Titratable Acidity in Fruit Juices by Fixed pH Endpoint Titration to 8.2 Using Hanna Instruments' HI932 Automatic Titrator

Introduction

Acidity in food is very important as the amount of acid can influence things such as shelf-life, texture, integrity, and taste. An interesting characteristic of fruits is that the acidity level can indicate fruit ripeness. The acidity tends to drop as a fruit ripens and starches are converted to sugars. The proper ratio of acidity to sugars is an indicator as to what markets the fruit can go to. For example, different quality levels can determine if a fruit goes to a cannery or grocery store. Fruits each have a different primary acid. Grapes have tartaric acid, apples have malic acid, and citrus such as oranges have citric acid. While there are other minority acids present in those fruits, the majority far outweighs the minority, and the titration results are representative of the percent of majority acid present. This report investigates the repeatability of results obtained with the Hanna Instruments HI932 for the acidity in three different fruits; grapefruit juice, orange juice, and apple juice. The results demonstrate that AOAC repeatability guidelines can be met using the Hanna Instrument titrator to determine acidity in fruit juices.

Equipment and Reagents

- Hanna Instruments HI932 Automatic Titrator
- Hanna Instruments HI1131B Combination pH Electrode
- Hanna Instruments HI7662 Temperature Probe
- Hanna Instruments HI7004 pH 4.01 Calibration Buffer
- Hanna Instruments HI7007 pH 7.01 Calibration Buffer
- Hanna Instruments HI7010 pH 10.01 Calibration Buffer
- 0.1 N NaOHx
- 5 mL Eppendorf Pipette
- 5 mL Eppendorf Pipette Tips
- KHP
- 100 mL Beakers
- Deionized Water
- Apple Juice
- Grapefruit Juice
- Orange Juice

Procedure

The standard operating procedure for the analysis of titratable acidity to a fixed endpoint of 8.2 was followed for this test. Prior to the analysis, the pH electrode was calibrated with 4.01, 7.01, and 10.01 buffers, and the offset and slope were determined to be within the working specifications. The NaOH titrant was standardized against granular potassium hydrogen phthalate (KHP) a total of three times to determine the titre value and the average titre value of 0.09689 N was used in the calculation for acidity. For the analysis, method HI3307EN Citric Acid (by Volume) was used for grapefruit juice and orange juice; method HI3309EN Malic Acid (by Volume) was used for apple juice. A 10 mL sample was taken and enough deionized water was added to the sample to submerge the junction of the pH electrode. Titration was completed using the HI932 Automatic Titrator, and results were reported in g/L of tartaric acid.

Results

The results of this test demonstrated that when the Hanna Instruments HI932 is used to determine the acidity of a wine, the results obtained are repeatable per the guidelines established by the Association of Agricultural Chemists (AOAC). Ten replicates were run for each of the three fruit juices. The average acidity for the grapefruit juice was 10.93 g/L with a 1.297 % RSD between replicates. For the orange juice, the average value obtained for acidity was 7.183 g/L, and the % RSD was 1.070 %. The apple juice yielded an average of 3.693 g/L and the % RSD between the replicates was 0.9120 %. According to the AOAC guidelines, the RSD % should be no more than 3.7% for samples between 1-10 g/L., which all of the % RSDs obtained were below.

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Table 1 - Acidity Results (g/L) for Grapefruit Juice

Replicate	mL Sample	mL NaOH	Time	g/L (Citric Acid)
1	10	17.65	3:18	11.00
2	10	17.78	3:36	11.00
3	10	17.57	3:00	10.90
4	10	17.42	3:15	10.80
5	10	17.43	3:35	10.80
6	10	17.82	2:57	11.10
7	10	17.60	4:00	10.90
8	10	17.33	2:54	10.80
9	10	18.12	2:47	11.20
10	10	17.41	3:19	10.80
			Average	10.93
			Std. Dev.	0.1418
			%RSD	1.297

Table 2 - Acidity Results (g/L) for Orange Juice

Replicate	mL Sample	mL NaOH	Time	g/L (Citric Acid)
1	10	11.62	2:24	7.210
2	10	11.69	2:23	7.250
3	10	11.43	2:16	7.090
4	10	11.39	2:49	7.070
5	10	11.48	2:53	7.120
6	10	11.64	3:07	7.220
7	10	11.54	2:22	7.160
8	10	11.53	2:30	7.150
9	10	11.71	3:16	7.260
10	10	11.77	2:57	7.300
			Average	7.183
			Std. Dev.	0.07689
			%RSD	1.070

Table 3 - Acidity Results (g/L) for Apple Juice

Replicate	mL Sample	mL NaOH	Time	g/L (Malic Acid)
1	10	5.509	4:35	3.690
2	10	5.482	4:19	3.680
3	10	5.490	4:23	3.680
4	10	5.474	4:17	3.670
5	10	5.467	4:18	3.670
6	10	5.478	4:22	3.670
7	10	5.600	4:33	3.750
8	10	5.481	4:25	3.670
9	10	5.506	4:30	3.690
10	10	5.611	4:21	3.760
			Average	3.693
			Std. Dev.	0.03368
			%RSD	0.9120

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