The Australian Wine Research Institute

Smart Technologies for Process Control

Are we there yet?

D. Cozzolino, W. Cynkar, N. Shah, R G. Dambergs, P. Smith

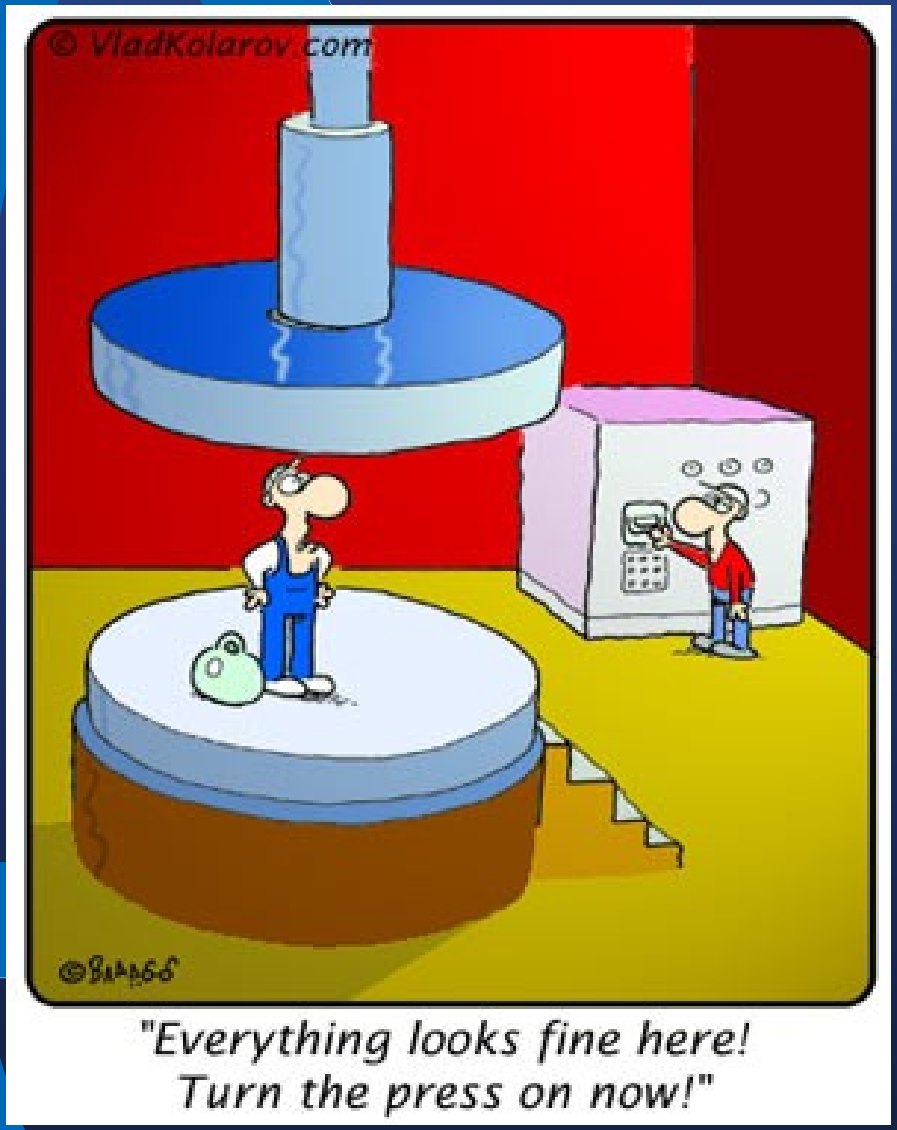
June 2009

Do Nothing

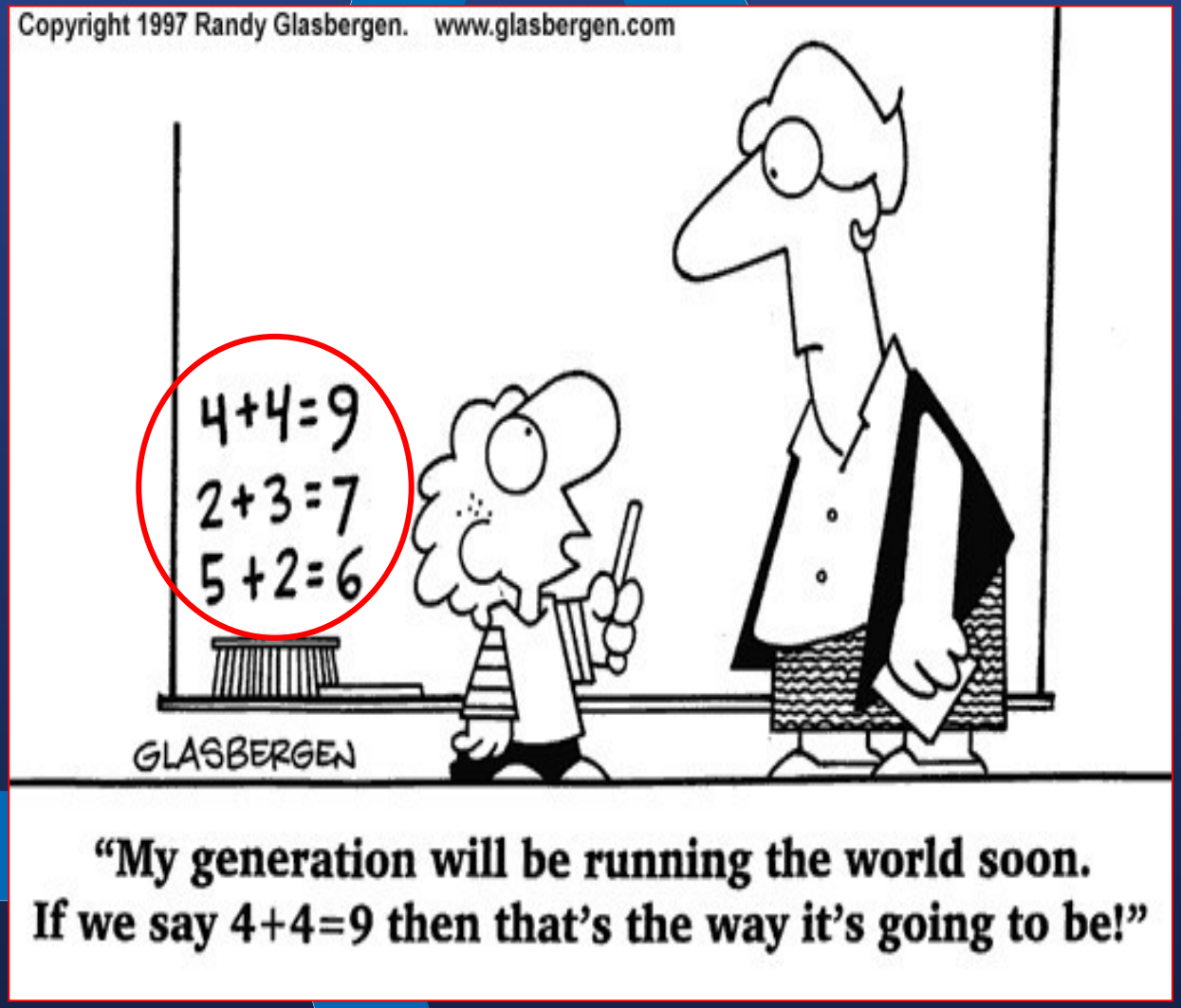
The undocumented first use of this well-known phrase.

