The Effect of Pan-Frying and other Food Processing on intrinsic Per- and Polyfluoroalkyl Substance (PFAS) Levels

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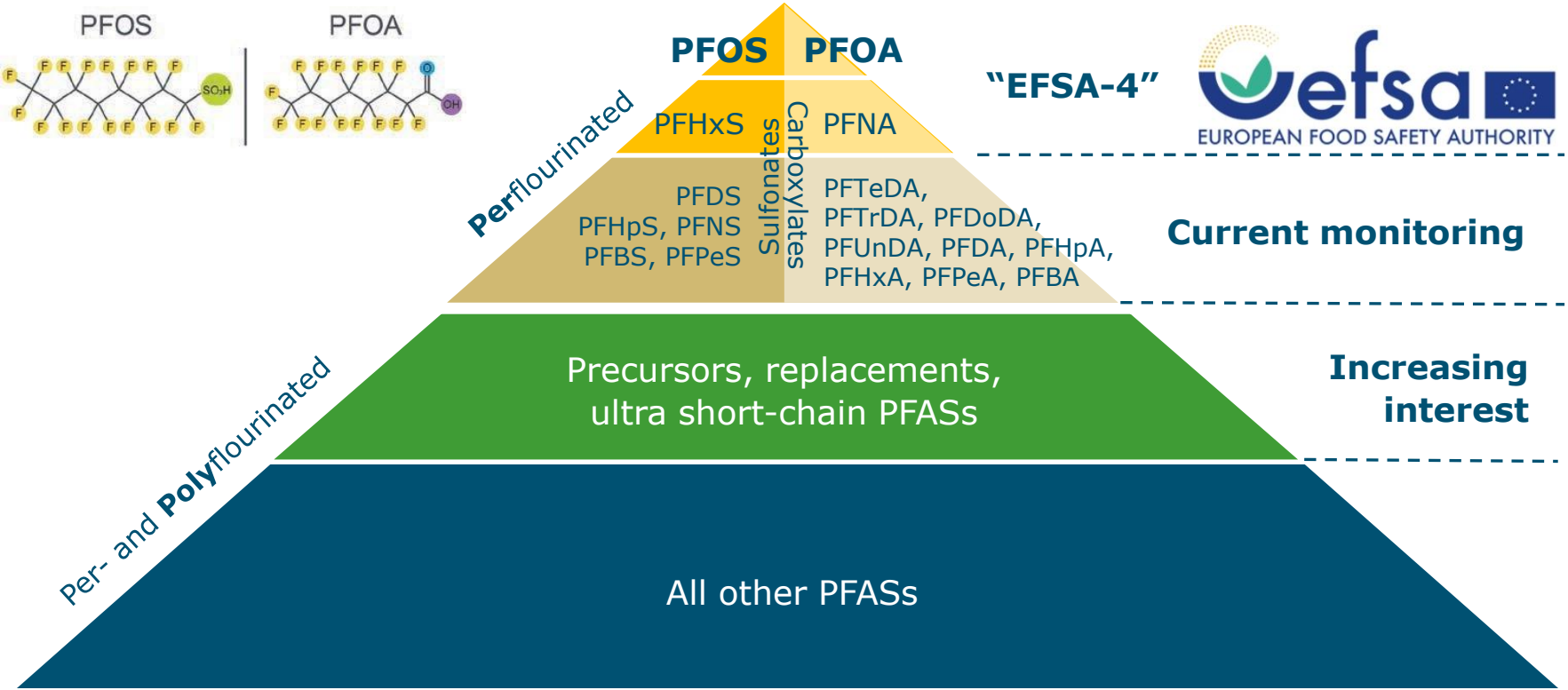
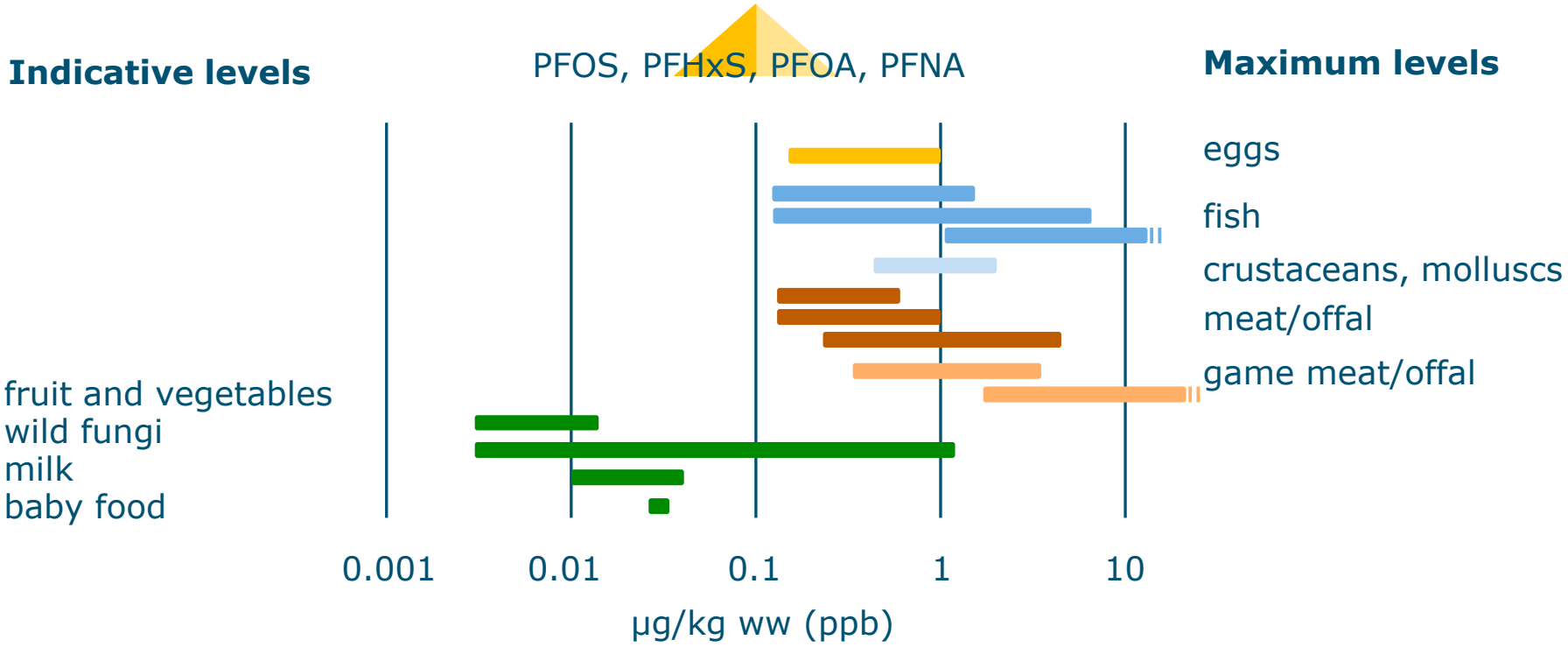
PFASs – a wide field



