

Stability of Egg White Foams

Introduction

In this activity we will compare the stability of egg white foams with various additives.

Material

4 Eggs

Lemon

Vegetable Oil

Cream of Tartar

Glass or ceramic bowl

Electric mixer

4 funnels

4 small beakers



To Do and Notice

Bring 4 eggs to room temperature by removing from the fridge $\frac{1}{2}$ hour before the activity is to begin. Take one egg and separate the white from the yoke. Discard the yoke and place the white in a glass bowl. Beat the egg white with the electric mixer set to a medium speed for four minutes. Take note of the foam quality. Immediately transfer the egg white foam to a funnel and place on top of a graduated cylinder or small beaker to catch the run off.

Repeat the above procedure with the remaining three eggs, one with the addition of $\frac{1}{2}$ teaspoon vegetable oil, another with the addition of $\frac{1}{2}$ teaspoon lemon juice, and the third with the addition of $\frac{1}{16}$ teaspoon cream of tartar.

Observe the quality of each foam immediately after mixing and after $\frac{1}{2}$ hour.

Which sample has the greatest volume immediately after mixing and after $\frac{1}{2}$ hour?

Which sample has the least run off after $\frac{1}{2}$ hour?

Which sample is more stable?

What's going on?

Egg white foams are used in baking as a leavening agent. When beaten, egg whites can swell to eight times their original volume. The secret to egg whites incredible ability to form a stable foam are the albumen proteins.

A foam is made up of tiny gas bubbles dispersed throughout a liquid. In beaten egg whites the albumen proteins unfold and align themselves at the liquid-gas interface of the tiny bubbles reinforcing the bubble walls creating a stable foam.

The addition of various ingredients can either heighten or hinder the ability of an egg white to form a stable foam. Acid, in the form of cream of tartar (tartaric acid) or lemons (citric acid), has a beneficial effect on the stability of egg white foams. This small addition of an acid changed the pH of albumen from 9 to 8 increasing the number of hydrogen ions ten fold lowering the reactivity of the protein molecules and reducing their ability to bond to each other. This prevents the coagulation of the proteins and the collapse of the foam.

Oil and egg yolks have a negative effect on the volume and the stability of egg white foams. Fats prevent coagulation. The lipoproteins in the yoke tend to bond with the proteins in the albumen preventing protein to protein coagulation within the egg white. Fatty materials also collect at the liquid gas interface interfering with the protein alignment therefore decreasing the stability of the foam.

Going Further

Try beating egg whites in a copper bowl.

Compare the beating time and stability of fresh eggs verses old eggs, or room temperature egg whites verses refrigerator temperature egg whites.

References

McGee, Harold. *On Food and Cooking: The Science and Lore of the Kitchen*. New York: Collier Cooks, 1997.

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