DNA isolation from bananas – kitchen experiment

Deoxyribonucleic acid (DNA) is the carrier of heritable information in all living organisms. In humans, DNA can be found inside almost every cell of the body. As in bananas, DNA is located within the cell in an even smaller compartment, the cell nucleus. With a few simple household items, you can isolate the DNA of bananas in your kitchen. In doing so, you follow the same principles as the biological researchers when they isolate DNA in the laboratory.

MATERIALS

- 3 cm piece of a ripe banana
- 8 g table salt (NaCl)
- 10 ml washing-up liquid
- 16 ml ice-cold 95-100% alcohol (e.g. burnspiritus)
- 600 ml water
- 1 fork
- 3 table spoons
- 4 tea spoons
- 1 small plate
- 2 small bowls (min. 200 ml volume)
- 2 glasses
- small, narrow glass (ca. 30 ml volume, e.g. shot glass)
- small glass or plastic container, optional (ca. 10 ml volume)
- 1 funnel
- 1 piece of kitchen roll
- 1 wooden toothpick or wooden stick
- 1 kitchen scale
- 1 measuring cup

TIP

If you don't have a measuring cup to hand that can measure small amounts of liquid, you can use tablespoons and teaspoons to determine quantities. Tablespoons usually hold a quantity of 10-15 millilitres (ml); teaspoons a quantity of 4-5 ml. To find out how much liquid your tea spoon or table spoon holds, take a small container with known volume and gradually fill it with water using your spoon. Count how many “spoon loads” you need to fill the container.
Now you can calculate in two simple steps how many millilitres your spoon holds:

Number of spoon loads: Known volume of the container (ml) = “Result 1”
“Result 1” x 100 = “Result 2”

“Result 2” tells you how many millilitres your spoon can hold.

PROTOCOL

1. Place 8 ml of alcohol in the freezer until it is freezing cold.

2. Prepare the salt solution and detergent solution in two separate bowls. Use a fresh, clean tablespoon for each buffer.

Recipe for salt solution
Dissolve 8 g of table salt in 150 ml of water. Stir the mixture with a tablespoon until the salt has completely dissolved.

Recipe for detergent solution
Mix 10 ml washing-up liquid with 100 ml water. Mix it with a tablespoon until the detergent has completely dissolved.

3. Place a 3 cm large piece of a peeled banana on a plate and squish it with the fork to a smooth mash.

What happens to the DNA?

To get to the DNA in the cell, we need to break the cell open. We can do this with mechanical and chemical methods. The crushing destroys the walls of the cells mechanically by shear forces acting on the cells.

4. Mix 15 ml salt solution with 4 ml detergent solution in a glass to make a salt solution-detergent solution mixture. Use clean tablespoon and teaspoon to measure the quantities.

5. Add the banana mash to the extraction buffer-detergent mixture and mix well with the fork.

What happens to the DNA?

The washing up liquid supports the chemical break-up of the cell. It destroys the membrane of the cell and nucleus, which are made of fat. The salt in the salt buffer increases the solubility of the DNA in our mixture by attacking the hydrate envelope of the DNA. The DNA is released from the nucleus and cell.

6. Carefully, using a clean teaspoon, drop a few drops of water on the piece of kitchen roll, so that the whole piece becomes moist (but not too wet). Be careful not to rip the kitchen roll.

7. Place the funnel in a clean glass and carefully cover the funnel with the damp kitchen roll.

8. Carefully fill the banana mixture with the teaspoon into the funnel. Wait until the solution has flowed through the filter (kitchen roll) into the glas.

What happens to the DNA?

By filtering, cell debris and unresolved cell components are separated from dissolved cell components. The coarse cell debris and unresolved cell components remain in the funnel, the dissolved cell components such as proteins and DNA are released into the glass.

9. Using a clean teaspoon, transfer 2 ml of the filtered solution into a small glass.

10. Using a clean teaspoon, add 2 ml of water to the filtered solution.

11. Now carefully cover the mixture with 16 ml of ice-cold alcohol.

What happens to the DNA?

When the released DNA comes into contact with alcohol of a concentration of least 70%, the DNA loses its stability. The hydrate envelope that normally stabilizes the DNA is displaced and the DNA precipitates and is separated from all water-soluble components in the mixture.

12. The white thread-like substance that appears between the two layers is the DNA of the banana. This might take a moment.

13. Dip the toothpick slowly into the glass, reel up the DNA and carefully transfer it into a small container.

Congratulations! You isolated the DNA of the banana!

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