

# More juice from apples

**ENZYMATIC JUICE EXTRACTION** from apples was introduced 20 years ago and today some 3–5 million tons of apples are processed into juice annually throughout the world.

The commercial production process is as follows. After they have been crushed, apples are usually left for 20–30 minutes so that enzyme inhibitors in the pulp are oxidised. The pulp is then heated to 30°C before pectinases are added (this compares with a temperature of 50–60°C which is needed if enzymes are not used). Enzyme treatment takes anything from 15 minutes to 2 hours depending upon the exact nature of the enzyme, the dosage rate, the reaction temperature and the variety of apple used. Some varieties, like *Golden Delicious*, are notoriously difficult to break down. During incubation, the pectinases degrade soluble pectin in the pulp, making the juice flow more freely. Next the apples are pressed. Yields of juice may be increased by up to 20% by enzyme treatment, depending upon the age and variety of apple used and whether pre-oxidation is employed. Pectinase treatment is particularly effective with mature apples and those from cold storage. Significant increases in yield are not usually achieved from fresh, early season fruit.

## Materials

Whole apples or apple pulp (this can be prepared beforehand or bought as tinned apple)  
Pectinase enzyme, Novo Nordisk *Pectinex*®, 1 cm<sup>3</sup> (available from the NCBE). *Dilute with an equal volume of water immediately before use.*  
Coffee filter papers, 2  
Knife (if pre-pulped apple is not used)  
Glass stirring rods, 2  
1 cm<sup>3</sup> syringes, 2 (for measuring out enzyme and water)  
Filter funnels, 2  
100 cm<sup>3</sup> measuring cylinders, 2  
100 cm<sup>3</sup> beakers, 2  
Water bath, set to 40°C  
Stopclock

## Practical details

1. Chop one medium-sized apple into small pieces. Put half into one beaker, and half into another.

2. Add 2 cm<sup>3</sup> of diluted pectinase enzyme to one of the beakers, and 2 cm<sup>3</sup> of water to the other.
3. Stir the beakers' contents with a clean glass rod.
4. Incubate the beakers in a water bath at 40°C for 15–20 minutes.
5. Filter the juice from the apple pieces, using coffee filter papers in funnels placed in measuring cylinders.
6. Record the volume of juice obtained from both lots of apple pulp at 5-minute intervals.

## Safety

Juice prepared in this way should NOT be consumed. The proportion of enzyme used is far greater than that employed in commercial production, where typically, 130 cm<sup>3</sup> of enzyme is added for every ton of apples!

Care should be taken by pupils when they are handling knives to chop the apple. Enzyme spills should be wiped up promptly and the area washed with water.

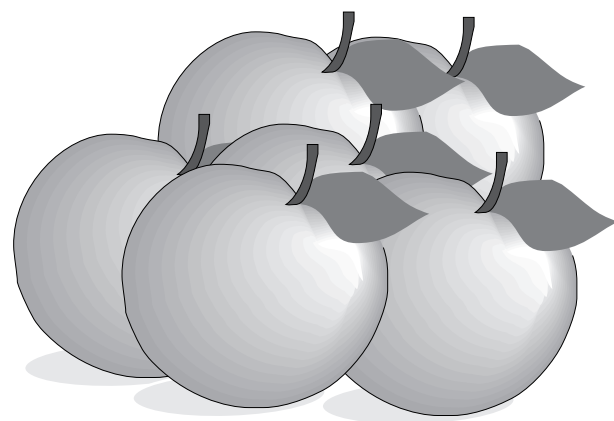
## Further activities

1. Compare the yield of juice from different varieties of apples (or other fruits).
2. Investigate the effects of enzyme dosage and incubation temperature on juice yield.
3. Compare the yield of juice from pulp which has or has not undergone pre-oxidation.
4. Does the addition of cellulase to the pulp enhance the yield of juice? Do pectinase and cellulase in combination further enhance yields?



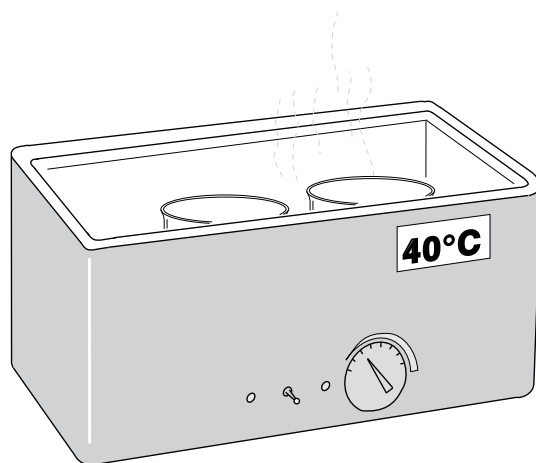
## ADDITIONAL INFORMATION

Madden, D.  
(1991) 'In a jam  
and out of juice'  
*NCBE Newsletter*,  
Winter 1991, pp.  
1–5.

