The benefits of feeding *Himanthalia elongata* to dairy cattle on nitrogen utilisation and end-product quality

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Seaweeds: what is the hype about?

- 3 main groups based on their dominant pigmentation
  - Phaeophyceae, Rhodophyceae, Chlorophayceae
- 10,000 seaweed species
- Marine and freshwater species
- Variation in habitats, water depths = different environmental conditions = phenotypical differences
- 3,000 bioactive compounds

Bioactive compound	Activity
Polysaccharides	Anti-thrombotic, anti-coagulant, anti-cancer, anti-proliferative, anti-viral, and anti-complementary agent, anti-inflammatory, prebiotics
Peptides and Amino Acids	Anti-inflammatory, anti-bacterial, anti-tumoral, antinociceptive; etc anti-oxidative, anti-inflammatory, anti-tumor, hepatoprotective and neuroprotective
Polyphenols and Phlorotannins	Antioxidants, anti-methanogenic
Pigments	Colour or pigment enhancement
Fatty Acids	Resilience to stress, alter Omega 6/3 ratio
Halogenated compounds	Antibacterial, anti-tumoral, anti-methanogenic

Himanthalia elongata

Brown temperate seaweed species

Grows in abundance around the UK&I coastlines

High phlorotannin content in comparison to some brown seaweeds:

- *A. nodosum* = 2.21
- *F. vesiculosus* = 3.35
- *H. elongata* = 5.53
- *H. elongata* extract = 7.46

