Your freezer temperature may not be what you think it is

Don Mercer
Associate Professor, Department of Food Science
University of Guelph

During the past few months, I've been looking at the freezing rates of various food products. While this may not seem particularly exciting to anyone else, there were a few things that struck me as being significant – and they might also help you understand what is actually going on in your freezer.

In each freezing test, I put two samples of product in the freezer and inserted temperature sensor probes into them. In order to monitor the temperature of the air around the samples, I suspended a temperature sensor from one of the freezer racks. The three temperatures were monitored over the course of ten to twelve hours to ensure that the samples were completely frozen.

I knew that there were fluctuations in temperature within home and industrial freezers, but I had never bothered to doing any tests to get any actual data. These fluctuations are similar to what you may notice with your home heating system where the furnace goes on when the temperature falls below a certain desired set-point. Once the furnace has heated your home to slightly above the set-point, it shuts off until the temperature falls again. This on-off cycling continues in order to maintain a comfortable temperature.

I was also aware of the self-defrosting feature on many freezers which involves a short period where the temperature of the air in the freezer is raised to help sublimate the frost that has built up on surfaces within the freezer. Sublimation is the process where ice crystals are converted directly to water vapour without going through the liquid water phase. Once again, I had never taken the time to look at this in any detail. However, thanks to my freezing tests, I now had an abundance of data.

Looking at the graphs of the temperatures for each normal test, it became evident that the temperature was cycling between about minus thirteen and minus twenty degrees Celsius. This is the top graph in our photo. The dots on the graphs show the temperature at fifteen minute intervals. While these fluctuations weren't desirable, they were consistent. You can also see how the temperature rose when the door was opened to put the probes in the freezer. This is at "time zero" in the top graph. So you should not open the door excessively, and you should not keep it open very long, or you will raise the internal freezer temperature. That's rather obvious, I know.

In a few of the trials, the air temperature in the freezer rose to about minus seven degrees Celsius. This was during the defrost cycle. While the frost is being removed from the freezer, the surface of the food can also warm up inside the packages. Moisture within the food that is in the form of ice crystals is then converted to water

vapour which ultimately condenses on the inner surface of the packaging material. It then freezes and we start to get a build-up of ice crystals inside the packages. As the freezer goes through more and more defrost cycles, more and more water is removed from the food, and the ice crystals continue to grow on the inside surface of the package. This removal of water from the food is what we call “freezer burn”.

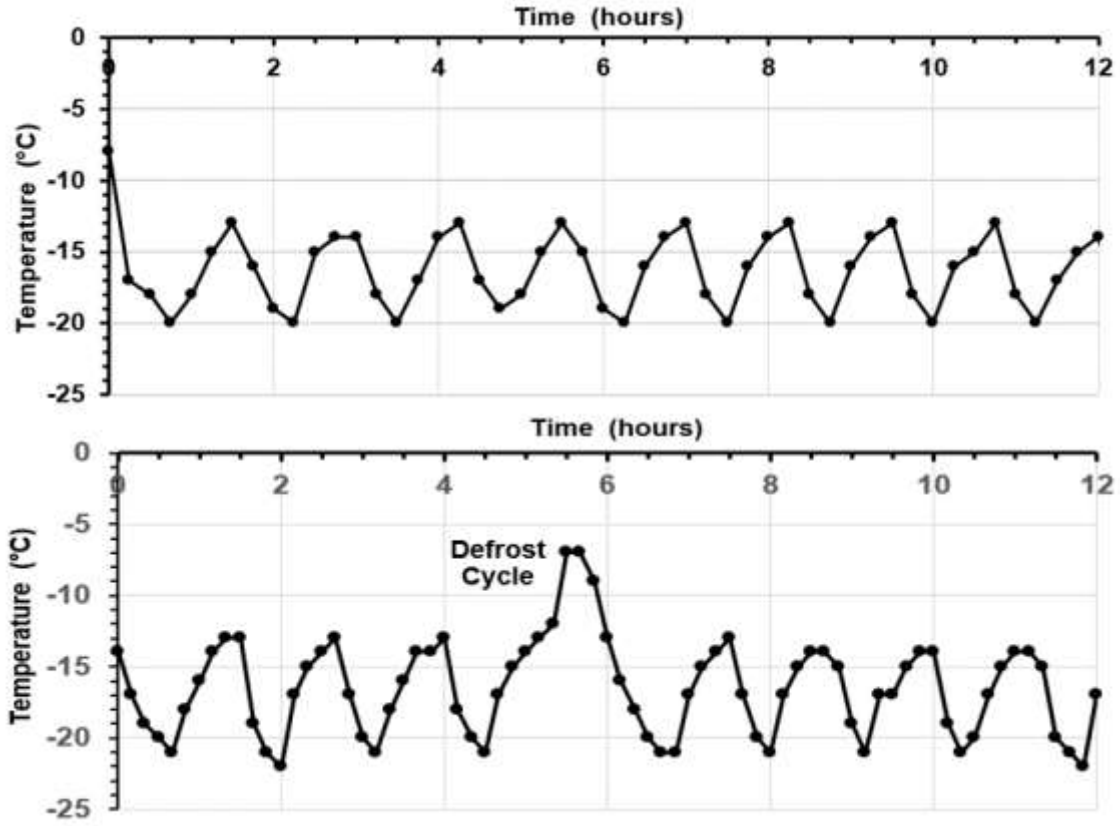
Home freezers should be kept at about minus eighteen degrees Celsius, or a bit lower. At temperatures above this, things like ice cream are not frozen solid and their quality can suffer accordingly. The freezer in my study averaged about minus seventeen degrees Celsius, so we turned it down a degree or two after the tests were completed.

If you keep food in your frost-free freezer for too long, it will become dehydrated to the point where it is no longer usable. There is really no way that you can get moisture back into the tissues of the food material after it has become freezer burned. This is especially heart-breaking when you see how much food is being wasted when you thought it would stay good forever.

Some people to whom I have spoken think that the ice crystals are getting into the packages because water is travelling through the wrapping from the outside. That’s not generally possible since air inside a freezer is so dry that there is not enough moisture present to diffuse through the packaging.

So what’s the take-away message from all this? Basically, you should not leave food in your freezer for excessively long periods of time. Even though it’s hard to do, try to have a “first in – first out” approach where you don’t just pile the new stuff on top of the old stuff. Piling it in will result in what resembles an archaeological dig, when you dive down to the bottom or back of the freezer and discover something you put there months, or even years, ago.

You should also check your freezer temperature to ensure that it is set at the proper level. If your ice cream seems a bit waxy and there are ice crystals on the surface, this may be the reason.



The top graph shows the normal fluctuations in the freezer temperature. The bottom graph shows how the temperature rises noticeably during a defrost cycle.