Application of ASCA to characterise effects of roasting temperature, -time and milling method on SWIR spectral data of whole and milled wheat

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INTRODUCTION

- Dry thermal treatment to modify wheat starch has been increasingly investigated (Ma et al., 2021).
- Structural changes of starch in heat treated wheat affects the molecular order, pasting properties, and retrogradation (Van Rooyen et al., 2022).
- Analysis of variance simultaneous component analysis (ASCA) partitions variation and interprets these partitions with SCA (Smilde et al., 2005).

AIM

Characterisation of wheat modification during roasting and milling of wheat kernels using SWIR spectroscopy and multivariate data analysis

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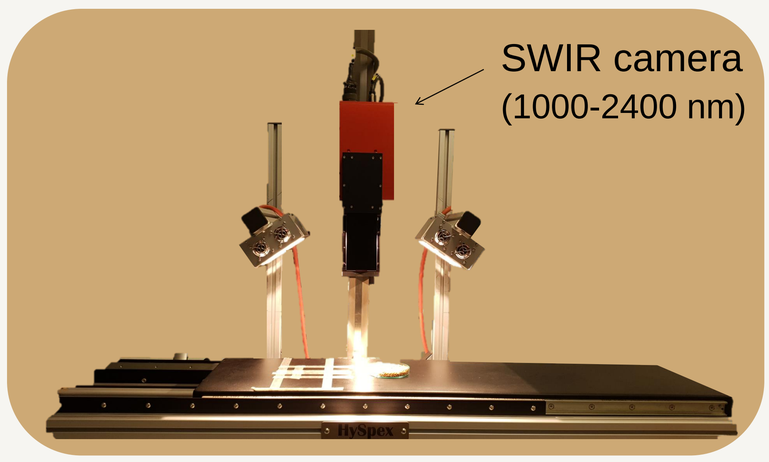
MATERIALS AND METHODS

1. The experimental design included three roasting temperatures (90°C, 115°C, 140°C), three roasting speeds (47 Hz, 65 Hz, 83 Hz) and two milling methods (Perten and Quadrumat).
2. SWIR spectral images were collected from roasted wheat and milled samples.
3. ASCA was used to assess statistical significance and characterisation of the contributing spectral features.



RESULTS & DISCUSSION

Table 1: 'Roasting temperature' and 'milling method' had significant effects ($p<0.05$) on the samples. High temperature significantly affected starch (i.e. partial gelatinisation) and protein (i.e. denaturation). Intermediate temperature affected starch and moisture more compared to low temperature. 'Roasting time' could have notable effect in practice ($p=0.06$). **Figure 1:** The most prominent difference between the two milling methods was observed as changes in starch, protein, moisture (Quadrumat) and fibre (Perten).

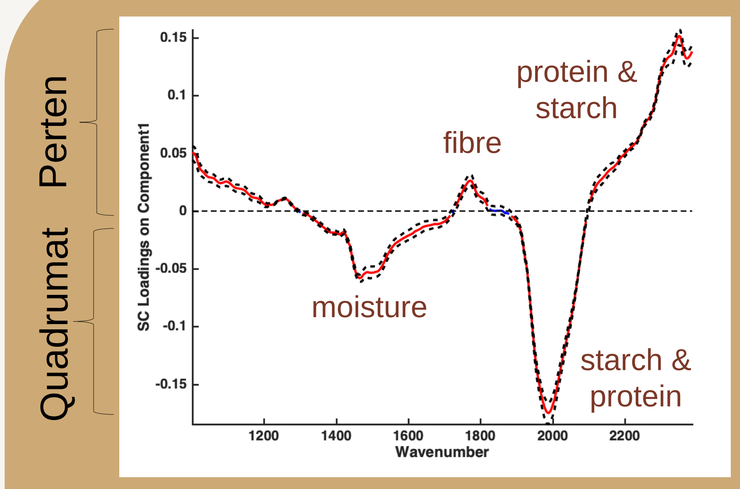
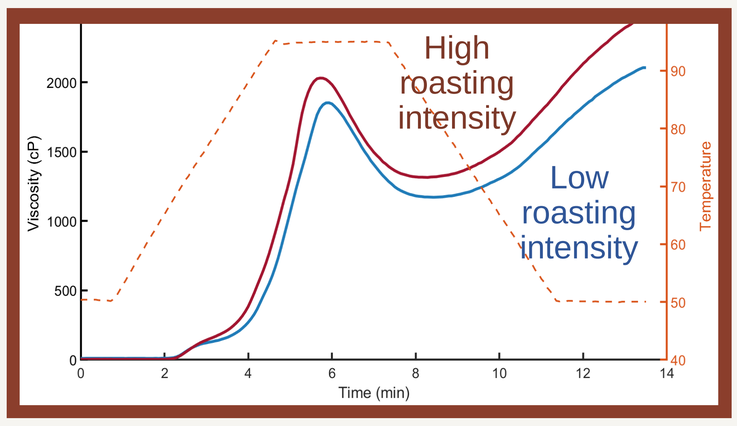


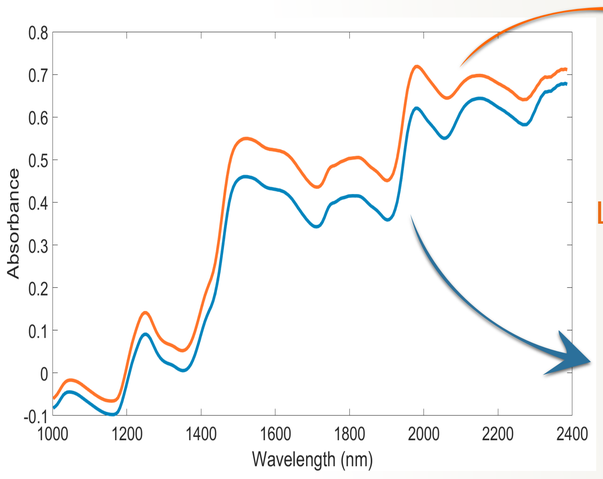
Figure 1 Loadings plot showing significant effects of milling method on SWIR spectral data

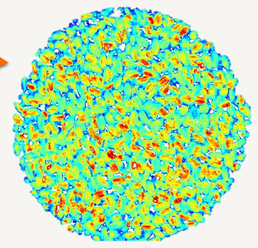
Table 1 Significant effect of roasting temperature on SWIR spectra

Wavelength (nm)	Bond vibration	Chemical structure
High temperature		
2000	C-O	Starch
2242	N-H, NH_3^+	Protein
2252, 2276	O-H, C-C	Starch
2294	N-H, C=O	Protein
Intermediate temperature		
1450, 1480, 1528, 1540	O-H str. 1st overtone	Starch, water

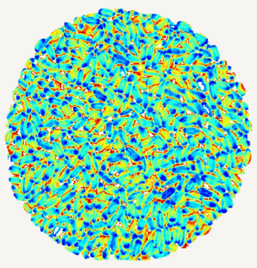
Confirmed protein denaturation and starch gelatinisation by increased RVA viscosities







Low roasting intensity



High roasting intensity

CONCLUSION

- ASCA applied to SWIR whole wheat and flour spectral data effectively characterised the effect of roasting on wheat properties.
- Significant differences in wheat starch and protein structures were observed.

ACKNOWLEDGEMENTS:

- H2020 MSCA RISE Consortium 'SuChAQuality' (Grant agreement: 101008228) funded by the EU
- Harry Crossley scholarship
- SU postgraduate scholarship

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