**Biotechnology Laboratory: Enzymatic Yield**

In order to meet the growing demand for food, we need to innovate and produce differently. Biotechnology can provide a solution to achieve the best possible yield from the transformation of raw materials. Some molecules are already synthesized and used in the food industry. In this laboratory, you will have to test different coagulation agents in order to obtain a maximum production yield.

**Goal**

Determine which coagulation agent produces the best cheese production yield.

**Material**

* 4 test tubes
* 4 transfer pipettes
* 40 ml whole milk
* 1 ml buttermilk
* Rennet solution (1 tablet per cup of water)
* Chymosin Enzyme
* Beaker
* Hot plate
* Thermometer
* Test tube holder
* 2 graduated bottles of 10 ml
* Filter paper or cheesecloth
* Funnel
* Timer
* Parafilm

**Method**

1. Label test tube 1: Milk + buttermilk. Variable 1
2. Label test tube #2 Milk + Rennet. Variable 2
3. Label test tube #3 Milk + Chymosin. Variable 3
4. Label the test tube #4 control: Milk + Milk
5. Using a transfer pipette, transfer 7 ml of whole milk into each test tube.
6. Add 0.25 ml (250 μl) of buttermilk to test tube #3. Close the tube with the parafilm and invert 3 times.
7. Add 0.25 ml (250 μl) of rennet solution to test tube #2. Close the tube with the parafilm and invert 3 times.
8. Add 0.25 ml (250 μl) of chymosin to test tube #3. Close the tube with the parafilm and invert 3 times.
9. Add 0.25 ml (250 μl) of milk to test tube #4. Close the tube with the parafilm and invert 3 times.
10. Place all tubes in a 37°C water bath for 20 minutes
11. Measure the total volume of curds (solid) and whey (liquid) together in a graduated cylinder. Record your results.
12. Using a funnel and filter paper cone, pour the curd/whey mixture into a second graduated cylinder. Record the amount of whey (liquid) in ml.

**Result**

1. Take the total volume of the mixture and subtract the amount of whey to determine the amount of curd. Record the amount of curd in the data table. Calculate the percentage of curds formed.
2. Produce a bar graph that shows the volume of curd produced by each treatment. Label the x and y axes and include an appropriate scale and title.

**Analysis**

1. To what extent did the experiment confirm the hypothesis? Explain.
2. Average data is the best way to answer an experimental question. Explain why.
3. Compare your data on the volume of curds produced by each treatment with that of another group. How do the values compare?
4. Do you think the tools used were adequate for an accurate determination of whey volume and, indirectly, curd volume? Why or why not? If yes, explain why. If not, suggest a better system for determining curd volume or whey volume.
5. Imagine that you are an employee of a cheese company. Make a recommendation to your company manager on which coagulating agent to use for cheese production.

**Conclusion**

Describe the results of the experiment. Include evidence (data) and explanations.

Discuss the extent to which the results support the hypothesis.

Identify the sources of error and explain what might happen as a result.

**Note:** other possibilities

* Determine which coagulating agent produces cheese the fastest.
* Determine what temperature produces optimal coagulation.
* Determine what concentration of coagulating agent produces maximum clotting.
* Determine which type of milk produces the most cheese.