SPRINT

Consumer exposure to pesticide residues from food

an exploratory study of duplicate food portions (DFP) intake and urinary metabolite excretion

Nina Wieland, Radboud University, Nijmegen, The Netherlands

Funded by the European Union

Goals from the SPRINT project

Start - 2020

2021

2022

2023

2024

Einde - 2025

Main objective:

- Occurrence of plant-protection products (PPP) in the environment and their effect on man, animal and environment
- Contribute to sustainable PPP use

Most important output:

Field campaign

- First large-scale monitoring of PPP residues

Lab

- (eco)-toxicological experiments, to observe and predict the effects residues

Future:

Innovative and sustainable agriculture by 2030

Background

Pesticides

Maximum Residue Levels (MRL)

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Background

Pesticides

Maximum Residue Levels (MRL)

Low internal concentrations (< 1 ng/mL)

Aggregate exposure
- Diet
- Pets

Mixture exposure

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Background

Pesticides

Maximum Residue Levels (MRL)

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- Diet
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Mixture exposure

New method: <u>Duplicate-portion analysis</u>
- Collection of an exact duplicate of the consumed food
- Collect urine

→ Better understanding of the relationship between intake and excretion

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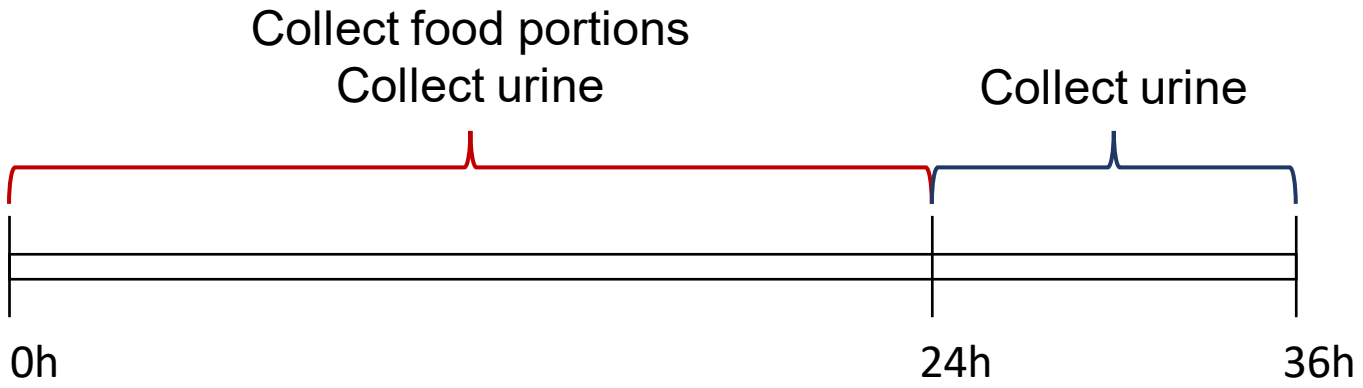
Study design

- Pilot study duplicate-portion analysis
- 43 participants,
  - from Argentinia, Croatia, Denmark, the Netherlands, Portugal, Slovenia, Spain
  - Balanced gender distribution

- Collect 24h exact duplicate of food portions
- Collect 24h urine (batch A) + 12h urine (batch B)
- Food diary



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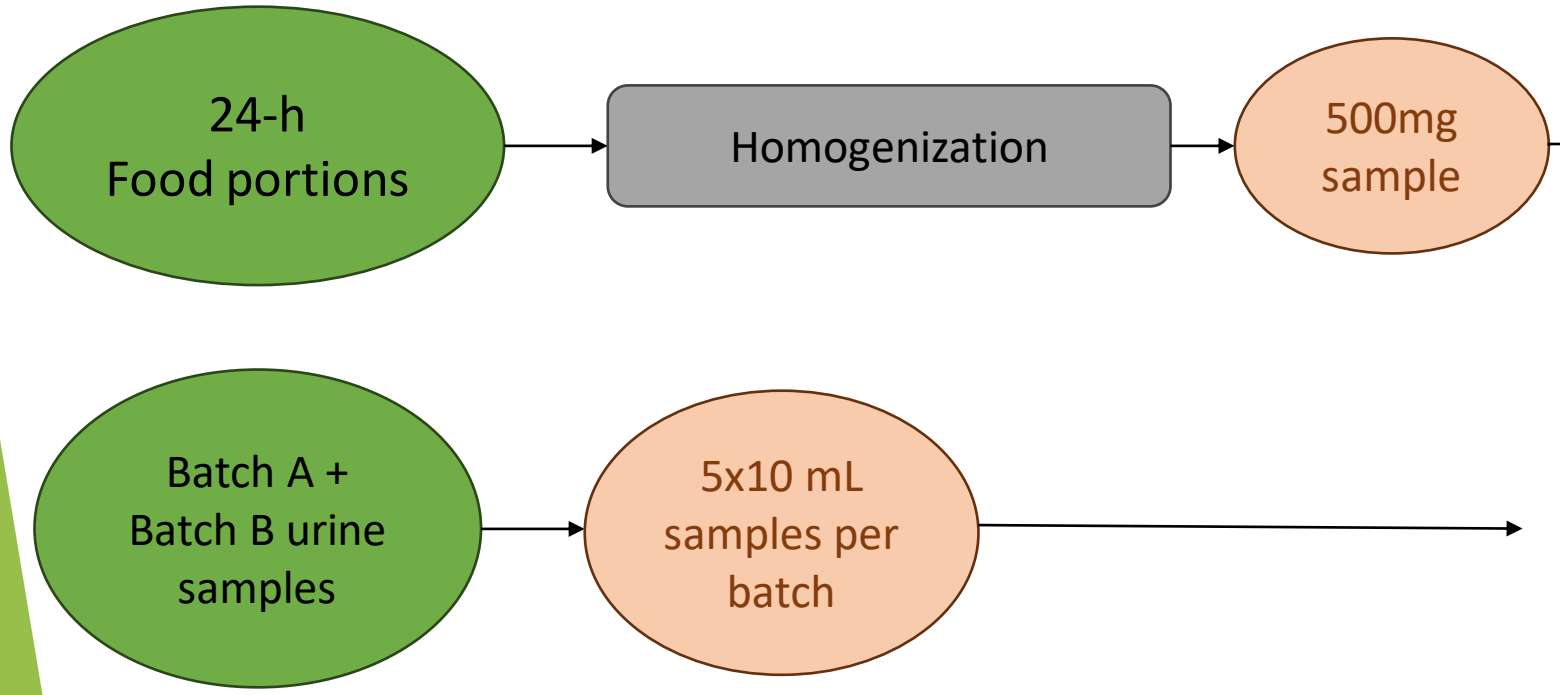
Laboratory analysis



QuEChERS

solid phase extraction method for detection of biocide residues in food

LC-MS → Most pesticides, glyphosate
GC-MS → Pyrethroids

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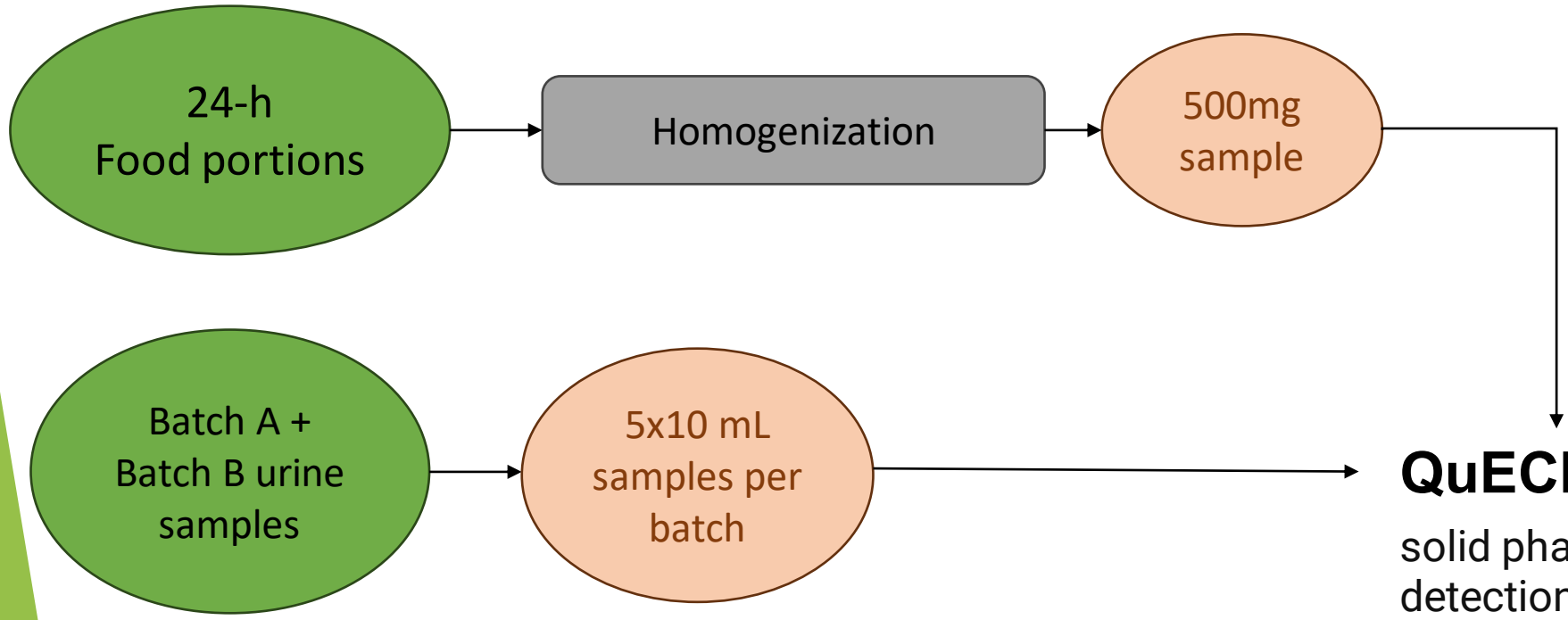
Laboratory analysis



