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THE MOLECULAR CHEF

& THE ART OF SPHERIFICATION

MODERN RECIPES THAT WOW!

By CHEF EDMUND

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What is Molecular Gastronomy?

There is a seismic shift taking place in the culinary world of today– it's a new cuisine . . . *molecular gastronomy*. It has been quietly building its popularity and now it is has taken center stage due to those popular cooking shows and super star chefs embracing it. Molecular gastronomy is the modernist style of cuisine that combines science with cooking. In Chef Edmund's newly released book, you will be introduced to the exact methods used by some of the most famous modern chefs used to build their reputations and their extraordinary successful businesses. This book will point you in the right direction and have you on the path to creating simple and easy molecular recipes beginning with the art of spherification - the culinary process of shaping a liquid into colorful and flavorful spheres to create unusual and fantastic new dishes.

The perfect sphere in the world of cuisine brings visual appeal to any savory culinary creation. The ultimate goal is to create something so perfect that it looks natural. Unfortunately, to make it natural takes a special technique called *Spherification*. *Spherification* was introduced by Ferran Adria at el Bulli in Spain in 2003. It is the process of shaping a liquid into spheres using sodium alginate and either calcium chloride or calcium gluconate lactate to produce the perfect sphere.

Sound complicated? Well, we'll take the mystery out of it. Here are some tips to help you master the spherification process and thus, impress your dinners every time!

First, let's discuss definitions. There are two types of spherification processes: *direct* (basic) *spherification* and *reverse spherification*. We will focus on the direct spherification process in more detail, but we will compare both processes to indicate which is easier and more effective. In most situations, direct spherification may work best for you. However, in a couple of examples, reverse spherification may be the direction you need to take.

Direct Spherification vs. Reverse Spherification

To create perfect spheres with direct spherification (or basic spherification), you submerge a flavorful (and usually a colorful one, too) liquid, with a bit of sodium alginate mixed in, into a bath of calcium – the setting bath. You prepare this setting bath by combining water with a calcium salt such as calcium chloride or calcium lactate. To complete the process, you fill a syringe, squeeze bottle or straw with the base and then hold it just above the setting bath, and slowly allow droplets of the base to drop into the setting bath. If the mix ratios are all correct, as soon as the liquid hits the water, perfect spheres are formed. The reverse spherification technique consists of submerging a liquid with calcium content in a bath of sodium alginate – just the opposite. If the juice or flavored liquid does not naturally contain calcium, calcium lactate or calcium lactate gluconate is added.

Pros of Direct Spherification

Direct spherification is best used for obtaining spheres with a very thin membrane that is almost imperceptible to the palate. It will then instantly "explode" inside the mouth as if there is no solid substance between your palate and the liquid. Dinners most often comment that the spheres bursts with a surprise flavor when entering their mouths.

The gel membrane is formed inside the sphere using the flavored ingredient so there is no flavorless gel surrounding the sphere as there is with reverse spherification. This results in a better tasting experience.

It is easier to get a perfect sphere on the plate using direct spherification than with reverse spherification. Even if the result is not a perfect sphere, it most likely will look like one as you position it on the plate. The subtle and flexible membrane will adapt and reshape when the quasi-sphere is placed on the plate. This is the preferred spherification method for producing what is identified as "caviar" (small spheres) since the viscosity of the bath is thin, allowing the small droplets to form into a spherical shape in the bath. In this process, the spheres don't stick together as they often do in reverse spherification.

In direct spherification, it is unnecessary to allow the calcium bath to rest for 12-24 hours before using it, to obtain optimal results, as must be done with reverse spherification. Thus, you can start and finish the preparation within an hour.

The reverse spherification technique is used where the liquid to be encapsulated has a high acid content or is an alcohol. So in the beginning we suggest you avoid those liquid choices until you have mastered basic spherification.

That is because in reverse spherification, the process takes far longer to accomplish as the sodium alginate bath needs to rest in the refrigerator for several hours to eliminate its air bubbles. These bubbles are created during rigorous blending. As sodium alginate takes a while to be fully dissolved and a great deal of air is incorporated into to the liquid. Another issue with choosing reverse spherification is that its spheres need to be served immediately and cannot be stored. That is because, once the sphere is removed from the sodium alginate bath, the process of jellification continues even after rinsing the sphere off with water. Waiting too long will convert the sphere into a compact gel ball with none of your tasty liq-

uid remaining inside.

Jellification does not occur if the liquid acidity is high (PH<3.6). But you can easily correct this by adding an alkaline, such as sodium citrate to the liquid to reduce the acidity level before beginning the spherification process.

Besides the high acid and alcohol ingredients, direct spherification cannot be used with ingredients that have a calcium content as it will react with the sodium alginate and gel before you pour the flavored ingredient in the calcium bath. If the calcium content is not too high however, it can be fixed. But if the calcium content is high, there may be problems at this point. The consistency of the liquid inside the sphere is made a little gummy by the addition of sodium alginate. Since sodium alginate has no discernable flavor, it just increases the viscosity.

Figure 1. Spheres created using the direct spherification process. Note the slotted spoon used to manipulate the spheres.

