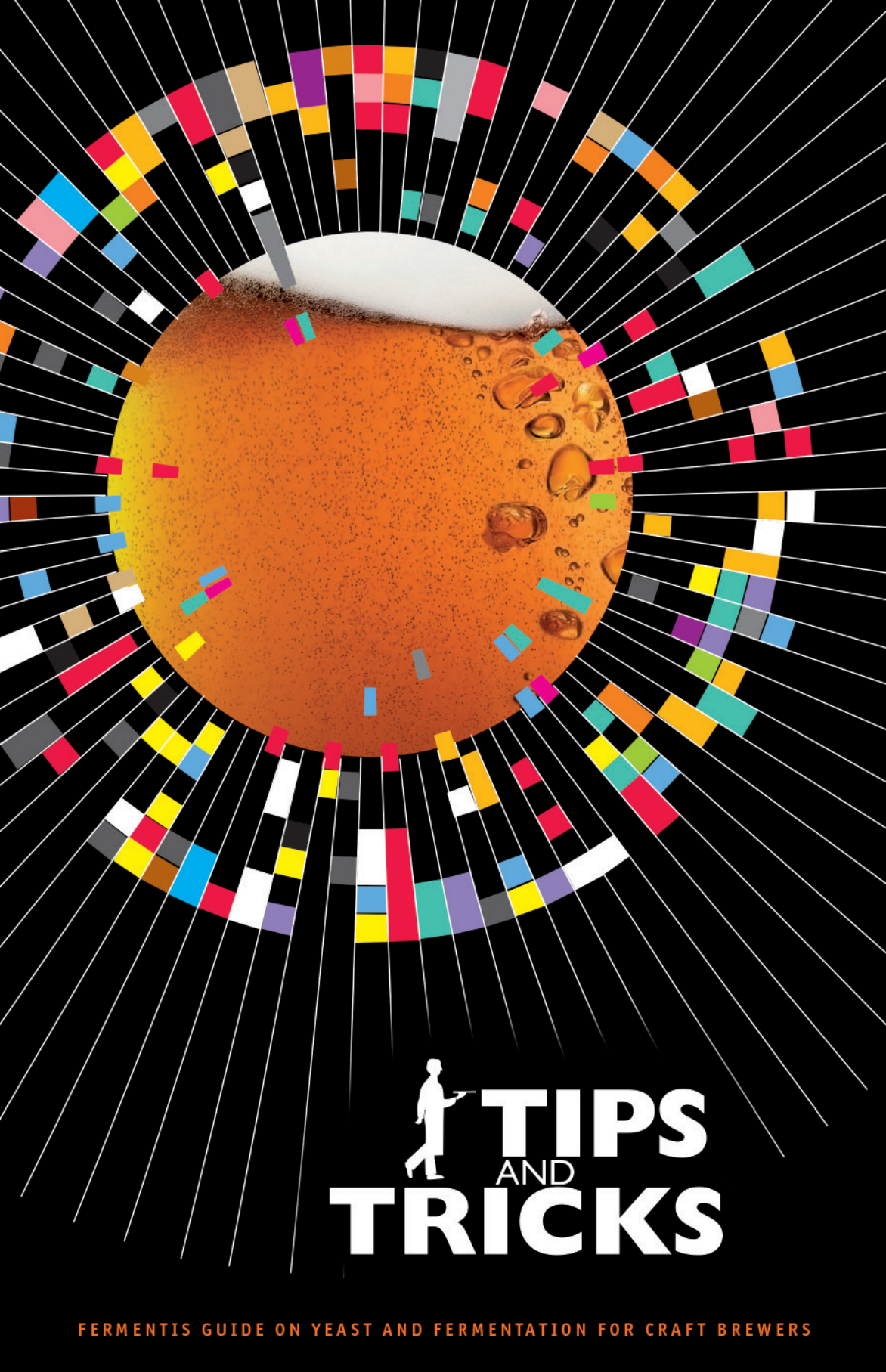

FERMENTIS GUIDE ON YEAST AND FERMENTATION FOR CRAFT BREWERS

TIPS AND TRICKS

is the Fermentis booklet on yeast and fermentation for craft brewers. With Tips & Tricks our purpose is to offer brewers a tool to learn how dry yeast is produced, what essential parameters will influence your fermentations, how the Fermentis yeast strains are characterized and give useful technical tips **to better manage yeast in your brewery.**

Tips & Tricks is downloadable from the craft brewers section of our website where you will also find downloadable recipes. For the list of available recipes, refer to the inside back cover of this booklet.

