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# Evaluation of Isotopic Abundance Ratio in Naphthalene Derivatives After Biofield Energy Treatment Using Gas Chromatography-Mass Spectrometry

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**Abstract:** Naphthalene and 2-naphthol are two naphthalene derivatives, which play important roles in the chemical and pharmaceutical industries. The aim of this study was to evaluate the impact of biofield energy treatment on the isotopic abundance of  $^{13}\text{C}/^{12}\text{C}$  or  $^2\text{H}/^1\text{H}$  and  $^{18}\text{O}/^{16}\text{O}$  in naphthalene and 2-naphthol using gas chromatography-mass spectrometry (GC-MS). Naphthalene and 2-naphthol samples were divided into two parts: control and treated. The control group remained as untreated, while the treated group was subjected to Mr. Trivedi's biofield energy treatment. The treated samples were subdivided into four parts named as T1, T2, T3 and T4. Control and treated samples were characterized using GC-MS. The GC-MS data revealed that the isotopic abundance ratio of  $^{13}\text{C}/^{12}\text{C}$  or  $^2\text{H}/^1\text{H}$ , (PM+1)/PM and  $^{18}\text{O}/^{16}\text{O}$ , (PM+2)/PM were increased significantly in treated naphthalene and 2-naphthol (where PM-primary molecule, (PM+1) isotopic molecule either for  $^{13}\text{C}$  or  $^2\text{H}$  and (PM+2) is the isotopic molecule for  $^{18}\text{O}$ ). The isotopic abundance ratio of (PM+1)/PM in the treated T2 samples of naphthalene and 2-naphthol was increased up to 129.40% and 165.40%, respectively as compared to their respective control. However, the isotopic abundance ratio of (PM+1)/PM in the treated T1, T3 and T4 samples of naphthalene was decreased by 44.41%, 33.49% and 30.3%, respectively as compared to their respective control. While in case of 2-naphthol, the isotopic abundance ratio of (PM+1)/PM was decreased by 39.57% in T1 sample and then gradually increased up to 9.85% from T3 to T4 samples. The isotopic abundance ratio of (PM+2)/PM in treated T2 sample of 2-naphthol was increased up to 163.24%, whereas this value was decreased by 39.57% in treated T1 sample. The GC-MS data suggest that the biofield energy treatment has significantly altered the isotopic abundance of  $^2\text{H}$ ,  $^{13}\text{C}$  in naphthalene and  $^2\text{H}$ ,  $^{13}\text{C}$  and  $^{18}\text{O}$  in 2-naphthol as compared to the control.

**Keywords:** Biofield Energy Treatment, Naphthalene, Gas Chromatography-Mass Spectrometry, 2-Naphthol

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## 1. Introduction

The naphthalene and naphthols that have been used commercially are most commonly petroleum products and byproducts of various combustion processes. They play an important role in the chemical industry and in production of pharmaceuticals. They are moderately toxic to the environment [1]. Petroleum and coal are the main sources of naphthalene, however burning tobacco or wood also produces naphthalene. The major commercial use of naphthalene is in the manufacturing of polyvinyl chloride

(PVC) plastics. Several naphthalene containing drugs are available in the market, such as nafcillin, naftifine, tolnaftate, terbinafine, etc., which play a vital role to as antimicrobials [2]. Naphthalene is a raw chemical for industrial synthesis, in particular of phthalic anhydride [3]. Besides, naphthalene has moderate toxic property while exposed to human and other living organisms and its high concentration may cause haemolytic anaemia [4]. Naphthalene is rather unreactive, it reacts more readily than benzene, for instance, with the electrophilic and hydrogenating agents [5]. 2-naphthol is a naphthalene derivative, prepared from the corresponding naphthalene

sulphonic acid. It is used as an intermediate for the production of odor agents, pharmaceuticals, dye-stuffs, fungicides, and as insecticides [6]. The naphthalene derivatives are also used as an antioxidant for rubber, plastic, grease and lubricants. Faizul *et al.*, have found naphthalene ring as an active antibacterial constituent in 2-naphthol and azo 2-naphthol to show antimicrobial activity against *Staphylococcus aureus* and *Escherichia coli* [7]. Literature data indicates that both naphthalene and 2-naphthol have moderate concern for environmental toxicity, low concern as Persistent Organic Pollutants (POP) [8], moderate apprehension for skin and eye irritation, carcinogenicity and low concern for mammalian toxicity.

