

# Characterization of Physicochemical and Thermal Properties of Energy of Consciousness Healing Treated Copper (II) Chloride Using PXRD, DSC, and TGA/DTG

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**Abstract:** Copper (II) chloride is an inorganic compound used as a source of copper ions for the treatment of several diseases like cancer, inflammation, hematological and neurological disorders. This article was aimed to evaluate the effect of The Trivedi Effect<sup>®</sup> - Energy of Consciousness Healing Treatment on the physicochemical and thermal properties of copper (II) chloride using PXRD, DSC, and TGA/DTG analysis. Copper chloride was divided into two parts, one part of copper chloride was considered as control (no Biofield Treatment was provided), while second part received The Trivedi Effect<sup>®</sup> - Biofield Energy Healing Treatment remotely by a renowned Biofield Energy Healer, Alice Branton. The PXRD analysis showed that the relative intensities of the characteristic diffraction peak in Alice's treated sample were significantly changed from -77.37% to 205.56% compared with the control sample. The crystallite size of the characteristic diffraction peak in the treated sample was altered from -14.29% to 40.01% compared with the control sample. The DSC analysis showed that the melting point of the treated copper chloride was significantly increased by 2.91% with a reduced latent heat of fusion ( $\Delta H$ ) by 28.73% compared to the control sample. The melting temperature of the 2<sup>nd</sup> peak in the treated sample was significantly increased by 7.08% with a significant enhancement of  $\Delta H$  by 77.37% compared with the control sample. The decomposition temperature of the treated sample was increased by 2.36% with a significant reduction of the enthalpy of decomposition by 18.46% compared with the control sample. The TGA analysis revealed the three steps of thermal degradation. The percentage weight loss in the treated sample was decreased by 0.47% and 9.63% in the 1<sup>st</sup> and 2<sup>nd</sup> steps of degradation, respectively, while the weight loss in the 3<sup>rd</sup> step was increased by 2.45% compared with the control sample. The total weight loss in the treated sample was increased by 1.32% compared with the control sample. The DTG analysis showed that the maximum thermal degradation temperature ( $T_{max}$ ) in the 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> peaks of the Biofield Treated sample were increased by 1.20%, 2.00%, and 4.61% compared with the control sample. Briefly, The Trivedi Effect<sup>®</sup> - Energy of Consciousness Healing Treatment might produce a polymorphic form of copper (II) chloride that could be more stable during manufacturing, delivery or storage conditions than the untreated sample. The Biofield Energy Treated copper chloride would provide better therapeutic response against cancer, inflammation, wound healing, etc.

**Keywords:** Copper Chloride, Biofield Energy, The Trivedi Effect<sup>®</sup>, Energy of Consciousness Healing Treatment, PXRD, DSC, TGA/DTG

## 1. Introduction

Copper is the third most abundant transition metal and essential trace element in all living organisms. Copper exists

in human body mostly in bound form with the transport proteins storage proteins or metalloenzymes. In the body, copper is dominated in both oxidized Cu(II) or Cu(I) states and plays an important role in oxidation and reduction chemistry in the cellular life [1-3]. Copper (II) chloride

(CuCl<sub>2</sub>) is an inorganic salt and naturally found as both the anhydrous (tolbachite) and dihydrate (erichalcite) forms. The yellow-brown anhydrous copper chloride absorbs moisture slowly from the atmosphere and remains as a blue-green dehydrate form [4, 5]. Anhydrous copper (II) chloride has the distorted cadmium iodide structure and is paramagnetic. Copper (II) chloride dehydrate shows highly distorted octahedral geometry. CuCl<sub>2</sub> is widely used as a catalyst in various organic reactions like Wacker process, agricultural chemicals, plating agents, surface treating agents, processing aids [3-6]. Copper complexes can be used as antitumor, anti-inflammatory agent and for wound healing [2, 7]. Copper chloride is useful as a source of copper ion in copper deficiency, such as haematological and neurological disorder.

