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Estimation of Alcohol by Different Evaluative Methods and Comparisons in Estimated Results of Various Methods

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Abstract - *Different methods of preparation are used but the ethanol obtained is initially obtained in admixture with water. From this solution ethanol is obtained by fractional distillation. Ethanol cannot be separated completely by distillation as its boiling point is significantly lower than water. Instead, an azeotropic mixture (i.e. mixture of 95% ethanol and 5% water) is obtained, and the boiling point of the azeotrope is 78.15°C. In a distillation, the most volatile material (i.e. the material that has the lowest boiling point) is the first material to distill out from the distillation flask, and this material is the azeotrope of 95% ethanol, which has the lowest boiling point. If an efficient fractionating column is used, first 95 % alcohol is obtained, then a small intermediate fraction of lower Concentration, and finally water- No matter how efficient the fractionating column used, 95° cannot be further concentrated by distillation. So we have used four different methods which are easily available and cost effective. The four methods used for estimations are Potassium dichromate Method, Specific Gravity Method, Sikes Hydrometer Method and Gas Chromatography Method and evaluated the results.*

Key Words: **Azeotropic Mixture**, Dichromate Method, Pycnometer, Gas Chromatography, Alcohol, Sikes Hydrometer.

1. INTRODUCTION

As we know that a azeotropic mixture is a mixture that cannot be separated from a simple distillation as when the mixture the boiled the vapour contains the same amount of the vapour of both the component present in the mixture so we have researched different cost effective methods by which the percentage of alcohol present in the azeotropic mixture. As this research is an important part of the beverage industry and can be used to find the percentage of alcohol in various beverages such as wines beers etc. In alcohol industry it has a wide scope for determination of percentage in this azeotropic mixture. The low cost methods which we have included are Potassium Dichromate Method, Gas Chromatography Method, Pyconometer and Sike's Hydrometer. We have further compared the results using different parameters to find out the better method for evaluation of the amount of alcohol present in the azeotropic mixture.

2. Materials and methods

All chemicals were used of A.R. grade. The methods used for analysing the amount of alcohol are potassium dichromate method, gas chromatography method, pyconometer and sike's hydrometer.

Experimental Methods:

A) Potassium dichromate Method: About 34 grams of potassium dichromate is dissolved in 500 ml distilled water in a one liter volumetric flask. The volumetric flask is placed in an ice container and 325 ml of conc. H_2SO_4 is added drop wise so that minimum heat is generated. The solution is thoroughly mixed, cooled and the made volume to1 liter with distilled water. Pipette out 1 ml sample in volumetric flask followed by 10ml dichromate reagent. The flask 15 incubated at 60˚C for 20 min. in a water bath and the mixture is cooled. Volume is made up to 50 ml using distilled water. The linearity curve plot by taking concentration from 1 to 10 % ethanol (v/v) the blank solution was prepared with distilled water. The amount of ethanol in the test sample is determined by UV from the linearity Curve plotted at 620 nm.

B) The Specific Gravity Method: The liquid was taken in the specific gravity bottle and the temperature of the liquid was measured then the liquid was completely filled in the bottle and the weight was measured for further calculations.

C) Sike's Hydrometer Method: The azeotropic mixture was taken in the cylinder and exact temperature of the liquid was measured. Spindle was selected likely to be the jar if released carelessly. Impress the measuring cylinder, depress it to the top mark on the scale, shaking free any adherent bubble from it and released gently. A proper spindle was floating at a point with divisions on its steam. Surface of the spirit was brought to the eye level and noted down the division that is cut by surface on seen from below. This was indication of the surface of liquid between any two steam divisions; the division nearest below the surface (seen from below) was recorded as the indication. To find out the strength of spirit was referred to spirit table for use with Sike's hydrometer. Opposite the indication in the table for the recorded temperature will refound this spirit strength.

D) Gas Chromatographic: Instrument Column: Hewlett Packard 6890 plus Gas Chromatograph Porapaq-Q (6 ft. X I/8"-ss packed column), Injector Temperature: 150°C, Injector: Splitless mode, Carrier gas: Hydrogen 20 ml/min

Detector: TCD, Injection volume: 0.4 µL. Samples of different concentration viz. 2%, 4% 6% 8% 10% of alcohol was taken to determine the exact concentration on different experimental methods to get the results.

3. Observations and Results

RESULT TABLE NO.1 – Distilled std. sample of various concentration ranges.

