

“EFFECT OF DIFFERENT FRUIT JUICES ON CATALASE ENZYME ACTIVITY”

NATIONAL SCIENCE FAIR RESEARCH PAPER

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ABSTRACT

This study explores the effect of different fruit juices—lemon, orange, and apple—on the activity of the catalase enzyme found in potatoes. Catalase is an important enzyme that breaks down hydrogen peroxide into water and oxygen. The presence of bubbles during the reaction indicates enzyme activity.

The experiment compared how various fruit juices influenced the amount of bubbling when hydrogen peroxide was added to potato extract. The results showed that the reactions differed slightly among the juices, suggesting that acidity and fruit composition may affect enzyme function. This small-scale experiment helped to understand basic enzyme behavior in a simple and practical way.

INTRODUCTION

Catalase is a naturally occurring enzyme present in most living organisms, including plants and animals. It helps to remove hydrogen peroxide, a harmful substance produced during metabolism, by converting it into water and oxygen.

Fruit juices contain acids, sugars, and vitamins that can change the conditions in which enzymes work. Since enzymes are sensitive to pH and other factors, fruit juices may influence their activity. This experiment aims to observe the visible effect of different fruit juices on the catalase enzyme found in potato extract. It is a simple school-level investigation that connects everyday materials to biological concepts.

SELECTION OF PROBLEM

Students often learn that enzymes are sensitive to their surroundings, but they rarely see this demonstrated with natural substances. Testing how common fruit juices affect catalase gives a clear, visual understanding of enzyme action without using complex laboratory equipment.

BACKGROUND RESEARCH

Catalase works best in neutral conditions. When the environment becomes too acidic or too basic, the enzyme's structure can change, leading to slower or weaker reactions.

Lemon and orange juices are acidic, while apple juice is comparatively less acidic. These juices may alter the pH of the mixture and influence catalase activity. Observing bubble formation provides an easy way to judge whether the enzyme is active or not.

This experiment was designed for basic observation rather than precise measurement, to help students relate textbook knowledge to real-life examples.

OBJECTIVES

- To observe how catalase breaks down hydrogen peroxide.
- To compare the effect of different fruit juices on catalase activity.
- To understand the influence of pH on enzyme behavior using simple materials.

STATEMENT OF THE PROBLEM

How do different fruit juices—lemon, orange, and apple—affect the activity of catalase enzyme in potato extract when reacting with hydrogen peroxide?

HYPOTHESIS

If the catalase enzyme is sensitive to pH, then the more acidic fruit juices (lemon and orange) will reduce the amount of bubble formation compared to apple juice or plain potato extract.

DESIGN OF STUDY

INDEPENDENT VARIABLE:

- Type of fruit juice used (lemon, orange, apple, or none).

DEPENDENT VARIABLE:

- Rate or amount of bubble formation (oxygen released).

CONTROLLED VARIABLES:

- Quantity of potato extract and hydrogen peroxide.
- Temperature, reaction time, and concentration of hydrogen peroxide.

- Equal proportion of juice and potato extract in all samples.

MATERIALS REQUIRED

- Fresh potato
- Fruit juices – lemon, orange, apple
- 3% hydrogen peroxide
- Test tubes or beakers
- Grater and knife
- Filter paper or strainer
- Measuring cylinder
- Dropper or pipette
- Gloves and safety glasses

PROCEDURE

1. Grate a fresh potato and filter the juice using a strainer to obtain the extract.
2. Pour equal amounts of potato extract into four test tubes labeled as: Control, Lemon, Orange, and Apple.
3. Add no juice to the Control tube.
4. Add equal amounts of lemon, orange, and apple juice to the respective tubes.

5. Add 5 ml of 3% hydrogen peroxide to each test tube.

6. Observe the rate and amount of bubbles formed for about 1–2 minutes.

7. Note the results based on how fast and how much bubbling occurs.

DATA ANALYSIS

Test Tube	Treatment (Juice)	Observation (Bubble Formation)	Relative Activity
1	Control (Potato only)	Clear bubbling observed	High
2	Lemon juice + Potato	Very few bubbles	Low
3	Orange juice + Potato	Moderate bubbling	Medium
4	Apple juice + Potato	Noticeable bubbling	Fair

The results showed some differences between samples, though the variations were not large. Bubble formation reduced slightly in acidic juices.

RESULT

Acidic juices such as lemon and orange produced slower reactions with fewer bubbles. Apple juice and the control sample produced more bubbles, showing higher enzyme activity. The difference between orange and apple was small and might be due to minor pH differences. Overall, enzyme activity appeared lower in more acidic environments.

CONCLUSION

The catalase enzyme works best in neutral conditions. Acidic fruit juices slightly reduced its activity, which was visible through fewer bubbles. However, the changes were not very sharp, and the results may vary with repeated trials.

This suggests that while acidity affects enzyme activity, other factors such as concentration and freshness of fruit juice may also influence the outcome.

Thus, the experiment supports the hypothesis only partly.

APPLICATION

- Demonstrates enzyme behavior using safe, everyday materials.
- Helps students understand the effect of pH on enzymes through observation.
- Encourages curiosity about biological reactions in simple, hands-on ways.

FUTURE ENHANCEMENTS

- Repeat the experiment with more trials to confirm accuracy.
- Use juices of different acidity levels to compare results.

- Measure the pH of each juice before mixing for more precise conclusions

REFERENCES

- NCERT Class XI Biology Textbook – Enzymes Chapter.
- Khan Academy – “Catalase and Hydrogen Peroxide Reaction.”
- Science Buddies: “Investigating Enzyme Activity.”
- Britannica Online – “Catalase Enzyme.”