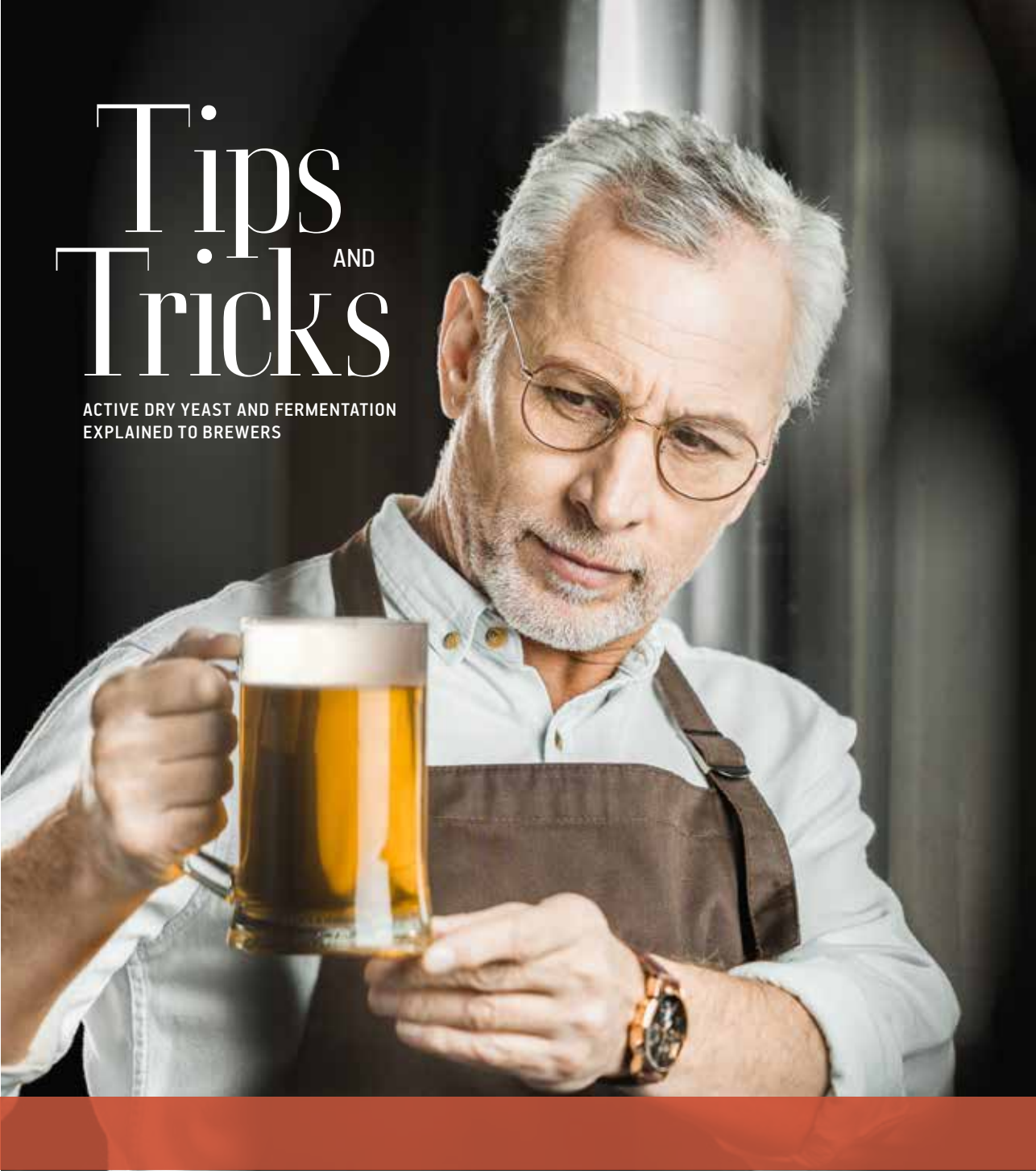


Tips AND Tricks

ACTIVE DRY YEAST AND FERMENTATION EXPLAINED TO BREWERS

Fermentis by Lesaffre

(*) Active Dry Yeast

We're here to help

There are some great things happening in the world of fermented beverages. We are seeing young designers, small distilleries, craft breweries, new wine estates... There are risks; there is daring and some wonderful results. And as with any kind of creative endeavor, there are also disappointments.
This is a virtuous model, even for the market's biggest players who are pushed to be even more inventive. This is why we want to support the efforts of those who give it a try, for sure because we share this taste for innovation and initiative.
This document, we designed it for you, brewers; to offer you a tool to learn how high quality 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.
We sincerely hope that it will be useful to you and will help you create the beers you dream of.

Tips and Tricks can be downloaded from our website, as well as other practical tips and tools.

Fermentis by Lesaffre

ADY: a precious tool for you

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, directly into the wort or after rehydration through a simple procedure, Fermentis Active Dry Yeast is easy to use (E2U™)! Correct yeast population is 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 (*Saccharomyces pastorianus*). Our different strains are available from recognized sources enabling high quality lager production.

A range of ale yeasts has also been developed to produce ales with authentic flavor profiles and a variety of specialty beers.

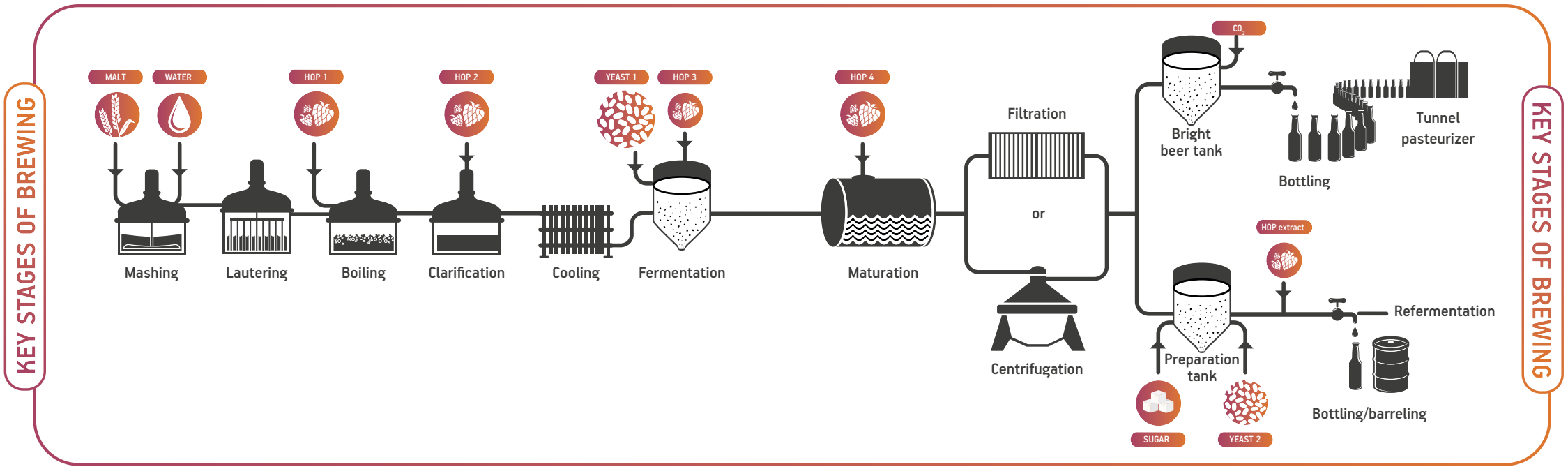
Each Fermentis yeast has its own characteristics; fermentation kinetics and profile, attenuation rate, alcohol tolerance, sedimentation, organoleptic expression...

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

The diagram hereunder 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; flavors 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 profile. All the elements in the brewing recipe will influence the final character and the final aromas of the beer: water, minerals, malts, hops and hopping regime.

Keep in mind that the choices made prior fermentation can also influence how the yeast reacts.

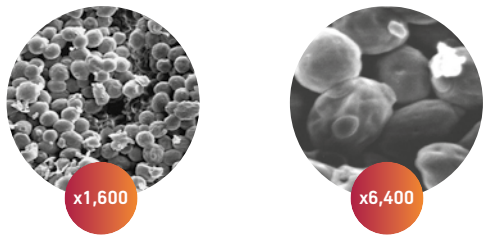


Yeast, what is it?

YEAST IS THE GENERIC NAME GIVEN TO A GROUP OF EUKARYOTIC UNICELLULAR MICRO-ORGANISMS, classified within Fungi Kingdom. They grow predominantly as single cells, and they include the gendre *Saccharomyces* (from Latin origin 'sugar fungus'). The yeast is responsible for transforming wort into beer and is also involved in a number of other fermentations. The taxonomy of yeasts can be confusing, but all classical beer yeasts are members of the genus *Saccharomyces.* Two species are commonly used in breweries: *S. cereviae* (top fermenting yeast) and *S. pastorianus* (bottom fermenting yeast). Although a variety of strains and other microorganisms may be used in brewing for different applications (see below).

THE TERM STRAIN IS USED TO DENOTE THE SMALLEST TAXONOMIC UNIT - a subdivision of the species. In the brewing industry, many thousands of yeast strains are used, although all have similar genetic material to allow them to be classified into the same genus or species. The taxonomy of yeasts has been and is still under a continual revision, often accompanied by changes in nomenclature.

DRY YEAST MICROSCOPE IMAGE



Yeast, *Saccharomyces cerevisiae*, is a unicellular fungi.
A *Saccharomyces cerevisiae* yeast cell measures between 5 and 50 µm.

FLASH BACK

PASTEUR DID A LOT FOR BREWERS

In 1876, Pasteur published his study *Études sur la Bière* and brought beer forward by describing the basis for fermentation.
With an extensive and meticulous work, he elucidated that beer was fermented not by chemicals but by microorganisms. He noticed that in the midst of another population of microorganisms ('wild yeast', bacterias and molds), there were the 'brewers yeasts' and just these microorganisms were the greatest responsible for a proper beer fermentation. With this new understanding, he and other scientists began to refine microbiological techniques and thus major improvements regarding principles and quality control for beer were effectively implemented.

