Nanoparticles Characterization of Homoeo Agrocare (agro homeopathic drug) by HRTEM and EDS Analysis

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Abstract

**Background** Homeopathy as a therapeutic tool is still very nascent in plant science and agriculture. Therapies used for plant growth and diseases are not relevant for plants alone, but they also drastically influence the ecosystem of the organic world too. Pesticides and chemical fertilizers was a boon during the initial phase of the green revolution around the world. Unfortunately, later they became the major reason for the chronic illnesses like cancers and a cause for soil degradation all over. The scenario demands the use of alternative models in agricultural practices in order to prevent diseases and to maintain the health status of the population. This is also very important to get rid of the damages done to the soil. **Aims** The present study aimed at analyzing the material content of the agro-homeopathic drug, 'Homeo agrocare'. **Methodology** High resolution transmission electron microscope (HRTEM) and Energy dispersion spectroscopy (EDS) were used to evaluate the material content of the drug. DLS and HRTEM were used for the analysis of control sample (Pharmaceutical grade alcohol). **Results** (1) Drug solution contains plenty of nanoparticles (NPs). (2) Size of NPs ranges between 4.99nm - 93.09 nm. (3) Twenty elements were identified in fields studied. (4) No particles identified in the control sample by DLS and HRTEM analysis. **Conclusion** Study conclusively proved the presence of NPs of the original drug materials used in the ‘Homoeo agrocare’ drug solution.

**Keywords:** Homeopathy, Homeo agrocare, Nanoparticles, Epigenetics, Agro-homeopathy

Introduction

Homeopathic ultra-high dilutions are used universally in the treatment of human, animal and plant diseases. Recent research publications of the author and many others demonstrated the presence of nanoparticles (NPs) in homeopathic ultra-high dilutions [1-15]. As ultra-high dilutions (UHDs) demonstrated the potential in regulating the growth [16-26] and effectiveness in treating a variety of plant diseases [27-32], it is decided to characterize one of the commonly used homeopathic plant remedies in India particularly in the state of Kerala. (‘Homoeo agrocare’ manufactured by Mini pharma, Kozhikode). Large number of agriculturists have testified the positive qualitative and quantitative impact of this homeopathic drug cocktail upon their crops (fruits, vegetables, rice, arecanut, coconut etc). Homoeo agrocare is a combination of 39 homeopathic drug potencies.

Agro-homeopathy is one of the recent approaches in agricultural research yet to be taken to the mainstream agricultural practice. In recent years, various scientific studies showed that potential homeopathic medicines can alter the physiological activities of plants [16,19,20,21]. It can alter the rate of enzymatic activities, total sugar, protein and chlorophyll contents in plants [17,18,22]. Eradication of biotic and abiotic stresses up to some extent is also made possible by the use of Homeopathy. In the case of biotic stresses; anti-fungal, anti-microbial, anti-insecticidal activities of various homeopathic drugs have been reported. Sometimes other paths of abiotic stress (salt stress, drought stress, cold stress, metal toxicity, mechanical damages etc.) control are costlier or less
efficient. But proper selection of homeopathic drugs can be cost effective and very efficient in terms of abiotic stress tolerance in various crop species [24,27,28,31,32,33].

Ultra-high dilution of homeopathic medicines can be used safely for various purposes in the plant kingdom (seed germination, the betterment of soil health, growth of seedlings, flowering, fruiting, protection against diseases and to overcome environmental stresses). With proper selection of drug and its potency, Agro-homeopathy can be an efficient and very cost-effective alternative that can increase farmers’ income by lower input cost of chemical fertilizers and insecticides [33]. Current scenario of universal use of pesticides in agriculture around the world is a major concern as these pesticides perennially damage the ecosystem on earth, generated by nature and sustained for millions of years, which supported the creation and sustenance of every animal and plant species on earth. Recent studies established the harmful effects of pesticides on human health including the development of allergies and varieties of cancers [34-49]. Agro-homeopathy seems to be an ideal choice of replacement for chemical intensive fertilizers and pesticides. Recent studies and research publications well established the fact that homeopathic ultra-high dilutions produce epigenetic modifications in animal models and cell lines [50-67]. Further researches are necessary to understand the potential of these ultra-high dilutions in the treatment of plant diseases and regulate growth without environmental and health impacts.

In human health conditions, homeopathic drugs are prescribed on the basis of ‘Similia’ principle, therefore the majority of prescriptions are single medicine at a time. But there is a multitude of combination or cocktail homeopathic drugs discovered and marketed around the world, which are also effective in curing many diseases. Identifying a unique constitutional medicine based on individual characteristic signs and symptoms (physical and mental) is a viable option in human beings. But, it is rather difficult to adopt the same approach in plant health conditions. It seems that the discoverer of ‘Homoeo agrocare’ adopted a principle of ‘selection by plant’, the apt element for its own cure rather than individualizing each plant for the selection of suitable drug. ‘Homoeo agrocare’ has been a commonly used homeopathic product by farming communities in Kerala for a long time. Farmers who use this cocktail drug in their field are happy with the outcome and the majority of them testify positive outcomes with the ‘Homoeo agrocare’ in their agricultural production.

