



Center for Craft
Food & Beverage

Malting Michigan Grains for Function & Flavor

Aaron MacLeod

Great Lakes Hops & Barley Conference

March 1, 2019



Center for Craft Food & Beverage

Supporting **growth** and **innovation** in craft food and beverage production through quality testing, technical support, research and education.





Megan Douglass



Rachel Truland

Grain Quality Testing

Malting Barley Selection (Moisture, Protein, Plumpness, Test Weight, Germination, RVA, & DON)	\$75
Moisture and Protein	\$15
Starch	\$25
Germination Energy (4mL, 8mL & Capacity)	\$20
RVA (pre-harvest sprout damage)	\$25
Cereal Extract (ASBC Cereals-5)	\$100
β-glucan	\$75
DON (ELISA)	\$35



Malt Quality Testing

Full Malt Analysis – (Moisture, Assortment, Friability, Fine Extract, Coarse Extract, F/C Difference, β -glucan, viscosity, FAN, soluble protein, S/T, DP, α -amylase, color, pH, filtration time, clarity)	\$150
Basic Malt Analysis – (Moisture, Friability, Fine Extract, β -glucan, FAN, DP, α -amylase, color, filtration time, clarity, pH)	\$75
Enzymes Only (Diastatic Power & α -amylase)	\$50
Specialty Malt Analysis - for high-dried and caramel malt (Moisture, Extract, Color)	\$25
Phenol – for peated malt	\$85
Fermentability (Apparent Attenuation Limit)	\$125
Predicted Spirit Yield (PSY)	\$175
Glycosidic Nitrile (GN)	\$225



Micro-malting

- 200 g to 10 kg sample size
- Variety & Agronomy Trials
- Process Optimization
- Applied Research



What is germination?

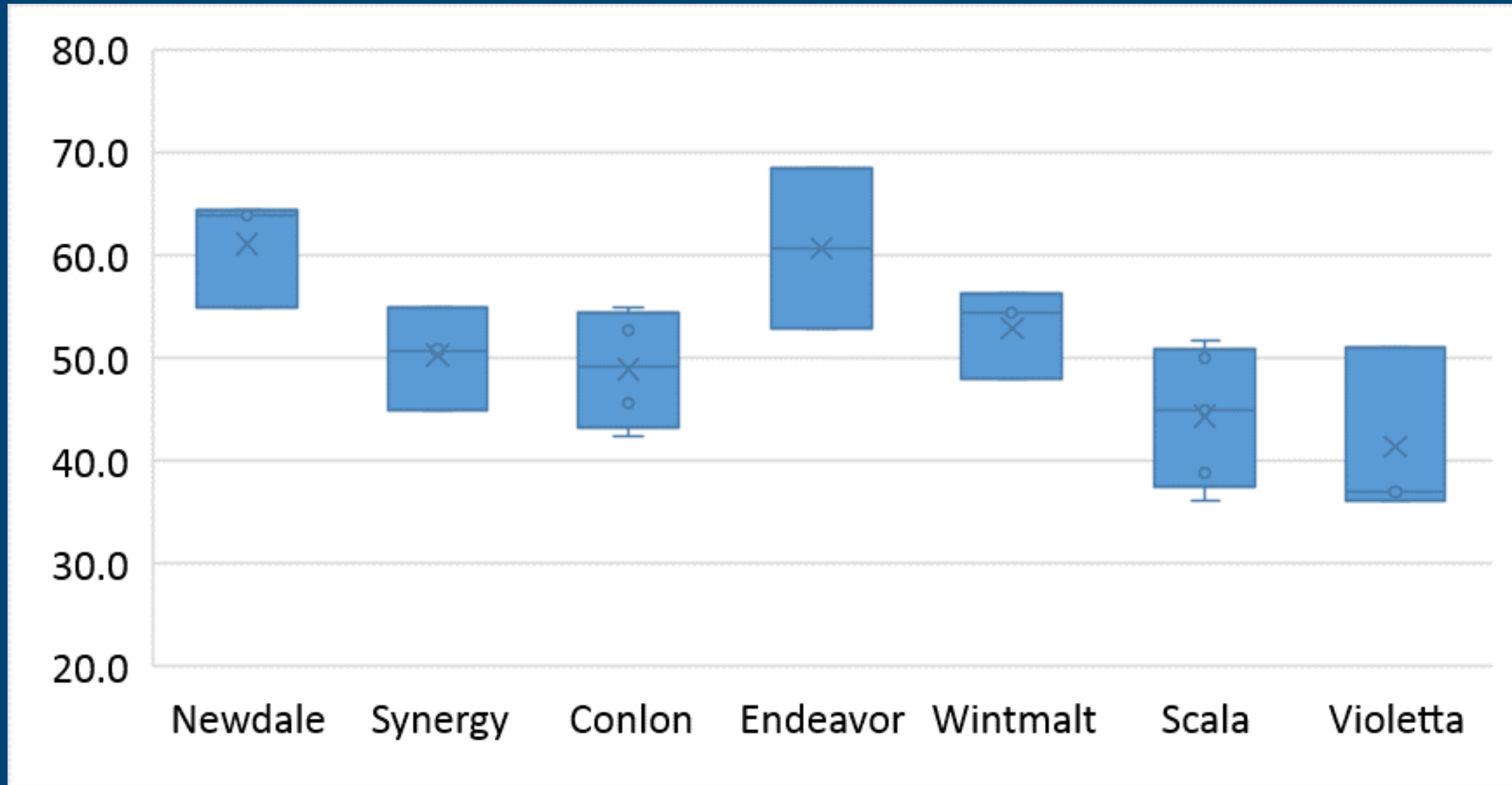
- Viability
 - *The ability to live*
 - Germination Capacity
- Vitality
 - *The state of being strong and active*
 - Germination Energy (3 day)
- Vigor
 - *Energetic Activity*
 - Germination Energy (1 day)



