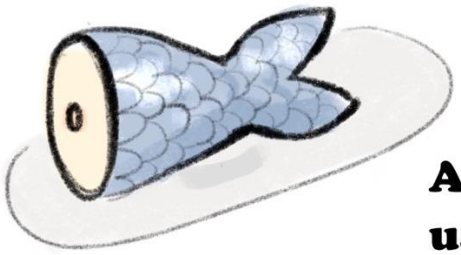
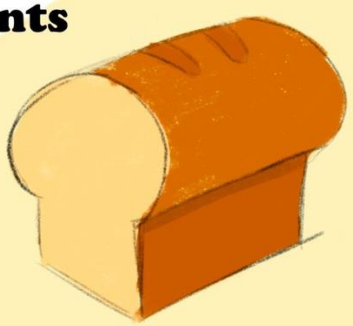
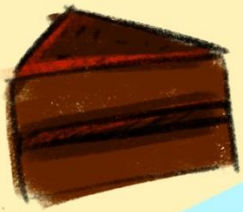
FOOD, COOKING AND STEM



A selection of simple experiments using food items, kitchen equipment, cooking processes, and STEM.





INTERNATIONAL STEM RECIPES

SCIENCE ON STAGE EUROPE

FOOD, COOKING AND STEM

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About us

Science on Stage Europe brings together science teachers from across Europe to exchange best practice and teaching ideas and concepts with passionate colleagues from over 30 countries. Science on Stage Europe believes that the best way to improve science teaching and to encourage more schoolchildren to consider a career in science or engineering is to motivate and inform their teachers. The non-profit organisation was founded in 2000 and reaches 100,000 teachers Europe-wide.

Credits

The authors have checked all aspects of copyright for the images and texts used in this publication to the best of their knowledge.

Cover illustration by Kristina Dovalova and Gabriela Coelho.

HEALTH AND SAFETY

Due caution should be taken with all recipes in terms of cleanliness when dealing with food that is to be consumed.

In addition, particular care should be taken when using hot ovens or hobs, when adult supervision is appropriate.

FOOD, COOKING AND STEM

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Foreword

FOOD, COOKING AND STEM

This is the fourth booklet in a series on FOOD, COOKING and STEM a collaborative project from Science on Stage Europe.
In this booklet we have brought together, from different parts of the world, recipes which illustrate some aspect of STEM teaching. Some are very simple and suitable for younger children to enjoy whilst others are more complex. All recipes which involve cooking involve some issues of health and safety and small children should not be left unsupervised, especially when access to cookers and hobs is possible. Care should also be taken with hygiene in making the products, and it has to be at the discretion of teachers and parents as to whether the students can consume what they produce. If any ingredient is difficult to find in your own country, check out similar recipes on the Internet. The science will be the same.

Nevertheless it is fun to try each other's recipes, especially those from another country. To that end we hope to try out internet gatherings where we can try out each other's recipes. Check the Science on Stage Europe website for details of any upcoming events.

Many recipes can be found in slightly different forms in different countries…the first recipe from UK, "cinder toffee", is no exception. It is known in parts of Scotland and Australia as "honeycomb" and as far away as Sponge Toffee in Canada. The editors would be interested to hear from you if you have a variation on any of the recipes we have here.

Our previous booklets are:
Food Cooking and STEM: Section 1 Experiments with Food Items
Food Cooking and STEM: Section 2 Chemistry
Food Cooking and STEM: Section 3 Eggs Experiments
…which, like this one, can be freely downloaded from the Science on Stage website:
www.science-on-stage.eu/food-cooking-and-stem
David Featonby

Rute Oliveira

Impossible Cake

Country: UK

Science Principle: Density, mixtures, and compounds

Impossible, yet probably the simplest you will make!

Ingredients

- 4 eggs
- 185 g sugar
- 450 mL milk
- 75 g plain flour *
- 55 g margarine
- 90 g desiccated coconut
- ½ teaspoon baking powder
- 1 teaspoon vanilla essence
- Pinch of salt

*Or use self-raising flour in place of plain flour and baking powder

Cooking Process

1. Preheat the oven to 180 °C.
2. Put all the ingredients in a bowl and blend together using a mixer.
3. Pour the runny mixture into a 23 cm greased round pie dish.
4. Bake in the oven for about one hour.
5. Prepare to be amazed at the result!

Impossible Cake

Country: UK
Science Principle: Density, mixtures, and compounds

The Science behind the Dish

So what is Impossible about it? Well you mix all the ingredients together into a quite liquid mixture, pour it into a cake tin and as it cooks it magically separates into three parts with a crust on the bottom, an egg custard in the middle and the coconut on the top!

There are three distinct parts, which have three distinct densities and although initially mixed together do not react (chemistry) but remain as a physical mixture. The desiccated coconut is clearly the least dense so rises to the top, and the egg custard, beaten eggs, milk, vanilla and margarine) initially is a runny liquid, with the base (flour, sugar and baking powder) being most dense and sinking to the bottom.

It really couldn't be easier to make. Just mix everything together, no special technique. It can be eaten hot or cold and keeps well in the fridge for a few days, (as long as you forget it is there!)

There are several more "impossible cakes" on the internet, and it is worth taking a look for something that appeals. Another suggestion would be the impossible flan found here: www.foxyfolksy.com/chocoflan/

Top Tips: Adult supervision needed when using oven.
Internet links: Google search "Impossible cakes"
Contributor: David Featonby (UK)

Egg Pudding

Country: Portugal

Science Principle: Chemical reaction and specific heat capacity

General Description

Although Portugal is a relatively small country it has a great culinary tradition and pudding is part of our traditional cuisine. Egg Pudding is a pudding with milk and eggs cooked in a bain-marie (water bath), the yolks curdle and take the shape of the mould, acquiring a gelatinous or creamy consistency.

