



EDUCATIONAL MODULE

Taste Alternative Protein!



In a nutshell

In this hands-on workshop, participants will make their own seitan patties from wheat flour, which is a fun tactile activity. This culminates with the final tasting of their own product and tasting of protein-rich insects. The cooking and eating process is complemented by discussion on nutrition and different sources of proteins, the environmental footprint of meat production and consumption, and sustainability. The goal of this module is to think and express ideas and experience new possibilities about food.

Food 2030 focus



What for?

To train or educate people on food system transformation.

For whom?

Educators

How long?

75 minutes

Created by

Science Centre AHHA Foundation (Tartu, Estonia)

Something to share?

Leave us a comment about this tool on the [FIT4FOOD2030 Knowledge Hub](#).
You can also contact Helin Haga, helin.haga@ahhaa.ee

This tool was developed as part of the FIT4FOOD2030 project; find this tool and many more on the [FIT4FOOD2030 Knowledge Hub](#).

Date of creation: March 2019

How to cite?

Science Centre AHHA Foundation (2019). Taste Alternative Protein. FIT4FOOD2030 project tool.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774088

What will you gain from this?

After successfully completing this module participants will:

- know why we need protein in our food and what are the different options of sourcing it;
- know about the environmental footprint of producing different foodstuff rich in protein;
- articulate opinions about and analyse their own preferred source of protein;
- be able to cook a vegetarian “alternative meat” meal, widening their perspective on such possibilities.



TASTE ALTERNATIVE PROTEIN!

The goal of this workshop is to have participants think and express ideas and experience new possibilities about food, and more precisely, the protein content in their food.

Within the current setting of information overload, it is easy to develop conflicting, polarizing and misinformed views about what we eat or should eat. Children should know the motivators behind different meatless (or less-meat) diets, the scientific consensus about diverse nutrition, and get an experiential introduction into food (protein) sources that they might not have thought fondly of before – to broaden their horizons, to better understand our changing world and to become more fit for the future.

However, it is essential for this workshop not to feel like top-down promotion of certain kinds of diets. This is why the facilitator are expected to use discussions to get different ideas and viewpoints on the table. Scientific information will focus on the scientific consensus and the discussion will not touch significantly on ethical questions of slaughtering animals.

This workshop can be facilitated in many different settings. It is created as a science centre / science museum one-hour workshop that requires participants to be present for the whole duration, from start to finish. With the necessary cooking equipment at hand, it could also be facilitated, for example, in a classroom, as part of a science festival or some other science seminar, as a fun hands-on workshop to further engage and energize the participants. The workshop was designed for non-formal education, but implementing it with the right students at the right time, it could be connected with the school curriculum as well, for example in biology classes.



Insects are a potential “protein of the future”

Thematic area

Nutrition, health, taste. Also, climate and the food system and alternative systems surrounding production of meat and other protein-rich food.

Target audience

Children and youngsters from primary school to high school.

Age of participants

7-18 years old

Number of participants

15-20

Number of facilitators

1

Prior knowledge required for participation

No prerequisites required, prior knowledge of nutritional components in food can help.

GETTING PREPARED

Inviting a guest speaker

Cooking teachers, nutritionists or dietary experts can be brought to the workshop to share their insights on what participants are currently doing, and help facilitate discussion or answer some of the questions the participants might have.

Set the scene

The room should have as many tables as there will be groups making seitan patties together. If there are 20 people, there should be 5 tables with 4 chairs around each table. Participants will mostly work at these tables.

If the stove in the room is fixed in a location, then this location will be used for boiling and frying, with participants moving around a bit when they get to those parts. Otherwise table-top stoves can be put on the tables as well (before the start or during the workshop) Extension cords are probably necessary for the table-top stoves but these should be hidden as much as possible, because spilling water on extension cords can pose a danger!

It could be useful to keep all of the stoves in one location, to minimize the use of extension cords and the potential confusion that rises when everybody is doing everything everywhere.

It is best to keep the materials participants need during the workshop on a large table at the front of the room.



Making seitan "meatballs" and patties. Source: freepik.com

Materials

- 10 large photos exemplifying protein-rich foods, such as beef, chicken, pork, eggs, milk-products, beans, lentils, insects, fish, nuts etc.
- 5 large infographics showing protein content in food
- 5 pots (can be shared, so 2 large pots might be enough)
- 5 pans (can be shared, so 2 large pans might be enough)
- 5 sieves
- 5 tabletop stoves (can be shared, so 2 might be enough)
- 5 spatulas (can be shared, so 2 might be enough)
- 5 measuring cups
- 25 liters of tap water
- 1 electric kettle (optional, but makes boiling water quicker)
- 1 kg of wheat flour
- 5 different resealable packets of seasoning, spices, salt
- 1 small bottle of soy sauce
- 1 small pack of edible insects
- 1 pack of paper towels to wipe hands, or preferably running water and fabric towels
- 5 plates
- 20 forks
- 5 knives (can be shared, so 1 might be enough)
- 1 small bottle of cooking oil



TIPS & TRICKS

Careful! Seitan is not suitable for people with celiac disease (or other forms of wheat allergies).