Biofield is sometimes referred to as quantum energy matrix that surrounds the human body resulting from the continuous movement of the electrically charged particles (ions, cells, etc.) inside the body and it continuously discharges the electromagnetic waves in the form of bio-photons. Healing practitioners have the ability to harness the energy from the “universal energy field” and can transmit into any living or nonliving object(s) around the earth. The process, where the objects receive the biofield energy and respond into useful way is called as Biofield Energy Healing Treatment [8, 9]. Biofield Energy Healing therapy has been recognized as a Complementary and Alternative Medicine (CAM) health care approach by National Center of Complementary and Integrative Health (NCCIH) with other therapies, medicines and practices such as yoga, Qi Gong, Tai Chi, chiropractic/osteopathic manipulation, meditation, homeopathy, acupressure, acupuncture, healing touch, hypnotherapy, movement therapy, naturopathy, Ayurvedic medicine, traditional Chinese herbs and medicines, aromatherapy, Reiki, cranial sacral therapy, etc. [10, 11]. Biofield Energy Healing Treatment (The Trivedi Effect<sup>®</sup>) is drawing importance in several fields include material science [12], pharmaceuticals [13], nutraceuticals [14], organic compounds [15, 16], microbiology [17], agricultural [18], biotechnology [19], genetics [20], medical [21] due to its amazing ability for modification of the characteristic properties of the numerous non-living and living substances. Recently literature reported that The Trivedi Effect<sup>®</sup>-Energy of Consciousness Healing Treatment has the astounding capability to alter physicochemical properties such as crystalline structure, crystallite size, particle size, surface area, and thermal stability of various nutraceuticals such as herbal medicines, minerals through introducing a new polymorph [22-26]. They assumed that Biofield Energy Treated pharmaceutical/nutraceutical compounds would be beneficial for enhancement of their therapeutic efficacy against the diseases. The physicochemical and thermal properties etc. of a pharmaceutical solid compound play an important role in drug product performance *i.e.* bioavailability, therapeutic efficacy, and toxicity [27, 28]. The Energy of Consciousness Healing Treatment (The Trivedi Effect<sup>®</sup>) might change the physicochemical and thermal properties through the possible intervention of

neutrinos [29]. Thus, it was aimed to investigate the effect of The Trivedi Effect<sup>®</sup> - Energy of Consciousness Healing Treatment on the physicochemical and thermal properties of copper chloride using powder X-ray diffraction (PXRD), differential scanning calorimetry (DSC), and thermogravimetric analysis (TGA).

## 2. Materials and Methods

### 2.1. Chemicals and Reagents

Copper (II) chloride or cupric chloride was purchased from VETEC, Sigma-Aldrich, India. All other chemicals used during the experiments were of analytical grade available in India.

### 2.2. Consciousness Energy Healing Treatment Strategies

The sample of copper chloride was divided into two parts. One part of copper chloride was considered as control (no Biofield Energy Treatment was provided). Consequently, the second part of copper chloride was treated with The Trivedi Effect<sup>®</sup> - Energy of Consciousness Healing Treatment remotely under standard laboratory conditions for 3 minutes and known as The Trivedi Effect<sup>®</sup> Treated or Biofield Energy Treated sample. This Biofield Energy Treatment was provided through the healer's unique energy transmission process by the renowned Biofield Energy Healer, Alice Branton, USA to the test item. Further, the control group was treated with “sham” healer for comparison purpose. The sham healer did not have any knowledge about the Biofield Energy Treatment. After that, the Biofield Energy Treated and untreated samples were kept in sealed conditions and characterized using PXRD, DSC, and TGA techniques.

### 2.3. Characterization

#### 2.3.1. Powder X-ray Diffraction (PXRD) Analysis

The PXRD analysis of copper chloride was performed on a PANalytical X'PERT3 powder X-ray diffractometer, UK. Diffraction of the analyte was carried out using a copper line as the source of radiation at the X-ray of wavelength of 0.154 nm, running at 45 kV voltage and 40 mA current with a scanning rate of 18.87° / second over a 2θ range of 3-90°. The ratio of Kα-2 and Kα-1 in this instrument was 0.5 (k, equipment constant). The data was collected in the form of a chart of the Bragg angle (2θ) vs. intensity (counts per second), and a detailed table containing information on peak intensity counts, d value (Å), relative intensity (%), full width half maximum (FWHM) (°2θ), area (cts\*°2θ) using X'Pert data collector and X'Pert high score plus processing software. The crystallite size (G) was calculated from the Scherrer equation following the literature [22-24, 30]. The crystallite size (G) was calculated by using the following equation 1:

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

Where, k is the equipment constant (0.5), λ is the X-ray

wavelength (0.154 nm);  $b$  in radians is the full-width at half of the peaks and  $\theta$  the corresponding Bragg angle.