QuEChERS

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203 analyzed parent compounds (food portions)
46 analyzed metabolites (urine samples)

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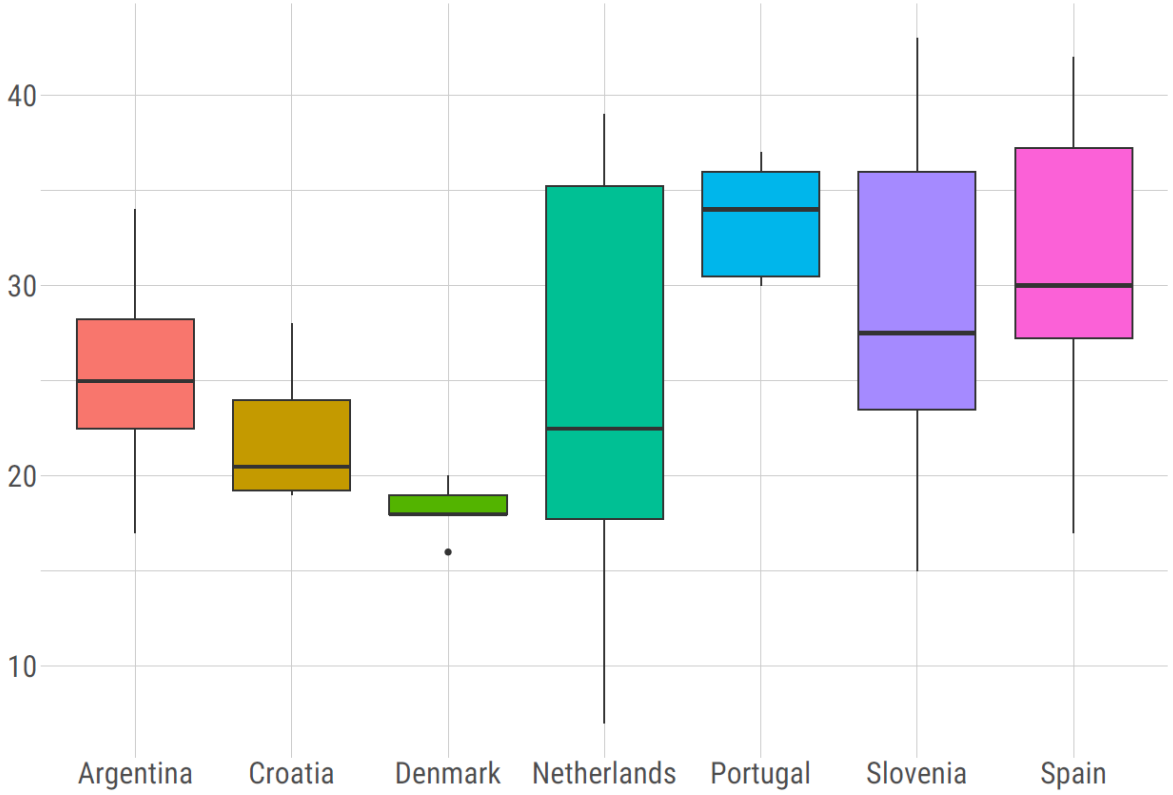
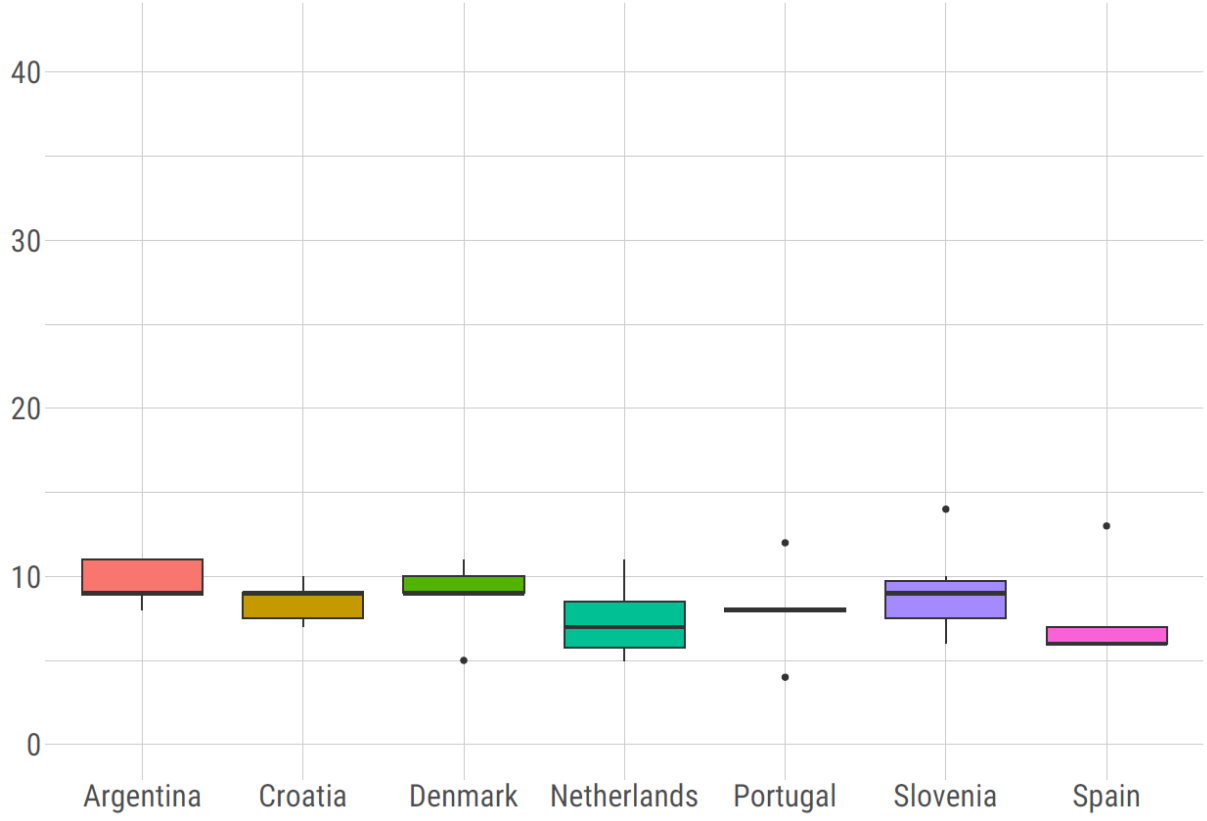
Results

Mixture exposure from food and aspecific metabolites in urine

Number of pesticide residues measured per **24h food portion**



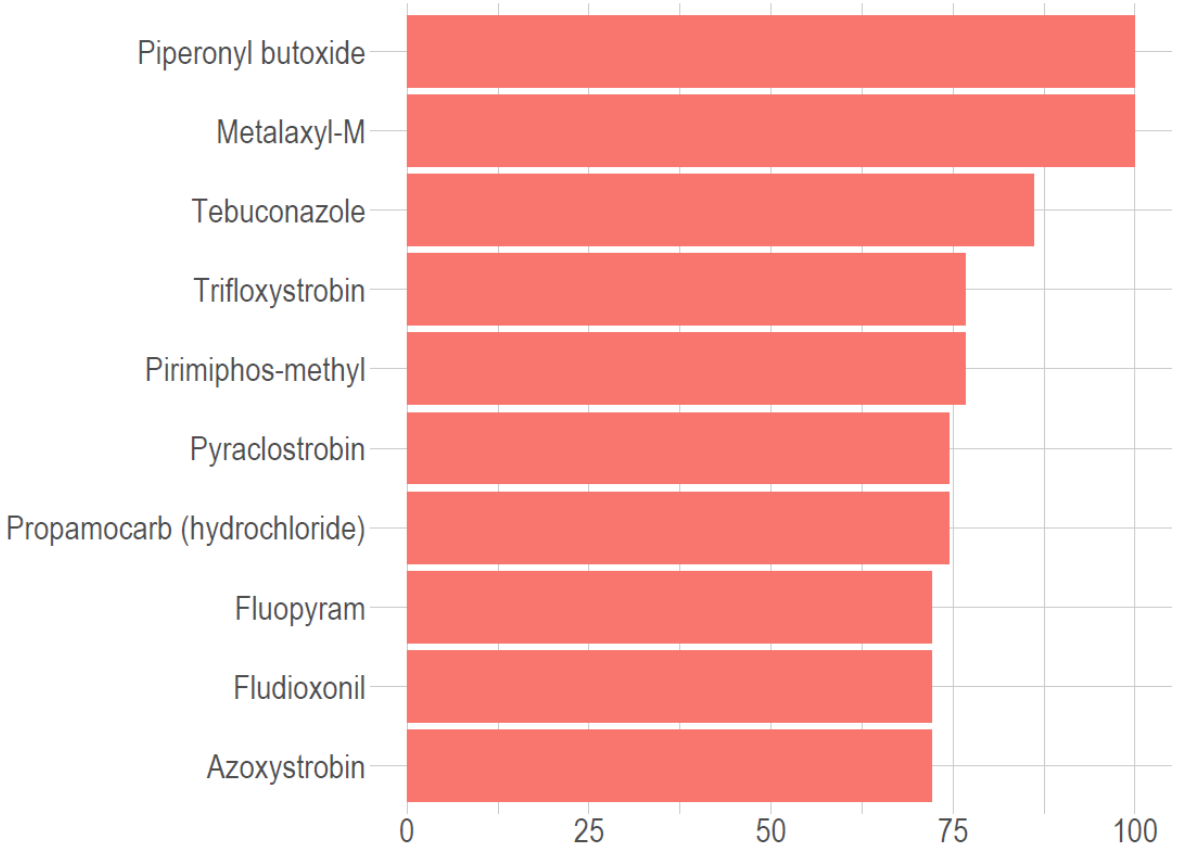
Number of pesticide metabolites measured per **36h urine sample**