The distribution of contaminant sources of any molecule on a native or global scale can be understood by determining the isotope abundance ratio and characterization of elementary reaction mechanisms. Moreover, phonon-related properties such as thermal conductivity, thermal expansion, and melting temperature are expected to alter which is dependent upon isotope mass [9]. The rate of chemical reaction depends on the mass of the nucleus with different isotopic substitutions, which slightly affect the partitioning of energy within the molecules. These deviations from perfect chemical equivalence are termed as isotope effects. The isotopic abundance ratio is commonly reported in terms of atom percent [10].

Both of the naphthalene derivatives taken for mass spectrometric study are photosensitive and moderately hazardous. The stability could be enhanced by Mr. Trivedi's unique biofield energy treatment which is already known to alter the physical and structural properties of various living and non-living substances [11]. The National Center for Complementary and Alternative Medicine (NCCAM), which is part of the National Institute of Health (NIH), has recommended the use of Complementary and Alternative Medicine (CAM) therapies in the health care sector and about 36% of Americans regularly use some form of CAM [12]. CAM includes numerous energy-healing therapies, in which biofield therapy is a form of putative energy medicine that is being widely used worldwide to improve the overall health and well-being of human beings. When an electrical signal passes through any material, a magnetic field is generated in the surrounding space [13]. Humans have the ability to harness energy from the environment/universe and can then transmit it to any object (living or non-living) around the globe. This process is called biofield energy treatment. Mr. Trivedi's unique biofield energy treatment is also called The Trivedi Effect<sup>®</sup>, which is known to alter the physical, structural and atomic properties in various metals [14-16] and ceramics [17, 18] in materials science and in microbiology research [19]. Based on the outstanding results achieved by the biofield energy treatment on metals and ceramics, an attempt was made to evaluate the effect of biofield energy treatment on the isotopic abundance ratio of  $^{13}\text{C}/^{12}\text{C}$  or  $^2\text{H}/^1\text{H}$  (PM+1)/PM and  $^{18}\text{O}/^{16}\text{O}$  (PM+2)/PM in naphthalene and 2-naphthol.

## 2. Experimental

### 2.1. Materials and Methods

Both naphthalene and 2-naphthol were procured from S. D. Fine Chem. Ltd., India. Each of the samples was distributed into two parts, where one part of each sample was referred as control sample and the other part was considered as treated group. The treated group of each sample was handed over to Mr. Trivedi for biofield energy treatment in a sealed pack and under standard laboratory conditions. Mr. Trivedi provided the treatment through his energy transmission process to the treated group without touching the samples. The control and treated samples of naphthalene and 2-naphthol were characterized using Gas Chromatography-Mass Spectrometry (GC-MS).

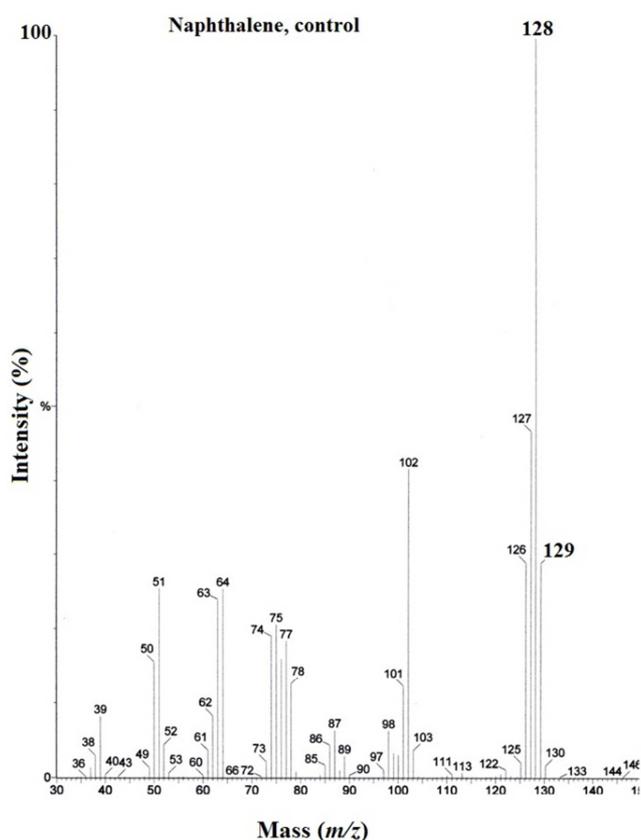


Figure 1. GC-MS spectrum of control naphthalene sample.

