AWRI

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Recent development in removing protein haze from white wines

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Wine Haze

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Wine Haze is caused by…

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Protein aggregation...

With sulfate

+ Polysaccharides

+ Phenolics

+ Organic acids

...and more...!

Haze-forming proteins

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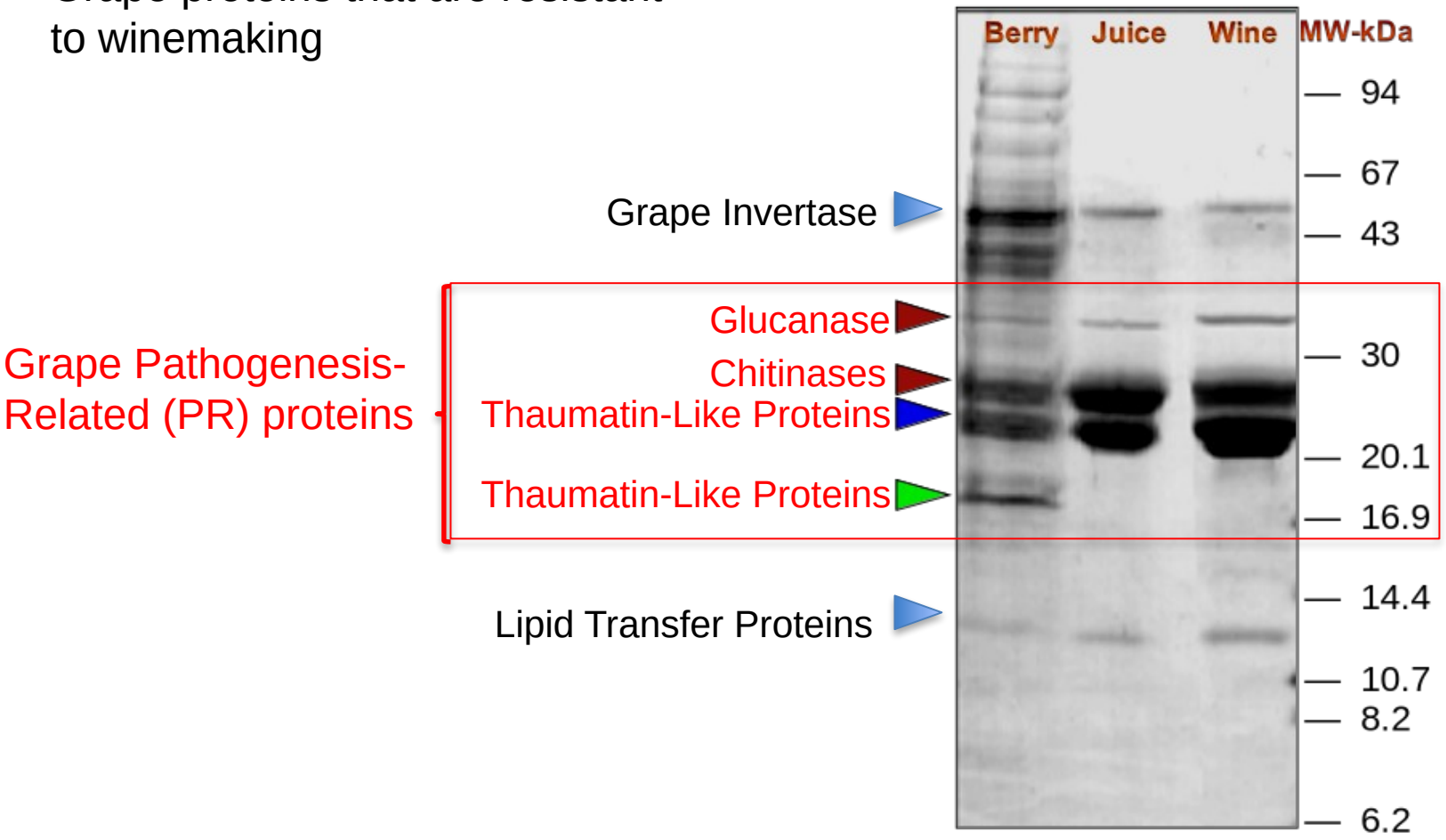
Grape proteins that are resistant to winemaking



Haze-forming proteins

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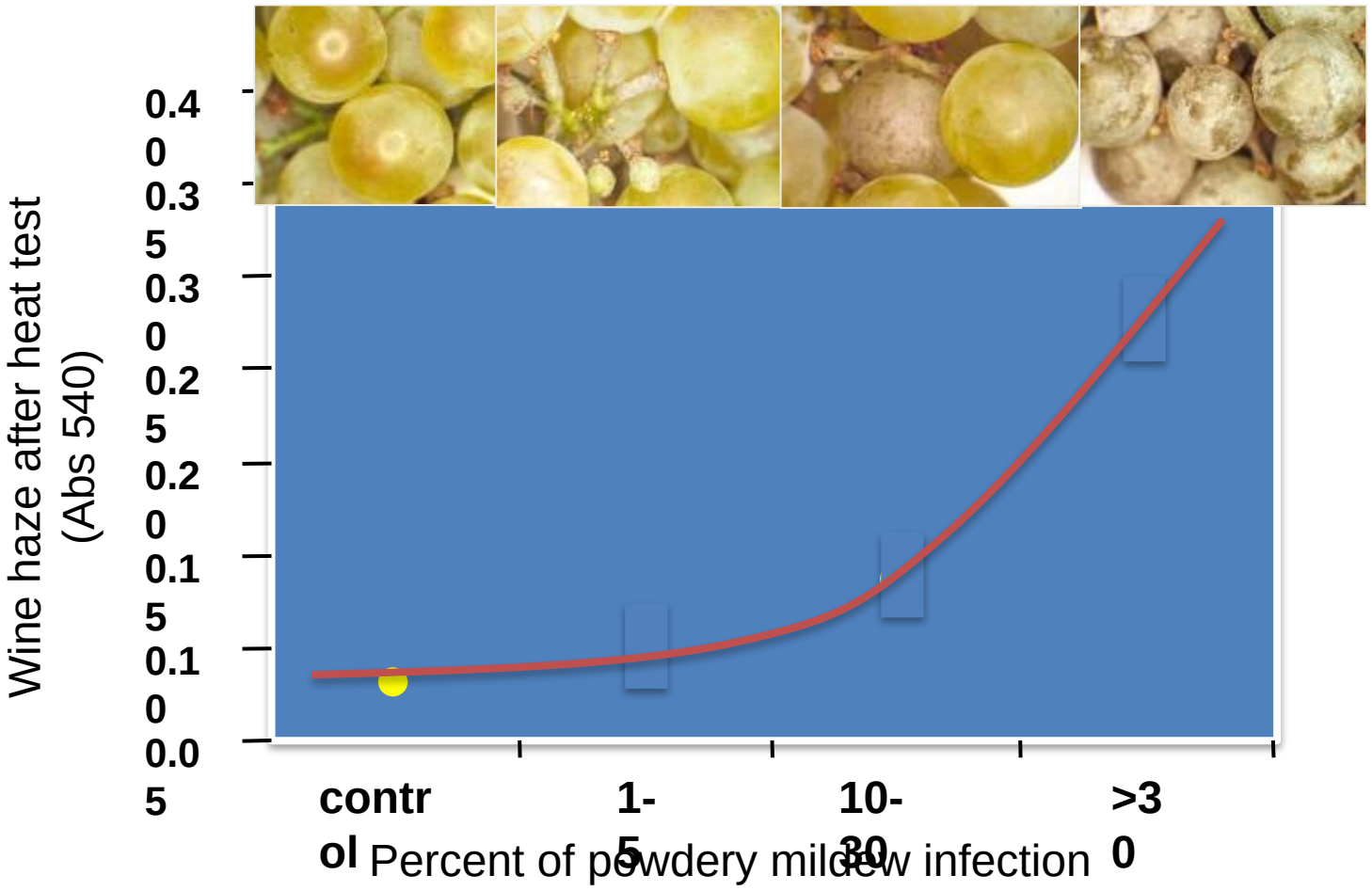
Grape Pathogenis-Related (PR) proteins increase in concentration with infection



