Soy in Food: What is that doing in there?
Why Is Soy in So Many Foods?
Teacher Instructions

Description:
Students will evaluate the role soy plays in various foods. Continuing from the findings of the previous lessons, students will begin by analyzing how the high protein content in soy is processed into tofu. Proteins are natively folded into a 3D, tertiary structure based on the hydrogen bonding among the various side chains in the primary amino acid sequence. Denaturation occurs when this tertiary structure is destroyed and can be seen on a macroscopic level as coagulation (think of how an egg changes as it is cooked). In cheese- and tofu-making, the proteins from milk and soy are coagulated by the addition of acid, which can either be added directly or produced by the growth of acid-producing bacteria (acid hydrolysis). The coagulated proteins, or curd, are collected and pressed to form blocks of cheese or tofu. By analyzing ingredient labels, students will realize that many foods contain soy, without having high protein content. Students may notice that soy is listed farther down the label, which would contribute relatively little to the listed protein content. However, it is worthwhile then to ask students why soy is included as an ingredient at all, since food companies do not include ingredients that do not serve a function. This discussion of product labels should transition to the brief PowerPoint presentation on lecithin and emulsification. Subsequently, students will prepare a bread dough recipe, one using lecithin and one without. Students will evaluate the "workability" of dough and, after the dough is baked, students will evaluate the quality of the finished product.

***Note:** The day prior to making soymilk, divide students into groups of 3-4. Have students soak 1 cup of soybeans in a 4 cups of water until the following class period.

Materials:

Pot
Colander
Bread pan or baking sheet
Food processor or blender
Burner or stove
Lemon juice or vinegar
Cheesecloth
Various packaged ingredients listing soy
Soybeans
Liquid lecithin
Flour
Sugar
Salt
Instant yeast

Dry, cracked soybean

Soaked overnight

Day 1:

Discussion

- What did we learn is unique about soy's macromolecular content?
    - *Really high in protein content*
- Let's look at some foods that utilize the high protein content from a vegetarian source, the soybean. What food can you think of is a meat alternative for many vegetarians? Tofu
- Tofu is essentially made the same way as cheese. This week we'll make cheese and tofu to illustrate the similarities in production practices.

  *Students may not have ever tried tofu. Since they will be making tofu and cheese, it may be worthwhile to bring in some tofu so they can see the difference between commercial tofu and what they are producing (both the cheese and tofu will be less smooth and overall lower quality than commercially produced products). Additionally, most tofu is not coagulated through acid hydrolysis. They are instead produced with salt coagulants, like gypsum salt, so that the final product has a much less sour (lemon) taste than what the students will be making.
- Start with a talk on protein structure and denaturation, coagulation and how it plays a role in tofu and cheese making.
- Discuss how acid hydrolysis of the hydrogen bonds in the tertiary structure is achieved through the addition of lemon juice or vinegar, and how this is similar to microbially fermented products.

Conclude the first day of this lesson by having students make soymilk from beans. Commercially available soymilk may not yield good curd following the addition of acid, so it is recommended this initial step be performed.

Activity – Make soymilk

- Transfer beans and water to blender/food processor and blend until smooth
- Pour blended mixture through cheesecloth, collecting the liquid portion
- Refrigerate until the next day

Alternatively, the teacher may perform this step on behalf of the students the day prior to the activity.

1. Mill the soaked soybeans with enough additional water for efficient blending.

2. The diluted, milled soy is strained to remove the solid portion (okara). The liquid remaining is soymilk.

3. Refrigerate until the next day

Day 2:

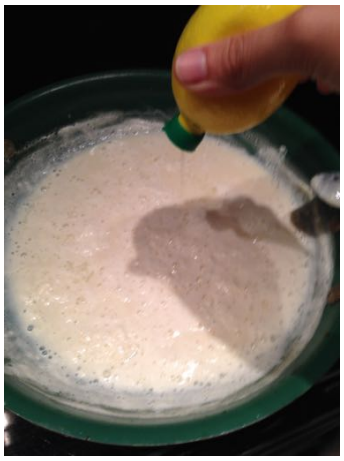
Activity – Make tofu and cheese

- For both milk and soymilk, have students transfer the solutions to separate pans over burners or stovetops
- Have student groups heat the milks until it reaches a low boil
- Simmer the soy milk

During the heating steps, students may participate in this breakout activity:

- Set out a variety of packaged foods (granola bars, chips, breads, pastries, cookies, etc) that have soy listed in the ingredients.
- Have students evaluate the protein content in the label (see handout). They should reach the conclusion that, even though soy is listed, the protein content is not necessarily very high. Students may point out that soy is not listed very high up on the label, and may not make up a large enough portion of the recipe to increase protein content. This is true, but then ask why include soy at all? Food manufacturers do not include ingredients (and spend the money to do so) if they do not serve a function.
- What other function can soy serve in a food product? What other macromolecules were found in abundance in the soybean?
- Provide a brief teaser about soy lecithin, which will be taken up in the powerpoint the following day

- Once milks are sufficiently heated, continue with coagulation step.
- Have students add ¼ cup lemon juice or vinegar slowly to the milks, with slow, continuous stirring. If no coagulation occurs, continue to add acid by the tablespoon until separation is observed. Over acidification is possible, and results in small, grainy curds that are harder to form into blocks, so don't rush the addition.



- Collect the curds into cheesecloth by either transferring with a slotted spoon, or pouring the pan of curdled milk through the cheesecloth over a sink.

- Wrap tightly and press to squeeze out the excess liquid.

- This step will take several minutes and will likely involve students wrapping the cheesecloth tighter as moisture is removed. You may also consider sitting something heavy (the pot just used to heat the milk, once cooled, for instance) to press the cheesecloth bag to remove water.

- Unwrap to reveal tofu and farmer's cheese. No eating ☺

Day 3:

- Presentation on lecithin
- See PP for discussion points

Activity Bread making with lecithin

- A variety of recipes may be used in this activity, but the provided recipe is for bread dough (with and without liquid lecithin). However, the selected recipe should not have include egg, as that is another source of lecithin.
- Split the students up into their same groups of 3-4
- Have them make two batches of dough, exactly the same, following the recipe according to the handout. However, do not include lecithin in one of the doughs.

- Observe the differences in how the doughs handle. The lecithin-containing dough is likely to handle more easily and stick less to the bowl, hands, and utensils. If the dough sits out, the lecithin-containing dough will resist drying out, and will not have a dry skin on the outside when compared to dough made without lecithin.
- . It should be easier to mix and mold as well. Ease in production (“workability”) is a consideration in food production and desirable in facilities in which large amounts of product are handled daily. A possible nuance to this activity is to freeze the dough before baking. This will further exaggerate the differences in quality between the two products.
- The teacher should bake the dough following class

Day 4/5:

- Record results of the baked goods
- Have students break the bread and observe differences in air pocket formation, tenderness/toughness, and density.
- Again, no eating ☺
- Ask students to leave out the bread until the next day. Observe the differences in the “staling” process between the two formulations.
- This last component gets at the idea of shelf life, discussed in the next lesson.