



Opening the 'yellow box':

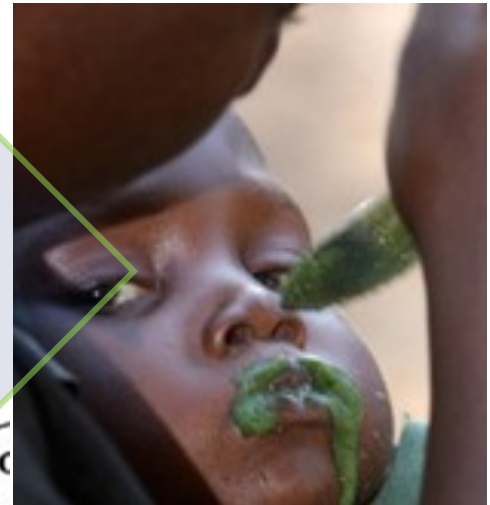
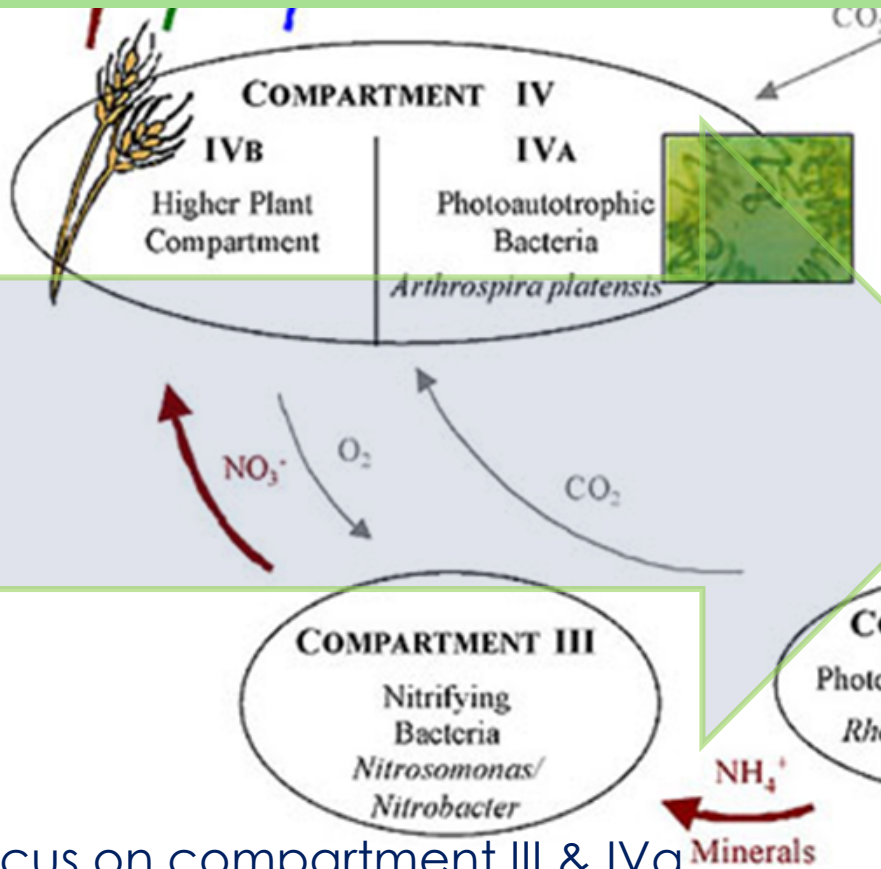
Main organics in urine and their fate during nitrification and microalgae cultivation



V. Van Malderen, N. Sachdeva, R. Wattiez, B. Leroy, Lidia Belova, Elias Iturrospe, Olivier Mortelé, Adrian Covaci, Alexander L.N. van Nuijs, S.E. Vlaeminck