Ingredients

- 6 eggs
- Lemon zest
- 250 g sugar + 6 tablespoons sugar
- 2 tablespoons water
- 0.5 L milk

Cooking Process

1. Place 6 tablespoons of sugar and 2 tablespoons of water in a pan and heat until the sugar turns to caramel.
2. Apart from mixing the 6 eggs well with 250 g of sugar, add the milk and the zest of a lemon. Place this mixture in the pan with the caramel.
3. Place the pan, covered with aluminum foil, in a tray with water about 2 fingers high. Cook in the oven at 200 °C for about 45 minutes.

Bom apetite!

Egg Pudding

Country: Portugal

Science Principle: Chemical reaction and specific heat capacity

The Science behind the Dish

Caramelization is a chemical process that occurs when sugar is heated to high temperatures, resulting in a transformation of the colour, flavour, and texture of sugar.

During the caramelization process, the sugar is heated until the water present in it begins to evaporate. When the temperature continues to rise, sugar begins to break down into two different substances: glucose and fructose. This occurs through a chemical reaction called hydrolysis, where water is added to the sucrose molecule, breaking it down into its component parts.

As the temperature continues to rise, glucose and fructose molecules begin to break down further, forming a variety of by-products, including acetic acid, carbon dioxide, and aromatic compounds, that impart flavour and aroma to caramel. Some of these by-products also contribute to the dark brown colour of caramelized sugar.

Another important reaction that occurs during caramelization is the Maillard reaction, where sugar reacts with the amino acids present in proteins to form compounds that impart flavour and aroma. This reaction occurs at higher temperatures and is responsible for the formation of compounds such as furfurals and dihydroxyacetone.

The water in the pan also acts as a buffer, preventing the temperature of the food from rising too quickly, which can cause the food to overcook or dry out. This is because water has a high specific heat capacity, meaning it takes a lot of energy to heat up, and it can absorb a lot of heat before its temperature increases significantly. As a result, the water in the pan helps to maintain a consistent temperature, ensuring that the food cooks evenly and is not exposed to sudden, extreme temperature changes.

Overall, the water bath cooking method is a useful technique for preparing delicate or sensitive foods that require gentle cooking and precise temperature control.

Contributor: Rute Oliveira (Portugal)

Pudding-Cake

Country: Portugal
Science Principle: Density

Ingredients

Pudding

- 3 eggs
- 1 can of condensed milk
- 200 mL milk

Cake

- 3 eggs
- 200 g self-raising flour or regular flour with baking powder (1 teaspoon for 200 g)
- 150 g sugar
- 100 mL milk
- 125 g butter
- 80 g cocoa powder
- Liquid caramel to grease the mould

Cooking Process

Prepare the cake:

1. Turn on the oven to 170 °C. Butter a chimney cake pan with the caramel.
2. Beat the butter with the sugar and then add the eggs, one by one and beat constantly. Add the milk and continue beating.
3. Sift the flour and mix well. Add the cocoa and mix well.
4. Pour the mixture into the cake pan on top of the caramel.

Prepare the pudding:

1. Mix the eggs with the condensed milk and milk and mix it very well (you can use a hand blender).
2. Pour this mixture into the cake pan, on top of the cake mixture.
3. Place the cake pan in a recipient with water and bake in a bain-marie for 1 hour. Remove from the oven, allow to cool in the bain-marie and remove from the cake pan when cold.

Pudding-Cake

Country: Portugal
Science Principle: Density

The Science behind the Dish

What happened? Did the cake and pudding mixtures merge?

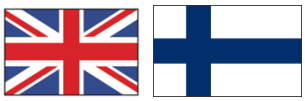
No, as you can see the cake and the pudding formed two distinct layers. We first placed the cake in the cake pan but then, during baking, they reversed positions, and the cake was on top and the pudding underneath. When unmoulding, we swapped the position again.

Why didn't the two mixtures merge?

In the pudding cake recipe, the pudding stays below, and the cake stays above due to the differences in density and composition of the ingredients used. Pudding is made from a liquid mixture of eggs, condensed milk and milk, which solidifies during cooking to form the creamy pudding layer. This mixture is denser than cake batter, which causes it to settle to the bottom of the pan during the baking process. The butter also plays an important role in the structure and texture of the cake, as well as helping to create a barrier between the cake and pudding layers.

Contributor: Cláudia Meirinhos (Portugal)

Ice Cream in a Bag



Country: UK and Finland
Science Principle: Freezing point and freezing mixtures

FOOD, COOKING AND STEM

General Description

Making delicious ice cream without a special machine and without a freezer.

Ingredients and Equipment

- Resealable bags
- 2 cups double cream
- 1 can condensed milk (chilled)
- Extra flavourings to your taste
- Ice
- Salt

Cooking Process

1. Whisk the cream until it stiffens and forms peaks.
1. Add the condensed milk. Add your extra flavourings/ingredients.
2. Mix in your first resealable bag, squeezing out as much air as possible. Place this bag in a second bag and do the same.
3. Place these sealed bags inside the third larger bag which should be filled with about 4 cups of ice together with 4 tablespoons of salt.
4. Seal the big bag, squeezing out the air.
5. Shake the bag vigorously (it may be best to wrap the bag up in a towel, or wear gloves) making sure that the ice-cream mix continues to mix, and the ice mix in the big bag gets in contact with the cream mix.
6. Shake for 4 plus minutes …the more you shake the smoother the ice cream you will produce.

The Science behind the Dish

Ice cream melts/freezes at about -3 °C.

To freeze the mixture you need to lower the freezing point of the ice surrounding the mixture which is done by adding the salt. The lower temperature with the salt an ice is sufficiently low to freeze your ice cream mix (well below -3 °C). The salt dissolves in the ice because there is a thin layer of water on the surface of the ice cubes.

