CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Alexander S. Powers

Project Number

S0624

Project Title

Chemistry of Fruits: Optimization of Postharvest Storage Conditions Affecting Nutrients and Taste

Abstract

Objectives/Goals

American families lose an estimated $2,000 a year to food spoilage. Complex chemical reactions result in loss of taste and nutrients such as essential Vitamin C (Ascorbic Acid, AA). This experiment was designed to quantify chemical changes in fruits and provide applicable conclusions to minimize damage. I hypothesized that an increase in temperature would accelerate the ripening process and decrease AA while enclosed environments would speed ripening.

Methods/Materials

Fresh mandarins were stored over 10 days in five conditions: countertop at 20°C, fridge at 3.3°C, freezer at -17°C, closed bag, and closed bag with bananas (to produce ethylene). Weight, pH, and soluble solid changes were measured. After centrifugation, juice samples were assayed colorimetrically with DCPIP dye and quantitative Benedict's solution to test for AA and reducing sugars respectively. A syringe method was implemented to extract initial juice samples and thus, account for variation between fruit.

Results

AA showed continuous and varied degradation with an average loss of 28.3%. The enclosed bag led to only 20% loss as opposed to 48% in regular air simulating a controlled atmosphere with lower O2 levels and high humidity. Weight loss and AA loss had a positive correlation. High loss of 34% in refrigeration at 3.3°C can be attributed to chilling damage. Reducing sugar increased by an average of 22% with a maximum increase of 35% on the counter and a minimum of 7% in the freezer. The enclosed bag containing bananas had an increase of 25% attributed to the accelerated hydrolysis of starch into sugar by ethylene stimulation. A method for detection of high levels of ethylene gas with potassium permanganate was developed. Results overall had statistical significance with low standard deviations of 2-4%.

Conclusions/Discussion

My hypothesis was not fully supported in that increasing temperature was not the only major factor to affect ascorbic acid loss. Losses are enhanced by extended storage, higher temperatures, low relative humidity, and chilling injury explainable on a chemical level. Increased temperature and ethylene did produce a statistically significant increase in concentration of soluble solids and reducing sugars. Although analyzing only a single fruit with limited factors, this experiment provides a basis for further exploration to efficiently minimize spoilage.

Summary Statement

This experiment quantified chemical changes during fruit storage to find optimum conditions.

Help Received

Borrowed equipment from school for use at home