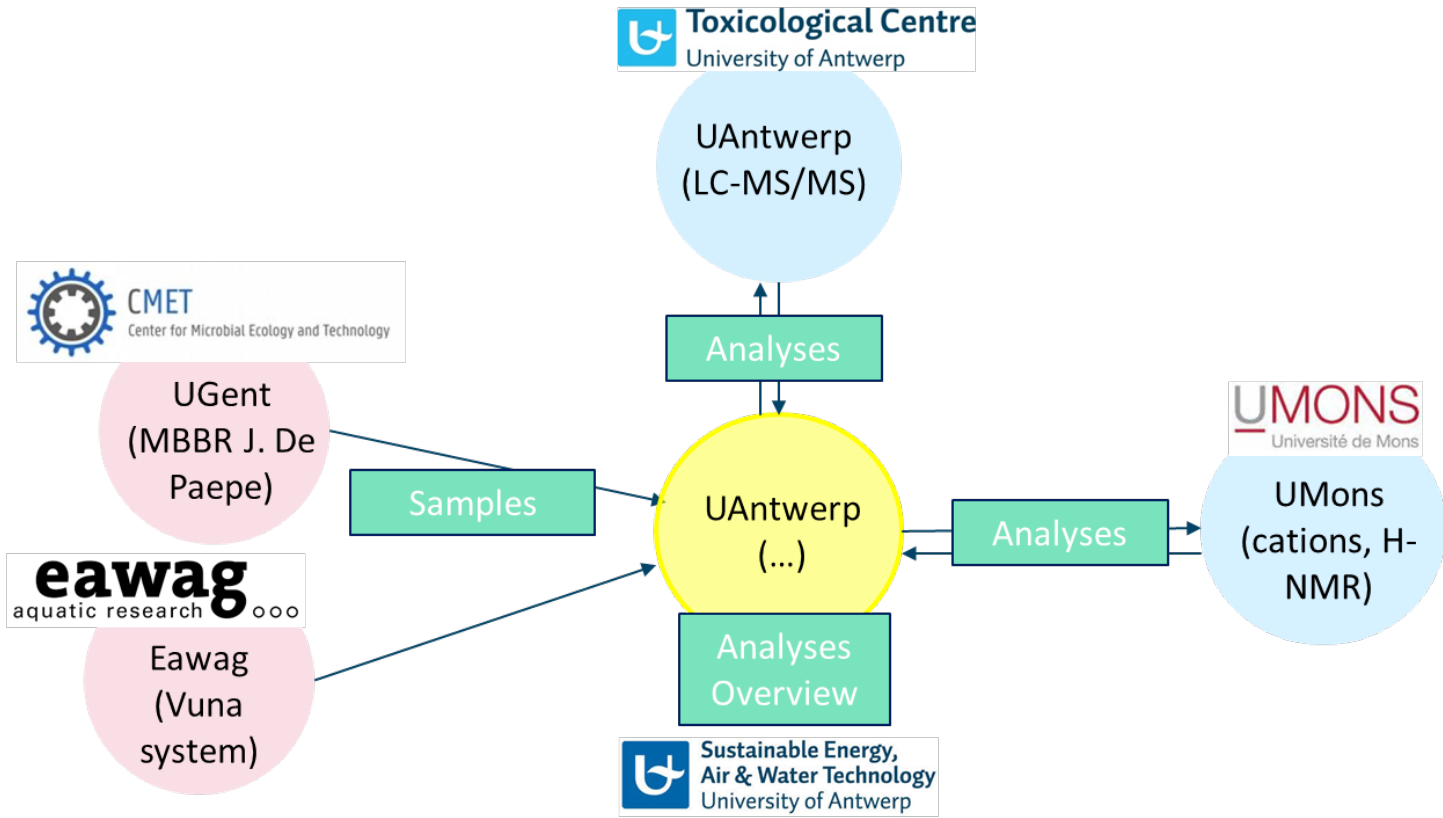
CLOSING THE NITROGEN CYCLE – from urine to fertilizer and food



