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Research Article

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Spectroscopic Characterization of Disodium Hydrogen Orthophosphate and Sodium Nitrate after Biofield Treatment

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Abstract

Disodium hydrogen orthophosphate is a water soluble white powder widely used as pH regulator and saline laxative. The sodium nitrate is a highly water soluble white solid, used in high blood pressure, dentinal hypersensitivity, and production of fertilizers. The present study was aimed to investigate the impact of biofield treatment on spectral properties of disodium hydrogen orthophosphate and sodium nitrate. The study was performed in two groups i.e., control and treatment of each compound. The treatment groups were subjected to Mr. Trivedi's biofield treatment. The spectral properties of control and treated groups of both compounds were studied using Fourier transform infrared (FT-IR) and Ultraviolet-Visible (UV-Vis) spectroscopic techniques. FT-IR spectrum of biofield treated disodium hydrogen orthophosphate showed the shifting in wavenumber of vibrational peaks (with respect to control) corresponding to O-H stretching from 2975 to 3357 cm^{-1}, PO-H symmetrical stretching from 2359 to 2350 cm^{-1}, O=P-OH deformation from 1717-1796 cm^{-1} to 1701-1735 cm^{-1}, P=O asymmetric stretching from 1356 to 1260 cm^{-1} and P=O symmetric stretching from 1159 to 1132 cm^{-1}, etc. Likewise, the FT-IR spectrum of sodium nitrate exhibited the shifting of vibrational frequency of N=O stretching from 1788 to 1648 cm^{-1} and NO_3 asymmetric and symmetric stretchings from 1369 to 1381 cm^{-1} and 1340 to 1267 cm^{-1}.

UV spectrum of treated disodium hydrogen orthophosphate revealed a negative absorbance; it may be due to decrease in UV absorbance as compared to control. UV spectrum of control sodium nitrate exhibited two absorbance maxima (λ_{max}) at 239.4 nm and 341.4 nm, which were altered to one absorbance maxima (λ_{max}) at 209.2 nm after biofield treatment.

Overall, the FT-IR and UV spectroscopic data of both compounds suggest an impact of biofield treatment on spectral properties with respect to force constant, bond strength, dipole moments and transition energy between two orbitals (ground state and excited state) as compared to respective control.

Keywords: Disodium hydrogen phosphate; Sodium nitrate; Biofield treatment; Fourier transform infrared spectroscopy; Ultraviolet spectroscopy

Introduction

Disodium hydrogen phosphate (Na_2HPO_4) or Disodium hydrogen orthophosphate is the inorganic salt exists in anhydrous form as well as forms with dihydrate, heptahydrate and octahydrate. All these forms are water-soluble white powders. It is widely used in food products to adjust the pH, and to prevent the milk coagulation in the preparation of condensed milk [1]. Similarly, it is used as an anti-caking additive in powdered products. In conjunction with trisodium phosphate it is used as detergents, cleaning agents and in water treatment [2]. The monobasic and dibasic sodium phosphate is used as a saline laxative to treat constipation or to clean the bowel before colonoscopy [3].

Sodium nitrate ($NaNO_3$) is a highly water soluble white powder. It is a readily available source of nitrate anion (NO_3^-) and widely used in numerous chemical reactions at industrial scale for the production of fertilizers, smoke bombs, pyrotechnics, and as a solid rocket propellant. It is also a food additive and used as color fixative and preservative [4]. Sodium nitrate is also used in conjunction with calcium nitrate and potassium nitrate for heat storage and heat transfer in solar power plants [5]. In addition, researcher also reported its beneficial effects in lowering blood pressure by slightly expanding the arteries [6]. However, it is also associated to higher risk of gastrointestinal cancer [7]. The chemical and physical stability of any compound are most desired qualities that determine the shelf life and effectiveness of compound [8]. Hence, it is advantageous to find out an alternate approach, which could alter the spectral properties of chemical compounds. Recently, biofield treatment is reported to alter the physical, and structural properties of various living and non-living substances [9,10].

