American Journal of Optics and Photonics
2019; 7(1): 18-27
http://www.sciencepublishinggroup.com/j/ajop
doi: 10.11648/j.ajop.20190701.13
ISSN: 2330-8486 (Print); ISSN: 2330-8494 (Online)

Antillatoxin (ATX) Time–Resolved Absorption and Resonance FT–IR and Raman Biospectroscopy and Density Functional Theory (DFT) Investigation of Vibronic–Mode Coupling Structure

Alireza Heidari[1, 2, *], Jennifer Esposito[1], Angela Caissutti[1]

[1]Faculty of Chemistry, California South University, Irvine, USA

[2]American International Standards Institute, Irvine, USA

Email address:

Scholar.Researcher.Scientist@gmail.com (A. Heidari), Alireza.Heidari@calsu.us (A. Heidari), Central@aisi-usa.org (A. Heidari)

[*]Corresponding author

To cite this article:

Alireza Heidari, Jennifer Esposito, Angela Caissutti. Antillatoxin (ATX) Time–Resolved Absorption and Resonance FT–IR and Raman Biospectroscopy and Density Functional Theory (DFT) Investigation of Vibronic–Mode Coupling Structure. *American Journal of Optics and Photonics*. Vol. 7, No. 1, 2019, pp. 18-27. doi: 10.11648/j.ajop.20190701.13

Received: April 8, 2019; **Accepted**: June 3, 2019; **Published**: June 13, 2019

Abstract: Antillatoxin (ATX) is a potent lipopeptide neurotoxin produced by the marine cyanobacterium Lyngbya majuscula. ATX activates voltage–gated sodium channels, which can cause cell depolarisation, NMDA–receptor over activity, excess calcium influx and neuronal necrosis. Parameters such as FT–IR and Raman vibrational wavelengths and intensities for single crystal Antillatoxin are calculated using density functional theory and were compared with empirical results. The investigation about vibrational spectrum of cycle dimers in crystal with carboxyl groups from each molecule of acid was shown that it leads to create Hydrogen bonds for adjacent molecules. The current study aimed to investigate the possibility of simulating the empirical values. Analysis of vibrational spectrum of Antillatoxin is performed based on theoretical simulation and FT–IR empirical spectrum and Raman empirical spectrum using density functional theory in levels of HF/6–31G*, HF/6–31++G**, MP2/6–31G, MP2/6–31++G**, BLYP/6–31G, BLYP/6–31++G**, B3LYP/6–31G and B3LYP6–31–HEG**. Vibration modes of methylene, carboxyl acid and phenyl cycle are separately investigated. The obtained values confirm high accuracy and validity of results obtained from calculations.

Keywords: Vibronic Structure, Vibrational Spectra Analysis, Density Functional Theory (DFT), Antillatoxin, Non–Focal Functions of Becke, Correlation Functions of Lee–Yang–Parr, Time–Resolved Absorption and Resonance, FT–IR and Raman Biospectroscopy

1. Introduction

Antillatoxin (ATX) is a potent lipopeptide neurotoxin produced by the marine cyanobacterium Lyngbya majuscula. ATX activates voltage–gated sodium channels, which can cause cell depolarisation, NMDA–receptor over activity, excess calcium influx and neuronal necrosis. Density Functional Theory (DFT) is one of the most powerful calculation methods for electronic structures [5–7]. Numerous results have been previously studied and indicate successful use of these methods [8–10]. The theory is one of the most appropriate methods for simulating the vibrational wavenumbers, molecular structure as well as total energy. It may be useful to initially consider the calculated results by density functional theory using HF/6–31G*, HF/6–31++G**, MP2/6–31G, MP2/6–31++G**, BLYP/6–31G, BLYP/6–31++G**, B3LYP/6–31G and B3LYP6–31–HEG** approach [11–16]. It should be noted that calculations are performed by considering one degree of quantum interference as well as polarization effects of 2d orbitals in interaction [17–23].

2. Details of Calculations

All calculations of molecular orbital in the base of ab are performed by Gaussian 09. In calculation process, the structure of Antillatoxin molecule (Figure 1) is optimized and FT–IR and Raman wavenumbers are calculated using HF/6–31G*, HF/6–31++G**, MP2/6–31G, MP2/6–31++G**, BLYP/6–31G, BLYP/6–31++G**, B3LYP/6–31G and B3LYP6–31–HEG** base [24–72]. All optimized structures are adjusted with minimum energy. Harmonic vibrational wavenumbers are calculated using second degree of derivation to adjust convergence on potential surface as good as possible and to evaluate vibrational energies at zero point. In optimized structures considered in the current study, virtual frequency modes are not observed which indicates that the minimum potential energy surface is correctly chosen [73–111]. The optimized geometry is calculated by minimizing the energy relative to all geometrical quantities without forcing any constraint on molecular symmetry. Calculations were performed by Gaussian 09 [112–137]. The current calculation is aimed to maximize structural optimization using density functional theory. The calculations of density functional theory are performed by HF/6–31G*, HF/6–31++G**, MP2/6–31G, MP2/6–31++G**, BLYP/6–31G, BLYP/6–31++G**, B3LYP/6–31G and B3LYP6–31–HEG** function in which non–focal functions of Becke and correlation functions of Lee–Yang–Parr beyond the Franck–Condon approximation are used [138–150]. After completion of optimization process, the second order derivation of energy is calculated as a function of core coordination and is investigated to evaluate whether the structure is accurately minimized. Vibrational frequencies used to simulate spectrums presented in the current study are derived from these second order derivatives. All calculations are performed for room temperature of 327(K).

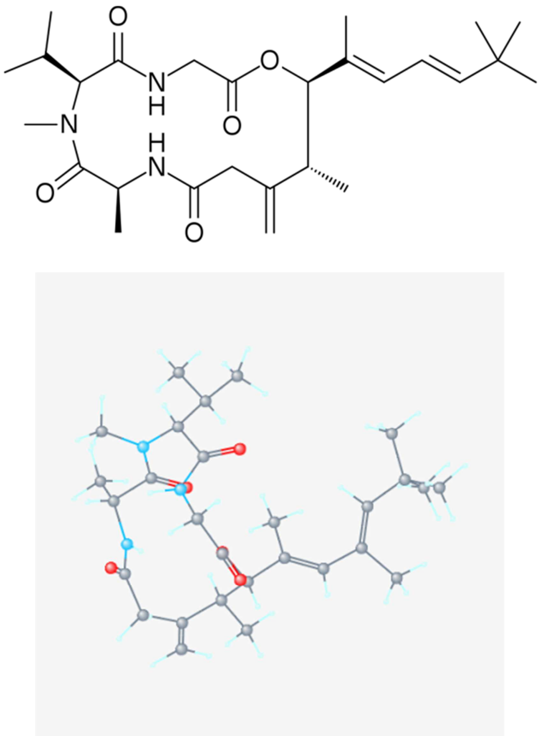


Figure 1. Different sections of the Antillatoxin [43–93].

3. Vibration Analysis

Analysis of vibrational spectrum of Antillatoxin is performed based on theoretical simulation and FT–IR empirical spectrum and Raman empirical spectrum using density functional theory in levels of HF/6–31G*, HF/6–31++G**, MP2/6–31G, MP2/6–31++G**, BLYP/6–31G, BLYP/6–31++G**, B3LYP/6–31G and B3LYP6–31–HEG**. Vibration modes of methylene, carboxyl acid and phenyl cycle are separately investigated.

C–H stretching vibrations in single replacement of benzene cycles are usually seen in band range of 3200–4200 cm^{-1}. Weak Raman bands are at 3289 cm^{-1} and 3302 cm^{-1}. C–C stretching mode is a strong Raman mode at 1299 cm^{-1}. Raman weak band is seen at 1773 cm^{-1}, too. Bending mode of C–H is emerged as a weak mode at 1498 cm^{-1} and 1297 cm^{-1} and a strong band at 1381 cm^{-1} in Raman spectrum. Raman is considerably active in the range of 1300–1550 cm^{-1} which 1293 cm^{-1} indicates this issue.