FLOW

STEP 1: Preparation (5 minutes)

STEP 2: Immersion into the topic (10 minutes)

STEP 3: Collecting the first necessary items (2 minutes)

STEP 4: Making the dough (7 minutes)

STEP 5: Dough setting time, discussion on meat consumption and alternative proteins (10 minutes)

STEP 6: Tasting insects (5 minutes)

STEP 7: Washing the starch out of the dough (10 minutes)

STEP 8: Boiling the seitan patty (5 minutes)

STEP 9: Seasoning the seitan patty (5 minutes)

STEP 10: Frying the seitan patty (5 minutes)

STEP 11: Eating the seitan patty (10 minutes)

STEP 12: Goodbyes (1 minute)

FACILITATOR TIPS

This tool needs to be carried out together with the participants.

As a facilitator you need several skills and competences, such as verbal and non-verbal skills, negotiating skills, flexibility, and leadership. You will need to create an environment in which all participants feel secure, are able to speak up and give their perspective on issues being discussed. This means that you may have to stimulate some participants to speak more often, while you may have to prevent other participants to speak too often or too long. It also means that you will need to avoid discussions on issues that are not directly relevant.

A brief guide with facilitation tips are provided in this address:
<https://knowledgehub.fit4food2030.eu/facilitatorstips>



Setting up the activity and kneading the dough.

STEP 1: PREPARATION

5 minutes

Before starting the workshop, have people wash their hands. Guide those who arrive early promptly to the hand washing station. Welcome and briefly introduce the activity ahead, dividing the participants into groups of 4 if they have not already divided themselves. Tell the participants that in this workshop they are going to learn what's up with these alternative meatless foods popping up these days, and make and taste some of them.



TIPS & TRICKS

Talk to a restaurant manager. This workshop could be carried out at a restaurant/cafeteria specializing in vegetarian food as a one-off special event. Restaurants already have the necessary equipment and the infrastructure to clean everything efficiently after the workshop.

STEP 2: IMMERSION INTO THE TOPIC

10 minutes

Start with a quick round of questions on who eats or does not eat meat and why. Try to get answers from each table and add extra information to the discussion building on the answers. Segway from talking about protein sources into the next activity – cooking an alternative protein source.

Questions to ask from the participants/topics for discussion (and extra information):

Raise your hand if you eat meat

Raise your hand if you don't eat meat

5% of the world's population are vegetarians and less than 1% are vegans. This differs by country, for example 30% of Indians are vegetarian, often for religious reasons.

How do you call people who don't eat meat?

Vegetarians don't eat meat, chicken or fish, but they can eat eggs and dairy products. Vegans don't eat any of those. There are numerous different versions of these diets, for example:

Lacto-vegetarianism (includes dairy products but not eggs)

Ovo-vegetarianism (includes eggs)

Raw veganism (food is not cooked past 48°C)

Some vegans don't eat honey, because it hurts insects, but some do.

Do you know any people who don't eat meat?

Why don't these people eat meat?

***Empathy** for animals is the most reported reason – vegetarians **don't want animals to be killed** for their food. If regular vegetarians are happy with milking cows and collecting eggs from chickens, then vegans*

don't tolerate that either. The definition of veganism is "a way of living that seeks to exclude all forms of exploitation of animals for food, clothing or any other purpose."

Animals that are grown not only for consumption, but also for their milk and eggs, are often living in **very difficult conditions**, regarding space, sunlight, nutrition, diseases and abundant antibiotics to combat them etc.

However, this ethical question does not fall within the scope of this workshop, as it is difficult or impossible to translate personal moral views into scientific facts. Participants can, of course, express their views on this topic and you can ask others if they agree or disagree, and why, but the focus should remain on nutrition, health and environment.

Health benefits – vegetarians who also eat eggs and milk-products, are consistently shown to have **less cardiovascular diseases**, diabetes and obesity, a lower blood lipid count, lower blood pressure and **longer lifetime**.

These benefits come from the facts that plant food usually has **lower energy content** (less obesity), lots of fibre (helps regulate the digestive system) and is a less processed food (more vitamins and antioxidants). But it should be noted, that "junk food vegetarians" (and vegans) also exist, who might eat, for example, large amounts of greasy fries. The quality of vegetarian food still matters.

Environmental reasons – Growing animals for food leaves a very large global environmental footprint. At any moment there are the following amounts of animals being grown for food: **23 billion chicken, 1.5 billion cows, a billion pigs and a billion sheep**. 83% of farmland is used to feed animals, as food crops or grazing lands. That is 26% of the Earth's total land area. Thus, meat and dairy production accounts for 27% of global fresh water consumption. **18-58% of the greenhouse gases** created by humans are a product of the meat industry (depending on the calculation method and inclusion of deforestation, food loss, transportation etc.)

These numbers are high, because animals **don't convert their food into muscle that efficiently**, much of their nutrition is used in their bodies to keep the animals alive. **Feed conversion ratio (FCR)** is used to measure how well animals convert the food they eat into the desired output (flesh, milk or eggs). An FCR of 7 means that 7 kg of animal feed are used to create 1 kg of flesh. The FCR numbers for different animals are:

Cow: 7

Pig: 4

Chicken: 2

Fish: 1

Crickets: 1

Note that these results vary wildly according to different sources. The FCR for cows could be as high as 25 kg of feed per kg of meat, and the freshwater footprint of a kg of beef could be as high as 15000 litres.