Focus on compartment III & IVa

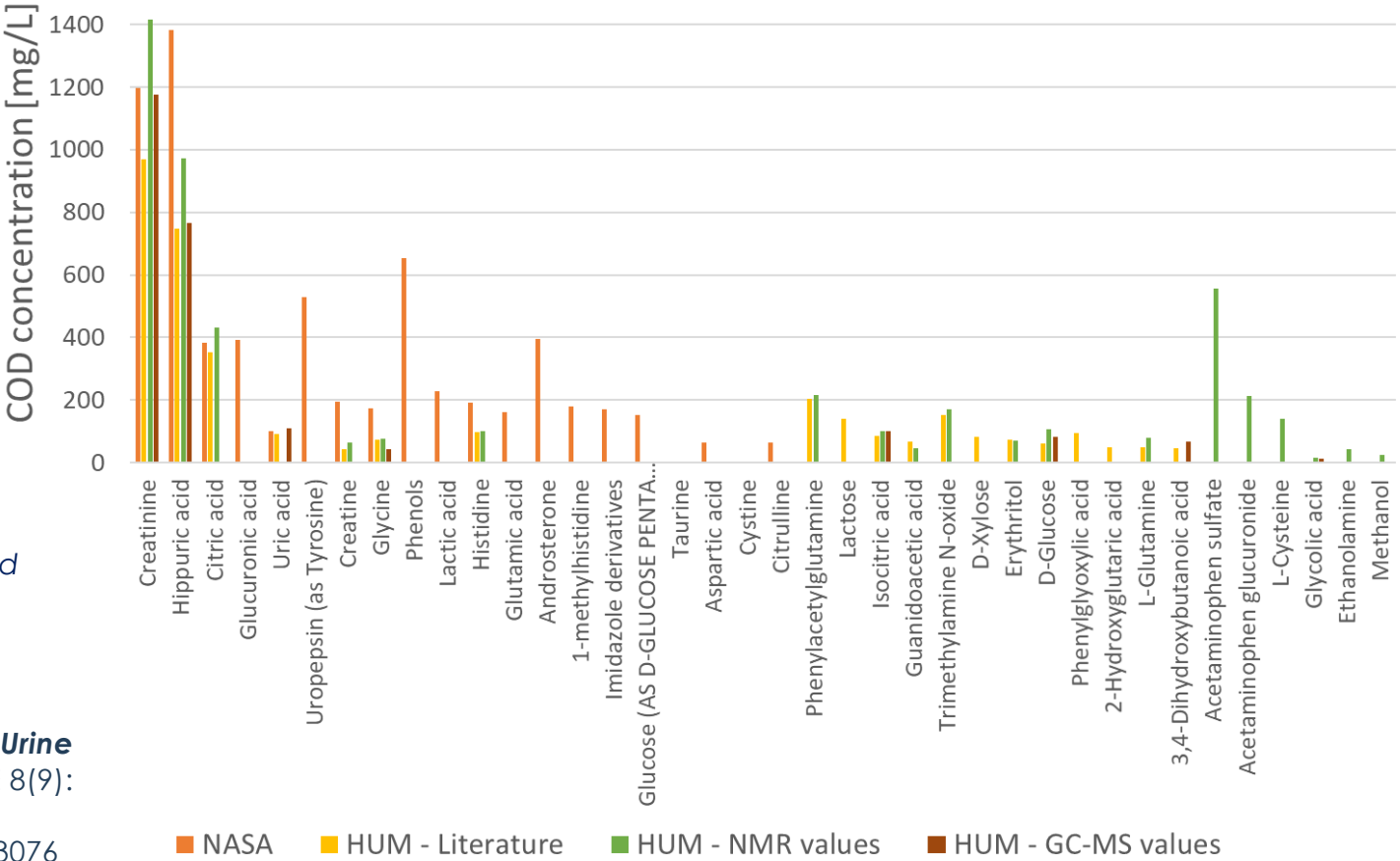
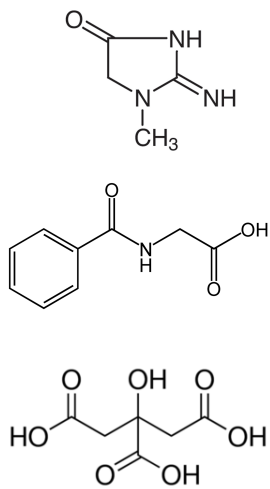


WHAT HAPPENS WITH THE ORGANICS during nitrification?





Step 1: Understanding the (organic) composition of fresh urine



D.F. Putnam, *Composition and concentrative properties of human urine*. 1971, **NASA** contractor report

