Ultrasonic Detection of Adulteration in Fluid Foods

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ABSTRACT

Fluid foods, like, milk, honey, alcohol, fruit juices and other beverages fall easy prey to adulteration as a number of cheap liquids are easily miscible with them. Sometimes, they are highly toxic and when mixed unscrupulously with liquids for human consumption, may cause serious health problems.

Propagation of ultrasonic waves through the fluid foods was studied because mixing of adulterants in them changes their physical properties, such as density, viscosity and homogeneity etc. These have direct impact on the velocity of ultrasonic waves passing through these media. This study would help in easy and quick detection of adulteration in fluid foods thereby resulting in better health care of the masses.

Keywords: Ultrasound, Propagation Velocity, Adulteration, Milk, Cream.

INTRODUCTION

Today, many adulterants have flooded the market. These adulterants may render the original edible product to a form whose consumption might result into any thing from mild food poisoning to fatality or permanent disability of any kind. In view of such serious conditions, it is necessary that some tests are made available to detect the presence of unwanted toxic materials, if present [1,2,3]. Evaluation of the nature of the adulterant and extent of adulteration in the food article is important. Chemical methods are commonly used for achieving the above objectives but these methods are of destructive nature and the material tested is rendered useless. Therefore, an attempt is made here to find an alternative method of non-destructive nature, in this case ultrasonic method. Study of chemical constituents of edible oils and fats is made here with ultrasonic technique.

MATERIALS AND METHOD

Purified laboratory grade materials procured from various manufactures were tested in our Laboratory for their chemical constituents. After that different amounts of other materials were added as adulterants in these sample and various parameters, mainly density and ultrasonic propagation velocity, were measured every time the amount of adulterant was changed. A double - probe - through transmission technique was used for the measurement of ultrasonic velocity to maintain the accuracy of results. A sample holder was kept between the transmitting and receiving transducers. To measure the time '**t**' taken by the ultrasonic wave to propagate through the media kept in sample holder of width '**d**' a calibrated cathode ray oscilloscope was used. The propagation velocity of ultrasonic wave through medium is given by,

$$V = d/t$$

RESULTS AND DISCUSSION

A few samples of fluid foods like edible oils were studied to correlate the change in ultrasonic velocity to the amount of adulteration. Ultrasonic velocity '**V**' and density 'ρ' were measured at a constant temperature as these parameters are functions of temperature. Processed milk cream sample contaminated with vegetable oil has been studied at a temperature of 304.5 K.

As evident from Table I the attenuation of ultrasonic waves in fatty material results from the intrinsic attenuation in its various components. This is also dependent on scattering (3), viscosity and thermal properties of the media. The medium being studied has fat component distributed throughout the sample in the form of globules and is the main cause of loss in the ultrasonic velocity in the form of thermal energy. As such the velocity is found to be more dependent on the fat content of the medium rather than the other components and the average ultrasonic velocity is found to decrease as the degree of adulteration increases. It is observed in Table 2 that in the case of the adulteration of honey with sugar, the ultrasonic velocity increases with the

TABLE - I

Percentage of vegetable oil mixed with processed milk cream	Density(ρ) × 10^3 kg/m^3	Average velocity (V) m/sec
100	0.8244	1300
90	0.8276	1300
80	0.8298	1300
70	0.8307	1300
60	0.8321	1333
50	0.8357	1333
40	0.8382	1333
30	0.8411	1333
20	0.8452	1371
10	0.8481	1371
0	0.8528	1371

TABLE II

Honey with sugar(%)	Density (ρ)× 10^3 kg/m^3	Average ultrasonic velocity (V) m/sec
100	1.54	2031
90	1.50	2022
80	1.40	2013
70	1.49	2000
60	1.48	1991
50	1.47	1983
40	1.46	1970
30	1.45	1964
20	1.44	1952
10	1.43	1941
0	1.42	1933

increase of honey component in the mixture. Though the flavour and taste do not change even upto the adulteration level of 50%, ultrasonic velocity is found to be affected by addition of sugar in honey.

CONCLUSIONS

Ultrasonic studies have been made in various fluid foods for adulteration. The cases of edible oils and honey are presented here. On the basis of these findings, instruments can be developed for the detection of adulteration for better health care.

REFERENCE

1. Javanaud, C., "Application of ultrasound to food systems", Ultrasonics, (U.K). 1988, Vol.26, pp.117-123.
2. Yadav, S., Gupta, P.K.Singh, V.R., Parashar, D.C. and Rai, J. "Studies on adulteration in alcohols with ultrasound for forensic and other scientific applications, Acustica, 67 (1986) pp. 162-164.
3. Miles, C.A. Share, D. and Larglay, K.R. "Attenuation of ultrasound in milks and creams", Ultrasonics, Nov.1990, Vol.23, pp 394-400.