The Science of Cooking

Bearbeitet von
Peter Barham

1. Auflage 2000. Buch. vii, 244 S. Hardcover
ISBN 978 3 540 67466 5
Format (B x L): 15,5 x 23,5 cm
Gewicht: 541 g

Weitere Fachgebiete > Technik > Verfahrenstechnik, Chemieingenieurwesen, Lebensmitteltechnik > Lebensmittel- und Getränketechnologie

Zu Inhaltsverzeichnis

schnell und portofrei erhältlich bei

beck-shop.de
DIE FACHBUCHHANDLUNG

Die Online-Fachbuchhandlung beck-shop.de ist spezialisiert auf Fachbücher, insbesondere Recht, Steuern und Wirtschaft. Im Sortiment finden Sie alle Medien (Bücher, Zeitschriften, CDs, eBooks, etc.) aller Verlage. Ergänzt wird das Programm durch Services wie Neuerscheinungsdienst oder Zusammenstellungen von Büchern zu Sonderpreisen. Der Shop führt mehr als 8 Millionen Produkte.

12 Soufflés



A hot, well risen soufflé, fresh from the oven always impresses dinner guests. However, many people think soufflés are difficult to cook. Perhaps this belief stems from some recipes that are more likely to result in disaster than in a beautifully risen, stable soufflé. The basis of all soufflés is a foam made from beaten egg whites. During cooking some steam is generated and the air in the foam expands causing the soufflé to rise. As the egg whites cook so the foam sets. All you need to be able to make perfect soufflés is to understand what ingredients and processes will tend to make the egg white foam collapse, and to avoid using them as far as possible.

Basic Principles

Following a few simple rules will ensure perfect well risen soufflés every time. Begin by preheating the oven and greasing the dishes (try to use smaller dishes where possible).

It is important to put soufflés into a hot oven so that they start cooking quickly. The egg-white foam at the heart of soufflés has a tendency to collapse after the final stages of mixing when any fats are added (as described later) so the sooner it starts to cook the better. It is also important to have the oven at the right temperature; if the temperature is too high then the soufflé may burn on the outside before it is cooked in the centre. Cooking at too low a temperature, however, can mean that the soufflé does not rise very well, as the egg proteins cook and stiffen the foam before enough steam is generated to make the soufflé rise.

Greasing the dishes is essential to allow the soufflé to rise properly. Any hard fat (butter, lard etc.) is suitable – hard fats are preferable to soft ones as they are

less likely to flow away during cooking. Egg whites are notorious for sticking to surfaces during cooking. This is because the egg proteins react with some metallic atoms in the glaze. (See Chapters 2 and 5 for more detailed explanations). Greasing the dish prevents the protein molecules reaching the glazed surface and thus reduces the risk of the soufflé sticking. Cleaning off any excess mixture from the rims of the dishes is a good idea, since this mixture would cook first and may stick to the rims so preventing the soufflé rising. A soufflé dish should have smooth vertical sides so that the soufflé does not change its shape as it rises. It is easier to cook good soufflés in small dishes. The foam that makes the basis of the soufflé is a very poor conductor of heat, just like the insulating foam used in cavity walls or in loft insulation. The outside of the soufflé gets hot quickly while the centre takes longer to cook.

The smaller the dishes you use the easier it is to produce a soufflé that is uniformly cooked all the way through to the centre, without the risk of burning the outside. If you use larger dishes it is preferable to cook the soufflés for longer times at lower temperatures; the table on page 202 gives a guide to cooking times and temperatures for soufflés cooked in different sized dishes. Thus it is often preferable to make several individual soufflés, rather than one large one.

Separate the eggs and beat the whites to make a very stiff foam

The most important instruction is to beat the egg whites into a really stiff foam. Without a really firm foam as the basis the soufflé simply will not work! Beaten egg whites provide bubbles that expand to make the soufflé rise and trap the air to make the soufflé light. The smaller the bubbles the better, as really small bubbles (so small that they can not be seen) provide a uniform and smooth texture to the soufflé. The more you beat the egg whites and the whiter they get, the smaller the bubbles are becoming.

