OUTREACH BRIEF:

TIPS FOR MANAGING SOUR ROT IN THE WINERY

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Introduction

Sour rot is a recurring problem in early season thin-skinned, tight-clustered varieties like Pinot noir, Pinot gris, Riesling, Gewurztraminer, Gamay and Baco noir. Sour rot results from interactions between multiple yeast species naturally present on grapes and acetic acid bacteria i.e. *Gluconobacter* and *Acetobacter spp* (Barata et. al. 2012). The causal organisms gain entry to the berries via microfissures around the pedicel, berry splitting, or due to other berry injuries. Berries become susceptible to infection between 10 and 15° Brix. Spread of the disease is linked to *Drosophila spp*. It is hypothesized that they carry the yeasts and bacteria from infected to healthy berries and/or that fly larvae contribute to the dessication of the berry (Hall et. al. 2018). Sour rot has been responsible for more than $1.5 million in crop loss in a given season in the Ontario region, when weather conditions promote infection, such as rain storms and hail in 2008 (Agrocorp, 2008).

Compounds associated with sour rot in juice and wine include acetic acid, ethyl acetate, acetaldehyde, galacturonic acid, gluconic acid, phenylacetic acid (PhAA), and ethyl phenylacetate (EPhA) (Campo et al. 2012). Acetic acid and ethyl acetate are the primary contributors to volatile acidity (VA), a common wine fault. The maximum permitted VA concentration in still table wine in Ontario is 1.3 g/L (Vintners Quality Alliance 1999). However, the consumer rejection threshold of acetic acid (vinegar aroma) and ethyl acetate (acetone/varnish aroma) are 0.8 g/L and 7.5 - 200 mg/L respectively. Ethyl phenylacetate (EPhA) and phenylacetic acid (PhAA), when present together in wine, have been found to bestow an undesirable "sweet/honey" off-flavour at high levels, which is considered a fault (Campo et al. 2012). The consumer rejection threshold for a combination of both compounds is over 140 ug/L of ethyl phenylacetate (EPhA) and at 700 ug/L or higher for phenylacetic acid (PhAA) (Campo et al. 2012, Kemp et al. 2019, 2020).

In years with high sour rot production, it may not always be possible to pick grapes earlier than anticipated or sort bunches. In this case, winemaking strategies to deal with sour rot in the winery are required, according to wine style and grape variety. These winemaking guidelines for sour rotten grapes have been compiled to help winemakers minimise the negative impacts of sour rot on wine quality and decrease a loss of income from reduced yield.

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Harvest

Fruit should be sorted in the vineyard prior to harvest or at picking, by staff trained to identify sour rotten grapes. If infection is high, sulfur dioxide (SO_2) can be added to the picking bins at a rate of 30 - 50 ppm as potassium metabisulphite (KMS). For those who wish to reduce the use of SO_2, there are several bioprotectant yeast preparations currently on the market that aim to reduce VA production by outcompeting sour rot causing microorganisms. Protection, either via the use of SO_2 or bioprotection, is important in a warm harvest when fruit has to wait in the vineyard for collection or travel long distances to a winery for processing. If fruit is machine harvested, grapes should be sorted outside the winery, either manually, on a conveyor belt, or using an optical sorter. Ensure the picking bins, winery equipment, and tanks are sterilised before and after use to prevent contamination by undesirable microbes.

Juice processing options

Sparkling and white grape juice:

Whole bunch press as normal, but at a lower pressure than when processing healthy fruit. Add SO_2 to the juice tray after pressing at 50 - 80 ppm. As with healthy fruit, fractionate the juice and vinify the fractions separately. The use of settling enzymes at a high rate and cold temperatures during settling is recommended to reduce microbial activity.

Red juice:

Destemming and crushing of red grapes should be gentle, and SO_2 can be added to the must at 20 - 50 ppm (or higher depending on the choice of yeast), and depending on the severity of the infection. It is preferable to avoid pre-fermentation maceration/cold soak, and instead inoculate with a robust, rapid yeast for alcoholic fermentation. If needed, acid addition should be considered to lower pH levels of the juice, especially for low colour/tannin varieties that are susceptible to colour loss.

