ARE WORT AMINO ACID PROFILE, MALT QUALITY AND FERMENTABILITY CORRELATED?

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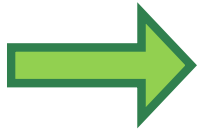
OUTLINE

- Fermentability
- Methodology
- Effects of malting conditions on wort quality
- Summary
- Conclusions

FERMENTABILITY

- Determines quantity of alcohol produced from a certain quantity of malt
- Malt provides
  - fermentable sugars
  - assimilable nitrogen



Yeast nutrition

- Apparent attenuation limit (AAL) measures the attenuation or reduction of wort gravity occurring when wort is fermented by yeast

MATERIALS

- Five different barley varieties:
  - Two from Uruguay
  - Three from Canada
- Varieties were study in two environments

MALTING SCHEDULES

- Four different treatments:
  - Standard
  - Addition of gibberellic acid (GA)
  - Longer kilning
  - Longer kilning and higher germination temperature
- Treatments were compare in pairs, no interaction effects were studied

MALTING SCHEDULES

- Standard program
  - 40 hrs Steeping
  - 84 hrs Germ
  - 24 hrs Kilning
- Addition of GA
  - 2 hrs Germ
  - 0.25 ppm

Step	Hours	Temp (°C)
Wet 1	7	13
Dry 1	14	13
Wet 2	7	13
Dry 2	12	13
Germ	84	15
Kilning 1	5	50
Kilning 2	7	60
Kilning 3	6	65
Kilning 4	2	75
Kilning 5	4	85

Total: 148 (6.2 days)