Percent change in crystallite size ( $G$ ) of copper chloride was calculated using following equation 2:

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

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

### 2.3.2. Differential Scanning Calorimetry (DSC)

The DSC thermogram of copper chloride was achieved in a DSC Q2000 differential scanning calorimeter, USA under

$$\% \text{ change in latent heat of fusion} = \frac{[\Delta H_{\text{Treated}} - \Delta H_{\text{Control}}]}{\Delta H_{\text{Control}}} \times 100 \quad (4)$$

Where,  $\Delta H_{\text{Control}}$  and  $\Delta H_{\text{Treated}}$  are the latent heat of fusion of the control and treated copper chloride, respectively.

### 2.3.3. Thermal Gravimetric Analysis (TGA) / Differential Thermogravimetric Analysis (DTG)

TGA/DTG thermograms of copper chloride were obtained in a TGA Q500 thermo analyzer apparatus, USA under dynamic nitrogen atmosphere (50 mL/min) using a platinum crucible at a heating rate of 10 °C/min from 25°C to 900°C with the recent literature [22-24]. The % change in weight

$$\% \text{ change in maximum thermal degradation temperature (M)} = \frac{[M_{\text{Treated}} - M_{\text{Control}}]}{M_{\text{Control}}} \times 100 \quad (6)$$

Where,  $M_{\text{Control}}$  and  $M_{\text{Treated}}$  are the maximum thermal degradation temperature of the control and Biofield Energy Treated copper chloride, respectively.

## 3. Results and Discussion

### 3.1. Powder X-ray Diffraction (PXRD) Analysis

Biofield Energy Treatment has the significant effect on the relative intensity and crystallite size of each diffraction face

dynamic nitrogen atmosphere with flow rate of 50 mL/min with a sample mass of 2.72 mg using aluminum pan at a heating rate of 10°C/min from 30°C to 400°C [22-24]. The % change in melting point ( $T$ ) was calculated using following equation 3:

$$\% \text{ change in melting point} = \frac{[T_{\text{Treated}} - T_{\text{Control}}]}{T_{\text{Control}}} \times 100 \quad (3)$$

Where,  $T_{\text{Control}}$  and  $T_{\text{Treated}}$  are the melting point of the control and treated samples, respectively.

Percent change in the latent heat of fusion ( $\Delta H$ ) was calculated using following equation 4:

loss ( $W$ ) was calculated using following equation 5:

$$\% \text{ change in weight loss} = \frac{[W_{\text{Treated}} - W_{\text{Control}}]}{W_{\text{Control}}} \times 100 \quad (5)$$

Where,  $W_{\text{Control}}$  and  $W_{\text{Treated}}$  are the weight loss of the control and Biofield Energy Treated copper chloride, respectively.

The % change in maximum thermal degradation temperature ( $M$ ) was calculated using following equation 6:

which are indication of the modification of the crystal morphology of a pharmaceutical/nutraceutical crystalline solid [22-24]. Thereafter, PXRD analysis of the control and Biofield Energy Treated copper chloride was conducted and their PXRD diffractograms and data are presented in Figure 1 and Table 1, respectively. The PXRD diffractograms of the control and Biofield Energy Treated copper chloride (Figure 1) exhibited sharp and intense peaks indicating that both the samples were crystalline in nature.

Table 1. PXRD data for the control and Biofield Energy Treated Copper chloride.

Entry No.	Bragg angle (°2θ)	Relative Intensity (%)			Crystallite size (G, nm)		
		Control	Treated	% change <sup>a</sup>	Control	Treated	% change <sup>b</sup>
1	16.3	100.00	100.00	0.00	49.68	43.46	-12.51
2	22.0	4.87	9.09	86.65	35.06	35.06	0.01
3	23.8	2.77	2.52	-9.03	50.26	58.57	16.54
4	26.7	1.26	3.85	205.56	44.22	48.34	9.31
5	28.9	2.76	8.28	200.00	41.63	58.28	40.01
6	32.8	17.95	10.31	-42.56	58.83	73.54	25.01
7	34.0	3.69	4.76	29.00	49.19	49.19	0.00
8	35.4	3.15	6.86	117.65	49.37	59.25	20.00
9	50.1	3.12	1.66	-46.79	51.92	62.31	20.01
10	54.4	5.17	1.17	-77.37	52.91	45.35	-14.29
11	68.6	7.01	3.20	-54.35	56.99	48.86	-14.27

