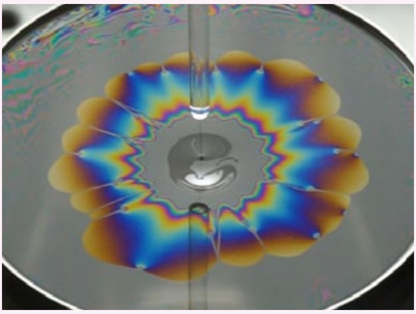
Daisy pattern discovered in a soap bubble

It sounds like magic. Let a drop of liquid fall onto a soap bubble and the liquid extends to form a flower shape. The first time she saw this, Melika Motaghian (Physics and Physical Chemistry of Foods) was surprised but now she can explain the physics.

Motaghian is doing a PhD on the behaviour of liquids when they spread. It is important to be able to understand and control this behaviour for the development of products such as shampoo, lubricants and cleaning agents.
The 'Marangoni effect' plays a key role in her research. This physical phenomenon is seen in the 'tears' on the side of a glass of wine. The alcohol (ethanol) on the edge of the glass evaporates faster than water, so the concentration of water is higher there. Water has a higher surface tension than ethanol and therefore pulls on the surrounding liquid. So the wine rises up until it falls back under the force of gravity.

Soap bubble

Motaghian used the Marangoni effect to test how liquids spread in a soap bubble. First she created a soap bubble using a kind of bubble blowing ring. Then she let one droplet of a mixture fall on the bubble. Because the soap has a higher surface tension, it pulls the drop apart in the soap film. Motaghian investigated mixtures of surfactants, such as soap, and polymers, such as polyethylene glycol, a molecule with a long chain of ethylene glycols.
At low concentrations of the polymer, the drop formed a perfect circle in the soap bubble. 'The surprising result was that when the polymer got above a certain concentration, instead of a circle it formed a daisy in rainbow colours,' says Motaghian. The daisy shape is due to the elasticity of the polymers in the drop. 'When a certain concentration is exceeded, the polymer strands become entangled. That makes the liquid elastic.'



A drop of the polymer surfactant solution spreads in a soap bubble. Photo Melika Motaghian

At high polymer concentrations, the drop spreads into a daisy pattern

So the drop doesn't extend equally far everywhere. The variation in the stretching looks like the petals of a daisy. Motaghian published her discovery in the *Journal of Colloid and Interface Science*. SS