Girbau, Stummer, Pocock, Baldock Scott and Waters, AJGWR 2004

Bentonite…

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Bentonite: the good

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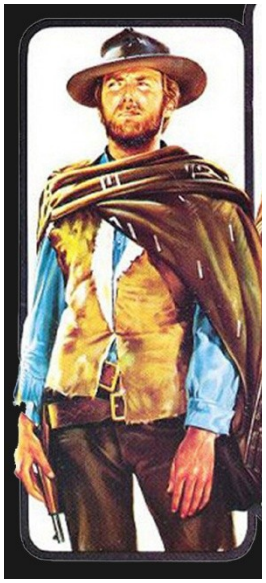
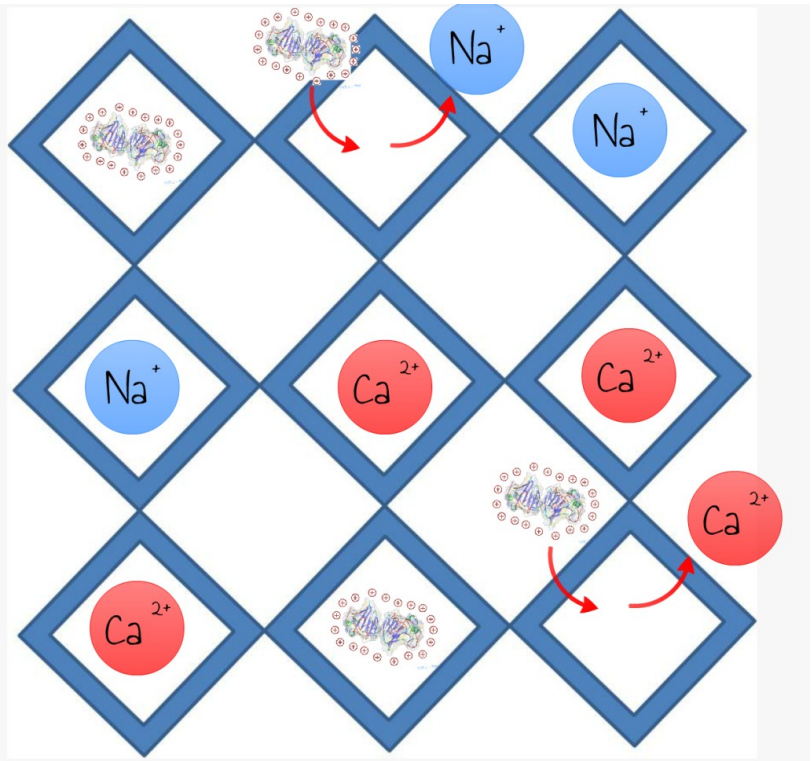


- ✓ Cheap
- ✓ Readily available
- ✓ Easy to use
- ✓ Non-toxic

Effective mechanism:



Bentonite: the bad

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- X Non-selective
- X Extra processing steps:
  - water addition
  - settling time
  - waste removal
- X Bad press...?

Daily Mail AUSTRALIA

Wine taste funny? It may contain cat litter... Malcolm Gluck reveals the unpalatable truth about the wine industry

Updated: 02:28 AEST, 28 September 2008

http://www.dailymail.co.uk/news/article-1063029/Wine-taste-funny-It-contain-cat-litter--Malcolm-Gluck-reveals-unpalatable-truth-wine-industry.html

Bentonite: the bad

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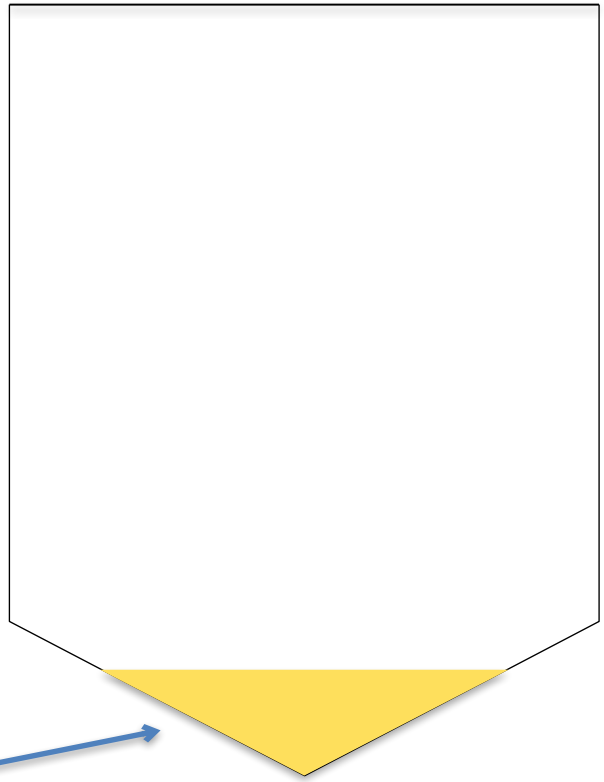

$1 Billion wasted worldwide

Majewski, P.; Barbalet, A.; Waters, E. J. *The Australian & New Zealand Grapegrower & Winemaker* **2011**, 58–62.

