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A Comparative Study of Molecular Interactions of Pure Cow Milk and Branded Milk

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Abstract: ***Ultrasound techniques find use in the food industry in both the analysis and modification of foods. Milk is a perfect food, readily digested and absorbed. It is a sole natural food for infants and children. To most of the cow milk, sold in open-air, sodium carbonate, sodium bicarbonate, urea and such chemicals are added. These chemicals prolong the life of the cow's milk and prevent its curding. The continuous use of such milk may cause health hazards to people. Very little work has been done to study the quality of milk using ultrasonic technique. This paper presents ultrasonic velocity, density and adiabatic compressibility of pure cow milk and branded milk at different temperatures have been measured. The variation of the thermo acoustic parameters of pure cow milk and branded milk are slightly dissimilar in nature which conclude that acoustic properties are very suitable for detecting the presence of chemical additives.***

Keywords: Cow milk, branded milk, ultrasonic velocity, density and adiabatic compressibility.

1. Introduction

Ultrasound is composed of sound waves with frequency beyond the limit of human hearing. By tuning frequency, ultrasound can be utilized in many industrial applications including food. Ultrasound techniques are relatively cheap, simple and energy saving and thus became an emerging technology for probing and modifying food products. Cow's milk is a major source of essential nutrients for adults and children in India. Since the frequency and quantity of milk consumed by children and infants, is much more, compare to adults, the health hazards, of course, is greater of them. Therefore, the knowledge of the chemical additives in natural cow's milk is of particular interest. In this chapter, the results obtained in the ultrasonic velocity and absorption investigations of the following seven binary systems are presented and discussed.

2. Methodology

The ultrasonic velocity (u) and density(ρ) were determined at 303 to 318K at interval of 5K with the help of digitally controlled temperature bath was maintained constant using a thermostatically-controlled water circulating arrangement with an accuracy of ±0.1K. Ultrasonic velocities were measured by a MHF-400 high frequency pulser-receiver at a frequency of 2MHz with an accuracy of ±0.1 m/s. The density is measured by relative density method using 10 ml relative density bottle with an accuracy of 0.001kg/m^3. Density measurements were performed using density bottle. Masses were measured by a single pan electronic balance with an accuracy of ±0.1 mg.

3. Results And Discussion

In this system ultrasonic velocity (u) is increases with increase in temperature of pure cow milk, Aarey, Dinshaw's, Haldirams and Amul (Sample A, B, C, D). Figure 1 shows the variation of ultrasonic velocity (u) with temperature (K) of pure cow milk and sample A, B, C, D. The variation of ultrasonic velocity (u) is increases as the temperature is increases in cow milk and branded milk indicating association in the component molecules. An analysis of the variation of these parameters with temperature for different branded sample, the velocity (u) of Haldiram milk (Sample C) shows a variation in the nature to that of pure cow milk and both the milks are more associative. This similar variation may indicate the absence of chemical additives in it. The variation of the Amul milk (Sample D) is dissimilar compare to pure cow milk it indicates the presence of chemical additives in it and also indicates the Amul milk (Sample D) contains more fat than the pure cow milk.

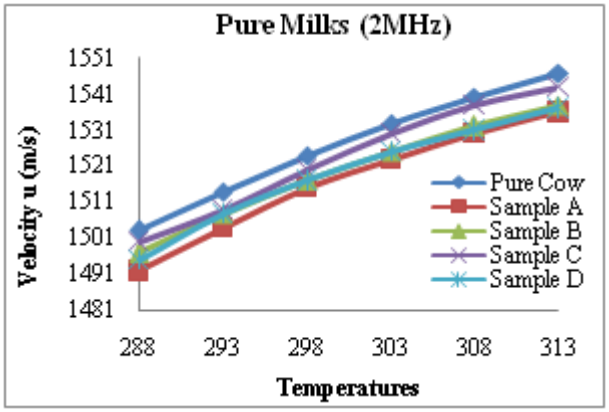

Figure 1: Variation of velocity with temp. (cow milk, Sample A, B, C D)

