Ultrasound Technology in Milk Product: A Review

[1]R.P Yadav, [2]Gaurav Kumar Misra, [3]Saurabh Misra

[1]Principal, [2]PhD Scholar, [3]PhD Scholar
Department of Physics
[1]Govt. P.G College, Bilaspur Rampur, UP, India
[2,3]M.J.P Rohilkhand, University,Bareilly, UP, India

***Abstract*: Ultrasound is a mechanical wave that is oscillating at a frequency above that of human hearing. Ultrasonic waves have any frequency above 20 KHz up to a practical limit of around 10MHz for various applications. Within this range the measurement of the speed of propagation and the attenuation reflection of ultrasonic signals can be the basis of tool systems for the dairy and milk industry. Using ultrasound technology in the milk and dairy and make the milk. It is very complicated process in second or minutes with high productivity, in minimum time and more production of milk is very complicated process. Minimizing the cost and steps, simplifying manipulation and proceed-up giving more purity of final product, in this review paper to reduce the waste water from the milk and take only a fraction of the time and energy normally needed for conventional process. Several such as freezing, cutting drying, tempering bleaching, sterilization, and extraction have been applied efficiently in the milk in the product. Using the ultrasound wave in the food processing to increase the purity of food, milk, also increase the rate of mixing or micro mixing. This is an advantage of ultrasound wave. To use the ultrasound, faster energy and mass transfer, reduce thermal and concentration, gradients, reduce temperature, selective extraction; reduce equipment size, faster response to process extraction control, increased production and elimination of process steps.**

***Keywords*: Ultrasonic waves, Processing, Treatment, Dairy Product, Parameters.**

I. INTRODUCTION

The customer demand, the preservation of the milk in the form of best quality. Therefore non thermal milk processing and preservation are crucial one of the current and important methods of non-thermal milk processing and preservation is application of ultrasound wave. Hearing capacity of man is 20Hz, these types of sound wave called infrasonic wave. The above frequency range called as ultrasonic wave. Ultrasound techniques are used in milk and dairy industry. The ultrasound wave also save the some important enzyme, bacteria, despite the fact that investigation is not yet complicated, ultrasonic techniques are relatively cheap simple and energy saving and thus become in emerging technology for probing and modifying dairy products milk is a major source of essential nutrients for adults and children in India. In this paper, the results obtained that this types of milk is very useful for children as comparison to other milk. And also the result obtained in ultrasonic parameters such as velocity, attenuation, compressibility acoustic impedances, bulk modules intermolecular free length specific heat capacity and thermal conductivity are calculated for different samples of milk to analyze the quality and adulteration. The ultrasonic techniques have been implemented is non-invasive on line measuring system. In the view of this an attempt has been made to study ultrasonic parameters of different milk samples in order to check the purity of milk.

