Yeast in breweries

NUMEROUS TINY ASSISTANTS | The strains used in breweries and their metabolism and metabolites were covered in detail in the article dealing with beer fermentation. This part of the series discusses a different issue relating to yeast i.e. yeast management, in particular for smaller breweries.

WHY OF ALL THINGS is the question of proper yeast management so interesting, arising again and again in everyday operations?

Well, yeast is a living organism. This means that it cannot be stored forever. Fresh yeast suitable for pitching a beer should contain at least 98 % live cells with very high vitality. If one stores such yeast too long or under improper conditions, vitality will drop on the one hand and the number of live cells will go down on the other hand. When using such impaired yeast for wort pitching, very massive off-flavours and off-odours may arise, even leading to complete fermentation standstill. In such a case, the brew has to be discarded.

Nevertheless, yeast management can be relatively easy. Yeast freshly cropped from a tank is used for pitching the very next brew. This would be the royal road in yeast management but, unfortunately, this is not feasible for many brewers because they do not run sufficient yeast cycles so that fresh wort is not always available when yeast is cropped. Or the brewer produces many beer types using different yeasts, also making it impossible to pitch immediately after cropping.

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Basic options

Our yeast becomes available basically in three different ways:

Cropped yeast

Cropped yeast is recovered at the end of main fermentation or, in the case of top-fermented beers, also during main fermentation. Top-fermenting yeasts can, theoretically, be used for an infinite number of cycles i.e. they can be used after the harvest, whereas the number of cycles is limited to "only" 5 to 8 in the case of bottom-fermenting yeasts. The explanation: a negative selection takes place during main fermentation in the case of bottom-fermenting yeasts whereas selection is positive in the case of top-fermenting species. Top-fermenting yeasts that are no longer in a position to ferment fall to the bottom, and this is the yeast that is harvested. Yeasts that are still active and vital remain in suspension. They cannot be harvested and, in addition, are required for subsequent conditioning and storage

Should yeast thus cropped undergo multiple cycles, yeast properties deteriorate gradually until, after several cycles, fresh yeast has to be used.

In the case of top-fermenting yeast, only the most vital yeasts float to the top and can be cropped. This means that only the fittest will survive. An infinite number of yeast cycles would thus be possible but, all too often, this is unfortunately thwarted by microbiological contamination of the yeast.

Propagated yeast

When using propagated yeast for pitching, a suitable yeast quantity (about 10 % of the pitching volume), taken from a pure culture originating in a laboratory, is progressively propagated. Propagated yeast is also downright vital and, with proper propagation, will always yield the same fermentative results. Some brewers start with propagated yeast that they harvest several times afterwards, i.e. using cropped yeast after the first cycle. New propagated yeast is then brought into circulation after several cycles. Other brewers always use propagated yeast for pitching, they discard the yeast harvested after the first cycle and use a new propagated yeast. Why is this done? Propagated yeast will always yield the same fermentation results when propagation conditions remain unchanged whereas yeast that is cropped contributes to a slightly changed fermentation in each cycle on account of selections.

Dry yeast

The option of adding dry yeast is a viable proposition, in particular for smaller breweries. In order to produce dry yeast, specialist companies propagate yeast using a suitable substrate, usually molasses, subsequently they wash the yeast and dry it using special drying techniques. Dry yeast has a disadvantage, it contains a relatively high number of dead cells. However, when suitably pumping dry yeast before addition, this disadvantage can be largely compensated. Before use, dry yeasts have to be rehydrated i.e. they are stirred up in sterile brewing liquor warm to the touch. It's an absolute no-go to use distilled water. Neither is it recommended to stir up the yeast in wort. When using distilled water or wort, osmotic pressure would rise and can no longer be toler-

ated by the yeast, leading to damage. Other sources describe use of about 50 % water and 50 % wort. But some tests have shown that best results are obtained when dry yeast is initially stirred up in water for about 30 min, followed by addition of about the same amount of wort. Subsequent propagation of the yeast increases its vitality further, ensuring a clearly superior fermentation process. It has been observed again and again that dry yeast was added directly to the yeast, this is something that should under no circumstances be done. In isolate` cases, this procedure may indeed yield the desired result but it is fraught with more problems than benefits. The cropped yeast resulting from pitching with dry yeast can indeed be used for further cycles. However, one should refrain from using dry yeast as starting yeast for yeast propagation. This will lead to major problems, in particular when trying to propagate bottom-fermenting dry yeasts.