EUROPEAN FOOD SAFETY AUTHORITY

What is regulated (in food) right now?



Regulation (EU) 2023/915
Commission Recommendation (EU) 2022/1431

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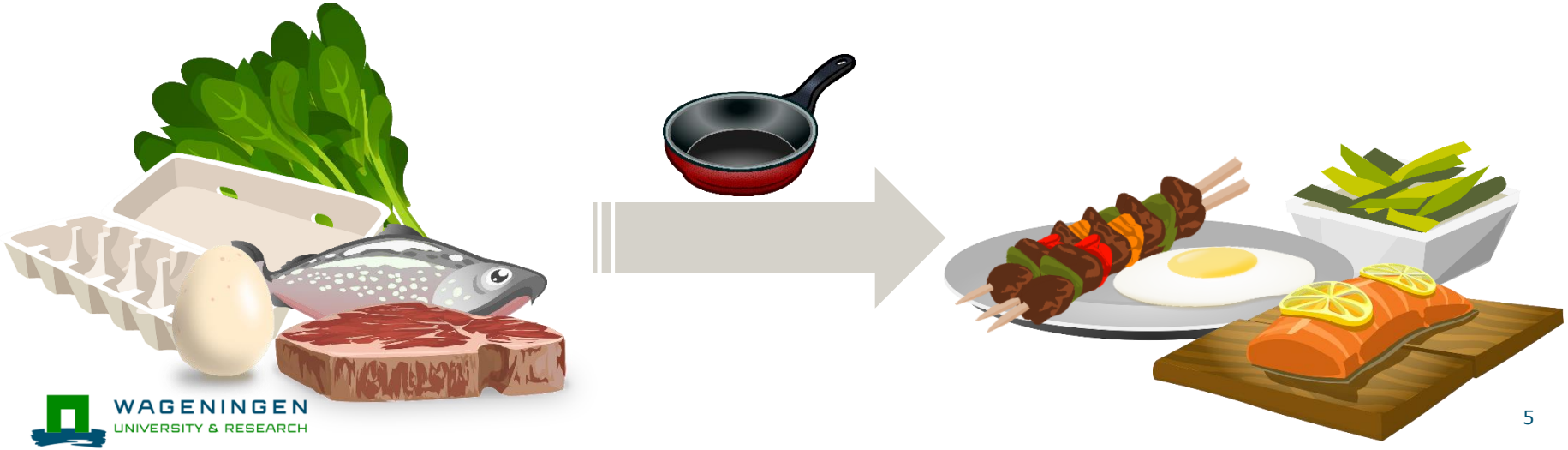
How does that relate to our diet?

