WINE

CATALOGUE

YEASTS & FERMENTATION SOLUTIONS FOR WINEMAKERS

Fermentis
by Lesaffre

FERMENTIS

WE'RE HERE TO HELP!

Great things are happening in the world of fermented beverages. We are seeing young designers, small distilleries, craft breweries, and new wine estates emerging everywhere. There is risk, there is daring, and maybe a few disappointments, but we are truly excited by the bounty of wonderful results.

This is a virtuous model, even for the market biggest players, who are also inspired to be more inventive. We enthusiastically support the efforts of those who get creative, because we share this taste for innovation and initiative.

We created this document for you, winemakers, to help you understand how high quality yeasts and yeast derivatives are produced, what essential parameters will influence your fermentations, and how our yeast products are characterized.

Throughout these pages, you will also find useful, technical tips to help you better manage yeast in your winery. We hope it will be an everyday resource to help you create the wines of your dreams.

SUMMARY

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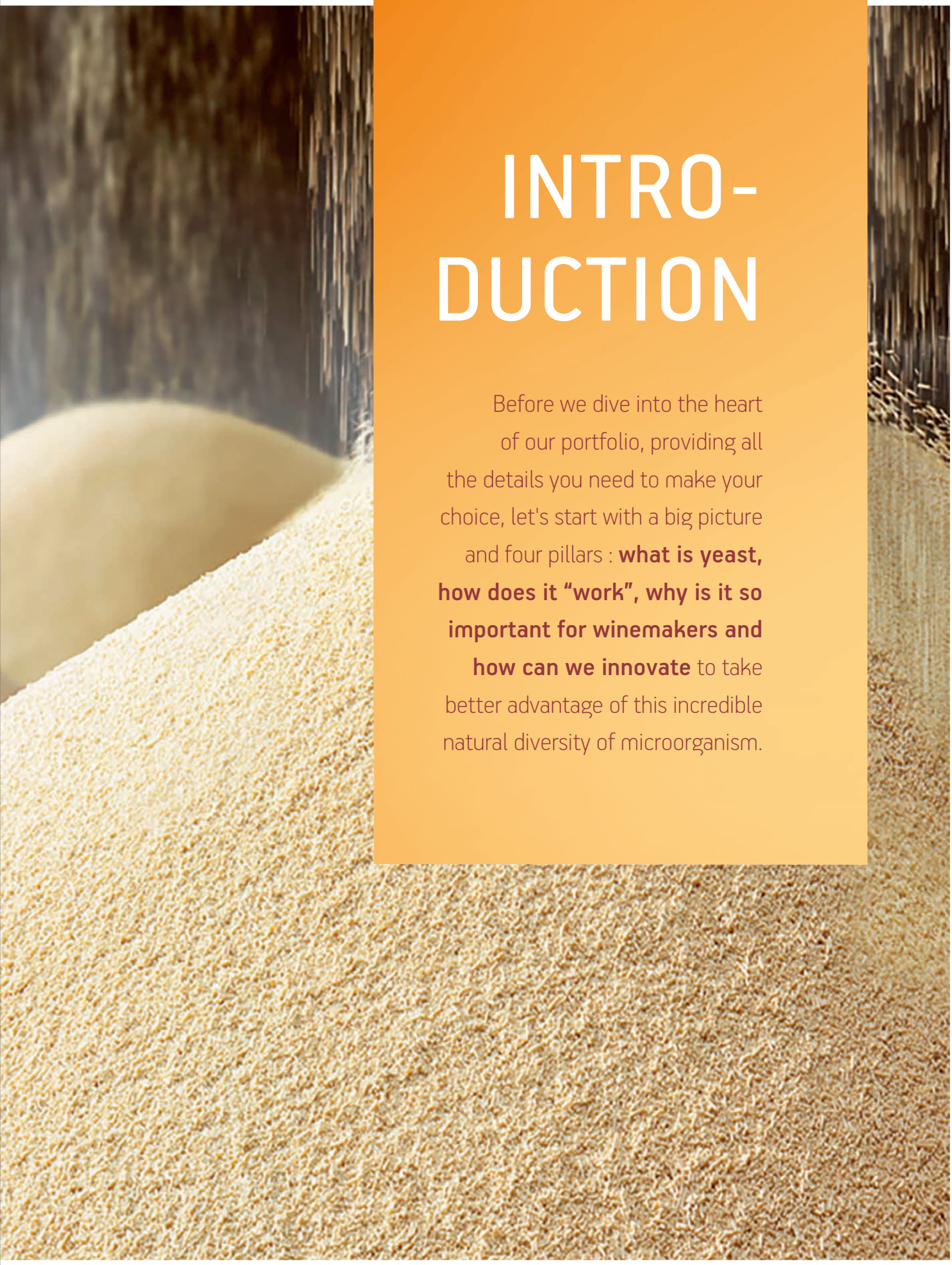


INTRO-DUCTION

Before we dive into the heart of our portfolio, providing all the details you need to make your choice, let's start with a big picture and four pillars : **what is yeast, how does it "work", why is it so important for winemakers and how can we innovate** to take better advantage of this incredible natural diversity of microorganism.

WHAT IS YEAST EXACTLY?

Yeast is an ovoid or spherical unicellular microscopic fungus. It is a simple living organism. Yeast cells are living and natural. It is a representative model of all eukaryotic cells – the first one whose genome has been entirely characterized. Its cell nucleus contains 16 linear chromosomes. The yeast cell is not visible to the naked eye. Its size, in fact, does not exceed 6 to 8 thousandths of a millimeter.

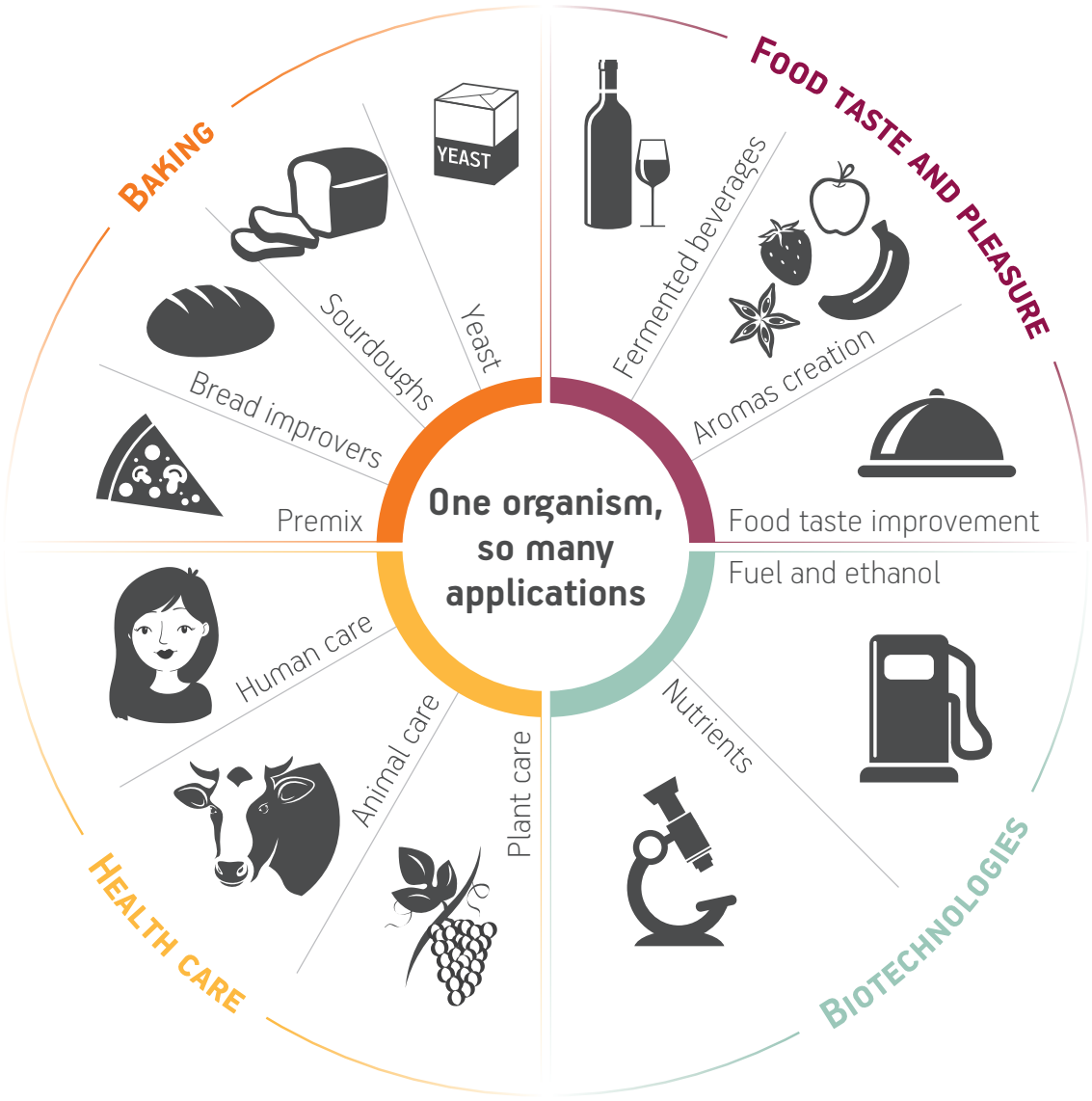
> Bread, beer, wine, food supplements... Yeast is everywhere.
>
> ”

Although it is much smaller than a pinhead, yeast plays an essential role in regulating the aromatic and fermentation activity in many different type of products: baking, food processing, flavoring, pharmaceuticals, animal and human health, fermentation of beverages like wine, etc. Yeast has an extraordinary capacity to ferment organic matter, like sugars and as a consequence, is the base of every alcoholic beverage.

Over 5,000 years ago, the Egyptians used yeast to rise breads and modify beverages, but without fully understanding its nature. The cell itself was not discovered until 1665, and it was first observed by Leewenhoeck in 1680. In 1857, Louis Pasteur analyzed the fermentation process. He stated that yeasts were responsible for fermentation and demonstrated that the yeast cell could live with or without oxygen, and was a key element in bread flavor and aroma. This was a decisive turn which still influences our everyday lives.

DON'T CONFUSE EUKARYOTES WITH 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 organelle called the nucleus. Example: yeast cells, animal cells.



For more than 165 years, yeast has been the foundation of Lesaffre; its backbone. Whether operating in the world of agri-foodstuffs, potable spirits, cosmetics, perfumes or pharmaceuticals, our Group has the high-added-value yeasts you need, including natural food flavors that reveal tastes and aromas, yeast extracts that optimize nutritional and sensory qualities (especially taste), and **yeasts for alcoholic beverages that can express and enhance special flavor features.**

Fermentis is a division of the Lesaffre group, a global key player in yeasts and fermentation. This family company, born in northern France in 1853, is now a multinational and multicultural company, earnestly committed to helping better nourish and protect the planet.

1680

First observation of a yeast by Antonie Van Leeuwenhoek

1857

Louis Pasteur discovers the fermentation process in Lille, France

1863

Lesaffre starts to develop research about yeast near to Lille

HOW DOES YEAST LIVE AND MULTIPLY?

A **yeast is defined by belonging to the kingdom of the Fungi.** This kingdom is the first classification before many others: division / sub-division / class / order / family / genus / species / variety. This sequence of classifications is what we call in biology the taxonomy (from Ancient Greek -taxis, meaning «arrangement», and -nomia, meaning «method»). It's the science of defining and naming groups of biological organisms on the basis of shared characteristics.

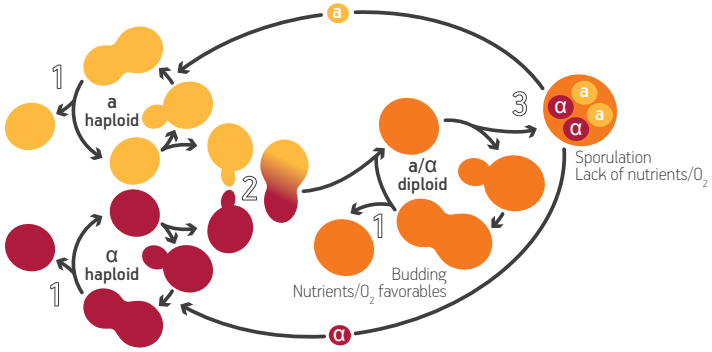
There are several yeast species in the Saccharomyces genera: *Saccharomyces cerevisiae*, *S. pastorianus*, *S. bayanus*, ... This diversity arises from different origins like mutations, genome assortment or hybridization. The most well-known is *Saccharomyces cerevisiae*, but there are many other types of yeast. Etymologically, "saccharo" comes from sugar, "myces" from fungus and "cerevisiae" means "beers" in Latin. More commonly, *Saccharomyces cerevisiae* are called "brewers yeasts" and "bakers yeasts" but they may also be called "budding yeast," according to their means of reproduction.

TAXONOMY OF OUR YEASTS

Taxonomy is in constant evolution depending upon the type of analysis conducted. Some methodologies compare similarities of genomic composition, while others assess the number and frequency of difference. The taxonomy of our wine yeasts is based on the reference book: The Yeasts, A Taxonomic Study, 5th edition, C.P. Kurtzman, J.W. Fell and T. Boekhout, 2011. What we called S. cerevisiae could be classified as well as *S. cerevisiae* var. *cerevisiae* and *S. bayanus* as *S. cerevisiae* var. *bayanus*.

External sources (page 8 to 11):

- Lonvaud-Funel, A. et al. (2010). *Microbiologie du vin, bases fondamentales et applications.*
- König, H. et al. (2017). *Biology of Microorganisms on Grapes, in Must and in Wine, second edition.*
- Lesaffre (2019). *What is yeast?* Collected on http://www.exploreyeast.com.

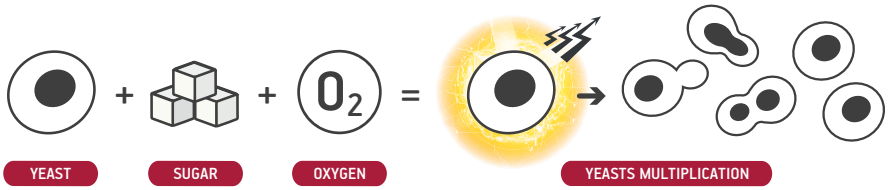


DID YOU SAY HYBRIDS?

Some of our newest releases in the wine yeast range are issued from the hybridization process, also called "HD". The stressful conditions represented bellow are the basis of the hybridization process intended to generate new yeasts by trying to combine both yeast parents genetic interests with a sexual reproduction.

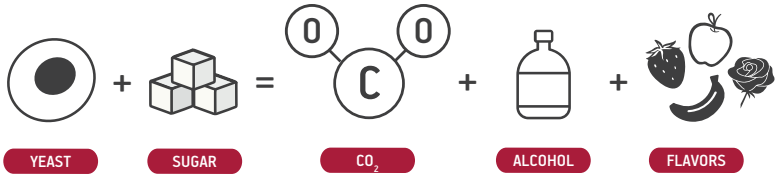
YEAST DEVELOPMENT

Yeast is a cellular factory and as such is naturally capable of modifying and combining several simple molecules, taken from its environment, such as sugars, lipids and amino acids, and synthesize all elements needed for its growth.



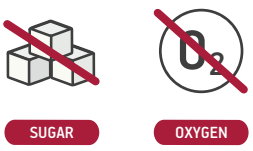
WITH AIR
(ASEXUAL REPRODUCTION OR BUDDING)

In the presence of air and low concentration of sugars, yeasts breathe and multiply abundantly, without forming alcohol. The sugar they feed on is transformed into carbon dioxide and water. This phenomenon is accompanied by a tremendous release of energy that allows them to grow and multiply by budding. When the two cells have reached the same size, they separate and cell budding continues. **This metabolic process is called respiration.** It is used by yeast manufacturers to multiply the cells.



WITHOUT AIR
(FERMENTATION)

When there is no air, sugar is mainly transformed into alcohol, to the detriment of the energy released. This happens in the case of winemaking. The yeast cannot find any more oxygen. The sugars provided by the must are transformed into alcohol and carbon dioxide, resulting in the **metabolic process of fermentation.**



IN STRESSFUL CONDITIONS
(SEXUAL REPRODUCTION)

Under high-stress conditions, like nutrient- or oxygen-starvation, yeast cells can undergo sporulation, entering sexual reproduction (meiosis) and producing a variety of spores containing the genetic material only one time. These spores can then go on mating (conjugating) with other spores, producing new yeast (daughter). The sexual reproduction process is explained on illustration above, it's the process implied in the creation of hybrids.

WHY IS YEAST A GREAT TOOL FOR YOU?

For a long time, yeast has been considered as a commodity to facilitate fermentation and safeguarding yields. Today, wine producers understand that yeast is also a tool for giving character to their wine. It can be used to stabilize the color, give roundness, modify the elegance of aromas, intensity of flavors and to give beverage's distinct final notes. Whether you produce red, white, rosé or sparkling wines, the quality of our yeasts and fermentation solutions can assist upstream in your creation process.

The Fermentis wine range is divided in three products families: active dry yeasts, fermentation aids and functional products. We have created these three families for different applications and usages in order to help you during all your steps of vinification.

ACTIVE DRY YEASTS

TO FERMENT EFFICIENTLY IN VARIOUS CONDITIONS AND REVEAL SPECIFIC FLAVORS

You can choose between thirteen different strains to ferment your must at the highest standards of quality and productivity. Red, white, rosé or sparkling, our yeasts can meet all your expectations, both technical and sensory, to reveal the aromas you are looking for. Specific or versatile, you can discover our entire range of options in the following pages.

PAGE 16

With your yeast, you can play on character, elegance, final notes...

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DERIVATIVES
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FERMENTATION AIDS

TO INCREASE FERMENTATION PERFORMANCES

We know that your time is precious and that the fermentation process is not always easy to master. For this purpose, we have created the *fermentation aids*, yeast derivatives. They help you ensure fermentation, even in the most difficult conditions.

The six products in this family allow you to optimize your work and address any possible problems such as stuck fermentations, for example. Find more information about our fermentation aids range in the following pages.

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FUNCTIONAL PRODUCTS

TO ENHANCE AND/OR PRESERVE THE QUALITY OF YOUR BEVERAGES

Also derived from yeast, **functional products complete your range of options** because they allow you to address the final details in creating the wine of your dreams. They can stabilize color, bring roundness, preserve aroma, etc.

Our five functional products have a significant impact on your final product, so be sure to discover all their possible applications in the following pages.

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HOW DO OUR E2U™ YEASTS MAKE THE DIFFERENCE?

What do you get and contribute to?

With E2U™, you have the opportunity to simplify your work and save time in your daily work at the winery. In fact, the yeast can be immediately put in contact with the must in the fermentation vessel (direct pitch). In studies where we compare rehydration vs direct pitch, we don't see any significant differences in the viability or vitality of the yeast.

This innovation is protected under the E2U™ umbrella. Fermentis E2U™ (Easy to Use™) products are designed to make life easier.

And because they are easy to handle, and easy to use, they help you save time, a benefit valued by wine producers around the world. In addition, E2U™ products positively impact the environment, the economy and users' health. This is our way of innovating in the right direction and modestly playing our part in protecting our planet.

You can discover more about how the E2U™ concept is applied to active dry yeasts on page 26 and how it is applied to yeast derivatives on page 77.

You can pitch directly

Our active dry yeasts no longer have to be rehydrated prior to pitching. You can pitch them directly into the must, the quality of your fermentation will not change. You save time and gain comfort.

You consume less water and energy

If all active dry yeast users (that is 75% of winemakers) decided not to rehydrate, 600,000 hl of water could be saved each year. Using E2U™ products would also mean using less electricity or gas and cutting CO_2 emissions by 240 tons every year.

You make savings

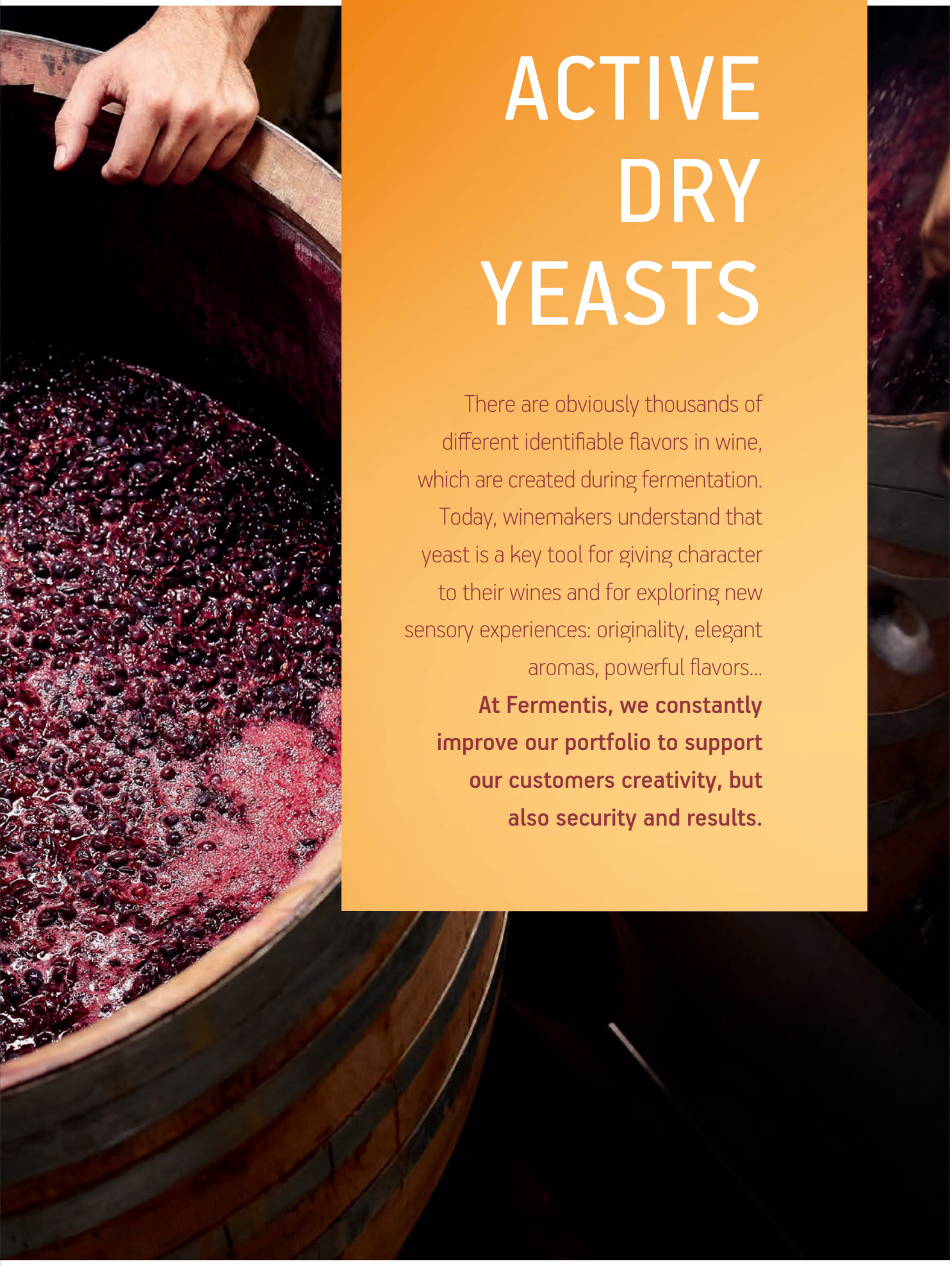
Avoiding the rehydration stage, or storing products at room temperature, also means avoiding certain equipments requiring capital expenditures (CAPEX). Having less to invest, means less to pay back. In this same spirit, we also improve our packaging and extend our products shelf life, helping you manage your costs and tackle waste.

You reduce pollution

Tens of tons of pure detergent are used every year to clean the equipment needed to prepare 2.15 million oenological leavens. Discharged into sewers, detergents end up in the environment, contaminating rivers and water tables, affecting aquatic plants and animals. Anything limiting their use is therefore positive.

You get greater safety and convenience

In partnership with several laboratories, Fermentis is tackling the problem of yeast particle inhalation during handling. Several solutions now ensure you maximum safety: micro-granulated solutions, such as our Spring'Finer™ fining agent, and liquid-based products, such as our fermentation activator ViniLiquid™.



ACTIVE DRY YEASTS

There are obviously thousands of different identifiable flavors in wine, which are created during fermentation. Today, winemakers understand that yeast is a key tool for giving character to their wines and for exploring new sensory experiences: originality, elegant aromas, powerful flavors...

At Fermentis, we constantly improve our portfolio to support our customers creativity, but also security and results.

The impact of yeast on a wine's profile

80% of all aroma-active compounds in wine come from yeast.

Wine is the result of the fermentative activity of yeasts and bacteria. The microbiota of grape juice fermentation can vary significantly as over 40 genera and 100 different species of yeast have been isolated from grapes or wine. The genus *Saccharomyces* is the one that interests most winemakers. The *S. cerevisiae* and *S. bayanus* species have indeed been found capable of dominating and conducting the alcoholic fermentation with *S. cerevisiae* being the more prevalent. However, other yeast, collectively known as non-*Saccharomyces* yeast, and bacteria may also contribute to the aroma and flavor profile of the wine.

There are two basic types of wine production practices with respect to management of the microbial populations: *indigenous* and *inoculated* (deliberate addition of pure cultures of selected microorganisms).

There are two main reasons for the inoculation of selected yeasts:

1. The rapid dominance of the fermentation by a high population of *Saccharomyces spp.* which minimizes the contribution of the non-*Saccharomyces* yeast and bacteria and maximizes the chance of a good fermentation achievement.
2. The wish to accent the fruit component of the wine aroma and flavor profile, and minimize that of the wild microflora.

Use of pure cultures in winemaking arose only within the last 70 years of the 7000-year history of wine production!

A HUGE IMPACT ON THE AROMATIC PROFILE

The use of selected yeasts by winemakers is primarily intended to successfully complete alcoholic fermentation, avoiding stuck or sluggish ferments. But their impact on a wine's aromatic profile is so huge, it is also an important criterion of choice. **Yeast is indeed a flavor engine responsible for up to 80% of all aroma-active compounds in wine** (Ribereau Gayon 2006, Meier-Dörnberg 2017).

VARIETAL AND FERMENTATIVE FLAVORS IN OPPOSITION?

Wine's aromatic profile is composed of a lot of different flavor molecules coming from grapes and fermentation. Together they interact and form what we call the "bouquet" or the "complexity". Varietal and fermentative flavors are not in opposition, but in combination, and sometimes in synergy, like the release of the 3-MH by the yeast from its precursor and its esterification in 3-MH acetate (3-MHA) during fermentation. The 3-MHA having a perception threshold 15 times lower than the 3-MH, it could be very interesting to have yeast favoring the production of acetate esters!

There are three different types of wine aromas, depending on their origin:

1 **GRAPE'S DERIVED OR VARIETAL AROMAS**

As the name indicates, they depend on the type of grapes and are mainly represented by polyfunctional thiols (Sauvignon Blanc, Colombard, etc...), terpenols (Muscat, Viognier, etc...) and C-13 norisoprenoids (Chardonnay, Cabernet Sauvignon, etc...).

2 **FERMENTATION'S DERIVED OR FERMENTATIVE AROMAS**

Two of the most important compounds for winemakers are higher alcohols and esters. But we also find here ethanol, sulphur compounds, acetaldehyde or acetic acid.

3 **AGEING AROMAS**

These aromas are coming from wine ageing in barrels or tanks. They are represented by oxidative notes and/or oak flavors, etc...

The two first types of aromas depend strongly on the selected yeast according to their metabolic and enzymatic characteristics.

FOR VARIETAL AROMAS, the base mechanism is the same for all compounds. In the grapes, the aromas are linked to other molecules (cysteine or glutathione for thiols, sugar chain for terpenols and C13) resulting in non-volatile and odorless compounds so-called "aromatic precursors". The volatile aroma can then be released through the action of specific enzymes (beta-lyase for thiols, glyco- and glucosidases for terpenols and C13), their effect can be expressed by yeasts or bacteria.

The main polyfunctional thiols are the 4-mercapto-4-methylpentan-2-one (4-MMP) with box tree, blackcurrant flavors; the 3-mercaptohexan-1-ol (3-MH) and its acetate (3-MHA) with respectively grapefruit and passion fruit flavors.

The main terpenols are the geraniol, the linalool, the nerol, the alpha-terpineol and the citronellol. They are mainly responsible for floral and citrus notes.

The main C13 norisoprenoid is the beta damascenone, generating rose flavors and being an aroma enhancer at low concentration.

Yeast metabolic pathways

Fermentative (positive or negative) aromas are generated through the metabolism of the yeast or bacteria during the fermentation process. The three sources of all these aromas are the fermentable sugars (glucose and fructose) that will undergo the glycolysis pathway, the assimilable nitrogen compounds (amino acids and ammonium) through the Ehrlich pathway, and the sulphur compounds (sulphates and sulphites) through the sulphate reduction pathway.

Depending on their genetics, yeast have more or less abilities to assimilate and biotransform these compounds and to generate corresponding aromas. **When we talk about fermentative aromas in wine, it generally refers to esters, as these molecules have the strongest aromatic impact.**

TRICKY TERPENOLS

S. cerevisiae have quite a weak effect on the release of terpenols from their precursors compared to certain non-*Saccharomyces* spp. or bacteria. Moreover, terpenols can easily be bioconverted by yeast (reduction and isomerization) into other terpenols and be naturally hydrolyzed due to the acid pH of the wine. As a consequence, their concentration is indeed affected by yeast, but it is quite complex to predict.

There are two types of esters

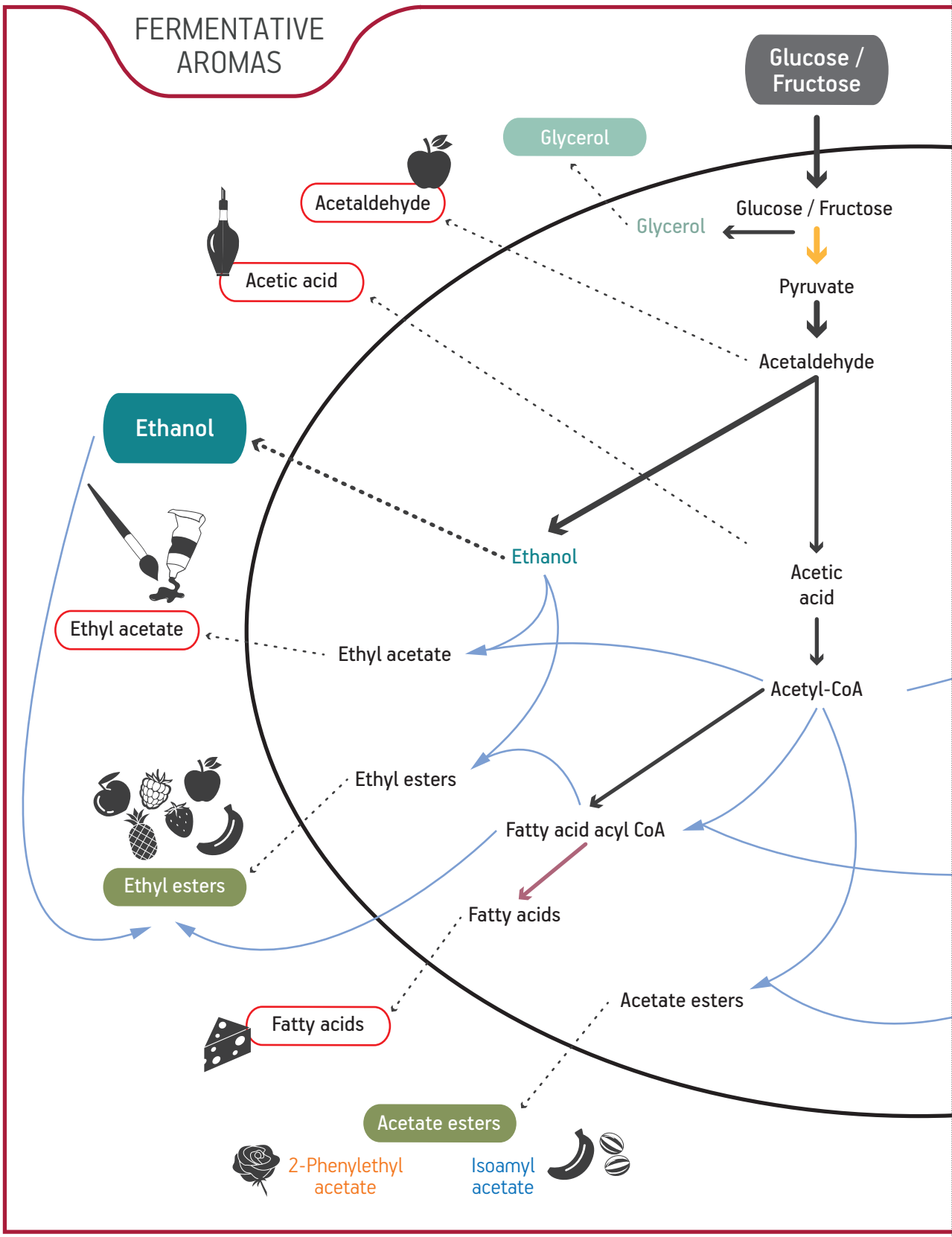
1

THE ACETATE ESTERS are derived from the esterification of their corresponding higher alcohols. The main ones are isobutyl acetate imparting fruity flavors; 2-phenylethyl acetate for floral flavors, and especially the isoamyl acetate, for its strong banana flavors and its ability to enhance other flavors at low concentration.

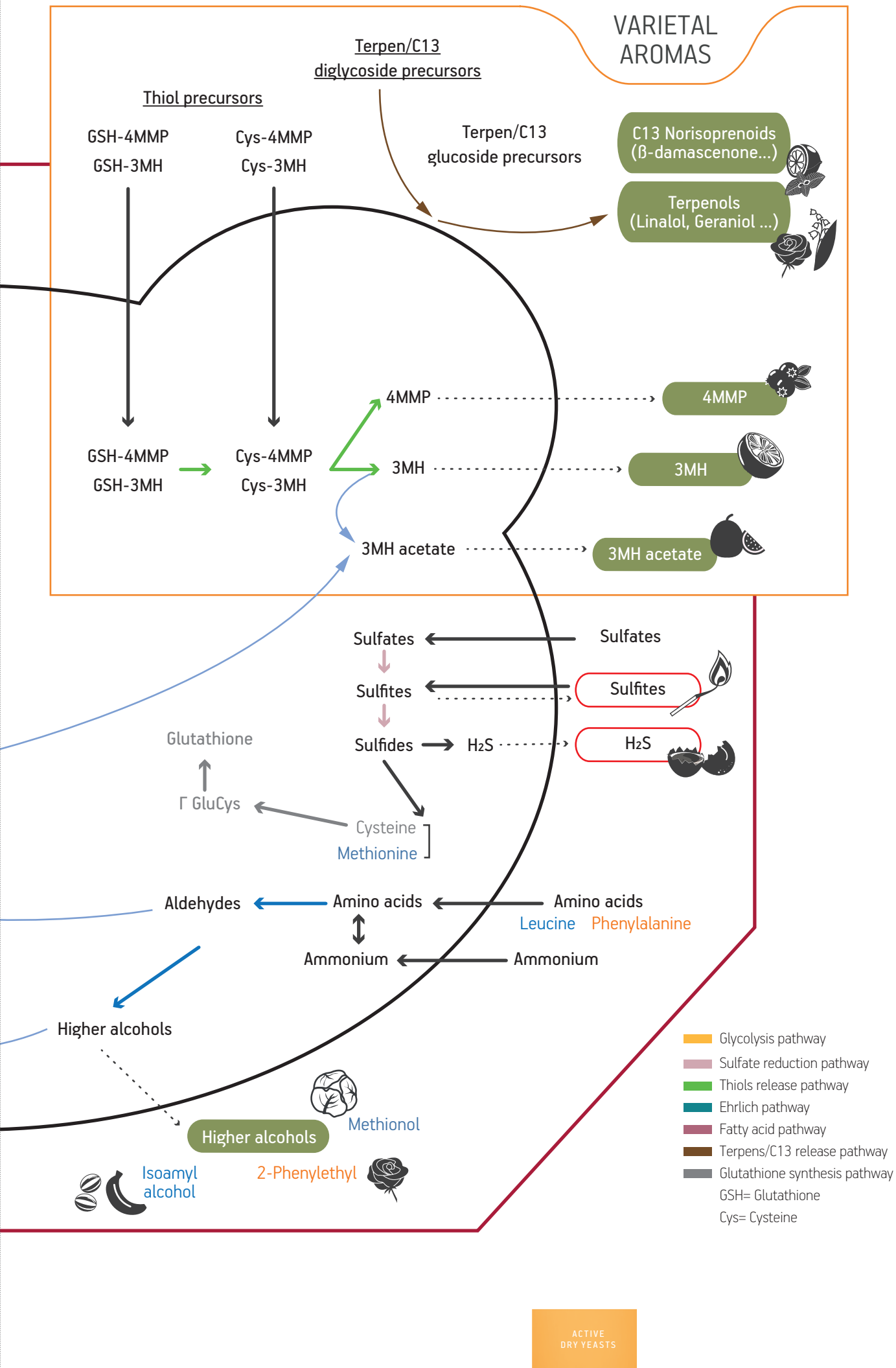
2

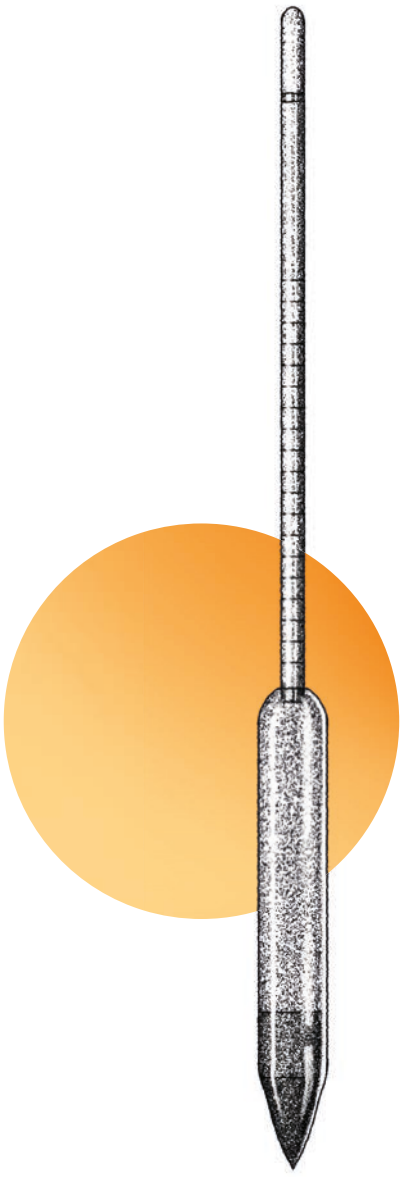
THE ETHYL ESTERS are derived from the esterification of ethanol with fatty acids. Medium chain ethyl esters (ethyl butanoate, hexanoate, octanoate and decanoate) are produced inside the cell, whereas branched chain ethyl esters are produced after the autolysis of the yeast when the corresponding big fatty acids can be released by the cell. These ethyl esters are mainly responsible for fruity flavors like pear, strawberry, pineapple, etc.

YEAST METABOLIC PATHWAYS



Schema adaptation based on the work of Swiegers et al (2005).
The metabolic role of yeast in the development of flavor compounds in wine, beer and saké.


VARIETAL AROMAS
Terpen/C13 diglycoside precursors
Thiol precursors
GSH-4MMP
GSH-3MH
Cys-4MMP
Cys-3MH
Terpen/C13 glucoside precursors
C13 Norisoprenoids (ß-damascenone...)
Terpenols (Linalol, Geraniol ...)
4MMP
3MH
3MH acetate
Sulfates
Sulfites
Sulfides
H2S
Glutathione
Γ GluCys
Cysteine
Methionine
Aldehydes
Amino acids
Leucine
Phenylalanine
Ammonium
Higher alcohols
Methionol
2-Phenylethyl
Isoamyl alcohol
Glycolysis pathway
Sulfate reduction pathway
Thiols release pathway
Ehrlich pathway
Fatty acid pathway
Terpens/C13 release pathway
Glutathione synthesis pathway
GSH= Glutathione
Cys= Cysteine

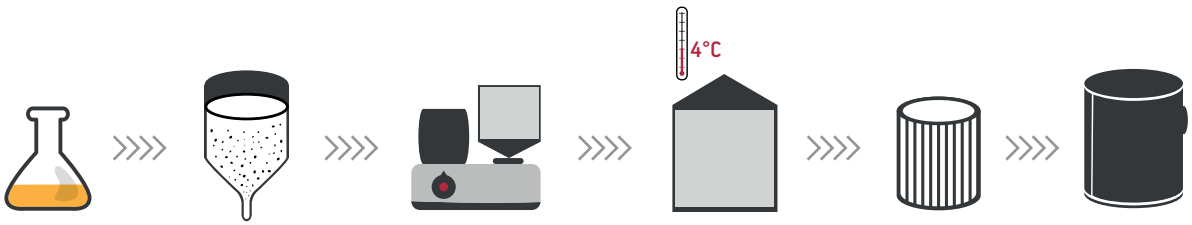


The yeast production process

Active dry yeast is the freshest yeast format used in the winemaking industry.

At Fermentis, we select and manufacture yeast that is used for wide variety of wine styles. Our experience and expertise allow us to produce yeast that preserves all its native properties during the entire production process. In addition, as soon as the yeast is in contact with must, it is ready to ferment. This is definitively the reliable way to achieve consistent fermentations from batch to batch and to meet winemakers'needs.

DRY YEAST MANUFACTURING



YEAST CYCLING

1 FROM THE LABORATORY TO CENTRIFUGATION

First, the yeast is multiplied by budding, an asexual reproduction. The mother cell forms a bud, which progressively receives a duplicate of all mother yeast content (cytosol, organites, nucleus, etc.). 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 again.

If the yeast environment is adverse to the growth, the yeast may start to produce protective compounds like glycerol, trehalose, and glycogen. Glycerol helps the yeast to resist the osmotic pressure. Trehalose is a key contributor to the membrane stability during drying. Trehalose and glycogen are reserve carbohydrates, compounds that allow the yeast to be naturally resistant to drying.

Fermentis yeasts are grown 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 the ingredients to start fermentation.

Discover more about this process on page 24.

2 FROM THE CREAM YEAST TO THE FRESH ACTIVE DRY 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.

IS YOUR YEAST READY TO "WORK"?

You want to be sure that your Fermentis active dry 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 around 10g of yeast.

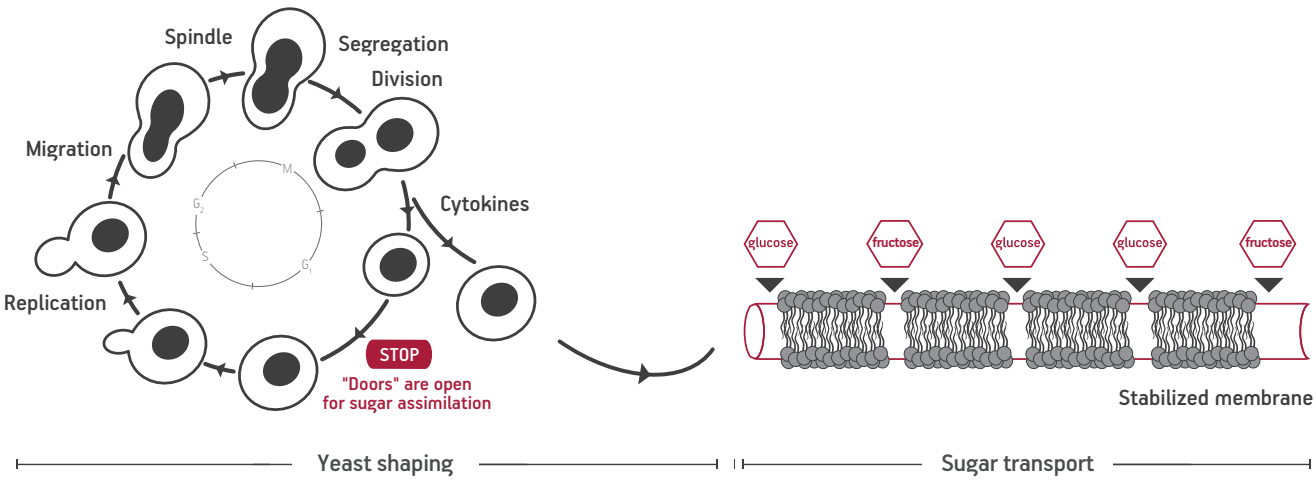
1. Put the water and the sugar in each of the bottles and in one add the yeast.
2. Immediately fix a ballon tightly on each bottle* (and place them in a warm environment: 40°C-104°F).
3. Observe.

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 dry yeast is active.

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

YEAST MULTIPLICATION IN THE PROPAGATOR



E2U™ applied to active dry yeasts

Winemakers have a lot to do. With E2U™, they reduce their less creative tasks.

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Fermentis relies on the exceptional know-how of the Lesaffre group for the production of its active dry yeast. In order to get the best quality products, Lesaffre produces pure yeast cultures on a complete nutritive medium and through a specifc recipe primarily adapted to each strain by the R&D department.

E491 AS ADY INGREDIENT

Our active dry yeast contains less than 1% of a food additive called monostearate of sorbitan, a vegetal oil that helps protect the yeast membrane. Classifications of additives contain the letter E for “Europe” and 3 digits corresponding to the International Numbering System (INS) as determined by the Codex Alimentarius.

This recipe is based on two critical steps: the multiplication and the drying.

• The crucial point for the multiplication is to maintain a maximum yeast growth rate while monitoring the alcohol production (minimized by favoring a sufficient and homogenous oxygenation throughout the propagation tank).

• The pH and the temperature of the growth medium must also be monitored, as well as the content of nitrogen of the propagated yeast as a major index of their physiology. During this step, we also condition the yeast to resist future drying, while ensuring a sufficient internal content of lipids and reserve sugars like threalose, that will help the membrane of the yeast maintain its flexibility during the drying.

• Finally, we know when to stop the propagation to get the majority of the yeast population at the growth stage (G1) in the asexual reproduction cycle. This allows the yeast to get ready – first, to assimilate sugars and nutrients, and second, to be dried without possible membrane damage due to the formation of the next bud.

On top of these first precautions, a vegetal oil called "emulsifier" is added to the yeast cream before drying to coat and protect the membrane from disruption risk during the drying and the subsequent rehydration before use. We then choose one of the gentlest process to remove the water from the yeast without damaging the membrane: a drying on fluidized bed.

