Sonication –A Developing Tool Used in Biological and Chemical Activities

Malan R. C[1,*] & Malan R. R[1]
[1]Applied Science and Humanities Department, Government Engineering College, (G. T. U.)
Valsad -396001, Gujarat, India.

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ABSTRACT *The present article reveals the ultrasonic sound (U. S. S.) as an effective factor for various biological activities, Chemical reaction and enzyme process. The effect of U. S. S. to the metabolite formation and bio degradation process also covered under the study. The article includes the application of U. S. S. in the field of gene and drug delivery. The collection of evidences provided for each of the effects of the U. S. S. in above mentioned activities. An effort has been made to provide the overall idea about the sonication effect with some previously reported facts.*

Keywords: *Sonicatio;, U.S.S. assisted biological and chemical activates; Drug-DNA deliver.*

Introduction

In a physics of sound depending upon the frequency the sound can be classified in three different types as mentioned in below:

1. Infrasonic sound (frequency ($F < 20\ KHz$),
2. Audible Sound (frequency ($20Hz < F < 20KHz$),
3. Ultrasonic Sound (frequency ($F > 20KHz$)).

The highest frequency sound (U. S. S.) having the high penetration power. Many of the reactions are wide effect of the present of U. S. S. (sonication) in context of reaction rate, total yield and byproducts. Influence of sonication on the activities depends upon the intensity and the power of U. S. S. used for the sonic treatment. The intensity of the U. S. S. used for biological process are of the order of$10\ w - cm^{-2}$. The following sections describe the various field of application of ultra sound and working mechanism required for the experiments.

U. S. S. interaction with material

On incident of the U. S. S. on material there will be following types of interactions are possible. Fig. 1 represents the schematics of the interaction. The liquid medium experiences the increased transport of constituent particles. [1-3].

- Mechanical part of interaction

In case of mechanical part of the interaction of the U. S. S. with material the energetic contractions and rarefactions are generated into the medium. This ultimately results into the stress on the various micro organism present in the interacting medium.

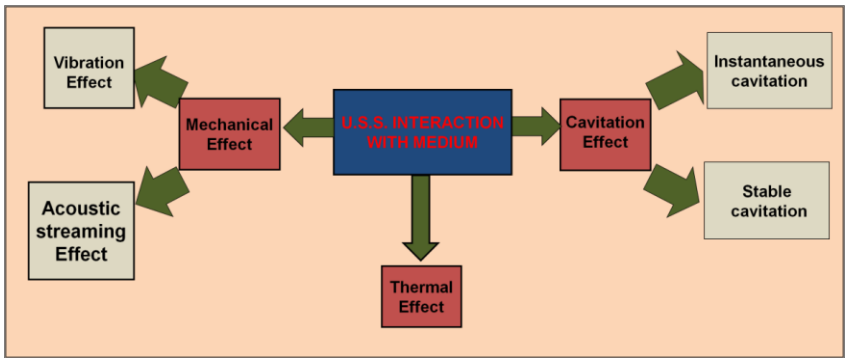

Figure 1. Interaction of the U. S. S. with material.

- Thermal part of interaction

This is part of the interaction has a significant role. The vibrations created by U. S. S. gives rise to the thermal heating of the material (i.e. increase in temperature). The rise in temperature leads other variations into the ambient of the process.

- Cavitations part of interaction

The U. S. S. produces the cavities in the medium which may categorize in following two parts:

a. Temporary/Instantaneous,

b. Stable.

U. S. S. assisted bacterial cell growth

The bacterial growth is affected by the sonication. As a common approach the U. S. S. is generally used to detach the microorganism from the material surfaces [4-7]. This happens because of the cavities created near the slots of the microorganism on the surfaces will also blasts continuously that results into the detachment of the living cells near the surfaces. This type of cleaning or removal stops the further growth of the bacteria. But it is not the case all the time that it destructively interact with the micro organisms. In some exceptional cases, the *P. aeruginosa, E. coli and S. epidermidis* bacteria films grown more as compare to the environment without sonication [8]. The reason for the increase in the growth of the bacterium is believed due to rise in the transportation of the waste and nutrients with the sonication. Not only the surface organism growth enhanced, but it is also possible with the suspended organism.

The possibility of the rise in the bacterial cell growth has wide applications in the Medical field. This can be used to development of tissues, pharmaceutical productions and medicinal proteins.

U. S. S. assisted Drug and DNA gene delivery

With another field that uses the U. S. S. is the drug and Gene delivery at targeted place in the body. The targeted drug delivery increases the effectiveness of the drug. In this type of technique the sealed drug is directly send at the site the affecting tissues. This in turn enhance the effect of the drug and decrease the waste during the flow through the common trajectory obtained with conventional methods of the drug treatment. The various techniques reported for drug and gen delivery is shown in figure 2.

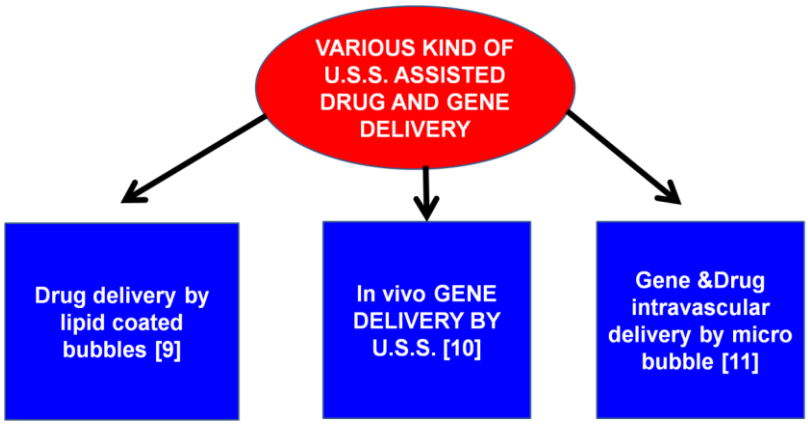

Figure 2. The techniques reported for gene and drug delivery with U. S. S.

U. S. S. assisted extraction

If the plant leaves extraction is done with the presence of U. S. S. the following area of the yield may vary as compare to the common extraction:

- Reduction in total extraction time,
- Improvement in efficiency of plant extraction,
- Increased concentration of extract.

Boldo leaves extraction has been reported by Petigny *et al.* [12]. It has its own importance in the industry due to its antioxidant properties. The parameters of U. S. S. are to be optimized to obtained the perfect benefit in terms of high yielding and less time for extraction.

U. S. S. assited food preservation

With the various combination of sonication and heat treatment following are the possible techniques may used for the food preservation

- Only sonication,
- Thermosonication,
- Monosonication and
- monothermosonication.

The inactivation treatment of different microorganisms such as E.Coli in model fluid[7], E.Coli in Apple cider[8], Listeria monocytogenes in apple cider[9], Lipoxygenase, Peroxidise, Polyphenol oxidase, Lipase and Protease[10].

Inactivation of the activity of the microorganism depends on the techniques adopted and type of organism.

Concluding Remarks

The area of applicability of the U. S. S. is very wide. It includes almost all field of research and development. There is a wide scope of the modification in the presently available treatments with the help of U. S. S. The present article provides the some of the best evidences of developing horizon of sonication injection in the conventional techniques. The academician, researchers and other personals working in the various field may take advantage of any of the sonication method and can have improved and desirable results.

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