Ice Cream in a Bag

Country: UK and Finland

Science Principle: Freezing point and freezing mixtures

Full recipe details can be found at https://www.thebestideasforkids.com/ice-cream-in-a-bag/ Perhaps the best “commercially” available ice cream “maker” is this ball …the ingredients are put in the centre and the ice around the side. The ball is then thrown around for 20 minutes or so, to produce the frozen ice cream.

Internet link https://sciencenotes.org/why-salt-makes-ice-colder-how-cold-ice-gets

Contributor: David Featonby (UK) and Oona Kiviluoto (Finland)

Potica

Country: Slovenia
Science Principle: Emulsion, fermentation

General Description

Potica is a traditional Slovenian pastry. It is usually consumed on holidays and festive occasions. There are different types of potica, most known is the walnut potica.

Ingredients

Batter:

- 1000 g white flour
- 30 g fresh yeast
- 120 g butter (softened)
- 10 g salt
- 3 egg yolks (60 g)
- 10 g vanilla sugar
- 50 g sugar
- 4 cL rum
- 400-500 mL milk

Filling:

- 1000 g ground walnuts
- 375 g sugar
- 100 g butter (softened)
- 3 egg whites
- 20 g vanilla sugar
- 30 g cinnamon
- 60 mL milk

Potica

Country: Slovenia
Science Principle: Emulsion, fermentation

Cooking Process

Creating the dough:

The dough is created by thoroughly mixing the ingredients (use standard methods for enriched yeasted dough). After mixing the ingredients and kneading, the dough should rest for 15 minutes, then it should be kneaded again and divided into loaves. According to the size of the loaves it might need to be additionally kneaded, covered and left to rise until doubled in volume. Roll out the risen dough to the thickness of your little finger (from 0.5 to 1.5 cm) and shape it into a rectangle. Thus, we have a prepared dough surface, which is smeared with the appropriate filling.

Creating the filling:

Pour hot milk over the ground walnuts and cool. Add vanilla sugar, sugar, cinnamon, softened butter, and finally the whipped egg whites to the mixture. The filling must be spreadable so that the dough does not tear when spread.
Roll out the dough to the thickness of your little finger (0.5 to 1.5 cm). At least 1 kg of walnut filling is added to 1 kg of yeast dough. Spread the filling over the dough. A small portion of dry ground walnuts can be sprinkled over the spread filling. Roll the dough with the filling tightly into a roll and place it in a round cake tin, which can be greased with butter and floured. The ends of the roll must meet well. Leave the potica to rise in the baking pan for 0.5-1 hour. Before baking, if desired, coat it with a mixture of butter, milk and egg yolks or with an individual component. Pierce the potica in several places on the surface and bake at 160-180 °C for at least 40 minutes. The temperature and baking time must be adjusted according to the type of oven and the size of the pot. Turn the potica out of the pot (upside down) and cool it. If desired, sprinkle it with powdered sugar and offer it cut into slices.

The Science behind the Dish

Fermentation: Yeast contains enzymes that can break down the starch in the flour into sugars; first using amylase to break down the starch to maltose, and then using maltase to break down maltose into glucose. This glucose acts as food for the yeast, and it metabolises it to produce carbon dioxide and ethanol.

$C_6H_{12}O_6$ (aq) ————> $2C_2H_5OH$ (aq) + $2CO_2$ (g) (+ 2ATP)

Emulsion: whole eggs, egg yolk and egg whites are all used to add structure to potica. The yolk's elevated fat content helps it bind fats and liquids together.

Contributor: Nika Cebin (Slovenia)

Porridge

Country: Scotland

Science Principle: Physical changes, mixtures

The famous dish from Scotland, ready to line the stomach for a day's action.

Ingredients

- Porridge oats
- Milk, water

Description

Porridge oats or simply crushed oats are used to make a welcome warming breakfast dish.
Place equal volumes of oats, water and milk in a pan, leave to soak. For how long depends on the cook, some prefer an overnight soak others will just leave the contents of the pan for a few minutes.

- Extra fruit may be added, though the tradition for many is simply the above with the addition of some salt.

Heat gently for a few minutes until the porridge boils and continue to simmer until all the liquid has been absorbed into the mass of oats.

The Science behind the Dish

The first thing to notice is that the 3 equal volumes totalling for example 3 x120 mL do not produce 360 mL of porridge+liquid. Instead just over 2/3 of the volume will be produced. This is because of the small volume of the oats themselves compared with the volume taken up by the oats in the pan. Also the spaces in between the crushed oats are filled with liquid.
When cooked the volume of a "solid" mass of porridge then turns out to be slightly larger than the original cold volume, because as the liquid is absorbed by the oats to produce the solid mass, the oats themselves expand taking up more volume than they do dry.

Ingredients: Crushed oats, milk and water

Porridge

Country: Scotland

Science Principle: Physical changes, mixtures

Checking the volume of the mixture before cooking

Cooking the porridge

Further ideas: Similar absorption experiments can be carried out with other foods, cooked in water and questions asked. E.g. why do frozen peas sink and cooked frozen peas float. Is there a volume change? Why?

Contributor: David Featonby (UK)

Haagse Bluf

Country: Netherlands
Science Principle: Process of whippings eggs into meringue

General Description

Haagse bluf is a Dutch dessert, based on a simple recipe. It consists of stiff whipped egg whites with sugar and berry juice, usually from red currants. The name *Haagse bluf* is a reference to the "air" the residents of The Hague are said to have. Indeed, the dessert *Haagse bluf* seems like a lot, but in fact it is largely air.

Ingredients

- 3 egg whites
- 250 mL berry juice
- 100 g sugar
- Pinch of salt



Cooking Process

1. Beat the egg whites with a pinch of salt and the sugar.
2. Beat in the berry juice until the egg whites are completely stiff.
3. Serve immediately.

