Northern Periphery and Arctic Programme

Northern Cereals – New Markets for a Changing Environment

SMALL-SCALE MALTING

Guidelines

(Deliverable T4.1.6)

1 Introduction

This document presents general guidelines for the small-scale malting of barley based upon floor malting methods. Since good quality malt requires good quality grain, the most important grain quality criteria for malting barley are outlined first, before considering the malting process.

2 Grain Quality

Only use grain of good quality (detailed in Project Report 4.1.1). The following are particularly important considerations:

- Variety:
  - decide which variety to use and whether it should be a recommended malting variety or not
  - do not use grain from a mixture of varieties for malting
- Sensory evaluation:
  - Grain should look visually bright and attractive and be free from insects and weeds and should not have a smell of mould
- Viability and Germination:
  - Grain should have a high viability (>98% is a common standard) and this can be tested with a tetrazolium test. Although, it may be difficult to achieve this level of viability in northern regions, it should ideally not be below 95% as this will impact on the malt quality.
  - Grain must also have lost its dormancy and water sensitivity and be ready for germination. This is tested for by a 4 ml and 8 ml water test on 100-grain samples in a petri dish.
- Grain nitrogen and protein:
  - Grain sold for malting on the world market usually has to meet standards for grain nitrogen or protein. For distilling, the optimum is considered to be 1.50 % nitrogen but it can be accepted up to about 1.65 %. For brewing beers and ales the range is 1.60-1.75 % nitrogen while for lagers it is 1.70-1.85 %.

  - One of the main drivers for the above specifications is to ensure a good alcohol yield as an increasing level of grain nitrogen is accompanied by a reduction in carbohydrate.
  - For growers in northern areas it may be difficult to achieve these nitrogen levels because of soil and climatic factors and also because very few “malting varieties” (which have been produced specifically for malting and a low grain nitrogen) are available for northern locations.
  - For producers of high provenance products, it may be more important to be able to source local grain, however, than to source it with specific levels of grain nitrogen.
- Grain size:
  - Plump grains give a higher alcohol yield than small grains and grain for malting usually needs to be passed over a screen (2.25 or 2.5 mm) to remove small grains (“screenings”). There will be a higher percentage of screenings in 6-row barley varieties because these have a smaller grain size than 2-row barley.

3 Malting

3.1 Introduction

Malting involves four main steps: steeping, germination, drying/kilning and cleaning. While the process is not very complicated, it can be very labour intensive without specialised equipment. Although a few companies produce small scale all-in-one units for producing malt (References 1, 2 and 5), these are usually very expensive and therefore many small scale (craft) maltsters have developed their own equipment. The sophistication of the equipment developed by maltsters depends upon the resources available and the scale depends upon the amount of malt required. Several examples of different approaches to small-scale malting are described in the references at the end of these guidelines.

3.2 Steeping

The purpose of steeping is to raise the moisture content of the grain to about 45% so that it will start to germinate. It is carried out by soaking the barley in water and requires a container/vessel which can hold the barley and water. During steeping, the grain is exposed to alternating periods of immersion in water and “air rests” when the water is removed from the vessel. The air rest allows oxygenation of the grain which is necessary for germination. Important considerations for steeping are:

- Use a steeping vessel which is easy to fill with grain and water and to drain off the water and remove the grain.
- Periodically, stir the barley in the vessel during water immersion
- Although variations occur, the steeping phase often includes three periods of immersion (each 4-10 h in duration) separated by two air-rest periods (each about 12 h) when the water is drained away
- During immersion, water temperature should not be lower than about 10 ^{o}C as this will result in slow rates of grain germination

At the end of steeping, the coleorhiza or root sheath (“chit”) should be starting to appear at the base of the grain (Fig. 1).

3.3 Germination

For the germination phase, remove the grain from the steeping vessel and spread it out on a clean, flat floor or other surface to a depth of about 10 cm (Figs 2 and 3). An area of about 3.0 m^2 is required per 100 kg grain. During germination, rootlets emerge, the acrospire (shoot) starts to grow beneath the husk and the contents of the grain become crumbly (modified) instead of hard and steely. During this process, enzymes are produced to convert starch and polysaccharides into sugars. Some important considerations are:

- The speed of germination is very temperature-dependent and progresses more rapidly at higher temperatures. Floor malting has been carried out successfully in Orkney in unheated stone buildings in months with average outside temperatures between 4 ^oC and 14 ^oC. At the bottom of this temperature range, however, some supplementary heating may be required while at higher temperatures it may be necessary to occasionally spray the germinating grains with water to prevent them drying out. Over a 4 ^oC to 14 ^oC temperature range, the grain typically requires 5 to 6 days on the malting floor.
- While the grain is on the malting floor, turn it about 3 to 4 times per day to prevent overheating and rootlets becoming matted together. Specialist machines have been developed for use with large quantities of malt (Fig. 4), but for small quantities this will need to be done manually. Traditionally, wooden malt shovels (Fig. 6) are used since these are gentler on the malt and floor than metal shovels.
- The germination process needs to be stopped when the coleoptile (or acrospire, which encloses the first leaf and grows under the husk of the grain) is about the same length as the grain, but before it emerges. Check for this by removing the husk from samples of grain. At this stage the grain has become green malt.