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BEER YEAST FOR CRAFT BREWING

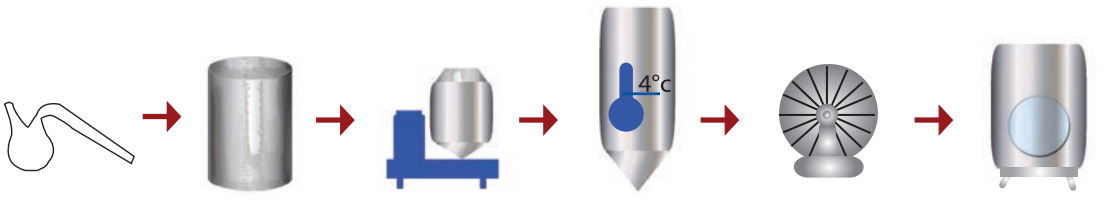
Constant innovation and creativity in brewing have made the success of the craft brewing industry.
Brewing a large number of beers in the same premises adds to the difficulty of yeast management, while beer quality and consistency between batches are key factors to exceed customers' expectations.

Dry yeast is a reliable answer and the choice of numerous craft brewers around the world to achieve consistent fermentations from batch to batch. Ready to pitch, their rehydration is a simple procedure and correct yeast counts are achieved simply by pitching a known weight of dry yeast. No propagation or in-house laboratory input is needed. The consistency of fermentations also adds the advantage of predictable fermentation output, which is essential for good planning in a busy brewery.

Fermentis is the supplier of choice for true dried lager yeasts. Our different strains are available from recognised sources enabling high quality lager production. A range of speciality ale yeasts has also been developed to produce ales with authentic flavor profiles and a variety of specialty beers.

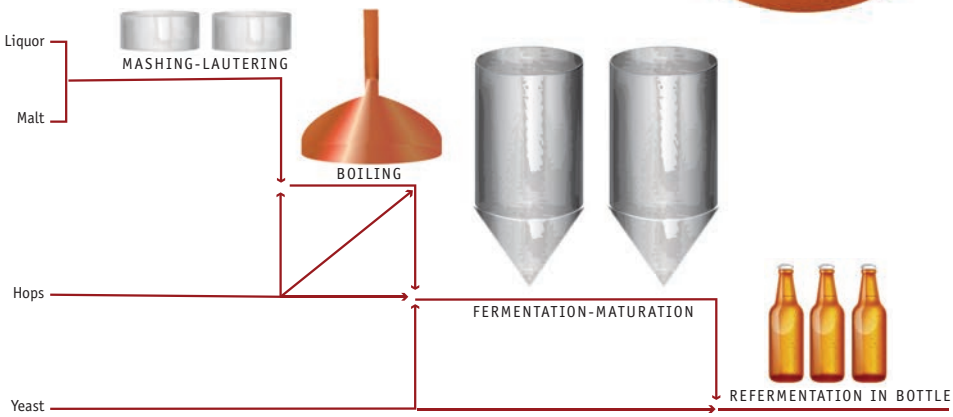
Each Fermentis yeast has its own characteristics ; **fermentation kinetics and profile, attenuation rate, alcohol tolerance, flocculation, sedimentation, organoleptic expression ...**

Better knowing our yeast range and better understanding their characteristics will allow you to get the best out of them and to adapt your brewing and fermentation conditions to brew the beer you want.



Dry yeast manufacturing

YEAST AND BREWING



This diagram shows the most important steps in beer production and at which stage each ingredient enters the process. Yeast affects fermentation and subsequent steps of beer production.

Yeast plays a key role in the release of aromas, flavour and mouthfeel compounds in the finished beer. A number of compounds will be released during fermentation and as such the yeast strain and fermentation conditions chosen by the brewer will impact the final beer. All the elements in the brewing recipe will influence the final character and the final aromas of the beer: the water composition, the minerals, the malt bill, the choice of hops and the hopping process. **Keep in mind that the choices made prior fermentation can also influence how the yeast reacts**.

Yeast basics

Yeast, *Saccharomyces cerevisiae*, is a unicellular fungi. They are eukaryotes with a similar cell structure to plants and animals including humans. A *Saccharomyces cerevisaie* yeast cell measures between 5 and 50 µm. During the fermentation in the brewery, it reproduces asexually through budding.