All these steps make our yeast "Easy to Use", i.e. resistant to very diverse usage conditions while preserving their fermentative efficiency and their aromatic characteristics. Specifically, our process is designed to create an active dry yeast that can be used directly into the must without prior rehydration and acclimatization.

CHOOSE
YOUR OWN WAY!

In practice, you can use E2U™ yeast as usual, with rehydration and acclimatization; with prior rehydration in tap water only; or without rehydration, directly pitched into the must.

DIRECT INOCULATION

The easiest way! Pour the yeast directly on the top of the tank or, for whites and rosés, during tank filing after settling.

OR

WITH PRIOR REHYDRATION

Pour the yeast on the surface of at least 10 times its weight of tap water at room temperature. Gently stir to avoid clumping or to break up clumps. Wait for 20 minutes, then transfer into the tank by pumping it over with aeration.

WATCH OUT! REHYDRATION IN WATER

If rehydration in water is chosen: beware of leaving the yeast rehydrating in the water for at least 10-15 min to avoid fermentation performances loss!!!

2 STEPS
TO GET AN E2U™-VALIDATION

Every year since 2013, one of our yeasts is subjected to a E2U™-validation process comprising of two steps:

1

A TEST OF VIABILITY AFTER REHYDRATION

in pure or up to 25% sugared water and at a range of temperatures from 10°C to 43°C (50°F to 109°F).

2

ONE OR SEVERAL MICROVINIFICATIONS

whose conditions are specifically chosen according to the main types of wine targeted by the selected strain. Prior to the fermentation, the yeasts are prepared in three different ways.

- **THE USUAL WAY**

  Rehydration in tap water at 35/37°C (95/98.6°F), then progressive acclimatization to must temperature, with must addition before inoculation.

- **COLD**

  Rehydration in tap water at 15°C for 15 minutes.

- **MUST**

  Direct pitching.

IF THE STRAIN SHOWS

- a high and preserved viability in all rehydration conditions
- maintained fermentation performances
- and an equivalent organoleptic profile whatever its mode of preparation

IT IS OFFICIALLY DECLARED E2U™.

A CONCRETE EXAMPLE

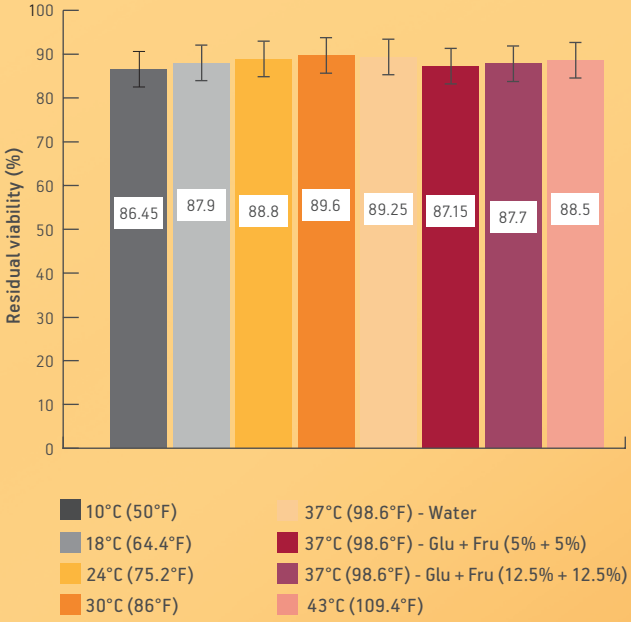
SafŒno™ GV S107

E2U EASY TO USE by Fermentis

PRESERVED VIABILITY

• **Conditions:** the SafŒno™ GV S107 yeast was rehydrated in distilled water heated to different temperatures, left to rest for 15 minutes and then moderately stirred (100 rpm) for another 30 minutes. At 37°C, 2 other rehydration medias were tested: 10% and 25% sugared distilled water (Glu:Fru, 1:1).

• **Findings:** the high viability of SafŒno™ GV S107 yeast is very stable and not affected by rehydration conditions (no significant differences with a 5% error margin). Even in extreme cases (10°C and 43°C); its residual viability lies between 86 and 90%.



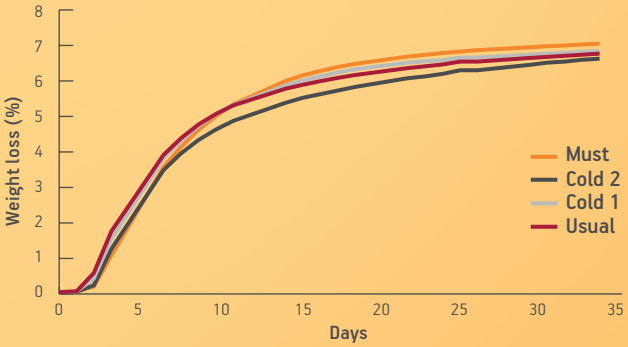
MAINTAINED FERMENTATION PERFORMANCES

(except in 1 case to be avoided!)

• **Conditions:** the SafŒno™ GV S107 yeast has been prepared in a range of 4 different conditions and tested on a laboratory scale vinified Chardonnay (2L), chaptalized to 14% v/v and adjusted from a ratio Yeast Available Nitrogen (ppm) / Sugar (g/l) of 0.57 to 0.8 with diammonium phosphate at inoculation. Fermentation temperature was constant at 18°C (64.4°F).

• **Findings:** only the condition in which SafŒno™ GV S107 yeast has been rehydrated just 1 min in 15°C water then directly transferred into the must affected the kinetic and lead to a stuck fermentation. All the other conditions of preparation did not affect its fermentation kinetic and analytical performances after alcoholic fermentation.

Alcoholic fermentation kinetics



Residual Glucose + Fructose (g/L)

Must	1
Cold 2	10.6
Cold 1	1.6
Usual	2.1

Yeast preparation conditions: Usual: rehydration in tap water at 35/37°C then progressive acclimatization to must temperature with must addition before inoculation, **Cold 1:** rehydration in tap water at 15°C for 15min, **Cold 2:** rehydration in tap water at 15°C for 1min, **Must:** direct pitching.

If rehydration in water is chosen: beware of leaving the yeast rehydrating in the water for at least 10-15 min to avoid fermentation performances loss!!!

AN ORGANOLEPTIC PROFILE OF EQUIVALENT QUALITY IN ALL CIRCUMSTANCES

• **Conditions:** on the same Chardonnay but microvinified in 50L tanks, a professional triangular tasting of 12 panelists ("Among 3 samples in which 2 are from the same condition and 1 from another condition, identify which one is different from the others") have been carried out in order to assess the organoleptic differences between conditions. This tasting has been done after SO_2 correction and stabilization.

• **Findings:** again the cold rehydration 2 fermented slower than the two other conditions (about 20 days more!) but finished the fermentation allowing a real tasting. All preparation conditions of the SafŒno™ GV S107 yeast had no impact on global organoleptic profile compared to usual acclimatization, thus validating time saving and sustainable alternatives.

Triangular tasting

Cold 2 vs Cold 1	**NS** (p=0.19)
Cold 2 vs Usual	**NS** (p=0.24)
Cold 1 vs Must	**NS** (p=0.24)

NS (p=X): Non-significant differences (probability value)

Tests conducted by Meurice institute (Brussels – Belgium) and the Institut Français de la Vigne et du Vin (Nantes – France) on Easy 2 Use SafŒno™ GV S107, a strain designed for the production of premium whites fermented at low temperature, especially Chardonnay-style.

Fermentis quality control

Our strains are of the highest quality. Everything that Fermentis produces from this natural, delicate and living raw material meets the same quality international standards. But the excellence does not stop there. It is also defined by stability over time. Tomorrow and the day after tomorrow, our products will keep their promises.

Obviously, Fermentis requires positive results before 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 20g/hl, contaminations are lower than 10 contaminating cells*/ml**.
- Therefore, semi quantitative PCR test may give positive results. It is recommended to cross check PCR results with plating methods.
- **All our products comply with the International Oenological Codex** until its "Best Before" end date when stored in the conditions recommended in our spec sheets.
- All quality and regulatory aspects related to our range of active dry yeast, such as allergen declaration, food grade, non-GMO, heavy metals, etc., are listed in a document named "Masterfile" or "Product data file" in US. Likewise, all our manufacturing plants are certified according to international quality standards (as ISO or BRC).
- **Finally, Fermentis is part of OENOPPIA** (Œnological Products and Practices International Association - www.oenoppia.com) and as such, contributes to the evolution of the quality standards regarding oenological products. We concur with the guidelines made in partnership with FIVS (Fédération Internationale des Vins et Spiritueux – www.fivs.org) concerning the information that should routinely be made available when oenological products are purchased by wine producers, which are downloadable on FIVS website.

* Contaminating cell: *Lactobacilus spp., Acetobacter spp., Pediococcus spp,* non-*Saccharomyces* yeast.

** Meaning that contaminating cell concentration is lower than 103 cfu/g.

OPTIMUM STORAGE

The high rate of dry matter of our yeasts assures an optimum storage in its original packaging at a temperature not higher than 20°C/68°F (during 3 years) and 10°C/50°F for an extended storage (4 years).

SHELF LIFE

The stability of each Fermentis ADY, in terms of freshness and activity, has been monitored for more than four years. The yeasts were stored at different temperatures.

Five batches of each Fermentis yeast were also submitted to forced ageing tests.

Batch clearance requires positive forced ageing tests results.

BATCH NUMBER & TRACEABILITY

All Fermentis sachets or boxes are identified by an alphanumeric code.

This allows us to find all data related to the batch produced, from raw material used to recorded process parameters and quality results.

All quality and regulatory documents are available upon request to Fermentis or your Fermentis distributor.

OUR ACTIVE DRY YEASTS

TOP QUALITY

You can choose between our thirteen different strains to ferment efficiently your must. You are guaranteed to get the highest standards of quality and productivity. Whatever conditions can be, and whatever you create, red, white, rosé or sparkling, our yeasts can meet all your expectations, both technical and sensory, to reveal the aromas you are looking for.

FERMENTIS 13 ACTIVE DRY YEASTS

a complete range to meet your needs

SafŒno™ BC S103
THE CHOICE FOR EXTREME CONDITIONS

SafŒno™ VR 44
FOR SAFE FERMENTATIONS AND *PRISE DE MOUSSE*

SafŒno™ SC 22
THE ORIGINAL STARTER YEAST

SafŒno™ STG S101
FOR FRUITY RED AND ROSÉ WINES

SafŒno™ CK S102
THE IDEAL STRAIN FOR AROMATIC WHITE AND ROSÉ WINES

SafŒno™ GV S107
IDEALLY ADAPTED TO PREMIUM WHITES

SafŒno™ HD A54
FOR INTENSELY FRUITY WHITE AND ROSÉ WINES

SafŒno™ HD T18
FOR ELEGANT AND FRESH TERPENIC WHITE WINES

SafŒno™ UCLM S325
VARIETAL CHARACTER AT THEIR BEST

SafŒno™ HD S135
FOR FULL BODIED... AND SMOOTH REDS

SafŒno™ HD S62
FOR DEEPLY COLORED AND STRUCTURED REDS

SafŒno™ NDA 21
THE CHOICE FOR ELEGANT FRUITY STYLE RED WINES

SafŒno™ UCLM S377
FOR LONG AGEING AND FRUITY RED WINES

ACTIVE
DRY YEAST

THE OBVIOUS CHOICE
FOR EXTREME CONDITIONS

SafŒno™ BC S103

E2U
EASY TO USE
by Fermentis

RESTART

BEST SUITED FOR

Extreme conditions of fermentation for all kind of wines.

AROMAS

Medium intensity. Promotion of thiols and terpens. Amylic notes at low temperature.

STRUCTURE

Low (reds)

ROUNDNESS

Low

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Sensitive but excellent settlement	Very fast	Wide range 10-30°C (50-86°F)	18%	Very low (160-180 ppm) Ratio*: 0.7-0.8	Low	Medium low - Medium

* More explanations about the ratio p87-88. ** Yeast capacity to produce compounds (such as aldehydes) which will combine SO_2.

Fermentis by Lesaffre

ACTIVE
DRY YEAST

FOR SAFE FERMENTATIONS AND *PRISE DE MOUSSE*

Also available in organic version

SafŒno™ VR 44

BEST SUITED FOR

Traditional sparkling and elegant premium wines.

AROMAS

Medium intensity. Promotion of fruit complexity at low temperature.

STRUCTURE

Low (reds)

ROUNDNESS

High

E2U EASY TO USE by Fermentis

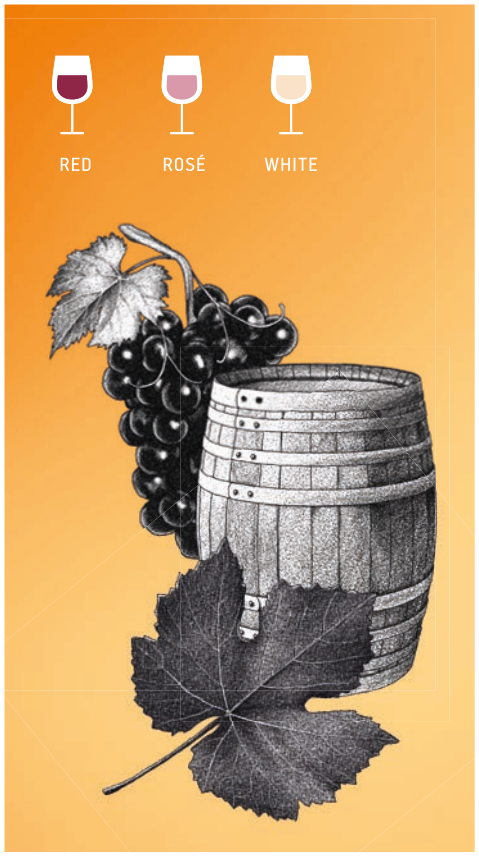
RESTART

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Killer strain and excellent settlement	Fast	Wide range 10-30°C (50-86°F)	16%	Very low (160-180 ppm) Ratio*: 0.7-0.8	Medium	Medium - Medium plus

ACTIVE
DRY YEAST

THE ORIGINAL
STARTER YEAST

SafŒno™ SC 22



E2U
EASY TO USE
by Fermentis

BEST SUITED FOR
Grand Crus, neat and clean fermentation that value premium fruity wines.

AROMAS
Medium intensity and fresh fruits.

STRUCTURE
Low (reds)

ROUNDNESS
High

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Sensitive but excellent settlement	Medium	14-30°C (57-86°F)	15%	Low (160-220 ppm) Ratio*: 0.7-0.8	Very low	Low - Medium

* More explanations about the ratio p87-88. ** Yeast capacity to produce compounds (such as aldehydes) which will combine SO_2.

Fermentis by Lesaffre

ACTIVE
DRY YEAST

FOR FRUITY RED AND ROSÉ WINES

SafŒno™ STG S101

BEST SUITED FOR

Primeur red wines with Pinot Noir, Grenache, Sangiovese, etc.

AROMAS

High intensity and ester production. Ripe and jammy fruits.

STRUCTURE

Low (reds)

ROUNDNESS

Medium

E2U
EASY TO USE
by Fermentis

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Neutral and good settlement at temperature → 17°C / 62°F	Slow	17-30°C (62-86°F)	13.5%	Medium (180-220 ppm) Ratio*: 0.8-0.9	Very low	Low - Medium

ACTIVE
DRY YEAST

THE IDEAL STRAIN FOR AROMATIC WHITE AND ROSÉ WINES

SafŒno™ CK S102

E2U
EASY TO USE
by Fermentis

BEST SUITED FOR
Sauvignon blanc, Semillon and rosé.

AROMAS
High intensity with thiol and terpenic release (tropical, citrus) & good ester production.

STRUCTURE
NO

ROUNDNESS
High

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Killer and excellent settlement	Very fast	Wide range 10-30°C (50-86°F)	15%	Strong to optimize aromatic expression (>220 ppm) Ratio*: → 0.9	Medium low	Medium plus - Medium plus

* More explanations about the ratio p87-88. ** Yeast capacity to produce compounds (such as aldehydes) which will combine SO_2.

Fermentis by Lesaffre

ACTIVE
DRY YEAST

IDEALLY ADAPTED TO PREMIUM WHITES

SafŒno™ GV S107

BEST SUITED FOR

Chardonnay, Viognier and Chenin Blanc.

AROMAS

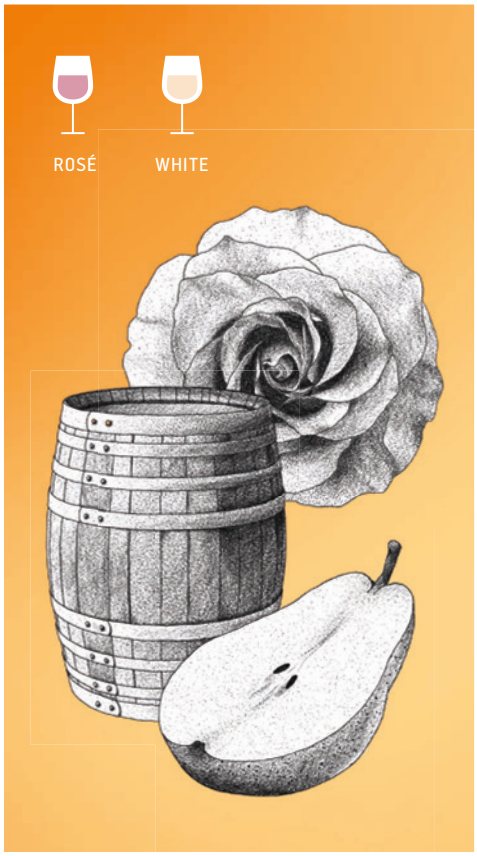
Medium intensity with a medium high production of esters: floral and fruity. Medium high release of terpenes & C13-Norisoprenoids.

STRUCTURE

NO

ROUNDNESS

Medium +



E2U
EASY TO USE
by Fermentis

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Neutral and good settlements	Slow (fast at PH →3.5)	Wide range 10-30°C (50-86°F)	15%	Medium (180-220 ppm) Ratio*: 0.8-0.9	Low	Medium low-Medium

ACTIVE
DRY YEAST

FOR INTENSELY FRUITY WHITE AND ROSÉ WINES

SafŒno™ HD A54

E2U
EASY TO USE
by Fermentis

BEST SUITED FOR

Young and technological wines with strong amylic notes. Perfect choice for blend base and low SO_2 wines.

AROMAS

High intensity. Overexpression of fruitiness towards banana, candies and green notes removal.

STRUCTURE

NO

ROUNDNESS

High

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Killer strain but moderate settlement strength	Regular (medium lag phase)	14-30°C (57-86°F)	15%	Medium (180-220 ppm) Ratio*: 0.8-0.9	Medium	Very low - Very low

* More explanations about the ratio p87-88. ** Yeast capacity to produce compounds (such as aldehydes) which will combine SO_2.

Fermentis by Lesaffre

ACTIVE
DRY YEAST

FOR ELEGANT AND FRESH TERPENIC WHITE WINES

SafŒno™ HD T18

BEST SUITED FOR

Terpenic varieties such as Muscat, Viognier, Gewürztraminer, Riesling, Pinot Gris...

AROMAS

Medium intensity. Promotion of terpenes supported by a good balance of esters. Particularly enhances fresh floral and citrus fruit notes.

STRUCTURE

NO

ROUNDNESS

Low

E2U
EASY TO USE
by Fermentis

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Killer and good settlement	Fast	Wide range 10-30°C (50-86°F)	15%	Low (160-220 ppm) Ratio*: 0.7-0.8	Low	Low - Medium low

ACTIVE
DRY YEAST

VARIETAL CHARACTER AT THEIR BEST

SafŒno™ UCLM S325

BEST SUITED FOR

Riesling, Muscat, Pinot gris and sweet wines.

AROMAS

High intensity. Increase of aromatic potential of terpenic and norisoprenoids varieties (floral, citrus).

STRUCTURE

NO

ROUNDNESS

Medium

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Killer and good settlements	Slow	17-30°C (62-86°F)	13%	Strong (→220 ppm) Ratio*: →0.9	Low	Low - Medium

* More explanations about the ratio p87-88. ** Yeast capacity to produce compounds (such as aldehydes) which will combine SO_2.

Fermentis by Lesaffre

ACTIVE
DRY YEAST

**FOR FULL BODIED...
AND SMOOTH REDS**

SafŒno™ HD S135

BEST SUITED FOR
Full bodied, fruity and smooth red wines.

AROMAS
High intensity. Red & black ripe fruits.

STRUCTURE
Medium +

ROUNDNESS
High

RED

E2U EASY TO USE by Fermentis

RESTART

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Sensitive but good settlements	Fast	14-30°C (57-86°F)	→15%	Low (160-220 ppm) Ratio*: 0.7-0.8	Medium	Low - Medium

ACTIVE
DRY YEAST

FOR DEEPLY COLORED AND STRUCTURED REDS

SafŒno™ HD S62

RED

E2U EASY TO USE by Fermentis

RESTART

BEST SUITED FOR
Red wines requiring structure enhancement.

AROMAS
Medium intensity and ester production. Fresh fruit & spicy.

STRUCTURE
High

ROUNDNESS
Medium

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Sensitive and good settlement at temperature →17°C / 62°F	Fast	14-30°C (57-86°F)	→15%	Low (160-220 ppm) Ratio*: 0.7-0.8	Medium low	Low - Medium

* More explanations about the ratio p87-88. ** Yeast capacity to produce compounds (such as aldehydes) which will combine SO_2.

Fermentis by Lesaffre

ACTIVE
DRY YEAST

THE CHOICE FOR ELEGANT
FRUITY STYLE RED WINES

SafŒno™ NDA 21

BEST SUITED FOR
Spicy and fruity Syrah, Zinfandel, Mourvedre, etc.

AROMAS
Medium intensity. Fruity & spicy notes.

STRUCTURE
Medium

ROUNDNESS
Medium

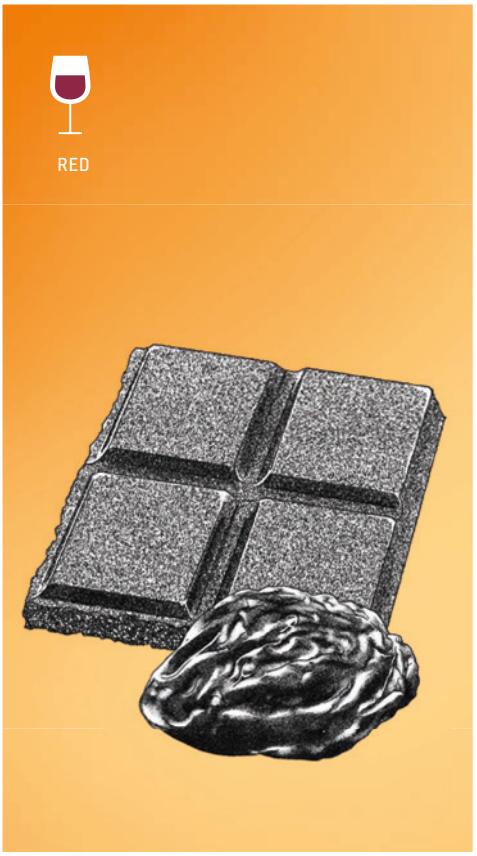
E2U
EASY TO USE
by Fermentis

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Sensitive but good settlement	Medium	14-30°C (57-86°F)	15%	Medium (180-220 ppm) Ratio*: 0.8-0.9	Medium	Low - Medium

ACTIVE DRY YEAST

FOR LONG AGEING AND FRUITY RED WINES

SafŒno™ UCLM S377



BEST SUITED FOR
Long aging and fruity red wines.

AROMAS
High intensity and ester production.
Ripe and jammy fruits.

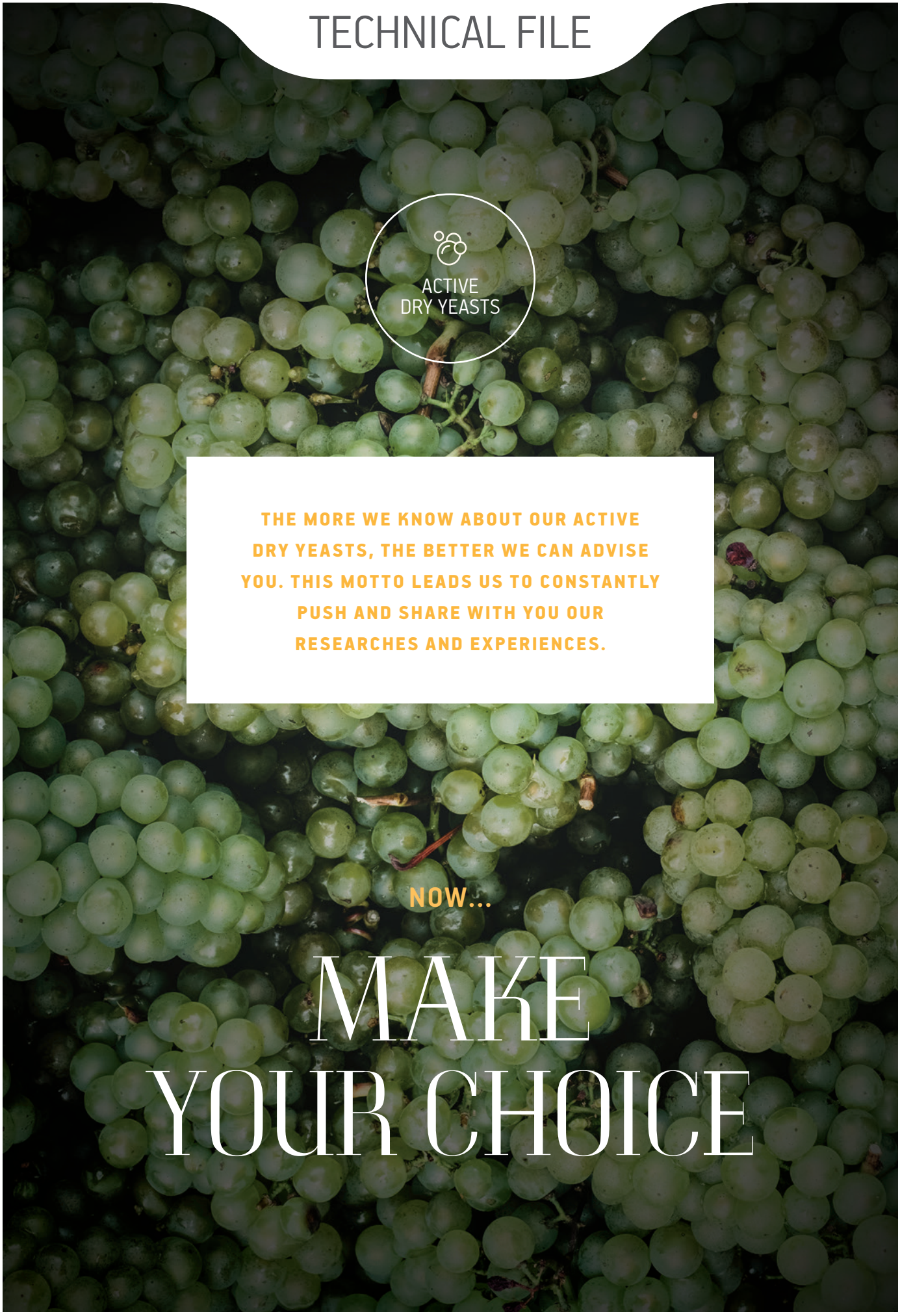
STRUCTURE
High

ROUNDNESS
Medium +

KILLER FACTOR	FERMENTATION KINETIC	TEMPERATURE RANGE	ALCOHOL TOLERANCE (%V/V)	NITROGEN NEEDS (MG/L)	VOLATILE ACIDITY PRODUCTION	SO_2 PRODUCTION / COMBINATION**
Sensitive but good settlement	Slow	Requires regular conditions 17-30°C (62-86°F)	14,5%	Strong (→220 ppm) Ratio*: →0.9	Low	Low - Medium

* More explanations about the ratio p87-88. ** Yeast capacity to produce compounds (such as aldehydes) which will combine SO_2.

Fermentis by Lesaffre

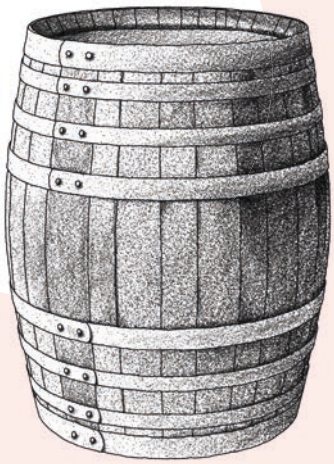


THE MORE WE KNOW ABOUT OUR ACTIVE DRY YEASTS, THE BETTER WE CAN ADVISE YOU. THIS MOTTO LEADS US TO CONSTANTLY PUSH AND SHARE WITH YOU OUR RESEARCHES AND EXPERIENCES.

NOW...

MAKE YOUR CHOICE

TECHNICAL CHARACTERISTICS

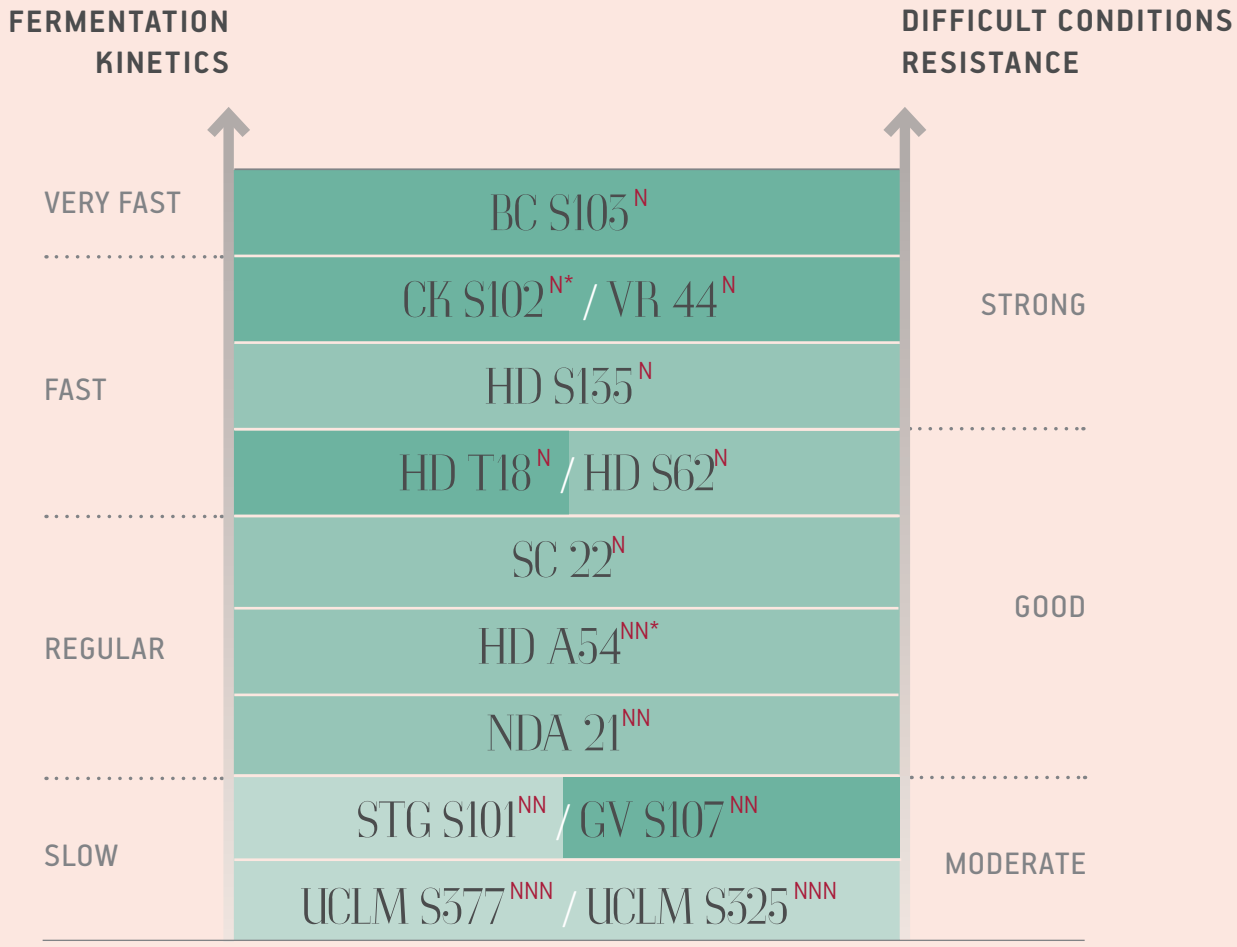


Like human beings, each yeast strain is unique. As such, yeast strains have different intrinsic/genetic capabilities, show different behaviors in the same situation, and require specific needs to achieve good growth and subsequent performant fermentation. One of the best examples to illustrate this is the production process in Lesaffre facilities.

Even if the production steps of all our yeasts are the same (see p.24-25), the production recipes are different and adapted to each of our strain in order to respect their specific needs. In the technical characteristic map, we categorize our yeast according to their global resistance to difficult fermentation conditions (such as high alcohol, low pH, low yeast available nitrogen (YAN), low temperature, etc.)

We then highlight three specifc and related parameters to understand their performances: their needs in available nitrogen (/nutrients) expressed in YAN (mg/L) / S: Initial sugars (g/L) ratio (see p.87); their minimum advised working temperature to ferment correctly; and their kinetic behavior during fermentation.

Of course, the more difficult the fermentation conditions, the more important the differences.



Yeast Available Nitrogen (YAN) needs:

N: 0.7 - 0.8 YAN (ppm) / Sugar (g/L)

NN: 0.8 - 0.9

NNN: >0.9

* NNN related to aromatic profile

Advised working temperature:

>10°C

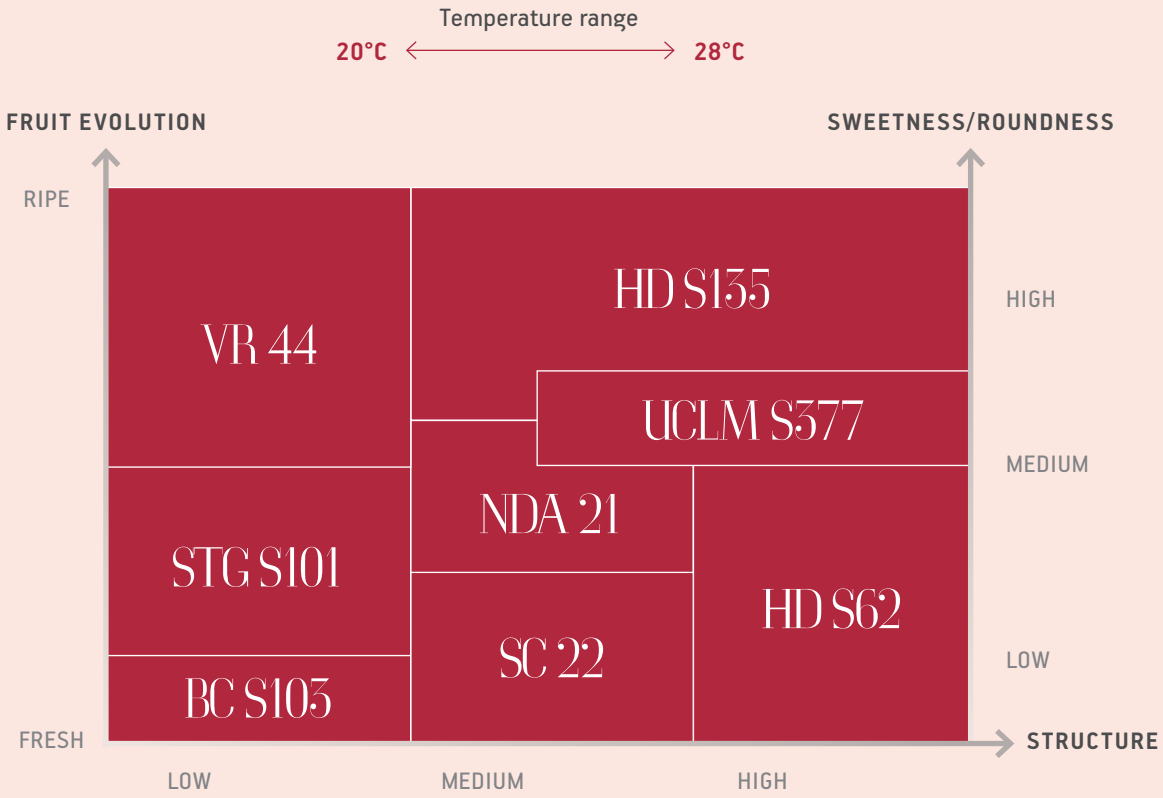
>14°C

>17°C

OUR YEASTS FOR

REDS

8 YEAST STRAINS



COMMENTS

Each wine is unique. For red wines, yeasts strongly participate to this uniqueness by creating and revealing aromas with rather fresh or ripe fruity profiles (evolution) but as well by influencing their body, meaning their polyphenolic profile (structure - skeleton) and its mouthfeel perception (roundness – muscles/fat).

Based on analyses and tastings of many diverse experiments (our yeast characterization R&D program), this map helps you to find the right choice for your red wine types, voluntarily away from a variety point of view.

OUR YEASTS FOR

WHITES & ROSÉS

9 YEAST STRAINS

Underlined: sparkling application possibility

A/F: main fermentative aroma promotion (A: amylic - F: fruity)

COMMENTS

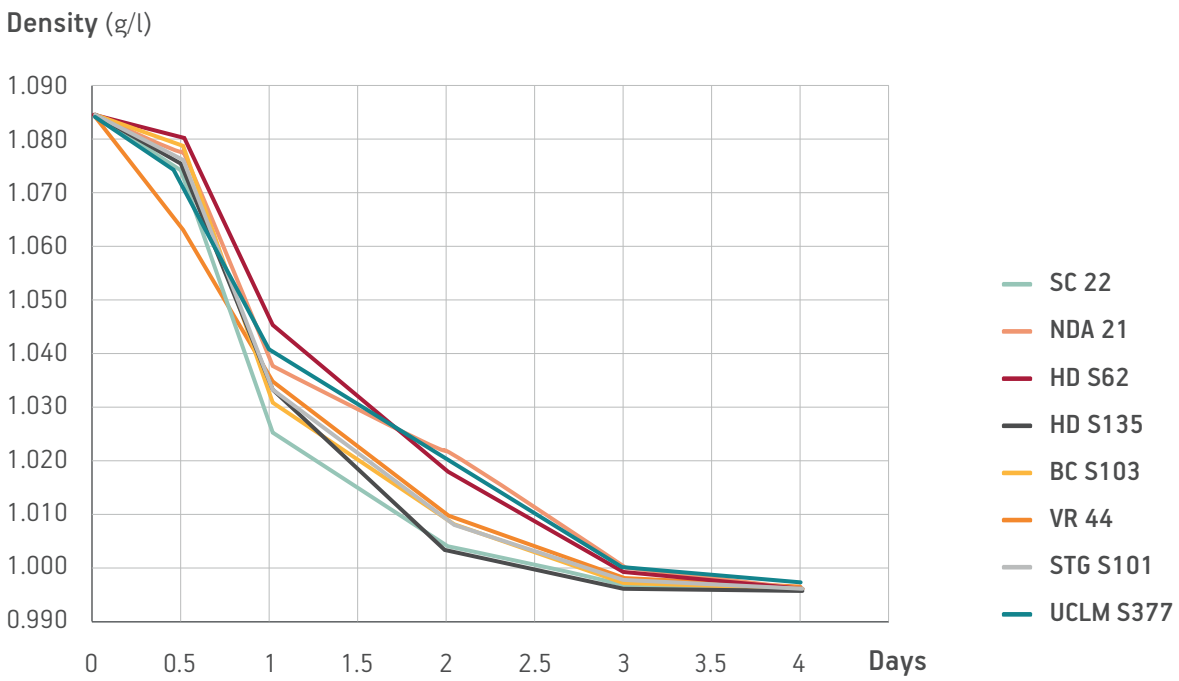
Establishing a profile for your white and rosé wines is complex. Apart from the roundness brought specifically by each yeast (as for reds), the factors strongly influencing the aromatic profile are diverse and very impactful.

Depending on their enzymatic pool, yeasts are more or less able to reveal different types of varietal aromas (C13 / Terpens / Thiols) and to create fermentative flavors (Amylic – acetate esters / Fruity – ethyl esters). This map will give you a chance to reach your goals.

KINETICS

NO NUTRITIVE DEFICIENCY

RED WINES



Pinot Noir – France 2018

Must parameters

Sugars (g/L)	221
Potential alcohol (%vol - base 16.83 g/L per % v/v of ethanol)	13.1
Total acidity (g H_2SO_4 /L)	5
pH	3.25
Malic acid (g/L)	3.8
Yeast Available Nitrogen mg/L	375
YAN / S	1.7

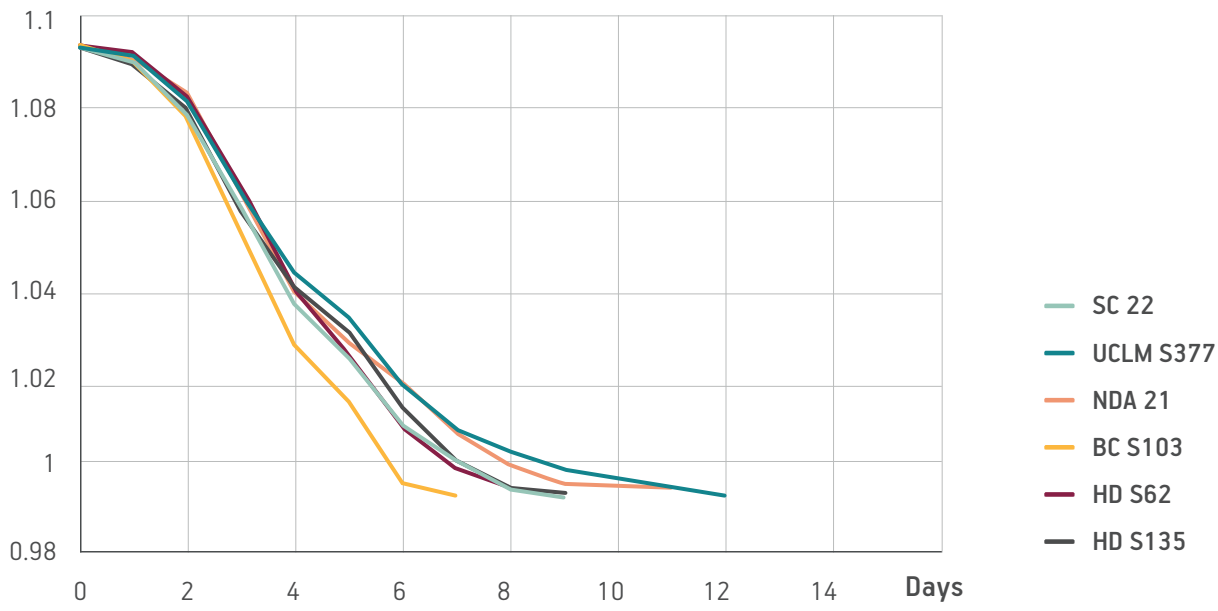
Temperature of fermentation between 20 and 28°C (68° to 82°F)

COMMENTS

The more difficult the conditions, the bigger the differences we see between the strains in terms of lag phase and kinetics. However, common features allow us to

INITIAL NUTRITIVE DEFICIENCY ADJUSTED

RED WINES



say that globally, BC S103 is always the fastest one, UCLM S377 is the slowest, especially at the end of fermentation, and HD S62 is fast but with a longer lag phase.

Merlot – France 2015

Must parameters

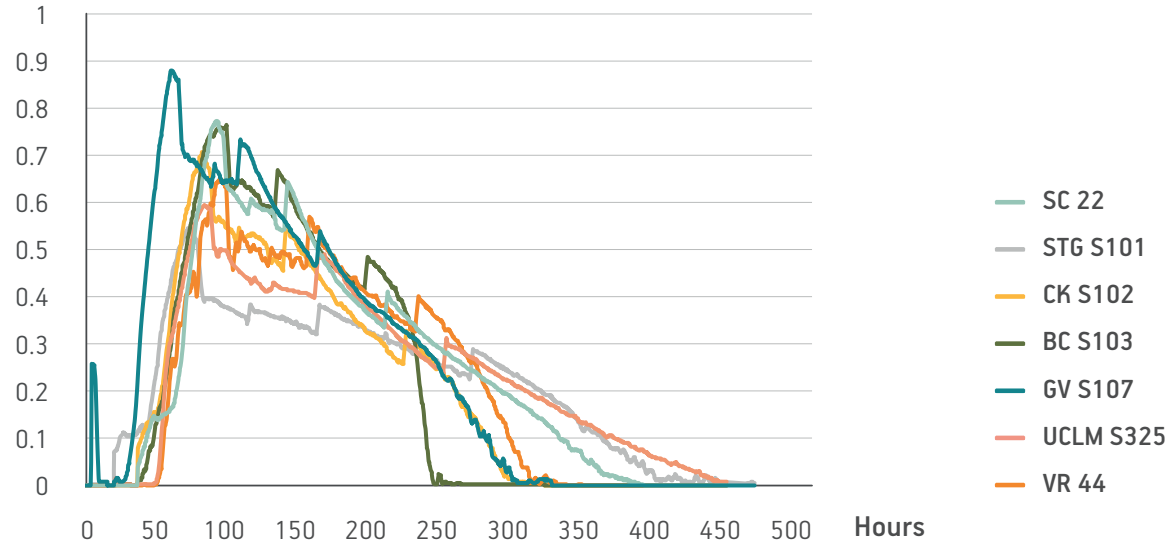
Potential alcohol (% vol.)	12.51
Sugars (g/L)	210
Total acidity (g H_2SO_4 /L)	3.2
pH	3.45
Malic acid (g/L)	2.5
Total SO_2 (mg/L)	62
Free SO_2 (mg/L)	34
YAN (mg/L)	105

Chaptalized to 15% v/v. Adjustment of YAN: DAP/Thiamine first addition to 150ppm then DAP/Thiamine to reach 200ppm (YAN / S= 0.8) at 1/3 of the alcoholic fermentation
Fermentation temperature start 17°C (63°F) then limitation at 24°C (75°F)

WINE YEASTS CHARACTERISTICS HIGHLIGHTS — KINETICS

NO NUTRITIVE DEFICIENCY | **LOW TEMPERATURE** | WHITE WINES

CO_2 flow speed (g/L/h)



Real-time follow-up of the fermentation speed by measuring the CO_2 released through a flowmeter during time. This data acquisition has been done thanks to a fermentation management system from Vivelys (SCALYA).