The relation between mass-energy was described by Hasenohrl [11]. Later on, Einstein gave the well-known equation $E=mc^2$ for light and mass [12]. The mass is consist of energy and once this energy vibrates at a certain frequency, it gives physical, atomic and structural properties like shape, size, texture, crystal structure, and atomic weight to the matter. Similarly, the human body also comprises of vibratory energy particles like neutrons, protons, and electrons. Due to the vibration of these particles in the nucleus, an electrical impulse generated [13]. According to Ampere-Maxwell-Law, varying of these electrical impulses with time generates magnetic field, which cumulatively form electromagnetic field [14]. Hence, electromagnetic field generated from human body is known as biofield and energy associated with this field called biofield energy [15,16]. Mr. Trivedi has the ability to harness the energy from environment or universe and can transmit into any living

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or nonliving object around this Globe. The object(s) always receive the energy and responding into useful way, this process is known as biofield treatment. Mr. Trivedi's biofield treatment has considerably changed the physicochemical, thermal and structural properties of metals [10,17] and ceramics [18,19]. Growth and anatomical characteristics of some plants were also increased after biofield treatment [20,21]. Further, biofield treatment has showed the significant effect in the field of microbiology [9,22] and agriculture science [23,24].

Considering the above mentioned facts, presented study was attempted to investigate the impact of biofield treatment on atomic level like force constant, dipole moment, and energy gape between highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO) of disodium hydrogen orthophosphate and sodium nitrate.

Materials and Methods

Study design

The disodium hydrogen orthophosphate was procured from Qualigens Fine Chemicals (Mumbai, India), and sodium nitrate was procured from Sigma-Aldrich, MA, USA. Each compound was divided into two parts i.e., control and treatment. The control samples were remained as untreated, and treatment samples were handed over in sealed pack to Mr. Trivedi for biofield treatment under laboratory condition. Mr. Trivedi provided this treatment through his energy transmission process to the treatment groups without touching the sample. The control and treated samples of disodium hydrogen orthophosphate and sodium nitrate (Figure 1) were evaluated using FT-IR and UV-Vis spectroscopy.

FT-IR spectroscopic characterization

FT-IR spectra of control and treated samples of disodium hydrogen orthophosphate and sodium nitrate were recorded on Shimadzu's Fourier transform infrared spectrometer (Japan) with frequency range of 4000-500 cm^{-1}. The analysis were carried out to evaluate the impact of biofield treatment at atomic level like dipole moment, force constant and bond strength in chemical structure [25].

UV-Vis spectroscopic analysis

UV spectra of control and treated sample of disodium hydrogen orthophosphate and sodium nitrate were recorded on Shimadzu UV-2400 PC series spectrophotometer with 1 cm quartz cell and a slit width of 2.0 nm. The analysis was carried out using wavelength in the range of 200-400 nm. The UV spectral analysis was performed to determine the effect of biofield treatment on the energy gap of two orbitals. Existing literature on principle of UV spectroscopy suggests that a molecule can absorbs UV radiation owing to presence of either or both conjugated pi (π) -bonding systems (π-π* transition) and nonbonding electron system (n-π* transition) in the compound. The UV absorption phenomenon occurred when electrons travelled from low energy orbital (i.e., σ, n, and π) to high energy orbital (i.e., σ* and π*). There is certain energy gape between σ-σ*, σ-π*, π -π* and n-π* orbitals. When this energy gap altered, the wavelength (λ_{max}) was also altered respectively [25].

Results and Discussion

FT-IR spectroscopic analysis

The FT-IR spectra of control and treated disodium hydrogen orthophosphate are shown in Figure 2 and the FT-IR data interpretation is reported in Table 1. Absorption bands in frequency region of 4000 to 1450 cm^{-1} are usually due to stretching vibrations of diatomic units, which sometime also called as group frequency region. The spectrum of control disodium hydrogen orthophosphate Figure 2 showed the IR peak at 2975 cm^{-1} for O-H stretching due to water of crystallization. This peak was shifted to 3357 cm^{-1} in treated sample, which indicated the enhanced hydrogen bonding inside the water of crystallization in the treated sample of disodium hydrogen orthophosphate with respect of control.

Frequency (ν) of stretching vibrational peak depends on two factors i.e., force constant (k) and reduced mass (μ), which can be explained by following equation [26] $\nu = 1/2\pi c \sqrt{(k/\mu)}$; here, c is speed of light. If μ is constant, then the frequency is directly proportional to the force constant; therefore, increase or decrease in frequency of any bond indicates a respective increase and decrease in force constant [25].

