DNA Extraction from Chicken Liver Cells

Can DNA be extracted from cells? Since DNA is the blueprint for life, everything living contains DNA. DNA isolation is one of the most basic and essential techniques in the study of DNA. The extraction of DNA from cells and its purification are of primary importance to the field of biotechnology and forensics. Extraction and purification of DNA are the first steps in the analysis and manipulation of DNA that allow scientists to detect genetic disorders, produce DNA fingerprints of individuals, and even create genetically engineered organisms that can produce beneficial products such as insulin, antibiotics, and hormones.

DNA can be extracted from many types of cells. Firstly, a blender is used to lyse or break apart tissue and cells in order to help increase the surface area to create a better solution for enzymatic reactions to occur more efficiently. Secondly, detergents are used to help break down membranes and help release DNA from the cells. Thirdly, salt and enzymes (ie. bromelain and/or papain found in meat tenderizer) are used to break down any proteins and some water from the DNA so that it could be less hydrophilic and escape from solution; in addition, clump together. Finally, isopropyl alcohol is added in order to create a "window" for DNA to appear in unlike carbohydrates, fats, and proteins which will settle to the bottom of the solution along with other cellular "junk". One will not see DNA as single molecules but instead as hundreds of strands of DNA collectively clumped together. The hypothesis is that nucleic acids such as DNA can be observed in chicken liver cells.

Materials:

Stock Table:

Chicken Liver Solution:

Fresh Chicken Liver (567g or 20oz)
Scale (with Weighing Boat(s))
Knife
Cutting Board
Blender
Non-Iodized Salt Only (ie canning salt) / pre-measured
Distilled Water (room temperature in 400 mL Beaker/Flask)
Liquid Detergent (ie Dawn) in 250 mL Beaker with Dropper(s)
Meat Tenderizer (ie Adolph's)

Chilled Isopropyl Alcohol 90%+ in 250 mL Beaker with Dropper(s)

Students: ~ 2-3 / Group

Chicken Liver Solution (pre-made)
100 mL Beaker
250 mL Beakers
20 x 150 mL Test Tube
Stirring Rod
Funnel
Pre-Cut Cheesecloth (10 cm x 10 cm)
Test Tube Holder
References

Procedure: *For about 16 Groups of ~ 2-3 Students Each*

Class: *Teacher Driven*

1. Using a scale and weighing boat, 40 g of pre-measured chicken liver is placed into a blender.

2. Using a scale and weighing boat, 5 g of pre-measured salt is placed into the blender. The salt will neutralize the DNA to become less soluble in water and appear in the alcohol easier.

3. Using distilled water at room temperature, 400 mL of water is placed into the blender. The water will help create a desired solution.

4. The contents are then blended on high (lid on) for 20 seconds. The blender separates and breaks up the liver tissues and cells to help increase surface area for further breakdown and reactions.

Group: *Student Driven (~ 2-3 Students per Group)*

5. Using a 100 mL beaker, collect about 20 mL's of the liver solution.

6. Place a funnel on top of a 250 mL beaker then place a piece of thin pre-cut cheesecloth on top of the funnel. Slowly pour all of the liver solution through the cheesecloth so that the filtrate collects inside the 250 mL beaker in order to get rid of the undesirable tissues from the blending. Once filtered, remove funnel and discard the cheesecloth in the trash.

7. Using an eyedropper, add about 2 droppers "full" *(press the bulb on the dropper in and release*) of the liquid detergent to the 250 mL beaker with the liver filtrate. The detergent will help lyse (break down) the cellular and nuclear membrane by emulsifying (separating (not breaking apart)) the fats (phospholipids) that make up the membranes in order to release the DNA. Using a stirring rod, slowly stir the mixture for about 1 minute (try to prevent suds). Let the mixture sit for about 5 minutes.

8. Using your fingers, add 3 heaping pinches of meat tenderizer containing the necessary enzymes (bromelain and/or papain) to the 250 mL beaker containing the filtered/soapy liver solution. Meat tenderizer enzymes help to cut the proteins (histones) away from the DNA. Using a stirring rod, stir the mixture vigorously for 30 seconds. Let the mixture sit for about 5 minutes.

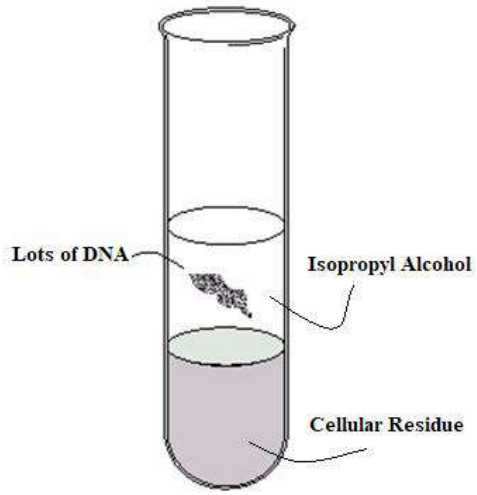
9. Pour all of the mixture from the 250 mL beaker carefully into a test tube.