	Germination Energy (4 mL %)			
	24h	48 h	72h	3 Day
AAC Synergy				99
Odyssey				99
Scala				99

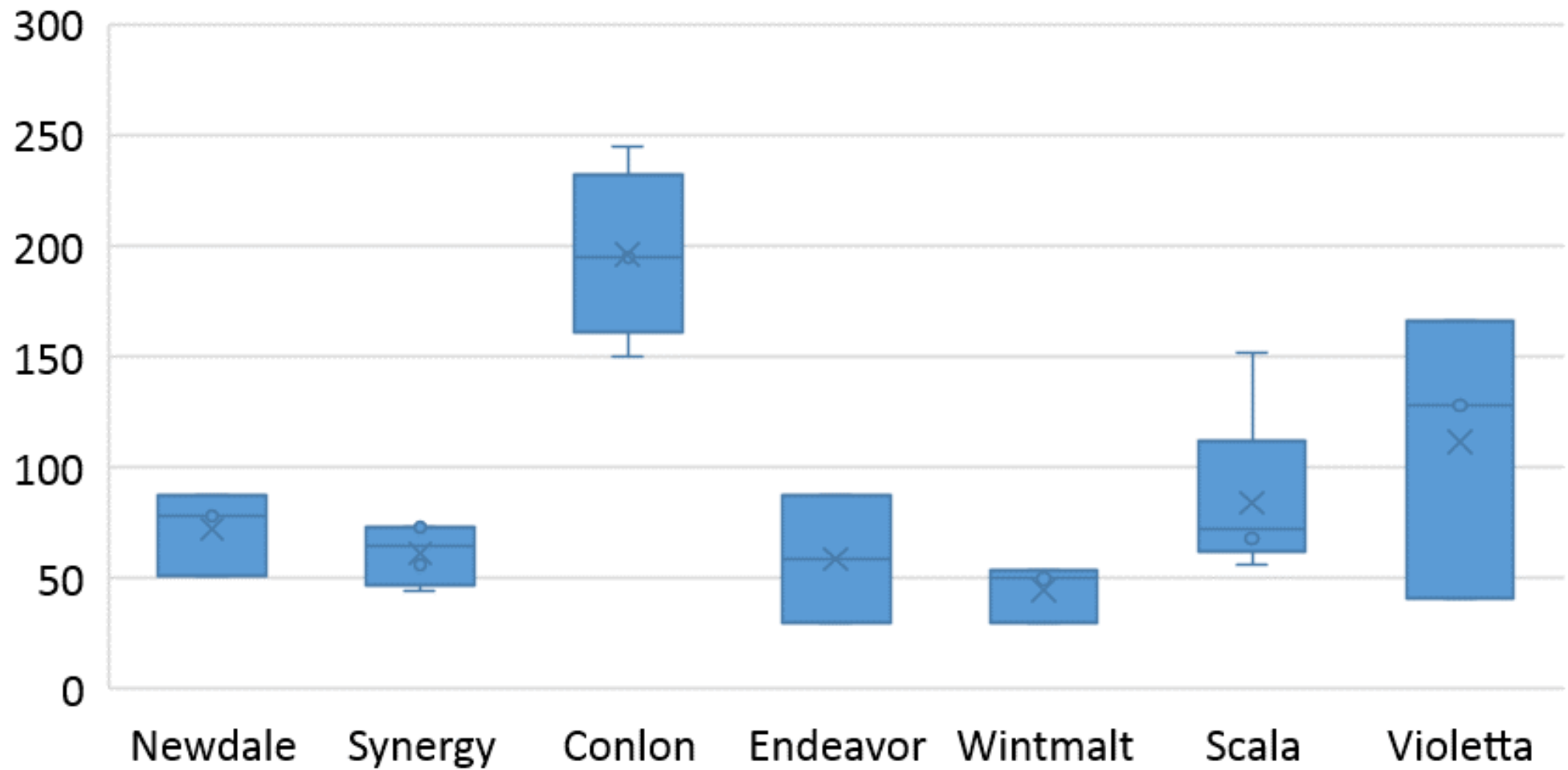
	Germination Energy (4 mL %)			
	24h	48 h	72h	3 Day
AAC Synergy	89	9	1	99
Odyssey	58	32	9	99
Scala	32	57	10	99

