

Examining How Proteins are Denatures in Unfavoured Environments

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Recommended Audience:

This activity is recommended for undergraduate biology students that have been learning about proteins in class.

Time to Complete:

This activity will likely take 15-20 minutes. 5-10 minutes for demonstration and 5-10 minutes for student reflection.

Inquiry Question:

How are protein conformations impacted by the environment?

Student Activity

Observation Activity:

In class teacher or students will cook an egg and/or whisk egg whites depending on resources and time. Watch what happens to the egg whites as the temperature increases and as they are whisked.

Predict:

Before watching/doing the demonstration predict what the egg will look like after being cooked or whisked. Also predict what you think is causing the change in appearance.

Examine the Demonstration:

After seeing/doing the demonstration and looking at the provided figure, what can be determined about the effect of environment on the egg's proteins in both scenarios?

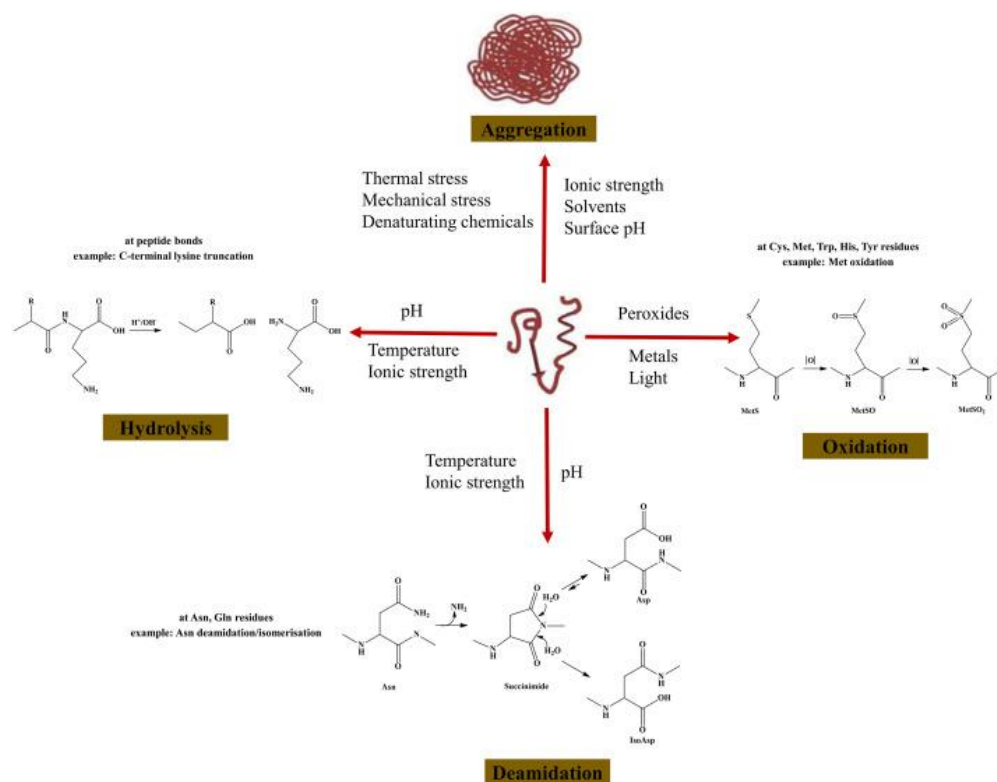


Figure 1. Causes of protein denaturation and resulting protein (Butreddy et al, 2020).

Explain:

Based on the demonstration and the figure what can be concluded about environmental impact on protein denaturation? What other evidence or resources could aid in your understanding and conclusion?

Instructor Guide

Purpose of the Activity:

This activity is intended to demonstrate how protein folding is affected by environmental changes by giving an everyday example of eggs. The hope is that by using cooked eggs and whisking students will be able to connect their learning to a daily reaction they can all understand.

Materials needed:

Eggs, Whisk, Pan, Hot Plate, Spatula, Bowl

Facilitation Notes:

This activity is meant to be introduced during lessons about proteins to better understanding of protein denaturation. The activity should begin by allowing students to predict what is happening to the egg as it cooks or is whisked. The instructor should then demonstrate the activity or facilitate the students completing the activity and allow time for students to discuss and explain their thinking.

Rough Answer Key:

Cooked egg: Students should connect the change in egg white colour from clear to white with the denaturation of proteins. They should connect to figure 1 and explain that the change is likely caused by temperature causing deamidation (Butreddy et al, 2020).

Whisked egg: Students should note observation of the whisked egg becoming foamy and is clearly visually different from the prior clear state. Students should connect to figure 1 that mechanical stress from whisking is causing protein aggregation (Butreddy et al, 2020).

Students should note that these are just examples of protein denaturation and not the only causes.

Safety:

Beware of hot surfaces you are working with, know where you are in relation to the hot plate and to the cooked egg and hot pan. Hair should be tied back, and no loose clothing should be near the heat.

Accessibility:

To make the activity accessible if the teacher is performing the demonstration, it can be broadcasted to a bigger screen for students to be able to better visualize the activity. If hot surfaces are too much of a risk the whisking alternative is a good safe option.

Connection to SDG 4:

This activity allows the topic of protein denaturation to be more accessible to students by connecting the lesson topic to something they see in daily life. This allows students to connect the ideas discussed in class with real life visual examples to aid in understanding.

References:

Haurowitz, F. (2026). Protein denaturation. Britannica.

<https://www.britannica.com/science/protein/Keratin>

Butreddy, A., et al. (2020). Instability of therapeutic proteins – an overview of stresses, stabilization mechanisms and analytical techniques involved in lyophilized proteins.

ScienceDirect. <https://www.sciencedirect.com/science/article/pii/S0141813020351242>

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