The Science behind the Dish

The science is in beating the eggs:
Beating egg whites breaks the chemical bonds that hold the chains in their initial spherical shape, allowing them to unwind into their actual long strands. These protein strands can form a kind of skin around captured air bubbles. If there's any fat present, the skin can't form, and the air leaks away. Even a trace of fat is ruinous. Sugar helps more proteins gather on the surface of the air bubbles, making the bubbles even more stable.

In this recipe, the egg white is raw, and therefore, it should not be eaten by people with weak health because there is a possibility of Salmonella in the egg. Salmonella are bacteria that causes diarrhoea, fever, cramps, and vomiting. There are two healthier alternatives for fresh egg whites:

Haagse Bluf

Country: Netherlands

Science Principle: Process of whippings eggs into meringue

1. Nowadays, you can buy cartons with pasteurized egg whites in the supermarket.
2. The vegan version: The viscous liquid in tinned beans and legumes (especially chickpeas). It is also called aquafaba and serves as a good vegan egg white substitute. When whipped, it forms similar foam to egg whites.

This dessert is basically a raw meringue.

Beating the mixture with added fruit

The final product

Contributor: Kirsten Sandermann (Netherlands)

Cinder Toffee

Country: UK

Science Principle: Chemical and physical changes

Cinder toffee is also known as sponge toffee (Canada) and honeycomb (Australia)

Ingredients

- Sugar
- Golden syrup or honey
- Water
- Baking soda (bicarbonate of soda)

Description

This is a simple toffee with the added interest of small carbon dioxide bubbles to give the honeycomb effect.
Honeycomb or cinder toffee is a fun and quick science experiment!
There are several variations using e.g. honey instead of syrup. But this is a simple recipe for the honeycomb reaction:

1. Grease a baking tray with butter.
2. Mix **100 g sugar** with **2.5 tablespoons of golden syrup or honey** in a pan. Mix the two well.
3. Gently heat the pan and let the mixture begin to melt.
4. Once you can see the sugar start to melt add the water (1-2 tablespoons) and stir the sugar mixture to ensure in melts evenly and doesn't burn. Cook the ingredients over high heat, without stirring, until the mixture reaches 150 °C, small bubbles will form, the bubbles will become larger, then the sugar will start to caramelise to an amber colour.
5. When the temperature reaches 150 °C, remove the pan from heat and mix **one teaspoon of bicarbonate of soda** (baking soda) into the hot syrup. This will cause the syrup to foam up.
6. Stir just enough to mix the ingredients, then dump the mixture onto the greased baking sheet. Don't spread out the candy, as this would pop your bubbles.

Cinder Toffee

Country: UK

Science Principle: Chemical and physical changes

The Science behind the Dish

We start with the physical change of melting the sugar, and then a further change as the water evaporates.

The heat then causes the bicarbonate of soda ($NaHCO_3$) to break down and release the gas, carbon dioxide (CO_2). The gas gets trapped within the sugar; this results in the bubbles in your honeycomb.

Contributor: David Featonby (UK)

Baked Alaska

Country: UK
Science Principle: Conductivity and insulation

General Description

Baked Alaska is a dessert that consists of ice cream surrounded by insulating materials, i.e. meringue on the top and a pastry base. The meringue must cook quickly and crisp up before the heat from the oven can get to the ice cream and melt it. Icey cold ice cream surrounded by a warm meringue ...delicious!

Ingredients

- Eggs (minimum 3, the amount depends on the size of your dessert)
- Sugar (depends on the number of eggs, 1 cup of sugar per 3 egg whites)
- Cream of tartar
- Pastry case base or sponge flan base (bought or could be homemade)
- Raspberry jam (or similar)
- Block of Ice cream

Egg white ready to be whipped and sponge with covering of jam.

Cooking Process

1. Keep the ice cream block in the freezer until you need it. The oven will need to be at 160-180 °C if serving soon.
2. Prepare the meringue with minimum of 3 egg whites:
   a) Beat the egg whites until they peak, adding in a teaspoon of cream of tartar.
   b) Whisk in a cup of caster sugar.
3. Spread a layer of raspberry jam (or similar) on your base.

Baked Alaska

Country: UK

Science Principle: Conductivity and insulation

Ice cream on sponge base with whipped egg white ready

Spooning egg white onto ice cream

4. Place block of ice cream in centre of base.
5. Scoop the whisked egg whites on top of the ice cream covering it completely. (If not ready to serve this can be placed in the freezer for up to 2 hours)

Alternatives for cooking

6a. Make sure oven is at 160-180 °C and place the baked Alaska in for about 3 minutes until meringue is crisp and brown.

Or

6b. Use a blow torch to scorch to top of the meringue cooking and browning the top Serve Immediately.

Into the oven

and ……out of the oven

The Science behind the Dish

The meringue is a good insulator as is the pastry base. Thus, the heat from the oven is able to cook the outside of the meringue, even browning it, without the heat reaching the ice-cream. Immediately on removing it from the oven use a temperature probe to plot the temperatures as the probe is inserted further and further into the pudding. Ask the children to estimate what a graph would look like…outside to inside.

Contributor: David Featonby (UK)

Matevž

Country: Slovenia

Science Principle: Starch gelatinization, Maillard reaction, bean softening, seasoning interaction

FOOD, COOKING AND STEM

General Description

Matevž is a traditional Slovenian dish that is often enjoyed during the colder months. It is a thick and hearty vegetable stew made primarily with potatoes and beans. The name "matevž" is derived from the Slovenian word "mati", which means "mother," suggesting that this dish is comforting and reminiscent of home-cooked meals.

