

LEVADURAS

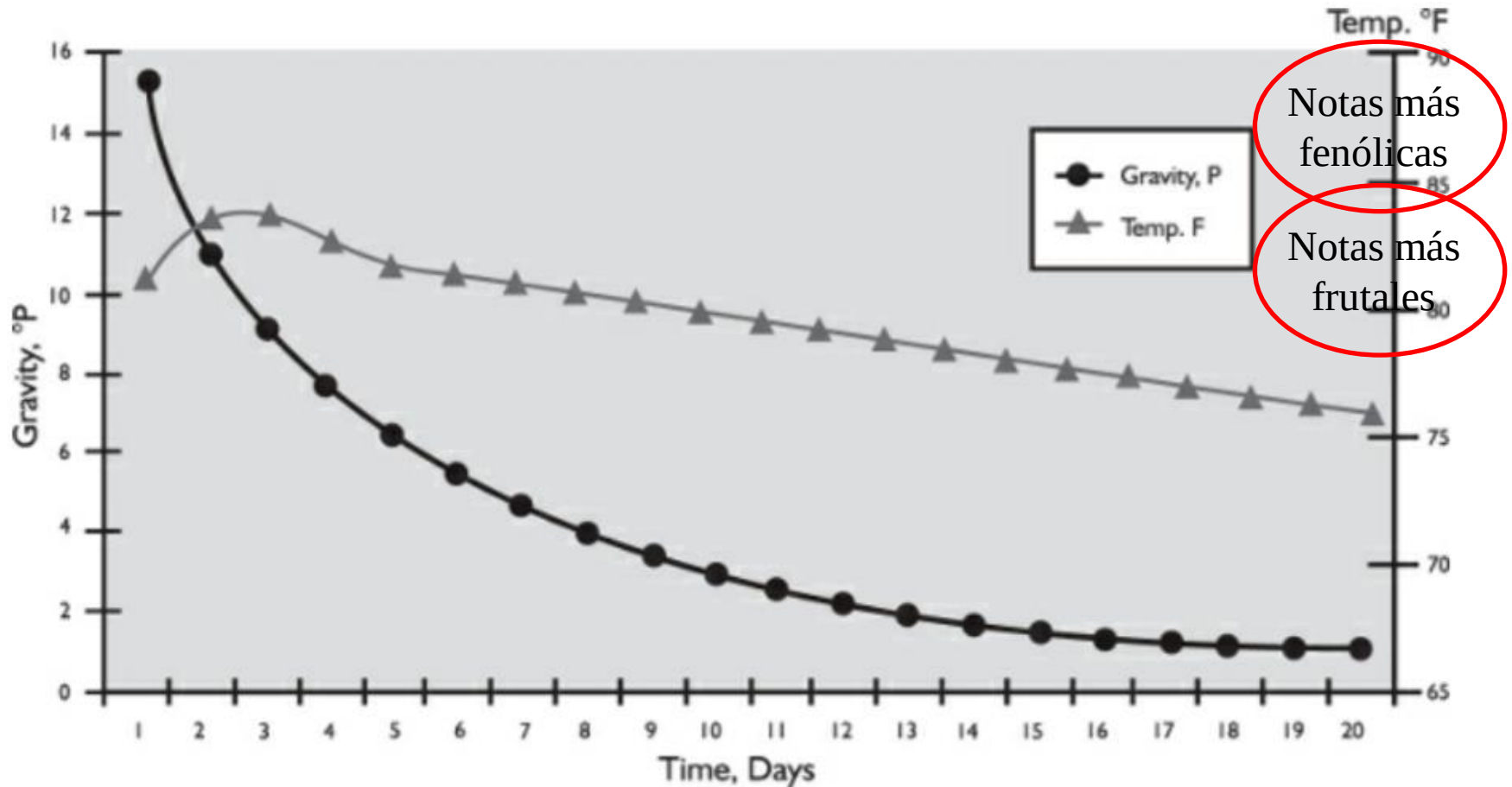
(Clase 5)