The PO-H asymmetrical stretching was appeared at 2826-2871 cm^{-1} in control sample that were shifted to higher wavenumber in treated sample i.e., at 2914-3111 cm^{-1}. The PO-H symmetrical stretching was appeared at 2359 cm^{-1} in control sample, which was shifted to lower wavenumber (2350 cm^{-1}) after biofield treatment. The PO-H bending was assigned

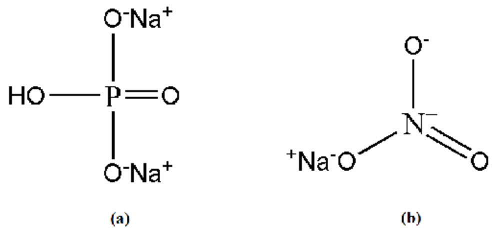

Figure 1: Chemical structure of (a) disodium hydrogen orthophosphate and (b) sodium nitrate.

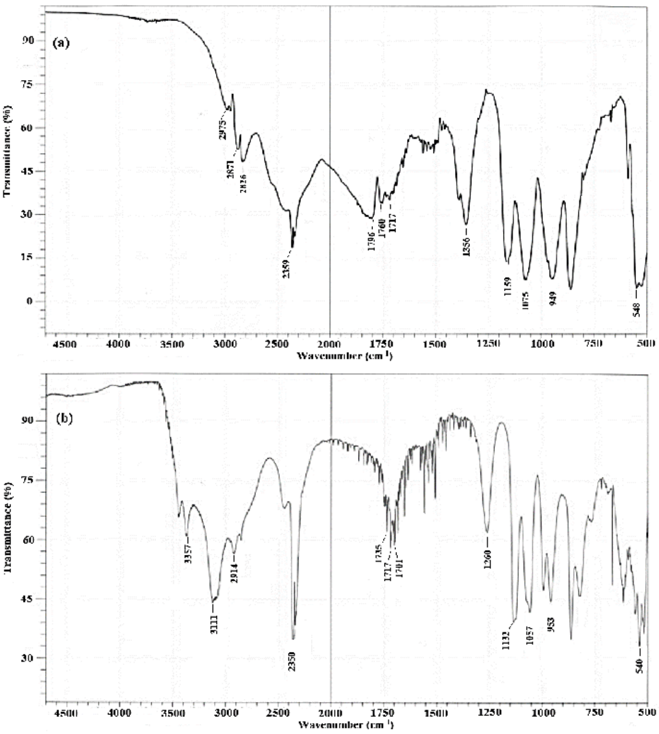

Figure 2: FT-IR spectra of disodium hydrogen orthophosphate (a) control and (b) treated.

Wave number (cm^{-1})		Frequency Assignment
Control	**Treated**	
2975	3357	O-H stretching due to water of crystallization
2826-2871	2914-3111	PO-H asymmetrical stretching
2359	2350	PO-H symmetrical stretching
1717-1760	1701-1717	O=P-OH deformation vibration
1159-1356	1132-1260	P=O stretching
1075	1057	P-O stretching
949	953	PO-H bending
548	540	Out of plane P-OH bending

Table 1: FT-IR vibrational peaks observed in disodium hydrogen orthophosphate.

to peak at 949 cm^{-1} in control sample, and 953 cm^{-1} in treated sample of disodium hydrogen orthophosphate. The alteration in wavenumber of PO-H asymmetric and symmetric stretchings might be due to alteration in bending and torsional force and flexibility of PO-H bond in treated disodium hydrogen orthophosphate as compared to control.

According to Colth up NB, coexisting of P-OH group with one P=O group leads to an additional broad band peak at frequency region of 1630-1750 cm^{-1} [27]. This band attributed to P-OH stretching vibration with overtone of out of plane P-OH bending. The disodium hydrogen orthophosphate molecule also have the similar pattern of P-OH and P=O groups, therefore peak appeared in the region of 1717-1760 cm^{-1} in control sample were assigned to O=P-OH deformation vibrations. After biofield treatment, the peak corresponding to O=P-OH deformation vibrations were observed at lower frequency region (1701-1717 cm^{-1}) with respect of control, this could be due to decrease in the bending force of O=P-OH deformation in treated sample. The P=O stretching in control disodium hydrogen orthophosphate was appeared at 1159-1356 cm^{-1} that was shifted to 1132-1260 cm^{-1} after biofield treatment. This could be due to reduced force constant of P=O in treated disodium hydrogen orthophosphate as compared to control. The vibrational frequency for P-O stretching was appeared at 1075 cm^{-1} in control, which was shifted to 1057 cm^{-1} after biofield treatment. It suggested a possible decrease in force constant of P-O bond after biofield treatment with respect of control. The IR peak for P-OH out plane bending was appeared at 548 cm^{-1} in control sample, which was observed at 540 cm^{-1} in treated sample. The FT-IR data of control disodium hydrogen orthophosphate was well supported by the literature data [28].

