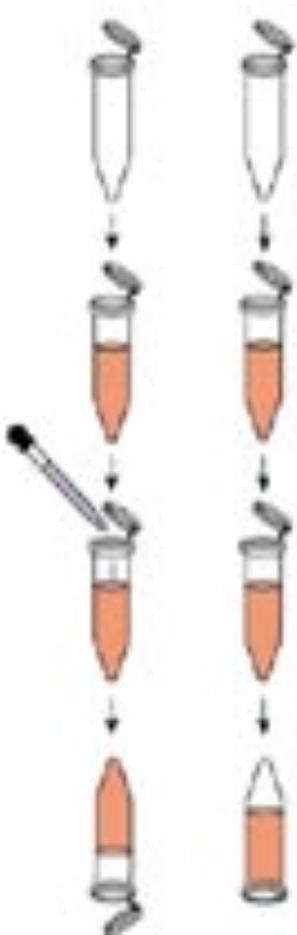


Chymosin

--Will it make milk stiff?

Step 1: Grab 2 microtubes and label one of the tubes “0” and the other “40”.

Step 2: Put 1000 μL of milk into each tube.



Step 3: Add 40 μL of chymosin to the tube labeled “40”.

Step 4: Add 0 μL of chymosin to the tube labeled “0”.

Do we use a micropipette for this step?

Step 5: Snap the tops of the tubes closed and shake 1 or 2 times.

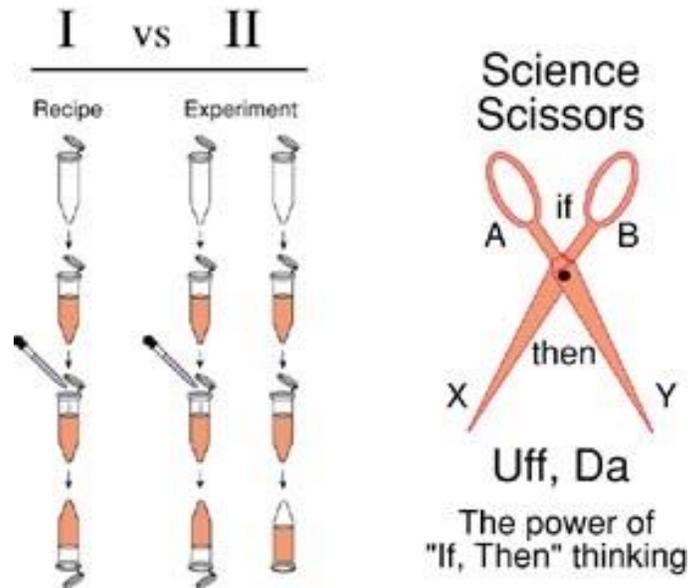
Step 6: Incubate (warm to body temperature in your hands) –**WITHOUT SHAKING** – for 4 – 5 minutes.

Step 7: Turn the microtubes upside down.

What Happens?



Chymosin: A Puzzle in Designing Experiments to Test Many Possible Explanations

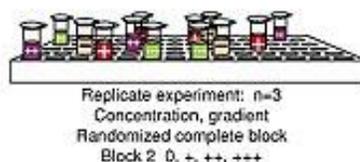
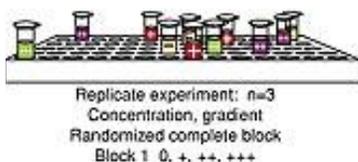
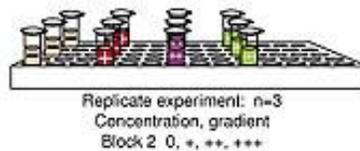
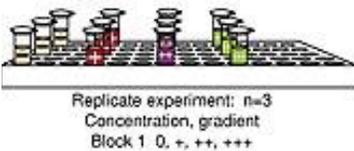
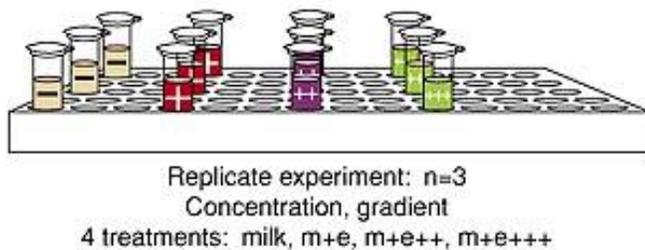
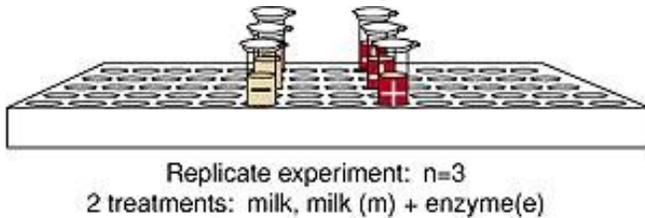
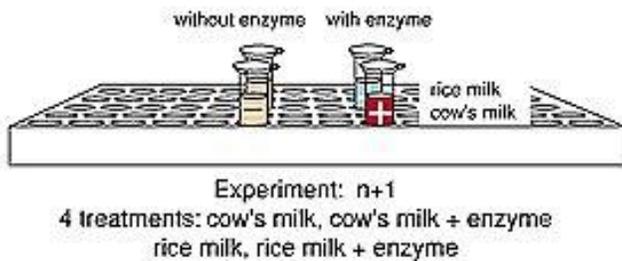
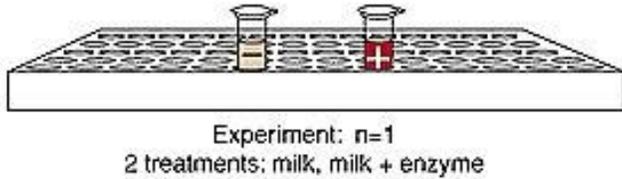
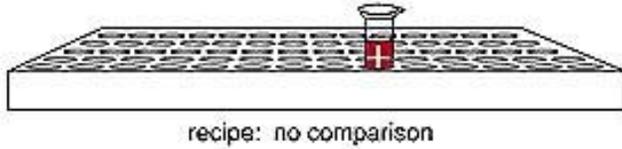
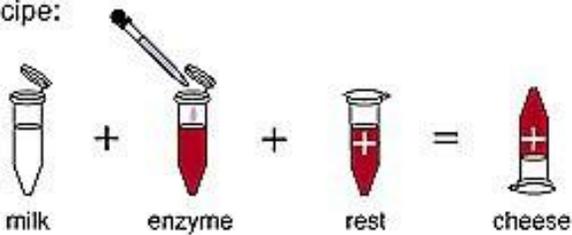