Storage and reactivation of cropped yeast

Brewers frequently ask about how cropped yeast that is not used immediately for pitching after having been harvested should be stored. And an even more burning question: for how long can it be stored.

Harvesting conditions are important here. The beer should be cooled down vigorously towards the end of fermentation. In cylindroconical tanks, cone cooling should also be switched on. The sediment in the tank separates into three layers. The top layer containing hop resins and physiologically highly active yeast cells, the core yeast containing many active cells, the bottom layer containing contaminants and yeasts with low fermentative capacity. Though the top layer contains very active cells, it should not be used as it is polluted with hop resins. It is recommended that the core yeast is carefully separated off and used. After harvesting, CO_2 should be expelled, e.g. using a classic yeast screen. It is often postulated that separation of unwanted trub substances is the main advantage of yeast screening. Though this is true, CO_2 expulsion has a considerably higher positive influence.

After CO_2 has been expelled, the yeast should be cooled down to 0 to 2 °C as fast as possible. Aeration during storage is discouraged. Another debatable point is whether wort should be added to the yeast during storage. As the yeast is, so to speak, cryopreserved, addition of yeast would have more disadvantages than advantages. Before being reused, yeast has to be homogenised and activated. This can be done by pumping the yeast in circulation, with subsequent wort addition and aeration. It is important to ensure that wort is not simply pumped onto the cold stored yeast but that thorough mixing of yeast and wort that should have pitching temperature takes place. The significance of concomitant aeration should not be underestimated. Yeast activated in this manner is ready for pitching after a few hours.

The time period over which cropped yeast can be stored remains controversial. But one thing is for sure: storage time should be as short as possible. The quality of yeast deteriorates in line with increasing storage time. The extent to which this is tolerated by brewers depends on individual preference and also on the yeast strain. Each operation should make its own experiences that can be optimised by test fermentations on a pilot scale.

The right yeast – where can it be got?

Obtaining yeast is yet another problem that is also frequently encountered in many smaller breweries. The easiest thing would be to resort to ample supplies of dry yeast. Be it as ample as it may come, yeasts that a brewery would like to source are sometimes not available in a dry state. Costs are also an issue. The higher price for dry yeasts is indeed justifiable for brew batches up to 20 hl. But when it comes to larger volumes, things get more difficult.

Now propagation enters the picture. Several yeast banks offer pure cultures that can be propagated. This leads to another issue: where should the wort for propagation be procured if the brew cycle does not yield wort on a continuous basis. Very good results have been obtained with malt extracts or dried wort powders that have to be boiled up separately for propagation. This requires in-house yeast propagation facilities. Though very affordable propagation plants are available for microbreweries (up to 10 hl pitching volume), investment costs rise considerably with increasing pitching volumes. However, in-house propagation pays off in the course of time. In addition, it offers a lot more flexibility in terms of yeasts that can be used.

If possible, buying propagated or cropped yeast from other brewers might also make sense. Care should be taken to ensure that the microbiological status of the yeast is impeccable to avoid importing contamination. Pre-sterilised stainless steel kegs have proven to be good transport containers. When filling the yeast, it should be ascertained that it is contained in a medium fermented to completion. Should fermentable sugars still be present, deformation of the kegs may occur, both unwelcome and unpleasant.

Trial and error

Many brewers have learned that classic doctrines are not always crowned with success. Brewers can strike out on their own, also in terms of yeast management. Prior pilot brews can avoid major financial damage even if something goes wrong. Can my yeast be stored and, if so, for how long; what's the best temperature for my yeast; how should it be reactivated; when building up one's own yeast management, it is best to use the trial and error method to get the best results. ■