The delicacy of the resulting subtle membrane with the direct spherification process reduces the versatility of the resulting product. Any slight pressure will break them so they need to be manipulated carefully and they cannot be used as fillings in such desserts such as mousses or sponge cakes.

A special note must be made here. Hard water is high in calcium. This is particularly true with well water. But also municipal water systems are not consistent in mineral content. So you should be in the habit of using distilled water in creating your molecular recipes for best possible results.

Preparing the Basic Liquid for Direct Spherification

Dispersing and Hydrating Sodium Alginate

To produce the spheres using direct spherification, you will require a solution with 0.5% sodium alginate. This translates to be 0.5 g per 100 g of flavored liquid to be spherified. Sodium alginate, like most hydrocolloids, needs to be dispersed in the liquid and absorbed before it will gel in the presence of calcium. This is done through the mixing of sodium alginate using an immersion blender or regular blender. Consider the following:

1. The liquid needs to be cold or the sodium alginate may gel before it can be thoroughly absorbed, resulting in gel lumps.
2. To make the absorption easier to accomplish, you can premix dry sodium alginate with another powder ingredient such as sugar.
3. The acidity of the liquid cannot be high or the sodium alginate will convert into algetic acid. This will prevent absorption and will overly and thicken the liquid. The liquid PH needs to be above 3.6. Adjust the PH by adding sodium citrate, if necessary before adding sodium alginate.
4. The liquid cannot contain free calcium, as it will prematurely gel as it reacts with the sodium alginate before you can make the spheres in the calcium bath.
5. Sodium alginate does not absorb well in alcohol either, so first, disperse and hydrate it in water or flavored liquid with high a water content.

Dealing with Thick or Watery Liquids

Liquids with Watery Density (e.g. melon cantaloupe juice):

Add the amount of sodium alginate indicated in the recipe to 1/3rd of the main ingredient and blend it together until the sodium alginate is absorbed. The sodium alginate will become sticky when it comes in contact with the liquid and it may take several minutes until it is completely dispersed in the liquid. Then add the remaining liquid and let it rest in the refrigerator for one to two hours to de-air. This last step is not only for aesthetics but will also make the droplets less buoyant in the bath and allow them to sink so as to be completely covered by the calcium bath.

Thick Liquids (e.g. mango puree):

In this preparation, distilled water with no calcium content is added to the main ingredient to obtain the right consistency for spherification. Do not use tap water since it usually contains calcium. Add the amount of sodium alginate indicated in the recipe to the water and until the sodium alginate is completely dispersed. Then add the main ingredient and let it rest in the refrigerator for one hour to two hours to eliminate any air bubbles created by the blending — the longer the better.

Correcting Acidity for Basic Spherification

The basic spherification process does not work if the main ingredient is too acidic (PH<3.6). If necessary, the acidity can be reduced by adding sodium citrate to the main ingredient or dilute it with water to reduce the ingredient density before you add the sodium alginate.

However, sodium citrate has a sour taste as well as a salty taste, so adding too much of it will change the flavor of the liquid in the sphere. Add small amounts of sodium citrate until you achieve a PH >3.6 by measuring with a PH Indicator -- Paper or a PH meter.

Correcting Free Calcium Content for Direct Spherification

As previously written, direct spherification cannot be used with ingredients that have calcium content as it will react with the sodium alginate and gel before you drip the flavored ingredient into the calcium bath. But, if the calcium content is not too high, you can add a sequestrant, such as sodium citrate, to the flavored liquid (if the PH is above 4.5) before mixing with the sodium alginate. The sodium citrate will bind to the free calcium ions so they are not available to react with the sodium alginate. If you have an ingredient with calcium content, it is better to use reverse spherification.

Removing Air Bubbles

Mixing sodium alginate with any liquid usually results in air bubbles getting trapped in the resulting dense liquid. Air bubbles are a problem because they may create weak points in the sphere membrane that will break or leak easily. In addition, air bubbles will increase the buoyancy of the sphere in the bath, making it float and not allowing it to sink or be completely covered by the calcium bath. The overall outcome is that it will affect the presentation, making the color of the flavorful liquid unattractively pale.

Here are a few ways to eliminate the air bubbles:

1. Let it rest in the refrigerator. Depending on the density of the liquid, this may take 1 to up to 24 hours.
2. Pass it through a fine sieve. In order to speed up the process, you can pass the sodium alginate solution through a fine sieve. Let the liquid flow through it on its own without applying pressure. You may have to repeat this process a few times.
3. Use a vacuum chamber. These are expensive, but if you have access to one, you can place the liquid in the vacuum chamber to eliminate the air bubbles. This is the fastest method.
4. Using a magnetic stirrer instead of a blender to prevent the formation of air bubbles.