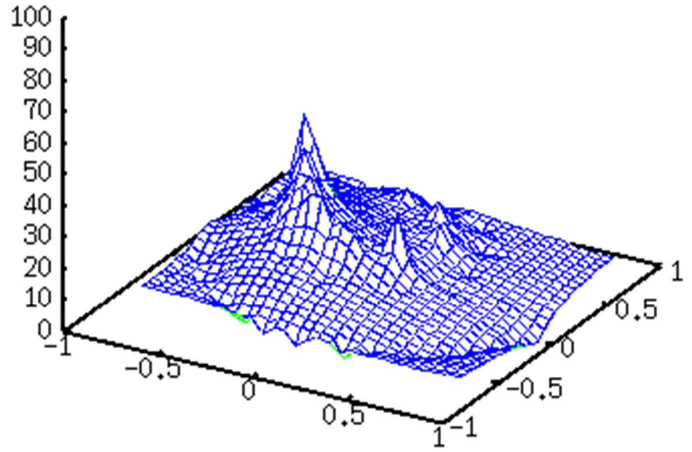
C–H skew–symmetric stretching mode of methylene group is expected at 3285 cm^{-1} and its symmetric mode is expected at 3099 cm^{-1}. Skew–symmetric stretching mode of CH_2 in Antillatoxin has a mode in mid–range of Raman spectrum at 3200–3320 cm^{-1}. When this mode is symmetric, it is at 3195 cm^{-1} and is sharp. The calculated wavenumbers of higher modes are at 3163 cm^{-1} and 3193 cm^{-1} for symmetric and skew–symmetric stretching mode of methylene, respectively.

Scissoring vibrations of CH_2 are usually seen at the range of 1627–1681 cm^{-1} which often includes mid–range bands. Weak bands at 1640 cm^{-1} are scissoring modes of CH_2 in Raman spectrum. Moving vibrations of methylene are usually seen at 1569 cm^{-1}. For the investigated chemical in the current study, these vibrations are at 1439 cm^{-1} were calculated using density functional theory. Twisting and rocking vibrations of CH_2 are seen in Raman spectrum at 1015 cm^{-1} and 1289 cm^{-1}, respectively, which are in good accordance with the results at 999 cm^{-1} and 1264 cm^{-1}, respectively.

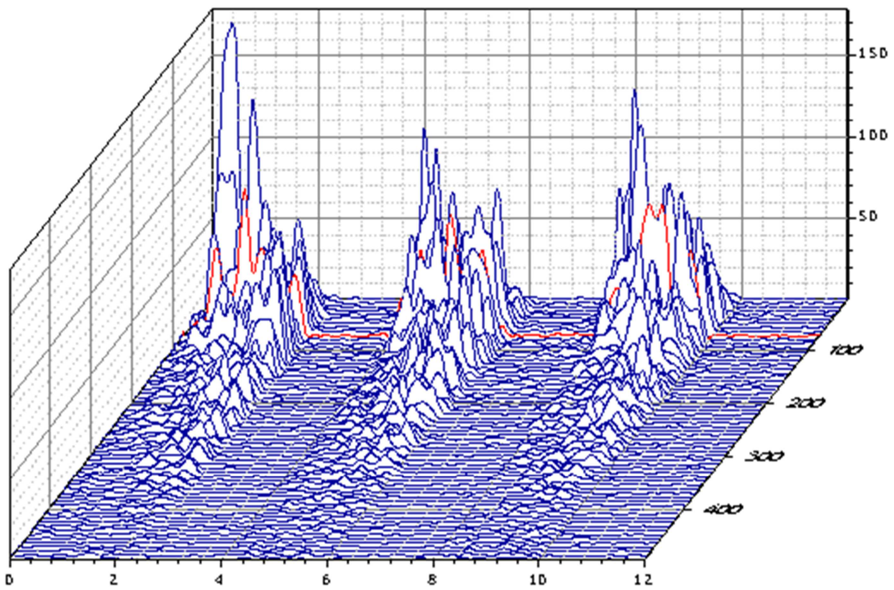
In a non–ionized carboxyl group (COOH), stretching vibrations of carbonyl [C=O] are mainly observed at the range of 1940–1988 cm^{-1}. If dimer is considered as an intact constituent, two stretching vibrations of carbonyl for symmetric stretching are at 1840–1885 cm^{-1} in Raman spectrum. In the current paper, stretching vibration of carbonyl mode is at 1897 cm^{-1} which is a mid–range value.

Stretching and bending bands of hydroxyl can be identified by width and band intensity which in turn is dependent on bond length of Hydrogen. In dimer form of Hydrogen bond, stretching band of O–H is of a strong Raman peak at 1467 cm^{-1} which is due to in–plain metamorphosis mode. Out–of–plain mode of O–H group is a very strong mode of peak at 1149 cm^{-1} of Raman spectrum. The stretching mode of C–O (H) emerges as a mid–band of Raman spectrum at 1347 cm^{-1}.

Lattice vibrations are usually seen at the range of 0–650 cm^{-1}. These modes are induced by rotary and transferring vibrations of molecules and vibrations and are including Hydrogen bond. Bands with low wavenumbers of Hydrogen bond vibrations in FT–IR and Raman spectrum (Figure 2) are frequently weak, width and unsymmetrical. Rotary lattice vibrations are frequently stronger than transferring ones. Intra–molecular vibrations with low wavenumbers involving two–bands O–H …O dimer at 188 cm^{-1}, 293 cm^{-1} and 349 cm^{-1} are attributed to a rotary moving of two molecules involving in–plain rotation of molecules against each other.



(a)



(b)

Figure 2. *3D Simulation of (a) FT–IR spectrum and (b) Raman spectrum of Antillatoxin.*

4. Results and Discussion

There are many unanswered questions regarding toxins huge polyol and polyether compounds, such as whether this type of compound has any limitations with regard to the molecular weight or length of the carbon chain as well as the need for and physiological roles of these unique metabolites in toxins biosystems. Preliminary studies in our group have shown that unprecedented huge polyol compounds, whose molecular weights are 5,170 and 8,250, may exist in symbiotic nature. Further studies on the conformation, mode of action, and interaction of these unique toxins secondary metabolites with biomacromolecules are essential. Huge polyol and polyether compounds larger than 2,000 mu are considered to be mid–size molecules that fall between small–size (drug–like) natural products and biopolymers, and further studies on their three–dimensional structures and dynamics in living systems should contribute to the creation of new scientific fields.

5. Conclusion and Summary

Calculations of density functional theory using HF/6–31G*, HF/6–31++G**, MP2/6–31G, MP2/6–31++G**, BLYP/6–31G, BLYP/6–31++G**, B3LYP/6–31G and B3LYP6–31–HEG** levels were used to obtain vibrational wavenumbers and intensities in single crystal of Antillatoxin. Investigation and consideration of vibrational spectrum confirm the formation of dimer cycles in the investigated crystal with carboxyl groups from each Hydrogen molecule of acid protected from adjacent molecules. The calculated vibrational spectrum which obtains from calculations of density functional theory is in good accordance with recorded empirical values which indicates successful simulation of the problem. The obtained results indicate that the results obtained from theoretical calculations are valid through comparing with empirical recorded results.

Acknowledgements

Authors are supported by an American International Standards Institute (AISI) Future Fellowship Grant FT1201009373496. We acknowledge Ms. Isabelle Villena for instrumental support and Dr. Michael N. Cocchi for constructing graphical abstract figure. We gratefully acknowledge Prof. Dr. Christopher Brown for proof reading the manuscript.