Juice fining

Juice fining agents that can be used prior to fermentation include bentonite to remove rot-derived proteins, polyvinylpolypyrrolidone (PVPP) and/or activated carbon to reduce the incidence of browning. Targeted addition of fining agents, via bench trials, is recommended as over use is associated with the removal of other compounds.

Nutrition

Yeast Assimilable Nitrogen (YAN mg N/L) must be analysed before the yeast inoculation to ensure low or high additions are avoided. YAN should be added according to the nutrient demands of the chosen yeast; low YAN levels can lead to sluggish or stuck fermentations, while high YAN can allow undesired yeast and bacteria to thrive. Yeast nutrient that contains a mixture of DAP and organic forms of nitrogen are advisable. DAP, which is primarily composed of Ammonium (NH_4^+) has been reportedly associated with higher concentrations of ethyl acetate in synthetic grape must fermentations (Beltran 2005).

Yeast and fermentation

The primary fermentation of sparkling wines should be carried out at low temperature to reduce bacterial and enzymatic activity. The yeast strain chosen needs to be a sparkling wine yeast that consumes acetic acid (Vasserot et al. 2010), is tolerant of high SO_2 and high volatile acidity, and a strong fermenter with low nutrient requirements. Ensure oxygen is limited in both sparkling primary fermentation to reduce the chance of microbial spoilage. For red wines, a fast fermentation at high temperatures is recommended. High temperature fermentation (30°C) can reduce acetic acid levels. It will also help the inoculated yeast and prevent competition from non-*saccharomyces* yeast and bacteria on grape skins. Where malolactic fermentation (MLF) is desired, co-inoculation with a compatible *O. oeni* strain is recommended to facilitate the rapid completion of MLF soon after the end of alcoholic fermentation and reduce the potential of bacterial spoilage (Abrahamse and Bartowsky 2012; Tristezza et. al. 2016).

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Fermentations must be monitored twice a day (morning and evening), and exposure to oxygen during cap management should be minimized; for example, by replacing pumpovers with punchdowns/plunging.

Techniques that add colour and promote colour stability are recommended as time on skins should be limited. Enzymes that assist in extracting phenolic compounds from grapes (pigment and tannin), especially for low tannin varieties like Gamay and Pinot noir, are recommended for enhanced colour extraction and stability (Marcotte et al. 2021). Other treatments have been reported in the literature to stabilize and increase colour in red wines. These include the use of untoasted oak dust, yeast hulls, activated tannins, increased SO_2, grape seed tannin, and neutral oak chips. Post-fermentation maceration is not recommended.

Sulfur dioxide (SO_2) additions post-fermentation

Monitor pH levels and ensure SO_2 additions post-fermentation are made according to pH level. The risk of high SO_2 addition to low colour/tannin wines (i.e. Gamay and Pinot noir) can further bleach the colour, hence colour and tannin stabilisation during fermentation is essential so that the pigment gets bound by tannin and traps it in a coloured form making it resistant to further bleaching by SO_2. Precautions that should be taken to prevent oxidation include: the use of dry ice, sparging with nitrogen or carbon dioxide (CO_2) gas, minimizing ullage in tanks and storage vessels, and reducing the incidents of moving/racking wines.

Fining and filtering sparkling base wine & red wine

Reduce time on primary lees by racking off solids as soon as possible after primary fermentation. Your local supplier will have details of specific fining agents that help to break down large compounds to aid in filterability. Filtration of all wines produced from sour rotten grapes prior to bottling at 0.45 µm is recommended.

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Alternative solutions

In extreme cases, reverse osmosis (RO) can reduce the concentration of VA; however, RO may also remove desirable compounds in addition to VA. Mobile RO units may be available in your region or another winery may offer that service. Winemakers can also conduct trials to test the potential of the wines made from sour rotten grapes in a blend, although ensuring the microbial stability of the wine before addition to a blend is of primary concern.

CCOVI Analytical Services

CCOVI Analytical Services provides a wide range of analyses to Ontario wineries for juice and wine analysis from ripening through to finished wine. These include sour rot-associated compounds (acetic acid (g/L), ethyl acetate (mg/L). Please contact ccovilab@brocku.ca for a full list of services.

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