AWRI

More of the same



Be Innovative



What is process analysis ?

AWRI

- It is a **continuous or regular means** of obtaining **information** either **quantitative** or **qualitative** for the assessment of raw materials and products

- Application
  - **Process control –** batch, on-line, at-line
  - **Quality control**
  - **Composition**
  - **Environmental**
  - **Safety (OH & S)**

In-/on-line vs. off-line analysis

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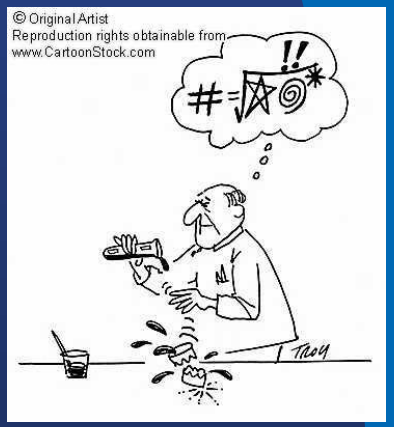

1day

Time delay
Between sampling and analysis

1hour

1min.

1sec.

Off-line

Lab

On-line

Winery

In-line

1hour

Time delay
Between two measurements

1day

sourced from Kueppers and Haider, 2003

Process analysis - sampling

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Lab sampling Preparation
Separation/Quantification

Field Sampling → **Lab**

Sample representative?
Sample change?
Analyte loss?
Time?

Lab preparation/
Quantification

On-site Sampling
Sample preparation → **Lab**

Sample representative?
Analyte loss?
Time?

On-site Analysis

Sensitivity?

~~Lab~~

Why process analysis in the wine industry?

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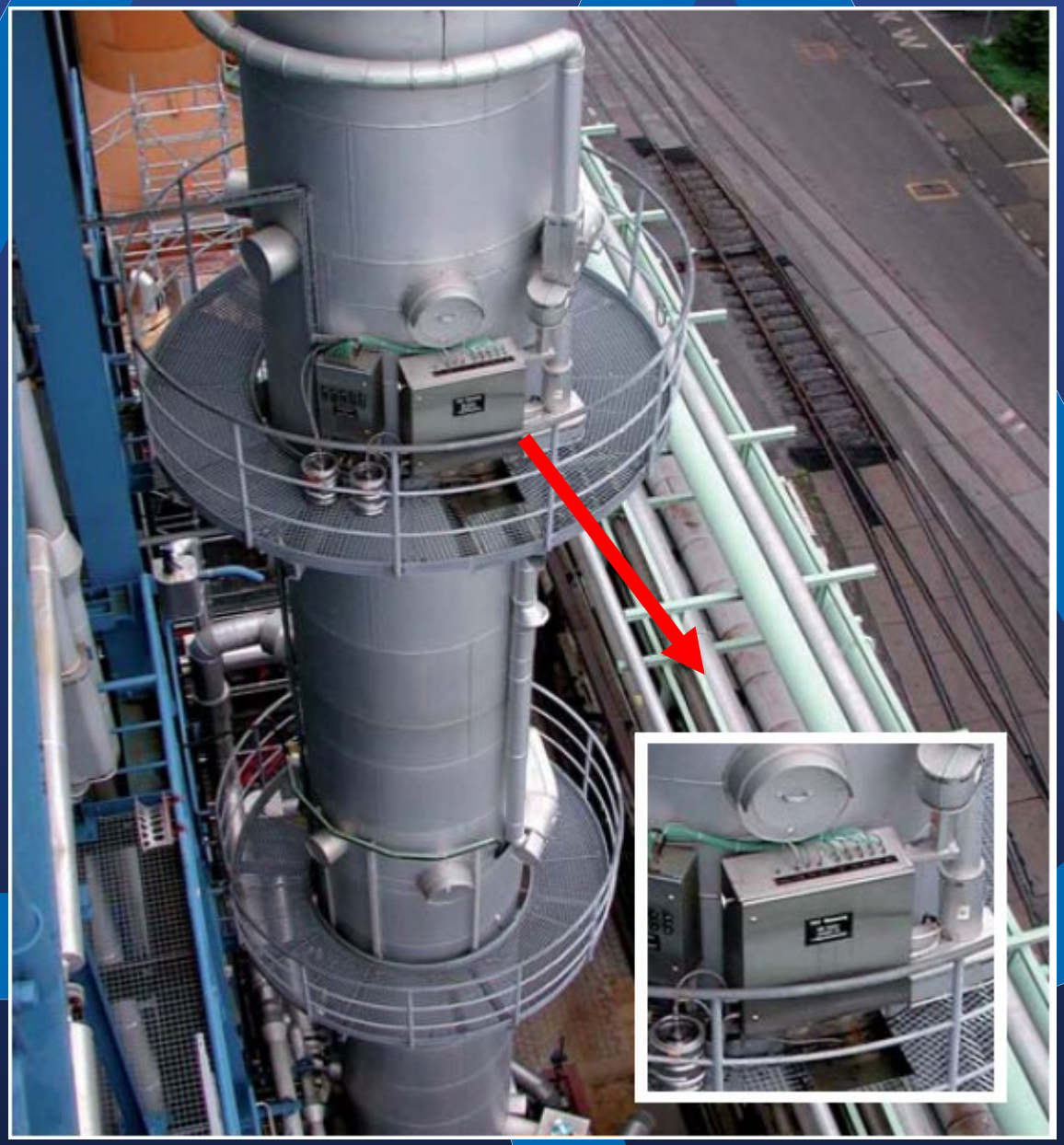
- Saves money
- Saves time (lab analysis, sampling)
- Reduce energy usage
- Improves process efficiency
- Environmentally friendly