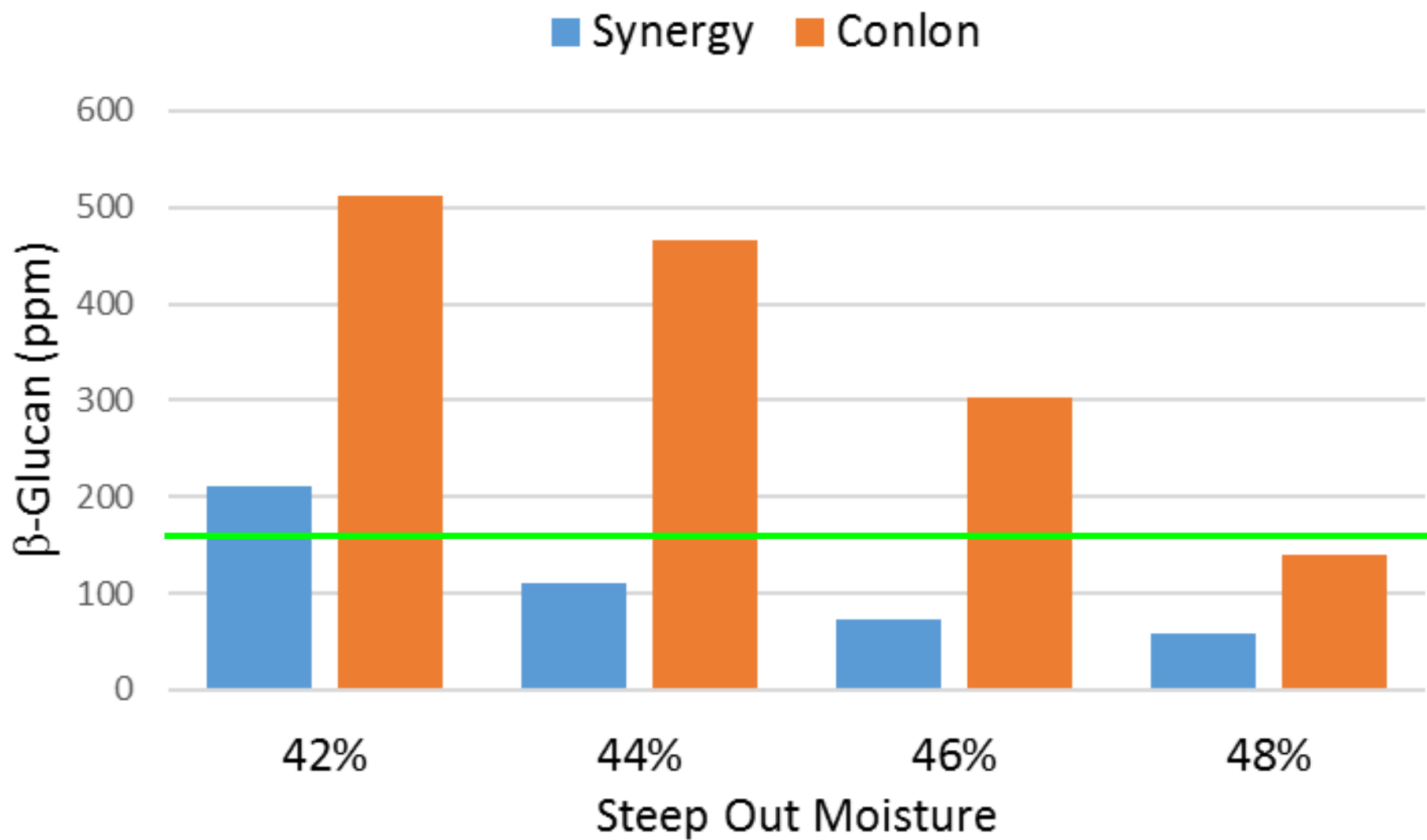
Enzyme Potential - Alpha Amylase



Scala (10.8% protein)	Fine Extract %	β-Glucan ppm	Soluble Protein %	S/T %	FAN mg/L	DP °L.	Alpha-Amylase D.U.
96 h germination @ 60°F	80.1	203	4.50	41.6	176	108	32.2
120 h germination @ 60°F	80.0	52	5.18	47.8	190	123	41.5

Ease of modification – β - glucan





What do brewers want?

- High Brewhouse Yield
 - high extract, low β -glucan
- Efficient conversion
 - Adequate alpha amylase
- Good wort separation
 - low β -glucan,
- Fermentability
 - adequate DP, adequate FAN



AMBA Guidelines

Malt Quality Characteristic	Adjunct Brewing	All Malt Brewing
Total protein (%)	>11.5%	<11.5%
Soluble/Total protein (%.)	40-47%	38-45%
Extract (%)	>80.0%	>81.0%
Diastatic power (°L)	>150	100 -120
Free Amino Nitrogen	180 - 220	120 - 180

	Crisp Marris Otter	Simpsons Golden Promise	Weyerman Pale Ale	Rahr 2-Row
Moisture, %	3.1	4.4	4.8	4.8
Extract, %	81.8	81.2	81.0	81.8
Protein, %	9.4	9.6	11.0	11.6
Friability, %	94.3	94.5	87.2	85.6
Color, °L	4.3	3.2	3.95	2.2
Kolbach, S/T %	47.1	46.7	39.5	43.0
FAN	154	192	148	187
β-glucan. %	212	64	114	118
Diastatic Power, °L	75	100	105	140
α-amylase, DU	40.0	53.2	59.5	63.0

	Odyssey	Pinnacle	Synergy	Spartan	Scala
Extract, %	80-81	79-80	81-82	72-74	80-81
S/T %	40-42	44-48	42-46	38-40	40-46
FAN ppm	140-180	180-220	200-230	180-200	140-160
β-glucan ppm	40-60	100-200	40-60	200-300	50-100
Diastatic Power, °L	100-110	100-120	110-130	90-100	100-120
α-amylase, DU	50-60	45-55	55-65	20-40	30-45

Considerations for Distilling

- **Grain Whisky**

- Use primarily un-malted cereals (corn, wheat, rye, etc) as source of fermentable extract
- A small amount of highly enzymatic malt (and/or exogenous enzymes)