Bentonite: making the most of it

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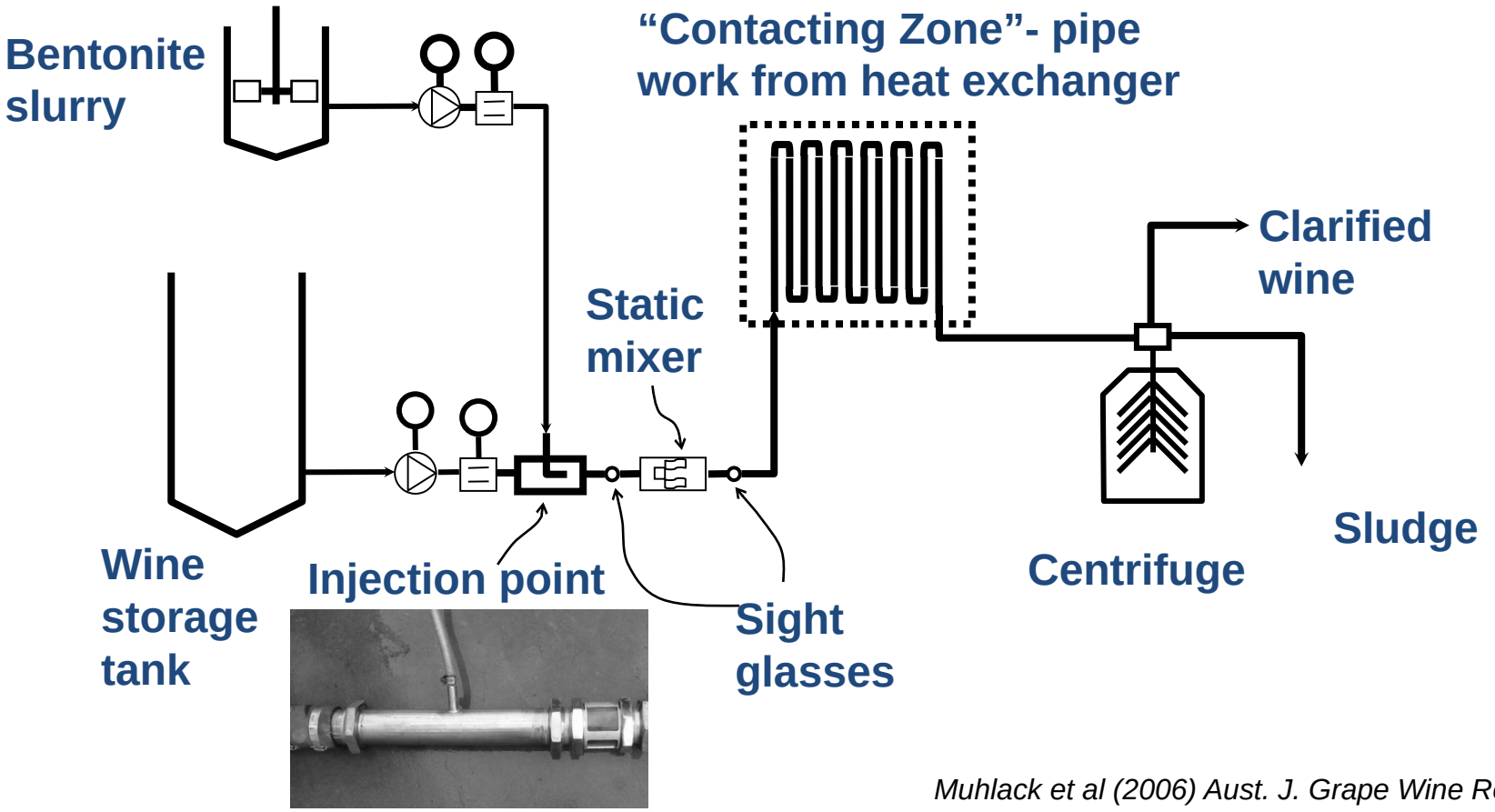
Inline dosing with centrifugation

Proof of concept



Muhlack et al (2006) Aust. J. Grape Wine Res. 12, 221-234

Bentonite: making the most of it

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WINE: 100 KL

Bentonite: the **crazy** alternatives

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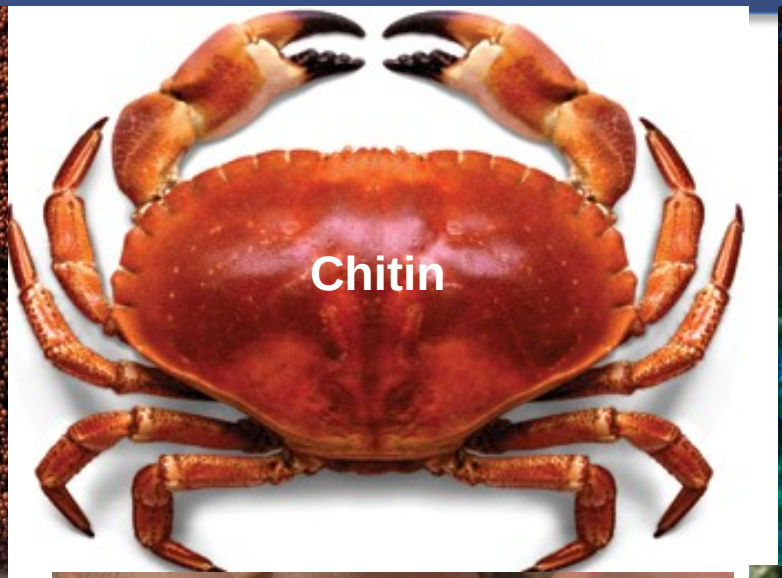
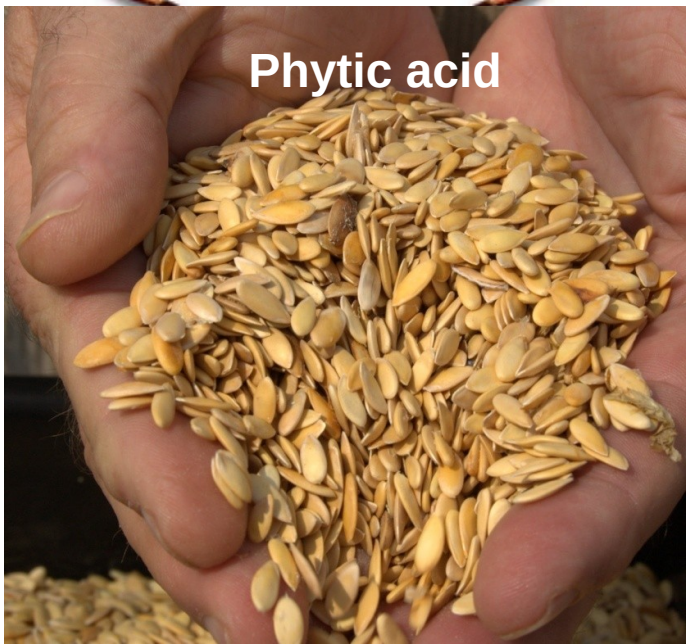
Criteria for bentonite alternatives:

