Ultrasonic Study on Bio-Liquids Before and After Sonication

G.Samuel	Centre for Nano science and Applied Thermodynamics, Department of Physics, St. Joseph's College (Autonomous), Trichy-620002, India
I. Johnson	Centre for Nano science and Applied Thermodynamics, Department of Physics, St. Joseph's College (Autonomous), Trichy-620002, India
K.Johnson	Centre for Nano science and Applied Thermodynamics, Department of Physics, St. Joseph's College (Autonomous), Trichy-620002, India

ABSTRACT Herbal medicines are currently in demand and their popularity is increasing day by day. The leaves of Solanum lycopersicums,solanum melongena are loaded with all kinds of health benefits for the body. They are in fact, a highly versatile health product and due to their equally versatile preparation options, there's really no reason to neglect the tomato as part of a healthy diet. One of the most well-known tomato eating benefit is its' Lycopene content. Solanum melongena: (Brinjal) probably has its original home in India and China. It is a popular vegetable in Southern Europe also, especially in the Balkans, France and Italy. It is used a vegetable. The leaves of its plants are extracted and they are used to as medicine in many diseases and it contains vitamins A. Both are underwent sonication and then it was studied through interferometer.

INTRODUCTION

Sonication is the act of applying sound energy to agitate particles in a sample, for various purposes. Ultrasonic frequencies (>20 KHz) are usually used, leading to the process also being known as ultrasonication or ultra-sonication.In the laboratory, it is usually applied using an ultrasonic bath or an ultrasonic probe, colloquially known as a sonicator. In a paper machine, an ultrasonic foil can distribute cellulose fibers more uniformly and strengthen the paper.Effects:Sonication has numerous effects, both chemical and physical. The chemical effects of ultrasound are concerned with understanding the effect of sonic waves on chemical systems. The chemical effects of ultrasound do not come from a direct interaction with molecular species. Studies have shown that no direct coupling of the acoustic field with chemical species on a molecular level can account for sono-chemistry.Biological applications, sonication may be sufficient to disrupt or deactivate a biological material. For example, sonication is often used to disrupt cell membranes and release cellular contents. This process is called sonoporation. Sonication is also used to fragment molecules of DNA, in which the DNA subjected to brief periods of sonication is sheared into smaller fragments.

PLANT LEAF EXTRACTION METHOD:

Decoction:

In this process, the crude drug is boiled in a specified volume of water for a defined time; it is then cooled and strained or filtered. This procedure is suitable for extracting water-soluble, heatstableconstituents. This process is typically used in preparation of Ayurvedic extracts called "quath" or "kawath". The starting ratio of crude drug to water is fixed, e.g. 1:4 or 1:16; the volume is then brought down to one-fourth its original volume by boiling during the extraction procedure. Then, the concentrated extract is filtered and used as such or processed further.

EXPERIMENTAL TECHNIQUE:

Ultrasonic Interferometer:

The schematic diagram of an ultrasonic interferometer is shown in the figure(i).
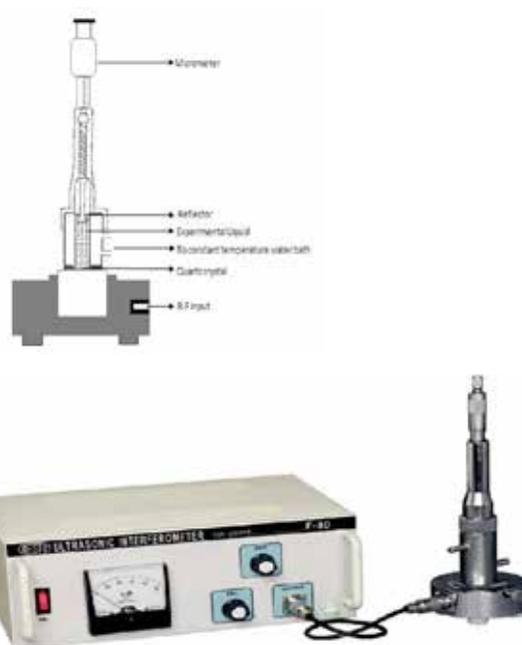
Figure(i)

In an ultrasonic interferometer, the ultrasonic waves are produced by the piezoelectric method. In a fixed frequency variable path interferometer, the wavelength of the sound in an experimental liquid medium is measured, and from this one can calculate its velocity through that medium. The apparatus consists of an ultrasonic cell, which is a double walled brass cell with chromium plated surfaces having a capacity of 10ml. The double wall allows water circulation around the experimental medium to maintain it at a known constant temperature.

