The Effects of Caffeine on Mitosis Rates

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Research: Caffeine Sources

- The top 5 Soft Drinks for the year 2013:
  1. Coca-Cola (2.83 mg/fl oz)
  2. Diet Coke (3.75 mg/fl oz)
  3. Pepsi (3.17 mg/fl oz)
  4. Mountain Dew (4.5 mg/fl oz)
  5. Dr. Pepper (3.42 mg/fl oz)

- The Top 3 Energy Drinks for the year 2013:
  1. Red Bull (9.45 mg/fl oz)
  2. Monster (10 mg/fl oz)
  3. Rockstar (10 mg/fl oz)
Research: Mitosis
Hypothesis

• The hypothesis for this experiment is that the more caffeinated the beverage, there will be more growth (and a higher mitosis rate) in those onions

• This is hypothesized because caffeine is a known stimulant in humans
Variables

- Independent variable: the liquid that the onions are submerged in
- Dependent variable: the onion root length & the rate of mitosis
- Control: the onions that are submerged in the water
- Constants: the type of onion & the amount of onions for each liquid
Materials

• Onion bulbs (27)
• Growing Cups (9)
• Toothpicks to suspend onions (81)
• Monster Energy Drink
• Rockstar Energy Drink
• Redbull Energy Drink
• Mountain Dew
• Diet Coke
• Dr. Pepper
• Pepsi
• Coca-Cola
• Distilled Water
• Metric Ruler

• Hydrochloric acid solution, 1 M
• Methylene blue stain solution, 1%
• Aceto-Orcein stain solution, 2%
• Deionized Water
• Compound Microscope
• Glass Microscope slides
• Cover Slips
• Forceps
• Paper Towels
• Pencil, with eraser
• Pipets
Procedure: Onion Growing

1. Set up the cups to grow the onion bulbs in
2. Fill the cups with the respective liquids
3. Place 3 toothpicks in each onion to be able to suspend it in the liquid
4. Allow the onion to grow a day before taking the first measurement
5. Take and record the measurement for day 1
6. Repeat step 5 for each of the liquids
7. Repeat steps 5 and 6 for each day (Saturday-Wednesday)
8. Dispose of soda and clean up all materials
Procedure: Making the Squashes

1. Cut three roots from an actively growing plant using a scalpel
2. Trim the tip of each root, to only use the tapered end of the root tip
3. Use forceps to place 2-3 root tips in a hydrochloric acid solution (1 M)
4. Allow the root tips to soak in the acid solution for 5 minutes
5. Use the forceps to move the root tips from the acid solution to a water bath
6. Allow the water to wash off the excess hydrochloric acid
7. Move the root tips to another water bath
8. Move the roots to a aceto-orcein stain solution (2%)
9. Place the roots onto a glass microscope slide
Procedure: Making the Squashes

10. Add a 1 or 2 drops of deionized water to the microscope slide

11. Place a cover slip over the stained root tip

12. Press the cover slip down (with something similar to a new pencil eraser tip) to spread out the roots

13. Place the slide underneath a microscope to examine the now-”dead” tissue

14. Observe the different stages of mitosis all of the cells that could be found in the root sample

15. Safely dispose of the hydrochloric acid and aceto-orcein stain
Days of Measurement
Data
Observations

• Day 1:
  • Almost all of the onions in the caffeine have shown very little signs of growth but have shown signs of possible growth within the next day or so
  • The onions have discolored the water
  • A good part of each onion has become saturated with the liquid that it is submerged in

• Day 2:
  • Mountain Dew- the roots have turned the color of the liquid that the onions have made it
  • Water has the most growth without the stimulant
  • The drinks with the highest caffeine amount yielded the smallest, if measurable, growth
    • For example, the energy drinks

• Day 3
  • Due to weather issues, measurements were not able to be taken

• Day 5
  • Mold beginning to grow in the Coke and Pepsi samples, as well as on the onions themselves
Conclusion

• The original hypothesis was not supported by my data conclusions

• In the original hypothesis, it was stated that the onions submerged in the liquids with more caffeine would have a higher mitosis rate (and therefore, growth)

• The results have shown that the drinks with the most caffeine (i.e. the energy drinks) have shown little, if any, growth at all

• The control (water) has shown the greatest growth of the onion roots
Limitations/Errors

- The room that was used to grow the onions, was not at a constant temperature
- Errors in the measurements of the roots could be the result of human error
Further Research

• Further research could include finding at what concentration of caffeine mitosis (and growth) is slowed down, if not completely stopped
Thank you!

- I’d like to take this time to thank the judges and students for being here today
References