Materials and methods

Samples and preparation

The homeopathic cocktail drug ‘Homoeo agrocare’ is a product formulated by Prof. M Abdul Lethif through many years of experimental studies on plant growth and productivity, prevention and cure of plant diseases. The product is manufactured by M/S Mini pharma, a partnership firm registered on 16.11.1999. Prof M Abdul Lethif did his experiments on various plants and combined 39 drugs to create a mixture of homeopathic ultra-high dilutions as a broad spectrum medicine, covering the growth and disease related concerns, as well as the productivity of crops. This cocktail of homeopathic ultra-high dilutions has been formulated from the following 39 drugs: Aqua marina, Acidum aceticum, Acidum citricum, Acidum lacticum, Acidum salicilicum, Allium cepa, Allium sativa, Alumina, Ammonium carb, Arnica montana, Azadiracta indica, Baptisia tinctoria, Belladona, Beriberis vulgaris, Boron, Bryonia, Calcarca carboonicum, Calcarca phosphoricum, Cina, Cuprum metallicum, Cuprum oxydatum nigrum, Cuprum sulphuricum, Dulcamera, Ferrum phosphoricum, Ferrum sulphuricum, Kalium permanganicum, Kalium phosphoricum, Kalium sulphuricum, Natrum muriaticum, Natrum phosphoricum, Natrum salicilicum, Ocimum canum, Phosphorus, Ricinis communis, Ruta graviolens, Tanacetum valgare, Teucreum marum verum, Zincum metallicum and
Zincum phosphoricum. The researcher used 37 drugs in 1M potency and Allium cepa in 30cH and Acidum phosphoricum in 200cH potency for the formulation of the drug mixture. This combination seems to work like a broad spectrum nanomedicine for the plant kingdom. The solutions of all these medicines were mixed in equal quantities to prepare the mother solution. The mother solution is used to medicate the globules. The prescribed number of medicated globules are dissolved in water and used in agriculture fields as well on individual plants.

The combination of the raw materials used for the discovery of this combination was kept under trade secret rules and principles under the control of Mini Pharma, Kozhikode and I am grateful to Prof M Abdul Lethif for revealing the details of the raw materials used in his formulation, after the completion of my characterization experiment of the drug solution in the laboratory.

Homoeo agrocare sample in liquid form (alcohol solution) was procured from M/S Mini Pharma, Kozhikode, India and the selected solution in the manufacturer’s sealed bottle was individually sonicated [68] for 20 minutes using bath sonicator. One micro drop of the alcohol solution was extracted from the middle of the bottle with a micropipette. The same was poured on to the TEM grid and left to dry overnight under infrared light (evaporation/dehydration method was used as the sample is prepared in alcohol). The grid was later placed in the TEM chamber, the particles and agglomerates identified, focused, TEM images were taken and particle size measured. The elementary composition of the particles and the weight percentage was measured by means of energy dispersion spectroscopy (EDS). Pharmaceutical grade alcohol was procured from Wilmer Schwabe India, Pvt Ltd, New Delhi and studied as the control. Control sample was also sonicated for 20 minutes using bath sonicator and analysed by DLS (Dynamic Light Scattering) and TEM. TEM analysis of the control sample was performed exactly the same way as that of the drug solution. It was decided to do DLS and HRTEM analysis of the control sample to double check the presence/absence of particles.

Instruments

In the present study, it was decided to use HRTEM and EDS for the analysis of the UHDs of Homoeo agrocare. Jeol TEM 2100 with operating voltage 200kV and 200 mesh carbon coated copper grid was used. For EDS, Oxford Instruments INCA equipment was used. Resolution of the HRTEM used was 0.23nm. EDS served to analyse the elementary composition of the identified NPs. EDS detector - 50mm², EDS resolution - 142 ev at 5.9 kev, analysed at 200kv. We performed the analysis on the specified area of the particles. Use of this equipment helped to detect the NPs of smallest size and to analyse their elementary composition. The DLS analysis of the control sample has been done with Horiba scientific nanopartica - nanoparticle analyser SZ-100, path length 100nm.

Study setting

The study was conducted at International and Inter University Center for Nanoscience and Nanotechnology, Mahatma Gandhi University, Kottayam, India.

Results

HRTEM and EDS analysis of Homoeo agrocare
Field I Homeo agrocare

![Image 1](image1.png)  ![Image 2](image2.png)

**Figure 1**  **Figure 2** – Magnified image

Figure 1 and 2 represents the HRTEM images of the particles and agglomerate in Field I. Figure 2 is the magnified image of Figure 1.

