



Malt

Rockhoppers Brew Club

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Overview: History

- Evidence shows humans using barley and wheat as a food source around 20,000 years ago.
- They discovered that soaking made the kernels softer to chew and more flavorful
- Hymn to Ninkasi: Mesopotamian Cuneiform
 - 1800 BC: Recipe for malting grain and brewing beer
- Late 15th Century, laws and regulations regarding malt process and quality are recorded
 - At this time, malting was very much a boutique process
 - Wood fired kilns would impart smoky character to malt
 - With advent of coke kilning (circa 1650), lighter, cleaner malts could be produced (pale ale)
 - Thus began industrialized brewing and brewing science



Overview: What is Malt?

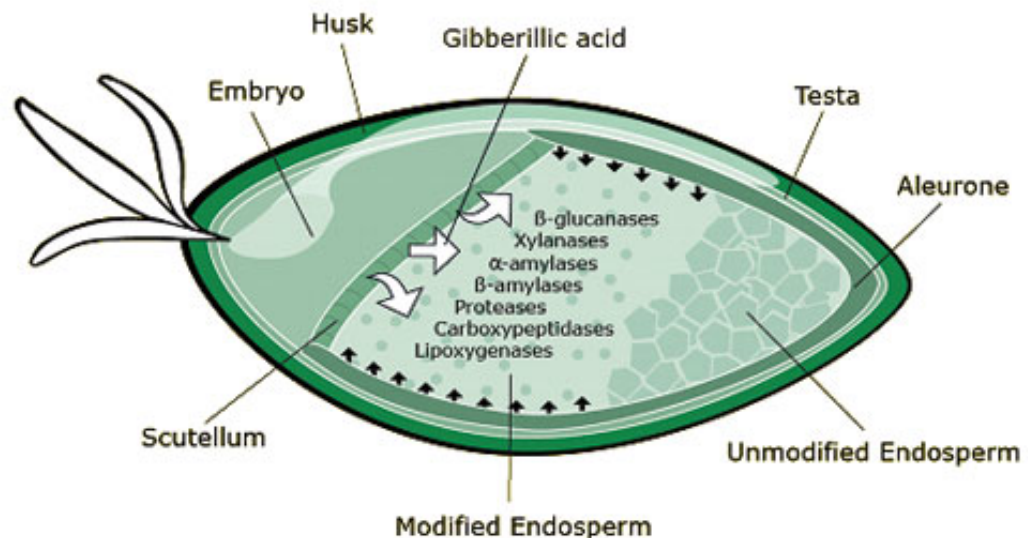
- Germinated cereal grain
 - Barley, wheat, rice, oat, rye, sorghum ...
- Barley is primary brewing grain
 - Available
 - Best at converting starch to sugar (high enzyme content)
 - Best flavor and beer qualities (color, clarity, mouthfeel)
- Malting
 - Barley is soaked in cold water for 40-50 hours
 - Rootlets sprout and enzymes are activated
 - Dried by kilning (warm air)
 - Sets properties



Overview: What's inside

Cereal grains (seeds) are plant “eggs”

- Plant embryo
- Endosperm (80% of dry grain weight)
- Amino Acids (molecular building blocks)
- Lipids (waxes, fats, fatty acids)
- Enzymes (break down sugars and proteins)
 - Extent to which enzymes can break down sugars is known as **Diastatic Power**
 - Enzymes are very temp specific



Application: Mashing

Soaking crushed malt in hot water at various temperatures to activate enzymes that break down proteins and sugars.

- The resultant sweet tea-like liquid is wort
- Concentrated wort is extract (LME/DME)

Temp	Enzyme	Purpose	Comments
45C/113F	β -glucanase	Break down proteins ("packets" that starch granules are contained in)	Not necessary with modern modified malts that have been kilned to break down these proteins
52C/126F	Protease	Solubilize proteins/FAN	Not necessary with modified malts*
63C/140F	β -amylase	Produces sucrose/maltose	More fermentable (dry)
<72C/162F	α -amylase	Produces maltose/malto-triose/dextrines	More malt flavor and body
>75C/167	Mash out	Set wort profile	Denatures enzymes – makes mash more viscous for sparge

Application: Base Malts

Base malts are lightly kilned and have high diastatic power. Used primarily to contribute fermentable sugar to wort.