- **All-Malt Whisky**

- Use 100% malted barley
- Must provide *both* fermentable extract *and* enzymes



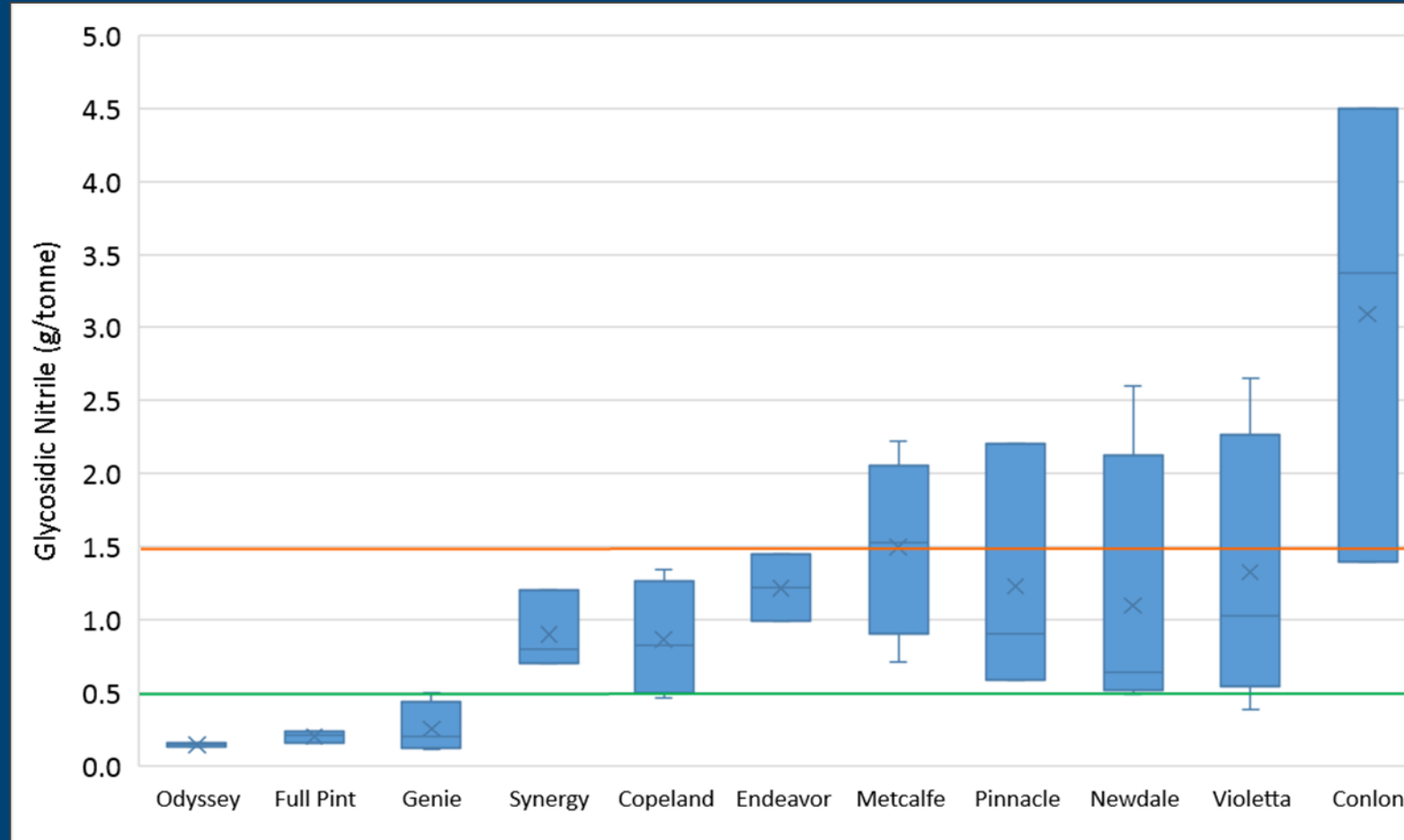
Functional Malt Needs

	Grain Distilling	All-Malt Distilling
Protein, % DB	High	Low
Extract, % DB	Low	High
Diastatic Power, °L	Very High	Moderate
Alpha Amylase, DU	Very High	Moderate
FAN, mg/L	Very High	Moderate
Spirit Yield	-	Maximum
Glycosidic Nitrile	Low	Very Low

Glycosidic Nitrile