Preparing the Calcium Bath for Direct Spherification

While waiting for the main ingredient to settle in the refrigerator, prepare the calcium bath by dissolving the calcium salt in a bowl to obtain a solution with 0.18% calcium. Keep in mind that different calcium salts contain different amounts of calcium ions and, therefore, the amount you use to create the calcium bath will be different too. Listed on the next page are the most common calcium salts used in spherification and their concentrations:

The preferred calcium salt to create the bath for direct spherification is 0.5% calcium chloride. Use 0.5 g per 100 g of water to create this percentage. You can stir it without concern for creating unwanted air bubbles, since the calcium chloride dissolves very easily in water. Calcium chloride has a strong salty flavor, but you can rinse it off with water. Calcium chloride is very hygroscopic (absorbs water easily). So close the container quickly, store it in a dry place and consider using a desiccant packet if the humidity in the air is high.

Calcium Salt	Calcium Content	Qty to Make 0.18% Calcium solution
Calcium Chloride	36.1%	0.5%
Calcium Lactate	18.4%	1%
Calcium Lactate Gluconate	9.3%	2%

Reverse spherification uses 1% calcium lactate because it has better flavor. Use 1 g per 100 g of water to create it. You can stir it or mix with a blender.

The preferred calcium salt for reverse spherification is 2% calcium lactate gluconate because it has no discernible flavor. Use 2 g per 100 g of water to create it. You can stir it or mix with a blender.

Adding Sugar to Increase the Calcium Bath Density

To aid the formation of spherical shapes when you pour the alginate solution into the bath, you can increase the density of the bath to prevent the spheres from flattening at the bottom of the container. You can achieve this by adding sugar to the calcium bath up to 20%. Here is the process:

1. Get the flavored liquid with sodium alginate from the refrigerator, the calcium bath and the measuring spoons (if making large spheres to resemble ravioli, gnocchi, etc.) or syringe, squeeze bottle or straw (if making small spheres to resemble caviar).
2. Prepare another bowl with plain water that you are going to use later for rinsing the spheres to remove the excess of calcium chloride.
3. Choose a syringe, squeeze bottle or spoon. Fill it with the flavored liquid and carefully pour it in the calcium bath. Create droplets by placing them about 3 inches above the bath surface. If using a spoon, wipe the bottom with a paper towel, place the spoon over the bath slightly touching its surface and flip it to pour the liquid into the calcium bath.
4. Stir the bath gently with the slotted *spherification spoon* without touching the spheres. If you let them sit in the bottom of the bath, they will flatten and if you let them float, the top won't be covered with the calcium solution and won't gel.
5. If making caviar wait for about a minute and, if making large spheres wait for about 2 minutes. The longer you wait, the thicker the gel will form. For a good eating experience, you want the gel layer surrounding the sphere to be as thin as possible but it also needs to be strong enough to hold the shape and allow for careful handling. If the membrane is too fragile, they may easily break when you remove them from the bath or place them on the serving spoon.
6. Carefully remove the sphere from the calcium bath using a slotted *spherification spoon* and rinse it in the bowl with clean water.

Always start with one sphere first to adjust the pouring process and the time in the calcium bath. If the sphere membrane is too subtle and the sphere easily breaks when handling it with the slotted spoon or when plating it, extend the time in the calcium bath until

you get the desired strength. Keep in mind that the thinner the membrane the better experience people are going to have when eating it.

Remember that the spheres made with the direct spherification technique need to be served immediately or they will eventually convert into a compact gel ball since the Spherification process continues even after removing it from the calcium bath.

Spherification Suggestions

Get the Right Viscosity. The difference in viscosity between the flavored solution and the bath affects how easy it is to form a sphere with direct and reverse spherification. The sphere shape forms due to surface tension between the liquids. The general rule is that it is easier to form a sphere if the flavored solution is thicker (more dense) and the bath is thinner (less dense).

In Direct Spherification, try adding more sodium alginate to the main ingredient if it spreads in the bath and is not holding its shape. Keep in mind that the eating experience will be better if the liquid inside the sphere is less dense so don't add too much sodium alginate. If the spheres sink too fast and flatten in the bottom, you can constantly stir the bath so the spheres float around or add sugar to it to increase the viscosity.

In Reverse Spherification, try adding xanthan gum to the main ingredient or in some cases even reducing the amount of sodium alginate in the bath helps. Keep in mind that the eating experience will be better if the liquid inside the sphere is less dense, so be careful how much xanthan gum you add.

- Do not use tap water. If the calcium content of your tap water is high, it will thicken the sodium alginate bath when doing Reverse Spherification as the calcium will trigger the jellification process. A thicker bath will make the spherification surface tension between the liquids. The general rule is that it is easier to form a sphere if the flavored solution is thicker (more dense) and the bath is thinner (less dense).

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- Do not use tap water. If the calcium content of your tap water is high, it will thicken the sodium alginate bath when doing Reverse Spherification as the calcium will trigger the jellification process. A thicker bath will make the spherification process more difficult. Use distilled water instead and not mineral water since it can also contain calcium.

- Use a spherical spoon. For preparations other than caviar in which you use a syringe, use measuring spoons with a spherical shape. These help get a better spherical shape when pouring the main ingredient into the bath, and they conveniently come in different sizes to create ravioli, gnocchi, and others.

