



Development of ultra-low-gluten barley

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Food Futures Flagship

www.csiro.au



Gluten-free food and beverage



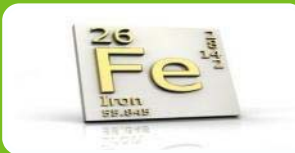
Coeliac disease requires a life-long gluten-free diet for 70 million people globally



The gluten free market is 5-10X larger

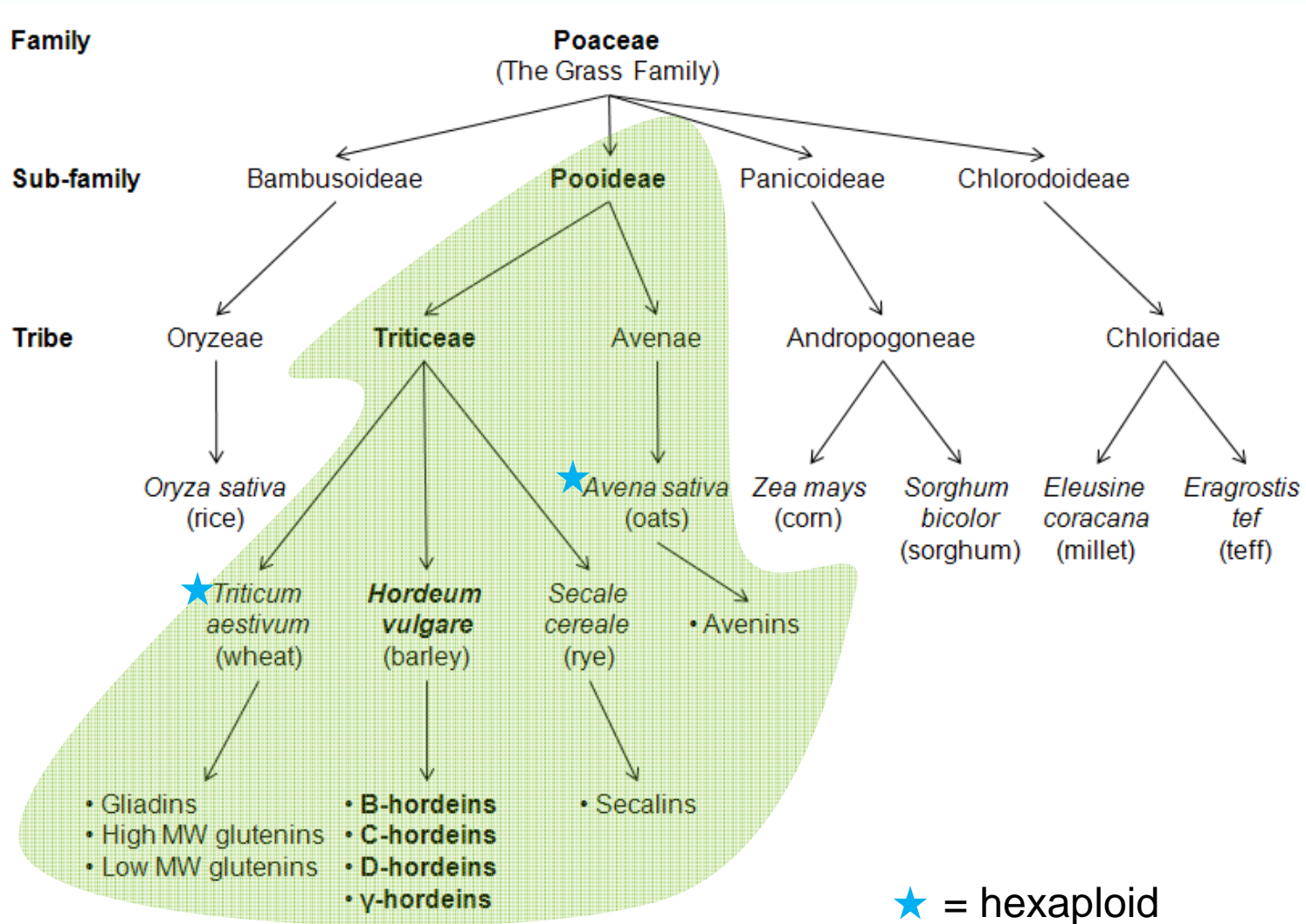


Worldwide market for gluten-free products is US \$6.2 billion and predicted to grow at over 10% p.a.

