Biotechnology: juicing apples

Transcript

Apple juice can be clear or cloudy. Cloudy apple juice contains tiny fragments of apple tissue, clear apple juice does not.

Apple juice is made commercially by chopping apples into small pieces, pulping the apple pieces to break open the cells, and then squeezing out the juice.

However, pulping the apple doesn't break open *all* of the cells because the cell walls contain pectin. Pectin strengthens the cell walls and sticks cells together.

Pectinase is an enzyme that breaks down pectin. It is used commercially to help separate the cells and break open more cells, resulting in the release of more juice from the same amount of apple.

Using enzymes in an industrial process like this is an example of biotechnology.

This experiment will demonstrate why pectinase is used to help produce over a million tonnes of apple juice a year.

Apple juice will be made from two apple samples.

One sample will be incubated with pectinase and the other sample will be incubated with distilled water; this is the control.

The apple sample from each beaker will be filtered to separate out the juice, and the volume of juice collected will be recorded.

Apple juice is made commercially from whole apples so there is no need to peel them or remove the stalks. The apple is cut into small pieces about 5 mm by 5 mm in size. The smaller the pieces, the greater the number of cells that can be reached by the pectinase. Cutting is done on a white tile and the sharp knife is handled carefully.

50 g of apple is needed for each sample. A beaker is placed on the balance and the mass is reset to zero. The apple is added slowly until the balance reads 50 grams to one decimal place.

This is repeated to create a second sample of equal mass.

One of the beakers is labelled with the letter ‘C’. This is the control. The other beaker is labelled with the letter ‘E’. This is the beaker to which pectinase will be added. The apple pieces are gently crushed into a pulp using a glass rod.

Four centimetres cubed of distilled water are added to sample ‘C’. The plunger of the syringe is drawn up until the top ring of the stopper is at four centimetres cubed on the scale.

A glass rod is used to gently mix the sample to make sure the water is evenly distributed.

The beaker is then covered with cling film to prevent evaporation.

A clean syringe is used to add four centimetres cubed of pectinase to sample ‘E’.

Before the beaker is covered with cling film, a glass rod is used to gently mix the sample to make sure the pectinase is evenly distributed. The timer is immediately started after the cling film is added, as the pectinase will already have started working.

Both beakers are left to incubate at room temperature for 20 minutes.

While the apple samples are incubating, a funnel is placed into each of the two measuring cylinders and a piece of coffee filter paper is added. The filter paper contains pores that will allow the juice to pass through but not large pieces of apple. This separates the juice from the pulp.

The two measuring cylinders are labelled to avoid mixing up the samples.

After 20 minutes the beaker labelled ‘E’ is emptied into the funnel in the measuring cylinder labelled ‘E’. All of the contents of the beaker are used.

Then the contents of beaker ‘C’ are emptied into the funnel for sample ‘C’. All of the contents of the beaker are used.

The samples are left to filter until there is no more juice coming from either funnel.

The last drops are usually seen after about 10 minutes.

The volume of apple juice collected from sample E is recorded as is the volume from sample C.

A greater volume of juice has been extracted from the apple incubated with pectinase.

For a more accurate interpretation of the results, the percentage increase in volume is calculated using this formula.

First, the difference between the two volumes is calculated. 32 centimetres cubed was collected from Sample E, and 19 cm cubed from sample C.

The difference is13 cm cubed.

The difference is divided by the volume of apple juice in the control sample, and the result is multiplied by 100.

In this experiment, the addition of the pectinase to the apple led to a 68% increase in the volume of apple juice produced in the same amount of time from the same mass of apple.

Look at the juice in both cylinders again. What else can be observed?

The apple juice collected from sample ‘C’ is more cloudy and darker than the apple juice collected from sample ‘E’.

The pectinase in sample E has broken down the tiny fragments of tissue in the apple juice to give it a lighter and clearer appearance. The addition of more pectinase or a longer incubation time, will likely have led to completely clear apple juice.

This experiment showed that 68% more apple juice was produced by using pectinase, which is why commercial apple juice manufacturers use this sort of biotechnology. Pectinase also creates clear apple juice, giving consumers the choice between clear or cloudy juice.