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

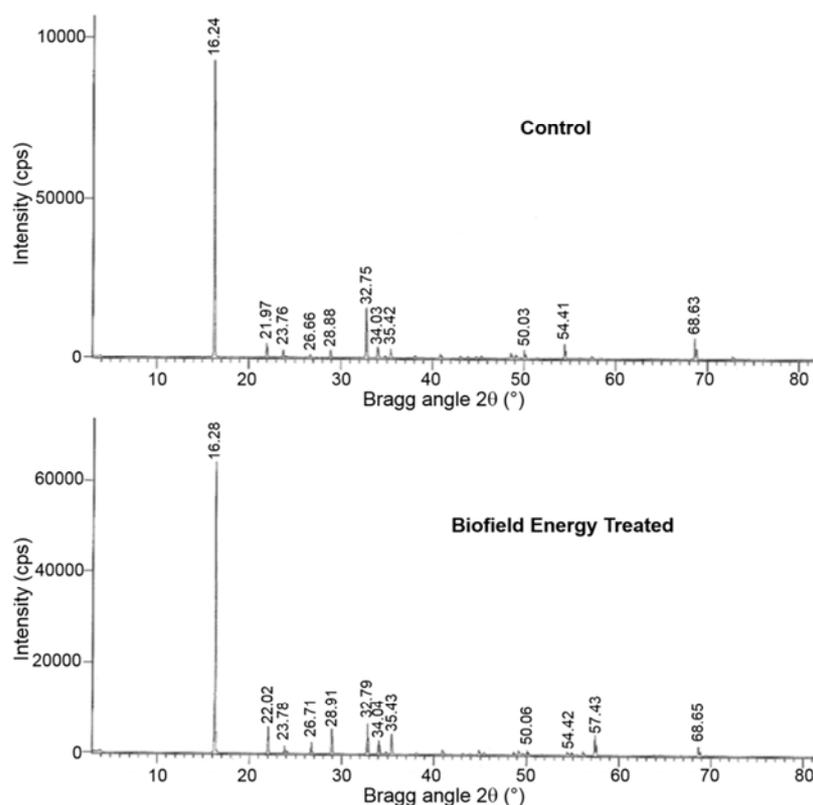


Figure 1. PXRD diffractograms of the control and Biofield Energy Treated copper chloride.

The PXRD diffractogram of the Control and Biofield Energy Treated samples showed highest peak intensity (100%) at Bragg's angle ( $2\theta$ ) equal to  $16.3^\circ$  (Table 1, entry 1). The relative intensities of the PXRD peaks at  $2\theta$  equal to  $22.0^\circ$ ,  $26.7^\circ$ ,  $28.9^\circ$ ,  $34.0^\circ$ , and  $35.4^\circ$  (Table 1, entry 2, 4, 5, 7, and 8) in the Biofield Energy Treated sample were significantly increased from 29.00% to 205.56% compared to the control sample. Consequently, the relative intensities of the PXRD peaks at  $2\theta$  equal to  $23.8^\circ$ ,  $32.8^\circ$ ,  $50.1^\circ$ ,  $54.4^\circ$ , and  $68.6^\circ$  (Table 1, entry 3, 6, and 9-11) in the Biofield Energy Treated sample were significantly decreased from 9.03% to 77.37% compared to the control sample.

Thereafter, the crystallite sizes of the Biofield Energy Treated sample at  $2\theta$  equal to  $16.3^\circ$ ,  $54.4^\circ$ , and  $68.6^\circ$  (Table 1, entry 1, 10, and 11) were significantly decreased from 12.51% to 14.29% compared to the control sample. Subsequently, the crystallite sizes of the control and Biofield Energy Treated copper chloride at  $2\theta$  equal to  $22.0^\circ$  and  $34.0^\circ$  (Table 1, entry 2 and 7) remained unaltered. Additionally, at  $2\theta$  equal to  $23.8^\circ$ ,  $26.7^\circ$ ,  $28.9^\circ$ ,  $32.8^\circ$ ,  $35.4^\circ$ , and  $50.1^\circ$  (Table 1, entry 3, 4, 5, 6, 8, and 9), the crystallite sizes of the Biofield Energy Treated sample were significantly increased in the range of 9.31% to 40.01% compared with the control sample. Besides, a new diffraction peak at  $2\theta = 23.8^\circ$  was observed in the Biofield Energy Treated sample compared with the control sample. The significant changes in the crystallite size and relative intensities indicated that the crystal morphology of the Biofield Energy Treated copper chloride was modified