- Use a flat pan for the bath. This is especially important for reverse spherification because the spheres tend to stick together if they become in contact with each other. If you use a bowl, it will be harder to keep the spheres separate as they will all flow into the middle of it as you pour the main ingredient into the bath to create multiple spheres.

- Fill the bath container up to the top. If you fill the container not less than an inch from the top, it will be easier for you to place the pouring spoon almost horizontally, touching the liquid for an easy and smooth pouring with the twist of your wrist. Otherwise, the container sides may be in your way and not allowing you to hold the spoon horizontally close to the surface of the liquid.

- Pour the liquid carefully. This is the most critical step in spherification and it requires practice. There are a few ways of doing this and some techniques work better for some people. Be patient and try different things until you find the right process for your preparation.

- Don't pour the main ingredient from high above the surface of the bath. The impact of the liquid on the surface of the bath will flatten the sphere. Place your spoon horizontally close to the bath surface or even touching it and, with a fast but gentle twist of your wrist, pour the liquid into the bath.

- Another technique is to place the spherical spoon in the bath and with a syringe, inject the liquid in the bath in the spoon cavity to help form the sphere. When mastered, this technique allows you to create spheres a little faster since you don't need to go back and forth between the bath and the main ingredient container while cleaning the spoon in between.

- Don't let the spheres float at the top. After pouring the spheres into the bath, sometimes they stay floating. You don't want this to happen because the top won't get much exposure to the bath solution and it won't gel and form a sphere. To make the sphere sink in the bath, gently create a few waves in the bath around the sphere using a spoon or your fingers so that the bath solution gets on top of the sphere. This will also help form the sphere shape as the floating edges of the sphere fold into the center of it.

- Flip the spheres occasionally while in the bath. If they stay touching the bottom of the recipient, the bottom of the spheres will be less in contact with the bath resulting in a thinner membrane than the rest of the sphere which could break easily. This side of the sphere will also be somewhat flattened.

- Clean your spoons. Always wipe your spherical spoon after each pour, especially if you are placing the spoon bottom on the bath to pour the liquid. Also make sure your slotted spoon is clean before you dip it in the bath to fish your spheres. If you don't clean your spoons, you may get small lumps of extra gel or "baby" spheres stuck to your sphere.

- Keep the bath clean. If a sphere breaks in the bath and there are small particles floating around, pass the bath solution through a sieve and continue the Spherification process with a clean bath to avoid these particles from sticking to your sphere.

Hopefully this detailed explanation of the spherification process will make it easier for you to accomplish. In the end, it is all about appearance. Impress your dinners by getting results that will wow your diners and keep them coming back for more.

Figure 2. An exquisite presentation plate made up of many molecularly created ingredients

01. Fruit Juice Caviar

To begin with let's start off with something simple, but awesome — Fruit Juice Caviar. You can show off your brilliant gastronomy skills with this great little recipe using just passion fruit juice and agar-agar. Agar-agar is a seaweed-based vegetarian gelatin used as a thickener and useful in thickening all types of jellies, puddings, and custards. This recipe makes a beautiful garnish for desserts and is the sure fire conversation starter you were seeking when you decided to master a few of our molecular recipes. My promise . . . your kids will go crazy for these.

SERVES	METHOD	TIME	DIFFICULTY
4	INCORPORATE	1.5 HRS	1/10

The Ingredients

1. 1/2 cup vegetable oil (flavorless and one that remains liquid when chilled)
2. 1/3 cup pure fruit juice non-acidic —meaning no citrus juice
3. 1/4 teaspoon agar agar powder — flakes or bars will not work

Figure 3. Passion fruit juice caviar.

Recipe Steps

- Pour oil into a tall glass and chill (the oil must be cold).
- In a very small saucepan bring the juice and agar agar to a boil.
- Reduce to gentle simmer and cook 1-2 minutes until the agar agar is dissolved.
- Let it cool 3-5 minutes.
- Fill a syringe or a squeeze bottle with the juice.
- Drop, one drop at a time, into the cold oil. Little caviar orbs will form on contact with the cold oil and fall to the bottom.
- Strain caviar using a fine mesh strainer or spherification spoon.
- Then rinse well with water.
- Store caviar in water until ready to use.
- Lay on a paper towel-lined plate and pat dry.

