HARTWICK COLLEGE
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Center for Craft Food & Beverage

Understanding Malting Barley Quality

Malt is the key ingredient in beer that provides the starch and enzymes necessary to produce the fermentable sugars which yeast then turn into alcohol. Malt also provides the color and flavor compounds which contribute to the final character of beer.

Malting is the biological process that turns barley into malt. It is a three stage process including soaking (or steeping) the grain in water to bring the kernels to 45% moisture; germination under cool, humid conditions and drying (or kilning) to dry and stabilize the final malt.

Barley must meet strict quality criteria to be acceptable for malt production. Maintaining tight controls on these quality factors in the grain is necessary to ensure good processing efficiency and final product quality in the malthouse and brewery. Care must be taken when growing malting barley to ensure that it meets the necessary specifications. A premium is paid to growers for high quality malting barley to compensate for the extra effort.

High quality malting barley should have the following characteristics:

- Pure lot of an acceptable variety
- Germination of 95% or higher
- Protein content raging between 9.5% to 12.5% (dry basis)
- Moisture content below 13.5%
- Plump and uniform kernels
- Free of disease and low DON content
- Less than 5% of peeled, broken, or damaged kernels
- Clean and free of insects, admixtures, ergot or foreign material

Varietal purity

Malting barley varieties are bred specifically for characteristics that promote good malting and brewing performance, such as high enzymatic activity, as well as good agronomic performance and disease resistance.

Each malting barley variety behaves differently during the malting process. For this reason is important to segregate varieties when they are grown, stored, shipped and processed. Using a high quality, certified seed can help ensure varietal purity. Barley of different varieties must not be blended or co-mingled prior to malting.

Protein

The protein content of the barley grain affects the chemical composition and enzyme levels of the finished malt. If the protein is too high, this limits the starch content and amount of extract available to the brewer. High protein grain also takes up water slowly and is harder to modify in the Malthouse. On the other hand, if the protein to too low, there may be insufficient enzymatic activity to modify the barley kernel and break down starch for brewing. An ideal protein range is 9.5% to 12.5% (dry basis). Grain with a higher protein content can be suitable for producing malt for distilling.

It is *not* permissible to blend lots of grain with differing protein to achieve an acceptable average. The lower protein kernels in the blend will absorb water more rapidly than those with thigh protein and result in malt that is unevenly modified.

The protein level in the grain is determined both by agronomic practice, and by the environment. Hot, dry growing seasons tend to result in higher protein grain at harvest than cool, wet seasons. Excessive rates of nitrogen fertilization can also increase protein levels, although varieties can respond differently.

Plumpness

Plump and uniform kernels are desirable as plump kernels contain higher levels of starch, which will produce more beer from a given weight of malt. Plumpness is assessed by sieving over a 6/64" slotted screen with greater than 80% kernel retention being ideal for a two rowed barley. Six rowed varieties are generally less plump than two rowed.

Moisture
To maintain quality on storage, moisture content of malting barley must be < 13.5%. This will reduce the risk of mold growth and ensure long term preservation of germination ability. Barley should be stored in bins with good air circulation to prevent 'hot spots' which can cause heat damage and mold problems. If barley is harvested at greater than 13.5% moisture level, it should be carefully dried using air temperatures below 40°C (100°F) as excessive heat will damage the germination.

Germination
Barley must be alive in order to be processed into malt. Germination ability for malting is assessed using standardized tests develop by the malting industry. The standard test called Germination Energy is a 3 day test where 4 mL of water is added to a Petri dish containing 100 seeds and 2 pieces of filter paper. Germinated kernels are removed every 24 hours. A sample with acceptable quality should have at least 95% germination after 72 hours under the conditions of this test.

Some malting barley varieties can exhibit dormancy, where live kernels fail to germinate under ideal conditions. A Germination Capacity test can be conducted, using hydrogen peroxide, where dormancy is suspected.

Pre-harvest sprout damage, or pre-germination, can occur when mature barley is exposed to wet conditions prior to harvest. Pre-germinated grains are at risk of losing germination rapidly over time, especially under poor storage conditions (hot and humid). Mild and moderate sprout damage cannot be visually detected, but can be assessed using Rapid Visco Analysis (RVA). The results of the RVA test can be used to predict storability of the sample. Samples with RVA greater than 120 are normally considered sound and the probability that they will retain germination after storage is very high. Samples with RVA between 50 and 120 are moderately pre-germinated, and the risk that they will lose germination after storage is intermediate. The risk can be lowered if the samples are dry and/or they are stored in cool and dry conditions. Samples with RVA < 50 are pre-germinated, and the probability that they will lose GE after storage is high. They should be malted as soon as possible.

Peeled and broken kernels
It is important that the husk on malting barley grain remains in-tact. The husk protects the shoot growth during the malting process, and helps regulate the uptake of water resulting in even modification. Broken kernels will not germinate, or may grow in an abnormal manner, resulting in a poor quality malt. Care must be taken in threshing and handling to not damage or peel the grains. No more than 5% of the kernels should be peeled or broken.

Mycotoxins and disease
Fusarium head blight (scab) is a fungal disease that occurs in barley resulting in damage to the kernels and reduced yield. The *fusarium* fungus can also produce mycotoxins such as deoxynivalenol (DON) which make the barley unsuitable for malting and brewing. Barley grown in areas where scab is prevalent must be tested for the presence of for DON by a qualified testing lab. Maltsters normally reject barley with DON levels over 1.0 ppm.

References
Cereal Grains: Assessing and Managing Quality. E.W Wrigley, ed. CRC Press, Florida, 2010

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For more information and quality testing services contact:

Aaron MacLeod
Director, Hartwick College Center for Craft Food & Beverage
607-431-4232
macleoda@hartwick.edu
www.hartwick.edu/craftfoodandbeverage