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Medical Education Article

Impact of Consciousness Energy Healing Treatment on the Physicochemical and Thermal Properties of Cefazolin Sodium: A Complementary and Alternative Medicine

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Cefazolin is a semisynthetic broad-spectrum first-generation cephalosporin antibiotic useful for the treatment of a number of both Gram-positive and Gram-negative bacterial infections. The objective of this research work was to evaluate the impact of the Consciousness Energy Healing Treatment (the Trivedi Effect®) on the physicochemical, and thermal properties of cefazolin sodium powder using modern analytical techniques. Cefazolin powder sample was divided into two parts. One part of the sample was considered as a control sample (no Biofield Energy Treatment was provided), while the other part of the sample was received the Consciousness Energy Healing Treatment remotely by a renowned Biofield Energy Healer, Dahryn Trivedi and termed as a treated sample. The particle size values in the treated cefazolin sodium were decreased by 5.98%(d_{10}), 3.55%(d_{50}), 6.66%(d_{90}), and 5.89%{D(4,3)}; hence, the specific surface area increased by 4.54% compared to the control sample. The latent heat of evaporation and decomposition was significantly altered by 57.32% and -24.39% in the treated sample compared with the control sample. The total weight loss was significantly decreased by 68.92% and the residue amount was significantly increased by 519.64% in the treated cefazolin sodium sample compared with the control sample. The maximum thermal degradation temperature of the 1st and 2nd peaks of the treated sample was increased by 8.72% and 1.42%, respectively compared to the control sample. The Trivedi Effect®-Consciousness Energy Healing Treatment might have generated a new form of cefazolin sodium which would offer better solubility, dissolution rate, bioavailability, and thermal stability compared to the control sample. The Biofield Energy Treated cefazolin sodium would be very useful to design more efficacious pharmaceutical formulations that might offer better therapeutic response against urinary tract infections, respiratory tract infections, cellulitis, pneumonia, endocarditis, joint infection, biliary tract infections, blood infections, genital infections, and also prevent group B streptococcal disease at the time of delivery and before surgery, *etc.*

Keywords: Complementary and Alternative Medicine, Cefazolin sodium, The Trivedi Effect®, Consciousness Energy Healing Treatment, Particle size, Surface area, DSC, TGA/DTG

1. INTRODUCTION

Cefazolin is a semisynthetic broad-spectrum first-generation cephalosporin antibiotic useful for the treatment of a number of both Gram-positive (*i.e., Staphylococcus aureus, Streptococcus pyogenes, Staphylococcus epidermidis, Streptococcus agalactiae, Streptococcus pneumonia,* and other strains of streptococci) and Gram-negative (*i.e., Proteus mirabilis, Escherichia coli*, *etc.*) bacterial infections (Eljaaly *et al.*, 2018; Kusaba, 2009). The mechanism of action involves the inhibition of bacterial cell wall synthesis (Katzung *et al.*, 2015). Cefazolin used for the treatment of many diseases, i.e., urinary tract infections, respiratory tract infections, cellulitis, pneumonia, endocarditis, joint infection, biliary tract infections, blood infections, genital infections, and also prevent group B streptococcal disease in the time of delivery and before surgery*, etc.* (Eljaaly *et al.*, 2018; Kusaba, 2009; Katzung *et al.*, 2015). During pregnancy and breast feeding some amount of cefazolin enters in the breast milk, so general safety needs to follow in that period (Katzung *et al.*, 2015; Allegaert *et al.*, 2009). Some of the common side effects associated with the cefazolin medication are stomach pain, diarrhoea, vomiting, rash, blood dyscrasias, allergic reaction, *etc*. (Kusaba, 2009; Katzung *et al.*, 2015).The release of free N-methylthiodiazole from cefazolin may cause hypoprothrombinemia (Stork, 2006). Cefazolin sodium is the sodium salt form of cefazolin available in various dosage form, *i.e.*, injectable, powder for injection, eye drop, etc. (How *et al.*, 1998). Physicochemical characteristics of cefazolin sodium are; it is white or near white crystalline powder, insoluble in acetone, chloroform, ethyl acetate, dichloromethane; slightly soluble in ethanol and methanol; and freely soluble in water and isopropanol; it has no fixed melting point, but decompose at the temperature of~193°C (Wang *et al.*, 2012).

