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Decoding chocolate mousses

Part I
The Science

by
Ramon Morató

Collaboration
Scinnov (Scientific advice)

Decoding chocolate mousses

In this new bulletin, we are going to take a look at the world of chocolate mousses, more specifically, chocolate mousses used for assembling desserts.

What are the differences between a crème anglaise-based mousse and one made with chocolate ganache?

How does using egg products affect the final texture and does it matter whether they are beaten or not? How is stability affected if cream is not used as an aerating agent?

To carry out this experiment, we went to the **University of Barcelona**, more specifically to the **Mineralogy department**, and looked at the texture of the chocolate mousse under a scanning electron microscope. We also worked with Anne Cazor from **Scinnov** (R&D company based in Paris) to obtain a scientific explanation on mousses.

To put theory into practice, we took six classic recipes for creating chocolate mousse with different techniques but used the same chocolate, the exceptional Fleur de Cao™ dark couverture chocolate from Cacao Barry®.

Since the techniques used vary greatly, the results were very diverse, but they all shared a common element. We wanted to ensure that the texture of the final product and the product stability were identical, so the mousse could be used in a display or piped into a dessert, an entremet or a serving glass.

Ramon Morató
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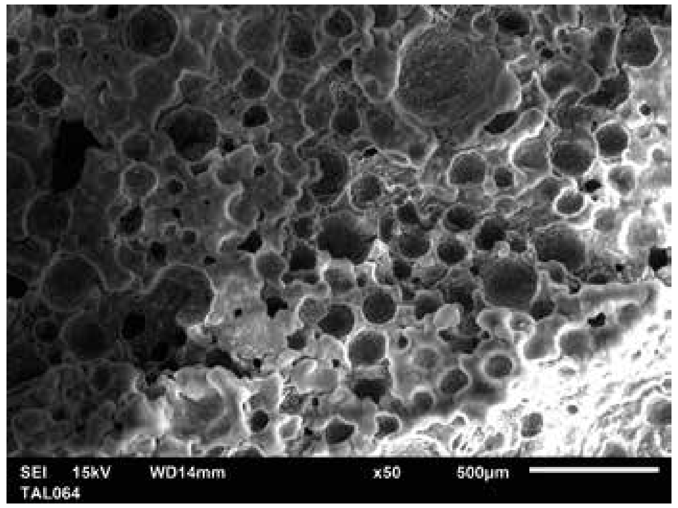
Scinnov
Scientific advice

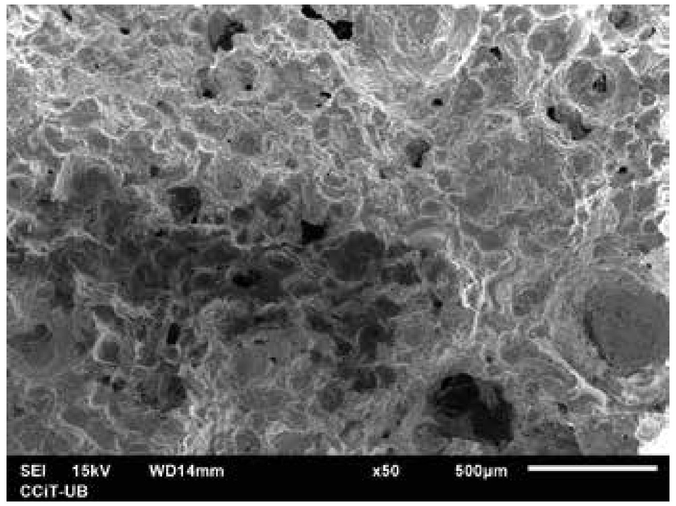
What is a chocolate mousse?

A chocolate mousse is a very airy liquid preparation that changes texture when cooled as the fat (cocoa butter and milk fat) crystallises and a stable gel forms thanks to a gelling agent (*gelatine where used).
These phenomena help mousses conserve the air inside until consumed.