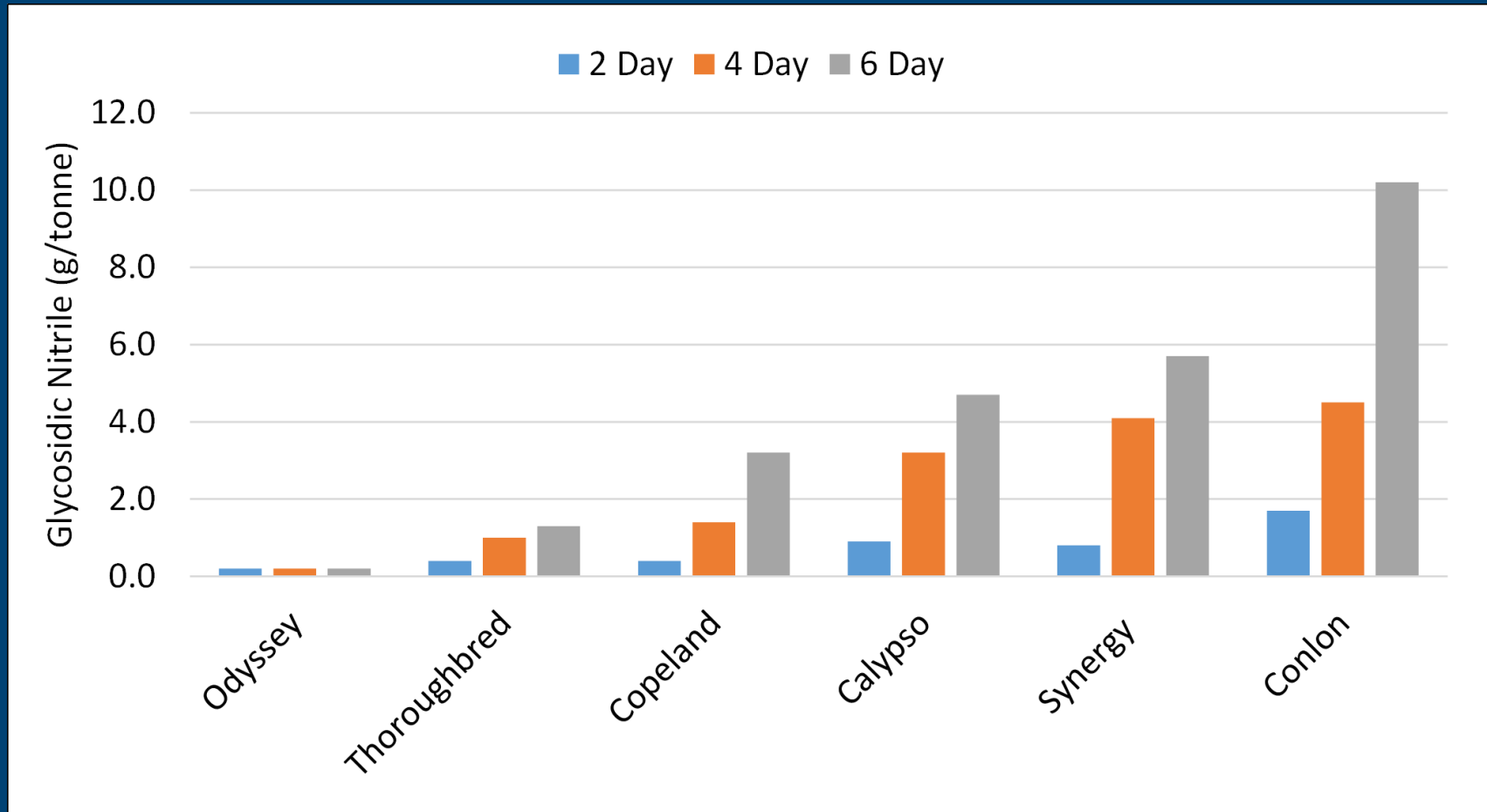
- Epiheterodendrin (EPH) is a glycosidic nitrile (GN) produced in a range of concentrations during the malting process
- The use of malt with high GN content in distilling can produce significant levels of Ethyl Carbamate (EC) which is a potential carcinogen and regulated in some markets (Canada & EU)
- GN is primarily genetically controlled, with some varieties lacking the gene for producing EPH (non-GN varieties)