### 2.2. GC-MS Spectroscopy

The gas chromatography-mass spectroscopy (GC-MS) analysis was performed on Perkin Elmer/auto system XL with Turbo mass, USA, having detection limit up to 1 picogram. For GC-MS analysis the treated sample was further divided into four parts as T1, T2, T3 and T4. The GC-MS data was obtained in the form of % abundance vs. mass to charge ratio ( $m/z$ ), which was known as mass spectrum. The isotopic abundance ratio  $^{13}\text{C}/^{12}\text{C}$  or  $^2\text{H}/^1\text{H}$  (PM+1)/PM and  $^{18}\text{O}/^{16}\text{O}$  (PM+2)/PM was expressed by its deviation in treated samples as compared to the control. The percentage changes in isotopic ratios (PM+1)/PM and (PM+2)/PM were

calculated on a percentage scale from the following formula:

$$\text{Percent change in isotopic abundance ratio (PM + 1/PM)} = \frac{R_{\text{Treated}} - R_{\text{Control}}}{R_{\text{Control}}} \times 100$$

Where,  $R_{\text{Treated}}$  and  $R_{\text{Control}}$  are the ratio of intensity at (PM+1) to PM in mass spectra of treated and control samples respectively.

### 3. Results and Discussion

#### 3.1. GC-MS Spectra of Naphthalene

The GC-MS spectra of control, and treated (T1, T2, T3 and T4) samples are presented in Figure 1 and 2, respectively. Mass spectra showed the base peak at  $m/z=128$  in all control and treated (T1, T2, T3 and T4) naphthalene samples, which was due to primary molecule (PM). The intensity ratio of PM+1 (*i.e.*  $m/z=129$ ) and PM (*i.e.*  $m/z=128$ ) peaks are presented in Table 1. Five major peaks at  $m/z=128$ , 102, 77, 64, and 51 were observed in control naphthalene sample, corresponded to the following ions respectively:  $C_{10}H_8$ ,  $C_8H_6^+$ ,  $C_6H_5^+$ ,  $C_5H_4^+$ , and  $C_4H_3^+$  ions. The peak at  $m/z=102$  was observed after breaking one of the aromatic

rings of naphthalene, leaving an acetylene molecule. Further,  $m/z=77$  peak was observed due to the phenyl ion, which again fragmented to give peaks at  $m/z=64$  and 51. Similarly, the treated naphthalene samples (T1-T4) were fragmented in the same way as control sample and showed similar peaks in the mass spectrum at  $m/z=128$ , 102, 77, 64, and 51 [20].

The isotopic abundance ratio of (PM+1)/PM in control and treated naphthalene was calculated and presented in Figure 3. The isotopic abundance ratio of (PM+1)/PM of treated naphthalene samples was decreased in T1 (44.41%), T3 (33.49%), and T4 (30.3%) but increased significantly in T2 (129.4%) after biofield energy treatment as compared to the control. The increased isotopic abundance ratio of (PM+1)/PM in treated (T2) naphthalene sample may increase effective mass ( $\mu$ ) and binding energy of this molecules with heavier isotopes, and this may results in high stability of the molecule.

Table 1. GC-MS isotopic abundance analysis result of naphthalene.