Important microorganisms in beer

WITH RESPECT TO BEER PRODUCTION RELATED PROPERTIES; THE YEASTS USED FOR FERMENTATION OF WORT INTO BEER ARE TRADITIONALLY CLASSIFIED AS ALE, LAGER OR 'WILD' TYPES. *Saccharomyces cerevisiae* are referred as ale yeasts or top-fermenting yeasts and *Saccharomyces pastorianus* as lager yeast or bottom-fermenting yeast. *S. cerevisiae* include a very diverse group – considered domesticated – of ale yeasts used for producing beer, wine, cider, spirits and other fermented beverages. They are distinct from lager beer strains called *Saccharomyces pastorianus* (a cryotolerant hybryd between *Saccharomyces cerevisiae* and *Saccharomyces eubayanus*). At times, lager yeasts were also called *Saccharomyces carlsbergensis*.

NOT ONLY *SACCHAROMYCES PASTORIANUS* IS A NATURAL HYBRID USED IN BEER PRODUCTION. There is actually a large number of *Saccharomyces cerevisiae* strains which are hybrids.

REGARDLESS OF NOMENCLATURE ISSUES, IN THE BREWING INDUSTRY THERE IS A FUNDAMENTAL 'RULE' THAT LAGER YEASTS PERFORM IDEALLY AT LOW TEMPERATURES (8-15°C / 46-59°F), whereas ale yeasts operate best at higher temperatures (approximately at or above 20°C / 68°F). The enormous range of beer styles, and its flavors and aromas are not only resulting of different processing parameters and raw materials, but also due to the use of specific yeast strains with their typical sensory expression. The yeast plays an important role in the primary fermentation (the main alcoholic fermentation) as well as bottle conditionning.

WILD YEAST ARE NON-*SACCHAROMYCES* SPP. YEAST identified by EBC Analytica 4.2.6 or ASBC Microbiological Control-5D. A specific media with lysin is used. Most brewer's yeast are *Saccharomyces* and cannot growth with lysin as the sole source of nitrogen (lysin-negative). On the other hand, non-*Saccharomyces* spp. are lysin-positive and grow on lysin media.

SOME YEASTS MAY INCLUDE VARIATIONS OF *SACCHAROMYCES CEREVISIAE* - for example *S. cerevisiae* var *diastaticus* which release glucoamylase in the media to degrade dextrins, leading to potential hyper attenuation. Aditionally, other species like the ones of the genus *Brettanomyces (Dekkera)* are known to give a typic animal and funky flavor to beers. Because they vary in the production of flavor-active metabolites, there is a big biodiversity that can be exploited as single or mixed cultures in beer brewing.

FLAVOR

POF+ OR POF-?

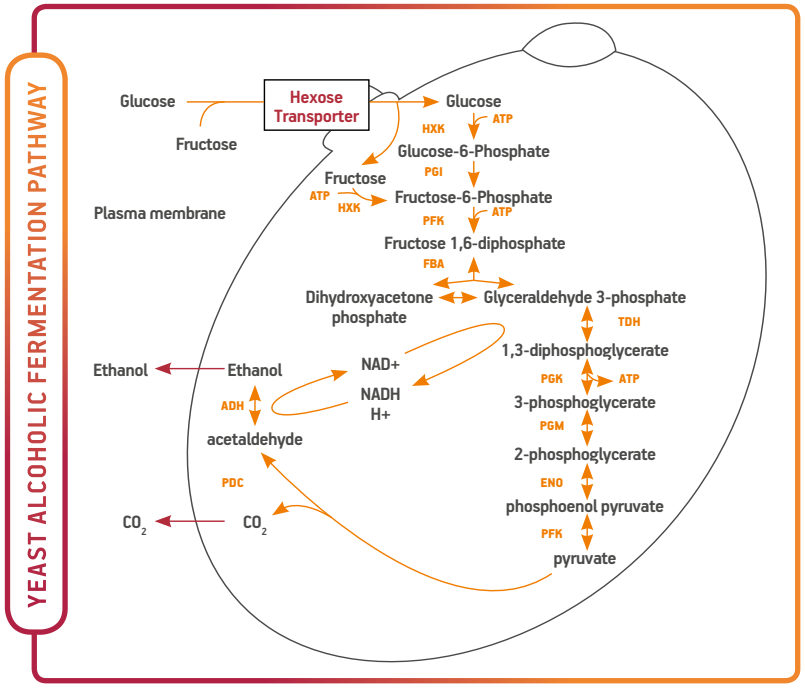
Some yeast strains may be from the same species, although they differentiate themselves by production of very diversified flavors. An example in beer is yeasts that differ in their 'POF' – *or phenolic off flavor* – gene expression.

In other words, those yeasts have a specific enzyme that decarboxylates phenolic acids -such as ferulic acid- present in wort and producing the flavor active compound 4VG. This compound contributes to spicy, clove-like flavors which, depending on the concentration, may give spicy and complex character in some Belgian ales and wheat based beers but, can be extremely undesirable in other beer types, such as Pilsen or Stout Beers.

Yeast in fermentation and maturation

TYPICAL BOTTOM FERMENTATION CAN TAKE ABOUT ONE OR A COUPLE OF WEEKS whereas top fermentation tends to be faster and takes about three to six days – depending on the conditions and more specifically the temperature. During main fermentation and depending on yeast strain and process parameters, specific flavors are produced. During maturation at low temperatures, there is minimal yeast activity, also contributing to some extend to the final beer flavor.

TRADITIONALLY BOTTOM-FERMENTED BEERS AND TOP-FERMENTED BEERS ARE DISTINGUISHED DUE TO THE TYPE OF YEAST used and the applied fermentation temperature. The choice of the fermentation temperatures in beer production processes is a critical factor: it can typically vary within a range of 8 to 28°C (46-82°F) and the higher the temperature, the faster the process, and sometimes the higher the concentration of co-products (such as flavor active components).



Sugars Involved

BEER YEAST STRAINS CAN UTILIZE VARIOUS CARBOHYDRATES with some differences between ale, lager and diastaticus. The wort supplies the yeasts with sugars such as glucose, fructose, maltose, maltotriose and dextrins.

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 beer 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 partially assimilate maltotriose. There are some top fermenting yeasts that have this capacity too, like SafAle™ BE-256, for example.

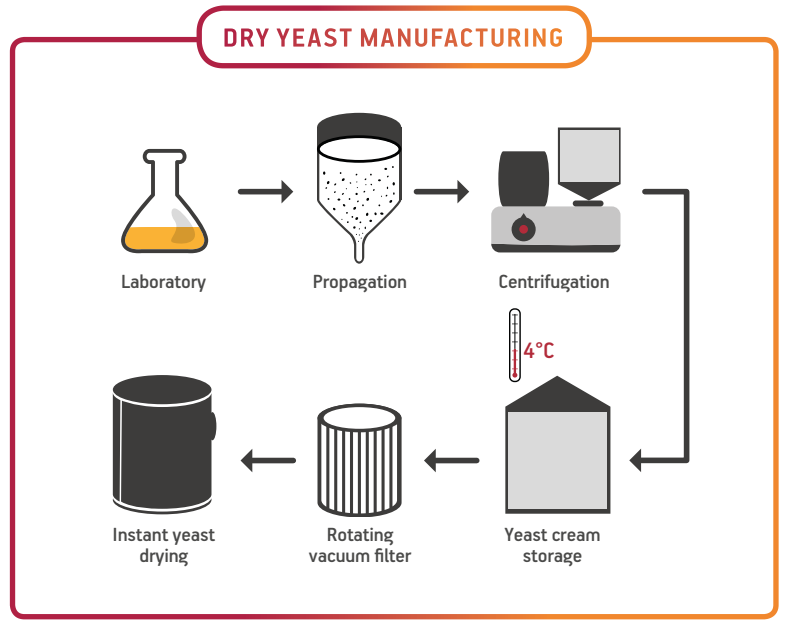
DEXTRINS

Dextrins are polymers (multiple units) of glucose in a linear or branched chain. They are formed in the wort during the mashing process. They are not fermented by beer yeast unless *Saccharomyces cerevisiae* var. *diastaticus* releases enzymes to convert them into fermentable sugars. Those non fermentable sugars (residual extract) contributes to the body and the mouthfeel of the beer.

Wort also contains several other nutrients for the yeast metabolism, such as minerals, ions and assimilable sources of nitrogen (amino acids, ammonium ion and some peptides) which will be utilized by yeast for growth, protein formation (structural and enzymic) as well flavor precursors.

How is ADY manufactured?

ACTIVE DRY YEAST IS THE FRESHEST YEAST FORMAT TO BE USED IN THE BREWING INDUSTRY. At Fermentis we select and manufacture yeast to produce a large amount of beer styles. Fermentis know-how allows yeast to preserves all its native properties during the entire production process.
In addition, as soon as it is in contact with wort, the yeast is ready to ferment. This is definitively the reliable answer to achieve consistent fermentations from batch to batch and to meet brewers needs.



Yeast cycling

1. FROM THE LABORATORY TO CENTRIFUGATION

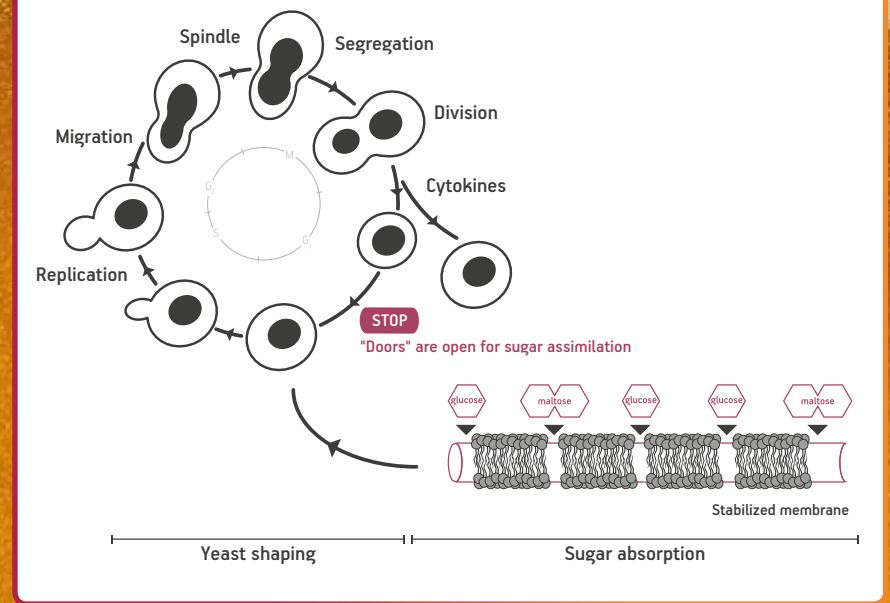
AT FIRST, THE YEAST IS MULTIPLIED BY BUDDING, AN ASEXUAL REPRODUCTION. The mother cell forms a bud. This bud receives progressively a duplicate of all mother yeast content (cytosol, organites, nucleus,...). The bud continues to grow until it separates from the parent cell, forming a daughter cell. If the mother and daughter cells are in a good medium, they both start budding.