compared to the control sample. Literature reported that different crystal morphology through the alteration in the crystallite size and relative intensities indicates the different polymorphs of the pharmaceutical and nutraceutical solid compounds [22-24, 31]. Hence, The Trivedi Effect<sup>®</sup> - Energy of Consciousness Healing Treatment probably introduced a new polymorphic form through the energy transferred into the copper chloride. A change in the crystal morphology has the significant effect on the *in vitro* dissolution rate and bioavailability of an orally administered pharmaceutical/nutraceutical [32, 33]. Thus, it can be assumed that The Trivedi Effect<sup>®</sup> might affect the bioavailability of copper chloride.

### 3.2. Differential Scanning Calorimetry (DSC) Analysis

The DSC thermograms of the control and Biofield Energy Treated samples of copper chloride (Figure 2) exhibited two broad endothermic peaks and one sharp exothermic peak. The DSC curve of the control sample showed a broad endothermic peak at  $129.13^\circ\text{C}$  that is the melting point of copper (II) chloride dihydrate according to the literature [34]. After the Biofield Energy Treatment, the melting point of the Biofield Energy Treated copper chloride was increased by 2.91% compared to the control sample (Table 2). The latent heat of fusion ( $\Delta H$ ) of the Biofield Energy Treated copper chloride was significantly reduced by 28.73% compared to the control sample. Thus, Biofield Energy Treated copper chloride required less energy in the form of  $\Delta H$  to undergo the whole process of melting after Alice's Biofield Energy

Treatment.

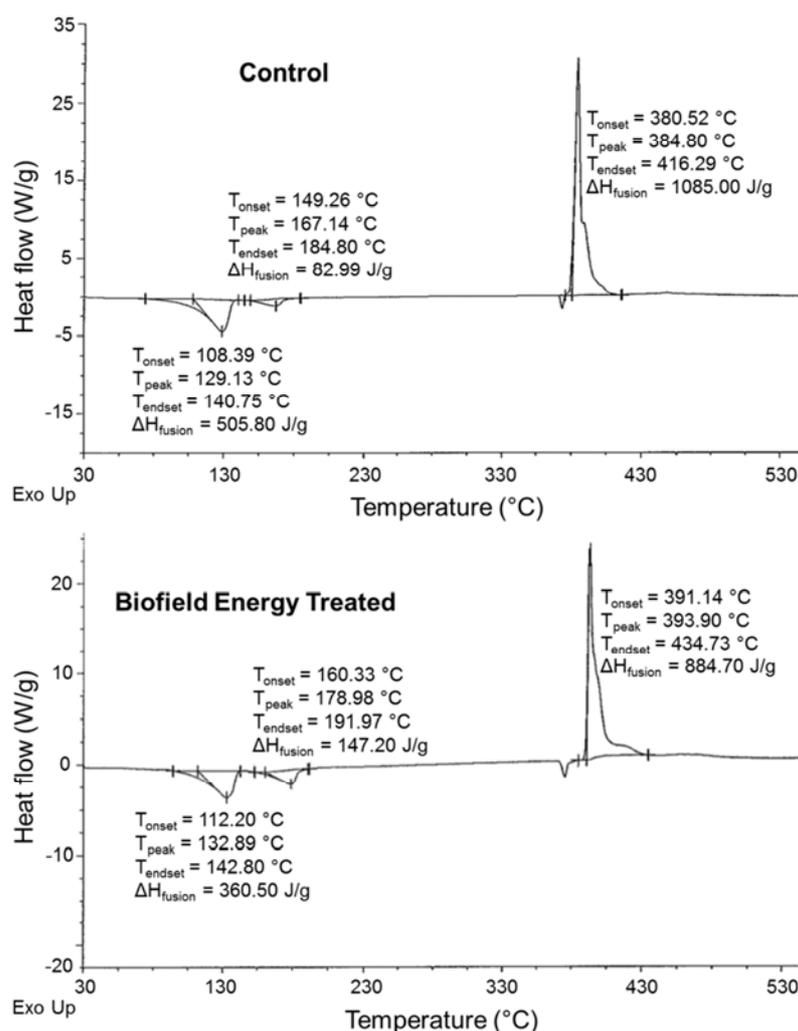


Figure 2. DSC thermograms of the control and Biofield Energy Treated copper chloride.

