PREFACE

This thesis entitled “ULTRASONIC AND DIELECTRIC STUDIES ON SOME VEGETABLE OILS AND MIXTURES” reports the work carried out by the author under the guidance of Prof. M. Rangacharyulu (Retd.), Department of Physics, Acharya Nagarjuna University, in the field of thermoacoustic studies. These studies have extensive use in the studies of mixture behaviors as these help in the determination of many thermodynamic properties in addition to indicating the various types of interactions.

This dissertation contains the presentation of the work carried out by the candidate in the field of ultrasonic and dielectric studies since the last years.

The present study consists of the experimental and theoretical studies made on the Sunflower oil, Rice bran oil, Palmolin oil and soybean oil and

The mixtures
(i) Sunflower oil + Rice bran oil
(ii) Palm oil + Soyabean oil

Sunflower oil and Rice bran oil are proved to be good for health particularly to patients with heart problems and to those whose family history indicates that they are prone to have the high risk of catching heart problem in near future. The Palm oil and Soya bean oil are cheap and best culinary oils for middle class and lower middle class people. The combination of these reduces the cost of oil to affordable level and helps in improving their health. For convenience this dissertation is divided into five chapters.

First chapter provides introduction to the problem and a review of the existing literature on the subject.

Second chapter gives the theoretical background needed to understand the subject and to compute various parameters that can be computed based on the present study.

Third chapter deals with the experimental methods and other details on measuring density, viscosity and ultrasonic velocity at different temperatures. It
also give the principle and working of the ultrasonic interferometer used in the present work.

**Chapter Four** deals with the ultrasonic and dielectric studies made on the pure oils.

**Chapter Five** deals with the ultrasonic and dielectric studies made on the oil mixtures cited above. The results of the study of the mixture of two oils treating them as binary mixtures are presented and the results of the calculation of various parameters are presented.

The summary and conclusions drawn from the present study are reported in **Chapter six**. Towards the end of the dissertation in the follow up programme for the work incorporated in this dissertation is presented. The following are the highlights of the results obtained in the present study

**Conclusions**

**Ultrasonic and Density studies:**

From the ultrasonic studies it is observed that except 0.3RB, 0.5RB and 0.8RB concentrations, there are no abnormal changes in the properties of blends. So we can use the blends of Sunflower oil and Ricebran oil to get the advantages of both the oils instead of individual oils. Ricebran oil is supposed to be good for skin and Sunflower oil for heart. So using the blends we may get advantages of both the oils. 0.8RB+0.2SF have changes at higher temperatures. So this blend may not be good for frying food items.

Due to the lack of data on critical parameters of oils, these were estimated by the author from the data on individual oils and these data are used to estimate the densities and molar volumes of oils. The agreement between these with the observed values is found to be good. Similar results are obtained when calculations are made on Soyabean oil, Palmolein oil and their blends. The densities values calculated for Ricebran oil and Sunflower oil blends from Lund’s equation and modified Rackett equation is less than 1%. So the
theoretical estimation can be used to calculate the density of blended oils using their fatty acid contents.

The variation of blend density is more nonlinear in Soy+Palm blend when compared to SF+RB blends.

Using the Mc Clements & Powey values and Gouw and Vultger values for ultrasonic velocities of triglycerides we proposed the ultrasonic velocities for simple triglycerides at temperatures of experimentation and calculated the ultrasonic velocities for blended oils which are mixed triglycerides with the help of equation given by Javanaud and Radhalkar. The percentage errors are less than 1%. We may use Javanaud and Radhalkar formula or McClements and Powey formula for calculating ultrasonic velocities of blended oils, error% is less than 1%.

The ultrasonic velocities of Soyabean-Palmolein oil blends are almost same at different temperatures except for 0.5P+0.5S at higher temperatures. This is substantiated by the changes observed in adiabatic compressibility and acoustic impedance. From Molar sound velocity graphs we can say there is no strong association between molecules of blends from 303K to 333K except for 0.5P and 0.8P at higher temperatures. Also there is small decrease in R value with concentration at higher temperatures. May be the vibrations of molecular segments at higher temperatures in these blends is creating some weak associations between the molecules.

