
EXPERIMENT 6 DETERMINATION OF ALCOHOL BY SPECIFIC GRAVITY METHOD

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6.1 INTRODUCTION

Alcohol content in alcoholic beverages like wines, beer, distilled spirits etc. is routinely determined. Good quality fruit juices contain practically no alcohol. The trace amount measured by distillation method is due to the other volatile components. However, if over ripe fruits are used for juice production or the juice has undergone some fermentation due to improper handling of the juice, the alcohol content will increase. Therefore, high alcohol content in fruit juices is an indication of poor quality.

Objectives

After studying and performing this experiment, you should be able to:

- carry out distillation of beverages to recover alcohol; and
- determine alcohol content by specific gravity method.

6.2 EXPERIMENT: DETERMINATION OF ALCOHOL

6.2.1 Principle

Alcohol present in fruit juices and beverages can be distilled out completely along with water. Based on the differences in specific gravities of water and alcohol, the alcohol content can be determined.

6.2.2 Requirements

Apparatus and Reagents

- Alcohol distillation apparatus
- Specific gravity bottle, 50 ml capacity
- Electronic balance, 0.1 mg sensitivity
- Volumetric flask
- Thermostatically controlled water bath

Chemicals

Bromothymol blue indicator (1% solution)

0.1 N Sodium hydroxide solution

6.2.3 Procedure

Expel CO₂ from the sample if present by shaking thoroughly. Fill the sample in a 100 ml volumetric flask to just below the mark and immerse the flask in a water bath maintained at a constant temperature (usually 25⁰C). After the sample has attained the bath temperature, make up the volume with more sample. Transfer the contents of the volumetric flask to the distillation flask (300 – 500 ml round bottomed flask) using 10 – 15 ml distilled water to rinse the flask thrice. Add a few drops of bromothymol blue indicator and titrate with 0.1 N NaOH to a distinctive blue colour to neutralize any volatile acids present. Connect the condenser to the distillation flask and let the tip of the condenser dip into about 10 ml of distilled water contained in the original 100 ml volumetric flask. Distil and collect the distillate almost to the 100 ml mark. Place volumetric flask in the water bath to attain the same temperature as was done for the sample and make up the volume with distilled water.

Weigh a specific gravity bottle accurately. Fill the bottle with the alcohol distillate, insert the stopper, remove the spill-over solution with a tissue paper and weigh. Transfer the solution back to the volumetric flask, clean and fill the bottle with distilled water and weigh as done for the sample. Calculate the specific gravity of the sample distillate and read the alcohol percentage from table of specific gravity vs. alcohol % by volume.

6.2.4 Observations

Weight of the empty sp. gravity bottle	= W ₁	= ----- g
----- do ---- with sample distillate	= W ₂	= ----- g
----- do ---- with distilled water	= W ₃	= ----- g

6.2.5 Calculations

Specific gravity of the sample distillate =

$$\frac{\text{Weight of a known volume of sample}}{\text{Weight of same volume of distilled water}} = \frac{(W_2 - W_1)}{(W_3 - W_1)}$$

Determine ethyl alcohol content (per cent by volume) corresponding to the specific gravity by using the following Table

6.2.6 Results

Alcohol content of sample = percent (v/v).

Ethyl alcohol content (v/v) at 15.56°C (60°F) corresponding to specific gravity

Apparent sp.gr	Alcohol conc. %	Apparent sp.gr	Alcohol conc. %
0.9992	0.53	0.9813	14.05
0.9990	0.66	0.9801	15.06
0.9985	1.00	0.9790	16.00
0.9976	1.60	0.9778	17.04
0.9970	2.01	0.9767	18.00
0.9955	3.04	0.9755	19.06
0.9941	4.02	0.9744	20.03
0.9927	5.02	0.9622	30.02
0.9913	6.06	0.9472	40.05
0.9900	7.05	0.9288	50.04
0.9887	8.06	0.9075	60.03
0.9875	9.01	0.8837	70.02
0.9862	10.05	0.9572	80.02
0.9850	11.00	0.8270	90.02
0.9837	12.06	0.7981	100.00
0.9825	13.04		

6.3 PRECAUTIONS

The general precautions mentioned in the course 'Introduction' and those indicated in the experiments should be followed meticulously.

Avoid holding the body of the specific gravity bottle, especially after filling solutions. This will cause expansion of the solution, which will flow out resulting in wrong results. Hold the bottle at the neck.