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I Scream, You Scream...

A New Twist on the Liquid Nitrogen Demonstrations

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Placing fruit and rubber balls in liquid nitrogen is a staple in the cupboard of demonstration activities. In case you missed it, Kurti and This-Benckhard (1) have suggested a culinary delight that makes a wonderful addition to any outreach program: instant ice cream. Stirring together equal volumes of ice cream or sorbet mix and liquid nitrogen gives the abundance of air bubbles and minute ice crystals that produce a smooth, light consistency. Rather than as a demonstration, we incorporated instant ice cream as a hands-on activity for middle school students at the end of our "Week of Chemistry" programs this summer, with delicious results!

The Recipes

We expect that any recipes for ice cream bases that work in home ice cream machines will work with the instant freeze technique. We have tried a traditional (high fat) cooked custard, two no-cook bases, and a citrus sorbet recipe from the Donvier Ice Cream book (2). All of them work well but require effort to prepare ahead of time. We have also tried samples of commercial soft-serve and frozen yogurt bases donated by a local ice cream shop; these mixes are convenient to use.

French Vanilla

Combine 12 eggs yolks with sugar ($1\frac{1}{3}$ cups) and flour (4 teaspoons) in a small bowl; whisk until smooth. After heating a mixture of milk (4 cups) and heavy cream (4 cups) to simmering in a large saucepan, remove from heat. Add 3 cups of the hot milk and cream to the yolk mixture with constant whisking, then return it to the saucepan. Heat and whisk the combined ingredients over a low to medium heat until it thickens into a light custard. Pour the custard into a bowl for cooling, stirring in vanilla extract (4 teaspoons) before covering. Stir the mixture intermittently while it cools to room temperature, after which it should be chilled in the refrigerator.

Vanilla

Combine milk (4 cups) and heavy cream (4 cups) with superfine sugar ($1\frac{1}{3}$ cups). Whisk or blend with an electric mixture until the sugar dissolves. Stir in vanilla extract (4 teaspoons). This mixture may be pre-chilled or used immediately. A lower fat (ice milk) version may be prepared by using low-fat milk and substituting whole milk for the heavy cream.

Chocolate-Chip-Almond

Same as the Vanilla, with the addition of chopped chocolate-covered almonds (6 oz) at the same time as the vanilla extract.

Strawberry-Citrus Sorbet

(Any mixtures that include fruits should not be prepared or stored in metal bowls for very long.) Puree sliced

strawberries (4 cups), orange juice (1 cup), and lemon juice (2 tablespoons) in a blender. Chill the mixture or use immediately.

The Procedures

A new, clean Dewar flask for the liquid nitrogen should be dedicated to use with food for obvious reasons.¹ We used Thermos bottles to transport the prepared ice cream bases from home. The 2 quart recipes are enough to give 30-35 people a taste of instant ice cream.

Big Batches

Usual precautions should be observed (goggles and gloves) when cooling and stirring 1-2 quarts of the ice cream mixtures as the liquid nitrogen splashes considerably.

Individual Portions

If you judge members of your audience capable of handling 4-6 oz of liquid nitrogen, we recommend a hands-on version of instant ice cream. The low volume of liquid nitrogen needed to cool a small amount of ice cream mixture makes this an acceptable risk (goggles and gloves are still recommended). We distributed 2 quarts of ice cream mixture into 20 14-oz plastic foam cups (makes each cup about one-quarter full), and added a plastic spoon to each one, about 15 min before cooling. After explaining the activity to the students, we gave them some safety precautions and asked them to pair up so they could take turns stirring. We half-filled each of the students' cups with liquid nitrogen as they stirred the mixture, and most of them needed to return for a little more nitrogen as the mixture froze (the amount of nitrogen initially added to the uncooked ice cream and ice milk bases should be kept low as they foam considerably until cooled). Within 60 seconds of stirring, the nitrogen had boiled away and there was enough ice cream in each cup for two students to have a taste.

Bon Apétit!

Acknowledgement

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Literature Cited

1. Kurti, N.; This-Benckhard, H. *Sci. Amer.* **1994**, 270 (4), 66-71.
2. Chalmers, I. *Donvier Ice Cream*; New York: Penguin Books, 1987.

¹During the sessions, we use a plastic foam cooler for liquid nitrogen instead of using a Dewar flask so that three of us can dispense liquid nitrogen simultaneously (by scooping it out with plastic foam cups) in a controlled manner.