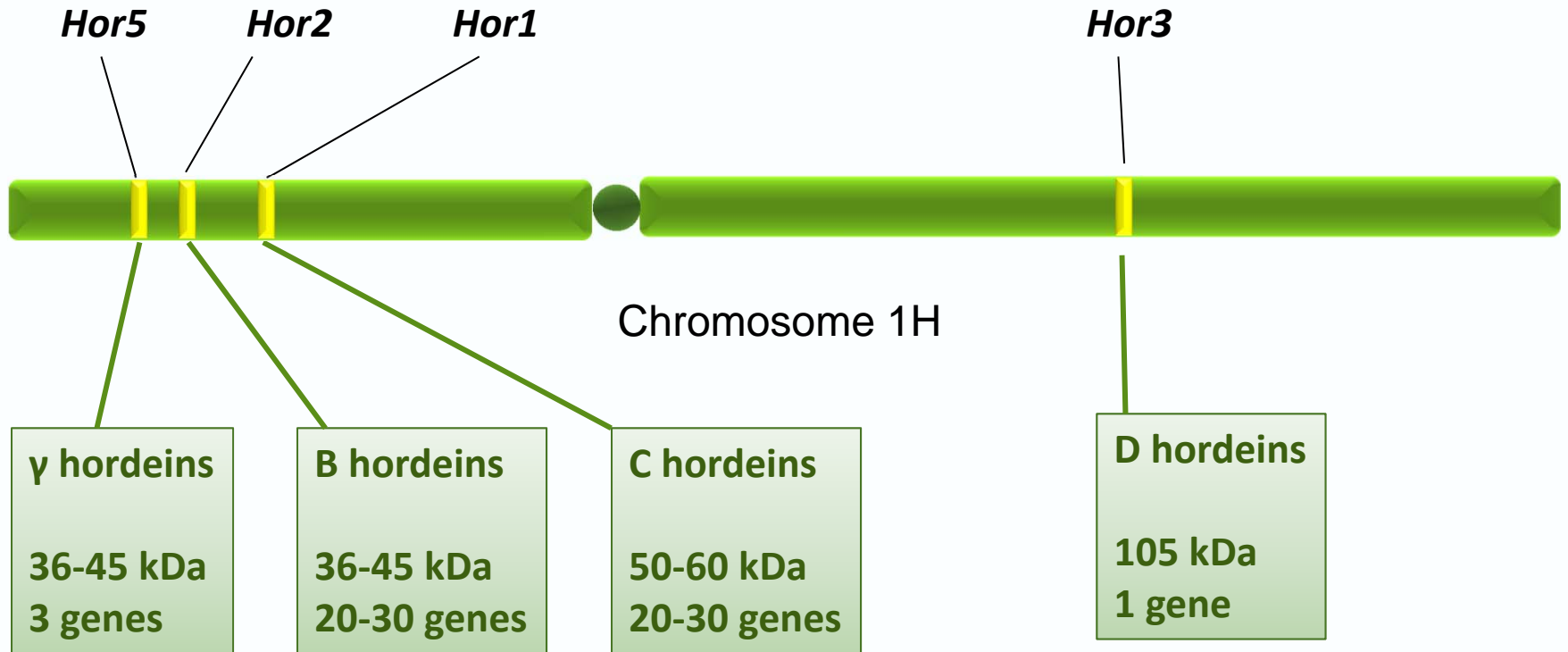


Growing recognition that gluten-free foods are poor in B vitamins, Fe and fibre

Gluten Containing Cereals

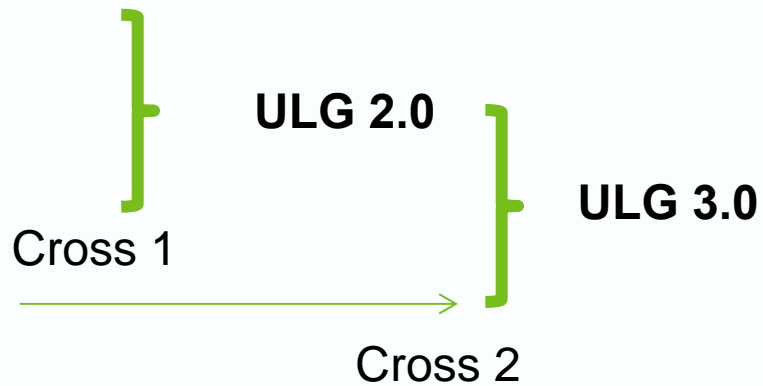


Hordein loci



ULG Barley – The Strategy

Hordein Class	Amount	Mutant
B	65-70 %	✓
C	25-30 %	✓
D	2-5 %	✓
γ	1%	✗



ULG Barley – Questions

Can these be combined to create a ULG barley?

How low can the gluten content go?

Are the plants viable?

If so, are they suitable for traditional products?