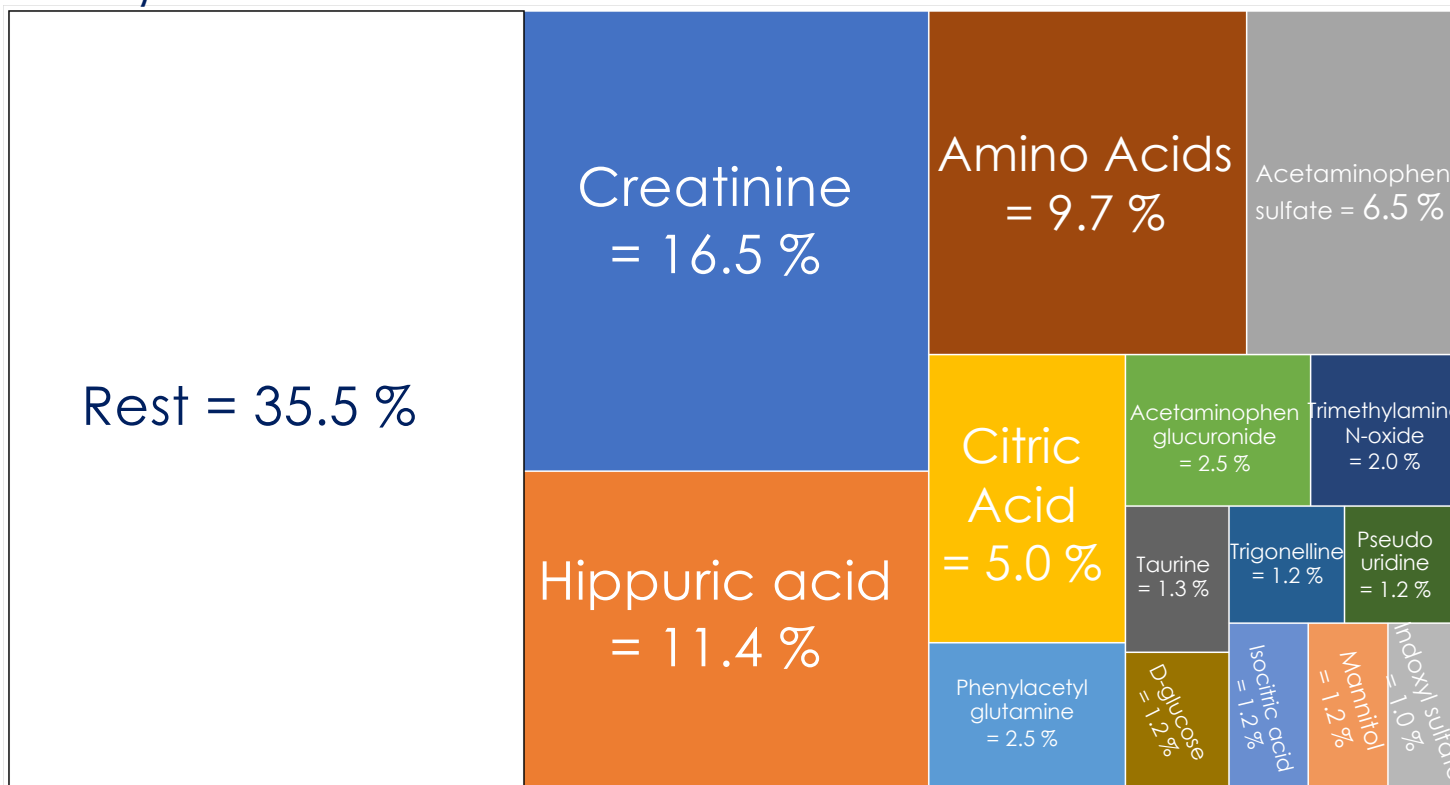
Bouatra, S., et al. *The Human Urine Metabolome*. 2013, PLoS ONE 8(9): e73076.
doi:10.1371/journal.pone.0073076

(credits: J. Barys)



Step 1: Understanding the (organic) composition of fresh urine

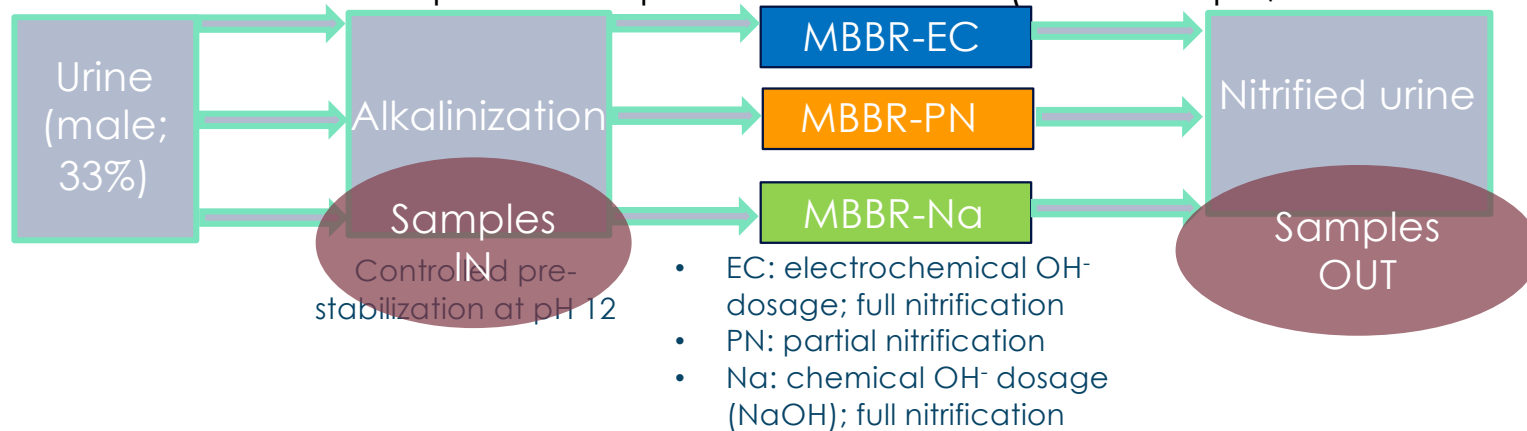
Compound distribution (%of total COD), COD = 8,561 mg/L (average H-NMR values from Metabolome)