Intrinsic physicochemical properties of the pharmaceutical compound play a crucial role in its dissolution, absorption, and bioavailability profile in the body (Chereson, 2009). The Trivedi Effect®-Biofield Energy Healing Treatment has the significant impact on the crystallite size, particle size, surface area, and thermal behaviour of pharmaceutical compounds (Trivedi *et al.*, 2015g; e; Trivedi et al., 2017b). The Trivedi Effect® is a natural and only scientifically proven phenomenon in which a person can harness this inherently intelligent energy from the “Universe”and transmit it anywhere on the planet through the possible mediation of neutrinos (Trivedi *et al.*, 2016c). Every living organism possesses a kind of unique, infinite, para-dimensional electromagnetic field surrounding the body, originate from the continuous movements of the charged particles, ions, cells, blood/lymph flow, brain functions, heart, etc. in the body known as a “Biofield”. This Biofield Energy Healing Therapy has been reported with significantly beneficial outcomes against various disease conditions (Rubik *et al.*, 2015). The National Institutes of Health (NIH) and National Center for Complementary and Alternative Medicine (NIH) recommend and included the Energy therapy under the Complementary and Alternative Medicine (CAM) category along with homeopathy, traditional Chinese herbs and medicines, Ayurveda medicine, acupuncture, yoga, meditation, Reiki, hypnotherapy, Tai Chi, Qi Gong, aroma therapy, chiropractic/osteopathic manipulation, cranial sacral therapy, etc. These CAM has been well accepted by most of the U.S.A. people with advantages (Barnes *et al.*, 2008; Koithan, 2009). Similarly, the significant impact of the Trivedi Effect®-Consciousness Energy Healing Treatment has been published in numerous peer-reviewed scientific journals in the field of material science (Trivedi *et al.*, 2015f; h), chemical science (Trivedi *et al.*, 2016a; b), pharmaceutical sciences (Trivedi *et al.*, 2017a; c), agricultural sciences (Trivedi *et al.*, 2015a; b), medical sciences (Trivedi *et al.*, 2015c), microbiology (Trivedi *et al.*, 2015c; d). Therefore, this experiment was designed to evaluate the impact of the Trivedi Effect®-Consciousness Energy Healing Treatment on the physicochemical, thermal, and behavioural properties of cefazolin sodium powder sample using particle size analysis (PSA), powder X-ray diffraction (PXRD), differential scanning calorimetry (DSC), and thermogravimetric analysis (TGA)/differential thermogravimetric analysis (DTG).

2. MATERIALS AND METHODS

2.1. Chemicals and Reagents

Cefazolin sodium ($C_{14}H_{13}N_8NaO_4S_3$) powder was purchased from Tokyo Chemical Industry Co.,

Ltd., Japan. Other chemicals used in the experiments were of analytical grade available in India.

2.2. Consciousness Energy Healing Treatment Strategies

The test sample, i.e., cefazolin sodium powder sample was divided into two parts. One part of the test sample was treated with the Trivedi Effect®-Consciousness Energy Healing Treatment remotely under standard laboratory conditions for 3 minutes by the renowned Biofield Energy Healer, Dahryn Trivedi, USA, and known as the Biofield Energy Treated sample. However, the other part of cefazolin powder sample was treated with a "sham" healer for the comparison purpose called a control sample. The "sham" healer did not have any knowledge about the Biofield Energy Treatment. After that, the Biofield Energy Treated and control cefazolin sodium were kept in sealed condition and characterized using PSA, PXRD, DSC, and TGA techniques.