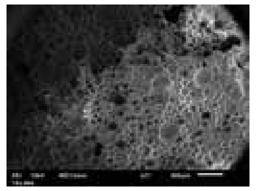
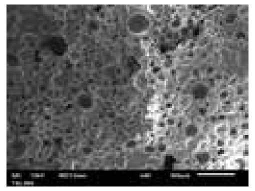
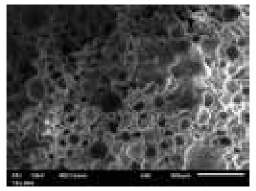
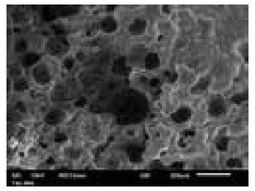
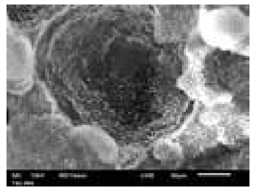
Crème anglaise base



Egg white base



These images taken with a scanning electron micoscope (SEM) show two very different examples of chocolate mousse.
The left photo shows a crème anglaise-based mousse at a magnification of 40, while the right photo shows at egg white-based mousse, also at a magnification of 40. In both cases, the scale bar is 500 micrometres (µm).
In both cases, a very airy structure can be seen, however in the case of the crème anglaise-based mousse, the structure of the air bubbles is very small and homogenous, with a relatively wide distribution of bubble size. However, in the egg white-based mousse, the bubbles are larger and more disorganised, with a greater distribution of size.
From these images, the reason why egg white-based mousses are less stable compared to crème anglaise-based mousses is evident.
Below you can see the same sample of crème anglaise-based mousse with different magnifications: 500, 100, 50 and 20 microns.

The process

Here we are going to look at the traditional system for confectionery mousses.

Traditional system

Mix various liquid or semi-liquids by hand with aerating agents and stabilise the whole mixture with a gelling agent or fat.

Siphon

Mix various unwhipped ingredients together and pour into a container incorporating gas, which will be responsible for giving the mousse or foam the airy texture when piped.

Industrial system

Similar to siphons, all the ingredients are mixed together as a liquid, added to the machine. The machine settings are then adjusted to pipe the product with the desired proportion of air.

Focusing on chocolate mousses for assembling desserts, the mechanisms for obtaining mousses are always the same, no matter the technique chosen:

- Prepare a liquid or semi-liquid base
- Incorporate a stabilising agent
- Prepare an aerating agent

Preparing a liquid or semi-liquid base
This can be a crème anglaise, fruit purée, milk, pouring cream, etc.
At this point, if the recipe includes it, you should add the gelatine, dissolving it in the warmed liquid.
Where the process allows it, we recommend you pasteurize the gelatine sheets. Take advantage to add them at the end of cooking of the crème anglaise or in purées and pouring cream, heating a section to 85˚C.
For the crème anglaise recipe, make sure the temperature reaches 80/84˚C to correctly pasteurize it.
If you are using a crème anglaise base for the various mousses, it should be used straight away once finished. If it is refrigerated, cover the surface with a plastic film and use it up to 48 hours after preparation.

Incorporating a stabilising agent
Mousses always need a stabiliser. Generally, two very common agents are used:

- Cocoa butter, found in the couverture in the case of chocolate mousses;
- Gelatine sheets, for mousses in general; or
- A combination of both in specific cases.

Couverture chocolate
In chocolate mousses, the cocoa butter found in the couverture added is responsible for controlling the texture of the mousse and stabilising the foam.
Cocoa butter is solid at temperatures under 35°C approximately, and liquid at temperatures above this point.
The final percentage of cocoa butter in most mousses used for assembling desserts is around 11 to 16 % according to the couverture used and will influence the percentage of air incorporated. Remember, with milk and white chocolates, the other fats found in these couvertures modify the crystallisation process of the cocoa butter. These fats do not have the same properties as cocoa butter and do not crystallise at the same temperature. In some cases, a small percentage of gelatine needs to be incorporated to solidify the structure of the mousse at room temperature.

To ensure the chocolate is correctly emulsified in cases where the liquid or semi-liquid part is not hot, melt the chocolate if required. Emulsify uniformly by adding the crème anglaise, fruit purée or pouring cream gradually to the couverture until an elastic, glossy core is achieved, which should be maintained until the end of mixing.
For fruit purées with a pH under 4.5, the purée doesn't need to be pasteurized, so it is recommended to heat the chocolate to 45°C and add the purée at 20°C.
Once the couverture has been emulsified, check the temperature of the base before adding the remaining ingredients of the mousse. This temperature may vary depending on the type of mousse being prepared, the couverture used, the quantity added, etc.