Online NIR measuring point on a distillation column

Bayer, 2009

AWRI

Meat

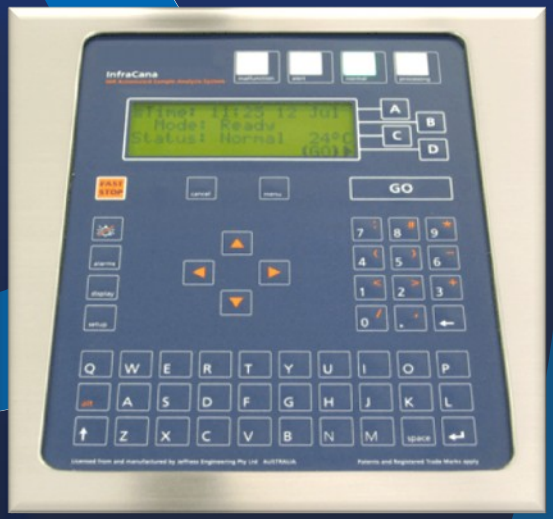
Tobacco

Milk

Beacon 2000-II NIR Process Analyzer

AWRI

InfraCana (300 – 700 samples/day)



Foss Directions - 2002

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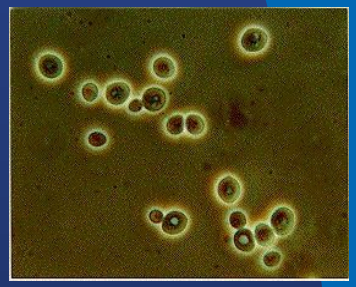

SMART TECHNOLOGIES

Grape and Juice composition

AWRI

Grape and Juice composition

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- **Multiple measurements in less than 1 MINUTE!!!!!**
  - Total anthocyanins (colour)
  - Total soluble solids (Brix)
  - Dry Matter
  - Tannins
  - pH
  - YAN and Ammonia

- **Different uses** (requirements for **accuracy**, **precision**, **cost**, and **speed**)
  - Viticulture
  - Streaming
  - Weighbridge
  - Payment