Different estimations show that our planet could support billions of more people if we simply ate the plants that we feed to animals. However, not all land that is used to feed animals (such as grazing land) can be used to efficiently grow edible plants for humans. Thus, **a totally vegan world would not be the most environmentally sustainable**, instead growing animals for food in moderation would be the most sustainable way.

Why do other people eat meat?

Because it is considered **tasty and nutritious**. Meat is an excellent source of **protein, vitamin B12**, iron and also other vitamins and minerals. Proteins are essential building blocks of the body and they take part in all bodily functions. A **deficiency of protein leads to lowered muscle mass, stunted growth and development**, weaker immune system and impaired nervous system, among other things. Overconsumption of protein burdens our livers, but is mostly not harmful (unless overconsumption happens for extended periods).

*But **meat is also rich in fat and salts**, which we shouldn't eat so much of, and diets rich in meat have been linked with cardiovascular disease and cancer, according to many studies.*

***Early humans evolved** to be drawn towards food that is **sweet, fatty and salty**, because such ingredients gave us necessary energy and minerals that were otherwise scarce. Other omnivores lick salty rocks when their bodies need minerals as well, but humans rely on sweating to release excess heat, so we have an even higher need for salty minerals.*

*At the modern times of abundance, however, it is **easy to eat too much of the things we like**, such as sweet, fatty and salty things. Couple that with the excessive environmental footprint of growing meat, and the fact that we can get our necessary protein from other sources, like vegetarians do and as participants are going to learn in this workshop, choosing to eat less meat should be logical.*

Throwing garbage on the ground or in the nature is comfortable, yet we don't do it (at least we shouldn't!). Leaving electric lights on and music playing when we leave home is convenient, but we don't do it either. The same mindset should be adopted when considering our consumption of meat.

***Cutting back** on our unsustainable meat consumption and replacing it with alternative protein is one of the **goals of European Commission's Food 2030 strategy**, under the heading '[Alternative proteins and dietary shift](#)'.*

STEP 3: COLLECTING THE FIRST NECESSARY ITEMS

2 minutes

Instruct teams to come and take necessary items and then return to their seat, and explain what each item is for.

At first, teams will need to take:

- A large bowl – for mixing the dough together;
- Flour and water – the basic ingredients of our experiment;
- A measuring cup – to measure the ingredients;
- A sieve – for washing the starch out of the dough;



TIPS & TRICKS

Be extra careful with electrical equipment. Extension cords might need to be used to connect the kitchen equipment necessary. Care must be had when moving around while carrying water. Preferably, all equipment will be placed at the front of the workshop room to avoid contact between water and electric wires.

STEP 4: MAKING THE DOUGH

7 minutes

Instruct teams to measure flour (1.5 cups) and water (0.5 cups) and to make the dough – mix the ingredients slowly and knead the dough thoroughly. Tell them to choose who does what, and how, and mention that there will be other important steps as well. Then let them work.



TIPS & TRICKS

Keep ingredient amounts fixed and emphasise the kneading of the dough. In our past experiences, extra cooking materials were readily made available upon request, resulting in more dough being produced and longer cooking time. When water or flour seems to be in short supply, it is often because more effort is needed for kneading the dough. So emphasise the kneading of the dough.

STEP 5: DOUGH SETTING TIME, DISCUSSION ON MEAT CONSUMPTION AND ALTERNATIVE PROTEINS

10 minutes

When the dough is ready, let it sit for 5-10 minutes. This is discussion time. Go deeper with the questions:

How often do you eat meat?

For instance, the Estonian National Health Institute recommends to eat about 100g of meat per day. This recommendation includes fish and eggs. Fish is the most recommended out of these three sources, followed by chicken and eggs. It is also noted that you don't have to eat these types of protein-rich foods every day, but in that case, you should replace them with legumes and grain.

It is recommended to eat at least 0.8 grams of protein per kilogram of body weight. For an adult that weighs 80 kg, this amounts to 64 grams of protein. If you are training or growing, then you need more. But eating more than 1.6 g or 2.2 g of protein per kg of bodyweight doesn't add any more benefits.

Have you tried other sources of protein? How do you like their taste?

Introduce different sources of protein with images and a protein-content chart (see Appendix B). Ask:

Are you surprised by any of the information in the protein chart?

If participants have not mentioned lack of certain essential nutrients in vegetarian food, then ask them about this:

Is it true that plant-based food lacks some of the key building blocks (nutrients) that our bodies need?

What have you heard about this?

*The protein that is so vital to our bodies is made up of amino acids. Our bodies can create and recombine many amino acids but there are also those that need to be obtained with food – our bodies cannot synthesize them. These are called **essential amino acids**.*

*It is a longstanding belief that only animal protein gives us all the essential amino acids, but this is not true. Meat has all of the essential amino acids and plants often miss some of them indeed, but **a mix of legumes and grains gives humans all of the different amino acids they need.***

However, vitamin **B12 needs to be added** by food supplements or fortified food, because plant-based food doesn't have it. Deficiency of B12 leads to anaemia and damage to the nervous system.

