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# Bio-modulating wine acidity: The role of non-*Saccharomyces* yeasts

Sourced from the research article "Use of nonconventional yeasts for modulating wine acidity"[1]

**>>> In recent years, wine consumers have been looking for fruitier wines, with less ethanol, but presenting a good balance in terms of mouthfeel. However, due to the effects of global climate change, wines can be more alcoholic and flatter in terms of acidity. If in the past, non-*Saccharomyces* yeasts were often considered as spoilage yeasts, now they are used to modulate wine composition, namely in terms of aroma and acidity. In this article, the ability of some non-*Saccharomyces* yeasts to modulate wine acidity is reviewed. <<<**

*Schizosaccharomyces pombe* ©Lucia Molnarova

## Acids present in wines and their perceived taste

Organic acids are a significant constituent of wines. They present a sour/acid taste, and influence wine stability, color, pH and have a significant effect on the final wine mouthfeel quality. The acid composition and concentration of wines is influenced by many factors, from grape variety and climatic conditions to fermentation process and yeast. Some of the acids are formed in the grape-berries, during berry development, others are formed during alcoholic fermentation (AF) and malolactic fermentation (MLF). During these biological processes, it is prudent to monitor the concentration of organic acids, and a distinction is made between acids directly produced in grapes (tartaric, malic, and citric) and those originating from AF and MLF (succinic, lactic, and acetic acids, among others), Table 1.

## Non-*Saccharomyces* yeasts and wine acidity modulation

The main volatile compounds and the organic acids formed/consumed by non-*Saccharomyces* yeasts during grape-must fermentation are described in Table 2.

During MLF, the metabolism of *Oenococcus oeni* can improve the wine sensory characteristics by decreasing acidity. However, the success of MLF is influenced by enological parameters, such as temperature, pH, alcohol content and $SO_2$ concentration, among others. An alternative to MLF was studied by Benito and coworkers[2] to be used, particularly, in warm viticulture regions such as the south of Spain where the risk of suffering a deviation during the MLF process increases due to the high must pH which may contribute to produce wines with high volatile acidity and biogenic amine values. The mentioned authors used two non-*Saccharomyces* yeasts as an alternative to MLF. Malic acid was consumed by *Schizosaccharomyces pombe* by converting it to ethanol and $CO_2$ (Figure 1), whereas *Lachancea thermotolerans* produces lactic acid in order to maintain wine acidity balance, especially in wines produced from low acidity musts.

Table 1. Major organic acids present in grapes and wines and their sensory descriptors. Adapted from Vilela[1].

| | Major Acids | |
|---|---|---|
| | L-tartaric (citrus-like taste) | Produced in grapes |
| | L-malic (metallic, green-apples taste) | |
| Fixed acids | Citric (fresh and citrus-like) | |
| | L-lactic (sour and spicy) | Produced during AF and MLF |
| | Succinic (sour, salty, and bitter) | |
| Volatile acid | Acetic (vinegar-like) | |

Another malic acid consuming strain, not yet commercialized or produced at an industrial level, is *Issatchenkia orientalis/Pichia kudriavzevii*. In 2014, del Mónaco and coworkers[3] found a *P. kudriavzevii* isolate that was able to degrade L-malic acid in microvinification assays, increasing the pH by 0.2–0.3 units. Furthermore, this yeast strain produced low levels of ethanol and significant levels of glycerol.

*L. thermotolerans* can produce lactic acid and glycerol during fermentation, and all these interesting features can be a way to address the problems of increased alcohol content/reduction in the total acidity of wines, associated with global climate changes. Moreover, *L. thermotolerans* in the presence of some $O_2$, by shifting its metabolism more towards respiration than fermentation, is also capable of decreasing wine volatile acidity[4].

At the beginning of AF, many species can grow at the same time in the grape-must and *Candida stellata* spp. have been described in this stage of fermentation. An interesting *C. stellata* feature is its ability to form succinic acid[5]. Succinic acid could positively influence the sensory/ mouthfeel profile of wines with insufficient acidity. Nevertheless, due to its 'salt-bitter-sour' taste, excessive levels would negatively influence wine quality.

