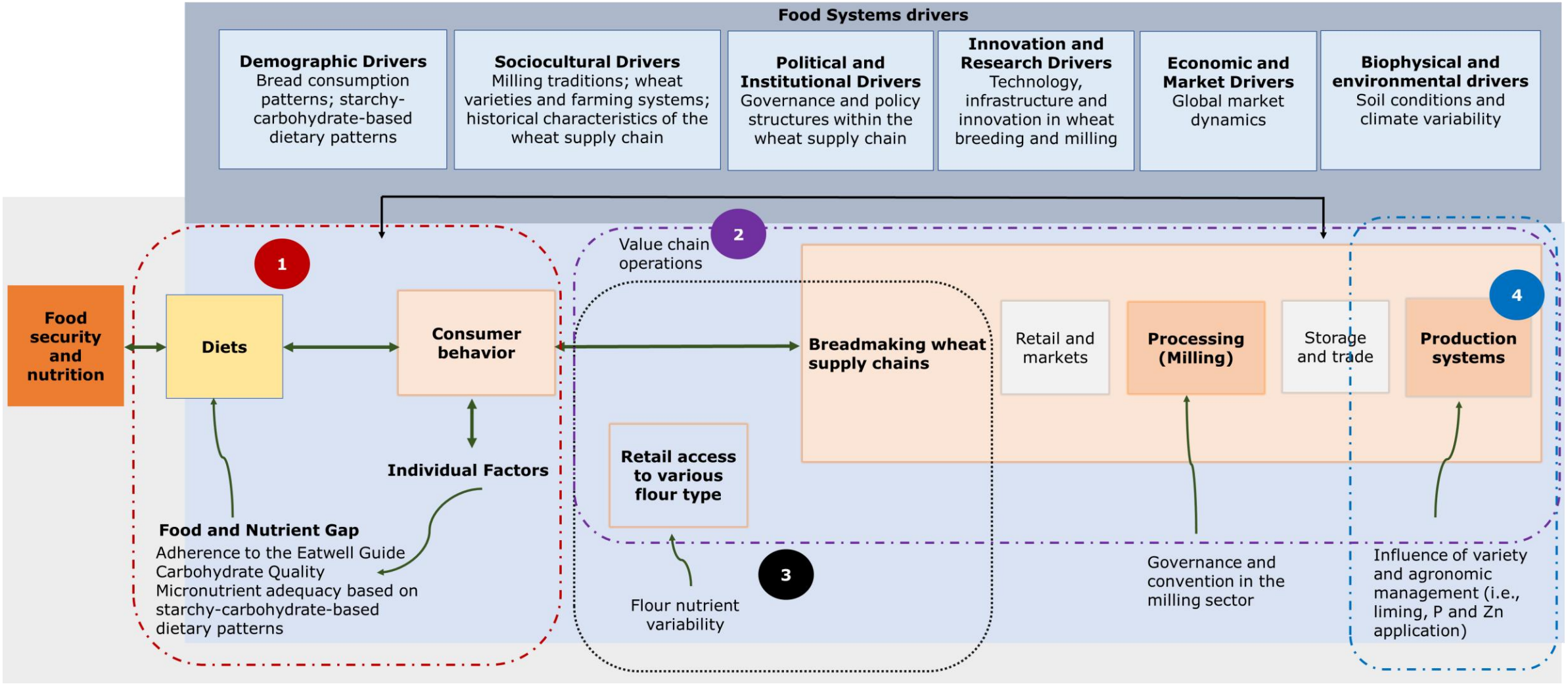
Variation in Iron, Zinc and Selenium Content of UK Bread-making Wheat Flours: *Implications for Nutrition Security*

Apple Espino *(PhD Candidate)*
University of Greenwich and Rothamsted Research
UK Food Systems Centre for Doctoral Training Program

PARTNERSHIP FOR A SUSTAINABLE FOOD FUTURE
UKFS-CDT is supported through the Strategic Priorities Fund (SPF) 'Transforming the UK Food System for Healthy People and a Healthy Environment Programme', delivered by UKRI, in partnership with the Global Food Security Programme, BBSRC, ESRC, MRC, NERC, Defra, DHSC, PHE, Innovate UK and FSA.

A Food Systems Approach to Increasing Wheat's Potential in Delivering Healthy Diets, Food Security, and Nutrition in the UK



UNIVERSITY OF GREENWICH
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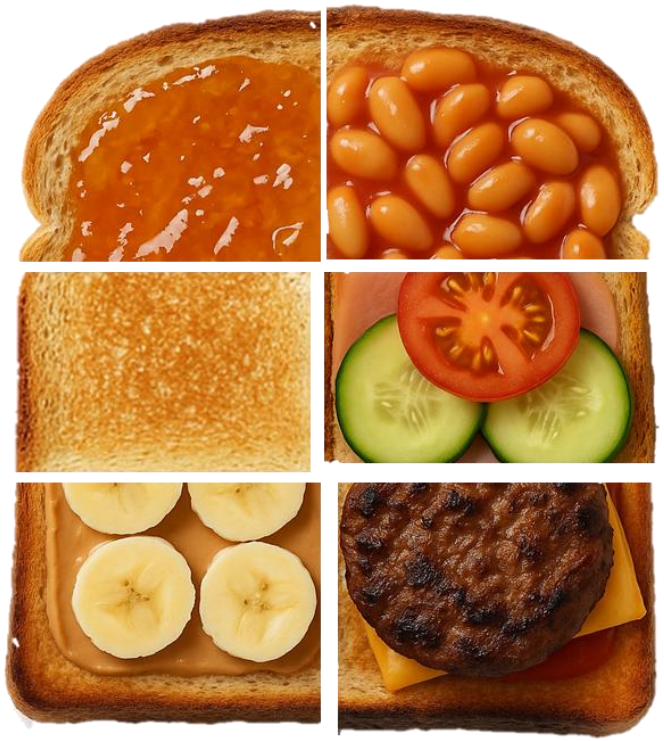
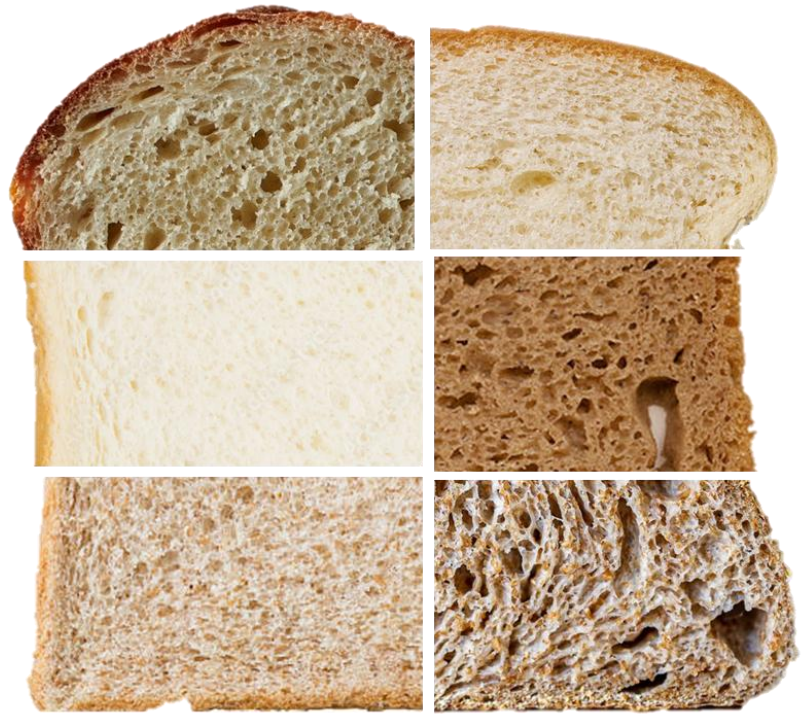
ROTHAMSTED RESEARCH