Plant-based diets can have low numbers of some other key nutrients, such as **vitamin D, calcium, iron** and some others (and some that are not researched so well yet, such as cholesterol and carnitine). Deficiencies of these ingredients can lead to serious health problems, but these deficiencies also rise among meat-eaters.

Eating diverse is key for both plant-based and meat-based diets. Furthermore, lack of these nutrients affects our bodies differently. Some people, for example in case of low iron in their diet, will then absorb iron better. The best way to determine what your body needs, is to undertake a metabolic analysis (by giving a sample of blood or urine etc.).

Estonian health specialists **don't recommend a totally vegan diet**. Vegetarian diet, however, includes milk products and eggs and thus leads to more balanced nutritional intake. A balanced and **healthy vegan diet is certainly possible with conscious planning and perhaps food supplements, but it is safer to be an omnivore**.

Humans are **omnivores**, which is evident from the fact that our bodies don't create all of the nutrients we need. Cows, for example, create their vitamin B12 using bacteria in their gut. But being an intelligent omnivore in the modern era means that we can choose what we eat – a vegan diet is possible, so is a meat-only diet, but both of those need some added supplements.

A counterargument for meat-only diet is that carnivorous humans would need **vitamin C supplements**. Most animals create their own vitamin C, but humans, apes and monkeys, for example, cannot. Not to mention that carnivores would have to eat organs too, not only meat tissue, to get a wider spectrum of nutritional intake. Thus, we were evolved to eat both plants and animals.

STEP 6: TASTING INSECTS

5 minutes

Once you get to talking about insects during the discussion, offer participants the opportunity to taste them. (This can also be done at a later point when the seitan patties are boiling.) Ask participants:

**How do you like the taste, texture etc.?
To what does the taste resemble?**

Insects are seen as a possible future food source, rich in protein and other nutrients. They need a lot **less resources** (feed, area, water, energy) to grow compared to animals and reach their full size in a matter of **weeks**. Insects are then freeze-dried or ground to make flour, which will be used to make different types of food.

In fact, only Europeans and North-Americans don't eat insects, but different kinds of worms, beetles, crickets, grasshoppers, cockroaches etc. have been eaten elsewhere in the world for thousands of years. The Food and Agriculture Organization of the United Nations lists around **2000 species of edible insects** and estimates that there are **2 billion insect consumers worldwide**. Insect farms have been set up in Europe and in the United States, in an effort to introduce this type of food here as well.

But even westerners eat bugs already, without knowing it. Chocolate, coffee and wheat grain contains **parts of insects**, with the largest amount actually in beer hops that are used to make beer – 25000 bugs per 100 grams. (But these insects are aphids that measure only a maximum of a couple of mm.)

Do you think this will be part of our future? Have you heard of other possible future foods?

For example, new initiatives are looking at cultured meat and cellular aquaculture. Cultured meat is the name of laboratory meat, or in-vitro cell culture. Animal cells are replicated through a laboratory process. Theoretically, there is less environmental impact and no issues of animal welfare. Large investments are already ongoing in those technologies, but research continues on whether it is sustainable and whether or not people will wish to consume it.

“Although the participants of the workshop initially hesitated to eat the grasshoppers, when I proposed tasting them, all hands in the room were raised and all participants had a go, mentioning the bad smell but also the pretty good taste.”

AHHA facilitator, commenting the piloting of the module

STEP 7: WASHING THE STARCH OUT OF THE DOUGH

10 minutes

When the dough is ready, instruct participants to wash the starch out of the dough by continuing to knead the dough intensely inside a bowl with cold water. Keep changing the rinsing water until further washing leaves it more or less transparent. The dough ball can crumble during washing so it might be necessary to press the pieces back together into a ball. Participants can also place it in a sieve to remove excess water and bring all the dough pieces together.

Tell them what will remain at the end of this process – the stringy protein named gluten that is supposed to have a texture similar to meat. You can also project a video illustrating this process (here is [a possible example](#)).

In the background, put the electric kettle on, to make boiling water in the next step faster. Fill the electric kettle to its limit and boil it.

Gluten is the stringy and sticky protein in wheat flour. It is **insoluble**, which means that other parts of wheat flour (mostly soluble starch – a carbohydrate used for energy) can be washed away, leaving only gluten behind. Different flours have different gluten content. Corn and buckwheat flour have none, but wheat flour can have 9%-80% gluten. When flour is made into dough, then the amount of gluten determines its baking properties – low gluten is good for crumbly cakes, but high gluten makes elastic bread.

Gluten, which as a dish also goes by the Japanese name **seitan**, is cooked before eating. The first time this ingredient is documented comes from the **6th century China** where Buddhist practitioners ate it as a substitute for meat. It is still popular in Asia, similar to soy-based tofu.

As gluten/seitan is a protein, the dish consists of almost **only protein** and water. It is a good protein source, but it is **not a complete protein** (it lacks other essential amino acids). You cannot survive eating seitan alone, but you should eat a variety of food anyway.