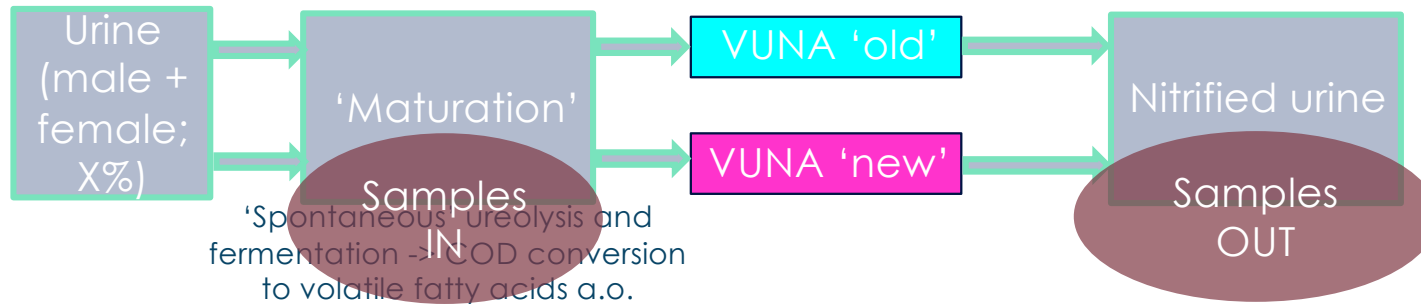


Step 2: Collecting (treated) urine products Origin of the samples

1. MBBR on urine - complete and partial nitrification (J. De Paepe; Ghent University)

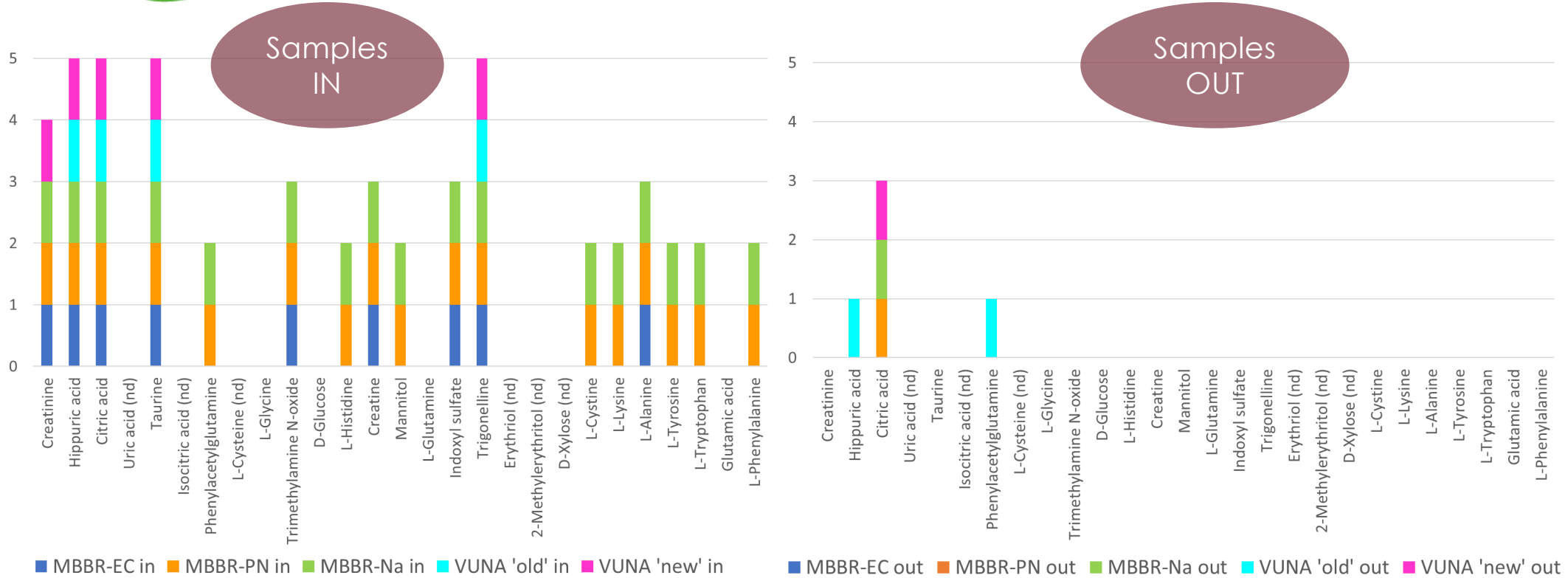


2. VUNA - Partial nitrification on 'fermented