10. To do last step, follow the preceding directions VERY carefully:

    * Tilt your test tube and slowly add 6 droppers full *(press the bulb on the dropper in and release*) of cool isopropyl alcohol into and along the side of the tube; do not over fill.

    * Place the test tube in a test tube holder so not to disturb the reaction.

    * The DNA should slowly appear in the "alcoholic window" within seconds as a "lightly tan colored strands or clumps" 1000's of DNA molecules.



Answer the result questions as directed first, only then clean and dry all materials as directed.

First and Last Name:

Extracting DNA from Chicken Liver Cells Questions

Choose: Circle [A or B or C] for the Best Correct Response. 4 pts each

1. Why did DNA and no other organic molecules like fats, carbohydrates and proteins, appear in the alcohol "window" layer? *(hint: something to with salt and its effect on DNA)*

   A. DNA BECAME LESS HYDROPHILIC AND ESCAPED THE SOLUTION
   B. DNA DEVELOPED THE SAME DENSITY AS THE ALCOHOL
   C. DNA WAS MADE TO HAVE THE SAME MOLECULAR STRUCTURE AS ALCOHOL

2. Why was it important to add soap to the liver solution? *(hint: something to do with separating)*

   A. SOAP HELPED TO EMULSIFY FATS IN THE LIVER CELL MEMBRANES
   B. SOAP HELPED TO BREAK APART CARBOHYDRATES AND PROTEINS IN THE CELL MEMBRANES
   C. SOAP HELPED TO REMOVE ANY FORM OF DIRT OR OIL FROM THE CELL MEMBRANES

3. What did the meat tenderizer contain that helped break or cut proteins away from DNA? *(hint: bromelain and/or papain are these)*

   A. CO-ENZYMES
   B. ENZYMES
   C. SUBSTRATES

4. The appearance of the nucleic acid(s) (ie DNA) from the liver cells would best be described as:

   A. STRINGY TO CLUMPY AND/OR A LITTLE TANNISH/WHITE
   B. CLEAR TO CLOUDY AND/OR A BIT DARK REDDISH/BROWN
   C. A SINGLE STRAND OF DNA THAT LOOKS LIKE A TWISTED HELICAL LADDER

5. Extraction and purification of DNA are the first steps in the analysis and manipulation of DNA that allow scientists to perform several tasks. Ways in which DNA can be used by scientists may include:

   A. TRACING THE EVOLUTIONARY TREE BACK THROUGH HISTORY FOR SEVERAL SPECIES INCLUDING THE HUMAN RACE.
   B. DETECTING GENETIC DISORDERS, IDENTIFYING CRIMINALS USING DNA FINGERPRINTING TECHNIQUES OR ENGINEERING ORGANISMS TO PRODUCE ANTIBIOTICS, INSULIN, OR HORMONES.
   C. BOTH (A) AND (B) ARE CORRECT

6. The problem question for this lab was:

   A. CAN DNA BE EXTRACTED FROM CELLS?
   B. DNA WILL BE EXTRACTED FROM CELLS.
   C. THERE WAS NO PROBLEM QUESTION FOR THIS LAB

7. The hypothesis for this lab was:

   A. NUCLEIC ACIDS SUCH AS DNA CAN BE OBSERVED IN CHICKEN LIVER CELLS
   B. IS THERE A POSSIBILITY THAT DNA CAN BE OBSERVED FROM CHICKEN CELLS?
   C. NUCLEIC ACIDS SUCH AS DNA MIGHT BE OBSERVED.

Selected Conclusion Questions: (Note: no pronouns (incl. "it"), proper grammar, complete sentences) 4 pts each

8. State an unforeseen event for this activity: ***Start off by writing****… An unforeseen event was …*

9. State an improvement for this activity: ***Start off by writing****… An improvement that could be made for this lab would be …*

10. State a spring board question (based off the problem question): *A springboard question is a "question" that <u>you make up</u> based on the problem question or this activity. Do not answer this question; but simply state it as the last sentence in your conclusion paragraph with a question mark (?) at the end. The question is meant to "springboard" other thoughts that the reader could investigate having done this lab which is an inventive yet effective way to end a lab activity.)*

Illustration: Draw/Label Where the Following (3) Main Components Were Found in Your Test Tube: 5 pts

- Nucleic Acid (DNA)
- Isopropyl Alcohol (Window)
- Liver Filtrate (Cellular Residue/Junk)