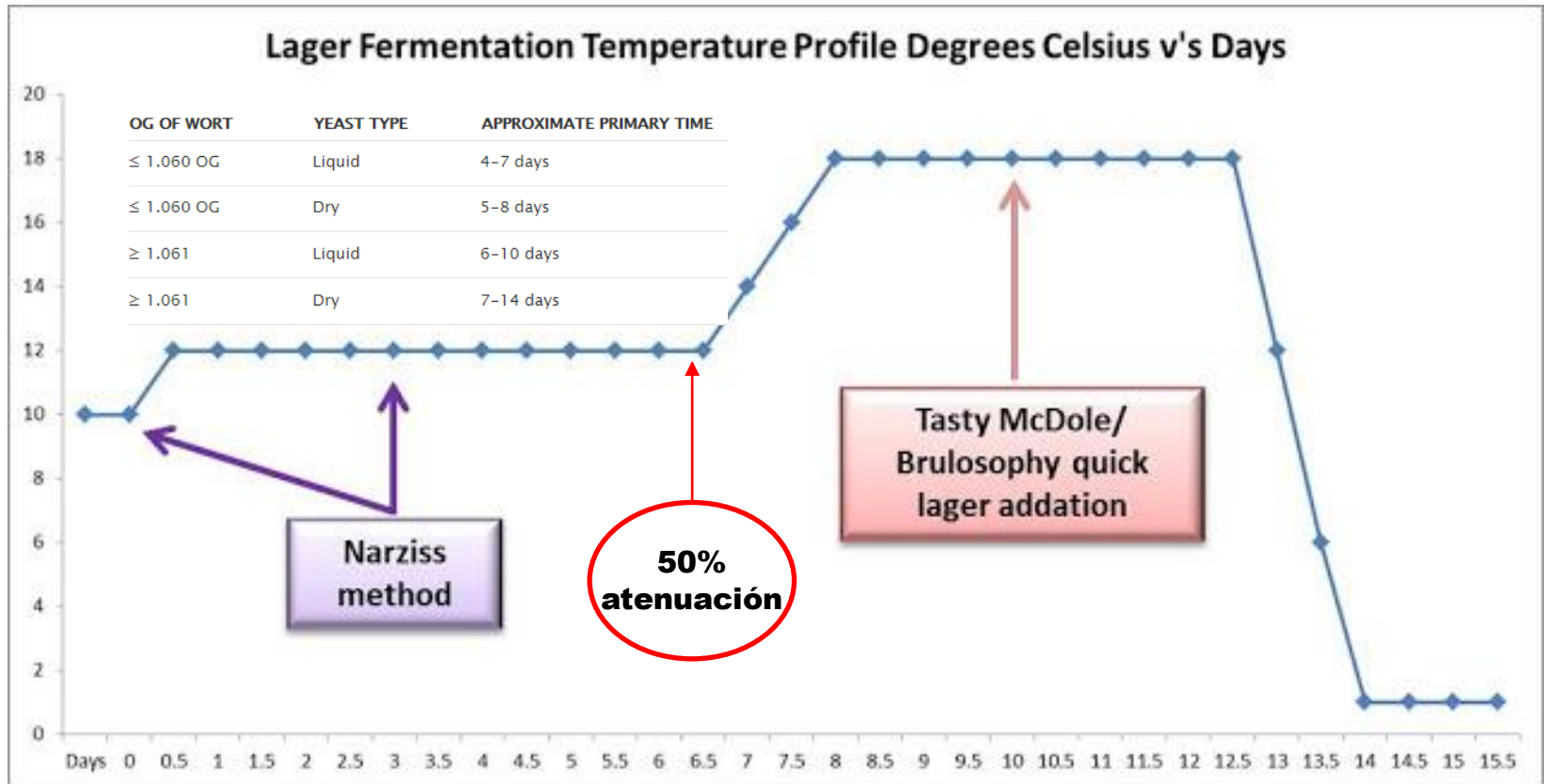
Lic. Sebastián Oddone

ESPECIALISTA EN FERMENTACIONES INDUSTRIALES

Fermentaciones especiales (Ej. Saison)



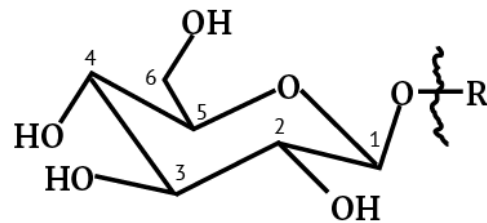
Fermentaciones Especiales (Lager)



Biotransformación

1- clivaje de glicósidos

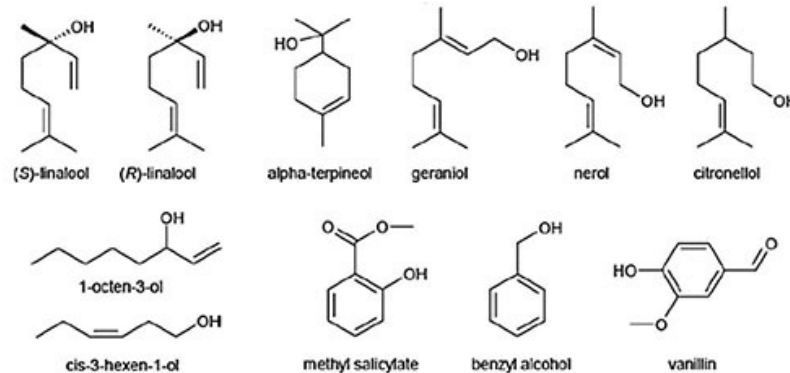
Figure 1: Structure of a glycoside



β -D-Glycosides
R=Aglycones

"R" represents the flavor molecule.