Table 2. DSC data for both control and Biofield Energy Treated samples of copper chloride.

Sample	Melting point/Decomposition Temperature (°C)			$\Delta H$ (J/g)		
	1 <sup>st</sup> Peak	2 <sup>nd</sup> Peak	3 <sup>rd</sup> Peak	1 <sup>st</sup> Peak	2 <sup>nd</sup> Peak	3 <sup>rd</sup> Peak
Control Sample	129.13	167.14	384.80	505.80	82.99	1085.00
Biofield Energy Treated	132.89	178.98	393.90	360.50	147.20	884.70
%Change*	2.91	7.08	2.36	-28.73	77.37	-18.46

$\Delta H$ : Latent heat of fusion/Enthalpy of decomposition, \*denotes the percentage change of the Biofield Energy Treated sample with respect to the control sample.

Subsequently, the 2<sup>nd</sup> broad endothermic peak at 167.14°C was observed in the control sample that may be due to the melting temperature of copper chloride monohydrate produced from the dihydrate during the thermal reaction. The melting temperature of the 2<sup>nd</sup> peak in the Biofield Energy Treated sample was significantly increased by 7.08% with a significant enhancement of  $\Delta H$  by 77.37% compared with the control sample. Scientific literature reported that copper (II) chloride dihydrate decomposes at above 300°C with releasing chlorine gas [35]. Thus, a sharp exothermic peak at 384.80 and 393.90°C was observed in both the control and Biofield Energy Treated samples, respectively, which were

the decomposition of the copper (II) chloride dihydrate. The decomposition temperature of the Biofield Energy Treated copper chloride were increased by 2.36% with a significant reduction of the enthalpy of decomposition by 18.46% compared with the control sample. The DSC results suggested that the thermal stability of the Biofield Energy Treated sample was significantly improved compared with the control sample (Table 2).

### 3.3. Thermal Gravimetric Analysis (TGA) / Differential Thermogravimetric Analysis (DTG)

Mohamed and Halawy reported that copper chloride

dihydrate salt loses its two water molecules in one step from the temperature 66 to 132°C. Copper chloride dihydrate exhibited a weight loss of 21.40% and  $T_{max}$  of 108.6°C at 10°C/min heating rate under a dynamic nitrogen atmosphere [34]. The TGA thermograms of the control and Biofield Energy Treated copper chloride showed three steps of thermal degradation (Figure 3). The weight loss and  $T_{max}$

value for the dehydration of two molecules of water (1<sup>st</sup> step degradation) in the control sample were 21.39% and 108.17°C, respectively. The 2<sup>nd</sup> and 3<sup>rd</sup> step degradations observed in both control and Biofield Treated samples may be due to the dehydration of water molecule from copper chloride monohydrate and decomposition of copper chloride, respectively.