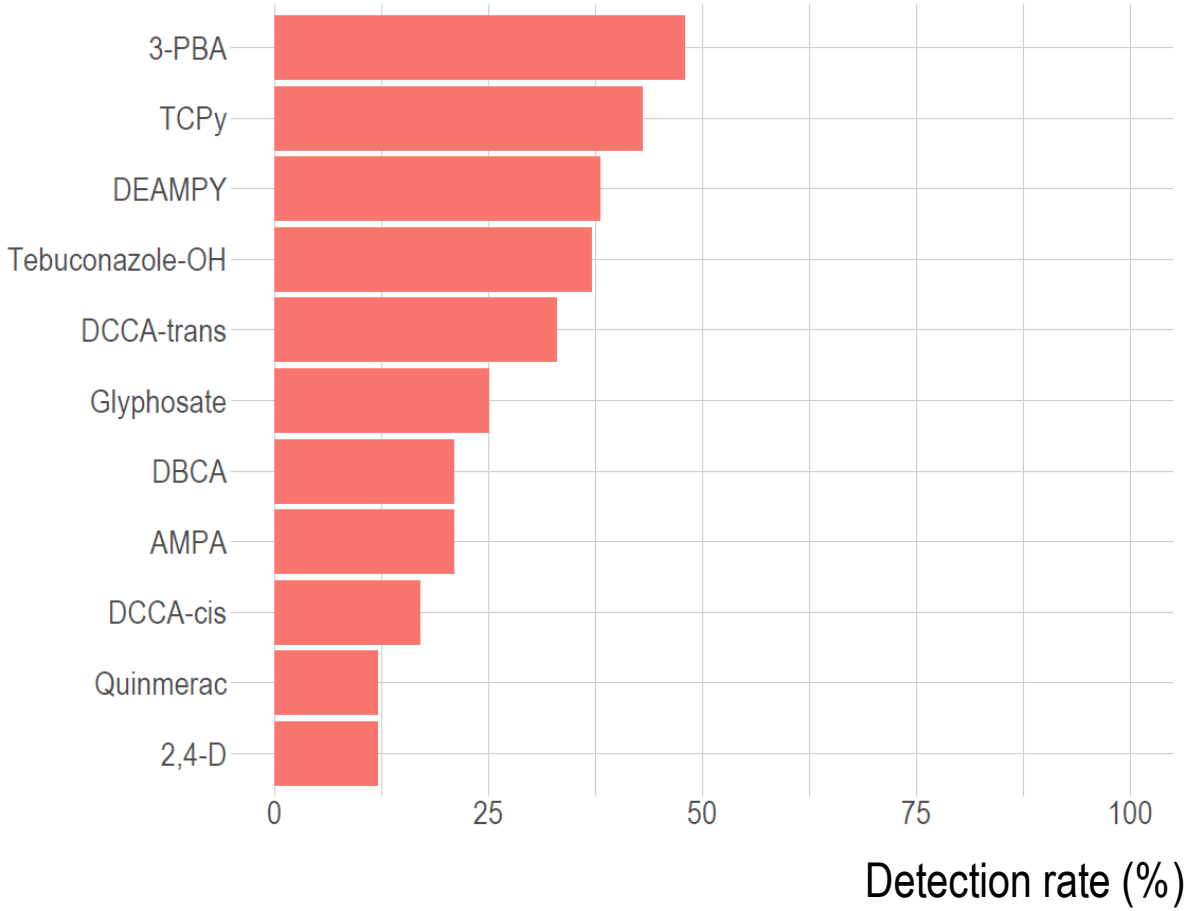
Results

Top 10 most often detected pesticides

Most frequently detected pesticides in **24h food portions**



Most frequently detected pesticides in **36h urine samples**



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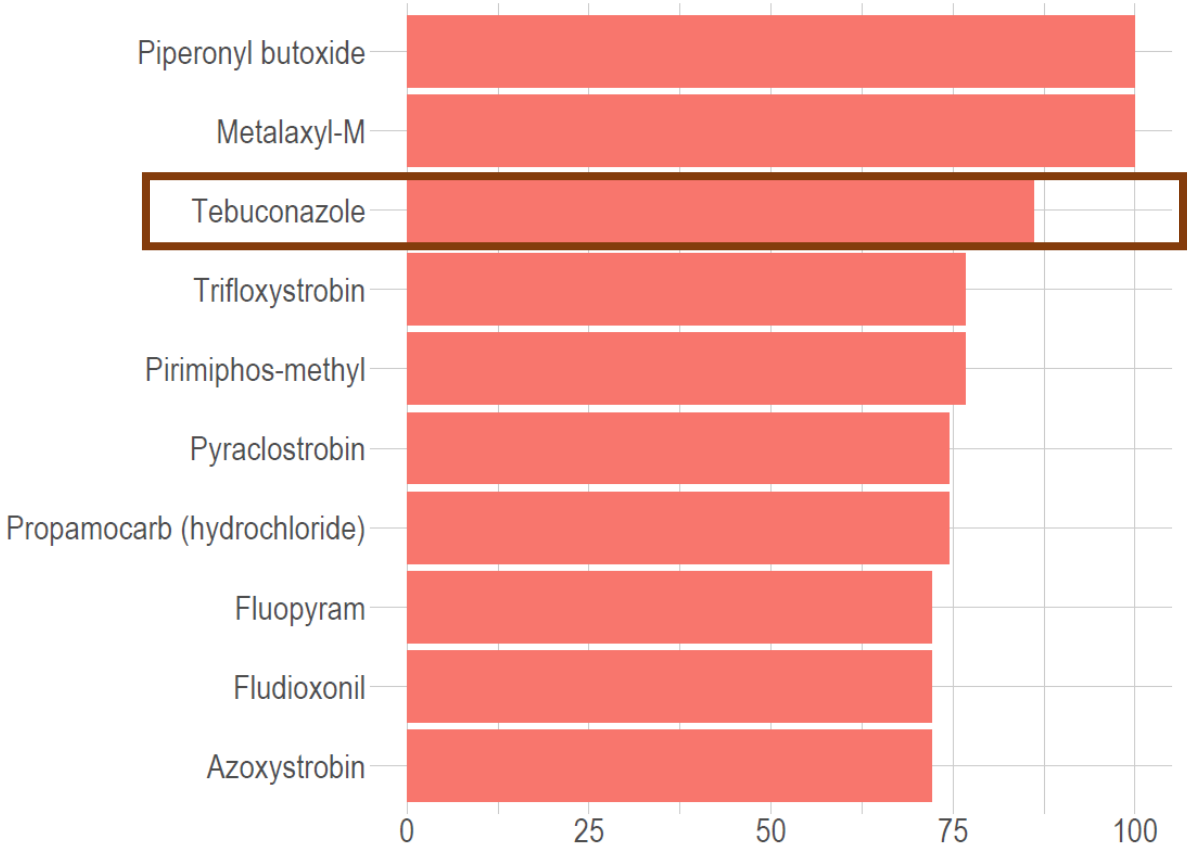
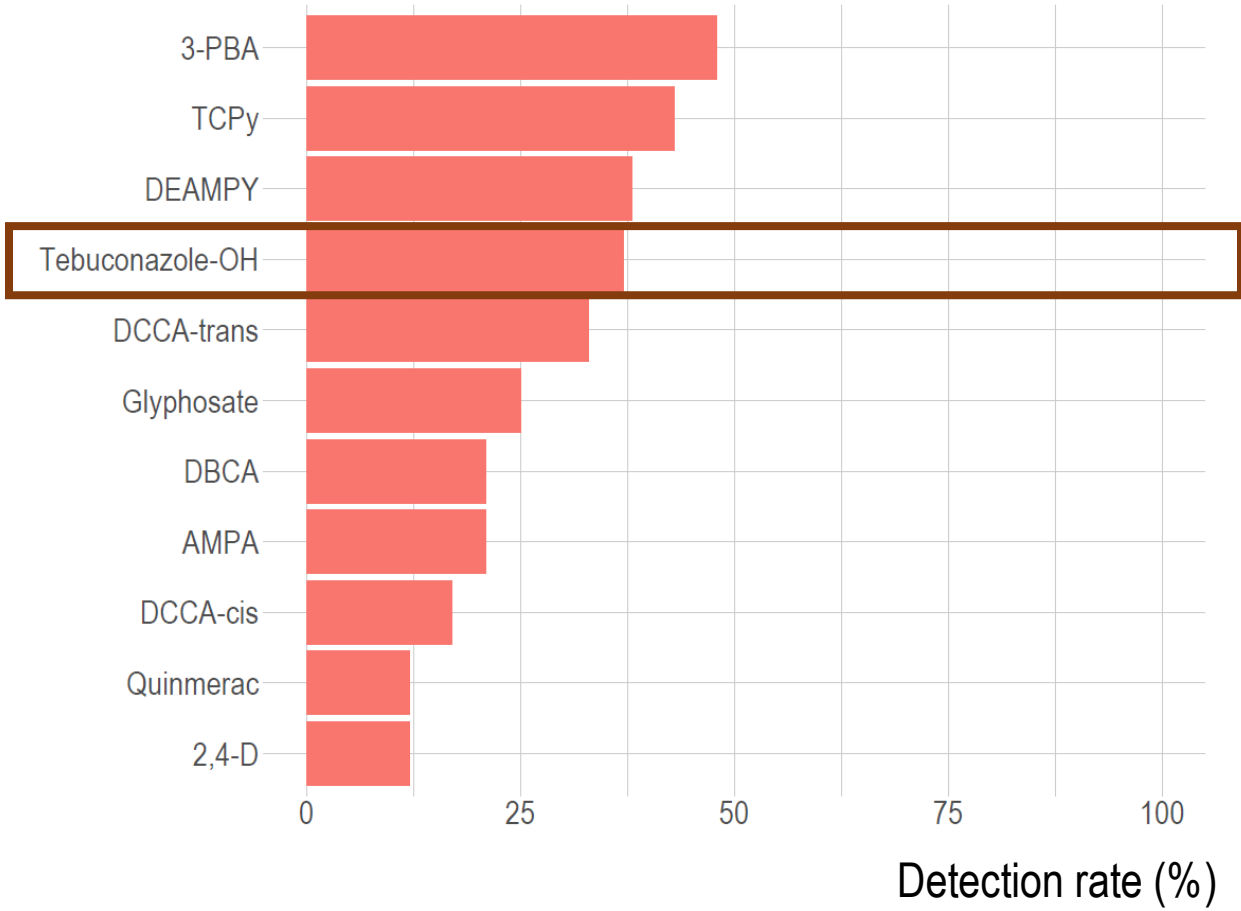


