



“Effect of bentonite treatment of grape juice on yeast fermentation”

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These authors study the effect of bentonite fining on juice and wine composition, and on fermentation rate. In particular, they compare the effect of leaving the bentonite in the juice throughout fermentation, versus adding it at the juice state and removing it before fermentation starts.

- Bentonite fining is widely used to increase the protein stability of a wine. Some authors have proposed treatment of the juice itself, rather than the wine, to enhance fermentation performance and flavor, and increase stability. Some authors have reported that this practice yields stable wines not requiring further fining, whereas others have found no increase in stability when treating the juice versus the wine.
- Regarding the effect of bentonite on fermentation rate, some authors suggest that bentonite may provide aggregation sites for the yeast to attach and divide, thus increasing fermentation rate. But another study did not find this effect, pointing to the fact that this was not just a matter of “increased surfaces”. Yet another author found that bentonite fining actually decreased fermentation rate, probably due to an increase in dissolved CO₂, which tends to be higher in the presence of solids (more CO₂ bubble formation). In brief, the current authors were unable to find agreement in the literature regarding whether the presence of solids stimulated or inhibited fermentations.
- So the goal of this study was to evaluate the effect of bentonite on alcoholic fermentation comparing two types of treatment: 1) one with addition, then *removal* of bentonite before inoculation, and 2) the other with bentonite *present* throughout the fermentation.
- The authors selected 6 different wines for treatment: two Chardonnays 1994 (Oakville and Davis), two Muscats (1994 and 1995), and two Sauvignon blancs (1995 and 1996). These juices were settled overnight and then racked. For each of the juices, the authors tested 3 bentonite levels (0.12, 0.24, and 0.36 g/l) and a control (no addition). As mentioned before, bentonite was then either allowed to remain in the juice or allowed to settle (5 hrs, -3°C) and racked off before inoculation (Premier Cuvee, UCD 819). Fermentations were carried in triplicate in 19 liters (5 gal) carboys at 15°C (58°F).
- **Effect of bentonite on juice composition.** Bentonite treatment had no effect on amino acid composition or the level of yeast assimilable nitrogen, when compared to the respective untreated juices. As expected, bentonite reduced the protein content of the juice.
- **Effect of bentonite on fermentation rate.** One of the wines (1994 Oakville Chardonnay) showed unusually slow fermentations for every treatment and had to be excluded from further study. The authors found that the presence of bentonite during fermentations had no effect on the maximum fermentation rate. In contrast, **bentonite fining** (treating with bentonite and removing it prior to inoculation) **decreased the maximum fermentation rate**. They also found that, in general, the presence of bentonite throughout the fermentation had no effect on total fermentation time, but **bentonite fining increased overall**

fermentation time , as one would expect with a slower fermentation rate. This is in agreement with the observation in commercial scale fermentations that clarified juices had longer fermentations, even though those same authors did not observe a reduction in juice free amino acids or ammonium nitrogen.

- To further explore this inhibitory effect of bentonite fining, the authors tried adding minerals, vitamins or ammonium to the fermentations, to see whether they could compensate for the effects of the bentonite fining prior to inoculation. They couldn't. Similarly, they tried adding additional bentonite, to see whether the presence of more solids was stimulatory. It wasn't.

- **Effect of bentonite on wine composition** Bentonite had no effect on wine pH, TA or ethanol. But it did have an effect on residual glucose, and particularly, on **residual fructose**, which **increased significantly in wines where the juice had been fined** (bentonite removed). The authors believe this is related to the relative use by the yeast of glucose versus fructose at the end of fermentation (“end of fermentations” lasting longer in fined juices).

- The authors also found that fermentations in the presence of bentonite resulted in lower protein concentration in the finished wines, at the higher bentonite rates. This was not the case when bentonite rates were low. In other words, leaving the bentonite throughout the duration of the fermentation was more effective in removal of protein than juice fining (adding and removing the bentonite), provided bentonite concentrations were not limiting.

- Since nutrient supplementation of the juice was unable to reverse the effect of bentonite fining, the authors believe that bentonite is removing some nutrient other than those absolutely indispensable for growth. Some candidates they proposed are fatty acids, phospholipids, and/or sterols, which might be required for ethanol tolerance. If factors responsible for increasing fermentation rate were to interact with the bentonite, then a reduction in rate and a longer fermentation would be observed. But if negative factors, that is, factors that would decrease fermentation rate, were the ones removed, then treatment with bentonite would lead to an increased fermentation rate. This would explain both the positive and negative effects of bentonite on fermentation rates reported in the literature.

In summary, bentonite fining can lead to sluggish fermentation in some juices if the bentonite lees are removed. This reduction in fermentation rate was not rectified by adding additional bentonite back to the juice, or by adding macro- or micronutrients. If a sluggish fermentation is detected due to bentonite treatment, the authors suggest adding fatty acids, or compensating with aeration.

Bentonite fining (adding + removing)	Bentonite presence (throughout fermentation)
▼ max. fermentation rate	no effect
▲ fermentation time	no effect
▲ glucose, ▲▲ fructose	less effect on glucose/fructose
less effective in removing proteins	more effective in removing proteins (when bentonite is not limiting)