Breakdown of a Malt COA

Bucket Analysis Approach

Presenters

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Great Western Malting

Breakdown of a Malt COA

Agenda

Overview of Malting and Modification

Certificate of Analysis Breakdown

Bucketing Analysis

- Protein Dependent Specifications
- Carbohydrate Dependent Specifications
- Enzyme Package Specifications
- Color

Breakdown of a Malt COA

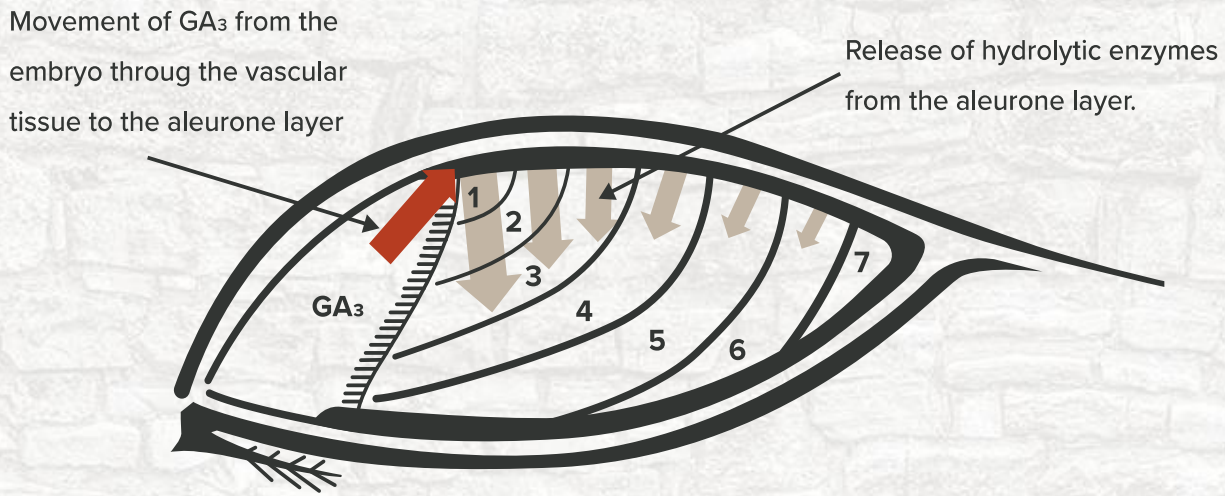
Malting and Modification

Breakdown of COA

Bucketing Analysis

Malting and the Certificate of Analysis

- Malting is the controlled germination and kilning of a seed to produce the desirable brewing characteristics
- Maltsters create ideal growing conditions for barley to germinate and drive **modification**
- "**Modification**" is the biochemical breakdown of cell wall structures, and protein matrices in order to gain access to the starch reserves held within the endosperm
- A malt Certificate of Analysis (COA) lists the results from a suite of standardized tests that serve to indicate how the malt will perform.



Breakdown of a Malt COA

Malting and Modification

Breakdown of COA

Bucketing Analysis

BA BREWERS ASSOCIATION

Breakdown of the COA

Malt Sieve Analysis (Assortment)

- Plump kernels provide more extract than thinner kernels
- Roller mill gaps are set according to the mean kernel size
  - A broad distribution can make mill setting difficult → poor extract recovery in the brewery
- Typical analysis – 7/64 + 6/64's (PLUMP's) > 90%
- Consistency is the key

Malt Sieve Analysis (Breakage)

- Damaged husks will form a poor filter bed
- Fines formed due to breakage → Slow run-off
- Dust and fines have a negative impact on malt silo housekeeping
- Peeled and broken malt kernels can lead to false (apparent) increase in extract

CUSTOMER:
TYPE: 2Row
SAMPLE #: UP94804
BLEND#: 36066
DATE: 43930

	% Assortment
7/64"	81.0
6/64"	15.4
5/64"	3.1
Thru 5/64"	0.5

Malt Analysis

Moisture, %	4.08
Extract %, finely ground malt, as is	79.0
Extract %, finely ground malt, dry basis	82.3
Extract %, coarsely ground malt, as is	78.0
Extract %, coarsely ground malt, dry basis	81.4
F/C Difference %	1.0
Color, laboratory Wort, ASBC method	1.91
Viscosity	1.44
Beta Glucan, ppm	61
Diastatic Power	129
Alpha Amylase (DU)	65.4
Free Amino Nitrogen (mg/L)	211
Total Soluble Protein %, dry basis	5.32
Total Protein %, dry basis	11.47
S/T Ratio %	46.4
Friability	89.9
Homogeneity	98.9
Whole Kernel	0.3

Breakdown of the COA

Malt Moisture

- Impacted by all process including degree of kilning
- Poor kilning may imply that other malt analysis (Color, DMS-P) will be out of specification
- Malt with very high moisture (>9%) may show a rapid decline in quality during storage
- Higher moisture = Lower Extract,
- Lower moisture = Higher Breakage
  - Typical 2 Row Base Malt Analysis → 3.8-4.6 %