Don't Mix-up

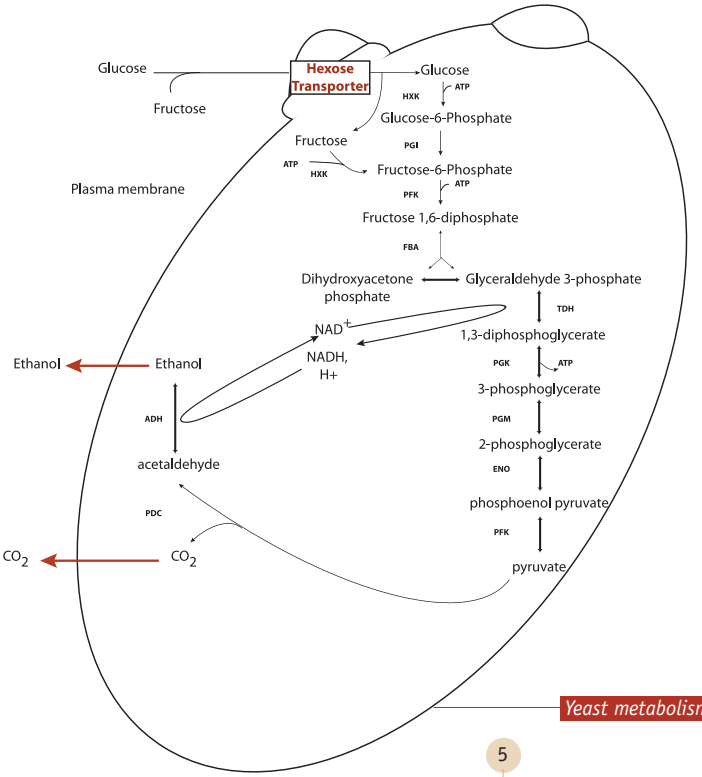
Eukaryotes & Prokaryotes

Prokaryotes are organisms that multiply by division and are constituted by a circular chromosome which is diffused in the cytoplasm. Example: bacteria

Eukaryotes are microorganisms of which genetic material is situated in a specific organ called the nucleus. Example: yeast cells, animal cells...

A yeast cell could be compared to a production facility on its own. To ferment correctly it needs to be supplied with the correct raw materials to be able to produce the right compounds. When a beer recipe contains 80 to 100% of malt its nutritional quality is sufficient for the yeast health.

The yeast will metabolize sugars, amino acids and nutrients from the wort to produce **ethanol, CO_2, aromas and other compounds** that will bring the final flavour to the beer.



Sugars are supplied by the wort. Depending on the recipe chosen for the malt bill, the quantity of sugars that can be metabolized by the yeast will vary. The three main sugars of interest for the yeast are glucose, maltose and maltotriose.

Glucose

Glucose is a monosaccharide, it is a single hexose and is the first sugar to be assimilated by the yeast. Glucose is a basic building block of the starch, which is a long ramified glucose chain.

Maltose

Maltose is a disaccharide (2 glucose units). All Fermentis brewing yeasts were selected for their high maltopermease activity. Maltopermease carries the maltose from the wort to the cytosol through the cell's membrane. Maltose is then hydrolyzed into two glucoses by intracellular maltase.

Maltotriose

Maltotriose is a trisaccharide sugar (3 glucose units). Not all yeasts are able to metabolize it. In theory, all bottom fermenting yeasts can assimilate maltotriose. There are some top fermenting yeasts that have this capacity too, like Safbrew™ WB-06, for example.

The result of a brew with high residual maltotriose levels will give beers with more roundness and mouthfeel, while beers with a high drinkability are those that contain no or very little residual maltotriose.

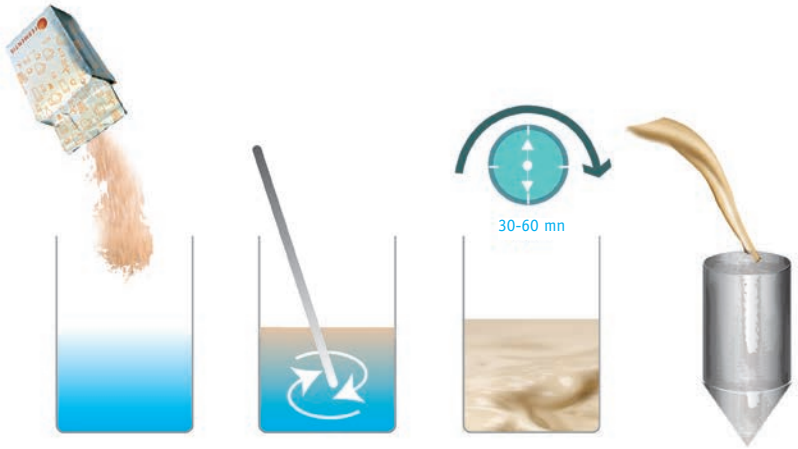
Rehydration

Microscopic picture of a yeast cell

Fermentis dry yeast looks like a compact sponge composed of microballs tightened close together. This sponge is ready to absorb the water. The yeast cells need to recover the water they lost during the drying to start fermenting. The membrane of the yeast cell after drying contains circumvolutions, after its rehydration it becomes perfectly smooth.