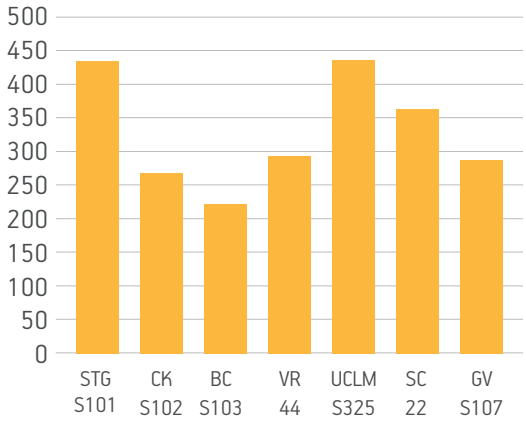
Chardonnay – France 2016

Must parameters

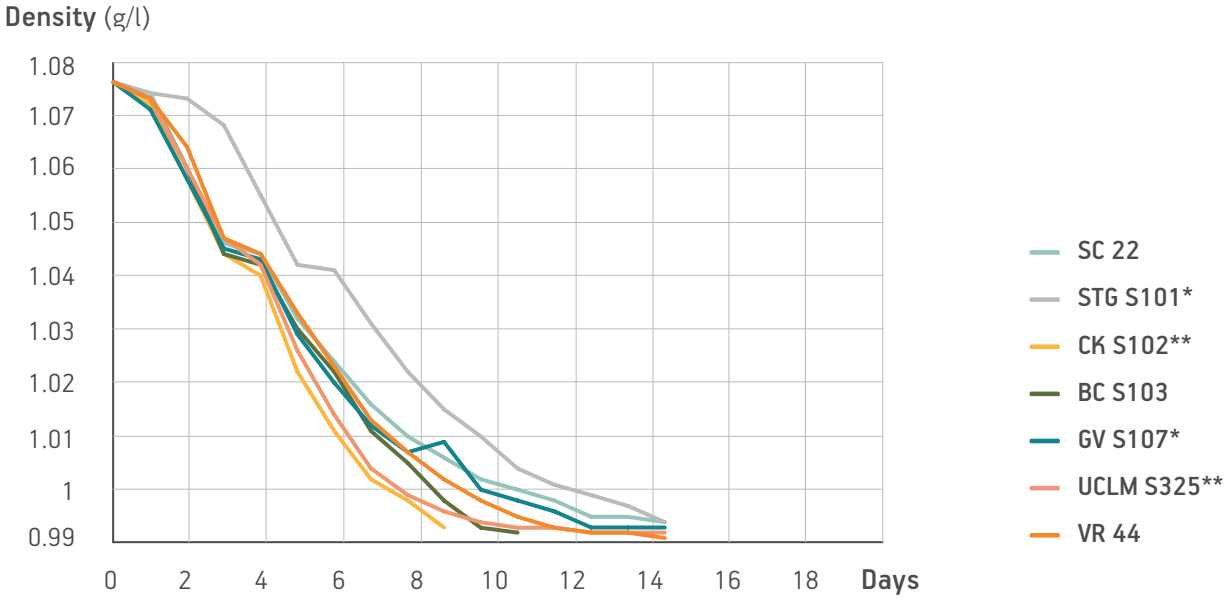
Sugars (g/L)	**207**
pH	**3.45**
Total acidity (g/L)	**3.22**
Malic acid (g/L)	**3.7**
Volatile Acidity (g/L)	**0**
Free SO_2 (mg/L)	**0**
Total SO_2 (mg/L	**24**
YAN (mg/L)	**165**

Initial turbidity adjustment to 150 NTU
5mg/L pulse of oxygen at the maximum speed (S_{max})
Adjustment of YAN to YAN/S= 1 at 35% of the fermentation advancement
Fermentation temperature between 14 and 18°C (57 to 64°F)

Fermentation duration (hrs)



INITIAL NUTRITIVE DEFICIENCY ADJUSTED | USUAL TEMPERATURE | WHITE WINES



COMMENTS

White and rosé wine fermentations are mainly characterized by nutritive deficiency and low temperature. Our yeast strains are more or less sensitive to these parameters that considerably affects their kinetics. Globally among our strains, the less sensitive are the SafŒno™ CK S102, BC S103 and VR 44. SafŒno™ STG S101 and UCLM S325 need smoother conditions.

Sauvignon Blanc – France 2016

Must parameters

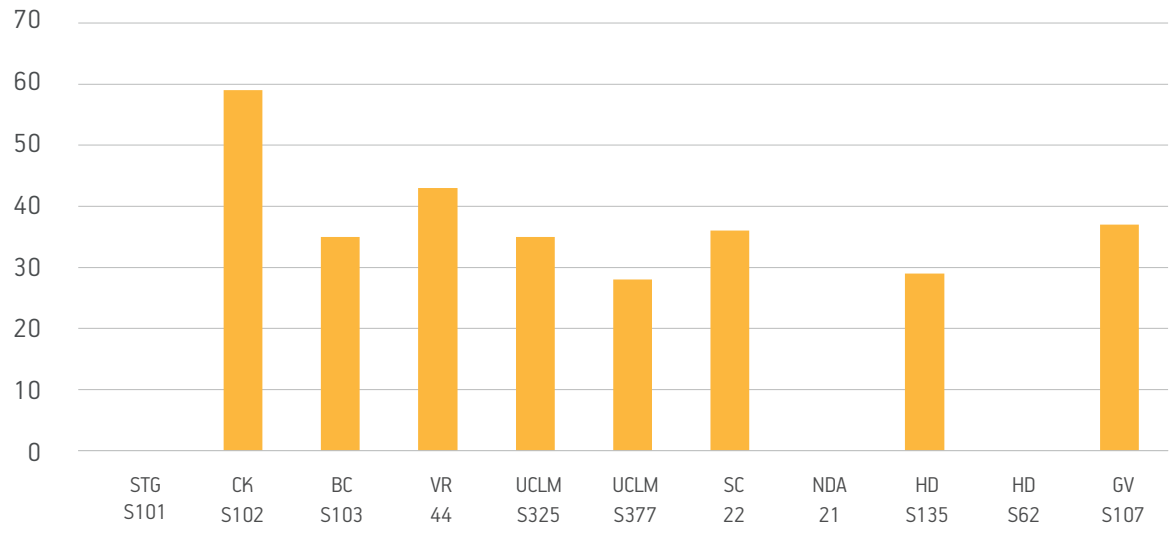
Potential alcohol (% vol.)	**10.71**
Sugars (g/L)	**180.3**
Total acidity (g H_2SO_4 /L)	**4.7**
pH	**3.15**
Malic acid (g/L)	**3.7**
Free SO_2 (mg/L)	**17**
Total SO_2 (mg/L)	**40**
YAN (mg/L)	**107**

Turbidity of 120 NTU
Adjustment to 205 g/l sugars (12.2% v/v) at 1/3 of the alcoholic fermentation
Adjustment to 150 ppm YAN initial with DAP
Readjusted to *174 ppm or **205ppm at 1/3 AF with DAP according to their needs
Fermentation temperature at 17°C (63°F)

Let's take the example of the Chardonnay 2016 – France

Same as page 54, as this one summarizes quite well the analytical behavior of all our strains.

TOTAL SO_2 (mg/L)



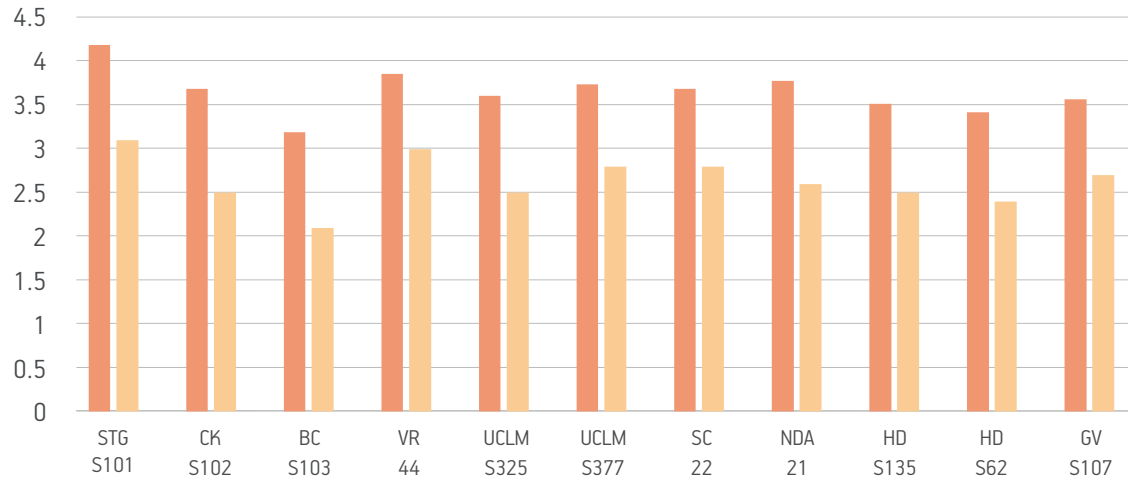
ALWAYS THE SAME?

Keep in mind that the statements in the product pages that summarize all features of our yeasts are made from a global perspective, with more data depending on the matrixes, to provide a general overview of all of our yeasts.

COMMENTS

This trial has been made on a white wine basis at low temperature and thus exaggerates the differences between strains, which will be lower in the case of less stressful red wines. However, some remarkable results can be noted: the high malic acid degradation of the SafŒno™ BC S103 and conversely, the high total acidity given by STG S101 and VR 44; the low production of volatile acidity of the BC S103, HD S62 and GV S107; the very low production of SO_2 by STG S101, NDA 21 and HD S62 on the opposition of CK S102, particularly active on Sulphur compounds including favorable thiols!

ORGANIC ACIDS

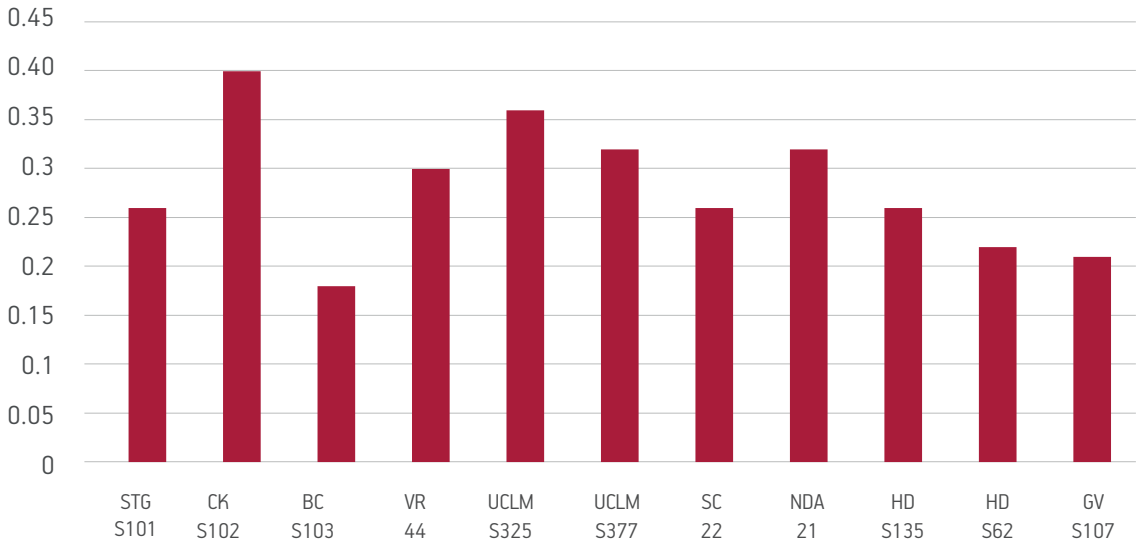


Total Acidity (g/L of H_2SO_4)

Malic Acid (g/L)

g/L		Acetic acid	Tartaric acid	Sulfuric acid (H_2SO_4)
1	Sulfuric acid (H_2SO_4)	1.22	1.53	1.00
1	Tartaric acid	0.80	1.00	0.65
1	Acetic acid	1.00	1.25	0.82

VOLATILE ACIDITY (g/L of H_2SO_4)



WINE YEASTS
CHARACTERISTICS HIGHLIGHTS ANALYTICS

Grenache – Spain 2015

Must parameters

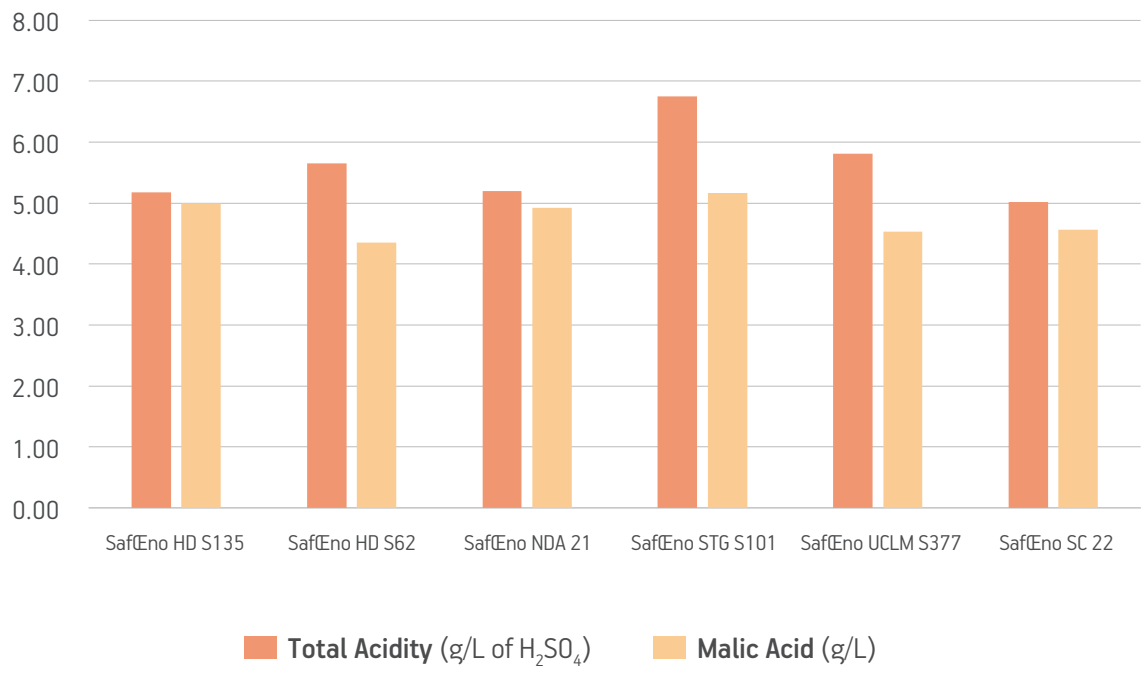
Potential alcohol (% vol.)	**15**
Sugars (g/L)	**250**
Total acidity (g H_2SO_4 /L)	**6.6**
pH	**3.8**
Malic acid (g/L)	**3.58**
Free SO_2 (mg/L)	**0**
Total SO_2 (mg/L)	**17**
YAN (mg/L)	**316**

Fermentation temperature at 24°C (75°F)

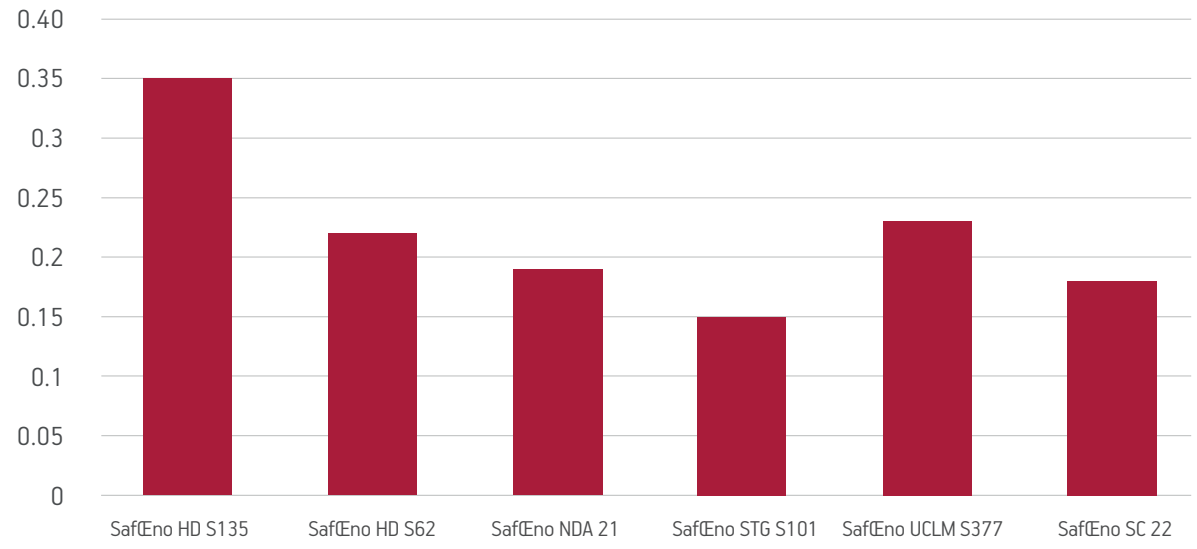
COMMENTS

We see that smoother conditions help SafŒno™ NDA 21 and SafŒno™ UCLM S377 significantly reduce their production of volatile acidity, which means they are much more sensitive to environmental conditions.

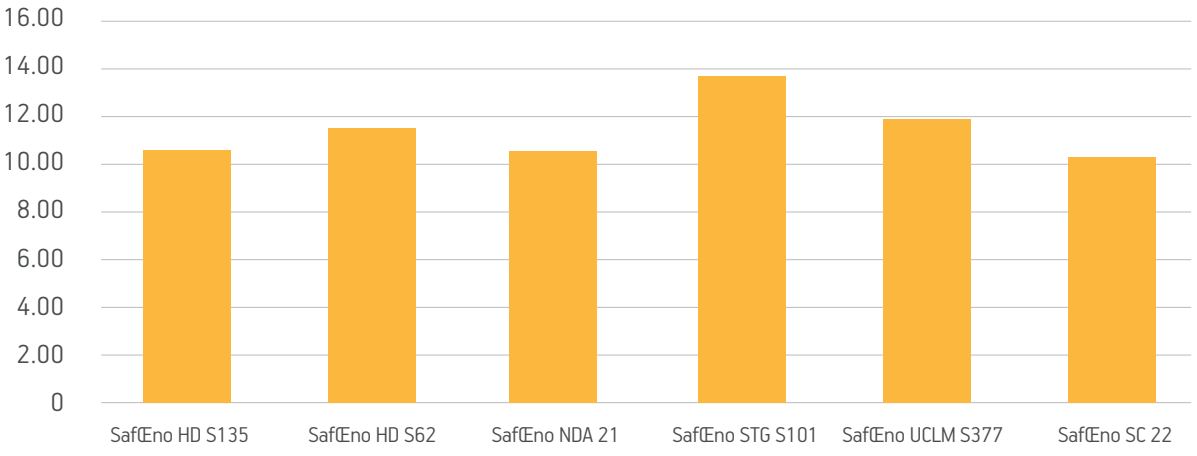
ORGANIC ACIDS



VOLATILE ACIDITY AFTER AF (g H_2SO_4/L)



FINAL TOTAL SO_2 (mg/L)



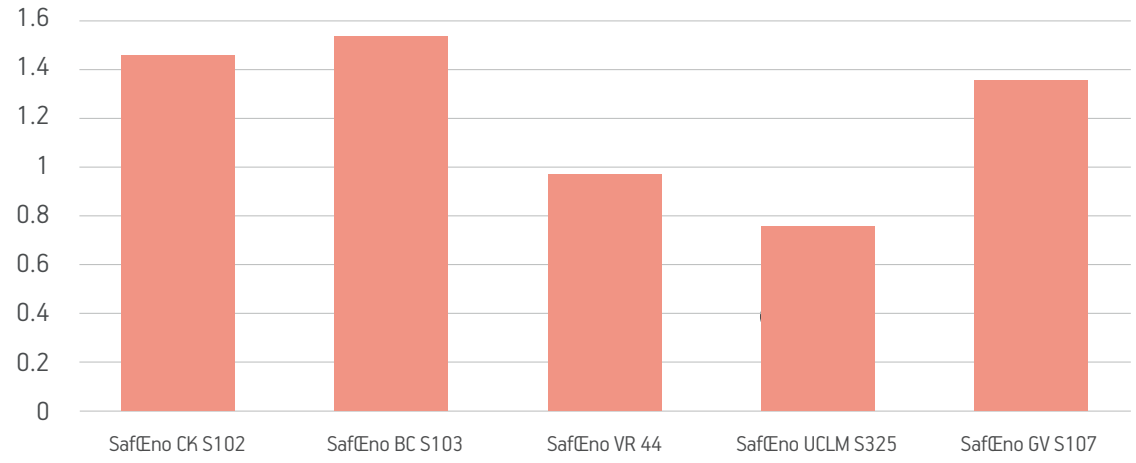
WINE YEASTS CHARACTERISTICS HIGHLIGHTS — AROMATICS

FERMENTATIVE AROMAS

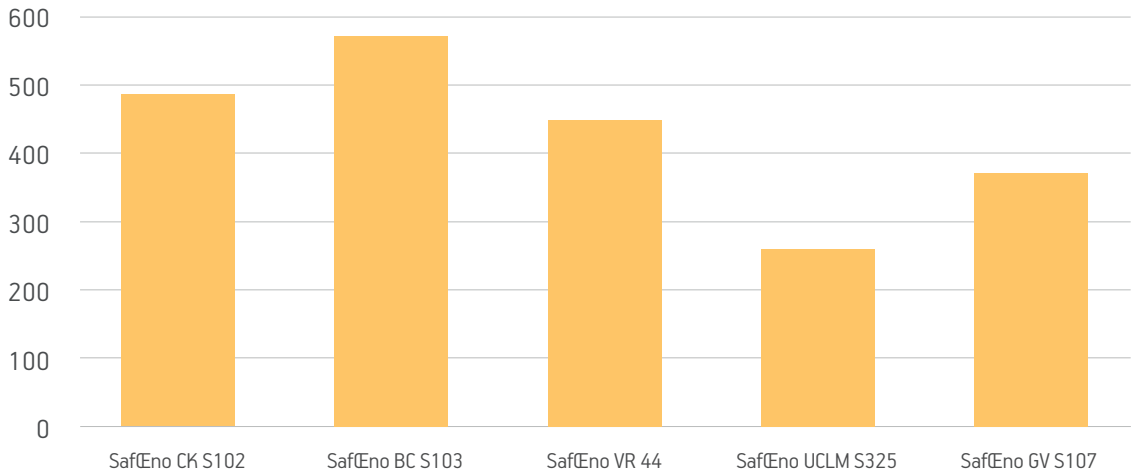
WHITE WINES

Again, the Chardonnay 2016 best describes the abilities of our yeast to generate fermentative higher alcohols and esters! This trial was designed for this purpose, without deficiencies in the must and with an adjustment ratio of YAN / Sugar of 1.

2-PHENYL-ETHANOL OAV*



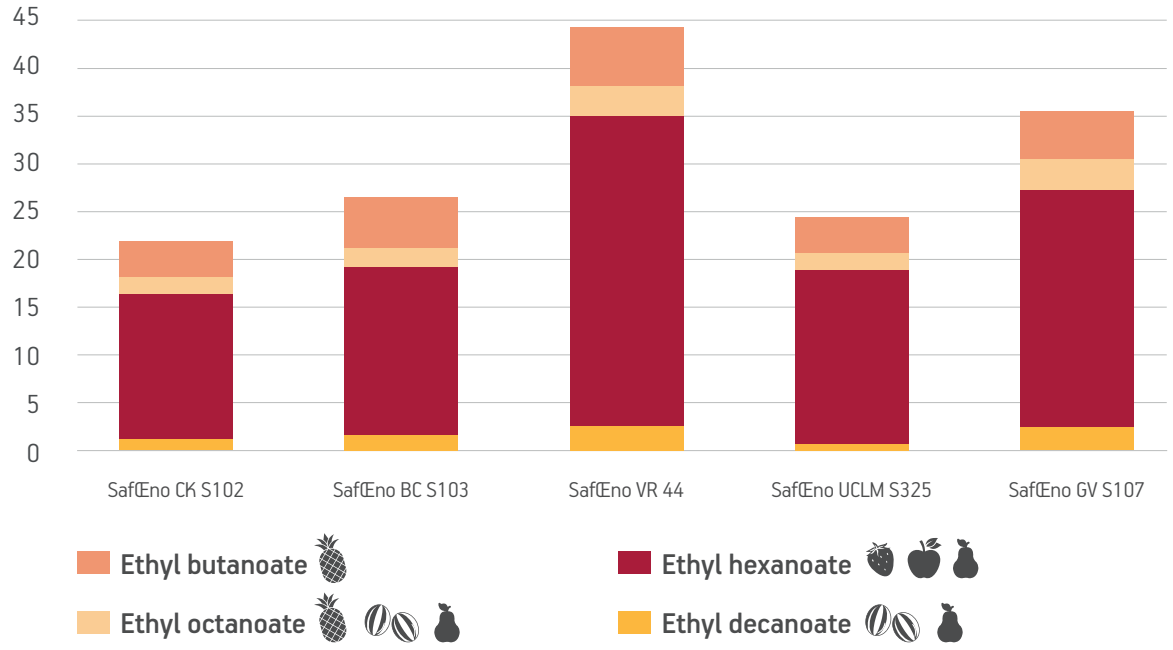
ISOAMYL ACETATE OAV



*WHAT DOES "OAV" MEAN?

We generally express aromatic results in Odor Active Values (OAV), which is the concentration of the molecule divided by its perception threshold in wine. Therefore, an OAV > 1 means that most of the tasters will potentially perceive it from an aromatic point of view. This allows us to have a better idea of which favor will more perceived compared to others.

ETHYL ESTERS OAV



COMMENTS

Most of the time, the production of higher alcohols, like 2-phenylethanol, follow the same trend as the acetate esters. They are associated with the same initial pathway, i.e. the Ehrlich pathway, generating higher alcohol that will be esterified in its corresponding acetate ester. These graphs also show that yeast can be defined through their acetate/ethyl esters ratio. Some, like the BC S103 and CK S102, are clearly oriented towards acetates, while VR 44 presents a ratio in favor of ethyl esters.

WINE YEASTS CHARACTERISTICS HIGHLIGHTS — AROMATICS

FERMENTATIVE AROMAS

RED WINES

Grenache – Spain 2015

Must parameters

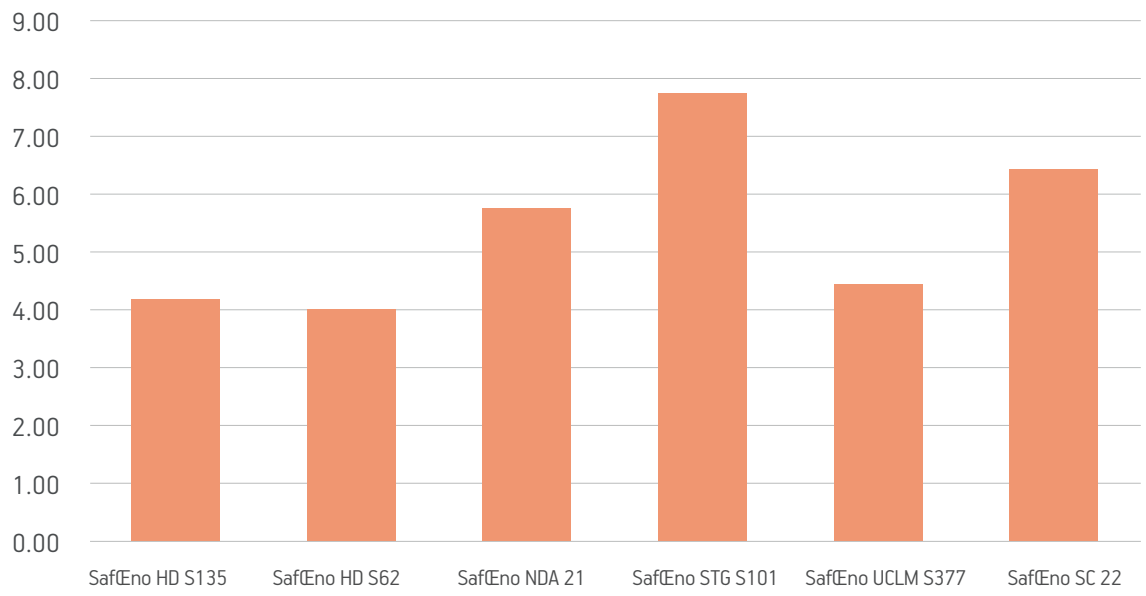
Potential alcohol (% vol.)	**15**
Sugars (g/L)	**250**
Total acidity (g H_2SO_4 /L)	**6.6**
pH	**3.8**
Malic acid (g/L)	**3.58**
Free SO_2 (mg/L)	**0**
Total SO_2 (mg/L)	**17**
YAN (mg/L)	**316**

Fermentation temperature at 24°C (75°F)

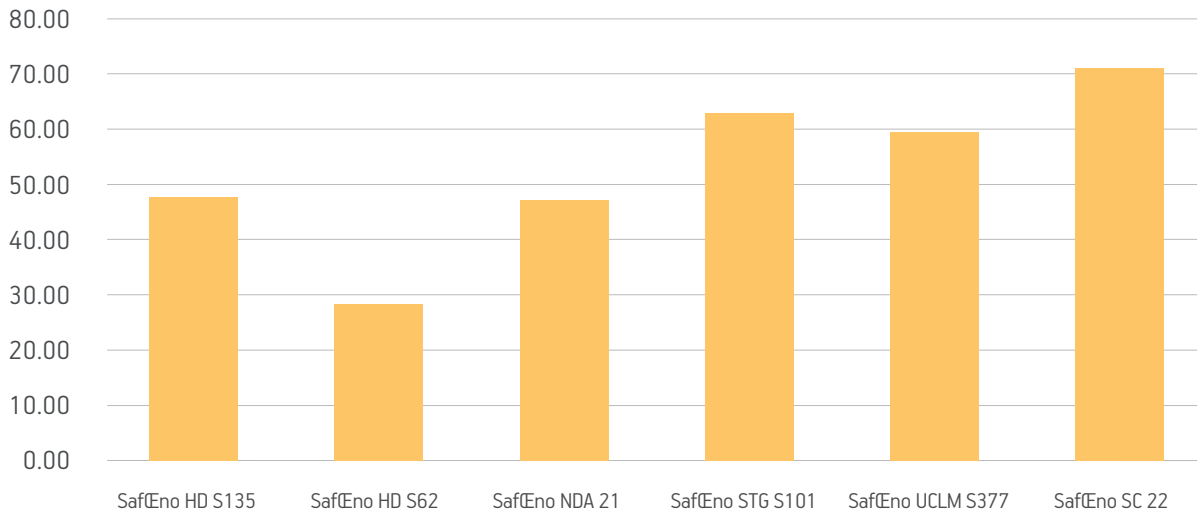
COMMENTS

We see that for non-deficient red wines made at higher temperature, STG S101, SC 22, and UCLM S377 show elevated ester levels. This proves that for UCLM S377, smoother conditions have a dramatic impact on its behavior.

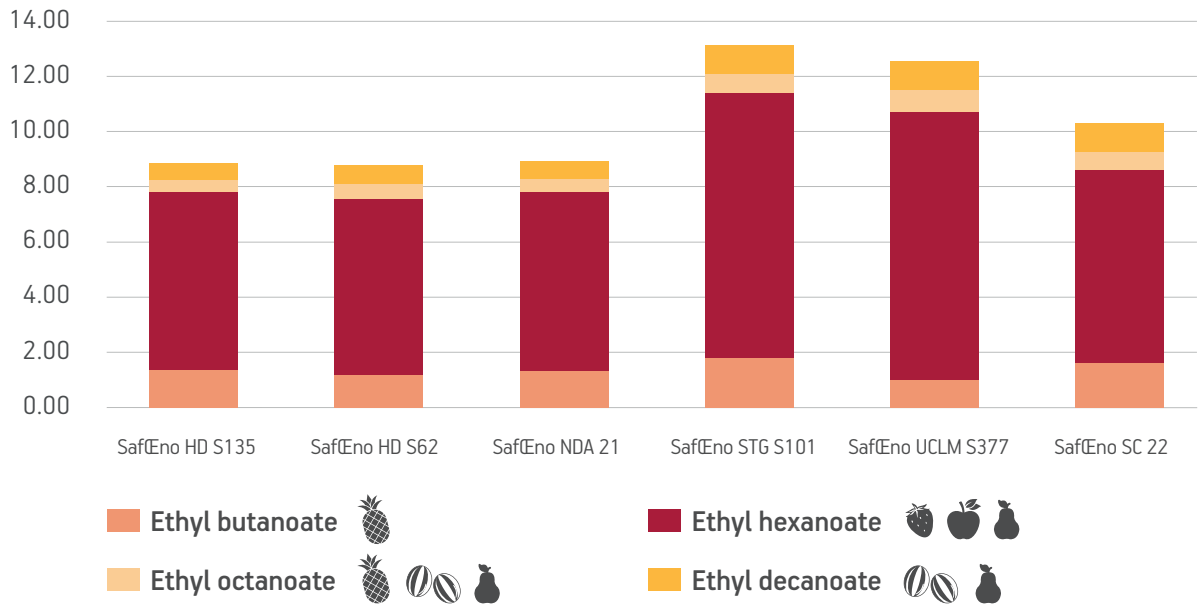
2-PHENYL-ETHANOL



ISOAMYL ACETATE OAV

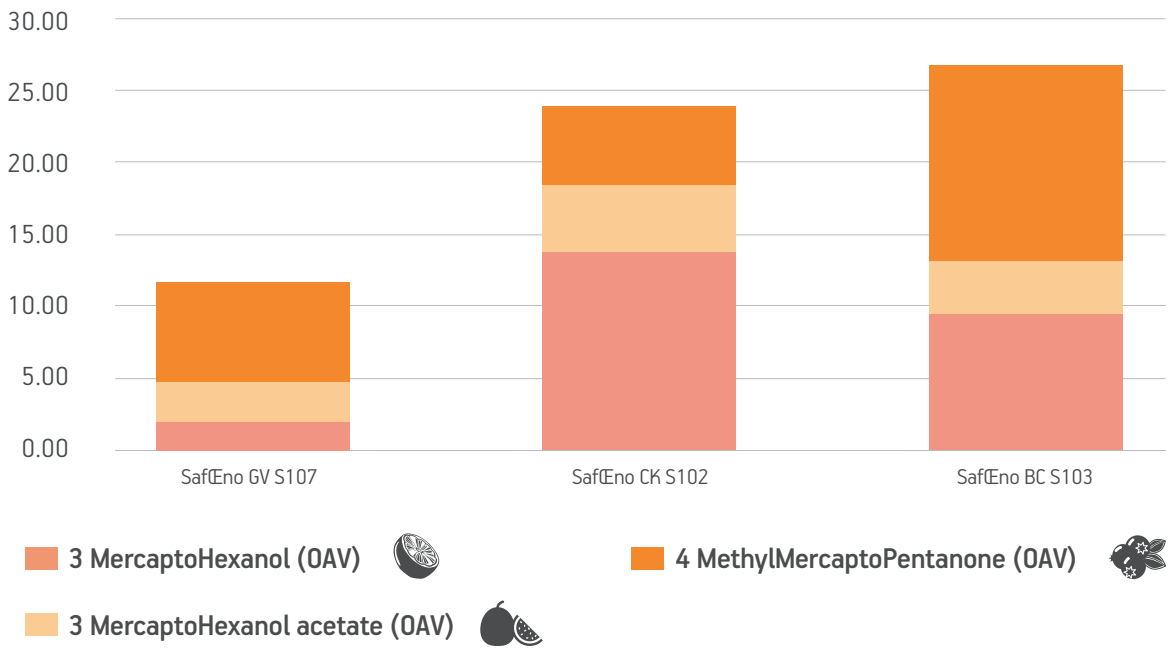


ETHYL ESTERS OAV



VARIETAL AROMAS - POLYFUNCTIONAL THIOLS

VOLATILE THIOLS RELEASES | **HIGHLY NUTRITIVE MUST** | **HIGH THIOL CONCENTRATIONS**



Alvarinho – Portugal 2015

Must parameters

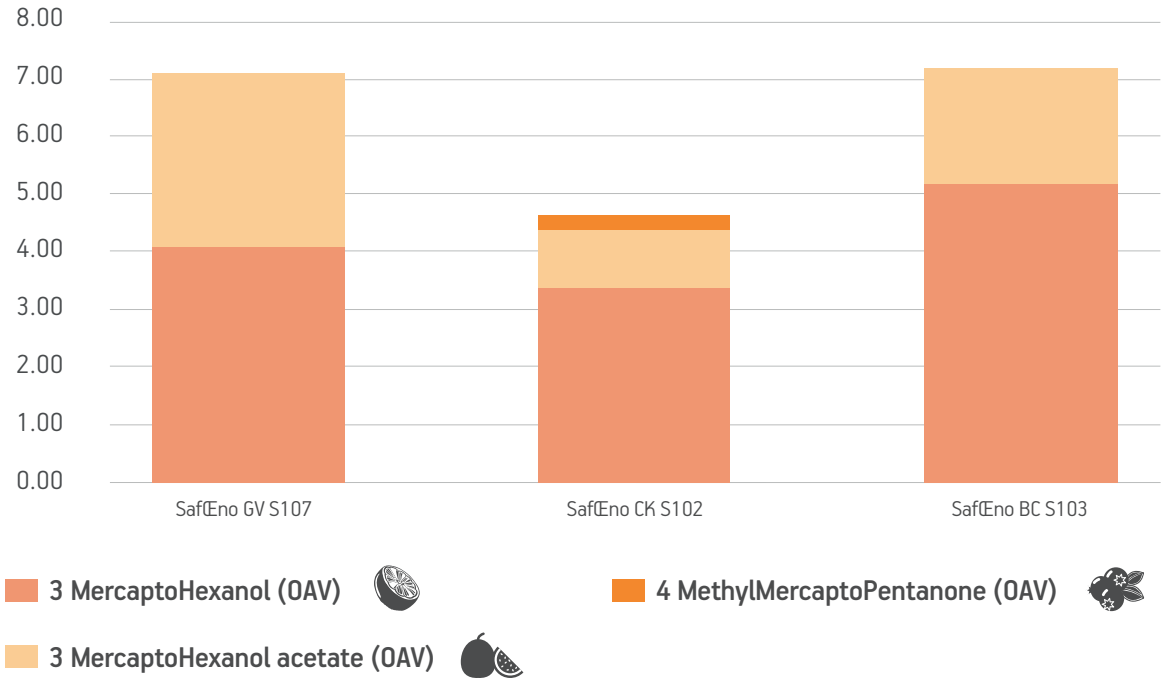
Potential alcohol (% vol.)	12.5
Sugars (g/L)	210
Total acidity (g H_2SO_4/L)	2.8
pH	3.38
Malic acid (g/L)	5.25
Free SO_2 (mg/L)	19
Total SO_2 (mg/L)	69
YAN (mg/L)	279
YAN / S	1.33

Fermentation temperature at 17°C (63°F)

COMMENTS

Depending on the medium and its richness in thiol precursors, the yeasts are releasing more or less volatile thiols. These results show that we can dramatically increase the release of thiols by CK S102 and BC S103 with a more nutritive medium, and that the distribution of these thiols is important: CK S102 releases more 3MH and its

VOLATILE THIOLS RELEASES | **MEDIUM NUTRITIVE MUST** | **LOW THIOL CONCENTRATIONS**



acetate, resulting in fruity thiols, and BC S103 produces a more balanced distribution towards fruity and vegetal thiols. However, CK S102 also produces a lot of isoamyl acetate, a compound that is a flavor enhancer, so it dramatically increases the aromatic perceived notes, making this yeast very suitable for thiol varieties.

Syrah rosé – France 2017

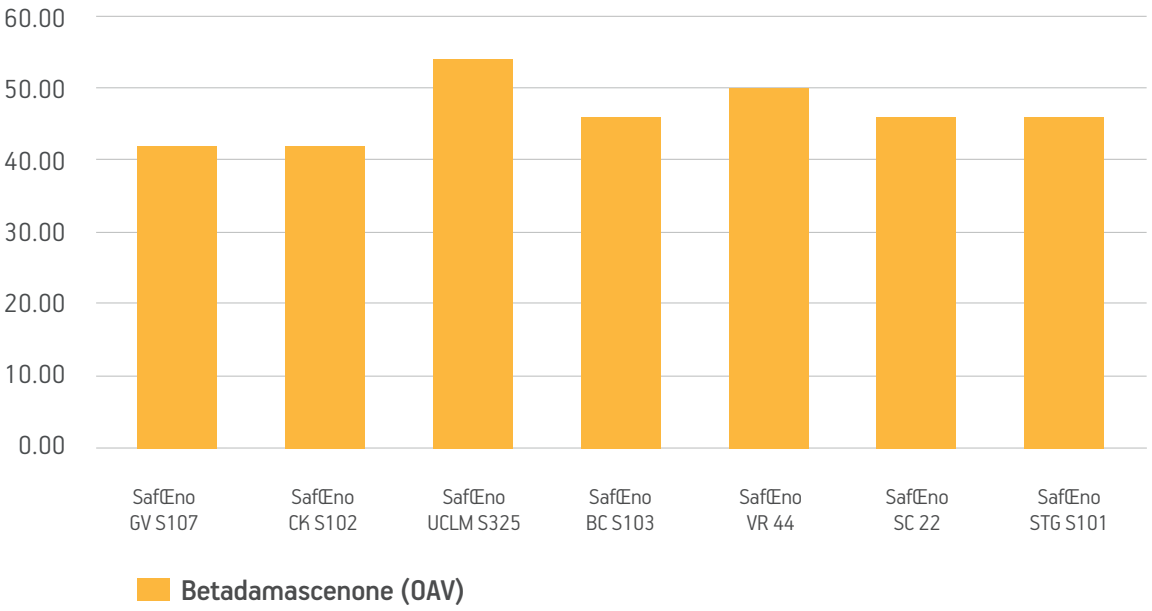
Must parameters

Potential alcohol (% vol.)	11.2
Sugars (g/L)	188
Total acidity (g H_2SO_4/L)	2.87
pH	3.49
Malic acid (g/L)	4.0
Free SO_2 (mg/L)	/
Total SO_2 (mg/L)	40
YAN (mg/L)	166
YAN / S	0.88

Adjusted turbidity 83 NTU
Fermentation temperature at 16-19°C (61-66°F)

VARIETAL AROMAS - C13-NORISOPRENOIDS

BETADAMASCENONE RELEASES



Chardonnay – France 2016

Must parameters

Sugars (g/L)	**207**
pH	**3.45**
Total acidity (g/L)	**3.22**
Malic acid (g/L)	**3.7**
Volatile Acidity (g/L)	**0**
Free SO_2 (mg/L)	**0**
Total SO_2 (mg/L	**24**
YAN (mg/L)	**165**

Initial turbidity adjustment to 150 NTU
5mg/L pulse of oxygen at the maximum speed (S_{max})
Adjustment of YAN to YAN/S= 1 at 35% of the fermentation advancement
Fermentation temperature between 14 and 18°C (57 to 64°F)

COMMENTS

Betadamascenone is a flavor-enhancer at low concentration, but with a relatively low impact from yeast. A small difference in its concentration can lead to a great change in flavor intensity. UCLM S325 is one of our yeasts releasing the most this compound.

VARIETAL AROMAS - TERPENOLS

Muscat – France 2016

Must parameters

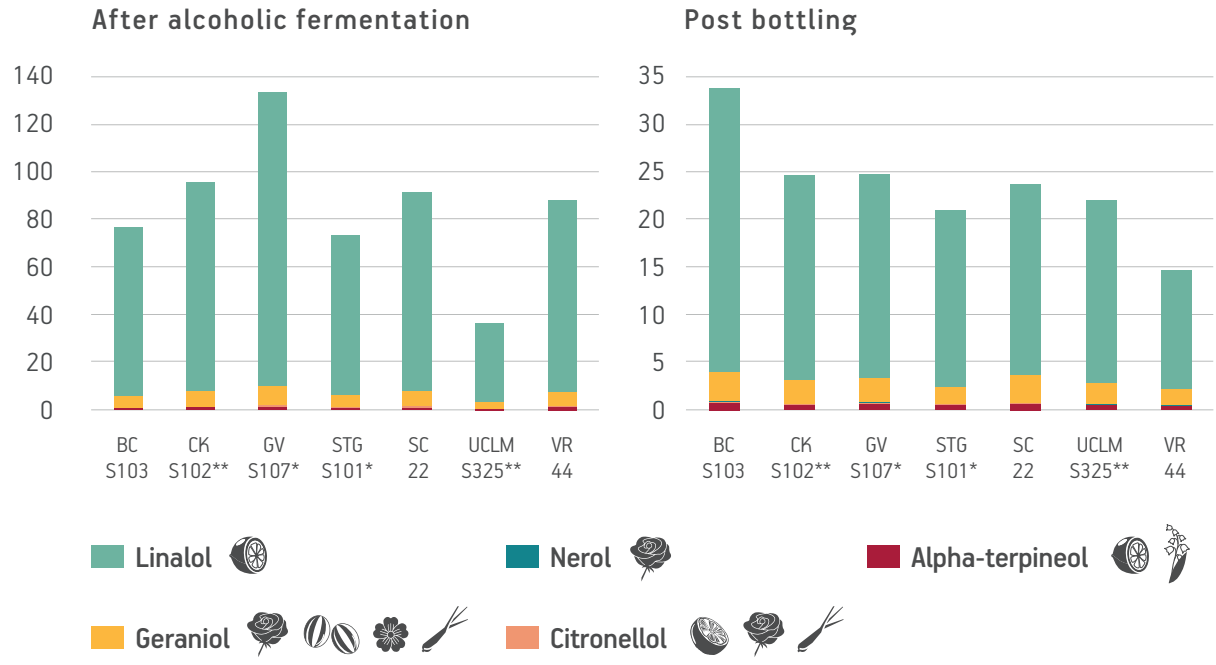
Sugars (g/L)	**188**
Potential alcohol (%vol - base 16.83 g/L per % v/v of ethanol)	**11.2**
Total acidity (g H_2SO_4/L)	**4.3**
pH	**3.17**
Malic acid g/L	**2.2**
Yeast Available Nitrogen mg/L	**82**
YAN / S	**0.43**

Adjustment to 145 ppm YAN initial with DAP (YAN / S=0.77) + 20g/hl of SpringFerm™
Readjusted to *162 ppm (YAN / S=0.85) or **190ppm (YAN / S=1) at 1/3 AF with DAP according to their needs
Fermentation temperature at 17°C (63°F)

COMMENTS

We see that terpenol concentration at the end of the alcoholic fermentation can vary, especially the linalool. However, depending on the yeast and the conditions before bottling, these concentrations can vary a lot because of the sensitivity of these compounds. And even though UCLM S325 is one of our yeast releasing the most the terpens, if the conditions at the beginning are very low in nutrients, it can lead to sluggish fermentation and a dramatic loss of action.