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Breakdown of the COA

Extract

- Many contributing factors to the amount of extract available for a brewer
- Typical analysis for Fine Grind Dry Basis → 79-84%
- Typical analysis for Coarse Grind Dry Bases → 77-83%

Fine/Coarse Difference (F/C)

- Fine Grind % minus Coarse Grind %
- Typical analysis → 0.5-1.5 %
- Larger F/C Difference indicates lack of homogeneity in malt
  - Potential under modification, glassy portions of kernels

Color

- Color generation occurs during the kilning of green malt
- Control of color through malting practices, kilning regime and blending
- 95%+ of beer color contribution is malt
  - Remaining 5% Maillard reaction of amino acids, sugars during boiling

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Wort Viscosity

- Broad correlation with wort run-off times in brewery and potential haze problems
- Measures Beta-Glucans, pentosans, and proteins combined
- Typical analysis < 1.6, normally → 1.44-1.52

Beta Glucan (BG)

- Malt with a laboratory wort BG figure of <140 will most likely show signs of quicker run off rates and better beer filtration rates
- Above 140 BG, there is a high potential for lautering and filtration issues
- Typical analysis → <120 mg/L, this year <100 mg/L

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Breakdown of the COA

Diastatic Power (DP)

- For most craft brewers, DP >115 will provide sufficient enzymes to process the mash
- Higher levels of enzymes support:
  - Increased attenuation (reduced residual dextrins)
  - High levels of adjunct addition
  - High gravity brewing

Alpha (α) Amylase (AA)

- α-amylase progressively breaks open the chains of amylose and amylopectin to form dextrins containing 7 to 12 glucose residues.
- For most brewers with normal levels of unmalted grains or adjuncts, >50 AA is more than enough for breakdown of starch into simple sugars

Starch degrading enzymes not individually reported:

- β-amylase
- Limit dextrinase

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Free Amino Nitrogen (FAN)

- FAN is the term for amino acids, which have been either freed or broken down from barley protein during germination
- Composed of various low molecular weight proteins
- Important for yeast nutrition
- Greater malt modification directly contributes to higher FAN in finished malt

- Insufficient FAN (<150mg/L)
  - Poor yeast growth
  - Slow or incomplete fermentations
- Excess FAN (>250 mg/L)
  - Utilized by other micro-organisms and converted into negative flavor compounds
  - More problematic in packaged beer and is less of a concern if your beer sells in a pub or tap room
  - Contributes to increased color formation during wort boil

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Breakdown of the COA

Soluble Protein (% dry basis)

- Measure of protein that has been solubilized during the malting process
- Water soluble → extracted into mash
- Lower molecular weights

Total Protein (% dry basis)

- Total Protein (%) = Total Nitrogen (%) x 6.25
- Lower protein malt
  - Higher extract
  - Lower enzymes
- Higher protein malt
  - Lower extract
  - Higher enzymes
  - Important for higher adjunct levels, high gravity brews and when targeting low residual dextrins
  - More foam positive
- Total protein is reduced slightly during malting
  - Removal of rootlets post-kiln
- Total protein content strongly influenced by weather

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Breakdown of the COA

S/T Ratio (%)

- S/T = Soluble Protein / Total Protein
- Normal values for base malt between 42 - 46%
  - Higher for some specialty malts 45 - 52%
  - Lower for classic pilsner malts 39 - 42%
- Somewhat challenging to interpret
  - As Total Protein increases – S/T ratio *decreases* even if soluble protein remains constant.
  - As Total Protein decreases – S/T ratio *increases* even if soluble protein remains constant
- Strong measure of modification – especially for protein consistent malt streams

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Breakdown of the COA

Friability

- Typical analysis > 80%
- Strong predictor of malt modification
- Low values indicate under-modification
  - Benefit from lower temperature mashes to favor the action of thermally sensitive β-glucanase and proteolytic enzymes
- High values indicate complete modification

Homogeneity

- Typical analysis > 90%
- Measure of uniformity of modification
- Very important as a descriptor for friability and malt quality

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Broadly Speaking…

Maltsters control moisture content, temperature, air flow and time in order to achieve the desired level of modification

Lower Modified Malts

Lower Free Amino Nitrogen
Reduced color formation
Increased foam potential
Increased β-glucan

- Slower wort separation
- Increased mouthfeel

Higher Modified Malts

Higher Free Amino Nitrogen
Increased color formation
Decreased foam potential
Decreased β-glucan