Research opportunity for provision to ruminants

Positive outcome from *in-vitro* rumen fermentation experiments

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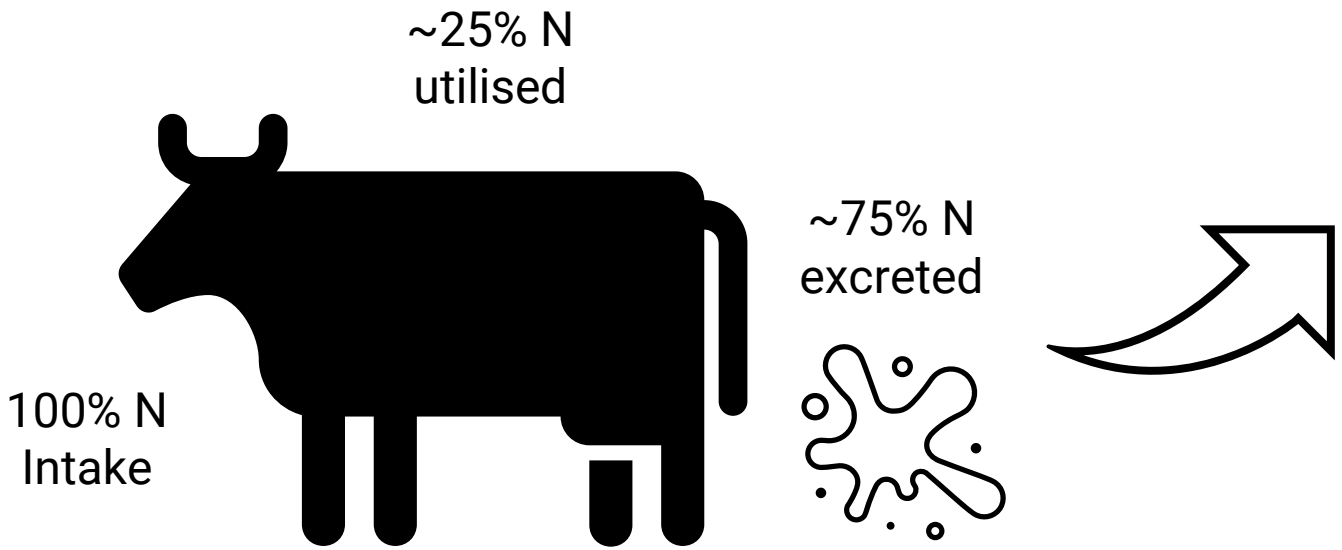
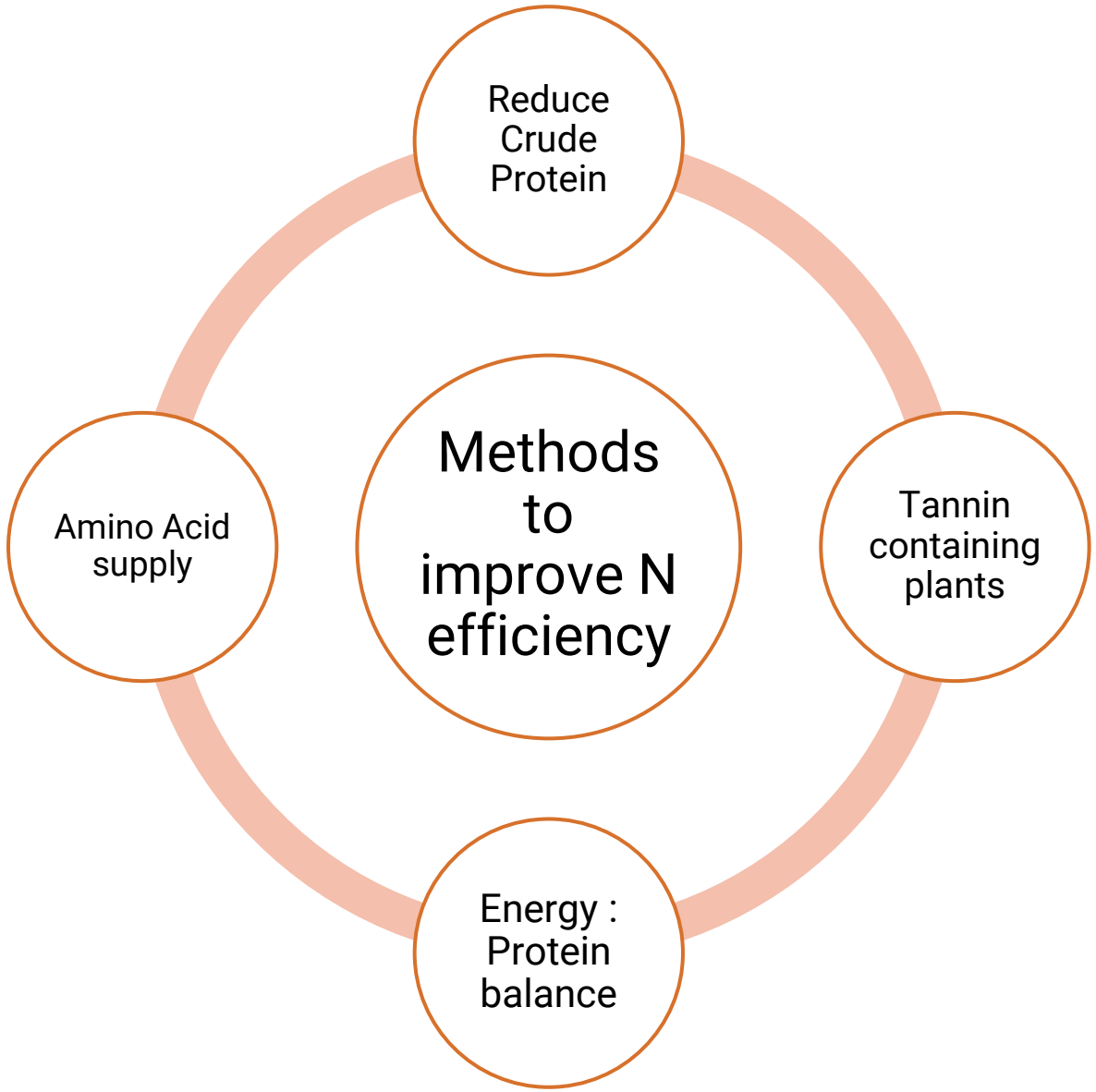
Nitrogen (N) Efficiency in ruminants