Development of ULG Barley



Sloop

~50,000 ppm
Grain 53 mg



ULG 2.0
June 2006

~1,600 ppm
Grain 33 mg

ULG 3.0
June 2009

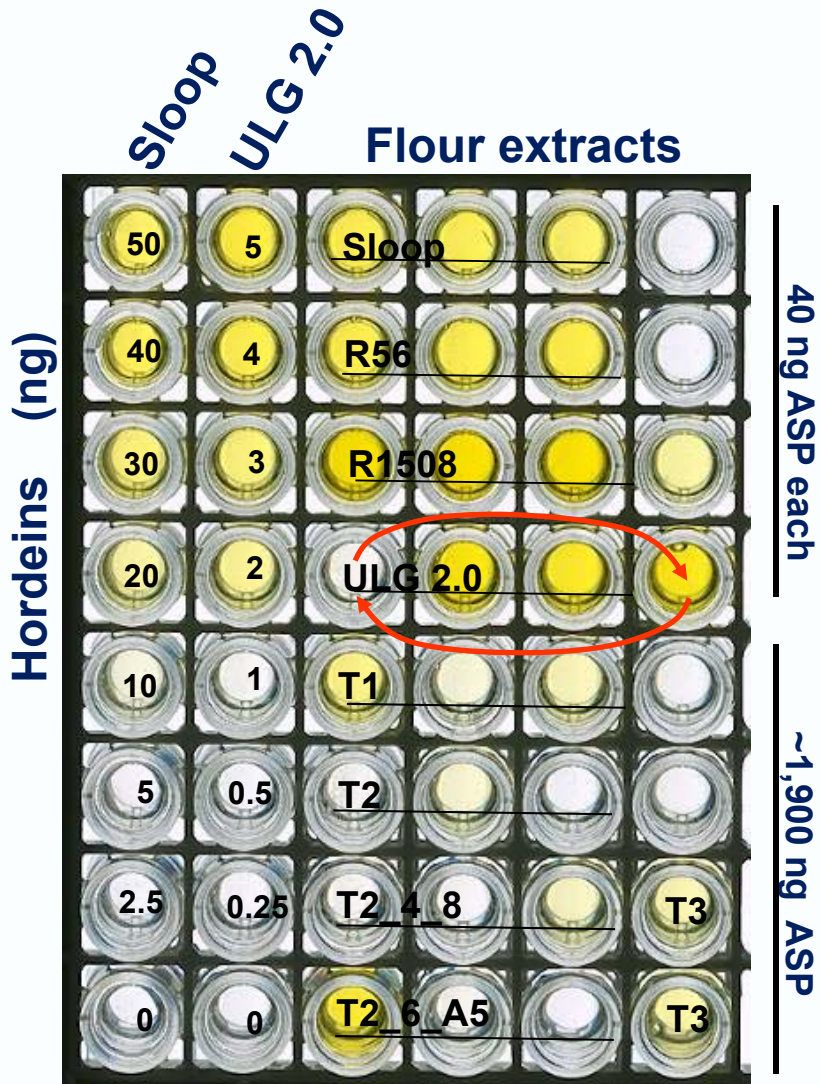
~4 ppm
Grain 42 mg

Unexpected suppression of γ -hordeins

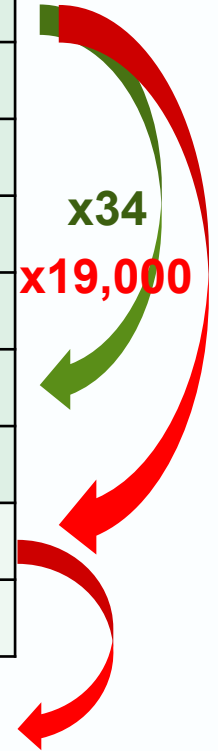