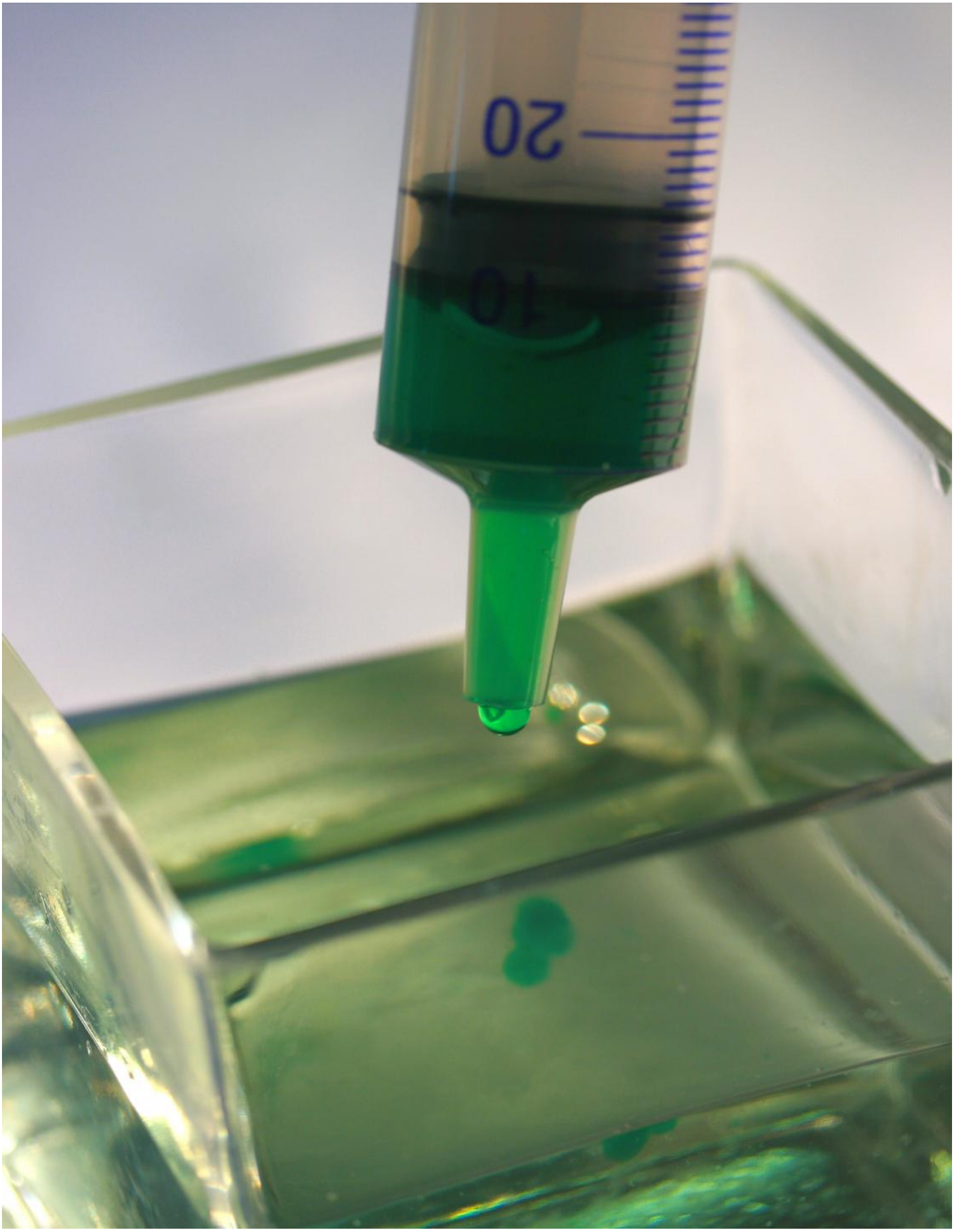


Figure 4. Encapsulating flavorful liquids in a thin membrane, by dropping liquid with sodium alginate in a calcium chloride bath.

02. Watermelon Caviar

While one of the most popular and easy-to make dishes is artificial caviar, molecular gastronomy poses no limits on the imagination. In this recipe the juice used for this caviar is watermelon juice. However, watermelon juice by itself is a bit thin too for spherification, so before dissolving the sodium alginate in the juice, it must be thickened by boiling some of the water off. After that is accomplished the spherification process can proceed. This is a very simple recipe that even novices will accomplish with success.

SERVES	METHOD	TIME	DIFFICULTY
4	INCORPORATE	1.5 HRS	2/10

The Ingredients

1. 250g Watermelon juice
2. 2g Sodium alginate
3. 500g Distilled water
4. 2.5g Calcium chloride
5. Syringe or squeeze bottle

Recipe Steps

- Evaporate the watermelon juice by heating it so that it thickens slightly s that you wind up with 250g of juice.
- Set it aside in the refrigerator for two hours to cool
- When the juice is cool mix in 2g of alginate with the juice.
- Mix well so the alginate is fully incorporated
- Dissolve 2.5g calcium chloride in a separate bath of 500g of distilled water.
- Fill the syringe or squeeze bottle with the watermelon juice and alginate mixture
- Drip droplets of watermelon juice solution into calcium chloride water.
- Use strainer or a spherification spoon to remove droplets from calcium chloride bath after 1-2 minutes.
- Place the spheres in a clean cold water bath.
- Before serving dry the sphere on a paper towel

Figure 5. Platted Watermelon Caviar.

Figure 6. Lemon-lime spheres and strawberry puree spheres.

Figure 8. Raspberry puree spheres in the process of being removed from the calcium bath with a slotted spherification spoon.

03. Carrots and Ginger Caviar

There are many wonderfully tasty and appetite appealing molecular recipes that simulate caviar roe. This excellent recipe is only but one of them. In this recipe we will be making vegetable caviar. It consists of an outer skin which encapsulates carrot juice with a touch of ginger inside of it—*spherification*. However, when your recipe calls for jelly caviar, that's *gelification*. And in this recipe of carrots and ginger caviar, spherification is achieved by using puree and the usual distilled water mixes of sodium alginate and calcium chloride.

