Task №6

Why do apple slices turn brown after being cut? Investigate the speed of this process and test methods to prevent browning of apple slices.
Why do apples turn brown?

1st version

• Some Fe(2+) is included in apples
• After the oxidation we have Fe(3+), that is brown

• On the foto there are ferrum solutions in different oxidation states

*there is 2.6mg of Fe in 100g of apples
Why do apples turn brown??

2nd theory

- Polyphenols are oxidated. Polyphenols are natural antioxidants. Their oxidation is speeded up by the enzyme (polyphenoloxidase).
- Produced quinone is yellow-brown colored
Brown apples after being for different time on the air
Speed of browning

- For detecting the grade of browning we’ve used the color sensor
Speed of ‘browning’

- Speed depends on the type of apples, because of microelements and acids in apples

- ‘Antonovka’ apples.
  2:07

- ‘Rozoviy naliv’ apples
  7:24
Methods of changing the speed of browning

- Increase or decrease the amount of oxygen in the air
- $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$ (MnO$_2$ - catalyst)

- $\text{Na}_2\text{CO}_3 + \text{H}_2\text{SO}_4 (\text{sol}) \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O} + \text{CO}_2$

H$_2$O$_2$ – the source of oxygen
The experiment

- Pieces of apple are put in different air
- 7 minutes is normal time
- On the left there is Increased oxygen air
- On the right - decreased

After 2.20 min (apple on the right is for comparison)
We couldn’t notice the browning on the right apple after 30 minutes
Methods of changing the speed of browning

- Changing the conditions of polyphenoloxidase influence
- Changing pH
- Changing temperature
Conclusion

- Browning of apples is caused by catalysed oxidation of polyphenols
- We can speed up the process by increasing the amount of oxygen in the air
- We can slow down this process by:
  a) Decreasing the amount of oxygen
  b) Decreasing pH on the surface of the apple
  c) Decreasing the temperature of the apple
  d) Destroying the polyphenoloxidase by heating
Sources

- Science american
- “Энциклопедия для детей том 17”