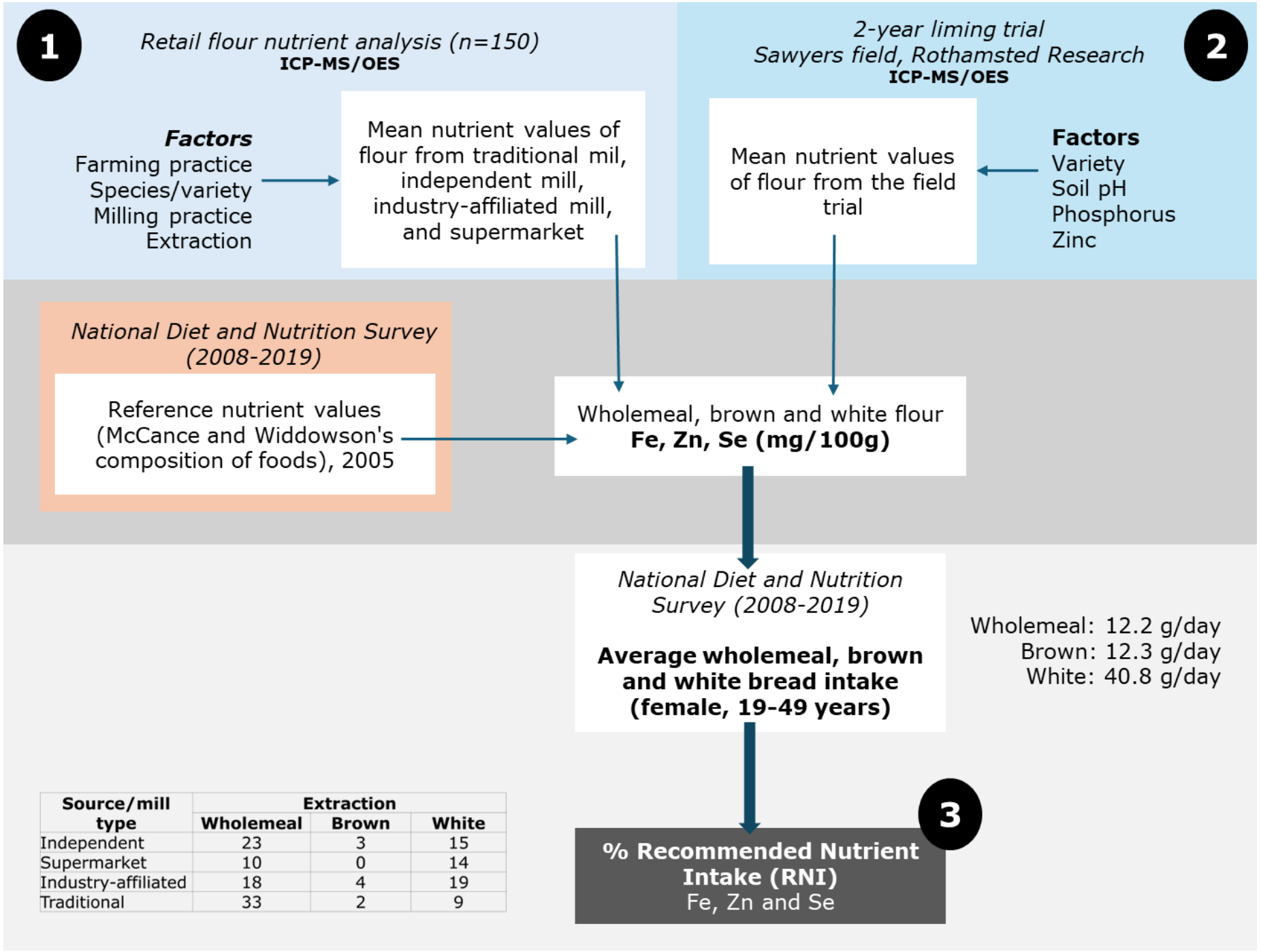
TRANSFORMING UK FOOD SYSTEMS
Strategic Priorities Fund

Adapted from HLPE food systems framework (2017) for wheat agrifood system Brouwer et al. (2021). Food Security, 13(6), 1497-1523.





Methodology



Source/mill type	Extraction		
	Wholemeal	Brown	White
Independent	23	3	15
Supermarket	10	0	14
Industry-affiliated	18	4	19
Traditional	33	2	9