Cookery books give a lot of different and sometimes contradictory instructions on how to achieve a stiff foam. The main reasons lie in changes that have occurred over the last few years. Power whisks take the hard work out of beating eggs so there is no need to employ any of the shortcuts offered in many older books. These short cuts aimed at making beating easier; all have good scientific explanations but are only necessary if beating by hand. Examples are: beating over a pan of hot water (which makes it easier to denature egg white proteins – see Chapter 10 for a detailed explanation), using a copper bowl (copper ions can 'cross-link' protein molecules together to make the foam stiffer – see Chapter 2 for a detailed explanation), adding cream of tartar (an acid environment makes proteins easier to denature – see Chapter 2 for a detailed explanation).

When beating egg whites use a metal, hard plastic, or Pyrex bowl in which to beat the eggs

One modern innovation that can cause problems is the plastic bowl. The softer type of bowls (especially the older ones), made from polypropylene or polythene can contain some fat like molecules which, although harmless in themselves, can act like other fats to prevent, or reduce, foam formation.

When choosing the ingredients for the soufflé flavouring avoid using fats as far as possible

Avoiding fats is important since they tend to make the egg white foam collapse. We are all familiar with the foams made by soaps in, for example, washing up liquids or bubble baths. We also know that adding oils (or fats) causes the bubbles to disappear. When you beat egg whites you denature, or alter the structure of, the protein molecules so that they act in a way directly analogous to soaps. The bubbles formed by these denatured proteins when egg whites are beaten are similarly burst by any added oils or fats.

Since foams are destroyed by the addition of fats or oils (see Chapter 2), an important item to look for in a list of ingredients for a soufflé is anything that contains fat. Avoiding fats is the simplest way to ensure a perfect soufflé. This includes the fats that are contained in the egg yolk; that is why, contrary to nearly all recipes I have seen in cookery books, I do not recommend adding the egg yolks back into the soufflé. If you do add the egg yolks they will start to collapse the foam, so that the soufflé will not rise as well, or may not rise at all.

Prepare the filling as a very firm paste and fold into the beaten egg whites

The reason the recipe below calls for the apple purée to be very stiff is that this filling provides the strength for the cooked soufflé enabling it to support its own weight. A (flavourless) soufflé can be made with beaten egg whites alone. However, apart from the flavour (or lack of it!), such a soufflé is rather weak and can collapse under its own weight when taken out of the oven. The filling therefore has to provide some additional strength to counter this weakness. Most recipes call for you to use a flour based paste to strengthen the soufflé; however, I prefer to keep the amount of added flour to a minimum as I believe it can affect the taste of the soufflé. Providing you prepare a very stiff and thick purée for the filling you should not need to use any flour.

Cooking Times for Soufflés

Dish diameter (cm)	Dish depth (cm)	Oven Temperature (°C)	Cooking Time (minutes)
6	3	180	10
10	4	180	15
10	5	170	20
15	5	160	25
20	5	160	30

Key Points to consider when making soufflés

- Preheat the oven
- Grease the dishes
- Separate the eggs and beat the whites to a very stiff foam
- Avoid using fats in the flavouring, as far as possible

Why these key points are important

To make a good soufflé you need to begin by making the bubbles that will keep the soufflé light. The bubbles are prepared by beating egg whites; whilst it is possible to beat eggs which have not been separated (see the recipe in Chapter 10 for a Genoese Sponge) the fats in the yolks tend to make this difficult and reduce the stability of the resulting foam. Once you have made your foam you want it to rise in the oven. It will rise when the air in the bubbles expands and some steam is generated inside the soufflé as it gets hot. To make sure the soufflé rises evenly, you need to make sure the egg proteins do not stick to the sides of the soufflé dish – this is easily achieved with a little grease on the insides of the dish. Finally, to prevent any risk of collapse of the carefully prepared foam, you should try to avoid using fats in the filling and start to cook it quickly as possible.

Cooking a soufflé with the oven open
Provided you take enough care in preparing the soufflé mixture it is actually possible, but not recommended, to cook a soufflé with the oven door open. All that happens is that the temperature inside the oven is quite a bit cooler than usual – so you set it on a higher temperature, and the front of the soufflé (nearest the front of the oven) is not as quickly cooked as the back – so you need to turn it round during the cooking.