SERVES	METHOD	TIME	DIFFICULTY
4	INCORPORATE	1.5 HRS	3/10

The Ingredients

1. 2 large carrots, peeled and chopped
2. One inch-long piece of ginger, peeled and chopped
3. 1/2 -1 cup cold distilled water
4. 1/2 tsp. sodium alginate
5. 2 cups bottled or distilled water (Tap water may be too "hard")

Figure 9. Carrots and Ginger Spheres

Recipe Steps

- Combine the carrots and ginger in your food processor and puree.
- As you blend them together, slowly add water to the puree until you reach 1 cup of the liquid.
- Then remix the mixture for a second time.
- Carefully strain off any pulp so you have only liquid remaining.
- Place it in the refrigerator for at least one hour to two hours.
- With a wire kitchen whisk, slowly incorporate a 1/2 tsp. of sodium alginate into mixture.
- Pour the contents into a large syringe or if you don't have one, a squeeze bottle will work fine
- Add 2 cups of water (use soft water as hard water contains calcium which could ruin your recipe) to shallow glass baking dish and add ½ tsp. calcium chloride to it.
- Let droplets of the carrot and ginger puree mixture fall, one at a time, into the calcium chloride and water mixture.
- When you finished forming the spheres, remove them from the water and dry them on paper towels.

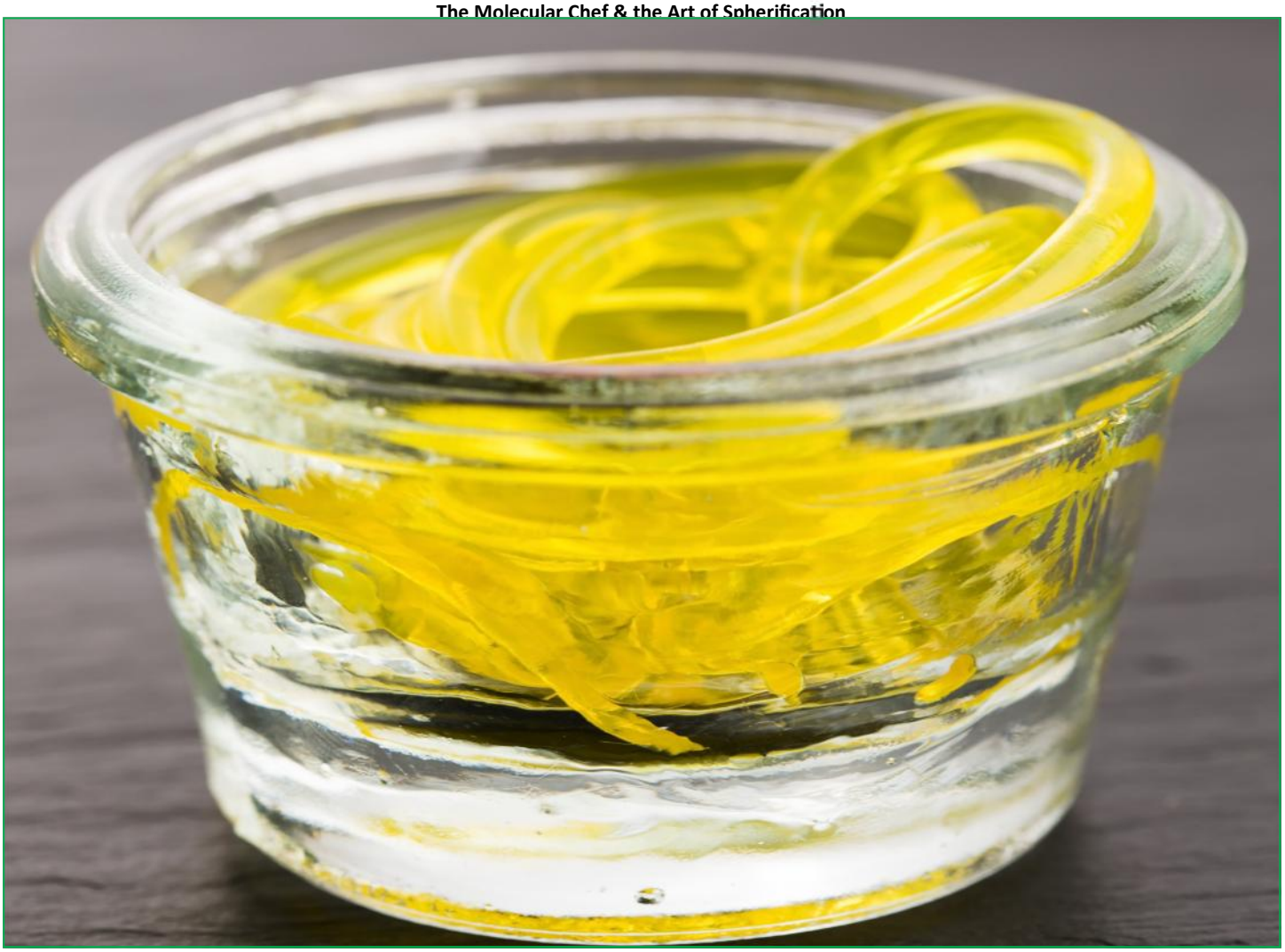


Figure 10. Summer squash noodles created using the same methods as augural spaghetti on the opposite page.