Type	Color	Notes
Pilsner	2L	High diastatic power. Can be 2-row or 6-row.
Pale	3L	Slightly toastier
Wheat	3L	Same diastatic power as barley. Huskless, so less astringent but can stick (use rice hulls with wheat)
Rye	3L	Stickier than wheat, so use sparingly (10%). Adds spicy notes.
Vienna	4L	Imparts lady-finger/honey characteristics. Generally combined with other base malt at (10-40%)
Munich	10-20L	Amber color and imparts “malty” flavor. Generally combined with other base malts (10-60%)
Aromatic Malt	20L	Often same as dark Munich malt. Relatively low diastatic power. Imparts rich malt character. (5-10%)
Amber Malt	25L	AKA “Biscuit” or “Victory”. Imparts flavors of biscuit, toast, bread. Deep amber color. 10%
Brown Malt	60L	Very dry roasted character. Bread crust flavors. Between amber and chocolate. 5-10%

Application: 2-row vs 6-row

2-row generally for brewing, 6-row generally for feed

- 6 Row
 - Higher protein content
 - More DMS, haze, protein break
 - More enzymes (improved conversion)
 - Favors use of cheaper adjuncts (rice, corn)
 - Cheaper (higher per acre yields)
 - Thicker husks improve lautering
 - Tannins
- 2 Row
 - More draught resistant
 - Better extract potential (2-5%)
 - Better tasting (per sensory experts)
 - Lower diastatic power (enzymes) reduce conversion efficacy with adjuncts
 - More expensive

Two Row

Six row



Application: Caramel Malts

AKA Crystal Malts. These malts have been “stewed” after malting to convert sugars within kernels. Various roasting temps caramelize the sugar, which yield flavors like honey, toffee, caramel, and raisin. Also add body, head and mouthfeel to beer. Best practice is to not exceed 15% of grist with all caramelts. Little diastatic power – can be mashed or steeped to impart character.

Type	Color	Notes
Cara-Pils	3L	Dextrin malt. Adds body and head with little effect on flavor or color. 1-5%
Crystal 10-40	10L-40L	Light honey to light caramel color and sweetness. Often used in Pale Ales and Ambers.
Honey Malt	25L	AKA “Brumalt”. Versatile, rich honey flavor.
Crystal 60-80	60L-80L	Most commonly used crystal malts. Adds full caramel flavor and color.
Crystal 120	120L	Add lots of color. Toasted caramel flavor. Hints of burnt sugar and raisin. Use with restraint for complexity.
Special B	150L	Unique Belgian Malt imparts raisin/plum character. Use with restraint in Belgian ales, and other dark beers. (1/4-1/2 lb in 5-gallon batch)

Application: Roasted Malts

These malts are highly roasted and no longer have any diastatic power. As such, they can be added at the end of the mash to contribute color and coffee, bitter chocolate, and burnt toast flavors to beer. Adding at the end of mash also reduces astringency and acid bite that roasted malts can contribute. A little goes a long way, generally should be less than 5% of grist.

Type	Color	Notes
Chocolate Malt	300-400L	Contributes ruby-black color and bittersweet chocolate flavor.
Debittered Black malt	500L	Generally offered under brand names (Black Prinz, Midnight wheat, Carafa). De-husked in order to smooth the roasted character it imparts.
Roasted barley	500L	Not actually a malt, rather highly roasted barley. Imparts strong coffee character. Signature flavor in stouts.
Black Patent	500-600L	Blackest of black. Contributes highly roasted flavor. Use sparingly (1-2 oz per 5 gallon).

Application: Other Grains

Other cereal grains can be used to contribute flavor, color and character to beer. These grains are often flaked to soften or “gelatinize” the starches so that enzymes can break them down. Whole grains often require a “cereal mash” to modify the starch. These grains will typically need to be mashed with barley to provide the enzymes required to convert the starches.