2.3. Characterization

The PSA, PXRD, DSC, and TGA analysis of cefazolin sodium were performed. The PSA was performed using Malvern Master sizer 2000, from the UK with a detection range between 0.01 µm to 3000 µm using the wet method (Trivedi *et al.*, 2017d; e). The PXRD analysis of cefazolin sodium powder sample was performed with the help of Rigaku MiniFlex-II Desktop X-ray diffractometer (Japan) (Rigaku, 1997; Zhang *et al.*, 2015). The average size of crystallites was calculated from PXRD data using the Scherrer's formula (1)

$$G = k\lambda/\beta\cos\theta \quad \ldots\ldots(1)$$

Where G is the crystallite size in nm, k is the equipment constant (0.94), λ is the radiation wavelength (0.154056 nm for Kα1 emission), β is the full-width at half maximum, and θ is the Bragg angle (Langford et al., 2017).

Similarly, the DSC analysis of cefazolin sodium was performed with the help of DSC Q200, TA instruments. The TGA/DTG thermograms of cefazolin sodium were obtained with the help of TGA Q50 TA instruments (Trivedi *et al.*, 2017d; e).

The % change in particle size, specific surface area (SSA), peak intensity, crystallite size, melting point, latent heat, weight loss and the maximum thermal degradation temperature (T_{max}) of the Biofield Energy Treated sample was calculated compared with the control sample using the following equation 2:

$$\%\ \text{change} = \frac{[\text{Treated} - \text{Control}]}{\text{Control}} \times 100 \quad \ldots\ldots\ldots\ldots\ldots(2)$$

3. RESULTS AND DISCUSSION

3.1. Particle Size Analysis (PSA)

The PSD analytical data of both the control and Biofield Energy Treated cefazolin powder sample are presented in Table 1. The particle size values of the control cefazolin sodium powder sample at d_{10}, d_{50}, d_{90}, and D (4,3) were 5.16 µm, 38.3 µm, 182.74 µm, and 69.48 µm, respectively. Likewise, the particle sizes of the Biofield Energy Treated cefazolin sodium at d_{10}, d_{50}, d_{90}, and D (4,3) were 4.86 µm, 36.94 µm, 170.57 µm, and 70.57 µm, respectively. The particle size values in the Biofield Energy Treated cefazolin sodium sample were significantly decreased at d_{10}, d_{50}, d_{90}, and D (4,3) by 5.98%, 3.55%, 6.66%, and 5.89% compared to the control sample. The specific surface area of the Biofield Energy Treated cefazolin sodium powder sample (0.516m^2/g) was increased by 4.67% compared to the control sample (0.493m^2/g). The Trivedi Effect®-Consciousness Energy Healing Treatment might have fractured the larger particle into smaller one, hence increased surface area. The reduced particle size increases the surface area and improves the solubility, dissolution rate, and bioavailability in the physiological system (Chereson, 2009; Mosharrof *et al.*, 1995; Buckton et al., 1992). Therefore, the Trivedi Effect®-Consciousness Energy Healing Treated cefazolin might offer better solubility, dissolution rate, and bioavailability compared with the untreated sample.

Table 1: Particle size distribution of the control and Biofield Energy Treated cefazolin sodium.

Parameter	d_{10} (µm)	d_{50} (µm)	d_{90} (µm)	D(4,3)(µm)	SSA(m^2/g)
Control	5.16	38.30	182.74	69.48	0.493
Biofield Treated	4.86	36.94	170.57	65.38	0.516
Percent change* (%)	-5.98	-3.55	-6.66	-5.89	4.67

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.

3.1. Powder X-ray Diffraction (PXRD) Analysis

The PXRD diffractograms of the control and Biofield Energy Treated cefazolin sodium samples did not show any clear, sharp, and intense peaks (Figure 1). Therefore, it was difficult to compare the Biofield Energy Treated cefazolin sodium with the control sample. It was concluded that both the samples were amorphous in nature and the Biofield Energy Treatment might not affect much the crystallinity of cefazolin sodium.

