

pH and Protein Instability*

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Wine proteins are derived primarily from grapes and autolyzed yeast. They consist of several (protein) fractions which appear to be the subunits of denatured grape enzymes. Their molecular weight varies from 20,000 to 40,000 Daltons. The polypeptides with molecular weights of less than 10,000 are mostly derived from yeast autolysis. The isoelectric point (PI) of wine protein fractions have been reported to be in the range of 2.5 - 8.7.

Wine proteins occasionally cause cloudiness or haze in white wine. Haze formation is poorly correlated with total protein content since only certain unstable protein fractions cause haze. When stabilizing a wine for protein, it is not necessary to remove all proteins, but only those fractions that are unstable and thus contribute to cloudiness.

A bentonite treatment is often used to remove unstable proteins from a wine. Bentonite is a negatively charged colloid which absorbs positively charged protein and removes it from the wine. Proteins with the greatest positive charge are removed first.

The pH influences protein stability in two ways:

1. It affects protein solubility
2. It influences the charge (positive or negative) on the protein molecule.

To understand the role of pH one needs to understand the isoionic properties of proteins.

Protein solubility

Proteins can be either positively (cation) or negatively (anion) charged based on pH conditions. When the positive and negative charges on protein are equal, the net charge is zero. The characteristic pH of a solution at which the net charge on protein is zero (positive and negative charges are equal) is defined as the isoelectric point (pH). The isoelectric point of a protein is an important property because it is at this point that the protein is least soluble, and therefore unstable. It should be noted that both below and above the isoelectric point (isoelectric pH) the protein will be soluble.

To understand the implication of pH, let us consider an example. Suppose we have a white wine with a pH of 3.30 and a protein fraction with a pH of 3.2. After blending with another wine, the pH of the new blend is changed to 3.2. Notice that the pH of the blend and the pH of the protein are the same. Since the protein is in a pH solution similar to its pH value, it will become insoluble and thus unstable. The blend could therefore be protein unstable even though the wine was stable before blending.

pH and the charge on protein

We have just noted above that protein can be positive or negative based on the pH of the solution. The important point to remember is that in a pH condition below its isoelectric point, the protein will carry net positive charge and behave like a cation. In a pH condition above its isoelectric point, the protein will carry a net negative charge.

In the example used above (wine with a pH of 3.3), the protein with an isoelectric point of 3.2 will carry a net negative charge. If this wine is fined with bentonite, the bentonite will not remove this protein fraction. This is because both the protein and bentonite carry a negative charge and we know that like charges repel. After blending, the pH will change to 3.2. The shift in pH will change the charge on the protein from negative to neutral which will make the protein insoluble because the pH is similar to the pI.

From these examples it should be clear that pH affects protein stability and that any change in pH, as often occurs after blending, can lead to the problem of insolubility. Therefore, it is a sound practice to stabilize a wine after blending, before it is bottled.

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