THE RIGHT TEMPERATURE IS IMPORTANT WHEN MAKING TOFFEE

QUESTION: Before Christmas I usually make toffee and I boil the mixture in our microwave oven. The mixture I use has to be heated to a specific temperature within the range of 120 to 140 °C. When I need to measure the temperature, I take out the bowl and stir the mixture and then use a food thermometer. My colleague at work says that stirring is not necessary because in a microwave oven the mixture becomes evenly hot. Is that true?

Pelle B

ANSWER: Microwave oven manufacturers try to create a microwave field that is as even as possible. To compensate for any inconsistencies in the field, they use a rotating plate on which to put the food. The microwaves only heat the toffee mixture, which consists of granulated sugar, syrup, cream etc. In turn, the mixture heats the bowl via thermal conduction and the air via convection. The inside of the bowl above the mixture is heated by the air via convection and radiation from the mixture. The heat transfer in the bowl itself occurs via thermal conduction. The outside of the bowl heats the air inside the oven via convection. The microwave oven's walls, floor and ceiling are heated by convection from the air and radiation from the bowl. Parts of the oven's walls and ceiling are also heated by radiation from the mixture. The rotating plate is heated by thermal conduction from the bowl, convection from the air, and radiation from the bowl and the oven's walls, ceiling and floor. In this case, the mixture and also the bowl become very hot and the temperature is influenced by such factors as how the oven's cooling and ventilation systems are designed.

The heat transfer from the toffee mixture to the bowl and the heat transfer from the surface of the mixture cause temperature differences in the toffee even if the microwave field is uniform. Pelle B is clearly a meticulous toffee maker. In this case, it is a good idea to stir the mixture to achieve as even a temperature as possible prior to measuring the temperature. Knowing the mixture's temperature is very important so that he can stop the boiling process at precisely the right temperature that will result in the type of toffee he wants to make.

In this case, heating the mixture should be stopped when it reaches a specific temperature within the range of 120 to 140 °C. The higher the temperature selected within this range, the harder the toffee will be. It is important to use a thermometer with a short response time so that the measuring process does not take longer than necessary. Because the range within which the boiling process must be stopped is relatively narrow, the thermometer must be calibrated in order to produce toffee with the desired hardness.

If you have questions or comments, contact Professor Emeritus Dan Loyd, LiU, dan.loyd@liu.se

QUESTION ? ANSWER

Questions should be of general interest and be about temperature measurement techniques and/or heat transfer.

Pentronic's recipe for good toffee:

Makes: 30 pieces
- 100 ml granulated sugar
- 100 ml whipping cream
- 100 ml syrup
- 1 tbsp butter or margarine
- 2 tbsp peeled and chopped almonds

Mix the sugar, cream and syrup in a bowl that can hold 2–3 litres and is microwave oven proof.

Place the bowl in the microwave oven, heat at maximum power, and monitor the mixture's temperature so that you get the desired consistency of the toffee.

At 120–140 °C the toffee mixture will have boiled for long enough. The hotter the mixture, the harder the toffee will be.

When you have achieved the right consistency it is time to stir in the almonds and butter/margarine. Then divide up the mixture into the paper candy cups.

Good luck!