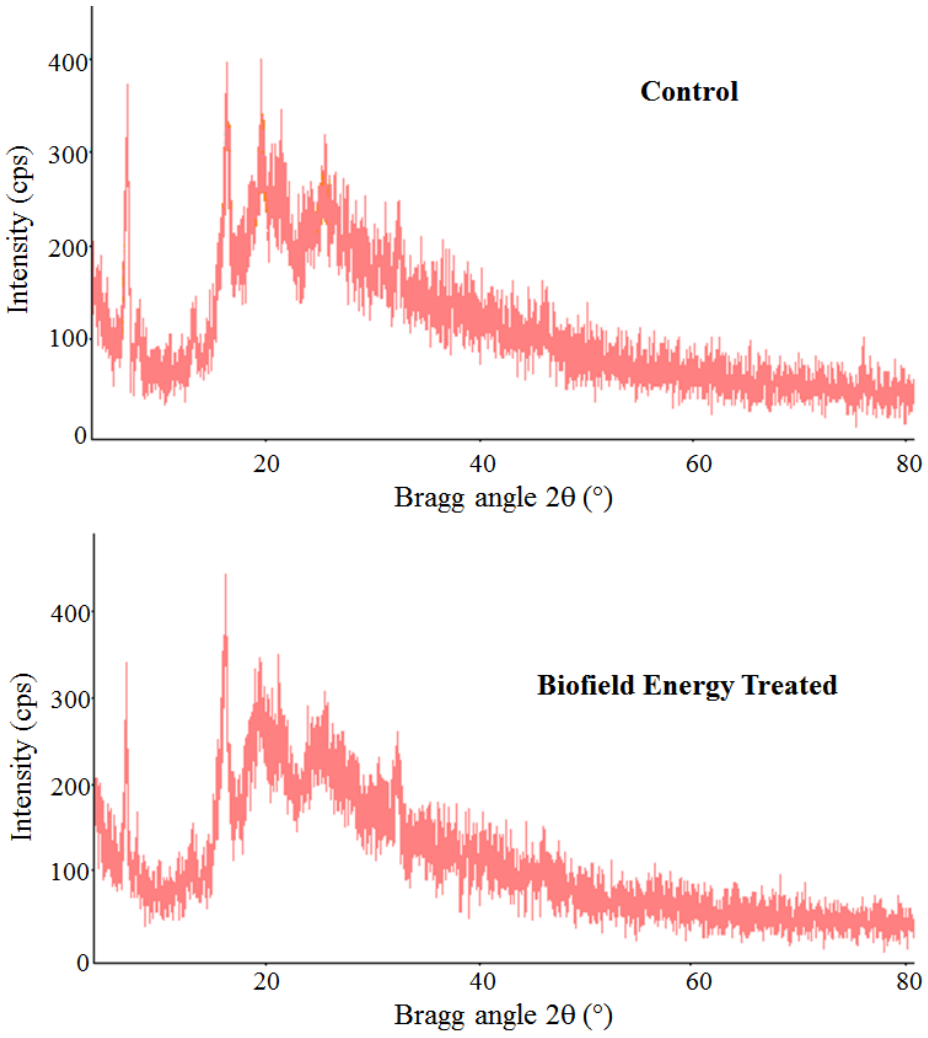

Figure 1: PXRD diffractograms of the control and Biofield Energy Treated cefazolin sodium.

3.3. Differential Scanning Calorimetry (DSC) Analysis

The DSC thermograms of the control and Biofield Energy Treated cefazolin sodium showed the endothermic peak at 92.96°C and 90.30°C, respectively(Figure 2). The thermogram pattern and melting point closely matched to the reported data (Wang *et al.*, 2012). The evaporation temperature of the Biofield Energy Treated cefazolin sodium was slightly decreased by 2.86% compared with the control sample(Table 2). Similarly, the control and Biofield Energy Treated cefazolin sodium samples showed exothermic peaks at 176.2°C and 176.89°C, respectively (Figure 2). The decomposition temperature of the Biofield Energy Treated cefazolin sodium was slightly increased by 0.39% compared with the control sample (Table 2).