Figure 11. Spherified fruit juice mixed with sodium alginate and formed shown removed from its calcium chloride bath .

04. Arugula Spaghetti

In this recipe we are magically turning arugula into delicious noodles using another interesting ingredient for *gelification*. Gelification relies on jellifying agents like Agar Agar or Carrageenan. In this recipe we use agar agar. Agar-agar is a substance derived from red algae that when used in recipes acts as a stabilizing and thickening agent due to its ability to hold shapes together (like caviar and spaghetti) out of the liquefied versions of the foods it's mixed in. Like gelatin, gelling only occurs with agar-agar, when a solution containing it has cooled after being boiled.

SERVES	METHOD	TIME	DIFFICULTY
4	BOIL	30 MIN	2/10

The Ingredients

1. 2 cups of Arugula
2. 3/4 cups of water
3. 1/2 tsp. of Agar Agar powder
4. Plastic syringe
5. Plastic tube 10-12 inches long

Figure 12. Coiled arugula spaghetti.

Recipe Steps

- Add 2 cups of arugula to a blender
- Add ¾ cup of water to the blender
- Blend and pour off into a sauce pan
- Add ½ tsp of agar agar to sauce pan
- Stir and bring contents to a boil
- Empty the sauce pan into a bowl
- Fill syringe with mixture
- Using a small rubber tube about 10-12 inches squirt the mix into the tube until it is filled
- Drop the tube in cold water bath to gel
- Fill another syringe with fresh water and force it into the tube to expel an arugula spaghetti strand
- Repeat until you have sufficient strands – about three per plate as a eye appealing garnish

Figure 13. Balsamic Vinegar Pearls

05. Balsamic Vinegar Pearls

Balsamic vinegar pearls are an easy and awesome way to add a touch of class your salads or dishes using molecular gastronomy techniques. The balsamic vinegar is transformed into small jelly balls using agar agar and the cold oil spherification method. Begin by placing the oil in a tall glass in the freezer for at least two hours as it needs to be really cold. It is better if you use a tall glass so there is more time for the balsamic vinegar droplets to get cold and gel before reaching the bottom of the glass.

SERVES	METHOD	TIME	DIFFICULTY
4	BOIL	30 MIN	2/10

The Ingredients

1. 100 g (7 oz) Balsamic Vinegar
2. 1.5 g (1.5%) Agar Agar by weight
3. 1 cup of oil, cold from being in the freezer for at least 2 hours

Figure 14. Balsamic vinegar pearls presented in cherry tomato.

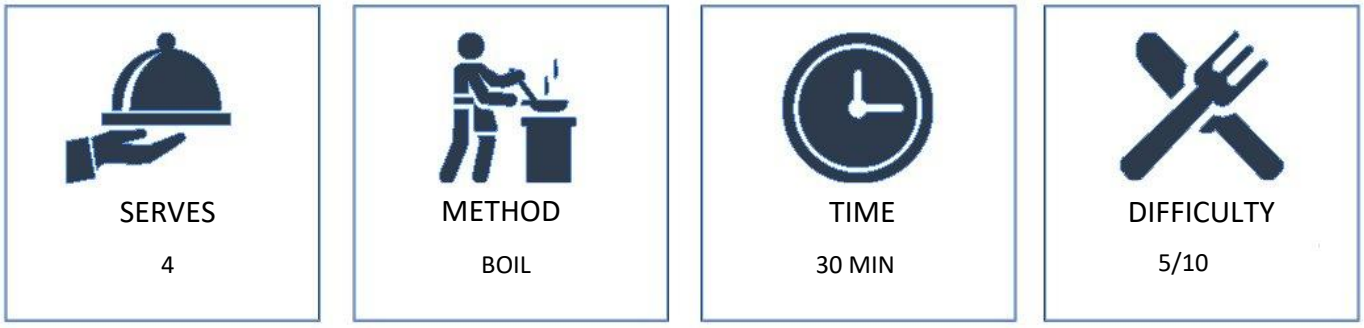
Recipe Steps

- Place the oil in a tall glass in the freezer for at least 2 hours.
- Pour 7-oz. of balsamic vinegar in a saucepan, dissolve the agar agar and bring it to the boil,
- Let it boil for 1-2 minutes, stirring vigorously .
- Remove from the heat and skim to eliminate any impurities.
- Let the mixture cool for 5-minutes, stirring occasionally
- Fill a syringe with the hot balsamic agar solution and slowly drip it into the cold oil. The syringe needs to be high enough for the drops to sink when they get in contact with the oil but not too high or the drops may break into smaller drops creating “baby” spheres.
- Wait a few minutes and then slowly remove them from the oil bath with a spherification spoon
- rinse them in water. You can keep them in a container in the fridge for later use.

