Single Malt Whisky

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Today's Menu

- **Highland** (Speyside) Glenlivit 12 yr 43%
- **Lowland** Auchentoshan 3 Wood NAS 43%
- **Islay** Lagavulin 8 yr 43%
- **Campbeltown**

The Scotch Whisky Problem

Regulations

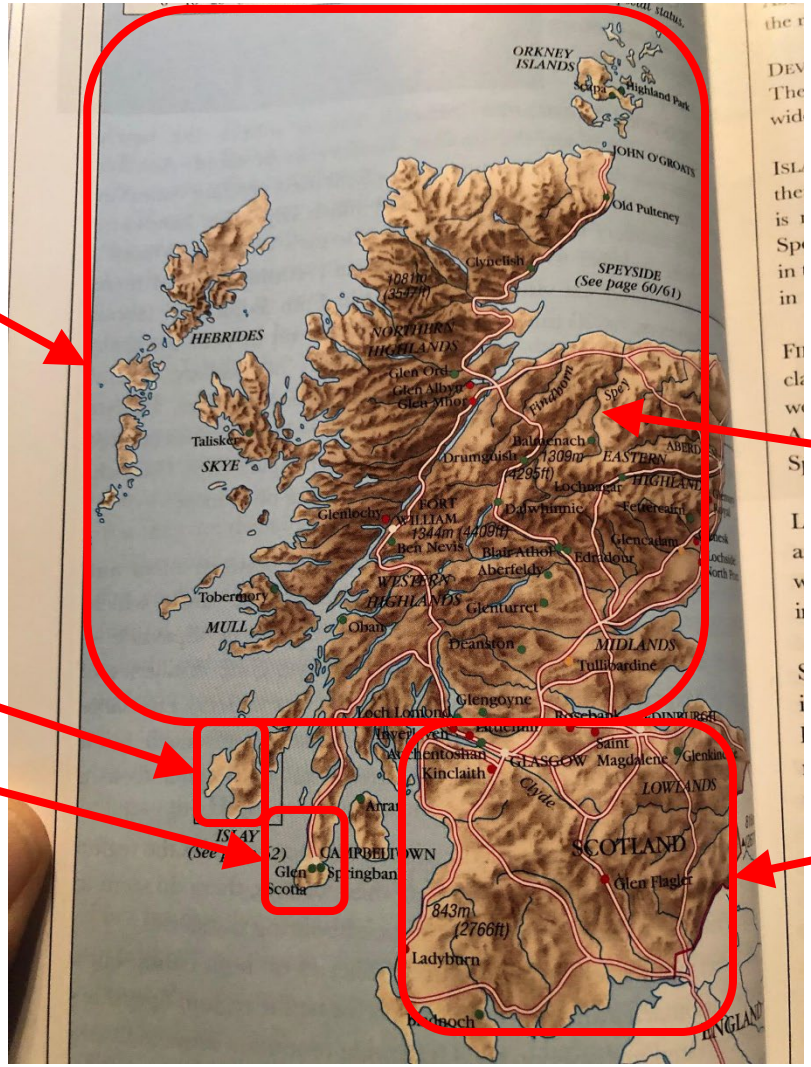
- Must be produced in Scotland
- Only ingredients: water, barley, yeast
- **Age requirements: 3 years + 1 day**
- **Age statement refers to youngest whisky in the vatting (teaspoon rule)**
- Minimum 40% ABV

Aside

- **Locally sourced barley, water**, and **fuel** lead to some of the distinctive aromas and flavors of the various regions.
- Today it is common to purchase malted barley that has already been dried and with the desired amount of **peat** (ppm phenols) according to the customer's preference.

Scotland

Highlands



Islay

Campbeltown

(Islands)

(Speyside)

Lowlands

The Scotch Whisky Problem

- Recognized regions
  - **Highland** (including **Speyside** and **islands except Islay**.)
  - **Lowland** (**Three distilleries, + new ones**)
    - Glenkinchie, Auchentoshan, Bladnoch, Daftmill, Kingsbarns…
  - **Islay** (characteristic flavors) (**Eight distilleries**)
  - **Campbeltown** (industry collapsed due to loss of transportation.) (**Three distilleries**.)
    - Springbank, Glen Gyle, Glen Scotia

Michael Jackson's Complete Guide to Single Malt Scotch, 6th Ed. 2010

The Scotch Whisky Problem

- Barley
- Malting
- Kilning
- Milling
- Mashing
- Fermentation
- Distilling
- Aging
- Blending