References

[1] A. Heidari, C. Brown, "Study of Composition and Morphology of Cadmium Oxide (CdO) Nanoparticles for Eliminating Cancer Cells", J Nanomed Res., Volume 2, Issue 5, 20 Pages, 2015.

[2] A. Heidari, C. Brown, "Study of Surface Morphological, Phytochemical and Structural Characteristics of Rhodium (III) Oxide (Rh_2O_3) Nanoparticles", International Journal of Pharmacology, Phytochemistry and Ethnomedicine, Volume 1, Issue 1, Pages 15–19, 2015.

[3] A. Heidari, "An Experimental Biospectroscopic Study on Seminal Plasma in Determination of Semen Quality for Evaluation of Male Infertility", Int J Adv Technol 7: e007, 2016.

[4] A. Heidari, "Extraction and Preconcentration of N–Tolyl–Sulfonyl–Phosphoramid–Saeure–Dichlorid as an Anti–Cancer Drug from Plants: A Pharmacognosy Study", J Pharmacogn Nat Prod 2: e103, 2016.

[5] A. Heidari, "A Thermodynamic Study on Hydration and Dehydration of DNA and RNA−Amphiphile Complexes", J Bioeng Biomed Sci S: 006, 2016.

[6] A. Heidari, "Computational Studies on Molecular Structures and Carbonyl and Ketene Groups' Effects of Singlet and Triplet Energies of Azidoketene O=C=CH–NNN and Isocyanatoketene O=C=CH–N=C=O", J Appl Computat Math 5: e142, 2016.

[7] A. Heidari, "Study of Irradiations to Enhance the Induces the Dissociation of Hydrogen Bonds between Peptide Chains and Transition from Helix Structure to Random Coil Structure Using ATR–FTIR, Raman and ^{1}HNMR Spectroscopies", J Biomol Res Ther 5: e146, 2016.

[8] A. Heidari, "Future Prospects of Point Fluorescence Spectroscopy, Fluorescence Imaging and Fluorescence Endoscopy in Photodynamic Therapy (PDT) for Cancer Cells", J Bioanal Biomed 8: e135, 2016.

[9] A. Heidari, "A Bio–Spectroscopic Study of DNA Density and Color Role as Determining Factor for Absorbed Irradiation in Cancer Cells", Adv Cancer Prev 1: e102, 2016.

[10] A. Heidari, "Manufacturing Process of Solar Cells Using Cadmium Oxide (CdO) and Rhodium (III) Oxide (Rh_2O_3) Nanoparticles", J Biotechnol Biomater 6: e125, 2016.

[11] A. Heidari, "A Novel Experimental and Computational Approach to Photobiosimulation of Telomeric DNA/RNA: A Biospectroscopic and Photobiological Study", J Res Development 4: 144, 2016.

[12] A. Heidari, "Biochemical and Pharmacodynamical Study of Microporous Molecularly Imprinted Polymer Selective for Vancomycin, Teicoplanin, Oritavancin, Telavancin and Dalbavancin Binding", Biochem Physiol 5: e146, 2016.

[13] A. Heidari, "Anti–Cancer Effect of UV Irradiation at Presence of Cadmium Oxide (CdO) Nanoparticles on DNA of Cancer Cells: A Photodynamic Therapy Study", Arch Cancer Res. 4: 1, 2016.

[14] A. Heidari, "Biospectroscopic Study on Multi–Component Reactions (MCRs) in Two A–Type and B–Type Conformations of Nucleic Acids to Determine Ligand Binding Modes, Binding Constant and Stability of Nucleic Acids in Cadmium Oxide (CdO) Nanoparticles–Nucleic Acids Complexes as Anti–Cancer Drugs", Arch Cancer Res. 4: 2, 2016.

[15] A. Heidari, "Simulation of Temperature Distribution of DNA/RNA of Human Cancer Cells Using Time–Dependent Bio–Heat Equation and Nd: YAG Lasers", Arch Cancer Res. 4: 2, 2016.

[16] A. Heidari, "Quantitative Structure–Activity Relationship (QSAR) Approximation for Cadmium Oxide (CdO) and Rhodium (III) Oxide (Rh_2O_3) Nanoparticles as Anti–Cancer Drugs for the Catalytic Formation of Proviral DNA from Viral RNA Using Multiple Linear and Non–Linear Correlation Approach", Ann Clin Lab Res. 4: 1, 2016.

[17] A. Heidari, "Biomedical Study of Cancer Cells DNA Therapy Using Laser Irradiations at Presence of Intelligent Nanoparticles", J Biomedical Sci. 5: 2, 2016.

[18] A. Heidari, "Measurement the Amount of Vitamin D2 (Ergocalciferol), Vitamin D3 (Cholecalciferol) and Absorbable Calcium (Ca^{2+}), Iron (II) (Fe^{2+}), Magnesium (Mg^{2+}), Phosphate (PO^{4-}) and Zinc (Zn^{2+}) in Apricot Using High–Performance Liquid Chromatography (HPLC) and Spectroscopic Techniques", J Biom Biostat 7: 292, 2016.

[19] A. Heidari, "Spectroscopy and Quantum Mechanics of the Helium Dimer (He^{2+}), Neon Dimer (Ne^{2+}), Argon Dimer (Ar^{2+}), Krypton Dimer (Kr^{2+}), Xenon Dimer (Xe^{2+}), Radon Dimer(Rn^{2+}) and Ununoctium Dimer (Uuo^{2+}) Molecular Cations", Chem Sci J 7: e112, 2016.

[20] A. Heidari, "Human Toxicity Photodynamic Therapy Studies on DNA/RNA Complexes as a Promising New Sensitizer for the Treatment of Malignant Tumors Using Bio–Spectroscopic Techniques", J Drug Metab Toxicol 7: e129, 2016.

[21] A. Heidari, "Novel and Stable Modifications of Intelligent Cadmium Oxide (CdO) Nanoparticles as Anti–Cancer Drug in Formation of Nucleic Acids Complexes for Human Cancer Cells' Treatment", Biochem Pharmacol (Los Angel) 5: 207, 2016.

[22] A. Heidari, "A Combined Computational and QM/MM Molecular Dynamics Study on Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a–BNNTs) and Hexagonal Boron Nitride Nanotubes (h–BNNTs) as Hydrogen Storage", Struct Chem Crystallogr Commun 2: 1, 2016.

[23] A. Heidari, "Pharmaceutical and Analytical Chemistry Study of Cadmium Oxide (CdO) Nanoparticles Synthesis Methods and Properties as Anti–Cancer Drug and its Effect on Human Cancer Cells", Pharm Anal Chem Open Access 2: 113, 2016.

[24] A. Heidari, "A Chemotherapeutic and Biospectroscopic Investigation of the Interaction of Double–Standard DNA/RNA–Binding Molecules with Cadmium Oxide (CdO) and Rhodium (III) Oxide (Rh_2O_3) Nanoparticles as Anti–Cancer Drugs for Cancer Cells' Treatment", Chemo Open Access 5: e129, 2016.

[25] A. Heidari, "Pharmacokinetics and Experimental Therapeutic Study of DNA and Other Biomolecules Using Lasers: Advantages and Applications", J Pharmacokinet Exp Ther 1: e005, 2016.

[26] A. Heidari, "Determination of Ratio and Stability Constant of DNA/RNA in Human Cancer Cells and Cadmium Oxide (CdO) Nanoparticles Complexes Using Analytical Electrochemical and Spectroscopic Techniques", Insights Anal Electrochem 2: 1, 2016.

[27] A. Heidari, "Discriminate between Antibacterial and Non–Antibacterial Drugs Artificial Neutral Networks of a Multilayer Perceptron (MLP) Type Using a Set of Topological Descriptors", J Heavy Met Toxicity Dis. 1: 2, 2016.

