HRI Research Article, Issue 30 Winter 2015

Chemical dyes can detect presence of homeopathic high dilutions

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During the manufacture of homeopathic medicines, a starting solution containing the source substance e.g. plant material, is subjected to multiple steps of dilution and 'succussion' (agitation). This process, known as 'potentisation', is considered to be key to the production of preparations which are biologically active, even at high dilution. However, the exact molecular and sub-molecular changes that occur during potentisation remain unknown. To address this knowledge gap, a new physico-chemical experiment has been developed by Dr Steven Cartwright. Using the unique properties of solvatochromic dyes, Dr Cartwright was able to detect the presence of homeopathically diluted substances in solution and begin to shed light on their physico-chemical properties[1].

Introduction

Despite a significant body of evidence in both fundamental and clinical research, the plausibility of homeopathy continues to be challenged. The persistence of this issue stems primarily from the fact that, for some homeopathic medicines, the serial dilution and succussion processes involved in their manufacture leads to such 'ultra-high' levels of dilution that no starting material should remain. A plausible mechanism of action for these medicines is therefore difficult to conceive. Dr Steven Cartwright's[1] ingenious approach to the problem uses the unique physico-chemical properties of solvatochromic dyes to explore some of the molecular and sub-molecular characteristics of homeopathic dilutions.

The experiment

Chemical dyes are frequently used in conventional research to detect the properties of their surroundings e.g. pH, temperature, concentration of a substance of interest etc. Solvatochromic dyes are particularly useful because their colour changes according to the electrical properties of their immediate surroundings. This colour shift can be measured as a change in 'absorption spectrum' using spectrophotometry (i.e. exposing the sample to an external light source and measuring how much light it absorbs at different wavelengths).

In this series of experiments, solvatochromic dyes were dissolved in either water, ethanol or *tert*-butyl alcohol. To these vials, Dr Cartwright added either a homeopathic preparation (*Glycerol 50M*) or a control solution. The difference in absorption spectra between the two samples was then measured to assess whether the colour change caused by adding the *Glycerol 50M* was different from the colour change caused by the control (see Fig.1A and B).

The control solution was the same 90% ethanol/water mixture used in preparing the *Glycerol 50M*. This meant that any difference detected would be due to the homeopathic 'active ingredient' rather than the ethanol/water.

Six slightly different solvatochromic dyes were used to maximise the likelihood of detecting a difference between the homeopathic dilution and controls.

Using this experimental system Dr Cartwright showed that the presence of the *Glycerol 50M* homeopathic dilution consistently and reproducibly affected the absorption spectra of all six solvatochromic dyes tested in all three solvents, when compared to control.

For example, using the dye ET33 dissolved in ethanol, the presence of *Glycerol 50M* caused an increase in absorbance at 442nm and a decrease at 542nm, compared to control (Figure 1A and B). Similar significant patterns of changes in absorption spectra were observed, whichever dye/solvent combination was tested ($p<0.0001$).

Interpretation

Solvatochromic dyes are known to stack one on top of each other in solution thus forming aggregates. The changes in absorption spectra triggered by the *Glycerol 50M* matched the changes in spectra known to occur when the amount of stacking in such dyes changes (Fig. 1C).

The hypothesis that aggregation was the underlying cause of the colour change seen here was tested by additional experiments in which strontium ions were added to disrupt the formation of aggregates; the results further supported this interpretation of the data.

Non-solvatochromic dyes were found to be unresponsive to *Glycerol 50M*. This suggests that the colour change was due to the unique sensitivity of solvatochromic dyes to the electrical characteristics of their environment. This in turn suggests that the homeopathic dilutions carry some form of electric charge which interacted with the dye.