IF THE YEAST ENVIRONMENT IS ADVERSE TO THE GROWTH, the yeast may start to produce protective compounds like glycerol, trehalose, glycogen,... Glycerol helps the yeast to resist to the osmotic pressure. Trehalose is a key contributor to the membrane stability during drying. Trehalose and Glycogen are reserve carbohydrates, those compounds allow the yeast to be naturally resistant to drying.

FERMENTIS YEASTS ARE GROWTH IN OPTIMUM MEDIA. By the end of duplication, the yeasts are shaped and the recipes are tuned to express resistance to drying. The yeasts contain all ingredients to start the fermentation.

2. FROM THE CREAM YEAST TO THE FRESH ACTIVE DRIED YEAST

BY THE END OF BIOMASS PRODUCTION, THE YEAST IS CENTRIFUGED. The resulting fresh cream yeast is stored cold. Afterwards, it is filtered to obtain compressed yeast which is extruded and dried.



experience!

Is your ADY ready to "work"?

You want to be sure that your Fermentis yeast is ready to work?
Do the test on your own!

What you need: two plastic bottles, two balloons, 20cl of water at room temperature (twice), 15g of sugar (twice) and 11.5g of yeast.

1. Put the water and the sugar in each of the bottles and in one add the yeast.
2. Immediately fix a ballon tightly on each bottle*
   (and place them in a warm environment: 40°C / 104°F).
3. Observe.

After a few minutes (which corresponds to what we call "lag phase") you should see the balloon inflate only in the bottle containing the yeast. This is due to the yeast metabolism which starts to produce CO_2 (carbon dioxide), the same CO_2 which is able to inflate the balloon.

Your experience is a success? Great, it is the sign that your Fermentis yeast is active.

* Make sure that the balloon is hermetically fixed on the neck of the bottle.

Quality control

FERMENTIS EXECUTES A POSITIVE RELEASE: after production, the batches are retained until all quality control results are obtained. If all results are good the batch is released.

WHEN PITCHING AT 50 G/HL FOR ALE OR AT 100 G/HL FOR LAGER, contaminations are lower than 1 contaminating cell (*)/ ml (**).

THEREFORE, SEMI QUANTITATIVE PCR TEST MAY GIVE POSITIVE RESULTS. It is recommended to cross check PCR results with plating methods.

UP TO NOW, NO CONTAMINATING BACTERIA GROWTH WERE OBSERVED IN HOPPED WORTS OR BEERS. The level of non-*Saccharomyces* yeast contamination is so low that it does not impact the flavor with up to several recyclings.

Shelf life

THE SHELF LIFE OF FERMENTIS YEAST IS 3 YEARS FROM PACKAGING DATE when stored below 15°C (59°F) for extended period of time (more than 6 months). For shorter periods of time (up to 6 months) it is acceptable to store yeast at temperatures up to 24°C (75°F).

Batch number and traceability

ALL FERMENTIS SACHETS, PACKS AND BOXES ARE IDENTIFIED BY AN ALPHANUMERIC CODE. It permits to find all data related to the batch produced, from raw material used to recorded process parameters and quality results.

(*) contaminating cell: *Lactobacilus spp.*, *Acetobacter spp.*, *Pediococcus spp*, non-*Saccharomyces* yeast.
(**) meanings that contaminating cell concentration is lower than 10^3 cfu/g.

CERTIFICATION

YOU NEED A STATEMENT?

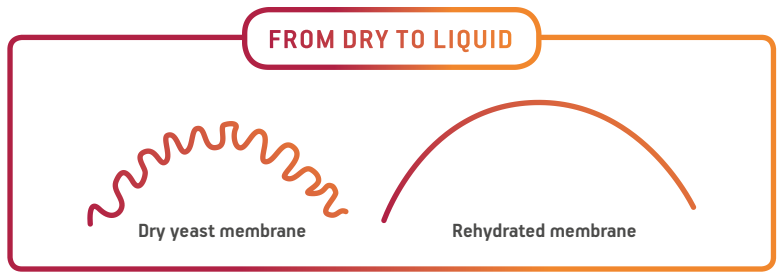
All our products are certified for your benefit. We remain at your disposal to provide any certificate or statement you may need. Simply send us an e-mail at fermentis@lesaffre.com

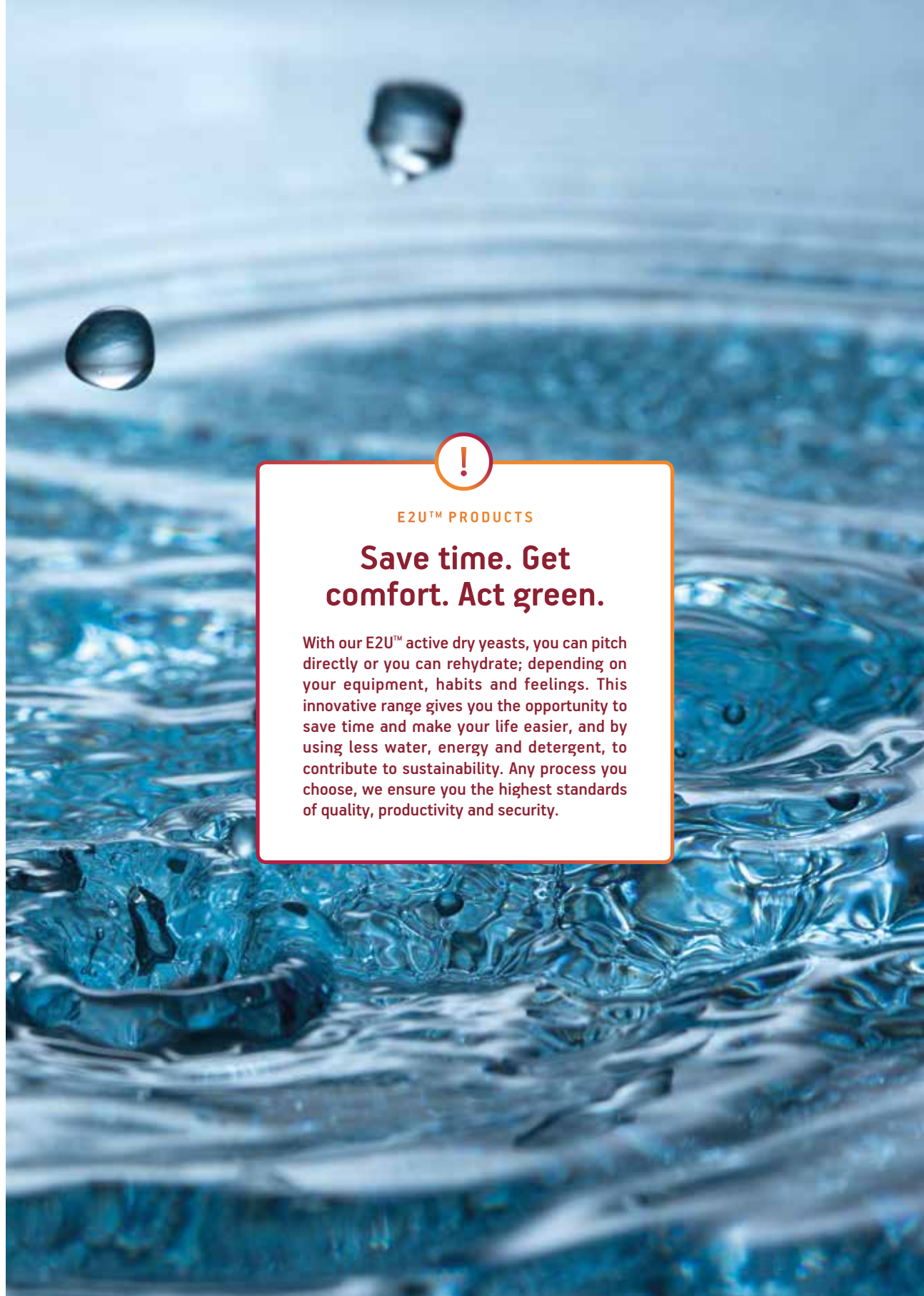
How to use active dry yeast?

TODAY A STUDY DEMONSTRATES THAT THE USE OF ACTIVE DRY YEASTS (ADY) is very easy and does not necessarily include a rehydration step. To the contrary, the ADY can advantageously be immediately put in contact with the wort into the fermentation vessel (direct pitch). Several rehydration and direct pitch conditions do not show any significant differences in terms of viability and vitality of the ADY. This concept is protected under the E2U™ umbrella.

E2U
EASY TO USE
by Fermentis

FERMENTIS ADY LOOKS LIKE A COMPACT SPONGE COMPOSED OF MICROSCOPIC BALLS TIGHTENED CLOSE TOGETHER (CF. P6). This sponge is ready to absorb water or wort. The yeast cells need to recover the liquid they lost during drying to start fermenting. The membrane of the yeast cell after drying contains circumvolutions, after its contact with water or wort it becomes perfectly smooth again.





E2U™ PRODUCTS

Save time. Get comfort. Act green.

With our E2U™ active dry yeasts, you can pitch directly or you can rehydrate; depending on your equipment, habits and feelings. This innovative range gives you the opportunity to save time and make your life easier, and by using less water, energy and detergent, to contribute to sustainability. Any process you choose, we ensure you the highest standards of quality, productivity and security.

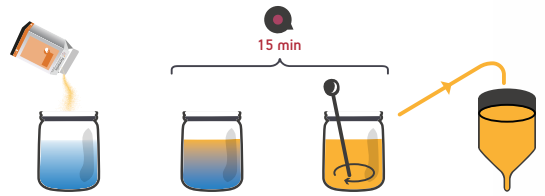
Rehydration process

1. TEMPERATURE MONITORING

IF YOU ARE USED TO REHYDRATE DRY YEAST, NO WORRY you still can!
Just follow our recommendation process.

- Rehydrate the dry yeast into yeast cream by sprinkling it on 10 times its own weight of sterile water or hopped wort.
- The temperature of the hydration media is between 10 and 28°C (50-82,4°F); and should ideally be close to fermentation temperature.
- Leave to rest; and optionally agitate gently (no violent agitation) for about 15 minutes.
- Finally, pitch the resultant cream into the fermentation vessel.

