Abracadabra! Transforming Yogurt into 'Ravioli'

https://www.sciencebuddies.org/science-fair-projects/project-ideas/FoodSci_p075/cooking-food-science/yogurt-ravioli (http://www.sciencebuddies.org/science-fair-projects/project-ideas/FoodSci_p075/cooking-food-science/yogurt-ravioli)

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Experimental Procedure

Preparations

In this part of the science project, you will prepare your solutions and plan your experiment.

1. Make the sodium alginate solution.
    a. *Note:* You will need to use a blender that can hold at least 3 cups (C) *or* a smaller blender that you can make multiple, smaller amounts of sodium alginate solution in at a time (to add up to 3 C total).
    b. Weigh out 2.9 grams (g) of sodium alginate.
        i. To weigh out the sodium alginate, cut a small piece of clean wax paper (around 8–10 centimeters [cm] on each side), place the wax paper on the scale, zero out the scale (so that it reads "0 g"), and then weigh out the chemical on the wax paper. Use a clean spoon to scoop the chemical out of its container. *Note*: You should use wax paper because it is harder for chemicals to stick to than normal paper.
        ii. *Tip*: If the scale you are using does not have a feature to zero it out, you will need to first weigh the piece of wax paper so that you can subtract this mass from the total when you weigh the chemicals on it.
    c. In the cup part of a blender, add 1/2 C distilled water.
    d. Add a little bit of the 2.9 g of sodium alginate that you weighed out to the blender cup, as shown in Figure 2.

Figure 2. To the blender cup, add ½ C distilled water and a little sodium alginate.

e. Have an adult help you use the blender to blend the water and sodium alginate together until the solution is completely smooth and well-blended, as shown in Figure 3.

Figure 3. Blend the sodium alginate with the water until they make a smooth solution.

f. Repeat steps 1.c.–1.e. until you have added and blended a total of 3 C of distilled water and the entire 2.9 g of sodium alginate together.
    i. Adding a little bit of the sodium alginate at a time will ensure the solution is well-mixed.
    ii. If you are using a blender that cannot hold at least 3 C, pour the blended solution into a clean bowl or container each time the blender cup is full. When all 3 C of the sodium alginate solution has been added to the bowl, mix it with a fork for several seconds.

2. Cover the sodium alginate solution (with a lid or a piece of plastic wrap) and place it in the refrigerator. Let it sit in the refrigerator for at least 2 hours, but as long as overnight, before testing it with the yogurt.
    a. Letting the solution sit will allow the air bubbles to escape from it, making it ready to use.
3. While the sodium alginate solution sits in the refrigerator, plan out what times you will be weighing the yogurt in your experiment. You will be weighing the yogurt raviolis to see how the reverse spherification reaction changes the yogurt raviolis over a period of 24 hours, specifically to see if the raviolis change in mass. Examples are given in step 3.c. Keep your schedule and the following tips in mind as you plan your time checkpoints:

a. You should let the yogurt sit in the sodium alginate solution for at least 24 hours total.
b. You should use at least five time checkpoints.
    i. One of these time checkpoints will be at the beginning of the experiment, before you put the yogurt in the sodium alginate solution.
    ii. Another time checkpoint will be at the end of the experiment, after 24 hours.
c. You will want to space out your time checkpoints by at least one hour, but keep in mind that you will be unable to take measurements while you are asleep or away from your experiment.
    i. For example, if you started the experiment in the morning and were around to take measurements all day and the next morning, you could do measurements at 10:00AM, 1:00PM, 4:00PM, 7:00PM, and then 10:00AM the next morning. (These measurements would be after 0, 3, 6, 9, and 24 hours [hrs].)
    ii. As another example, if you started the experiment in the late afternoon and were around later that day and the next to take measurements, you could do measurements at 5:00PM, 6:00PM, and 8:00PM, and then at 4:00PM and 5:00PM the next day. (These measurements would be after 0, 1, 3, 23, and 24 hrs.)

4. Now prepare the cups in which you will be testing the yogurt over time.
    a. Take four 8 ounce (oz) plastic cups. Carefully use scissors to cut the tops off of each cup so that they are only 6 centimeters (cm) tall. For an idea of how these cups should now look, see Figure 4.
    b. Use a permanent marker to label the little cups 1, 2, and 3. The fourth cup can be unlabeled; you will be using it to practice making yogurt raviolis.

Testing Reverse Spherification with Yogurt

In this part of the science project, you will investigate how the reverse spherification reaction changes the yogurt raviolis over time. To do this, you will put a spoonful of yogurt in the sodium alginate solution and weight the yogurt at different times over 24 hours. Do you think the gel-like layer around the yogurt will get bigger, resulting in heavier yogurt raviolis over time? It is time to find out!

1. Before starting your experiment, make a data table like Table 1, in your lab notebook. You will record your data in this data table.

	Mass Over Time (g)				
Yogurt Samples	0 hrs	3 hrs	6 hrs	9 hrs	24 hrs
1					
2					
3					
Average					

Table 1. In your lab notebook, make a data table like this one in which to record the mass of your yogurt samples over time (in grams [g]). Be sure to write down your exact time points (the hours shown here are from the example given in step 3.c.).

