Application of quality measures in winery processing

Opportunities, challenges and roadblocks on the innovation road to achieve best practices in winery processing

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"The missing gap measuring and paying for grape quality"

Alex Sas, HWC, 13 AWITC 2007

- ☑ **Innovative research into grape&wine quality attributes and novel analytical methods**
- ❑ **Lacking practical tools for industry application**

- **No agreement by winemakers on key grape quality attributes that relate to grape value**
- **We don't agree on what, when and how to measure relevant grape and wine quality markers**
- **We don't have an environment that encourages "toolmakers" to participate**

Old & new targets for quality measures by wineries

- **vineyard history**
- **phenological data**
- **vigour, yield**
- **TSS, pH, TA, grape colour**

- sun exposure: quercetin glycosides, skin tannins, anthocyanin composition
- grape & wine tannin
- aroma: methoxypyrazines, terpenoids (wine lactone, rotundone), C_{13}-norisoprenoids (β-damascenone, TDN)
- aroma precusors: GG, cystein-S-conjugates
- YAN, amino acids

- MOG, sunburnt grapes, undersize berries
- Powdery mildew by NIRS
- White wine oxidation in bottle
- VA, H_2S, DMS, 1,8-cineole, smoke taint-guaiacol, "Brett"-4EP, TCA,…..

Roadblock:
too many targets for quality measures?

- too many targets?
- methods too complicated? slow? expensive?
- data rich, but information poor?
- unclear about the benefits?
- cost / benefit of measuring quality parameters?

What to measure?
Focus on absence of negatives

- Sunburnt grapes — **Optical - image analysis**
- MOG
- Undersize berries (chicken&hen, average size)

- Overexposed fruit — **Chemical marker - hyperspectral analysis**
- Powdery mildew
- YAN
- White wine oxidation

- Smoke taint, 1,8-cineole, 4-EP, TCA **GC-MS**

Too many targets for quality measures?

- **Concentrate on what we need - "lean principles"**
  - absence of negatives
  - confirmation of varieties that are in high demand
    (PR proteins by ESI-MS, molecular biology, UV/Vis/NIRS spectroscopy)
  - sourcing of fruit for special purposes & styles

- **Classification models**

  (Gishen et al., Proceedings of the 11 AWITC, 2001)

Quality measures: Grape to wine

- **limited/no agreement by winemakers on key grape quality attributes that relate to grape value*, and wine quality***

- **limited/no agreement agreement from sensory research consumer preferences ⇔ expert quality assessments**

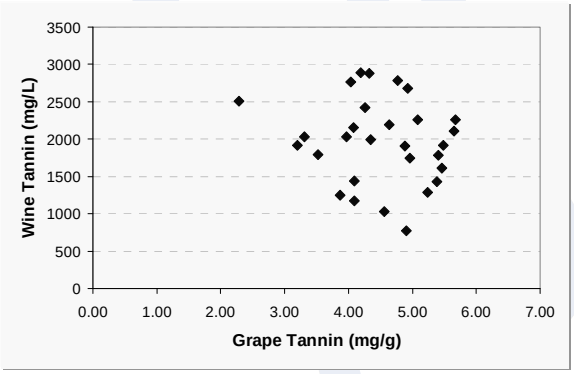
➢ **'quality' means different things to different people**

➢ **challenge:**
link grape parameters (beyond colour) to wine quality

Grape to wine:
linking grape parameters to wine quality

- **research samples ≠ winery samples**
- **winemaking practices are major factor!**

Example: tannins - grape to wine in commercial winemaking



Grape to wine: opportunities

- **No agreement by winemakers on key grape quality attributes that relate to grape value and wine quality**
- **Traceability**
- Sampling, process measurement and control

Grape to wine: opportunities
Traceability

REGULATION (EC) No 178/2002 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 28 January 2002
laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety

15. 'traceability' means the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution;

Grape to wine: opportunities
Traceability

- ➢ requires ability to follow grapes from vineyard/weighbridge through winery into bottled product
- combine in-house systems & databases for traceability with analytical data (spectra, etc.) and other meta data (vineyard management & winemaking practices)
- structured process, adequately resourced
- long term approach
- comply with regulatory requirement & expand knowledge base for decision making

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Grape to wine: opportunities

- **No agreement by winemakers on key grape quality attributes that relate to grape value**
- **Traceability**
- **Sampling & Cost of quality measures**

Roadblock:
too many targets for quality measures?