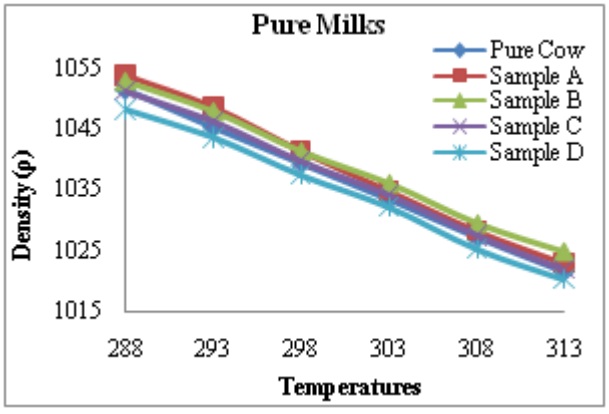

Figure 2: Variation of density with temp. (cow milk, Sample A, B, C D)

The variation of the density (ρ) is decreases with increase in temperature of pure cow milk, Aarey, Dinshaw's, Haldirams and Amul (Sample A, B, C, D). Figure 2 shows the variation of density (ρ) with temperature (K) of pure cow milk and sample A, B, C, D. The variation of density is decreases as the temperature increase in cow milk and branded milk (Sample A, B, C, D). An analysis of the variation of these parameters with temperature for different branded sample, the density (ρ) of Haldiram milk (Sample C) shows a variation in the nature to that of pure cow milk and Aarey and Dinshaw's milks (Sample A and B) are also more associative. This similar variation may indicate the absence of chemical additives in it. The variation of the Amul milk (Sample D) is dissimilar compare to pure cow milk it indicates the precence of chemical additives in it and also indicates the Sample D contains more fat than the pure cow milk. Density is an important concept regarding buoyancy, purity and packaging. It varies with temperature and pressure. Increasing the pressure on an object decreases the volume of the object and therefore increases its density, increasing the temperature of a substance decreases its density. Decrease in density shows the structure breaking property (Hydrophoic nature) of interacting molecules in mixtures.

The variation of adiabatic compressibility (βa) is decreases with increase in temperature of pure cow milk, Aarey, Dinshaw's, Haldirams and Amul (Sample A, B, C, D). Figure 3 show the variation of adiabatic compressibility (βa) with temperature (K) of pure cow milk and sample A, B, C, D. Adiabatic compressibility (βa) is a measure of intermolecular association or dissociation or repulsion. It also determines the orientation of the component molecules. The structural arrangement of the molecule affects the adiabatic compressibility. The variation of adiabatic compressibility gives decreasesas the temperature is increases in cow milk and branded milk. The decrease in adiabatic compressibility indicates enhancement of degree of association among the liquid molecules.

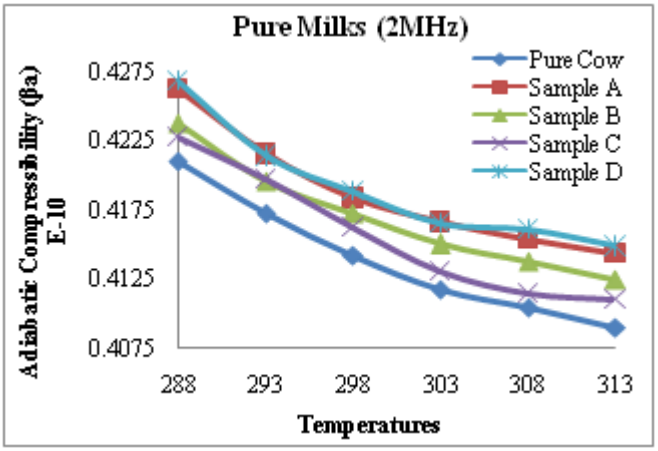

Figure 3: Variation of adiabatic compressibility with temp. (Cow milk, Sample A, B, C D)

Hence the intermolecular distance decreases with increase in temperature indicating strong inter molecular interaction in the component molecules shows associating tendency of the component molecules. Pure cow milk gives low value of βa and remaining branded milks have high value of βa it indicates the presence of chemical additives and also indicates the more fat contains than the pure cow milk. The pure cow milk and Haldiram milk (Sample C) nearly same compressibility at the lowest temperature. The decrease in compressibility with temperature is smooth for pure cow milk and Haldiram milk (Sample C). However, such variation is not seen in case of other remaining branded milk. The decrease in adiabatic compressibility brings the molecules to a closer packing resulting into a decrease of intermolecular free length. The decrease in the values of adiabatic compressibility strengthens the strong molecular association between the unlike molecules through dipole-dipole interaction.

4. Conclusions

From the present analysis, we also arrive at the conclusion that Sample C is free from chemical additives. The variation of this sample from the pure sample may be due to the presence of required level of fat content from the standard milk, which may be greater than that for the pure sample we have chosen for our present study.

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