The picture below illustrates how the yeast membrane will act to recover their shape as they replenish with water.

From dry to liquid



Dry yeast rehydration

Rehydrate the dry yeast into yeast cream by sprinkling it in 10 times its own weight of sterile water or wort. Gently stir and leave for 30 minutes. Finally, pitch the resultant cream into the fermentation vessel.
The rehydration step is done in a vessel outside the fermenter. The objective is to allow the yeast to recover all its functionalities before pitching.

Ale yeasts

Optimum
rehydration temperature

25-29°C (77-84°F)

Lager yeasts

Optimum
rehydration temperature

21-25°C (69-77°F)

After rehydration bacterial contamination can develop in the slurry. Follow our recommendations of maximum time between rehydration in sterile water and pitching depending on the storage temperature of the rehydrated yeast.

Stored at 4°C (39°F) pitch within 18H

Stored at 20°C (68°F) pitch within 6H

Stored at 25°C (77°F) pitch within 4H

Water or wort?

Fermentis yeast can be rehydrated with sterile water or sterile wort.

After a first hop addition and wort boiling for at least 15 minutes, collect the volume required for rehydration and leave to cool to the required temperature. Rehydrate the yeast for 30 minutes. Pitch immediately into the tank after checking the temperature of wort, in order to avoid foam.

Don't forget your rehydration essentials:

1. Respect recommended rehydration temperatures to assure the yeast membrane fluidity
2. Water or wort, whatever you choose make it sterile
3. Do not use chlorinated water it will kill the yeast
4. Do not use demineralized water

Effects of pitching rate

Dry yeast adds the advantage of converting a dry yeast weight to accurately know the number of viable cells pitched in the wort.

	Fermentis yeast dosage	*Minimum equivalent cell count at pitching*
Ale yeast	50-80g/hl (0.06-0.10 oz/gal)	4-6E06 cells/ml
Lager yeast*	80-120g/hl (0.10 – 0.16 oz/gal)	8-12E06 cells/ml

**Values given are for fermentation between 12 -15°C (53-59°F). The yeast dosage should be increased at temperatures below 12°C (53°F), up to 200 to 300g/hl (0.26-0.40 oz/gal.) at 9°C (48°F).*

Pitching at the correct level will guarantee a rapid start in fermentation.
Using a low pitching rate will delay the start of the fermentation and increase the risk of contamination.

Activity

Fermentation starts immediately, but the apparition of CO_2 bubbles and smell will only be perceptible **after 12 to 24 hours for ale yeasts and 16 to 32 hours for lager yeasts.**

Temperature during fermentation

The recommended fermentation temperature range (refer to product packaging or specification sheets) of each strain has to be respected. The higher the temperature is at the beginning of the fermentation, the faster the fermentation will start. Using higher temperatures for your brew will increase the ester and diacetyl formation. Also for the reduction of diacetyl it may be necessary at the end of fermentation to allow the temperature to rise. Low temperature is required at the end of the fermentation to achieve good yeast flocculation.

Effect of oxygen

Oxygen is required to assure a healthy cell multiplication. Oxygen should only be added in the first eighteen hours of fermentation. Adding oxygen later will increase aldehyde and diacetyl levels.

Yeast recycling

Reusing yeast from a previous batch requires dedicated tanks, specific know-how and needs to be done in good hygienic conditions. Laboratory equipment and staff is required to validate the quality of the cropped yeast before pitching. As far as lager yeasts are concerned, we recommend to limit their recycling to no more than 4 to 6 times.

Bottle and cask conditioning

Yeast is used for refermentation in bottle or in cask. If the primary objective of the method is to saturate the beer in CO_2, doing a refermentation brings other benefits to the beer. First, the presence of living yeast in the bottle/cask will prevent the beer from oxidation and increase its shelf life. It will also bring mouthfeel and roundness to the beer. When selecting a yeast for refermentation some aspects need to be considered:

- Its tolerance to higher alcohol levels
- Its aroma development capabilities
- Its sugar assimilation profiles
- Its ability to settle and stick well to the bottom of the bottle/cask

After primary fermentation, yeast is often exhausted and as such we do not recommend to use cropped yeast to make a refermentation.

