



**CALIFORNIA STATE SCIENCE FAIR  
2013 PROJECT SUMMARY**

<b>Name(s)</b> Nicholas D. Schanzer	<b>Project Number</b> <b>J1512</b>
<b>Project Title</b> <b>High CO(2) + Low O(2) = Burgers That Stay Fresher Longer</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The objective of this project was to investigate how a high CO<sub>2</sub>/low O<sub>2</sub> environment affects the degradation of raw hamburger patties. I hypothesized that the bag containing CO<sub>2</sub>, O<sub>2</sub> absorbers, and the fuel cell would extend the freshness and slow the degradation of the hamburger patty to the greatest extent. The bag with CO<sub>2</sub> and O<sub>2</sub> absorbers would be the next freshest, and the bag with O<sub>2</sub> absorbers only would be the third freshest. I expected that the control would spoil first.</p> <p><b>Methods/Materials</b> I put 4 raw hamburger patties in different packaged environments in a refrigerator for 14 days: one with nothing in it except ambient air; one with O<sub>2</sub> absorbers; one with a CO<sub>2</sub> flush and O<sub>2</sub> absorbers; and one with a CO<sub>2</sub> flush, O<sub>2</sub> absorbers, and a fuel cell to see which hamburger would appear and smell the freshest after 2 weeks. After every 4 days, I took O<sub>2</sub> and CO<sub>2</sub> readings with an oxygen analyzer. On day 14, I took out the hamburgers and rated them on a scale of 1-5 in terms of smell and appearance.</p> <p><b>Results</b> The percentage of O<sub>2</sub> dropped drastically in Bags 1 and 2 over the course of the experiment. Bags 1 and 2 started out with 19.7% and 19.9% O<sub>2</sub> respectively. Over time, the O<sub>2</sub> dropped all the way down to zero. Since Bag 3 was flushed with CO<sub>2</sub>, almost all the O<sub>2</sub> inside it was removed. Shortly after day 1, the level of O<sub>2</sub> dropped and remained at 0%. Bag 4 was also flushed with CO<sub>2</sub> and nearly all the O<sub>2</sub> was removed. The O<sub>2</sub> in Bag 4 slowly rose until days 12-14 when a major spike occurred. A leak was suspected. The percentage of CO<sub>2</sub> increased in Bags 1 and 2 over the course of the experiment. Bag 3 remained constant with a 100% CO<sub>2</sub> environment throughout the experiment. In Bag 4, CO<sub>2</sub> started at 100%. It steadily dropped until days 12-14 when a major decrease occurred. Again, a leak was likely. The hamburger in Bag 3 had the best appearance and the freshest smell at the end of the experiment while Bag 4 had the worst appearance, and Bag 1 had the worst smell.</p> <p><b>Conclusions/Discussion</b> Most of my results supported my hypothesis. A high CO<sub>2</sub>/low O<sub>2</sub> environment extends the freshness of and arrests microbial growth on raw hamburger patties. Bag 3 appeared and smelled the freshest because bacteria couldn't survive in the 100% CO<sub>2</sub> environment. Bags 1 and 2 had the most spoilage. Bag 4 was the second freshest, which did not follow my hypothesis, because there was a leak in the bag.</p>	
<b>Summary Statement</b> A high CO <sub>2</sub> /low O <sub>2</sub> modified atmosphere environment can keep raw hamburger patties fresher over 14 days.	
<b>Help Received</b> My dad helped get the supplies and taught me how to use the equipment. Mr. Larry Bell and Mr. Dave Nemiroff were my advisors and offered technical support.	