- Better settling – less waste
- More efficient – use less material
- More selective
- Cost effective
- No flavour taint

Bentonite: the **crazy** alternatives

The Australian Wine Research Institute

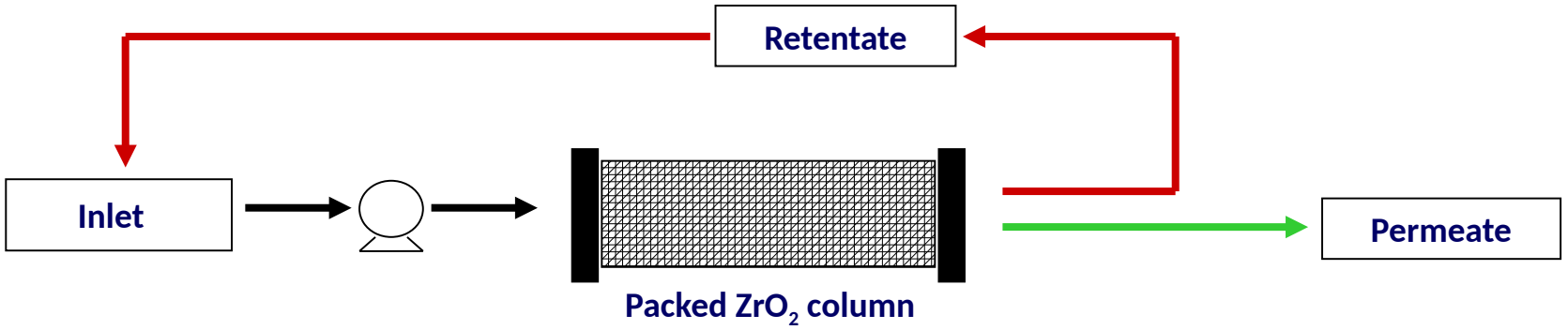




Zirconia - Fast Facts:

- Low corrosion potential
- Low thermal conductivity and hardness
- High thermal and mechanical resistances

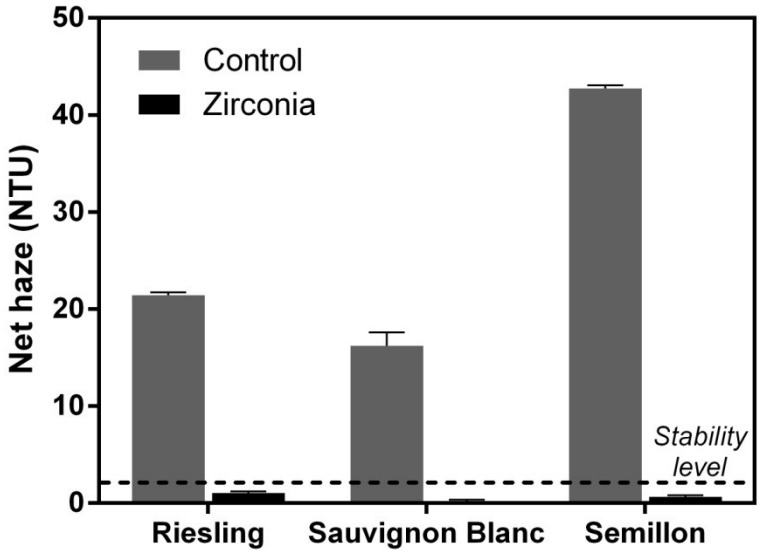
Proof of concept:



- ✓ Selectively removes protein (with low flow rates)
- ✓ Can be regenerated (at 500ºC for 12 h)

Pashova et al., 2004. J. Agric. Food Chem., 52: 1558-1563. Salazar et al., 2006 J. Agric Food Chem 54: 9955-9958

