Malts and Malting

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Why Malt Grains?

- Unmalted grains (alone) are unacceptable for brewing
- Malting performs two critical activities
  - Necessary enzymes are formed or activated
  - Starches become accessible
Anatomy of a barley grain

- Endosperm
  - Contains the starches and proteins in a glassy matrix
- Embryo
  - Where the growth is initiate
  - All contained within the husk

http://www.crc.dk/flab/the.htm
Malting Process – Steeping

- At beginning raw barley is ~12% moisture
- Steeping raises the moisture content to ~45%
- Water is added at 50 to 65F
- Water is drained and refilled several times
- Oxygen is introduced to aerate the liquor
- Total time for this step is 2 to 4 days
- Steeping is complete when rootlets begin to show
  - “Chitted” barley
- Enzymes are activated or synthesized
Malting Process – Steeping

- Water infusion of steeping malt

Malting Process – Steeping

• Full malt steep tank

http://www.undiscoveredscotland.co.uk/usfeatures/maltwhisky/maltings.html
Malting Process – Germination

- Properly hydrated barley transferred to germination area
  - Saladin box
  - Floor malting
- Germination continues and barley undergoes modification
- Critical control points
  - Moisture content (≈45% moisture)
  - Temperature (50 to 70F)
  - Time (3 to 8 days)
  - Oxygen uptake
- Germinating malt is also called “green malt”
Malting Process – Saladin Box

- Modern malting facilities use a rectangular box for the germination stage
- Air can pass through the bottom
  - Introduces oxygen to the malt
  - Carries off other gaseous byproducts
- Rotating screws level and turn the malt
- Gives precise temperature and humidity control
Malting Process – Saladin Box

• Saladin box loaded and being leveled

Malting Process – Saladin Box

- Helical turners of type used in Saladin box

Malting Process – Floor Malting

- Traditional method of malting
- Spread a thin layer of the malt on the floor
  - Depth could be varied to control temperature
- Used lower temperatures and longer germination times
- A much more variable process
Malting Process – Floor Malting

- Picture of a floor malting (Laphroaig Whiskey distillery)

http://www.maison-de-stuff.net/john/pictures/EdinburghAndIslay/05/
Malting Process – Floor Malting

- Turning floor malting with a rake

http://brewpublic.com/oregon-beer/rogue-nation-breaks-ground-on-floor-malting-facility/
Malting Process – Modification

• Changes to the kernel during germination
  • Endosperm breaks down
  • New enzymes created
  • Acrospire grows from embryo
  • Acrospire length ratio
    • <75% undermodified
    • 75-100% fully modified

http://www.homebrewcompanion.com/malt.html
Malting Process – Modification

- Modification of malt helped distinguish brewing techniques and styles
- British brewers have always used fully modified malts
- German brewers often had undermodified malts
  - Protein rest
  - Decoction
- Most malts today are fully modified

- Maltsters do not want to overmodify malts because this reduces the potential extract of the malt
Malting Process – Drying

- Following completion of germination the malt is kilned
- First step of kilning is drying
  - Reduces moisture content to ~5%
- Slow drying with temperature below 120F
  - Halts the germination process
  - Protects enzymes from denaturation
- Forced air is used to carry off moisture
- Kiln typically has several floors to accommodate malt
Malting Process – Drying

• Malt kiln

Malting Process – Curing

• After drying the malt is cured to give it its character
• Temperature ranges vary greatly
  • Palest malts – 180F
  • Darkest malt – 500F
• Time and temperature combine to give the malt its character
• Darker malts also frequently use drum roaster
Malting Process – Drum Roaster

- Drum roaster for darker colored malts

Malt Color Scales

• 2 separate scales for measuring color
  • SRM – Standard Reference Method
    • Used interchangeable with °Lovibond
    • °Lovibond is used for malt color
  • European Brewing Convention – EBC
  • Rule of thumb is that EBC is twice SRM

• Lower numbers lighter / higher numbers darker
Classes of Malts – Base Malts

- Grainy, graham cracker, biscuity
- Color contribution – yellow, gold
- **European Pilsner** – 1-2ºL
  - Lightest base malts, kilned 130-180ºF
  - German lagers, Belgian styles
- **US 2-row** – 2-3ºL
  - Intermediate base malt, kilned 130-180ºF
  - Most US styles
- **British Pale Malt** – 2-4ºL
  - More robust flavor, kilned 200-220ºF
  - Most UK styles
Classes of Malts – High Dried Malts

- Can be used as base malts in lager styles
- Drying stage usually done at a higher temperature
- More melanoidin content – bready, toasty
- Color contribution – amber, copper
- **Vienna** – 4ºL
  - Kilned 210 to 230ºF
  - Vienna lagers
- **Munich** – 5-10ºL
  - Kilned 210 to 240ºF
  - Oktoberfest, Munich Dunkel, Bock
- Others – **Victory**, **Aromatic**, **Brown Malt**
Classes of Malts – Crystal Malts

- Different process than other types of malts
- Kilned while still wet (~50% moisture) at ~150-160°F
  - No ventilation to dry out the malts
  - Completes a “mash” while still in the husk
- After this rest, they are kilned to get desired color/flavor
- Color contribution amber to red/brown
  - Range of Colors and Flavors
    - Crystal 10 – honeylike sweetness
    - Crystal 60 - caramel
    - Crystal 120 – dark caramel, raisin, burnt sugar
- Crystal Malts very common in British styles
Classes of Malts – Roasted Malts

- Kilned very high 400-500°F
- Roasted, chocolate, coffee, burnt flavors
- Color contribution brown to black
  - Reddish hue at very low levels
- Common in Porters and Stouts
- Chocolate – 300 to 400°L
- Black Patent – 500 to 600°L
- Roasted Barley (unmalted) – 500°L
Other Malted Grains

- **Wheat Malt**
  - Characteristic spicy, tart flavor
  - High protein content
    - Helps head retention
    - Causes haze
  - Many wheat beer styles

- **Rye Malt**
  - Spicy character
  - Roggenbier is a classic example

- **Sorghum**
  - Not very common, gluten-free
Adjunct Grains

- Other grains that are not malted but added to mash
- Need to be treated differently to access starches
  - Cereal mash
  - Flaked, torrified raw grains
- Often have different protein content
  - Lower protein – reduce flavor contributions
    - rice, corn
  - Higher protein – aid head retention, body
    - barley, wheat, oats
Other sugar additives

- Other sugars can be added to provide fermentables
- Simple sugars do not contribute much to body, flavor
- Simple sugars
  - Corn sugar, table sugar
  - Common in Belgian styles to reduce body
- Other fermentables
  - Honey, molasses, maple syrup
- Belgian Candi Syrups
  - Light and Dark syrups