- MLs (and ILs) are valid for the raw agricultural products, unless specified
- Some vegetables and most fruit are consumed raw
- However: other foods are often cooked before consumption!
- Collecting samples of interest with elevated PFAS levels
    - Leafy greens (pot plant experiment)
    - Meat (beef feeding study)
    - Eggs (from private chicken owners)
    - Seafood (from hot spot monitoring)

Experimental set-up

- 3 samples eggs, meat, fish, greens with intrinsic PFAS levels >>LOQ
- Pan-frying in a new/damaged non-stick pan and a stainless-steel pan
- Collection of processed food and cooking medium (maize oil)



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Experimental set-up

- Unified cooking protocol
- Exception raw milk and eggs:
  - Spray homogenisation
  - Pasteurization 90 s
  - Boiling whole eggs

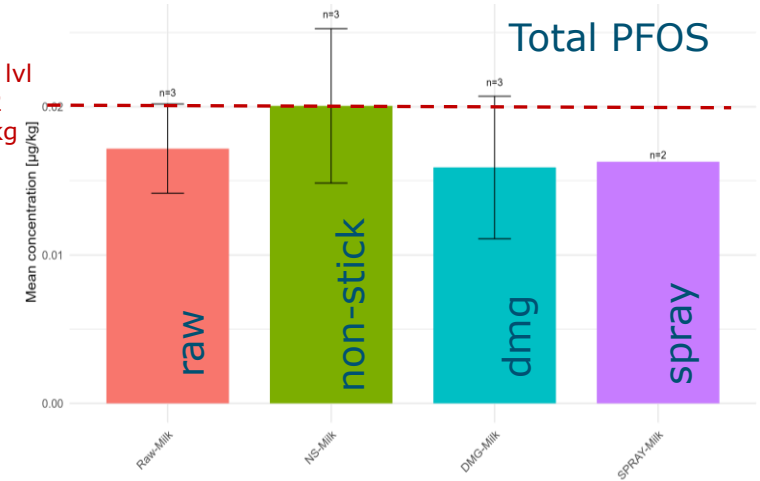
	raw	Non-stick pan	Damaged NS pan	Steel pan	other
Meat	x	x	x	x	-
Seafood	x	x	x	x	-
Greens	x	x	x	x	-
Eggs	x	x	x	x	B
Milk	x	P	P	-	S
Blank	x	x	x	x	-

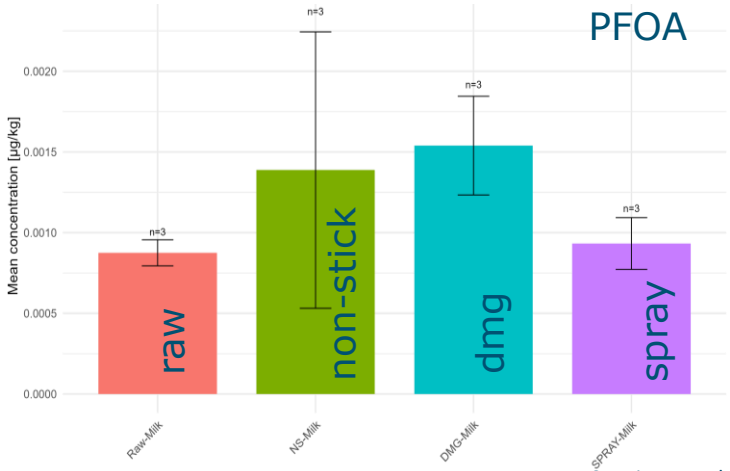
- New, unused non-stick pan
- Damaging of pan for 2nd half of the experiment

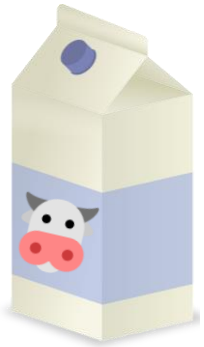
Raw milk: Pasteurization...