Since this recipe is so robust, you can be quite rough with the cooking soufflés. For example, you can if you wish open the oven door while the soufflé is cooking and then slam it shut – something that all normal cookery books say will ruin a soufflé. Indeed, when ever I cook a soufflé in a public lecture I invariably open the oven door well before the soufflé is

cooked and say – "it still needs a few minutes yet" before slamming the door shut – just to emphasise the point that provided you have made a good stable foam in the first place nothing can go wrong when you cook it. On one occasion, at the Edinburgh Science Festival, my partner was sitting in the audience next to the very distinguished lady who was chairing the session when I did this. She leant over to my partner and said "Oh dear! What a pity the soufflé will be ruined!". She point blank refused to believe my partner's protestations that my actions were quite deliberate and the soufflé would come out just fine, as of course it did.

Apple soufflé

The main example recipe is for a dessert soufflé. Variations are given later that include a range of savoury soufflés suitable for starters and main courses. In order to avoid any fats, the recipe calls for egg whites, but not for egg yolks. The egg yolks are best used to make a custard to serve with the soufflé (see Chapter 9 for a recipe for egg custard).

The recipe is designed to produce a little more than 1.2 litres of soufflé mixture, enough to make 4 individual soufflés in soufflé dishes with a diameter of about 10 cm and a depth of about 4 cm.

Initial Preparation

Preheat the oven to the cooking temperature, see the table above for cooking temperatures and times. Thoroughly grease individual soufflé dishes with butter or any other hard fat.

Ingredients

200 ml	egg whites (about 5 large eggs)
100 g	icing sugar
250 ml	apple purée (made from 400 g apples) thickened with a little flour or cornflour if necessary

Method

Begin by preparing the fruit purée, this can be done in advance well before the meal. Cook the fruit in a little water and drain before liquidising the cooked fruit in a food processor or liquidiser. The purée should be very dry and stiff, a good guide is that a spoonful of the purée put on a plate should retain its shape and not flow away. If the purée is even slightly runny you can easily thicken it by adding a teaspoon of cornflour and heating slowly until boiling.

Whisk the egg whites until they are stiff. A guide to when they are ready (if you dare try) is that you can turn the bowl upside down without the egg whites falling out! Add the icing sugar and beat the egg whites some more. Taste a little of the egg white foam to check for sweetness, and add more sugar if needed. Once the sweetness is to your liking then finish off with a little more beating to give a very stiff and glossy finish. Next fold some of the beaten egg whites into

the fruit purée to give it a less stiff texture, keep adding more beaten egg white and folding it in until it is all used up.

Immediately, fill the soufflé dishes right to the top, making sure that there are no air pockets by knocking the dishes on a hard surface. Clean off any excess mixture and flatten off the tops with a palette knife. Make sure that there is no mixture over the rims of the dishes as this will cook first and prevent the even rising of the soufflés. Dust the tops of the soufflés with icing sugar and put them in the oven to cook for about 15 minutes until the tops and sides just start to brown. Remember to leave space above the soufflés for them to rise. The soufflés should rise up so that the height is more or less doubled. An interesting finish can be achieved by branding a pattern in the sugar on the tops of the cooked soufflés with a red hot wire or skewer. Serve immediately, before the soufflés start to cool and shrink.

Problem solving with soufflés

Unfortunately there is no way to rescue most failed soufflés once they have been cooked, so the guide below just shows you how to do better next time.

Problem	Cause	Solution
Soufflé does not rise	The bubbles in the egg foam burst before cooking started	
	Insufficient 'soap like' molecules to stabilise foam	Beat egg whites more, make sure there is no yolk in egg whites
	Too much fat or oil in flavourings	Avoid using fatty or oily fillings
Soufflé rises, but it is all air inside	Bubbles in the egg foam burst during cooking, after the top has cooked	
	Insufficient 'soap like' molecules to stabilise foam	Beat egg whites more, make sure there is no yolk in egg whites
	Too much fat or oil in flavourings	Avoid using fatty or oily fillings
Soufflé collapses as soon as it is taken out of oven	Cooked foam unable to support its own weight, insufficient cross-linking of egg white proteins or the filling is not having a reinforcing effect.	
	Not cooked long enough.	Increase cooking time and/or temperature;
	Not enough filling.	Use more filling;
	Filling too runny.	Use drier filling, or thicken with cornflour.

