An Investigation of the Consciousness Energy Healing Therapy on Physicochemical and Thermal Properties of Silver Sulfadiazine

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Abstract

Silver sulfadiazine is a topical sulfa drug antibiotic that is used by burn patients to prevent the bacterial infection. This study was aimed to analyze the impact of the Trivedi Effect® on the physicochemical and thermal properties of silver sulfadiazine with the help of various analytical techniques. The silver sulfadiazine sample was divided into the control and treated parts; where, no Biofield Treatment was provided to the control part, while the treated part received the Biofield Treatment remotely by a renowned Biofield Energy Healer, Dahryn Trivedi. The PXRD peak intensities and the crystallite sizes were significantly altered ranging from -75.25% to 31.21% and -8.80% to 192.76% respectively, along with 64.06% increase in the average crystallite size of the treated sample than the control sample. The particle sizes were decreased by 1.60% (d100), 2.30% (d200), 2.06% (d220), and 4.40% (D (4,3)); therefore, the surface area was increased by 2.61% in the treated sample in contrast to the control sample. The latent heat of fusion and decomposition of the treated sample were significantly altered by -21.52% and 32.03%, respectively, compared to the control sample. Additionally, the total weight loss was reduced by 1.86%; however, the residue amount was increased by 2.88% in the treated sample compared with the control sample. Hence, the Biofield Treatment might be considered as a novel approach to generate a new polymorph of silver sulfadiazine that is more soluble, bioavailable, and thermally stable, which could be useful in designing a novel pharmaceutical formulation for the better therapeutic response against various type of bacterial disease.

Keywords: Silver sulfadiazine; Consciousness Energy Healing Treatment; The Trivedi Effect®; Complementary and Alternative Medicine; PXRD; Particle size; TGA/DTG

Introduction

Silver sulfadiazine is a drug belongs to the sulfa drug antibiotics class [1]. It is mainly used to prevent and treat wound infections in burn patients by preventing the growth of infectious bacteria on the open wound [2]. It also helps in decreasing the risk of bacterial growth on the surrounding skin and blood and prevents the serious blood infection such as sepsis [3]. Silver sulfadiazine is a broad spectrum drug that mainly acts on the gram-negative bacteria. Moreover, it shows good tolerance and low toxicity in patients; thus, also used for third & fourth-degree burns [4]. The bactericidal activity of silver sulfadiazine is takes place on the cell membrane and cell wall of the bacteria. For this, the silver ions present in the drug, catalyse the disulphide bonds formation, which causes change in the protein structure and thereby inactivates the thiol-containing enzymes [5]. Also, the silver ions may act by intercalating the DNA that interferes with the process of replication and transcription of the bacteria [6]. The sulfadiazine part of drug acts by inhibiting the bacterial dihydropteroate synthase, thereby disrupting the folic acid metabolism and DNA synthesis in bacteria [7,8].

The silver sulfadiazine shows its effect by reacting at a slow and steady rate with serum and other body fluids, which allows only the slow and sustained delivery of silver ions into the wound area. However, it reduces the bioavailability of the drug within the body [9]. Also, the studies reported the poor solubility of the drug and its limited penetration through the intact skin [10]. Thus, the study of its physicochemical properties is done to improve its dissolution and absorption parameters in the formulation. The Biofield Energy Healing Treatment (the Trivedi Effect®) has been known for its considerable effect on the physicochemical and thermal behaviour of many compounds [11-14], that may also affect the solubility and bioavailability profile of both the pharmaceuticals and nutraceuticals.

A unique energy (infinite, para-dimensional electromagnetic field) is possessed by every living organism that surrounds their body and known as the “Biofield Energy”. The Trivedi Effect® is a phenomenon that is established as; a person can harness the inherently intelligent energy and transmit it anywhere on the planet through the possible mediation of neutrinos [15]. The
Characterization

Powder X-ray Diffraction (PXRD) Analysis

The PXRD analysis of silver sulfadiazine was performed with the help of Rigaku MiniFlex II Desktop X-ray diffractometer (Japan) [34,35]. The Cu Kα radiation source tube output voltage was 30 kV and tube output current 15 mA. Scans were performed at room temperature. The average size of individual crystallites was calculated from XRD data using the Scherrer’s formula (1):

$$G = k\lambda/β\cosθ$$  \hspace{1cm} (1)

Where k is the equipment constant (0.94), G is the crystallite size in nm, λ is the radiation wavelength (0.154056 nm for Kα1 emission), β is the full-width at half maximum (FWHM), and θ is the Bragg angle [36]. The percent change in crystallite size (G) of silver sulfadiazine was calculated using the following equation 2:

$$\% \text{ change in crystallite size} = \left(\frac{G_{\text{Treated}} - G_{\text{Control}}}{G_{\text{Control}}}\right) \times 100 \hspace{1cm} (2)$$

Where G_{Control} and G_{Treated} are the crystallite size of the control and the Biofield Energy Treated samples, respectively.