Another interesting yeast is *Torulaspora delbrueckii*. An indication of the positive impact of *T. delbrueckii* activity on wine quality was demonstrated by Bely and coworkers[6]



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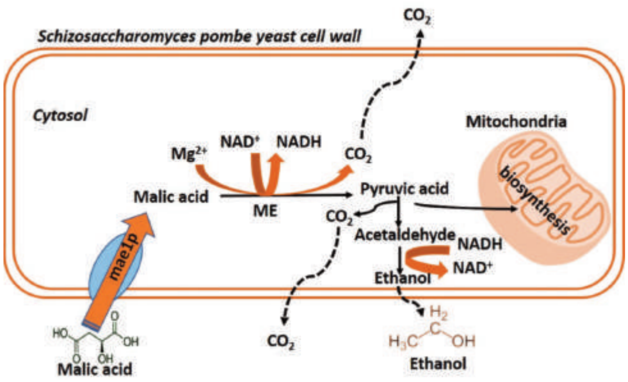


Figure 1. Schematic representation of the maloalcoholic fermentation performed by *Schizosaccharomyces pombe*. Adapted from Vilela[1].

Table 2. Main volatile compounds produced and effect on wine acidity of seven non-*Saccharomyces* yeasts. Adapted from Vilela[1].

| Yeast species | Volatile compounds | Effect on wine acidity |
|---|---|---|
| *Lachancea thermotolerans* | 2-P henylethylacetate and ethyl lactate | Acidity enrichment (lactic acid) Acidity reduction (acetic acid) |
| *Schizosaccharomyces pombe* | Higher alcohols and esters | Maloalcoholic deacidification |
| *Candida stellata* | Esters and acetoin | Acidity enrichment (succinic acid) |
| *Torulaspora delbrueckii* | Long-chain alcohols, esters, aldehydes and glycerol | Low production of acetic acid |
| *Zygosaccharomyces florentinus* *Zygotorulaspora florentina* | Higher alcohols and esters | Low production of acetic acid Some species are able to consume acetic acid |
| *Pichia kudriavzevii* *Issatchenkia orientalis* | Esters and higher alcohols | l-malic acid consumption |
| *Starmerella bacillaris* *Candida zemplinina* | A higher level of some terpenes, lactones and thiols | Malic acid degradation Reduction of acetic acid in sweet wines Production of pyruvic acid |

when fermenting botrytized musts and, afterward, by Azzolini and coworkers[7] in Vino Santo, a sweet wine, due to its low production of acetic acid. Moreover, *T. delbrueckii* in the production of Amarone wine (*Amarone della Valpolicella*), a high-alcohol dry red wine obtained from withered grapes, was able to promote the formation of alcohols, fermentative esters, fatty acids, and lactones, which are important in the Amarone wine flavor[7].

*S. pombe* and *L. thermotolerans* are presently produced at an industrial level by biotechnological companies. *T. delbrueckii* is commercialized in the form of a pure culture, selected for its properties such as increase in aromatic complexity, mouthfeel, low production of volatile acidity and high resistance to initial osmotic shock. According to the supplier, it is highly recommended for the fermentation of late harvest wines in sequential culture with *S. cerevisiae*.

*Zygosaccharomyces* spp. are well known for their ability to spoil food and beverages. The fermentative nature of *Zygosaccharomyces* metabolism produces $CO_2$ that is of concern if the food product is in a sealed container, as the increase in gas can cause the container to leak or, in extreme cases, explode. Haze or sediment can occur in beverages as cellular biomass accumulates, and in some cases, surface biofilms can be formed. The aroma and taste modification can occur by the production of secondary metabolites with sensory impacts on the food or beverage and include acetic acid, esters, and higher alcohols. Nevertheless, some strains are used in the industrial production of balsamic vinegar and other food products.

Recently, Lencioni and coworkers[8] studied the possibility to decrease wine volatile acidity of high-sugar musts, by using *Zygosaccharomyces florentina* and *Starmerella bacillaris* in multistarter fermentations with *S. cerevisiae*. Independently of fermentation temperature, the mixed fermentations performed best to reduce volatile acidity, therefore being a valuable tool for performing fermentation of high-sugar musts.

## Final remarks

In conclusion, many non-*Saccharomyces* yeasts present interesting enological properties and when used in single or mixed cultures with *S. cerevisiae*, these yeast species can modulate wine acidity and increase the production of some interesting compounds, such as polysaccharides, glycerol, and volatile compounds, such as 2-phenyl ethanol and 2-methyl 1-butanol.

Nevertheless, if the use of some of the yeast species cited could modulate wine acidity, some can also act as spoilage, through the production of off-flavors, haze or sediment, depending on the environmental conditions. So, a deeper study of the enological traits of these yeasts will provide new data for consideration in the modulation of wine acidity. ■

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