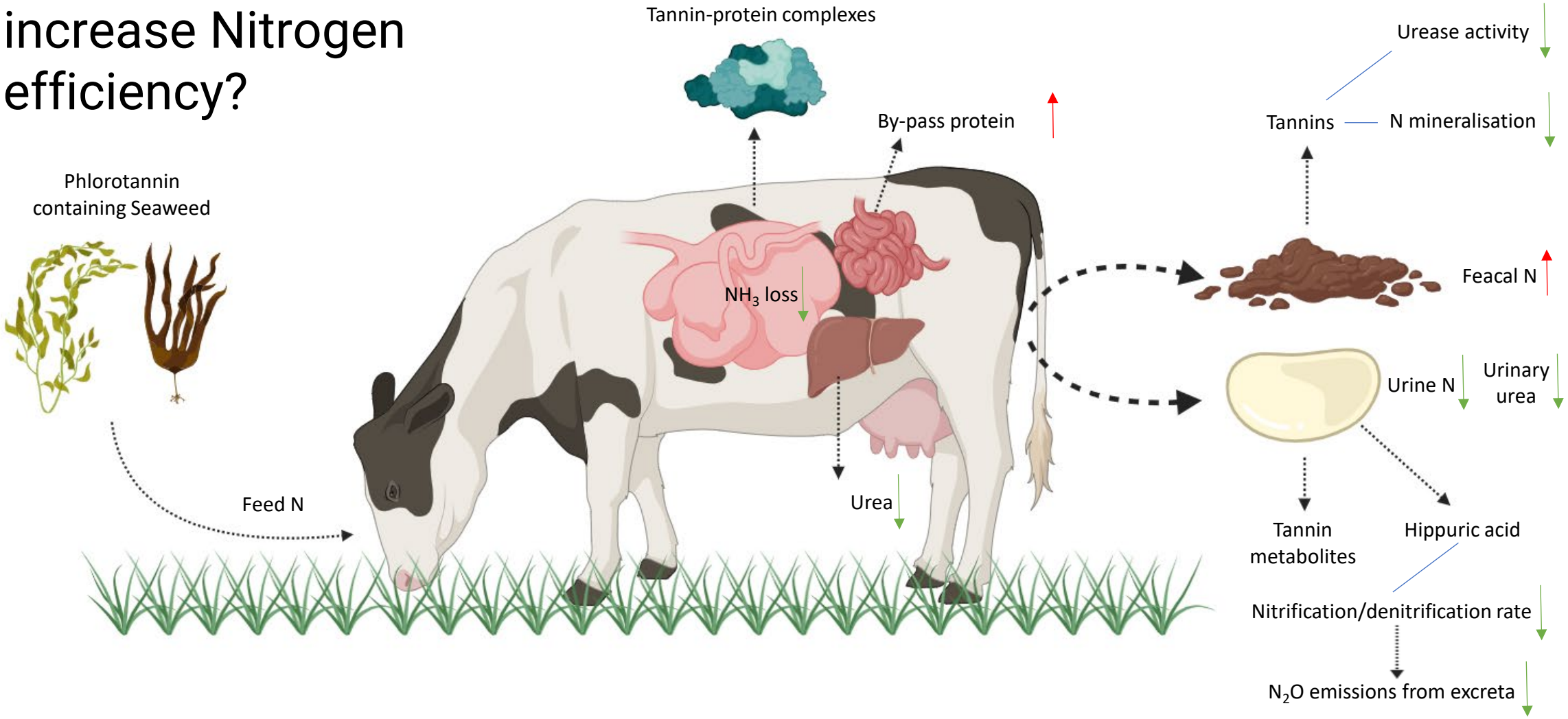
- Water pollution, gaseous N emissions and small particulate matter formation in the atmosphere
- Approx. 81% of anthropogenic N_2O emissions are attributed to the agricultural sector - 46% of which from ruminant excreta
- Urinary N is less stable than faecal N = more N loss



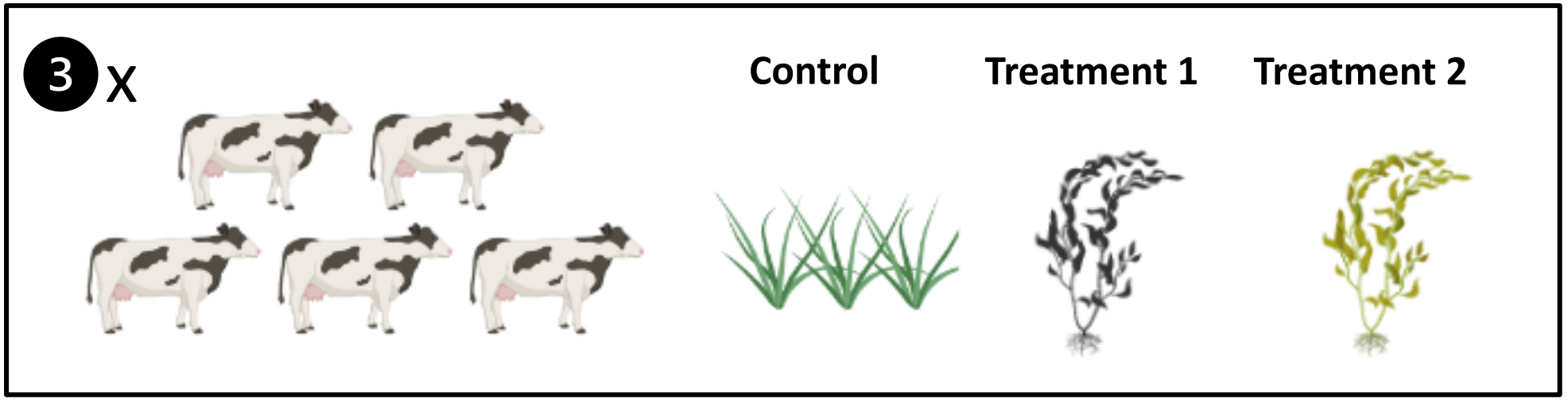
Condensed tannin containing terrestrial plants