Ingredients

- 500 g dried white beans or kidney beans
- 4 large potatoes
- 1 onion, finely chopped
- 3 cloves of garlic, minced
- Salt and pepper (to taste)
- 2 tablespoons oil or butter
- 1 teaspoon dried thyme (optional)
- 2 bay leaves (optional)
- Smoked bacon or sausage (optional), diced or sliced
- Vegetable stock (optional)

Cooking Process

1. Soak the dried beans: Place the beans in a large bowl and cover them with water. Allow them to soak overnight.
2. Cook the beans: Drain and rinse the soaked beans. Place them in a large pot, cover with water, and bring to a boil. Simmer and cook the beans until they are tender but not mushy.
3. Prepare the potatoes: Peel the potatoes and cut them into small cubes. Place the cubes in a separate pot with water and bring to the boil. Cook until the potatoes are soft.
4. Sauté the onion and garlic in a separate pan.
5. Combine the ingredients: Once the beans and potatoes are cooked, drain the potatoes and add them to the pot with the cooked beans. Add the sautéed onion and garlic to the pot. If using, add the thyme, bay leaves, smoked bacon or sausage, and vegetable stock. Stir well to combine.
6. Mash the mixture: mash the mixture of beans, potatoes, and other ingredients until you reach a thick and creamy consistency. You can leave some chunks for texture if desired. If the stew is too thick, you can add a little water or vegetable stock to adjust the consistency.
7. Season and simmer: Season the matevž with salt and pepper to taste. Bring the pot to a simmer and cook for an additional 15-20 minutes to allow the flavours to meld together. Stir occasionally to prevent sticking.
8. Serve: Remove the bay leaves before serving. Matevž is traditionally served hot. You can enjoy it as a standalone dish or serve it with slices of homemade bread or traditional Slovenian sausage.

Matevž

Country: Slovenia

Science Principle: Starch gelatinization, Maillard reaction, bean softening, seasoning interaction




The Science behind the Dish

1. Starch gelatinization: When potatoes are boiled, the heat causes the starch granules present in the potatoes to absorb water and swell. This process, known as gelatinization, results in the softening of the potatoes and the release of starch into the cooking liquid. Gelatinization helps thicken the stew and contributes to its creamy texture.
2. Maillard reaction: If you choose to include smoked bacon or sausage in your matevž, the Maillard reaction comes into play. This reaction occurs when proteins and sugars in the meat interact under high heat, resulting in browning and the development of complex flavours and aromas. The Maillard reaction adds depth and richness to the overall taste profile of the dish.
3. Bean softening: Dried beans used in matevž need to be soaked and cooked to make them tender. During cooking, the beans absorb water, causing their cells to expand and soften. This process helps break down complex carbohydrates, making the beans more digestible and releasing flavours and nutrients.
4. Seasoning interaction: When you add salt and other seasonings to matevž, chemical reactions occur that contribute to flavour development. Salt, for example, enhances the perception of other flavours by interacting with taste receptors on the tongue. Herbs and spices contain aromatic compounds that dissolve in the stew, infusing it with their characteristic flavour.

Contributor: Nika Cebin (Slovenia)

Bacalhau à Brás

Country: Portugal
Science Principle: Osmosis

FOOD, COOKING AND STEM

General Description

Bacalhau à Brás is a typical portuguese codfish dish. Being one of the most popular dishes made with this fish, it consists of dry cod, fried potato sticks, thinly sliced fried onion, scrambled egg and chopped parsley. It is widely consumed in Portugal.

Ingredients

- 400 g of salted and dry cod
- 600 g of straw fries*
- 1 medium onion cut into thin slices
- 3 garlic cloves, chopped
- 4 beaten eggs
- Olive oil
- Chopped parsley to taste
- Salt and pepper to taste

Preparation time: About 40 minutes

*In Portugal we can buy these potatoes ready-made, but you can make them at home by slicing them very thinly and frying them in oil.

Cooking Process

1. Boil the cod (having already gone through the desalting process) for about 8 to 10 minutes.
2. Once cooked, shred the codfish.
3. Start by frying the straw potatoes in hot oil and set aside.
4. In a skillet, place the chopped onion and garlic with a little olive oil and sauté until the onion is tender.
5. Add the shredded cod and sauté for a few more minutes.
6. Add the straw potatoes and mix well.

7. Then add the beaten eggs and stir until they are cooked.
8. Season with salt and pepper to taste and finish with chopped parsley.

The Science behind the Dish

Cod salting and subsequent desalting are processes that involve chemical and physical reactions that alter the chemical composition and structure of the fish.
Cod salting is a conservation process that involves immersing the fish in salt. The water present in the fish is then extracted by the high concentration of salt outside, dehydrating the fish and creating a hostile environment for the growth of bacteria and fungi.
Salting process: First, the salt dissolves in the fish water, creating a saline solution. This saline solution increases the concentration of ions in the fish's water, causing a migration of water from the fish to the saline solution, which is a process called osmosis. In addition, the high concentration of salt in the saline dehydrates the fish, removing moisture from the fish and inhibiting the growth of microorganisms.
Desalting process: To desalt the cod, it is necessary to remove the excess salt present in the fish. This can be done by soaking the fish in clean water for a period sufficient for the excess salt to be removed. During this process, physical reactions occur that help remove salt from the fish. Fresh water is a less concentrated solution of salt, which means that water flows from the less concentrated medium (the water) to the more concentrated medium (the fish). As excess salt is removed from the fish water, freshwater flows into the fish, rehydrating it and restoring its texture and flavour.

Contributor: Rute Oliveira (Portugal)

Gazpacho with sherry vinegar

Country: Spain
Science Principle: Spherification, molecular gastronomy

General Description

A combination of chemical and physical reactions is used to create a structure of liquid spheres containing a liquid core surrounded by a gelatinous layer.