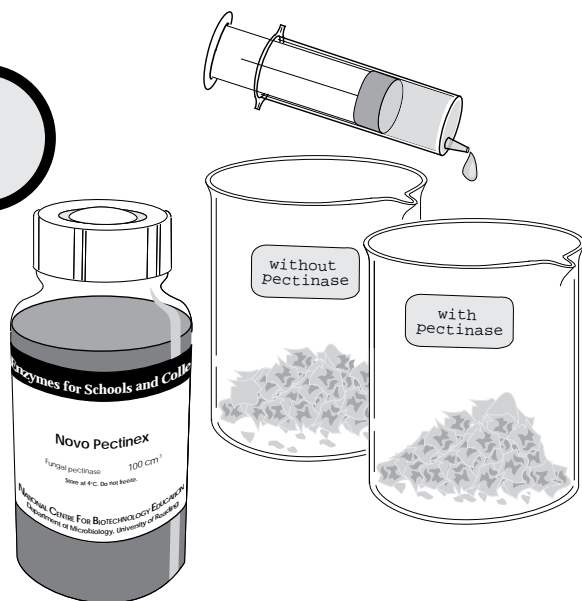


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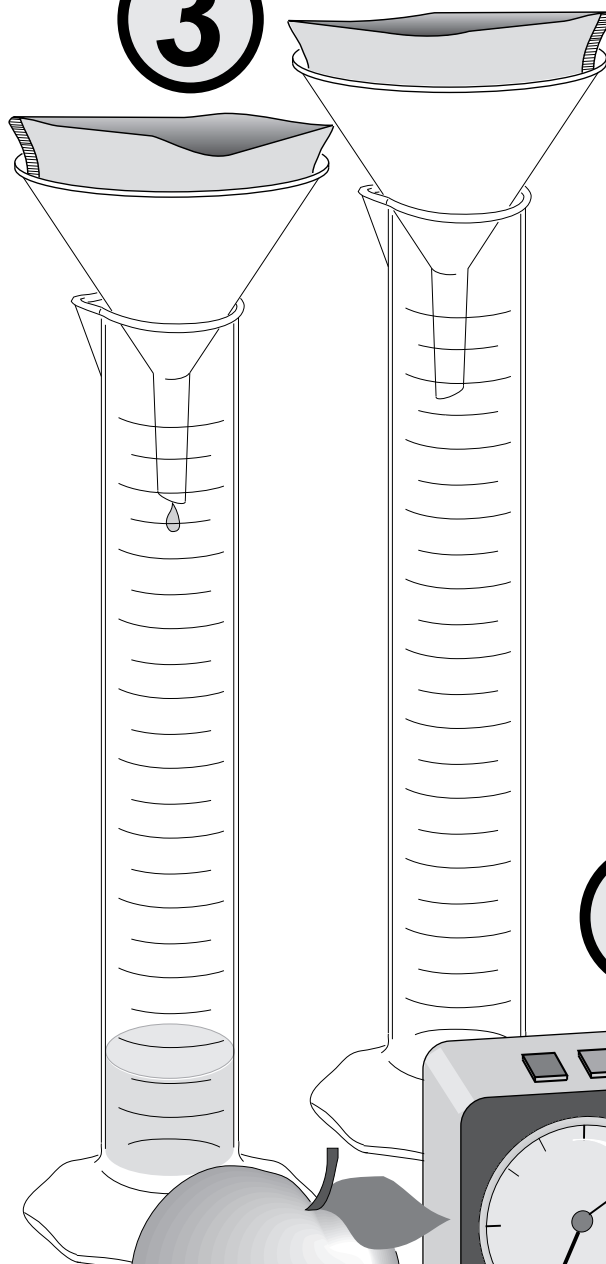
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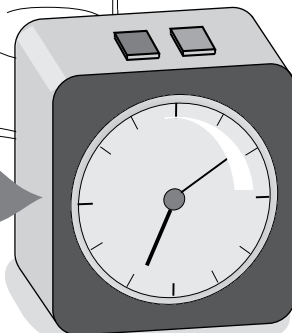
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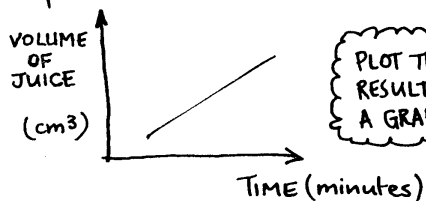


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## INSTRUCTIONS

- ① Cut up the apple into small pieces. Put half into one beaker, and half into another. Add  $2\text{cm}^3$  of pectinase enzyme to one beaker, and  $2\text{cm}^3$  of water to the other.
- ② Incubate both beakers at  $40^\circ\text{C}$  in a water bath for 15 minutes.
- ③ Filter the juice from the apple pieces.
- ④ Record how much juice has been produced at 5 minute intervals.



PLOT THE RESULTS ON A GRAPH