- Chymosin is the protein that is the active enzyme in rennet used in making cheese.
- Chymosin makes milk stiff, and then the cheesemaker separates the stiff milk into curds and whey.
- There are at least two sources of chymosin.

First, chymosin can be purified from the stomachs of young calves.

- Second, chymosin can be made in bacteria that through gene splicing technology contain a copy of the cow gene for chymosin.
- Chymosin is also the first product of gene splicing (recombinant DNA technology) in the US food supply.

recipe:



Recipe for Using Chymosin to Make Milk Stiff

1. Put 500 microliters (half a milliliter) of milk into a small plastic test tube with a lid (a microcentrifuge tube).
2. Warm the milk to body temperature (around 100 F).
3. Add 20 microliters of chymosin and close the tube of the lid.
4. Shake the tube three times up and down and then keep it still.
5. Keep the tube at body temperature for five minutes.
6. Turn the tube upside down and see if the milk is stiff.

But should you do it just once?

Replicate, replicate, replicate!

CHYMOSIN (K-eye-mo-sin)--Will it make milk stiff?

General protocol

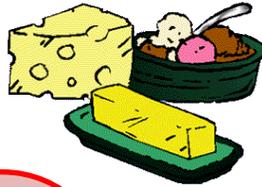
1. Have a control tube of milk for each experiment.
2. Put 1000µL of milk into each tube.
3. Label one tube with the volume of chymosin added. Label the other one '0'.
4. Put the correct amount of chymosin into the tube using a fresh tip for each tube.
5. Snap the tops of the tubes closed.
6. Shake only once or twice.
7. Incubate without shaking for a specified period of time.

DATE

	Chymosin vol.				
Milk type					
Incubation time					
Milk type					
Incubation time					
Milk type					
Incubation time					
Milk type					
Incubation time					
Milk type					
Incubation time					
Milk type					
Incubation time					
Milk type					
Incubation time					
Milk type					
Incubation time					
Obsevatons:					
Conclusions:					

Can you think of 8 ways to make milk stiff?

Tom Zinnen, UW Biotechnology Center
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How can you make milk stiff?

1. Scald it
2. Dry it
3. Freeze it
4. Churn it
5. Acidify it
6. Ferment it
7. Enzyme it
8. Ferment and Enzyme it

What do you get?

1. Scalded milk is used in some baking recipes.
2. Drying milk makes powdered milk.
3. When you freeze milk, you get ice cream.
4. Churning milk gives butter.
5. Acidifying milk makes cottage cheese.
6. Fermenting milk makes Yogurt.
7. Adding an enzyme called rennet to milk will give you custard.
8. When you ferment and add an enzyme to milk, you get cheese.

Which of these 8 ways uses the Tools of Biology?

COTTAGE :	Acidification by adding vinegar to milk (clabbering); vinegar is made by microbes fermenting fruit juices into acetic acid.
CHEESE	
YOGURT:	Gelling by fermentation by adding bacteria, such as lactobacillus, that produce lactic acid.
CUSTARD:	Gelling by adding an enzyme called rennet or chymosin found originally in the stomachs of calves.
CHEESE:	Gelling by adding both lactobacillus and enzyme (rennet), leading to curds and whey.

For a booklet that describes fun experiments using milk, order

"Science Fun with Dairy Foods"

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