



Experiment: Make your own plant based burger

- Video: <https://youtu.be/dFmLROvtAeM>
- More info: <http://www.wur.eu/gyi21>

Meat is a product that is highly appreciated by consumers. At the same time it is also a product that is hard to produce sustainably. Meat substitutes help the consumer to eat less real meat. A number of meat substitutes currently on the market (e.g. Valess and Alpro Burger) are produced using the method that you will study in this experiment. The meat substitute consists of a protein source, alginate and calcium chloride (CaCl₂). A key characteristic of a meat substitute is its fibrous structure. The fibre formation is influenced by stirring speed, the type of stirring and the rate of addition of the CaCl₂ solution. You will study those parameters and suggest optimal settings eventually. Purpose is to understand the structure formation process by investigating the role of the process conditions and the ingredients on the final structure formed.

To do that, complete the following steps:

1. Analysis of the meat substitute product.
2. The procedure for a fibrous milk-based product.
3. The procedure for making a fibrous lupine-based product.
4. Own recipe

Materials:

- Food processor with preferably a plastic + steel knife¹
- Beaker glasses (3x 100 ml, 1x 200 ml, 1x 1 L) or some different cups
- Measuring cylinder or measuring cup
- Thermometer (not required)
- Plastic spatula
- Sieve
- 30 (+30) gram lupine powder
- Semi-skimmed milk
- 60 (+60) gram sodium alginate
- 25 (+25) gram calcium chloride in solution²
- Water
- Spoon
- Meat substitute product
- Measuring tape
- Microwave or stove with pan to heat up all liquids to 50°C³

Between brackets you can find the ingredients that can be used at another moment to experiment yourself. You can purchase the special ingredients (lupine powder, sodium alginate and calcium chloride) online.

¹If you have no excess to a food processor, you can also make the fibers with a spatula in a bowl. The result however will be a bit different.

² Before starting with the experiment the solution has to be made. Dissolve 20 gram calcium chloride (CaCl₂) per half a liter water. Start with half a liter solution.

³ Both the water and calcium chloride solution can be made with hot water from the tap (if the water is save to use). In that case it is not necessary to heat up the both solutions again in the microwave or on the stove. It is no problem if the solutions are not exactly 50°C.



Description of the experiments

1. Analyze the prefab meat substitute.

Before starting to make fibrous structure of meat substitute yourself you will start to analyze the structure of prefab meat substitute. Answer the questions on the basis of the meat substitute and the product label:

- a. Observe the material. Pull the meat substitute apart with your fingers to get find the fibers. Does the structure looks like something you know? How sticky is the product? Describe the structure of the product and your findings in words.

- b. Take a look at the listed ingredients. What is the function of all ingredients? What ingredient is responsible for firmness? What ingredient is responsible for binding of the meat?

If all goes well you found a structure that is comparable to the structure of meat. A meat substitute starts to looks like meat through fibers in the product. The length of the fibers determines the structure of the meat substitute.

- c. What are fibers and where do they originate from?



- d. Take a look at the length of your found fibers. Can you find even more clear fibers? Measure the length of the fibers with the measuring tape. Try yourself to make fibers of the same length or even longer in the experiments below.

The fibers of the meat substitute are cm

2. Making a milk based meat substitute.

You are going to make a milk based burger. The use of milk makes the product not plant based. Before starting the experiment read carefully what to do. It is crucial that all ingredients are exactly measured.

First determine how to use the food processor. Test the food processor without anything in it. Make sure you understand how the machine works. **Read carefully in which order the ingredients need to be added. Changing the order will leave you empty handed. No fibers will be formed.**

Decide if you are going to use the plastic or the metal knife of the food processor. Which knife will make the longest fibers? How does that work? How does mixing influence the grow of structures?

If you only have one of the two knives, try to describe the effect of the knife you have on the fiber length. If you are going to make the fibers in a bowl with a spatula without a food processor you can answer the question as if you have a plastic knife. The spatula simulates the plastic knife.

I am going to use the metal/plastic knife because...

The following ingredients you need to make the milk based fibers:

- 10 g sodium alginate
 - 135 ml CaCl_2 solution
 - 200 ml semi-skimmed milk at 50°C
- a. What are sodium alginate, CaCl_2 and milk for chemical substances? What is the function of these different ingredients?

