



Analysis of Vinegar samples for the Measurement of the amount of Acetic Acid

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The various vinegar samples were analysed with a view of determining acetic acid content in them. Vinegar is an acidic liquid made from the fermentation of ethanol in a process that yields its key ingredient acetic acid whose concentration typically ranges from 4 to 8% by volume for table vinegar and up to 18% for pickling vinegar. Acetic acid in the form of vinegar has been made by acetic acid bacteria of genus Acetobactor. In sufficient oxygen these bacteria can produce vinegar from a variety of alcoholic food stuffs. The alcohol may be derived from different sources including wine, cider, beer or fermented fruit juice. The consumption of acetic acid significantly lowers the value of serum total cholesterol and triacylglycerol. Long term ingestion may cause Hyperkalemia, Hyperreninemia and osteoporosis. The amount of acetic acid in different vinegar samples was determined by titrimetric method with a colored pH indicator to determine the end point. The strength of acetic acid in different samples of vinegar was found to be in the range of 0.48 to 2.07.

Keywords: Vinegar, Acetic acid, Titrimetric.

Introduction : The word vinegar is derived from the old French word vin aigre, meaning sour wine. Vinegar has been made and used by people for thousand of years. According to shennog's herb classic, vinegar was invented in china during the Xia dynasty around 2000 B.C. The name acetic acid is derived from the Latin word acetum which means vinegar. Vinegar is an acidic liquid made from the fermentation of ethanol in a process that yields its key ingredients acetic acid whose concentration typically ranges from 4 to 8% by volume for table vinegar and up to 18% for pickling vinegar (FDA: Sec, 525.325 Vinegar, Definitions-Adultration with vinegar Eels (CPG 7109.22). Acetic acid is used as a food additive in food industry as an acidity regulator. Acetic acid is produced both synthetically and by bacterial fermentation. Acetic acid in the form of vinegar has been made by acetic acid bacteria of genus *Acetobactor*. In sufficient oxygen these bacteria can produce vinegar from a variety of alcoholic food stuffs. The alcohol may be derived from different sources including wine, cider, beer or fermented fruit juice. The overall chemical reaction facilitated by these bacteria is $C_2H_5OH + O_2 \rightarrow CH_3COOH + H_2O$.

Vinegar is commonly used in food preparation particularly in pickling processes, vinaigrettes & other

salad dressings. It controls blood glucose (Fushimi T. et. al., May 2006). It is effective antibacterial agent (Johnston CS, Gaas CA, (2006). It is used as herbicide. Also used to increase the acidity of soil. The consumption of acetic acid significantly lowers the value of serum total cholesterol and triacylglycerol (Lhotta K. et. al., Oct 1998).

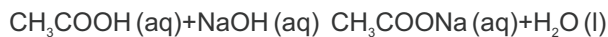
Long term ingestion may cause Hyperkalemia, Hyperreninemia and osteoporosis. Higher Concentration may cause skin burns permanent eye damage and irritation to mucous membrane. It causes severe damage to digestive system. It increases the acidity of blood.

Objective :

The goal of this project was to "determine the amount of acetic acid in different samples of vinegar by titrimetric method with a colored pH indicator to determine the end point".

Theory :

The acetic acid content of vinegar may be determined by titrating a vinegar sample with a solution of sodium hydroxide of known molar concentration (molarity).



Acid + base salt + water

At the end point in the titration stoichiometry between the both solutions lies in a 1:1 ratio.

$$\frac{M_{\text{CH}_3\text{COOH}} \cdot V_{\text{CH}_3\text{COOH}}}{M_{\text{NaOH}} \cdot V_{\text{NaOH}}} = \frac{1}{1}$$

Strength of acid in vinegar can be determined by the following formula:

$$\text{Strength of acetic acid} = M_{\text{CH}_3\text{COOH}} \cdot 60$$

The indicator used was phenolphthalein. And the end point was colorless to pink.