2. When the sodium alginate solution has sat for at least 2 hours and you are ready to start your experiment, use a clean liquid measuring cup to fill each of the cut-off plastic cups (which you prepared in step 4 of the *Preparations* section) with 2/3 C of the sodium alginate solution. This should fill the little cups almost full. Be sure to also fill the unlabeled cup.
3. Take the unlabeled cup and practice adding yogurt to the sodium alginate solution as described in step 4 (but you do not need to weigh your yogurt). It can take some practice to get the hang of it. Once you think you have it, repeat step 4 to create your yogurt test samples.
4. Now weigh and start testing your three yogurt samples.
    a. Put a drop of vegetable oil on a paper towel and wipe the inside of the round tablespoon measuring spoon with the oil on the towel. This will make it easier for the yogurt to slide out of the spoon.
    b. Place the round tablespoon measuring spoon on the scale and zero out the scale.
        i. *Tip*: If the scale you are using does not have a feature to zero it out, weigh the spoon so that you can subtract this mass from the total mass of the spoon and yogurt later.
    c. Use the round tablespoon measuring spoon to scoop out a spoonful of yogurt. Use the straight edge of a butter knife to make the top of the spoonful flat (this is called making a *level* spoonful).
    d. Place the spoon filled with yogurt back on to the scale. Record the mass of the yogurt sample in your data table (under "0 hrs").
        i. Your first yogurt sample will be sample 1.
    e. Carefully hold the spoon just above the surface of the sodium alginate solution in the cup labeled "1." Slowly tilt the yogurt into the solution while using a second spoon to help scoop *all* of the yogurt out of the measuring spoon in one smooth motion (all at once), as shown in Figure 4. The yogurt should form a sphere-like blob in the solution.

Figure 4. Holding the spoon with the yogurt just above the sodium alginate solution's surface, carefully scoop the yogurt out (using a second spoon) so that it stays together as one whole blob in the solution.

    f. Clean out the measuring spoon and repeat steps 4.a.–4.e. two more times to make a total of three samples. (The second sample will be sample 2 in the

data table and go in cup 2, and the third sample will be sample 3 and go in cup 3.)

5. Now it is time to take your first weight measurement. This will be the "0" hour time point. Be sure to fill in your data table with your results. Do the following to weigh the yogurt samples:
    a. Put a piece of plastic wrap on top of the digital scale. (This will protect it from the liquid sodium alginate solution.) Zero out the scale.
    b. Use a spoon to carefully scoop out the yogurt "ravioli" from the sodium alginate solution in the cup. Hold the ravioli against the side of the cup as you take it out, letting extra solution go back into the cup. Be careful not to pop the ravioli! If you do pop a ravioli, make a note of when it happened in your lab notebook and, if you have time, repeat the Experimental Procedure to create and test additional yogurt ravioli(s).
    c. Carefully tilt the spoon so that the ravioli slides onto the plastic wrap on the digital scale. Record the mass of the yogurt sample in your data table for the correct time checkpoint.
    d. Carefully lift the plastic wrap and slide the ravioli back into its cup.
    e. Repeat steps 5.b.–5.d. for each yogurt sample.
    f. Put the yogurt samples in the refrigerator (in their cups) and leave them there. Only take the samples out of the refrigerator to weigh them.
6. Continue to weigh the yogurt samples at the time checkpoints you decided on (in step 3 of the *Preparations* section). Be sure to fill in your data table with your results. Also, at each time checkpoint, make observations of how the yogurt samples look. Do they change over time? If so, what changes do you see? Be sure to record your observations in your lab notebook.
    a. If you have a camera, you may want to also take pictures of your samples over time and/or at the end of your experiment. Later, you could print your pictures and put them on your Science Fair Project Display Board (http://www.sciencebuddies.org/science-fair-projects/science-fair/science-fair-project-display-boards).

Analyzing Your Data

In this part of the science project, you will analyze your data and draw conclusions about how the yogurt raviolis changed over time as they were left in the sodium alginate solution.

1. Calculate the average mass of your yogurt samples at each time checkpoint. Record these numbers in your data table (in the "Average" row at the bottom).
    a. For example, if at the 0 hrs time checkpoint one sample weighed 13.5 g, a second sample weighed 14.2 g, and a third sample weighed 13.7 g, the average mass at the 0 hrs time checkpoint would be 13.8 g (since 13.5 g + 14.2 g + 13.7 g = 41.4 g, and 41.4 g ÷ 3 = 13.8 g).
2. Make a line graph of your average mass data over time. Put the time (in hours) on the x-axis (the horizontal axis going across) and put the average mass (in grams) on the y-axis (the vertical axis going up and down).
    a. You can make a graph by hand or make a graph using a computer program, such as Create a Graph (http://nces.ed.gov/nceskids/createagraph), and print it out.
3. Look at your data table, graph, and observations and try to draw conclusions from your results.
    a. How does the mass of the yogurt raviolis change over time?
    b. How did spending more time in the sodium alginate solution affect the gel-like layer that formed around the yogurt? Did it get bigger? Did it reach a maximum?
    c. Can you explain your results in terms of the chemical reaction that is going on in reverse spherification, which is explained in the Introduction in the Background (#background) section? Did the chemical reaction stop quickly, or did it continue working for a while?
    d. Overall, is there a time checkpoint that looked like the "best," or most appealing, yogurt raviolis and why? If you ended up with different types of raviolis (such as with different types of gel-like layers), do you think some would be better in certain food dishes than others?