Phlorotannin containing brown seaweeds

How can Tannins increase Nitrogen efficiency?



AFBI dairy cow study (3x3 Latin square)



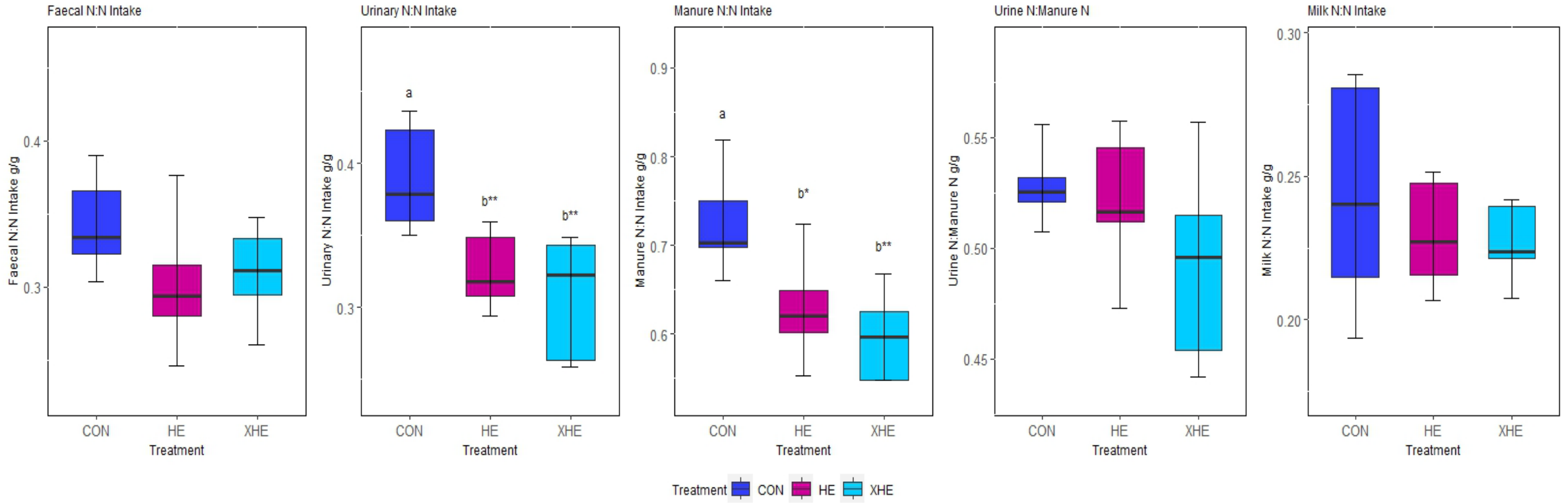
- Feeding period = 21 days
- TMR diets with 60% grass silage and 40% concentrate (DM basis)
  - **Control:** Grass silage + concentrate
  - **Treatment 1:** grass silage + concentrate + 4% dried brown seaweed extract
  - **Treatment 2:** grass silage + concentrate + 4% dried brown seaweed

Measurements in digestibility units

- During the final 6 days of each 21d period, 9 cows (3 cows/diet) were selected and housed in individual stalls
  - ✓Feed intake, LW, milk yield, milk composition, milk iodine content
  - ✓Total collection of faeces and urine
  - ✓Collection of rumen fluid and blood samples on d 21

DMI, Milk Yield & DM digestibility in the final 6 d digestibility measurements

Item	Treatment			SED	P-value
	Control	Whole seaweed	Seaweed Extract		
Animal measurement					
DM intake (kg/d)	22.4[a]	24.5[b]	25.4[b]	0.802	0.046
Milk yield (kg/d)	27.4	27.5	28.6	1.72	0.742
Digestibility					
DM digestibility (g/kg)	750	785	785	15.5	0.057



