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ORIGINAL PAPER

Establishing the interfacial nano-structure and elemental composition of homeopathic medicines based on inorganic salts: a scientific approach

Mayur Kiran Temgire[1], Akkihebbal Krishnamurthy Suresh[1,2], Shantaram Govind Kane[1,*] and Jayesh Ramesh Bellare[1,2,*]

[1]*Department of Chemical Engineering, Indian Institute of Technology (IIT) Bombay, Adi Shankaracharya Marg, Powai, Mumbai 400076, Maharashtra, India*
[2]*Department of Biosciences and Bioengineering, Indian Institute of Technology (IIT) Bombay, Adi Shankaracharya Marg, Powai, Mumbai 400076, Maharashtra, India*

Extremely dilute systems arise in homeopathy, which uses dilution factors 10^{60}, 10^{400} and also higher. These amounts to potencies of 30c, 200c or more, those are far beyond Avogadro's number. There is extreme skepticism among scientists about the possibility of presence of starting materials due to these high dilutions. This has led modern scientists to believe homeopathy may be at its best a placebo effect. However, our recent studies on 30c and 200c metal based homeopathic medicines clearly revealed the presence of nanoparticles of starting metals, which were found to be retained due to the manufacturing processes involved, as published earlier.[9,10] Here, we use HR-TEM and STEM techniques to study medicines arising from inorganic salts as starting materials. We show that the inorganic starting materials are present as nano-scale particles in the medicines even at 1 M potency (having a large dilution factor of 10^{2000}). Thus this study has extended our physicochemical studies of metal based medicines to inorganic based medicines, and also to higher dilution. Further, we show that the particles develop a coat of silica: these particles were seen embedded in a meso-microporous silicate layer through interfacial encapsulation. Similar silicate coatings were also seen in metal based medicines. Thus, metal and inorganic salt based homeopathic medicines retain the starting material as nanoparticles encapsulated within a silicate coating. On the basis of these studies, we propose a universal microstructural hypothesis that all types of homeopathic medicines consist of silicate coated nano-structures dispersed in the solvent. *Homeopathy* (2016) **105**, 160–172.

Keywords: Homeopathy; Nanoparticles; Silicate coating; HR-Transmission electron microscopy

Introduction

Homeopathic medicines have dilution factors 10^{60}, 10^{400} and 10^{2000}, which amounts to 30c, 200c and 1 M potency are routinely used for treatment. These super Avogadro dilutions, if ideally done, should result in complete absence of a single molecule in a typical medicinal sample. To explain why activity is still retained, theories such as liquid memory,[1–4] clathrate formation,[5] and quantum physical[6,7] have been proposed in the past. Out of all theories only the silica hypothesis[8] implies the

*Correspondence: Jayesh Ramesh Bellare, Shantaram Govind Kane, Department of Chemical Engineering, Indian Institute of Technology (IIT) Bombay, Adi Shankaracharya Marg, Powai, Mumbai 400076, Maharashtra, India.
E-mail: mayurkt@iitb.ac.in, aksuresh@iitb.ac.in, sgkane@gmail.com, jb@iitb.ac.in
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presence of physical entities. In several industrial and biological processes we come across the ultra-high dilutions, but are not well studied since there are still no easy instrumental means to analyze the presence of trace materials. In the case of Homeopathic medicines the process of manufacture uses dilutions that exceed Avogadro's number by several orders of magnitude—so much so that one would not expect any measurable remnant of the starting material to be present. A scientific approach is necessary to fully understand the process of extreme dilutions and its implications to the materials involved from a physical and chemical viewpoint. Also important is the need to justify the prescribed process of manufacture consisting of the tedious task of arriving at ultra-high dilution involved in homeopathic medicine preparations, and relate it to the structure and function of the medicines.

There are few scientifically accepted studies in this area. The first is by Chikramane *et al.*[9] who have examined metal based homeopathic medicines and have shown that respective starting materials are still present as nanoparticles even at 200c potency. They have also explained this as a result of froth floatation[10] due to extensive foaming during succussion. The second is by Ives *et al.* (Anick and Ives,[8] Ives *et al.*[31]) who hypothesize but not prove that silica particles are present in the sample.