DRY YEAST REHYDRATION



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.

AFTER REHYDRATION, BACTERIAL CONTAMINATION CAN DEVELOP IN THE SLURRY. For that reason, we recommend a rehydration in sterile hopped wort compared to sterile unhopped wort or sterile water. The iso-alpha acids (ideally above 5ppm, the equivalent of 5 IBU) present in the media will protect it from Gram + bacterial development and will not affect the rehydration process of the ADY.

2. WATER OR HOPPED WORT?

Fermentis yeast can be rehydrated with sterile water or sterile hopped wort:

IF THE REHYDRATION PROCESS OCCURS IN WATER, it can be tap water, mineral water or distilled water, but in any case, sterility is mandatory.

IF THE REHYDRATION PROCESS OCCURS IN HOPPED WORT (with first hop addition and minimum 20 minutes boil) collect the required volume in a closed vessel. Leave it to cool down to pitching temperature before adding Fermentis yeast.

IN BOTH CASES, rehydrate the yeast for 15 minutes. Pitch immediately into the tank, during the first part of cooling.

DON'T FORGET YOUR REHYDRATION ESSENTIALS

- 1 -
Respect recommended rehydration temperatures to ensure good start of the fermentation.

- 2 -
Water or hopped wort, whatever you choose make it sterile.

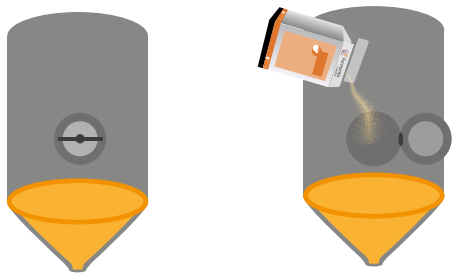
GOOD TO KNOW

Direct pitch

If the brewery is not equipped with a system designed for the rehydration step, we highly recommend a direct pitch.

To do so we recommend using the necessary quantity in weight of ADY and to put it into the fermentation vessel during the first part of the wort cooling step. The temperature of cooling will be the same as the temperature used to start fermentation. There is no need for aeration during this process.

DRY YEAST DIRECT PITCH

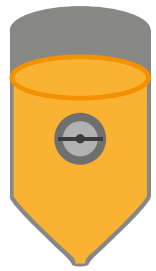


Step 1

Start to fill your fermenter with hopped wort until the cone is filled

Step 2

Sprinkle dry yeast directly in the hopped wort



Step 3

Finish to fill the fermenter

What to be careful about?

Pitching rate

PITCHING AT THE CORRECT LEVEL WILL GUARANTEE A RAPID START of fermentation. Using a low pitching rate will delay the start of fermentation and increase contamination risk.

ACTIVE DRY YEAST HAS THE ADVANTAGE OF CONVERTING A DRY YEAST WEIGHT to an accurate number of viable cells pitched in the wort.

IF THE FERMENTATION VESSEL WILL CONTAIN MORE THAN ONE BREW, we also recommend adding the total quantity of ADY of the fermentation vessel during the cooling of the first brew.

	FERMENTIS YEAST DOSAGE	
ALE YEASTS	50-80 g/hl (0.06-0.10 oz/gal)	4-6 10^6 cells/ml
LAGER YEASTS*	80-120 g/hl (0.10-0.16 oz/gal)	8-12 10^6 cells/ml

*Values given are for fermentation between 12-15°C (53-59°F).
Lager 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).

Fermentation temperatures

THE RECOMMENDED FERMENTATION TEMPERATURE RANGE (refer to technical data sheets) of each strain must be respected.

THE HIGHER THE TEMPERATURE IS AT THE BEGINNING OF FERMENTATION, the faster the fermentation will start.

DIACETYL REDUCTION WILL ALSO BE FASTER AT HIGHER TEMPERATURES towards the end of fermentation. For ale, a 24h diacetyl reduction rest at 23°C (73°F) minimum should be applied before cooling. For lager, temperature may be raised (during the second part of fermentation) to 16°C to 18°C (61-64°F) and left for 48h to reduce diacetyl.

LOW TEMPERATURE (0-5°C / 32-41°F) IS REQUIRED 24h after the end of the fermentation to achieve good yeast sedimentation.

GOOD TO KNOW

Be careful, it starts right away!

Fermentation starts immediately, but significant CO_2 release and aroma formation will only be perceptible after 12 to 24 hours for ale yeasts and 16 to 32 hours for lager yeasts.

Effect of oxygen

WHEN USING ADY THERE IS NO SPECIFIC REQUIREMENT OF AIR OR OXYGEN DURING WORT COOLING AND TRANSFER TO THE FERMENTER. Indeed, ADY is rich enough in sterols (lipids) and minerals for its own multiplication process.

IN CASE THE YEAST IS CROPPED AND REPITCHED FOR A NUMBER OF GENERATIONS, supply of air or oxygen is mandatory.

Yeast recycling

REUSING YEAST FROM A PREVIOUS BATCH REQUIRES DEDICATED TANKS and specific know-how; and needs to be done in good hygienic conditions. A viability test should be performed on the slurry and the dosage rate should be calculated based on the living cells and according to the population required at fermentation start.

THERE IS A RISK OF GENERATING VARIANTS AFTER A FEW GENERATIONS, that may result in a change of the aromatic profile of the beer. The maximum number of generations is highly dependent of the brewery and the process and should be evaluated based on experiences and consistency of the product.

Bottle and cask conditioning

YEAST IS USED FOR REFERMENTATION IN BOTTLES OR IN CASKS. If the primary objective is to saturate the beer with CO_2, refermentation brings other benefits to the beer. First, the presence of living yeast in the bottles/casks will prevent beer oxidation and increase its shelf life. It will also provide mouthfeel and roundness to the beer.

WHEN SELECTING A YEAST for refermentation, you have to consider:

- ☑ Its tolerance to high alcohol and CO_2 levels
- ☑ Its aroma development capabilities
- ☑ Its sugar assimilation profile (maltotriose negative)
- ☑ Its ability to settle and stick well to the bottom of the bottle/cask at the end of refermentation

AFTER PRIMARY FERMENTATION, yeast is often inhibited by alcohol and as such we do not recommend to use cropped yeast to make the refermentation.

THE SUGAR ADDITION NEEDS TO BE CAREFULLY 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.

SMART CHOICE. SAFALE™ F-2.

SafAle™ F-2 has been selected specifically for secondary fermentation. It garanties a neutral aroma profile respecting the base beer character (see more page 38).

ACCORDING TO THE ALCOHOL CONTENT AND THE CARBONATATION LEVEL before refermentation, the quantity of SafAle™ F-2 to be added is indicated in the table below (you can also calculate it with the Fermentis App').

		CO2 (g/l)			
	g/hl	0,5	1,5	3	6
ABV (%)	5	2	7	7	14
	8	2	7	7	14
	12	2	7	7	35

Yeast characteristics

ONE OF THE MAJOR PILARS OF THE FERMENTIS TECHNICAL PROGRAM is to constantly improve the understanding of the yeast promise. In this respect, our Fermentis Academy is rolling out a strategy under which both technical and sensory characteristics linked to the fermentation are explored. Here we will expose some of our findings, amongst which kinetics, attenuation, sugar assimilation, alcohol tolerance, flocculation, sedimentation, aromas, etc.

FERMENTIS
ACADEMY

Learn, Share, Exchange

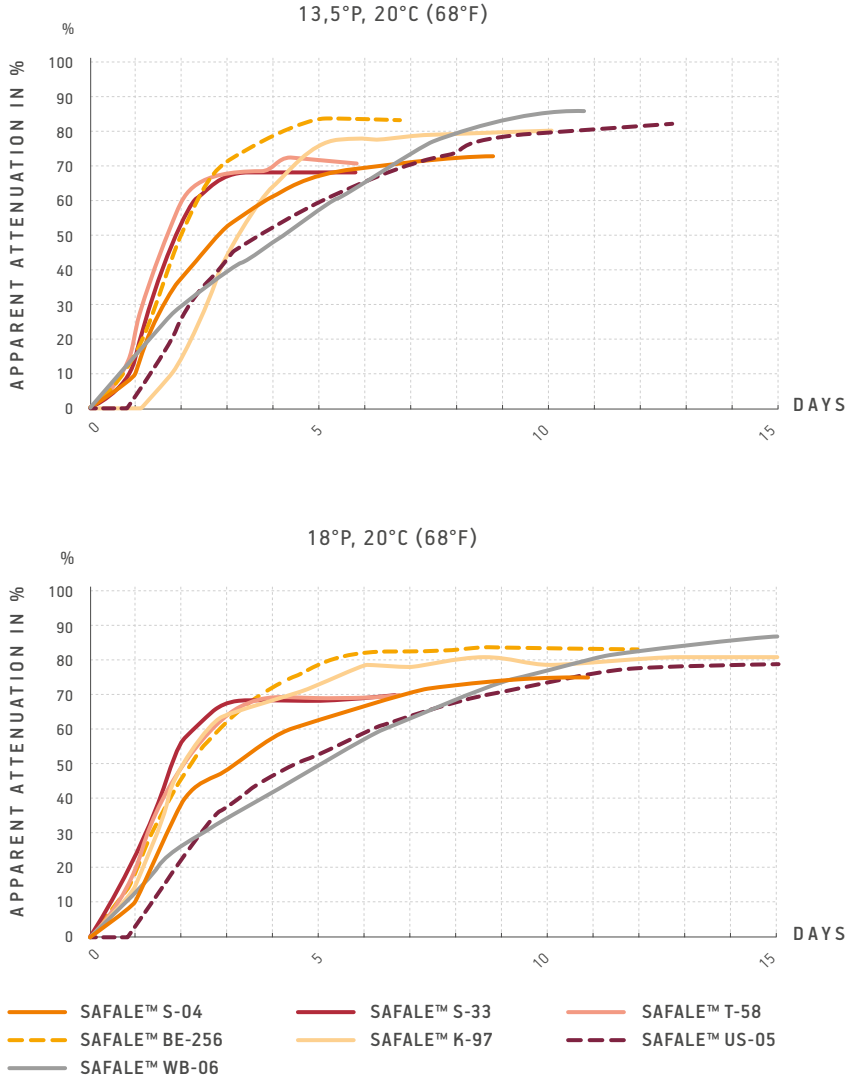
The Fermentis Academy is a place of unique inspiration, at the crossroads between the world of research and creation. In this open, cosmopolitan place you will be welcomed by our researchers and tasting experts. You will also meet with other professionals who, like you, are seeking to make progress or innovate. You will be able to test our products, taste the latest creations from our cellars or even train your teams in the art of fermentation and in the aromatic variations offered by our products.

