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OBJECTIVE

The Objective of this project is to study the rates of fermentation of the following fruit or vegetable juices.

1. Apple juice
2. Carrot juice

INTRODUCTION

Fermentation is the slow decomposition of complex organic compound into simpler compounds by the action of enzymes. Enzymes are complex organic compounds, generally proteins. Examples of fermentation are: souring of milk or curd, bread making, wine making and brewing.

The word Fermentation has been derived from Latin (Ferver which means to 'boil').As during fermentation there is lot of frothing of the liquid due to the evolution of carbon dioxide, it gives the appearance as if it is boiling.

Sugars like glucose and sucrose when fermented in the presence of yeast cells are converted to ethyl alcohol. During fermentation of starch, starch is first hydrolysed to maltose by the action of enzyme diastase. The enzyme diastase is obtained from germinated barley seeds.

Fermentation is carried out at a temperature of 4–16 °C (40–60 °F). This is low for most kinds of fermentation, but is beneficial for cider as it leads to slower fermentation with less loss of delicate aromas. Apple based juices with cranberry also make fine ciders; and many other fruit purées or flavorings can be used, such as grape, cherry, and raspberry. The cider is ready to drink after a three month fermentation period, though more often it is matured in the vats for up to two or three years.

THEORY

Louis Pasteur in 1860 demonstrated that fermentation is a purely physiological process carried out by living micro-organism like yeast. This view was abandoned in 1897 when Buchner demonstrated that yeast extract could bring about alcoholic fermentation in the absence of any yeast cells. He proposed that fermenting activity of yeast is due to active catalysts of biochemical origin. These biochemical catalyst are called enzymes. Enzymes are highly specific. A given enzyme acts on a specific compound or a closely related group of compounds.

Fermentation has been utilized for many years in the preparation of beverages. Materials from Egyptian tombs demonstrate the procedures used in making beer and leavened bread. The history of fermentation, whereby sugar is converted to ethanol by action of yeast, is also a history of chemistry. Van Helmont coined the word iogaslt in 1610 to describe the bubbles produced in fermentation. Leeuwenhoek observed and described the cells of yeast with his newly invented microscope in 1680.

The fruit and vegetable juices contain sugar such as sucrose, glucose and fructose. These sugars on fermentation in the presence of the enzymes invertase and zymase give with the evolution of carbon dioxide. Maltose is converted to glucose by enzyme maltose. Glucose is converted to ethanol by another enzyme zymase

Invertase

$C_{12}H_{22}O_{11} + H_2O$ $C_6H_{12}O_6 + C_6H_{12}O_6$

Sucrose GlucoseFructose

Zymase

$C_6H_{12}O_6 + C_6H_{12}O_6$ $2C_2H_5OH + 2CO_2$

Glucose Fructose Ethanol

Diastase

$2(C_6H_{10}O5)_n + nH_2O$ $nC_{12}H_{22}O_{11}$

Starch Maltose Maltose

$C_{12}H_{22}O_{11} + H_2O$ $2C_6H_{12}O_6$

Maltose Glucose

Zymase

$C_6H_{12}O_6$ $2C_2H_5OH + 2CO_2$

Glucose Ethyl alcohol

Glucose is a reducing sugar and gives red coloured precipitates with Fehling's solution, when warmed. When the fermentation is complete, the reaction mixture stops giving any red colour or precipitate with Fehling solution.

EXPERIMENT-1

REQUIREMENTS

Conical flasks (250 ml), test tubes and water bath, Apple juice and Fehling's solution.

PROCEDURE

1. Take 5.0 ml of apple juice in a clean 250 ml conical flask and dilute it with 50 ml of distilled water.
2. Add 2.0 gram of Baker's yeast and 5.0 ml of solution of Pasteur's salts to the above conical flask.
3. Shake well the contents of the flask and maintain the temperature of the reaction mixture between 35-40°C.
4. After 10minutes take 5 drops of the reaction mixture from the flask and add to a test tube containing 2 ml of Fehling reagent. Place the test tube in the boiling water bath for about 2 minutes and note the colour of the solution or precipitate.
5. Repeat the step 4 after every 10 minutes when the reaction mixture stops giving any red colour or precipitate.
6. Note the time taken for completion of fermentation

EXPERIMENT-2

REQUIREMENTS

Conical flasks (250 ml), test tubes and water bath, Carrot juice and Fehling's solution.

PROCEDURE

1. Take 5.0 ml of carrot juice in a clean 250 ml conical flask and dilute it with 50 ml of distilled water.
2. Add 2.0 gram of Baker's yeast and 5.0 ml of solution of Pasteur's salts to the above conical flask.
3. Shake well the contents of the flask and maintain the temperature of the reaction mixture between 35-40°C.
4. After 10minutes take 5 drops of the reaction mixture from the flask and add to a test tube containing 2 ml of Fehling reagent. Place the test tube in the boiling water bath for about 2 minutes and note the colour of the solution or precipitate.
5. Repeat the step 4 after every 10 minutes when the reaction mixture stops giving any red colour or precipitate.
6. Note the time taken for completion of fermentation.

Pasteur's Salt Solution – Pasteur salt solution is prepared by dissolving ammonium tartrate 10.0g; potassium phosphate 2.0 g; calcium phosphate 0.2g, and magnesium sulphate 0.2 g dissolved in 860ml of water

OBSERVATION

Volume of fruit juice taken	= 5.0 ml
Volume of distilled water added	= 50.0 ml
Weight of Baker's yeast added	= 2.0 g
Volume of solution of Pasteur's salts	= 5.0 ml