The micrometer scale is marked in units of 0.01mm and has an overall length of 25mm. Ultrasonic waves of known frequency are produced by a quartz crystal which is fixed at the bottom of the cell. There is a movable metallic plate parallel to the quartz plate, which reflects the waves. The waves interfere with their reflections, and if the separation between the plates is exactly an integer multiple of half-wavelengths of sound, standing waves are produced in the liquid medium. Under these circumstances, acoustic resonance occurs. The resonant waves are a maximum in amplitude, causing a corresponding maximum in the anode

current of the piezoelectric generator.

If we increase or decrease the distance by exactly one half of the wavelength ($\lambda/2$) or an integer multiple of one half wavelength, the anode current again becomes maximum. If d is the separation between successive adjacent maxima of anodecurrent, then

$$d = \frac{\lambda}{2}$$

We have, the velocity (v) of a wave is related to its wavelength (λ) by the relation,Where, f is the frequency of the wave. Then,

$$v = \lambda f = 2df$$

The velocity of ultrasound is determined principally by the compressibility of the material of the medium. For a medium with high compressibility, the velocity will be less. Adiabatic compressibility of a fluid is a measure of the relative volume change of the fluid as a response to a pressure change. Compressibility is the reciprocal of bulk modulus, and is usually denoted by the Greek word beta (β).The adiabatic compressibility of the material of the sample can be calculated using the equation,

$$\beta = \frac{1}{\rho v^2}$$

Where ρ is the density of the material of the medium and v is the velocity of the sound wave through that medium.

RESULTS AND DISCUSSION:
From the present study,it is known that liquid physics is more important to understand the molecular interaction between them. Sonication does the disruption of bio –cells of plants leaves extraction   and transforms in to new compound. This changes are confirmed from physical study like ultrasonic velocity,density and viscosity.

TABLE – 1

NAME OF THE LIQUID	VELOCITY (m/s)	DENSITY (kg/m³)	COMPRESSIBILITY (cm²/dyne)	VISCOSITY (mPa.s)
Distilled water	1494.714	0.9984	4.4831	0.798
Sample – E	1511.771	0.9926	4.4081	0.761
Sample – F	1502.571	0.9937	4.4573	0.782
Sample – E after sonication	1510.257	0.9939	4.4111	0.789
Sample – F after sonication	1483.457	0.9973	4.5564	0.793

CONCLUSIONS
It is observed that from the table (i) there is a definte change in the readings of ultrasonic velocity ,density and viscosity before and after sonication method. And its resuls are confirmed and verified from the FTIR studies at a point where it shows deletion peaks which shows that due to sonication the amino acid compounds are disrupted.so ultrasonic studies can be used to analyze bio-plants extraction.

REFERENCE

[1]. Kalidoss, I. Johnson, and R. Srinivasamoorthy, J. Acoust. Soc. Ind. 27, 319 (1999). | [2]. M. Kalidoss, and R. Srinivasamoorthy, J. Pure Appl. Ultrason. 19, 9 (1997). | [3]. Weissberger, Organic solvents, Vol. VII, Inter-science publisher, New York, 1955. | [4]. J.A. Riddick, W.B. Bunger, and T.K. Sakano, Techniques in Chemistry : Vol. 11, Organic solvents, 4th Edition, John-Wiley, New York, 1986. | [5]. Handbook of Chemistry and Physics, 65th Edn., The Chemical Rubber company, Cleveland, Ohio, USA, 1984. | [6]. Fundamental of Molecular Spectroscopy - C N Banwell | [7]. Organic Spectroscopy – W. Kemp | [8]. Molecular Spectroscopy – Arul Dhas. | [9]. C.V. Suryanarayana and S. Kuppusamy J. Acous. Soc. Ind. 7, 131 (1979). | [10]. Robert M. Silverstein and Francis X. Webster, Spectrometric identification of organic compounds, 6th edition, John Wiley & Sons, Singapore, (1998). | [11]. Journals of Acoustical Society of India and Ultrasonic Society of India. |