1 Supply chain and retail flour nutrient analysis

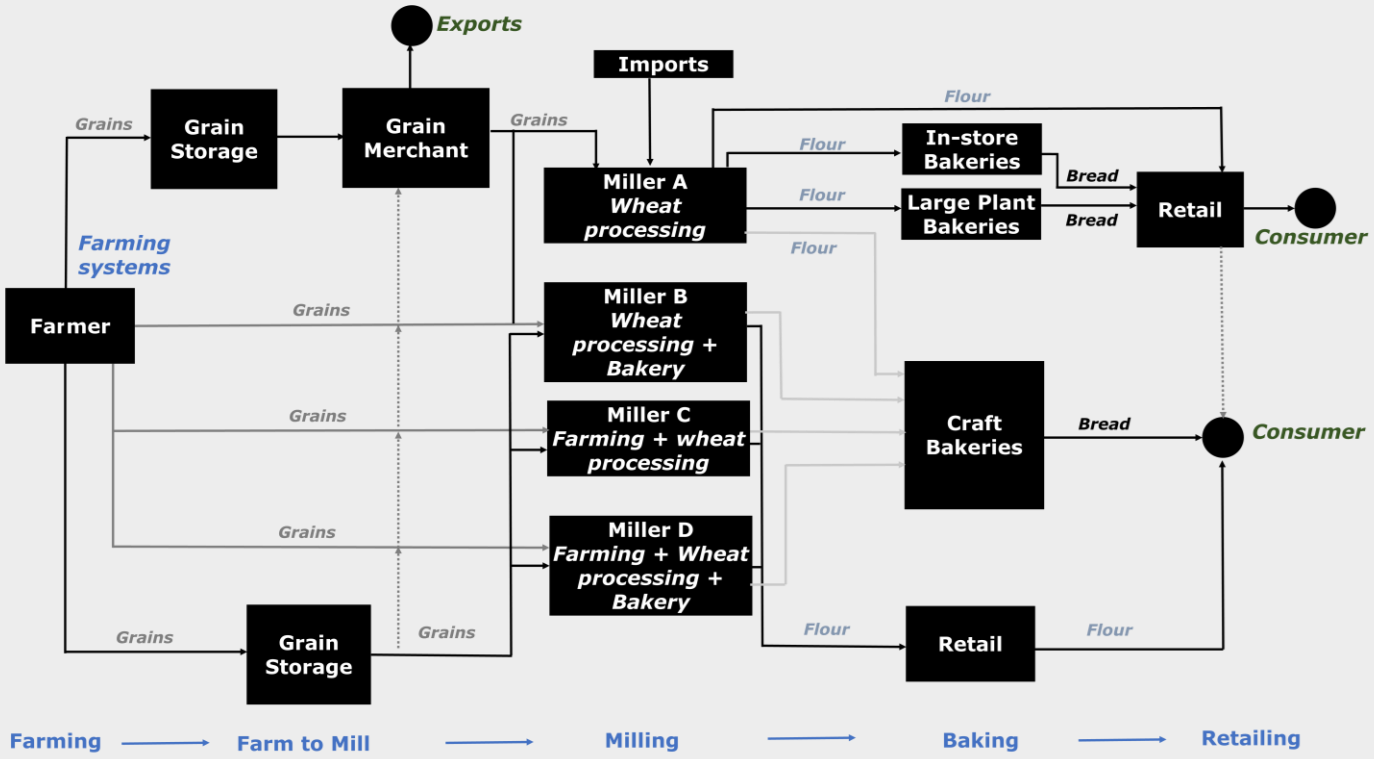
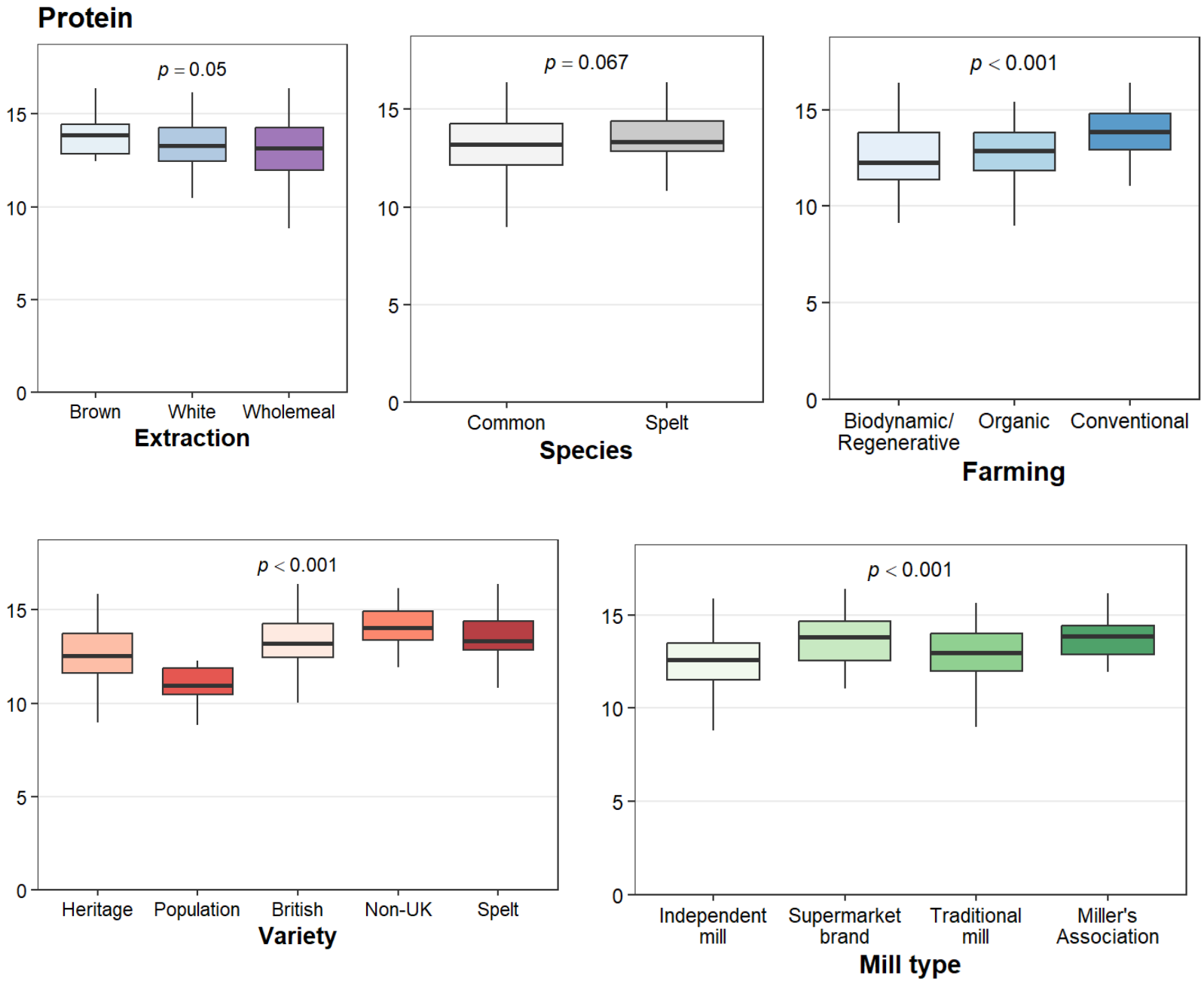


Figure 1. Representation of the UK wheat supply chain.

Figure 2. Some samples collected across retail sources (n=150).

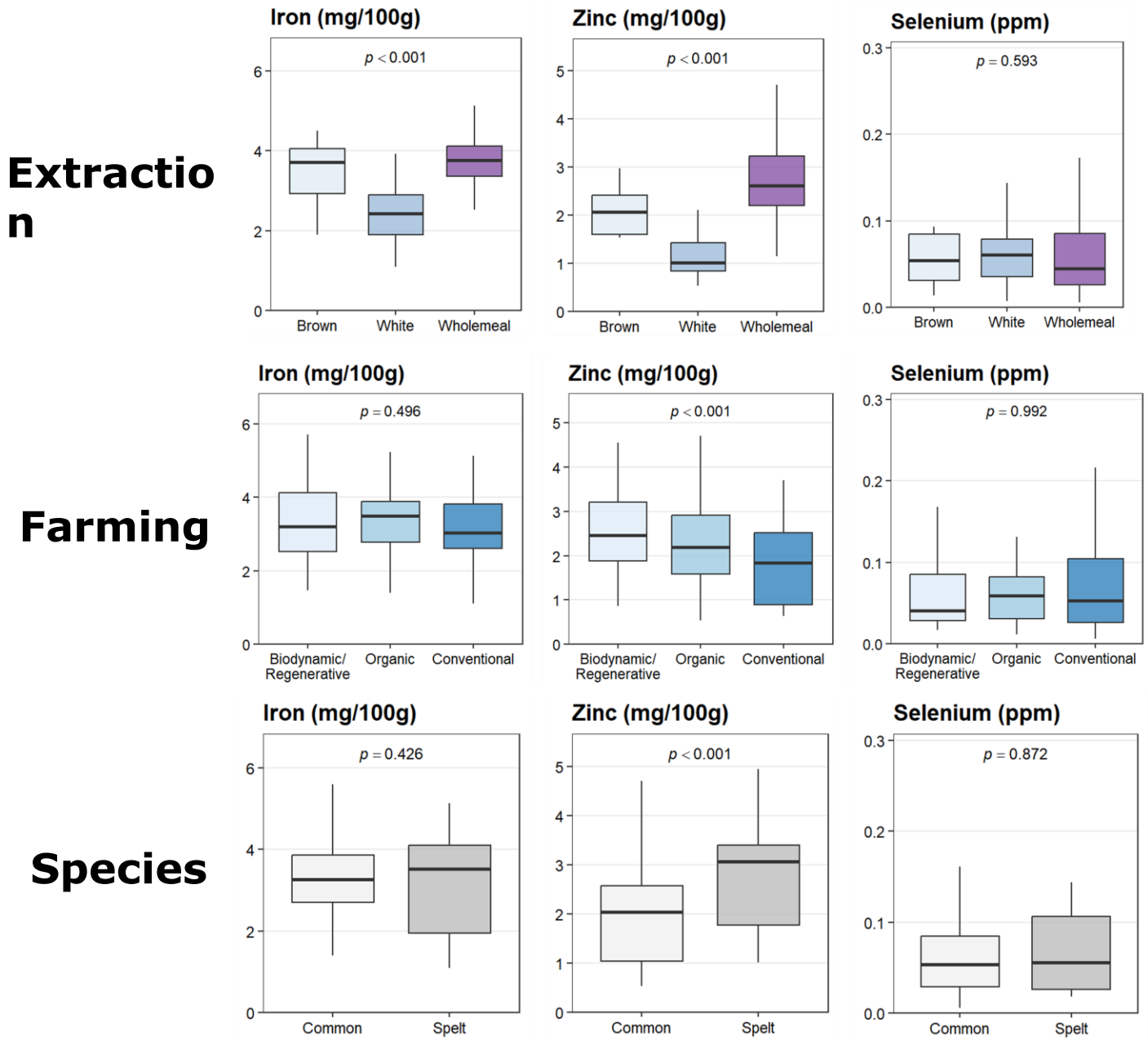
Chemical analysis:
Total nitrogen and carbon contents were determined using a LECO CN628 Combustion Analyser (LECO Corporation, St. Joseph, MI, USA; LECO UK, Stockport, UK) following a modified version of the Dumas digestion method. **Nutrient concentartions** were quantified using an Agilent 5900 SVDV Inductively Coupled Plasma–Optical Emission Spectrometer (ICP-OES) (Agilent Technologies LDA UK Ltd, Stockport, UK).