Overview

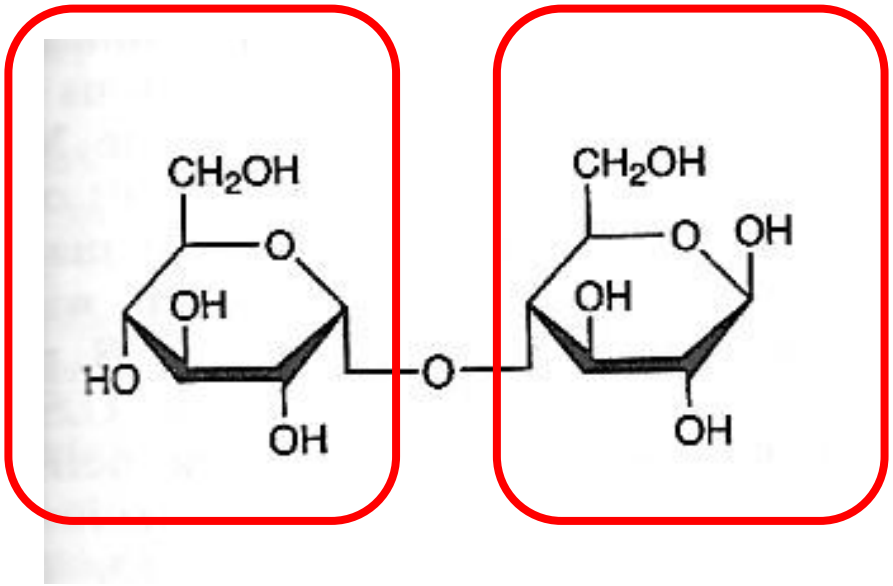
- Starch → Maltose (**Malting**)
- Maltose → Glucose (**Mashing**)
- Glucose → Ethanol (**Fermentation**)
- Collect and concentrate Ethanol (**Distillation**)
- Age

The Scotch Whisky Problem

- Malting (may be done by others)
  - Exothermic process (produces heat)
  - Control temperature (hand tools)
  - **Starches** become **sugars**; **cogeners** form
  - **Starch** broken down to **Maltose** by **diastase** (enzyme)
  - Germination allowed to proceed until the desired point, then ended by the **kilning** step.

The Scotch Whisky Problem

- Maltose (a disaccharide)



Malting Floor

Bowmore Distillery (Photo Keith Tomazi)

Malting Floor

Laphroaig Distillery (Photo Keith Tomazi)

Kilning

- Stops germination
- May impart aroma and flavor, depending on fuel
- Dries malted barley in preparation for milling

Kiln

Laphroaig Distillery (Photo Keith Tomazi)

Kiln

Bowmore Distillery (Photo Keith Tomazi)

Kiln

Bowmore Distillery (Photo Keith Tomazi)

Milling

- Milling
  - Obtain **grist** of desired particle size (minimize flour)
  - Flour very difficult to filter
  - Husk and flour remain with grist (filter aids)
  - Hammer mills seem to be fairly common

Milling

Auchentoshan Distillery (Photo Keith Tomazi)

Milling

Ardbeg Distillery (Photo Keith Tomazi)

Milling

Bunnahabhain Distillery (Photo Keith Tomazi)

Mashing

- Mashing (Mash Tuns, Lauter Tuns)
  - **Extraction** of **sugars**, etc. with water
  - Conversion of **maltose** to **glucose**
  - Maltose + H_2O + invertase → 2 glucose ($C_6H_{12}O_6$)
  - Each distillery has a water source, which may add to distinctive flavors and aromas