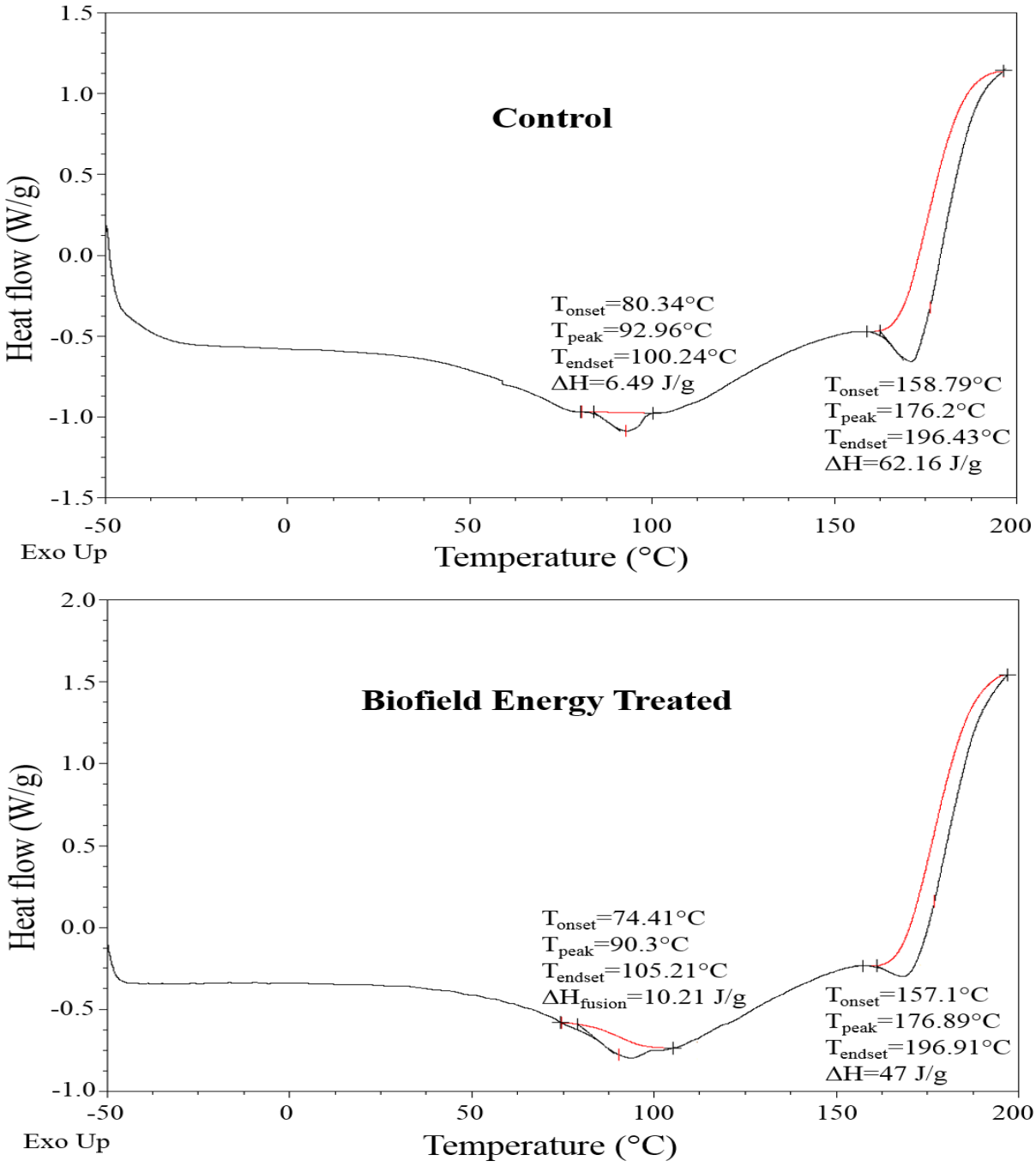

Figure 2: DSC thermograms of the control and Biofield Energy Treated cefazolin sodium.

Table 2: DSC data for both control and Biofield Energy Treated samples of cefazolin sodium.

Sample	Evaporation Temp (°C)	Decomposition Temp (°C)	ΔH(J/g)	
			Evaporation	Decomposition
Control Sample	92.96	176.20	6.49	62.16
Biofield Energy Treated	90.30	176.89	10.21	47.00
% Change*	-2.86	0.39	57.32	-24.39

ΔH: Latent heat of evaporation/decomposition, *denotes the percentage change of the Biofield Energy Treated cefazolin sodium with respect to the control sample.