Batch addition of zirconia to model ferments



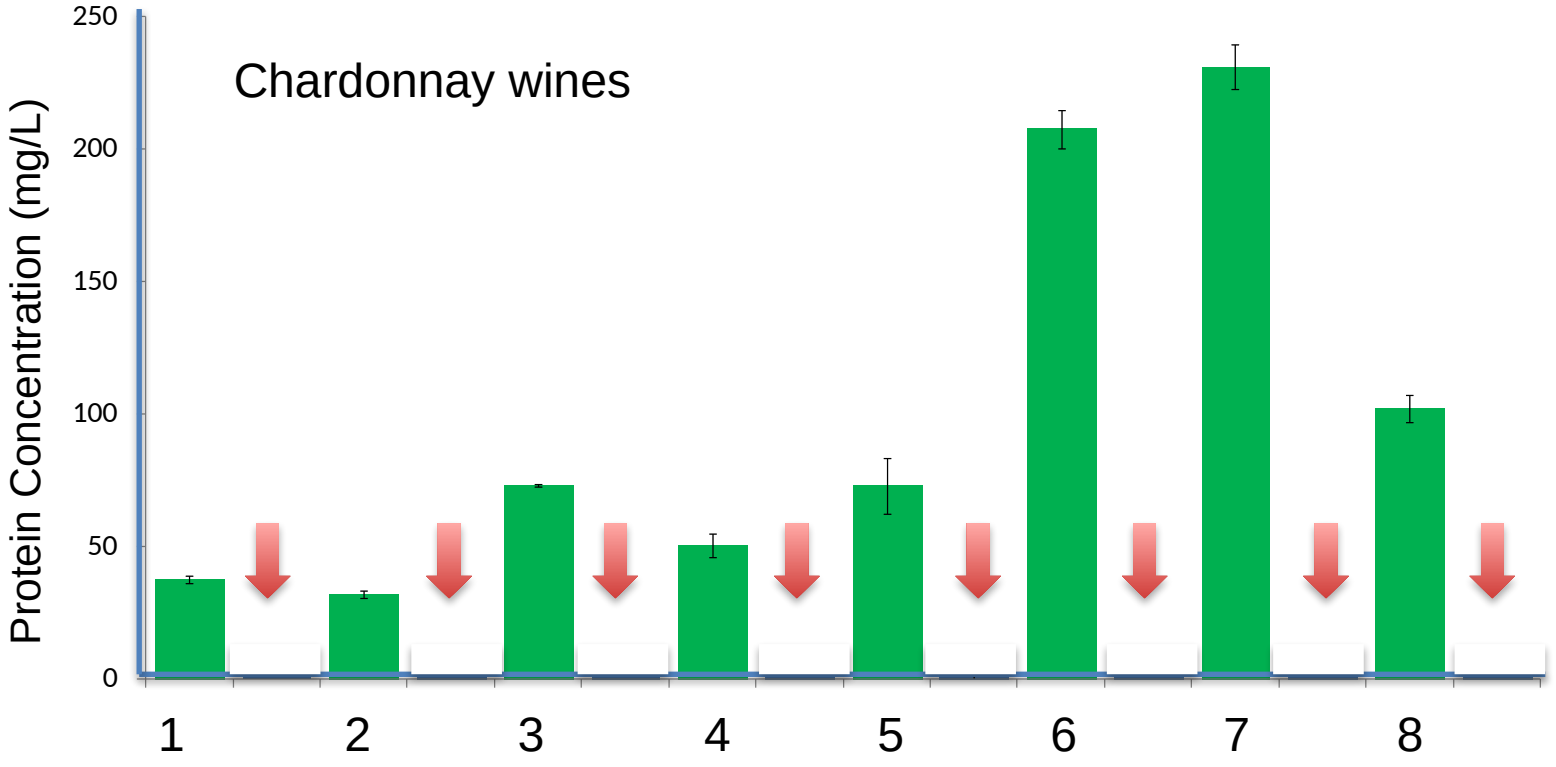
- ✓ Easy to regenerate (wash with NaOH)
- ✓ Produces heat stable wines
- ✓ No lees production

Lucchetta et al., AJEV, 2013, 64: 400-404

Carrageenan - Fast Facts:

- Cell wall hydrocolloid extracted from red seaweeds
- Used in beer for protein stabilization and copper fining
- Negatively charged at low pH

Proof of concept



✓Removes grape and wine proteins

✓Low sensory and chemical impacts on treated wines

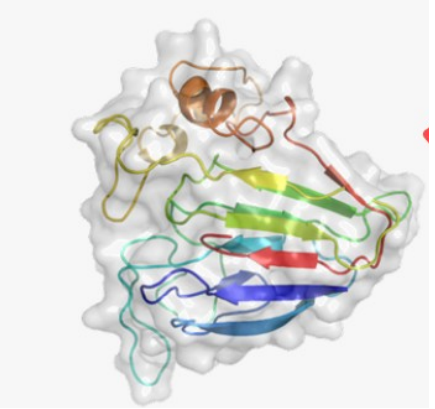
Cabello-Pasini et al., AJEV 2005; Marangon et al., 2012, AJGWR, 18 (2), 194-202.

Adsorbent resins:

- New polymers are being developed that are specific for haze-forming proteins in wine

Stage 1: Know your target

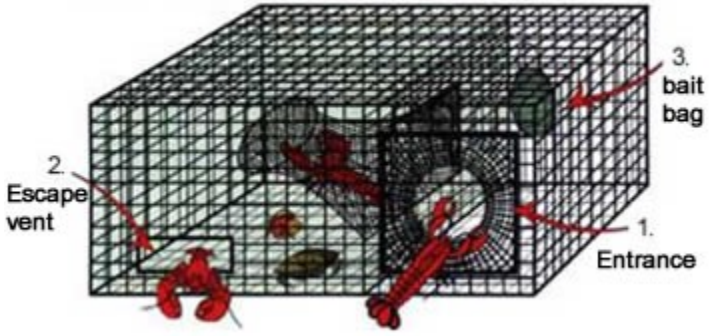
X-Ray Crystallography at the Australian Synchrotron to determine the structure of wine proteins