Table (continued)

Problem	Cause	Solution
Soufflé rises at first in the oven but collapses during cooking	The bubbles burst when the steam pressure becomes too great, the foam does not cook quickly enough to become strong before the steam is generated.	
	Egg whites not beaten enough to provide small bubbles (small bubbles withstand higher pressures).	Beat eggs longer
	Filling too runny.	Use drier filling, or thicken with flour or cornflour.
Top browned but inside raw	Oven too hot so that top cooks too quickly	Reduce oven temperature, or cook in smaller dishes
Soufflé has chewy texture	Oven too cool, middle overcooked before outside browned	Increase oven temperature, or cook in larger dish
Top of soufflé splits or soufflé rises unevenly	Soufflé prevented from rising by sticking to sides of dish	Make sure dish is well greased
Uneven sides to soufflé	Mixture not filling dish properly so that some large air pockets are left behind	Make sure you knock the dishes on a hard surface to get rid of any large air bubbles before putting in oven

Common Problems with soufflés
Soufflés collapse for many reasons. The most usual causes are: too much fat making the egg white foam collapse; not beating the egg whites enough to make a really stiff foam; using too runny a filling so that it cannot reinforce the egg foam; not cooking the soufflé long enough. Soufflés, even when they have risen properly can sometimes have a rough appearance. The usual cause is that the top of the soufflé was not smoothed off well enough before it was put in the oven.

Often soufflés rise more in the middle than at the edges and the tops break open. This happens when the soufflé dish is not properly greased and the soufflé mixture sticks to the sides and so prevents the soufflé from rising properly.

Occasionally, a soufflé will only rise from one side which results in a lopsided finish. There are two possible causes: some of the mixture has stuck at one place on the rim of the dish where it was not cleaned away properly before putting in the oven or the soufflé has been cooked in an oven with a heating element at the back – the more risen side would have been closer to the heat and would have risen more quickly leading to the lopsided finish.

Soufflé recipe variations

It is instructive to look at some of the worst recipes to be found in cook books. I have found several recipes by reputable authors that are, without the utmost care and greatest skill and experience, almost certain to fail.

The commonest problem is the use of more fat than is strictly necessary for the soufflé. For example, many recipes start with instructions to prepare a roux from melted butter, flour (and in some cases milk as well) and then proceed to use this roux as the basis of a white sauce to which the beaten egg yolks and flavourings are added. This sauce is then folded in to the beaten egg whites. These recipes are adding far more fat than is necessary. The fat in the egg yolks and the fat from the butter (and milk) in the roux will begin to burst some of the bubbles in the egg white foam as soon as they are folded in. The result will be larger bubbles in the soufflé, giving a coarser texture, and a weaker, less well risen product that is more prone to collapse.

Other instructions that add unnecessary complications include cooking with the soufflé dishes on a hot metal plate. If the dishes are placed on a hot plate the soufflés will cook more quickly at the bottom than elsewhere. The result will be a soufflé that is either burnt at the bottom, or else undercooked about half way down. Whenever you are cooking something with a foam structure (such as a soufflé, or a sponge cake) you must bear in mind that it is a good thermal insulator, so that it will only heat through slowly. It is best to try to heat it as evenly as possible, so the use of a hot plate underneath is not to be recommended.

Of course, for certain soufflés some fat is essential as it forms a part of the basic flavour. The most important examples are cheese soufflés and chocolate soufflés. There are several tricks you can employ to reduce the difficulties caused by the presence of the fats in these flavours.

You can avoid the problem of fats in cheese by using a coarsely grated hard cheese, so that the cheese only starts to melt and release its fat once the egg whites in the foam have started to cook and harden. For a chocolate soufflé you can avoid the use of fat altogether by using cocoa powder, rather than whole chocolate (which contains 40 to 50% fat), to provide the flavour.

