

By how much does salt increase the boiling point of water?

Introduction

Heston Blumenthal is one of the top chefs in the country – his restaurant, The Fat Duck, has three Michelin stars, the highest rating. He is noted for his scientific approach to cooking – he regularly asks the question ‘*why?*’ rather than accepting what other chefs say, and he devises and carries out experiments to try to find answers.



Heston Blumenthal in The Fat Duck

One question posed by Heston Blumenthal early in his career as a ‘scientific chef’ was ‘*Why do cooks add salt (sodium chloride) when cooking vegetables, for example green beans?*’ Possible reasons suggested by cooks included:

- it keeps the beans green
- it raises the boiling point of water so the beans cook faster
- it prevents the beans going soggy
- it improves the flavour.

Adding the amount of salt used by cooks *does* increase the boiling point of water but only by a small amount. Heston was able to find this out by consulting a scientist, Peter Barham from Bristol University. Your task is to find out how much this increase is by doing an experiment. Measure the boiling point of pure water and of a series of salt solutions containing different amounts of salt. A graph would help you interpret your results. You will need to estimate the concentration of salt usually used by cooks when cooking beans.

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Apparatus and equipment

Your group will need:

- retort stand, boss and clamp
- boiling tube
- Bunsen burner and heatproof mat
- thermometer 0–110 °C or a digital thermometer, if available, ideally measuring to 0.1 °C
- spatula
- glass rod
- 250 cm³ beakers



Cooking with salt

- 100 cm³ measuring cylinder
- access to a top pan balance.

Chemicals

Your group will need:

- salt (sodium chloride)
- anti-bumping granules
- your teacher may give you a concentrated solution of sodium chloride to dilute.



Safety

- Wear eye protection.
- Take care with boiling water.



Measuring the boiling point of a salt solution

Method

You will need to measure the boiling points of several solutions containing different amounts of dissolved salt. Make sure that the salt is dissolved fully before measuring the boiling point.

Discuss with your partner(s) what solutions to make and how to make them (by adding weighed amounts of salt to water or by diluting a concentrated solution of salt).

To measure the boiling point, place enough salt water in a boiling tube to comfortably cover the bulb of your thermometer. Add a couple of anti-bumping granules (these are glass beads that make the liquid



Cooking with salt

boil more gently but do not change the temperature). Clamp the tube vertically and heat with a *small* roaring Bunsen flame until it is boiling. Place the thermometer in the boiling liquid taking care that the bulb is fully immersed in the liquid and is not touching the side or base of the tube. Record the boiling point when the temperature is steady.

What is the effect on the boiling point of water of adding the amount of salt that cooks usually use? Do you think that this would make a significant difference to the cooking time?