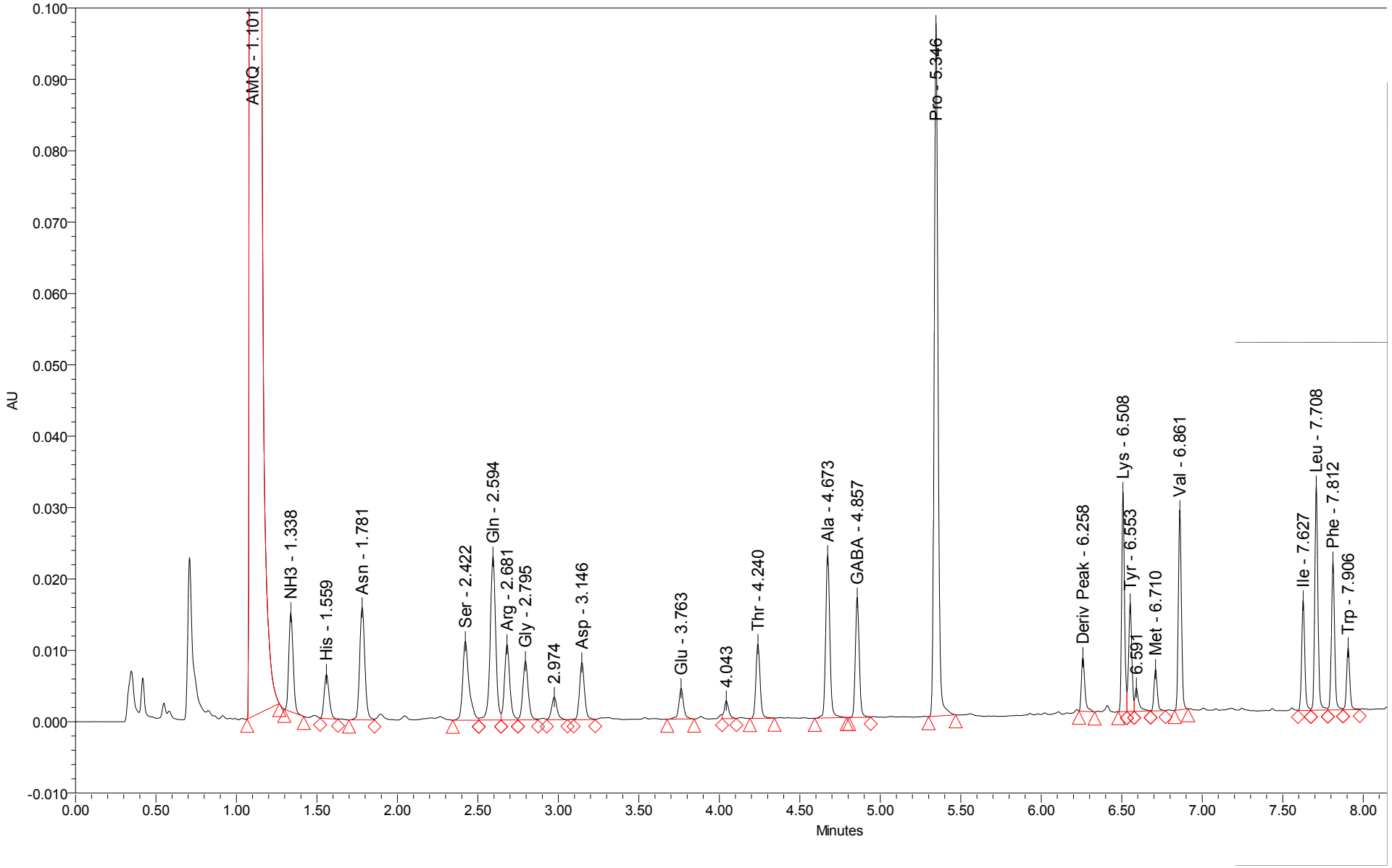
MALTING SCHEDULES

- Longer Kilning
  - 40 hrs Steeping
  - 84 hrs Germ
  - 48 hrs Kilning
- Higher germ temp
  - 18ºC

Step	Hours	Temp (ºC)
Wet 1	7	13
Dry 1	14	13
Wet 2	7	13
Dry 2	12	13
Germ	84	18
Kilning 1	6	30-48
Kilning 2	16	48
Kilning 3	8	48-66
Kilning 4	10	66
Kilning 5	2	66-80
Kilning 6	6	80

Total: 172 (7.2 days)

AMINO ACID ANALYSIS



MALTING TREATMENT EFFECTS

Quality Parameter	Add of GA
AAL	↑ **
FAN	↑ ***
Fine Extract	↑ ***
B-Glucans	ns
Viscosity	ns
Friability	↑ **
DP	ns
Beta Amylase	ns
Soluble P	↑ ***
Colour	↑ **
pH	↓***

Level of significance: *** P<0.001; **P<0.01; *P<0.05; ns: non sig

MALTING TREATMENT EFFECTS