3.4 Drying and Kilning

Germination is halted by drying the green malt. Initially, this is done at about 45 ^oC to 50 ^oC to avoid damaging the enzymes in the malt, but once the malt is below about 10% moisture, it can be dried at a higher temperature (about 65 ^oC). The process takes about two days. Depending on the quantity of malt produced, drying and kilnining can be done in ovens or on perforated or wedge wire drying floors (Fig. 7) above a heat source (see also Reference 7). Since drying is energy-intensive, the possibility of using renewable energy or waste heat should be explored. Important points are:

- Turn the malt about 3 times daily during drying
- For safe storage, reduce the malt to at least 5% moisture content

3.5 Cleaning

Before the malt is stored, it should be cleaned of rootlets (de-culming). The procedure for doing this will depend on the amount of malt produced, but is likely to require equipment which will rub the grains against each other to break off the rootlets which are then removed by screening (sieving) the grain. If the scale of the malt production is large enough, this could be done by auguring the malt into a hopper and then passing it over seed cleaning equipment. Store the malt in airtight bags in a dry, cool environment.

References

There are several articles about small-scale malting on the internet and a selection of these is provided below; all were accessed on 24/11/17:

1. AutoMalt™, an all-in-one Craft Malting System https://www.ipec-inc.com/foodbev/malt/automalt/

2. Custom Laboratory Products, Pilot Plant System (see also http://maltbox.com/):

The steep.

http://www.customlab.co.uk/wp-content/uploads/2016/01/CLP-250-Pilot-Plant-Ind-Steep-v2.0s.pdf

The germinator.

http://www.customlab.co.uk/wp-content/uploads/2016/01/CLP-250-Pilot-Plant-Ind-Germinator-v2.0s.pdf

The kiln.

http://www.customlab.co.uk/wp-content/uploads/2016/01/CLP-250-Pilot-Plant-Ind-Kiln-v2.0s.pdf

3. How to malt. http://www.hennebergbrewing.com/p/how-to-malt.html

4. How to malt at home. https://www.sprowtlabs.com/2017/02/23/how-to-malt-at-home/

5. Malting systems. http://www.kaspar-schulz.de/en/innovations/malt-production/malting-systems/malting-systems.html

6. Malting your own: techniques. https://byo.com/malt/item/1108-malting-your-own-techniques

7. Norwegian malting house, *såinnhus*. http://www.garshol.priv.no/blog/298.html

8. Starting a micro-malthouse on a shoestring budget. http://farmhousemalt.blogspot.co.uk/2014/10/starting-micro-malthouse-on-shoestring.html

9. Valley Malt, Bringing back the local malt house. http://ogrin.org/content/9-factsheets-reports/2-grain-processing-case-studies/valleymalt.pdf

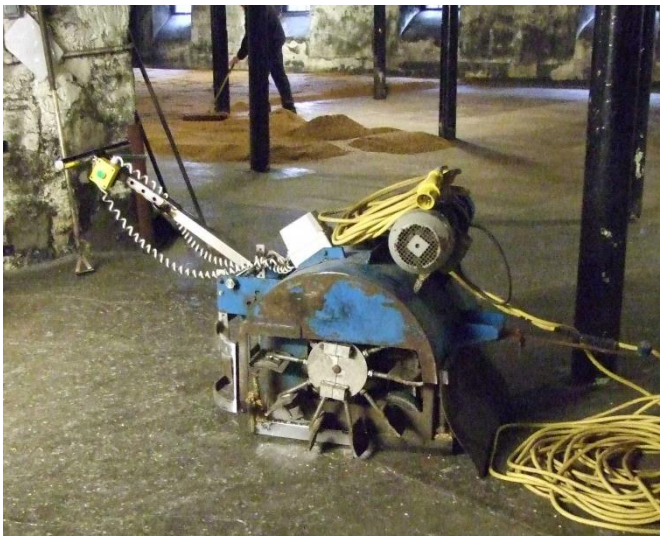

Fig. 1 (top left). Barley grains at the end of steeping. The white outgrowth at the end of some grains is the root emerging (chitting).

Fig. 2 (top right). Casting the steeped barley on the malting floor

Fig. 3 (bottom left). Steeped barley spread out on the malting floor.

Fig. 4 (bottom right). Machine for turning malt

Fig. 5 (top left). Germinating barley at the start of day 6 on the malting floor, just before drying

Fig. 6 (top right). Green malt being removed from the malting floor for drying. Note the wooden malt shovel

Fig. 7 (bottom). A drying floor made from wedge wire panels