Most frequently detected pesticides in **36h urine samples**



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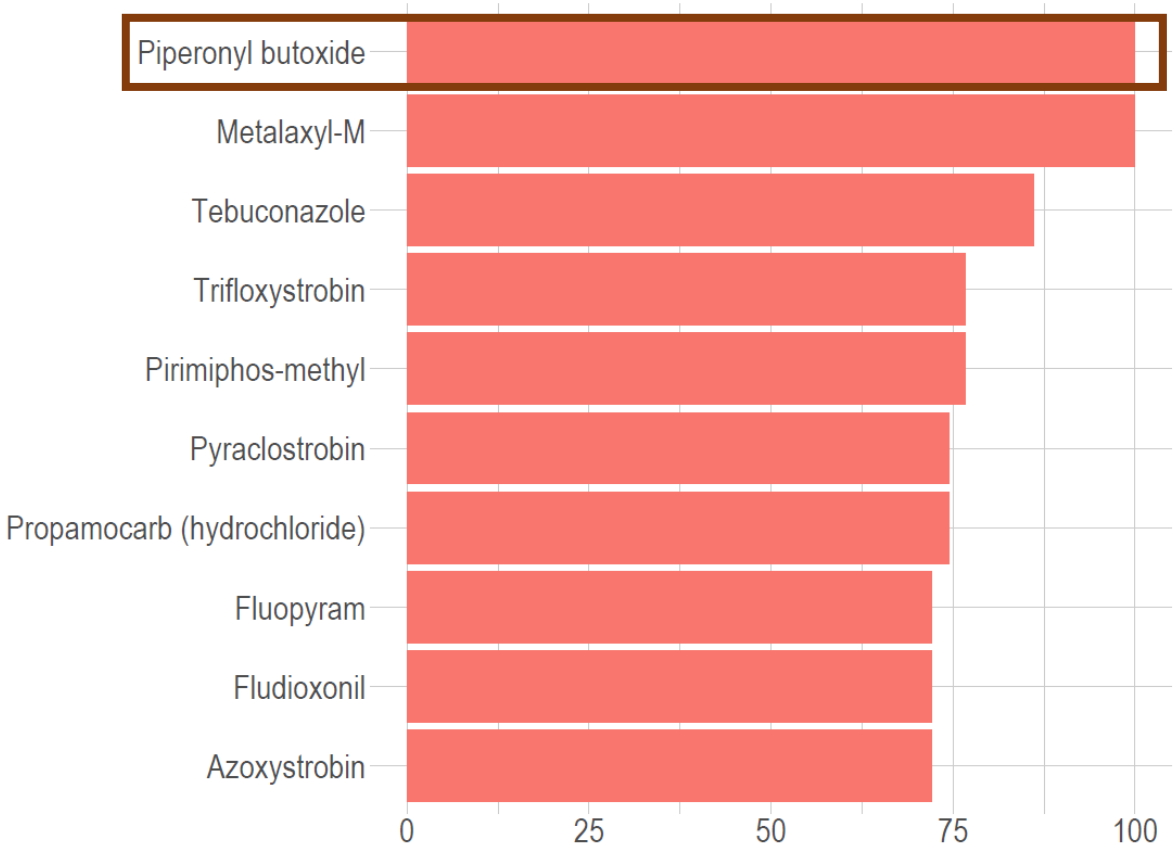

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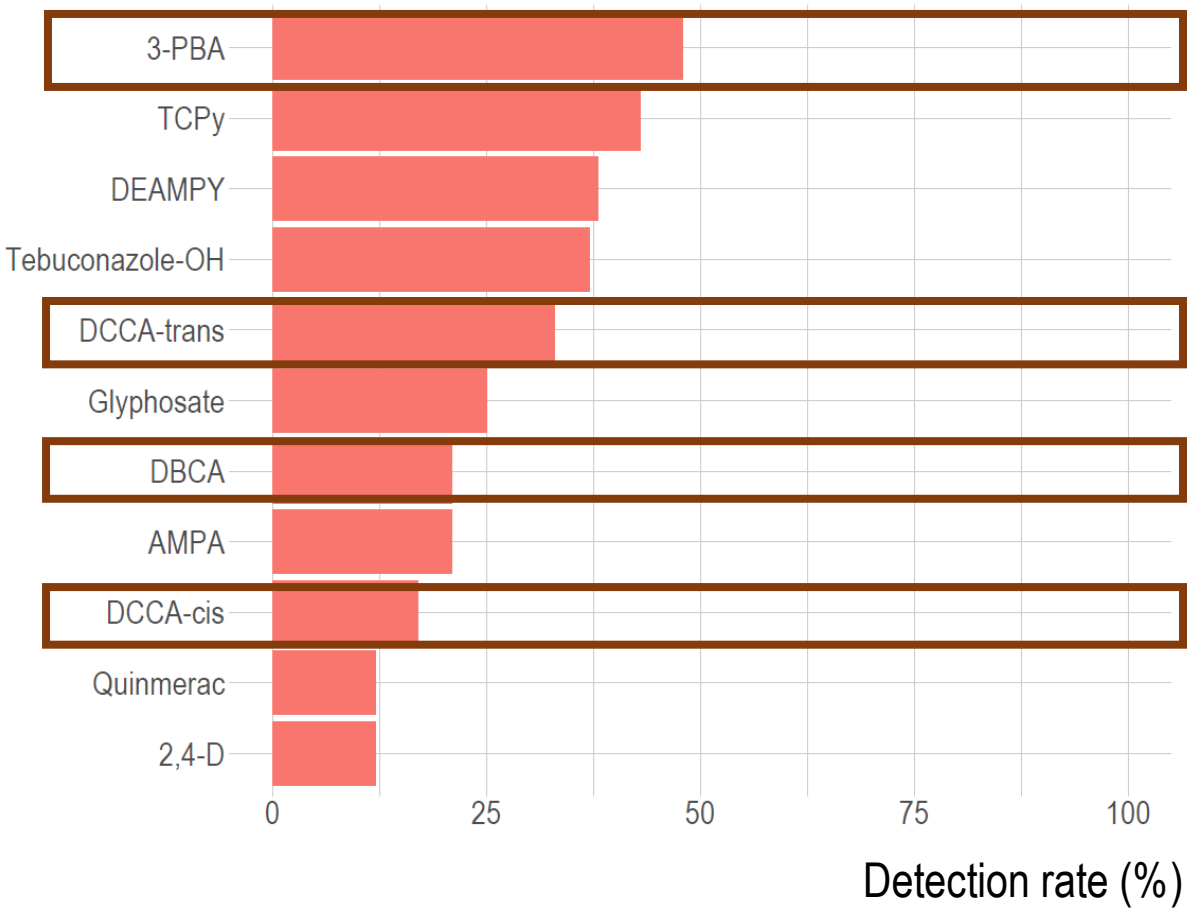
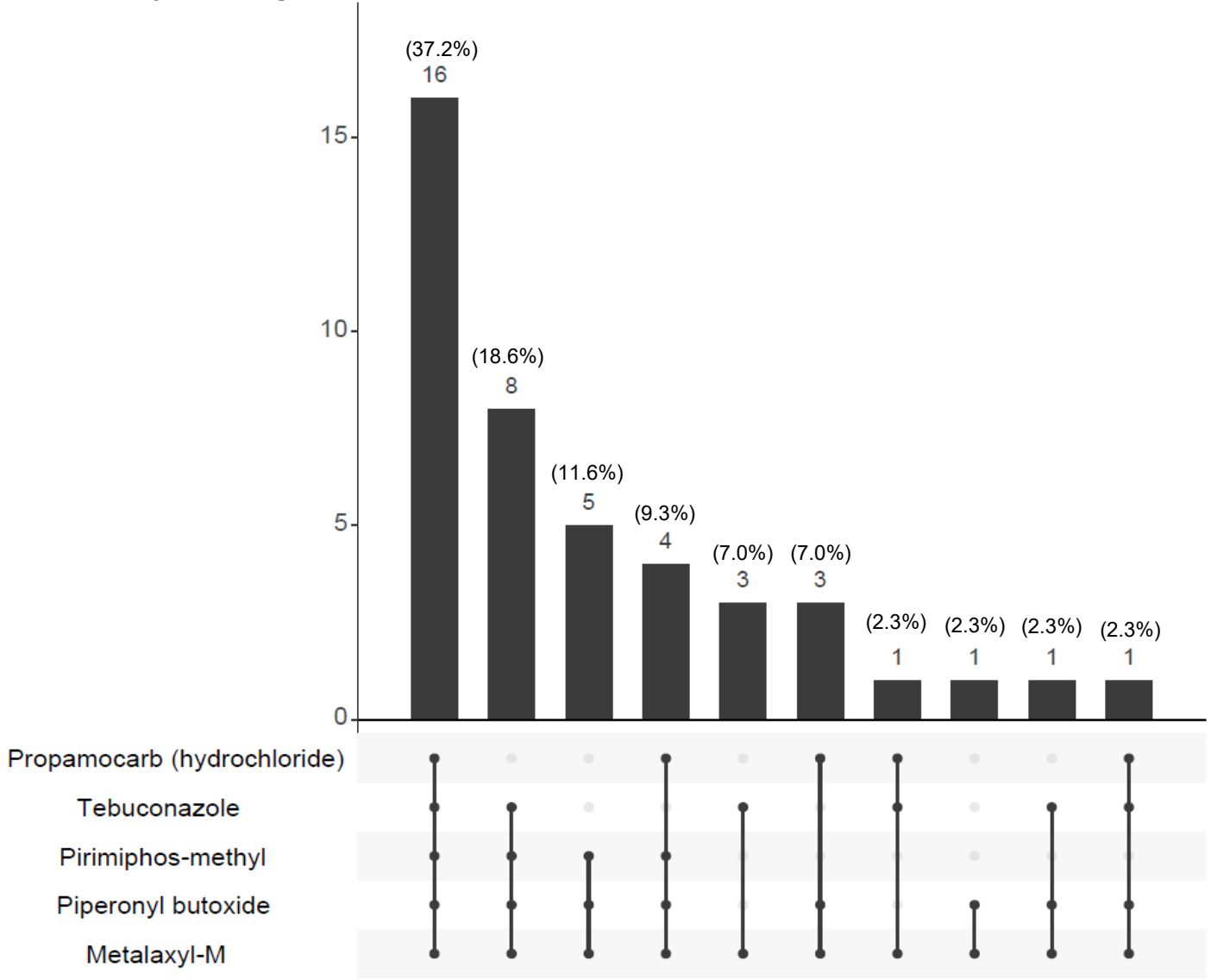