Peak Intensity	Control	Treated			
		T1	T2	T3	T4
PM ( $m/z$ )	100	100	100	100	100
PM+1 ( $m/z$ )	28.84	16.03	66.16	19.18	20.10

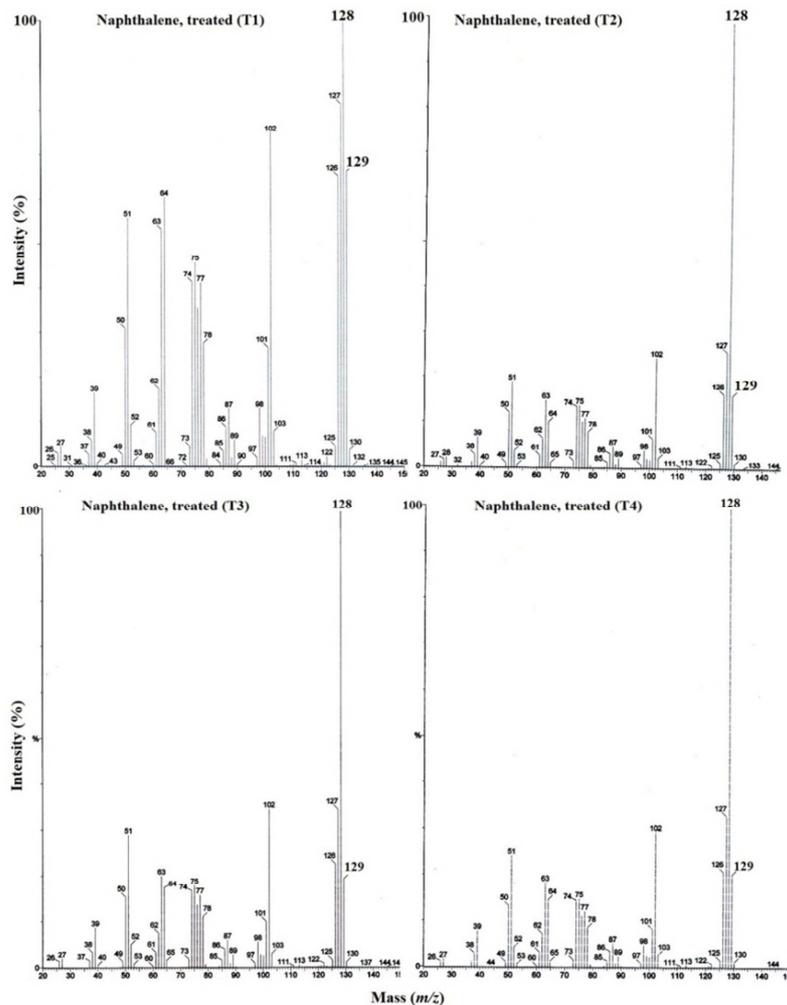


Figure 2. GC-MS spectra of treated naphthalene samples T1, T2, T3 and T4.

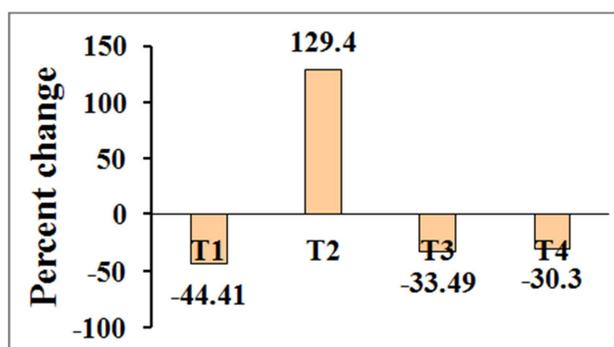


Figure 3. Percent change in the isotopic abundance (PM+1)/PM of naphthalene under biofield energy treatment as compared to the control.

### 3.2. GC-MS Spectra of 2-Naphthol

Molecular ion peak was observed at  $m/z=144$  in both control and treated samples of 2-naphthol (Figure 4 and 5). The intensity ratio of PM peak and (PM+1) peak are given in Table 2. Total four major peaks at  $m/z=144$ , 115, 89, and 63 were observed for both control and treated samples of 2-naphthol due to  $C_{10}H_8O$ ,  $C_9H_7^+$ ,  $C_5H_{13}O^+$ , and  $C_5H_3^+$  ions, respectively. The peak at  $m/z=115$  was observed due to the initial fragmentation of 2-naphthol to a benzyl derivative and methyl radical where benzyl derivative was further reduced to cyclopentadienyl ion ( $m/z=C_5H_3$ ). The fragmentation pattern of both control and treated 2-naphthol molecules were same, however, the number of fragmented peaks were increased from control to treated samples [21].