Wine fermentation

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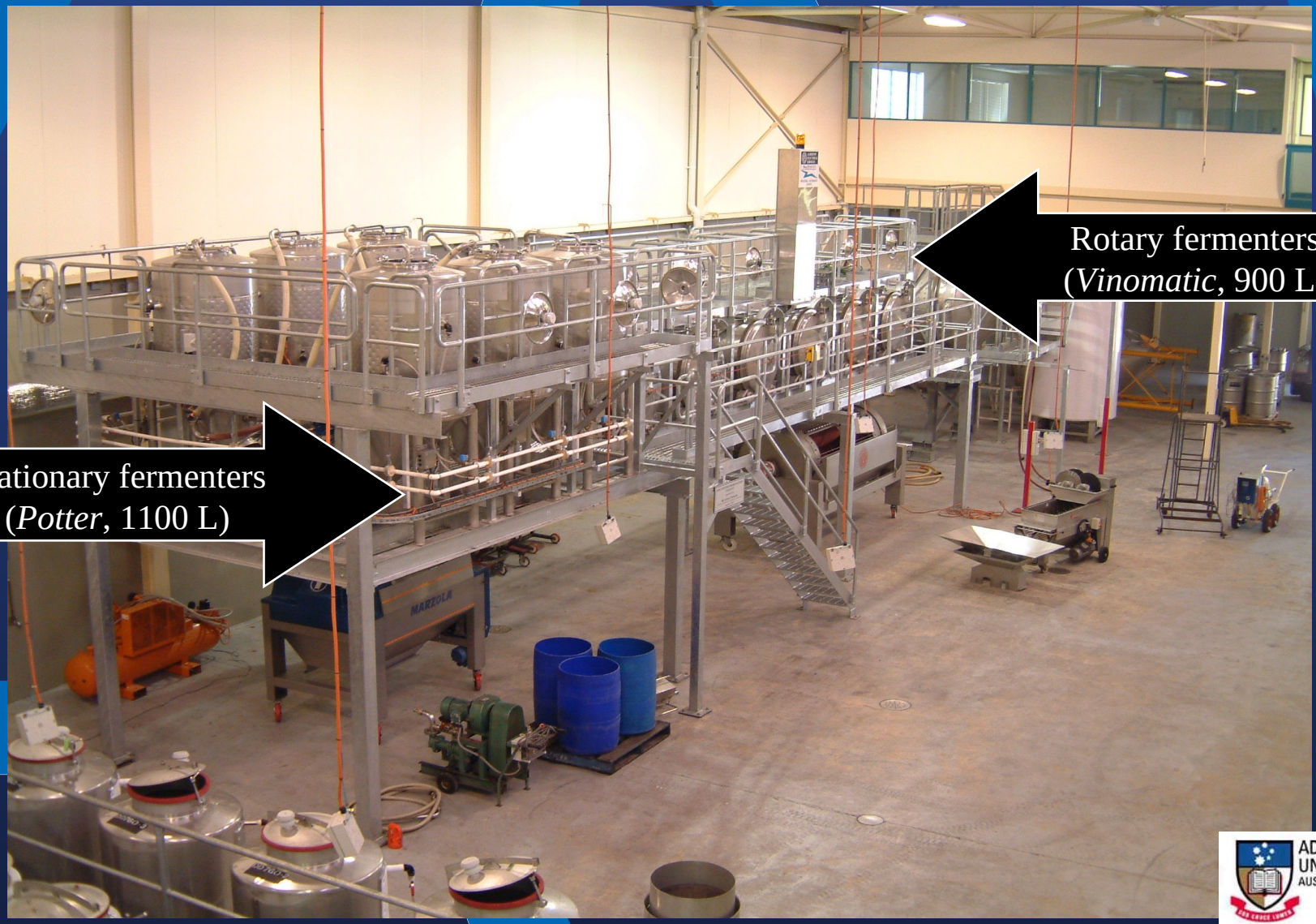
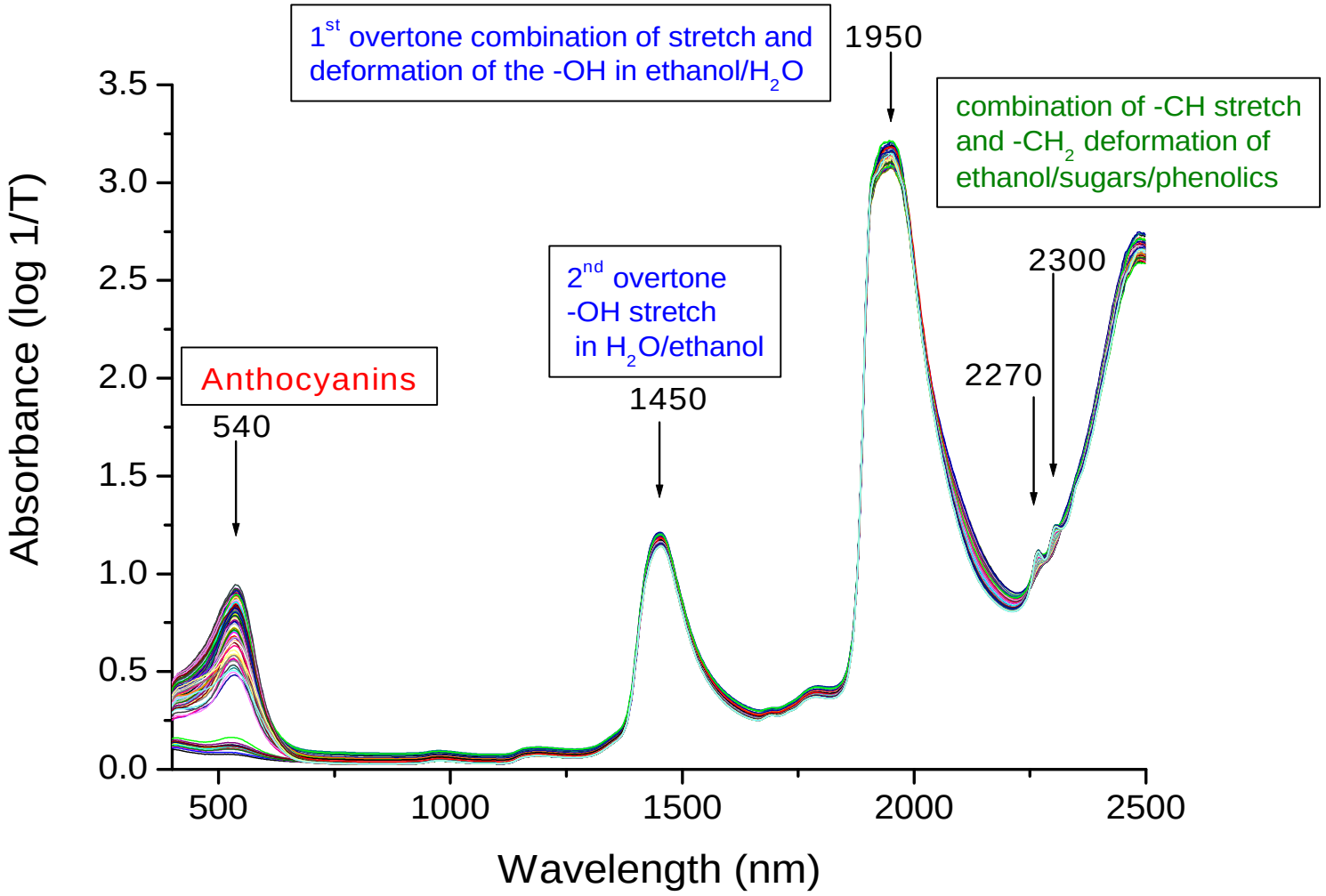
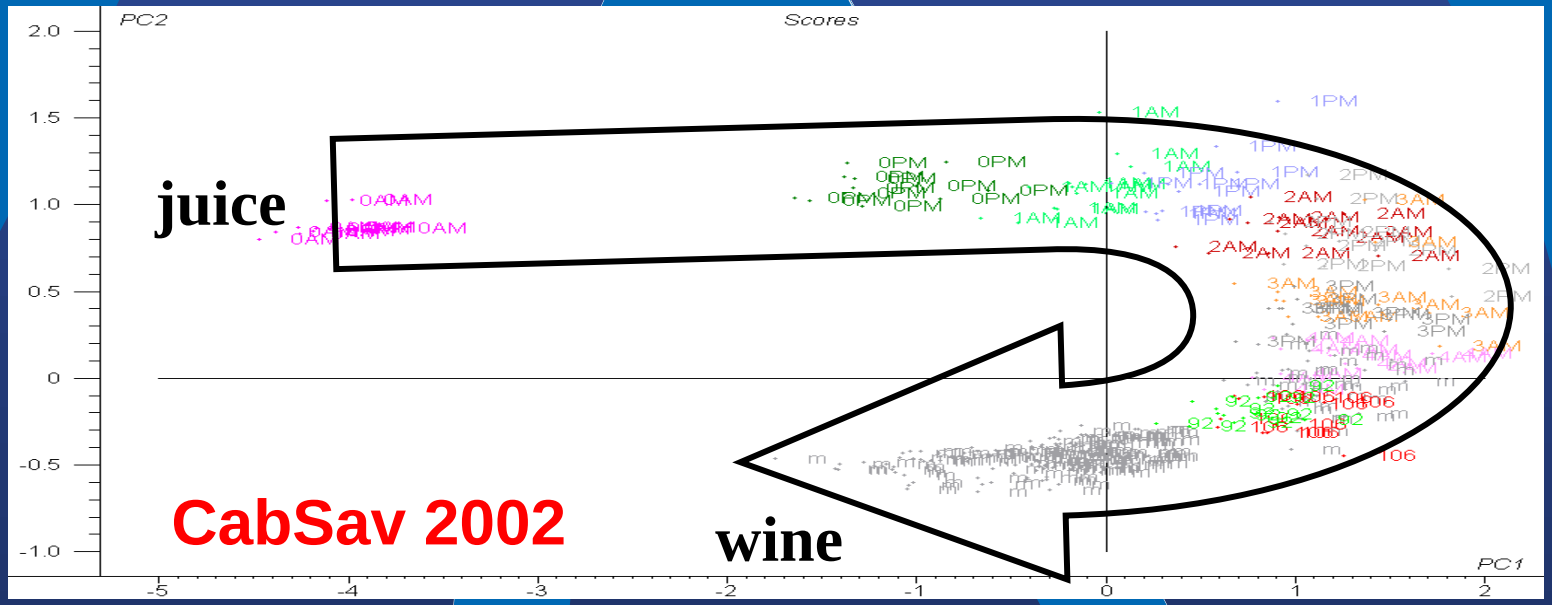
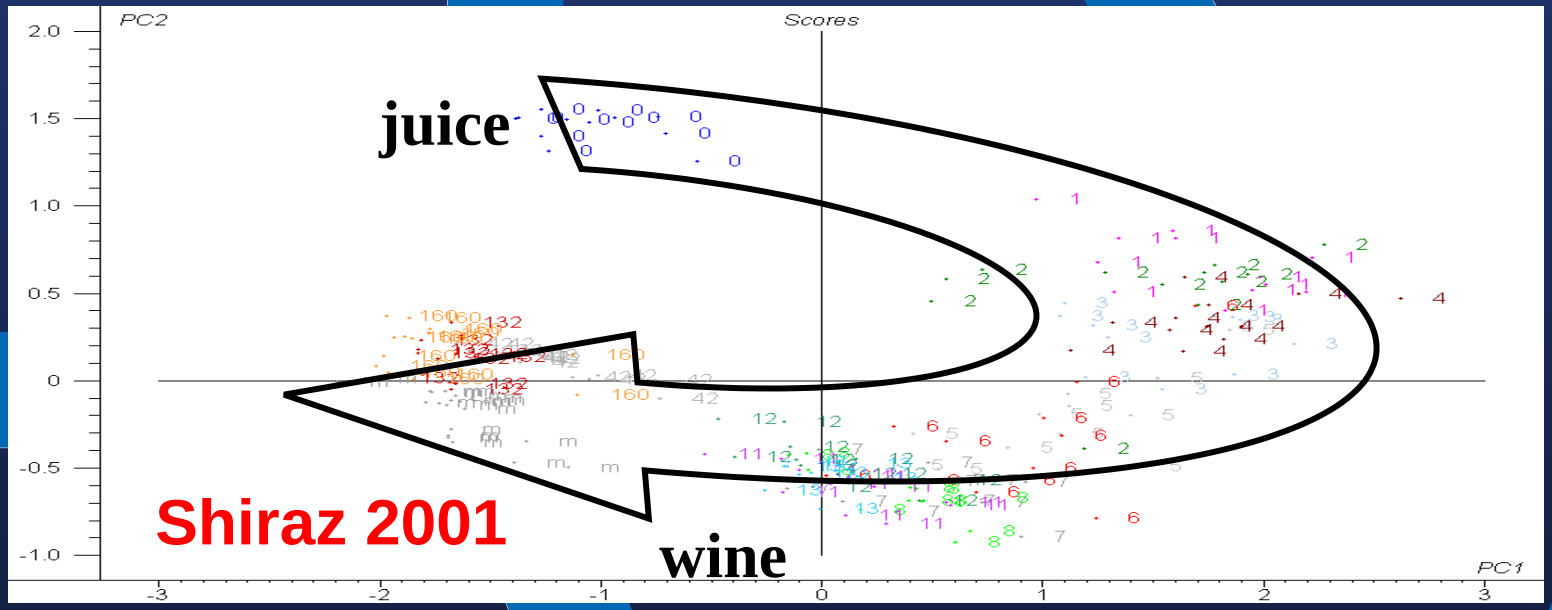