Experimental procedure :

1.5 ml of vinegar was taken in a conical flask and it was dissolved with distilled water so that the volume becomes 20ml. 1-2 drops of 0.5% phenolphthalein solution was added to it. The burette was filled with 0.1M solution of NaOH with the help of a funnel. The Vinegar solution was titrated against the M/10 NaOH solution to its end point of permanent pink.

Required amount of sodium hydroxide (NaOH) for the preparation of 0.1M NaOH solution can be calculated using the formula:

$$W = \frac{\text{Molarity} \cdot \text{Molar mass} \cdot \text{Volume}(\text{cm}^3)}{1000}$$

$$\text{Molar mass of NaOH} = 40 \text{ g/mol}$$

$$= \frac{0.1 \cdot 40 \cdot 2000}{1000}$$

$$= 8 \text{ g}$$

Similarly, this process was repeated for all the different vinegar samples.

Observation and Calculation :

SAMPLE 1 - NON FRUIT VINEGAR (TOPS)

S. No	Volume of Vinegar Solution	Burette Reading (In ml)			Concurrent Reading
		Initial (in mL)	Final (in mL)	Difference	
1.	20 ml	0	6.9	6.9	
2.	20 ml	0	6.9	6.9	6.9
3.	20 ml	0	6.9	6.9	

Calculation :

We know that,

$$M_{\text{CH}_3\text{COOH}} \cdot V_{\text{CH}_3\text{COOH}} = M_{\text{NaOH}} \cdot V_{\text{NaOH}}$$

$$\Rightarrow M_{\text{CH}_3\text{COOH}} = \frac{M_{\text{NaOH}} \cdot V_{\text{NaOH}}}{V_{\text{CH}_3\text{COOH}}}$$

$$\Rightarrow M_{\text{CH}_3\text{COOH}} = \frac{0.1 \times 6.9}{20}$$

$$= 0.0345 \text{ mol/L}$$

$$\text{Strength of acetic acid} = 0.0345 \times 60 = 2.07 \text{ g/L}$$

Similarly, the titration was repeated for all the other samples of vinegar.

OBSERVATION TABLE OF TITRATION

S. No	Vinegar Samples	Volume of vinegar solution (in ml)	Volume of NaOH Solution Used (concurrent reading)
1.	Non fruit vinegar (tops)	20	6.9
2.	Jamun fruit vinegar (uday)	20	3.8
3.	Synthetic vinegar (royal no. 1)	20	1.6
4.	Non fruit vinegar (samurai)	20	5.0
5.	Non fruit vinegar (nationals)	20	6.6

Result :

S. No	Vinegar Sample	Molarity of CH ₃ COOH (mol)/L	Strength of CH ₃ COOH (g/L)
1.	Non fruit vinegar (tops)	0.0345	2.07
2.	Jamun fruit vinegar (uday)	0.019	1.14
3.	Synthetic vinegar (royal no. 1)	0.008	0.48
4.	Non fruit vinegar (samurai)	0.025	1.5
5.	Non fruit vinegar (nationals)	0.033	1.98

Conclusion and Discussion :

After performing the titration with different samples of vinegar, we found that the amount of acetic acid is varying in all the types. Order of amount of acetic acid in different samples of Vinegar is

TOPS > NATIONAL'S > SAMURAI > UDAY > ROYAL No.1
(Nonfruit) (Nonfruit) (Nonfruit) (Jamunfruit) (Synthetic)

Most suitable Vinegar for household purpose is Tops.

The dilute acetic acid in the form of vinegar is harmless. But ingestion of more concentrated solution is dangerous to human and animal life.

Concentration of acetic acid by weight	Molarity (mol/L)	Classification
1. 10-25%	1.67-4.16	Irritant
2. 25-90%	4.16-14.99	Corrosive
3. >90%	>14.99	Corrosive & Flammable

So, the Vinegar solution above 10% needs careful handling.

References :

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