Every year, we're organizing Fermentis Academy events all around the world, for sure, we'll be somewhere close to you. Follow us on our social networks to not miss the next event and learn more about yeast and fermentation.

Indicative fermentation kinetics and attenuation

SafAle™ range

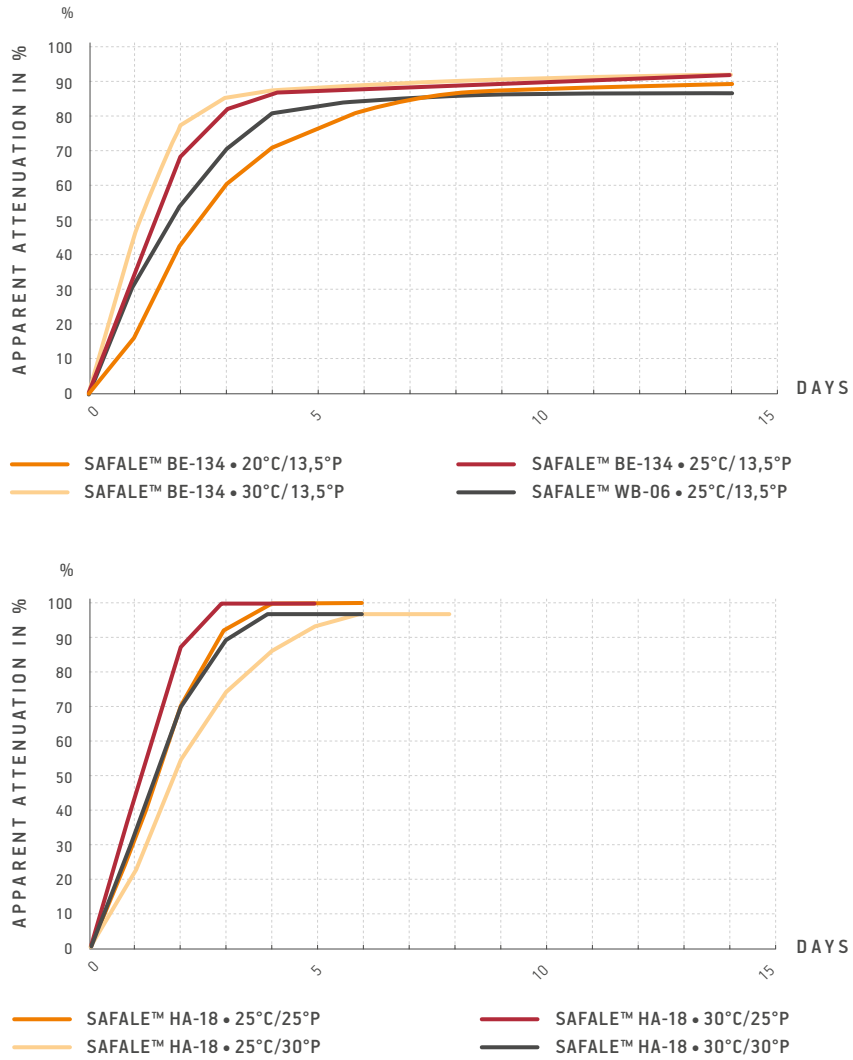
13,5°P, 20°C (68°F)



Apparent attenuation is indicative and may vary under different conditions.

Other SafAle™ yeast strains

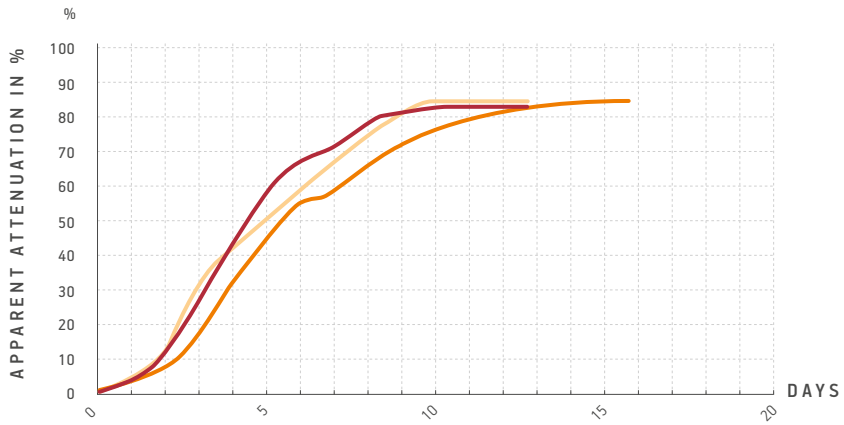
THIS IS OUR SELECTION OF HYPER ATTENUATING YEASTS .They present a high attenuation with low residual sugar content and allow production of different beer styles and flavors.



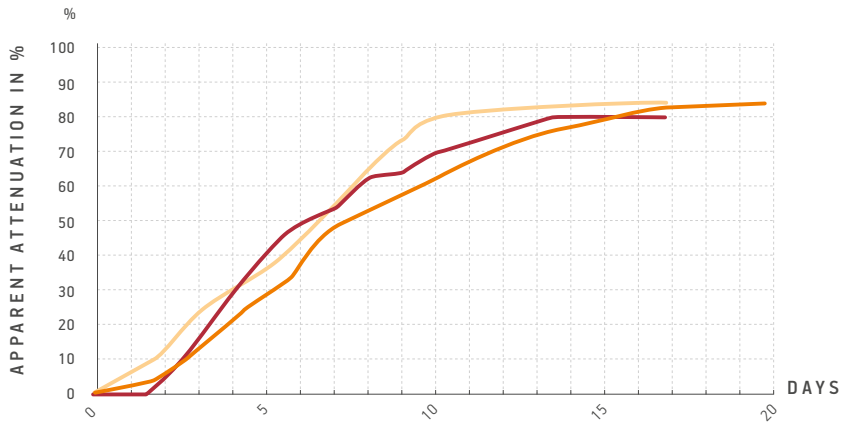
Apparent attenuation is indicative and may vary under different conditions.

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

Apparent attenuation is indicative and may vary under different conditions.

Apparent Degree of Fermentation (ADF)

THE TABLE BELOW SHOWS THE APPARENT DEGREE OF FERMENTATION (ADF) in % after fermentation for each strain.

SafAle™ range

	ADF
SafAle™ S-04	74-82%
SafAle™ K-97	80-84%
SafAle™ US-05	78-82%
SafAle™ WB-06	86-90%
SafAle™ S-33	68-72%
SafAle™ T-58	72-78%
SafAle™ BE-256	82-86%
SafAle™ BE-134	89-93%
SafAle™ HA-18	98-102%

SafLager™ range

	ADF
SafLager™ S-23	80-84%
SafLager™ S-189	80-84%
SafLager™ W-34/70	80-84%

Flocculation

FLOCCULATION IS THE ABILITY OF YEAST CELLS TO FORM AGGREGATES. It is the ability of yeast to raise in the foam at the end of fermentation. If the yeast is not remaining in the foam at the end of fermentation, a highly flocculent yeast will sediment fast and give a clear beer with little cells in suspension. On the contrary, a low flocculent yeast will sediment slowly and leave the beer hazy for a longer time.

SafAle™ range

	FLOCCULATION	SEDIMENTATION	FLOTTATION
SafAle™ S-04	+	Fast	-
SafAle™ K-97	+	Slow	+
SafAle™ US-05	+	Medium	+
SafAle™ WB-06	-	Slow	+
SafAle™ S-33	-	Medium	-
SafAle™ T-58	-	Medium	-
SafAle™ BE-256	+	Fast	-
SafAle™ BE-134	-	Slow	-
SafAle™ HA-18	-	Medium	-

SafLager™ range

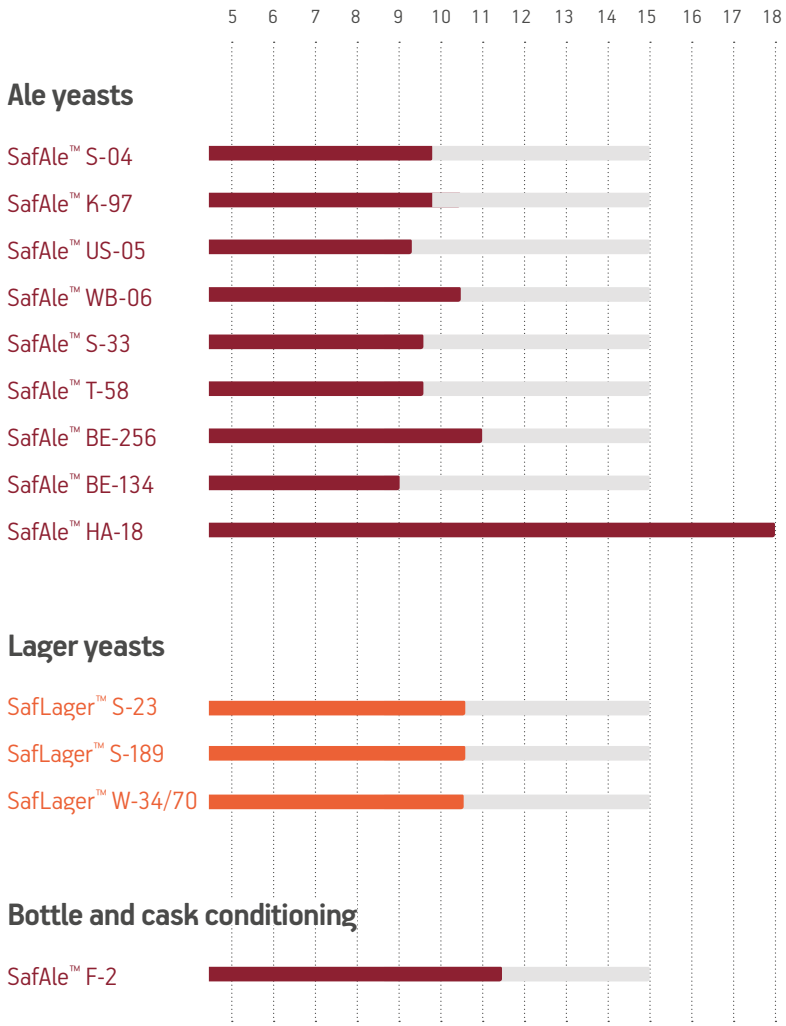
	FLOCCULATION	SEDIMENTATION	FLOTTATION
SafLager™ S-23	+	Fast	-
SafLager™ S-189	+	Fast	-
SafLager™ W-34/70	+	Fast	-

GOOD TO KNOW

Ca^{++}

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

Indicative alcohol tolerance in % v/v



Indicative alcohol tolerance under standard fermentation conditions.
Alcohol tolerance reached in laboratory under constant agitation.