Figure 2: Examples of glycosidically-bound aroma compounds



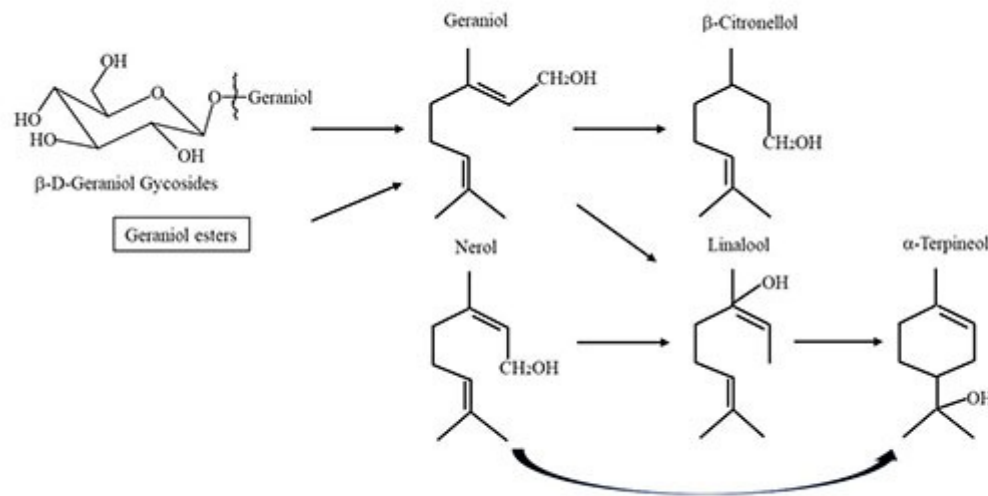
Adapted from Daenen³

El glicósido no aporta aroma, sin embargo el compuesto liberado del clivaje sí lo hace.

Biotransformación

2- transformación de terpenos

Figure 3: Biotransformation pathway of monoterpene alcohols by yeast



Adapted from K. Takoi, et al. Brewing Science 70, 177–186, 2017

Las levaduras pueden metabolizar algunos compuestos del lúpulo y transformarlos en otros, con otras características de aroma y sabor

Biotransformación

3- liberación de tioles

Las levaduras también pueden liberar “Tioles” a partir de sus precursores. Dichos compuestos sulfurados otorgan a la cerveza potentes aromas frutales, exóticos, uva, maracuyá.