[28] A. Heidari, "Combined Theoretical and Computational Study of the Belousov–Zhabotinsky Chaotic Reaction and Curtius Rearrangement for Synthesis of Mechlorethamine, Cisplatin, Streptozotocin, Cyclophosphamide, Melphalan, Busulphan and BCNU as Anti–Cancer Drugs", Insights Med Phys. 1: 2, 2016.

[29] A. Heidari, "A Translational Biomedical Approach to Structural Arrangement of Amino Acids' Complexes: A Combined Theoretical and Computational Study", Transl Biomed. 7: 2, 2016.

[30] A. Heidari, "Ab Initio and Density Functional Theory (DFT) Studies of Dynamic NMR Shielding Tensors and Vibrational Frequencies of DNA/RNA and Cadmium Oxide (CdO) Nanoparticles Complexes in Human Cancer Cells", J Nanomedine Biotherapeutic Discov 6: e144, 2016.

[31] A. Heidari, "Molecular Dynamics and Monte–Carlo Simulations for Replacement Sugars in Insulin Resistance, Obesity, LDL Cholesterol, Triglycerides, Metabolic Syndrome, Type 2 Diabetes and Cardiovascular Disease: A Glycobiological Study", J Glycobiol 5: e111, 2016.

[32] A. Heidari, "Synthesis and Study of 5–[(Phenylsulfonyl)Amino]–1, 3, 4–Thiadiazole–2–Sulfonamide as Potential Anti–Pertussis Drug Using Chromatography and Spectroscopy Techniques", Transl Med (Sunnyvale) 6: e138, 2016.

[33] A. Heidari, "Nitrogen, Oxygen, Phosphorus and Sulphur Heterocyclic Anti–Cancer Nano Drugs Separation in the Supercritical Fluid of Ozone (O_3) Using Soave–Redlich–Kwong (SRK) and Pang–Robinson (PR) Equations", Electronic J Biol 12: 4, 2016.

[34] A. Heidari, "An Analytical and Computational Infrared Spectroscopic Review of Vibrational Modes in Nucleic Acids", Austin J Anal Pharm Chem. 3 (1): 1058, 2016.

[35] A. Heidari, C. Brown, "Phase, Composition and Morphology Study and Analysis of Os–Pd/HfC Nanocomposites", Nano Res Appl. 2: 1, 2016.

[36] A. Heidari, C. Brown, "Vibrational Spectroscopic Study of Intensities and Shifts of Symmetric Vibration Modes of Ozone Diluted by Cumene", International Journal of Advanced Chemistry, 4 (1) 5–9, 2016.

[37] A. Heidari, "Study of the Role of Anti–Cancer Molecules with Different Sizes for Decreasing Corresponding Bulk Tumor Multiple Organs or Tissues", Arch Can Res. 4: 2, 2016.

[38] A. Heidari, "Genomics and Proteomics Studies of Zolpidem, Necopidem, Alpidem, Saripidem, Miroprofen, Zolimidine, Olprinone and Abafungin as Anti–Tumor, Peptide Antibiotics, Antiviral and Central Nervous System (CNS) Drugs", J Data Mining Genomics & Proteomics 7: e125, 2016.

[39] A. Heidari, "Pharmacogenomics and Pharmacoproteomics Studies of Phosphodiesterase–5 (PDE5) Inhibitors and Paclitaxel Albumin–Stabilized Nanoparticles as Sandwiched Anti–Cancer Nano Drugs between Two DNA/RNA Molecules of Human Cancer Cells", J Pharmacogenomics Pharmacoproteomics 7: e153, 2016.

[40] A. Heidari, "Biotranslational Medical and Biospectroscopic Studies of Cadmium Oxide (CdO) Nanoparticles–DNA/RNA Straight and Cycle Chain Complexes as Potent Anti–Viral, Anti–Tumor and Anti–Microbial Drugs: A Clinical Approach", Transl Biomed. 7: 2, 2016.

[41] A. Heidari, "A Comparative Study on Simultaneous Determination and Separation of Adsorbed Cadmium Oxide (CdO) Nanoparticles on DNA/RNA of Human Cancer Cells Using Biospectroscopic Techniques and Dielectrophoresis (DEP) Method", Arch Can Res. 4: 2, 2016.

[42] A. Heidari, "Cheminformatics and System Chemistry of Cisplatin, Carboplatin, Nedaplatin, Oxaliplatin, Heptaplatin and Lobaplatin as Anti–Cancer Nano Drugs: A Combined Computational and Experimental Study", J Inform Data Min 1: 3, 2016.

[43] A. Heidari, "Linear and Non–Linear Quantitative Structure–Anti–Cancer–Activity Relationship (QSACAR) Study of Hydrous Ruthenium (IV) Oxide (RuO_2) Nanoparticles as Non–Nucleoside Reverse Transcriptase Inhibitors (NNRTIs) and Anti–Cancer Nano Drugs", J Integr Oncol 5: e110, 2016.

[44] A. Heidari, "Synthesis, Characterization and Biospectroscopic Studies of Cadmium Oxide (CdO) Nanoparticles–Nucleic Acids Complexes Absence of Soluble Polymer as a Protective Agent Using Nucleic Acids Condensation and Solution Reduction Method", J Nanosci Curr Res 1: e101, 2016.

[45] A. Heidari, "Coplanarity and Collinearity of 4'–Dinonyl–2,2'–Bithiazole in One Domain of Bleomycin and Pingyangmycin to be Responsible for Binding of Cadmium Oxide (CdO) Nanoparticles to DNA/RNA Bidentate Ligands as Anti–Tumor Nano Drug", Int J Drug Dev & Res 8: 007–008, 2016.

[46] A. Heidari, "A Pharmacovigilance Study on Linear and Non–Linear Quantitative Structure (Chromatographic) Retention Relationships (QSRR) Models for the Prediction of Retention Time of Anti–Cancer Nano Drugs under Synchrotron Radiations", J Pharmacovigil 4: e161, 2016.

[47] A. Heidari, "Nanotechnology in Preparation of Semipermeable Polymers", J Adv Chem Eng 6: 157, 2016.

[48] A. Heidari, "A Gastrointestinal Study on Linear and Non–Linear Quantitative Structure (Chromatographic) Retention Relationships (QSRR) Models for Analysis 5–Aminosalicylates Nano Particles as Digestive System Nano Drugs under Synchrotron Radiations", J Gastrointest Dig Syst 6: e119, 2016.

[49] A. Heidari, "DNA/RNA Fragmentation and Cytolysis in Human Cancer Cells Treated with Diphthamide Nano Particles Derivatives", Biomedical Data Mining 5: e102, 2016.

[50] A. Heidari, "A Successful Strategy for the Prediction of Solubility in the Construction of Quantitative Structure–Activity Relationship (QSAR) and Quantitative Structure–Property Relationship (QSPR) under Synchrotron Radiations Using Genetic Function Approximation (GFA) Algorithm", J Mol Biol Biotechnol 1: 1, 2016.

[51] A. Heidari, "Computational Study on Molecular Structures of C_{20}, C_{60}, C_{240}, C_{540}, C_{960}, C_{2160} and C_{3840} Fullerene Nano Molecules under Synchrotron Radiations Using Fuzzy Logic", J Material Sci Eng 5: 282, 2016.

[52] A. Heidari, "Graph Theoretical Analysis of Zigzag Polyhexamethylene Biguanide, Polyhexamethylene Adipamide, Polyhexamethylene Biguanide Gauze and Polyhexamethylene Biguanide Hydrochloride (PHMB) Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a–BNNTs) and Hexagonal Boron Nitride Nanotubes (h–BNNTs)", J Appl Computat Math 5: e143, 2016.

[53] A. Heidari, "The Impact of High Resolution Imaging on Diagnosis", Int J Clin Med Imaging 3: 1000e101, 2016.

[54] A. Heidari, "A Comparative Study of Conformational Behavior of Isotretinoin (13–Cis Retinoic Acid) and Tretinoin (All–Trans Retinoic Acid (ATRA)) Nano Particles as Anti–Cancer Nano Drugs under Synchrotron Radiations Using Hartree–Fock (HF) and Density Functional Theory (DFT) Methods", Insights in Biomed 1: 2, 2016.

