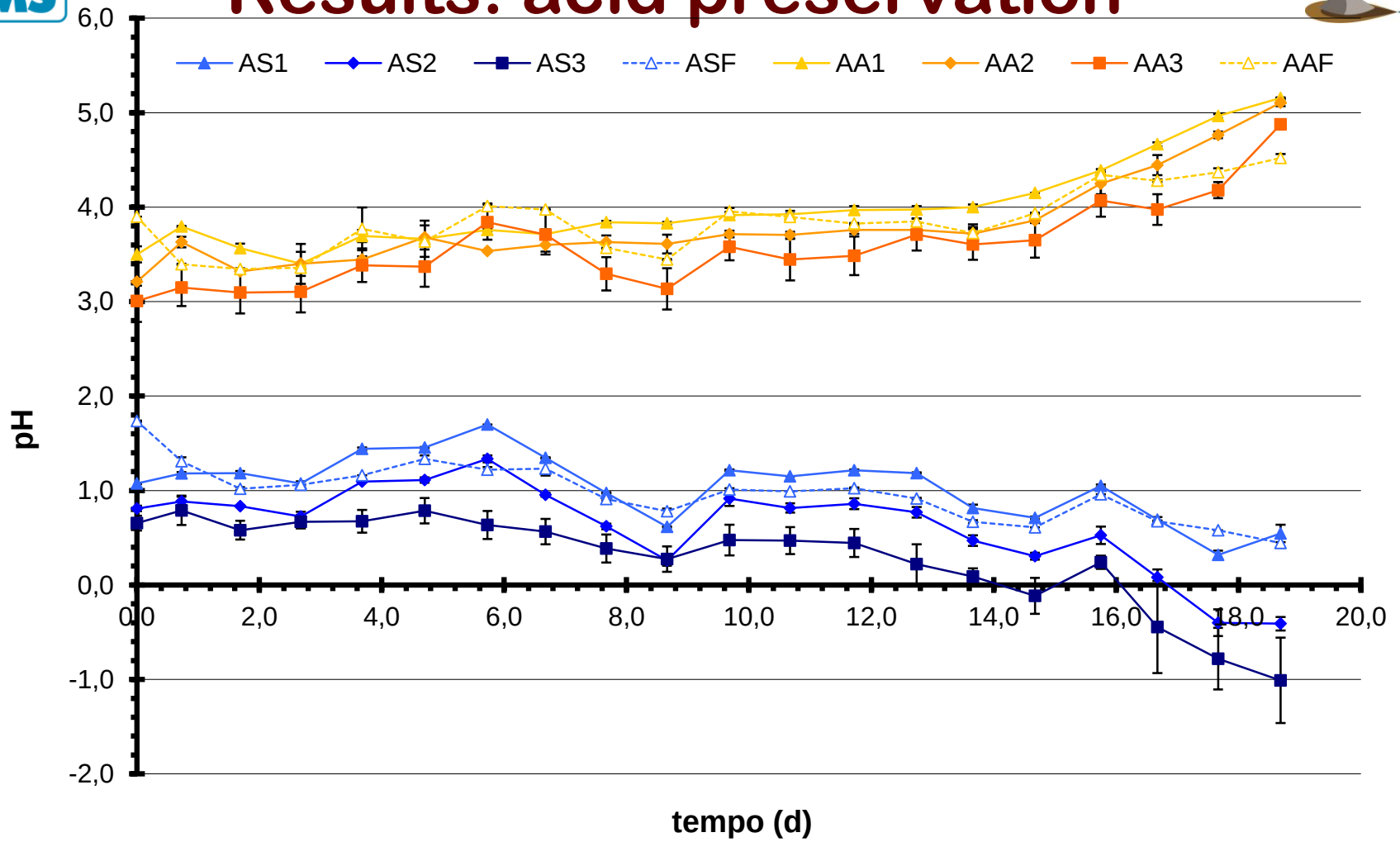




Results: hydrolysis



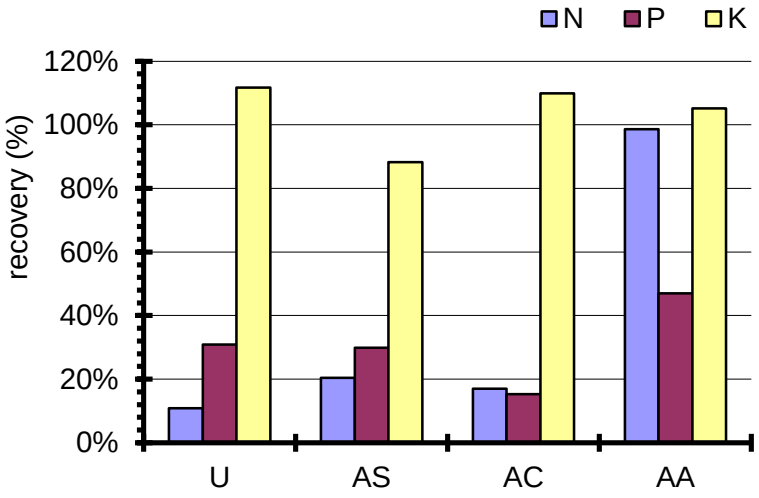
Results: acid preservation

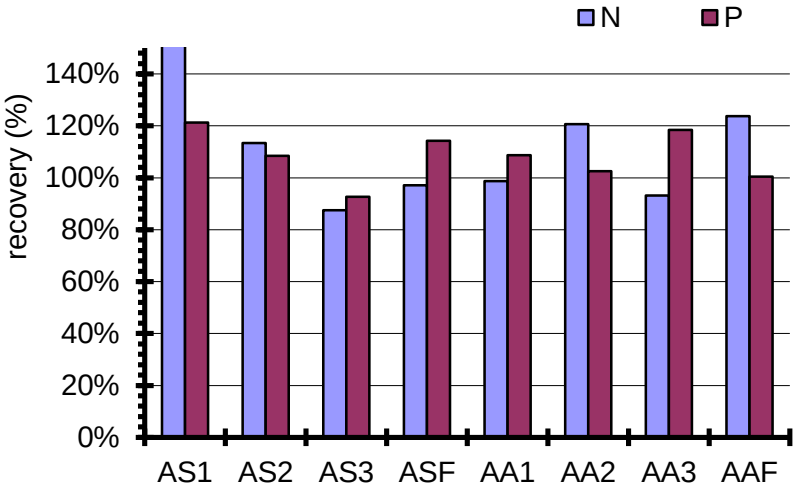


acids: 0.065 ... 0.27 M

Results: nutrient recovery

- **Nutrient recovery:**
  - Nitrogen – compatible to the capacity of the maintenance of a high or low pH
  - K mostly 100%
  - Results for P are comparable to N





Conclusions

- It is possible to preserve the nutrients in the urine by using acids or bases.
- Better results obtained with acids (lower loss of nitrogen) and easier to implement (e.g. use of vinegar).
- For the case of bases, better results were obtained by using limestone.

  \+ can be used to improve quality of soil

  \- Significant increase of the weight of produced fertilizer

Thanks
for the attention!

marc.boncz@ufms.br
paula.paulo@ufms.br

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