Figure 15. A reverse spherified olive. Note that reverse spherification allows for much larger spheres.

06. Spherified Olives

This is an interesting recipe using reverse *spherification, a* dishe that was first introduced at el Bulli in 2005. The spherical *olives* are created from a puree of green *olive* juice. Before you attempt this recipe you must search out the better tasting olive variety, as the average olive will provide an unhappy taste in that there is a tendency toward bitterness. elBulli recommends *Verdial* olives, which are thick-skinned, medium to large-sized olives grown for their oil. But you can substitute for Verdial olives with Mt. Athos Greek olives which are marinated in garlic and herbs and also have a delectable taste.



The Ingredients

1. 500 g of de-pitted olives
2. 3/4 g xanthan
3. 2 g (1%) calcium lactate gluconate
4. 1500 g (35 oz) of distilled water
5. *7.5* g sodium alginate
6. Extra virgin olive oil
7. Lemon peel
8. Fresh thyme sprigs
9. Fresh rosemary sprigs
10. Garlic cloves

Recipe Steps

- Mix the sodium alginate in the distilled water until the sodium alginate is completely dissolved.
- Let it rest for 24 hours in the refrigerator to de-air
- Puree the de-pitted olives with a food blender.
- Strain the puree through a cheesecloth pressing with the hands. You may have to press the olive puree with a spatula to get all the juice out.
- Mix the calcium lactate gluconate with the olive juice and then add the xanthan and leave to hydrate for 1 minute.
- Mix with a blender at medium speed and let it stand in the refrigerator for 10 minutes.
- Check the density of the olive juice if it is too liquid, add some Xanthan in small increments of 0.2 g and repeat the process. Keep in the fridge for 24 hours.

For the aromatized olive oil, crush the garlic lightly and fry it in 20% of the oil you are planning to use to marinate the olives without letting the garlic color. Add the rest of the oil and once it is warm, add the rest of the ingredients. Keep in a sealed container in a cool dry place.

- You are now ready to start creating the spheres! Remove the alginate bath from the fridge. Scoop the olive mixture with a half sphere 5ml measure spoon and carefully pour it into the alginate bath. It is important that the spherical olives don't touch since they would stick together. Leave the spherical olives "cooking" for about 2½ minutes in the alginate bath and then carefully remove it using a slotted spoon spherification spoon. Then rinse them very gently with water, strain them carefully and place them, not touching each other, in the aromatized oil. Keep in the refrigerator for 12 hours for later use.

Figure 17. Tasty chilled yogurt spheres that burst with flavor when they hit the palate.

07. Yogurt Spheres

Here is a very tasty dessert surprise using reverse spherification techniques. It is a an interesting take on the ever healthy yogurt, yet you will not expect how exhilarating it is to bite into an odd little sphere that bursts like a cherry tomato, yet with the taste of infused yogurt. This molecular gastronomy recipe is msut use the reverse spherification technique which is great for ingredients rich in calcium like yogurt.

SERVES	METHOD	TIME	DIFFICULTY
4	INCORPORATE	150 MIN	6/10

The Ingredients

1. 1000 ml (4 cups) of distilled water
2. 5 g premium sodium alginate
3. 100 g yogurt (do not use non fat or low fat yogurt because the calcium content too low.)

Recipe Steps

- Pour water in a bowl. Add sodium alginate and mix with a hand mixer or a blender.
- To remove bubbles or lumps in the sodium-alginate solution, place it in the refrigerator until they disappear. Overnight is best.
- Scoop up yogurt and place the scoops in the sodium-alginate solution.
- Once the jelly has set (about 2 minutes), remove the yogurt spheres from the solution
- Begin forming one sphere to adjust the pouring process and the time in the sodium alginate bath. If the sphere membrane is too thin, the sphere will easily break when handling it. In that case extend the time in the calcium bath until you get the desired strength. But remember, that the thinner the membrane the better experience people are going to have when eating it.

Figure 18. Strawberry yogurt spheres using yogurt and strawberry preserve.

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Advanced reverse spherification used in the construction of this hand made citrus tart

Molecular gastronomy is a cross between cooking and science, using scientific experimentation to deconstruct food to its simplest elements, only to reconstruct it in new and unexpected ways. Getting started with the spherification technique created by the award-winning Chef Ferran Adria at el Bulli is not difficult, but creating a perfect sphere shape requires some practice. This book is written to introduce you to molecular gastronomy and to help you master its spherification techniques to impress your dinners with the perfect encapsulated liquid spheres.

Chef Edmund has been a student of molecular gastronomy since 1990, two years after the term was coined by the late Oxford physicist Nicholas Kurti and the French INRA chemist Hervé. Chef Edmund is the Executive Chef for Cape Crystal Brands an ingredients company dedicated to producing the finest food products for this culinary art form. Know as the Molecular Chef, Chef Edmund has published the first in a series of instructional books of the art of molecular gastronomy. His first, *The Art of Spherification,* explores the various methods of encapsulating liquid ds in a thin film to create unique dishes and colorful garnishes.