Individual amino acids

	Add of GA	Longer kiln	Higher germ temp
***	Val– Thr– Ile– Gln Arg- Pro– Trp- Leu- Phe–Met- Tyr	Ala- Glu- Pro- Cys	Ala- Glu- GABA- Pro
**	Ser– Ala- Lys	Gly	Gln- Arg-
*	Asn – Gly- Asp	His- Lys	Asn- Trp
ns	His – Glu - GABA - Cys	Thr- Val-Ile- Ser- Asp- Gln- Arg- Asn- GABA- Met- Leu- Phe- Tyr- Trp	Thr- Val-Ile- Ser- His- Asp- Gly- Cys- Lys- Leu- Phe- Tyr- Met

Level of significance: *** P<0.001; **P<0.01; *P<0.05; ns: non sig

ARE WORT AMINO ACID PROFILE, MALT QUALITY AND FERMENTABILITY CORRELATED?

FERMENTABILITY CORRELATIONS

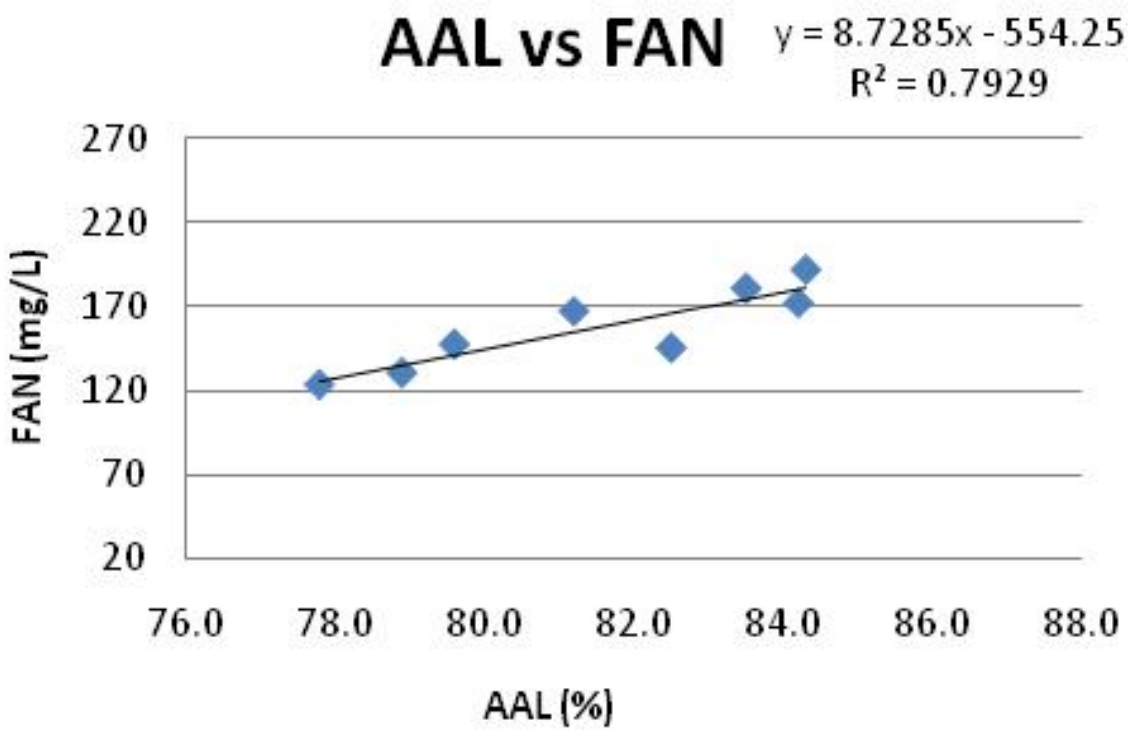
Highest and significant correlation values (r) related to malt quality among all the treatments

