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Text: The Science of Spherification

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Did you know that you can turn just about any drink or pureed food into small spheres? The spheres have a gelatinous outside with a liquid center. **Molecular gastronomy** is the area of food science that explores how to make these spheres, as well as other ways ingredients in our food are physically and chemically changed when we prepare and cook it. In other words, molecular gastronomy looks at the *molecules* in our food and how they change. (*Gastronomy* is the study of picking, preparing, and eating good food.) The molecular gastronomy technique that is used to make food into spheres has a fitting name: **spherification**. Figure 1 shows spheres (balls) that have been made out of green tea using spherification.

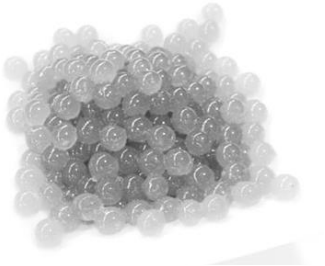

Figure 1. These are balls of green tea that have been made using the spherification process. (Image credits: Wikimedia Commons,

How does spherification work? Like much of food science, it is based on some specific chemical reactions. These reactions take place in solutions that are made up of key chemicals. The two key chemicals involved in spherification are **sodium alginate** and **calcium chloride**. Sodium alginate is made from seaweed and can form a gel-like substance when dropped into a calcium chloride solution. When the two chemicals come into contact with one another they rearrange so that the alginate binds to the calcium, forming calcium alginate, which is a gelatinous substance.

Equation 1: Sodium alginate ($NaC_6H_7O_6$) can react with calcium chloride ($CaCl_2$) to make calcium alginate ($C_{12}H_{14}CaO_{12}$), which is a gelatinous substance.

$$2NaC_6H_7O_6 + CaCl_2 \rightarrow 2NaCl + CaC_{12}H_{14}O_{12}$$

When doing spherification with food, the food is typically a liquid or has a liquid-like consistency (such as fruit juice, soda, pudding, soup, or pureed fruit). The food is mixed with sodium alginate in a blender to make a smooth solution. Then, the food and sodium alginate solution is added, one drop at a time, to a solution of calcium chloride (in water). If everything goes right, the food and sodium alginate solution turns into small (drop-size) spheres as it comes into contact with the calcium chloride. The spheres can then be removed from the calcium chloride solution (using a spoon) and eaten!

Although it may seem easy, getting the conditions just right to turn food into perfect little spheres can actually be challenging. One factor that spherification enthusiasts have to pay close attention to is the *pH* of the food they want to use. **pH** is a scale that measures how acidic or

basic a solution is. A **neutral** pH is 7; water typically has a pH of close to 7. An **acidic** pH is below 7, such as lemon juice or battery acid. A **basic** pH is above 7, such as baking soda or bleach.

For foods to be able to go through spherification, they need to have a certain pH. For example, if a food is too acidic, spherification will not work well. To solve this problem, people who want to turn acidic food into spheres add a third chemical, **sodium citrate**, to the food. Sodium citrate and water make a basic solution, so when it is added to acidic foods, it makes them less acidic. However, if too much sodium citrate is added, spheres do not form; just the right amount of sodium citrate needs to be added. (This is because sodium citrate can bind to, or *chelate*, calcium, and prevent the calcium from participating in the spherification reaction.)

Questions:

1. What are some foods that have a basic, acidic, or neutral pH?

2. How do sodium alginate and calcium chloride react during spherification? What is the gelatinous product they make?

3. Why is sodium citrate sometimes added to foods in the spherification process?

4. Why is calcium important in the spherification reaction?