The sugar addition needs to be calculated depending on the desired carbonation of the finished beer. Knowing that **2g of sugar give 1g of CO_2** and assuming there is no CO_2 in the green beer, 10g of sugar per liter will need to be added to saturate the beer at 5g of CO_2/l. If the green beer already contains 2g of CO_2/l, then 6g of sugar per liter have to be added.

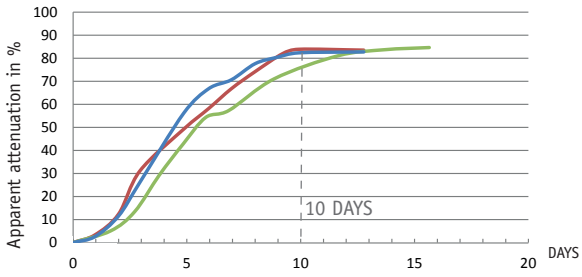
YEAST CHARACTERISTICS

Fermentis led a yeast characterization study in collaboration with a technical center* to compare the strains between themselves in standard conditions. This study was done in EBC columns. Its purpose is to caracterize each strain regarding its fermentation kinetics and attenuation, its maltotriose assimilation, its alcohol tolerance, its flocculation and its aromatic profile.

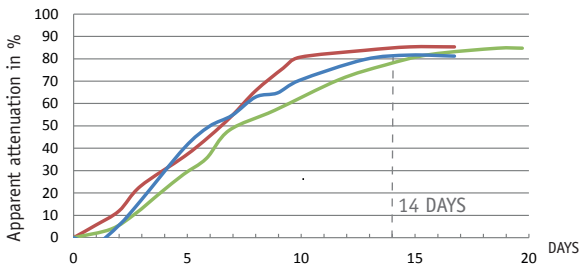
Fermentation kinetics and attenuation

Saflager™ range

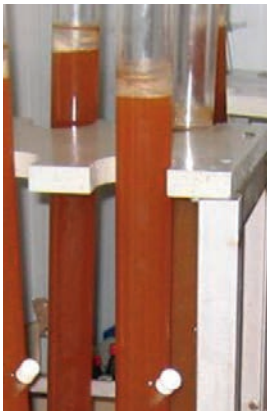
13,5°P at 12°C (53.6°F) for 48h then 14°C (57.2°F)



18°P at 12°C (53.6°F) for 48h then 14°C (57.2°F)

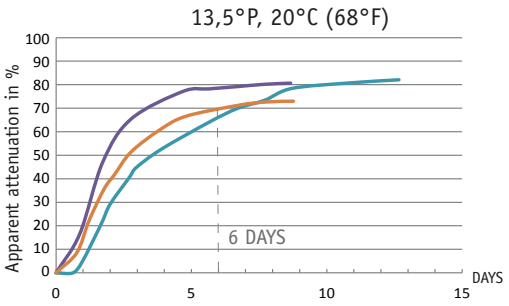


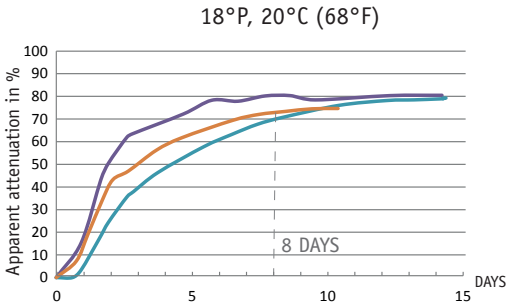
Saflager™ W 34/70
Saflager™ S-189
Saflager™ S-23



**Study conducted in collaboration with Institut Meurice - Department of Brewing Sciences and Fermentation Technology - Haute Ecole Lucia de Brouckère - Brussels, Belgium.*