- Varied PFAS patterns in raw milk samples
- Increase of total PFOS and PFOA when pasteurizing in non-stick pan

Ind. lvl 0.02 µg/kg







Cow image: Flaticon.com/Marz Gallery

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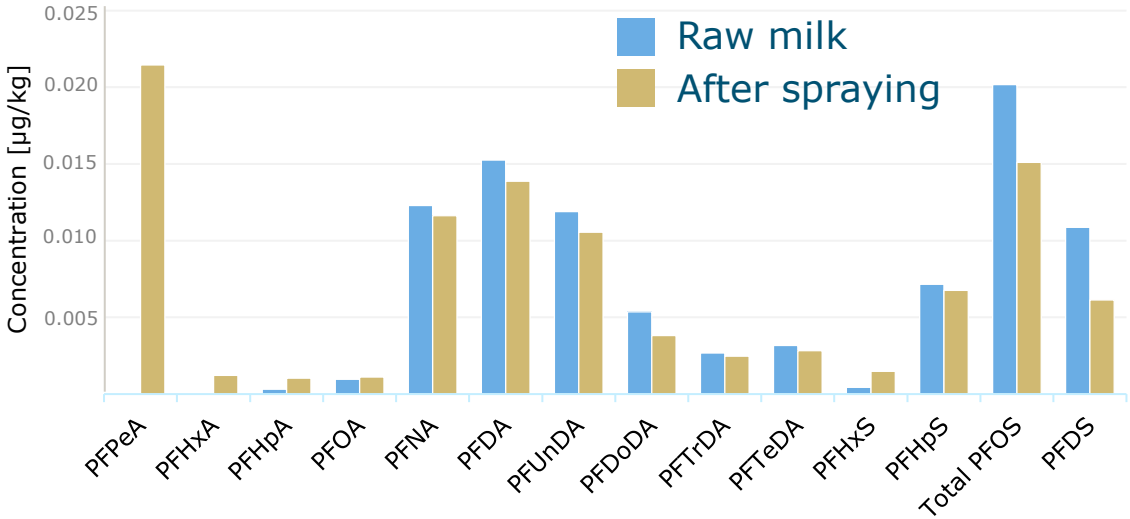
Milk: ...and spray homogenization

- Spraying adds shorter chained PFASs
- Likely contamination from the bottle



Some indication of decrease of PFOS, but inconclusive

Cow image: Flaticon.com/Marz Gallery

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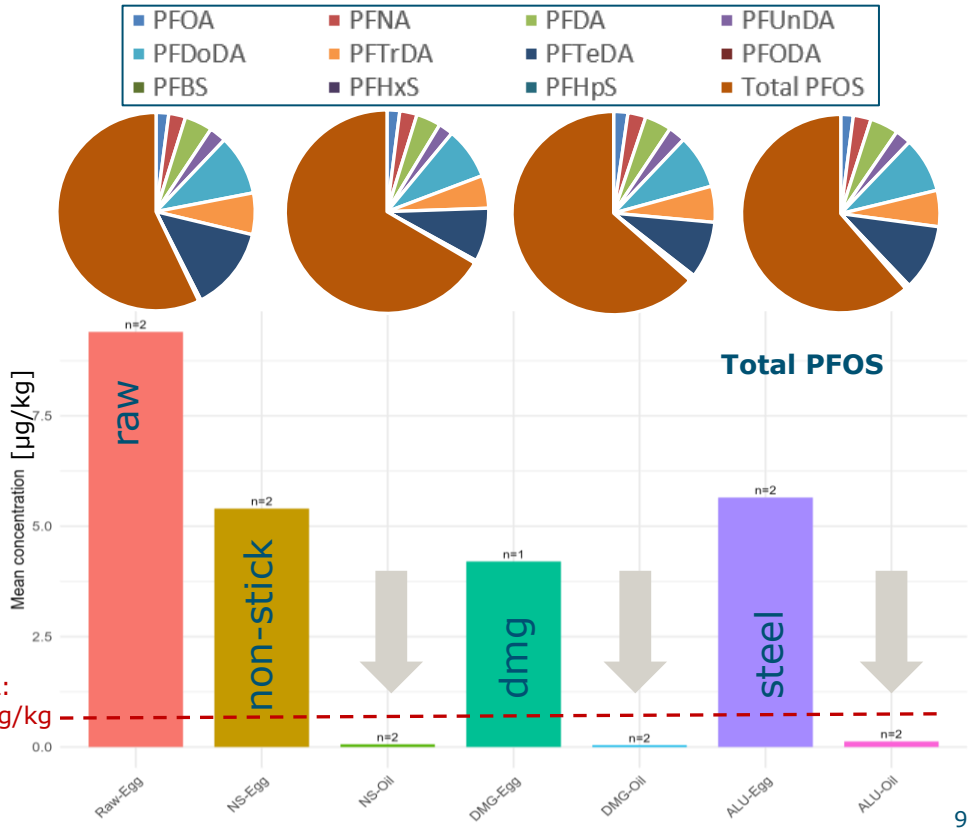
Eggs: Effect of baking...