	FAN	pH	DP	B-Glucans
AAL	0.884 ***	-0.838***	0.777***	-0.626***

Level of significance: *** P<0.001; **P<0.01; *P<0.05

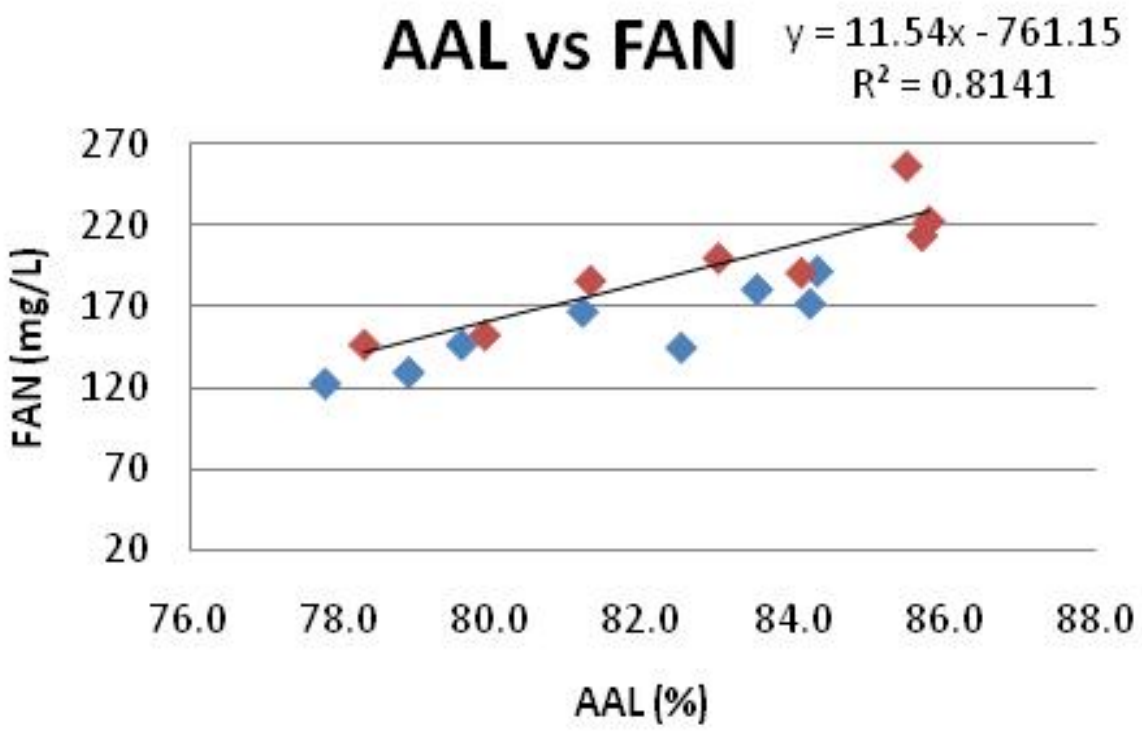
CORRELATIONS

Standard ♦ treatment



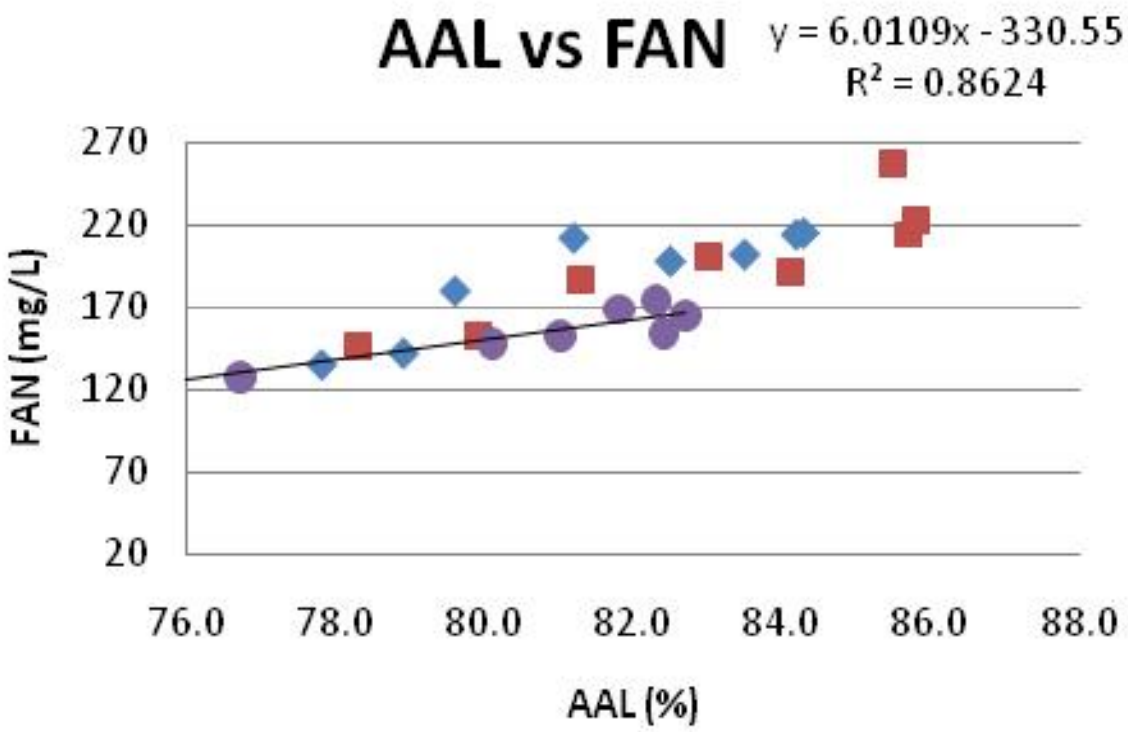
CORRELATIONS

Standard ♦ and GA ♦ treatments



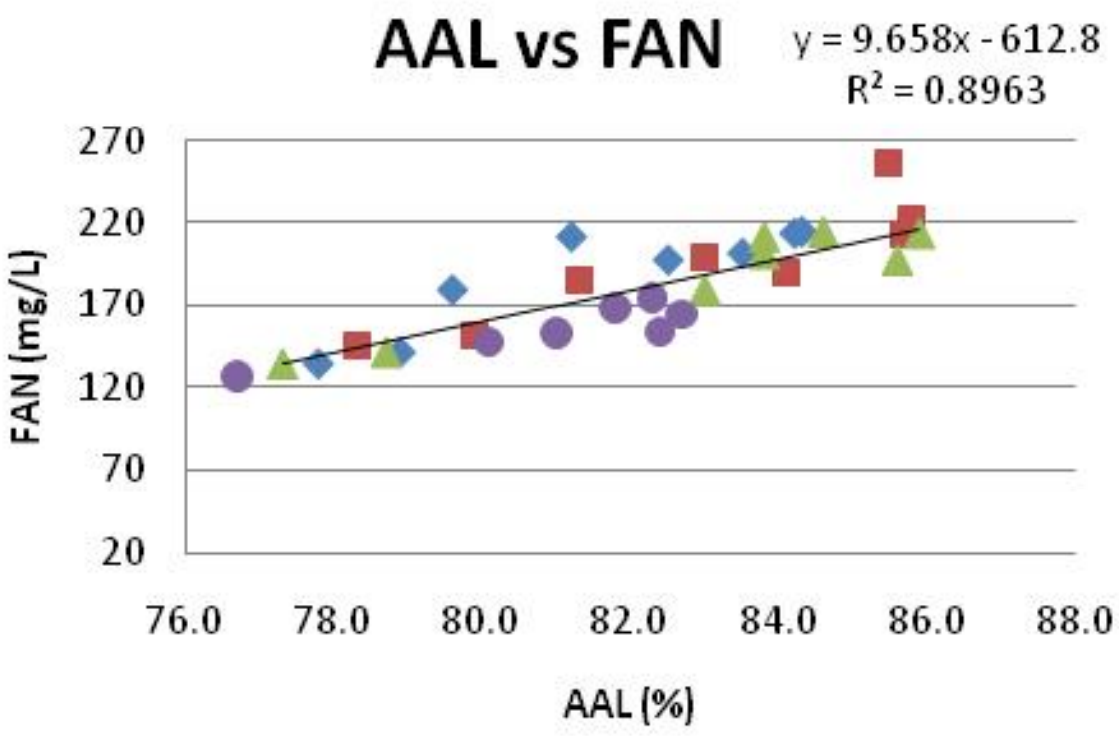