Particle Size Analysis (PSA)

The particle size analysis of silver sulfadiazine was conducted on Malvern Mastersizer 2000, from the UK with a detection range between 0.01 µm to 3000 µm using wet method [37,38]. The sample unit (Hydro MV) was filled with a dispersant medium (sunflower oil) and the stirrer operated at 2500 rpm. The PSA analysis of silver sulfadiazine was performed to obtain the average particle size distribution. Where, d (0.1) µm, d (0.5) µm, d (0.9) µm represent particle diameter corresponding to 10%, 50%, and 90% of the cumulative distribution. D (4,3) represents the average mass-volume diameter, and SSA is the specific surface area (m²/g). The calculations were done by using software Mastersizer Ver. 5.54.

The percent change in particle size (d) at below 10% level (d_{0.1}), 50% level (d_{0.5}), 90% level (d_{0.9}), and D (4,3) was calculated using the following equation 3:

$$\% \text{ change in particle size} = \left(\frac{d_{\text{Treated}} - d_{\text{Control}}}{d_{\text{Control}}}\right) \times 100 \hspace{1cm} (3)$$

Where d_{Treated} and d_{Control} are the particle size (µm) for at below 10% level (d_{0.1}), 50% level (d_{0.5}), and 90% level (d_{0.9}) of the control and the Biofield Energy Treated samples, respectively.

The percent change in surface area (S) was calculated using the following equation 4:

$$\% \text{ change in surface area} = \left(\frac{S_{\text{Treated}} - S_{\text{Control}}}{S_{\text{Control}}}\right) \times 100 \hspace{1cm} (4)$$

Where S_{Treated} and S_{Control} are the surface area of the control and the Biofield Energy Treated silver sulfadiazine, respectively.
Differential Scanning Calorimetry (DSC)

The DSC analysis of silver sulfadiazine was performed with the help of DSC Q200, TA instruments. Sample of ~1-5 mg was loaded to the platinum sample pan at a heating rate of 10°C/min from 30°C to 350°C [37,38]. The % change in melting point (T) was calculated using the following equation 5:

\[
\% \text{ change in melting point} = \frac{T_{\text{Treated}} - T_{\text{Control}}}{T_{\text{Control}}} \times 100 \quad (5)
\]

Where \( T_{\text{Control}} \) and \( T_{\text{Treated}} \) are the melting point of the control and Biofield Energy Treated samples, respectively. The percent change in the latent heat of fusion (ΔH) was calculated using the following equation 6:

\[
\% \text{ change in latent heat of fusion} = \frac{\Delta H_{\text{Treated}} - \Delta H_{\text{Control}}}{\Delta H_{\text{Control}}} \times 100 \quad (6)
\]

Where \( \Delta H_{\text{Control}} \) and \( \Delta H_{\text{Treated}} \) are the latent heat of fusion of the control and Biofield Energy Treated silver sulfadiazine, respectively.

Thermal Gravimetric Analysis (TGA)/ Differential thermogravimetric analysis (DTG)

TGA/DTG thermograms of silver sulfadiazine were obtained with the help of TGA Q500 TA instruments. Sample of 5 mg was loaded to the platinum crucible at a heating rate of 10°C/min from 25°C to 1000°C with the recent literature [37,38]. The % change in weight loss (W) was calculated using the following equation 7:

\[
\% \text{ change in weight loss} = \frac{W_{\text{Treated}} - W_{\text{Control}}}{W_{\text{Control}}} \times 100 \quad (7)
\]

Where \( W_{\text{Control}} \) and \( W_{\text{Treated}} \) are the weight loss of the control and Biofield Energy Treated silver sulfadiazine, respectively.