Pesticide mixtures in food portions

Frequency histogram



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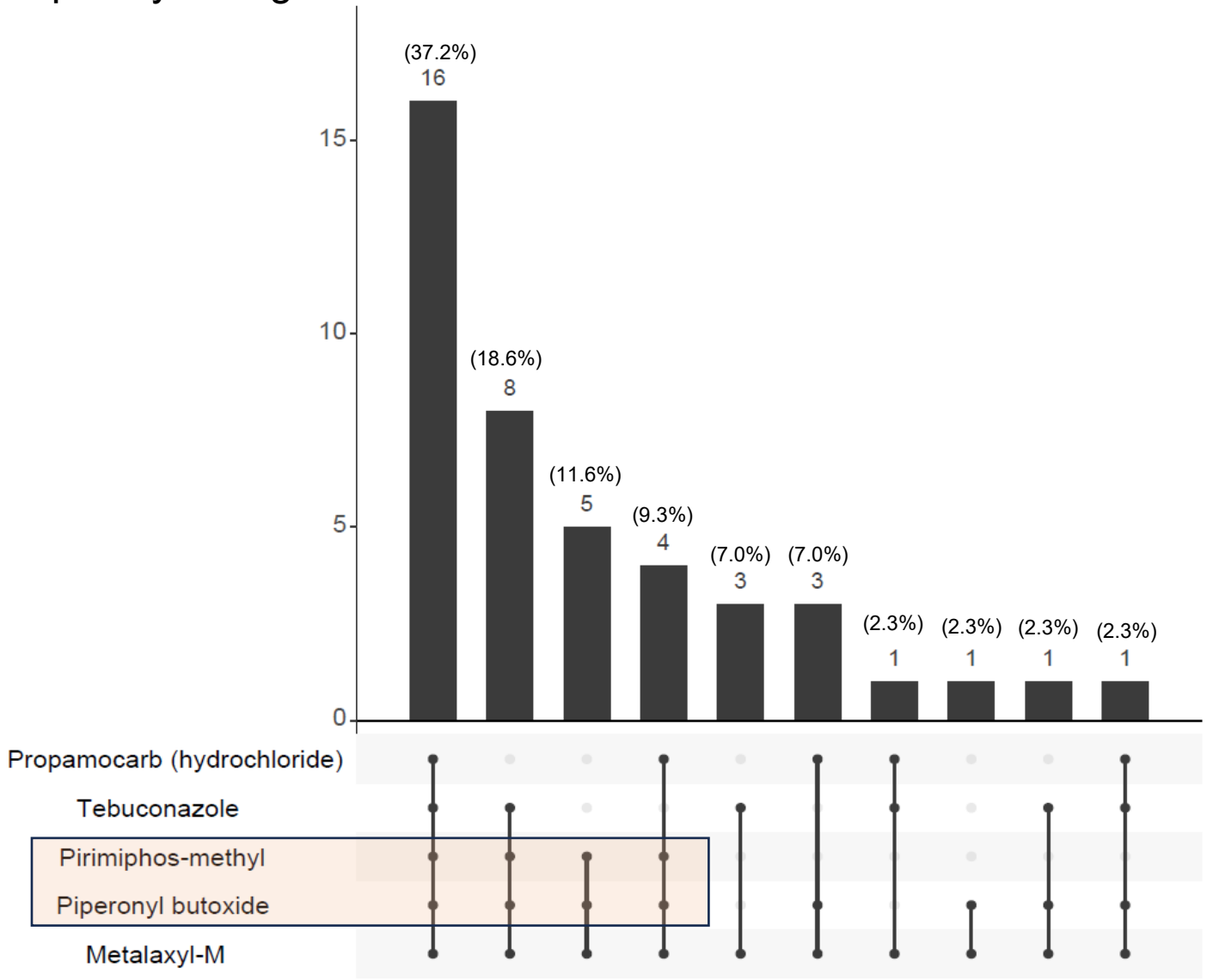