The FT-IR spectra of control and treated sodium nitrate are shown in Figure 3 and the FT-IR data interpretation is reported in Table 2. The FT-IR spectrum of control and treated sodium nitrate exhibited a vibrational peak at 3478 cm^{-1} and 3445 cm^{-1}, respectively, which were attributed to O-H stretching of H_2O molecules due to water absorption. The characteristic vibrational peak for N=O stretching was appeared at 1788 cm^{-1} in control sample of sodium nitrate that was shifted to 1648 cm^{-1} after biofield treatment. This suggested a decreases in force constant of N=O bond as compared to control sodium nitrate. The NO_3 asymmetric stretching was appeared at 1340-1369 cm^{-1} in control sample and at 1267-1381 cm^{-1} in treated sample of sodium nitrate. It showed an alteration in wavenumber of NO_3 stretching due to possible alteration in force constant and dipole moment of NO_3 group vibrations. The NO_3 symmetric stretching peak was observed at 835 cm^{-1} in control and at 827 cm^{-1} in treated sample of sodium nitrate. The downstream shifting in frequency of NO_3 symmetric stretching indicates a possible reduction in force constant of NO_3 group after biofield treatment as compared to control. The FT-IR data of control sodium nitrate was well supported by the literature data [29].

Overall, the FT-IR spectra of biofield treated disodium hydrogen orthophosphate exhibited the alteration in wavenumber of some functional group or bonds like O=P-H, P-OH, P=O, and P-O with respect of control sample. Whereas, the biofield treated sodium nitrate showed the alteration in wavenumber of N=O and NO_3 asymmetric and symmetric stretching as compared to control. It may be due to alteration in force constant, bond strength and dipole moment of respective bonds of disodium hydrogen orthophosphate and sodium nitrate as compared to respective control.

UV-Vis spectroscopy

UV spectra of control and biofield treated disodium hydrogen orthophosphate are shown in Figure 4. The UV spectrum of treated disodium hydrogen orthophosphate (Figure 4b) did not show the significant change in absorption maxima (λ_{max}), however the negative UV absorbance appeared with respect to control (Figure 4a). This could be due to decrease in UV absorbance of disodium hydrogen orthophosphate after biofield treatment as compared to control.

The UV spectra of control and treated sodium nitrate are shown in Figure 5. The control sample exhibited two absorbance maxima (λ_{max}) at 239.4 nm and 341.4 nm. However, the biofield treated sodium nitrate exhibited only one absorbance maxima at 209.2 nm. The UV

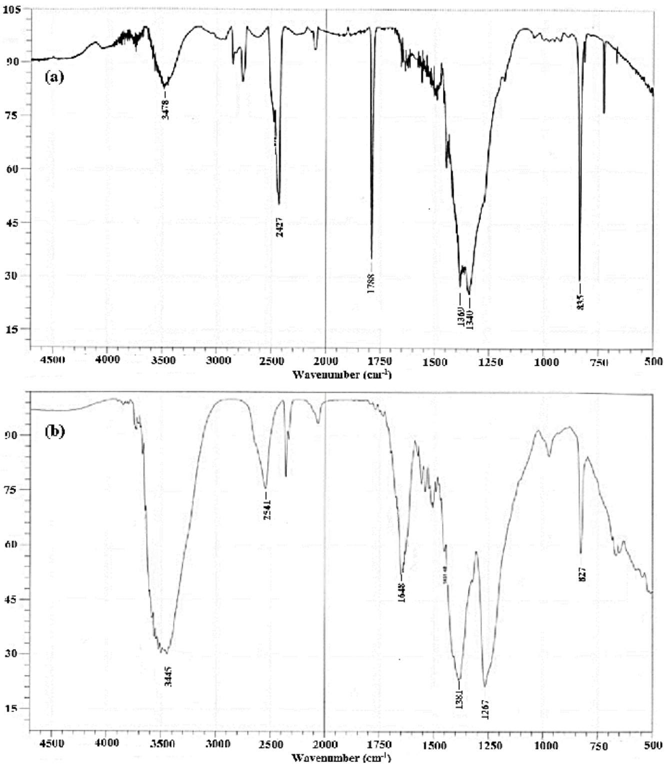

Figure 3: FT-IR spectra of sodium nitrate (a) control and (b) treated.