- Most eggs from hobby chickens with clear PFOS contamination
- Otherwise longer chain (C_{12-14}) carboxylic acids dominant
- Reduction during baking, more for longer chains than PFOS
- Loss cannot be explained through used cooking oil!



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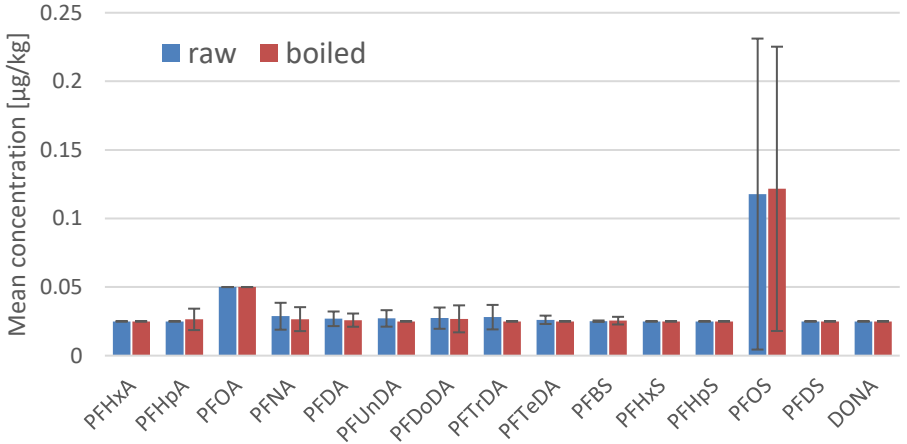
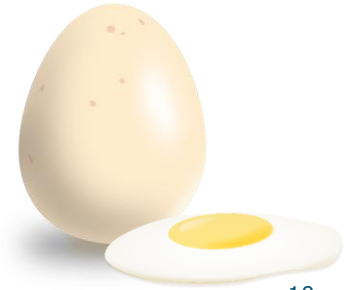
Eggs: ...versus whole boiling

- Eggs boiled whole for 7 min in LC-MS water, peeled and homogenised for measurement
- No change in egg PFAS levels
- No change in water PFAS levels



Eggs seem to need direct contact with cooking medium for changes to occur – boiling in the shell is not enough!



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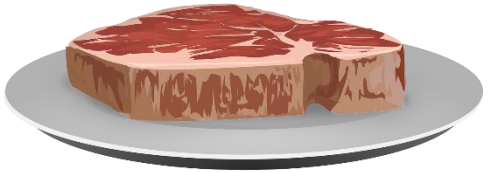
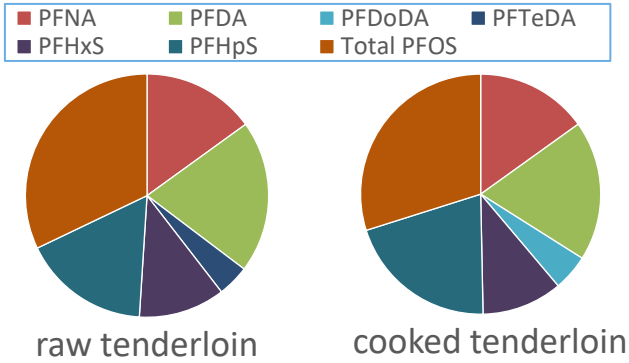
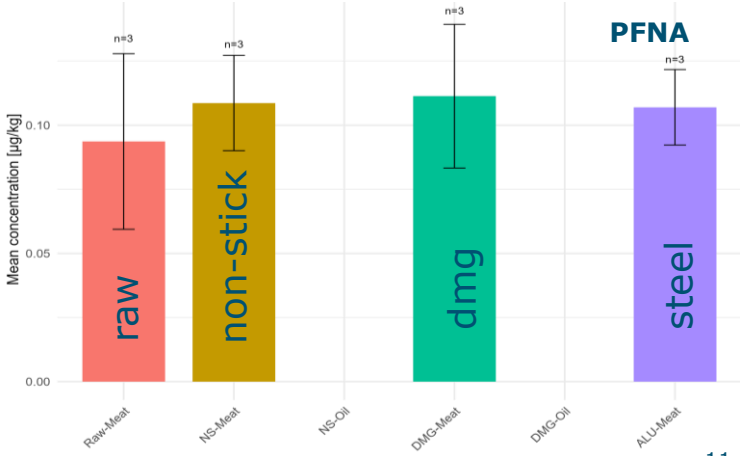
Meat: no clear effect!