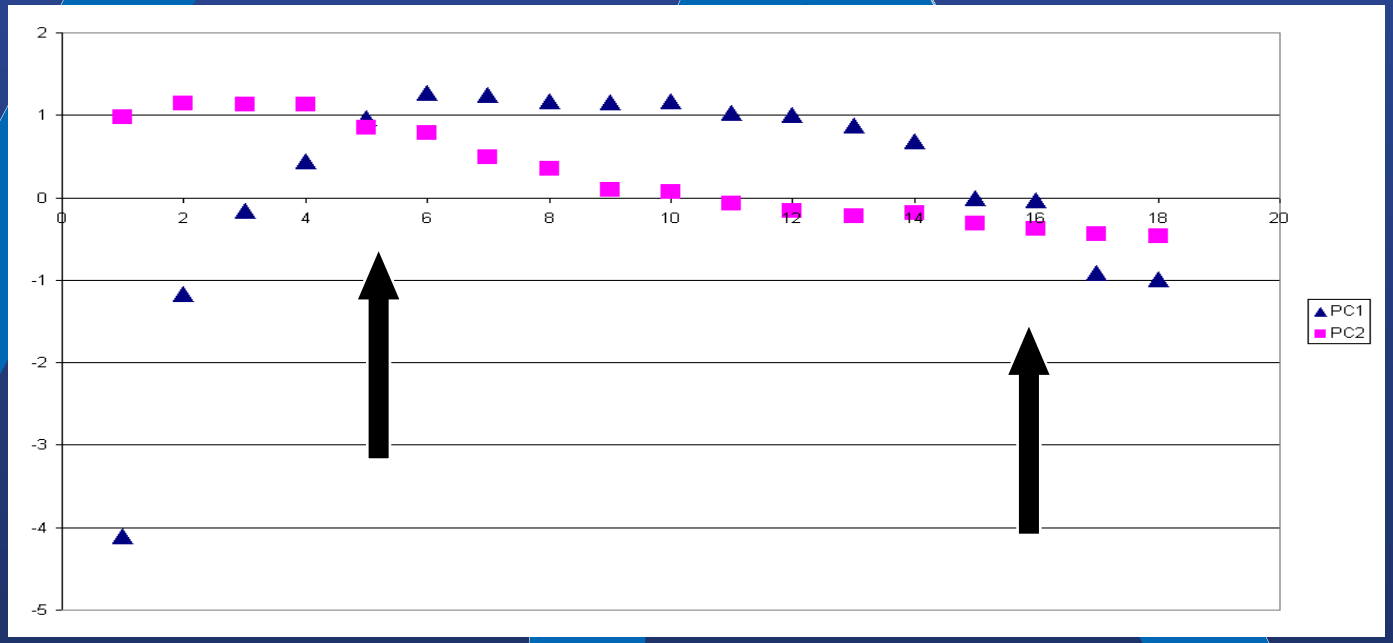
ADELAIDE UNIVERSITY AUSTRALIA


1st overtone combination of stretch and deformation of the -OH in ethanol/H2O
1950
combination of -CH stretch and -CH2 deformation of ethanol/sugars/phenolics
2300
2270
2nd overtone -OH stretch in H2O/ethanol
1450
Anthocyanins
540
Absorbance (log 1/T)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
500
1000
1500
2000
2500
Wavelength (nm)