Gelatine sheets
One of the advantages of gelatine over other gelling agents is that it melts at body temperature.
It melts or becomes soluble in liquids at around 35/40°C and starts to form a gel once the temperature of the mixture drops below 35°.
It is difficult to identify the exact gelling point of gelatine as it will be determined by the ratio used in the recipe, and more specifically, the gelatine's bloom, however it can be seen as the viscosity of the mixture increases, going from a fluid texture to an elastic texture.
Generally speaking, temperatures below 20/22°C should be avoided.
In most of the classic mousse recipes, the percentage of gelatine incorporated to stabilise the foam varies from 0.5 % to 1.5 %. If the mousse contains alcohol, acidic fruit or incorporates lots of air, its percentage will be close to the higher threshold.
Otherwise, if the mousse is chocolate-based and incorporates sufficient cocoa butter, gelatine may not be required, or in any case, only in a very low percentage in mousses using milk or white couvertures.

Some countries do not use gelatine of animal origin and it can be easily replaced by agar-agar or other gelling agents.

Preparing the aerating agents
Of all the ingredients used in pastry, only two can be whisked and allow their airy texture to be transferred to other ingredients: whipping cream and egg products.
In fact, it is the fat present in the cream that crystallises and also the egg proteins that provide this capacity to stabilise the air incorporated in mousses.
The overrun is the percentage increase in the volume of a mixture due to air incorporation.
To calculate this value, weigh the initial product (without any added air) in a container. Subtract the weight of the final product with air incorporation, weighed in the same container, and finally divide by the final weight and multiply by 100.
It is very important to ensure both measurements are taken with the container completely full.

Let's look at the example of whipping cream. In a container filled to maximum capacity, whipping cream weighs 216 g. Once whipped, the container is filled again and its weight is 87 g.

The calculations are: 216 g - 87 g = 129 /87 = 1.48 x 100 = 148 % air incorporation.

Note: To perform these calculations, always work with the net weight and tare the container.

To understand the aerating capacity of each of the agents usually used to incorporate air in preparations, the approximate overrun of each of the bases used to create mousses is listed in ascending order:

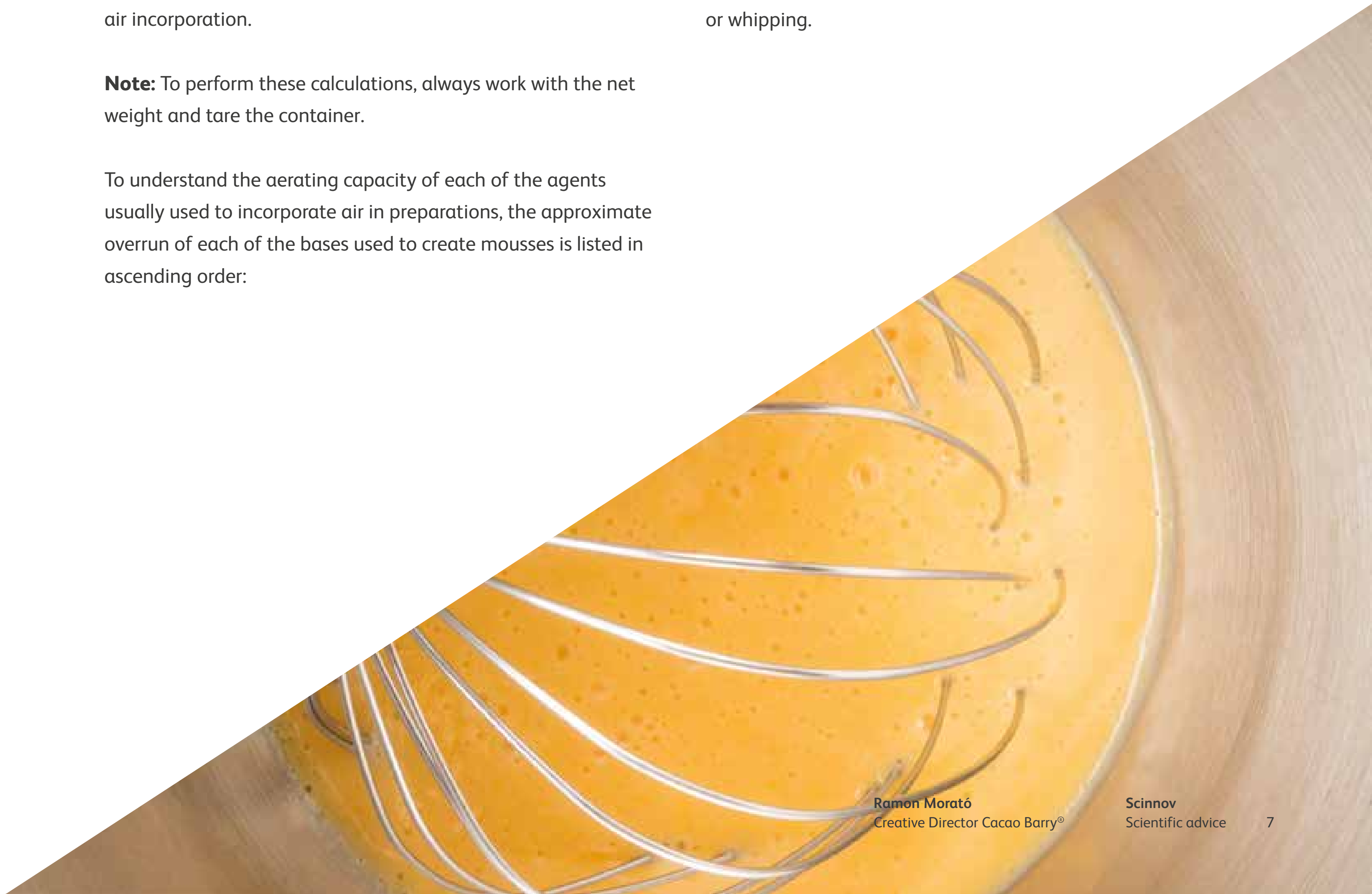
Fresh semi-whipped whipping cream (35 % fat):	148 % approx.
Classic Italian meringue:	250 % approx.
2:3 ratio meringue:	275 % approx.
Classic “pâte à bombe”:	345 % approx.
Whisked egg whites with 20 % sugar:	650 % approx.