TERPENOLS RELEASES (OAV)



WINE YEASTS
CHARACTERISTICS HIGHLIGHTS

STRUCTURE

Merlot – France 2015

Must parameters

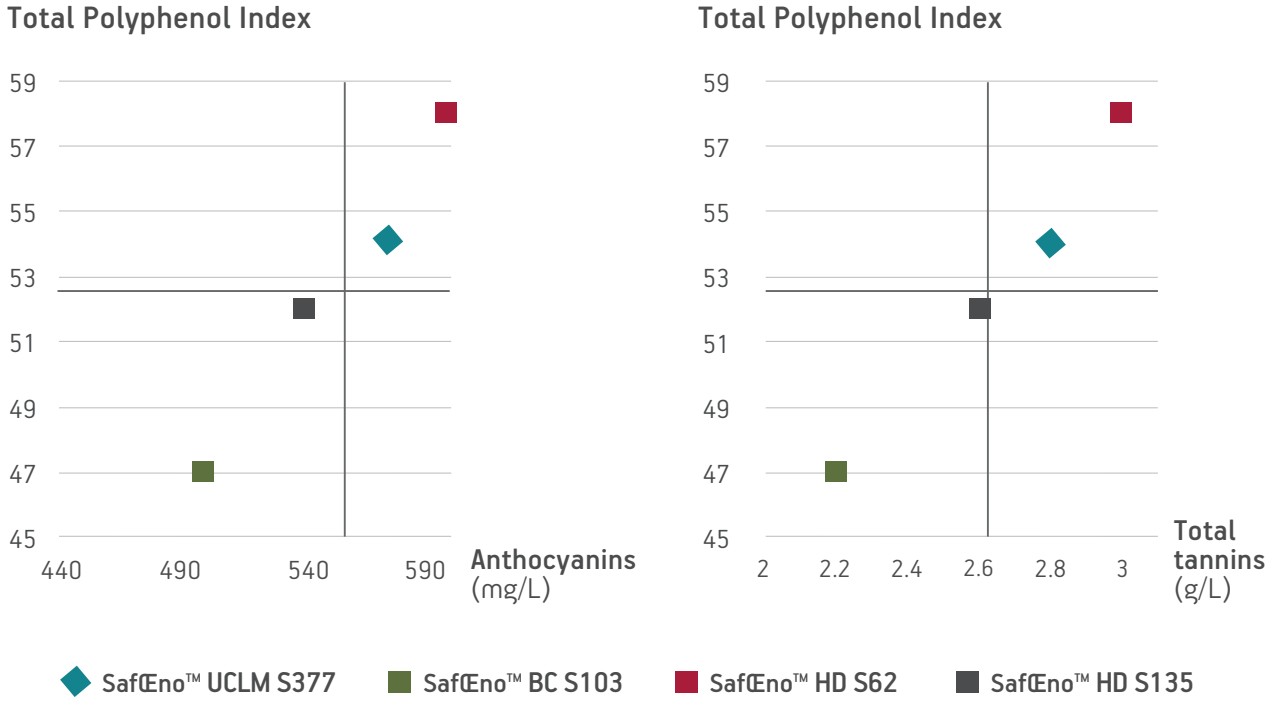
Potential alcohol (% vol.)	12.51
Sugars (g/L)	210
Total acidity (g H_2SO_4 /L)	3.2
pH	3.45
Malic acid (g/L)	2.5
Total SO_2 (mg/L)	62
Free SO_2 (mg/L)	34
YAN (mg/L)	105

Chaptalized to 15% v/v. Adjustment of YAN: DAP/Thiamine first addition to 150ppm then DAP/Thiamine to reach 200ppm (YAN / S= 0.8) at 1/3 of the alcoholic fermentation
Fermentation temperature start 17°C (63°F) then limitation at 24°C (75°F)

COMMENTS

With exactly the same ratio of solid/liquid and the same process of maceration, yeast can play a role on the structure of a wine by mainly two actions. First, its release of polysaccharides during fermentation (especially mannoproteins) can act as colloidal protectors for polyphenols and polyphenol complexes. And second, its cell wall can adsorb polyphenols. HD S62 and HD S135 are yeast hybrids in which we wanted to keep high structure profile while boosting fermentative capabilities.

POLYPHENOL INDEX



WINE YEASTS
CHARACTERISTICS HIGHLIGHTS ORGANOLEPTICS

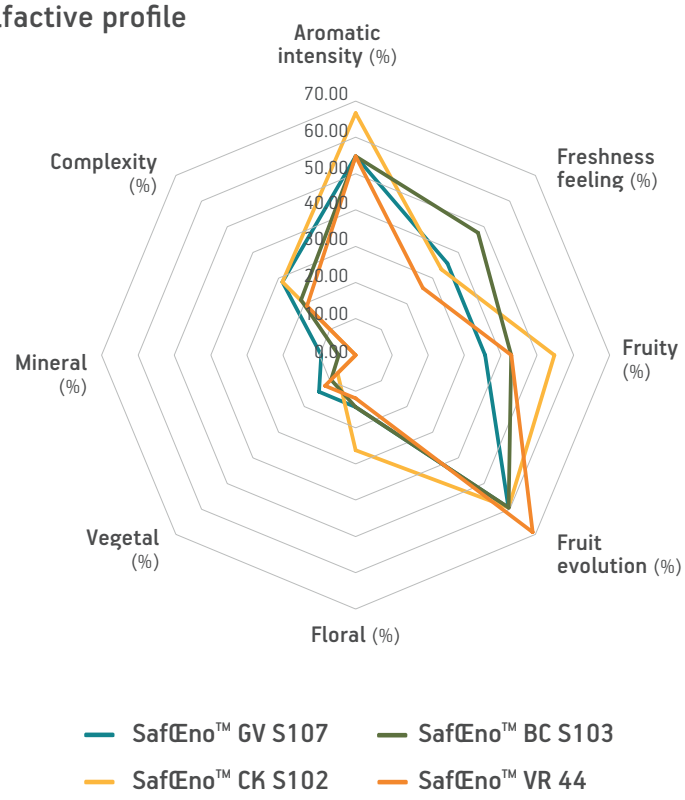
Syrah rosé – France 2017

Must parameters

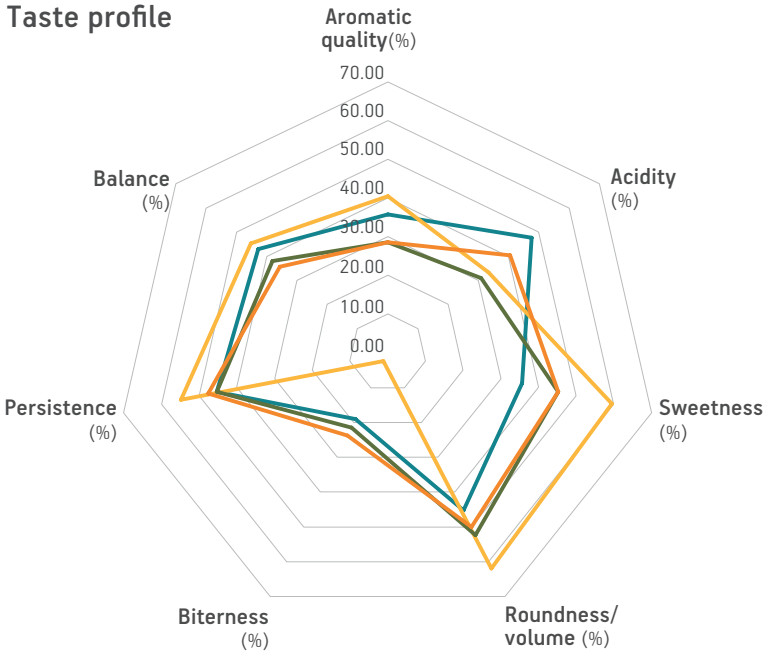
Potential alcohol (% vol.)	11.2
Sugars (g/L)	188
Total acidity (g H_2SO_4/L)	2.87
pH	3.49
Malic acid (g/L)	4.0
Free SO_2 (mg/L)	/
Total SO_2 (mg/L)	40
YAN (mg/L)	166
YAN / S	0.88

Adjusted turbidity 83 NTU
Fermentation temperature at 16-19°C (61-66°F)

Olfactive profile



Taste profile



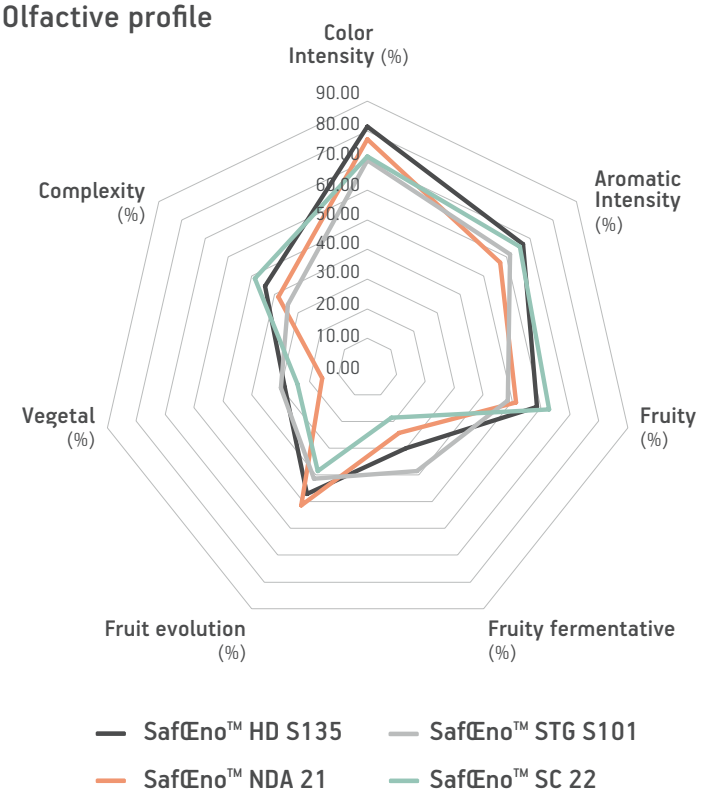
Syrah red – France 2015

Must parameters

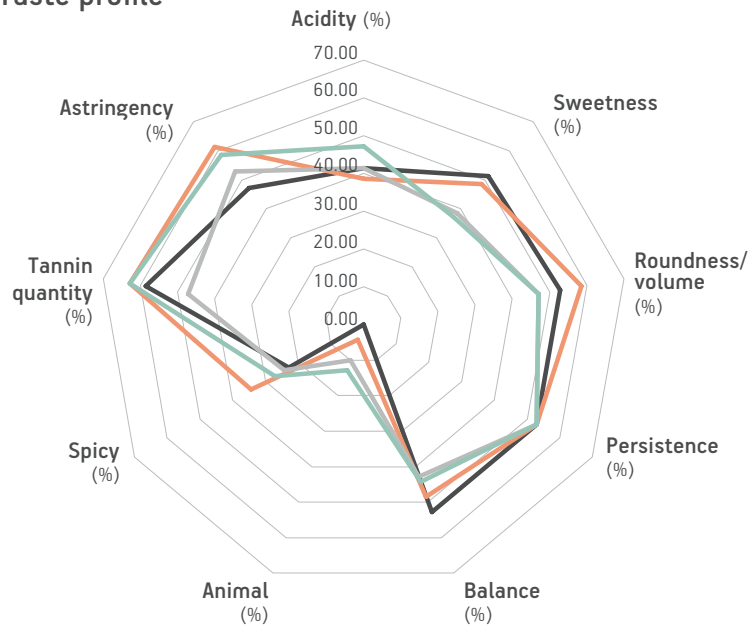
Potential alcohol (% vol.)	14.0
Sugars (g/L)	236
Total acidity (g H_2SO_4/L)	3.05
pH	3.7
Malic acid (g/L)	2.0
YAN (mg/L)	150
YAN / S	0.64

Adjustment to 190 ppm YAN initial with DAP (YAN / S=0.81) at 1/3 AF
Fermentation temperature 20-27°C (68-80.6°F)

Olfactive profile



Taste profile



COMMENTS

Certainly, taste depends primarily on the grapes, their quality and the winemaking process. However, all things being equal, real trends are being influenced by the choice and use of yeast, in regard to the type of aroma they reveal and generate, and to the compounds they release at the end of the fermentation. Examples of these trends are illustrated in the maps.

YEAST DERI-VATIVES

Our range includes two product families: fermentation aids and functional products. As their name indicates, **the first ones improve and accelerate fermentations whilst the second ones help act on clarification, color, organoleptic stability** and so on. Yeast derivatives are highly technical products which often require years of research.

FERMENTATION AIDS - PAGE 84

FUNCTIONAL PRODUCTS - PAGE 112

What is a yeast derivative?

Yeast derivatives are yeast cellular fractions obtained by inactivation of living yeast cells through plasmolysis (heat treatment), autolysis (a yeast's own enzyme action, from "auto" – itself and "lysis" -destruction), hydrolysis (external action of enzymes, water, acids, etc.) or other degradation means.

These fractions or their components can subsequently be isolated and purified.

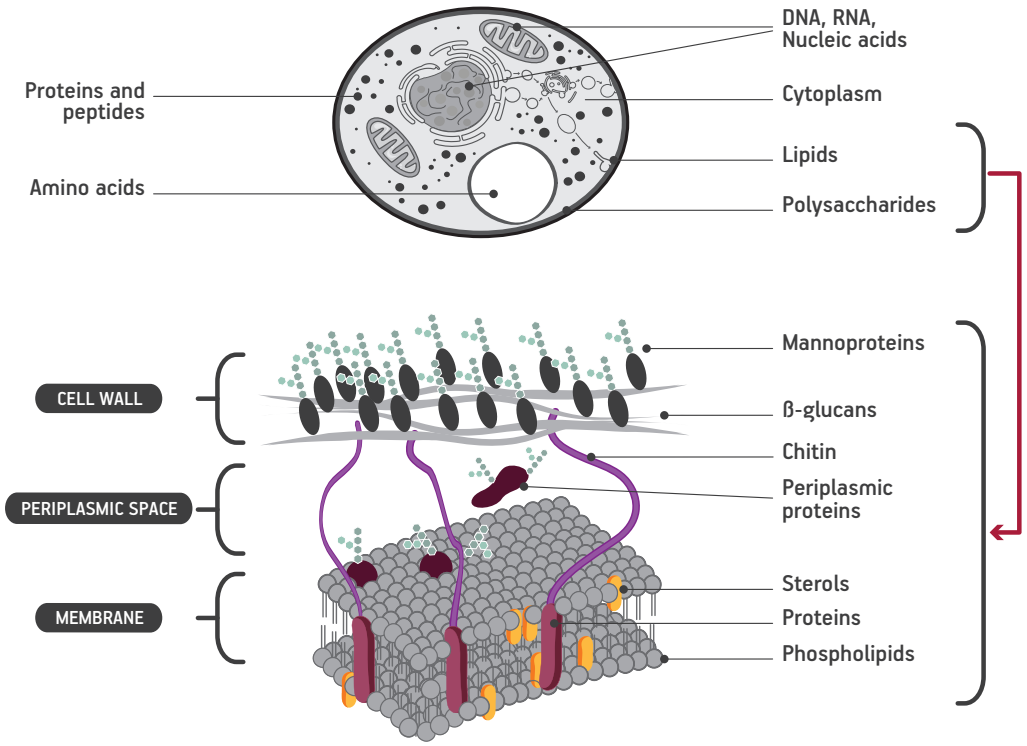
The yeast derivatives family regroups the inactivated (or inert) yeasts, the yeast autolysates, the yeast extracts (100% soluble cellular fraction), and the yeast hulls (almost insoluble fractions).

They are mainly commercialized for their nutritional and aromatic qualities in the Nutrition and Health segments, and as growth factors for micro-organisms.

"YEAST HULL" OR "YEAST CELL WALL"?

When yeast derivatives manufacturers talk about the yeast hull or envelope, they talk about the combination of both yeast membrane and yeast cell wall. The term "yeast well wall" is generally tolerated but is, in fact, a misuse of language!

To understand the potential benefits of yeast derivatives for the wine world, we need to come back to the general composition of a yeast. Even when inactivated, yeast is still a valuable resource, full of compounds beneficial for winemaking applications. The diagram below illustrates most of the molecules of interest for winemakers and their localization inside the yeast.



WHAT'S THE OENOLOGICAL INTEREST?

Depending on the targeted fraction (cytoplasm, yeast membrane, or cell wall) and its degree of degradation, several specific molecules can be generated. Each of them may represent an interest for winemaking purposes.

		MOLECULES	PHYSICO-CHEMICAL EFFECT	OENOLOGICAL INTEREST
CELL WALL	NON-DEGRADED	Glucan networks and other neutral polysaccharides	Adsorption capabilities	**Fermentations, clarity and olfactive profile improvements**
	DEGRADED	• Soluble neutral polysaccharides • Soluble mannoproteins	Tensioactive and colloidal effect	**Roundness, foam and stability improvements**
MEMBRANE	NON-DEGRADED	Double phospholipidic layer	Adsorption capabilities	**Fermentations, clarity and olfactive profile improvements**
	DEGRADED	Unsaturated fatty acids, sterols and soluble lipids	Membrane rigidity and permeability modification	**Alcoholic fermentation improvement**
CYTOPLASM	NON-DEGRADED	Native proteins DNA, RNA	Reactivity with tannins	**Fining and stability Organoleptic profile improvement**
	INTERMEDIATE	Poly/Oligopeptides Poly/Oligonucleotides	Reactivity with tannins	**Fining and stability Organoleptic profile improvement**
	DEGRADED	Free amino acids Free nucleotides, nucleosides	Nutrients, aromatic precursors, redox regulators and taste enhancers	**Fermentations, organoleptic potential and stability improvements**

Yeast derivatives production process

Our process ensures quality and stability.

To manufacture yeast derivatives, the first step always consists of producing active yeast biomass as described in the "Yeast Production Process" section on pages 24-25. But instead of producing a very healthy and viable biomass that could efficiently ferment sugars and resist stress factors, the idea here is to generate yeasts that are easily degraded by external and/or internal means (for example, full of active proteases).

One of the specialties of BioSpringer in France and the Lesaffre Ingredients Services in Poland is that they produce their own active biomass to inactivate afterwards, thus allowing perfect control of each step of the production and ensuring a regular and optimum quality of the initial yeast cream used.

The second step represents the yeast inactivation process. It can be carried out in several ways, two of which are described on the right page: a "classic" one that involves the autolysis of the yeast and a "specific" one that intends to avoid this latter autolysis.

"SPRING" RANGE

The Lesaffre Group has specialized in the production of yeast derivatives since 1959, with its subsidiary BioSpringer, and has acquired unique expertise in this field. As a nod to our history, almost the entire Fermentis yeast derivatives range begins with the prefix "Spring".

YEAST DERIVATIVES PRODUCTION

TWO
DIFFERENT PROCESSES

1. CLASSICAL PROCESS

The initial yeast cream is heated at a light temperature (T_{lp}) to permeabilize the cell membrane and partially inhibit the yeast endo-enzymatic (proteolytic) pool. This is called a "light plasmolysis" and generates dead yeasts classically, named "inactivated" yeasts.

A variant of this process consists in setting up a lower temperature (T_a) at which the cell membrane will also be permeabilized and all the enzymatic activities of the yeast destabilized, with or without a prior light plasmolysis step. At that temperature, the work of the endo-enzymatic pool will now be optimized to favor the yeast self-destruction. In other words, the autolysis leads to its progressive degradation of the intracellular proteins into soluble polypeptides and free amino acids.

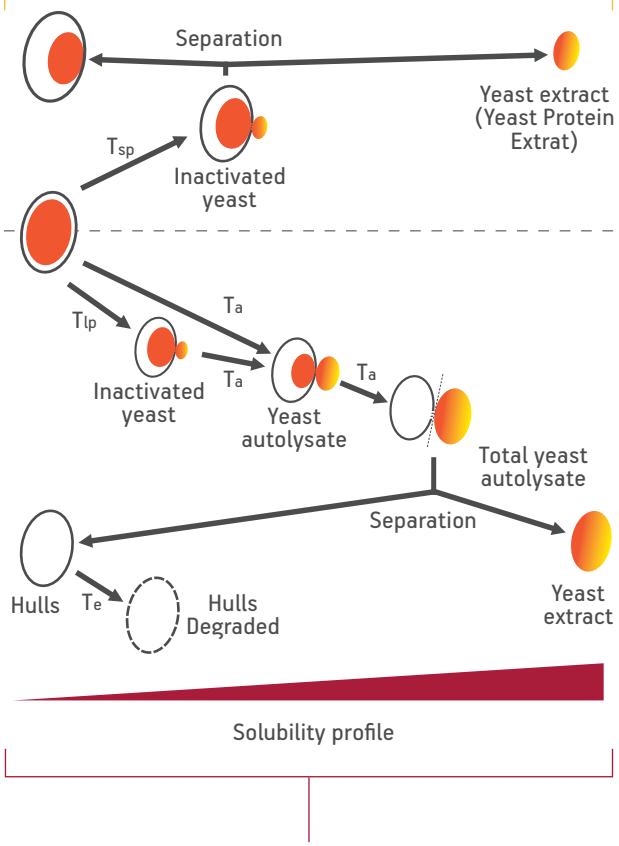
This process generates autolyzed yeast products, partially or totally depending on the duration of the autolysis with an increased nutritive value.

OR

2. SPECIFIC PROCESS

Here, the yeast endo-enzymatic activities are totally inhibited as the initial active yeast cream undergoes a "strong plasmolysis" at a higher temperature (T_{sp}). This generates other types of inactivated yeasts, a bit more soluble than the classical ones, but whose intracellular proteins are of higher molecular weight.

SPECIFIC PROCESS



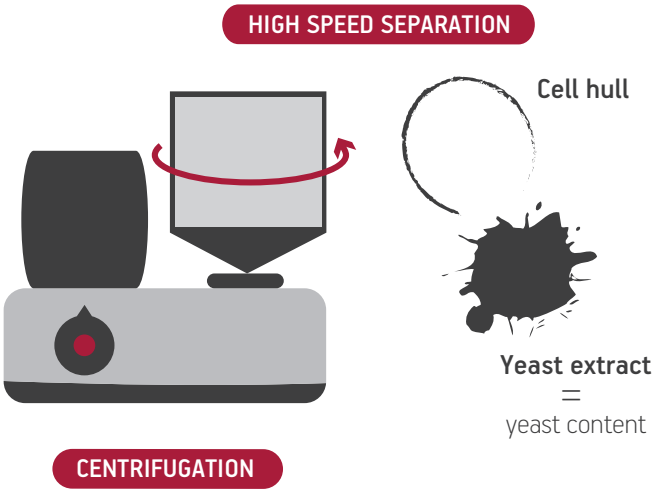
CLASSICAL PROCESS

T: temperature.
sp: strong plasmolysis.
lp: light plasmolysis, a: autolysis, e: extraction).

The orange/yellow part outside the cell schematically represents the intracellular content that is solubilized.

The color is important as the more yellow the content, the more degraded the proteins are inside. Dotted lines schematically represent the effect of a strong degradation process on yeast hulls but or course, doesn't illustrate the microscopical reality.

Whatever the process, in the end, it gives two fractions: an insoluble part, generally called "yeast hull" and a soluble one, generally called "yeast extract". In order to separate both these fractions, a simple centrifugation step may be applied. See next page.



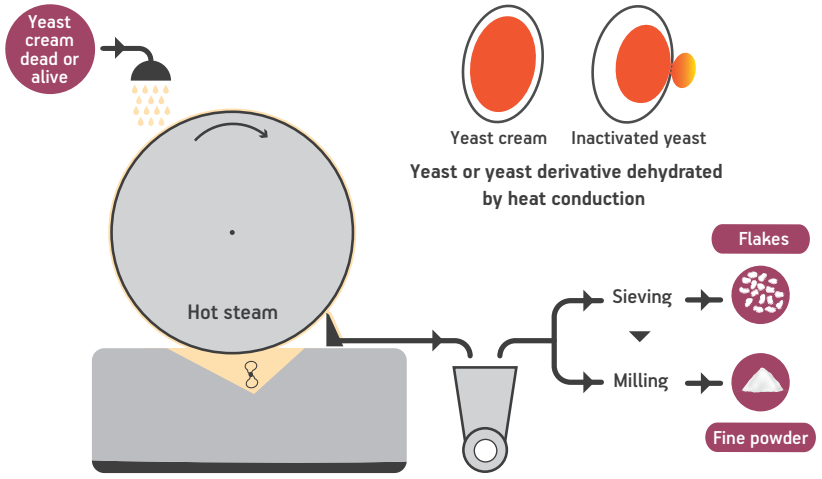
Other treatments are then possible on the remaining fractions. For example, when classic hulls are subjected to a very high temperature (T_e), it solubilizes a part of the cell wall components, particularly the mannoproteins. An enzymatic treatment with beta-glucanase can also achieve such a solubilization, in which it changes the nature and molecular weight distribution profile of these mannoproteins.

All along the production process, the yeast derivatives stay in a liquid form in order to facilitate all treatments, and are then pasteurized to ensure a good microbiological quality and stability. At this time, they can either be concentrated by evaporation to remain in a liquid or paste form, or dried mainly through two different types of equipment explained herebelow.

YEAST DERIVATIVE CREAM CAN BE...

DRUM DRYING

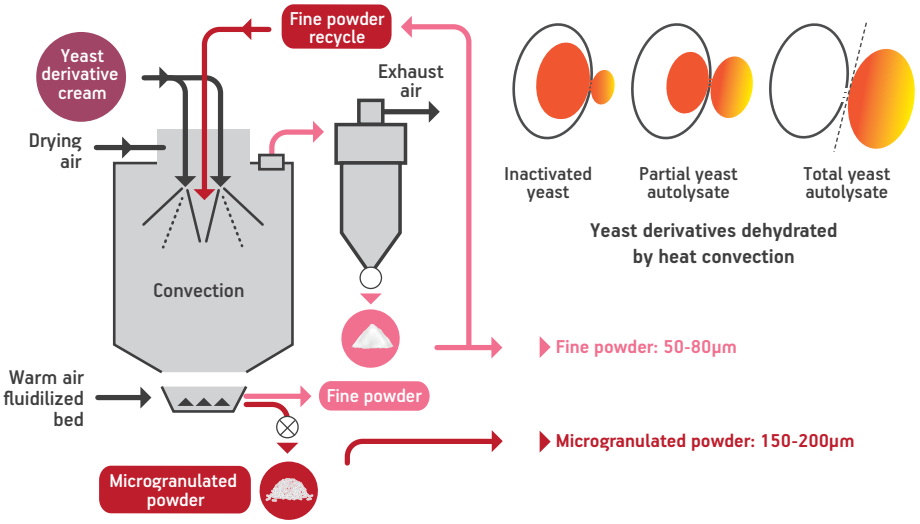
Sprayed on a hot drum, instantaneously dehydrated, and then recovered, sieved, and usually, milled to become a fine powder.



OR

SPRAY DRYING

Injected into a spray-dryer, progressively dehydrated, then recovered into a fine powder.



Derivatives general composition

Each derivative is different, the more you know about their composition, the better you'll use them.

In a general way, the composition of yeast derivatives depends directly on the yeast strain used and its production (allowing, for example, for the accumulation or degradation of specific molecules). It also depends on the inactivation process applied (plasmolysis, autolysis, etc...) and its duration.
If we take into consideration a classic autolysis process, we can describe the following intermediate products and classify them in regard to their solubility (schema p.77) and their components that aid wine fermentation with the schema on the right page.

INACTIVATED YEASTS

The composition of these products is relatively close to active yeast and full of native compounds. Being weakly solubilized, the amount of free amino nitrogen is low and the amount of vitamins, especially B1, quite high, as it has not degraded.

YEAST AUTOLYSATES

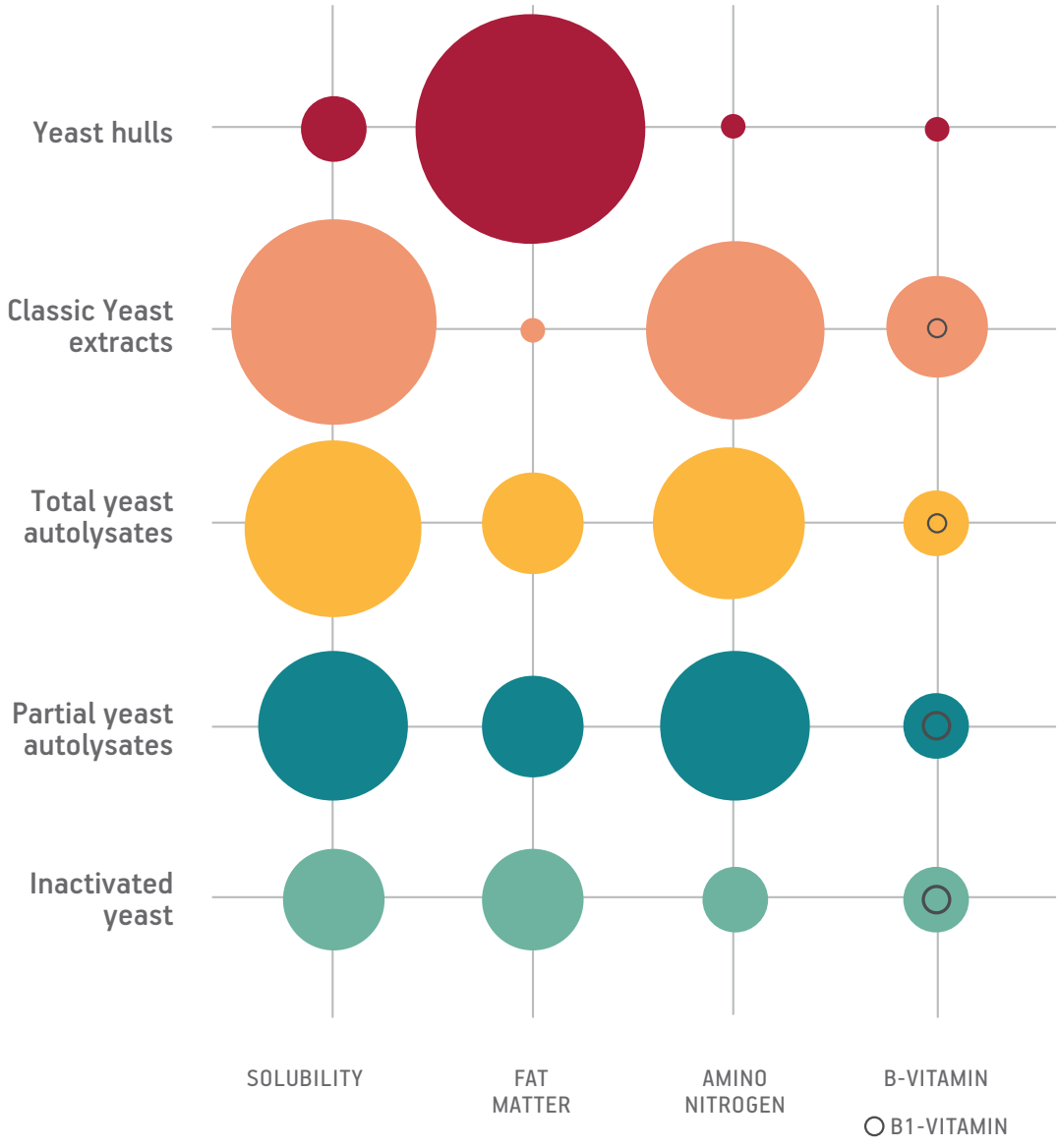
During the autolysis, yeast endo enzymes (mainly proteases) degrade complex molecules present in the cytoplasm (like proteins) into simple entities (such as free amino acids, i.e. available amino nitrogen). The longer the digestion time, the stronger the degradation and subsequent solubilization.

This makes the difference between partial and total yeast autolysates for which almost all the intracellular content is solubilized. However, the fat matter remains the same as these products still globally represent an entire cell with a complete cell hull.

YEAST EXTRACTS AND HULLS

Both of these intermediates are coming from the separation of the soluble (extract) and insoluble (hull) parts of a total yeast autolysate. Obviously, free amino nitrogen and vitamins are concentrated in the 100% soluble yeast extracts, whereas fat matter and polysaccharides are concentrated in the almost insoluble yeast hulls.

GENERAL COMPOSITION



SOLUBILITY: Support element for the fermenting yeast

FAT MATTER: Potential of survival factors for the yeast to resist ethanol during fermentation

AMINO NITROGEN: Available nutrients

B-VITAMIN: Growth factors necessary to many reactions in a yeast cell

E2U™ applied to yeast derivatives

The E2U™ (Easy to Use) concept[1] applied to yeast derivatives essentially validates two aspects of their use: the ease and the safety. Both of these aspects are evaluated through the follow-up of two criteria:

1. PULVERULENCE*
2. DISPERSIBILITY

As long as they are pumpable, liquid products are easy to implement during wine production. On the other hand, the implementation of products in powder form (most prevalent in the market) is more delicate and riskier. Powders may show pulverulent/dusty properties.

The pulverulence is characterized by the ability of fine particles to stay suspended in the air and as such, can also constitute a health risk through inhalation. This could happen when fine particles are released from a sachet when it is opened, especially when opened quickly or vigorously). Dispersibility which is the ability of a powder to spread homogenously into a liquid, is also a concern when using dry product because lumps may be created on the liquid surface, which could hinder/delay the yeast's beneficial effect.

This is why the Fermentis research department pursued the concept called E2U™, a powder characterized by low pulverulence and high dispersibility.

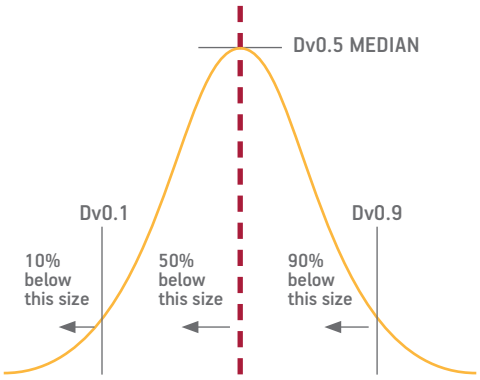
DISPERSIBILITY *VS* DISSOLUTION

Yeast derivatives powders are "dispersed" and not "dissolved," as most of the time we are considering insoluble products!

1. THE PULVERULENCE

The pulverulence of a powder is defined by:

- The median diameter of a particle in the distribution
- The span (= (Dv0.9 – Dv0.1)/Dv0.5) of this distribution (see schema herebelow)
- The minimum speed of an air flow applied into a specific glass cylinder from bottom upwards required to provoke the suspension of the whole powder



A non-pulverulent powder must meet the three following specifications:

- Median diameter > 100 µm
- Span < 1.5
- Minimum air flow speed > 6 mm/s

2. DISPERSIBILITY

A powder is considered dispersible when it takes less than three minutes to disperse in the total liquid volume under a moderate stirring.

[1] See page 14 (the E2U™ concept) and page 26 (the E2U™ concept applied to active dry yeasts).

* Dustiness.

Yeast derivatives quality control

As well as for our active dry yeasts, Fermentis requires positive results before release.
After production, the batches are retained until all quality control results are obtained. If all results are good, the batch is released.
When adding at rate of 20g/hl, contaminations are lower than 1 contaminating cell*/ml**.

All of our products comply with the International Oenological Codex according to the following resolutions:

- OIV-OENO 496-2013: Yeast Autolysates
- OIV-OENO 459-2013: Inactivated Yeasts
- OIV-OENO 497-2013: Cellular Yeast Hulls
- OIV-OENO 452-2012: Yeast Protein Extracts
- OIV-OENO 26-2004: Yeast Mannoproteins
- OIV-OENO 603-2018: Inactivated Yeasts with Guaranteed Glutathione Levels.

Until its "Best Before" end date in the storage conditions when stored in the conditions recommended in our spec sheets.

All quality and regulatory aspects related to our range of yeast derivatives, such as allergen declaration, food grade, non-GMO, heavy metals etc., are listed in a document named "Masterfile" or "Product data file" in US.

Likewise, all of our manufacturing plants are certified according to international quality standards (as ISO or BRC).

Finally, Fermentis is part of OENOPPIA (Oenological Products and Practices International Association - http://www.oenoppia.com) and as such, is contributes to the evolution of the quality standards regarding oenological products.

We comply with the guidelines made in partnership with FIVS (Fédération Internationale des Vins et Spiritueux – www.fivs.org) concerning the information that should routinely be made available when oenological products are purchased by wine producers, which are downloadable on FIVS website.

For the US, all products recommended by Fermentis are fully authorized per TTB 27 CFR 24.246 prior to and during fermentation. Dosage limits may apply. Information contained in this catalogue is considered accurate to the best of our knowledge at the time of revision. Please contact your product specialist for more information.

All quality and regulatory documents are available upon request to Fermentis or your Fermentis distributor.

* Contaminating cell: Lactobacillus spp., *Acetobacter spp.*, yeast and moulds.

** Meaning that contaminating cell concentration is lower than 103 cfu/g.

YEAST DERI-VATIVES

FERMENTATION AIDS

FUNCTIONAL PRODUCTS

The types of nutrients and inhibitors for yeast

MACRO AND MICRO NUTRIENTS RELATED EFFECTS			
TYPE	**CATEGORY**	**NATURE**	**EFFECTS**
Macronutrients (Cell material renewal)	Carbon	Glu/Fru, Sucrose	**Energy sources (glycolytic pathway)**
	Nitrogen	Amino acids, ammonia, nucleotides, peptides	**Protein synthesis: Production of biomass, Fermentation rate-time-flavors**
	Phosphate* / Sulfur	Inorganic and organic P/S compounds	**Cell growth (biomass) fermentation rate** **S-volatiles flavors**
	Survival factors	Oxygen Fatty acids Sterols (ergosterols)	**Yeast growth: Energy, fermentation rate** **Glycogen and threalose (stress protecting factors) high content maintaining** **Stimulate lipid biosynthesis Strengthen yeast membrane (integrity, permeability) viability** **Decrease production of toxic medium chain fatty acids**
Micronutrients (necessary for reactions within the cell)	Vitamins*	Most important: Biotin, Thiamine, Pantothenate	**Growth factors, Co-factors in enzymatic conversions**
	Minerals*	Most important: Mg, K, Mn, Zn, Fe, Cu	**Co-factors for glycolytic and other enzymatic reactions**

FAN *VS.* YAN

Be careful not to confuse free amino nitrogen (only the organic part of the YAN) with yeast available nitrogen (YAN)! That's why we always refer to YAN – it is less confusing.

INTERESTED IN USING YEAST PRODUCED BY LESAFFRE?

During the growth of yeast, the budding process divides the lipid pool to create the new generation. Under full aerobiosis, like in our manufacturing processes, the synthesis of lipids is at its maximum, ensuring the quality of newly generated yeasts. This is not the same when yeasts are propagated in must in which oxygen is a limiting factor. That's why a minimum dosage of yeast is always required to provide a sufficient population of highly resistant yeast to start the fermentation.

It is beneficial to select a yeast with specific impacts on the aromatic profile of your wine only if you allow this yeast to work in favorable conditions so that it will express its potential. All winemakers should understand what the fundamental needs for a yeast are to grow and ferment properly, and should be able to identify conditions and substances that can prevent them from doing a good job.
A summary of yeast needs is listed in the table on the left page.

Knowing the differences in available nitrogen and oxygen demands (survival factors) accounts for most of the variance between yeast strains. Let's focus on the two main types of macronutrients that may be deficient in grapes' musts, and that winemakers can address.

FOCUS ON NITROGEN

Yeast is able to assimilate different nitrogen sources and uses for its metabolism, i.e. mainly for its growth and fermentative power. These nitrogen sources represent what we call YAN or Yeast Assimilable/ Available Nitrogen.

The YAN is composed of:

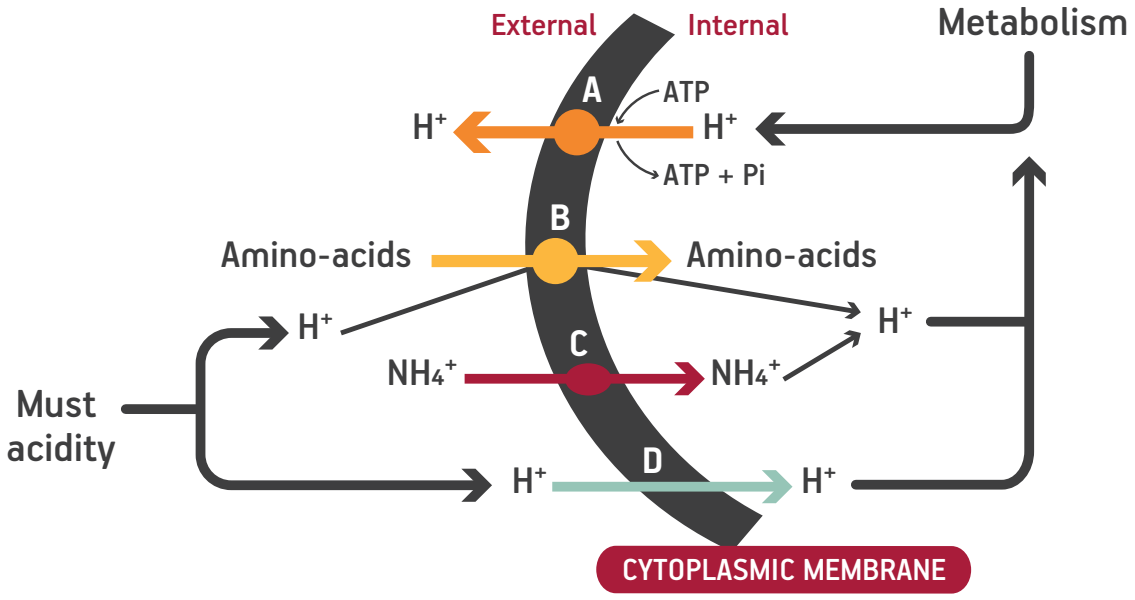
- **Primary or alpha amino acids** *(without proline, as it needs oxygen for uptake and so, it is not assimilated during fermentation),* also referred to as FAN (Free Amino Nitrogen) or organic-available nitrogen. This is the most prevalent form in must, comprising up to 90% of YAN. Amino acids will be incorporated as it is in the proteins. This process requires rather low energy for the yeast, and thus can be done under anaerobic/fermentative conditions. They can also be transformed into different amino acids or broken down as a source of nitrogen or sulfur when ammonia nitrogen source is limiting.
- **Ammonium ions,** also referred to as mineral-available nitrogen, can represent up to 30% of YAN in the must. Ammonium ions will mostly be converted by the yeast into needed amino acids. What requires quite a bit of energy, thus best performed when the yeast is growing under aerobic conditions, i.e. at the beginning of the fermentation.

The yeast membrane is not freely permeable to nitrogen compounds, therefore both sources must first be transported into the cell. Ammonium ions are the preferred source, as they can be easily taken up, whereas amino acids need symporters (specific permeases) or adapted uptake systems under stressful conditions.
Therefore, a supply too high in ammonium ions can be detrimental for amino acid uptakes.

Assimilation of both sources lead to a proton uptake by the yeast. This proton must then be released by the yeast to maintain an optimum internal pH, and that requires energy. When the ethanol concentration increases along the fermentation, this permeabilizes more and more of the membrane and favors simple proton uptake by the yeast, which leads to the progressive shutdown of amino acid uptake as the yeast focuses on its survival.

Yeast needs nitrogen for its growth and fermentative power.

Minimum YAN for a correct fermentation is considered to be about 140-150 mg N/L (ppm). However, this number does not take into account the more or less stressful conditions that can be applied to the yeast during fermentation, nor its specific needs. We thus consider a more accurate number expressed by the ratio YAN (mg/L)/S: Initial sugars (g/L) to express yeast needs. An average ratio for wine yeast is 0.8.



Source : *Salmon (1998).*

FOCUS ON OXYGEN

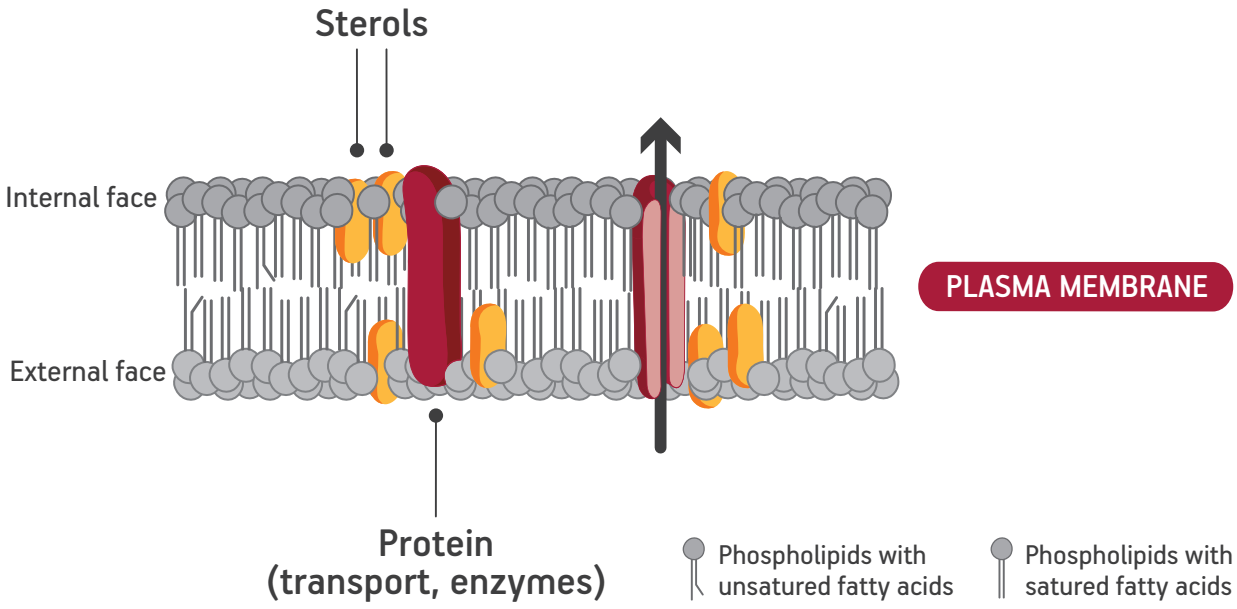
In a general way, oxygen is essential for the respiratory metabolism of yeast, and so its growth. The first steps of glucose and fructose usage are on the glycolysis pathway. Then the pyruvic acid is decarboxylated and undergoes the Krebs cycle. This latter step provides all the necessary molecules for biosynthesis reactions as the alpha keto glutarate is the precursor of amino acid synthesis, and the acetyl group opens the lipid, fatty acids and sterols synthesis.