The latent heat of evaporation ($\Delta H_{evaporation}$) of the Biofield Energy Treated cefazolin sodium (10.21 J/g) was significantly increased by 57.32% compared with the control sample (6.49 J/g) (Table 2). But, the latent heat of decomposition ($\Delta H_{decomposition}$) of the Biofield Energy Treated cefazolin sodium (47 J/g) was significantly decreased by 24.39% compared with the control sample (62.16 J/g) (Table 2).The Trivedi Effect®-Consciousness Energy Healing Treatment mighthave disrupted the molecular chains and crystal structure of cefazolin (Zhao *et al.*, 2015), which could be the root cause of altered thermal stability of the Biofield Energy Treated sample compared with the control sample.

Table 3: TGA/DTG data of the control and Biofield Energy Treated samples of cefazolin sodium.

Sample	TGA		DTG	
	Total weight loss (%)	Residue %	Peak 1 T_{max} (°C)	Peak 2 T_{max} (°C)
Control	88.29	11.71	182.03	612.62
Biofield Energy Treated	27.44	72.56	197.9	621.29
% Change*	-68.92	519.64	8.72	1.42

*denotes the percentage change of the Biofield Energy Treated sample with respect to the control sample,T_{max} = the temperature at which maximum weight loss takes place in TG or peak temperature in DTG.

3.4. Thermal Gravimetric Analysis (TGA)/ Differential Thermogravimetric Analysis (DTG)

The control and Biofield Energy Treated cefazolin sodium samples displayed three steps of thermal degradation in the TGA thermograms (Figure 3). The total weight loss in Biofield Energy Treated sample was significantly decreased by 68.92% compared with the control sample (Table 3). Hence, the residue amount was significantly increased by 519.64% in the Biofield Energy Treated cefazolin sodium compared to the control sample (Table 3).

The DTG thermograms of the control and Biofield Energy Treated cefazolin sodium exhibited two peaksin the thermograms (Figure 4). The maximum thermal degradation temperature (T_{max}) of the 1st and 2nd peaks of the Biofield Energy Treated sample was increased by 8.72% and1.42% compared to the control sample (Table 3). Overall,thermal analysis (i.e., DSC and TGA/DTG) of cefazolin sodium samples revealed that the thermal stability of the Biofield Energy Treated sample was significantly improved compared with the control sample.