2% standard ethanol sample (distilled)

ALCOHOL %	SP. GRAVITY	G.C. METHOD	SPECTRO (DICHROMATE)		SIKES HYDROMETER	
			587nm	620nm	TEMP	FAHRENHEIT
1	2.14	1.84	2	2.03	0.74	1.14
2	2.12	1.88	1.98	2.07	0.7	1.08
3	2.12	1.85	1.95	2.03	0.74	1.14
MEAN	2.12	1.86	1.98	2.04	0.73	1.12
STDEV	0.012	0.021	0.025	0.023	0.023	0.035
CV	0.543	1.121	1.273	1.130	3.178	3.093

4% standard ethanol sample (distilled)

ALCOHOL %	SP. GRAVITY	G.C. METHOD	SPECTRO (DICHROMATE)		SIKES HYDROMETER	
			587nm	620nm	TEMP	FAHRENHEIT
1	3.6	3.94	4.02	4.07	2.57	2.91
2	3.58	3.91	4.15	4.2	2.68	2.99
3	3.6	3.88	4.12	4.16	2.58	2.88
MEAN	3.59	3.91	4.10	4.14	2.61	2.93
STDEV	0.012	0.030	0.068	0.067	0.061	0.057
CV	0.321	0.767	1.662	1.607	2.331	1.943

6% standard ethanol sample (distilled)

ALCOHOL %	SP. GRAVITY	G.C. METHOD	SPECTRO (DICHROMATE)		SIKES HYDROMETER	
			587nm	620nm	TEMP	FAHRENHEIT
1	5.4	5.89	6.02	6.08	4.51	4.98
2	5.32	5.82	5.85	5.95	4.38	4.82
3	5.4	5.77	5.95	6.02	4.58	4.9
MEAN	5.37	5.83	5.94	6.02	4.49	4.90
STDEV	0.046	0.060	0.085	0.065	0.101	0.080
CV	0.860	1.035	1.438	1.081	2.260	1.633

8% standard ethanol sample (distilled)

ALCOHOL %	SP. GRAVITY	G.C. METHOD	SPECTRO (DICHROMATE)		SIKES HYDROMETER	
			587nm	620nm	TEMP	FAHRENHEIT
1	7.79	7.84	7.6	7.61	6.3	6.7
2	7.89	7.89	7.96	7.8	6.57	6.968
3	7.85	7.77	7.77	7.52	6.4	6.84
MEAN	7.84	7.83	7.78	7.64	6.42	6.84
STDEV	0.050	0.060	0.180	0.143	0.137	0.140
CV	0.642	0.769	2.316	1.870	2.125	2.047

10% standard ethanol sample (distilled)

ALCOHOL %	SP. GRAVITY	G.C. METHOD	SPECTRO (DICHROMATE)		SIKES HYDROMETER	
			587nm	620nm	TEMP	FAHRENHEIT
1	9.7	9.98	9.34	9.55	8.4	8.96
2	9.6	10.05	9.69	9.89	8.55	9.13
3	9.7	9.89	9.69	9.89	8.38	8.96
MEAN	9.67	9.97	9.57	9.78	8.44	9.02
STDEV	0.058	0.080	0.202	0.196	0.093	0.098
CV	0.597	0.804	2.111	2.008	1.100	1.089

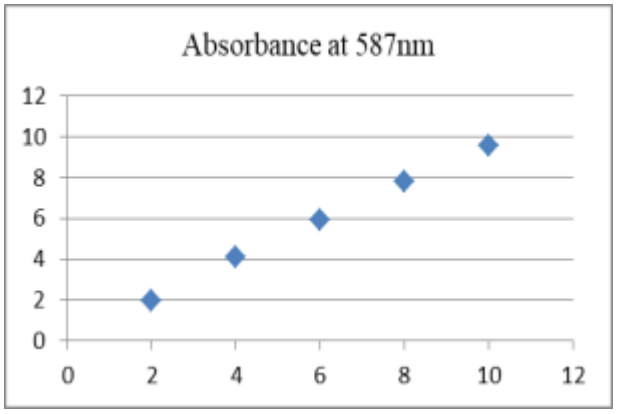

Chart -1: Graph of Absorbance vs. % alcohol at 587 nm

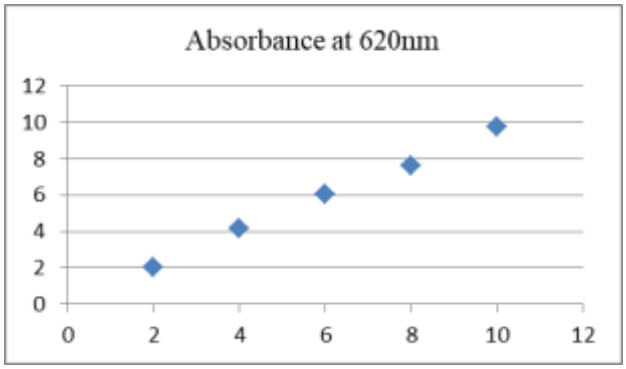

Chart -1: Graph of Absorbance vs. % alcohol at 620nm.

