Food Explorations Lab III:
Foam Formulations

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

This investigation is in two parts. In Part A, you will make observations of an egg's parts and diagram its anatomy. You will then form a colloidal dispersion (a foam) with the egg white and become familiar with its appearance as the whisking time increases. In Part B, your class will determine the effects of different substances on the stability of the egg white foam.

Lab Objectives

In this lab, you will learn how to…

1. Diagram the anatomy of an egg and make observations of its parts.

2. Form colloidal suspensions from the egg white.

3. Determine the effects of substances on the stability of egg white foams.

Lab Safety: Before beginning ANY investigation you should put on your safety goggles and apron. It is important to avoid getting chemicals on your hands. Always wash your hands following completion of an investigation. When handling food, you should also wash your hands prior to beginning an investigation. *Raw egg material is not safe for consumption; do not eat any of the foams in your investigation.*

Lab Question

Which of the following will increase the stability (firmness) of egg white foams? (Circle your answer.)

Sugar Acid Salt Agitation Time Fat

Predictions: I predict the following substance(s) will increase the stability of egg white foam _____ because…

PART A: Observation of Egg Anatomy & Stages of Foam Formation

MATERIALS

1 egg
1 egg separator
2 small glass or steel bowls
1 paper plate
1 whisk or electric mixer
1 kitchen timer or stopwatch

PROCEDURE

1. Break your egg and separate the egg white from the egg yolk. Tap the egg lightly against the bowl to create a crack. Hold the egg separator over the small bowl. Using your fingers, pull apart the shell and dump the egg contents into the egg separator. The egg white should fall into the bowl with **gentle** shaking while the egg yolk stays in the egg separator. Be careful not to break the egg yolk. **Be sure no egg yolk mixes with your egg white.**

2. Once your egg whites have been prepared, you are ready to begin. Using the diagram found in the reading *Foaming Bonds* as a guide, describe your *visual* observations of the egg white, egg yolk, and eggshell in Table A under the column labeled "Physical Properties."

3. Draw a diagram of your egg's anatomy in the space provided. Neatly label the following in your diagram: outer membrane, inner membrane, shell, yolk, vitelline (yolk) membrane, air cell, chalazae, and albumen (egg white).

4. Using your whisk, beat the egg white in a small bowl. Whisk the egg white until it becomes foamy (i.e. foam on a recently poured carbonated drink). This is the "no peaks" stage. Use the timer to record how long it takes to reach this stage. Record the time and your observations of the foam in Table B under the column labeled "Appearance of Foam."

5. Repeat Step 5 for each of the following:

a. *Soft Peaks*: Beat until egg whites form peaks that bend slightly at the tips. The foam should be shiny and moist. Record the time it takes to reach this stage and your observations of the foam in Table B.

b. *Stiff Peaks*: Beat the egg white until the foam no longer slips when the bowl is tilted. Record the time it takes to reach this stage and your observations of the foam in Table B.

c. *Overbeaten*: Beat the egg white until the foam begins to break down and become grainy. Liquid may begin to drain from the foam. Record the time it takes to reach this stage and your observations of the foam in Table B.

Table A: Physical Properties of Eggs

	Physical Properties
Egg White	Clear liquid
Egg Yolk	Thick, yellow liquid
Egg Shell	White and thin

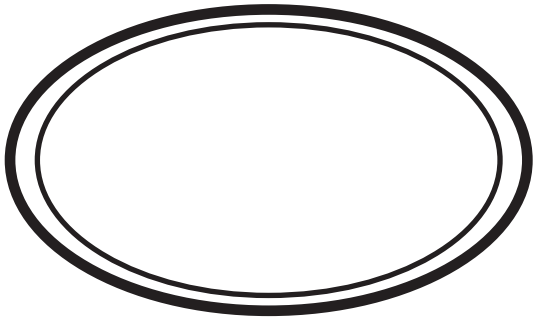
Egg Anatomy Diagram


Table B: Egg White Whisking Observations

Stages	Time to Stage (Minutes)	Appearance of Foam
No Peaks (Frothy)	2-3 minutes	Bubbly, frothy, lots of bubbles
Soft Peaks	3-6 minutes	The peaks fall back down after being formed
Stiff Peaks	2-3 minutes	The peaks stand up straight after being formed
Overbeating	>3 minutes	Grainy and dull

Conclusion:

1. Describe how the color of the egg white changed as it moved from frothy to stiff peaks.

Clear to white

2. As you continued to beat your egg white, what happened to the volume of the foam?

Volume increased

3. As you continued to beat your egg white, how did the stability (firmness) of the foam change?

Stability increased until overbeaten stage when egg white foam begins to breakdown.