Fig 1 – Ultrasonic continuous wave generator

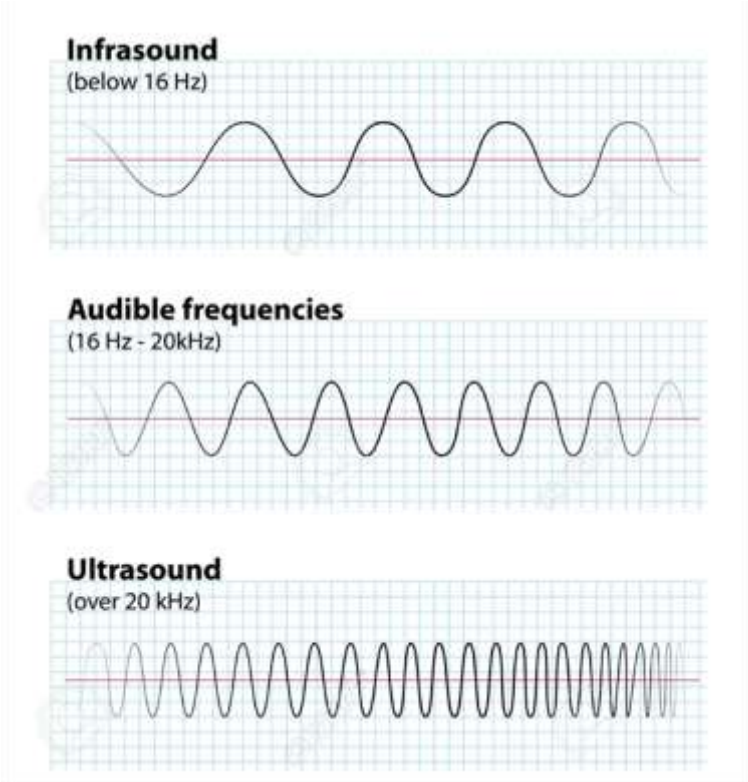

Fig 2- Sound Waves: - Infrasound, Audible frequencies, ultrasound

II. ULTRASONIC WAVES AND APPLICATION

Ultrasonic waves are sound waves, the frequency of ultrasonic waves are higher than normally audible to the human ear. The application of ultrasonic waves are flaw detection, cutting and matching of hard materials, ultrasonic soldering and welding, measuring of flow devices. Some important properties of ultrasonic waves also defined as ultrasonic waves vibrate at a frequency greater than the audible range for humans. The ultrasonic waves have smaller wave length; the ultrasonic wave cannot travel through vacuum. The ultrasonic waves travel at the speed of sound in the medium. Application of ultrasonic waves is one of the novel techniques for the improvement of water treatment process. In this study, ultrasonic waves were irradiated to milk for milk softening process and other contaminants removal. The experimental results showed that this technique improved the water treatment process efficiently. The study also revealed that the various parameters such as amplitude, frequency and irradiation time could affect the efficiency of ultrasound techniques for the improvement of milk quality. An understanding that the milk conservation at the source of drinking water rather than remediation and treatment is very important has been deepened. However, the milk sources that have been already contaminated have to be treated to make safe milk. At present, the milk purification treatment and its management have been fully carried out to respond citizens who require potable and tasty milk.

Fig 3- ultrasonic system

III. Milk

Milk is a colloidal dispersion holding fat globules, casein micelles and whey proteins in an aqueous solution of lactose minerals and a few other minor compounds its physical and chemical properties are dependent on a variety of compositional and processing factors. An understanding of these properties is important to dairy industry. Measurement of the sum of the physico-chemical properties are also used to determine the concentration of milk components or to access the quality of milk products. The ultrasonic wave parameters help us to determine the physico-chemical properties of milk of different sources as by cow, buffalo packed and adulterated etc. will be exposed by ultrasonic wave interferometer and measuring the various parameters as velocity, attenuation acoustic impedance. These parameters of ultrasonic wave interferometer for pure and adulterated milk are different by this we can compare the quality of milk of different samples to different temperatures and frequencies. When milk is coagulated the attenuation is reduced. Raw and treaded milk with ultrasonic wave have the same flavor and taste as like unprocessed milk. According to WHO (world health organization) pure milk of cow having the following structural components 2.6% fat, 3.5% protein, 0.017% T.A, 7071% SNF, 1.030 SG, 1.3x106 cfu/ml Bacteria PH=6.6 at 100c to 117c ensure the freshness of milk.

IV. Parameters, principles and methodology

The two major parameters measured in high resolution ultrasonic spectroscopy are attenuation and the velocity of the wave's attenuation is determined by the energy losses in compressions and expansion in ultrasonic waves, which include absorption and scattering contributions. Ultrasonic velocity is determined by the density and the elasticity of the medium. This is extraordinarily touchy to the molecular agency and intermolecular interplay in the pattern and can be exploited in the evaluation of board vary of molecular processes. In this method an ultrasonic pulse generated at a positive frequency is dispatched thru a pattern and acquired both at the contrary facet and after the reflection from the properly of the container. Measurements of the amplitude of the propagation time which represent the ultrasonic velocity.

V. Experimental setup

The experimental setup for ultrasound pace size is essential. Ultrasonic speed measurements are carried out the usage of ultrasonic interferometer which yields correct and regular data, from which we can decide the speed ultrasonic waves in pattern of milk medium. When an ultrasonic waves travels via a medium, the molecules in that medium oscillates over very brief distance in a path parallel to the longitudinal wave. During this vibration momentum is transferred amongst molecules. This motives the wave to ignore thru the medium. In an ultrasonic interferometer, the ultrasonic waves are produced with the aid of the piezoelectric method. The equipment consist of an ultrasonic cell, which is a double walled brass mobile with chromium plated surfaces having a capability of 10ml. the double wall lets in water circulation round the experimental medium to keep it at a acknowledged steady temperature. The micrometer scale is marked in unit of 0.01 mm and size 25 mm. ultrasonic waves of regarded frequency are produced by means of quartz plate which displays the waves. The waves intrude with their reflections, and if the separation between the plates is precisely an integer multiple. Under these occasions acoustic resonance occurs. The resonant waves are a most in amplitude, inflicting a corresponding most in the anode cutting-edge of the piezoelectric generator. If we amplify or reduce the distance by way of precisely one 1/2 of the wavelength $\lambda/2$ or an integer a couple of half of wavelength the anode modern again. Becomes most if d is the separation between successive adjoining maxima of anode modern-day then $d=\lambda/2$. We have speed of wave is associated to its wavelength through the relation v=fd,V=2df. Where f is the frequency of waves. Ultrasonic velocities for two exceptional frequencies (2Mhz and 4Mhz) are calculated for a number of temperature wavelengths bought from the micrometer and the corresponding ultrasonic velocities had been tabulated.

VI. Related work

L Benguigui et al (1994) studied the ultrasonic techniques for monitoring milk coagulation. Amit salunkhe et al (2013) studied the implementation of fuzzy system ultrasonic technique Rustem B et al (2016) researched on physico-chemical properties of milk and milk derived products. Siti J. Iswarin et al (2012) studied the breaking of coconut milk fat by means of ultrasound and found that ultrasonic treatment with high power level has an important effect on coconut milk homogenization and is an effective technique for the reduction of the fat globule size effect of reduction represents the symptom of cavitation's phenomenon.