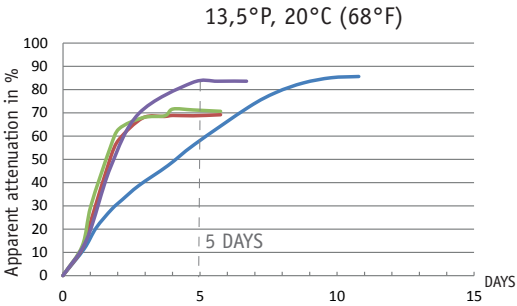
Safale™ range

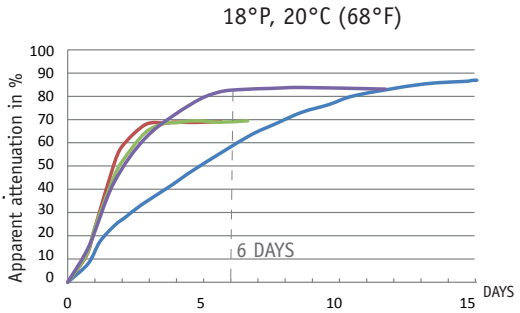




Safale™ K-97 — Safale™ US-05 — Safale™ S-04

Safbrew™ range





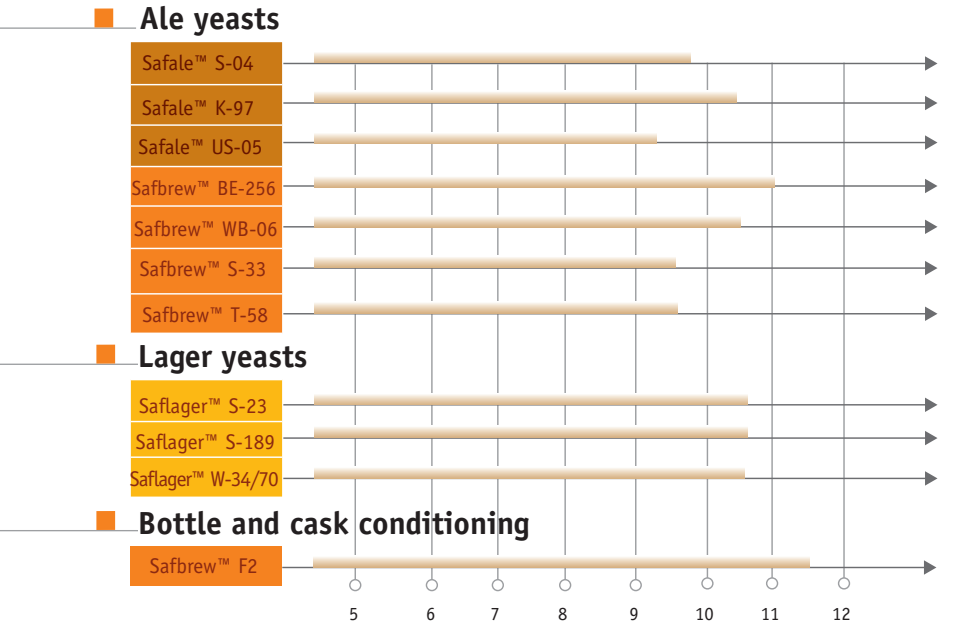
Safbrew™ WB-06 — Safbrew™ T-58 — Safbrew™ S-33 — Safbrew™ BE-256

Maltotriose

The table below shows the amount of remaining maltotriose in g/l after fermentation for each strain.

	Maltotriose in g/l
Safale™ S-04	10
Safale™ K-97	2
Safale™ US-05	3
Safbrew™ WB-06	0
Safbrew™ S-33	12
Safbrew™ T-58	11
Safbrew™ BE-256	0
Saflager™ S-23	4
Saflager™ S-189	2
Saflager™ W-34/70	2

Alcohol tolerance in % v/v



Flocculation

Flocculation is the ability of yeast cells to form aggregates.
If the yeast is not remaining in the foam at the end of fermentation, a high flocculent yeast could settle down fast and give a clear beer with little cells in suspension. On the opposite, a low flocculent yeast will settle down slowly and leave the beer hazy for a longer time.

	Flocculation	Clarification*	Sedimentation
Safale™ S-04	+	-	Fast
Safale™ K-97	+	+	Slow
Safale™ US-05	+/-	+/-	Medium
Safbrew™ WB-06	-	+	Slow
Safbrew™ S-33	-	-	Medium
Safbrew™ T-58	-	-	Medium
Safbrew™ BE-256	+	-	Fast
Saflager™ S-23	+	-	Fast
Saflager™ S-189	+	-	Fast
Saflager™ W-34/70	+	-	Fast

Yeast in the foam at the end of fermentation.

Ca++

A minimum concentration of 100 mg/l of Ca++ is required to allow good flocculation.

Aromas, Flavours and Beer Styles

A beer yeast is able to produce or contribute to body, mouthfeel, flavor and many aromas which could typically be grouped into four categories: neutral, fruity, floral and spicy. However, while the yeast strain itself will obviously play a major role; the organoleptic characteristics exhibited by a yeast strain will also largely depend on process parameters (density, fermentation temperature, pitching rate,...) and beer composition.
Indeed, a yeast strain will not make a beer by itself but will contribute to the elaboration of it; based on the recipe (process parameters) and together with the other raw materials; primarily water, malt and hops.