Wave number (cm^{-1})		
Control	**Treated**	**Frequency Assignment**
3478	3445	O-H stretching of H_2O molecules due to water absorption
1788	1648	N=O stretching
1340-1369	1267-1381	NO_3 asymmetric stretching
835	827	NO_3 symmetric stretching

Table 2: FT-IR vibrational peaks observed in sodium nitrate.

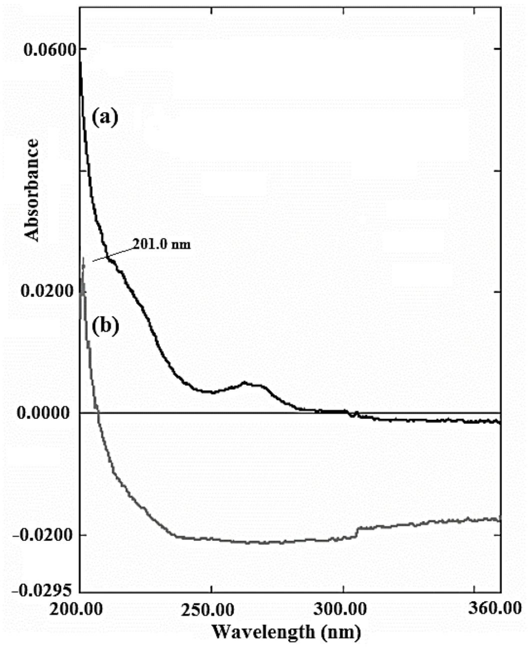

Figure 4: UV spectra of disodium hydrogen orthophosphate (a) control and (b) treated.

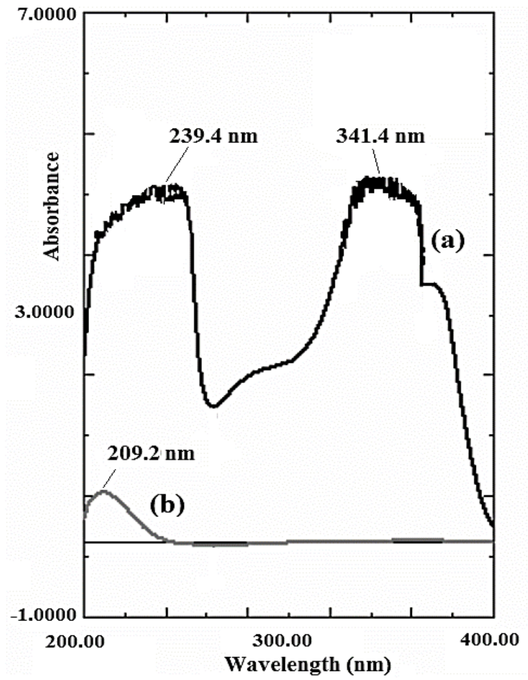

Figure 5: UV spectra of sodium nitrate (a) control and (b) treated.

absorption occurred due to transition of electron i.e., bonding (π-π^* transition) or nonbonding (n-π^* transition) from ground state to excited state. Alteration in absorption peak in UV spectrum might refer to alteration in bonding or nonbonding electron transition possibly due to chemical alteration in structure of tested compound [25]. Therefore, it is hypothesized that, biofield treatment may induce the alteration in bonding or nonbonding electron transition of sodium nitrate as compared to control, which might be due to an alteration in chemical structure of sodium nitrate with respect of control sample. To the best of our knowledge, this is the first report showing an impact of biofield treatment on structural properties like force constant, bond strength, and dipole moment, of disodium hydrogen orthophosphate and sodium nitrate.

Conclusion

FT-IR spectrum of biofield treated disodium hydrogen orthophosphate showed the alteration in wavenumber of IR peaks assigned to O=P-H, O=P-OH, P=O, and P-O vibrations as compared to control. Likewise, the biofield treated sodium nitrate also showed the alteration in wavenumber of IR peaks assigned to N=O stretching and NO_3 stretching with respect of control. UV spectrum of treated disodium hydrogen orthophosphate showed the alteration in UV absorbance and UV spectrum of treated sodium nitrate showed the alteration in absorption maxima (λ_{max}), as compared to respective control.

Altogether, the FT-IR results showed an impact of biofield treatment on structural properties like force constant, bond strength, and flexibility of treated compounds with respect to control. Likely, the UV result suggests the impact of biofield treatment on bonding and nonbonding electron transition of treated compounds with respect to control.

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