CORRELATIONS

Standard ♦ , GA ■ and longer kilning ● treatments



CORRELATIONS

Standard ♦, GA ■, longer kilning ● and higher germ tempt ▲ treatments



FERMENTABILITY CORRELATIONS

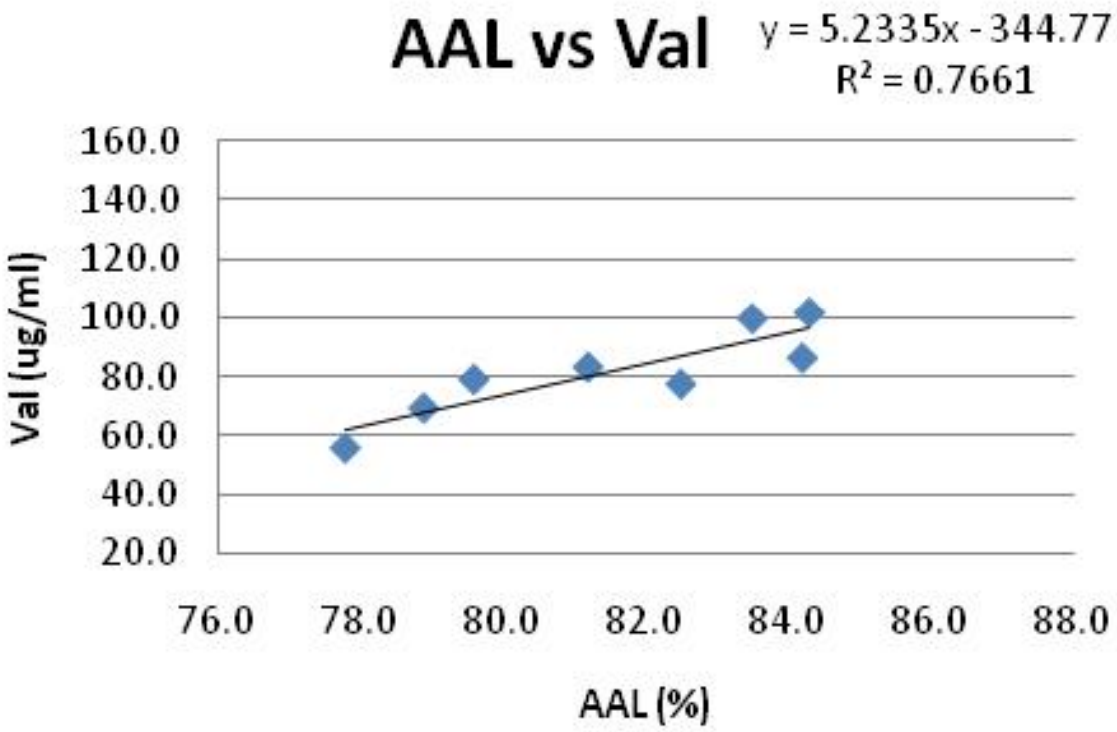
Highest and significant correlation values(r) related to amino acids among all the treatments