4. Were the observed changes in the egg (liquid to foam) chemical or physical? Explain.

They were physical changes because the molecules were rearranged.

PART B: Observation of Foam Emulsions

Your teacher will begin by assigning each group 1 treatment.

Assignment A: Sugar

Assignment B: Acid

Assignment C: Fat

Assignment D: Salt

MATERIALS

⅛ cup (2 tablespoons) of egg white
1 small glass or steel bowl
1 whisk or electric mixer
1 rubber spatula
1 kitchen timer or stopwatch
1 set measuring spoons
assigned treatment
1 funnel
1 10- or 25-mL graduated cylinders
ruler

Obtain your assignment from you teacher. Record your group's assignment/treatment (sugar, acid, fat, or salt) below.

My group's treatment is: _____

Predictions: Predict what will happen when you add your assigned treatment to the egg white. Will your treatment increase or decrease the egg white foam stability (firmness)? Why?

PROCEDURE

1. Using your whisk, beat the egg white. Whisk your new egg white until it becomes foamy or reaches the *no peak stage* (i.e. foam on a recently poured carbonated drink).

2. Once your egg white has become foamy, add your treatment.

   - Assignment A: *Treatment = Sugar* – Add 1 teaspoon sugar to the frothy foam.
   - Assignment B: *Treatment = Acid* – Add ¼ tablespoon acid to the frothy foam.
   - Assignment C: *Treatment = Fat* – Add ¼ teaspoon of oil to the frothy foam.

- Assignment D: *Treatment* = *Salt* – Add ¼ teaspoon salt to the frothy foam.

3. Continue to beat your egg white for 10-15 minutes or until soft peaks are obtained. Record your *visual* observations in Table A under the column labeled "Treatment." Be sure to describe the texture of the foam.

4. Using a rubber spatula, push the egg white foam into a funnel and flatten the top so it is level. Plug the bottom of the funnel with your thumb to ensure no liquid escapes.

5. Keeping the bottom of the funnel plugged, hold the base of the funnel next to the top of a counter or table. Stand a ruler upright on the counter and use it to measure the height of the foam. Record your results in Table B under the column "Treatment."

6. Place the funnel in a graduated cylinder and allow it to sit for 5 minutes. Record the volume of any fluid that drained into the cylinder in Table B.

7. Share the data with the other student groups and complete Table B using their data.

Table A: Egg White Treatment Observations

	TREATMENT	
Egg White Formation	Sugar	Smooth, shiny, white
	Acid	Smooth, porous, liquidy
	Fat	Very liquidy, yellow, small amount of foam on the surface
	Salt	Very white, foamy mixture (more than acid) and very liquidy

Table B: Foam Property Treatment Observations

	TREATMENT	
Foam Height (cm)	**Sugar**	14.5 cm
	Acid	10 cm
	Fat	3 cm
	Salt	2 cm
Foam Leakage (mL)	**Sugar**	25 mL
	Acid	30 mL
	Fat	36 mL
	Salt	40 mL

TEACHER'S NOTE: Numbers in the above tables are estimates only. Student values may vary.

Conclusion:

1. Explain what foams are and how they form.

Foams are a colloidal dispersion of air in egg white. They are formed when the egg white is beaten, forcing air between the liquid molecules.

2. What two states of matter make up a foam?

Solid and liquid

3. As a class, discuss observations of each group and complete Table C.

Table C: Foam Treatment Observations

		OBSERVATIONS
Sugar	Foam Height (cm)	
	Foam Leakage (mL)	
Acid	Foam Height (cm)	
	Foam Leakage (mL)	
Fat	Foam Height (cm)	
	Foam Leakage (mL)	
Salt	Foam Height (cm)	
	Foam Leakage (mL)	

4. Which substance(s) increased the volume of egg white foams?

Sugar

5. Which substance(s) increased the stability of egg white foams?

The addition of acid and sugar.

6. Were the observed changes in the egg white chemical or physical? Explain.

They were physical because even though a foam was formed, there was still no change in internal structure.