



**CALIFORNIA STATE SCIENCE FAIR  
2015 PROJECT SUMMARY**

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**Project Title**  
**Holy Spinach! The Effect of Varying Sodium Bicarbonate Concentrations on the Rate of Photosynthesis in Spinach Leaves**

**Abstract**

**Objectives/Goals**

This experiment aims to evaluate how different concentrations of sodium bicarbonate solutions affect the rate of photosynthesis in spinach leaves.

**Methods/Materials**

In a series of 25 trials, five different sodium bicarbonate solution concentrations were prepared, using distilled water at room temperature along with baking soda. Next, 100 mL of each respective solution was prepared. Subsequently, spinach leaf disks of equal size were perforated using a single hole puncher. Ten of the spinach leaf disks were placed in the syringe along with 3 mL of each solution and the excess air was removed by creating a vacuum which was accomplished by placing a thumb along the opening of the syringe whilst pulling the plunger. This extracted existing air in the disks which removed their existing buoyancy to eliminate any preexisting variables such as the existing oxygen concentration within the spinach leaves. After all the disks had sunk, they were quickly transferred to the rest of the sodium bicarbonate solution which was placed four inches under a light source (70 watt lamp). A timer was initiated as soon as the disks made contact with the solution. The amount of time each disk exhausted to float to the top was recorded. The variation in required time to float to the surface of the solution indicated oxygen release as a product of the rate of photosynthesis. The experiment was repeated using each increasing concentration of the prepared sodium bicarbonate solutions, and analyzing the resulting data.

**Results**

The rate of photosynthesis steadily increased as the concentration of carbon dioxide present (sodium bicarbonate solution concentration) increased (directly proportional relationship). The leaf disks which were not exposed to any carbon dioxide source (control trials) averaged the lowest rates of photosynthesis by requiring an average of 20.54 minutes for all 10 leaf disks to rise. In contrast, the leaf disks which were submerged in the highest concentration (0.8% sodium bicarbonate solution) all rose within 4.91 minutes on average.

**Conclusions/Discussion**

This experiment demonstrates the fact that an increase in the amount of carbon dioxide present can increase the rate of photosynthesis. An increase in the rate of photosynthesis is indicated by the speed by which leaf disks rise which is due to higher rates of released oxygen, the primary product of photosynthesis.

**Summary Statement**

How do varying sodium bicarbonate concentrations (CO<sub>2</sub> levels) affect the rate of photosynthesis in spinach leaves?

**Help Received**

Mom purchased materials needed to perform this experiment.