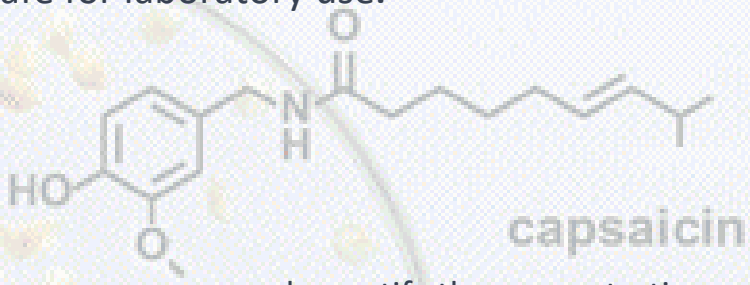
SOLVENT EXTRACTION OF CAPSAICIN

Capsaicin is the active component responsible for the pungency and spiciness in red chilli peppers. It is also the active ingredient in pepper spray used by riot squads during civil disobedience. Extracting capsaicin from these peppers allows for its isolation and further study. In this practical experiment, we will employ ethanol as a solvent to extract capsaicin from green and red chilli peppers. Ethanol is chosen for its ability to dissolve capsaicin efficiently while being relatively safe for laboratory use.



capsaicin

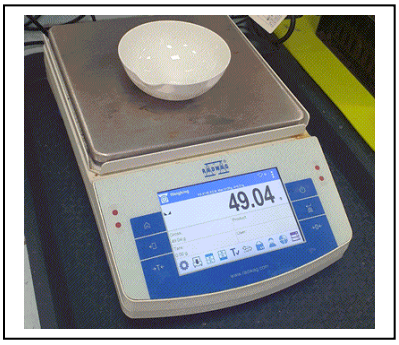
Aim To extract capsaicin from red and green peppers and quantify the concentration, in %m/m, of capsaicin in each variety of pepper.

Apparatus:

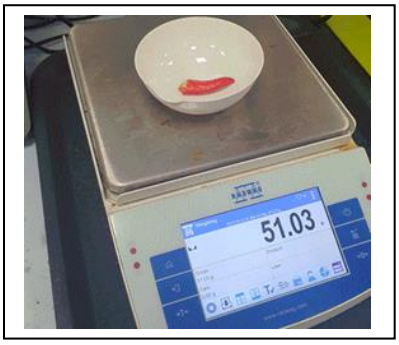
- A collection of green and red chilli peppers
- 1 X Mortar and pestle
- Ethanol 30 mL
- 1 X Filter paper
- 1 X 100 mL beaker
- 1 X plastic funnel
- 1 X small spatula
- 1 X glass rod
- 1 X evaporating dish
- 1 X Electronic weighing scale (3 decimal places)
- Safety goggles and gloves
- Access to fume cupboard.
- 2.00 grams of washed river sand
- Retort stand and ring clamp.

Procedure

1. Weigh an evaporating dish using the electronic balance and record the reading.



2. Select a pepper, remove the seeds and stem, place into the preweighed evapoating dish and weigh. Record the reading.



3. Grind the flesh of the pepper using a mortar and pestle and a small spatula of river sand. Grind to a fine paste to increase the surface area

4. Using half of the ethanol, rinse the pestle into the mortar and stir the solution with a glass rod.

5. Set up the retort stand with the ring clamp and secure the funnel and filter paper as shown on the right. Pour the contents of the mortar into the filter paper and rinse with the remainder of the ethanol. Collect the filtrate in the pre-weighed evaporating dish, as in step 1. Rinse the particles in the filter with the remaining ethanol.

6. Remove the evaporating dish and leave in a fume-cupboard overnight for the alcohol to evaporate. Weigh the evaporating dish with its contents and record the result.

7. Repeat steps 1-6 with another variety of pepper.

Results

Pepper	Mass of evaporating dish (g)	Mass of evaporating dish and sample (g)	Mass of sample (g)	Mass of evaporating dish and dried filtrate (g)	Mass of capsaicin (g)	Concentration of capsaicin %m/m
Green						
Red						

Questions

1. Suggest 2 improvements to the procedure and explain how each suggestion will impact ***one*** of the three factors accuracy, validity or repeatability. You may use each factor only once.
   4 marks

2. What is the : *2 marks*

   Dependent variable _____

   Independent variable _____

3. Using the theoretical results given in the table below calculate the concentration, in %m/m, of capsaicin in the red variety of pepper to the right number of significant figures.

   3 marks

Pepper	Mass of evaporating dish (g)	Mass of evaporating dish and sample (g)	Mass of sample (g)	Mass of evaporating dish and dried filtrate (g)	Mass of capsaicin (g)	Concentration of capsaicin %m/m
Red	49.04	51.03		49.12		

4. Capsaicin is a non-volatile compound with a boiling point of around 210 ^{o}C which undergoes thermal decomposition at temperatures close to 200 ^{o}C.

i. Suggest why steam distillation and fractional distillation techniques are not used to purify capsaicin but rather solvent extraction is the preferred purifying technique? *2 marks*

ii. Suggest how the validity of the results can be improved by using hexane as opposed to ethanol. Refer to chemical structure and intermolecular bonding in your answer. You may draw diagrams to assist you. *4 marks*

5. Capsaicin is the main ingredient in pepper spray. Its chemical structure is shown in fig. 1.

   The chemical structures of casein, a protein found in milk as well as a fat storage molecule, triglyceride also found in milk, are both shown in fig 2.

General advise for the treatment of capsaicin in the eyes is to rinse the eyes with water for 30 minutes and if possible wash with milk. Given that capsaicin is a relatively non-polar molecule discuss the different modes of operation by which water and milk interact with capsaicin to ease the pain and other physiological impacts of the molecule. Refer to structure and intermolecular bonding.

4 marks

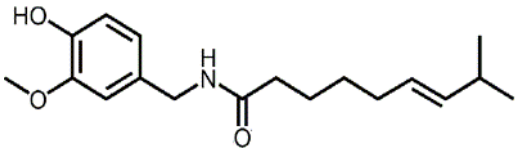
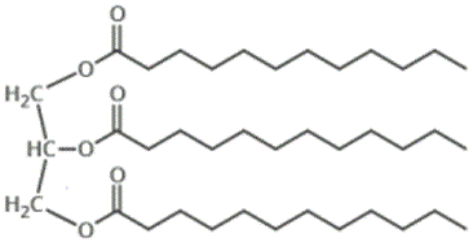
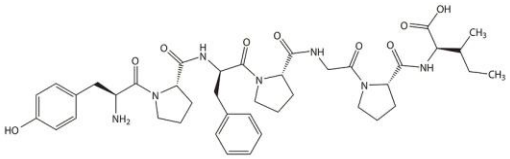


Figure 1 Capsaicin



Triglyceride



Casein

Figure 2