Aromas, flavors and beer styles

NOT ONLY THE ETHANOL AND CO_2 PLAY AN IMPORTANT ROLE IN BEER: its flavor components are chemically and sensorially diverse. The unique flavor profiles of beer can largely be attributed to the biochemical activities within the yeast cell during fermentation along with the other raw materials and process parameters.

THE YEAST-DERIVED FLAVOR-ACTIVE COMPOUNDS CAN BE LISTED AS CARBONYLS (aldehydes/ketones), vicinal diketones, fatty and organic acids, sulphur compounds, higher/fusel alcohols, esters (acetate and ethyl esters), etc. For example, the last ones correspond to a family of compounds closely linked to lipid metabolism and yeast growth and over dozens different esters are present in beer and often given fruity and floral notes.

THERE ARE TWO MAIN ESTERS GROUPS: first the so-called acetate esters (in which the acid group is acetate and the alcohol group is ethanol or a complex alcohol derived from amino acid metabolism), such as ethyl acetate (solvent-like aroma), isoamyl acetate (banana aroma), and phenyl ethyl acetate (roses, honey). The second group, called ethyl esters (in which the alcohol group is ethanol and the acid group is a medium-chain fatty acid) includes ethyl hexanoate (aniseed, apple like aroma), ethyl octanoate (fruity, apple aroma), ethyl decanoate (floral / fruity), etc.

THUS, THE AMOUNT AND / OR VARIETY OF FLAVORING COMPOUNDS in beer is a consequence of the metabolism of a given yeast strain, in a particular wort composition and processes parameters, whereas some of these flavoring agents may be pleasant.

Representatives of Important Beer Styles	Organoleptic characteristics	Suggested yeast*
Pilsners and Special Lagers	Pronounced flavors from raw materials, specially from malts and hops (variable). Neutral fermentation character, high drinkability.	W-34/70, S-189, S-23
Blond / Pales, Ambers and Browns Ales - American and British Ales	Balanced fermentation flavors along with malt and hop notes.	S-04, US-05, S-33
Belgian Strong Ales (Dubbel, Tripel, Quadruppels, Abbey styles)	Intense Fermentation flavors, rich fruitiness and alcoholic notes, often spicy. Low to high attenuation.	BE-256, S-33, S-04, HA-18
Kolsch	Light and perfumed fruity-floral notes in balance. Delicated, light with very high drinkability	K-97
Saison	Strong Fermentation flavors, specially intense in fruity notes and spicy character. High attenuation and very dry body, slight acidity, refreshing and sparkling.	BE-134, WB-06, T-58
Weizen beers	Strong Fermentation flavors, specially fruity, banana like and spicy-clove hints. Medium-High attenuation.	WB-06, T-58
Wit Beers (Blanche)	Balanced fruity, grainy and spicy flavors. Light and refreshing.	WB-06, T-58, K-97
India Pale Ales (IPAs)	Hoppy forward beer style, flavors depending on it's varieties. Low to mild fermentation flavors.	US-05, S-04
Hazy IPAs	Hoppy-fruity forward style. Juicy and Hazy.	S-33, K-97, S-04
Brut IPAs	Hoppy and bone-dry beer style (achieved by enzyme utilization). Refreshing and sparkling.	S-33, US-05
Imperial IPAs	Stronger version of India Pale Ale: strong hoppy flavors, high bitterness level and usually higher degrees of alcohol.	K-97, US-05, S-04
Session IPAs	Gentle and lighter IPA versions. High drinkability and lower alcohol and bitterness level.	US-05, K-97, S-04, S-33
Porters	Balanced fermentation flavors along with a complex and flavorfull dark malt character, with variable hop notes intensities.	S-04, US-05
Stouts	Mild and balanced fermentation flavors along with intense dark and roasted malt character, with variable and hop notes intensities and dryness.	S-04, S-33, US-05
Imperial Porters / Stouts	Supports higher fermentation fruity-flavors along with intense dark malt character, and variable hop notes. High alcohol levels, may present warmer mouthfeel.	BE-256, HA-18, US-05, S-04, T-58
Barley Wines	Rich maltiness, sustained fermentation flavors and hoppy notes. High alcohol levels including warm mouthfeel.	HA-18, BE-256, S-33, T-58
OTHER SPECIALTIES		
Acidic Beers	Represent a great variety of beers types, mainly characterized by its acidity often by mix fermentation with bacteria.	LP 652
Low and Non alcoholic beers	Every beer with low or no ethanol content.	LA-01

*Recommendation of a single yeast strain accordingly with the major flavor expectations. Every strain will vary the flavor profile. For more informartion about every strain, see next table or, for more informations access: Fermentis App.

Strain	Taxonomy	Attenuation*	Pitching Rate	Phenolic Off-Flavor	E2U™	Usage Recommendation
SafAle™ S-04	*S. cerevisiae*	74-82%	50-80 g/hl	⊖	YES	English ale yeast selected for its fast fermentation character. Produces balanced fruity and floral notes. Due to its flocculation power, tends to produce beers with higher clarity. Ideal for a large range of American and English Ales - including highly hopped beers - and is specially adapted to cask-conditioned ones and fermentated in cylindo-conical tanks.
SafAle™ BE-256	*S. cerevisiae*	82-86%	50-80 g/hl	⊖	YES	Active dry yeast recommended to brew a diversity of Belgian type beers such as abbey style known for its fruitiness and high alcohol content. It ferments very fast and reveals strong fermentation aromas. To maintain the aromatic profile at the end of the fermentation, we do recommend to crop this yeast as soon as possible after fermentation.
SafAle™ US-05	*S. cerevisiae*	78-82%	50-80 g/hl	⊖	YES	American ale yeast producing neutral and well balanced ales, clean and crispy. Forms a firm foam head and presents a very good ability to stay in suspension during fermentation. Ideal for American beer types and highly hopped beers.
SafAle™ S-33	*S. cerevisiae*	68-72%	50-80 g/hl	⊖	YES	Fruity driven strain, gives a high mouthfeel and body to the beer. Ideal for Belgian Ales (Blond, Dubbel, Tripel, Quadrupel Styles) and strong English ales (ex. Imperial Stouts). Is ideal also for New England IPA's. Yeast with a medium sedimentation: forms no clumps but a powdery haze when resuspended in the beer.
SafAle™ K-97	*S. cerevisiae*	80-84%	50-80 g/hl	⊖	YES	German ale yeast producing subtle fermentation character. Depending on the conditions tend to present floral and balanced fruity character. Ideal for delicate beers such as German Kolsch beers, Belgian Wits and some versions of Session Beers. Suitable for heavily hopped beers and has ability to form a large firm head when fermenting.
SafAle™ T-58	*S. cerevisiae*	72-78%	50-80 g/hl	⊕	YES	Specialty yeast selected for its strong fermentation character, intense fruity and phenolic flavors - specially banana, clove and peppery notes. Suitable for a great variety of wheat-base beers and fruity-spicy oriented styles. Yeast with a medium sedimentation: forms no clumps but a powdery haze when resuspended in the beer.
SafAle™ WB-06	*S. cerevisiae* var. *diastaticus*	86-90%	50-80 g/hl	⊕	YES	Fruity and phenolic character, varying with the fermentation conditions. Produce well-attenuated beers and its ideal for wheat base beers, such as Belgian and German Styles (Ex. Wit Beers and Weizen Beers). Produces typical phenolic notes of wheat beers. Allows to brew beer with a high drinkability profile and presents a very good ability to suspend during fermentation.
SafAle™ BE-134	*S. cerevisiae* var. *diastaticus*	89-93%	50-80 g/hl	⊕	YES	This typical yeast strain is recommended for well-attenuated beers, produces fruity, floral and phenolic notes and a dry character. Produces highly refreshing beers, it is ideal for Belgian-Saison style.
SafAle™ HA-18	*S. cerevisiae + enzyme* (glucoamylase)	98-102%	100-160 g/hl	⊕	NO	SafAle™ HA-18 is a powerful solution (consisting of Active Dry Yeast and enzymes) for the production of high-gravity and particularly high alcoholic beers - such as strong ales, barley wines and barrel aged beers with very high density. It has a very good resistance to osmotic pressure and high fermentation temperatures (thermotolerant yeast).
SafAle™ F-2	*S. cerevisiae*	NA	2-35 g/hl	⊖	NO	SafAle™ F-2 has been selected specifically for secondary fermentation in bottle and in cask. This yeast assimilates very little ammount of maltotriose but assimilates basic sugars (glucose, fructose, saccharose, maltose). It is caracterized by a neutral aroma profile respecting the base beer character and settles very homogeneously at the end of fermentation.
SafLager™ W-34/70	*S. pastorianus*	80-84%	80-120 g/hl	⊖	YES	This famous yeast strain from Weihenstephan in Germany is used world-wide within the brewing industry. Known by its neutral character, SafLager™ W-34/70 produces neutral fermentation character, giving clean and neutral profile. Depending on the conditions it may present slight fruity and floral notes.
SafLager™ S-23	*S. pastorianus*	80-84%	80-120 g/hl	⊖	YES	Bottom fermenting yeast originating from Berlin (Germany) recommended for the production of more fruity and estery lagers. Its profile gives beers with a good length on the palate.
SafLager™ S-189	*S. pastorianus*	80-84%	80-120 g/hl	⊖	YES	Originating from the Hürlimann brewery in Switzerland. This lager strain's profile allows to brew fairly neutral flavor beers with a high drinkability. Depending on the conditions, tend to present noticeable herbal and floral notes to lager beers.