However, neither of these solutions is completely satisfactory, you may wish to make a soufflé from a soft cheese, and you may want the full richness that comes from whole chocolate in your chocolate soufflé. The trick to be employed in these cases is to encapsulate the fat in a thick starch based sauce so that it doesn't reach the egg white proteins at all, and hence does not cause any collapse of the soufflé.

Encapsulation of fats can be achieved by several means. The easiest way is to use a very stiff, almost solid, starch thickened sauce to surround the fat. A mixture of cocoa powder and cornflour is very suitable for chocolate, while cornflour on its own is acceptable for cheeses. There are two methods that can be employed, either add the solid fatty ingredient in a finely grated form to a nearly set sauce, or add the fatty food to the hot sauce and beat really hard while the sauce cools to divide the fat into fine droplets that solidify and are coated by the sauce.

Chocolate Soufflé

You can apply the first of the encapsulation methods described above to make a simple chocolate soufflé. Begin by making the sauce base by adding a mixture of equal quantities of cocoa powder and cornflour to a little water and mixing to a smooth paste (you should use about 40 g of cocoa powder and 100 ml water for a 4 egg whites soufflé). Heat this paste until it thickens and allow to simmer for a few moments. Allow the thick mixture to cool (below the melting point of the chocolate) and then add about 150 g of finely grated chocolate. Fold the mixture into beaten egg whites as in the recipe above and cook in the usual way. In the soufflé, the egg white will start to cook before the fats are released from the starchy paste so producing an excellent soufflé.

Brie Soufflé

The second encapsulation method can be applied to make a Brie soufflé. Melt about 200 g Brie with a little (50 ml) water, once it is all melted add 40 g cornflour made into a paste with a little cold water. Beat vigorously and continue to heat until the mixture thickens (and starts to bubble). Remove from the heat and keep beating (in a food processor or with a power whisk if available) until the mixture is cool and the fat has set. Fold this mixture into the beaten egg whites as above and cook in the usual way. In the soufflé, the egg whites will cook before any fats are released so producing an impressive Brie soufflé. Of course this recipe can be adapted for use with any cheese.

Unusual recipes that can be made using the science principles

With a good understanding of what makes the soufflé recipes work, you should be able to make a soufflé without any recipe at all. Such a skill might be useful when on holiday where there are, say, lots of cheap plums just waiting to be turned into a delicious dessert, but you have no recipe book to look up what is needed. The confidence of knowing what will work means that you can just make it up as you go along.

Once you have grasped the important principles involved in cooking soufflés, you should be able to move on to using them to make interesting and different types of soufflé. In practice the only limitations to the possibilities are your own imagination, and the problems that are associated with making soufflés with particularly fatty fillings. To start you off thinking up novel soufflés I have put together a few oddball recipes below. In these recipes I have deliberately kept the detail to a minimum, so that you can use your own skills to interpret and adapt them to your own taste.

Spotted Dick Soufflé

Ingredients

200 ml	Egg whites (from about 4 large eggs)
100 g	Icing sugar
150 g	Raisins (and/or sultanas etc.)
30 g	Cornflour

Method

Prepare the soufflé dishes and preheat the oven. Beat the egg whites to a stiff foam and fold in the icing sugar, beat a little more until the mixture is so stiff that you can turn the bowl upside down without dropping the foam on the floor. Fold in the cornflour and gently mix in the dried fruit. Fill the soufflé bowls to the brim, level off the tops with a palette knife, clean off any excess mixture and cook in the usual way. Serve as soon as you take the soufflés out of the oven. N.B. cornflour is used in this recipe to thicken the egg foam enough to make sure that the raisins don't sink to the bottom during cooking.

Smartie Soufflé

A simple variation on the above recipe using Smarties instead of raisins makes for a fun dessert for youngsters of all ages (at least my partner thinks its fun!)

