LUMA CENTRE FINLAND
ChemistryLab Gadolin

Unit of Chemistry Teacher Education
University of Helsinki
Science Education Centre
LUMA Centre Finland

BLUEBERRY TRIO

Focus group: Suitable for all school levels

Length: 45 minutes

Aim: To learn about acids, bases and indicators in an inspiring and tasty way

Key words: Acid, base, indicator, molecular gastronomy, food science

SAFETY AND WASTE DISPOSAL

- This molecular gastronomy practical is not to be carried out in a laboratory
- Biodegradable waste is to be disposed of in the biowaste container

BEFORE THE PRACTICAL WORK: QUESTIONS FOR STUDENTS

What is molecular gastronomy?

Molecular gastronomy is the science of cooking; investigating the physical and chemical changes in cooking.

What is an acid?

An acid is a molecule or an ion capable of donating a proton, H^+. Acids have a sour taste, for example lemon juice is acidic.

What is a base?

A base is a molecule or an ion capable of receiving a proton, H^+. Bases have a bitter taste and feel slippery or soapy. Baking soda is an example of a base found in the kitchen.

What is an indicator?

Indicators are substances whose solutions change colour due to changes in pH. The pigment found in blueberries is an example of a natural indicator.

What is the difference between a strong and a weak acid?

The strength of an acid refers to its ability or tendency to lose a proton. A strong acid is one that completely dissociates in water. In contrast, a weak acid only partially dissociates.

What is the pH-scale?

The pH scale measures how acidic or basic a substance is. The pH scale is logarithmic and ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is acidic. A pH greater than 7 is basic.

$pH = - \log [H_3O^+]$

INGREDIENTS FOR THE QUARK LAYER

- 1 dl cream
- 250 g quark
- 0.5 dl sugar
- 1 tbsp lemon juice
- 1 dl (frozen) blueberries

INGREDIENTS FOR THE WHIPPED EGG WHITE LAYER

- 1 egg white
- 1 tbsp sugar
- 0.5 dl (frozen) blueberries

EQUIPMENT

- 2 bowls
- 1 tablespoon
- 1dl measuring cup
- 1 whisk
- 4 drinking glasses (for the portions)
- 4 teaspoons (for eating)

PROCEDURE

To prepare the quark layer:

1. Whip 1 dl of heavy cream until soft to medium peaks form.
2. Add the quark, the sugar, the lemon juice and the blueberries to the whipped cream and mix thoroughly.

To prepare the egg white layer:

3. Whip the egg white until you get a thick foam that forms firm peaks that keep their shape when you remove the whisk.
4. Add sugar to the whipped egg white and mix carefully.
5. Add blueberries and carefully mix just until the egg white turns into a blue colour. Do not overmix.

To prepare the portions:

6. Cover the bottom of the drinking glass with blueberries.
7. Add a layer of the quark you have prepared.
8. Add a layer of the blueberry egg white mixture you have prepared.

AFTER THE PRACTICAL WORK: QUESTIONS FOR STUDENTS

Why does the white egg turn into a foam when whipped?

Whipping causes the intricate 3D-folding of the egg proteins to open. The opened protein chains form a mesh-like structure, where air bubbles are caught when the egg white is whipped. A foam is thus essentially air bubbles caught in a network of protein chains.

Why does the cream turn into a foam when whipped?

Cream also contains proteins, which contribute to the formation of foam, as described in the previous question. Cream contains a larger percentage of fat than egg whites, which are almost fat-free. Fat molecules interfere with the formation of the protein mesh into which air bubbles are caught, so the formation of the foam takes longer with the cream than with the egg whites.

Why do the quark layer and the egg white layer have different colours?

Blueberry is a natural indicator and it changes colour according to the pH; blueberry is red in acidic solution and blue in basic solution. The quark layer is acidic because of the lactic acid contained in the quark and because of the acidic lemon juice that was added to this layer – in the acidic layer we see the red colour of the blueberry indicator. Egg whites are naturally basic, which is why we see the blue colour of the blueberry indicator in the egg white layer.

REFERENCES

Linnea Peurakoski (*nee* Töyrylä), Master's thesis: Argumentaation tukeminen yläasteen happamuuden kemian opetuksessa molekyyligastronomiaa soveltaen. University of Helsinki.