Ingredients

Gazpacho

- 1 kg tomatoes
- 50 mL olive oil
- 50 gr bread
- Salt and pepper to taste
- 2 cloves of garlic
- 250 mL water

Pepper Spherification

- Agar-agar
- Sunflower oil
- Sherry vinegar
- Kitchen thermometer
- Dropper

Cooking Process

Making the gazpacho

Place all the ingredients in a blender and blend until you get a smooth, creamy consistency.

Making the spheres

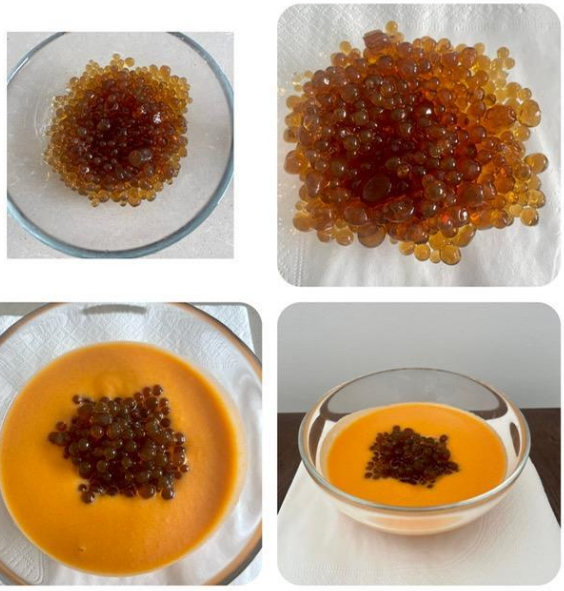
1. Fill a tall glass with sunflower oil and put it in the refrigerator.
2. Pour 150 mL of sherry vinegar and agar-agar in the saucepan.
3. Stir and wait for it to boil then remove from heat.
4. Put the thermometer in the saucepan and wait until it cools down to 37 °C.
5. Get the oil out of the refrigerator.
6. Put the mixture in the dropper and let the mixture drop into the sunflower oil.
7. Strain the oil and put the spheres under cold water.
8. Add the spheres to the gazpacho.

Gazpacho with sherry vinegar

Country: Spain
Science Principle: Spherification, molecular gastronomy

FOOD, COOKING AND STEM

The Science behind the Dish



Agar-agar is a polysaccharide extracted from various species of marine algae. When the agar-agar is mixed with a liquid and heated, the molecules of the agar-agar dissolve in the liquid and disperse evenly in it. During the cooling, the agar-agar molecules begin to form a three-dimensional network, in which the molecules intertwine with each other to form a solid and gelatinous structure.

The process of formation of the agar-agar gelling in the presence of calcium ions, which are found in the liquid encapsulated in the spheres. Calcium binds to agar-agar molecules and helps stabilize the three-dimensional structure of the gelatinous network.

This is an example of how science and technology combine in molecular cooking to create new textures and food presentation.

Top Tips: Adult supervision is required.

Contributor: Palma García Hormigo, Spain

Lemon Tea Cake

Country: Portugal
Science Principle: General cooking, raising agent

General Description

Traditionally, cake is made from a mixture of flour, eggs, sugar and butter.
One of the classics is the English pound cake, on which the Victoria sponge is based, or the simple lemon cake so appreciated in Portugal to accompany the tea. These cakes generally contain equal weights of the four main ingredients: flour and eggs, which reinforce the structure, fat and sugar, which weaken the structure. This recipe provides the perfect balance between these ingredients. Thus, variations in the proportion of the main ingredients in the cake (flour, eggs, fat and sugar) will give different qualities to the dough in terms of moisture, softness, lightness and sweetness.

Ingredients

- 250 g flour with yeast or self-rising flour
- 250 g refined sugar
- 250 g butter or margarine
- 5 eggs
- Pinch of salt

Cooking Process

1. Mix the butter with the sugar. Beat until you obtain a whitish cream.
2. Add the eggs one by one and stir well.
3. Add the flour with the baking powder mixed.
4. Add the pinch of salt and lemon zest.
5. It goes to the preheated oven at 180 °C, in a greased form with butter and flour.

The Science behind the Dish

Sugar and fat:

- In addition to the taste, the sugar and fat give moisture and softness to the cake.
- Sugar has great affinity with the water present in eggs and liquid ingredients, retaining it and preventing the cake from drying out.
- The initial mixture of fat and sugar creates a foam, incorporating air into the dough. Refined sugar is used to obtain smaller crystals, allowing for greater incorporation of air and formation of air bubbles surrounded by a film of fat.

Lemon Tea Cake

Country: Portugal
Science Principle: General cooking, raising agent

Eggs and flour:

- Eggs and flour provide structure to the cake as they contain proteins and starch that combine and form a more or less rigid matrix.
- Flour has efficient proteins, so it is added last to prevent an excessive bond between them, resulting in a softer cake.
- Eggs also provide most of the liquid (water) for the cake mix.

Baking powder:

- A chemical raising agent, such as baking powder, is a combination of an acid (such as cream of tartar) and a base (such as baking soda). The addition of water and heat allows the acid to react with the base, producing carbon dioxide.
- Carbon dioxide is retained in the air pockets of the dough, created by the mixture of fat and sugar. This reduces the need to incorporate a lot of air into the mixture.

Smooth folding action:

- Gentle folding when incorporating the flour prevents the breakdown of air bubbles and reduces the formation of excess gluten. Proper gluten formation is essential to the structure of the cake, but an excess would result in a heavy, bready texture.

Salt:

- Salt acts as a flavour enhancer and strengthens the gluten network.

Temperature and Maillard reactions:

- During baking, on the surface of the cake, where the temperature is higher, the water evaporates and forms a dry, impermeable layer that retains the steam formed inside.
- The beautiful golden colour of the cake is a result of chemical Maillard reactions between sugars and proteins, which produce substances that contribute to the pleasant aroma and taste.