- Increased DMI in both treatments = Significant increase in N intake
- Both treatments significantly reduced Manure N and Urinary N ratios against N intake ($P < 0.05$)
  - Showing increased N utilization and reduced N loss

UK Iodin

- The UK is or
  countries to l
  deficient pop
- Deficiency ca
  muscle weakness, depression, hair
  ognitive

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Effect of dietary seaweed (*Ascophyllum nodosum*) supplementation on milk mineral concentrations, transfer efficiency, and hematological parameters in lactating Holstein cows

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Variation in macrominerals and trace elements in cows' retail milk and implications for consumers nutrition

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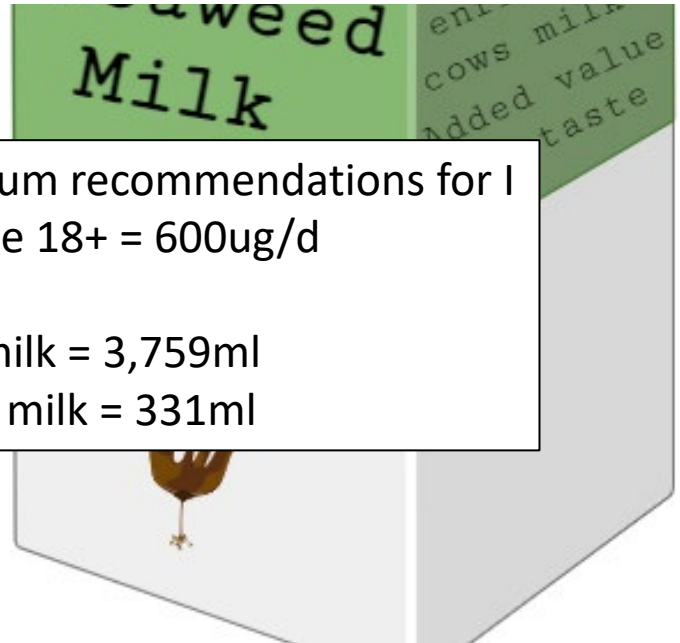
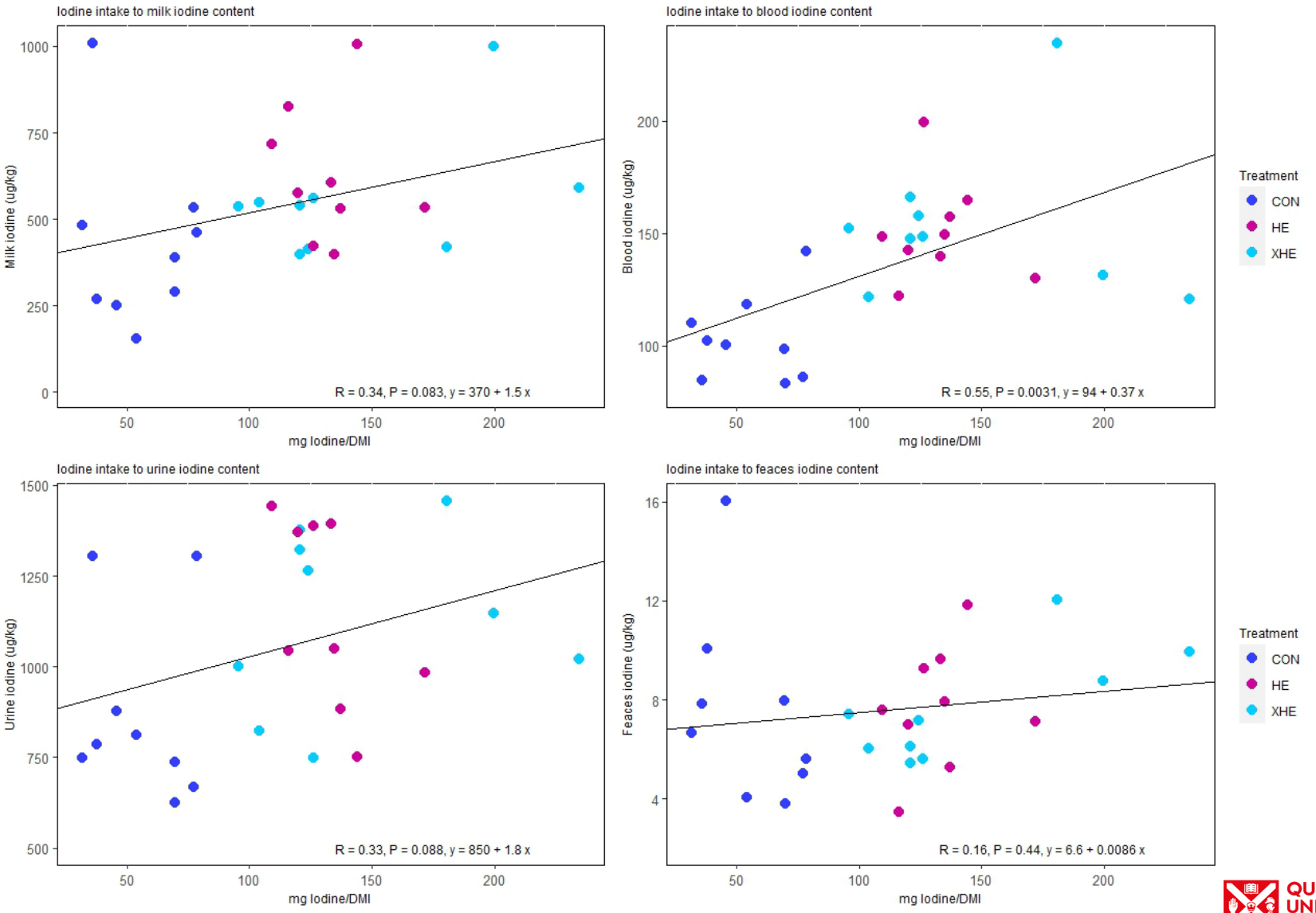
in cows