urine' – old/new installation (K. Udert; Eawag)





Step 3: Analyzing (treated) urine products Qualitative HPLC-MS/MS results – targeted compounds



The majority of the main compounds are removed after nitrification

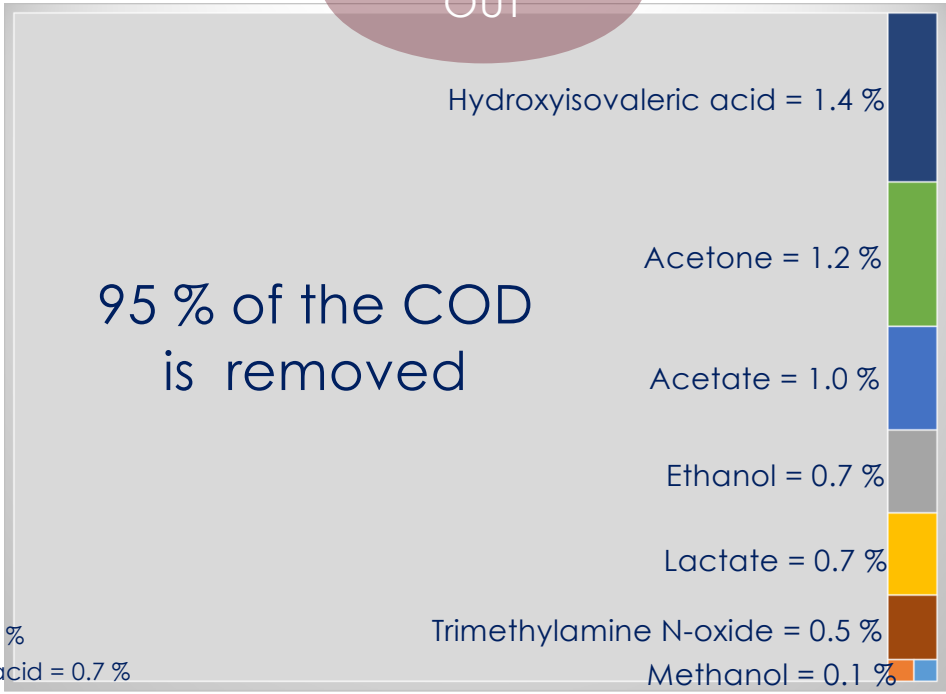
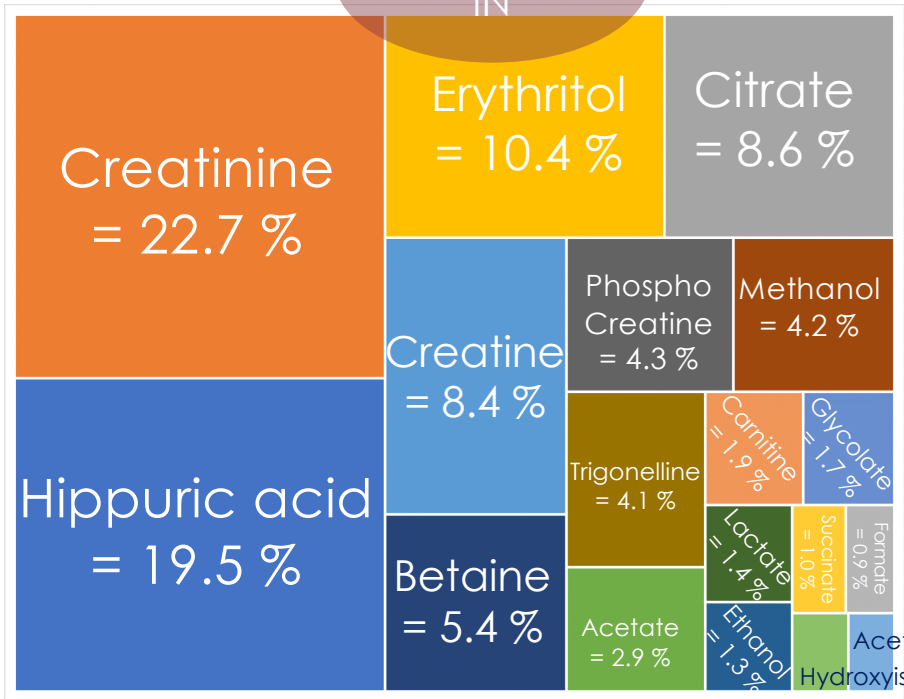