Not all people can eat gluten, however, because they have **gluten intolerance**. This includes the well-researched **coeliac disease**, which affects the small intestine and gradually makes absorbing nutrients more difficult, as a reaction to ingesting gluten. However more and more people self-diagnose gluten intolerance and report that they feel better if they cut gluten from their diet.

Estonian nutritional recommendations **suggest to not completely cut out food groups** from of your diet, such as wheat. This would raise the risk of having a deficiency of key nutrients. More research is required to understand completely whether it is gluten that can cause harm or some other factors, such as high consumption of wheat-based products.

Specialists are currently divided between **two opposing sides**:

*Some say that gluten is **harmless**, the self-reported cases are **nocebo** (the negative opposite of placebo), you shouldn't follow trends based on little research and instead save money by not buying expensive gluten-free products;*

*Others believe that if the components of gluten are not digested completely, they will **form toxic substances**, and that even though bread has been eaten for thousands of years, modern wheat is genetically different (because of selective breeding) and can have abnormal side effects.*

STEP 8: BOILING THE SEITAN PATTY

5 minutes

Once the flour is washed, instruct participants to shape their patty and start to boil it. It should take about 5 minutes to boil, or until the patty rises to the top.

Boiling can be done at their tables or at the designated stove-area. Boiling needs to be checked from time to time, but other than that it is a hands-off part of the activity.



TIPS & TRICKS

Take the experimentation further. Kneading duration, the time the dough ball rests, the number of washes and the boiling duration are all steps that affect seitan and there is a lot of potential for experimentation. The Teachers' Guide in Appendix B proposes such experimentation for a better understanding of gluten network formation.

STEP 9: SEASONING THE SEITAN PATTY

5 minutes

Once the seitan patty has risen to the top, instruct teams to put their patty on their plate and add seasoning to it. Participants can experiment how they wish – choose as much or as little flavouring as they want, different kinds, and also cut their patty into pieces, or not. Seitan requires quite a lot of seasoning. Marinating would be ideal, but quickly sprinkling on spices, salt and/or soy sauce works good enough.

STEP 10: FRYING THE SEITAN PATTY

5 minutes

Instruct teams to fry their seasoned patty for a short while, from each side, to make it brown and crunchy.

STEP 11: EATING THE SEITAN PATTY

10 minutes

Once the seitan patty is fried, let the participants put it on their shared plate, cut it (or let them cut it) and let them taste it! Ask questions:

What does your seitan patty taste like?

How is the texture?

Is it similar to meat or not?

Should it be similar to meat or not?

Encourage participants to share and test the results of other groups.

STEP 12: GOODBYES

1 minute

Once finished, thank the participants for participating, let them leave the workshop and clean up after them. You can also ask participants to help you clean.

APPENDIX A: USEFUL LINKS

Search keywords: protein, essential amino acids, vegetarian source of protein, seitan, insect protein, gluten intolerance, environmental footprint of meat production, feed conversion ratio, entomophagy.

The environmental footprint of meat consumption

Arjen Y. Hoekstra. "The hidden water resource use behind meat and dairy". Water Footprint Network. Accessible at: https://waterfootprint.org/media/downloads/Hoekstra-2012-Water-Meat-Dairy_1.pdf

Cirad. "Transforming our food system to ensure a sustainable future." ScienceDaily. Accessible at: www.sciencedaily.com/releases/2018/12/181206114729.htm

European Commission. "FOOD 2030 Pathways for Action: Alternative Proteins and Dietary Shift." Accessible at: https://ec.europa.eu/info/sites/info/files/research_and_innovation/research_by_area/documents/2020.2057_en_05.pdf

FAO. "Key facts and findings – Major cuts of greenhouse gas emissions from livestock within reach." Accessible at: <http://www.fao.org/news/story/en/item/197623/icode/>

FIT4FOOD2030 project. "Breakthrough: Diversity in the diet" Accessible at: <https://fit4food2030.eu/breakthroughs/diversity-in-the-diet/>

Different diets

Harvard Health Letter. "The hidden dangers of protein powders." Accessible at: <https://www.health.harvard.edu/staying-healthy/the-hidden-dangers-of-protein-powders>

Holly Strawbridge. "Going gluten-free just because? Here's what you need to know." Harbard Health Blog. Accessible at: <https://www.health.harvard.edu/blog/going-gluten-free-just-because-heres-what-you-need-to-know-201302205916>

John McDougall (comment) and Barbara V Howard (reply). "Plant Foods Have a Complete Amino Acid Composition." Journal Circulation. Accessible at: <https://www.ahajournals.org/doi/pdf/10.1161/01.CIR.0000018905.97677.1F>

Paul A.S. Breslin. "An Evolutionary Perspective on Food and Human Taste." Current Biology, Volume 23, Issue 9, 6 May 2013. Accessible at: <https://www.sciencedirect.com/science/article/pii/S0960982213004181>

The Vegan Society. "Definition of Veganism." Accessible at: <https://www.vegansociety.com/go-vegan/definition-veganism>