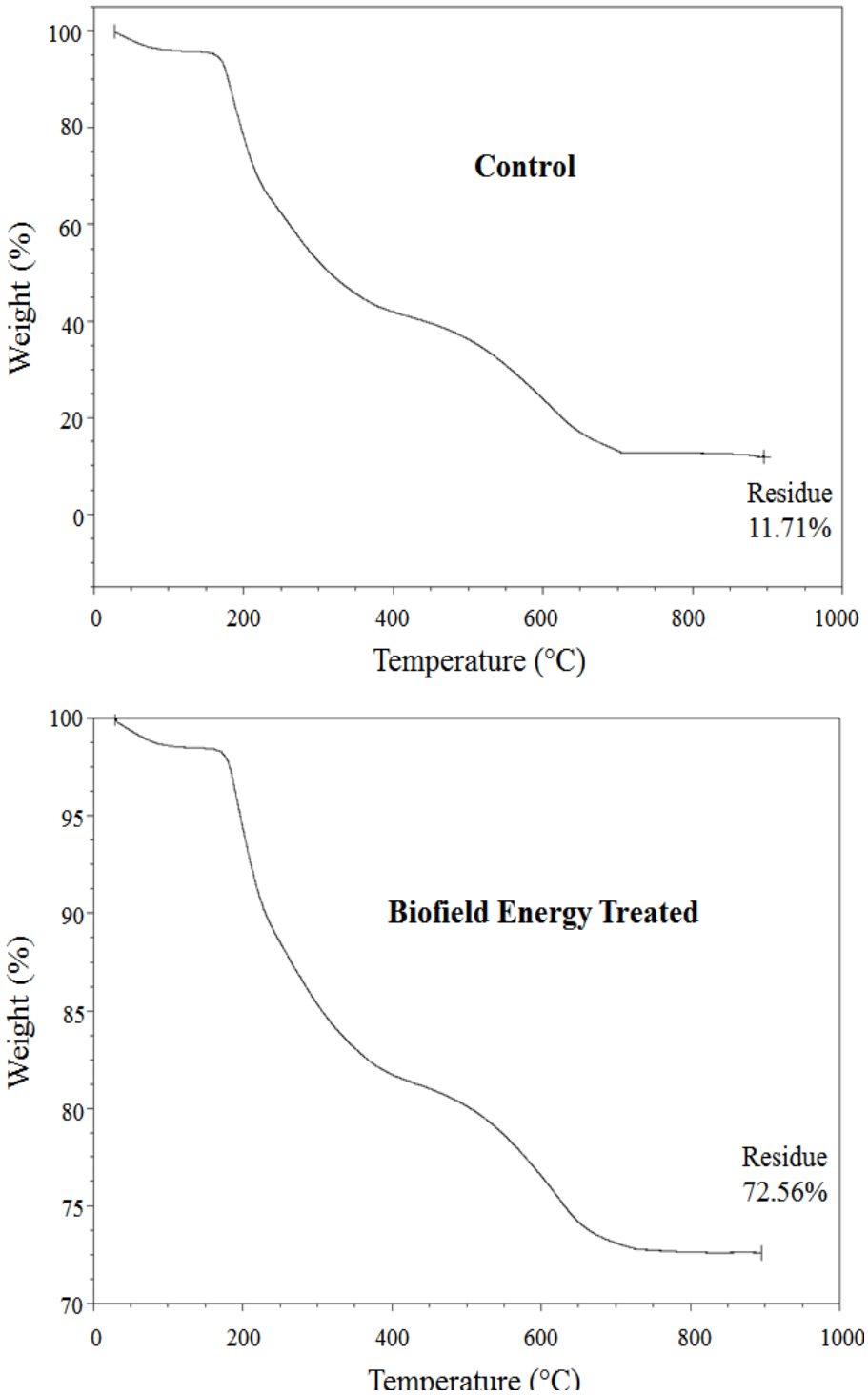

Figure 3: TGA thermograms of the control and Biofield Energy Treated cefazolin sodium.