Particle size: 12.66nm - 14.53nm

| Elements | O  | Na | Cl | Si | P  | S  | Fe | K  | Ca | Cu |
|----------|----|----|----|----|----|----|----|----|----|----|
| Wt %     | 34.56 | 11.36 | 2.30 | 4.29 | 4.18 | 2.80 | 2.39 | 4.33 | 4.55 | 29.32 |

*Table 1. Comparative weight percentage of various elements in Field I obtained by EDS*

Field II Homeo agrocare

![Image 3](image3.png)  ![Image 4](image4.png)

**Figure 3**  **Figure 4** - Magnified image

Figure 3 and 4 represents the HRTEM images of the particles in Field II. Figure 4 is the magnified image of Figure 3 and Figure 4 is the high resolution lattice fringe phase of Figure 3. Four particles were identified in this field and spectroscopic analysis was done on the same. Particle size: 4.99nm - 6.06nm.

| Elements | C | O | Cl | Cr | Fe | Cu | Au | Co | Os |
|----------|---|---|----|----|----|----|----|----|----|
| Wt %     | 87.47 | 2.5 | 0.1 | 0.08 | 0.13 | 8.77 | 0.34 | 0.13 | 0.48 |

*Table 2. Comparative weight percentage of various elements in Field II obtained by EDS*
Field III Homeo agrocare

Figure 5 - HRTEM images of the particles in Field III. A large agglomerate is seen surrounded by aggregates of particles.

Particle size: 9.83nm - 93.09nm

| Elements | C  | O  | Cl | Si | F  | Cr | Mn | Fe | Cu | Ni | Ag | Au | Co |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Wt %     | 13.83 | 21.31 | 0.45 | 10.12 | 10.06 | 3.11 | 1.64 | 25.07 | 7.93 | 0.34 | 4.08 | 1.48 | 0.56 |

Table 3. Comparative weight percentage of various elements in Field III obtained by EDS

Field IV Homeo agrocare

Figure 6 - HRTEM images of a particle in Field IV.

Particle size: 15.15nm - 81.74nm

| Elements | C  | O  | Na | Cl | Si | P  | S  | Fe | K  | Ca | Cu | Mg | Co |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Wt %     | 74.1 | 7.47 | 0.98 | 0.18 | 0.34 | 0.38 | 0.2 | 0.19 | 0.21 | 3.78 | 11.5 | 0.44 | 0.23 |

Table 4. Comparative weight percentage of various elements in Field IV obtained by EDS
DLS and HRTEM analysis of control sample (pharmaceutical grade alcohol)

DLS analysis of pharmaceutical grade alcohol

Figure 7. DLS analysis of pharmaceutical grade alcohol

HRTEM analysis of pharmaceutical grade alcohol

Figure 8. HRTEM image of control sample (pharmaceutical grade alcohol) in 100nm scale

Figure 9. HRTEM image of control sample (pharmaceutical grade alcohol) in 10nm scale.
Discussion

The HRTEM and EDS analysis of the homeopathic cocktail agrocare product ‘Homoeo agrocare’ shows the presence of nanoscale particles in the drug solution. During the analysis more than 4 TEM fields were studied and the particles analysed. The particle size varied from 4.99nm to 93.09nm. The elementary composition of the particles showed the presence of 20 elements, i.e. C, O, Na, Cl, Si, P, F, S, Cr, Mn, Fe, K, Ca, Cu, Ni, Ag, Au, Mg, Co and Os, which covers the basic elements of majority of drugs used in the formulation. Majority of drugs used in the combination is of plant origin (15 numbers). Remaining drugs are from metallic and mineral sources. Elements like Zn and B are not detected in the studied fields, but there is a high chance of their identification as we analyse more fields. Elements like Ag and Au are seen outside the list of drugs used for the formulation. The identification of these extra elements demands further studies and analysis. The presence of NPs in the combination of ‘Homoeo agrocare’ made up of ultra-high dilution of 39 homeopathic drugs can be viewed as a confirmation of the similar results obtained in the earlier studies (1,3,4,5,7,9,12,13,14,15). The presence of NPs in UHDs is not confirming the linearity model of conventional thoughts, hence other scientific possibilities to explain their presence needs to be explored for the future advancement of science. The nanomedicine aspect of homeopathic ultra-high dilutions can open up a new era of inquiry in plant genetics leading to subtle cure for plant diseases. The evidence that homeopathic ultra-high dilution initiates epigenetic modifications like up and down regulations, and switching on and off the genes from bacteria to animal models are pointers to indicate the possibility of the same UHDs to initiate similar modification in plants.

Conclusion

This study conclusively proved the presence of NPs of the original drug materials used in the combination of ‘Homoeo agrocare’. Now it is clearly evident that the earlier hypothesis of homeopathic drug action based on the theories of water memory [69-71], formation of clathrates [72], epitaxy [73], silica hypothesis [74] and quantum physical aspects [75,76], etc. in the current model stands nullified with the clear evidence of the material content of the original homeopathic drug elements in nanoscale. But there is a high possibility that these NPs close to atomic scale can initiate quantum mechanical properties in biological systems and modify water structure. It seems that rational use of homeopathic UHDs can improve agricultural production by improving plant health; prevent and cure diseases. Therefore, all the desired results can be achieved without the extensive use of pesticides and chemicals which damage organic life and environment.

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