The Vegan Society. "Nutrients." Accessible at: <https://www.vegansociety.com/resources/nutrition-and-health/nutrients>

Positions from popular sources

Kyle Smith. "Selfish vegans are ruining the environment." New York Post. Accessible at: <https://nypost.com/2016/08/04/selfish-vegans-are-ruining-the-environment/>

Kurzgesagt – In a Nutshell. "Why Meat is the Best Worst Thing in the World". YouTube. Accessible at: <https://youtu.be/NxvQPzrg2Wg>

Kurzgesagt – In a Nutshell. "Is Organic Really Better? Healthy Food or Trendy Scam". YouTube. Accessible at: <https://youtu.be/8PmM6SUn7Es>

The Infographics Show. "What Would Happen If The World Suddenly Became Vegetarian." YouTube. Accessible at: <https://www.youtube.com/watch?v=2pPwwU1N9hM>

APPENDIX B: PROTEIN CONTENT IN FOOD (P. 16)

APPENDIX C: TEACHERS' GUIDE (PP. 17-18)

APPENDIX D: ACTIVITY CARD (PP. 19-20)

Protein content in finished foods

Source: Food composition database (tka.nutridata.ee/en)

**Foodstuffs
(ready to eat)
protein per 100g**

1. Beef	31g
2. Chicken fillet	29g
3. Peanuts	27g
4. Pork	24g
5. Salmon fillet	23g
6. Sunflower seeds	23g
7. Peanut butter	23g
8. Seitan	22g
9. Shrimps	21g
10. Grasshoppers	20g
11. Curd cheese	17g
12. Egg	13g
13. Beans	9g
14. Lentils	8g
15. Tofu	8g
16. Bread	7g
17. Milk	3g
18. Pasta	3g
19. Mushrooms	3g
20. Cauliflower	2g
21. Tomato	1g



Seitan - Meatless Patty



Duration

90 min



Related topics

BIOMOLECULES

PROTEIN SOURCES

COOKING

NUTRITION

GREENHOUSE GASES

AGRICULTURE

THERMAL FOOD PROCESSING

GENETIC
PREDISPOSITION
TO DISEASE

GRAIN FOODS



What you need (for each group)

- **300 g** Wheat flour (durum flour, if possible)
- **1-3 packs** Spices (low sodium, if possible)
- **30 ml** Iodine solution (enough for whole class)
- **1-2 tk** Measuring cup (100-200 ml) or spoon for measuring 150 and 50 ml
- **2 pcs** Small bowl (for seasoning boiled seitan)
- Small bottle of soy sauce
- Bowl (2-3l)
- Large measuring cup (1l)
- Oil for frying
- Kitchen burner
- Boiling pot
- Frying pan
- Spatula
- Plates, forks, knives for serving



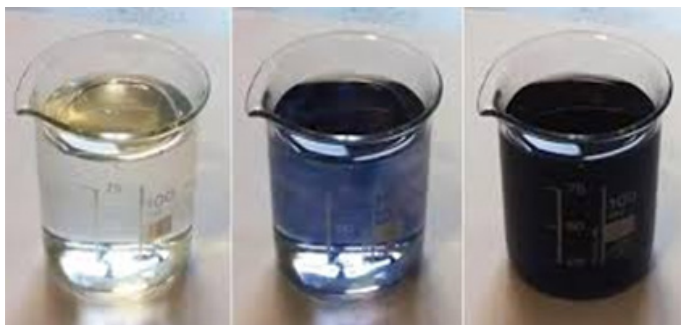
Instructions

The goal is to show that every meal doesn't need to include animal protein and that there are different protein sources available. The task of the participants is to find out how is seitan affected by:

- kneading duration;
- the time the dough ball rests;
- number of washes;
- boiling duration.

Since there are 5 different experiments (including the control group) it is good to divide participants into 5 teams - one team performs the control test and 4 teams study the effect of a variable. There could also be more teams with some teams experimenting with new or combined variables. In order to better divide seitan patties for evaluation, each team could make as many patties as there are teams, e.g. 5 patties for 5 teams. Note that the recipe on the Activity Card is meant for one seitan patty. The patties can later be cut into smaller pieces, one for each team member.

Thinner seitan patties cook better and faster. People with celiac disease (or other forms of wheat allergies) should not eat seitan, of course.



To see if seitan contains starch or not, drop 5 drops of iodine solution into a small sample of the final dough-washing water. Order the test solutions by their starch content.

Lighter color indicates lower amount of starch in seitan.

Figure 1. The more starch there is in the solution, the darker it will become through reactions with iodine compounds.



Explanation

Seitan consists of the protein gluten (latin for “glue”) which is a mixture of other wheat proteins. The formation of a gluten network is **promoted by**:

- **Kneading** (proteins that form gluten have a higher chance of positioning next to each other)
- **Resting** (dough has to rest, because network formation takes time)

The formation of gluten is **hindered by** additives in the dough, such as **starch** (or milk or oil). These will stop gliadin and glutenin (proteins) from making bonds.

It is sufficient to boil seitan for 5 minutes (after it has risen to the water surface). Longer boiling duration will make seitan denser.

