Finding the amount of ethanoic acid in vinegar

ASSIGN BUSTER

I am going to do an investigation into the ethanoic acid content of various vinegars. The chemical equation for the making of ethanoic acid is as follows:

Ethanol oxidization ? bacteria Ethanoic Acid

To do this experiment I intend to do an accurate titration using a burette.

Hypothesis: I predict that the amount of acid in the vinegar depends on the alcohol content that you start off with. For example if we decided to use a lot of alcohol then the vinegar produced would be have a lower pH than if we used a smaller amount of alcohol.

Prediction: I predict that the vinegar with the highest amount of acid (concentration) in is the distilled vinegar as distilled means to increase the concentration of, or purify. So I think that all the impurities will not be present and so there will be more acid in this vinegar.

Apparatus: Firstly here is a complete list of apparatus that I will need to complete the experiment successfully.

* Burette and burette clip

* Stand and white tile

* Different Vinegars:

Red Wine Vinegar

Cider

White Wine

Malt Vinegar

Distilled Vinegar

* Flask

* Sodium hydroxide solution of concentration 0. 1M or 0. 4M

* Phenalthaylene or Methyl Orange indicator

* Pipette

* Funnel and 100ml Conical flask

Preliminary Experiments: Before starting the investigation I will need to experiment with the two concentrations of NaOH and the two different types of indicator and then choose one of each, which I think best fits the purpose. In order to make a fair choice I will carry out the following experiment using the ‘ red wine vinegar’ as the fixed variable in the test. I will try to find out which concentration of NaOH would be easiest to use with accuracy and which indicator gives the biggest and most obvious change.

Concentration

Type of Vinegar

Amount of NaOH

Indicator Used

NaOH 0. 4M

Red Wine Vinegar

40+

Phenalthaylene

NaOH 0. 1M

Red Wine Vinegar

10+

Phenalthaylene

NaOH 0. 4M

Red Wine Vinegar

40+

Methyl Orange

NaOH 0. 1M

Red Wine Vinegar

40+

Methyl Orange

From this preliminary experiment I conclude that as the methyl orange was reluctant to change I will use the Phenalthaylene indicator, which is also very

clear and easy to see the neutralization point. The concentration I will be using is the 0. 1M as the 0. 4M took a very large quantity of NaOH to neutralize the acid and I think using this will only be a waste of the vinegar.

Method: To begin with I will fill the burette with one of the five vinegars by pouring it with a funnel while looking at eye level. I will then fill up the conical flash with exactly 10cmï¿½ of NaOH of concentration 0. 1M. I will then put the Phenalthaylene indicator into the conical flash and slowly add the vinegar through the burette until I find the exact amount of vinegar that neutralises the NaOH, I will know that this has happened as the indicator will change colour. I will then repeat this process with all of the five vinegars so that I can find the amount of ethanoic acid in each one. The degree of accuracy that I will take the measurements will be to the nearest 1mmï¿½ and I will repeat each experiment 3 times and average these 3 results to cancel out any error.

Health & Safety: To make sure the experiment is as safe as possible you should take a few safety precautions. Wearing safety goggle until all practical work and clearing up is finished. Standing up during the experiment and making sure that nothing is on the floor is also very important in case of an emergency. Stools should be under the bench, and you should not drink or eat anything during the experiment.

Observations

Here are the results that I collected after I had followed my method. All results in the table are cmï¿½ unless otherwise stated.

Red Wine

Start Volume

Volume Used

Average Used

Cider

Start Volume

Volume Used

Average Used

White Wine

Start Volume

Volume Used

Average Used

Malt Vinegar

Start Volume

Volume Used

Average Used

Distilled Malt

Start volume

Volume Used

Average Used

Rangefinder

0

9. 7

0

11. 5

0

9. 5

0

11. 1

0

11. 4

First Time

0

9. 7

0

11. 4

0

9. 0

0

11. 1

0

11. 3

Second Time

0

9. 7

0

11. 6

0

9. 2

0

11. 2

0

11. 3

Third Time

0

9. 7

9. 7

0

11. 5

11. 5

0

9. 1

9. 1

0

11. 2

11. 2

0

11. 3

11. 3

I took a rangefinder so that it was easier to get the exact volume when I did it for the three real attempts. This way it allowed me to drip the acid drip by drip until it was perfect. I took three reading rather than one so I would get sufficient evidence to support my conclusion. If I had only taken one reading then it may not have been quite right. I think that by presenting my results in a table it is visually easy to see what results I got for different things and the different attempts.

Analysis

I then proceeded to find the molarity of each of the vinegars using the average values I had obtained from the experiment. To make these calculations I used the following equation

b x Ma x Va = a x Mb x Vb or bMaVa = aMbVb

NaOH +CH3COOH –> CH3COONa + H2O

b a

Red Wine

1 x Ma x 9. 7 = 1 x 0. 1 x 10

–> Ma = 0. 1 x 10 ï¿½ 9. 7 = 0. 103 (x10)

= 1. 03M

Cider

1 x Ma x 11. 5 = 1 x 0. 1 x 10

–> Ma = 0. 1 x 10 ï¿½ 11. 5 = 0. 086 (x10)

= 0. 86M

White Wine

1 x Ma x 9. 1 = 1 x 0. 1 x 10

–> Ma = 0. 1 x 10 ï¿½ 9. 1 = 0. 110 (x10)

= 1. 10M

Malt Vinegar

1 x Ma x 11. 2 = 1 x 0. 1 x 10

–> Ma = 0. 1 x 10 ï¿½ 11. 2 = 0. 089 (x10)

= 0. 89M

Distilled Malt

1 x Ma x 11. 3 = 1 x 0. 1 x 10

–> Ma = 0. 1 x 10 ï¿½ 11. 3 = 0. 088 (x10)

= 0. 88M

The reason that I multiplied all the final readings by 10 is that the original vinegars were all diluted by a factor of 10 before the experiment.

In order of concentration:

* White Wine 1. 10M

* Red Wine 1. 03M

* Malt Vinegar 0. 89M

* Distilled Malt 0. 88M

* Cider 0. 86M

From this we can see that both of the wines have the higher concentration, which was very unexpected, as one would think that distilled vinegar has a higher concentration. This disproves my prediction that the distilled vinegar is the strongest. I think that the wine has a higher concentration as wine is left longer to ferment and it allow the alcohol to be produced. Whereas cider has a low alcohol content and the vinegar has not been left to ferment. So it is true to say that the alcohol content is proportional to the amount of acid in the vinegar.

Evaluation

I think that we used a safe and easy procedure to obtain the results that we did, (meaning that if we did the experiment again we would get the same results) without getting any anomalies. We tried to be as accurate as possible on every reading that we made, as well as taking precautions so any anomalies would not occur. I feel that my hypothesis was correct, by stating that the more alcohol content you start with the higher the concentration of acid. As this is proven by the fact that the wines both had the highest alcohol content. If I were to repeat the experiment then I would

take a bigger variety of vinegars from which I could get additional evidence to support my conclusion. Also I would use a pH meter so rather than guessing the neutral point the pH meter could be a lot more accurate. Another thing that I think that would have improved the experiment was to standardize the amount of indicator used to around 5 drops. Because if there was too much indicator it affected the results, in that slightly more vinegar was needed to neutralize the solution. If too little indicator was added it was very hard to see the colour change. I would also have taken more readings so that I would have a better average and more accurate calculations.