At the beginning of the winemaking process, both respiration and fermentation metabolisms are expressed by yeast. This is what we call the respiro-fermentative period, when biomass and ethanol are produced at the same time. In grape must conditions, yeasts indeed undergo the "Crabtree" effect due to the high content in sugars that partly represses its oxidative metabolism (respiratory metabolism) and ethanol is produced. Paradoxically, oxygen even activates the fermentative metabolism of the yeast. In that case, oxygen doesn't play its role of electron acceptor brought buy the respiratory chain, but is involved in sterol and long-chain unsaturated fatty acids that are components of the membrane. Sterols are especially present at the membrane protein sites (enzymes, transporters) to maintain transport activities.

When the ethanol concentration increases during fermentation, it replaces water molecules linked to membrane phospholipids, which alters the fluidity of the membrane and its capacity to transport sugar and amino acid.
Moreover, without oxygen, cells are synthetizing saturated fatty acids, having an inhibitory effect on transport activity while accumulating at the level of the yeast cell wall. This synthesis can also be stopped, leading to the presence of particularly toxic, medium-chain, saturated fatty acids, that will disturb the membrane fluidity.

That is why oxygen addition is crucial to maintain yeast viability lead the fermentation to the end and why sterols and fatty acids are considered as "oxygen substitutes." All these oxygen-related compounds are named "survival factors".

Finally, it is proven that yeast hulls can act both ways towards oxygen-related species by adsorbing medium-chain, saturated fatty acids when they are intact, thus "detoxifying" the fermentation medium. Their capacity to release some unsaturated fatty acids and sterols when they are more or less degraded also improves active yeast membrane resistance towards ethanol toxicity.



Source : *Salmon (2008).*

How to use a fermentation aid?

CONCEPT OF FERMENTATIVE POWER

Among the fundamental needs of yeast for its growth and survival, it is interesting to note that most can be supplied naturally through yeast derivatives, i.e. unsaturated lipids and sterols, vitamins, minerals and available amino nitrogen. This is actually the idea behind using yeast derivatives as fermentation aids: what is good for the yeast is found inside the yeast!

The diversity and complementarity of nutrients offered by yeast derivatives cannot reduce them as just simple sources of YAN. That is why **we prefer talking about the "fermentative power" of a nutrient** as it relates to its effect on fermentation speed boost and to the resulting decrease in fermentation time and/or completion of the fermentation.

This fermentative power is based on its YAN, but also on its content in support/insoluble elements, survival factors, and other nutritive elements like vitamins and minerals, as well as on its physical form.

As with turbidity, YAN is the simplest and the fastest way to express the nutrient deficiency of a must, so we choose to express the fermentative power of our nutrients in terms of "YAN equivalent" figures, allowing winemakers to calculate and tune their supplies according to must initial YAN.

Yeast derivatives are not only a source of YAN...

You will find the fermentative power of our fermentation aids in the Protocols section of this catalogue, on page 150.

DIAMMONIUM PHOSPHATE OR AMMONIUM SULPHATE?

The value of these nutrients relies on their ammonium ion content, which we call the "mineral available nitrogen" for the yeast. Based on their chemical formula, DAP and AS provide exactly the same amount of mineral nitrogen, which is quite easy to remember. However, the counterpart of these nutrients can be critical depending on the selected yeast. Phosphate and sulphate are indeed used by yeast for their growth and the generation of specifc amino acids, but sulphate can be assimilated by certain strains to overproduce sulphites during fermentation.
For example, we discovered in an experiment that our SafŒno™ CK S102 had the ability to consume half of the must sulphate during fermentation and produce twice as many sulphites as our SafŒno™ BC S103, which does not consume sulphates.

FERMENTATION MANAGEMENT

While using fermentation aids, the winemaker's main objective is to ensure an efficient alcoholic fermentation to get the best from the selected yeast characteristics and capex. For this purpose, it is crucial to identify the needs of the yeast first, according to the initial characteristics of the must, then to add the right quantity of the right nutrient at the right time. This is fermentation management.

Fermentation is generally followed up by winemakers with density measurements. However, the density curve doesn't give much information about the four different phases passed by the yeast during the fermentation:

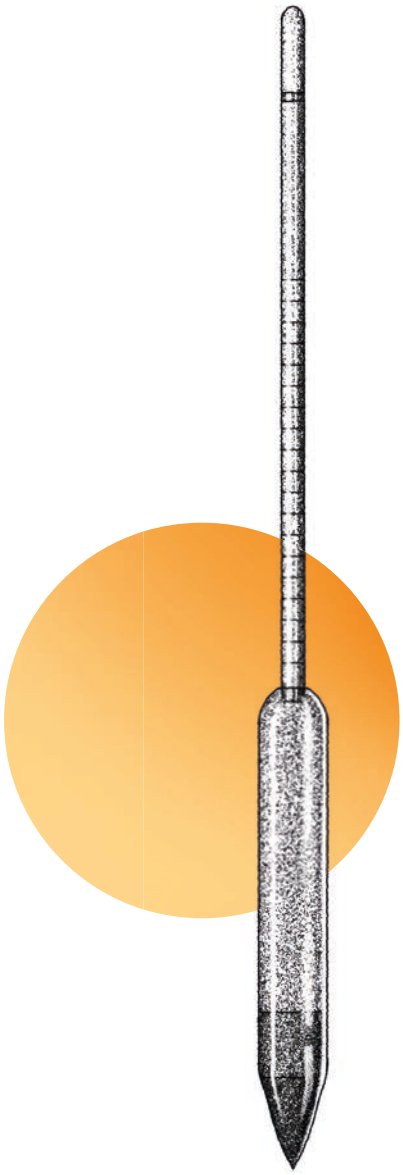
- **the adaptation or lag phase** in which the yeast adapts to its environment,
- **the growth phase,** in which the yeast multiplies itself to reach its final population while consuming most dissolved oxygen and available nitrogen sources (5-6 generations),
- **the stationary phase,** in which the yeast population doesn't grow anymore and survives only to ferment; and finally,
- **the mortality phase,** when the ethanol toxicity is too high and the sugar content too low to maintain a good viability of the yeast.

Plotting the fermentation speed, i.e. the derivative of the concentration of CO_2 released function of the time, distinctly shows these four phases, especially the moment when the yeast population reaches its final population, corresponding to the maximum fermentation speed (S_{max}).

THREE KEY MOMENTS

1. YEAST INOCULATION
2. MAXIMUM SPEED OF FERMENTATION
3. THIRD OF FERMENTATION (in sugar consumed)

See next page



M1 MOMENT 1 : YEAST INOCULATION

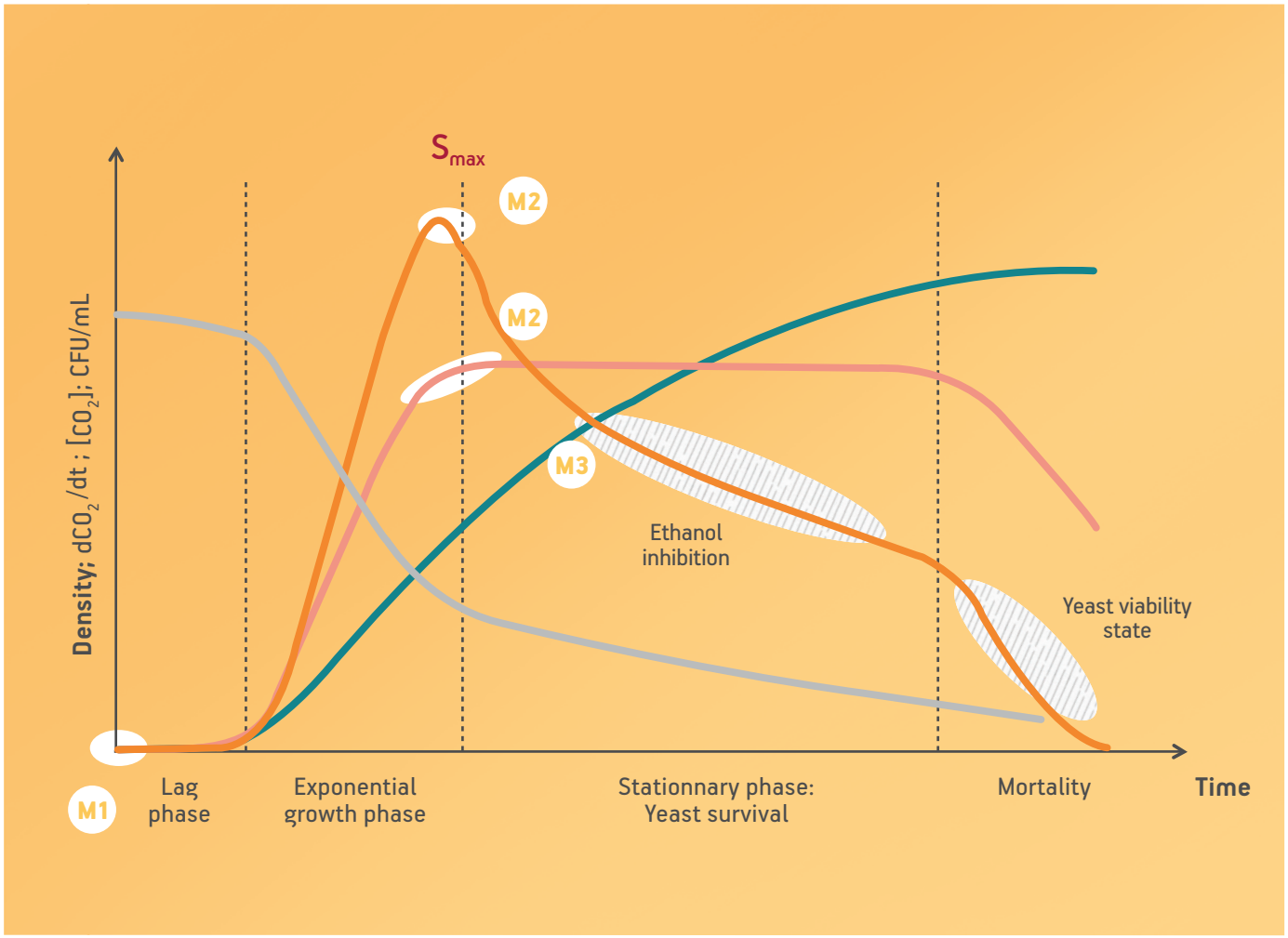
At this time, the goal of any nutrient addition will be to correct all initial deficiencies to build a numerous and healthy yeast population. Several cases can occur:

- **No initial deficiency:** no nutrient addition needed.
- **YAN deficiency:** a must is generally composed of 1/3 mineral available nitrogen and 2/3 organic available nitrogen, and knowing that mineral nitrogen is better assimilated and used when yeast has energy (i.e. when O_2 is available), we suggest you supply mineral nitrogen in the form of diammonium phosphate (DAP) in order to avoid possible deviations due to sulphate supply.
- **Turbidity deficiency:** a too strong clarification can lead to a lack of:
  - insoluble elements that can physically support the yeast and represent CO_2 nucleation sites to help the yeast ferment better with less toxic dissolved CO_2 concentration;
  - lipids like ergosterols and phytosterols coming from grapes and helping improve yeast membrane resistance, and thus activity;
  - vitamins and minerals favoring a good yeast growth and metabolism

In that case, we suggest adding rather low to partially autolyzed yeast derivative supplies (SpringArom™, SpringFerm™), full of nutrients and weakly solubilized.

M2 MOMENT 2 : MAXIMUM SPEED OF FERMENTATION

At this time, an oxygen supply will help build a strong, viable yeast population, whatever the must conditions. 10mg/L is ideally recommended via microoxygenation or pumping over with aeration.



Source: *Blateyron and Sablayrolles (2001).*

From this curve, we can identify three moments that are crucial in terms of fermentation management.

M3

MOMENT 3 : THIRD OF FERMENTATION (in sugar consumed)

Around ~35g/L of CO_2 released (1/3-1/2 of the alcoholic fermentation: initial density – 40 points): At this time, as there is no dissolved oxygen nor available nitrogen sources in the must, yeasts need directly available nutrients and the cleanest environment in regard to toxic substances. This ensures its most efficient fermentative metabolism. That's why we suggest using both:

- partially to highly autolyzed yeast derivatives (SpringFerm™, SpringFerm™ Xtrem, ViniLiquid™), full of readily assimilable nutrients that are highly solubilized, and/or
- yeast hulls (SpringCell™), the most insoluble and adsorbing yeast fraction to help CO_2 nucleation and medium chain saturated fatty acids removal.

OUR FER-MEN-TATION AIDS

AT EVERY STEP

Depending on your requirements, you can choose between six fermentation aids. Created to answer all your needs, from detoxifying your must to improving yeast survival rate, our products will help you handle each and every step of fermentation with ease.

6 FERMENTATION AIDS

to secure your fermentation and increase yield

SpringFerm™

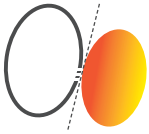
MULTI-PURPOSE FERMENTATION BOOSTER

Partial yeast autolysate

SpringFerm™ Xtrem

POWERFUL FERMENTATION ACTIVATOR FOR DIFFICULT CONDITIONS

Total yeast autolysate



SpringFerm™ Equilibre/Complete*

THE HEALTH PACKAGE FOR YOUR YEAST

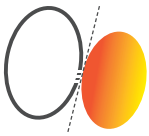
Classic yeast hull, diammonium phosphate, yeast autolysates, thimaine hydrochloride

MIX

Viniliquid™

INNOVATIVE LIQUID FERMENTATION AID COMBINING EFFICIENCY, EASE AND SECURITY

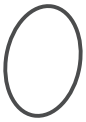
Total yeast autolysate



SpringCell™

THE SOLUTION FOR STUCK FERMENTATIONS

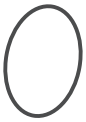
Cellular yeast hulls



SpringCell™ BIO

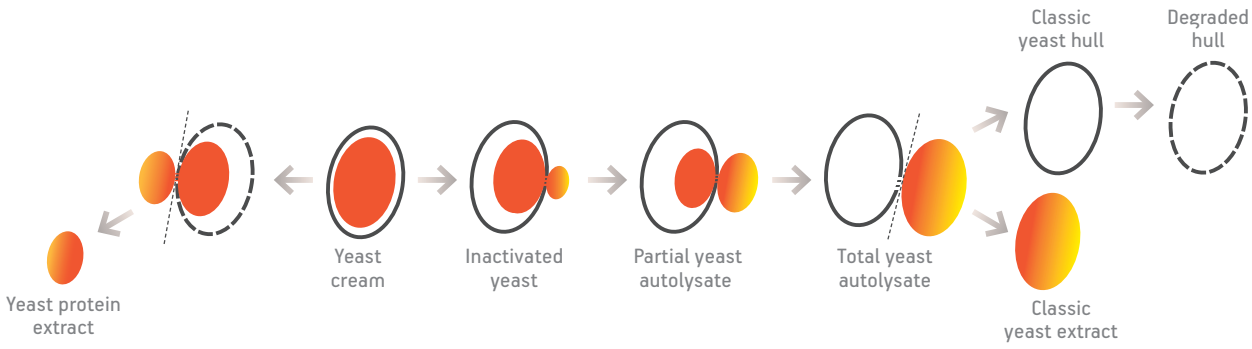
THE ORGANIC SOLUTION FOR SLUGGISH AND STUCK FERMENTATIONS

Cellular yeast hulls



* SpringFerm™ Complete for Northern American market.

GENERAL SCHEME OF YEAST DERIVATIVES PRODUCTION

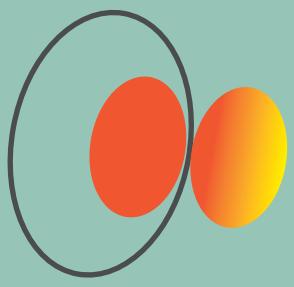


As a reminder, each derivative is mainly composed by a specific part of the yeast. We isolate these parts with a process summarized hereabove and explained in details page 77. You can also find the general composition of each yeast part page 81.

FERMENTATION AID

MULTI-PURPOSE FERMENTATION BOOSTER

SpringFerm™



Partial yeast autolysate

Balanced source of organic available nitrogen (free amino acids), vitamins (especially B1) as growth factors, lipids as survival factors, oligoelements (minerals) and support elements (insoluble component). Helps favoring the growth and the fermentative metabolism of the yeast to avoid sluggish fermentations, favor yeast aromatic expression and prevent off flavors (like H2S).

BEST SUITED FOR

All types of musts slightly deficient in YAN and/or strongly clarified before fermentation. As a securing agent whatever the fermentation conditions, especially for low intrants organic wines.

DOSAGE

20g/hl of SpringFerm™ for an equivalent supply of 10 ppm of Yeast Available Nitrogen.

MOMENT OF ADDITION

At third-mid fermentation in case of slightly YAN deficient must.

At yeast inoculation in case of strongly clarified musts and renewed if needed at third-mid fermentation.

SOLUBILITY	FAT MATTER	AMINO NITROGEN	B-VITAMIN
			

Fermentis by Lesaffre

FERMENTATION AID

POWERFUL FERMENTATION ACTIVATOR FOR DIFFICULT CONDITIONS

E2U EASY TO USE by Fermentis

SpringFerm™ Xtrem

BEST SUITED FOR

Highly YAN deficient musts coming from overripe grapes, organic vineyards, etc... Wines undergoing malolactic fermentations. As a complement for stuck fermentation restart and yeast propagation aid.

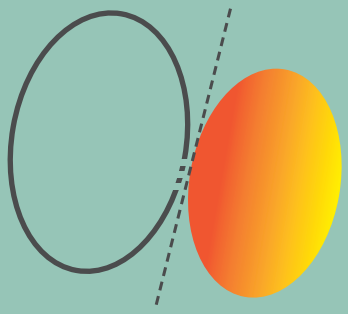
DOSAGE

20g/hl of SpringFerm™ Xtrem for an equivalent supply of 20 ppm of Yeast Available Nitrogen.

MOMENT OF ADDITION

At third-mid fermentation in case of highly YAN deficient must.

At lactic bacteria inoculation to initiate malolactic fermentation.



Total yeast autolysate

Source of highly available organic nitrogen (free amino acids for yeasts and small peptides for lactic bacteria) as well as vitamins from B group. Strengthens yeast fermentative metabolism in difficult conditions to secure fermentations and ensure optimum aromatic expression.

SOLUBILITY	FAT MATTER	AMINO NITROGEN	B-VITAMIN

FERMENTATION AID

THE HEALTH PACKAGE FOR YOUR YEAST

SpringFerm™ Equilibre/Complete

MIX

Classic yeast hull, diammonium phosphate, yeast autolysates, thimaine hydrochloride

All in one nutritive source based on strong B1 vitamin supplementation, high ammoniacal nitrogen availability (DAP) and great detoxification power. Use the synergy between mineral and organic nitrogen for fermentation improvement.

BEST SUITED FOR

Musts or wine highly deficient in all nutritive compounds, particularly to restart stuck fermentation.

DOSAGE

Maximum EU legal dosage: 20 g/hl.

Maximum US dosage: 6lbs/1000 gallons.

MOMENT OF ADDITION

Usually at yeast inoculation. Alternatively, split between inoculation and 1/3 of fermentation.

SOLUBILITY	FAT MATTER	AMINO NITROGEN	B-VITAMIN*
			

* See box Specificity on page 103.

Fermentis by Lesaffre

FERMENTATION AID

INNOVATIVE LIQUID FERMENTATION AID COMBINING EFFICIENCY, EASE AND SECURITY

E2U EASY TO USE by Fermentis

ViniLiquid™

BEST SUITED FOR

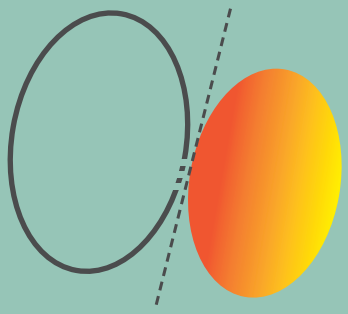
Highly YAN deficient and/or high potential alcohol musts. Wineries requiring fast tank turnover during harvest, reduction of operational time and/or equiped with fermentation management automation system.

DOSAGE

50 ml/hl of ViniLiquid for an equivalent supply of 20 mg/l of Yeast Available Nitrogen.

MOMENT OF ADDITION

For a maximum efficiency, use ViniLiquid™ between third and mid-fermentation.



Total yeast autolysate

Source of highly available organic nitrogen (free amino acids for yeasts and small peptides for lactic bacteria) naturally combined with yeast hulls strengthening its fermentative power. Reinforces yeast fermentative metabolism in difficult conditions to secure fermentations and ensure optimum aromatic expression. Its innovative liquid form makes it even more performant and easy-to-use.

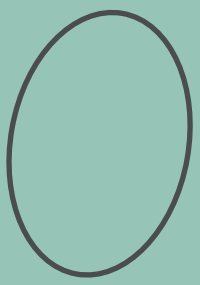
SOLUBILITY	FAT MATTER	AMINO NITROGEN	B-VITAMIN

FERMENTATION AID

THE SOLUTION FOR STUCK FERMENTATIONS

SpringCell™

E2U EASY TO USE by Fermentis



Cellular yeast hulls

Source of survival factors (lipids as oxygen substitutes) and support elements (insoluble components) that will help yeast multiplication and viability maintenance till the end of the fermentation. Shows high adsorption capabilities, especially towards inhibitive fatty acids to detoxify the musts.

BEST SUITED FOR

As a prevention for high alcohol potential and/or highly clarified musts. For fermentations without oxygen addition possibility. As a cure before restarting a stuck ferment.

DOSAGE

Normal dosage: 20g/hl. For maximum detoxification properties, apply the maximum legal dosage: 40g/hl or 3lbs/1000gal. Yeast hulls are indeed subjected to usage limit of 40g/hl according to the European legislation and 3lbs/1000gal according to US (TTB) legislation.

MOMENT OF ADDITION

As preventive: between third and mid-fermentation in combination or not with a nutrient source. As a cure, in the stuck wine before repitching yeast.

SOLUBILITY	FAT MATTER	AMINO NITROGEN	B-VITAMIN
◔	●	○	○

FERMENTATION AID

THE ORGANIC SOLUTION FOR SLUGGISH AND STUCK FERMENTATIONS

SpringCell™ Bio

BEST SUITED FOR

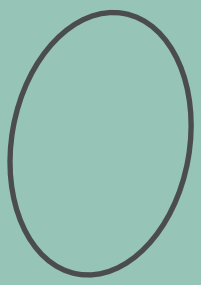
Organic wines! As a prevention for high alcohol potential and/or highly clarified musts. For fermentations without oxygen addition possibility. As a cure before restarting a stuck ferment.

DOSAGE

Normal dosage: 20g/hl. For maximum detoxification properties, apply the maximum legal dosage: 40g/hl or 3lbs/1000gal. Yeast hulls are indeed subjected to usage limit of 40g/hl according to the European legislation and 3lbs/1000gal according to US (TTB) legislation.

MOMENT OF ADDITION

As preventive: between third and mid-fermentation in combination or not with a nutrient source. As a cure, in the stuck wine before repitching yeast.



Cellular yeast hulls

Source of survival factors (lipids as oxygen substitutes) and support elements (insoluble components) that will help yeast multiplication and viability maintenance till the end of the fermentation. Shows high adsorption capabilities, especially towards inhibitive fatty acids to detoxify the musts.

SOLUBILITY	FAT MATTER	AMINO NITROGEN	B-VITAMIN
○	◒	○	○

FERMENTATION AIDS

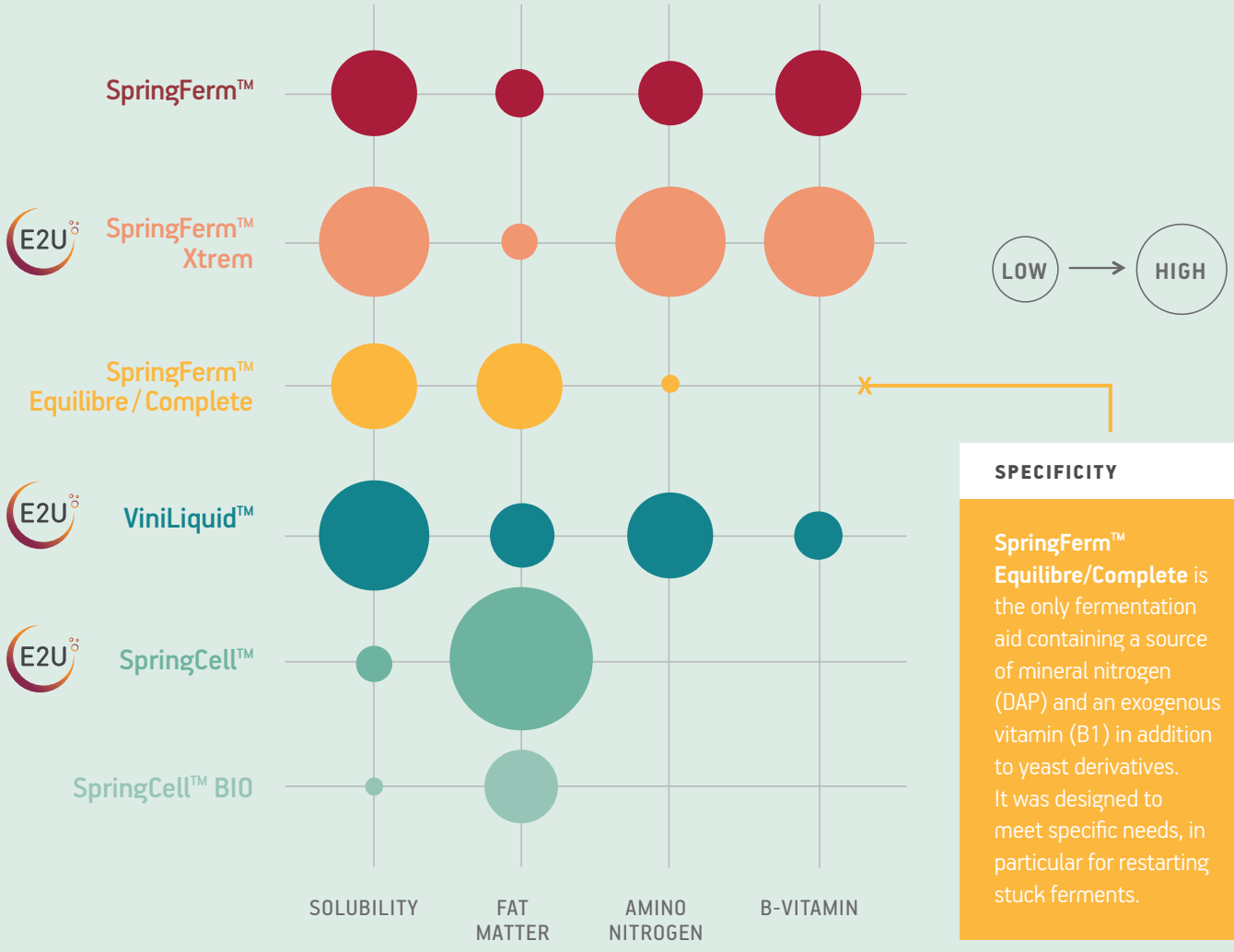
ALL OUR FERMENTATION AIDS ARE DIFFERENT AND DESIGNED FOR MULTIPLE PURPOSES. WE HAVE CHARACTERISED THEM IN ORDER TO HELP YOU CHOOSE THE BEST ONES FOR YOUR NEEDS.

NOW...

MAKE YOUR CHOICE

CHARACTERISTICS HIGHLIGHTS

YEAST NUTRIENTS



SPECIFICITY

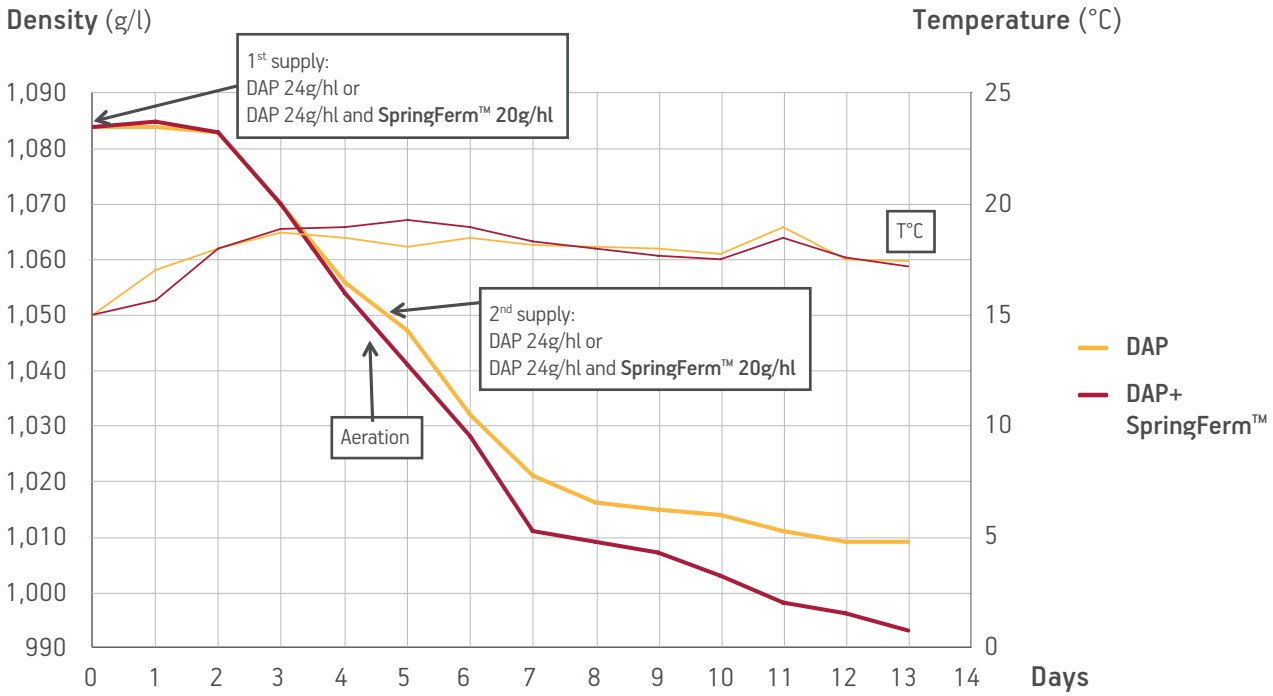
SpringFerm™ Equilibre/Complete is the only fermentation aid containing a source of mineral nitrogen (DAP) and an exogenous vitamin (B1) in addition to yeast derivatives. It was designed to meet specific needs, in particular for restarting stuck ferments.

COMMENTS

A complex range of nutrients is required by yeast to ferment correctly. Organic yeast available nitrogen, vitamins, lipids and support elements are all nutrients that help yeast to grow and survive, and which are necessary for its development. So, what could be more natural than adding the same components that yeast is made of to optimise its performance? This is the philosophy behind our range of fermentation aids that are specifically yeast-derived, which includes from polyvalent simple yeast autolysate to total autolysates for maximal nutritive power. In addition, yeast hulls serve to detoxify the yeast fermentation environment for safer fermentation.

EFFECT OF SPRINGFERM™

FERMENTATION KINETICS WITH AND WITHOUT SPRINGFERM™ ADDITION



Carignan Rosé – France 2012

Must parameters

Potential alcohol (% vol.)	**11.7**
Sugars (g/L)	**197**
Total acidity (g H_2SO_4 /L)	**3.9**
pH	**3.43**
Malic acid (g/L)	**2.4**
Free SO_2 (mg/L)	**36**
Total SO_2 (mg/L)	**70**
YAN (mg/L)	**102**
YAN / S	**0.52**

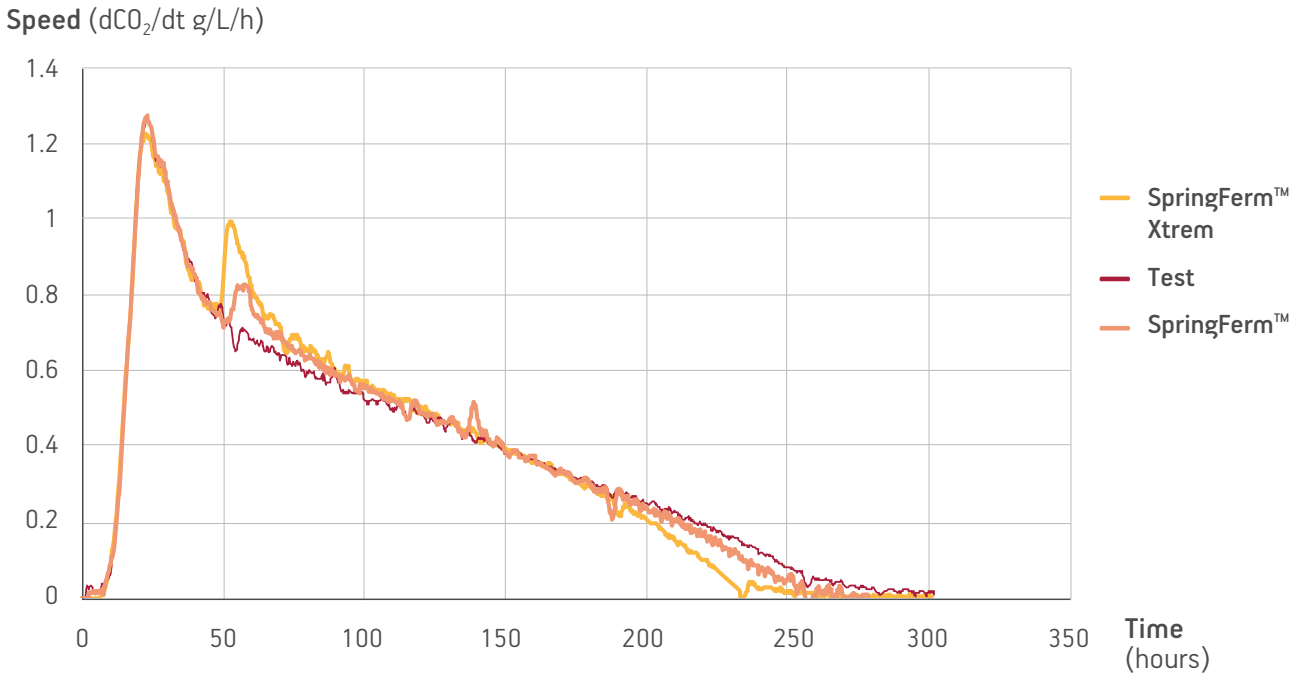
Temperature of fermentation between 20 and 28°C (68° to 82°F)

COMMENTS

If the must is highly sulphited and deficient in available nitrogen, only adding mineral nitrogen (DAP) is not sufficient to achieve the fermentation. Comparing the supply in YAN of the DAP and the SpringFerm™ will give tremendous differences (about 10 times less in SpringFerm™), however the SpringFerm™ addition leads to fermentation achievement. This is a real example of "fermentative power" versus YAN!

EFFECT OF SPRINGFERM™ & SPRINGFERM™ XTREM

FERMENTATION KINETICS WITH SPRINGFERM™ VS SPRINGFERM™ XTREM ADDITION AT 1/3 AF (KEY MOMENT 3)



UNDERSTAND CO_2 FLOW SPEED MEASUREMENT

Real-time follow-up of the fermentation speed by measuring the CO_2 released through a flowmeter during time. This data acquisition has been done thanks to a fermentation management system from Vivelys (SCALYA).

COMMENTS

The effect of SpringFerm™ Xtrem in the same conditions is almost double compared to the SpringFerm™. This illustrates well the importance of a high concentration of readily available nutrients at 1/3rd of the fermentation. This addition drastically increases the fermentative activity of the yeast for a safer and shorter fermentation. 7% gain of time with SpringFerm™, 13% with SpringFerm™ Xtrem.

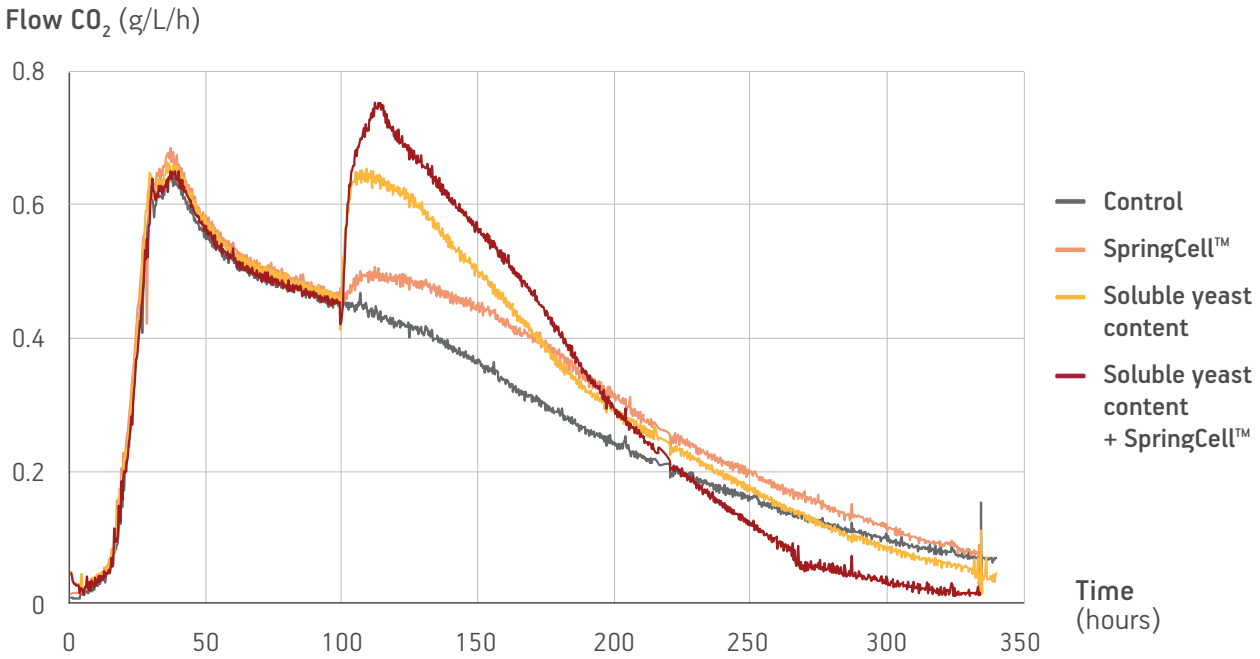
Synthetic must

Must parameters

Sugars (g/L) (1:1, Glu:Fru)	250
YAN (ppm)	170
YAN / S	0.68
Strain: STG S101 (g/hl)	20
Constant fermentation temperature (°C/°F)	24/75
Activators at 35g/L of CO_2 released (g/hl)	30

EFFECT OF SPRINGCELL™

FERMENTATION KINETICS WITH SPRINGCELL™ ADDITION AT 1/3 AF (KEY MOMENT 3)



Gros Manseng – France 2012

Must parameters

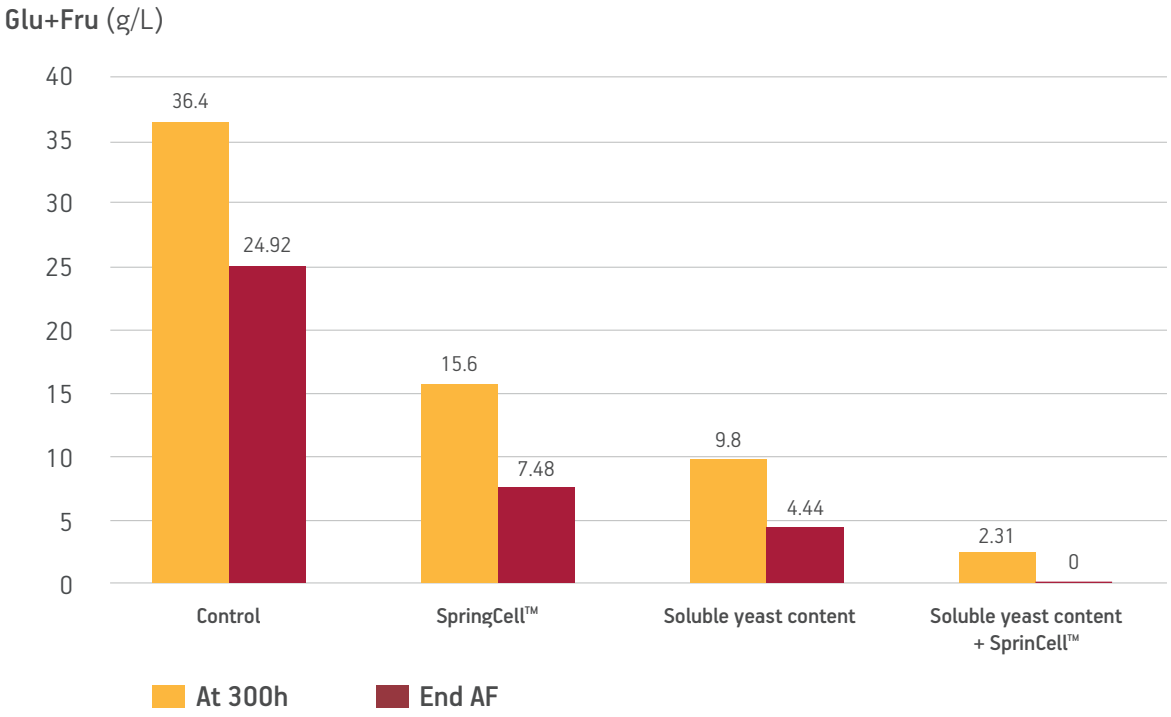
Potential alcohol (% vol.)	**14.3**
Sugars (g/L)	**244**
Total acidity (g H_2SO_4 /L)	**5.94**
pH	**3.04**
YAN (mg/L)	**98**
YAN / S	**0.4**

Fermentation done with 20g/hl of CK S102 at 20°C (68°F)

COMMENTS

Although almost insoluble, SpringCell™ yeast hulls are playing a big role in increasing the fermentation speed and thus the activity of the yeast when added at 1/3 of AF. It's even more true when you combine SpringCell ™ with nitrogen addition, it's clearly visible on the graph above. This is certainly due to the combination of CO_2 degassing effect, addition of sterols, and detoxification capacities towards toxic substances like octanoic and decanoic acid, as we clearly see in the synthetic medium. Consequently, SpringCell™ can help reducing oxygen and nitrogen supplementation as shown on the end fermentation analyses.