The isotopic abundance ratio of  $^{13}C/^{12}C$  or  $^2H/^1H \equiv (PM+1)/PM$  and  $^{18}O/^{16}O \equiv (PM+2)/PM$  of control and treated 2-naphthol was calculated and presented in Figure 6. The isotopic abundance ratio of (PM+1)/PM of treated 2-naphthol was increased significantly up to 165.40% in T2 sample but decreased in T1, and T3 samples (T1= -39.57%, T3= -5.08%) as compared to the control. The isotope abundance ratio of (PM+2)/PM was also increased in a similar way to up to 163.24% in T2 sample of 2-naphthol, however, decreased in T1, and T3 samples (T1= -40.44%, T3= -1.47%). The isotopic abundance ratio of (PM+1)/PM and (PM+2)/PM in treated T4 sample of 2-naphthol was increased slightly, 9.85% and 11.03% respectively as compared to the control.

Table 2. GC-MS isotopic abundance analysis result of 2-naphthol.

Peak Intensity	Control	Treated			
		T1	T2	T3	T4
PM ( $m/z$ )	100	100	100	100	100
PM+1 ( $m/z$ )	18.47	11.16	49.02	17.53	20.29
PM+2 ( $m/z$ )	1.36	0.81	3.58	1.34	1.51

Atoms in chemical bonds with higher isotopic number have higher binding energy with increased effective mass ( $\mu$ ) and *vice versa*. Thus, the increased isotopic abundance ratio of (PM+1)/PM in T2 samples of naphthalene and 2-naphthol, might increase the effective mass and binding energy after biofield energy treatment that may significantly enhance the

chemical stability of naphthalene derivatives.

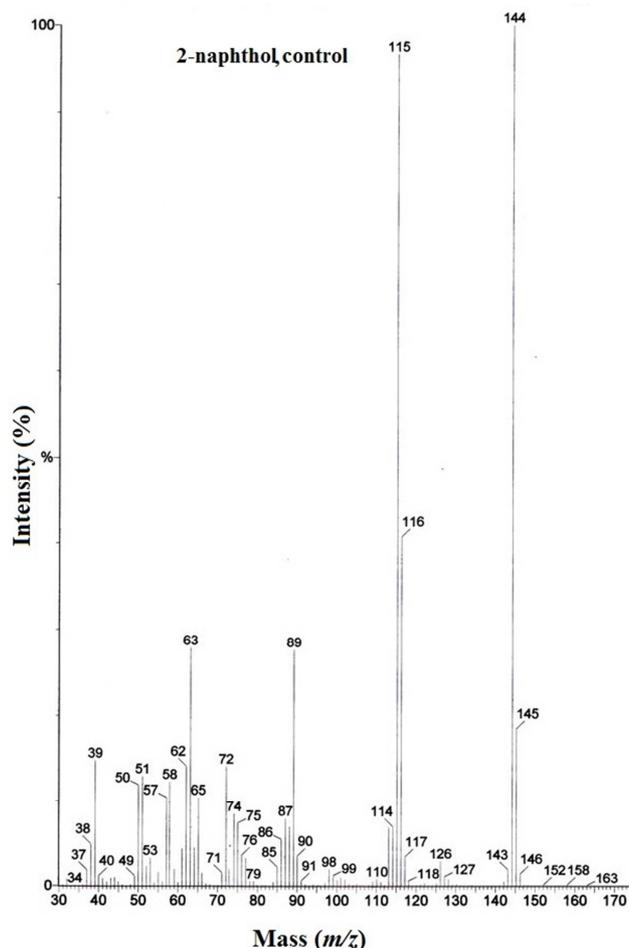


Figure 4. GC-MS spectrum of control sample of 2-naphthol.

Table 3. Possible isotopic bonds in naphthalene and 2-naphthol.