As an example; WB-06 expression of banana flavor will significantly depend on pitching rate and fermentation temperature.

Below table will list a number of beer styles with their flavor characteristics and the recommended yeast strain(s) to achieve those.

Type of beer	Organoleptic characteristics	Yeast suggested
Weissen	Hazy, wheat base, phenolic, citrussy	WB-06
Blanche	Hazy, wheat base, refreshing, spicy	WB-06,T-58, K-97
Pils	Lager beer, blond to golden, brilliant, refreshing, drinkable, slightly crispy, medium bitterness, highly digestable, neutral, malty or gently fruity	W-34/70, S-189, S-23
Session	Blond, light body, low alcohol, hoppy, high drinkability	K-97
Kölsch	Blond, palatable, low alcohol, low bitterness, gently fruity	US-05, S-04
IPA	Blond to amber, dry and hoppy	S-04, BE-256, US-05
Triple	Blond to amber, high alcohol, malty, fruity, full body, roundness	US-05, BE-256, S-33,K-97
Saison	Blond to amber, refreshing, very dry, low alcohol, gently acidic and yeasty, hoppy, gently saturated	K-97, WB-06
Bitter	Blond to amber, medium body and residual sweetness balanced with high bitterness, hop character	S-33, S-04, US-05
Ales (Pale/Amber/ Brown)	Blond to brown, medium alcohol content, fruity (estery), more or less malty tastes & notes, nutty, caramel	S-04, BE-256, US-05
Double	Amber - Brown/Dark, high alcohol, malty, fruity, caramel, roundness	S-33, S-04
Scotch	Amber to brown, full bodied, malty and lightly hopped	S-33, S-04
Barley wine	Amber - Brown, woody, slightly saturated, maderized, stewed fruit	S-33, T-58, BE-256, K-97
Porter	Mild to dark brown with red tint, roast malt flavor and aroma, sweet to bitter flavor, medium body, fruity esters	S-04, BE-256, US-05
Stout	Dark, creamy, smooth body, chocolate, coffee, roasted	S-33, S-04
Imperial Stout	Dark, high alcohol, hot mouthfeel, chocolat, coffee, roasted	T-58, US-05

Recommendations can be obtained from your distributor or from a Fermentis representative.

A

Alcohol By Volume (v/v): The percentage of volume of alcohol per volume of beer. To calculate the approximate volume content apply the following method:

initial Gravity (°P)/2,5 =% vol

Alpha-Acid Content: Measurement of the potential bitterness of hops, expressed by their percentage of alpha acids. Low: 2-6%; medium: 6-10%; high 10-14%; super > 14%

Attenuation: Measurement of the quantity of sugar in the wort that has been fermented by the yeast into alcohol and carbon-dioxide gas.

C

Color: There are two different analytical methods (SRM Standard Reference Method) and EBC (European Brewery Convention) to measure the color of wort and beer. SRM units are equivalent to Lovibond degrees and are used by ASBC (American Society of Brewing Chemists).

EBC /1.97 = SRM

D

Density: Measurement of the weight of a solution compared with the weight of an equal volume of pure water.

Diacetyl: is a fermentation by-product giving "butter" off flavor. It is dismantled in the end of fermentation by the yeast. Its threshold is around 0.1 mg/l.

Dimethyl sulphide (DMS): An important sulphur-carrying compound originating from malt. At low levels, DMS adds a crisp character, at high levels it will add corn or cabbage flavors.

E

Esters: Aromatic compounds generated by fermentation composed of an organic acid and an alcohol.

F

Final specific gravity: The specific gravity a beer has obtained when the fermentation is over.

I

International Bitterness Unit (IBU): Standard unit used to measure the concentration of bitter compounds in beer, i.e. isoalpha-acids and other related components in milligrams per litre.

M

Malt: Barley steeped in water, germinated and dried in kilns. This process produces the enzymes necessary to convert insoluble starches to soluble substances and sugars and gives the colour to the grain transferable to beer.

Mash - Mashing: Process of enzymatically extracting and converting malt solubles to wort, in an acid uric aqueous solution. In infusion mashing, the conversion goes through different phases: the acid rest, the protein rest, saccharification & the lauter rest.

O

Original Gravity: Specific gravity of wort prior to fermentation. Original gravity is the measure of the total amount of dissolved solids in the wort.

P

Plato degrees: Expresses a solution's density in grams of sucrose per 100 grams of solution. Plato degrees are measured at 20°C (68°F).