RESIDUAL SUGARS WITH SPRINGCELL™ ADDITION AT 1/3 AF (KEY MOMENT 3)



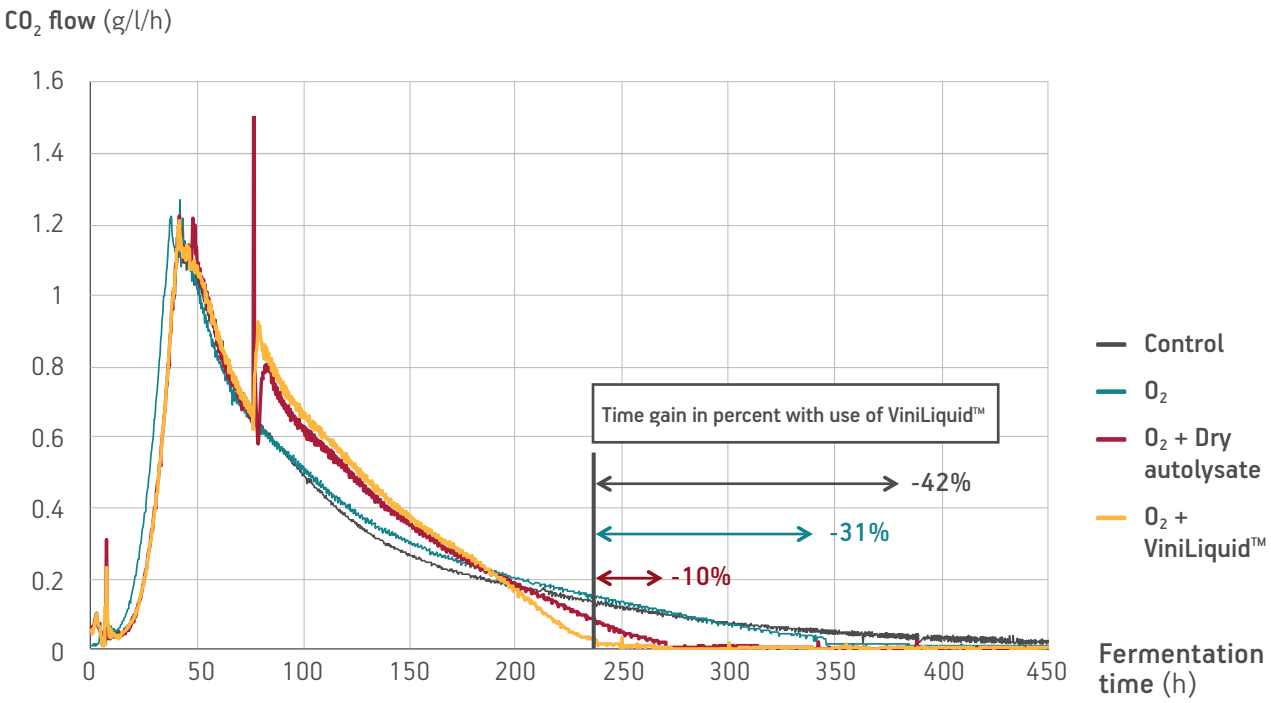
EFFICIENCY IN DECREASING THE LEVELS OF MEDIUM CHAIN FATTY ACIDS (TOXIC SUBSTANCE FOR YEASTS)

WEIGHT OF SPRINGCELL YEAST HULLS ADDED IN G/HL	% ACIDS ADSORBED	
	OCTANOIC	DECANOIC
20	1.2	20.2
50	4.5	40.7
100	**7.2**	**54.5**

Stuck wine, 13% alcohol, inoculation 10^6 CFU/ml

Sterile medium, 10% ethanol solution in water, 10mg/L of octanoic and 3 mg/L of decanoic acid added

VINILIQUID™ FERMENTATIVE POWER IN COMPARISON WITH DRY AUTOLYSATE



Chardonnay – France 2012

Must parameters

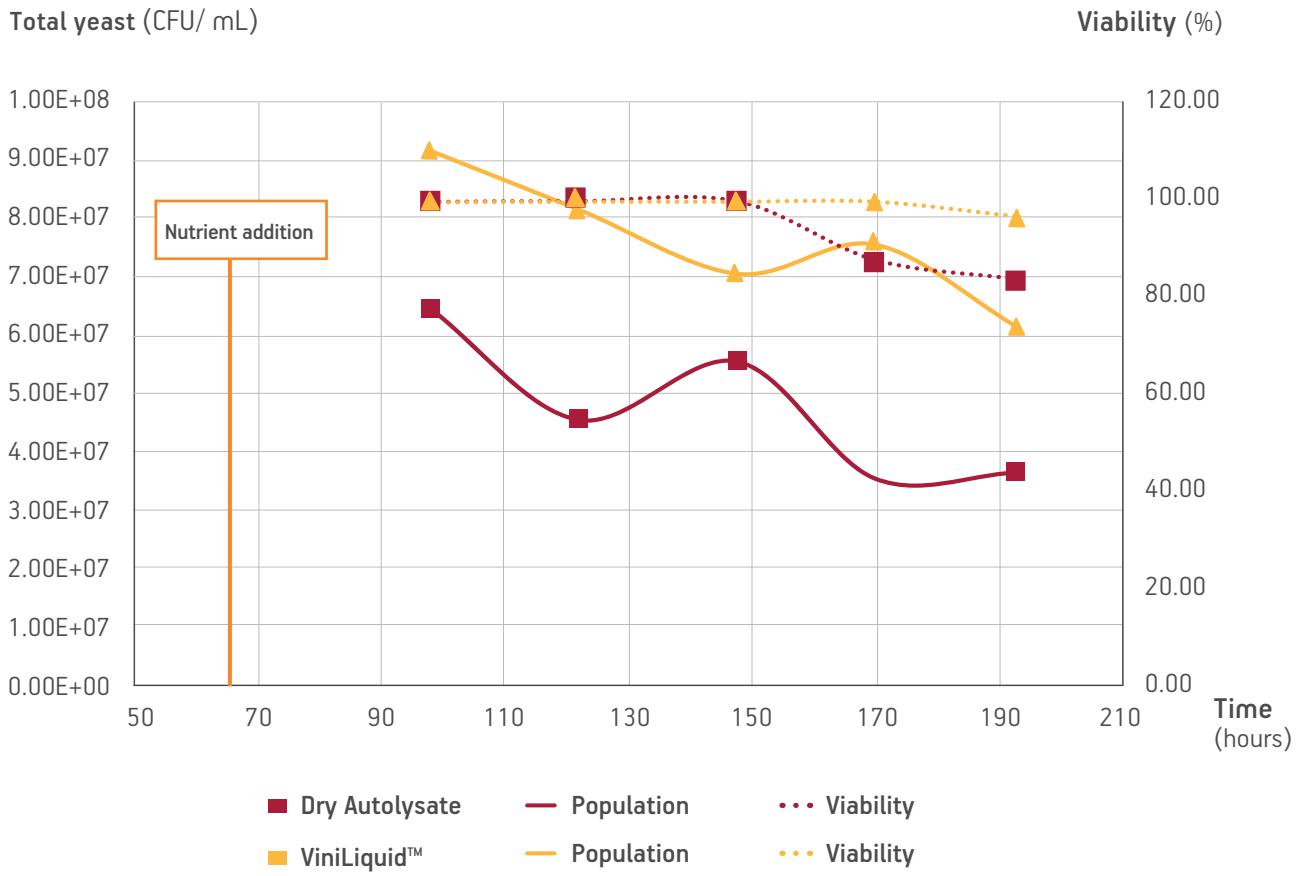
Potential alcohol (% vol.)	12.5
Sugars (g/L)	214
Total acidity (g H_2SO_4 /L)	3.75
pH	3.42
YAN (mg/L)	188
YAN / S	0.88

Addition of 10mg/l O_2 at S_{max}, 20ppm YAN and 13.4g/hl yeast hulls (calculated on ViniLiquid™ hulls fraction) at 1/3rd AF
Fermentation done with 20g/hl of CK S102 at 20°C (68°F)

COMMENTS

In addition to its content in nutrients and yeast hulls, the physical form of a yeast derivative can modulate its fermentative power. ViniLiquid™ is the first yeast autolysate produced and

VINILIQUID™ IMPACT ON POPULATION AND VIABILITY IN COMPARISON WITH DRY AUTOLYSATE



stabilized in a liquid form. It shows great impact on yeast fermentation performances and population/ viability, especially towards the end of the fermentation.

Colombard – INRA Montpellier

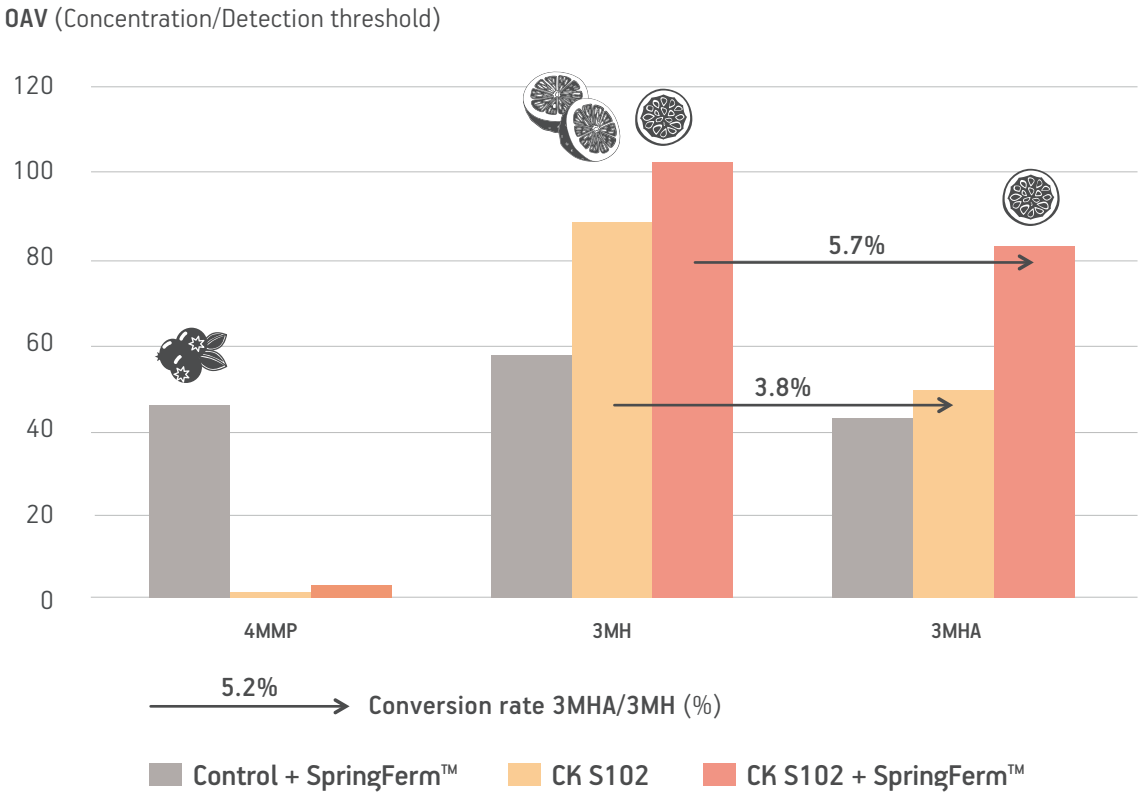
Must parameters

Potential alcohol (% vol.)	**11.2**
Sugars (g/L)	**188**
pH	**3.3**
YAN (mg/L)	**185**

Addition of 5mg/l O_2 at S_{max}, 20ppm equivalent YAN at 37% of CO_2 released, 18°C (64.4°F)

EFFECT OF SPRINGFERM™

YEAST AUTOLYSATES IMPACT ON THIOLS RELEASE



Sauvignon Blanc – Chile 2009

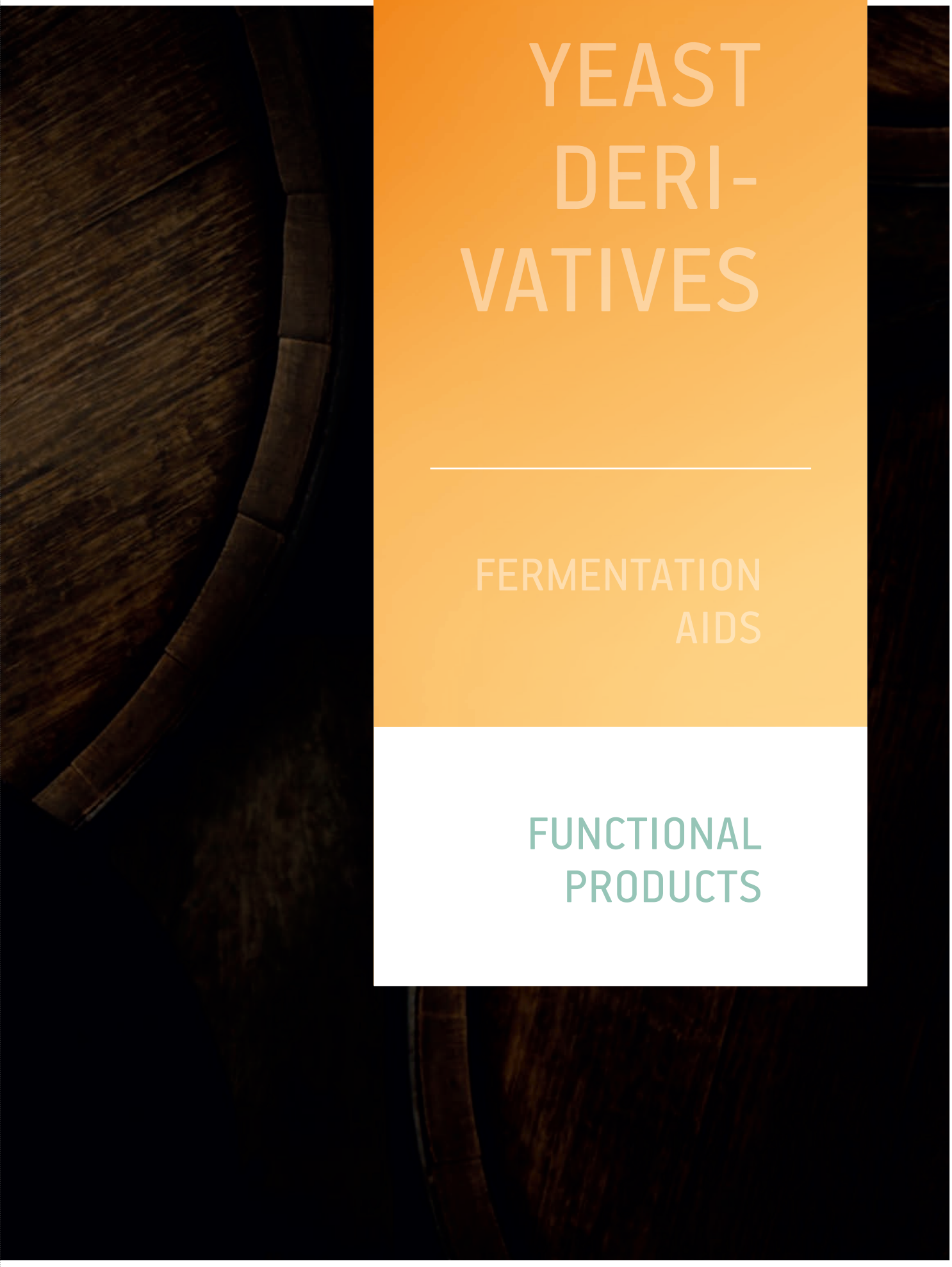
Must parameters

Potential alcohol (% vol.)	12.2
Sugars (g/L)	205
Total acidity (g H_2SO_4 /L)	5.4
pH	3.05
YAN (mg/L)	230
YAN / S	1.12

Turbidity at 80 NTU
Fermentation done with 22g/hl of CK S102 at 11-14°C (51.8-57.2°F)
Addition of nutrients at 25g/hl within 24hrs after yeast inoculation

COMMENTS

Having an impact on fermentation speed and achievement, yeast derivatives also impact a wine's aromatic profile, as sources of amino acids (base of fermentative aromas) and providers of compounds favor yeast metabolism. On this Sauvignon Blanc, the addition of SpringFerm™ favors the release of polyfunctional thiols from their precursors (increased enzymatic activity), as well as their conversion into their corresponding acetates.



YEAST DERI-VATIVES

FERMENTATION AIDS

FUNCTIONAL PRODUCTS

Concept & type of action

It is very important for winemakers to select the most appropriate yeast according to their targeted type of wine, and to secure alcoholic fermentation with activators that achieve the highest potential of both the selected grapes and the yeast. However, all these efforts can be drastically diminished if key factors such as temperature, precipitation of unstable compounds, or oxidation, especially after the alcoholic fermentation, are not controlled.

Traditionally and still widely carried out nowadays, winemakers use a natural tool to stabilize their wines – the "aging on lees". This is based on the release into the wine of cellular material coming from the yeast through different mechanisms, such as natural autolysis and hydrolysis processes, as well as mechanical actions like batonnage.

Master the wine balance at all stages.

"

The main observed effects of the aging on lees are:

- **an antioxidant action** protecting wine color and aromas,
- **a stabilization action towards polyphenols** (tannins and anthocyanins, so wine structure and color), proteins and acids like tartaric acids,
- **an improvement of the mouthfeel** through an increase of the wine roundness and its aromatic persistence,
- **a spontaneous clarification** for insoluble particles, thus improving wine clarity.

Although useful, these effects are almost uncontrolled during the aging on lees. Therefore, the idea is:

- to first understand what are the yeast compounds responsible for these effects are,
- to find a way to increase or concentrate the content of these compounds in specific yeasts or fractions of these yeasts,
- and finally, to produce, at an industrial scale, quality-controlled and reliable yeast derivatives, each with a targeted effect according to the needs.

The objective is indeed to control these effects compared to those of a traditional aging on lees and correct the desired balance of the wine before, during or after fermentation.

Yeast antioxydants

A. MUST AND WINE OXIDATION MECHANISMS

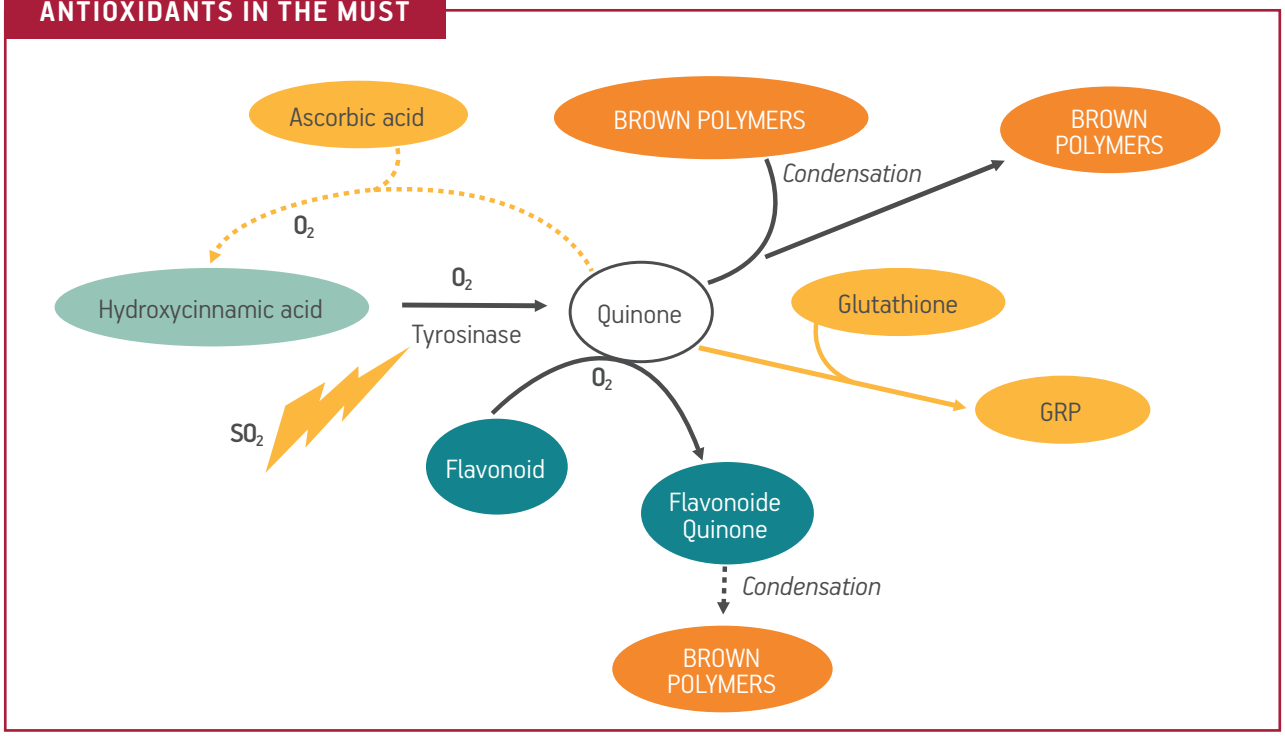
Must and wine oxidation are closely related to their content in phenolic compounds. This oxidation is the result of both biological (specific enzymes) and chemical processes (presence of metals). In the must, especially for whites, the enzymatic effect of an oxidoreductase called tyrosinase is of great interest, as it preferentially and very quickly oxidizes the hydroxycinnamic acids and their esters with tartaric acid (caftaric and coutaric acids) present in majority in the pulp.

The produced quinones are unstable and can:

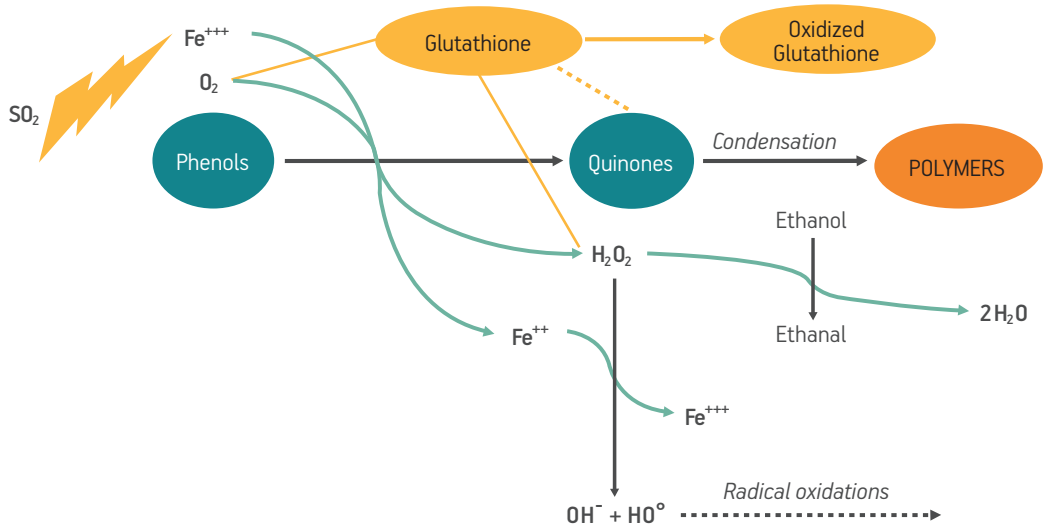
- **enter into coupled oxidation mechanisms** with flavonoids and lead to flavonoid quinones, themselves entering condensation mechanisms whose polymerized products are strongly colored and insoluble,
- **condense with other phenolic compound molecules,** like the hydroxycinnamic acid itself. This process also leads to the production of polymerized products whose insolubility and color evolves from yellow to brown, depending on the condensation degree.

In the wine, especially for reds due to their richness in oxidizable polyphenols, the oxidation of the phenols can be catalyzed by the presence of metal cations (Fe^{+++}, Cu^{++}) and lead to the generation of hydrogen peroxide involved in the peroxidation of the ethanol in ethanal, and in the creation of strongly oxidant species that can provoke considerable changes of color and aroma. The oxidation of these components can occur all along the elaboration process of the wine, and even more after fermentation, as the alcohol favors O_2 consumption. It is thus beneficial to find ways to prevent these phenomena.

ANTIOXIDANTS IN THE MUST



ANTIOXIDANTS IN THE WINE



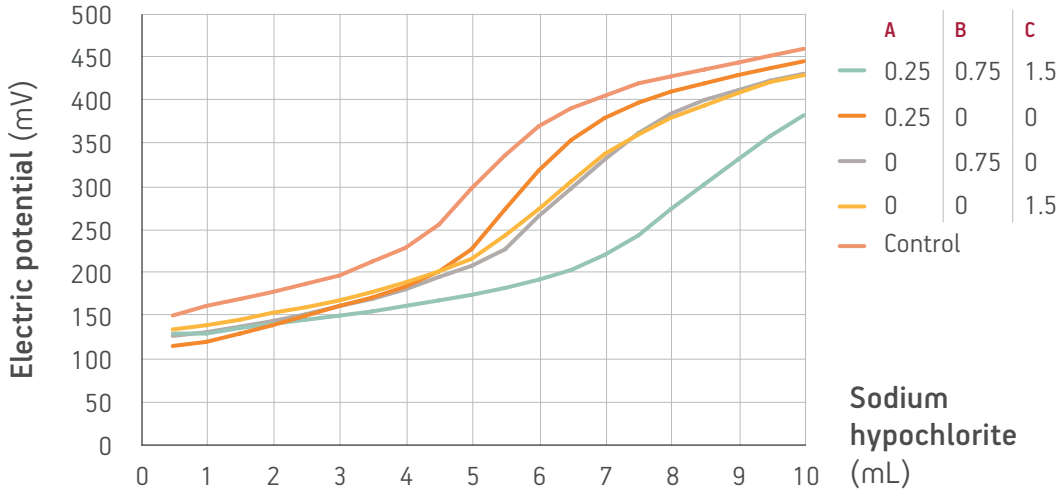
More globally, we assess the sensitivity towards oxidation of a wine by measuring its oxidoreduction potential. This is an analysis of both oxidation and reduction level of the medium at a certain balance. Its value is related to the concentration of dissolved oxygen. The normal oxidoreduction potential Eo of a wine is the value for which the wine ensemble is half-oxidized, half-reduced. This characterizes its oxidation capability.

Among others, two methods can evaluate the wine antioxidant power:

1 **Follow-up of the oxidation of the wine over time,** while progressively adding a strong oxidant (sodium hypochlorite) and measuring the variation of its redox potential (see graphic below).

2 **Measure tsee optical density at 420nm** (yellow color corresponding to the oxidation level of the polyphenols) before and after the addition of an oxidant (hydrogen peroxide) and assess the difference.

GLUTATHIONE AND ITS DERIVATIVES IMPACT ON WINE REDOX POTENTIAL



Code	Cysteine	Glu-cys	Gluthatione	Units
A / B / C	A	B	C	mg/40mL of wine

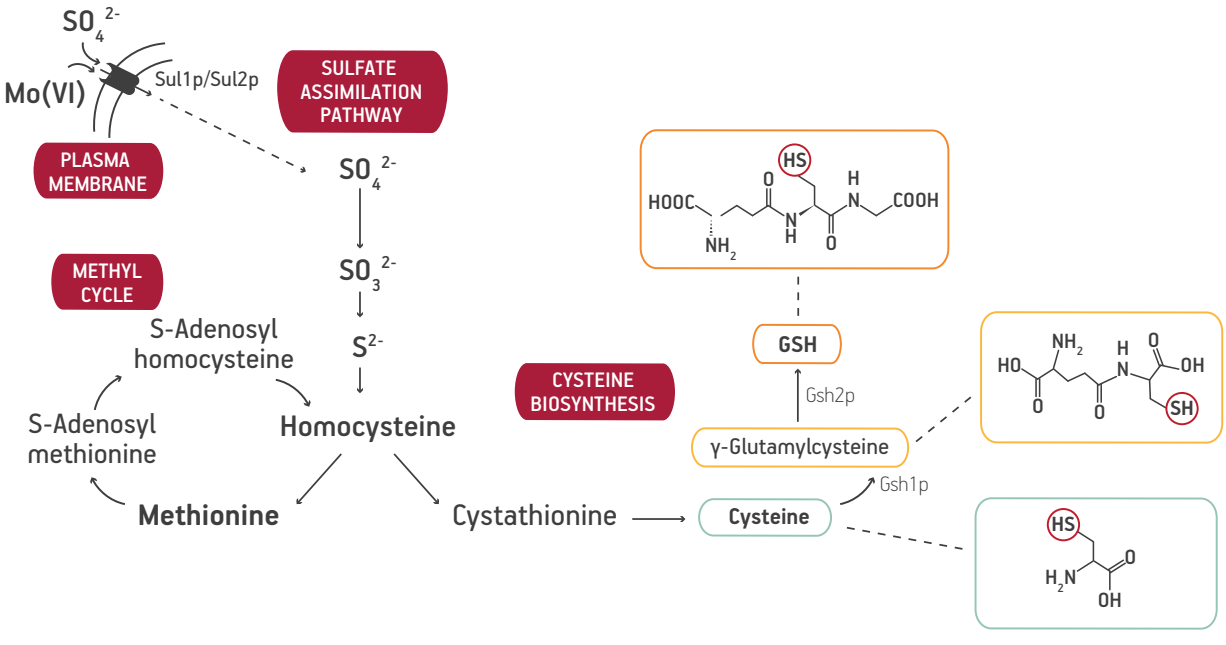
B. GLUTATHIONE AND ITS DERIVATIVES

The aging on lees confers to the wine a reduction power that prevents or slows down the loss of aromas and the evolution of the color towards yellow to brown shades. This phenomenon is partly due to the release of antioxidant compounds through the autolysis of the yeast. Among these compounds, the glutathione is one major interests, as it represents more than 95% of the intracellular pool of low molecular weight thiols in the yeast.

Glutathione (GSH) is a natural major constituent of numerous plants and foods, especially in fruits like grapes. It is a tripeptide ((L-γ-glutamyl-L-cysteinylglycine) composed of three amino acids: glutamic acid, cysteine and glycine. Thanks to its free thiol group (-SH) conferred by the cysteine, it has a strong antioxidant power and its redox potential is very low (Eo=-250 mV at pH 7.0), even lower than ascorbic acid (Eo=+ 60 mV at pH 7.0). It is thus involved in many oxidoreduction mechanisms into the cells and acts as a buffer or detoxifier towards oxygen-reactive species (peroxides, free radicals, etc.), which is, for example, essential for the multiplication of the yeast. Its oxidation leads to the generation of the oxidized glutathione by combing two glutathione molecules through a disulphur bound (GSSG), and can prevent the oxidation of other sensitive thiols like the aromas 4MMP, 3MH and its acetate (Eo=+ 100-150 mV at pH 7.0).

In the yeast, the glutathione synthesis comes from the sulphate reduction pathways, leading to the synthesis of cysteine, and then to the glutathione through an intermediate dipeptide, the γ-glutamyl-L-cysteine. All these three compounds have a free thiol group and as such, antioxidant powers which can add up and lower the redox potential of the must or the wine, thus strengthening its resistance towards oxidation attacks. This is the base of the concept of global reductive power expressed in "glutathione equivalent" of a yeast. The glutathione equivalent is calculated as such: $[Cys]*M_{GSH}/M_{Cys})+[GSH]+[GluCys]*M_{GSH}/M_{GluCys}$.

GLUTATHIONE SYNTHESIS PATHWAY



Glutathione also plays a fundamental role in the must and wine, as it has the property, like ascorbic acid, to act as a quinone trap (see 1.a.) and thus prevent subsequent brown polymers generation and wine color evolution. The generated product (S-glutathionyl-2-caftaric acid) is called "Grape Reaction Product" (GRP). It is colorless and not oxidable by tyrosinase anymore, but can be by another polyphenol oxidase coming from Botrytis, the laccase. This reaction can also preserve other sensitive thiols, like 4MMP, 3MH and 3MHA, which can react with quinones leading to a strong aromatic loss. As long as there are high concentrations of glutathione and ascorbic acid in the must, the oxygen consumption by the must doesn't lead to the accumulation of quinones and to must browning.

WHAT ARE SULPHITES USED FOR?

Sulphites are used in vinification mainly for their antiseptic actions, but also for their antioxidant actions. However, these antioxidant actions are direct and indirect.

To protect musts from oxidation, the direct antioxidant action of the sulphites (i.e. its chemical consumption of the oxygen catalyzed by metal ions) is weak, as the main oxidation phenomenon is enzymatic and very fast. In that case, sulphites acts more indirectly with their antioxidasic action, immediately inhibiting the oxidation enzymes, like tyrosinase and laccase, and eventually ensuring their destruction.

In wine, its direct antioxidant action contributes to lowering the redox potential of the wine, thus preserving phenolic and aroma compounds. As a consequence, the value of using glutathione-rich products is even more beneficial when musts and wines contain low sulphite concentrations.

C. INACTIVATED YEASTS WITH GUARANTEED GLUTATHIONE LEVELS

The amount of glutathione present in the must decreases at the beginning of the fermentation and then progressively increases towards the end of the fermentation. It seems there is a good correlation between the amount in the must and the amount in the final wine. Glutathione can be used by the yeast as a nutrient when needed, and is then released during the autolysis of the yeast, thus conferring a reductive power to the final wine.

Using inactivated yeasts, from a selected strain and production process lead to an increased level in natural glutathione and its derivatives (Lesaffre's specific expertise), can be used in the must or at the beginning of aging on lees. In the first case, there will be an increased protection towards enzymatic oxidation mechanisms directly after racking off. In the second one, both enzymatic and chemical oxidation mechanisms will be battled.

Moreover, when used at the beginning of the fermentation, these inactivated yeasts will also be beneficial for the growth of the yeast, as these products supply support elements and nutrients. (see the Fermentation Aids section). Good nutrition, along with the addition of inactivated yeast rich in GSH, will be even better, as glutathione will not be a preferred source of nitrogen.

External sources:

- Dubourdieu et al. (2003). *Rôle du glutathione sur l'évolution aromatique des vins blancs secs.*

- Ribéreau-Gavon et al. (1998). *Traité d'œnologie.*

Yeast polysaccharides and proteins

A. WINE COLLOIDAL PHENOMENA

A young wine is a complex balance between several particles coming from mainly two origins: vegetal (plant and grape compounds) and microbiological (yeast lees). This balance is most often unstable and can lead to haziness and/or subsequent precipitation that results in a stabilization of the wine. The major families involved in these phenomena are polyphenols, proteins, polysaccharides and metals, and deals with colloidal phenomena.

A colloidal solution is constituted by small solid particles dispersedly maintained in a liquid by a group of forces that prevents their aggregation, and thus, flocculation. It is composed of two phases (liquid and solid) whose common limit is the interface.

The colloidal solutions diffuse light but to generate a haziness, the particles must reach a certain size for a defined total quantity of colloids. The apparition of this haziness is not only regulated by their weight, their subsequent flocculation occurs if the forces of interaction between particles is stronger Two groups of colloids are differentiated by their constitution.

MICELLAR COLLOIDS

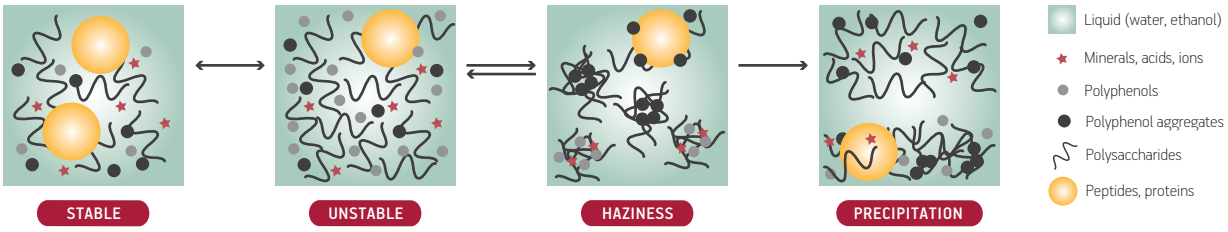
They are constituted by micelles, i.e. aggregates of numerous simple particles linked together by physical bounds, which ensures their cohesion (Van der Waals, hydrogen, etc.). The stability of these colloids can be ensured by electric charges, but micelles can adsorb other substances, and also be disturbed by the presence of opposed-charge compounds that suppress the forces which were ensuring their cohesion, leading to subsequent precipitation. For example, condensed phenolic compounds and colloidal coloring material represents micelles and the hydrophobic character of them contributes to their instability.

OR

MACROMOLECULAR COLLOIDS

They are constituted by macromolecules like polysaccharides and proteins, for which only chemical covalent bounds are involved. These molecules are generally charged and hydrophilic, which contributes to their stability in wine. Polysaccharides can notably confer their stability to micelles by coating them and protecting them from opposed charge compounds precipitant action, which is why they are called "protective colloids." Proteins flocculation is, on the other hand, the base of fining mechanisms.

COLLOIDAL STABILITY



Two groups of colloids are differentiated by their constitution.

Source: *Demptos*.

B. PROTECTIVE COLLOIDS: POLYSACCHARIDES

Polysaccharides are polymers constituted by several sugars (oses) linked between themselves by osidic bounds. Depending on their biological function, we can differentiate two groups. Reserve polysaccharides (like starch) represent a reserve in energy source (simple sugars) for a living being. Structural polysaccharides (like cellulose or chitin) participate in the formation of organic structure of the support tissues in vegetal or animal cells.

> They bring structure and energy.
>
> ”

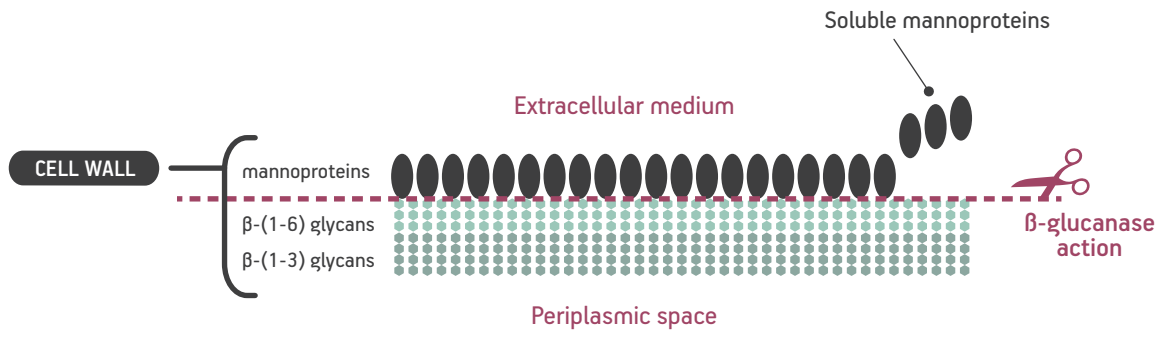
There are two types of these structural polysaccharides in wine:

- **The first main category comes from the grapes,** a result of the degradation and solubilization of pectic substances contained in the berry and pulp cell walls. They can be classified in neutral or acid (containing galacturonic acid) pectic substances.
- **The second major source comes from yeasts,** a result of the autolysis of the cell wall through parietal endoglucanases enzymatic activities occurring during fermentation and ageing. 80% of them are mannoproteins, globally containing 90% of mannose and 10% of proteins and presenting a large spectrum of molecular weight. The remaining 20% are glucomannoproteins, containing 25% of glucose, 25% of mannose and 50% of proteins.

Both sources have protective colloidal effects towards wine phenolic compounds. However, yeast mannoproteins have a stronger effect towards the stabilization against protein and tartaric precipitations.

The quantity of polysaccharides released by the yeast depends on the strain and conditions of fermentation and aging on lees. The release of mannoproteins is strengthened by a temperature increase (enzymatic reaction), the stirring (during aging: the batonnage), and the contact time between wine and lees. From an industrial point of view, mannoproteins can be extracted enzymatically or thermally, then separated or not following a specific process (Lesaffre's expertise).

B-GLUCANASE ACTION ON YEAST CELL WALL



C. OTHER HYDROPHILIC COLLOIDS: PROTEINS

Proteins are biological macromolecules (generally weighing over 10 kDa) that are present in every living cell. They are formed by one or several chain of polypeptides. These chains are constituted by a sequence of amino acid residues linked by peptidic bounds.
Proteins are essential for living cells, as they ensure a multitude of structural (like collagen) and functional (like enzymes) activities. Depending on the pH, they are charged positively (as in wine) or negatively, and their activity is related to their spatial conformation coming from their specific sequence of amino acids.

As they have the property to react with tannins (see below), there are almost no free proteins coming from grapes in red wines. To the contrary, white and rosé wines can contain quite a few proteins which contribute to their instability and are not assimilated, thus degraded by yeast. Degraded proteins, i.e. small peptidic chains, released by yeast during their autolysis don't react with tannins and thus don't provoke any instability.

However, it has been shown that **certain small peptides released by yeast can have a sweetness effect in the wine, and improve mouthfeel sensations.**

D. INTERACTION MECHANISMS BETWEEN POLYPHENOLS, PROTEINS AND POLYSACCHARIDES

Unstable protein precipitation and protein fining treatments are two phenomena based on the same reality, that is, the denaturation of the proteins caused by their loss of electric charge and hydrophilic character, which leads to their precipitation.

The denaturation can be caused by alcohol, tannins or heat converting the protein, previously hydrophilic colloid, into a hydrophobic colloid that can be flocculated by salts (cations). Tannins can notably associate between themselves and create hydrophobic colloidal particles that can be destabilized by the proteins (electric or adsorption phenomenon) to generate aggregates that precipitate.

It is the base of fining mechanism and will lead to:

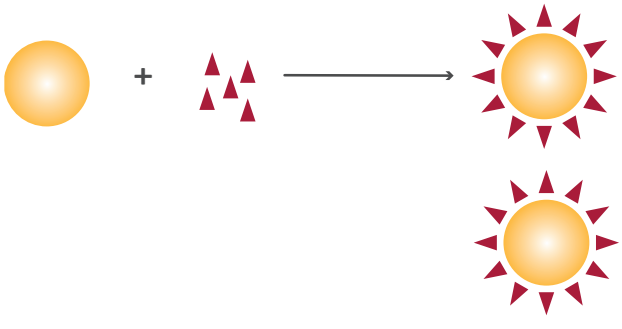
- an improvement of the clarity of the wine,
- the removal of instable and reactive tannins towards proteins (like those of the saliva), thus decreasing astringent sensations.

FINING PRINCIPLE

Incorporation of high molecular weight proteins (+)
reacting with wine particles/colloids (-) to make them unstable.

Creation of a cloudiness then sedimentation in order to improve wine

- Clarity
- Stability
- Filterability
- Tasting feeling



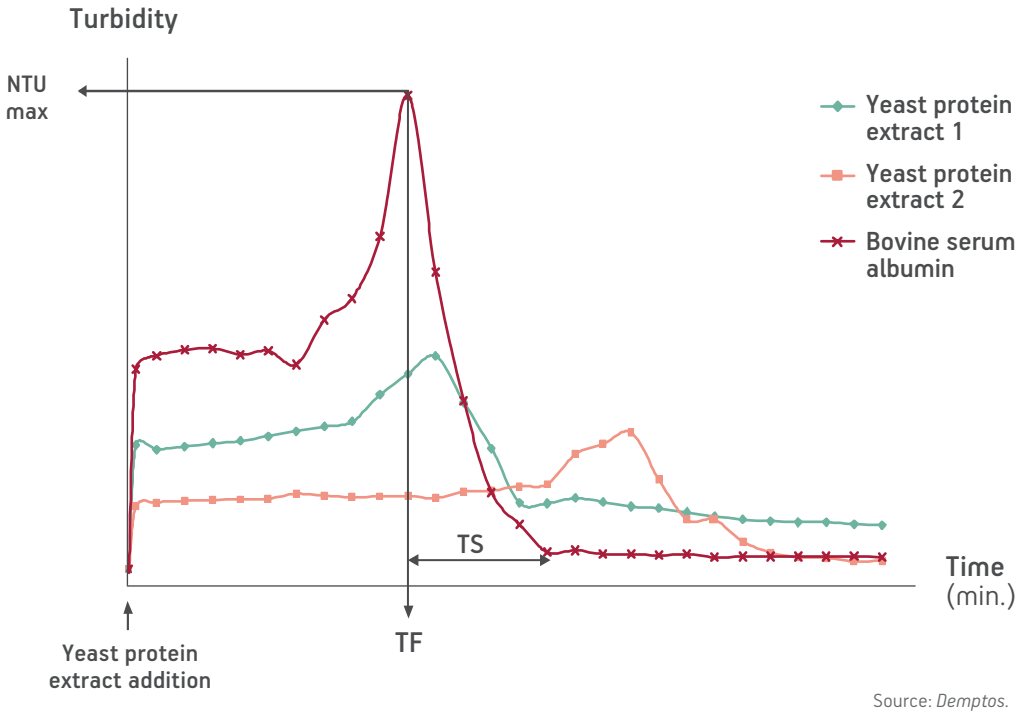
Source: *Demptos.*

We can measure the efficiency of a fining treatment by following the precipitation of tannins by nephelometry (turbidity measurement).

The fining effect is characterized by three parameters:

1. The flake apparition time illustrating the level of tannin-protein interaction: the shorter, the higher the reactivity (*TF* on the graphic below);
2. The maximum haziness that will be proportional to the size of newly generated molecules: the greater, the higher the reactivity (*NTU max* on the graphic below);
3. The sedimentation time: the shorter, the better efficiency (*TS* on the graphic below).

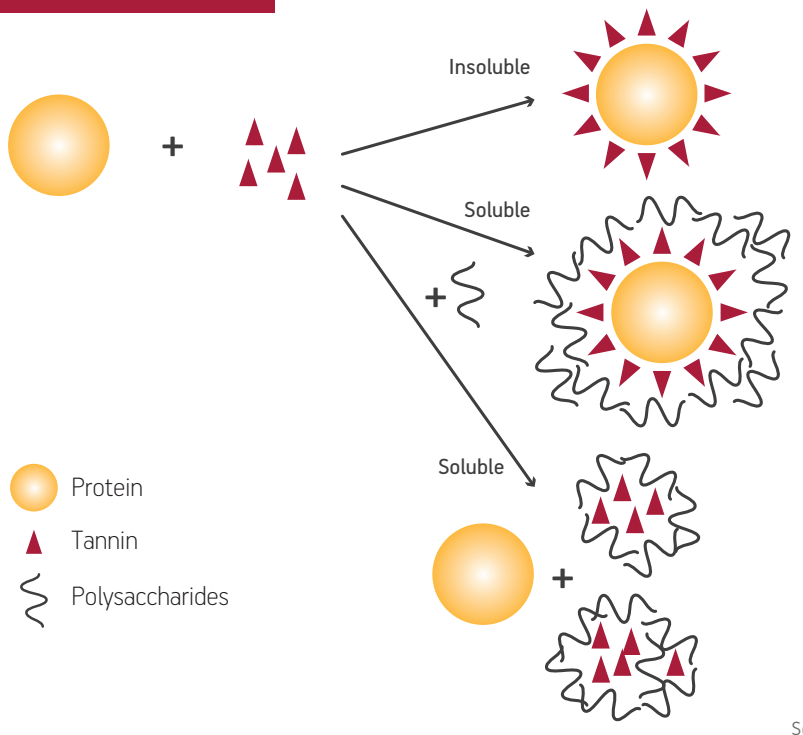
FINING EFFICIENCY MEASUREMENT



Source: *Demptos.*

If we introduce polysaccharides like mannoproteins into this scenario, a stabilization of the instable colloids (tannins aggregates or tannin-anthocyanins aggregates or tannin-protein complexes) can appear. In fact, if they are in sufficient amount, polysaccharides will have a coating effect (by covalent bounds or electric interactions) on the surface of the colloids and prevent their flocculation by maintaining enough separation. (The opposite occurs when there are too many polysaccharides in the solution, as they will create flocculation by themselves.)

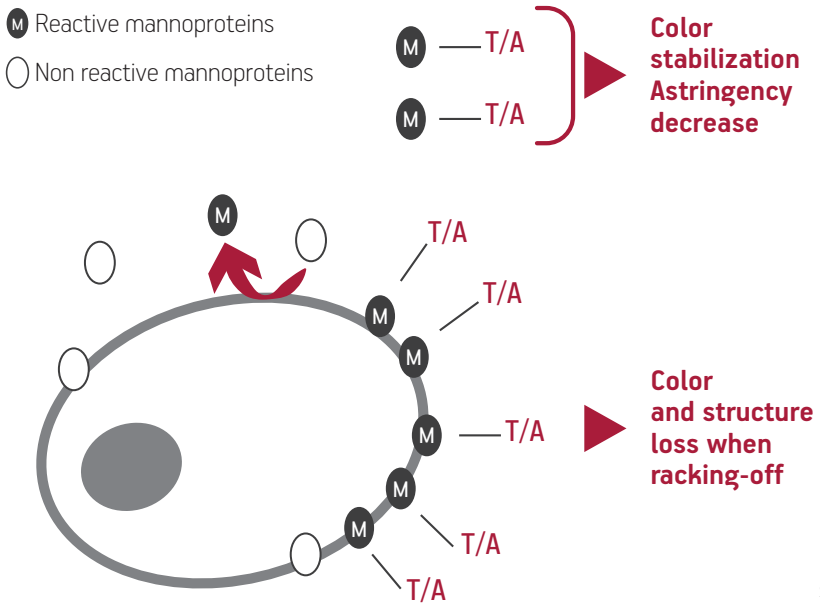
EFFECT ON ASTRINGENCY



Source: *Demptos.*

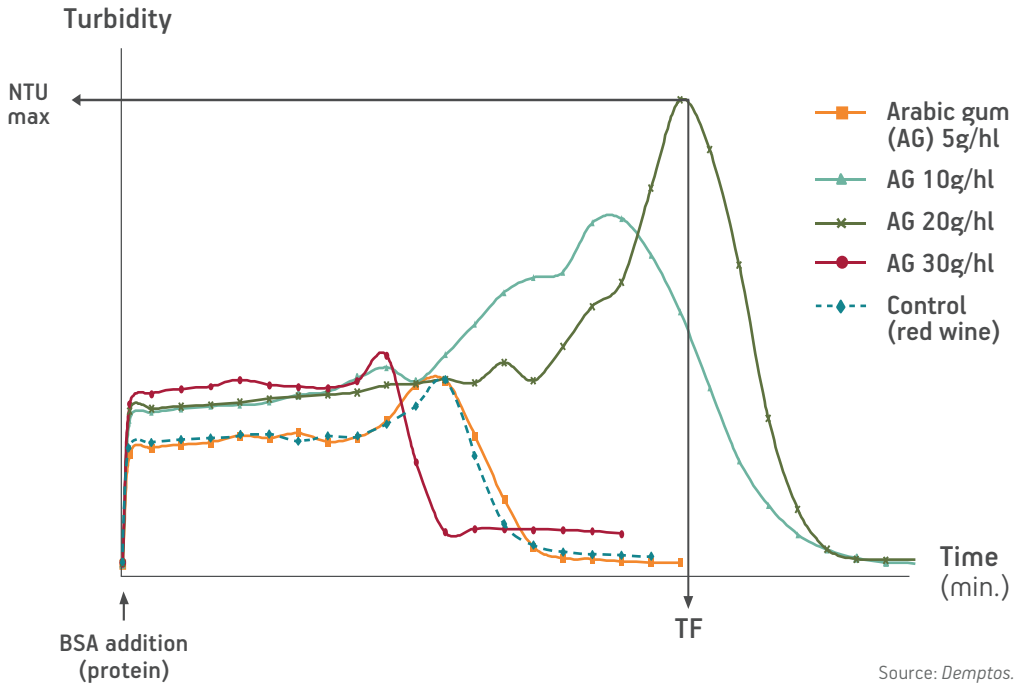
This property will lead to an increased stabilization of the structure and color if the colloids are tannin aggregates or tannin-anthocyanin aggregates, and to a decrease in astringency and a gain in roundness, as the new generated molecules will be bigger and less reactive to other proteins. On the other hand, if the polysaccharides are not released into the wine and stay at the surface of the yeast, it could provoke a loss in structure and color when lees are racked off. This loss can also occur with the proteins located inside yeast cells.