ULG 3.2
June 2012

<4 ppm
Grain 48 mg

ELISA determination of hordein

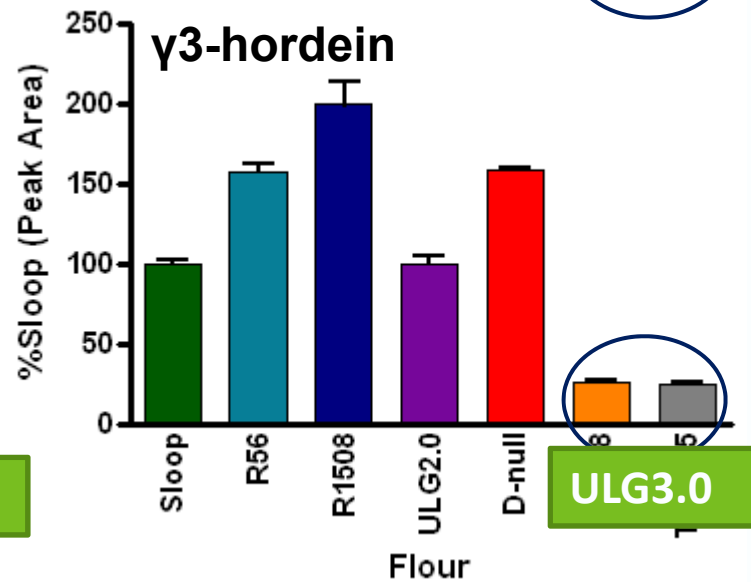
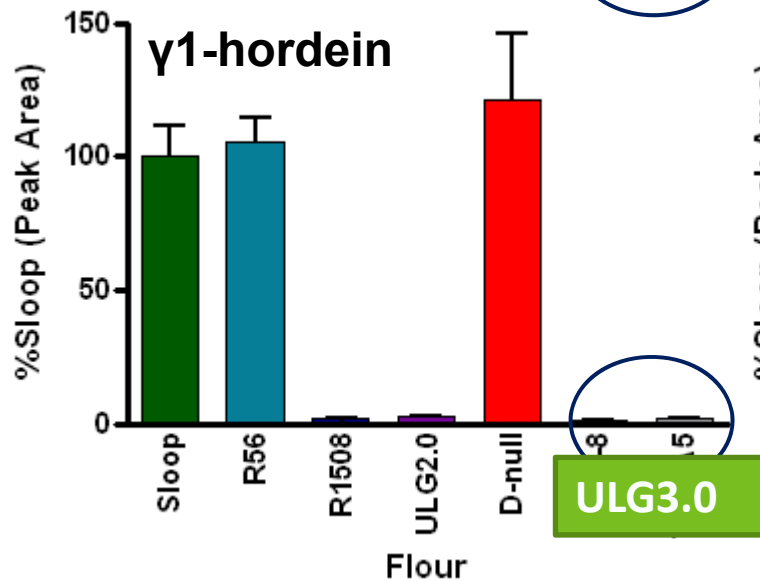
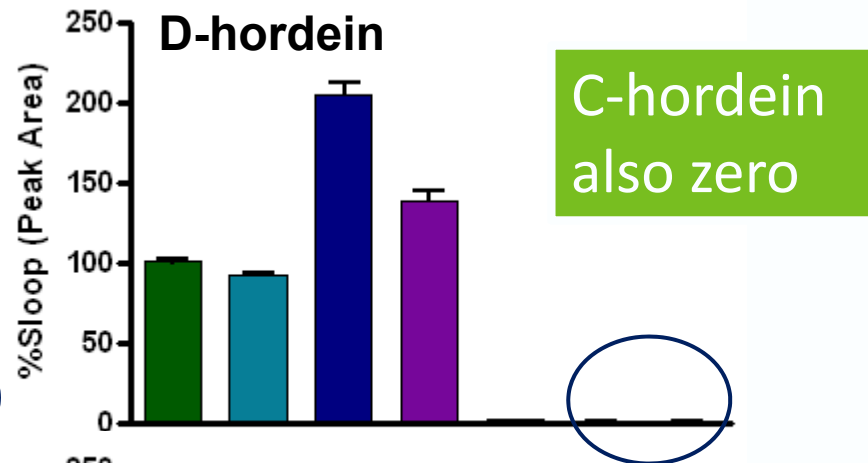
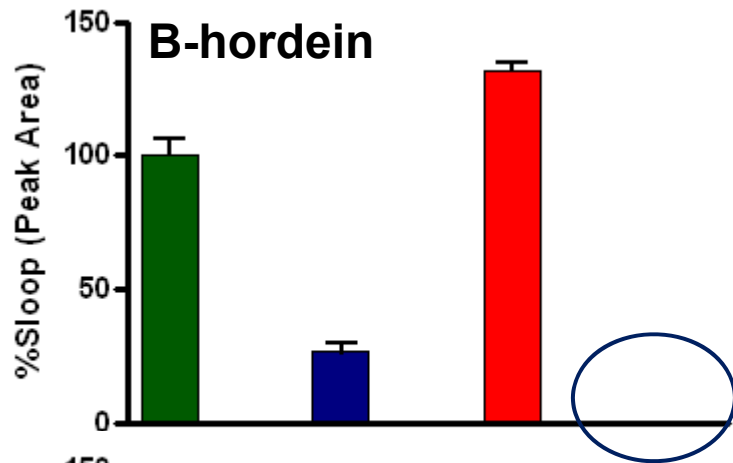