[55] A. Heidari, "Advances in Logic, Operations and Computational Mathematics", J Appl Computat Math 5: 5, 2016.

[56] A. Heidari, "Mathematical Equations in Predicting Physical Behavior", J Appl Computat Math 5: 5, 2016.

[57] A. Heidari, "Chemotherapy a Last Resort for Cancer Treatment", Chemo Open Access 5: 4, 2016.

[58] A. Heidari, "Separation and Pre–Concentration of Metal Cations–DNA/RNA Chelates Using Molecular Beam Mass Spectrometry with Tunable Vacuum Ultraviolet (VUV) Synchrotron Radiation and Various Analytical Methods", Mass Spectrom Purif Tech 2: e101, 2016.

[59] A. Heidari, "Yoctosecond Quantitative Structure–Activity Relationship (QSAR) and Quantitative Structure–Property Relationship (QSPR) under Synchrotron Radiations Studies for Prediction of Solubility of Anti–Cancer Nano Drugs in Aqueous Solutions Using Genetic Function Approximation (GFA) Algorithm", Insight Pharm Res. 1: 1, 2016.

[60] A. Heidari, "Cancer Risk Prediction and Assessment in Human Cells under Synchrotron Radiations Using Quantitative Structure Activity Relationship (QSAR) and Quantitative Structure Properties Relationship (QSPR) Studies", Int J Clin Med Imaging 3: 516, 2016.

[61] A. Heidari, "A Novel Approach to Biology", Electronic J Biol 12: 4, 2016.

[62] A. Heidari, "Innovative Biomedical Equipment's for Diagnosis and Treatment", J Bioengineer & Biomedical Sci 6: 2, 2016.

[63] A. Heidari, "Integrating Precision Cancer Medicine into Healthcare, Medicare Reimbursement Changes and the Practice of Oncology: Trends in Oncology Medicine and Practices", J Oncol Med & Pract 1: 2, 2016.

[64] A. Heidari, "Promoting Convergence in Biomedical and Biomaterials Sciences and Silk Proteins for Biomedical and Biomaterials Applications: An Introduction to Materials in Medicine and Bioengineering Perspectives", J Bioengineer & Biomedical Sci 6: 3, 2016.

[65] A. Heidari, "X–Ray Fluorescence and X–Ray Diffraction Analysis on Discrete Element Modeling of Nano Powder Metallurgy Processes in Optimal Container Design", J Powder Metall Min 6: 1, 2017.

[66] A. Heidari, "Biomolecular Spectroscopy and Dynamics of Nano–Sized Molecules and Clusters as Cross–Linking–Induced Anti–Cancer and Immune–Oncology Nano Drugs Delivery in DNA/RNA of Human Cancer Cells' Membranes under Synchrotron Radiations: A Payload–Based Perspective", Arch Chem Res. 1: 2, 2017.

[67] A. Heidari, "Deficiencies in Repair of Double–Standard DNA/RNA–Binding Molecules Identified in Many Types of Solid and Liquid Tumors Oncology in Human Body for Advancing Cancer Immunotherapy Using Computer Simulations and Data Analysis: Number of Mutations in a Synchronous Tumor Varies by Age and Type of Synchronous Cancer", J Appl Bioinforma Comput Biol, 6: 1, 2017.

[68] A. Heidari, "Electronic Coupling among the Five Nanomolecules Shuts Down Quantum Tunneling in the Presence and Absence of an Applied Magnetic Field for Indication of the Dimer or other Provide Different Influences on the Magnetic Behavior of Single Molecular Magnets (SMMs) as Qubits for Quantum Computing", Glob J Res Rev. 4: 2, 2017.

[69] A. Heidari, "Polymorphism in Nano–Sized Graphene Ligand–Induced Transformation of Au_{38}–xAg_x/xCu_x(SPh–tBu)$_{24}$ to Au_{36}–xAg_x/xCu_x(SPh–tBu)$_{24}$ (x = 1–12) Nanomolecules for Synthesis of Au_{144}–xAg_x/xCu_x[(SR)$_{60}$, $(SC_4)_{60}$, $(SC_6)_{60}$, $(SC_{12})_{60}$, (PET)$_{60}$, (p–MBA)$_{60}$, (F)$_{60}$, (Cl)$_{60}$, (Br)$_{60}$, (I)$_{60}$, (At)$_{60}$, (Uus)$_{60}$ and $(SC_6H_{13})_{60}$] Nano Clusters as Anti–Cancer Nano Drugs", J Nanomater Mol Nanotechnol, 6: 3, 2017.

[70] A. Heidari, "Biomedical Resource Oncology and Data Mining to Enable Resource Discovery in Medical, Medicinal, Clinical, Pharmaceutical, Chemical and Translational Research and Their Applications in Cancer Research", Int J Biomed Data Min 6: e103, 2017.

[71] A. Heidari, "Study of Synthesis, Pharmacokinetics, Pharmacodynamics, Dosing, Stability, Safety and Efficacy of Olympiadane Nanomolecules as Agent for Cancer Enzymotherapy, Immunotherapy, Chemotherapy, Radiotherapy, Hormone Therapy and Targeted Therapy under Synchrotorn Radiation", J Dev Drugs 6: e154, 2017.

[72] A. Heidari, "A Novel Approach to Future Horizon of Top Seven Biomedical Research Topics to Watch in 2017: Alzheimer's, Ebola, Hypersomnia, Human Immunodeficiency Virus (HIV), Tuberculosis (TB), Microbiome/Antibiotic Resistance and Endovascular Stroke", J Bioengineer & Biomedical Sci 7: e127, 2017.

[73] A. Heidari, "Opinion on Computational Fluid Dynamics (CFD) Technique", Fluid Mech Open Acc 4: 157, 2017.

[74] A. Heidari, "Concurrent Diagnosis of Oncology Influence Outcomes in Emergency General Surgery for Colorectal Cancer and Multiple Sclerosis (MS) Treatment Using Magnetic Resonance Imaging (MRI) and $Au_{329}(SR)_{84}$, $Au_{329-x}Ag_x(SR)_{84}$, $Au_{144}(SR)_{60}$, $Au_{68}(SR)_{36}$, $Au_{30}(SR)_{18}$, $Au_{102}(SPh)_{44}$, $Au_{38}(SPh)_{24}$, $Au_{38}(SC_2H_4Ph)_{24}$, $Au_{21}S(SAdm)_{15}$, $Au_{36}(pMBA)_{24}$ and $Au_{25}(pMBA)_{18}$ Nano Clusters", J Surgery Emerg Med 1: 21, 2017.

[75] A. Heidari, "Developmental Cell Biology in Adult Stem Cells Death and Autophagy to Trigger a Preventive Allergic Reaction to Common Airborne Allergens under Synchrotron Radiation Using Nanotechnology for Therapeutic Goals in Particular Allergy Shots (Immunotherapy)", Cell Biol (Henderson, NV) 6: 1, 2017.

[76] A. Heidari, "Changing Metal Powder Characteristics for Elimination of the Heavy Metals Toxicity and Diseases in Disruption of Extracellular Matrix (ECM) Proteins Adjustment in Cancer Metastases Induced by Osteosarcoma, Chondrosarcoma, Carcinoid, Carcinoma, Ewing's Sarcoma, Fibrosarcoma and Secondary Hematopoietic Solid or Soft Tissue Tumors", J Powder Metall Min 6: 170, 2017.

[77] A. Heidari, "Nanomedicine–Based Combination Anti–Cancer Therapy between Nucleic Acids and Anti–Cancer Nano Drugs in Covalent Nano Drugs Delivery Systems for Selective Imaging and Treatment of Human Brain Tumors Using Hyaluronic Acid, Alguronic Acid and Sodium Hyaluronate as Anti–Cancer Nano Drugs and Nucleic Acids Delivery under Synchrotron Radiation", Am J Drug Deliv 5: 2, 2017.