Isotopes Bond	Isotope type	Reduced mass ( $m_A m_B / (m_A + m_B)$ )
$^{12}C-^{12}C$	Lighter	6.00
$^{13}C-^{12}C$	Heavier	6.26
$^1H-^{12}C$	Lighter	0.92
$^1H-^{13}C$	Heavier	0.93
$^2H-^{12}C$	Heavier	1.71
$^1H-^{18}O$	Heavier	0.94
$^2H-^{16}O$	Heavier	1.77
$^{18}O-^{12}C$	Heavier	7.20
$^{16}O-^{13}C$	Heavier	7.17

Where,  $m_A$ - mass of atom A,  $m_B$ - mass of atom B, here A may be Carbon or Hydrogen and so on

If a lighter nucleus is replaced by a heavier one, then corresponding effective mass ( $\mu$ ) of that particular bond increased. Some probable bonds are presented that might present in control and treated samples such as  $^{12}C-^{12}C$ ,  $^1H-^{12}C$ ,  $^{13}C-^{12}C$ ,  $^2H-^{12}C$ ,  $^1H-^{13}C$ ,  $^{12}C-^{18}O$ ,  $^1H-^{18}O$ ,  $^{13}C-^{16}O$  and  $^2H-^{16}O$ . The effective mass is calculated and presented in Table 3. The result showed that  $\mu$  of normal  $^{12}C-^{12}C$  ( $\mu = 6$ ),  $^1H-^{12}C$  ( $\mu = 0.923$ ), and  $^1H-^{16}O$  ( $\mu = 0.941$ ) bonds are higher in case of

heavier isotopes (*i.e.*  $^{13}\text{C}-^{12}\text{C} = 6.26$ ,  $^2\text{H}-^{12}\text{C} = 1.71$  and  $^2\text{H}-^{16}\text{O} = 1.77$ ) respectively. The isotope abundance ratio of (PM+1)/PM in treated samples of naphthalene and 2-naphthol was first decreased by ~40% in T1 sample as compared to the control. This was increased up to 129.4% and 165.4% in treated T2 samples in naphthalene and 2-naphthol, respectively. Both naphthalene and 2-naphthol, in treated T2,

maximum number of isotope replacement might occur whereas, in treatment T1, reverse phenomena was observed. After biofield energy treatment in T2 sample, bond strength, stability, and binding energy of naphthalene and 2-naphthol molecules might be increased due to the higher effective mass ( $\mu$ ) however these parameters might be decreased (~35%) in treated T1, T3 and T4 samples of naphthalene molecule.