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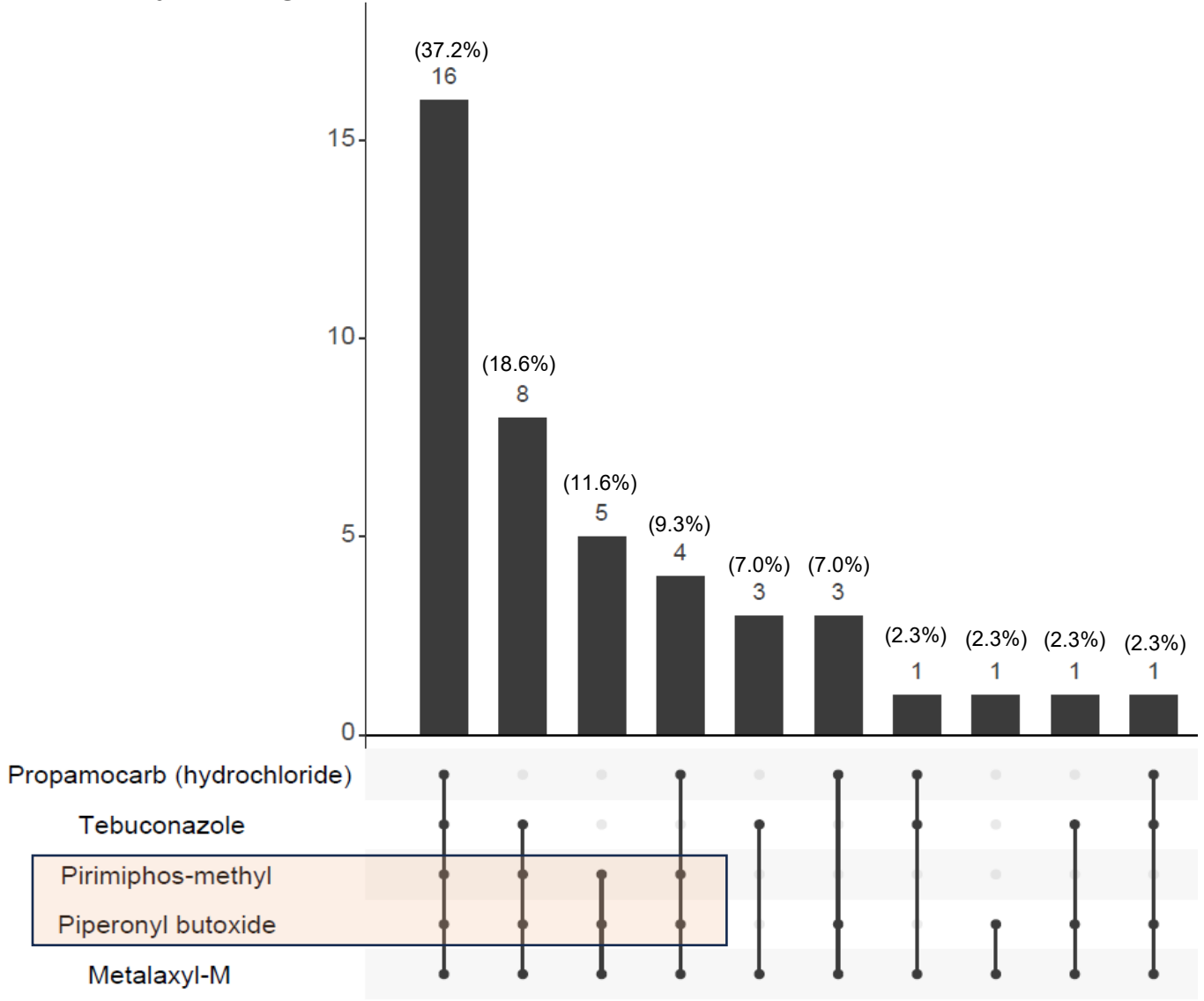
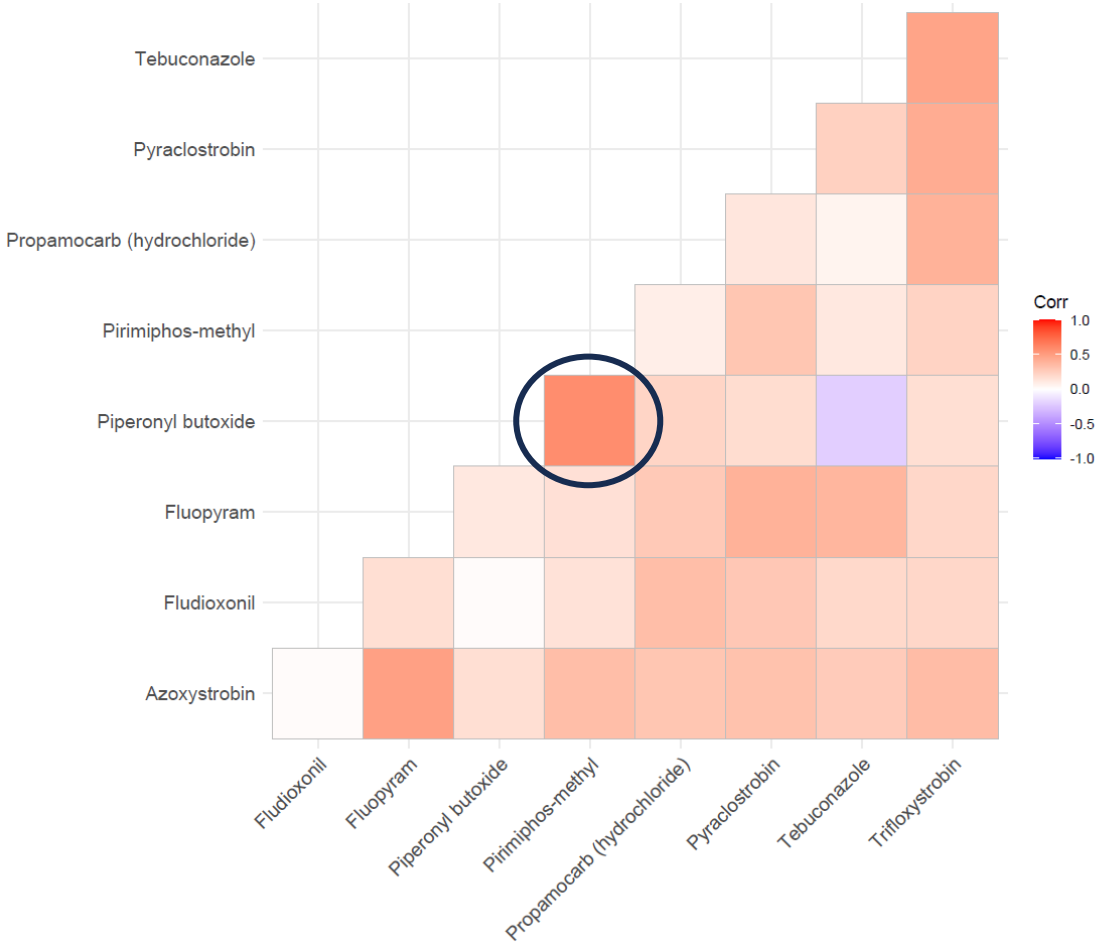
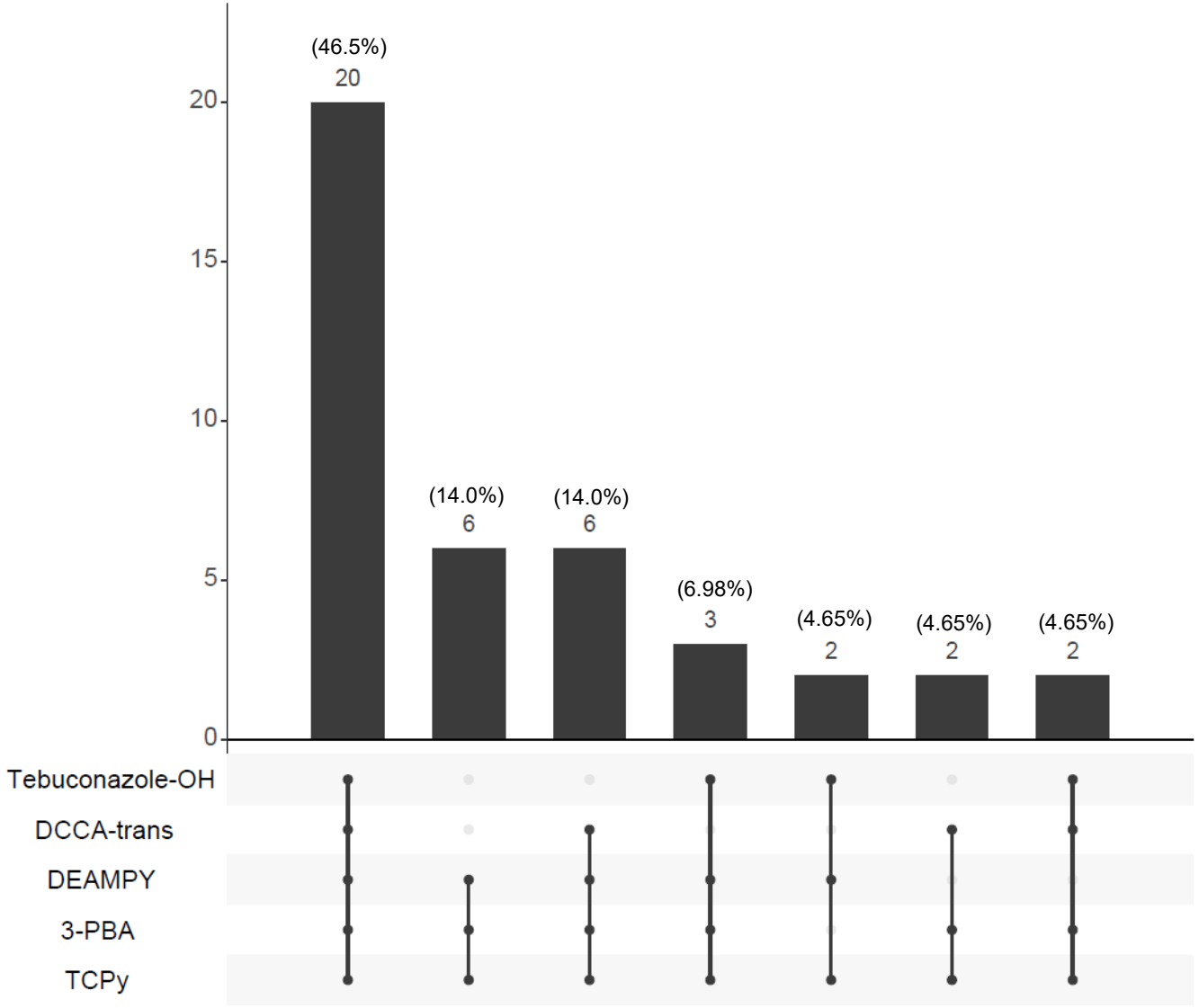