Step 3: Analyzing (treated) urine products Quantitative H-NMR results - scanning

Compound distribution for MBBR-EC

Sample
IN

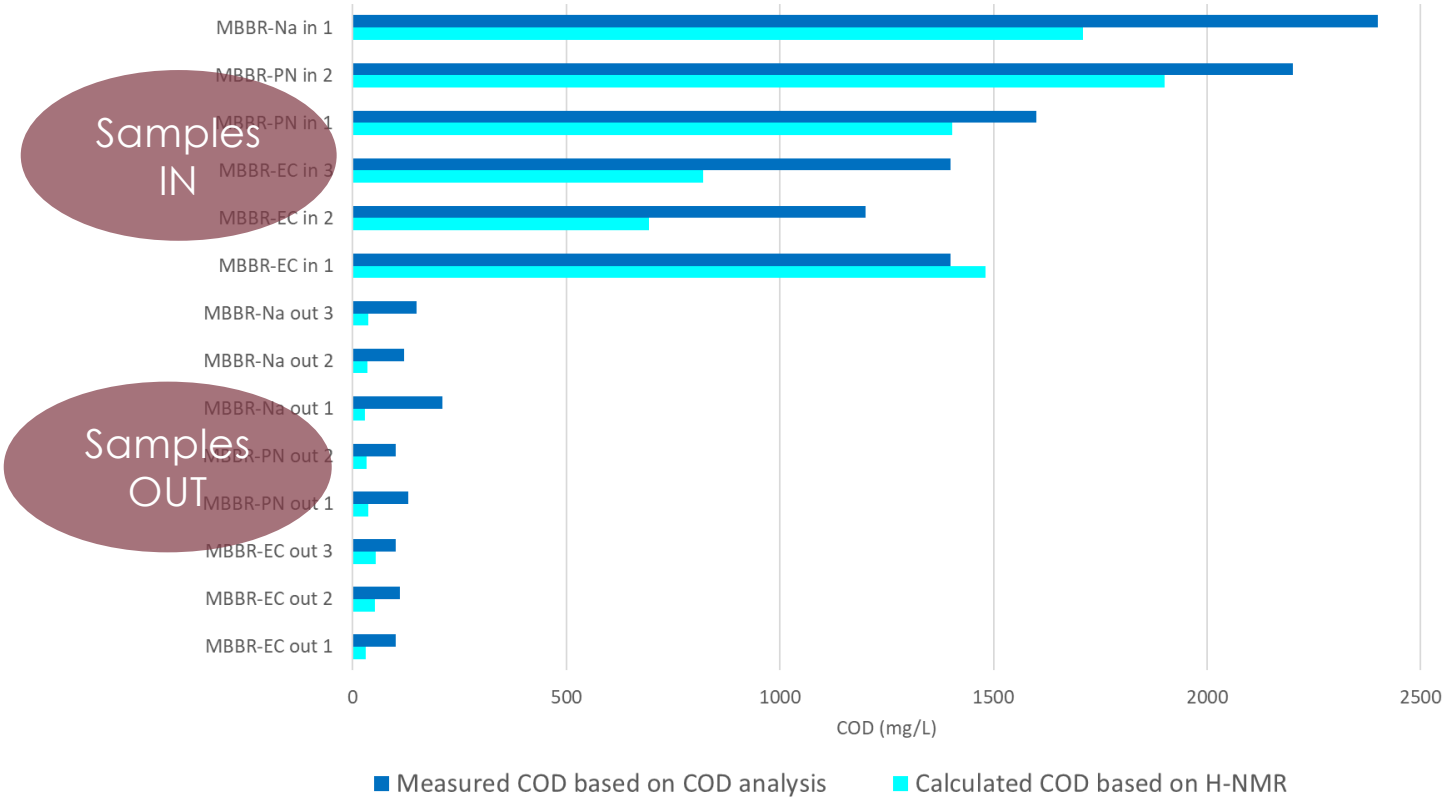
Sample
OUT





Step 3: Analyzing (treated) urine products COD analysis versus H-NMR scanning

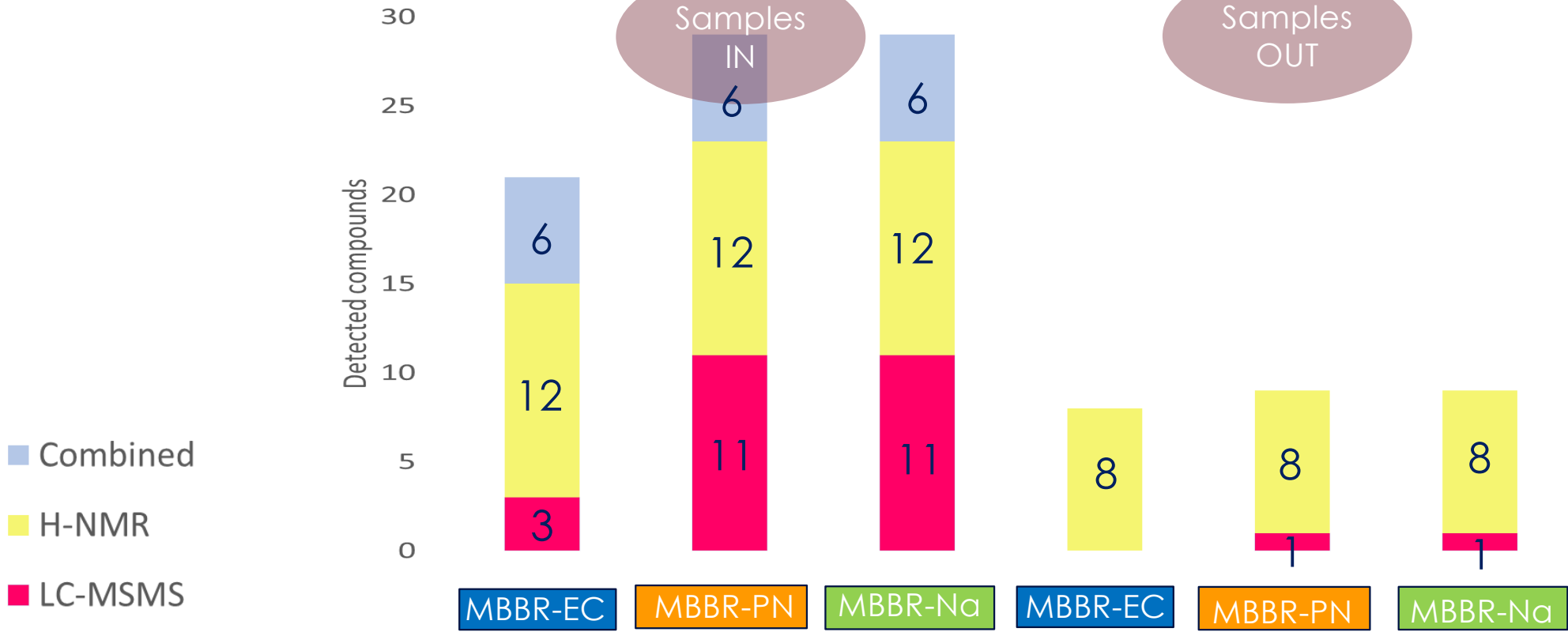
How much COD are we missing?





Step 3: Analyzing (treated) urine products HPLC-MS/MS versus H-NMR

How many compounds did we detect?





CONCLUSIONS & FURTHER RESEARCH

CONCLUSION

Nitrification of pre-alkalinized or matured urine with open communities is **largely effective** in removing the major COD contributors

FURTHER RESEARCH

- ✓ **Confirmation** by analysing more samples
- ✓ More **quantitative** with HPLC-MS/MS (?)
- ✓ How **representative** is the 'donor' urine for astronauts in space?
- ✓ How **representative** are the (partial) nitrification set-ups for MELISSA?

But what with the remaining COD...?

MELISSA



MICRO-ECOLOGICAL
LIFE SUPPORT SYSTEM
ALTERNATIVE

THANK YOU.

Veerle Van Malderen
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