Commercial Malt GN Survey



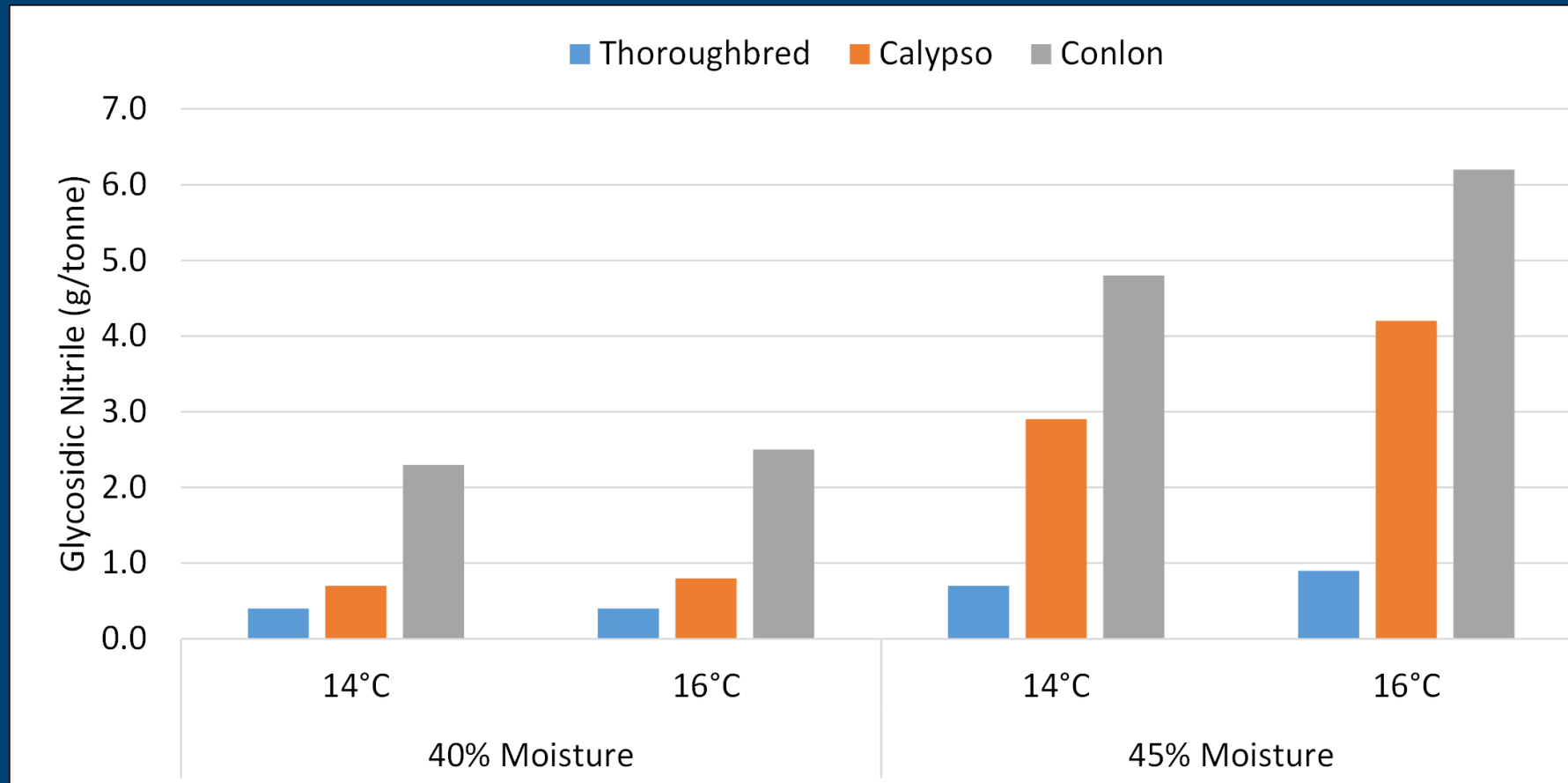
Macleod, A. Zuluaga, G. Turner, H & Sherman, J. Levels of glycosidic nitrile in North American malting barley cultivars. American Society of Brewing Chemist Annual Meeting. 2018.

