EXPERIMENT #7: TOTAL ACIDITY IN WINE OR FRUIT JUICES

OBJECTIVES

To apply knowledge of polyprotic acid titration behavior to elucidating the acid or acids in wine or fruit juices.

Study and compare the different total acidity levels of in different wines or fruit juices.

INTRODUCTION

Acidity is a very important aspect of many foods and foodstuffs. In the beverage industry, quality control often looks at the total acid content of their products. For instance, in cola drinks, phosphoric acid is a dominate component, and it gives the beverage its crisp taste and bite. Other acids may be present like carbonic acid, benzoic acid or even citric acid (in citrus-based soft drinks).

The manufacturers look at the total acidity as part of the analysis of their product. In the previous lab, the titration curves for two polyprotic acids were examined. In the current analysis, you will use this knowledge to identify the major acid component of a wine or fruit juice and quantify it. The procedure we will work with refers to the titration of total acidity in wines or fruit juices. The main acid in most wines is tartaric acid, in juices it is usually citric or malic acid. These beverages also contain several other acids in different proportions. The total acidity corresponds to the sum of titratable acidities not just the free protons. i.e. hydronium ions.

The procedure has its foundation in the titration of a weak acid by a strong base. Despite the presence of several acids in the sample, we only observe one major inflection point in the titration curve. Experimentally, the complete potentiometric titration curve will be obtained, but we will record the endpoint volume when the pH reaches ~8.2. This is by recommendation from the Association of Analytical Communities. Please see the file 'pH and total acidity in wine and fruit juice' loaded under Experiment 7 on eLC. This describes the method used to perform this analysis.

Total acidity in mol H^+/L can be directly calculated from the equivalent (endpoint) volume. Total acidity can also be expressed in grams per Liter of a chosen acid, considering its molar weight and the stoichiometry of the acid-base reaction:

Acid	Molar Mass (g/mol)	Titratable Protons
Tartaric	150.087	2
Malic	134.0874	2
Citric	192.124	3
Sulfuric	98.079	2
Acetic	60.05	1

You will need to report the mean total acidity in mol H^+/L and mean total acidity based upon the grams of the acid appropriate for you sample type (see table). Therefore, you will have to look at your titration curve and analyze the pK_a values to see which acid is dominating and prove it. You will decide how to report your total acidity based on the type of sample you are given. Formulas for the total acidity can be found in the method file 'pH and total acidity in wine and fruit juice.'

You will need to do some research on the types of acids in fruit juices and different wines (white and red wines are different).

Procedure:

1. Set up and calibrate a drop counter and a pH probe on your MicroLab box (see previous labs and appendices). You should also prepare a magnetic stirrer. **Make sure that it is programmed to take data after every drop not every second. This is important!**

2. Fill the drop counter with your standard NaOH solution.

3. Using a volumetric pipet, dispense 5 mL* of your juice into a 250 mL beaker and add about enough distilled water to make the final volume ~50 mL (enough to cover the probes and not cause the stirrer to splatter!). * If you have Lemon Juice use 1 mL.

4. As you perform the titration take note of the volume when the pH reaches ~8.2. That will be your endpoint volume, but please go past this point until it plateaus.

6. Start the titration. Make sure that the Microlab software is taking a pH measurement at every drop. Drop at a slow rate to make sure you have reached equilibrium.

7. At this point you should consider adjusting the amount of sample you used such that about 10 mL of the titrant will be required to achieve the endpoint.

8. Perform the titration three more times using the new conditions.

9. Calculate the total acidity for the sample in mol H^+/L and using the appropriate acid for your sample (see the table in the Introduction). The units are grams of the selected acid per Liter. The equation are found in the method file on eLC. Please read it! Find the mean, standard deviation, %RSD and 95% confidence limits for your data.

10. A discussion and critical analysis identifying acid should also be presented in your report. This analysis should compare your results with others who have different fruit juices/wines. (Summer 2020 you will be provided with a second sample set). The analysis should also discuss and consider the shape of your titration curve and the pK_a's of the acid titrated. You can use Curtiplot and load your data and see if you can find an acid that will match your data as closely as possible.

11. You can include one good titration plot in your results section properly plotted (see Appendices in previous labs).

11. You should also discuss any issues with this type of 'total acidity' calculation.