EFFECT ON COLOR



Source: *Demptos.*

COATING EFFICIENCY MEASUREMENT



Source: *Demptos.*

We can measure the coating effect of polysaccharides by observing the generation of macromolecules by nephelometry (turbidity measurement).

The coating effect will be characterized by two parameters:

1. The flake apparition time, illustrating the level of tannin-protein interaction: the longer, the better coating effect (tannin-protein interaction slowing down), TF on the graphic below;
2. The maximum haziness, which will be proportional to the size of newly generated molecules: the higher, the higher the coating effect, NTU max on the graphic below.

E. OTHER PROTECTIVE COLLOIDAL EFFECTS OF POLYSACCHARIDES

The stabilization effect of mannoproteins is also playing a role in other precipitation phenomena. It has been effectively proven that enzymatic mannoproteins can decrease the instability of thermo-instable proteins (parietal invertase fragment with a size of 32kDa – MP32), but also hinder or lastingly inhibit the crystallization of tartaric acid salts (highly glycosylated mannoproteins around 40kDa – MP40). In this case, the protective colloids counteract the precipitation even if the product solubility is exceeded.

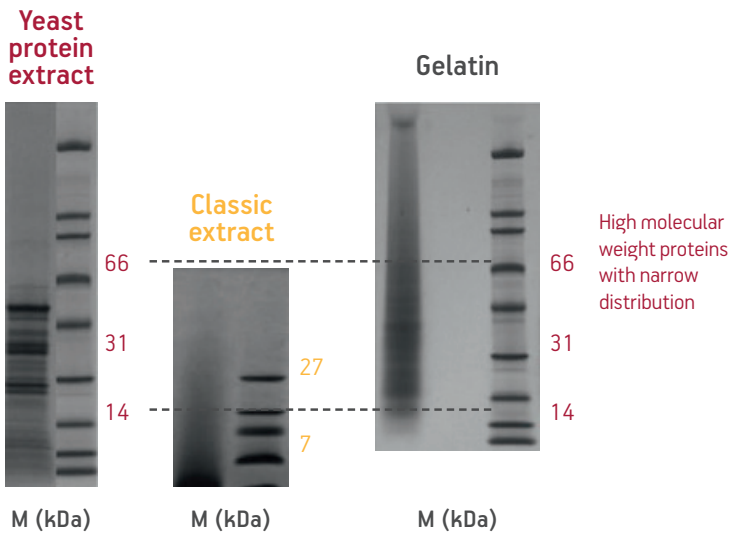
F. YEAST DERIVATIVES RICH IN COLLOIDS

YEAST DERIVATIVES RICH IN REACTIVE PROTEINS

In order to mimic the clarification effect of lees towards wine polyphenols, Lesaffre R&D developed a specific process of degradation of yeast in order to preserve yeast native proteins. This process inactivates the proteases responsible for the autolysis of the proteins and solubilizes a higher part of the intracellular content of the yeast compared to a classic inactivated yeast. The obtained soluble part is then separated, and contains high molecular weight proteins with remarkable fining capabilities towards wine tannins. It is therefore called "yeast protein extract," as opposed to a classic yeast extract coming from a common autolysis process.

In these graphs and pictures, we clearly see that the yeast protein extract shows a distribution of protein oriented towards high molecular weights that can partly mimic the ones present in other fining agents, like gelatin.

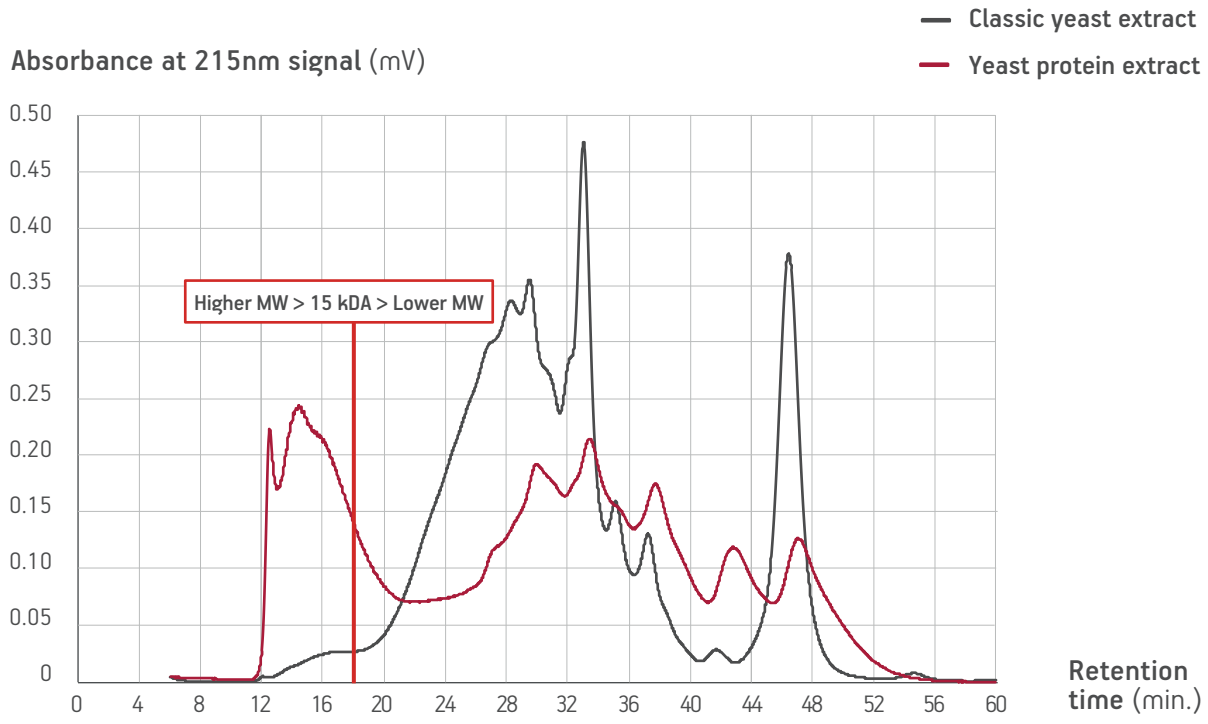
MOLECULAR WEIGHT DISTRIBUTION



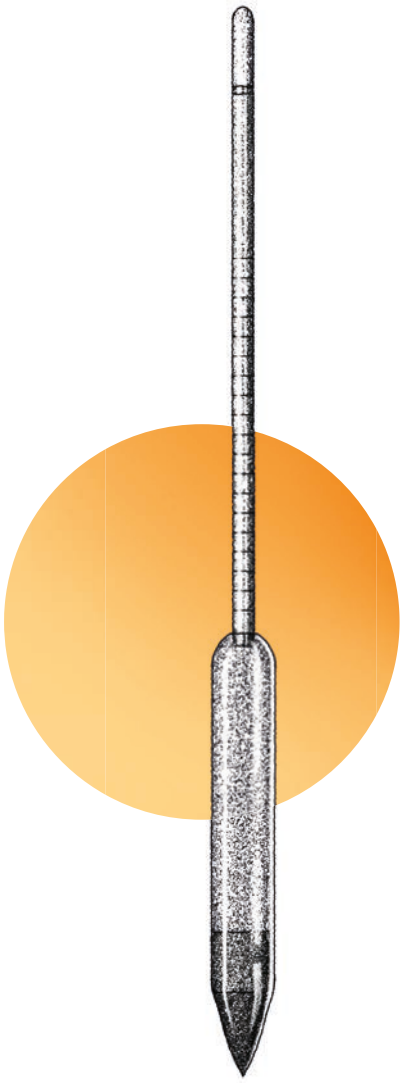
SDS PAGE electrophoresis profiles

This product can thus be used as a fining agent all along the wine elaboration process. However, its well-defined protein distribution, compared to other fining agents, favors its use at the end as a wine "polisher" only removing most bitter and astringent tannins. Besides these properties, this product is not allergenic and is the only fining agent that can be considered as endogenous to wine elaboration, as it is purely issued from yeast.

ABSORBANCE SIGNAL PROTEIN YEAST EXTRACT



Steric exclusion chromatography profiles



YEAST DERIVATIVES RICH IN POLYSACCHARIDES

In this category, we can differentiate two types of products:

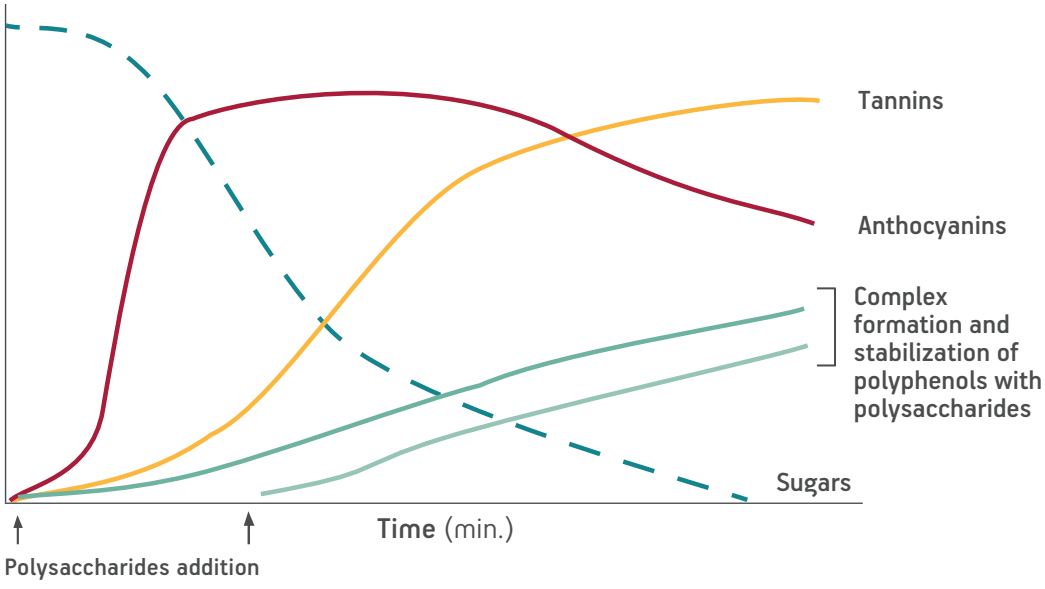
- Inactivated and autolyzed yeasts that will progressively release polysaccharides all along the fermentation and aging process,
- Thermally (Lesaffre's expertise) or enzymatically degraded cell hulls, whose polysaccharides are already solubilized for an immediate action.

The first ones will be used at the beginning of the fermentation, as they will act both ways:

1. Allowing the earliest combination of the polysaccharides with the tannins and the complex tannins-anthocyanins at the same time as they are released from the maceration,
2. Bringing some specific nutrients for the active yeast.

The second ones will be used during aging with an immediate coating effect on tannins and other instable colloids like instable proteins or tartaric acid salts, in order to stabilize the wine and improve its mouthfeel.

IMPACT OF POLYSACCHARIDES ON POLYPHENOLS STABILIZATION



Source: *Richardi.*

OUR FUNC-TIONAL PRO-DUCTS

CONTROL

We are proud to present five different functional products. Aroma, fining, color: all of them will help you work on specific characteristics of your wine. Control before, during or after fermentation is a key factor to obtain the desired balance of your final product, and it's exactly what we offer with this range of products. Find out more about it in the following pages.

5 FUNCTIONAL PRODUCTS

to enhance and/or preserve the quality of your wine

SpringCell™ Color G2

FOR ENHANCED POLYPHENOL AND ORGANOLEPTIC PROFILES

Inactivated yeast

Spring'Finer™

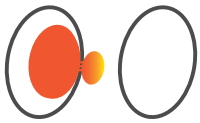
A PERFECT FINING AGENT PRODUCED FROM YEAST

Yeast protein extracts

SpringCell™ Color

FOR STABLE COLOR AND SMOOTHNESS

Inactivated yeasts and Cellular yeast hulls



SpringArom®

TO PRESERVE WINES' FRESHNESS AND AROMAS

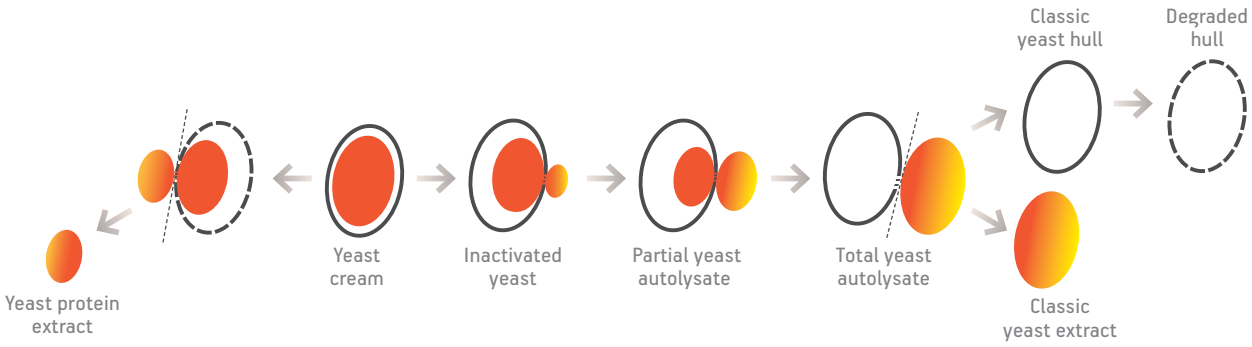
Inactivated yeasts with guaranteed glutathione levels

SpringCell™ Manno

THE BEST OF LEES FOR THE BALANCE, THE RICHNESS AND THE STABILITY OF YOUR WINE

Cellular yeast hulls preparation

GENERAL SCHEME OF YEAST DERIVATIVES PRODUCTION



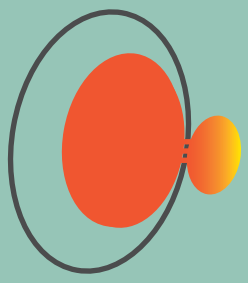
As a reminder, each derivative is mainly composed by a specific part of the yeast. We isolate these parts with a process summarized hereabove and explained in details page 77. You can also find the general composition of each yeast part page 81.

FUNCTIONAL PRODUCT

FOR ENHANCED POLYPHENOL AND ORGANOLEPTIC PROFILES

SpringCell™ Color G2

E2U EASY TO USE by Fermentis



Inactivated yeast

Optimized source of polysaccharides to act on the intensity (tannin content) and stability (tannin-anthocyanin complexes and highly polymerized tannins) of the polyphenolic profile. Helps softening wine mouthfeel. Source of organic nitrogen and vitamins to strengthen yeast metabolism.

BEST SUITED FOR

Full bodied and medium to long ageing premium red wines, strongly macerated must, varieties poorly colored or subjected to color instability.

DOSAGE

20 to 30g/hl.

MOMENT OF ADDITION

Must be incorporated just before the inoculation of yeasts.

ROUNDNESS INCREASE	CLARIFICATION ACTION	COLOR STABILIZATION	ANTIOXIDANT PROTECTION

FUNCTIONAL PRODUCT

E2U EASY TO USE by Fermentis

A PERFECT FINING AGENT PRODUCED FROM YEAST

Spring'Finer™

BEST SUITED FOR

Premium red and white wines, notably aged in barrels, requesting a soft clarification prior to bottling.
Strongly pressed musts and wines.

DOSAGE

Must: 5-20 g/hl.

Red wines: 5-15 g/hl.

White and rosés wines: 1-5 g /hl.

MOMENT OF ADDITION

For wines: most of the time, must be incorporated at the end of the ageing prior to the final filtration.

For musts: directly after settling, before fementation for whites and rosés.

Yeast protein extract

Source of high molecular weight yeast proteins with remarkable fining abilities and non allergenic. Helps precipitating the most astringent and bitter tannins as well as oxidable polyphenols thus improving wine quality and stability.

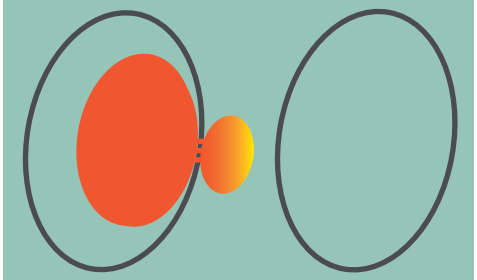
ROUNDNESS INCREASE	CLARIFICATION ACTION	COLOR STABILIZATION	ANTIOXIDANT PROTECTION

FUNCTIONAL PRODUCT

FOR STABLE COLOR AND SMOOTHNESS

SpringCell™ Color

E2U EASY TO USE by Fermentis



Inactivated yeast | Cellular yeast hulls

Source of polysaccharides to improve the quality and stability of the polyphenols. Helps softening wine mouthfeel by coating green tanins. Source of organic nitrogen and survival factors to improve fermentation achievement.

BEST SUITED FOR

Highly tannic and colored red wines, strongly macerated and thermovinified must, varieties poorly colored or subjected to color instability.

DOSAGE

Normal dosage: 20 to 30g/hl. SpringCell™ Color contains yeast hulls that are subjected to usage limit of 40g/hl according to the European legislation and 3lbs/1000gal according to US (TTB) legislation. For higher dosages, please contact Fermentis.

MOMENT OF ADDITION

Must be incorporated just before the inoculation of yeasts.

ROUNDNESS INCREASE	CLARIFICATION ACTION	COLOR STABILIZATION	ANTIOXIDANT PROTECTION

FUNCTIONAL PRODUCT

TO PRESERVE WINES' FRESHNESS AND AROMAS

E2U EASY TO USE by Fermentis

SpringArom®

BEST SUITED FOR

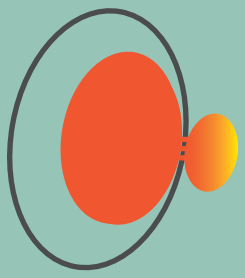
Fresh and fruity young wines, especially whites and rosés sensitive to oxidation regarding their aroma (thiol rich varieties) or color (oxidable polyphenol rich varieties).

DOSAGE

20 to 30g/hl.

MOMENT OF ADDITION

Immediately after pressing or settling and just before the inoculation of yeasts.



Inactivated yeast

Source of natural yeast antioxidants, especially reduced glutathione, protecting color from browning and preserving aromatic molecules as thiols. Improves wine freshness and roundness. Source of organic nitrogen and vitamins to strengthen yeast metabolism.

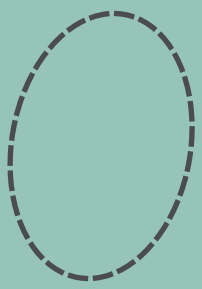
ROUNDNESS INCREASE	CLARIFICATION ACTION	COLOR STABILIZATION	ANTIOXIDANT PROTECTION
			

FUNCTIONAL PRODUCT

THE BEST OF LEES FOR THE BALANCE, THE RICHNESS AND THE STABILITY OF YOUR WINE

SpringCell™ Manno

E2U EASY TO USE by Fermentis



Cellular yeast hulls preparation

Source of soluble manno-proteins that act on astringency decrease, color stabilization, oxidation/reduction phases leveling. Can be substituted to the natural lees to avoid microbiological and/or flavor deviations.

BEST SUITED FOR

Highly astringent and deeply colored red wines. All types of early market release wines with a lack of roundness.

DOSAGE

Normal dosages: Red wines: 20 to 40 g/hl. White wines: 10 to 30 g/hl. Maximum dosage is 40g/hl as yeast hulls are subjected to usage limit of 40g/hl according to the European legislation and 3lbs/1000gal according to US (TTB) legislation.

MOMENT OF ADDITION

At the beginning of ageing.

ROUNDNESS INCREASE	CLARIFICATION ACTION	COLOR STABILIZATION	ANTIOXIDANT PROTECTION
●	◒	◒	◒

FUNCTIONAL PRODUCTS

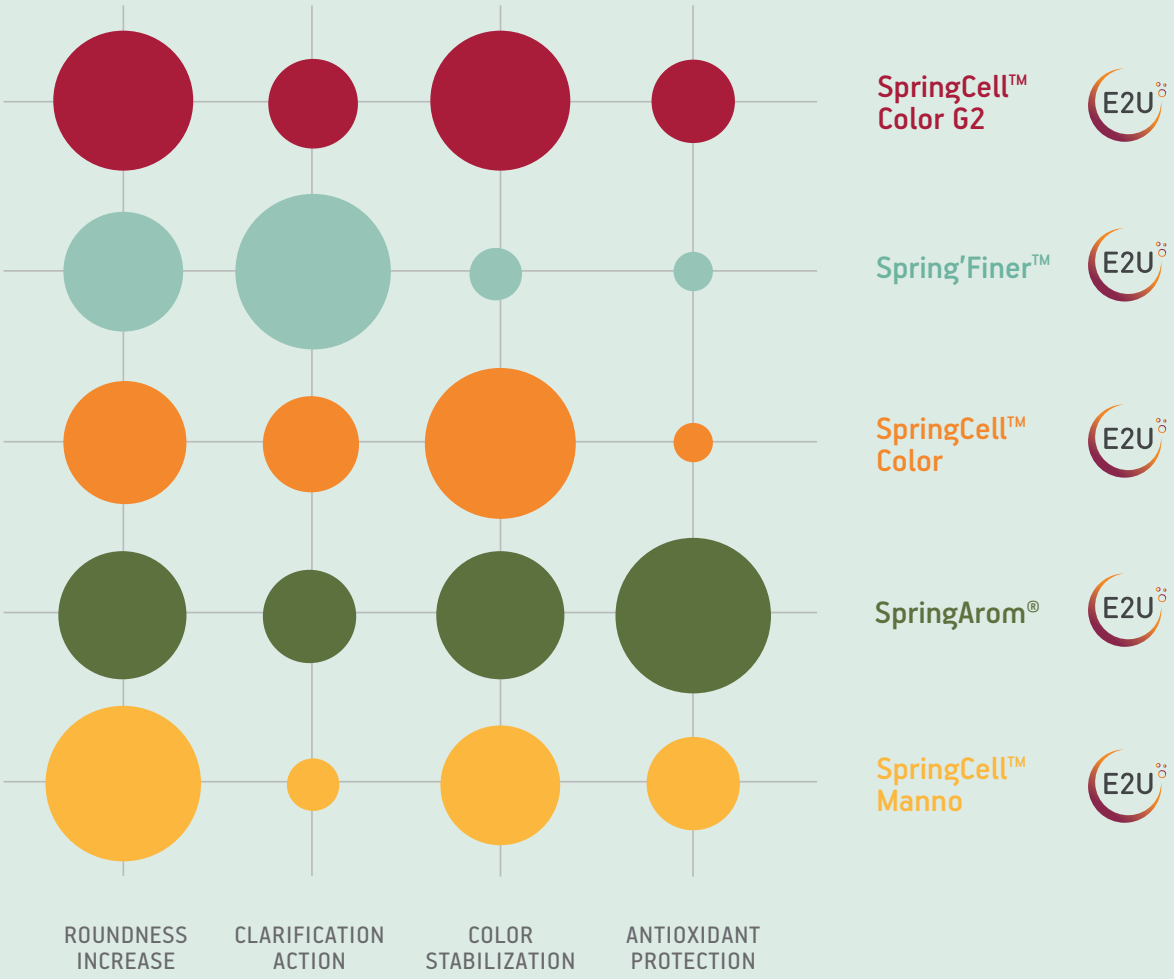
TO EASE YOU THE UNDERSTANDING OF OUR FUNCTIONAL PRODUCTS, ALL OUR R&D EXPERTS HAVE CONDUCTED A LOT OF TRIALS TO PUT FORWARD THEIR MAIN CHARACTERISTICS.

NOW...

MAKE YOUR CHOICE

CHARACTERISTICS HIGHLIGHTS

RELATIVE CONTRIBUTION



COMMENTS

The lees provide many yeast compounds with properties that enhance wine quality during ageing. Resistance to oxidation, greater roundness, color stability and even natural clarification are among the advantages that are mainly due to the presence of yeast peptides and proteins, along with specific polysaccharides. Functional products are based on these findings to provide winemakers with precise refining tools to preserve or even improve the quality of their wines. Our common goal being to provide even more pleasure to the amateurs of quality wines.

TARTARIC STABILIZATION EFFECT OF SPRINGCELL™ MANNO

Cabernet Sauvignon – Argentina 2012

Must parameters

Potential alcohol (% vol.)	**15.0**
Sugars (g/L)	**252**
Total acidity (g H_2SO_4/L)	**4.76**
pH	**3.6**
Malic acid (g/L)	**3.06**
Free SO_2 (mg/L)	**/**
Total SO_2 (mg/L)	**/**
YAN (mg/L)	**210**
YAN / S	**0.83**
Yeast BC S103 (g/hl)	**20**
Nutrients (g/hl)	**/**
AF temperature (°C/°F)	**24-26 / 75.2-78.8**
Free SO_2 adjustment end of AF (ppm)	**35**

Addition of SpringCell™ Color/SpringCell™ Color G2 or SpringCell™ Manno at 30g/hl at yeast inoculation

COMMENTS

SpringCell™ Manno shows a slight increase of the potassium hydrogenotartrate solubility, leading to a drop of conductivity of less than 5%, which is considered stable. Morever, pure mannoproteins extracted from SpringCell™ Manno showed efficiency towards tartaric and proteic precipitations according to COEI-1-MANPROT: 2004 OIV resolution tests, meaning that such components have the required colloidal action when the insoluble part of the yeast hull is removed.

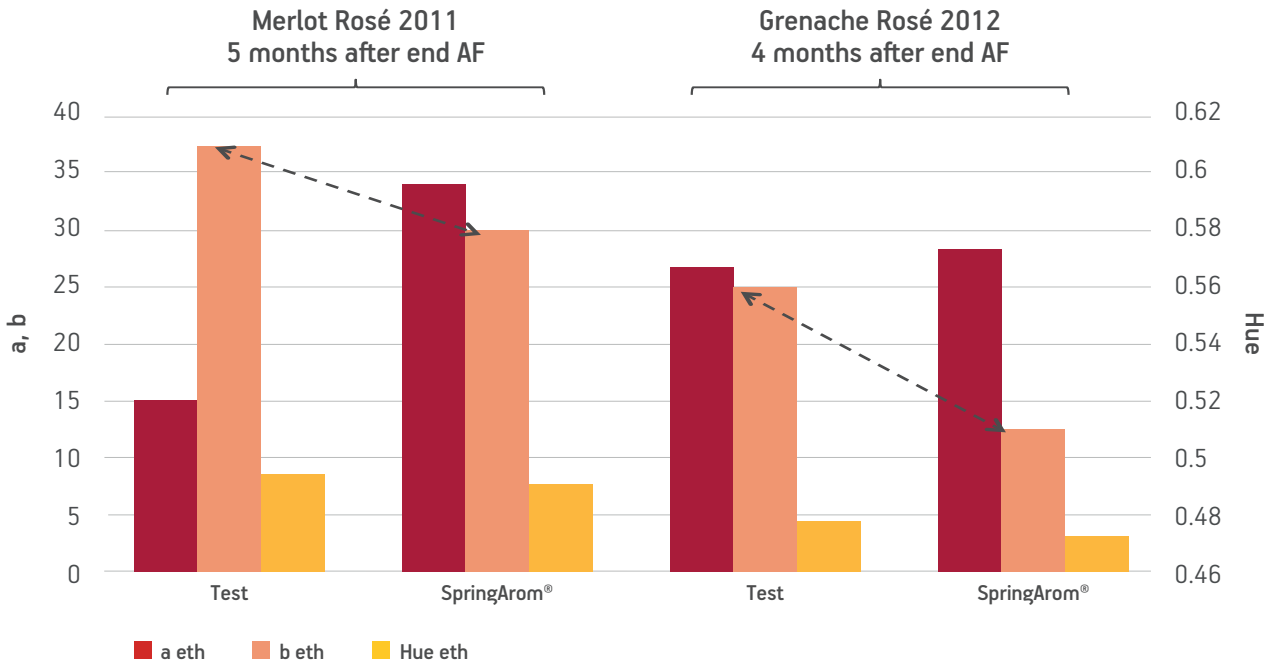
EVALUATION OF THE TARTARIC STABILITY

	TARTARIC STABILIZATION TESTS	
	CONDUCTIVITY DECREASE (% TOLERANCE <5%)	COLD TREATMENT (4° C, 4 DAYS)
CONTROL	6.68	NEGATIVE
SPRINGCELL™ MANNO	3.26	NEGATIVE

Minicontact method proposed by Martin Vialatte company (1984)

EFFECT OF THE SPRINGAROM®

EFFECT ON COLOR OF SPRINGAROM ADDED AT YEAST INOCULATION (KEY MOMENT 1)



Must parameters	Merlot rosé 2011	Grenache rosé 2011
Potential alcohol (% vol.)	11.5	14.1
Sugars (g/L)	193.5	237.3
Total acidity (g H_2SO_4/L)	3.3	3.5
pH	3.64	3.4
Malic acid (g/L)	2.7	1.7
Free SO_2 (mg/L)	/	6
Total SO_2 (mg/L)	18	27
YAN (mg/L)	159	120
YAN / S	0.82	0.51
NTU	100	/
Yeast reference (g/hl)	25	20
Nutrients (g/hl)	40	30
AF temperature (°C/°F)	17/62.6	17/62.6
Free SO_2 adjustment end of AF (ppm)	20	20

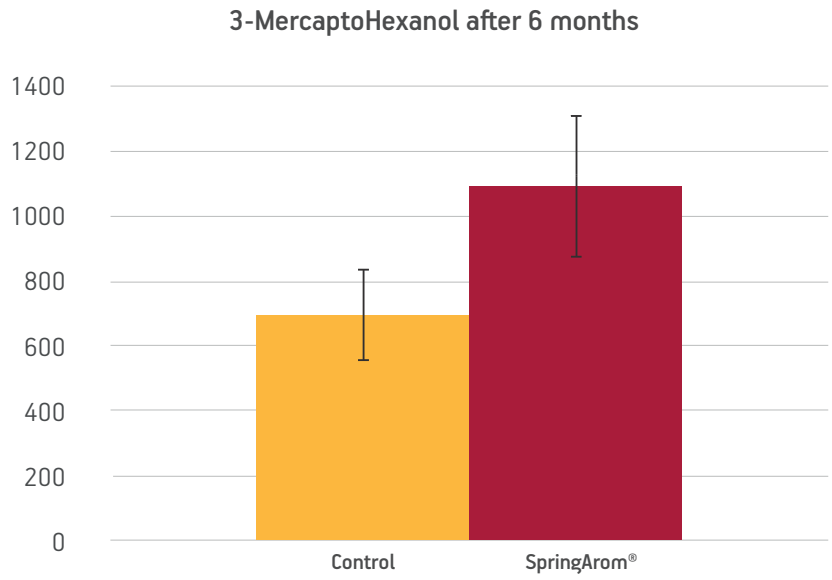
Addition of SpringArom® at 30g/hl after settling

COMMENTS

We see in this graph the potential of SpringArom® to maintain the red color and limit the apparition of yellow color synonym of polyphenol oxidation. This effect is even more important as the variety contains anthocyanins that are particularly sensitive to oxidation, such as Grenache.

A and b respectively represent the tristimulus coordinates of the red and yellow color in the CIELAB color space. The hue represents the ratio between both optical densities at 420nm (yellow color) and 520nm (red), thus illustrating the orientation of the color towards the yellow notes, i.e. the oxidation level. "eth" means that the values are considered as free from potential SO_2 bleaching effect, i.e. the real ones.

SPRINGAROM® IMPACT ON VOLATILE THIOLS PRODUCTION



COMMENTS

Whereas the addition of SpringArom® did not significantly affect the concentration of volatile thiols just after fermentation, a significant increase was shown after six months in the bottle, even with a quite good protection with SO_2 at bottling. A professional triangular tasting ("Among three samples, in which two are from the same condition and one from another condition... identify which one is different from the others") including six panelists has been carried out in order to assess the organoleptic differences between conditions. This tasting showed a significant difference at 5% threshold between the control and SpringArom® conditions.

Grenache rosé – France 2016

Must parameters

Potential alcohol (% vol.)	13.1
Sugars (g/L)	221
Total acidity (g H_2SO_4/L)	2.68
pH	3.38
Malic acid (g/L)	0.8
Free SO_2 (mg/L)	/
Total SO_2 (mg/L)	/
YAN (mg/L)	186
YAN / S	0.84
NTU	120
Yeast BC S103 (g/hl)	20
Nutrients (g/hl)	/
AF temperature (°C/°F)	15/17
Free SO_2 adjustment end of AF (ppm)	23

Addition of SpringArom® at 30g/hl after settling

EFFECT OF SPRINGCELL™ COLOR,

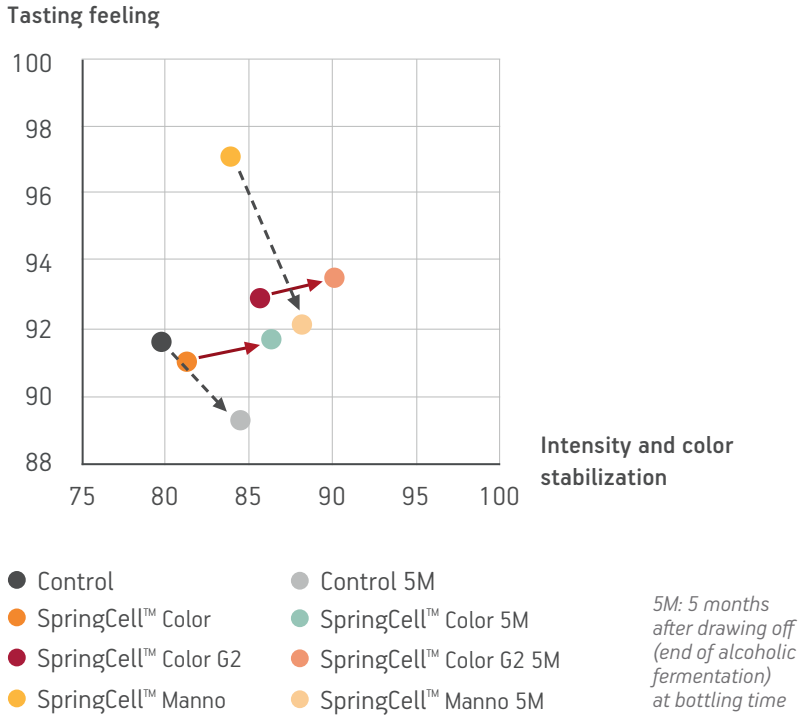
COLOR STABILIZATION AND MOUTHFEEL IMPROVEMENT OF YEAST DERIVATIVES RICH IN POLYSACCHARIDES

There are a lot of different analyses to define the polyphenolic profile of wines. Analyzing them one by one is possible but doesn't often lead to clear conclusions. For that reason, Professor N. Richardi proposes both following methods:

Main component analyses :
This method groups together the data related to the sensations we perceived: the taste and the visual components. The analyses or indexes integrated in the main component analyses are expressed in percentage of a reference value. These percentages are then summed up and determine the global percentage in regard to the referenced wine.

- **Visual component:** Color intensity, quality and stabilization. Combination of Color intensity, Color Hue (related to color quality), IPT (related to color intensity and stability), Molar ratio tanins anthocyanins, (related, with IPT, to color stabilization), Tannins-Anthocyanins, (related to color stability)
- **Taste component:** Body, Smoothness and Tanicity. Combination of Alcohol (related to body and smoothness), Total Extract, (mainly related to body), Ethanol index (strongly related to smoothness), Tannic power (related to tanicity), IPT (Phenolic richness related to body and tanicity).

MAIN COMPONENT ANALYSES



COMMENTS

In this experiment, we can compare the effects of all products in the Fermentis range related to polysaccharides and their availability or release during the fermentation and the aging process. Both SpringCell™ Color and Color G2 have low soluble polysaccharides content at the beginning, which are released during maceration. This lead to the same kind of effect, but was enhanced through SpringCell™ Color G2 use. That is, the pure, specific inactivated yeasts could have a better effect on the colloidal stabilization of the wine by releasing the right amount of polysaccharides and other

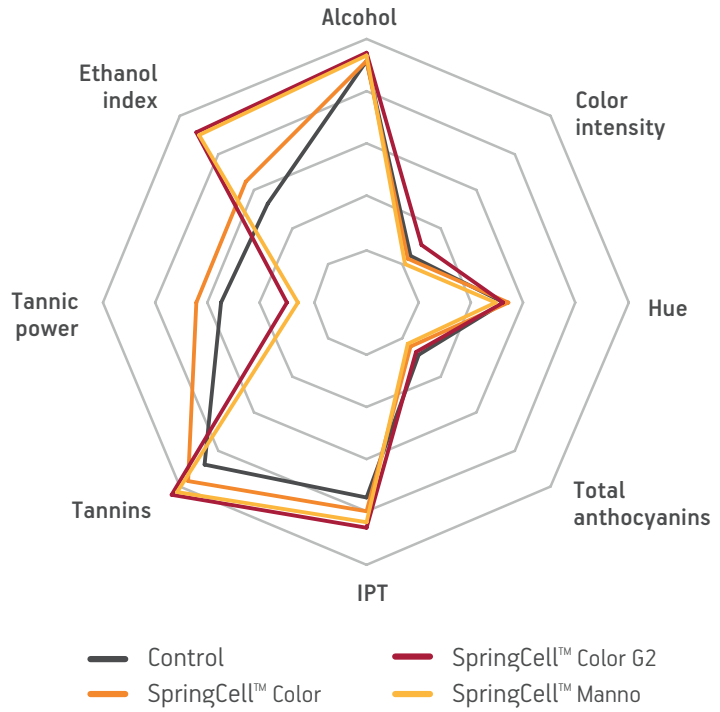
SPRINGCELL™ COLOR G2 & SPRINGCELL™ MANNO

SPRINGCELL™ COLOR *VS* SPRINGCELL™ COLOR G2.

If you need more information about the respective effects of both products on polyphenolic profiles, see the SpringCell™ Color G2 product sheet on page 130.

Polyphenolic profile: In this case the color, tanicity and unctuosity of the wine is illustrated by a spider graph grouping eight analyses, also expressed in percentage related to reference values.

POLYPHENOLIC PROFILE AFTER 5 MONTHS



Cabernet Sauvignon –
Argentina 2012

Must parameters

Potential alcohol (% vol.)	15.0
Sugars (g/L)	252
Total acidity (g H_2SO_4/L)	4.76
pH	3.6
Malic acid (g/L)	3.06
Free SO_2 (mg/L)	/
Total SO_2 (mg/L)	/
YAN (mg/L)	210
YAN / S	0.83
Yeast BC S103 (g/hl)	20
Nutrients (g/hl)	/
AF temperature (°C/°F)	24-26/ 75.2-78.8
Free SO_2 adjustment end of AF (ppm)	35

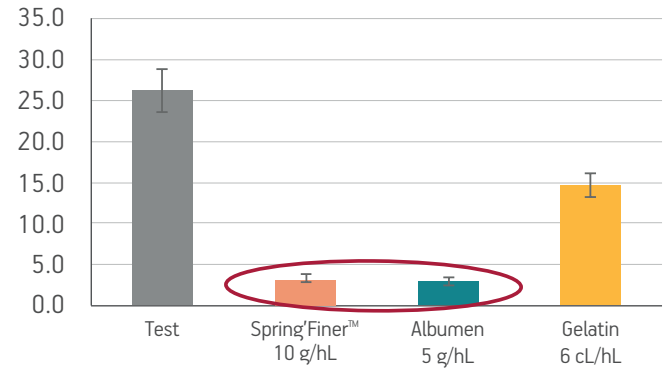
Addition of SpringCell™ Color/SpringCell™ Color G2 or SpringCell™ Manno at 30g/hl at yeast inoculation

intracellular compounds, which would improve polyphenol stability (tannin-anthocyanin and tannin polymerization degree) and coating actions (Ethanol index), as opposed to a mix with non-degraded yeast hulls, probably adsorbing part of the polyphenols. On the contrary, degraded yeast hulls like SpringCell™ Manno with a high content in soluble polysaccharides have a strong immediate effect after fermentation, especially on the mouthfeel (coating effect), but less stable and less effective towards polyphenol stability, making this product a great corrective tool.

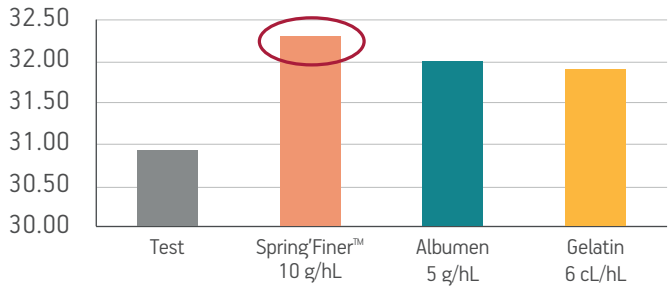
EFFECT OF SPRING'FINER™

CLARIFICATION ABILITIES

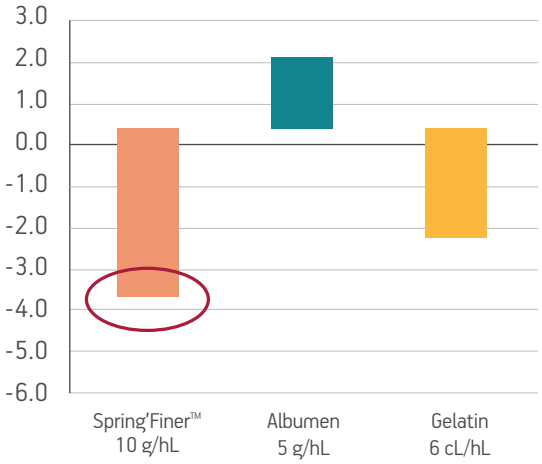
Final turbidity (NTU)



Brillance



Oxydation sensitivity (%)



Acting on clarification and oxydation sensitivity

Cabernet Sauvignon – France 2014

Must parameters

Potential alcohol (% vol.)	**13.6**
Sugars (g/L)	**< 1.0**
Total acidity (g H_2SO_4/L)	**3.63**
pH	**3.59**
Free SO_2 (mg/L)	**22**
Total SO_2 (mg/L)	**40**
Turbidity (NTU)	**55**

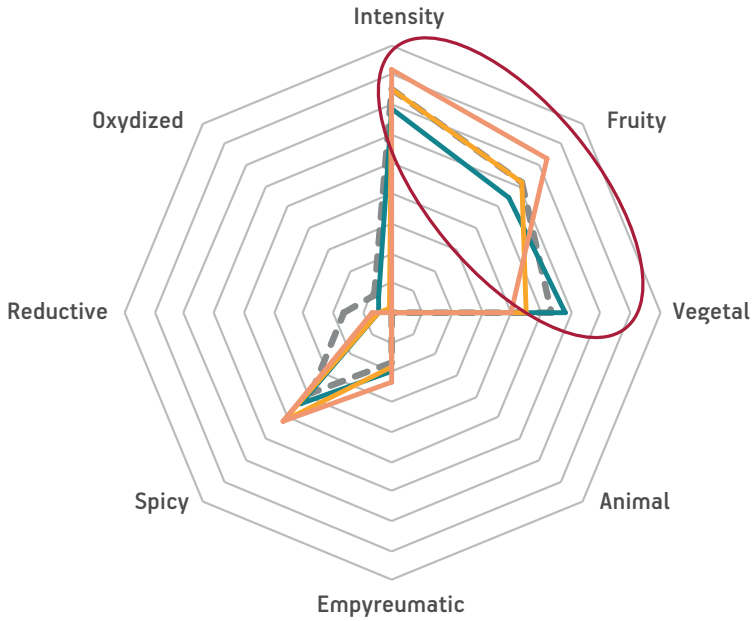
The wine has been fined in 10L jerrycans over eight to ten days, then drawn off and filtered on 1.2 µm membranes. Free SO_2 was adjusted to ~30ppm and CO_2 at ~400mg/L Oxidation sensitivity of the wines were measured by a test developed by Sofralab company consisting of oxidizing the wines with hydrogen peroxide and measuring the change in optical density at 420nm (yellow color)

COMMENTS

Spring'Finer™ shows a slower but equivalent clarification action compared to reference fining agents like gelatin and albumin. However, it seems that yeast proteins are acting in a gentler way and specifically towards the most oxidizable polyphenols, making the wines less sensitive to oxidation. This specific action also helps to remove the most bitter and astringent (reactive) tannins, improving both olfactive and gustative notes with a globally rounder and more balanced mouthfeel.