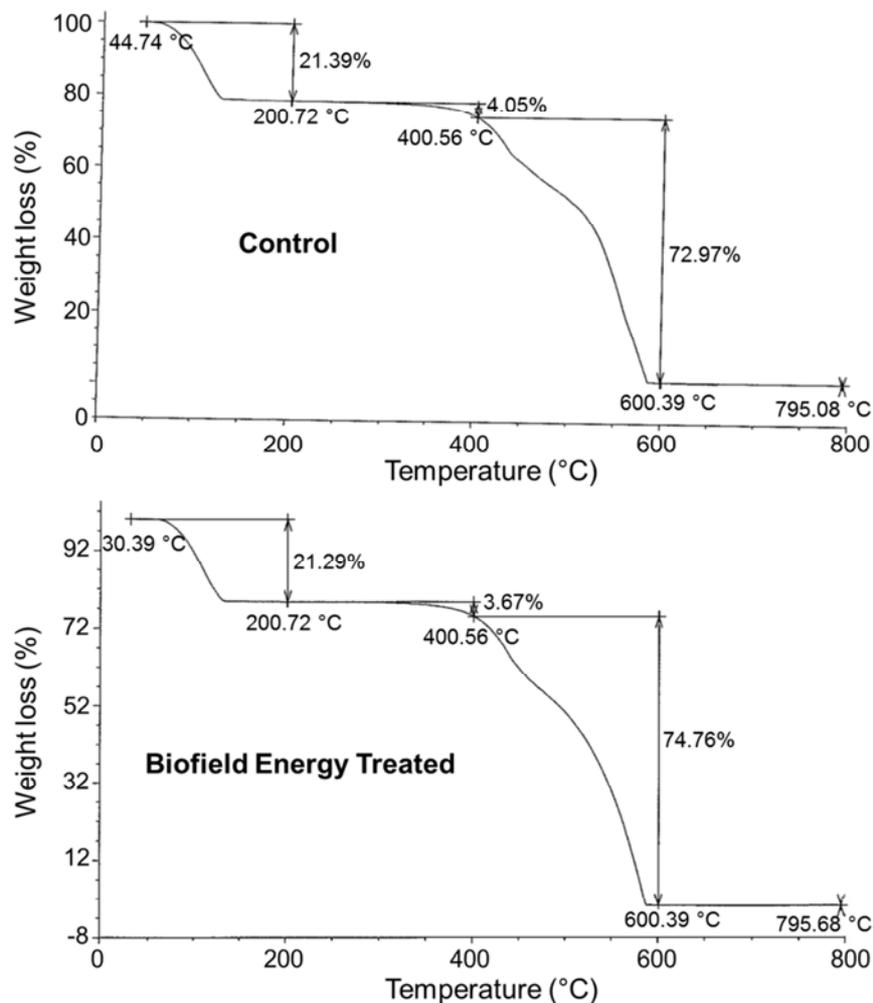


Figure 3. TGA thermograms of the control and Biofield Energy Treated copper chloride.

The percentage weight loss in Biofield Energy Treated copper chloride was decreased by 0.47% and 9.63% in the 1<sup>st</sup> and 2<sup>nd</sup> steps of degradation, respectively, while the percentage weight loss in the 3<sup>rd</sup> step degradation was increased by 2.45% compared with the control sample (Table 3). The overall weight loss in the Biofield Energy Treated Copper chloride was increased by 1.32% compared with the control sample (Table 3).

The DTG thermograms of the control and Biofield Energy Treated samples (Figure 4) exhibited three peaks. The  $T_{max}$  values in the 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> peaks of the Biofield Energy Treated sample were increased by 1.20%, 2.00%, and 4.61% compared with the control sample (Table 3). Overall, TGA/DTG revealed that the thermal stability of the Biofield Energy Treated copper chloride was significantly improved compared to the control sample.

Table 3. TGA/DTG data of the control and Biofield Energy Treated samples of copper chloride.

Sample	TGA Weight loss (%)				DTG $T_{max}$ (°C)		
	1 <sup>st</sup> step	2 <sup>nd</sup> step	3 <sup>rd</sup> step	Total	1 <sup>st</sup> step	2 <sup>nd</sup> step	3 <sup>rd</sup> step
Control	21.39	4.05	72.97	98.41	108.17	429.27	555.95
Biofield Energy Treated	21.29	3.66	74.76	99.71	109.47	437.87	581.57
% Change*	-0.47	-9.63	2.45	1.32	1.20	2.00	4.61

\*denotes the percentage change of the Biofield Energy Treated sample with respect to the control sample;  $T_{max}$ : maximum thermal degradation temperature.

