Team Image 3

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MCEN 4151: Flow Visualization

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5/1/2014

Introduction

This image was created for the third team image in the University of Colorado's Flow Visualization course. This image shows the change in properties of an egg when it is whipped into hard peaks by sculpting it into a dog shape.

Visualization and Photographic Technique

The materials used include white poster board, white Tupperware lid, egg whites, stand mixer, butter knife, Olympus micro four-thirds camera, and an incandescent lamp. The lighting was provided by an overhead incandescent lamp. The egg whites were whipped for approximately 4 minutes in the stand mixture to change their properties. They were sculpted with a butter knife to show the how stiff the final material was. The sculpture was then placed on a white Tupperware lid with a white poster in the background. The dog was approximately 3 X 1 X 2 inches in size. The camera was placed about 4 inches from the sculpture. A schematic for the setup is shown in Figure 1.

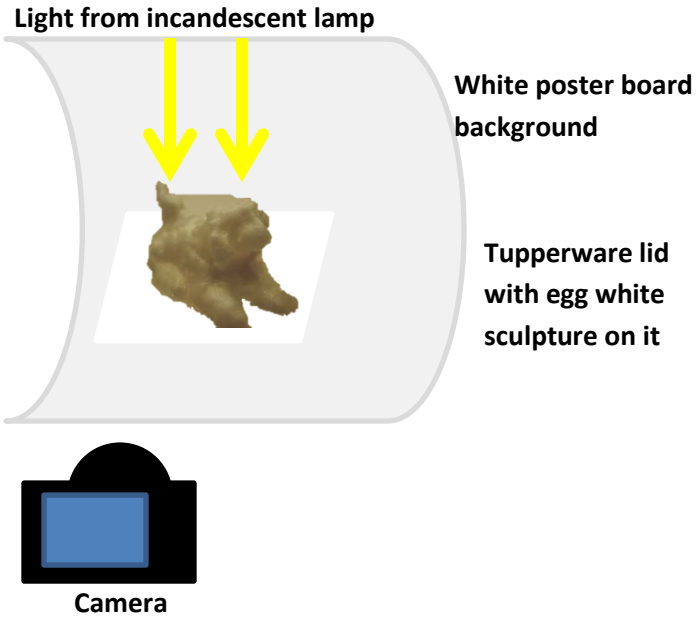

Figure 1: Setup

This photo was taken with an Olympus E-PM2 micro four-thirds camera with a 14-42mm zoom kit lens. It was shot in macro mode with an f-stop of f/4.0, exposure time of 1/60 seconds, ISO of 320, and focal length of 20 mm. The camera was on a tripod for added stability. The unedited image, shown below, is 4608 x 3456 pixels.

Figure 2: Original Image

The main problem with the original image was the white balance, probably because of the incandescent lighting. In post-processing in Gimp 2.8, the curves function was used to adjust the saturation of the image. Unsharp mask was used to further define the bubbles in the egg whites.

Description of Flow

When egg whites are whipped, their volume can expand six to eight times in size (Greene.) They also become more stiff. The change in the physical properties of the egg whites is caused by the introduction of air bubbles to the fluid. Egg whites are composed of 10.5% proteins and 85% water (Zayas 287.) The main protein is called ovalbumin. In long protein chains, there are hydrophobic (water-fearing) and hydrophilic (water-loving) parts. In an egg's natural form, they are folded such that the hydrophilic sides are on the outside (near the water), but when the eggs are whipped, the proteins are denatured. Denaturation is caused when heat created when whipping the eggs causes the molecules in the proteins to vibrate so much that the secondary and tertiary bonds that keep the chain held in its folded shape break (Ophurdt.) When these bonds are broken, the proteins wrap around the bubbles such that the hydrophobic sides are towards the center of the bubble as seen below in Figure 3.

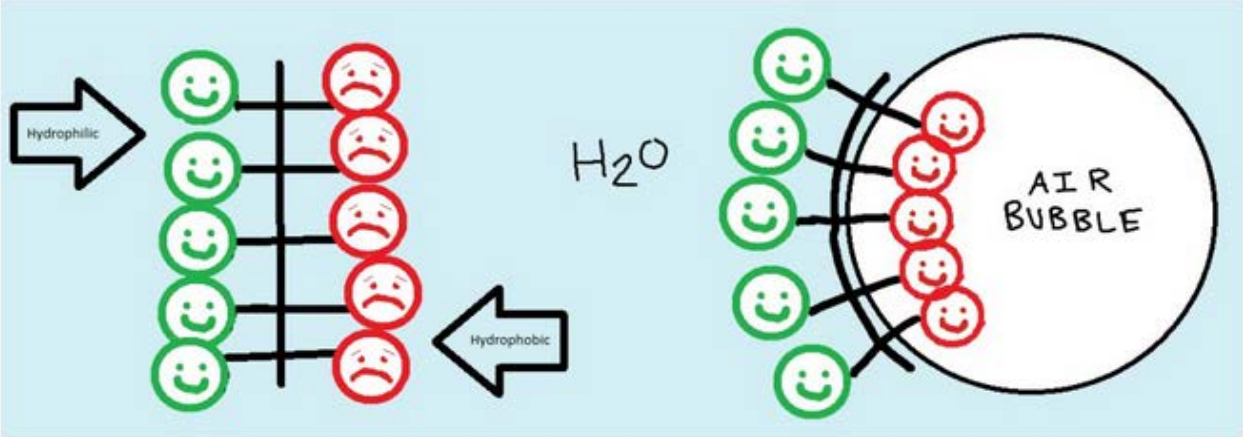

Figure 3: Orientation of Proteins in Whipped Egg Whites (Greene)

This orientation causes protein chains to create secondary bonds with other proteins in the suspension. These secondary bonds cause the stiffness seen in whipped egg whites. The air bubbles in the whites cause the expansion in volume.

Discussion and Reflection

The image successfully fulfilled the intent of showcasing the properties of a whipped egg white. Artistically, it used a creative shape that showed the stiffness of the egg white and bubbles could be seen in the photo, illuminating the science behind the fluid's properties. If the image were to be replicated, better lighting would be used as well as a different-colored background that showed the edges of the whipped whites better.

References

Greene, Amanda. "Egg Foams - Decoding Delicious." *Decoding Delicious.* N.p., 6 Feb. 2013. Web. 23 Apr. 2014. <http://www.decodingdelicious.com/egg-foams/>.

Ophurdt, Charles E. "Denaturation Protein." *Denaturation Protein.* Elmhurst College, 2003. Web. 23 Apr. 2014. <http://www.elmhurst.edu/~chm/vchembook/568denaturation.html>.

Zayas, Joseph F. *Functionality of Proteins in Food.* New York: Springer, 1997. 287-91. Print.