The microwave energy is non-ionizing. It does not alter the molecular structure of the mixtures. It provides only thermal activation. The characterization of materials is significant activity in material science. The properties of materials depend not only on chemical composition and structural features but also on the degree of molecular order. Spectroscopy is one of the important tools to get information at molecular level. Dielectric spectroscopy is a branch of spectroscopy where one gets information about structural changes and molecular interaction through dielectric relaxation data.

In the present work, interaction of Carboxyl –C=O, Carboxylic-COOH, Amine –NH$_2$ and Cyanide C-N, which are the most common groups in Ayurvedic medicines (Asava and Arishtas) such as Ashwagandharishta, Saraswatarishta, Saptarishta, Drakshasava (Special), Tej-Ras and Abhayarishta with Hydroxyl –OH group in Ethanol, Methanol and Acetone at 15 $^\circ$C, 25 $^\circ$C, 35 $^\circ$C and 45 $^\circ$C is studied. The basics of molecular interaction are the hydrogen bonding. Hydrogen bonds occur between hydrogen containing dipoles and electronegative element. Electro-negativity provides us a relative ability of atom in molecule to attract bonding electrons.

Time Domain Spectroscopy developed by Prof. Cole in reflection mode is used for obtaining dielectric relaxation data. This technique is very useful, economic and fast as compared to other techniques. TDR technique requires very small amount of sample and in single measurement we get permittivity and dielectric loss over wide range from range 10MHz to 20 GHz.

The basic TDR setup consists of step generator, sampling head, sample cell and broadband storage oscilloscope. A fast rising step pulse from generator propagates through coaxial transmission line and reaches dielectric sample placed in sample cell connected as open-ended load. It is partly transmitted and partly reflected at air dielectric interface. Both, reflected as well as transmitted step pulse from sample contains information about dielectric behavior of sample. In the present work reflected step is used to evaluate dielectric relaxation data. The time profile of reflected step with and without sample is recorded in the oscilloscope. This time domain data is
transformed into frequency domain data using Fourier transformation. Frequency domain data is used to obtain complex reflection coefficient \( \rho^*(\omega) \) over frequency range of 10 MHz to 20 GHz. Complex reflection Coefficient gives permittivity and dielectric loss in selected frequency range. But normally there occurs error in this data at higher frequencies due to fringing field, multiple reflections or due to quarter-wave resonance in case of high lossy liquids. The complex reflection data is called “RAW” data. An error in RAW data is corrected by bilinear calibration process. The corrected data is called “COR” data. The dielectric parameters of the Ayurvedic Medicines obtained by fitting “COR” data to Havriliak-Negami equation,

\[
\varepsilon^*(\omega) = \varepsilon_\infty + \frac{\varepsilon_0 - \varepsilon_\infty}{1 + (j\omega\tau)^{-\alpha}} + \frac{\varepsilon_\infty - \varepsilon_0}{1 + (j\omega\tau)^{-\beta}}
\]

Where \( \varepsilon^*(\omega) \) is complex reflection coefficient, \( \varepsilon_0 \) is static permittivity, \( \varepsilon_\infty \) is dielectric loss, \( \omega \) is angular frequency, \( \tau \) is relaxation time, \( \alpha \) is relaxation time distribution parameter defined in Cole-Cole model, \( \beta \) is relaxation time distribution parameter defined in Davison-Cole model. If we put \( \alpha = 0 \) and \( \beta = 1 \), above equation represents simple Debye model. A least squares fit method is used to obtain dielectric parameters.

The permittivity (\( \varepsilon \)) is related to square of molecular dipole moment; the value of permittivity (\( \varepsilon \)) is related to size of molecule in solution and temperature. The dielectric relaxation time \( \tau \) of biological material is related to nature of intermolecular bonding, size of molecule, mobility of molecules in solution, molecular volume, viscosity and temperature. Thus information at molecular level can be gained from a study of dielectric behavior. To understand structural changes in systems Excess permittivity (\( \varepsilon^E \)), Excess inverse relaxation time \( (1/\tau^E) \) and Bruggeman factor \( (f_B) \) are obtained. Thermodynamic parameters i.e. activation energy in kg/mole, change in enthalpy (\( \Delta H \)) and entropy (\( \Delta S \)) are calculated using Eyring’s equation to understand molecular dynamics of the system.
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