Protein/gluten content is an important characteristic of flour. The properties of gluten will determine the properties of the dough made from that flour. Gluten swells up in contact with liquids and, with the help of gases emitted during rising and baking of dough, forms a strong and porous wireframe. These proteins also give baked goods their rigid form and dense crust.

Dough made of flour with a lower protein content rises less. Protein-rich flour (over 12%) is used to bake fluffy bread and pizza. Shortcrust pastry and sponge cakes use flour with a lower protein content (5-9%). A medium protein content (~10%) is suitable for most home-baked pastry.

In addition to protein content in food, the amino acid content of those proteins is also important. Our bodies are unable to construct some of the necessary amino acids and we must get them from food. These can be easily obtained from meat, but also from plants, if your menu is varied. Vegans should also take supplements or foods fortified with vitamin B12, which is important for our nervous system. Vitamin D, calcium and iron should also be noted, as they are more readily available in animal-based food, however these deficiencies plague omnivores as well, whose menu is very one-sided.

Starch is an organic substance that acts as the glucose reserve of plants'. Adding iodine into starch solution makes the starch molecules twist around iodine ions which forms a dark blue compound (Figure 2).

Insects (e.g fly larvae, crickets and mealworms) are a sustainable alternative to usual animal protein. Their production doesn't require large land areas, but instead needs the right humidity and temperature (in the range of 22-30 °C).



Figure 2. Starch molecule chain twists around iodine ions, which changes the color of the solution.

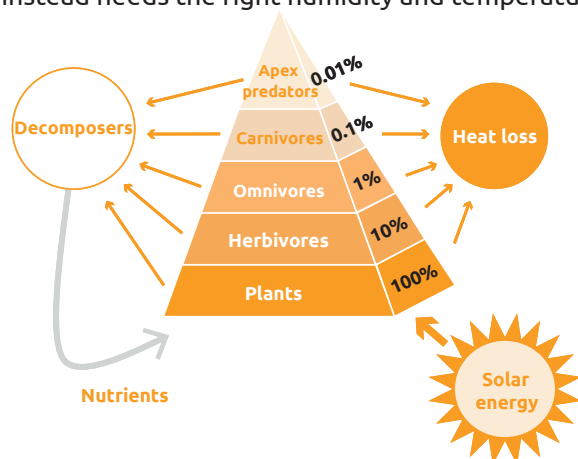


Figure 3. Ecological pyramid

Unlike regular livestock, insects reach their maximum weight within a few weeks. Once ready for consumption, insects are either freeze dried or ground into insect flour. One product, such as a patty, an energy bar or a pack of pasta, could require hundreds or even thousands of insects. Their nutritional value is high, 400-500 kcal per 100g.

If you don't count Europeans or North-Americans, humans have actually always eaten bugs. In fact, we have insects in our Western diets even now, for example in chocolate, coffee and grains. The largest amount of insects (tiny aphids) is in the hops that go straight into beer production.

The agricultural land that is used to grow animal feed could be used to directly produce food for humans. Raising animals requires additional drinking water, releases methane and could pollute the soil and water. Every level of the ecological pyramid captures about 10% of the energy available in the previous level (Figure 3.), the rest is dissipated as heat.



Keywords for online search:

Celiac disease, gluten, seitan, biomolecules, plant-based protein, edible insects, WHO (World Health Organisation), FAO (Food and Agriculture Organization)

SEITAN - MEATLESS PATTY

Pasta is made of high-protein durum wheat flour.



Cats produce their own vitamin C in their bodies. Humans that, for example, live in the arctic and eat only animals, experience vitamin C deficiency.

Estonians eat on average 215 g of meat per person daily, which is more than twice the recommended maximum of 100 g. Long-term over-consumption of fat, protein and salt burdens our liver, kidneys and heart. In Asia people also eat for example seitan instead of meat. Nuts, legumes and insects are also excellent sources of protein. Lowering our meat consumption would lower our environmental footprint, as at least a fifth of all human-emitted greenhouse gases comes from livestock production.

TASK

Find out, how seitan is affected by:

- kneading duration;
- the time the dough ball rests;
- number of washes;
- boiling duration.

ATTENTION!

Seitan is not suitable for gluten intolerants.
Stove burners are hot.
Hands are covered with microbes.
Water dropped in hot oil makes it splash around.
A balanced diet is required to get all of the essential amino acids and other nutrients.



PLANNING

Remember to change only one variable in order to get reliable results. Decide which team will do the control experiment.

How many seitan patties should each team prepare?

Are there any other variables that can affect the properties of seitan?

83% of agricultural land is used to grow food for animals, which is 26% of the surface area of Earth.

Estonian agronomist Mihkel Pill proved in the 20th century that you can grow sufficient quality wheat in Estonia by breeding his own varieties.

Wheat has the most gluten, rye and barley have less and oat has the least.

Write down how long did you knead the dough, let the dough rest, how many times you washed and how long did you boil.

