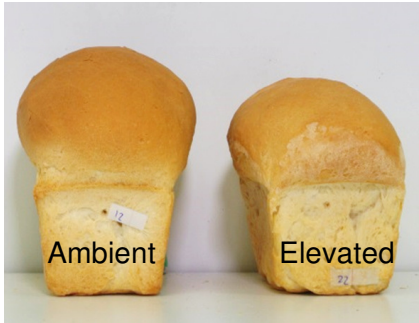


An empirical model of wheat baking quality under elevated CO₂

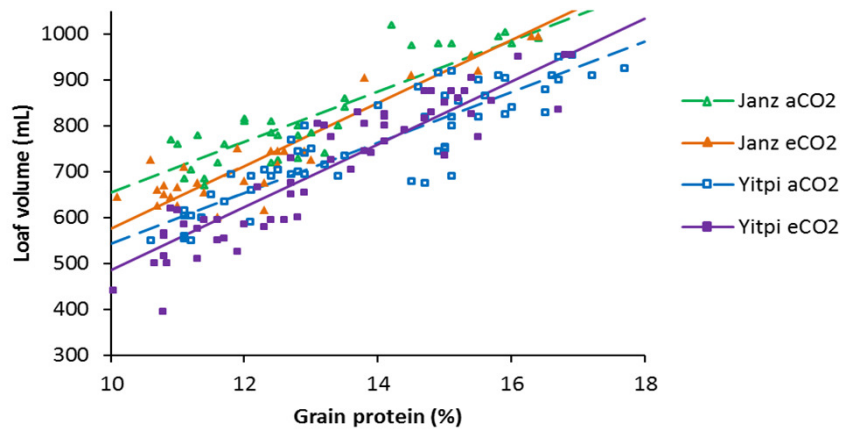
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Elevated CO₂ (eCO₂) is associated with lower grain protein concentration for wheat, and an inferior baking quality. To extend the functionality of process-based models of wheat growth and nitrogen uptake, an empirical model for bread making quality (loaf volume) was developed from five years of data from the free air carbon dioxide enrichment experiment at Horsham, Victoria, for three bread-wheat cultivars – Janz, Silverstar and Yitpi.

Results

- A regression-based model accounted for 82% of variation in loaf volume.
- Significant terms were grain protein concentration, eCO₂, cultivar and a cultivar x eCO₂ interaction.
- At a given protein concentration and CO₂ level, Janz and Silverstar both had loaf volumes over 100 cm³ larger than Yitpi.
- Fewer samples met the current minimum grain protein percentage (13%) for acceptance into the hard-wheat H1 pool under eCO₂.
- The greatest impact of eCO₂ on acceptance into H1 pool was on Silverstar.



Relationship between grain protein concentration and loaf volume for cultivars Janz and Yitpi under ambient (aCO₂) and elevated CO₂ (eCO₂).

Summary of the percentage of cases satisfying the minimum grain protein (GP) level (13%) for the H1 hard wheat pool under ambient (aCO₂) and elevated CO₂ (eCO₂), mean GP concentration, loaf volume predicted at a GP concentration of 13%, standard errors of differences (SED) and the statistical probability level of significance (P).

Cultivar	n	Percentage of samples in H1 hard wheat pool		Grain protein concentration (%)			P	Loaf volume (cm ³)			P
		aCO ₂	eCO ₂	aCO ₂	eCO ₂	SED		aCO ₂	eCO ₂	SED	
Janz	75	76	62	13.57	13.14	0.15	< 0.01	820	780	13	<0.01
Silverstar	43	64	24	12.09	11.53	0.01	<0.001	830	840	16	ns
Yitpi	118	81	71	13.98	13.33	0.13	<0.001	710	690	10	<0.1

If grain receival thresholds were instead cultivar dependent (based on comparable loaf volumes), this may provide an incentive for growers and breeders to select cultivars for improved baking quality at a given protein concentration as CO₂ levels increase.

Additional research is required to move from this empirical model to more mechanistic models of grain quality so that the impact and potential adaptation strategies throughout Australia are better understood.

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