Link: https://www.theguardian.com/science/blog/2010/jun/09/science-cake-baking-andy-connelly

Contributor: Rute Oliveira (Portugal)

Cottage Cheese Štruklji

Country: Slovenia
Science Principle: Chemical change

FOOD, COOKING AND STEM

General Description

Cottage cheese štruklji is a traditional Slovenian dish that combines simplicity with delicious flavours. Štruklji are rolled dumplings made from a soft, doughy pastry wrapped around a creamy filling of cottage cheese. The cottage cheese is typically mixed with eggs, herbs, and seasonings to enhance the taste. The struklji are then steamed or baked to perfection, resulting in a tender texture and a delightful blend of flavours. This comforting dish is often served as a main course or as a side dish, accompanied by a variety of sauces or toppings. Cottage cheese štruklji exemplifies the comforting and hearty nature of Slovenian cuisine.

Ingredients

Dough:

- 2 cups all-purpose flour
- 1 egg
- 1/2 cup lukewarm water
- 1 tablespoon vegetable oil
- a pinch of salt.

Filling:

- 2 cups cottage cheese (preferably fresh and creamy)
- 2 eggs
- 2 tablespoons butter (melted)
- 2 tablespoons breadcrumbs
- 2 tablespoons chopped fresh herbs (such as parsley or dill)
- Salt and pepper to taste.

Toppings/sauces (optional):

- Sour cream
- Melted butter
- Breadcrumbs
- Fresh herbs for garnish

Cooking Process

1. Prepare the dough by combining flour, egg, lukewarm water, vegetable oil, and a pinch of salt. Knead the dough until it becomes smooth and elastic. Let it rest for about 30 minutes.
2. In a separate bowl, prepare the filling by mixing cottage cheese, eggs, melted butter, breadcrumbs, chopped fresh herbs, salt, and pepper. Ensure the filling is well combined.
3. Roll out the dough into a thin rectangle on a floured surface. Spread the cottage cheese filling evenly over the dough, leaving a small border.
4. Carefully roll the dough into a log, starting from one side. Seal the edges to prevent the filling from leaking.
5. Cut the rolled log into smaller pieces, about 2-3 inches wide, to form individual struklji.

6. Cook the štruklji by either steaming or baking. If steaming, place the struklji in a steamer basket and steam for about 30 minutes until the dough is cooked and tender. If baking, place the struklji in a greased baking dish and bake at around 180°C for approximately 40-45 minutes until golden brown.
7. Once cooked, remove the struklji from the steamer or oven and let them cool slightly.
8. Serve the cottage cheese štruklji warm, optionally accompanied by toppings such as sour cream, melted butter, breadcrumbs, and fresh herbs.



The Science behind the Dish

The science behind cottage cheese struklji lies in the transformation of ingredients and the cooking techniques involved. Here are some key scientific aspects:

Dough formation

Mixing flour, water, egg, and oil triggers gluten formation in the dough. Gluten, a protein network, provides structure and elasticity to the dough, making it stretchable and pliable.

Filling binding

The eggs in the cottage cheese filling act as a binder, helping to hold the ingredients together. When heated during cooking, the proteins in the eggs coagulate, creating a solid structure and ensuring the filling retains its shape.

Steaming/baking

The cooking methods affect the texture and taste of the dish. Steaming allows the struklji to cook gently and evenly, resulting in a moist and tender texture. Baking provides a drier and slightly crisp exterior, adding a contrasting texture.

Maillard reaction

Baking the struklji can induce the Maillard reaction, a chemical reaction between amino acids and sugars at high temperatures. This reaction contributes to the golden-brown colour and adds complex flavours, enhancing the overall taste experience.

Flavour development

The combination of fresh herbs, seasonings, and cottage cheese contributes to the taste profile. Herbs contain aromatic compounds that infuse the filling, enhancing the overall flavour and creating a harmonious blend with the mild, creamy cottage cheese.

Understanding these scientific processes can help achieve the desired texture, flavour, and appearance of cottage cheese struklji, making it a delightful culinary experience.

Contributor: Kika Dovalova (Slovakia)

Thai green curry

Country: Adapted Thai recipe
Science Principle: Miscibility

General Description

The migration of people from Asia to Europe brought with it their culinary traditions. As Asian communities settled in Europe, they maintained their cuisine as a way of preserving their cultural identity. Over time, Asian dishes became popular among the local population and were adapted to suit European tastes. This recipe is a good example of that.

Ingredients

For the curry paste

- 4 lemongrass stalks
- 6 medium-hot green chillies, seeded and chopped
- 3 cloves garlic, peeled and crushed
- 5 cm/2 in piece of ginger, peeled
- 2 shallots, peeled
- 4 tbsp chopped fresh coriander
- 1 tsp ground cumin
- 1 tsp chopped lime zest
- 1 tbsp nam pla (Thai fish sauce)
- ½ tsp ground black peppercorns
- 4 tbsp chopped fresh coriander
- 1 tsp ground cumin
- 1 tsp chopped lime zest
- 1 tbsp nam pla (Thai fish sauce)
- ½ tsp ground black peppercorns

For the curry

- 750 g free-range chicken breasts or thighs, bones removed
- 3 tbsp groundnut oil
- 200 g chestnut mushrooms, quartered
- 400 mL tin coconut milk
- 400 mL of chicken stock
- 4 lime leaves
- 1 tbsp nam pla (Thai fish sauce)
- 1 tbsp bottled green peppercorns, drained
- leaves from a large bunch (about 20 g) basil, shredded
- 15 g fresh coriander (leaves and stalks,) roughly chopped

Method

1. Start by preparing the curry paste. Combine all the ingredients in a food processor and blend until they form a thick, consistent paste.
2. Then prepare the curry. Slice the chicken into strips that are about the width of your finger.