Choice of homeopathic preparation

The homeopathic dilution used was *Glycerol 50M*, meaning that the glycerol starting material underwent 50 000 dilutions of 1 in 100 and was succussed between each dilution step (equivalent to a $10^{-100\,000}$ dilution). A number of different potencies were tested in the early stages and 50M was chosen because this was the 'ultra-high dilution' which gave the clearest results..[2]

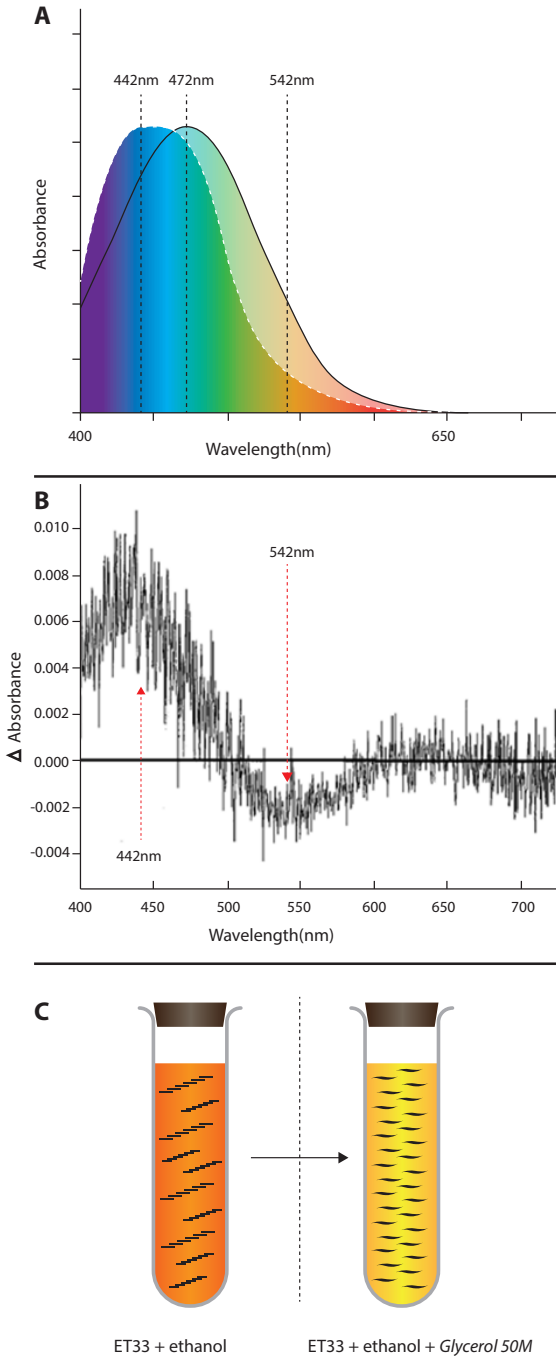

Figure 1: Schematic representation of the changes seen in absorption spectra and aggregation behaviour of dye ET33 in ethanol (Fig. A and B adapted from Cartwright[1,2]). **A:** Absorption spectra with/without *Glycerol 50M* (dashed/solid line). **B:** Difference in absorption spectra with/without *Glycerol 50M*. **C:** Aggregation/disaggregation behaviour of ET33 with/without *Glycerol 50M*.

Although not reported in this publication, several well-known homeopathic medicines were also tested and gave similar results[2]. Dr Cartwright focused his work on glycerol because, unlike complex plants or minerals, it is a simple molecule that is pharmacologically inactive and can be purchased in a very pure form. This avoids introducing other factors which make it difficult to interpret the meaning of the results.

The next steps

Trace analysis confirmed that there was no difference in material composition between the *Glycerol 50M* and control solution. This is consistent with the hypothesis that the underlying mechanism of action of homeopathic medicines is not biochemical in nature.

Time course experiments were performed to investigate how the changes in spectra evolved over time. The effect of *Glycerol 50M* on the dyes was found to build steadily over time, reaching a maximum effect after 1 to 2 hours, and was then lost over the following 12 to 18 hours.

As homeopathic medicines are considered to be stable for many months or even years, reasons why the homeopathic preparation in this experiment diminished over time need to be explored further. One possible explanation is that Dr Cartwright used pure solvents, whereas other researchers suggest that impurities are necessary for stabilising the homeopathic dilutions[3]. Alternatively, although strenuous care was taken to eliminate confounding factors, the possibility of a role for nano-bubbles remains, as dissolved gases are not detectable by trace element analysis[4]. These possibilities will need to be investigated through the on-going research.

Conclusion

Using a new experimental system, the study by Dr Cartwright[1] demonstrated that solvatochromic dyes can detect the presence of an ultra-high homeopathic dilution (namely *Glycerol 50M*). This suggests that homeopathic dilutions are not 'just water'.

References

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