[78] A. Heidari, "Clinical Trials of Dendritic Cell Therapies for Cancer Exposing Vulnerabilities in Human Cancer Cells' Metabolism and Metabolomics: New Discoveries, Unique Features Inform New Therapeutic Opportunities, Biotech's Bumpy Road to the Market and Elucidating the Biochemical Programs that Support Cancer Initiation and Progression", J Biol Med Science 1: e103, 2017.

[79] A. Heidari, "The Design Graphene–Based Nanosheets as a New Nanomaterial in Anti–Cancer Therapy and Delivery of Chemotherapeutics and Biological Nano Drugs for Liposomal Anti–Cancer Nano Drugs and Gene Delivery", Br Biomed Bull 5: 305, 2017.

[80] A. Heidari, "Integrative Approach to Biological Networks for Emerging Roles of Proteomics, Genomics and Transcriptomics in the Discovery and Validation of Human Colorectal Cancer Biomarkers from DNA/RNA Sequencing Data under Synchrotron Radiation", Transcriptomics 5: e117, 2017.

[81] A. Heidari, "Elimination of the Heavy Metals Toxicity and Diseases in Disruption of Extracellular Matrix (ECM) Proteins and Cell Adhesion Intelligent Nanomolecules Adjustment in Cancer Metastases Using Metalloenzymes and under Synchrotron Radiation", Lett Health Biol Sci 2 (2): 1–4, 2017.

[82] A. Heidari, "Treatment of Breast Cancer Brain Metastases through a Targeted Nanomolecule Drug Delivery System Based on Dopamine Functionalized Multi–Wall Carbon Nanotubes (MWCNTs) Coated with Nano Graphene Oxide (GO) and Protonated Polyaniline (PANI) in Situ During the Polymerization of Aniline Autogenic Nanoparticles for the Delivery of Anti–Cancer Nano Drugs under Synchrotron Radiation", Br J Res, 4 (3): 16, 2017.

[83] A. Heidari, "Sedative, Analgesic and Ultrasound–Mediated Gastrointestinal Nano Drugs Delivery for Gastrointestinal Endoscopic Procedure, Nano Drug–Induced Gastrointestinal Disorders and Nano Drug Treatment of Gastric Acidity", Res Rep Gastroenterol, 1: 1, 2017.

[84] A. Heidari, "Synthesis, Pharmacokinetics, Pharmacodynamics, Dosing, Stability, Safety and Efficacy of Orphan Nano Drugs to Treat High Cholesterol and Related Conditions and to Prevent Cardiovascular Disease under Synchrotron Radiation", J Pharm Sci Emerg Drugs 5: 1, 2017.

[85] A. Heidari, "Non–Linear Compact Proton Synchrotrons to Improve Human Cancer Cells and Tissues Treatments and Diagnostics through Particle Therapy Accelerators with Monochromatic Microbeams", J Cell Biol Mol Sci 2 (1): 1–5, 2017.

[86] A. Heidari, "Design of Targeted Metal Chelation Therapeutics Nanocapsules as Colloidal Carriers and Blood–Brain Barrier (BBB) Translocation to Targeted Deliver Anti–Cancer Nano Drugs into the Human Brain to Treat Alzheimer's Disease under Synchrotron Radiation", J Nanotechnol Material Sci 4 (2): 1–5, 2017.

[87] R. Gobato, A. Heidari, "Calculations Using Quantum Chemistry for Inorganic Molecule Simulation $BeLi_2SeSi$", Science Journal of Analytical Chemistry, Vol. 5, No. 6, Pages 76–85, 2017.

[88] A. Heidari, "Different High–Resolution Simulations of Medical, Medicinal, Clinical, Pharmaceutical and Therapeutics Oncology of Human Lung Cancer Translational Anti–Cancer Nano Drugs Delivery Treatment Process under Synchrotron and X–Ray Radiations", J Med Oncol. Vol. 1 No. 1: 1, 2017.

[89] A. Heidari, "A Modern Ethnomedicinal Technique for Transformation, Prevention and Treatment of Human Malignant Gliomas Tumors into Human Benign Gliomas Tumors under Synchrotron Radiation", Am J Ethnomed, Vol. 4 No. 1: 10, 2017.

[90] A. Heidari, "Active Targeted Nanoparticles for Anti–Cancer Nano Drugs Delivery across the Blood–Brain Barrier for Human Brain Cancer Treatment, Multiple Sclerosis (MS) and Alzheimer's Diseases Using Chemical Modifications of Anti–Cancer Nano Drugs or Drug–Nanoparticles through Zika Virus (ZIKV) Nanocarriers under Synchrotron Radiation", J Med Chem Toxicol, 2 (3): 1–5, 2017.

[91] A. Heidari, "Investigation of Medical, Medicinal, Clinical and Pharmaceutical Applications of Estradiol, Mestranol (Norlutin), Norethindrone (NET), Norethisterone Acetate (NETA), Norethisterone Enanthate (NETE) and Testosterone Nanoparticles as Biological Imaging, Cell Labeling, Anti–Microbial Agents and Anti–Cancer Nano Drugs in Nanomedicines Based Drug Delivery Systems for Anti–Cancer Targeting and Treatment", Parana Journal of Science and Education (PJSE)–v.3, n.4, (10–19) October 12, 2017.

[92] A. Heidari, "A Comparative Computational and Experimental Study on Different Vibrational Biospectroscopy Methods, Techniques and Applications for Human Cancer Cells in Tumor Tissues Simulation, Modeling, Research, Diagnosis and Treatment", Open J Anal Bioanal Chem 1 (1): 014–020, 2017.

[93] A. Heidari, "Combination of DNA/RNA Ligands and Linear/Non–Linear Visible–Synchrotron Radiation–Driven N–Doped Ordered Mesoporous Cadmium Oxide (CdO) Nanoparticles Photocatalysts Channels Resulted in an Interesting Synergistic Effect Enhancing Catalytic Anti–Cancer Activity", Enz Eng 6: 1, 2017.

[94] A. Heidari, "Modern Approaches in Designing Ferritin, Ferritin Light Chain, Transferrin, Beta–2 Transferrin and Bacterioferritin–Based Anti–Cancer Nano Drugs Encapsulating Nanosphere as DNA–Binding Proteins from Starved Cells (DPS)", Mod Appro Drug Des. 1 (1). MADD.000504. 2017.

[95] A. Heidari, "Potency of Human Interferon β–1a and Human Interferon β–1b in Enzymotherapy, Immunotherapy, Chemotherapy, Radiotherapy, Hormone Therapy and Targeted Therapy of Encephalomyelitis Disseminate/Multiple Sclerosis (MS) and Hepatitis A, B, C, D, E, F and G Virus Enter and Targets Liver Cells", J Proteomics Enzymol 6: 1, 2017.

[96] A. Heidari, "Transport Therapeutic Active Targeting of Human Brain Tumors Enable Anti–Cancer Nanodrugs Delivery across the Blood–Brain Barrier (BBB) to Treat Brain Diseases Using Nanoparticles and Nanocarriers under Synchrotron Radiation", J Pharm Pharmaceutics 4 (2): 1–5, 2017.

[97] A. Heidari, C. Brown, "Combinatorial Therapeutic Approaches to DNA/RNA and Benzylpenicillin (Penicillin G), Fluoxetine Hydrochloride (Prozac and Sarafem), Propofol (Diprivan), Acetylsalicylic Acid (ASA) (Aspirin), Naproxen Sodium (Aleve and Naprosyn) and Dextromethamphetamine Nanocapsules with Surface Conjugated DNA/RNA to Targeted Nano Drugs for Enhanced Anti–Cancer Efficacy and Targeted Cancer Therapy Using Nano Drugs Delivery Systems", Ann Adv Chem. 1 (2): 061–069, 2017.