- Thinner beer
- Less mouthfeel

Breakdown of a Malt COA

Malting and Modification

Breakdown of COA

Bucketing Analysis

Breakdown of the COA

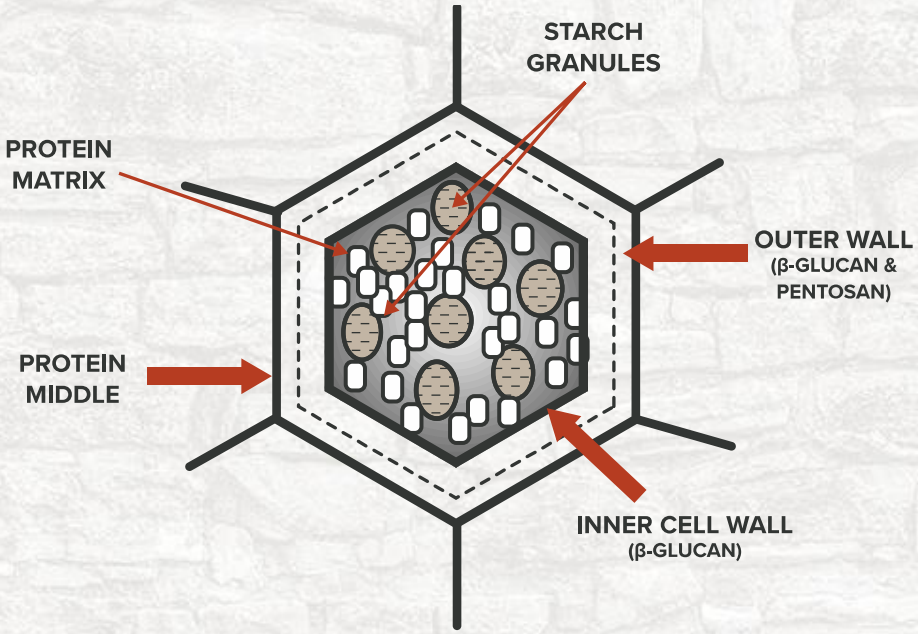
Bucket 1 – Protein Modification

Has there been adequate digestion of the barley protein into usable soluble protein?

- Nutrients for yeast → Free Amino Nitrogen (FAN)
- Mid size proteins → Body and Foam
- Large Size proteins → Haze

Analysis

- S/T Ratio
- Free Amino Nitrogen
- Total Protein
- Soluble Protein



Winner

- **S/T Ratio**

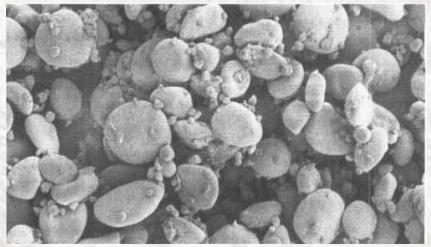
Breakdown of the COA

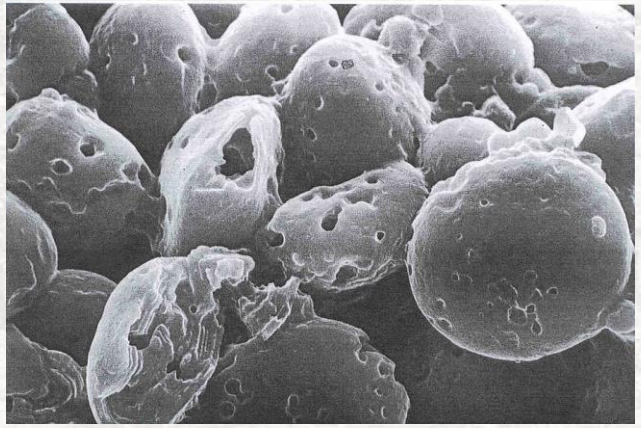
Bucket 2 – Carbohydrate Modification

Has there been adequate digestion of the cell wall, so that it is friable for milling, protein is accessible, and extract is free flowing?

- Breakdown of dense carbohydrate structures, and long chain starches

Is there good quality recoverable extract?
Can we get consistent attenuation?





Analysis

- Fine Coarse Difference
- Viscosity
- Beta Glucan
- Friability

Winner

- **Beta Glucan**

Breakdown of the COA

Bucket 3 – Enzyme Potential

Not so concerned with development of enzymatic potential but rather the preservation of them!

- Prior to kilning → 180 DP
- After kilning → >120 DP (1/3 or more of DP denatured or damaged)

- By slowly increasing temperatures (115 ºF to 150 ºF) as moisture decreases to below 30%, we are able to stabilize enzymes. thereby preventing denaturing from occurring.

- Enzymes are in excess of what brewers require

ENZYME	LETHAL TEMPERATURE	COMMENT
α-amylase	<80 ºC (176 F)	Most stable enzyme
β-amylase	65 – 70 ºC (149-158 F)	Thermally sensitive

Analysis

- Diastatic Power
- Alpha Amylase

Winner

- **Diastatic Power**

Breakdown of the COA

- Each measurement on a COA also informs you about other aspects of the malt
- Brewers should know to request actual Lot COAs, rather than typical COAs
- Invisible strings connect each of the 20+ analysis
- Each brewery is configured differently. Figure out what *is important to you* and focus on those aspects of your malt analysis. Monitoring things that don't matter won't help.

The Winners

- S/T Ratio
- Beta Glucan
- Diastatic Power

- Color
- Extract

Thank you!