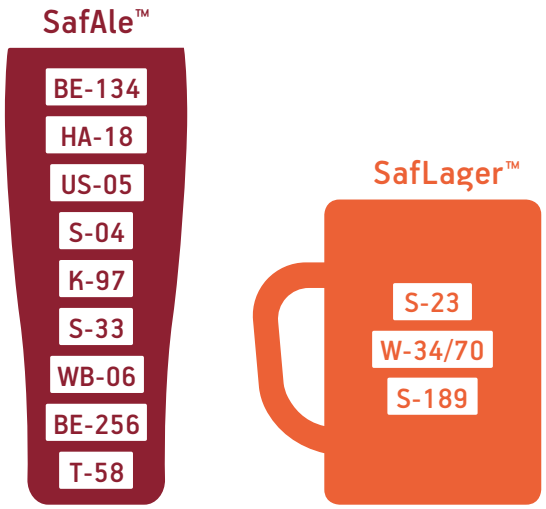
Make your choice!

THIS IS OUR SPECIFIC PORTFOLIO COVERING BREWERS NEEDS. We offer you efficient and qualitative strains which will help you design the beer of your dreams. Let's discover their main characteristics.

PLEASE KEEP IN MIND THAT ALL OUR RESULTS ARE INDICATIVE and may vary according to raw materials, brewing process and fermentation conditions.

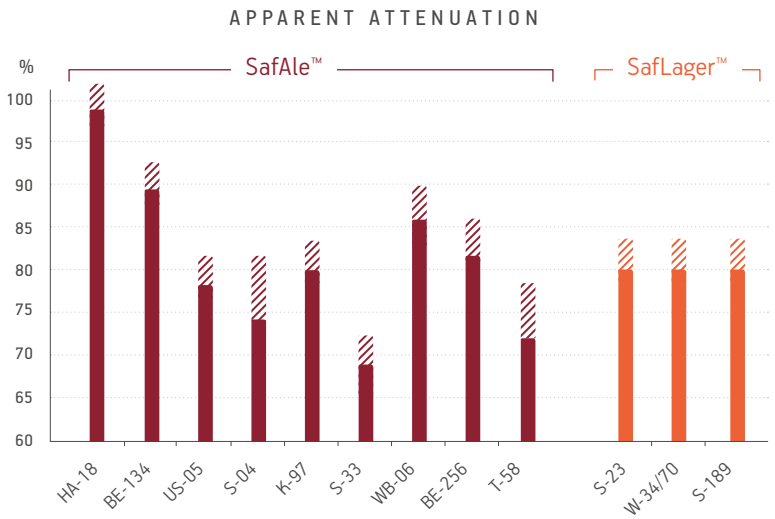
Ale or Lager?

FERMENTIS SUPPLIES 2 RANGES OF YEAST STRAINS. You want to make a Lager beer? Ask for our 3 dedicated yeasts. An Ale? You can select amongst 9 strains.



Dry or full-bodied beers?

FIND THE RIGHT BALANCE BETWEEN RESIDUAL SUGARS AND FINAL ALCOHOL. Almost all of our yeast strains guarantee a medium/high attenuation rate: around 78-84%. If you want to obtain a beer with a higher attenuation and a low level of residual sugars, SafAle™ BE-256 or SafAle™ BE-134 will be the obvious choices. Likewise for high-density beers, SafAle™ HA-18 will allow a very high attenuation. However, if you want to obtain a medium level of residual sugars, SafAle™ S-33 will fit perfectly.

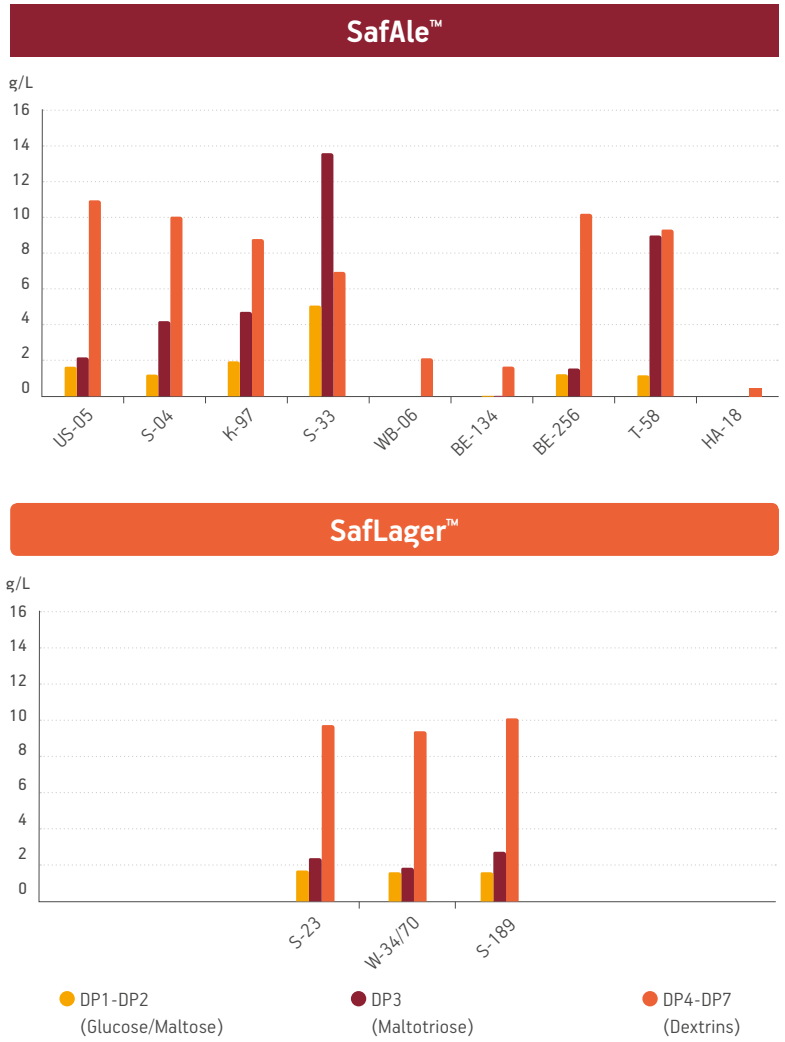


GOOD TO KNOW

We have set up a study to picture and compare the flavor and aroma characteristics of our main commercial yeast strains (see page 45). All have been tested in the same standard conditions, with the lowest possible impact of other ingredients, i.e. in the most neutral conditions. Wort: 100% 2 row spring barley pils malt, 15°P / Bitterness: 25 IBU with pure iso-alpha-acids (end of boiling) / Pitching rate: 50 g ADY/hl / Fermentation: 23°C, @Atm. P.

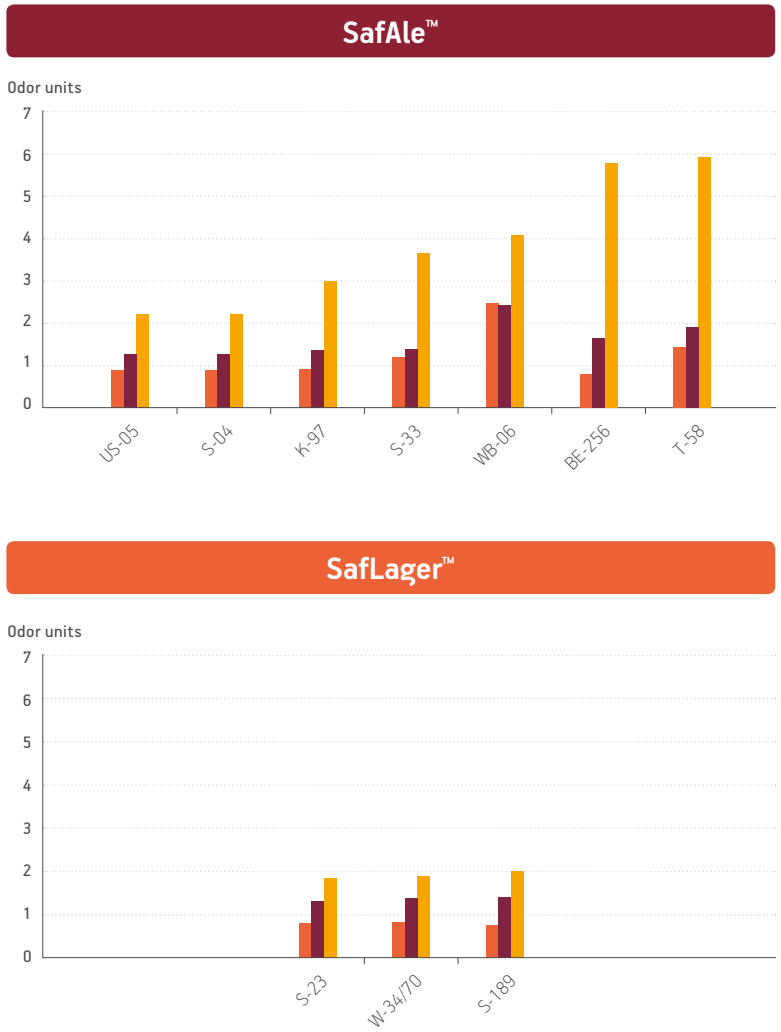
Residual sugars

LOOKING FOR YEASTS WHICH LEAVE SOME SPECIFIC SUGARS BEHIND? SafAle™ S-33 will leave most of the maltotriose. Conversely, SafAle™ BE-256 consume almost all of it. Furthermore, SafAle™ WB-06 and SafAle™ BE-134 are *S. cerevisiae* var. *diastaticus* and will convert dextrins into fermentable sugars.