- Raw meat: PFNA, PFDA, PFHpS, total PFOS ~0.13 µg/kg, PFHxS ~0.07 µg/kg
- Longer carboxylic acids (e.g., PFDoDA, PFTrDA) in the patterns change, stay around LOQ
- No clear change in these compounds for any of the processed samples







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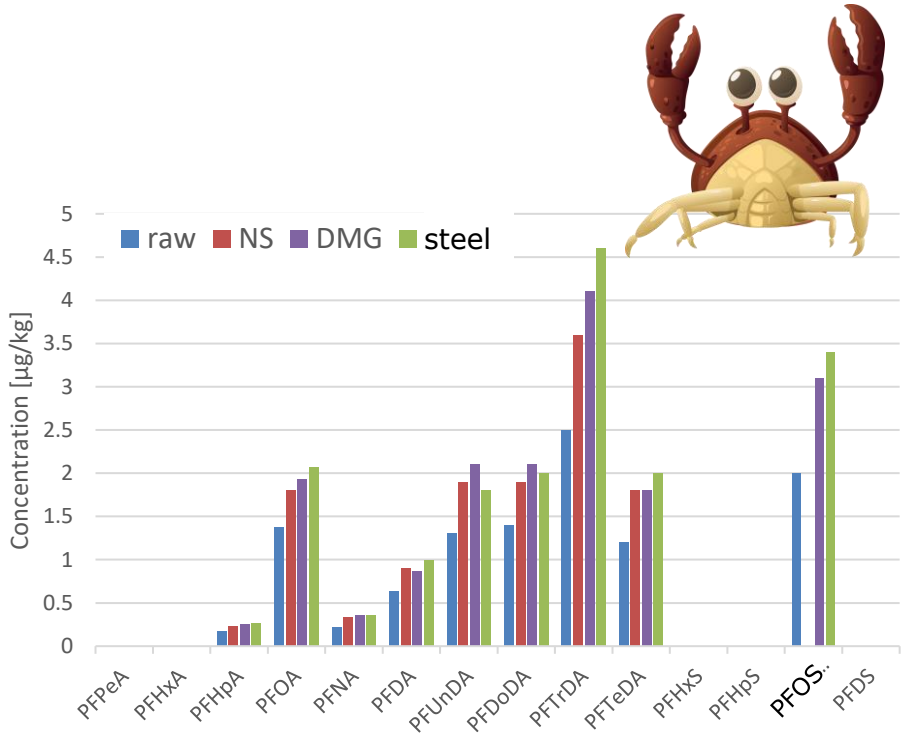
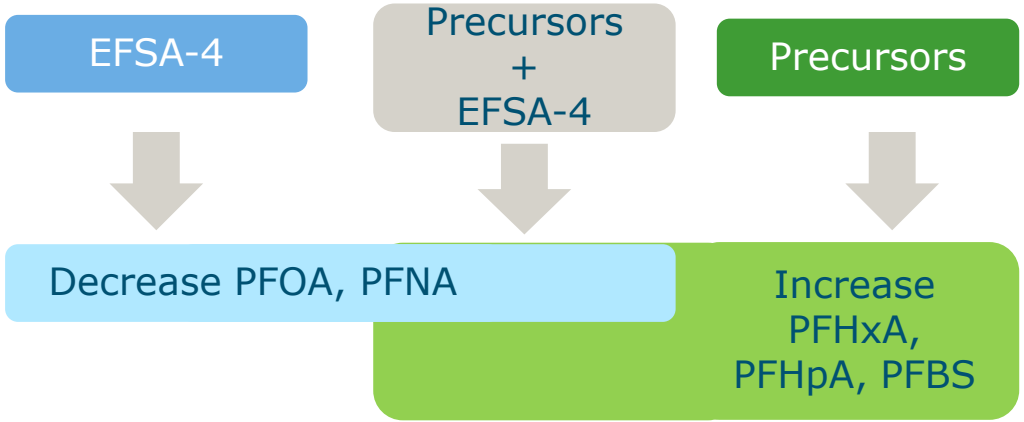
Seafood: overall increase