EFSA maximum recommendations for I intake for age 18+ = 600ug/d

- Control milk = 3,759ml
- Seaweed milk = 331ml





Increased milk, blood, urine and feacal iodine content

Iodine intake

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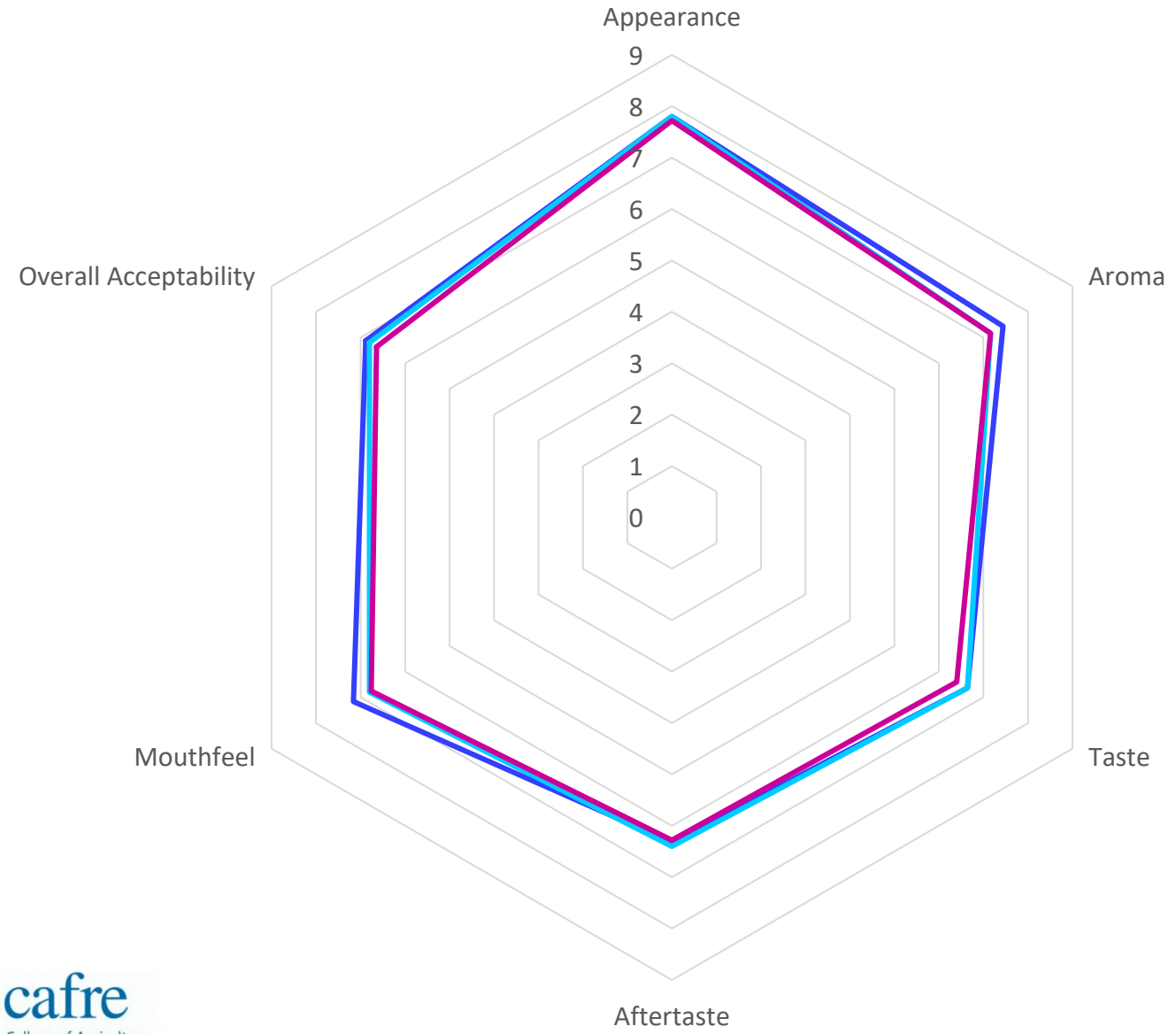
Milk fatty acid results