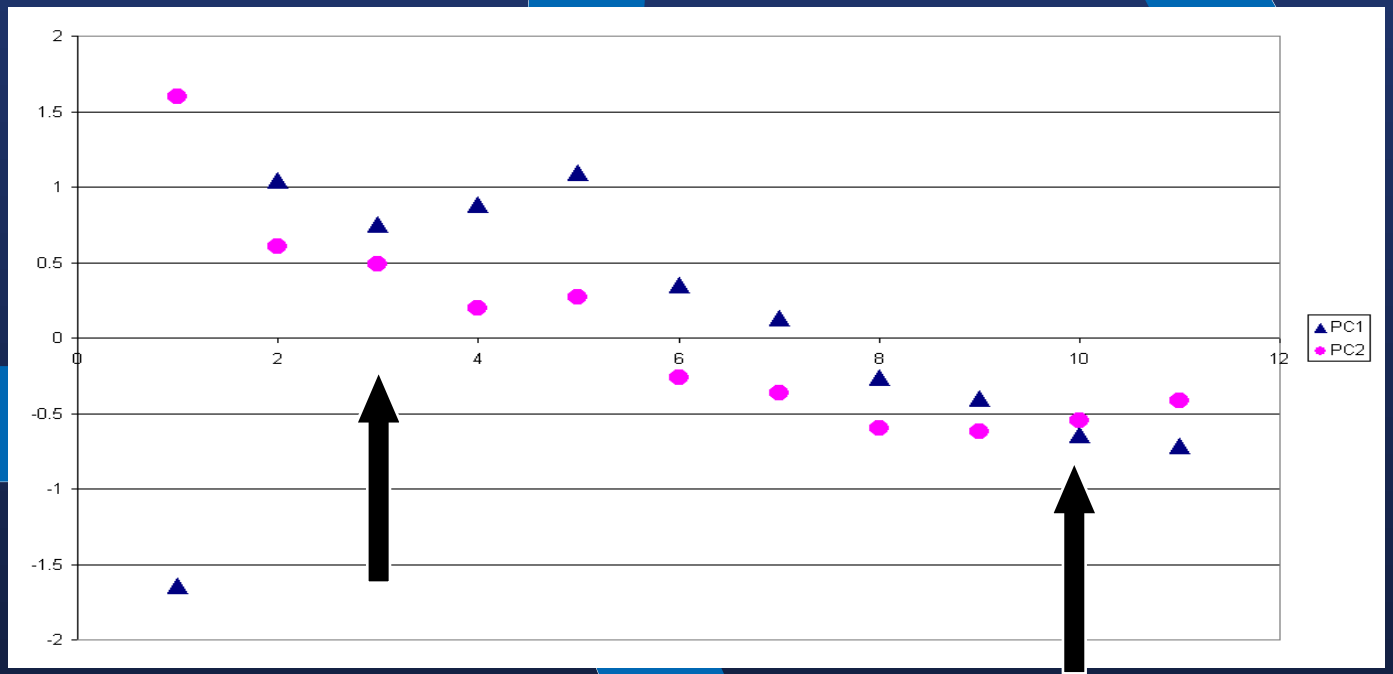

PC2
Scores
juice
CabSav 2002
wine
PC1


PC2
Scores
juice
Shiraz 2001
wine
PC1

AWRI



CabSav 2002



Shiraz 2003

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