Figure 3. Main effects of extraction level, species, farming system, variety, and mill type on wheat flour **protein** content (%) based on ANOVA.



Boxplots show the distribution of protein content (%) across factor levels. Horizontal lines represent medians, boxes indicate interquartile ranges, and whiskers show data spread. Reported p-values represent the main effects from the ANOVA model.

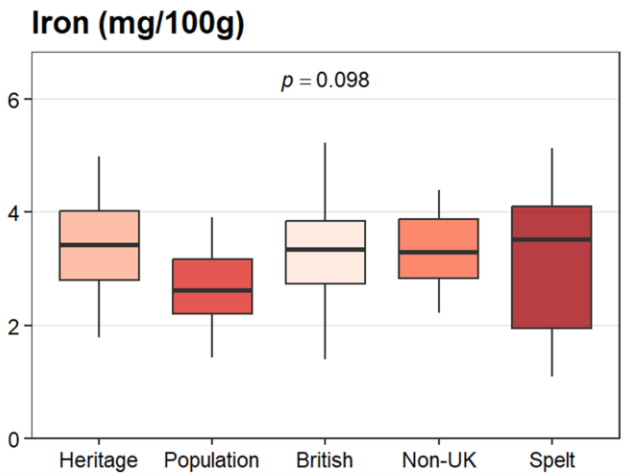
Figure 4. Main effects of extraction level, farming and species **Fe, Zn and Se concentrations** based on ANOVA.

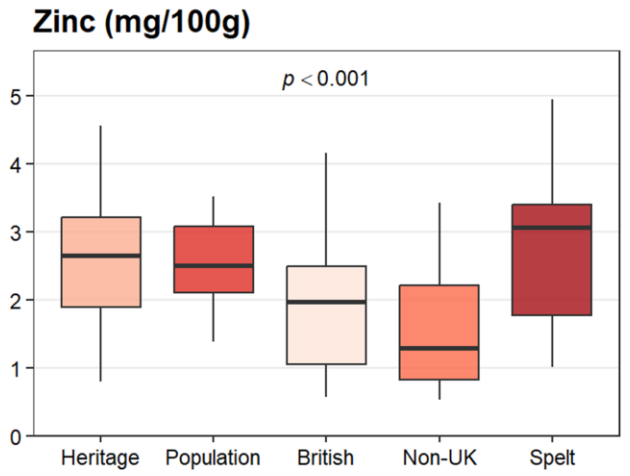


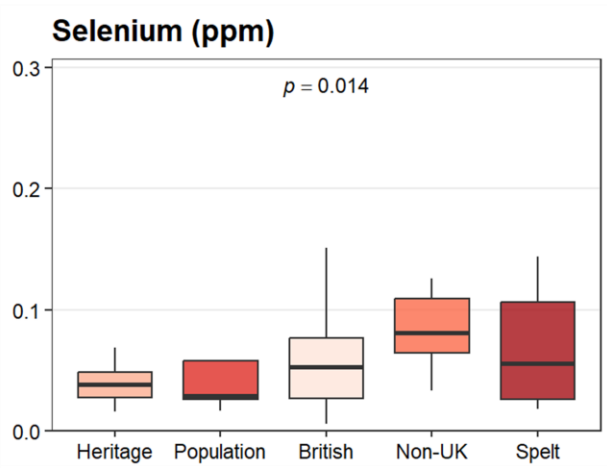
Boxplots show the distribution of Fe, Zn and Se across factor levels. Horizontal lines represent medians, boxes indicate interquartile ranges, and whiskers show data spread. Reported p-values represent the main effects from the ANOVA model.

Figure 5. Main effects of variety and source on **Fe, Zn and Se concentrations** based on ANOVA.

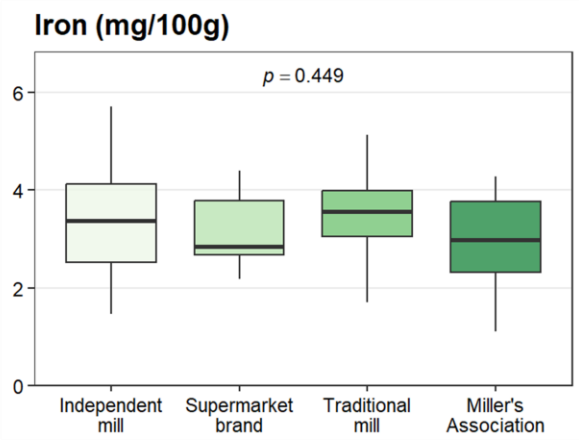
Variety

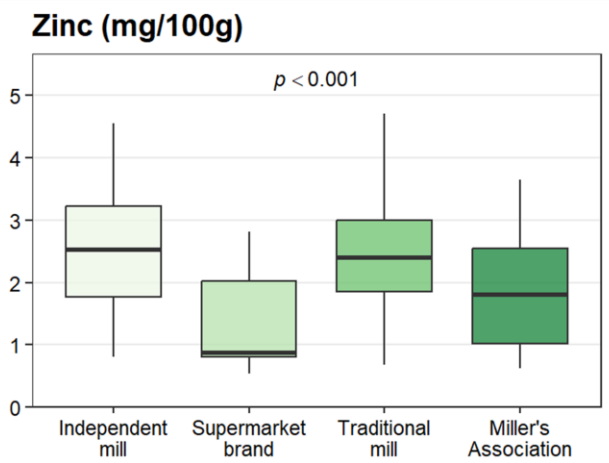


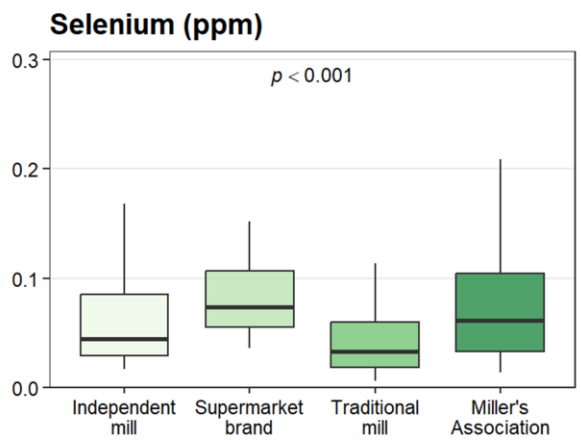




Source







Boxplots show the distribution of Fe, Zn and Se across factor levels. Horizontal lines represent medians, boxes indicate interquartile ranges, and whiskers show data spread. Reported p-values represent the main effects from the ANOVA model.