[98] A. Heidari, "High–Resolution Simulations of Human Brain Cancer Translational Nano Drugs Delivery Treatment Process under Synchrotron Radiation", J Transl Res. 1 (1): 1–3, 2017.

[99] A. Heidari, "Investigation of Anti–Cancer Nano Drugs' Effects' Trend on Human Pancreas Cancer Cells and Tissues Prevention, Diagnosis and Treatment Process under Synchrotron and X–Ray Radiations with the Passage of Time Using Mathematica", Current Trends Anal Bioanal Chem, 1 (1): 36–41, 2017.

[100] A. Heidari, "Pros and Cons Controversy on Molecular Imaging and Dynamics of Double–Standard DNA/RNA of Human Preserving Stem Cells–Binding Nano Molecules with Androgens/Anabolic Steroids (AAS) or Testosterone Derivatives through Tracking of Helium–4 Nucleus (Alpha Particle) Using Synchrotron Radiation", Arch Biotechnol Biomed. 1 (1): 067–0100, 2017.

[101] A. Heidari, "Visualizing Metabolic Changes in Probing Human Cancer Cells and Tissues Metabolism Using Vivo ^{1}H or Proton NMR, ^{13}C NMR, ^{15}N NMR and ^{31}P NMR Spectroscopy and Self–Organizing Maps under Synchrotron Radiation", SOJ Mater Sci Eng 5 (2): 1–6, 2017.

[102] A. Heidari, "Cavity Ring–Down Spectroscopy (CRDS), Circular Dichroism Spectroscopy, Cold Vapour Atomic Fluorescence Spectroscopy and Correlation Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Enliven: Challenges Cancer Detect Ther 4 (2): e001, 2017.

[103] A. Heidari, "Laser Spectroscopy, Laser–Induced Breakdown Spectroscopy and Laser–Induced Plasma Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Int J Hepatol Gastroenterol, 3 (4): 079–084, 2017.

[104] A. Heidari, "Time–Resolved Spectroscopy and Time–Stretch Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Enliven: Pharmacovigilance and Drug Safety 4 (2): e001, 2017.

[105] A. Heidari, "Overview of the Role of Vitamins in Reducing Negative Effect of Decapeptyl (Triptorelin Acetate or Pamoate Salts) on Prostate Cancer Cells and Tissues in Prostate Cancer Treatment Process through Transformation of Malignant Prostate Tumors into Benign Prostate Tumors under Synchrotron Radiation", Open J Anal Bioanal Chem 1 (1): 021–026, 2017.

[106] A. Heidari, "Electron Phenomenological Spectroscopy, Electron Paramagnetic Resonance (EPR) Spectroscopy and Electron Spin Resonance (ESR) Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Austin J Anal Pharm Chem. 4 (3): 1091, 2017.

[107] A. Heidari, "Therapeutic Nanomedicine Different High–Resolution Experimental Images and Computational Simulations for Human Brain Cancer Cells and Tissues Using Nanocarriers Deliver DNA/RNA to Brain Tumors under Synchrotron Radiation with the Passage of Time Using Mathematica and MATLAB", Madridge J Nano Tech. Sci. 2 (2): 77–83, 2017.

[108] A. Heidari, "A Consensus and Prospective Study on Restoring Cadmium Oxide (CdO) Nanoparticles Sensitivity in Recurrent Ovarian Cancer by Extending the Cadmium Oxide (CdO) Nanoparticles–Free Interval Using Synchrotron Radiation Therapy as Antibody–Drug Conjugate for the Treatment of Limited–Stage Small Cell Diverse Epithelial Cancers", Cancer Clin Res Rep, 1: 2, e001, 2017.

[109] A. Heidari, "A Novel and Modern Experimental Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under White Synchrotron Radiation", Cancer Sci Res Open Access 4 (2): 1–8, 2017.

[110] A. Heidari, "Different High–Resolution Simulations of Medical, Medicinal, Clinical, Pharmaceutical and Therapeutics Oncology of Human Breast Cancer Translational Nano Drugs Delivery Treatment Process under Synchrotron and X–Ray Radiations", J Oral Cancer Res 1 (1): 12–17, 2017.

[111] A. Heidari, "Vibrational Decihertz (dHz), Centihertz (cHz), Millihertz (mHz), Microhertz (μHz), Nanohertz (nHz), Picohertz (pHz), Femtohertz (fHz), Attohertz (aHz), Zeptohertz (zHz) and Yoctohertz (yHz) Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", International Journal of Biomedicine, 7 (4), 335–340, 2017.

[112] A. Heidari, "Force Spectroscopy and Fluorescence Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", EC Cancer, 2 (5), 239–246, 2017.

[113] A. Heidari, "Photoacoustic Spectroscopy, Photoemission Spectroscopy and Photothermal Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", BAOJ Cancer Res Ther, 3: 3, 045–052, 2017.

[114] A. Heidari, "J–Spectroscopy, Exchange Spectroscopy (EXSY), Nuclear Overhauser Effect Spectroscopy (NOESY) and Total Correlation Spectroscopy (TOCSY) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", EMS Eng Sci J, 1 (2): 006–013, 2017.

[115] A. Heidari, "Neutron Spin Echo Spectroscopy and Spin Noise Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Int J Biopharm Sci, 1: 103–107, 2017.

[116] A. Heidari, "Vibrational Decahertz (daHz), Hectohertz (hHz), Kilohertz (kHz), Megahertz (MHz), Gigahertz (GHz), Terahertz (THz), Petahertz (PHz), Exahertz (EHz), Zettahertz (ZHz) and Yottahertz (YHz) Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Madridge J Anal Sci Instrum, 2 (1): 41–46, 2017.

[117] A. Heidari, "Two–Dimensional Infrared Correlation Spectroscopy, Linear Two–Dimensional Infrared Spectroscopy and Non–Linear Two–Dimensional Infrared Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", J Mater Sci Nanotechnol 6 (1): 101, 2018.

[118] A. Heidari, "Fourier Transform Infrared (FTIR) Spectroscopy, Near–Infrared Spectroscopy (NIRS) and Mid–Infrared Spectroscopy (MIRS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", Int J Nanotechnol Nanomed, Volume 3, Issue 1, Pages 1–6, 2018.

[119] A. Heidari, "Infrared Photo Dissociation Spectroscopy and Infrared Correlation Table Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", Austin Pharmacol Pharm, 3 (1): 1011, 2018.

[120] A. Heidari, "Novel and Transcendental Prevention, Diagnosis and Treatment Strategies for Investigation of Interaction among Human Blood Cancer Cells, Tissues, Tumors and Metastases with Synchrotron Radiation under Anti–Cancer Nano Drugs Delivery Efficacy Using MATLAB Modeling and Simulation", Madridge J Nov Drug Res, 1 (1): 18–24, 2017.

[121] A. Heidari, "Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Open Access J Trans Med Res, 2 (1): 00026–00032, 2018.

[122] M. R. R. Gobato, R. Gobato, A. Heidari, "Planting of Jaboticaba Trees for Landscape Repair of Degraded Area", Landscape Architecture and Regional Planning, Vol. 3, No. 1, 2018, Pages 1–9, 2018.

[123] A. Heidari, "Fluorescence Spectroscopy, Phosphorescence Spectroscopy and Luminescence Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", SM J Clin. Med. Imaging, 4 (1): 1018, 2018.

[124] A. Heidari, "Nuclear Inelastic Scattering Spectroscopy (NISS) and Nuclear Inelastic Absorption Spectroscopy (NIAS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Int J Pharm Sci, 2 (1): 1–14, 2018.

[125] A. Heidari, "X–Ray Diffraction (XRD), Powder X–Ray Diffraction (PXRD) and Energy–Dispersive X–Ray Diffraction (EDXRD) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", J Oncol Res; 2 (1): 1–14, 2018.