The effect of seaweed provision to milk fatty acid profile hasn't been previously investigated.

Small but positive changes in milk FA profile, especially EPA and DHA content

% of total	CON	HE	XHE	sd	SEM	P Value
EPA C20:5 n-3	0.055[a]	0.061[b]	0.061[b]	0.007	0.001	0.016
DPA C22:5 n-3	0.085[a]	0.095[b]	0.090	0.011	0.002	0.048
DHA C22:6 n-3	0.004	0.004	0.004	0.001	0.000	0.293
FA groups (g/kg Total FA)						
SFA	75.766	75.184	75.623	1.790	0.246	0.623
MUFA	21.052	21.330	21.031	1.380	0.189	0.791
PUFA	3.181	3.486	3.344	0.470	0.065	0.205
n-3	0.840	0.899	0.883	0.128	0.018	0.457
n-6	1.543[a]	1.694[b]	1.629[ab]	0.180	0.025	0.043
n-3:n-6 ratio	0.543	0.528	0.541	0.351	0.005	0.412
n-6:n-3 ratio	1.848	1.899	1.859	0.125	0.017	0.459
EPA + DHA	0.059[a]	0.065[b]	0.066[b]	0.007	0.001	0.012
trans FA	29.030	28.853	28.895	1.010	0.139	0.898