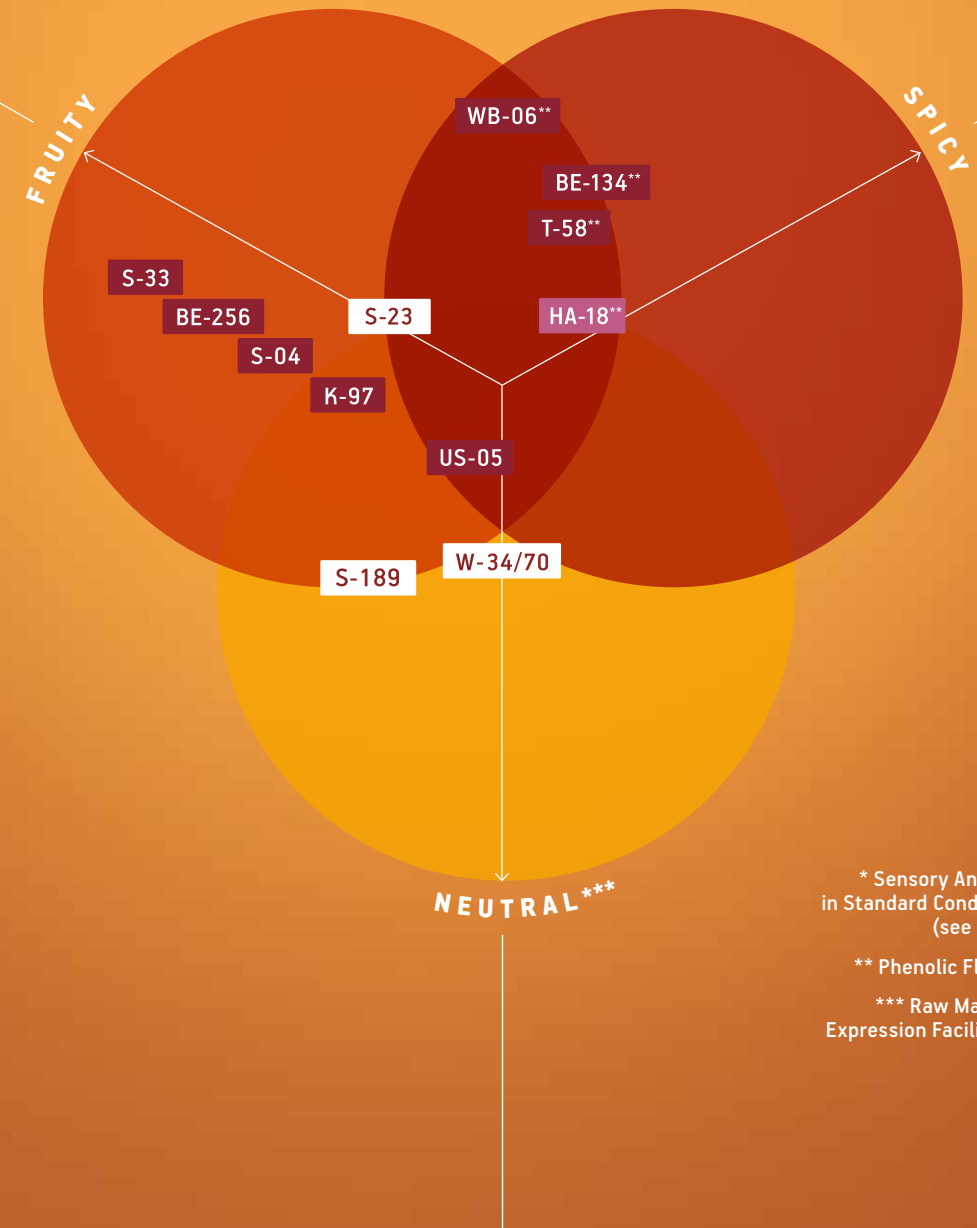
Esters

SOME SPECIFIC SAFALE™ STRAINS DEVELOP A NEUTRAL PROFILE, while other yeasts express more fruity flavor – mainly SafAle™ BE-256 and SafAle™ WB-06.



Baseline Flavor & Aromas*

SafLager™ Yeasts | SafAle™ Yeasts | Mix: Yeast + Enzyme



* Sensory Analysis in Standard Conditions (see p.42).

** Phenolic Flavors

*** Raw Material Expression Facilitated

Major notes & flavors descriptors

Malt	
Grainy	Cereals, Bready
Malty	Biscuity
Caramel	Toffee, Molasses, Honey
Nutty	Almond, Nuts, Marzipan
Roasty	Coffee, Cocoa, Chocolate
Smoky	Smoked

Hop	
Herbal	Herbs, Tea-Like
Menthol	Mint, Camphor, Pine, Resinous
Citrusy	Grapefruit, Orange, Lime, Lemon, Mandarin, Etc.
Fruity	Berries, Melon, Peach, Apricot, Passion Fruit, Lychee, Pineapple
Spicy	Spices, Pepper, Chili, Curry, Juniper
Floral	Lily, Jasmine, Violet, Rose, Geranium
Vegetal	Celeriac, Onion, Garlic

Yeast	
Fruity	Banana, Apple, Pear, Apricot, Pineapple, Tropical Fruits, Sweety-Riped Fruits, Tutti-Frutti
Floral	Roses, Geranium
Phenolics	Spicy, Clovy
Alcoholic	Vinous, Sherry
Aromatic	Perfumy, Estery

Off Notes	
Sulfury	Lightstruck, DMS, H_2S, Sulfitic
Stale/Oxidized	Metallic, Papery, Cardboard
Fatty/Dairy	Diacetyl (Buttery), Isovaleric (Cheesy), Butyric (Rancid), Caprylic (Goaty, Waxy)
Acetaldehyde	Cidery, Green Apple-Like
Infection	Medicinal, Lactic, Acetic, Animal, Leathery, Musty, Earthy
Autholysis	Yeasty, Meaty, Mercaptans
Phenols	Plastics, Rubber, Smoky, Clorophenol
Solvent	Chemical, Paint, Glue

Glossary

Alcohol By Volume (v/v)

THE PERCENTAGE OF VOLUME OF ALCOHOL per volume of beer.

Alpha-Acid Content

MEASUREMENT OF THE POTENTIAL BITTERNESS OF HOPS,
expressed by their percentage of alpha acids.

Apparent extract (AE)

MEASUREMENT OF THE EXTRACT, EXPRESSED IN PLATO (°P), and without correcting the depressing effect due to ethanol presence.

Apparent Specific gravity (ASG)

MEASUREMENT OF THE BEER SPECIFIC GRAVITY without correcting the depressing effect due to ethanol presence (See Specific gravity).

Attenuation/Apparent Degree of Fermentation

PERCENTAGE OF EXTRACT THAT HAS BEEN FERMENTED when comparing apparent extract to original extract. It is calculated by one the following formulas: 100*(OE-AE)/OE or 100*(OSG-ASG)/(OSG-1)

Diacetyl (Butane-2,3-dione)

A FERMENTATION BY-PRODUCT GIVING "BUTTERY" OFF-FLAVOR.
It is formed and reduced during and at the end of fermentation by the yeast. It can also come from contamination.

Dimethyl sulphide (DMS)

A SULFUR AROMA COMPOUND FROM MALT ORIGIN that brings corn or cabage flavor to the beer. At high temperature S-methylmethionine (SMM) is converted into DMS. During boiling, evaporation eliminates DMS whereas DMS formed during whirlpool stays in the wort.

Esters

AROMATIC COMPOUNDS GENERATED BY YEAST DURING FERMENTATION.
The main esters are: isoamylacetate – banana; ethylhexanoate – red apple and ethylacetate – fruity/solvent (in excess).

International Bitterness Unit (IBU)

STANDARD UNIT TO MEASURE THE CONCENTRATION OF BITTER COMPOUND
in beer. 1 IBU stands for 1 ppm (mg/l) of iso-alpha-acid.media.

Malt

BARLEY OR OTHER CEREAL STEEPED IN WATER, GERMINATED AND KILNED (DRIED).
The malt contents the necessary enzymes to convert insoluble starch to soluble substances and sugars during mashing. It also provides color and flavor to the beer.

Mash - Mashing

PROCESS OF MIXING THE CRUSHED CEREAL (mainly malted barley) with water and heating it to produce an aqueous extract. During this process, natural malt enzymes degrade starch into fermentable sugar and dextrins.

Original Extract (OE)

MEASUREMENT OF THE WORT CONCENTRATION (total dissolved solid present in the wort), expressed in plato (°P), prior to fermentation. It includes fermentable and non-fermentable substances.

Original Specific Gravity (OSG)

SPECIFIC GRAVITY OF THE WORT PRIOR TO FERMENTATION (see Specific Gravity).

Plato degree (°P) / Extract

MEASURE OF DISSOLVED SUBSTANCES INTO THE WORT OR BEER.
Extract is expressed in plato degree (°P). 1°P equals 1g of extract per 100g of liquid. When measured into the beer, alcohol is mixed with water. As alcohol has a weight by volume lower than water, a measure of extract in beer is lowered due the alcohol presence. This is the depletion effect of the alcohol.

Specific gravity

RATIO between the weight by volume of wort/beer to the weight by volume of pure water at 20°C / 78°F. Example a specific gravity of 1.048 (or 1048).

Wild yeast

WILD YEAST ARE NON-SACCHAROMYCES SPP. YEAST identified by EBC Analytica 4.2.6 or ASBC Microbiological Control-5D.

Get our app!

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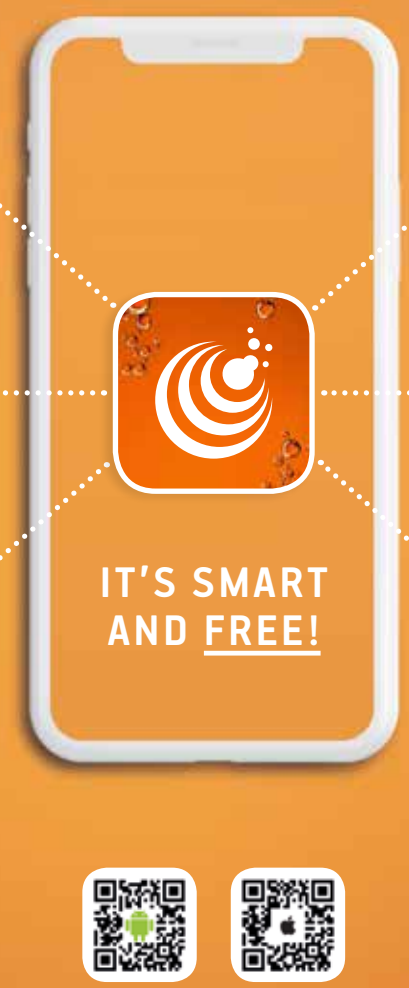
DRIVEN BY THIS SPIRIT, THE FERMENTIS TEAM HAS DESIGNED A NEW APPLICATION TO ADVISE AND HELP ALL BREWERS.

In this app, available on Apple Store and Google Play, you will find supporting and creative tools.



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October 2019

An expert in the art of fermentation

Fermentis works with everyone in the world of beer, wine, spirits and other fermented beverages. Its range of products and services covers almost all professional requirements: from safeguarding production to expressing sensory characteristics. Business Unit of the Lesaffre Group, global key player in fermentation and yeast, Fermentis builds solutions and results upon its talented experts, visionary R&D program, industrial expertise which meets the highest international quality standards and a strong and coherent marketing and communication strategy. Its mission? Become the obvious choice for brewers, winemakers and all producers of fermented beverages, helping them express their inventiveness and creativity.

THE OBVIOUS CHOICE FOR BEVERAGE FERMENTATION

Fermentis by Lesaffre