Results and Discussion

Powder X-ray Diffraction (PXRD) Analysis

The diffractograms of the control and the Biofield Energy Treated sample showed peaks of high intensity and narrow base width that are the properties of crystalline materials (Figure 1). However, the Bragg’s angles of the characteristic peaks of the Biofield Energy Treated sample, including the highest intensity peak (2θ = 10.1°), were observed to differ from the Bragg’s angles of the control sample (highest intensity peak at 2θ = 10.3°). It reveals some alterations in the crystalline structure of the Biofield Energy Treated sample after the Biofield energy Treatment. Moreover, the Biofield Energy Treated silver sulfadiazine also showed alterations in the intensities of the characteristic peaks and their corresponding crystallite sizes ranging from -75.25% to 31.21% and -8.80% to 192.76%, respectively (Table 1). Besides, the huge alteration was observed in the average crystallite size of the Biofield Energy Treated sample (455.14 nm), which was significantly increased by 64.06% compared with the control sample (277.43 nm).

### Table 1: PXRD data for the control and the Biofield Energy Treated silver sulfadiazine.

<table>
<thead>
<tr>
<th>Entry No.</th>
<th>Bragg angle (°2θ)</th>
<th>Peak Intensity (%)</th>
<th>Crystallite size (G, nm)</th>
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<td>Treated</td>
<td>Control</td>
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</tr>
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</table>

<sup>a</sup> % denotes the percentage change in the Peak intensity of the Biofield Energy Treated sample with respect to the control sample.<br>
<sup>b</sup> % denotes the percentage change in the crystallite size of the Biofield Energy Treated sample with respect to the control sample.

In crystalline compounds, the changes in peak intensity corresponding to each diffraction face indicates the alteration in the crystal morphology [39], and the alterations in the overall PXRD pattern are the proof of polymorphic transitions taking place in drug [40,41]. Hence, such significant changes in the Bragg’s angles of the peaks, their intensities, and the corresponding crystallite sizes indicate the altered morphology and polymorphic transitions of the Biofield Energy Treated silver sulfadiazine crystals after the Biofield Energy Treatment, compared with the untreated sample. Moreover, the variation in the polymorphic forms of pharmaceuticals is known for its impact on the drug performance in terms of its therapeutic efficacy, bioavailability, and toxicity [42,43]. Thus, it could be presumed that the Trivedi Effect® Treated sample might offer a better therapeutic response in comparison to the untreated silver sulfadiazine.

Particle Size Analysis (PSA)

The particle size distribution analysis of the control and the Biofield Energy Treated samples were done (Table 2) to see any changes due to the Biofield Energy Treatment on the silver sulfadiazine. The data showed that the particle size values of the Biofield Energy Treated sample at $d_{10}$, $d_{50}$, and $d_{90}$: particle diameter corresponding to 10%, 50%, and 90% of the cumulative distribution, D (4,3): the average mass-volume diameter, and SSA: the specific surface area. *denotes the percentage change in the Particle size distribution of the Biofield Energy Treated sample with respect to the control sample.

The reduction in particle size is known to improve the solubility and absorption, and ultimately the bioavailability in the body by increasing the surface area of the drug [45-47]. Hence, the decreased particle size and increased surface area of the Biofield Energy Treated silver sulfadiazine after the Biofield Energy Treatment might be considered as the improved bioavailability profile of drug compared with the untreated sample.

Differential Scanning Calorimetry (DSC) Analysis

The DSC technique determines the enthalpy of the control and the Biofield Energy Treated samples of silver sulfadiazine. $\Delta H$: Latent heat of fusion and decomposition, *denotes the percentage change of the Biofield Energy Treated sample with respect to the control sample.

The DSC thermograms of the control and the Biofield Energy Treated sample showed the sharp endothermic peak at 261.85 and 262.04°C, respectively, indicating the melting and decomposition points. The data showed that the heating and decomposition temperatures of the Biofield Energy Treated sample were reduced by 1.60%, 2.30%, 2.06%, and 4.40%, respectively compared to the control silver sulfadiazine. Therefore, the specific surface area (SSA) of the Biofield Energy Treated sample (0.551 m$^2$/g) was increased by 2.61% in comparison to the SSA of the control sample (0.537 m$^2$/g). Thus, it could be presumed the Biofield Energy Healing Treatment might reduce the particle size of silver sulfadiazine by acting as an external force [44]. The reduction in particle size is known to improve the solubility and absorption, and ultimately the bioavailability in the body by increasing the surface area of the drug [45-47]. Hence, the decreased particle size and increased surface area of the Biofield Energy Treated silver sulfadiazine after the Biofield Energy Treatment might be considered as the improved bioavailability profile of drug compared with the untreated sample.
262.04°C, respectively (Figure 2) that is considered as their melting points. It indicated the similar melting points of both the samples; however, the latent heat of fusion ($\Delta H_{\text{fusion}}$) of the Biofield Energy Treated sample (42.91 J/g) was significantly reduced by 21.52% (Table 3) compared with the control sample (54.68 J/g).