Stage 2: Build a custom-designed protein-targeting polymer

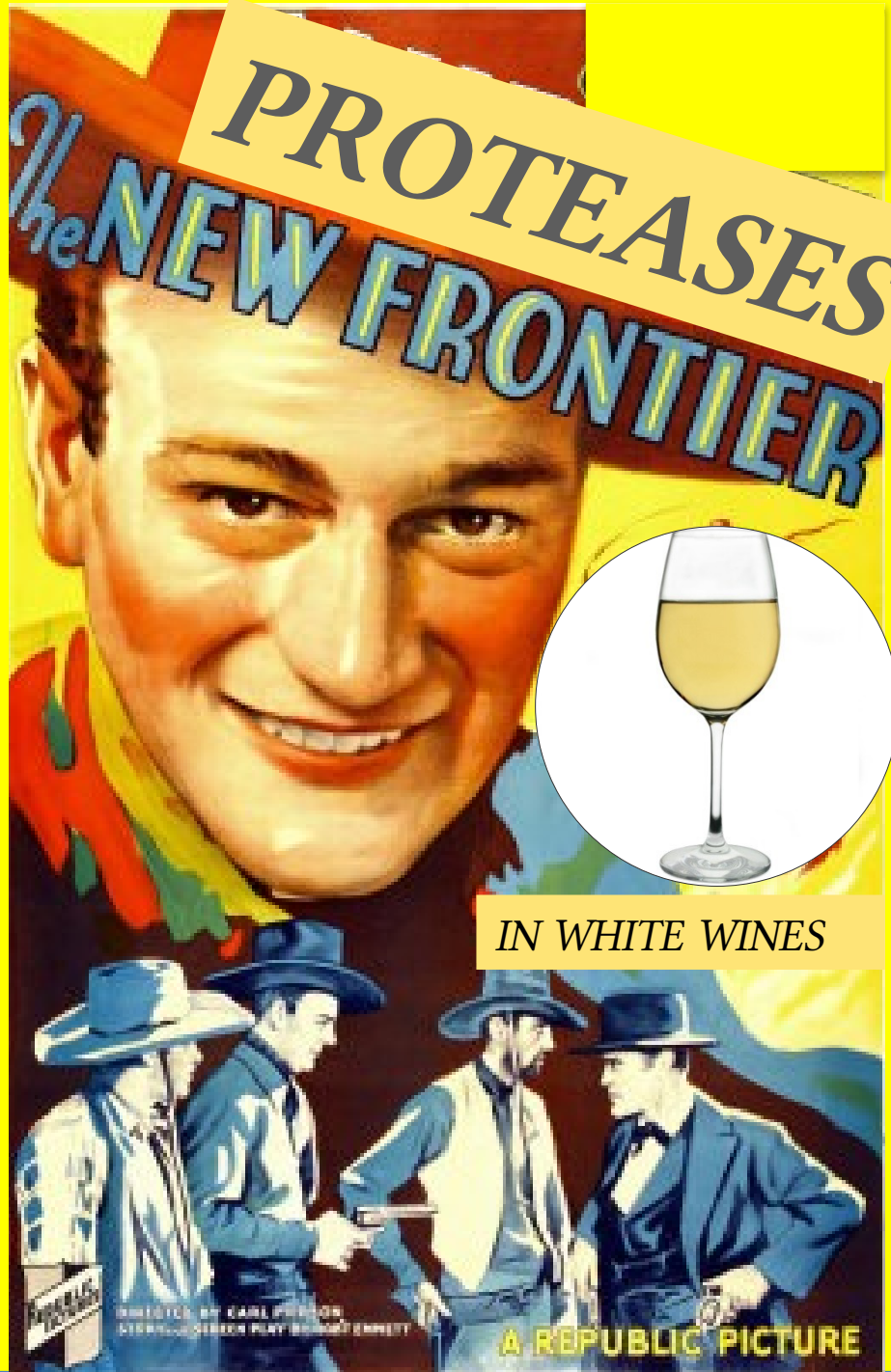
Criteria:

- Tolerate wine-like conditions
- Renewable/recoverable
- Precipitate with less lees or fit readily into inline systems
- Approved for food-grade applications



www.calendarislandsmainelobster.com

PROTEASES



IN WHITE WINES

Proteases

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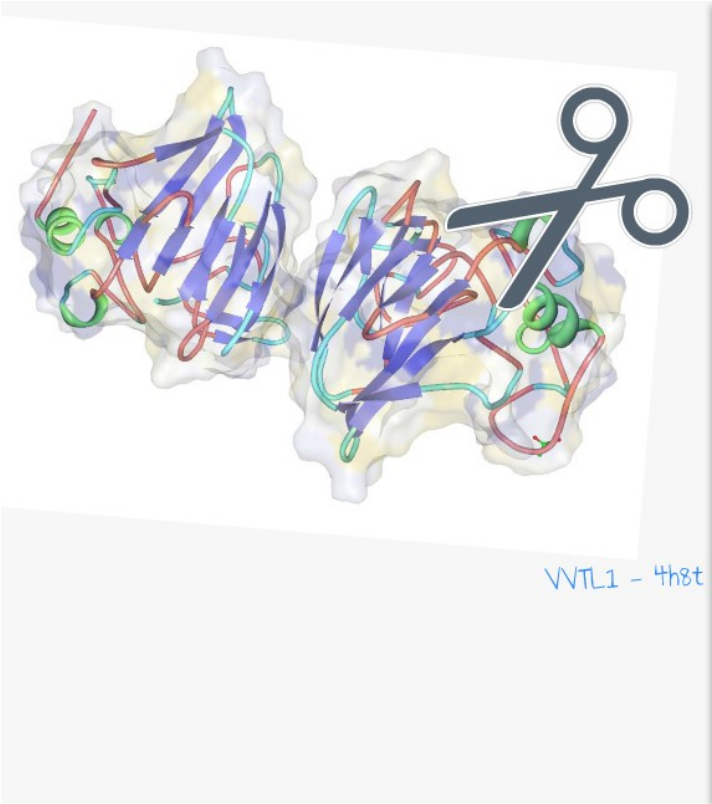
Grape proteins are globular → resistant to proteases



…but

proteases CAN work when proteins are in unfolded status

Proteases

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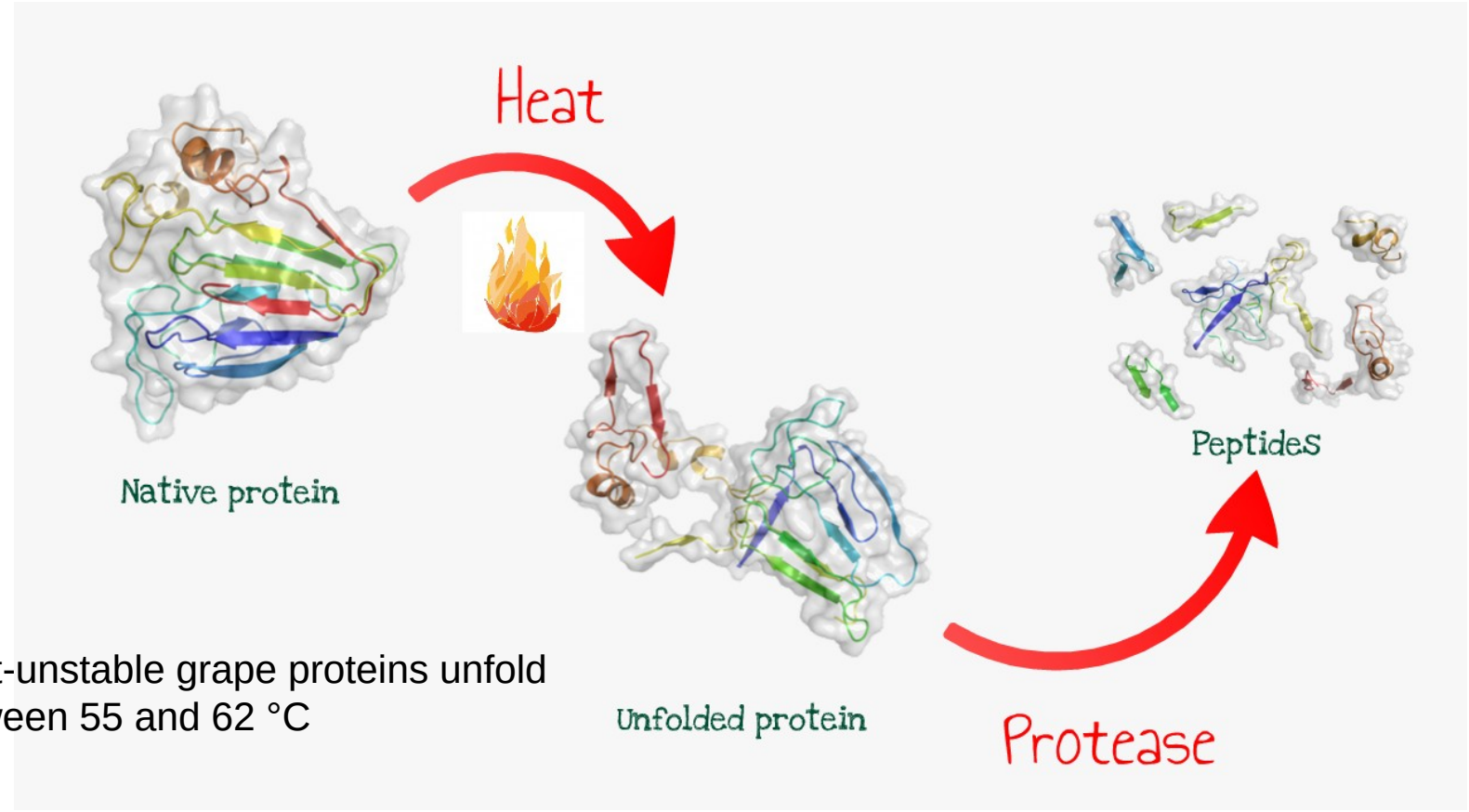