S

Sparging: Spraying the spent grains in the mash with hot water to remove the remaining malt sugar.

W

Wort: Sweet wort is the mash extract. Bitter wort is the hopped sugar solution before pitching.

BREWING LOG SHEET

Beer name:

Beer style:

Batch size: Target OG/°P:

Brew date:

Brewer:

Brew number:

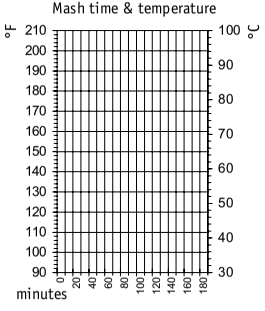
Lautering/sparging

Lb/Kg per hl | Ingredients | Colour (SRM/EBC)

Start time: End time:

Sparging number | Volume(L/Gal) | Temperature (°C/°F) | Time (minutes)

Boiling and hopping



Mash type:

Volume of water for washing (L/gal):

Volume of wort (hL):

Iodine Starch Test:

Start time: End time:

% evaporation rate:

Oz/g/hl | Hop/seasoning | % Acid | IBU | Addition time

Gravity (°P):

Whirpool time:

FERMENTATION LOG SHEET

Fermenter:

Wort volume:

Start date:

Type of yeasts:

Generation:

Fermentation temperature (°C/F):

Pitching rate (g/hL):

Original gravity (°P):

Date/time	Gravity (°P)	Tank temperature (°C/F)	Pressure (bar)	Comments

Sensory description

Green beer	Finished beer
Date:	Date:
Colour:	Colour:
Odour:	Odour:
Flavour:	Flavour:
Taste:	Taste:

Lagering

Start date:

Tank temperature (°C/°F):

End date:

BREWING LOG SHEET

Beer name:

Beer style:

Batch size:

Target OG/°P:

Brew date:

Brewer:

Brew number:

Lautering/sparging

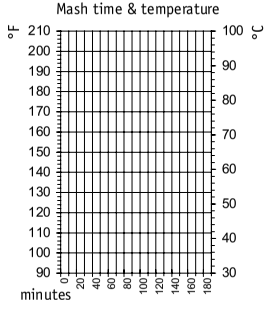
Lb/Kg per hl | Ingredients | Colour (SRM/EBC)

Start time:

End time:

Sparging number | Volume(L/Gal) | Temperature (°C/°F) | Time (minutes)

Boiling and hopping



Mash type:

Volume of water for washing (L/gal):

Volume of wort (hL):

Iodine Starch Test:

Start time:

End time:

% evaporation rate:

Oz/g/hl | Hop/seasoning | % Acid | IBU | Addition time

Gravity (°P):

Whirpool time:

FERMENTATION LOG SHEET

Fermenter:

Wort volume:

Start date:

Type of yeasts:

Generation:

Fermentation temperature (°C/F):

Pitching rate (g/hL):

Original gravity (°P):

Date/time	Gravity (°P)	Tank temperature (°C/F)	Pressure (bar)	Comments

Sensory description

Green beer	Finished beer
Date:	Date:
Colour:	Colour:
Odour:	Odour:
Flavour:	Flavour:
Taste:	Taste:

Lagering

Start date:

Tank temperature (°C/°F):

End date:


NOTES


NOTES

BEER YEAST FOR CRAFT BREWING

OUR RECIPES ONLINE

DOWNLOAD THEM HERE:
http://www.fermentis.com/brewing/craftbrewing/tips-tricks/

	Using	
Red Smoky Lager	→	Saflager™ W-34/70
Weizen Beer	→	Safbrew™ WB-06
Red ale	→	Safale™ US-05
Light bock	→	Saflager™ S-189
German Light Lager	→	Saflager™ W-34/70
Dark bock	→	Saflager™ S-189
Christmas Special	→	Safale™ S-04
Amber	→	Safale™ S-04
Stout	→	Safbrew™ S-33
IPA	→	Safale™ US-05
Belgian Red Pure Malt	→	Safale™ US-05
Belgian Abbaye Dark Beer	→	Safbrew™ BE-256
Belgian Amber Beer	→	Safbrew™ S-33
Belgian Wheat Beer	→	Safbrew™ WB-06
Belgian Weizen	→	Safbrew™ WB-06
Belgian Blond Beer	→	Safbrew™ T-58
Triple	→	Safbrew™ BE-256

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Fermentis
LESAFFRE FOR BEVERAGES

A LESAFFRE BUSINESS UNIT