The t-TABLE:-

Results Table:

Comparative t-TEST TABLE of specific gravity, G.C., Sikes spectrophotometric methods for samples for understanding the relation between two tests taken for analysing the % of alcohol.

A

	SP. GRAVITY	G.C. METHOD
ALOCOHOL%	X1	X2
1	96.06	100.29
2	96.06	100.44
3	96.00	99.74
4	95.74	96.51
5	95.69	100.00
6	95.74	98.20
MEAN	95.88	99.20
STD	1.0973	
t-test	5.2343	
t-table	2.228	

B

	SP. GRAVITY	SPECTROPHOTOMTER
ALOCOHOL%	X1	X2
1	96.06	97.81
2	96.06	97.54
3	96.00	97.81
4	95.74	99.00
5	95.69	98.50
6	95.74	99.00
MEAN	95.88	98.28
STD	0.471	
t-test	80823	
t-table	2.228	

C

	SP. GRAVITY	SIKES HYDROMETER
ALOCOHOL%	X1	X2
1	96.06	96.56
2	96.06	96.50
3	96.00	96.50
4	95.74	96.38
5	95.69	96.30
6	95.74	96.38
MEAN	95.88	96.44
STD	0.141	
t-test	6.859	
t-table	2.228	

3. CONCLUSIONS and DISCUSSION

The table T (a), T(b) and T-(c) gives the comparative data between Sp. Gravity, method by Spectrophotometer (potassium dichromate) method, G.C. method, Sike's hydrometer method by the t-Test method . We found that the calculated value is more than the table value, therefore hypothesis are, hence it likely to have the variables in the alcohol determination methods. Then the T-a) is much better than T-b) & T-c) by the t-Test method.

Using t-test, it is observed that for higher concentration, alcohol estimation by specific gravity & G.C.method shows significant difference at 5 % level, because calculated t-value equal to 5.23 is greater than table-t value i.e. 2.228 at 5 % level of significant for 10 ° freedom & alcohol estimation determined by Specific Gravity Method gives average value of 95.88 % which is closed to 96%. Hence Specific Gravity Method is the good method than G.C.Method for alcohol estimation for higher concentration.

CONCLUSION

1) In the given dichromate method the reported ƛ-max is 620nm and Department of Viticulture and Enology, University of California, Davis, California 95616 reference wavelength reported 620nm but actually, We found at it gives 587nm.we took reading at both wavelength i.e. 587nm & 620nm. The plotted linearity graph gives correct or accurate result at 587 run rather than 620nm.

2) Conclusion: Sike's Hydrometer gives the less % of alcohol in Low concentration. As compare to G.C. as well as Specific gravity method.

3) From result table no II: - The Sp. Gravity Method is good for alcohol estimation compared to G.C. Dichromate & Sike's

hydrometer method as well as Sp. Gravity Method & G.C. Method gives nearly same result. It means for lower concentration of alcohol estimation Sp. Gravity method & G.C. Method are more useful than Dichromate & Sike's Hydrometer Method.

4) From result Table no III: - The Sp. Gravity Methods are more usefull for alcohol estimation than Dichromate method & G.C. Method. The G.C method gives much different result as compare to Result Table no I, II & III.

5) Using t-test. It is observed that for higher concentration Alcohol estimation by Sp. Gravity & G.C.method. Indicate significant different At 5% level because calculated t-value equal to 5.24 is greater than table-t value-2.228 at 5% level of significant for 10° of freedom & Alcohol estimation determine by Specific gravity method gives average value of 95.88% which is closed to 96% hence specific gravity method is better Method than G.C.Method for alcohol estimation for higher concentration.

REFERENCES

[1] E. A. Crowell 1 and C.S. Ough 1, Department Of Viticulture and Enology, University of California, Davis, California, 95616

[2] Craig A. Gallet, "The demand for alcohol: a meta-analysis of elasticities , The Australian Journal of Agricultural and Resource Economics"

[3] Ranjana Mehrotra, "Infrared Spectroscopy, Gas Chromatography/Infrared in Food Analysis", National Physical Laboratory, New Delhi, India.

[4] Kurt M. Dubowski, "Alcohol Determination in the Clinical Laboratory", Department of Medicine and Toxicology Laboratories, The University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma

[5] AOAC Method , or use standard reference material 1590, Stablized ratio (RR)

[6] Indian Standard — Table for alcoholometery-by Pyknometer method. II

[7] AOAC Method , or use standard reference material 1590, Stablized ratio (RR)