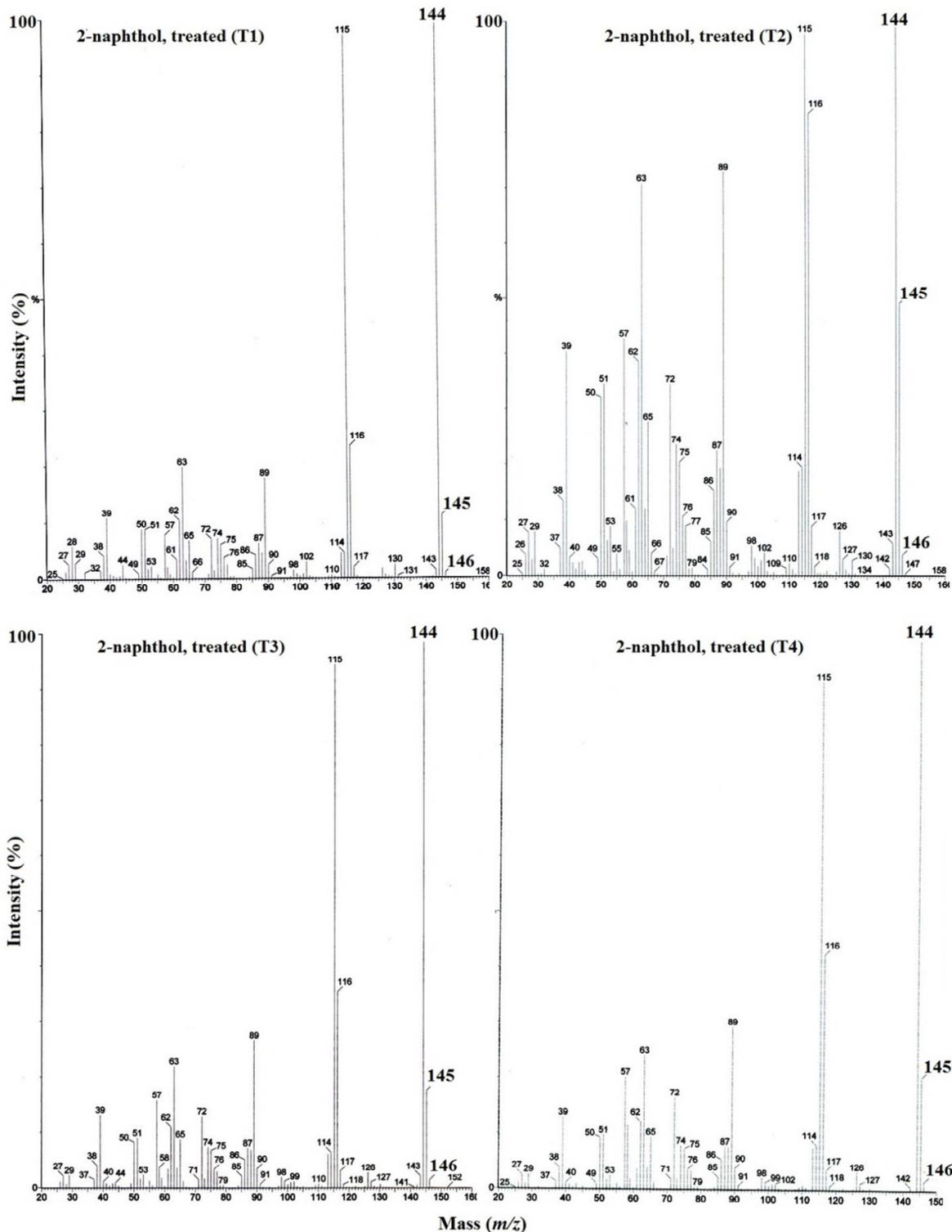
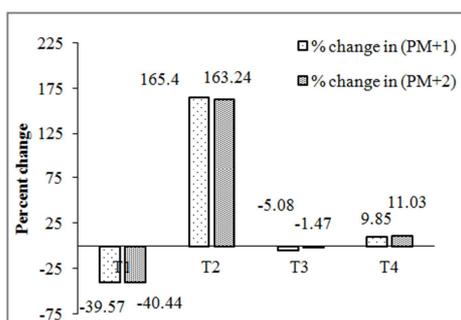


Figure 5. GC-MS spectra of treated samples of 2-naphthol (T1, T2, T3 and T4).



**Figure 6.** Percent change in the isotopic abundance of (PM+1)/PM and (PM+2)/PM of 2-naphthol under biofield energy treatment as compared to the control.

## 4. Conclusions

In summary, naphthalene and 2-naphthol were studied under the influence of biofield energy treatment and significant change in isotope abundance of  $^2\text{H}$ ,  $^{13}\text{C}$ , and  $^{18}\text{O}$  in treated samples as compared to the control was observed. The percent change in isotope abundance ratio of  $^{13}\text{C}/^{12}\text{C}$  or  $^2\text{H}/^1\text{H}$  in treated naphthalene was increased up to 129.40% as compared to the control. However, the isotope abundance ratio of  $^{13}\text{C}/^{12}\text{C}$  or  $^2\text{H}/^1\text{H}$  and  $^{18}\text{O}/^{16}\text{O}$  in 2-naphthol was increased up to 165.40% and 163.24%, respectively for treated samples. Similar trend was observed in changing the isotopic abundance ratio from T1 to T4 samples of both the molecules after the biofield energy treatment. The increased isotopic abundance ratio after biofield energy treatment (T2) of naphthalene and 2-naphthol molecules may increase the bond stability which will reduce photosensitive reactions initiated by heat, light and molecular oxygen.

## Abbreviations

GC-MS: Gas chromatography-mass spectrometry

PM: Primary molecule

PM+1: Represents isotopic molecule either for  $^{13}\text{C}/^{12}\text{C}$  or  $^2\text{H}/^1\text{H}$

PM+2: Represents isotopic molecule for  $^{18}\text{O}/^{16}\text{O}$

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