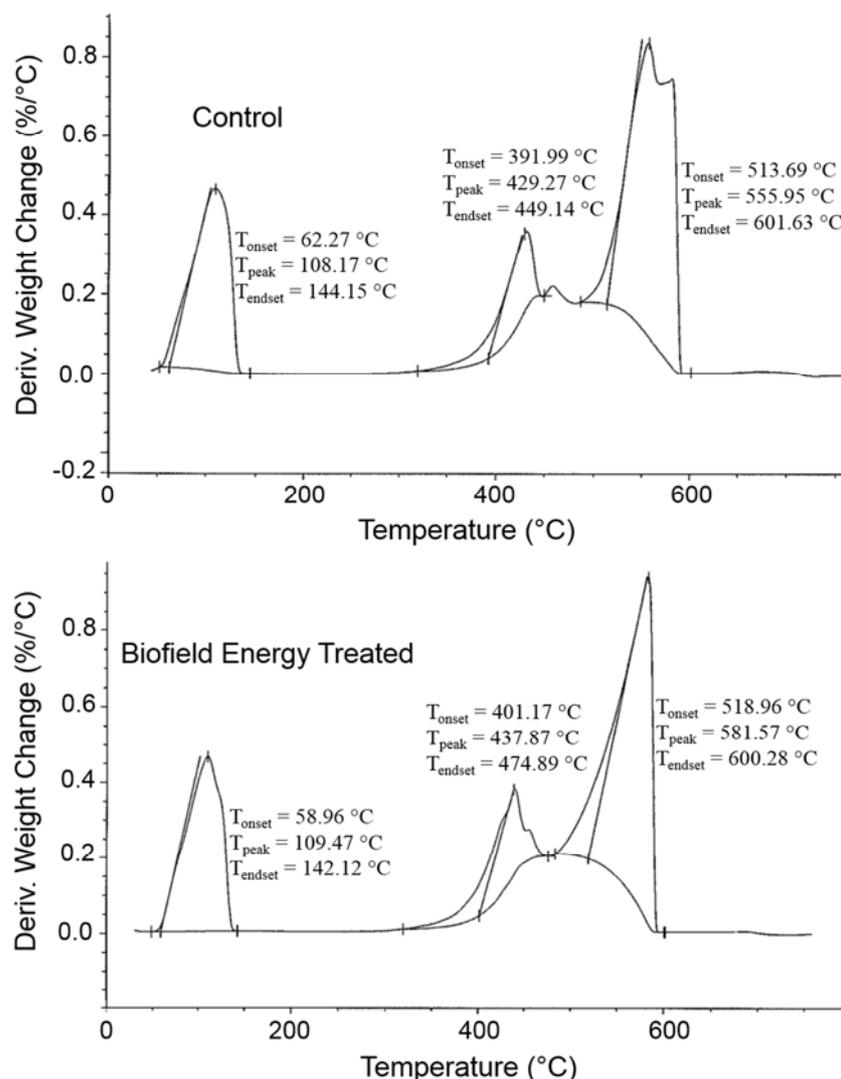


Figure 4. DTG thermograms of the control and Biofield Energy Treated copper chloride.

## 4. Conclusions

The present study demonstrated that The Trivedi Effect® - Energy of Consciousness Healing Treatment exhibited a significant effect on the relative intensities and crystallite size of the characteristic diffraction peaks as well as the thermal stability of copper chloride. The relative intensities of each characteristic diffraction peak in the Alice's Biofield Energy Treated copper chloride were significantly altered from -77.37 to 205.56% compared with the control sample. Consequently, the crystallite size of each characteristic diffraction peak in the Biofield Energy Treated sample was changed from -14.29% to 40.01% compared with the control sample. The melting point of the Biofield Energy Treated copper (II) chloride was significantly improved by 2.91% with a reduced  $\Delta H$  by 28.73% compared to the control sample. The melting temperature of the 2<sup>nd</sup> peak in the Biofield Energy Treated sample was significantly increased by 7.08% with a significant improvement of  $\Delta H$  by 77.37% compared with

the control sample. Consequently, the decomposition temperature of the Biofield Energy Treated copper chloride was increased by 2.36% with a significant reduction of the enthalpy of decomposition by 18.46% compared to the control sample. The TGA analysis revealed the three steps thermal degradation. The percentage weight loss in Biofield Energy Treated copper chloride was reduced by 0.47% and 9.63% in the 1<sup>st</sup> and 2<sup>nd</sup> steps of degradation, respectively, while the percentage weight loss in the 3<sup>rd</sup> step degradation was increased by 2.45% compared with the control sample. The total weight loss in the Biofield Energy Treated copper chloride was increased by 1.32% compared with the control sample. The DTG analysis showed that the  $T_{max}$  values in the 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> peaks of the Biofield Energy Treated sample were increased by 1.20%, 2.00%, and 4.61% compared with the control sample. Overall, the thermal analysis (DSC, TGA/DTG) indicated that the thermal stability of Alice's treated copper chloride was significantly increased compared to the control sample. Thus, the Energy of Consciousness Healing Treatment (The Trivedi Effect®) might introduce a polymorphic form of copper chloride that

could be more stable during manufacturing, delivery or storage conditions than the untreated sample. The Biofield Energy Treated copper chloride would be offer better therapeutic response against cancer, inflammation, wound healing, etc.

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