Oguz Gursoy et al (2015) studied the effect of ultrasound power on physico-chemical and rheological properties of yrghurt drink produced with thermosonicated milk and concluded that thermosonication treatment could be successfully used in the production of Yrghurt drink and improve its major quality parameters such as delayed serum separation and increased apparent viscosity. S karlovie et al (2014) studied reducing fat globules particle size in goat milk using ultrasonic technique. Concluded that ultrasonic homogenization indicated enhanced homogeneity of fat globules while high pressure process parameters have a significant influence on the observed mean particle diameter (fat globules). Improve stability and quality of emulsion (goat milk) was obtained by both applied processes (Ultrasound and high hydrostatic pressure approach).

Zoran herceg et al (2012) studied the inactivation of mesophilic bacteria in milk by means of high intensity ultrasound using response surface methodology. He found that a significant inactivation of microorganism under longer period of the treatment with ultrasound waves, in combination of higher temperature and amplitude. The output value of total bacteria count was defined by statgraphics where the lowest bacteria count was 3688lg (Au/ml) for the following specific ultrasound parameters amplitude 120mm, treatment time 9.84 min and temperature 45.34.

Gisele OS Meir et al (2015) studied the detection of raw milk adulterated with cheese whey by ultrasound method. Concluded that only the ultrasound method showed the differenced in samples adulterea with 2.5% onwards Uzma Altaf et al (2018) studies the ultrasound treatment for good preservation, concluded that it is more effective in micromixing, faster mass and energy and mass transfer minimized thermal and concentration gradients, reduced temperature, more selective extraction, more minimized equipment size quick response to process extraction control increased production and reduced the processing steps, full reproducible food process can now be completed in seconds with high reproducibility, reducing the processing cost, more simplifying manipulation and giving more purity of the final product eliminating post-treatment of waste water and consuming only a fraction of time and energy normally needed for convectional processes.

Zoran Herceg et al (2012) studied the effect of high intensity ultrasound treatment on the amount of staphylococcus aureus and Escherichia coli in milk concluded that increased inactivation of microorganisms under longer period of treatment, particularly in combination with higher temperature and or amplitude. Assad Rehman saeed Al-hilphy et al (2012) studied the effect of ultrasonic treatment on buffalo milk homogenization. The lowest homogenization indices were 2% and 3% at 430 and 338 w respectively. The homogenization index was reduced with increasing time of homogenization with ultrasonic treatment M.Faith Ertugay et al (2004).

Studied the effects of ultrasound treatment on milk homogenization and particle size distribution of fat. It was observed that ultrasound treatment with large amplitude power had an important effect on milk homogenization compared with conventional homogenization efficiency also rose Luis Elvira and Jaime Rodriguez et at 2009 shidied the sound speed and density characterization milk adulterated with melamine. Found that ultrasonic speed and desity measurements were made in skim milk as a function of melamine adulterations.

Mohammed Habib Ali et al (2017) studied attenuation of ultration of ultra-sounding reconstituted milk. It is observed that there is an increase in ultrasonic attenuation with increase in density of the reconstituted milk which may be due to the molecular rearrangement and relaxtion process due to propagation of ultrasonic waves Tomislave Brsilikav et al (2012) studied the influence of high intensity ultrasound treatment on physical properties of sheep milk. Concluded that longer time of treatment with ultrasonic waves influence temperature, absorbance and changes on viscosity of sheep milk while on PH-value and density has no influenced.

Aba Preev et al (2013) analyzed the milk by rapid ultrasonic technique for the Indian market and concluded that this technique enable continuing on-line monitoring of the quality of milk and will facilitate the prediction of mastitis by the determination of the main component with the following accuracy fat (0.05%) protein (0.05%) SNF (0.05%) A later stage the ultrasonic milk analyzer will be applied to compositional analysis and quality different liquid milk products.

Anita Rana et al 2017 studied the ultrasonic processing and its use in food industry and concluded that it offers a great productivity, yield better quality, less time and being environment friendly.

Summary and Conclusions

The growth of the ultrasonic is following a natural pattern for any fledging field initially ultrasonic was found to be extremely efficient for the production of an oil and water emulsion. Its application have boarded considerably and now it is believed that ultrasonic is set to make a considerable impact on the milk industry over the next decade. Several factors via new materials which can reduce the cost of ultrasonic equipment, methods for producing vibrations of sufficient intensity and consequently, more powerful source of vibrations, improvement in basic designing and finally the availability of trained personal, have to be explored in depth to make the application of ultrasonic more meaningful and significant in food industry.

Now days, power ultrasound is considered to be an emerging and promising technology for industry milk processing the use of ultrasound in processing create interesting methodologies which are often complementary to classical techniques. Various areas have been identified with great potential for future development crystallization, degassing, drying extraction, and filtration, freezing, homogenization, meat tenderization, sterilization etc. there is a wide scope for farther research in to the use of ultrasound in milk processing both from an industrial and academic viewpoint.

It is observed statistically significant difference between various adulterated samples of milk on ultrasonic treatment. The proposed method shows the possibility of developing reusable equipment by which it will be quick and easy to detect the water in milk. This method can be extended to determine properties of milk products (density, viscosity PH, SNF, level of adulterated milk or dairy products in the packages.

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