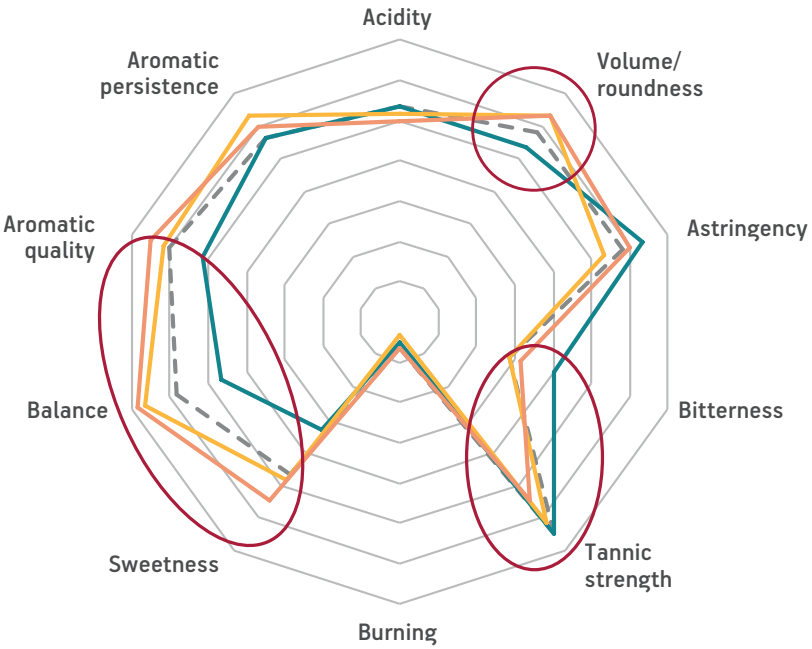
ORGANOLEPTIC EFFECT

Olfactory aspect



Fruitiness expression increase with more intensity and less vegetal

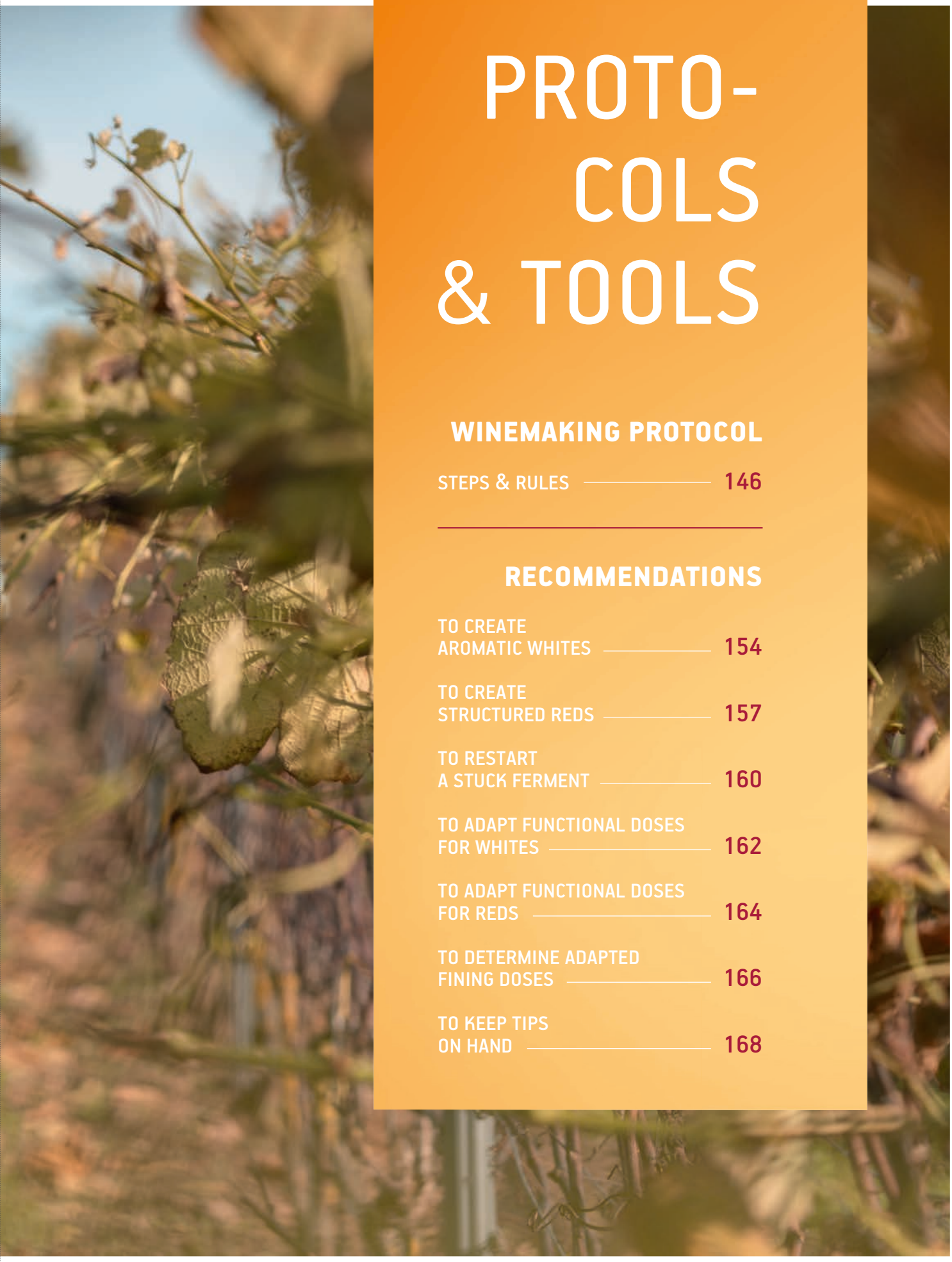
Mouthfeel aspect



Test
Gelatin 6 cL/hL
Albumen 5 g/hL
Spring'Finer™ 10 g/hL

Tannicity decrease for better balance and sweetness

Professional panel (12 tasters)



PROTO-COLS & TOOLS

WINEMAKING PROTOCOL

RECOMMENDATIONS

Winemaking protocol. Steps & rules.

Fermentis specializes in the production and application of yeasts and yeast derivatives to help winemakers produce precisely the type of wine they wish. Even as the selection of yeast and its correct use is critical, we fully understand there are many more aspects in winemaking that influence the final result. **Our goal in this chapter is to present "tips and tricks" on how to use our products** to enhance your outcomes from a "yeast" point of view.

Several logical steps are involved in the elaboration of a fermentation protocol and for each, there are different tools to help you make your choice. Below is a review of some of the questions you should ask yourself, and the related Fermentis tools that can help you with the answers.

STEP	QUESTIONS	TOOLS TO ANSWER	SPECIFICITIES YOUR ANSWER INVOLVES
STEP 1	What type of wine do I wish to make?	**Use** • Maps for Reds + Whites and Rosés • Map for technical characteristics • Table for yeast characteristics overview • Technical data sheets • Wine App • THIS CATALOGUE!	This will guide you all along your choices.
STEP 2	Does this type of wine 1. Require a strong clarification? 2. Express varietal flavors? If so, which ones? 3. Present sensitivity to oxidation? 4. Present sensitivity to color lack or loss?		After answering to all these questions, the selection of a yeast and a nutritional/ functional protocol will be defined.
STEP 3	Which yeast should I select for this type of wine?		This selected yeast has **specific aroma release/production (step 2, case 2)**, kinetics, alcohol resistance, nutrient needs and optimum working temperature.
STEP 4	Do I know the "yeast-related" critical parameters of my must, i.e. its Potential Alcohol/ Sugar concentration, YAN and turbidity (after clarification for whites and rosés)?	Only measurements can tell you that!	According to the selected yeast and these parameters, a specific nutrition protocol will be applied. Eventually, you will have to re-select the yeast according to Potential Alcohol and YAN needs.

STEP	QUESTIONS	TOOLS TO ANSWER	SPECIFICITIES YOUR ANSWER INVOLVES
STEP 5	What protocol of nutrition should I apply and with which nutrients?	Apply the "3 key moments" protocol, according to steps 2, 3 and 4 answers. **Use** • Fermentation aids composition graphs • Technical data sheets • Wine App • THIS CATALOGUE!	Depending on step 2 answers, add or replace **SpringFerm™** (step2., case 1.) before yeast inoculation by **SpringArom®** (step 2., case 3.) or **SpringCell™ Color/G2** (step 2., case 4.).
STEP 6	What is the best fermentation temperature to best express the type of aromas I want?	**Varietal flavors (step 2., case 2.) are better expressed at higher temperature (18 - 20°C) than fermentation aromas (14 - 18°C)**	Temperature control equipment will be needed in some cases.
STEP 7	Do I need to make the malolactic fermentation?	Malolactic bacteria are sensitive to medium chain fatty acid toxicity and have the ability to eat small peptides. They optimally ferment between 18 and 22°C. **Use** • Detoxification properties of **SpringCell™** • Small peptides availability of **SpringFerm™ Xtrem or ViniLiquid™**	Bacteria are like yeast, as they have specific aromatic features and working requirements. Refer to malolactic bacteria manufacturers' use to select the best one for your wine.
STEP 8	Is my wine missing something in terms of taste after alcoholic fermentation?	**Use** • Contribution graphs of functional products • Technical data sheets • Wine App • THIS CATALOGUE! Especially: • **SpringCell™ Manno** for roundness increase • **Spring'Finer™** for fining	Make preliminary dosage tests of our functional products before applying to the whole volume!

The selection and use of active yeast is pretty much self-explanatory. On the other hand, the selection and use of yeast derivatives is more specific and complicated.

To clearly understand all of our protocols and to become a master, you will find below some explanations on steps 5, 7 and 8.

STEP 5

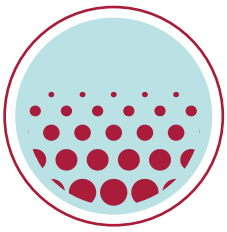
EXPLANATIONS

According to the selected yeast and the analyses of the initial must (steps 3 & 4 answers), a specific nutrient-addition program will have to be applied according to the three key moments of the fermentation p.92-93.

Below is a general overview of the program you will find in all our protocols, with related instructions:

		MOMENT OF ADDITION			
		BEFORE YEAST INOCULATION	**AT YEAST INOCULATION**	**AT 25 % OF THE SUGAR CONSUMED** Most of the time: at initial density – 20 (in g/L)	**AT 35 - 45 % OF THE SUGAR CONSUMED** Most of the time: at initial density – 30/40 (in g/L)
YAN NEEDED (mg/L)	**<40 PPM**	Ø or **SpringFerm™** According to recommended turbidity levels	Ø	10mg/l **Oxygen** supply or at least a pumping over with full aeration	**SpringFerm™**
	>40 PPM	½ YAN need with **DAP**		½ YAN need with - **SpringFerm™ Xtrem** or **ViniLiquid™** - DAP if needed - **SpringCell™** if needed	

From now, we share several concepts derived from Fermentis' experience:



TURBIDITY LEVEL COMPENSATION

Strong clarification is not always related to strong nutrient deficiency. However, it is still a good indicator of a possible link. To compensate for this, we can use mostly insoluble yeast derivatives like SpringCell™ and SpringFerm™. SpringCell™ is a great tool to supply support elements and oxygen substitutes (see "focus on oxygen" p.89 and "effect of SpringCell™" p.106-107). However, this product doesn't have any vitamins, minerals and available nitrogen, which are also very useful at the beginning of fermentation. That's why we prefer recommending SpringFerm™ for this purpose.

SpringArom® and SpringCell™ Color (/G2) are close to SpringFerm™ composition, while having an extra function (richness in antioxidant or in polysaccharides). If these products are appropriate to use for the type of wine you want, they can replace the use of SpringFerm™ at that stage, thus acting on both fields.

TOTAL AMOUNT OF YAN NEEDED – PRELIMINARY CALCULATION

According to the yeast you selected, the Fermentis "Make Your Choice" table provides two different figures:

- A minimum ratio YAN (mg/L) / Sugars (g/L) and
- An absolute minimum content of YAN needed for the yeast to ferment correctly.

The total amount of YAN needed in mg/L is calculated as follows: Concentration of sugars (g/L) x Ratio for the selected yeast (mg/g). If this calculation gives a value < to the absolute minimum of YAN required, you will have to adjust to at least the absolute minimum value. We consider that, whatever the initial sugars, at least a minimum amount of YAN is always needed by the yeast to achieve a good growth and population.

NUTRIENT TYPE CHOICE AND ADDITION MOMENTS

According to the "Fermentation Management" section (previous page), we consider that

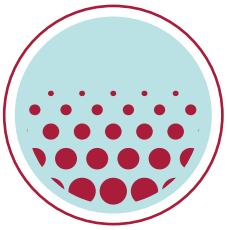
- In case of weak nutrient deficiency (<40 ppm of YAN needed), one single addition of nutrient at 1/3-1/2 fermentation is enough, as there are sufficient nutrients in the must to achieve good growth and population, and that there is only a need of nutrients to allow a correct fermentative metabolism of the yeast.
- In case of strong nutrient deficiency (>40 ppm of YAN needed), one addition is needed at the beginning to achieve a good growth and subsequent population, then another addition is needed at 1/3-1/2 fermentation to allow a correct fermentative metabolism. To make it simple, it is almost always sufficient to add half of the needed YAN dose at each moment.
- Mineral nitrogen (Diammonium phosphate – DAP) is favored at the beginning of the fermentation, while amino nitrogen is preferred during the stationary phase (see the "Focus on Nitrogen" section, p.87).

FERMENTATIVE POWERS

To express the complexity and efficiency of nutrients like SpringFerm™, SpringFerm™ Xtrem or ViniLiquid™, their fermentative power is expressed in "YAN equivalent," see p.90-91. This value will be used in our protocols to calculate the dose you should apply to achieve the amount of YAN needed.
In addition to our experiments and information in the Fermentation Aids Performance section, p.104 to 110, refer to this table to find the estimated fermentative powers of our nutrients:

PRODUCT	ML/HL	G/HL	MG/L	YAN EQUIVALENT (PPM)	YAN EQUIVALENT (%)
SpringFerm™		20.0	200.0	10.0	5.0
SpringFerm™ Xtrem		20.0	200.0	20.0	10.0
ViniLiquid™	50.0	17.4	174.4	20.0	11.5

Exception! In case of weak nutrient deficiency (<40 ppm of YAN needed), we know that the complexity and the polyvalence of SpringFerm is still sufficient, even compared to a "YAN equivalent" content of 10% like the SpringFerm™ Xtrem. You can, of course, still use SpringFerm™ Xtrem, but this could save money and still achieve positive efficiency.



40 PPM LIMIT FOR YAN NEEDS

Based on the old fact that more than 40 g/hl of a yeast nutrient could impart some "yeasty" flavors, and considering the fermentative powers of our nutrients (see previous table) for which 40 g/hl corresponds to 40 ppm of YAN equivalent and brings more than enough complex nutrients, we advise you to limit the dose of our fermentation aids to the equivalent of 40 g/hl for nutritional purpose, and to distinguish weak and strong deficiencies with this 40 ppm limit.

If you exceed this limit, DAP could be used to compensate the extra deficiency.

OXYGENATION

See the Fermentation Management section, p.91.

Remember that oxygen is crucial for yeast and that oxygenation at the end or just after the growth phase will always be beneficial. A pumping over with aeration in red traditional winemaking is considered to provide 3 to 4 mg/L of oxygen – an amount much better than nothing!

40G/HL FOR YEAST NUTRIENTS: A GLASS CEILING?

Regarding organic fermentation aids authorized by the OIV, only one has a limit usage dose: the yeast hulls. This is partly due to the fact that this was the first yeast derivative allowed in wine production and in the past, yeast hulls were not as purified as today. As a consequence, **a too high dose of yeast hulls could impart strong "yeasty" flavors,** which explains the chosen limit. Nowadays, yeast hulls are of a much better quality, yet are still limited in use. Inactivated and autolysed yeasts do not have such limitations, and exceeding 40 g/hl in total with different yeast derivatives is not a problem from an organoleptic point of view.

SPRINGCELL™ OR NOT SPRINGCELL™?

SpringCell™ yeast hulls only figure optionally in this program. This is to highlight that most of the time, the must will have sufficient dissolved oxygen to ensure a good fermentation, especially if there is oxygenation at moment 2.

However, in case of high alcohol wines (>14 % v/v) or incorrect oxygenation, the stress applied to the yeast can be dramatic and lead to membrane dysfunctions. In order to slow down these effects, the detoxifying properties of yeast hulls can be very useful (see the Effect of SpringCell™, p.106-107).

All these concepts explain the Dose Calculation Instructions section you will have in our protocols, see the Protocol Example section, from the p.154.

STEP 7

EXPLANATIONS

In case a malolactic fermentation is needed, the idea is to favor the conditions for the bacteria to ferment in a good way. Firstly, you will have to select bacteria that are adapted to your wines according to manufacturers' documentation and advise.

Even if these selected bacteria are strong, they all have limitations towards pH, sulphites, alcohol and temperature. As long as you are able to set up a correct temperature (most preferably between 18 and 22°C) and potentially adjust the pH and/or limit SO_2 doses, the only parameter you won't be able to change is the alcohol level. For that reason, we advise you to boost your bacteria in two ways:

When the alcohol IS NOT REALLY LIMITING

It could be very efficient to only clean the environment for the bacteria to evolve in a good way. The detoxifying properties of SpringCell™ yeast hulls could therefore be very useful.

When the alcohol LEVEL STARTS TO BE HIGH

Bacteria will suffer and detoxification actions may not be sufficient. We then recommend you maximize your chances by using the content in small peptides of fully autolyzed yeast, like SpringFerm™ Xtrem or ViniLiquid™ at standard doses (10 g/hl or 25 ml/hl).

STEP 8

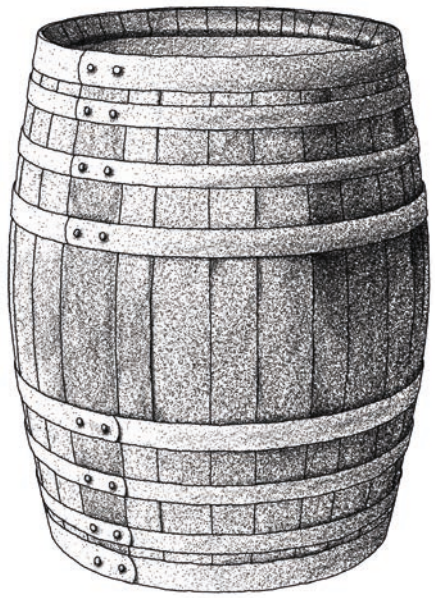
EXPLANATIONS

This step is always optional and just intended to improve the quality of your wine based on preliminary tasting.

Use of SPRINGCELL™ MANNO

This is related to the roundness/astringency of your wine. Depending on the winemaking process and the selected yeast giving more or less roundness after fermentation, we have some recommendations for the possible dosage of SpringCell™ Manno and the contact time to get the best result. This product is particularly useful if you want to accelerate the roundness uptake and if the quality of your lees is too bad to be used during ageing (microbiological or sulfury deviations).

A quick way to assess the effect of SpringCell™ Manno (and SpringArom, SpringCell™ Color or Color G2 if used at the end of fermentation or during ageing) in your wine is available in the Winemaking Tools section, p.162 to 165.



Use of SPRING'FINER™

Spring'Finer™ has to be considered like all other fining agents based on proteins in terms of usage (clarification, removal of bitter and astringent tannins, etc.) and as such, dosage evaluation tests are compulsory before use. A method to evaluate the required dose of Spring'Finer™ in your wine is presented in the Winemaking Tools section, p.166.

Recommendations to create aromatic whites

To help you create an aromatic white wine, **Fermentis has built a specific protocol. Starting from clarification,** it covers different steps and highlights the usage conditions of our very nicely aromatic SafŒno™ CK S102. Follow our recommendations to the letter and everything should go as you hoped.

I ACT PRIOR TO FERMENTATION

We recommend you **manage your clarification with SpringArom™ or SpringFerm™** and adapt their dose depending on your must turbidity as specified below:

MUST TURBIDITY AFTER CLARIFICATION (NTU)	DOSE OF SPRINGAROM® (preferred) OR SPRINGFERM™ (g/hl)
> 100	10
50 - 100	20
≤ 50	30

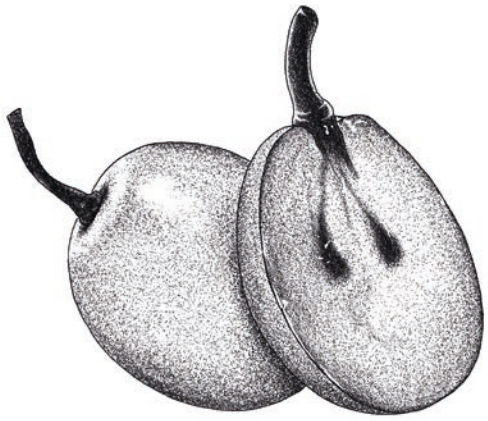
II SELECT YOUR YEAST

For aromatic whites, several yeasts can be selected depending on the target.
Please refer to the classification table p.33.

SELECTED YEAST	WINE STYLE	YEAST AVAILABLE NITROGEN (YAN): MINIMUM REQUIREMENT, RATIO (YAN (mg/l) / SUGARS (g/l))	ALCOHOL TOLERANCE & KINETICS
SafŒno™ CK S102	Good roundness. Floral, amylic and fresh fruit notes. Promotion of Thiols.	220 ppm, 0.9*	Up to 15-15.5% Alc. v/v Very fast fermentation

Follow rehydration and dosage instructions on technical data sheet.

* Minimum requirement means to achieve a complete and clean fermentation. In order to optimize aromatic expression, we recommend to increase YAN adjustment up to ratio = 1.



III MANAGE THE ALCOHOLIC FERMENTATION

NUTRIENT ADDITION PROGRAM:

YAN NEEDED (mg/L) \ MOMENT OF ADDITION	BEFORE YEAST INOCULATION	AT YEAST INOCULATION	AT 35-45% OF THE SUGARS CONSUMED (initial density -30/40)
≤ 40 PPM	**SpringArom® or SpringFerm™** see previous table	Ø	**SpringFerm™**
> 40 PPM		½ YAN needs → DAP	½ YAN needs - **SpringFerm™ Xtrem** or **ViniLiquid™** - DAP if needed - **SpringCell™** if needed

DOSE CALCULATION INSTRUCTIONS:

- Total amount of YAN needed in mg/L: concentration of sugar (g/L) x Ratio for selected yeast (mg/g). If this calculation gives a value < minimum YAN required, **please adjust at least to the minimum.**
- YAN adjustment at yeast inoculation with DAP considering that 10g/hL DAP supplies 20 ppm of YAN.
- YAN adjustment at 35-45% of the sugar consumed considering that 20 g/hL of **SpringFerm™**, 20 g/hL of **SpringFerm™ Xtrem** or 50 ml/hl **ViniLiquid™** supplies 20 ppm of YAN. Over 40 ppm of YAN needed, complete with DAP.
- Add 20 g/hl of **SpringCell™** during the second YAN adjustment if the potential alcohol (PA) is >14 % v/v (23.3 °Bx) and/or if a correct oxygenation is not possible after 25 % of the sugar are consumed.

EXAMPLE

Must clarified at 90 NTU and at 20.2 °Bx= 220 g/L sugar, initial YAN = 120 mg/L, PA= 13 % v/v. CK S102.

- SpringArom® at 20g/hL.
- YAN needed: 0.9*220 ~ 120 ppm 80 ppm to be added.
- Amount of YAN to be added at yeast inoculation: 0.5 x (200-120) = 40 ppm, i.e. 40 / 2 = 20g/hL DAP.
- Amount of YAN to be added at 35-45 % of the sugar consumed: 0,5 x (200-120) = 40 ppm, i.e. 40 g/hL SpringFerm™ Xtrem or 100 ml/hL of ViniLiquid™.

FERMENTATION TEMPERATURE:

SELECTED YEAST	RECOMMENDED TEMPERATURE DURING FERMENTATION
SafŒno™ CK S102	< 14°C for maximized concentration of esters remaining after fermentation > 18°C for promotion of grapes' aromas (especially thiols)

OXYGEN SUPPLY MANAGEMENT:

10 mg/l oxygen supply or at least a pumping over with full aeration is needed after 25 % of the sugar consumed (initial density – 20).

FORGET THE MALOLACTIC FERMENTATION

It is obviously not wanted!

PILOT THE END OF FERMENTATIONS AND AFTER

Fermentis recommends to add **SpringCell™ Manno** at the end of your fermentation or after.

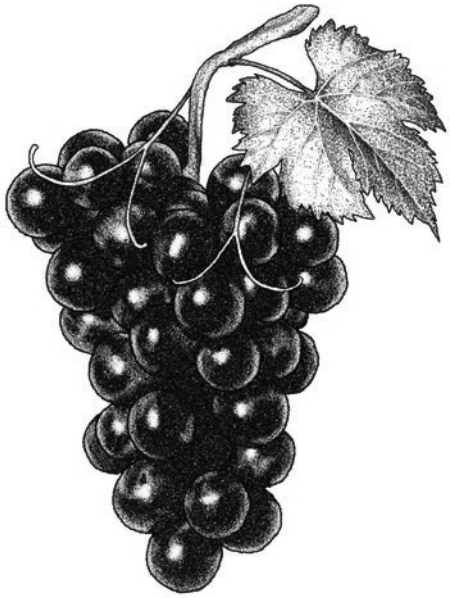
SPRINGCELL™ MANNO RECOMMENDED ADDITION TOWARDS THE END OF THE FERMENTATION (g/hl) *	COMMENTS
10 - 20	**OPTIONAL** (depending on tasting) or **RECOMMENDED** when poor quality lees** or early wine release.

* SpringCell™ Manno must be used depending on tasting and dosage trials if there is a lack of body or if a stabilization towards ageing is needed.

** i.e. microbiological contaminations or reductive notes.

Leave the product on the lees at least 1 month with "bâtonnage" or lees re-suspension at least twice a week.

Recommendations to create structured reds



You want to create an **elegant and structured long ageing red wine?** Fermentis has built this specific protocol for you. It is based on the great capabilities of one of our active dry yeast: SafŒno™ HD S62. Follow our recommendations to the letter and you shall get the wine you really want.

I SELECT YOUR YEAST

We recommend you to choose **SafŒno™ HD S62** for at least three good reasons : it favors high polyphenols extraction and amplifies the final aromatic intensity; it ensures stable color and well polymerized tannins and it shows very strong fermentation abilities. **Now, check the dose!**

SELECTED YEAST	WINE STYLE	YEAST AVAILABLE NITROGEN (YAN): MINIMUM REQUIREMENT, RATIO (YAN (mg/l) / SUGARS (g/l))	ALCOHOL TOLERANCE & KINETICS
SafŒno™ HD S62	High polyphenol extraction favoring and amplification of the aromatic intensity. Stable color and well polymerized tannins.	160 ppm / 0,7	Up to 15-15.5% Alc. v/v Fast fermentation.

Follow rehydration and dosage instructions on technical data sheet

II MANAGE THE ALCOHOLIC FERMENTATION

NUTRIENT ADDITION PROGRAM:

YAN NEEDED (mg/L) \ MOMENT OF ADDITION	BEFORE YEAST INOCULATION	AT YEAST INOCULATION	AT 35-45 % OF THE SUGARS CONSUMED (INITIAL DENSITY -30/40)
≤ 40 PPM	SpringCell™ Color /G2 (optional)	Ø	SpringFerm™
> 40 PPM		½ YAN needs → DAP	½ YAN needs - SpringfFerm™ Xtrem or ViniLiquid™ - DAP if needed - SpringCell™ if needed

DOSE CALCULATION INSTRUCTIONS:

- Before inoculation add 30 g/hl of **SpringCell™ Color or Color G2** to favour the stabilization of the color and to improve the roundness perception if wanted.
- Total amount of YAN needed in mg/L: concentration of sugar (g/L) * 0.7 (mg/g). If this calculation gives a value < 160 ppm, please adjust to 160ppm at least.
- YAN adjustment at yeast inoculation with DAP considering that 10g/hl DAP supplies 20ppm of YAN
- YAN adjustment at 35-45 % of the sugar consumed considering that 20 g/hl **SpringFerm™**, 20 g/hl. **SpringFerm™ Xtrem** or 50 ml/hl **ViniLiquid™** supply 20 ppm of YAN. Over 40 ppm of YAN supply needed, complete with DAP.
- Add 20 g/hl of **SpringCell™** during the second YAN adjustment if the potential alcohol (PA) is >14% (23°Bx) and/or if a correct oxygenation is not possible after 25% of the sugars are consumed.

EXAMPLE

Must at 22.9 °Bx= 250 g/L of sugars, initial YAN = 120 mg/L, PA: 15 %

- YAN needed: 0.7*250 ~ 180 ppm.
- Amount of YAN to be added at yeast inoculation: ½ x (180 - 120) = 30 ppm, i.e. 30 / 2 = 15 g/hL DAP.
- Amount of YAN to be added at 35-45 % of the sugar consumed: ½ x (180 - 120) = 30 ppm, i.e. 30 g/hL SpringFerm™ Xtrem or 75 ml/hl of ViniLiquid™.
- SpringCell™ at 35-45 % sugar consumed: 20 g/hL

FERMENTATION TEMPERATURE:

SELECTED YEAST	RECOMMENDED TEMPERATURE DURING FERMENTATION
SafŒno™ HD S62	20 - 28°C

OXYGEN SUPPLY MANAGEMENT:

10mg/l oxygen supply or at least a pumping over with full aeration is needed after 25% of the sugars consumed (initial density – 20).

III MANAGE THE MALOLACTIC FERMENTATION

NUTRIENT ADDITION PROGRAM:

POTENTIAL ALCOHOL % V/V (°Bx)	**AT 35-45 % OF THE SUGARS CONSUMED** (initial density -30/40)
≤ 13 % (≤ 21.7 °Bx)	**SpringCell™** 10 g/hl
> 13 % (> 21.7 °Bx)	**SpringCell™** 10 g/hl + **SpringFerm™ Xtrem** 10 g/hl or **ViniLiquid™** 25 ml/hl

FERMENTATION TEMPERATURE:

18-22°C

IV PILOT THE END OF FERMENTATIONS AND AFTER

Fermentis recommends to add **SpringCell™ Manno** at the end of your fermentation or after.

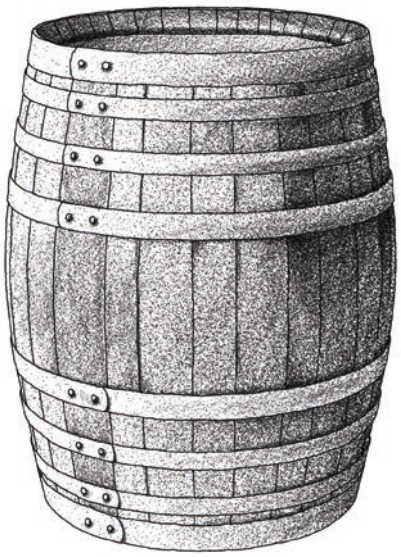
SPRINGCELL™ MANNO RECOMMENDED ADDITION TOWARDS THE END OF THE FERMENTATION *	**COMMENTS**
20 to 35 g/hl	**It is PREFERRED** (depending on tasting) or **RECOMMENDED** when poor quality lees** or early wine release.

* SpringCell™ Manno must be used depending on tasting and dosage trials if there is a lack of body or if a stabilization towards ageing is needed.

** i.e. microbiological contaminations or reductive notes.

Leave the product on the lees at least 1 month with "bâtonnage" or lees re-suspension at least twice a week.

Recommendations to restart a stuck ferment



Making fermentation safe, implementing corrective protocols, giving advice to help turn things around... When fermentation is difficult, our teams can provide emergency assistance. As it happens, and to help you in case of stuck ferment, we have built the following recommendations which shall help you restart your fermentation efficiently.

THE MATERIAL YOU NEED

SPRINGCELL™
SAFŒNO™ BC S103
SPRINGFERM™

To treat 100 hl of stuck ferment

4 kg (40 g/hl) yeast hulls SpringCell™

- 3 kg (30 g/hl) active dry yeast SafŒno™ BC S103
- 1 kg DAP (10g/hl) or DAP/Thiamine mix
- 3 kg (30g/hl) fermentation aid activator SpringFerm™
- 300 g (3 g/hl) of SO_2
- 220 l of non-chlorinated water
- 25 kg of sugar

I TREAT YOUR STUCK WINE

At 20 to 25°C (68 to 77°F)

- Rack off the wine from the lees (for red wines: rack off with aeration and press immediately).
- Add 2-3 g/hl of SO_2.
- Add 4 kg of yeast hulls SpringCell™.
- Make a gentle pumping over to homogenize.
- Wait for 24 - 48hrs and rack off the wine.

II PREPARE A YEAST STARTER

In a tank with a volume ≥ 10 hl

FIRST STEP

- Sprinkle 3 kg of SafŒno™ BC S103 into 30l of clean water at 25-30°C (77° - 86°F).
- Wait for the rehydration of most of the yeasts and gently homogenize.
- Wait for 15 minutes.

SECOND STEP

Add :

- 30 l of treated stuck wine as mentioned above
- 40 l of non-chlorinated water at 25 -30°C (77 - 86°F)
- 10 kg of sugar
- 100 g of SpringFerm™
- 100 g of DAP or DAP/Thiamine mix

Follow the density and start the acclimatization of the yeast starter when it reaches d=1,000 (1.5 °Bal/Brx).

III ACCLIMATIZE YOUR STARTER

At 20 to 25°C (68 to 77°F)

FIRST STEP: 500 LITERS

Add to the yeast starter:

- 250 l of treated stuck wine
- 150 l of non-chlorinated water at 20 -25°C (68 - 77°F)
- 15 kg of sugar
- 400 g of SpringFerm™
- 400 g of DAP or DAP/Thiamine mix

Leave for 24hrs before starting the second step.

SECOND STEP: 10 HL

Add :

- Add 500 l of treated stuck wine to the previous 500 l.
- Add 500 g of SpringFerm™ + 500 g of DAP or DAP/Thiamine mix.
- Homogenize and leave for 3hrs before pitching.

IV PITCH YOUR YEAST STARTER

At 20 to 25°C (68 to 77°F)

- Add 2 kg of SpringFerm™ just before yeast starter pitching.
- Through a pumping over with aeration, pitch the yeast starter in the treated stuck wine.

Recommendations to adapt functional products doses for whites

Functional products are designed to **preserve or enhance a specific property of your wine** to improve its stability and its quality overtime. For white wines, it mainly deals with **redox stabilization and roundness improvement.** In order to help you finding the dosage of such products perfectly adapted to your wine matrix and maximize their effect, we have built the following recommendations.

THE MATERIAL YOU NEED

- (1+X) * 75 cl bottles of your white wine (X: number of doses)
- Scale with a precision of ± 1 mg to weight the yeast derivatives
- Aluminium foil
- 1 l jug
- Manual wine bottle vacuum pump with related plastic corks
- 10 ml pipettes
- Tasting glasses (best INAO standard glasses) and spittoons

I PREPARE THE TEST SOLUTIONS

For each condition/dose (each bottle):

1. Open the bottle and pour the wine into the 1l jug.
2. Add into the jug the correct dose of product* (for the control, go to step 4 directly).
3. Rinse twice the vessel in which was contained the product with wine.
4. Stir the wine in the jug to homogenize the product and avoid the formation of any clumps.

PRODUCT	RECOMMENDED DOSE OF TREATMENT (g/hl)	CORRESPONDING WEIGHT TO ADD IN A 0,75L BOTTLE (mg)
Control	0	0
SpringArom®	20 - 40	150 - 300
SpringCell™ Manno	10 - 20	75 - 150

II MAKE THE TEST

WITH SPRINGAROM®	OR	WITH SPRINGCELL™ MANNO
1 | **Re-fill the bottles with ¾ of the volume (at the height where the diameter is still the biggest).** 2 | **Don't close the bottles (control and test ones).** 3 | **Put them into the fridge.** 4 | **Put up and down twice the bottles (closed with your thumb) after 5-10 hours of storage if possible and leave to rest again for at least 24 hours.**		1 | **Re-fill completely the bottles with the whole volume.** 2 | **Close the bottles with the specific plastic corks and pump till obtaining the vacuum or close with the initial cork if no pump available.** 3 | **Put them into the fridge.** 4 | **Put up and down twice the bottles (closed with your thumb above the cork) after 5-10 hours of storage if possible and leave to rest again for at least 24 hours.**

III TASTE & SELECT

1. Remove the bottles from the fridge at least 30 minutes before tasting and place at room temperature. You have the possibility to coat the bottles with aluminium foil if blind test is required (it is always better not to influence tasting panel).
2. Taste, choosing your own way:
   • Sample three times 10ml of wine in the upper part of the bottle with the 10ml pipette and put them into a tasting glass, or:
   • Gently pour the wine into the tasting glasses. (Important: avoid putting in suspension the deposit and/or taking the cloudy bottom part of the wine.)
3. Put the glass on a blank paper sheet and start the tasting (eyes, then nose, then mouth).

Recommendations to adapt functional products doses for reds

Functional products are designed to **preserve or enhance a specific property of your wine** to improve its stability and its quality overtime. For red wines, it mainly deals with **color stabilization** but rather at that stage with **structure and roundness improvement.** In order to help you finding the dosage of such products perfectly adapted to your wine matrix and maximize their effect, we have built the following recommendations.

THE MATERIAL YOU NEED

- (1+X) * 75 cl bottles of your white wine (X: number of doses)
- Scale with a precision of ± 1 mg to weight the yeast derivatives
- Aluminium foil
- 1 l jug
- Manual wine bottle vacuum pump with related plastic corks
- 10 ml pipettes
- Tasting glasses (best INAO standard glasses) and spittoons

I PREPARE THE TEST SOLUTIONS

For each condition/dose (each bottle):

1. Open the bottle and pour the wine into the 1 l jug.
2. Add into the jug the correct dose of product* (for the control, go to step 4 directly).
3. Rinse twice the vessel in which was contained the product with wine.
4. Stir the wine in the jug to homogenize the product and avoid the formation of any clumps.

PRODUCT	RECOMMENDED DOSE OF TREATMENT (g/hl)	CORRESPONDING WEIGHT TO ADD IN A 0,75L BOTTLE (mg)
Control	0	0
SpringCell™ Color / Color G2	20 - 40	150 - 300
SpringCell™ Manno	10 - 40	75 - 300

II MAKE THE TEST

WITH SPRINGCELL™ COLOR OR SPRINGCELL™ COLOR G2 OR SPRINGCELL™ MANNO

1 | **Re-fill completely the bottles with the whole volume.**

2 | **Leave the bottles for rest at least 24 hours at room temperature.**

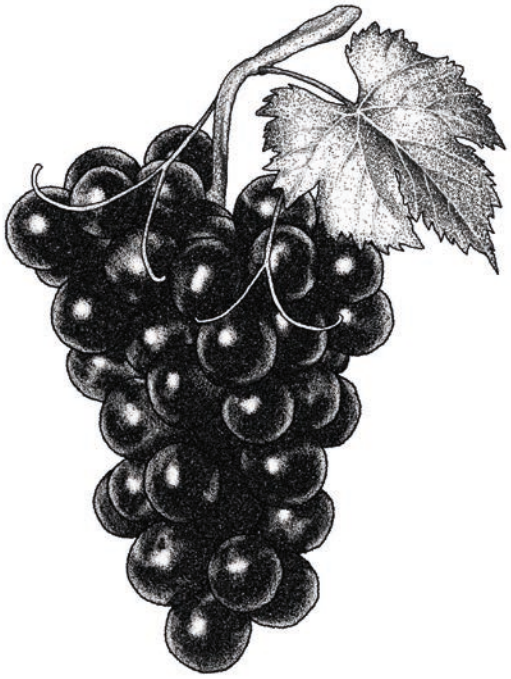
3 | **Close the bottles with the specific plastic corks and pump till obtaining the vacuum or close with the initial cork if no pump available.**

4 | **Put up and down twice the bottle (closed with your thumb above the cork) after 5 and 15 hours of storage if possible and leave to rest again.**

III TASTE & SELECT

1. You have the possibility to coat the bottles with aluminium foil if blind test is required (it is always better not to influence tasting panel).
2. Taste, choosing your own way:
   • Sample three times 10ml of wine in the upper part of the bottle with the 10ml pipette and put them into a tasting glass, or:
   • Gently pour the wine into the tasting glasses. (Important: avoid putting in suspension the deposit and/or taking the cloudy bottom part of the wine.)
3. Put the glass on a blank paper sheet and start the tasting (eyes, then nose, then mouth).

Recommendations to determine adapted fining doses



You need a fining agent to improve your wine's quality? We recommend you Spring'Finer™. This functional product is a concentration of yeast native proteins with remarkable fining capabilities. **It guarantees a specific removal of astringent and bitter tannins for a better organoleptic profile.** It brings also thick and compact lees for a limited loss of premium wine.

THE MATERIAL YOU NEED

SPRING'FINER™!

- (2+X) * glass tubes with a volume >100ml (X: number of doses, 1 for mother solution and 1 for control)
- Scale with a precision of ± 1 mg to weight Spring'Finer™
- Glass tube closure or plastic film
- Pipettes that can measure 0.1ml
- Tasting glasses (best INAO standard glasses) and spittoons

I PREPARE YOUR MOTHER SOLUTION

We recommend to prepare a 1% m/v SpringFiner™ solution, as followed:

- Pour 1 g of Spring'Finer™ in 100 ml of water at 10 - 20°C (50° - 68°F).
- Wait for Spring'Finer™ complete dissolution.
- Stir for good homogenization.

II MAKE THE TEST

PRODUCT		RECOMMENDED DOSE OF TREATMENT (g/hl)	CORRESPONDING VOLUME TO ADD IN 100 ML TOTAL (mL)
Control		0	0
SpringFiner™	For whites	1 - 5	0.1 – 0.5
	For reds	5 - 15	0.5 – 1.5

At 20 to 25°C (68 to 77°F)

- Introduce the required quantity of Spring'Finer™ solution into the wine.
- Turn immediately the vessel 2 to 3 times vigorously to get a perfect homogenization.
- Close the vessel with an adequate closure or plastic film.
- Wait at least for 48hrs at room temperature or lower than 25°C (77°F) before analyzing and/or tasting.

III TASTE AND SELECT

- Gently pour the wine into the tasting glasses. (Important: avoid putting in suspension the deposit and/or taking the cloudy bottom part of the wine.)
- Put the glass on a blank paper sheet and start the tasting (eyes, then nose, then mouth).

ADAPT THE TEST!

This protocol can obviously be done in bigger volumes while respecting the proportionality if the right equipment is not available or even done without preparing a mother solution but introducing directly Spring'Finer™ into the wine at the right dose.

Fermentis app'

Fermentation is an art that has been passionately practiced and perfected by Fermentis, as we always strive to improve taste, achievement and enjoyment in the beverage industry. That's why Fermentis has designed a new app to help winemakers around the world create the wines of their dreams. **A wide range of helpful and creative tools are included** in this new application, available now at the Apple Store and Google Play.

SELECT THE BEST PRODUCTS

Find out all you need to know about our products, including active dry yeasts, fermentation aids and functional products. You can easily review technical and sensory information, and download all of our technical data sheets.

TRACK OUR EVENTS

Stay up to date about our upcoming events. Fermentis travels all around the world and we're taking part in more than 100 events every year. The next one may be close to you, so don't miss the opportunity to meet up with us!

COMPARE OUR YEASTS

Still not sure about which yeast to use? Use our Yeast Advisor! You'll be able to compare all our yeasts profiles in detail. Whether you're looking from an organoleptic or technical perspective, we'll give you recommendations to best meet your needs.

KEEP IN TOUCH WITH US

Keep in touch with us! The App is the perfect place to contact us if you have any question or comment. We'll answer you as soon as we can.

Fermentis'application is free. Its tools have been designed by our team to advise and help winemakers in their daily work and in a very convenient way.

Fermentis by Lesaffre

NOTES

Contact
For any question or project, feel free to call or mail us. We'll be very pleased to help you.
+33 (0)3 20 81 62 75
fermentis@lesaffre.com
fermentis.com

		OUR PRODUCTS	E2U	PACKAGING AVAILABLE	CONDITIONING
ACTIVE DRY YEASTS	p.34	**SafŒno™ BC S103**	YES	500g | 10kg	Under vacuum
	p.35	**SafŒno™ VR 44**	YES	500g | 10kg	Under vacuum
	p.35	**SafŒno™ VR 44 BIO**	NO	500g | 10kg	Under vacuum
	p.36	**SafŒno™ SC 22**	YES	500g | 10kg	Under vacuum
	p.37	**SafŒno™ STG S101**	YES	500g | 10kg	Under vacuum
	p.38	**SafŒno™ CK S102**	YES	500g | 10kg	Under vacuum
	p.39	**SafŒno™ GV S107**	YES	500g | 10kg	Under vacuum
	p.40	**SafŒno™ HD A54**	YES	500g | 10kg	Under vacuum
	p.41	**SafŒno™ HD T18**	YES	500g | 10kg	Under vacuum
	p.42	**SafŒno™ UCLM S325**	NO	500g | 10kg	Under vacuum
	p.43	**SafŒno™ HD S135**	YES	500g | 10kg	Under vacuum
	p.44	**SafŒno™ HD S62**	YES	500g | 10kg	Under vacuum
	p.45	**SafŒno™ NDA 21**	YES	500g | 10kg	Under vacuum
	p.46	**SafŒno™ UCLM S377**	NO	500g | 10kg	Under vacuum
FERMENTATION AIDS	p.96	**SpringFerm™**	NO	1kg | 10kg | 25kg	Under air
	p.97	**SpringFerm™ Xtrem**	YES	1kg | 10kg | 20kg	Under air
	p.98	**SpringFerm™ Equilibre/ Complete**	NO	500g	Under vacuum
				25kg	Under air
	p.99	**ViniLiquid™**	YES	6kg | 12kg | 210kg	Liquid
	p.100	**SpringCell™**	YES	500g | 10kg	Under vacuum
				25kg (only in the US)	Under air
	p.101	**SpringCell™ BIO**	NO	500g	Under vacuum
FUNCTIONAL PRODUCTS	p.130	**SpringCell™ Color G2**	YES	500g	Under vacuum
	p.131	**Spring'Finer™**	YES	125g	Under vacuum
	p.132	**SpringCell™ Color**	YES	500g | 10kg	Under vacuum
	p.133	**SpringArom®**	YES	1kg | 10kg	Under vacuum
				25kg	Under air
	p.134	**SpringCell™ Manno**	YES	500g | 10kg	Under vacuum

Some packagings could be unavailable in your country, contact your Fermentis referent for more information.

Winemakers, we created this document for you, to help you understand how high quality yeasts and yeast derivatives are produced, what essential parameters will influence your fermentations, and how our yeast products are characterized.
We hope it will be an everyday resource and we wish you wonderful results.

THE OBVIOUS CHOICE FOR BEVERAGE FERMENTATION

Fermentis by Lesaffre