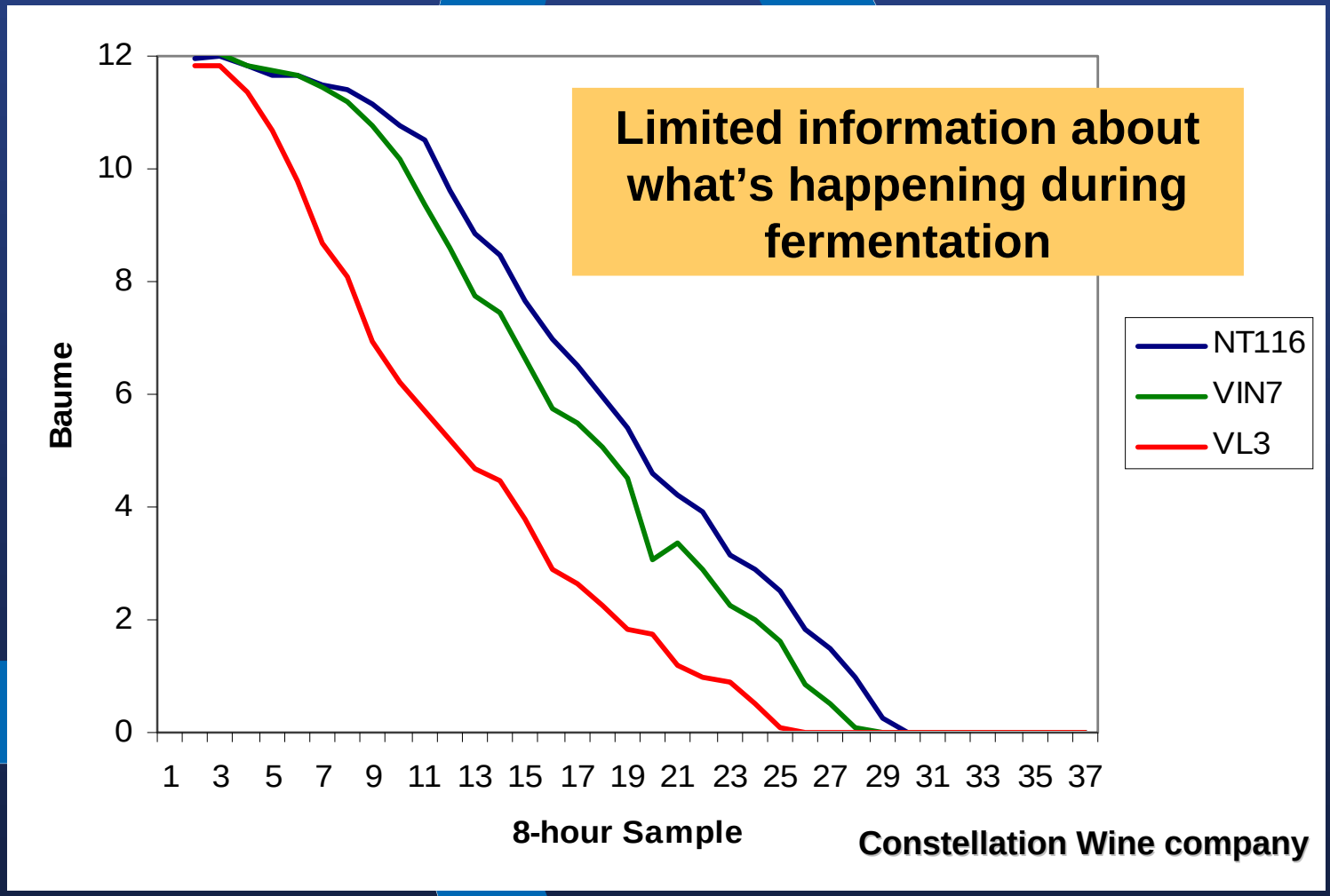
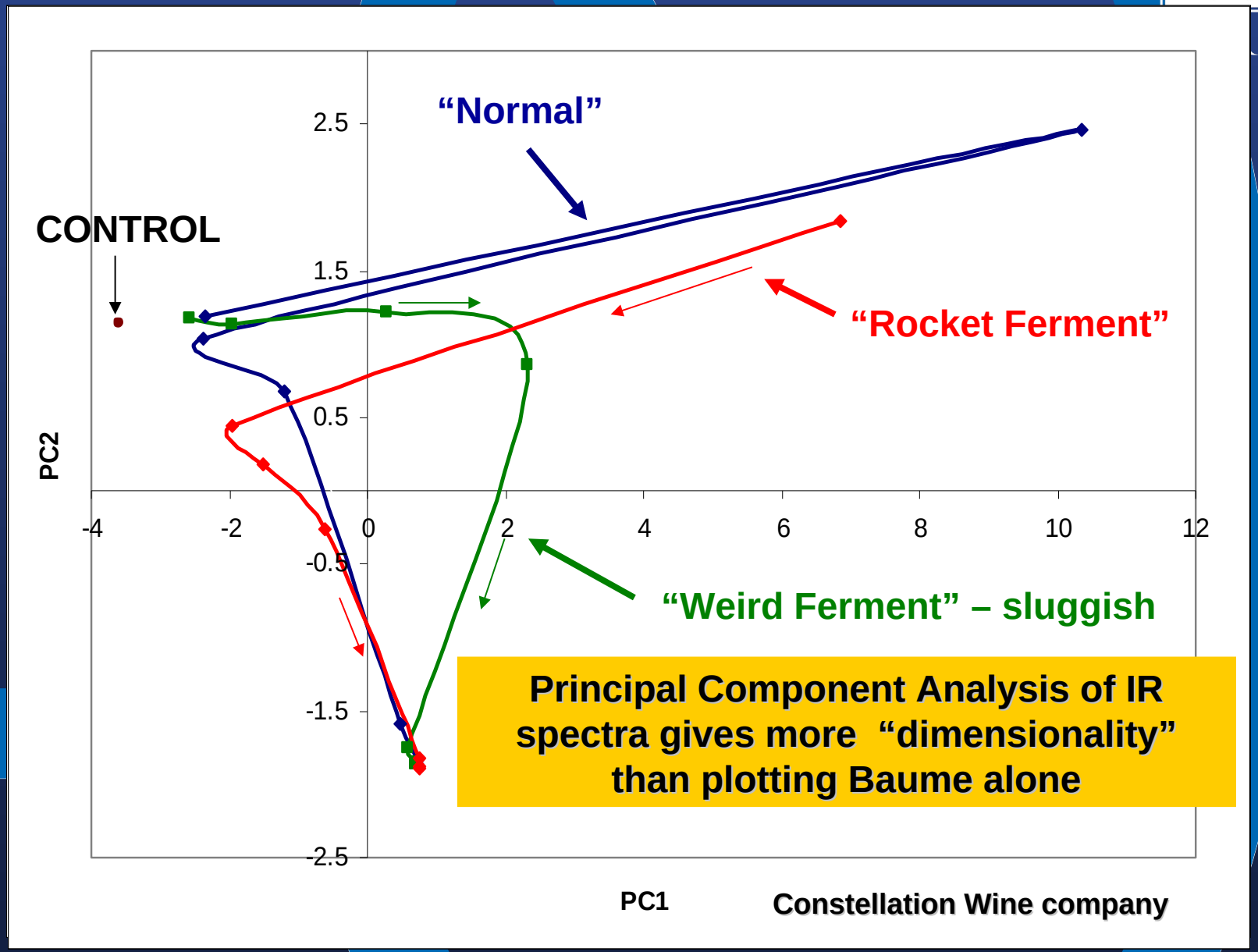
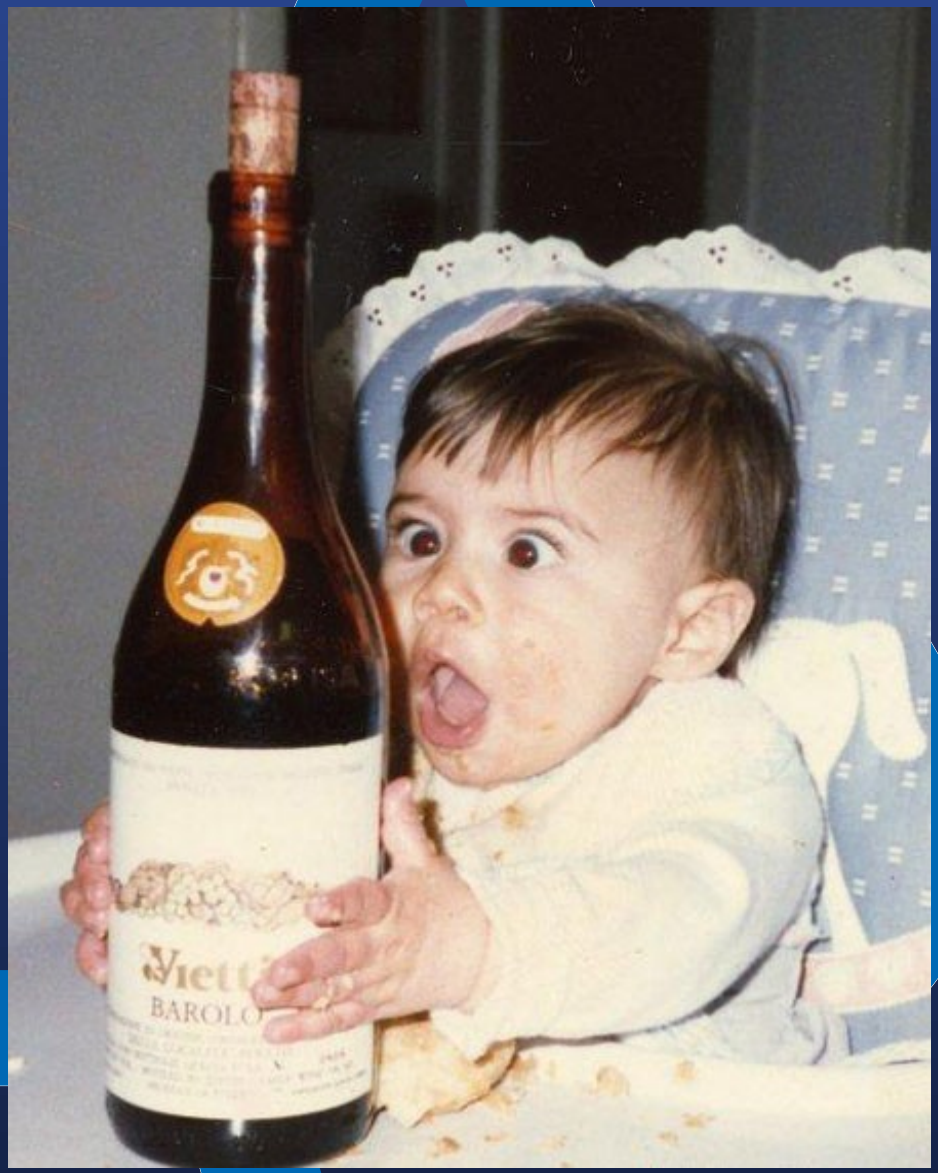
Fermentation time course monitored by Refractometer (Sauvignon Blanc)

