Aquaculture biomass:
a rich source of nutritional supplements to promote fitness and health

Lesson 2. Aquaculture biomass. Part II: BY-PRODUCTS FROM FISH

Teacher resources

This lesson is based on the following resources, which are accessible at:

https://www.aquabioprofit.eu/

Before teaching this lesson, teachers can get more information

Module 1 Unit 1

1.1 Volumes and qualities of fish side stream biomasses in Europe

Module 1 Unit 2

1.2 Fish proteins and protein hydrolysates - products and applications

Module 1 Unit 3

1.3. Fish collagen and marine oil-based supplements - products and applications

Lesson plan

Aims

To present aquaculture biomass from the fishing industry as a rich source of value-added by-products to promote fitness and health

Materials

Editable PowerPoint presentation (Presentation2-Part2-Byproducts from fish.pptx); worksheets (can be used in class or as a homework assignment); answer key

Terminology

This lesson uses some terminology that your students may or may not be familiar with. If your students are not familiar with some of this terminology, plan some time to explain it at relevant points throughout the lesson.

Specialized vocabulary used in this lesson: *by-product, side-stream biomass, fish mince, restructured fish products, fish burgers, calcium phosphate, hydroxyapatite, PUFA (polyunsaturated fatty acids), omega-3 fatty acids, processed protein, fish protein concentrates (FPC), fish protein hydrolysates, bioactive fish peptides, collagen, gelatin, chitin, pelagic sector*

Competences

Your students will be aware of a range of value-added by-products produced from side-stream biomass from the fishing industry and will be able to talk about different health-promoting nutritional supplements from such biomass.

1. **Warm-up: Slides 1** and **2**
   Aim: To introduce the topic of the lesson and bring attention to side-stream biomass of marine origin as an important value-added resource
   Slide 1 (Title): Tell students that this lesson will focus on the by-products from fish and their health benefits.
   Slide 2 (Warm-up activity, links to the previous lesson): The fishing industry produces a lot of "left over" (side-stream) biomass. This side-stream biomass does not need to be discarded. We can use it more wisely it to produce nutritional supplements that promote fitness and health. Ask: *Do you remember what goes to waste?* Elicit answers: backbone, head, skin, scales, fins, viscera.

2. **Presentation**
   - **Introduction: Slides 3** and **4**

   Aim: To draw attention to the ways we can use the by-products from fish
   Slide 3: Ask: How can we use by-products? Quickly brainstorm the class for suggestions. Then reveal the text and briefly outline the main uses of by-products.

Slide 4: By-products from side-stream fish biomass
Ask: What types of side-stream biomass does the diagram show? Elicit answers: muscle (off-cuts), backbone, head, liver, viscera, skin, scales, fins.
Draw attention to the fact that the side-stream biomass from the fishery and aquaculture industry is used in many productions. Tell students that the next slides will discuss these by-products in more details.

- **Value-added by-products from fish: Slides 5–15**

Aim: To present in detail a variety of healthy value-added products from side-stream biomass
Slides 5–15 (*Worksheets Part 2 Activity 1*) Students complete the activity item by item as you go or after you finish Slide 15. Alternatively, the activity can be assigned for homework.

Slide 5: Muscle (off-cuts). Draw attention to the picture in the top left corner of the slide.
Ask: *Can you think of any food products made from fish off-cuts?* Then reveal the text.
Slide 6: Bones. Ask: *Why are calcium and phosphorus important for you?* Elicit answers, then reveal the text.
Slide 7: Head (Part 1 – Protein hydrolysate). Give the definition of protein hydrolysate and reveal the rest of the text. Ask students if they are familiar with such products. Have they used any of them? Is anyone in their households using any?
Slide 8: Head (Part 2 – Fish oil, PUFA, pronounced /ˈpʌfə/ or /ˈpju:fə/). Explain that PUFA is an abbreviation and what it stands for. Probably students will have heard of *omega-3*. Elicit from students what they know about it.
Depending on your students' knowledge in organic chemistry/biochemistry you could explain that Omega−3 fatty acids, also called Omega-3 oils, ω−3 fatty acids or *n*−3 fatty acids, are polyunsaturated fatty acids (PUFAs) with a double bond three atoms away from the terminal methyl group in their chemical structure.
[Alternatively, you may choose to give a simpler explanation that the Greek letter omega (**ω**, lowercase; **Ω**, uppercase) or the Latin *n* followed by the number 3 are just part of the international naming conventions in chemistry.]
Slide 9: Video[1]. Tell students that they are going to watch a short video about the health benefits of omega-3 fatty acids.
(*Worksheets Part 2 Activity 2*) Students watch the video and number the benefits in the order in which they are mentioned in the video.
Play the video (2:16 min). Students watch and complete *Activity 2* in their *worksheets*. Then students check their answers with their partner and finally take turns to say what each numbered item is.

[1] The video is a cropped version of a video available on a Youtube channel devoted to weight loss and fitness diets (serious-fitness-programs.com). A hyperlink to the original version is provided at the bottom of the slide. To protect school-age students from misinterpreting the information on that channel, in the edited version of the video, the logo serious-fitness-programs.com and any references to weight loss diets have been deliberately deleted.

Note: If asked about vegan sources of omega-3s, you can mention chia seeds, ground flaxseed, flaxseed oil and canola oil, to name a few.

Slide 10: Liver. Ask students if anyone has tried any of the products mentioned on the slide. If yes, did they like them?
Slide 11: (*Worksheets Part 2 Activity 3*) Viscera. Outline three main types of processed protein. Give students some time to complete *Activity 3* in their *worksheets,* then check it.
Slide 12: Highlight that processed fish protein has many health benefits.
Slide 13: Skin. Are your students familiar with the words *collagen* and *gelatin*? They will have probably heard collagen advertised in some cosmetics and/or seen gelatin used in the kitchen.
Slide 14: Scales. Chitin /ˈkaɪtɪn/. Your students may be familiar with chitin as a component of fungal cell walls and/or arthropod exoskeleton. The emphasis here, however, is on fish scales.
Slide 15: Fins. Highlight that they are used for production of animal feed and bioenergy.

3. **Ending the lesson: Slides 16–19**
   Aim: To review the main concepts of the lesson.
   Slide 16: Explain that although the side-stream biomass from fish can be used to produce many added-value by-products, it is not always economically feasible to do so.
   Slide 17: Finish on a positive note that the pelagic sector and the aquaculture sector utilise nearly all the side-stream biomass.
   Slide 18: *The end* sign
   Slide 19: Final credits, project-related hyperlinks

Answer key

Activity 1. 1e, 2g, 3b, 4d, 5f, 6h, 7c, 8a (Also see Slide 4 in the presentation)

Activity 2:

1. Good for your **heart**
2. Good for your **brain**
3. Good for your **eyes**
4. Good for your **hair**, **skin** and **nails**
5. Can potentially help prevent some types of **cancer**
6. Can help you **sleep** better

Activity 3.

1. **Fish protein concentrates (FPC)** are powder preparations where the protein is more concentrated than in the original fish source.
2. **Fish hydrolysates** are proteins that are enzymatically broken down into smaller peptides.
3. **Bioactive fish peptides** are specific protein fragments that have a positive effect on body functions and are good for your health.
4. Processed fish proteins have many **health benefits**. They have a high nutritional value and can act as antioxidants and antimicrobials, can control blood pressure and modulate the immune system.