2 Field trial

Long-term liming trial (Sawyers Field, initiated 1962, revised 2019) aimed to examine the effect of liming, P and Zn treatments on grain yield and nutrient uptake of 7 wheat (Triticum aestivum L.) varieties.

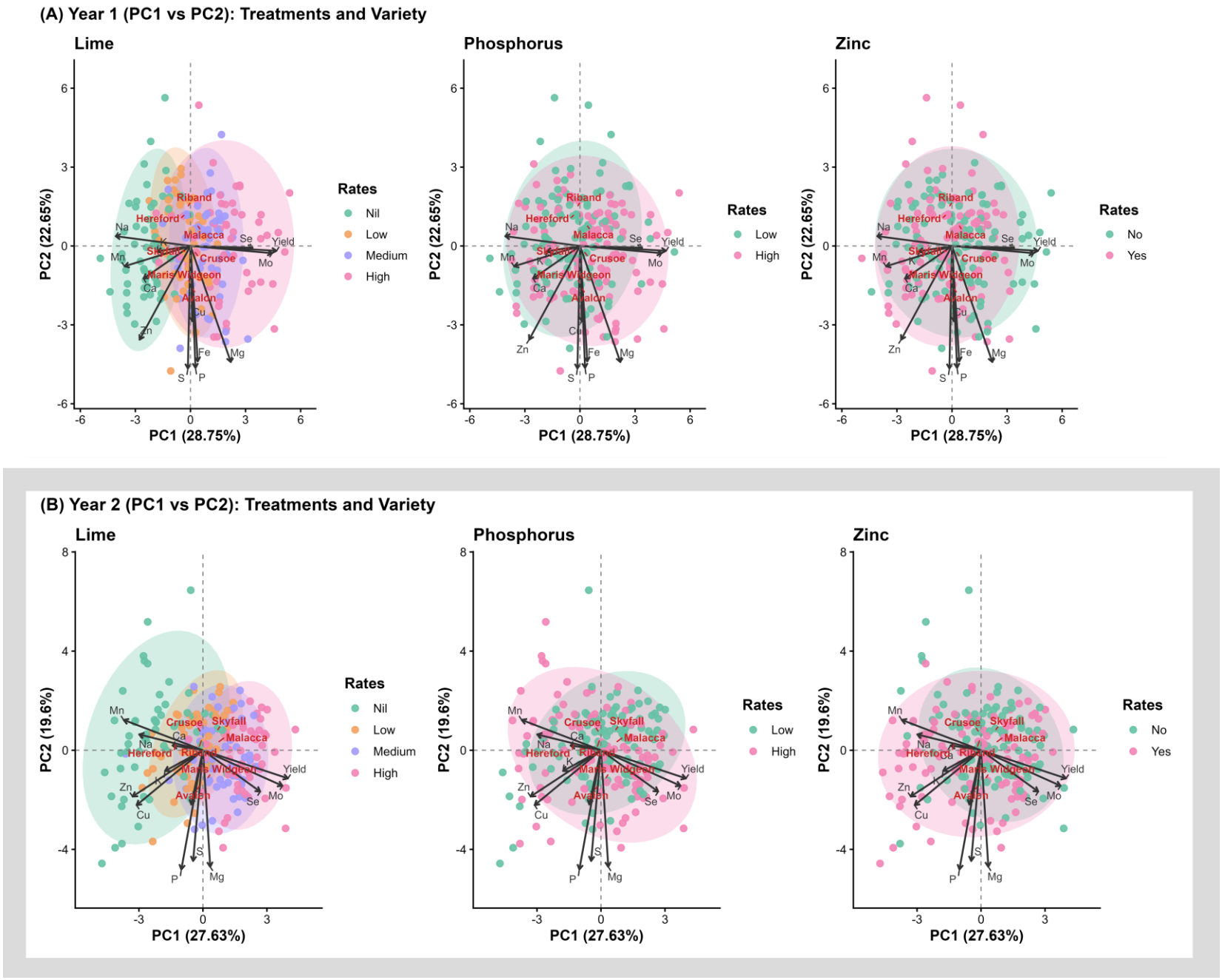
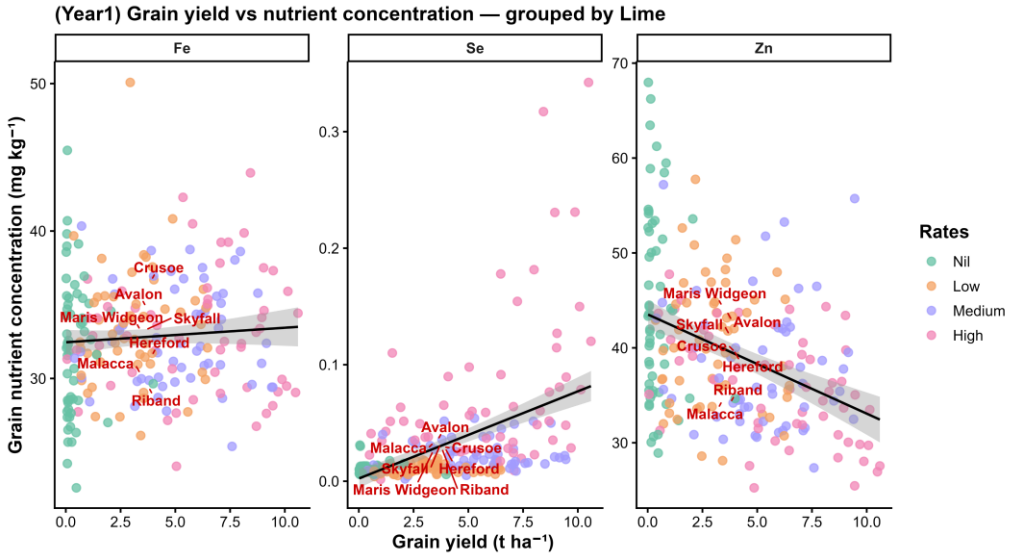
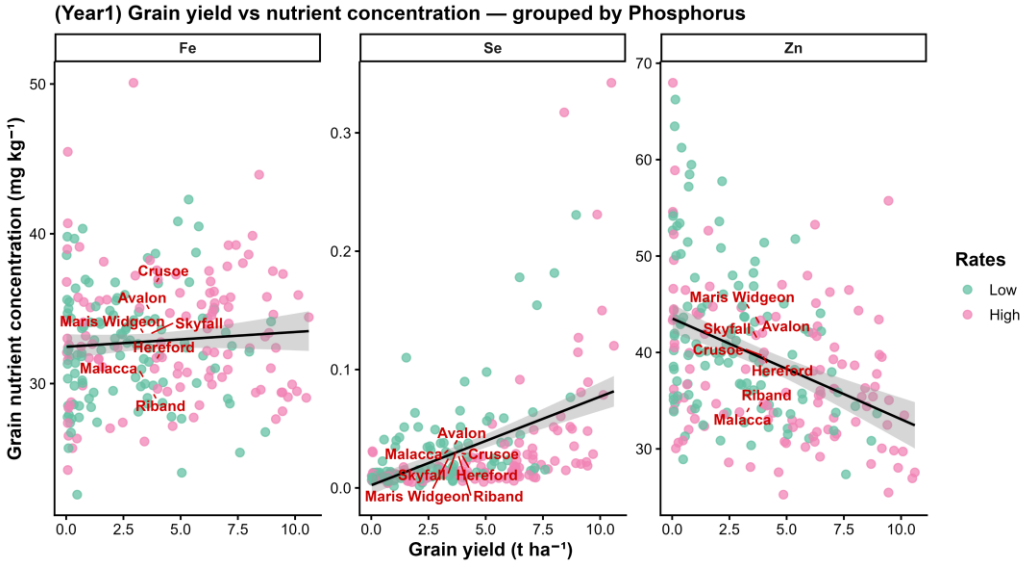