Lúpulos con altos niveles de
Tioles **libres**

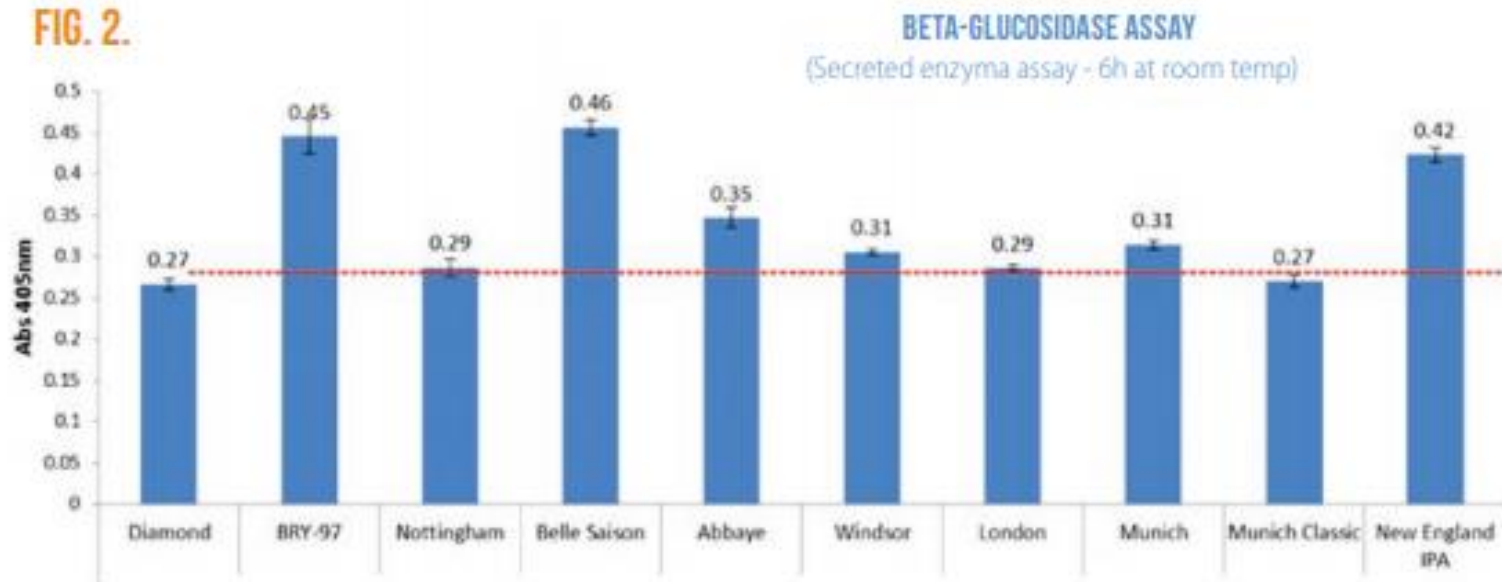
Citra
Apollo
Eureka!
Simcoe

Lúpulos con altos niveles de
“**precursores**” de Tioles

Citra	Hellertau
Simcoe	Perle
Eureka!	Saaz
Apollo	Calypso
Cascade	Sorachi Ace

Biotransformación del lúpulo

FIG. 2.



Durante la maduración

- **Algunos esteres se van degradando como el Acetato de Isoamilo**
- **Bajan los niveles de acetaldehído y diacetilo (carbonilos)**
- **Bajan los compuestos de sulfuro**



Tipos de levaduras

Aspectos generales

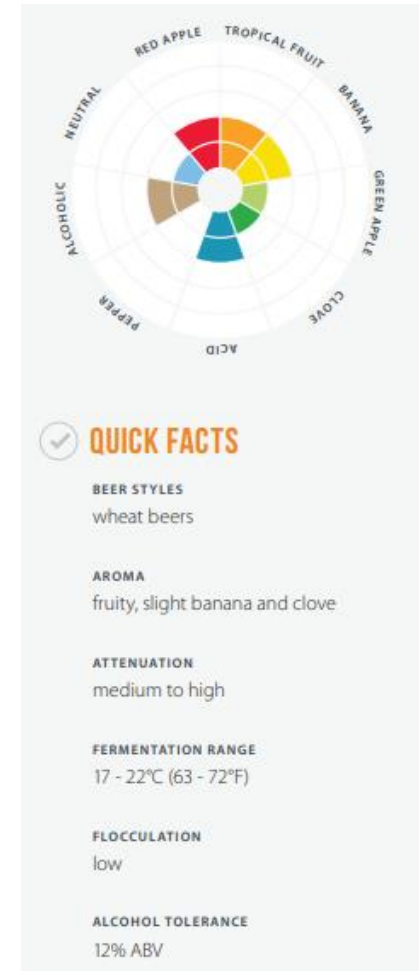
- **ALE (*S. cerevisiae*) vs LAGER (*S. pastorianus*)**
- **Líquida vs deshidratada vs recuperada**
- **Cepa única o combinada**