Type	Notes
Oatmeal	Popular in porters and stouts. Provides smooth, silky mouthfeel and creaminess as well as body. High protein content typically reserves use for dark beers due to haze. Unless using “instant” oats, you will need to conduct cereal mash before adding to brew mash (cook like oatmeal, boil in water).
Flaked Corn	A common adjunct in British bitters and milds. Will lighten flavor and body without overpowering flavor.
Corn Grits	Used by mega breweries to further diminish flavor and body in American Light Lagers. Cheaper than flaked corn.
Flaked Wheat	Adds body and haze consistent with many wheat beer styles. Adds a crisp character to beer. Also used in sour styles as protein is a food source for funky organisms.
Flaked Rice	A common adjunct in light lagers. Adds little flavor and makes for drier tasting beer than corn.
Rice Hulls	Not an adjunct per se, as they are not fermentable and add no flavor or color to beer. Rather they assist in preventing stuck sparges when huskless malts (wheat, oats, etc) are being used.

Application: Other Malt Flavors

Maillard Reaction

- Caramelization is thermal decomposition of sugar
- In much the same way Maillard is thermal decomposition of amino acids (proteins)
- Maillard is what occurs in toasting of bread and when we cook a steak
- Can achieve through decocting the mash or by long boil times
 - Melanoidins are the browning aspect of the Maillard reaction

Dimethyl Sulfide (DMS)

- S-methylmethionine (SMM) is DMS precursor and is inherent in malt.
 - Tastes like corn, cabbage, shrimp in finished beer
 - Usually driven away by kilning (heat)
- Light malts (especially pilsner) haven't been heated enough
 - Increase boil time (90 min)
 - Don't cover boil so DMS can dissipate

Application: Decoction

Part of mash is removed and boiled, then returned to the mash

- Technique for increasing step temperatures
- Caramelizes sugars
- Further breaks down starches
- Maillard products
- Deeper malt flavor and color

Technique

- Determine amount to decoct through brewing software
- Allow mash to settle
- Draw decoction from thick grain into separate kettle
 - Enzymes have dissolved into solution
- Raise decocted mash to boil
 - Stir continuously
 - Rest at 150
 - Boil for 15-minutes
- Return to main mash



Application: Troubleshooting

Poor Conversion

- Be sure you are using adequate base malt (diastatic power)
- Be sure that you have crushed the malt adequately
- Be sure pH is in 5.2-5.5 range
- Protein rest (120-130) if using unmodified malts

Stuck Lauter

- Malt crushed too finely
- If using huskless grain (wheat), be sure to add rice hulls
- Raise temp of mash to make more viscous (like warming honey)

Hazy Beer

- Check recipe to determine if you are using high protein malts (6-row, wheat, oats)
- Be sure you are using modified malts, or are performing a protein rest
- Be sure you are getting good hot/cold break
- Use finings: Whirlfloc, Isinglass, Irish Moss, Gelatin

Under-attenuation

- Check mash temps
- Be sure that you haven't raised mash temps too high and denatured enzymes
- Check recipe for > 15% cara malts

Sensory:

- **Light Lager**
 - Corn, light biscuit/toast
- **Marzen**
 - Moderate German malt, rich, bready, somewhat toasty, bread crust
 - Caramel, biscuit, roast are inappropriate
- **Barleywine**
 - Very rich and strongly malty.
 - Bready, biscuity, nutty, toasty, caramel, toffee, dark/dried fruit, molasses
- **WeizenBock**
 - Med-hi to high malty-rich character, bready wheat.
 - Wheat, bready, toasty, grainy, sweet, Maillard, caramel.
 - Dark fruit (plum, prunes, raisins), chocolate (no roast)

Sensory:

- **Wheat**
 - **High protein content – usually cloudy with good head retention**
 - **Silky mouthfeel with a crisp character**
 - **Light flavor – grainy, bready**

Don't confuse the malt flavor with the clove/banana yeast character common with many wheat beers



Application: Resources

Malt

- **John Mallett**

How to Brew

- **Palmer**

Brewing (2nd Edition)

- **Lewis and Young**

Wikipedia

BYO