Silicates from the glass walls are continuously leaching out. We show that this silicate plays a key role in coating and retaining the starting materials in the solution. The role of this silicate shell is twofold, since it not only provides greatly enhanced colloidal stability in water, but also can be used to control the distance between core particles within assemblies through shell thickness.[11–25] From this point of view, extensive studies on metal–silica core–shell particles prepared by a liquid phase procedure have been made.[11, 12, 16, 17, 26]

In this present study, we have investigated the inorganic salt based homeopathic medicines such as Natrum muriaticum (NaCl), Kali muriaticum (KCl), Calcarea sulfuricum ($CaSO_4$), Natrum sulfuricum (Na_2SO_4) to show that these salts also remain in detectable quantities in the high potency medicines despite super Avogadro dilutions. Moreover, they are embedded in a silica layer containing nano-voids or air-bubbles. We further show similar findings for metal based medicines by reexamining the gold one in detailed and explain why the silica coating was not seen in our earlier work.

Materials and method

Materials

Five homeopathic medicines (6c, 30c, 200c and 1 M dilutions) Sodium chloride (*Natrum muriaticum or Natrum mur.*), Potassium Chloride (*Kali muriaticum or Kali mur.*), Calcium sulfate (*Calcarea Sulphurica or Calcarea sulph.*), Sodium sulfate (*Natrum sulphuricum or Natrum sulph.*), and Gold metal (*Aurum metallicum*) used in this study were purchased commercially from authorized distributors of a reputed homeopathic manufacturer in India (SBL), an Indian subsidiary of a multi-national firm viz. Wilmar Schwabe India Pvt. Ltd., and Healwell, Sintex Int. Ltd. The pure ethanol of HPLC grade was procured from Commercial Alcohols Inc., Canada. The formvar-carbon coated copper grids of 200 mesh were bought from Pacific Grid-Tech (U.S.A.). The manufacturing process used was ascertained by personal discussion with the manufacturers. It consisted of solid substances for Natrum mur, Kali mur, Natrum Sulph that were used as raw materials. 90 or 91% alcohol solutions were used in potentization along with lactose trituration for the process of dilutions. The dilutions were carried out by Hahnemannian method. Glass bottles used by the manufacturers for succussion were made of neutral glass or USP type III soda lime glass.

Method

Preparation of TEM grids: High Resolution TEM/EDX/STEM: Characterization of ultra-high dilute medicines was carried out using JEOL JEM 2100 electron microscope operated at 200 kV. HR-TEM formvar-carbon coated copper grids were held using anti-capillary forceps. A drop of medicine was directly placed on the grid. The drop was allowed to evaporate until it visually appeared to be dry, which took approximately ½ to 1 h in air at 23°C depending on the ambient humidity levels. After complete drying, another drop was placed as previously on the grid. This process was repeated 5–6 times. After letting the sample dry in air completely the grid was warmed using an IR lamp for about 15 min for ensuring a completely dry sample and removal of all solvent from the grid. During TEM, bright field and dark field images of the sample particles were captured with Orius 200 bottom mount camera. Selected area diffraction patterns were also taken. Energy dispersive X-ray analysis (EDX) was done with Oxford instruments (Model: EDS7688) for elemental analysis. Along with it STEM mapping was used for detailed distribution of elements present in the sample.

Typical TEM characterization: The most significant finding we had with TEM was the detection and imaging of inorganic salt based medicines, a typical figure of which is in Figure 1 (A–C), which shows a particle in bright field image along with selected area diffraction pattern of single crystal and energy dispersive X-ray analysis showing presence of active ingredients in Natrum mur. at 200c potency. The EDX shows prominent peaks of sodium and chlorine, together with other peaks of carbon, oxygen and copper, which are due to the substrate of Cu-grid coated with formvar-carbon.

Special precaution had to be taken to achieve all of the above: Inorganic salt based medicines were found to be electron beam sensitive and sublimed on exposure to the intense electron beam.[27] The phenomenon of sublimation can be observed in Figure 1 (D–L), where the salt particle is seen part by part disintegrating that begins from bottom of Figure 1(F) and continues to the top in