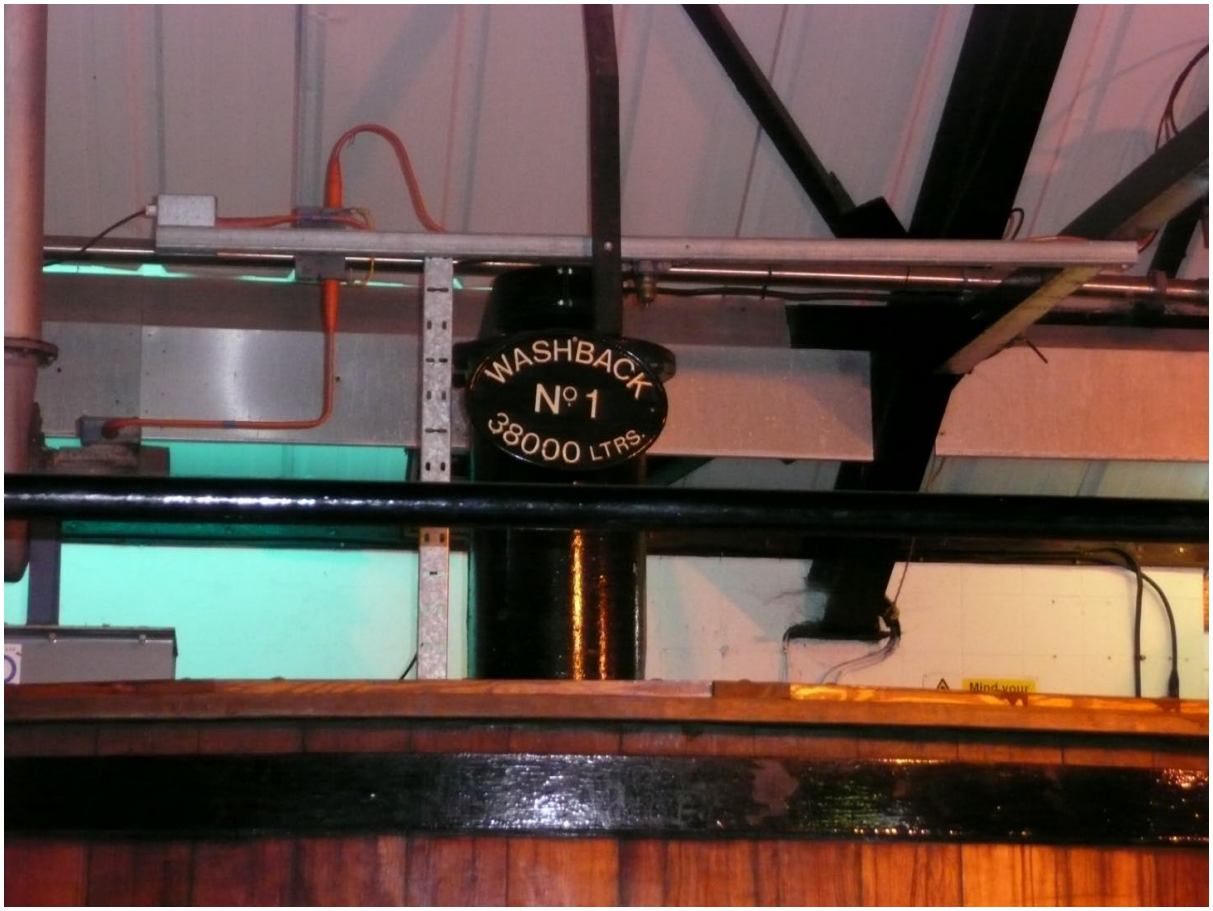
Mashing

Auchentoshan Distillery (Photo Keith Tomazi)

Fermentation

- Fermentation (Washbacks)
  - Yeast consumes sugars, produce **ethanol**, **cogeners**, and **CO_2**
  - Glucose → 2 EtOH + 2 CO_2
  - **Cogeners** produce flavors, aromas
  - 7 - 8% ABV

Fermentation



Auchentoshan Distillery (Photo Keith Tomazi)

Fermentation

Auchentoshan Distillery (Photo Keith Tomazi)

Distillation

Auchentoshan Distillery (Photo Keith Tomazi)

Distillation

- Shape and angle of lyne arm seen to be critical to flavor and mouthfeel
- Ardbeg uses “purifier” in lyne arm, produces more reflux and provides a more efficient distillation.
- Lore: strenuous attempts to maintain product attributes, even having coppersmith adding dents to new stills.
- Originally stills were direct – fired, now steam coils commonly used.

Wash Still (17,500 liters)

Auchentoshan Distillery (Photo Keith Tomazi)

Intermediate Still (8,200 Liters)

Auchentoshan Distillery (Photo Keith Tomazi)

Wash and Spirit Stills

Bowmore Distillery (Photo Keith Tomazi)

Distillation

Auchentoshan Distillery (Photo Keith Tomazi)

Auchentoshan Distillery (Photo Keith Tomazi)

Auchentoshan Distillery (Photo Keith Tomazi)

Spirit Safe

Auchentoshan Distillery (Photo Keith Tomazi)

Aging

- Aging
  - **New** or **repurposed** wood barrels
  - Adds greatly to **flavor**, **color**, **aroma**
  - May move whisky between types of barrel, or combine whisky from different types of barrels and ages
  - Barrels reused from **bourbon**, **sherry**, or **other products**
  - **Typically done at ca. 62% ABV**
  - May take decades to achieve optimum
  - **Angel's Share**: approx. 2% loss per year

Warehouse

Auchentoshan Distillery (Photo Keith Tomazi)

Speeding up the Aging Process…..

The Scotch Whisky Problem

- Vatting/Blending, bottling
  - **Blended Scotch** Whisky
    - Neutral grain spirits + malts from one or more distilleries
    - Age rules apply to the malt whiskies in the blend
  - **Single Malt** Whisky
    - Meets all other requirements
    - Only whisky from **one distillery (teaspoon rule)**
    - Age rules still apply
  - **Blended Malt** Whisky blend of 2 or more single malts
  - Water may be added to obtain ≥ 40% ABV

Blending

Glengoyne Distillery (Photo Keith Tomazi)

Bottling and Packaging

Kilchoman Distillery (Photo Keith Tomazi)

The Scotch Whisky Problem

- How much whisky should be made now to satisfy markets decades from now?