Spearman's correlation matrix



Pesticide metabolite urinary excretion

Frequency histogram



(Aspecific) metabolites

Tebuconazole

Pyrethroids

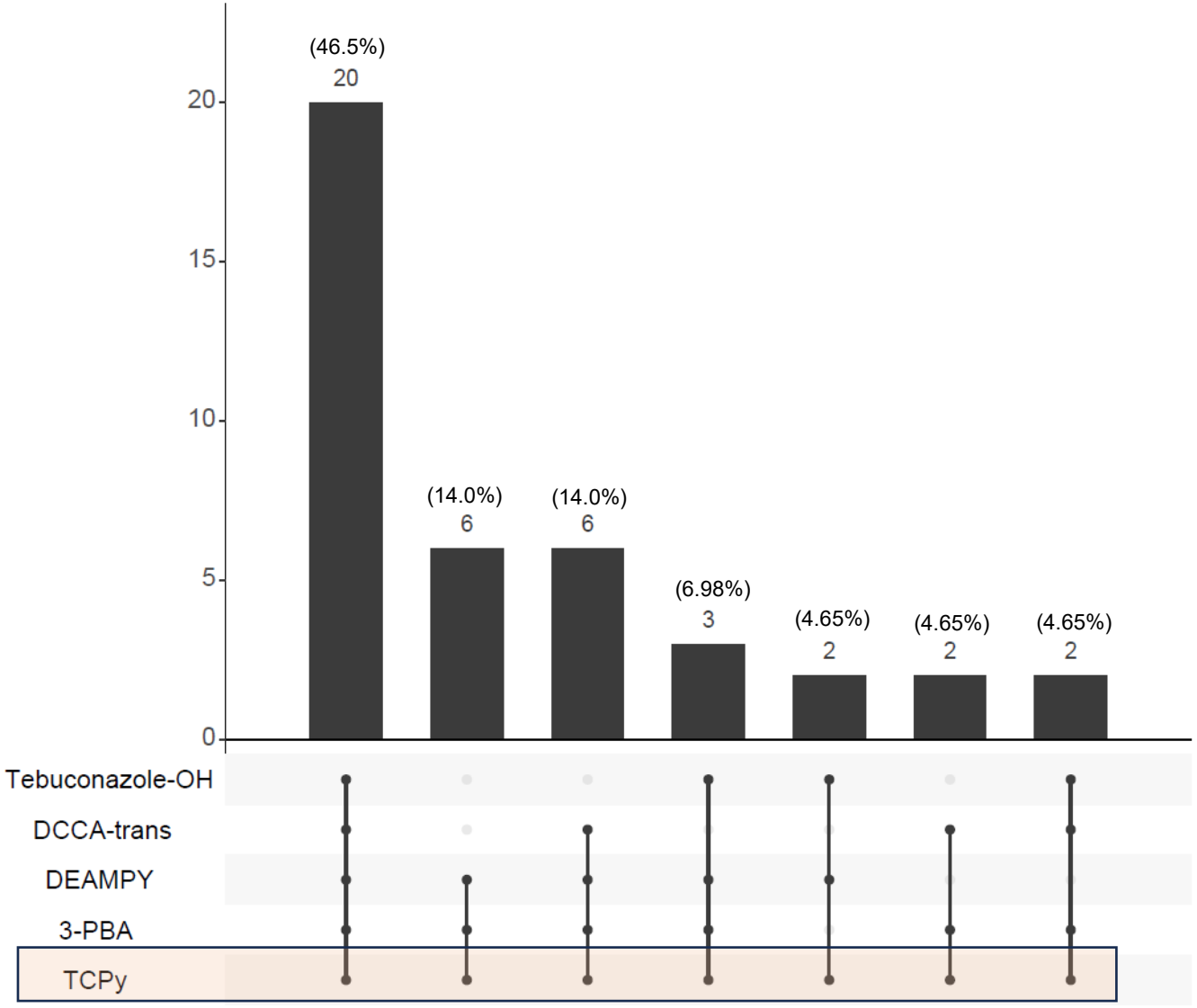
Pirimiphos-methyl

Pyrethroids

Chlorpyrifos & Chlorpyriphos-methyl

Pesticide metabolite urinary excretion

Frequency histogram



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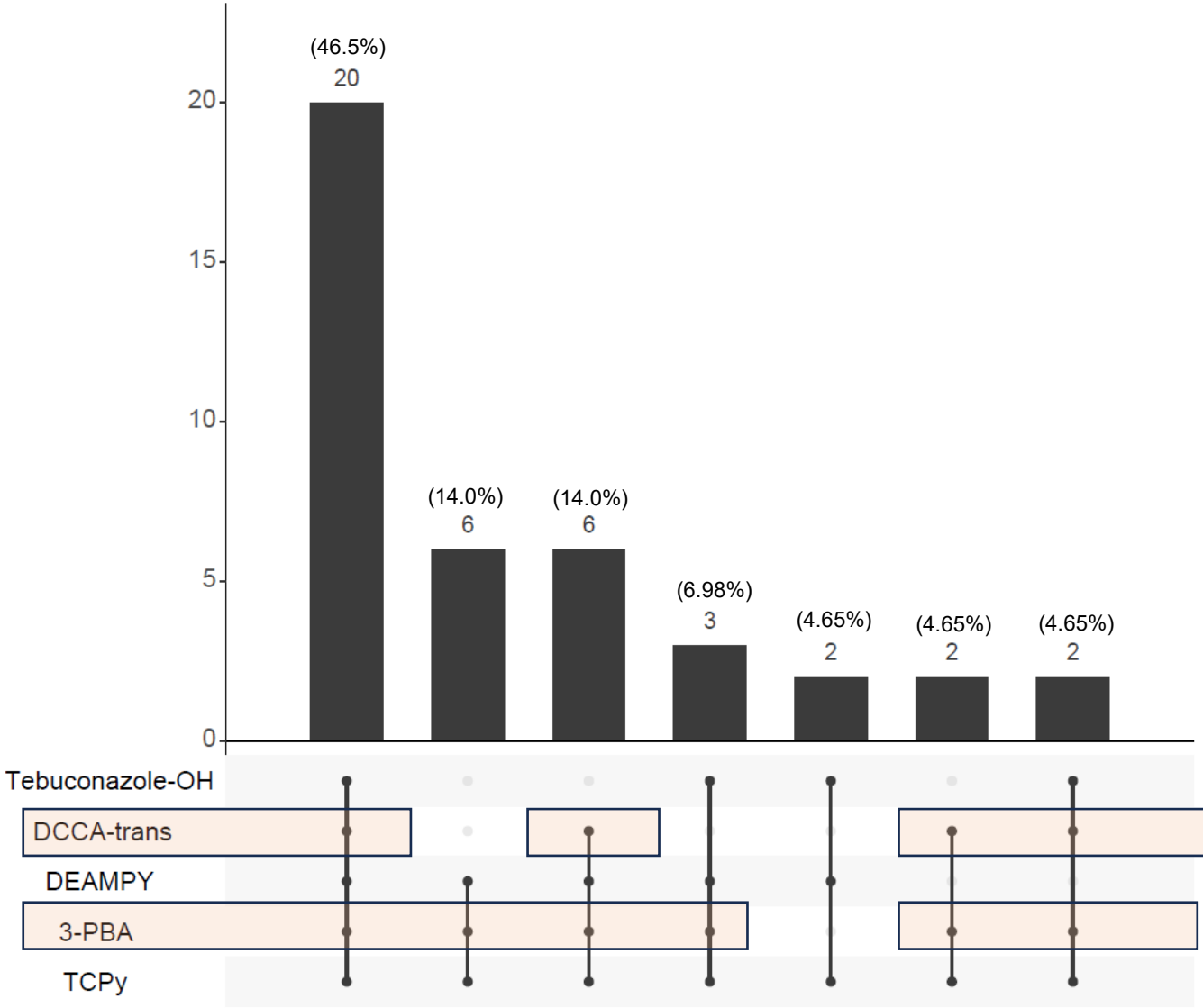