	Val	Thr	Ile	Ser	Ala
AAL	0.820 ***	0.820***	0.802***	0.780***	0.775***

Level of significance: *** P<0.001; **P<0.01; *P<0.05

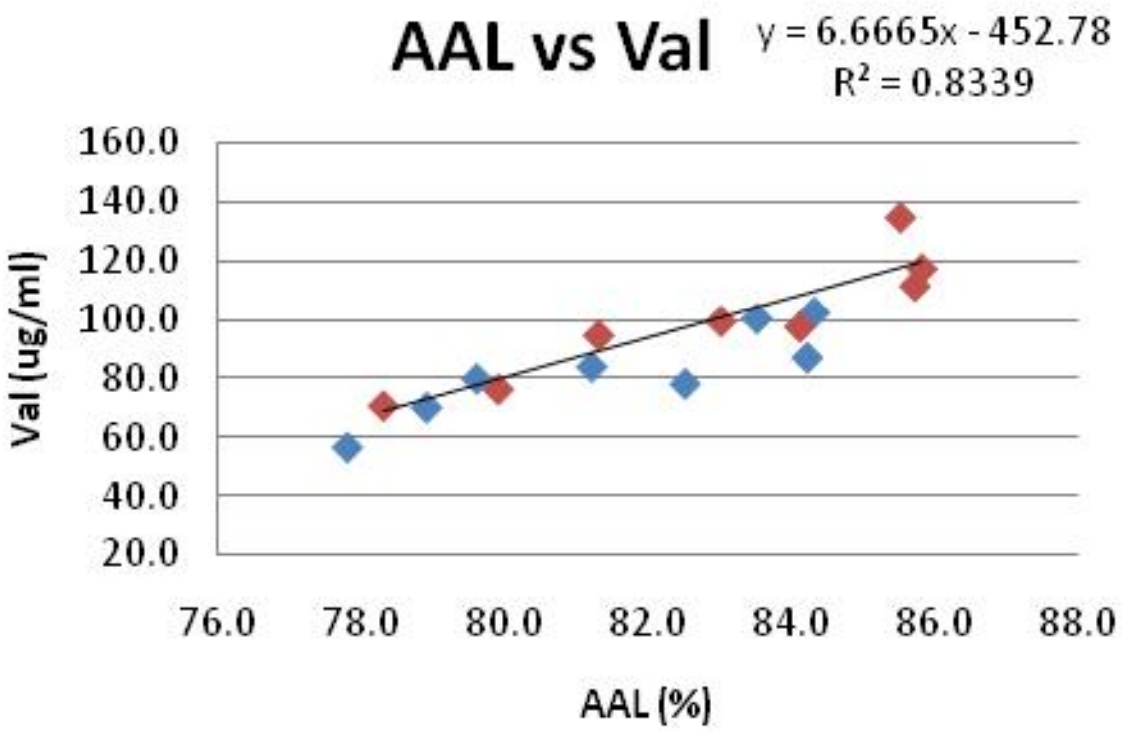
CORRELATIONS

Standard ♦ treatment



CORRELATIONS

Standard ♦ and GA ♦ treatments



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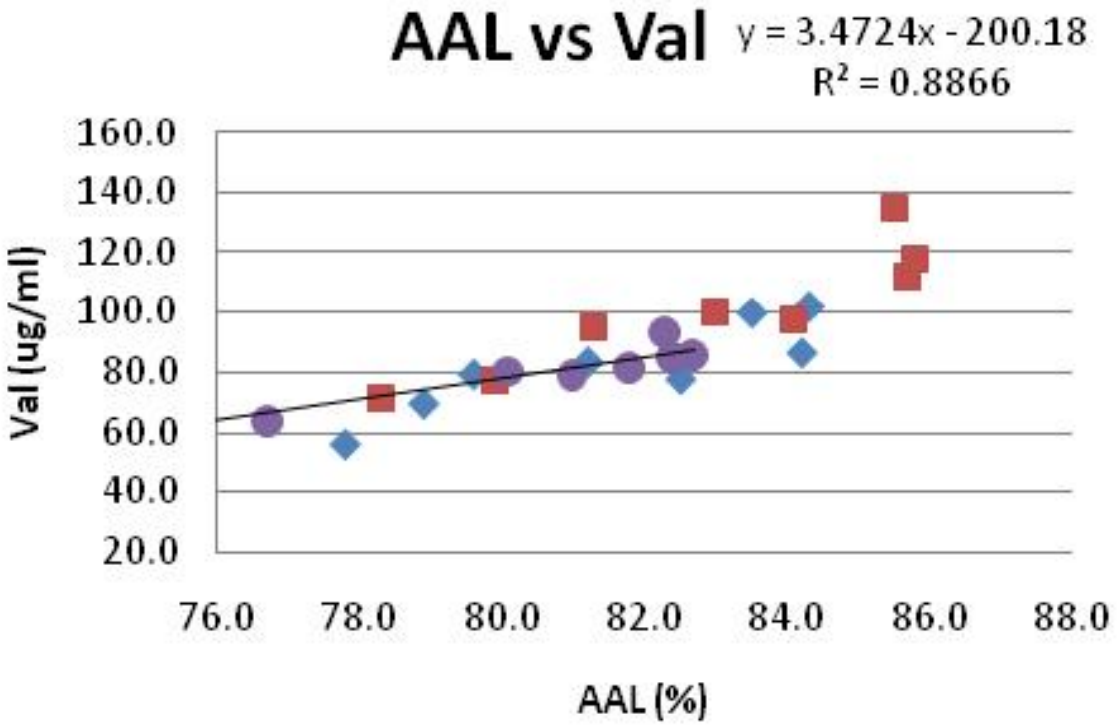