Tipos de levaduras

Características

- **Atenuación**
- **Floculación**
- **Tolerancia al alcohol**
- **Flavors**



Atenuación Apparente %AtA

$$\%AtA = \frac{PD_i - PD_f}{PD_i} \times 100$$

$$\%AtA = \frac{50 - 10}{50} \times 100 = 80\%$$

Tipos de levaduras

Lallemand

	STRAIN	BEER STYLES	ATTENUATION	FERMENTATION RANGE	FLOCCULATION	ALCOHOL TOLERANCE	PITCHING RATE
	ABBAYE BELGIAN-STYLE ALE YEAST	Belgian	high	17 - 25°C (63 - 77°F)	medium to high	12% ABV	50 - 100g/hL to achieve a minimum of 2.5 - 5 million cells/mL
	BELLE SAISON BELGIAN SAISON-STYLE YEAST	Saison	high	15 - 35°C (59 - 95°F)	medium to high	14% ABV	50 - 100g/hL to achieve a minimum of 2.5 - 5 million cells/mL
	BRY-97 AMERICAN WEST COAST ALE YEAST	American ales	medium to high	15 - 22°C (59 - 72°F)	high	9% ABV	50 - 100g/hL to achieve a minimum of 2.5 - 5 million cells/mL
	CBC-1 CASK AND BOTTLE CONDITIONING YEAST	champagne-like and fruit beers	---	primary: 20°C refermentation: 15-25°C	---	12 - 14% ABV	primary: 50-100g/hL refermentation: 10g yeast to 1hL
	DIAMOND LAGER YEAST	lagers	high	10 - 15°C (50 - 59°F)	high	9% ABV	100 - 200g/hL to achieve a minimum of 5 - 10 million cells/mL
	LONDON ESB ENGLISH-STYLE ALE YEAST	English-style ales, pale ales	medium	18 - 22°C (65 - 72°F)	low	9% ABV	50 - 100g/hL to achieve a minimum of 2.5 - 5 million cells/mL
	MUNICH WHEAT BEER YEAST	wheat-based beers, Weizen and Hefeweizen	medium to high	17 - 22°C (63 - 72°F)	low	9% ABV	50 - 100g/hL to achieve a minimum of 2.5 - 5 million cells/mL
	MUNICH CLASSIC WHEAT BEER YEAST	Bavarian-style wheat	medium to high	17 - 22°C (63 - 72°F)	low	9% ABV	50 - 100g/hL to achieve a minimum of 2.5 - 5 million cells/mL
	NOTTINGHAM HIGH PERFORMANCE ALE YEAST	wide variety of ales	high	10 - 22°C (50 - 72°F)	high	9% ABV	50 - 100g/hL to achieve a minimum of 2.5 - 5 million cells/mL
	SERVOMYCES YEAST NUTRIENT	---	---	---	---	---	---
	WINDSOR BRITISH-STYLE BEER YEAST	fruity English ales, pale ales, porters	medium	15 - 22°C (59 - 72°F)	low	9% ABV	50 - 100g/hL to achieve a minimum of 2.5 - 5 million cells/mL

Tipos de levaduras

Fermentis

Maltotriose

THE TABLE BELOW SHOWS THE AMOUNT OF REMAINING maltotriose in g/l after fermentation for each strain.

SafAle™ range

	MALTOTRIOSE IN G/L
SAFALE™ S-04	10
SAFALE™ K-97	2
SAFALE™ US-05	3
SAFALE™ WB-06	0
SAFALE™ S-33	12
SAFALE™ T-58	11
SAFALE™ BE-256	0
SAFALE™ BE-134	0
SAFALE™ HA-18	0

SafLager™ range

	MALTOTRIOSE IN G/L
SAFLAGER™ S-23	4
SAFLAGER™ S-189	2
SAFLAGER™ W-34/70	2

SafAle™ range

	FLOCCULATION	CLARIFICATION*	SEDIMENTATION
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

*Yeast in the foam at the end of fermentation.