Figure 6. Principal component analysis (PCA) biplot showing the relationships between grain macro- and micro-nutrient concentrations and yield across seven crop varieties under different nutrient management treatments, in Year 1 (A) and Year 2 (B).

Lime



P



Zinc

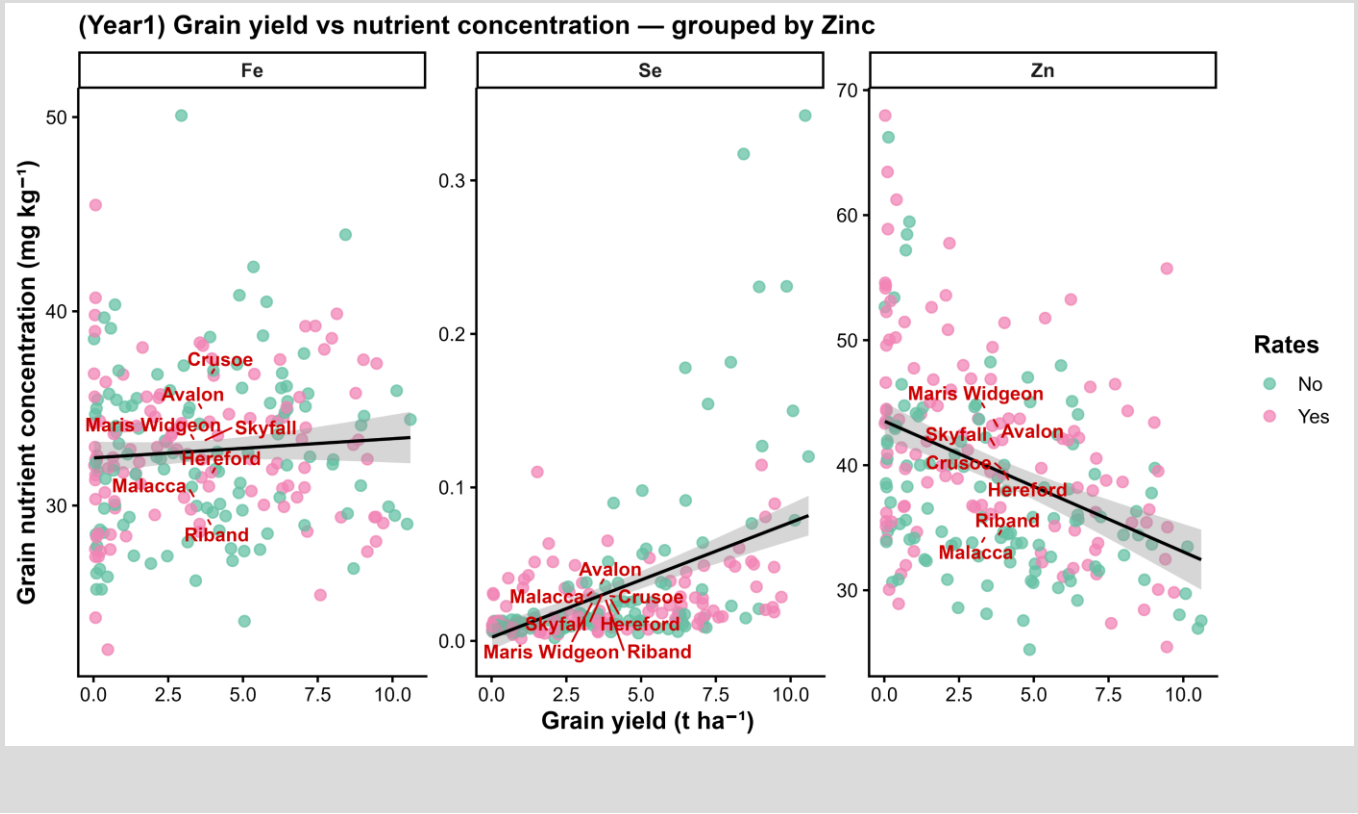


Figure 7. Relationships between grain yield and grain micronutrient concentrations (Fe, Se and Zn) in wheat for Year 1 under different lime, P and zinc rates application.