Ingredients

200 ml	Egg whites (from about 4 large eggs)
100 g	Icing sugar
2	tubes of Smarties
20 g	Cornflour
10 g	Cocoa powder

Method

Prepare the soufflé dishes and preheat the oven. Beat the egg whites to a stiff foam and fold in the icing sugar, beat a little more until the mixture is so stiff that you can turn the bowl upside down without dropping the foam on the floor. Fold in the cornflour and cocoa powder and gently mix in the Smarties. Fill the soufflé bowls to the brim, level off the tops with a palette knife, clean off any excess mixture and cook in the usual way. Serve as soon as you take the soufflés out of the oven. Note the colour from the coating of the smarties will diffuse into the soufflé, so if you do not use any cocoa powder (which gives a dark brown soufflé), the finished soufflé will have a rainbow appearance.

Tricolour soufflé

Ingredients

200 ml	Egg whites (from about 4 large eggs)
100 g	Icing sugar
10 g	Cornflour
100 ml	Very stiff Strawberry purée (raspberry or cherry will work as well) – add a little cornflour if necessary
100 ml	Very stiff Blueberry purée (plums will also work) – add a little cornflour if necessary

Method

Prepare the soufflé dishes and preheat the oven. Beat the egg whites to a stiff foam and fold in the icing sugar, beat a little more until the mixture is so stiff that you can turn the bowl upside down without dropping the foam on the floor. Divide into three equal quantities in separate bowls. Fold in the Strawberry purée in one bowl and the blueberry in another, fold the cornflour into the third (the cornflour will act to stiffen the egg-white foam without giving it any colour). One third fill the bowls with the red, strawberry, soufflé mixture and smooth the surfaces with the back of a teaspoon, pour on the white soufflé mix until the dishes are two thirds full, smooth the surface and finish off with the blue soufflé mix, filling the soufflé bowls to the brim. Level off the tops with a palette knife, clean off any excess mixture and cook in the usual way. Serve as soon as you take the soufflés out of the oven.

An Experiment to try for yourself

People sized bubbles

As you have learnt, making soufflés is all about making good stable foams, which are just collections of bubbles. So it is fun to apply the same principles to make really big bubbles – big enough for you to get inside them!

First you need to make a really good bubble mixture. At the heart of the mixture are the soap molecules. You need to get the right ones – these are usually those in washing up liquids or detergents for washing cars. In most washing up liquids the manufacturers add salt to make the liquid thicker. While this may give the impression you are getting more for your money, it is just a marketing ploy. However, the salt in these washing liquids can limit the size of bubbles you can produce from them. So look for a cheap and runny liquid.

To make up the bubble solution take about 4 parts of detergent to about 20 parts water and add about 1 part of glycerine (available from chemists) and mix well. Test the mixture by creating a large bubble with a clean metal coat

hanger bent into a roughly circular hoop. Dip the coat hanger in the mixture and lift it out. A thin bubble film should be suspended in the hanger. Then hold the hanger at arms length and swing it around in a circle – a big bubble should be formed behind the hanger.

If no film is formed on the hanger when you take it out of the bubble mixture then add some more detergent. If the film does not form a good sized bubble when you swing the hanger around then add a little more glycerine. Keep adjusting the mixture until you can make good bubbles with the coat hanger every time.

Once you have prepared a really good mixture you are ready to try making giant bubbles. You will need to make up a large loop to make the big bubbles. Take a strip of cotton fabric about 5cm wide and about 3metres long and roll it into a stiff tube about 1cm in diameter. Stitch the tube along its length to hold it together and then join the ends neatly to form a loop. Now sew on another length of cotton fabric to act as a handle. Dip the loop of cotton fabric in the bubble mixture and then take it out and run along holding it out beside you by the handle you made – make sure it does not touch the ground. With a little practice you will be able to get the loop to open up to a ring about 1 metre in diameter and then make a bubble about 1 metre in diameter and maybe as much a 3 metres long.

You can also make a bubble large enough to stand inside using an old hula hoop covered with cotton fabric. You will need a friend to help with this bubble. Put the bubble mixture in a child's paddling pool and stand in the pool yourself inside the hula hoop which should be fully immersed in the bubble mixture. Get your friend to take the hula hoop and quickly lift it up over your head, without touching you at all. This will make a bubble with you inside!