- Seabass, tung, crab from Western Scheldt area
- Fish dominated by PFOS (6-20 µg/kg), crab with longer chain PFCAs more prevalent
- All samples with increase of PFASs after cooking
- No additional compounds introduced through cooking

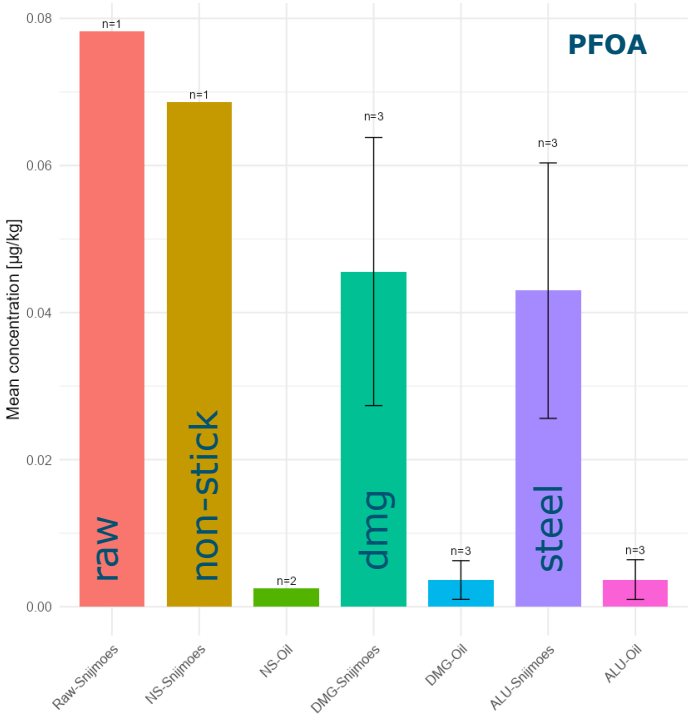


Leafy greens: effect of precursors

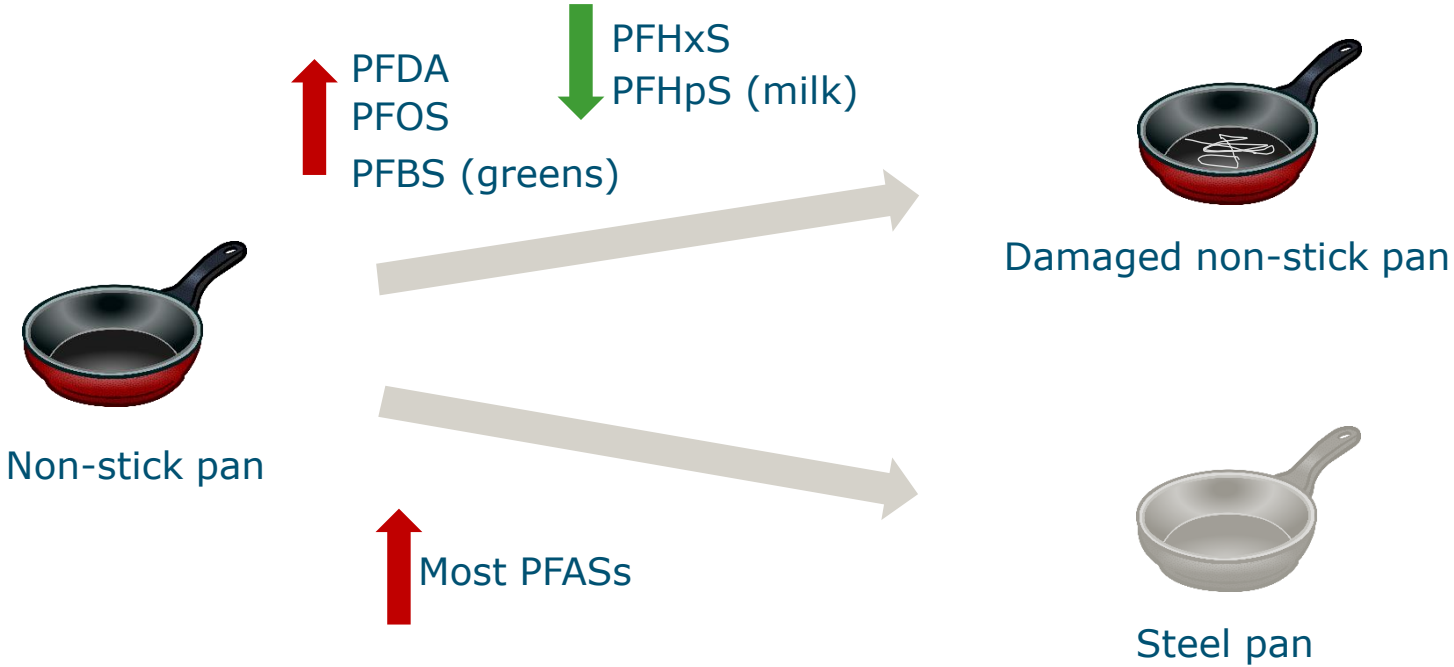
- Interesting effect of precursors:



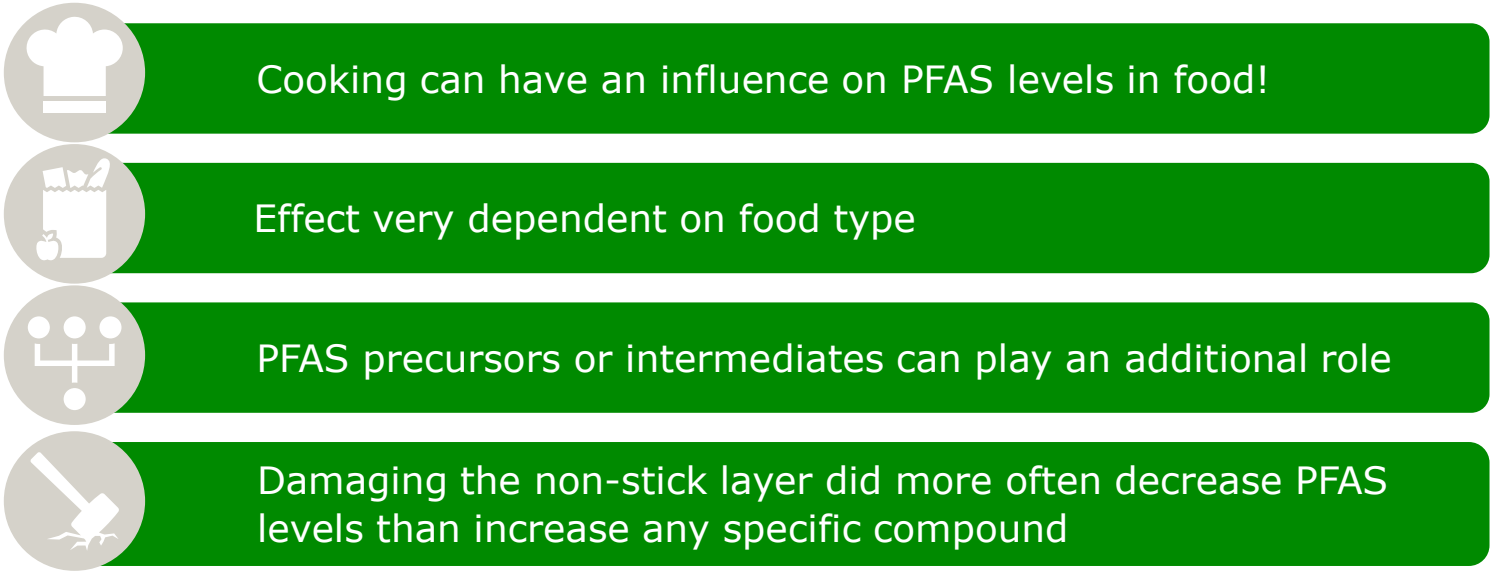
- Clear presence of PFOA in used oil



Comparison of pan types



Conclusions and outlook



- Very limited pilot study, needs statistically sound follow up
- Cooking might help especially with (mildly) contaminated eggs, vegetables

Thank you for your attention!

Any questions / comments?

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