FIREWORKS IN MILK



Surface tension, surfactants and moving colours

Name: _____ Class: _____ Date: _____

Background

Food colouring placed on milk may remain in separate patches. When detergent touches the surface, the colours move rapidly. Detergent is a surfactant: it changes the attractions at the liquid surface, lowering surface tension where it is added. The resulting differences in surface tension cause liquid to flow and carry the dye.

Aim

Investigate whether milk fat content and milk temperature affect how long colours move after detergent is added.

Equipment & safety

Watch-glasses or shallow dishes; full-cream and light milk; food colouring; detergent; dropper; stopwatch; thermometer; measuring cylinder; paper towel. Warm milk at 60 °C must be prepared and handled by the teacher. Do not drink laboratory milk; clean spills promptly.

Method

1. Use identical dishes and equal volumes of milk. Test: (1) full-cream at room temperature; (2) light milk at room temperature; (3) full-cream at 60 °C.
2. Add food dye in the same colours, number of drops and positions for every trial. Start with four separated coloured drops, using the same pattern each time.
3. Place one drop of detergent at the centre. Start the stopwatch and record the time until visible colour movement has ceased.
4. Record brightness and speed of colour movement. Add further detergent drops one at a time and note whether the movement restarts.
5. Repeat each condition three times using fresh milk and a clean dish. Calculate the mean movement time.

Results — record your own observations

Movement time = time from adding the first detergent drop until obvious swirling stops. Use seconds (s).

Milk condition	Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	Mean (s)
Full-cream, room temperature				
Light milk, room temperature				
Full-cream, 60 °C				

Mean time = (Trial 1 + Trial 2 + Trial 3) ÷ 3 =

Milk condition	Colour brightness / pattern
Full-cream, room temp.	
Light milk, room temp.	
Full-cream, 60 °C	

ANALYSIS & CONCLUSION

Answer using your results and the science of surface tension.

1. When comparing full-cream with light milk, identify the independent variable and the dependent variable.

2. When comparing room-temperature with warm full-cream milk, identify the independent variable.

3. Name TWO variables that must remain constant across trials. Explain why one is controlled.

4. Compare the mean swirling times for full-cream and light milk at room temperature. Which is longer?

5. Compare full-cream milk at room temperature and at 60 °C. What effect did temperature have?

6. Explain why food dye moves away from the point where detergent first touches the milk.

7. What is a surfactant? Explain how detergent alters surface tension.

8. Did another detergent drop restart movement? Suggest why movement eventually becomes weaker.

Conclusion

9. Write a conclusion answering the aim. Refer to at least TWO results (include units).

Evaluation

10. Identify ONE source of uncertainty and describe ONE change that would make the investigation more reliable.