[126] A. Heidari, "Correlation Two–Dimensional Nuclear Magnetic Resonance (NMR) (2D–NMR) (COSY) Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", EMS Can Sci, 1–1–001, 2018.

[127] A. Heidari, "Thermal Spectroscopy, Photothermal Spectroscopy, Thermal Microspectroscopy, Photothermal Microspectroscopy, Thermal Macrospectroscopy and Photothermal Macrospectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", SM J Biometrics Biostat, 3 (1): 1024, 2018.

[128] A. Heidari, "A Modern and Comprehensive Experimental Biospectroscopic Comparative Study on Human Common Cancers' Cells, Tissues and Tumors before and after Synchrotron Radiation Therapy", Open Acc J Oncol Med. 1 (1), 2018.

[129] A. Heidari, "Heteronuclear Correlation Experiments such as Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC), Heteronuclear Multiple–Quantum Correlation Spectroscopy (HMQC) and Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC) Comparative Study on Malignant and Benign Human Endocrinology and Thyroid Cancer Cells and Tissues under Synchrotron Radiation", J Endocrinol Thyroid Res, 3 (1): 555603, 2018.

[130] A. Heidari, "Nuclear Resonance Vibrational Spectroscopy (NRVS), Nuclear Inelastic Scattering Spectroscopy (NISS), Nuclear Inelastic Absorption Spectroscopy (NIAS) and Nuclear Resonant Inelastic X–Ray Scattering Spectroscopy (NRIXSS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Int J Bioorg Chem Mol Biol. 6 (1e): 1–5, 2018.

[131] A. Heidari, "A Novel and Modern Experimental Approach to Vibrational Circular Dichroism Spectroscopy and Video Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under White and Monochromatic Synchrotron Radiation", Glob J Endocrinol Metab. 1 (3). GJEM. 000514–000519, 2018.

[132] A. Heidari, "Pros and Cons Controversy on Heteronuclear Correlation Experiments such as Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC), Heteronuclear Multiple–Quantum Correlation Spectroscopy (HMQC) and Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", EMS Pharma J. 1 (1): 002–008, 2018.

[133] A. Heidari, "A Modern Comparative and Comprehensive Experimental Biospectroscopic Study on Different Types of Infrared Spectroscopy of Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", J Analyt Molecul Tech. 3 (1): 8, 2018.

[134] A. Heidari, "Investigation of Cancer Types Using Synchrotron Technology for Proton Beam Therapy: An Experimental Biospectroscopic Comparative Study", European Modern Studies Journal, Vol. 2, No. 1, 13–29, 2018.

[135] A. Heidari, "Saturated Spectroscopy and Unsaturated Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Imaging J Clin Medical Sci. 5 (1): 001–007, 2018.

[136] A. Heidari, "Small–Angle Neutron Scattering (SANS) and Wide–Angle X–Ray Diffraction (WAXD) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Int J Bioorg Chem Mol Biol. 6 (2e): 1–6, 2018.

[137] A. Heidari, "Investigation of Bladder Cancer, Breast Cancer, Colorectal Cancer, Endometrial Cancer, Kidney Cancer, Leukemia, Liver, Lung Cancer, Melanoma, Non–Hodgkin Lymphoma, Pancreatic Cancer, Prostate Cancer, Thyroid Cancer and Non–Melanoma Skin Cancer Using Synchrotron Technology for Proton Beam Therapy: An Experimental Biospectroscopic Comparative Study", Ther Res Skin Dis 1 (1), 2018.

[138] A. Heidari, "Attenuated Total Reflectance Fourier Transform Infrared (ATR–FTIR) Spectroscopy, Micro–Attenuated Total Reflectance Fourier Transform Infrared (Micro–ATR–FTIR) Spectroscopy and Macro–Attenuated Total Reflectance Fourier Transform Infrared (Macro–ATR–FTIR) Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", International Journal of Chemistry Papers, 2 (1): 1–12, 2018.

[139] A. Heidari, "Mössbauer Spectroscopy, Mössbauer Emission Spectroscopy and ^{57}Fe Mössbauer Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Acta Scientific Cancer Biology 2.3: 17–20, 2018.

[140] A. Heidari, "Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", Organic & Medicinal Chem IJ. 6 (1): 555676, 2018.

[141] A. Heidari, "Correlation Spectroscopy, Exclusive Correlation Spectroscopy and Total Correlation Spectroscopy Comparative Study on Malignant and Benign Human AIDS–Related Cancers Cells and Tissues with the Passage of Time under Synchrotron Radiation", Int J Bioanal Biomed. 2 (1): 001–007, 2018.

[142] A. Heidari, "Biomedical Instrumentation and Applications of Biospectroscopic Methods and Techniques in Malignant and Benign Human Cancer Cells and Tissues Studies under Synchrotron Radiation and Anti–Cancer Nano Drugs Delivery", Am J Nanotechnol Nanomed. 1 (1): 001–009, 2018.

[143] A. Heidari, "Vivo ^{1}H or Proton NMR, ^{13}C NMR, ^{15}N NMR and ^{31}P NMR Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Ann Biomet Biostat. 1 (1): 1001, 2018.

[144] A. Heidari, "Grazing–Incidence Small–Angle Neutron Scattering (GISANS) and Grazing–Incidence X–Ray Diffraction (GIXD) Comparative Study on Malignant and Benign Human Cancer Cells, Tissues and Tumors under Synchrotron Radiation", Ann Cardiovasc Surg. 1 (2): 1006, 2018.

[145] A. Heidari, "Adsorption Isotherms and Kinetics of Multi–Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a–BNNTs) and Hexagonal Boron Nitride Nanotubes (h–BNNTs) for Eliminating Carcinoma, Sarcoma, Lymphoma, Leukemia, Germ Cell Tumor and Blastoma Cancer Cells and Tissues", Clin Med Rev Case Rep 5: 201, 2018.

[146] A. Heidari, "Correlation Spectroscopy (COSY), Exclusive Correlation Spectroscopy (ECOSY), Total Correlation Spectroscopy (TOCSY), Incredible Natural–Abundance Double–Quantum Transfer Experiment (INADEQUATE), Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC), Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC), Nuclear Overhauser Effect Spectroscopy (NOESY) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESY) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Acta Scientific Pharmaceutical Sciences 2.5: 30–35, 2018.

[147] A. Heidari, "Small–Angle X–Ray Scattering (SAXS), Ultra–Small Angle X–Ray Scattering (USAXS), Fluctuation X–Ray Scattering (FXS), Wide–Angle X–Ray Scattering (WAXS), Grazing–Incidence Small–Angle X–Ray Scattering (GISAXS), Grazing–Incidence Wide–Angle X–Ray Scattering (GIWAXS), Small–Angle Neutron Scattering (SANS), Grazing–Incidence Small–Angle Neutron Scattering (GISANS), X–Ray Diffraction (XRD), Powder X–Ray Diffraction (PXRD), Wide–Angle X–Ray Diffraction (WAXD), Grazing–Incidence X–Ray Diffraction (GIXD) and Energy–Dispersive X–Ray Diffraction (EDXRD) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Oncol Res Rev, Volume 1 (1): 1–10, 2018.

[148] A. Heidari, "Pump–Probe Spectroscopy and Transient Grating Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Adv Material Sci Engg, Volume 2, Issue 1, Pages 1–7, 2018.

[149] A. Heidari, "Grazing–Incidence Small–Angle X–Ray Scattering (GISAXS) and Grazing–Incidence Wide–Angle X–Ray Scattering (GIWAXS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Insights Pharmacol Pharm Sci 1 (1): 1–8, 2018.

[150] A. Heidari, "Acoustic Spectroscopy, Acoustic Resonance Spectroscopy and Auger Spectroscopy Comparative Study on Anti–Cancer Nano Drugs Delivery in Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Nanosci Technol 5 (1): 1–9, 2018.