Heat-unstable grape proteins unfold between 55 and 62 °C

A suitable protease needs to be active at these elevated temperatures

Protease 1: Aspergillopepsin

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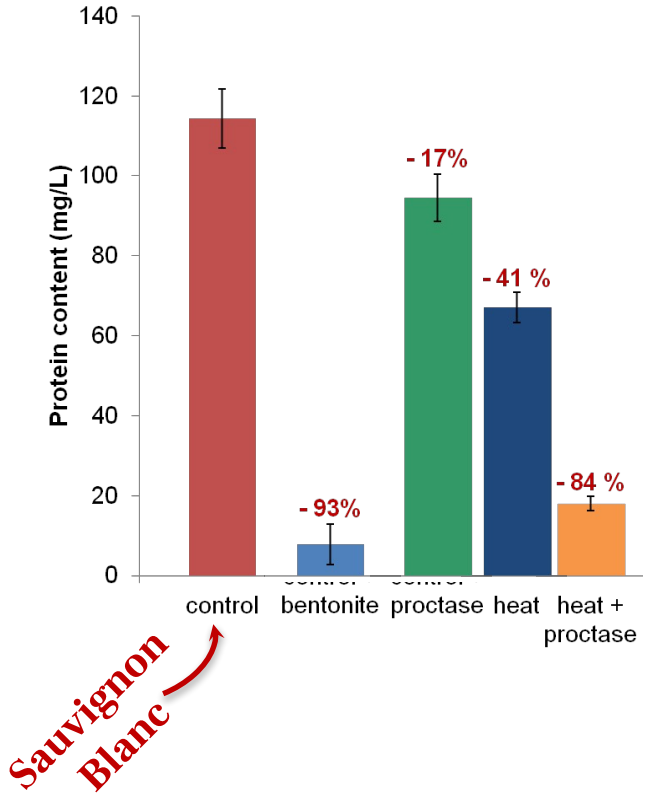
Aspergillopepsin (Proctase) - Fast Facts:

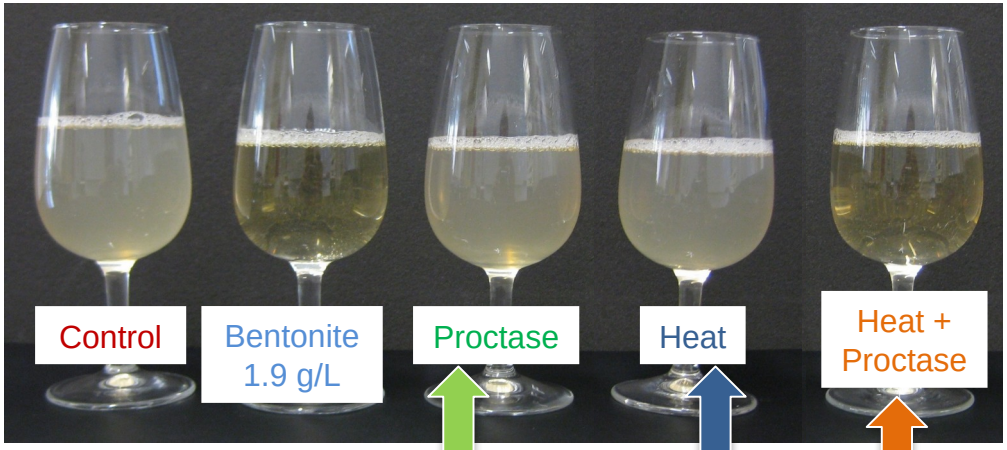
- Inexpensive food grade proteolytic enzyme
- Active at acidic pH and high temperatures (50-70 °C)

Successful pilot trial: Flash pasteurisation + protease

Conditions: Juice flash pasteurisation (1 min @ 70°C) with/without 15 mg/L Proctase



Heat test results



Still need 1.5 g/L Bentonite

Only needs 0.2 g/L Bentonite

Marangon et al., Food Chemistry 135 (2012) 1157–1165

Protease 1: Aspergillopepsin

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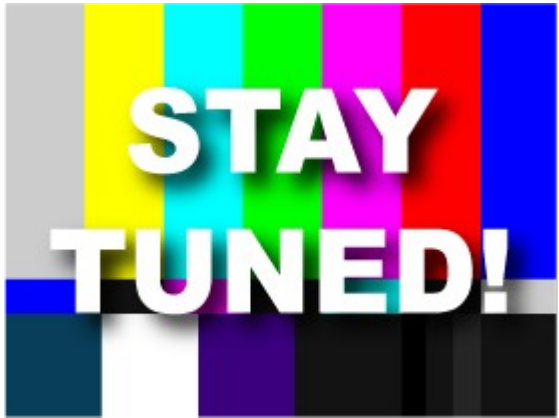
- ✓ Selectively removes the majority of haze-forming proteins from wine
- ✓ Cost effective:
  - Significant reduction in the amount of bentonite required
  - Substantially less lees
- ✓ Commercially available

X Requires juice to be heated

X Requires specialized equipment

Currently waiting on approval for use in winemaking...



