Go Bananas for Kiwi and Papaya

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Abstract:
The experiment studied the possible evolutionary relationship between bananas, green kiwi, and papaya in both an American wholesale market and an Asian market. To explore this relationship, we compared the DNA sequences of these fruits. We hypothesized that these fruits have an evolutionary relationship because they cause similar allergic reactions in people and give similar allergic symptoms, we hypothesize that these fruits have an evolutionary relationship to each other. In order to test our hypothesis, we took a sample of each fruit and isolated the rbcl sequence in chloroplast DNA by polymerase chain reaction (PCR). We confirmed that we isolated DNA from each sample by running the samples through gel electrophoresis, and then sending the samples to the DNA Learning Center for DNA sequencing. Our results found a high percentage of similarity between the rbcl sequence of the chloroplast DNA of each fruit showing a relationship between each sample of fruit, proving that these fruits may have an evolutionary relationship.

Introduction:
The importance of fruits from areas outside of the United States has increased in the population of people living in America. Being so culturally diverse, New York City has a variety of tropical fruits in its many markets, including bananas, green kiwi, golden kiwi, and papaya. Sometimes factors of these specific fruits that we would like to analyze is the fact that when a person is allergic to one of these fruits they are likely to have an allergy to another one. Symptoms of an allergic reaction to bananas can include itchy mouth and throat, rash, hives, (urticaria), of swelling, and sometimes also of breathlessness. Environmental allergic reaction symptoms to a specific fruit include hives, sneezing, and nasal congestion. When studying in depth into the same fruits, we found that the all three of these fruits have similar symptoms in the gut mucosa with symptoms of red itching, hives, diarrhea, nausea, and severe gastrointestinal shock. The fact that there is a common allergy to all of these fruits indicates that there is a common molecular quality that triggers a response. Because of the common threats in these fruits, are they related through a shared ancestry?

Materials & Methods:
Our experiment was conducted from an American wholesale market and an Asian market in New York City. green kiwi, golden kiwi, and bananas. Upon removing our samples we dissected each sample accordingly, which included taking pictures of the specimens and running all of the DNA isolated in the DNA gel electrophoresis sample database. We brought all of collected samples to our school lab and prepared the samples for analysis.

We cut small samples from each of the specimens that were about 15 mm and preserved the rest of the samples by keeping them frozen at -20°C in separate, labeled bags. We took precautions not to cross-contaminate our samples by using different tools for each sample. We then placed the samples in separate, labeled centrifuge tubes. We added 100 µL of lytic solution to each tube which dissolves membrane-bound organelles so that DNA can be accessible. We then added 100 µL of silica resin to each of the new tubes and ensured that it was mixed well with the supernatant by pipetting up and down. The silica resin binded to the DNA and separated it from the other components, without disrupting the resin pellet at the bottom of each tube.

In order to remove contaminants from the samples, we added 500 µL of cold ethanol to each resin pellet and resuspended the silica resin by pipetting up and down. The tubes were then placed into the cold ethanol at -20°C for 30 minutes. After the samples were cooled, we added 300 µL of cold ethanol to each tube and added the tubes to a centrifuge for 30 seconds. We then transferred 50 µL of the supernatant to a new, labeled tube. We stored the samples at -20°C until we were ready to submit our samples for sequencing.

Figure 1. DNA Subway alignment viewer

Figure 2. Gel results

Figure 3. DNA Learning Center

Figure 4. Phylogenetic tree (ML)

Discussion:
The fruits that were analyzed in this experiment were papaya (Carica papaya), banana (Musa acuminata), and green kiwi (Actinidia deliciosa). All of the fruits showed high similarity percentages that were greater than 77%. These results show a high percentage of genome similarity and a strong relationship between all of the fruits. Therefore, we can conclude that there is an evolutionary relationship between these fruits. This experiment was conducted twice to test the reproducibility of the results. In the first attempt of this experiment, the gel electrophoresis results showed that there was DNA present in all samples, except for 02 (American banana), 007 (American papaya), and 009 (Asian banana). When we left the lab for sequencing however, the results came back inconclusive. A possible error was that the primer that was used was not defective. At the time that we attempted are experiment for the second time, golden kiwis were not in season. Therefore, we decided to eliminate golden kiwis from the experiment. The American kiwi and the Asian kiwi showed a 100% similarity in their DNA. The American papaya and the Asian papaya showed a 100% similarity in their DNA as well. However, the American banana and the Asian banana only showed an 80.35% similarity in their DNA. After further research, we discovered that bananas are exceptionally different from each other in terms of species. We were able to further our research by reviewing the DNA sequences of different banana varieties is further research for another project. Because of the differences between the rbcl sequence of the banana fruits from each market, we could classify each of the fruits from each sample market. The American kiwi and banana showed a 92.7% similarity in their DNA and the American banana and Asian kiwi showed 73.3% similarity. The phylogenetic tree (Figure 4) highlights the relationship between all of the samples. Compositely, there is a relatively high percentage of sequence similarity between all of the species that were sampled. This might explain the common characteristics such as having black spots, containing digestive enzymes, and common allergens that people tend to have to a few of these fruits. If a person is more likely to exhibit symptoms of an allergic reaction to one of these fruits, then it is possible that they are more likely to exhibit symptoms of an allergic reaction to other fruits as well.

American Market:

Asian Market:

References:
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