Effect of germination time on GN levels in malt for six different barley varieties.



Macleod, A. Zuluaga, G. Turner, H & Sherman, J. Levels of glycosidic nitrile in North American malting barley cultivars. American Society of Brewing Chemist Annual Meeting. 2018.

Effect of germination moisture and temperature on GN levels in malt for three different barley varieties

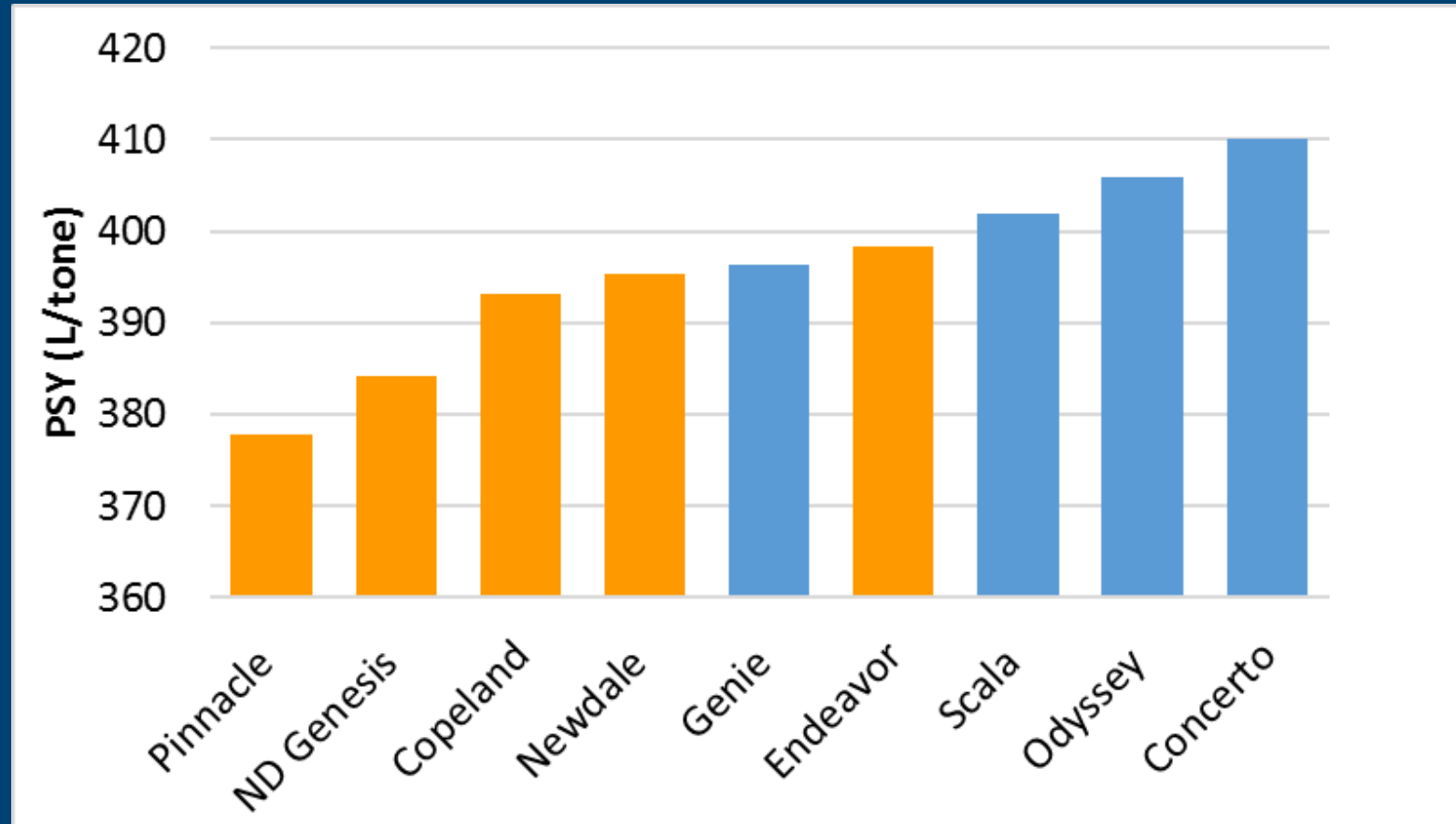


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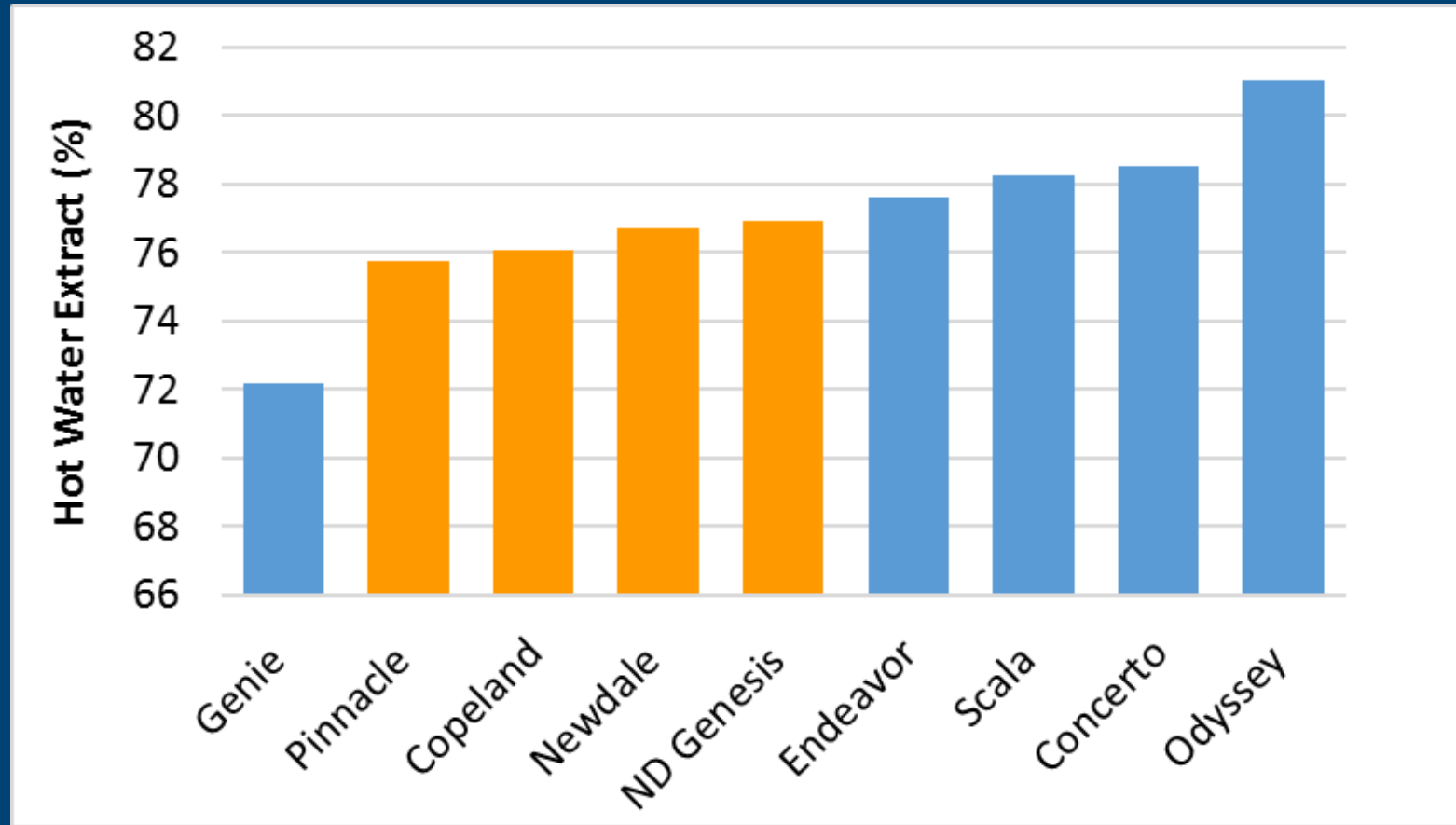
Spirit Yield

- Represents alcohol production potential per malt weight
- Reported as Liters Absolute Alcohol / tonne of malt
- Product of Extract & Fermentability
 - Positively correlated with Extract
 - Negatively correlated with grain protein
 - Positively correlated with Fermentability