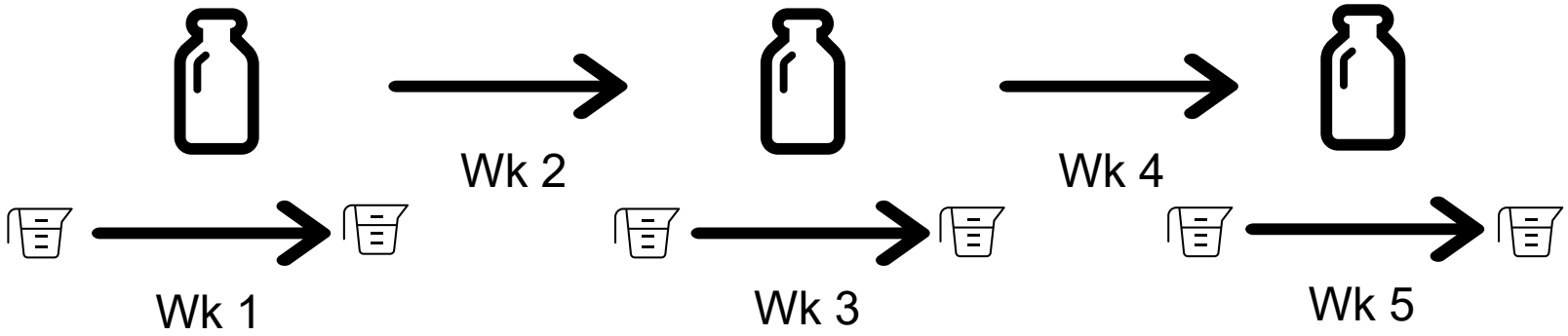
Consumer taste panel



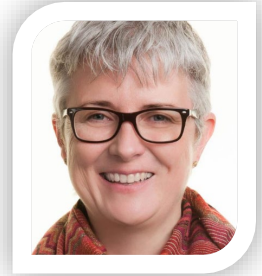
Human intervention study

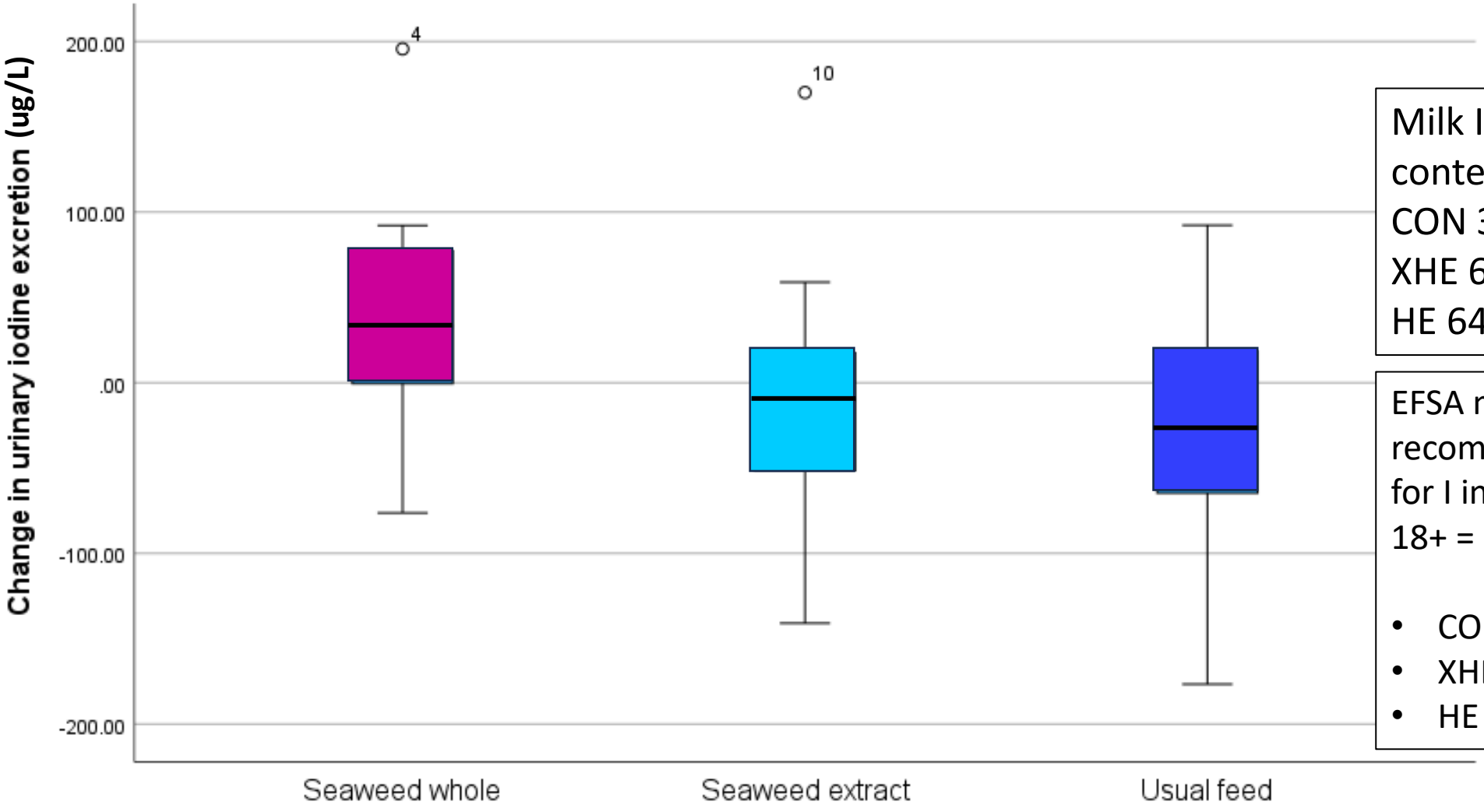
Collaboration with the Centre of Public Health

- Collected 60L/treatment after 20 days of seaweed provision in P3
  - Pasteurised, split into 500ml portions and frozen
- 9 participants
- 5 week study: consume 190ml milk/day



Preliminary results





Milk Iodine content
CON 399.5 µg/L
XHE 649.5 µg/L
HE 646.4 µg/L

EFSA maximum recommendations for I intake for age 18+ = 600ug/d

- CON = 1500ml
- XHE = 923ml
- HE = 930ml

Seaweeds have a role in the future of animal feed, sustainability and society!

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