It can be seen that whisked eggs such as pâte à bomb or whisked egg whites such as meringues will give a texture with the greatest amount of air.

Here the aerating agents used for the chocolate mousses are:

• Fresh semi-whipped whipping cream
• Pâte à bombe
• Whisked egg whites

Although for mousses in general, meringue is a good option as an aerating agent, for chocolate mousses it will not be used here as it provides too much sugar to the preparation.
Since pasteurised egg whites are now readily available, they will be used directly as if they were a pasteurised cream ready f or whipping.



Semi-whipped cream

To obtain whipped cream with optimum air incorporation and good foam stability, the following conditions must be met:
Fat content between 33 and 36 %.
Cream should be whipped at medium speed; if it is whipped quickly, a lower quantity of less stable foam is achieved.
Optimum temperature for whipping cream is 0 to 5°C; if the temperature is 3 or 4°C higher, the cream whips less and has a greater tendency to curdle.
Finally, remember for mixing processes, the milk fat (butter) must be partially solid. Milk fat is only 20/22 % solid at 20°C. If the temperature is increased, the percentage of fat solids falls and this results in a loss in air bubbles in the mousse. Hence, logically you need to avoid high temperatures during mixing.

Pâte à bombe

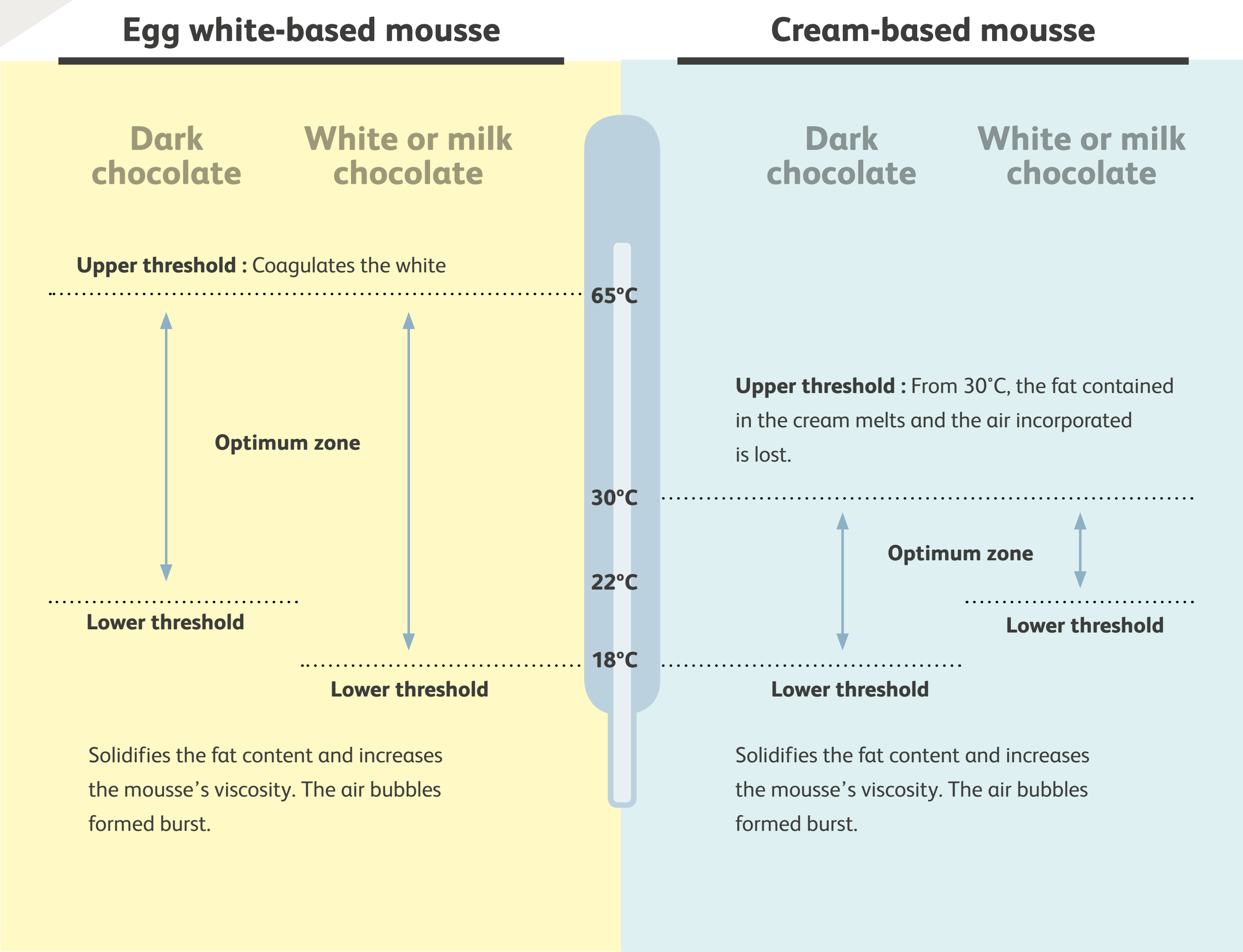
There are many recipes for pâte à bombe, however the basis is always a sugar syrup with a higher or lower concentration that is used to scald a egg yolk and/or whole egg base.
If the recipe only requires for egg yolks, the mixture will contain less air. We prefer a mixed base using yolks/whole eggs and have replaced the standard sugar for invert sugar due to its hygroscopic properties.
Remember that, after scalding the egg mixture with the syrup, it is essential to check that the pasteurization values have been reached. Once scalded, the mixture needs to be re-heated in a bain-marie until reaching 82/84°C. The egg proteins will be less diluted than in the crème anglaise and hence will be more exposed to coagulation, so you need to be careful during this process.