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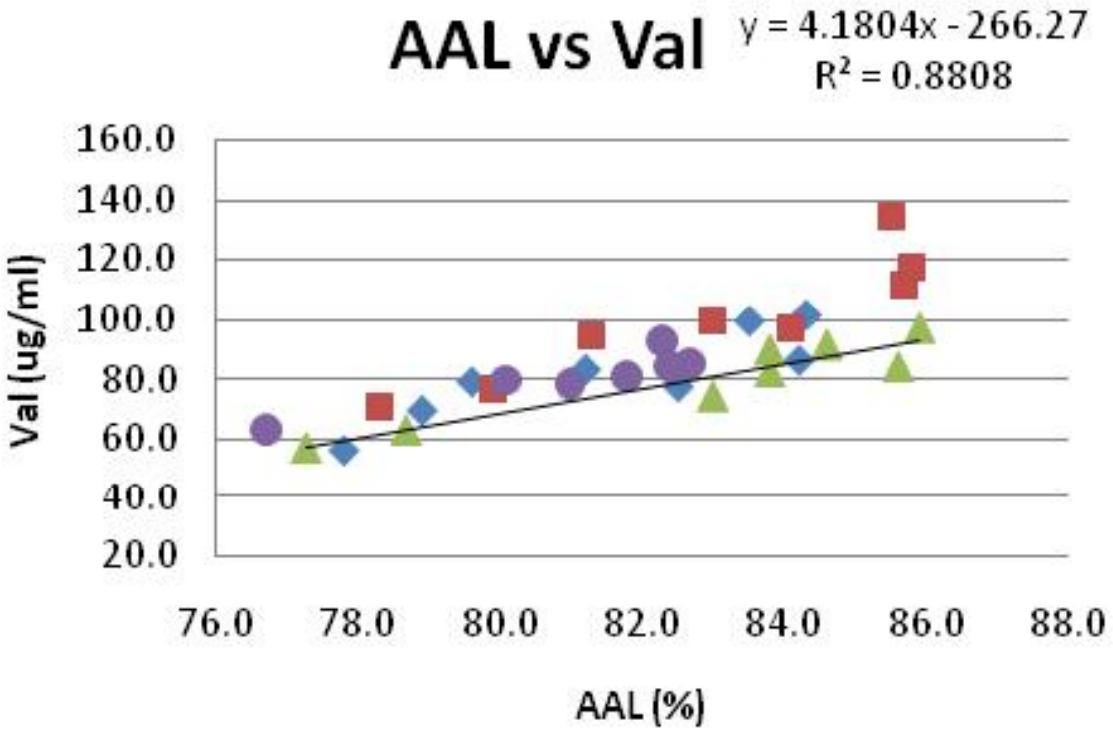
Standard ♦, GA ■ , longer kilning ● and higher germ tempt ▲ treatments



SUMMARY

- Individual amino acids were found to vary significantly among malts made from different malting schedules
- Fermentability levels: ↑addition of GA, ↓longer kilning treatment and ↑ higher germination temperature.
- Free amino nitrogen, pH, valine, threonine, and isoleucine highly correlate with fermentability levels

CONCLUSIONS

- Assimilable nitrogen significantly affect fermentability levels in accordance with a decrease in pH
- Valine and threonine are key amino acids to achieve higher wort fermentability levels

FUTURE RESEARCH

- Interaction between malting effects will be studied
- Measurements of amino acid profile from fermented wort produced under different malting conditions are needed
- Endoproteases analysis and their relationship with amino acid profile, will provide insight on the proteolytic mechanism in malting

THANK YOU

Financial support:

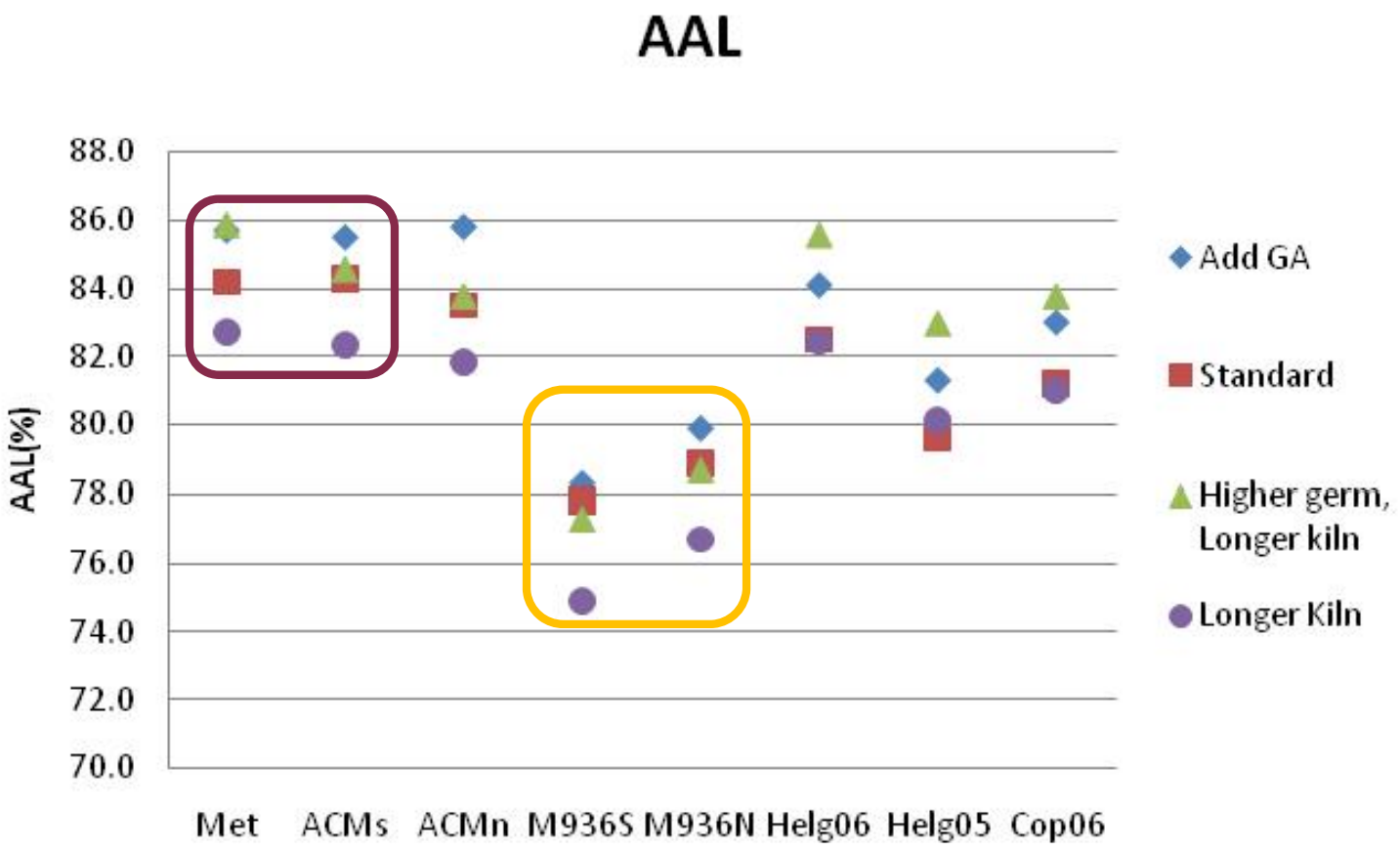
Government of Uruguay

Canadian Grain Commission

Commission canadienne des grains

STATISTICAL ANALYSIS

- Experimental Design: randomize complete block (RCB)
  - Each variety is consider a block
  - Each malting treatment is comparing in pairs by contrast
- Proc Mixed analysis
- Study of Normality – Proc Univariate
- Proc Correlation between all the parameters from all samples


AAL
AAL(%)
88.0
86.0
84.0
82.0
80.0
78.0
76.0
74.0
72.0
70.0
Met
ACMs
ACMn
M936S
M936N
Helg06
Helg05
Cop06
Add GA
Standard
Higher germ, Longer kiln
Longer Kiln