SafLager™ range

	FLOCCULATION	CLARIFICATION*	SEDIMENTATION
SAFLAGER™ S-23	+	-	Fast
SAFLAGER™ S-189	+	-	Fast
SAFLAGER™ W-34/70	+	-	Fast



GOOD TO KNOW

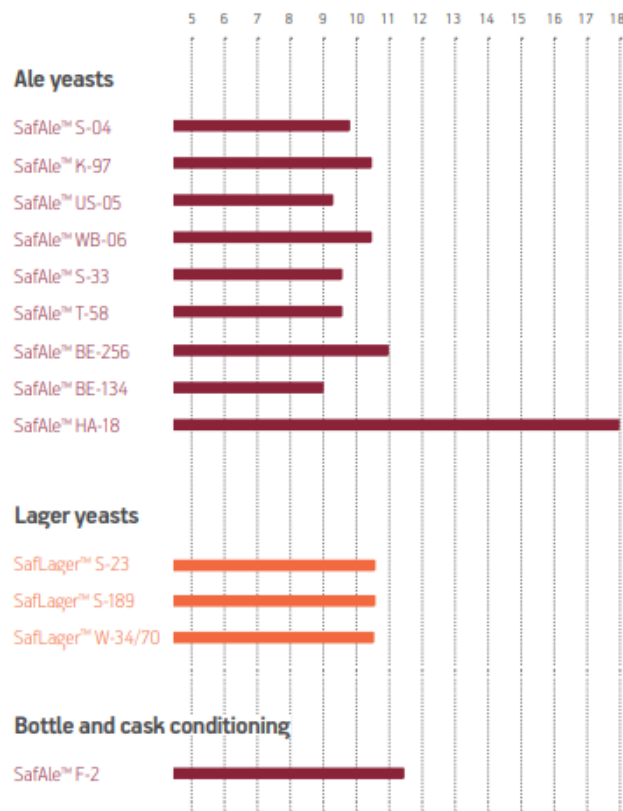
Ca++

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

Tipos de levaduras

Fermentis

Alcohol tolerance in % v/v



Type of beer	Organoleptic characteristics	Suggested yeast
NE IPA	Juicy, hoppy, hazy	S-33, K-97, S-04
Weissen	Hazy, wheat base, phenolic, citrusy	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 digestible, neutral, malty or gently fruity	W-34/70, S-189, S-23
Session	Blond, light body, low alcohol, hoppy, high drinkability	BE-134, K-97, US-05
Kölsch	Blond, palatable, low alcohol, low bitterness, gently fruity	K-97, US-05, S-04
IPA	Blond to amber, dry and hoppy	S-04, US-05
Triple	Blond to amber, high alcohol, malty, fruity, full body, roundness	HA-18, US-05, BE-256, S-33, K-97
Saison	Blond to amber, refreshing, very dry, low alcohol, gently acidic and yeasty, hoppy, gently saturated	BE-134, WB-06, T-58
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	HA-18, S-33, S-04, BE-256
Scotch	Amber to brown, full bodied, malty and lightly hopped	HA-18, S-33, S-04
Barley wine	Amber - Brown, woody, slightly saturated, maderized, stewed fruit	HA-18, 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, chocolate, coffee, roasted	HA-18, T-58, BE-256, US-05

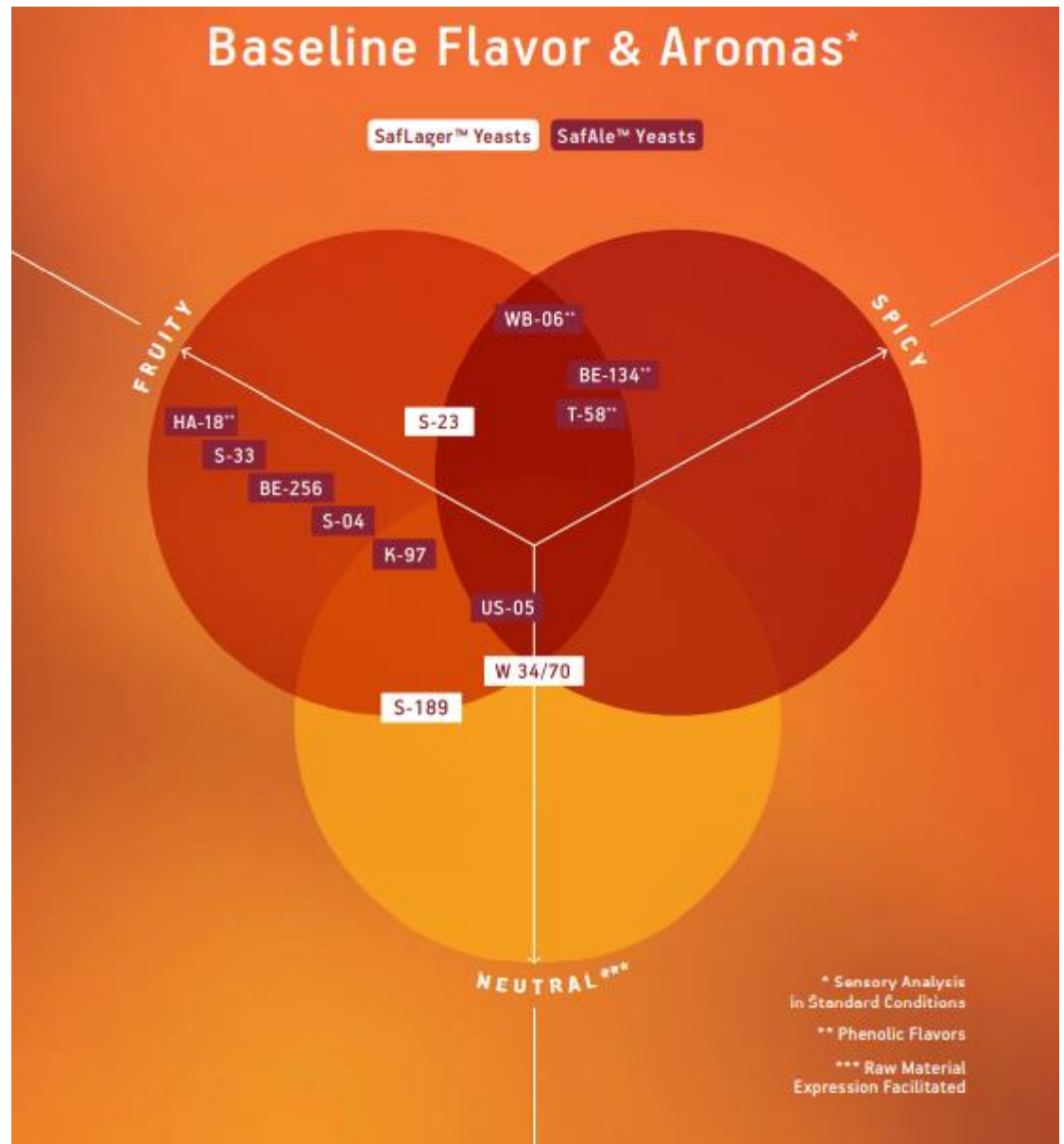
Recommendations can be obtained from your distributor or from a Fermentis representative.