(Aspecific) metabolites

Tebuconazole

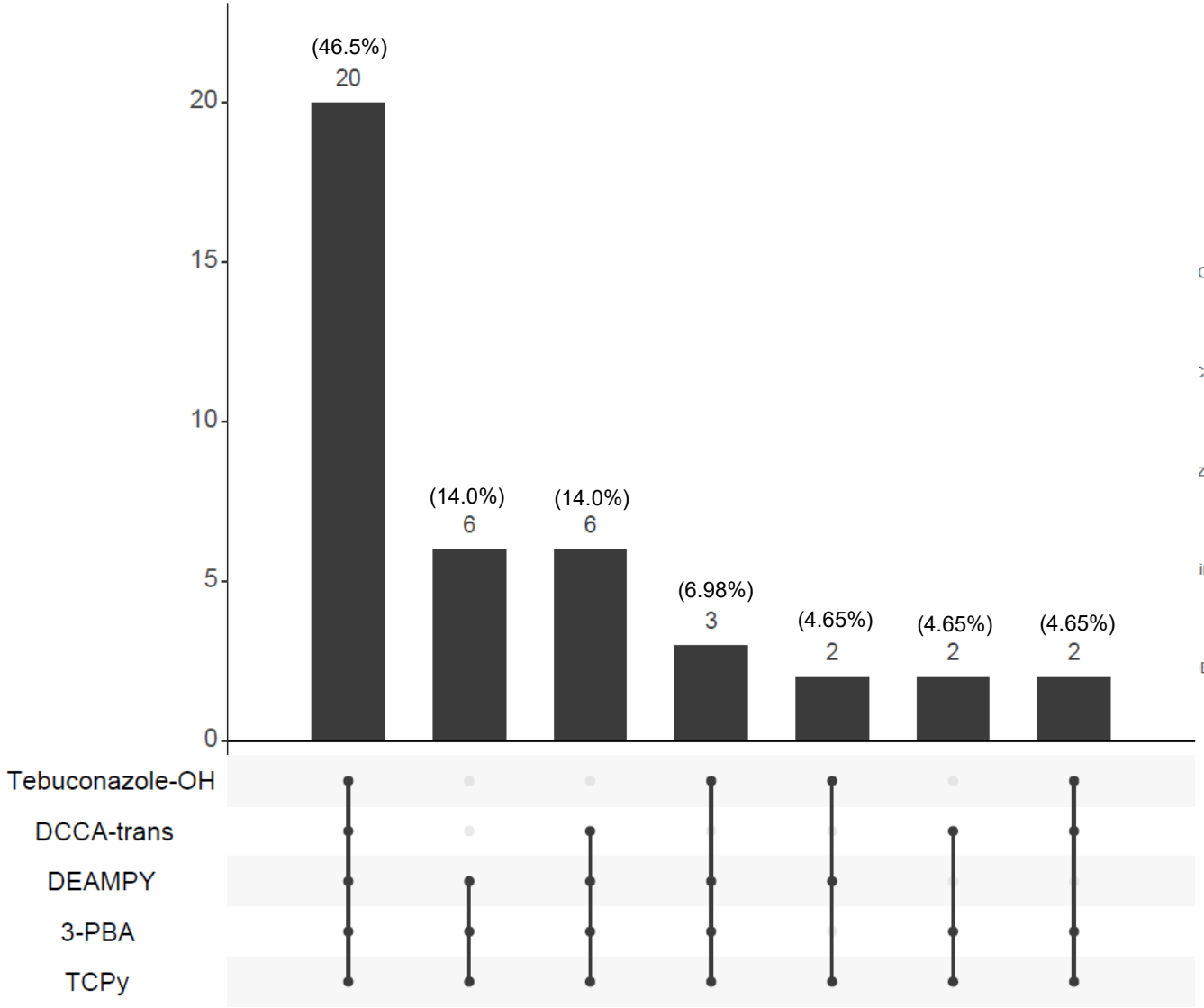
Pyrethroids

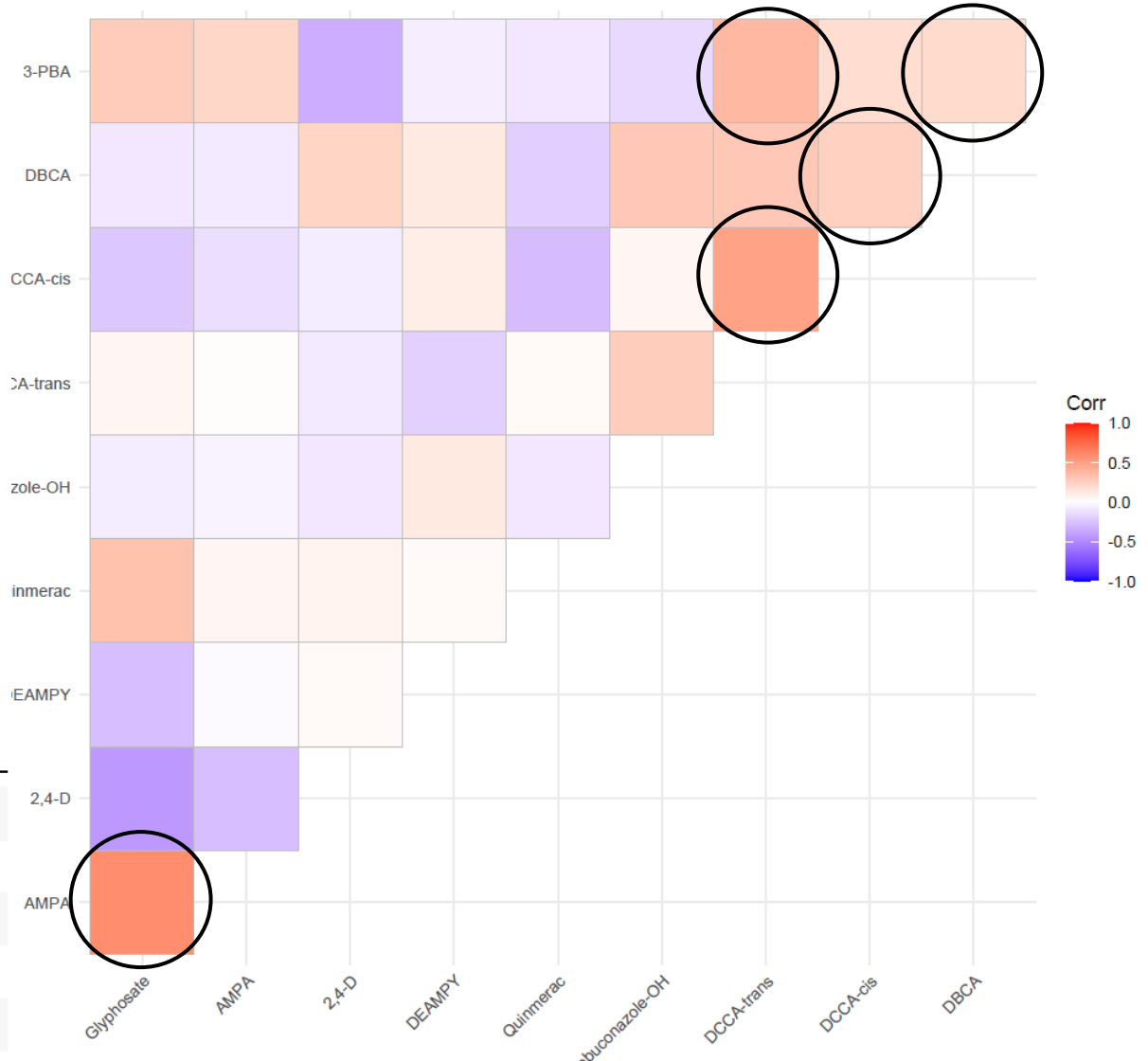
Pirimiphos-methyl

Pyrethroids

Chlorpyrifos & Chlorpyriphos-methyl

1:1 the strongest correlation is found between metabolites





Discussion

- Piperonyl butoxide →
  Pyrethroids→
  3-PBA, DCCA
- Chlorpyrifos (-methyl) →
  TCPy
- Pirimiphos-methyl →
  DEAMPY
- Glyphosate & AMPA

Insecticide pesticides

- Synthetic pyrethroids
- Continued sodium channel influx
- Co-formulant piperonyl butoxide to increase effectiveness
- Common metabolites
- Home use and professional use

ADI: 0.16 mg/kg bw/day

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- Piperonyl butoxide →
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- Pirimiphos-methyl →
  DEAMPY
- Glyphosate & AMPA

Insecticide pesticides

- Organophosphate
- Acetylcholinesterase (AChE) inhibition
- Lipophilic nature
- TCPy common metabolite

ADI: 0.01 mg/kg bw/day → Legislation expired in 2020

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Discussion

- Piperonyl butoxide →
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- Chlorpyrifos (-methyl) →
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- Pirimiphos-methyl →
  DEAMPY
- Glyphosate & AMPA

Insecticide pesticides

- Organophosphate
- Acetylcholinesterase (AChE) inhibition
- Use in storage warehouses and grains

ADI: 0.004 mg/kg bw/day

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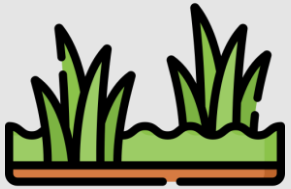
Herbicide pesticides



- Organophosphate
- Shikimate-pathway inhibition
- AMPA from environment and human metabolism

ADI: 0.5 mg/kg bw/day

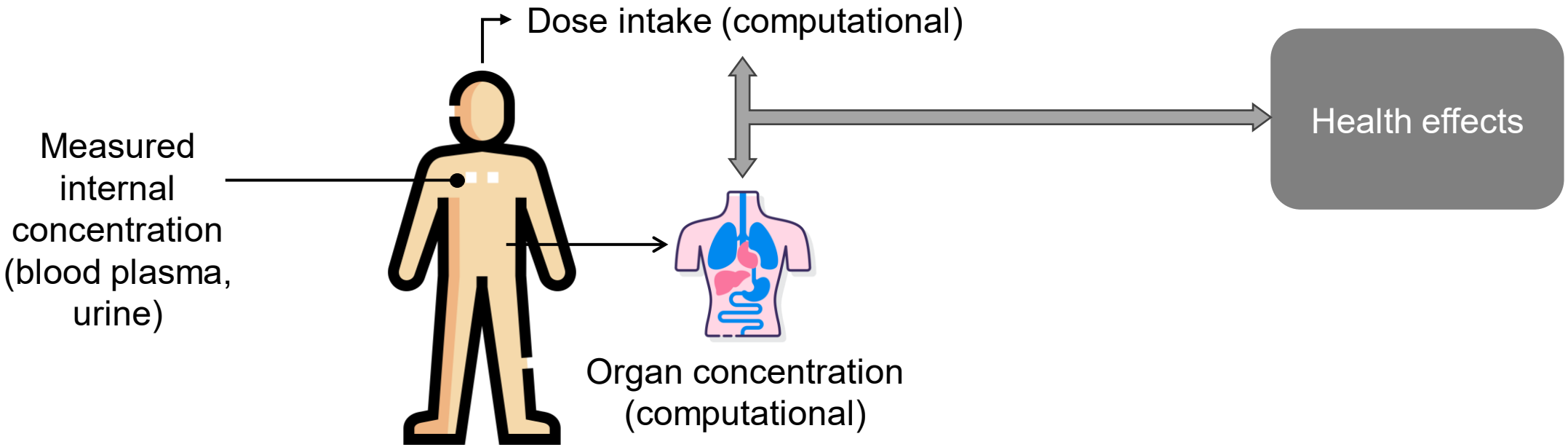
Discussion and future perspectives

- The diet is the **main source** of pesticide exposure in the general population
- Duplicate portion studies help understand the relationship between external and internal pesticide exposure
- EFSA currently determines safe levels of pesticide residues in food items in retail

- In this study we analysed individual food portions and included food processing (removal of peels and food processing by cooking)
- We identified real-life mixture patterns from food and how they translate into urinary excretion of metabolites

Future perspectives

- Publication (exp. mid-2024)
- **PBK-models** for reverse dosimetry and assess target organ dose
- Monte Carlo Risk Assessment (MCRA)



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SUSTAINABLE PLANT PROTECTION TRANSITION: A GLOBAL HEALTH APPROACH

Thank you for listening!

Acknowledgements:

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https://sprint-h2020.eu/

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