- **Lets assume we are unclear about benefits**
  (because we don't quite know what to measure, don't fully understand the relationship between grape measures and wine quality)
- **Whats in the budget & what measures, how many measures could we afford?**

Hypothetical case study on direct benefits of quality measures

Application of quality measures to assess grape value and pricing

grade	tonnes	$/tonne	total $k	false pos	false neg	correct	
A	20000	1200	24000	15%	0%	**85%**	17000
B	30000	1000	30000	10%	5%	**85%**	25500
C	30000	800	24000	10%	5%	**85%**	25500
D	20000	600	12000	10%	5%	**85%**	17000
E	0	400	0	0%	0%	**0%**	0
	100000 tonnes		**90000 $k**				**85000 tonnes**

have paid $90M | **ideally could have paid $88.6M** | **$1.4M (1.5%) off the mark**

- **How much would you spend on quality measures? Less than $14/tonne, if its only about the grape price.**

Benefits of quality measures

- Grape oversupply: Get the price for grapes right?

- Grape oversupply & undersupply:
- ***Have the product, product mix and volume the winemaker/marketing folks/wine show judge/consumer wants***

+ *Absence of faults in grapes & wine*

+ *Authenticity*
+ *Traceability*

Reduce cost of quality measures

- Concentrate on what you need
- Classification models

- define your purpose & reduce the number of targets
- utilise or evaluate the information

- ***simplify sampling***
- ***automatise measurements & data analysis***
  => rapid analytical techniques for continuous on-line measurements
- ***process measurement and control***

Opportunities:
rapid analytical techniques for established parameters anthocyanins & total wine tannins by UV

Correlation matrix – Somers & HPLC of red wine

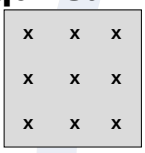
	Col_Den	Anth_Som	A520_SO_2	Phen	M3G	PP
Col. Density	1.00					
Antho_Somers	0.53	1.00				
A520 in SO_2	**0.82**	0.03	1.00			
Phenolics	0.87	0.47	0.77	1.00		
M3G_HPLC	0.44	**0.97**	-0.04	0.34	1.00	
PP_HPLC	**0.87**	0.17	**0.94**	0.76	0.10	1.00
Tannin_HPLC	0.24	-0.39	0.58	0.32	-0.39	0.54

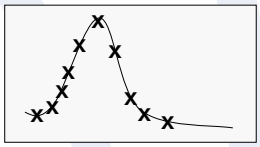
- **Somers total anthocyanins can replace HPLC anthocyanins**
- **A_{520} in high SO_2 can replace HPLC pigmented polymers**
- **Total wine tannin by UV**

Opportunities: Optimise sampling

- **Traditional vineyard sampling**
  requires many hands & good legs, and tedious sub-sampling
  it's a batch process!

- **Sample numbers required?**
  - Precision viticulture:
    30m grid
    => 9+ samples/ha

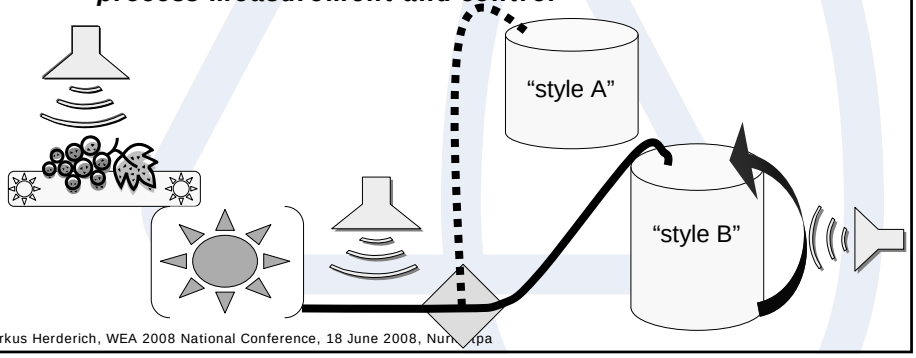




  - Analytical chemistry:
    5-10 data points to describe a normal distributed sample
    => 5-10+ samples
    to describe fruit going into 1 fermenting tank?

Opportunities: Optimise sampling and measurement

- **Traditional sampling**
  - it's a manual batch process
  - sample numbers are a major cost & success factor
- ***automatise measurements & data analysis***
  => continuous on-line measurements
  => process measurement and control



Application of quality measures: Summary

- Innovation =
  bright ideas plus *successful execution*

- *cost of development: 10x cost of research*
- *define priorities & targets*
- *needed: appropriate resources & endurance*
- *wine industry wide collaboration in technical development*
- *involve "toolmakers" & other industries*

➔*AWRI's new Industry Application group*

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