Fermentis

Strain	Taxonomy	Attenuation*	Pitching Rate	Phenolic Off-Flavor	E2U™	Usage Recommendation
SafAle™ S-04	<i>S. cerevisiae</i>	Medium	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 fermented in cylindro-conical tanks.
SafAle™ BE-256	<i>S. cerevisiae</i>	High	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	<i>S. cerevisiae</i>	Medium	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	<i>S. cerevisiae</i>	Low	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	<i>S. cerevisiae</i>	Medium	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	<i>S. cerevisiae</i>	Medium	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	<i>S. cerevisiae</i> var. <i>diastaticus</i>	High	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	<i>S. cerevisiae</i> var. <i>diastaticus</i>	High	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	<i>S. cerevisiae</i> + enzyme (glucoamylase)	High	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	<i>S. cerevisiae</i>	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 amount of maltotriose but assimilates basic sugars (glucose, fructose, saccharose, maltose). It is characterized by a neutral aroma profile respecting the base beer character and settles very homogeneously at the end of fermentation.
SafLager™ W-34/70	<i>S. pastorianus</i>	Medium	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™ W34/70 produces neutral fermentation character, giving clean and neutral profile. Depending on the conditions may present slight fruity and floral notes.
SafLager™ S-23	<i>S. pastorianus</i>	Medium	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	<i>S. pastorianus</i>	Medium	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.

*Low= less than 75%, Medium= 80-84%, High= 85%+

Fermentis



Tipos de levaduras

Una x Una

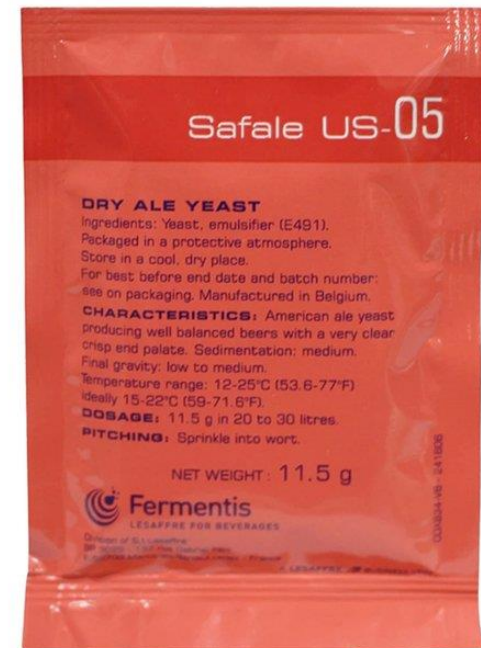
Algunas cepas de levaduras ALE producen menor nivel de metabolitos secundarios, que provocan a su vez menos flavor.

Estas cepas se conocen como “levaduras limpias”. Las cepas **Americanas** y las cepas **Kölsch** son las más limpias entre las ALE.

Estas cepas desarrollan fermentaciones limpias que dan lugar a cervezas ALE (con sus temperaturas y tiempos de fermentación), pero con características Lager.

Fermentan un poco más lento que otras cepas ALE y floculan menos. Esto asegura que estarán en contacto con la cerveza más tiempo y el acondicionamiento será superior.

También producen ciertos niveles de sulfuro pero en menor medida que las cepas Lager.



Tipos de levaduras

Una x Una

Por su parte, las levaduras ALE **inglesas**, son levaduras más afrutadas, y le brindan mayor carácter a la cerveza.

Usualmente floculan rápido, lo que puede dejar acetaldehído y diacetilo en solución.

Por este motivo también dan lugar a cervezas que clarifican muy rápido, y se pueden beber en pocos días.



Tipos de levaduras

Una x Una

Las levaduras **Lager** fermentan mejor a temperaturas más bajas, entre 10 y 13°C. Fueron las primeras levaduras aisladas en cultivo puro. Esto las popularizó mucho y marcó el crecimiento de las cervezas estilo Lager.