Protease 2: BcAp8

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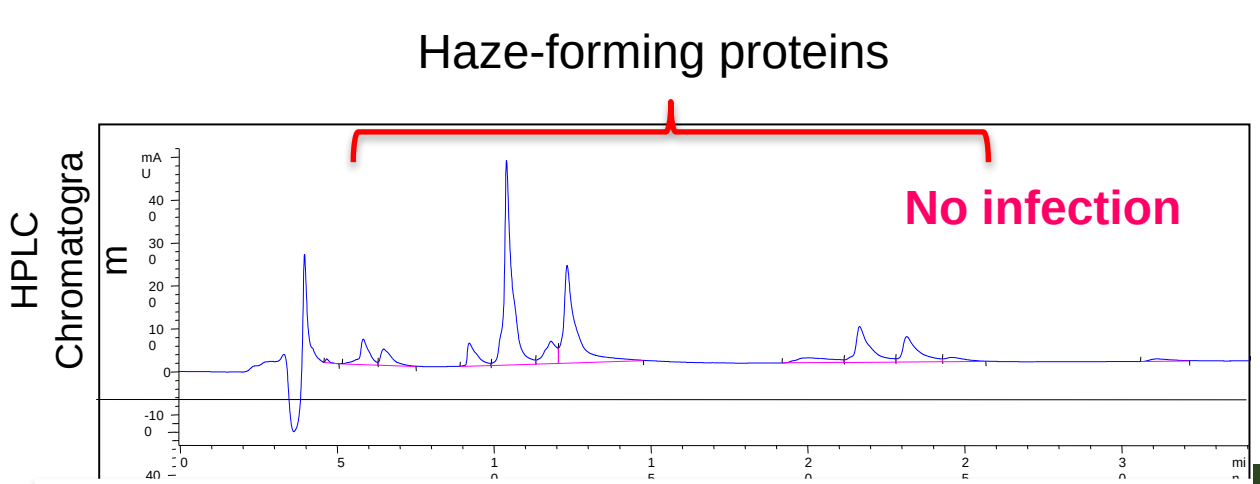

Girbau, Stummer, Pocock, Baldock Scott and Waters, AJGWR 2004

Protease 2: BcAp8

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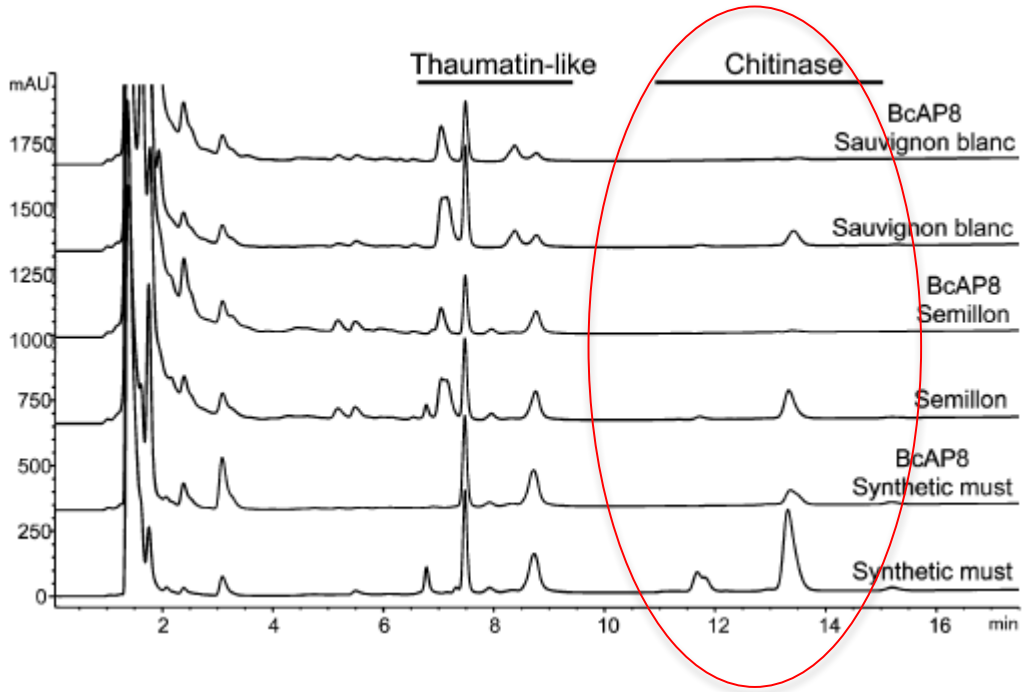
Small scale proof of concept:

Addition of BcAP8 to juice prior to inoculation.

✓ After 3 weeks at 22°C, significant decrease in concentration of chitinase



➢ Trials are continuing to confirm that this relates to wine stability

Van Sluyter et al., Journal of Agricultural and Food Chemistry, 2013, 61: 9705-9711

New and improved proteases

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The search is continuing for enzymes that degrade proteins in winemaking conditions

The next big thing?

MACQUARIE UNIVERSITY

Summary

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Recent developments in wine stability:

1. Improve bentonite efficiency
   - Inline dosing
   - Centrifugation and wine recovery from lees

2. Alternative protein adsorbents
   - Zirconia – trials continuing to ensure long-term stability
   - Carrageenan – trials continuing to ensure long-term stability
   - New protein-targeting polymers – to be developed

3. Proteases to degrade haze-forming proteins
   - Aspergillopepsin (Proctase) – Requires flash pasteurization, approval for wine addition
   - BcAP8 – Works in winemaking conditions – trials are continuing for proof of concept
   - Antartic fungi – Screening continues for enzymes that are effective in winemaking conditions

Acknowledgements

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AWRI

Matteo Marangon

Paul Smith

Liz Waters

Ken Pocock

Simon Schmidt

Ella Robinson

TREASURY WINE ESTATES

Vanessa Stockdale

MACQUARIE UNIVERSITY

Steve Van Sluyter

GWRDC GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

This work was supported financially by Australia's grapegrowers and winemakers through their investment body the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.