Moreover, there was an exothermic peak also observed in the thermograms of the control and the Biofield Energy Treated sample that is considered as the decomposition temperature. The analysis revealed that the decomposition temperature of the Biofield Energy Treated sample was decreased by 1.61%; whereas the $\Delta H_{\text{decomposition}}$ was significantly increased by 32.03%, compared to the control sample (Table 3). Hence, it could be assumed that the Biofield Energy Treatment might disrupt the molecular chains, as well as the crystal structure of the Biofield Energy Treated silver sulfadiazine that might be responsible for the alterations in the melting temperatures and latent heat [42] compared with the control sample.

**Thermal Gravimetric Analysis (TGA)/ Differential Thermogravimetric Analysis (DTG)**

The TGA thermograms were used to establish the thermal degradation profile of the samples, displayed single step thermal degradation for the control and the Biofield Energy Treated samples (Figure 3). The experimental data showed that the total weight loss due to thermal degradation of the Biofield Energy Treated sample was reduced by 1.86% in comparison to the control sample (Table 4). In response to this, the residue amount of the Biofield Energy Treated sample was observed to be increased by 2.88% compared to the control sample. Thus, the thermal degradation of the Biofield Energy Treated sample was observed to be reduced after the Biofield Energy Treatment compared with the untreated silver sulfadiazine.

The first derivative of the weight loss curve (i.e., the DTG thermogram) is used to determine the temperature points at which the weight loss is most apparent [48]. In this study, the DTG thermograms of the control and the Biofield Energy Treated sample showed a single peak (Figure 4). It was observed that the Biofield Energy Treated silver sulfadiazine showed maximum weight loss $T_{\text{max}}$ at 276.78°C, which was slightly increased by 0.94% (Table 4) in comparison to the $T_{\text{max}}$ of the control silver sulfadiazine (274.21°C). Overall, the TGA/DTG study indicated that the thermal stability of the Biofield Energy Treated sample was improved compared with the control sample.

**Conclusion**

The impact of the Trivedi Effect®-Consciousness Energy Healing Treatment on silver sulfadiazine was significant on the crystal morphology and structure, particle size, and thermal properties. The PXRD data showed alterations in the Bragg’s angles of the characteristic peaks of the Biofield Energy Treated sample along with the peak intensity in comparison to the untreated sample. The intensities of those peaks of the Biofield Energy Treated sample were altered ranging from -75.25% to 31.21%; while the crystallite sizes showed the significant alteration ranging from -8.80% to 192.76%, compared with the control sample. Moreover, the Biofield Energy Treated sample
showed a significant increase in the average crystallite size by 64.06% compared with the untreated silver sulfadiazine sample. The particle size distribution of the Biofield Energy Treated sample also indicated significant alterations in the particle sizes after the Biofield Energy Treatment. The particle size values were reduced by 1.60%, 2.30%, 2.06%, and 4.40% at d_{10}, d_{50}, d_{90}, and D(4,3), respectively compared to the control sample. Therefore, the specific surface area of the Biofield Energy Treated sample was increased by 2.63% compared to the control sample. The \( \Delta H_{\text{fusion}} \) of the Biofield Energy Treated silver sulfadiazine was significantly decreased by 21.52% compared with the untreated sample. Nevertheless, the \( \Delta H_{\text{decomposition}} \) of the Biofield Energy Treated sample was significantly increased by 32.03% compared to the control sample. The total weight loss analyzed from the TGA analysis showed 1.86% reduction in the Biofield Energy Treated sample that resulted in 2.88% increase in the residual amount in comparison to the untreated silver sulfadiazine. The DTG analysis showed \( \Delta T \) of 2.5°C increase (0.94%) in the T_{max} of the Biofield Energy Treated silver sulfadiazine sample compared with the control sample. Thus, the overall data suggests that the Trivedi Effect\(^{\circledR}\)-Consciousness Energy Healing Treatment might generate a novel polymorph of silver sulfadiazine which would be more soluble, absorbable, and bioavailable and thermally more stable compared with the untreated sample. Hence, the Trivedi Effect\(^{\circledR}\) Treated silver sulfadiazine can provide better therapeutic benefits to prevent and treat microbial infections by designing more efficacious pharmaceutical formulations.

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Conflict of Interest

Authors declare no conflict of interest.

References