So by blending Soyabean oil and Palmolein oil, there are some changes in the intermolecular bonding observed from density changes, expansions and molar volumes. There is weak association between molecules in the blend at higher temperatures. So by blending Soyabean oil and Palmolein oil, the molecules are not forgoing their individual properties except 0.5P+0.5S. So we can use the Soyabean oil and palmolein oil blends to get the advantage of both oils like more shelf life for Palmolein and presence of essential fatty acids in Soyabean oil for body harmones.
Dielectric studies:

The dielectric constant and loss values of Sunflower oil, Ricebran oil, Soyabean oil, Palmolein oil, Sunflower oil+Ricebran oil blends and Soyabeanoil+Palmolein oil blends are studied in frequency range of 500Hz to 10MHz, in temperature range $30^0C$ to $60^0C$.

The dielectric constants of all oils and their blends investigated in present studies are having a constant value in kHz range of frequencies, which may be considered as their static dielectric constants at room temperature. The dielectric constant value is sharply decreasing with increase of frequency in mega hertz range. The dielectric losses are decreasing with increase of frequency in kHz range, and then taking minimum constant value for all the oils. Dielectric loss values are increasing with frequency in megahertz range. Some of the oils and their blends investigated in the study showed small negative dielectric loss values between 4MHz and 6MHz.

When the temperature is raised from room temperature i.e., $30^0C$ to higher temperatures, the dielectric loss values are increasing with frequency in kHz range, then showing a constant value and again decreasing in megahertz range. The dielectric loss values are increasing with temperature initially and then decreasing with further increase of temperature. The dielectric losses are high in 1.8kHz to 100kHz region once the oil is heated, with two relaxation peaks.

The dielectric constant values of Ricebran oil are more and palmolein oil has lesser values in the four oils investigated at all temperatures. So orientation polarization may be large in ricebran oil. The dielectric loss values of ricebran oil are less compared to other three oils. The dielectric constant values of Sunflower oil and Soyabean oil are almost equal since the major contents in these two oils are Linoleic acid. Palmolein oil relaxation times are more compared to other three oils. So we may conclude the oils having larger amounts of Palmitic acid like Palmolein have lower dielectric constant due to its larger viscosity. Oils having all the three, saturates, monounsaturates and
poly unsaturates, like ricebran oil, in considerable amounts have larger dielectric constant and lower dielectric losses.

When Sunflower oil is blended with Ricebran oil in different proportions, the dielectric constant values of blend in general are lesser than the individual oils. So orientation polarization is reducing by blending ricebran oil to Sunflower oil. These values are nearer to Sunflower oil values rather than Ricebran oil. So we may say the Linoleic content in Sunflower oil is influencing dielectric value of blend. The dielectric loss values of blends are more than the individual oil values. Blends are also showing two relaxation peaks. The general plateau region observed in the dielectric value with frequency is diminishing as the temperature of blends is increased. Some of the Ricebran-Sunflower oil blends are showing small negative dielectric losses between 4 kHz and 6 MHz regions.

When Soyabean oil is blended with palmolein oil in different proportions, the dielectric constant values are slightly higher than the individual oil values. So by blending unsaturated oil like Soyabean to saturated oil Palmolein the orientation polarization of blend molecules is increasing. When the blended oils are heated, the dielectric values of blends are lying between the values of two oils except 0.8Soyabean oil+0.2 Palmolein oil. The dielectric values are nearer to the Soyabean oil values. So the dielectric constant value is influenced more by the Linoleic content in the oil. The dielectric losses are more for blended oils in frequency range 1.6 kHz to 100 kHz than the individual oils except for 0.7Soyabean+0.3Palmolein oil blend and 0.9Soyabean+0.1Palmolein oil blend. When the blended oils are heated, the dielectric constant values are not constant in kilo hertz frequency range but changing with frequency. Some blends are showing small negative dielectric loss values in 4MHz to 6MHz region.
List of Publications

Papers Accepted:

1. The ultrasonic and density studies on Sunflower oil, Ricebran oil, Soyabean oil and Palmolein oil – BioScience Research Bulletin, Volume 28, No.1, June 2012 issue

Papers Communicated:


Papers to be communicated:

1. Ultrasonic and density studies on Ricebran oil, Sunflower oil and their blends
2. Ultrasonic and density studies on Palmolein oil, Soyabean oil and their blends
3. Dielectric studies on Sun flower oil, Ricebran oil, and their blends
4. Dielectric studies on Soyabean oil, Palmolein oil and their blends