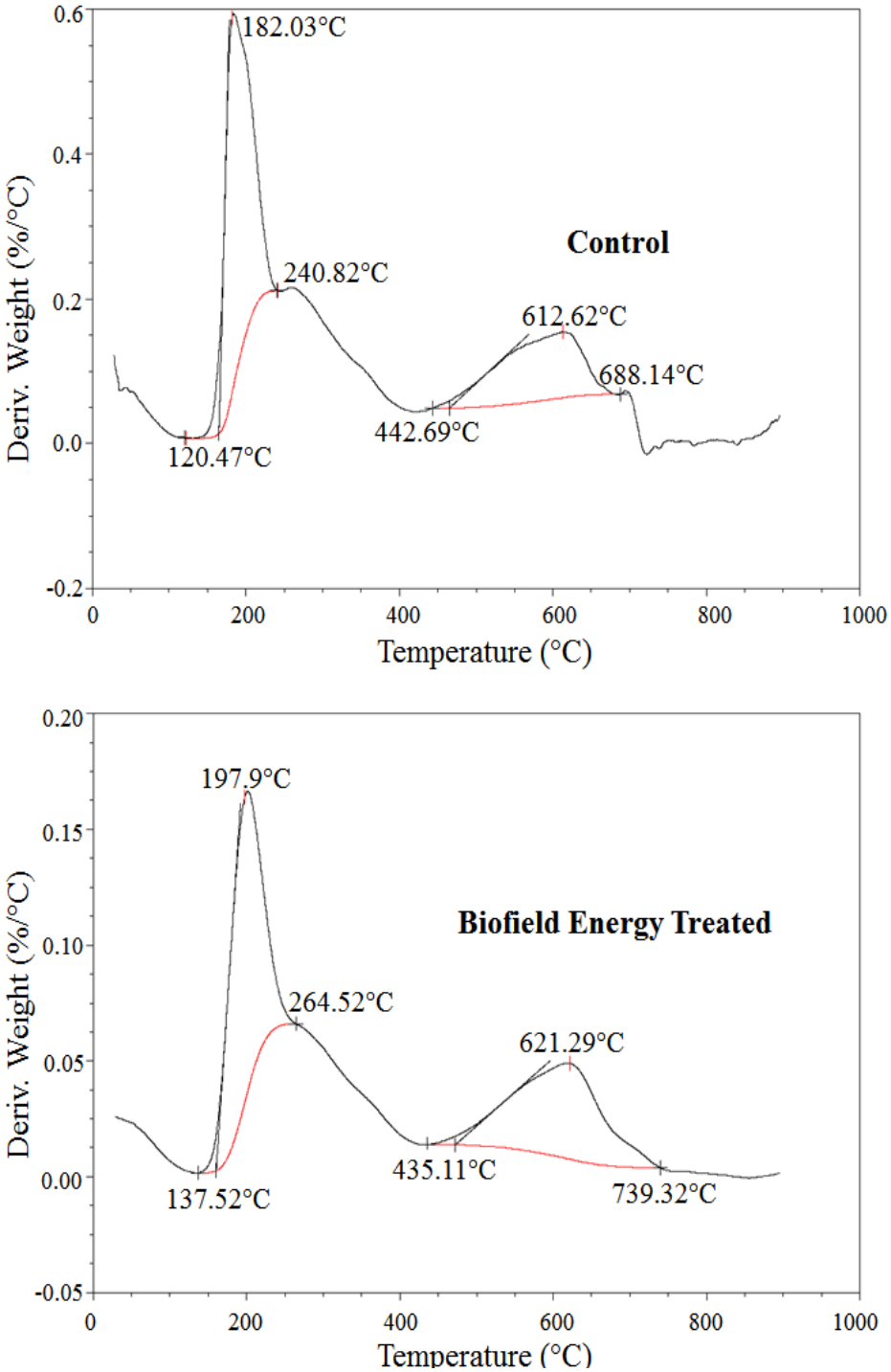

Figure 4: DTG thermograms of the control and Biofield Energy Treated cefazolin sodium.

4. CONCLUSIONS

The Trivedi Effect®-Consciousness Energy Healing Treatment has significant effects on the particle size, surface area, and thermal properties of cefazolin sodium powder sample. The particle size values in the Biofield Energy Treated cefazolin sodium were significantly decreased by 5.98%, 3.55%, 6.66%, and 5.89% at d_{10}, d_{50}, d_{90}, and D(4,3), respectively compared to the control sample. Hence, the specific surface area of Biofield Energy Treated cefazolin sodium was increased by

4.54% compared to the control sample. The $\Delta H_{evaporation}$ and $\Delta H_{decomposition}$ was significantly altered by 57.32% and -24.39% in the Biofield Energy Treated sample compared with the control sample. The total weight loss was significantly decreased by 68.92%, and the residue amount was significantly increased by 519.64% in the Biofield Energy Treated cefazolin sodium sample compared with the control sample. The T_{max} of the 1st and 2nd peaks of Biofield Energy Treated sample was increased by 8.72% and 1.42% compared to the control sample. The Trivedi Effect®-Consciousness Energy Healing Treatment might have generated a new form of cefazolin sodium which would offer better solubility, dissolution rate, bioavailability, and thermal stability compared to the control sample. The Consciousness Energy Healing Treated cefazolin sodium would be very useful to design more efficacious pharmaceutical formulations that might offer better therapeutic response against urinary tract infections, respiratory tract infections, cellulitis, pneumonia, endocarditis, joint infection, biliary tract infections, blood infections, genital infections, and also prevent group B streptococcal disease at the time of delivery and before surgery, *etc.*

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