Same patch of fruit fermented with three different yeast strains



Fermentation time course monitored by MIR spectroscopy (Sauvignon Blanc)





AWRI

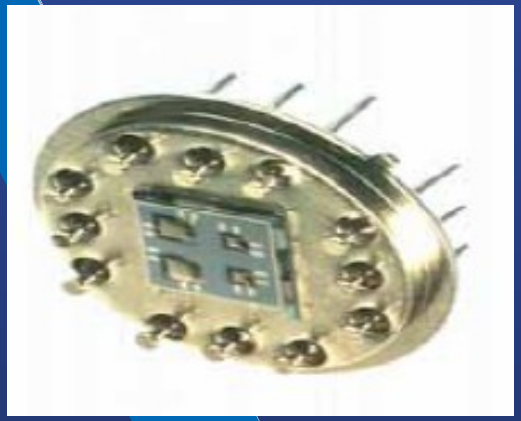
JEFFCO
BevScan
In Bottle Wine Analyser

Oxidation
Chemical Composition
Varietal integrity
Vintage
Region
CLOSE
Go to Setup Page
Single Scan
Continuous Scan
Bottle Check
Calibrate Wavelength
Calibrate Reference

The wine tasting robot

http://www.robots-dreams.com/2006/07/wine_tasting_ro.html

AWRI



E-nose
Micro GC

AXSUN Tech. USA

Temp data loggers, cap, label

Dr Mazzolai, CRIM Lab - Italy

Smart technologies in winemaking

AWRI

+ **Reduce COST and TIME** (reduce sampling, sample pre-processing)

+ **Multiple measurements - Holistic**

+ **Bring together motivated and skilled persons** (winemakers and engineers)

– **Barriers to adoption**
  - Availability of hardware and software
  - Lack of formal education and training

Acknowledgments

- Colleagues at the AWRI and Industry Applications Group
- The many wineries who have participated with our projects
- WEA, David Clark

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Australian Government

Grape and Wine Research and Development Corporation

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