3. Heat up the oil in a cooking pot. Once it's hot and sizzling, place the chicken strips into the pot and let them slightly brown on all sides.
4. Using a slotted spoon, take out the cooked chicken strips from the pot. Add the mushrooms that have been quartered into the pot and sauté them until they turn a golden-brown colour, adding more oil if necessary.
5. Pour in the coconut milk and stock, then introduce the lime leaves, four generous tablespoons of the curry paste, fish sauce, peppercorns, and half of the finely chopped herbs. Allow it to come to a boil, then reduce the heat and let it simmer for about 10 minutes, occasionally stirring.
6. Put the cooked chicken back into the pot, adding an additional tablespoon of the curry paste. Let it simmer for five to six minutes more, or until the chicken is fully cooked. Finally, mix in the remaining herbs and serve.

You can store the leftover curry paste in the fridge to use in another dish.
Instead of chicken, you can use shrimp or various vegetables.

Recipe by Nigel Slater: https://www.bbc.co.uk/food/recipes/nigelslatersthaigree_80244

The Science behind the Dish

The use of milk or milk products (like the coconut milk in this recipe) to alleviate the spiciness of food is related to the ability of these ingredients to alleviate the sensation of heat and burning in the mouth. There are a few reasons why milk is often used in this context:

Milk proteins

Milk contains proteins, such as casein, that can bind to the molecules responsible for the spicy sensation, called capsaicinoids. These proteins help reduce the concentration of these substances in the mouth, providing temporary relief.

Fat

Milk contains fat, which is fat-soluble, i.e. it dissolves in fatty substances. Capsaicin, the compound responsible for the pungency of chili peppers, is fat-soluble, which means that it dissolves and is dispersed by the fat present in milk. This helps to dilute and spread the capsaicin in the mouth, reducing the intensity of the spiciness.

Contributor: Adrian Allan (Scotland) and Rute Oliveira (Portugal)

The perfect Spanish omelette

(Tortilla de patatas)
Country: Spain
Science Principle: boiling point, cooking process with water, states of matter.

General Description

Looking for an authentic Spanish omelette recipe?
This is the classic Spanish omelette recipe made with potatoes, eggs, onion, and olive oil, that's it! In Spain, we eat “tortilla de patatas” all day long …It's the perfect breakfast, lunch, snack, or dinner.

Ingredients

- 5 eggs
- 500 g waxy potatoes
- ½ L virgin olive oil
- salt and (optional)
- 1 large white onion

Cooking Process

1. Start by adding your salty sliced potatoes to hot olive oil in a heavy pan. They need to be fully covered in the oil. Cook the potatoes over a medium heat.
2. (OPTIONAL) While the potatoes are cooking, add the sliced onions to a separate pan with a bit of olive oil. Sauté these over a medium heat until starting to caramelize (about 15-20 minutes). Add a splash of water if needed from time to time so that they don't burn.
3. When the potatoes are fully cooked, some may start to break apart. That's okay but don't let them become too broken down.
4. In a large bowl, beat your eggs (which should be at room temperature) with a punch of salt. Add the cooked onion and mix. Then, drain the potatoes in a large colander. Once the potatoes have cooled slightly (about five minutes or so) gently stir them into the onion and egg mixture. Now let this mixture sit for 15 minutes.
5. Gently pour the tortilla batter into a frying pan over medium-low heat. Gently cook the tortilla for about five minutes on the first side. You can run a spatula along the sides to make sure it's not sticking.
6. To flip the tortilla grab a large plate, it must be larger than the frying pan. Put the plate on top of the pan and flip quickly and confidently. It will be runny, but don't worry, you'll put everything back into the pan to cook the other side.
7. Slide the tortilla back into the frying pan and let the other side cook for another five minutes (let it cook longer if you like your tortilla fully cooked through). Then flip back out onto a clean plate. Allow it to cool for at least five minutes before slicing and enjoying.

The perfect Spanish omelette

(Tortilla de patatas)
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The Science behind the Dish

1. We use “new potatoes” which contain less starch and that makes them maintain cohesion even after cooking. Avoid using potatoes that have green spots on their skin because that color indicates that the potato is loaded with a toxic chemical compound called solanine, a molecule that, in addition to bittering its taste, can cause digestive problems.
2. When the potato pieces are immersed in oil that is hotter than the boiling point of water, they immediately release steam, which becomes visible as bubbles. Just when those bubbles disappear, you have to take the potatoes out of the pan to prevent the oil from entering the pores previously occupied by the water by capillarity, since the potatoes would become impregnated with fat and would become difficult to digest, as well as much less healthy.
3. Let's think now about a beaten egg. That it is liquid is due to the fact that both the yolk and the white are made up of large bags of water that contain dispersed protein molecules, chains of amino acids folded in on themselves. As soon as we start to raise the temperature, the egg molecules shake, and the proteins collide with each other.

The perfect Spanish omelette

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The weak bonds that kept the protein chains folded are broken and the proteins unfold and join each other to form a gigantic three-dimensional network. The liquid egg transforms into a wet solid.

4. Another detail to keep in mind is that the tortilla is cooked over low heat. In general, all dishes containing eggs are only heated to the temperature at which the proteins coagulate. It is estimated that the mixed yolk and white coagulate when reaching 73 °C. Overcooking would eliminate all the liquid and we would obtain a “rubber tortilla”.
5. The option to add onion is because it helps prevent the tortilla from drying out and gives it the sweetish flavor that sulfur compounds in the onion provide when cooked over low heat. Meanwhile the onion is cooked, it releases its moisture and cells begin to break down causing it to soften. Sugars are released and as they heat up, both caramelization and the Maillard reaction occur when the onion is browned.

Contributor: Nuria Muñoz, Spain
Links: https://spanishsabores.com/best-spanish-omelet-recipe/

Notes

Notes

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