En esos momentos las cepas ALE contenían muchas bacterias y levaduras salvajes que deterioraban más rápido a las cervezas.

Las cepas Lager permanecen mucho tiempo en suspensión, lo que permite eliminar los sulfuros y el diacetilo producido por la fermentación a baja temperatura.



Tipos de levaduras

Una x Una

Las cepas ALE de **trigo** producen gran cantidad de flavors, como los descritos para las levaduras de panadería o las salvajes. Sin embargo en este caso los flavors son bien placenteros y combinan muy bien con las materias primas utilizadas en las cervezas de trigo.

El diacetilo no suele ser un problema en las cervezas de trigo, ya que estas cepas lo absorben rápido.

Son productoras de sulfuros, por lo tanto se debe dejar que finalice bien la fermentación, permitiendo la reducción de los sulfuros.

Son de floculación muy baja, lo que ofrece un aspecto turbio a estas cervezas.



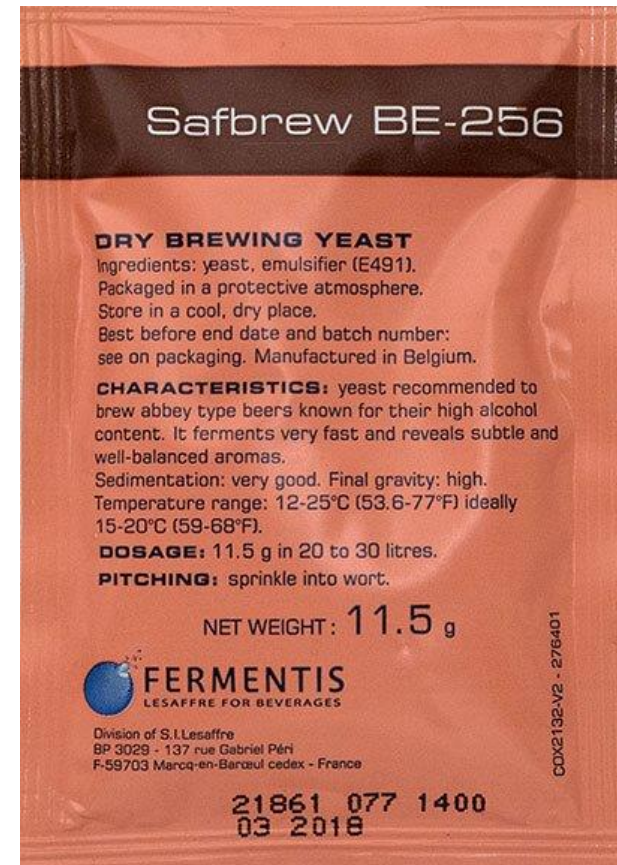
Tipos de levaduras

Una x Una

Las cepas ALE de **belgas** producen gran cantidad de flavors, esteres y fenoles tipo clavo.

Hay una gran variedad de cepas belgas con muy diferentes comportamientos, pero en general son de baja floculación.

Algunas presentan actividad glucoamilasa (var. *diastaticus*), lo que permite una alta atenuación.



Tipos de levaduras

Una x Una

Las cepas ALE Kviek son originarias de granjas de Noruega.

Fermentan a altas temperaturas, 30 – 40°C, y a gran velocidad 2 o 3 días.

Son de floculación alta, clarifican muy rápido.

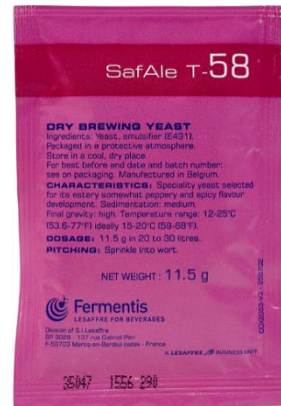
Presentan flavors frutales con notas cítricas.



Tipos de levaduras

Una x Una

Cepa con aportes
frutales y especiados,
para cervezas de trigo,
belgas, IPAs



Cepa de perfil limpio
ideal para re-
fermentación en botella



Cepa con aportes
frutales especial para
ALE Belgas, Neipas.



Cepa con aportes
frutales, florales,
fenólicos y carácter
seco.



Tipos de levaduras

Una x Una

Cepa con aporte a frutas tropicales y cuerpo especial para IPAs



Cepa frutal y especiada, muy atenuante



Cepa de alta performance, muy versátil y de fermentación limpia.



Cepa productora de etanol y ácido láctico, ideal para Berliner, Gose, sour IPAs por su resistencia al lúpulo