The pâte à bombe needs to be beaten at medium speed to achieve an aerated but homogeneous mixture that can be used. Remember for mixing processes that eggs start to coagulate from 65°C.
If you are using a pâte à bombe base for the various mousses, it should be used straight away once ready. If it is refrigerated, cover the surface with a plastic film and use it up to two days after preparation.

Egg whites

Since pasteurised egg whites are used for the mousses, the problem we encountered was the sugar wasn't dissolved fully by the water in the white during beating. For this reason, we have used invert sugar in the whisked white-based mousses. Invert sugar is already partially dissolved in water, provides viscosity and improves the beating process. It is also hygroscopic. As white-based mousses contain the most air, they tend to dry out in the display, so this sugar prevents this issue.
To get a better yield during beating, use egg whites at room temperature (the egg proteins will be more active in stabilising the air incorporated than at low temperature) and remember during mixing processes that egg whites start to coagulate from 62°C.

Final temperature of the mousses
There is no final temperature for all the mousses, since the temperatures will vary according to the percentage of couverture in the recipe, the type of couverture used, and the percentage of aerating agent (cream, egg white or pâte à bombe).

Nonetheless, it can be described in general terms as:



Leaving the final temperature aside, the final texture of the mousse can be more or less dense according to the air incorporated. If the viscosity of the mousse so allows, such as in the case of a bavarois-based or a crème anglaise-based mousse, the desserts can be assembled using a ladle. In other cases, it needs to be done using a piping bag.

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We would like to thank the University of Barcelona for their precious support.

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