3 % Contribution to RNI: Wholemeal bread

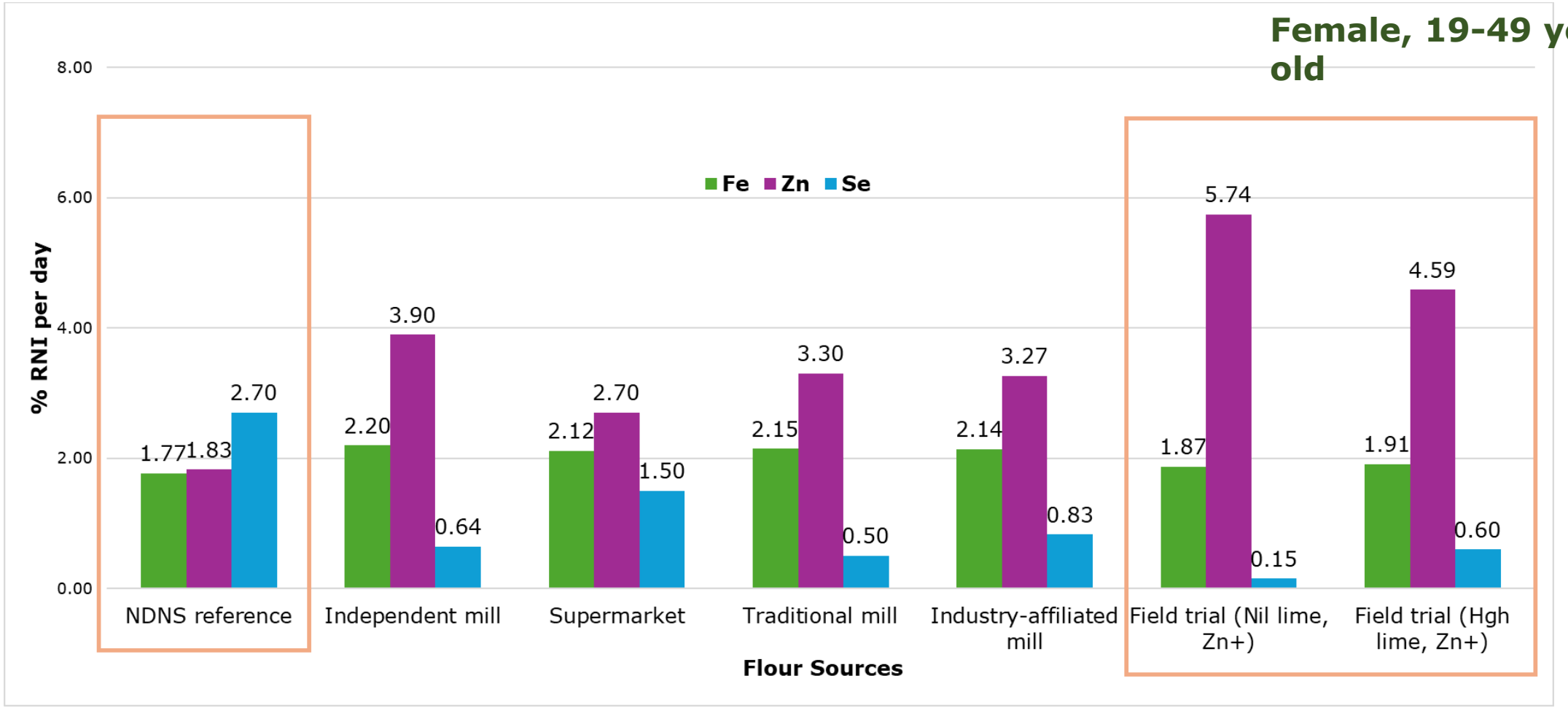


Figure 8. Percentage contribution of **wholemeal bread** from different flour sources to the recommended nutrient intake (RNI) of iron (Fe), zinc (Zn), and selenium (Se).

Values were calculated assuming bread composition of 70% flour and 30% moisture, and nutrient concentrations derived from the corresponding flour samples. NDNS = UK National Diet and Nutrition Survey reference composition data.

3 % Contribution to RNI: White bread

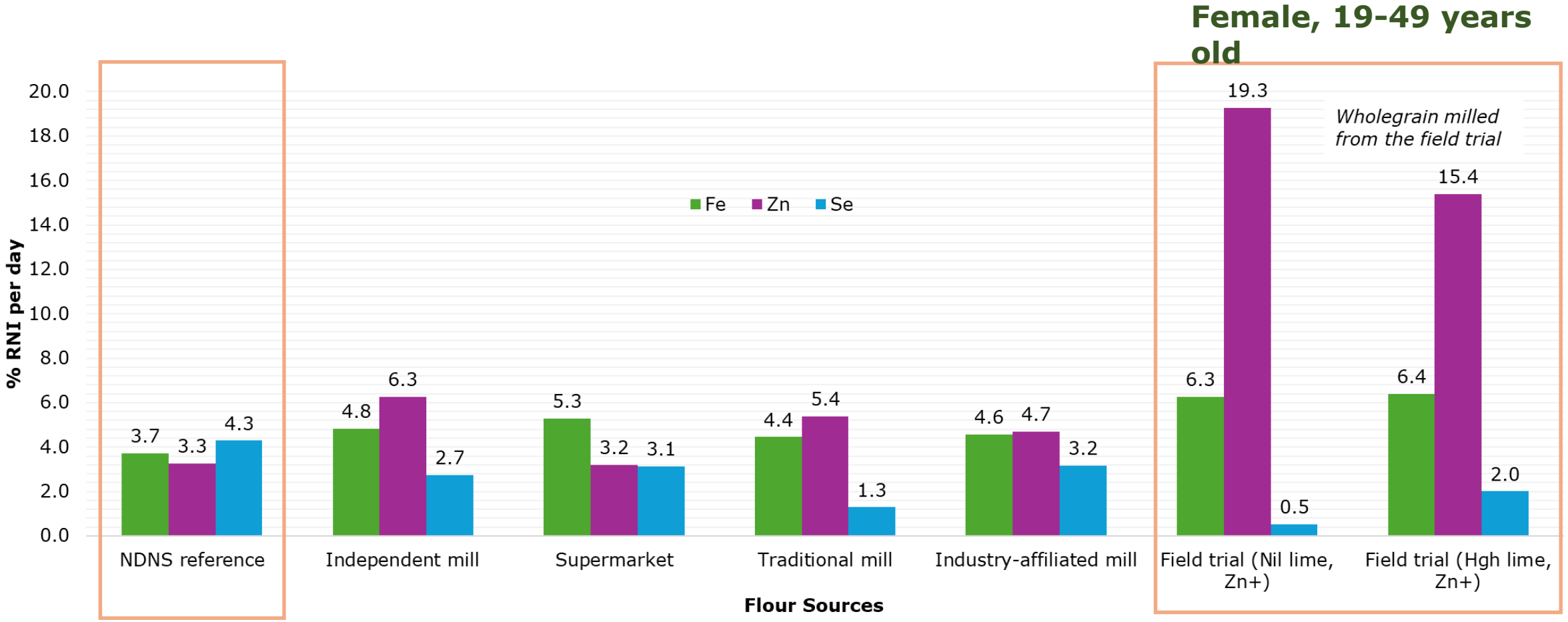


Figure 9. Percentage contribution of **white bread** from different flour sources to the recommended nutrient intake (RNI) of iron (Fe), zinc (Zn), and selenium (Se).

Values were calculated assuming bread composition of 70% flour and 30% moisture, and nutrient concentrations derived from the corresponding flour samples. NDNS = UK National Diet and Nutrition Survey reference composition data.

Conclusion

- Micronutrient content of breadmaking wheat flour varies across retail sources.
- Current food composition data may not capture this variability.

Conclusion

Putting back old wheat varieties in the system

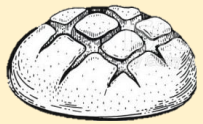
Rise of alternative wheat supply chain

Soil management (i.e., liming, phosphorus input, and micronutrient management) to increase **micronutrients** in winter wheat

Bread and Flour Regulations 1998: Mandatory fortification of non-wholemeal flour with thiamine, niacin, calcium and iron (+ folate in 2026)