Line	mg Hordein/ gm flour
Sloop	56.6 ± 3.3
R56	33.3 ± 1.1
R1508	4.9 ± 0.26
ULG 2.0	1.67 ± 0.07
ULG 3.0	0.0039 ± 0.0017
T2_6_A5	0.0015 ± 0.0004



ULG 3.0 ~4 ppm in flour

Mass Spec. analysis of ULG3.0 flour



Brewing Trial VLB - Tasting results

Characteristic	Standard	ULG
Smell	4.8	4.2
Taste	4.3	4.1
Full Body / Mouth Feel	4.5	4.2
Sparkling Quality	4.7	4.7
Quality of Bitterness	4.9	4.5
Off Flavours	-	-
Smell	Bloomy	Fruity
Taste		Slight Diacetyl Less Body

Brewing Summary - Drawbacks

- Small grain size impacts performance
 - Poor sorting
 - Low extract yield
 - Low brewing yield
 - Low apparent final attenuation
- Improving grain size is likely to overcome these
- Haze in beer impacts filtration, but can be removed

Brewing Summary - Positives

- Despite limitations of grain size positive features were seen
 - High FAN (use as adjunct)
 - Extremely low β -glucan (confirmed in grain)
 - Good cytosolic modification
 - Malting at lower moisture content
 - Easy lautering
- Gluten content is very low
- Sensory qualities were similar to control

ULG Barley Conclusions

- Production of ULG barley is viable
- Gluten content is below 10 ppm
- Small grain size impacts some brewing parameters
- Other brewing parameters are equivalent to standard malting barleys
- Versions with larger grains have been developed



Next Steps

- We continue to work with partners to understand
 - the brewing characteristics,
 - the opportunity for an ultra low gluten beer
 - we are happy to discuss the opportunity with you
- Samples of ULG 3.0 available
- Small scale field trials of ULG 3.2 in 2014.
- We are also interested in exploring ultra low gluten barley food applications to address the low fibre in celiac diets

Acknowledgments

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VLB

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Thank you

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