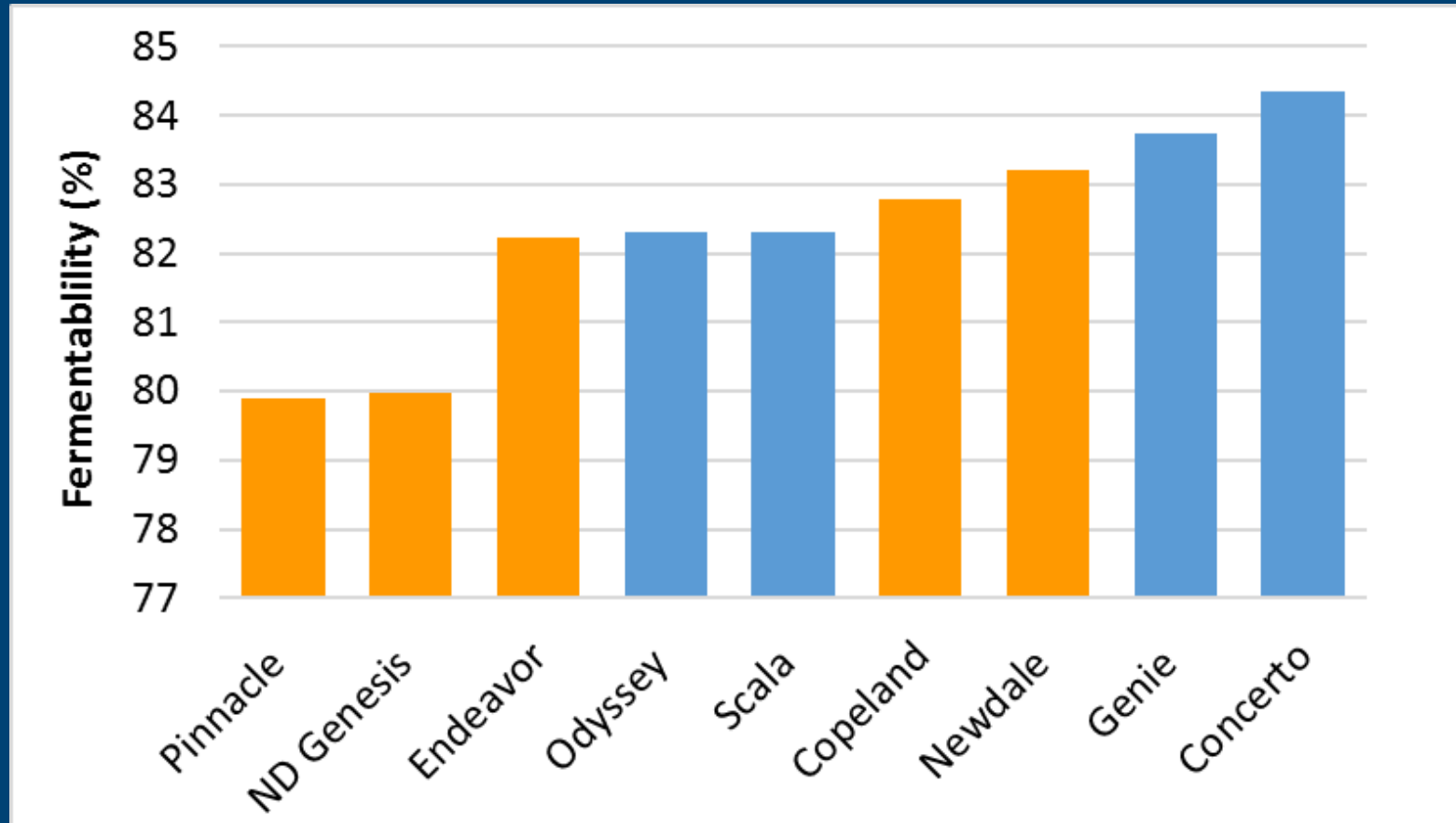
Variety Comparison



Comparative Extract



Comparative Fermentability



A world of grains!

- Wheat
- Rye
- Spelt
- Triticale
- Oats
- Corn



Malting Quality of Rye Varieties

	Danko	Brassetto	Abruzzi
Protein, %	8.5 – 10.5	9.0 – 11.5	11.0 – 13.5
Plumpness, %	40 – 80	40 – 60	20 - 35
Extract, %	89 - 92	85 - 87	83 -85
Diastatic Power	115 -125	145 - 165	120 - 135
Alpha Amylase	35 – 45	45 - 55	25 - 40

Malting Quality of Oats

Variety	Protein	Plump	G.E.	Extract	Color
	%, DB	>6/64%	%	% (DB)	°SRM
Beta Gene	11.7	67.9	96	57.4	2.8
Badger	11.3	60.8	100	57.4	2.5
Dion	12.5	31.1	86	54.4	3.0
Excell	11.4	69.8	94	54.5	2.5
Hayden	11.1	26.2	85	54.2	3.1
Horsepower	11.1	45.1	85	49.8	5.6
Ida	11.4	41.1	89	55.8	2.2
Jerry	11.6	40.5	90	51.5	1.8
Jumo	12.5	73.4	95	60.0	2.0
Newburgh	11.2	37.2	93	53.7	2.4

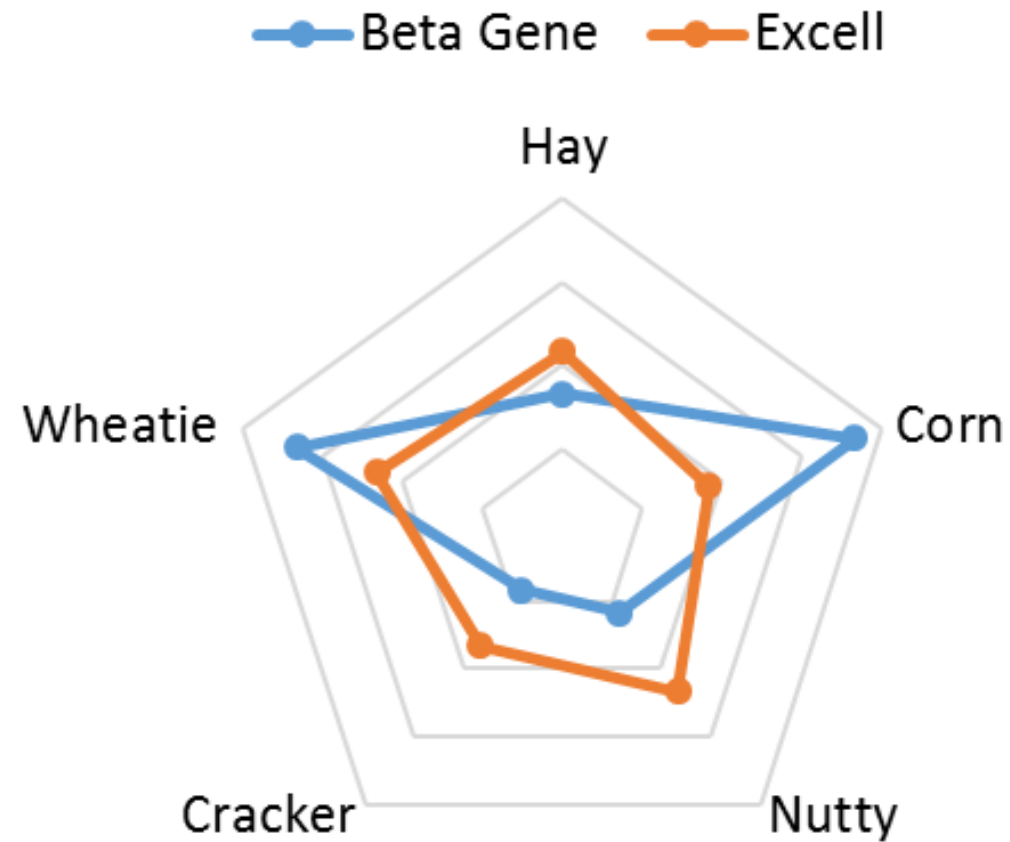
BASE MALT FLAVOR MAP



Malt Sensory – ASBC Hot Steep



Oat Sensory Attributes



Developing flavor in pale malt

- Use higher protein barley
- Promote modification
 - Higher steep out moisture
 - Extend germination time
- Higher cure temp (195 vs 185°F)
- Raise temperature (130 - 150°F) at higher moisture levels (withering)
- Increasing color will reduce DP

- *“If you want something different, then it isn't going to be the same”*

-J.Sahler, Strong Rope Brewery

Contact us!

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