Promotion of wholemeal flour

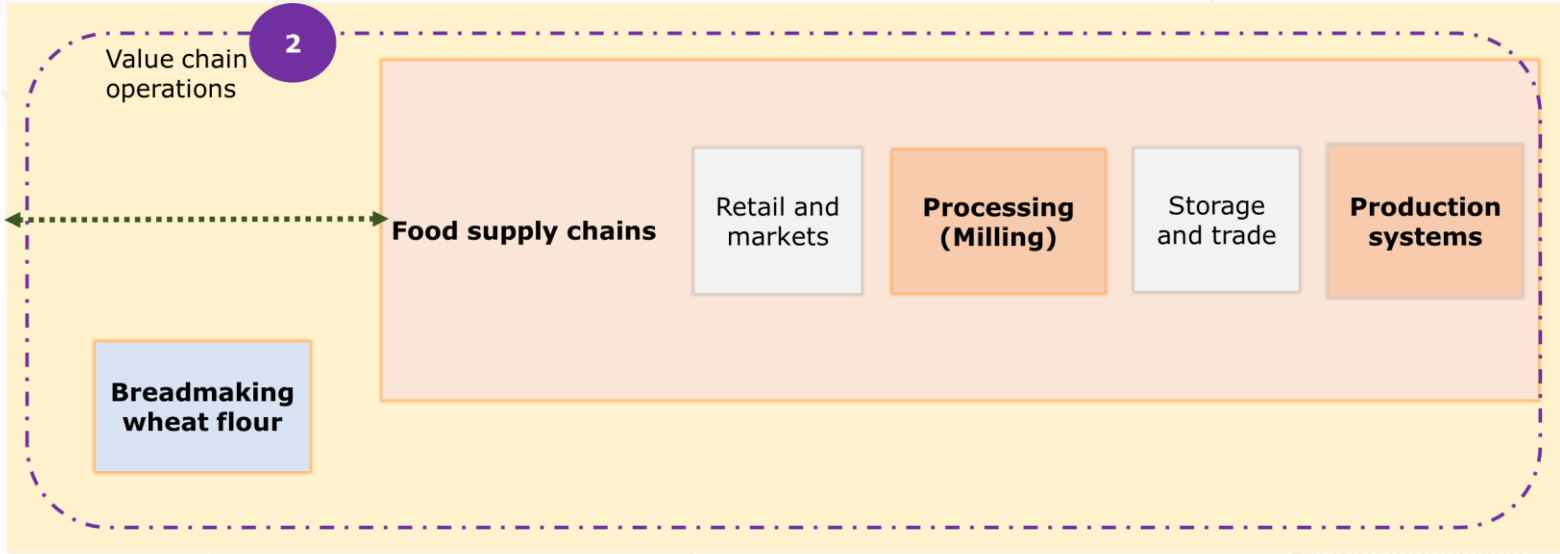
Keeping the old milling tradition



Use of sourdough

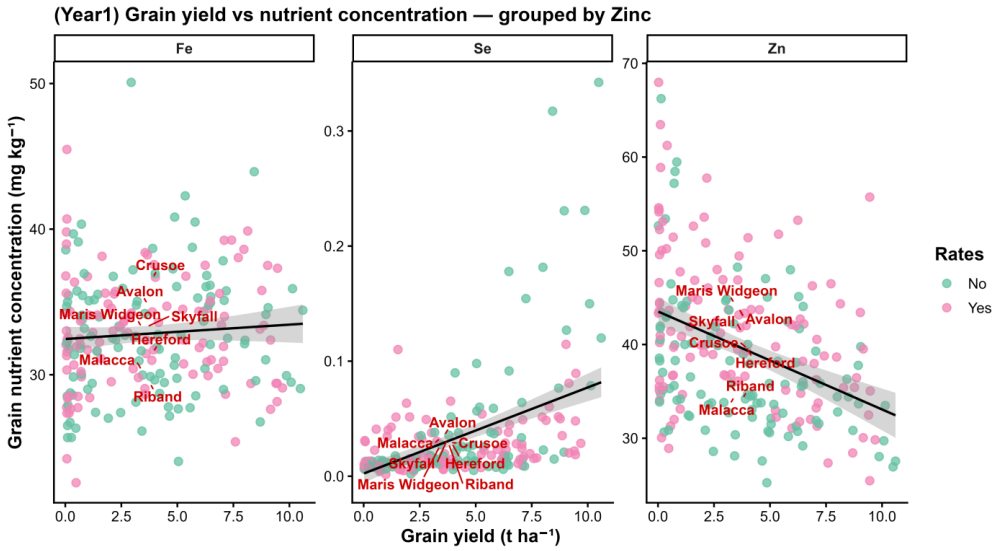
Promotion of wholemeal bread

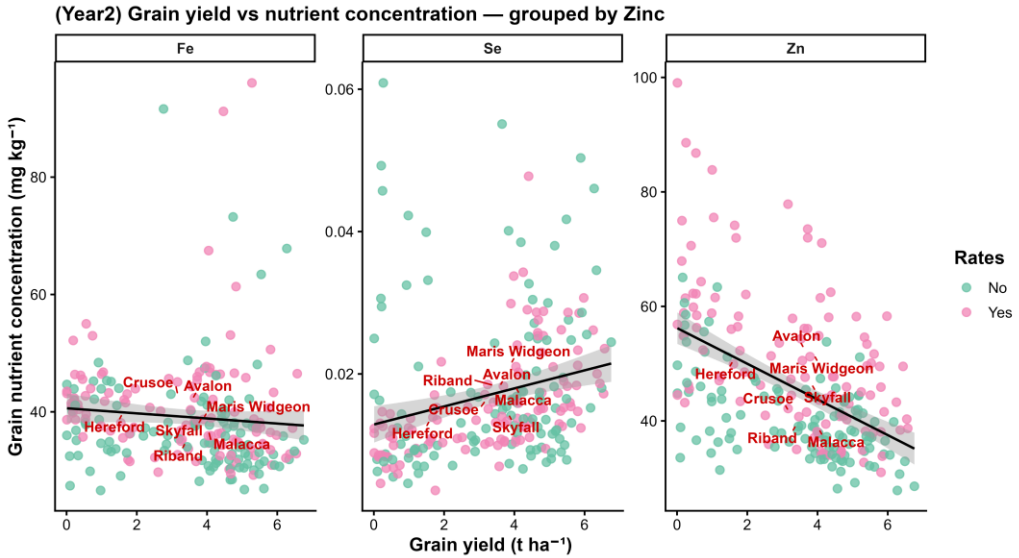
Innovation and Research Drivers
Technology, infrastructure and innovation in wheat breeding and milling



Opportunities exist in the supply chain to support the delivery of micronutrients for healthy diets.

Conclusion





Interventions across the wheat value chain must balance trade-offs in Fe, Zn, and Se delivery to support nutrition security under changing climates and diets.

Selecting wheat varieties that combine high yield potential, nutrient density, and responsiveness to soil amendments is essential for meeting productivity and improving nutrition.

Named varieties in the retail environment (November 2024-January 2025): Orange Blue, Skyfall, Balcaskie landrace, Zyatt, Crusoe, Mariagertoba, YQ, Trencher, Lammas, Mulika, Maris Widgeon, Paragon, and AC Barrie. Others fall under more generic terms such as name of the source (e.g., from East England), British or English wheat to denote local sourcing, heritage grains, blend of varieties, wheat from more than one country, and others not mentioned.

Apple Espino
PhD Researcher, UKFS CDT Programme Cohort 1
A.B.Espino@gre.ac.uk | apple.espino@rothamsted.ac.uk

Dr June Y T Po
Senior Research Fellow in Gender and Diversity in Food Systems
Livelihoods and Institutions Department, Natural Resources Institute, Faculty of Engineering & Science, University of Greenwich
+44 (0)1634 88 3644
J.Y.T.Po@greenwich.ac.uk

Dr Kate Wellard
Principal Research Fellow
Natural Resource Management and Innovations;
Livelihoods and Institutions Department, Natural Resources Institute, Faculty of Engineering & Science
University of Greenwich
+44 (0)1634 88 3015
K.L.H.Wellard@gre.ac.uk

Andrew Mead
Statistician and Head of Statistics and Data Science
Intelligent Data Ecosystems, Rothamsted Research
+44 (0) 1582 938 278
andrew.mead@rothamsted.ac.uk

Dr Stephan Haefele
Systems Agronomist
Sustainable Soils and Crops, Rothamsted Research
+44 (0) 1582 938 124
stephan.haefele@rothamsted.ac.uk

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Thank you!

Apple Espino
PhD Researcher, UKFS CDT Programme Cohort 1

A.B.Espino@gre.ac.uk
apple.espino@rothamsted.ac.uk