CONTROL EXPERIMENT

1 MAKING THE DOUGH BALL
For one seitan patty mix **75 ml flour** and **25 ml water**.
Knead until the dough doesn't stick to hands anymore. Let the ball rest for **15 minutes**.
Wash the ball with cold water until the rinsed water is more-or-less transparent. **1 wash = 1 l water**.
Dough ball can crumble during washing. Press the pieces back into a ball.

2 IDENTIFYING STARCH
Put **50 ml** of the final rinsing water into a glass. Add **5 drops of iodine solution**.
Compare your solution with the other teams and order the glasses by their starch content.

3 POST-PROCESSING
Form the resulting spongy mass into patties (thinner patties are easier to fry) and boil them **for 5 extra minutes after rising to the surface**. Make sure that the patties can move freely in the boiling water.
Season with soy sauce and/or spices and finally fry them in a bit of oil until they are golden brown.

EXPERIMENT

Do the experiment by changing one variable and keeping the other variables as they are.

Use **50 ml** of the final rinsing water to identify starch content.

Write down how long did you knead and how long did you let the dough rest, how many times you washed and how long did you boil.

RESULTS

Sort the fried patties according to the variable that you studied. Cut the patties so that everybody could taste different ones.

Evaluate the results according to:
taste, texture, similarity to a meat product.

CONCLUSION

How are the properties of seitan affected by:

- kneading duration;
- the time the dough ball rests;
- number of washes;
- boiling duration;
- seasoning.

Is the resulting patty in any way similar to meat patty? Would you include seitan in your regular menu?

ADDITIONAL INFORMATION

Seitan is a meat substitute made out of gluten, a wheat protein. Starch must be removed from the flour in order to make seitan.

100 grams of seitan has the same total amount of protein as 100 g of fish.

Flour type numbers indicate the remaining bran content. A larger number indicates a larger bran content and darker flour. For example type 495 flour is suitable for baking sponge cake and type 812 flour, which is high on nutrient and low on energy contents, is good for whole wheat bread.

A - Gliadin

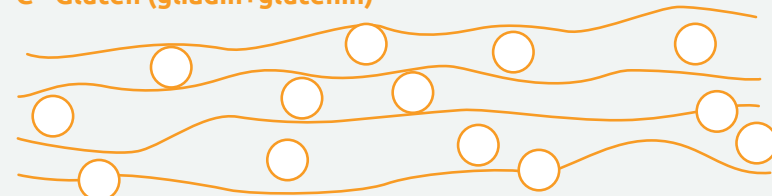


B - Glutenin



+ mixing
+ kneading

C - Gluten (gliadin+glutenin)



Proteins unravel, gluten network is formed.

Celiac disease is a hereditary disease that leads to damage or disappearance of villi in the small intestine. This results in bloating, nausea, diarrhea, constipation, tiredness and nutrient deficiency because of the loss of nutrient absorbing surface.

This material was developed using co-funding by European Union's Horizon 2020 programme under grant agreement No 774088.

Authors: Kristel Schreiner, Pille Randjärv, Sander Kask, Helen Järvpöld, Elisabeth Parman.



SEITAN - MEATLESS PATTY



What kind of variables will most likely make seitan denser?

- ☐ Longer kneading
- ☐ Letting the dough rest longer
- ☐ More thorough washing
- ☐ Longer boiling

Are there any other variables that can effect the properties of seitan?



Fill the table with planned and actual durations for each step.

Variable	Kneading (min)		Washing (min)		Resting (min)		Boiling (min) after rising to the surface	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Control test	Until it doesn't stick to hands		More-or-less transparent water		15		5	
Test/Team 1								
Test/Team 2								
Test/Team 3								
Test/Team 4								

Mark the cell that has the variable that your team is going to study.



Write down the results of the taste test. Think about how will you evaluate the results.
What kind of scale will you use? What are the outermost values of the scale?

Quality	Taste	Texture	Similarity to meat
Control test			
Test/Team 1			
Test/Team 2			
Test/Team 3			
Test/Team 4			

Best tasting seitan was

Seitan most similar to meat was

The softest seitan was

The toughest seitan was

The most was



Connect the pairs

- If you boil seitan longer...

If you knead seitan less...

If the dough rests longer...

If you was the dough less...
- •

•

•
- ... your seitan will be denser.

... your seitan will be softer.

... your seitan will be softer.

... your seitan will be denser.

How to promote the formation of gluten?

How much protein does your final seitan contain, if you presume that you didn't wash out any of the proteins? (look at the package for more info)

Why is protein-rich flour more suitable for making airy bread and why can you find gluten in many bread products?



It is recommended to get 10-20% of your daily energy intake through proteins. How many grams of protein should you eat, if your daily energy requirement is 2000 kcal? (1 g of protein is approximately 4 kcal)

Choose the right amount of diverse protein sources for a three day menu.

Day 1	Day 2	Day 3

Which health problems are linked to eating too much meat? Which are linked to eating only plants?



KEYWORDS FOR ONLINE SEARCH

Celiac disease, gluten, seitan, biomolecules, plant-based protein, edible insects, WHO (World Health Organisation), FAO (Food and Agriculture Organization)



Coordinated by:



Partners



OSLO METROPOLITAN UNIVERSITY
WORK RESEARCH INSTITUTE AFI



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774088