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# Malts and Malting

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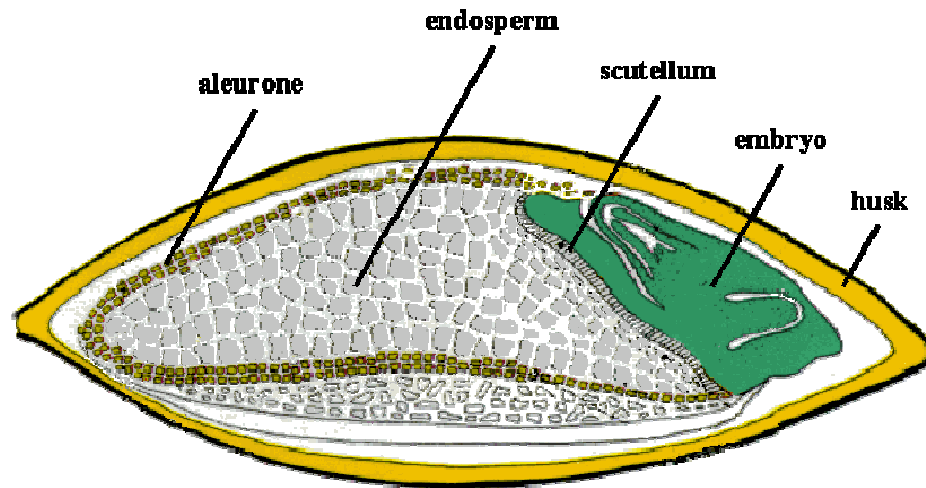
# Why Malt Grains?

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

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

# Malting Process – Steeping

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- 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
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# Malting Process – Steeping

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- Water infusion of steeping malt



# Malting Process – Steeping

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- Full malt steep tank



# Malting Process – Germination

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- 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”
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# Malting Process – Saladin Box

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- 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
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# Malting Process – Saladin Box

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- Saladin box loaded and being leveled



# Malting Process – Saladin Box

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- Helical turners of type used in Saladin box



# Malting Process – Floor Malting

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- 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

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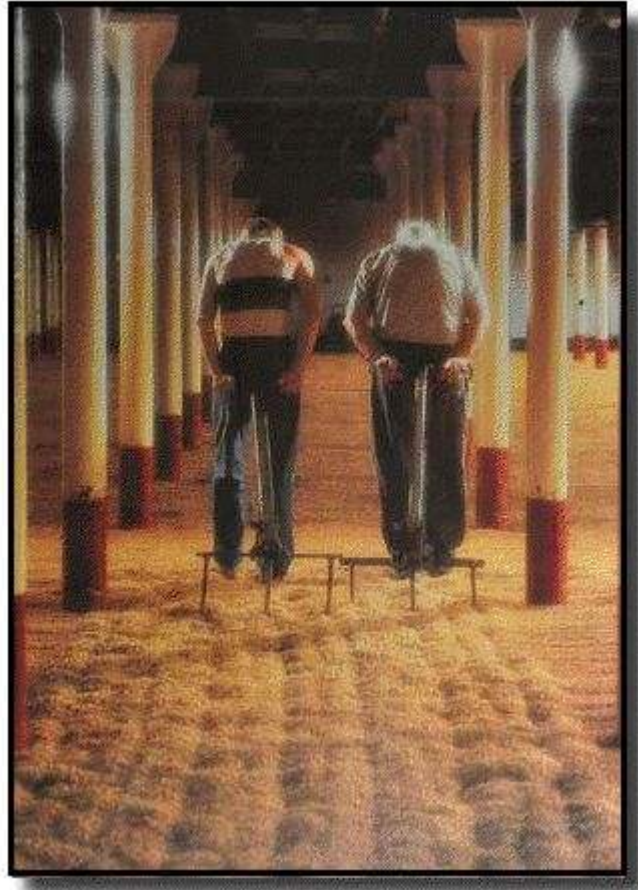
- Picture of a floor malting (Laphroaig Whiskey distillery)



# Malting Process – Floor Malting

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- Turning floor malting with a rake



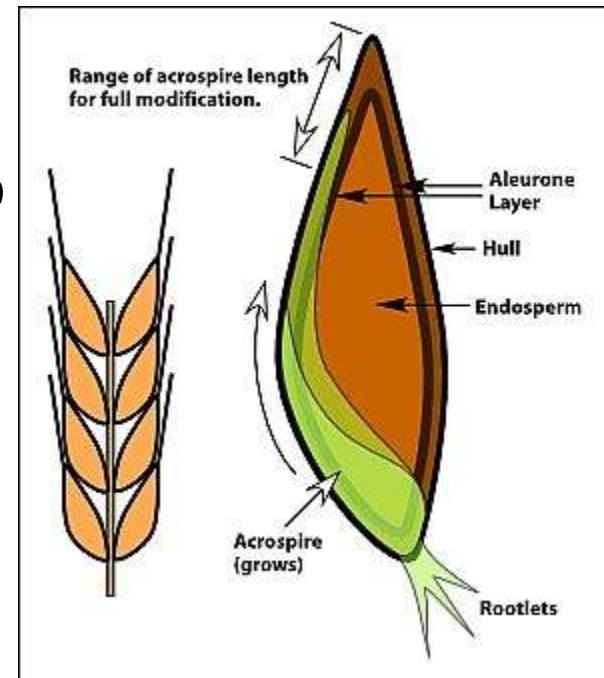
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<http://brewpublic.com/oregon-beer/rogue-nation-breaks-ground-on-floor-malting-facility/>

# Malting Process – Modification

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- 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



# Malting Process – Modification

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- 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
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# Malting Process – Drying

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- 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
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# Malting Process – Drying

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- Malt kiln



# Malting Process – Curing

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- 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
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# Malting Process – Drum Roaster

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- Drum roaster for darker colored malts



# Malt Color Scales

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- 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
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# Classes of Malts – Base Malts

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

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- 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** – 4°L
    - Kilned 210 to 230°F
    - Vienna lagers
  - **Munich** – 5-10°L
    - Kilned 210 to 240°F
    - Oktoberfest, Munich Dunkel, Bock
  - Others – **Victory, Aromatic, Brown Malt**
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# Classes of Malts – Crystal Malts

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- 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
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# Classes of Malts – Roasted Malts

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- 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
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# Other Malted Grains

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- **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
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# Adjunct Grains

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- 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

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- 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
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# Malt Ingredients Question

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- *Explain the malting process, identifying and describing the different types of malts by their color and the flavor they impart to the beer. Give the styles with which they are associated*
  - Explain why grains are malted
  - Description of the malting process
    - Steeping, germination, drying, kilning
  - Types of malts and associated styles
    - Base malts, high dried, crystal, roasted
  - Mention other grains than barley that are malted
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