Put the 200 ml semi-skimmed milk in the food processor and turn on the machine on low speed. Add 10 g sodium alginate. Turn the machine off when the sodium alginate is all dissolved.

- b. Observe the material and feel with your fingers. Does it look like a structure you know? How sticky is the product? Describe the structure of the product in words.



Turn on the machine again at low speed and slowly/gradually add 135 ml CaCl₂ solution. Turn the machine off when all the solution is added. Pour the mixture over a sieve to drain the excess of water. Save the mixture till the end of the practical!

- c. Observe the material and feel with your fingers. How did the structure of the material change after adding the CaCl₂ solution? Does it look like a structure you know? How sticky is the product? Describe the structure of the product in words.

- d. Why would you use or not use these fibers in a meat substitute? (e.g. wrong structure, environmental reason)

- e. Do you think that making a meat substitute like you just did is more sustainable than eating real meat? Argue your answer.



3. Making a plant protein based meat substitute.

You are going to make a plant protein based burger. Before starting the experiment read carefully what to do. It is crucial that all ingredients are exactly measured. **Read carefully in which order the ingredients need to be added. Changing the order will leave you empty handed. No fibers will be formed.**

Measure the following ingredients:

- 20 g plant based proteins (lupine powder)
- 10 g sodium alginate
- 320 ml water at 50°C
- 135 ml CaCl₂ solution at 50°C

Put 20 g lupine powder in the food processor and add 10 g sodium alginate. Mix with a spoon. Do not turn the machine on. Decide again which knife you are going to use.

I chose the plastic/metal knife because..

Pour the 320 ml water in the food processor and turn the machine on at the same time. Mix for 10-20 sec. Powder stuck to the bottom you can mix into the mixture again with the spatula. After using the spatula turn the machine on again for 10 sec.

- a. Observe the material and feel with your fingers. Does it look like a structure you know? How sticky is the product? Describe the structure of the product in words.



If you are using the metal knife, now is the time to switch to the plastic knife (if you have one). Turn the food processor on for 10 seconds while you pour 135 ml CaCl₂ solution in the machine. Turn off the machine as soon as all the solution is added. Pour the mixture over a sieve to drain the excess of water. Save the mixture till the end of the practical.

- b. Observe the material and feel with your fingers. How did the structure of the material change after adding the CaCl₂ solution? Does it look like a structure you know? How sticky is the product? Describe the structure of the product in words.

- c. Why would you use or not use these fibers in a meat substitute? (e.g. wrong structure, environmental reason)

- d. Do you think that making a meat substitute like you just did is more sustainable than eating real meat? Are the plant protein based fibers more sustainable than the milk based fibers? Argue your answer.



4. Making more structures.

The last step of the practical is looking at the impact of the ingredients in different amounts, order and mixing speed.

There are different things that could be varied:

1. Add the CaCl_2 solution on a much lower speed.
2. Mix 10 seconds longer after adding the CaCl_2 solution.
3. Use 30% less sodium alginate
4. Use the metal knife instead of the plastic knife.

Chose 1 of the 4 options above and change the recipe of the milk or plant based fiber recipe with the chosen option. Walk through the same steps as the first time except for the change you are going to make.

- a. Think about these questions on forehand: How is are the fibers and the structure of the mixer influenced by the change you made to the recipe? How does that work?

- b. Observe the material and feel with your fingers. How did the structure of the material change after changing the recipe? Does it look like a structure you know? How sticky is the product? Describe the structure of the product in words.

- c. What is based on your observation the effect of changing the recipe on the structure of the fibers? Did you create better fibers after changing the recipe?



5. Questions to answer

After making fibers yourself it is time to think about the use of these fibers for making a burger.

- a. What are the similarities and differences between the prefab meat substitute and the fibers you made?

- b. What is the differences in fibers length between the metal and plastic knife?

- c. What is the function of CaCl_2 and why does it need to be added slowly?

- d. Which vegetables (plant based proteins) can be used as substitute for lupine?

- e. Can you come up with a reason why you would not use a protein source although it has a positive effect on the structure of the fibers?