



THE DIELECTRIC STUDY OF SOME EDIBLE OIL USING X-BAND MICROWAVE BENCH

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ABSTRACT

The dielectric study is carried out using X-band microwave bench with liquid cell. The frequency of 9.8 GHz is used for the study at temperature 220 to 260 C. The dielectric constant (ϵ') and dielectric loss (ϵ'') of each sample of all types of oils are determined by using X-band microwave bench. The results obtained for all edible oils are in good agreement with reported work.

Keywords: *Microwave X-band, Dielectric constant, Dielectric loss etc.*

1 INTRODUCTION

India is the leading oilseed producing country in the world. Some of the oilseeds grown in India are Groundnut, Mustard seed, rapeseed, sesame, linseed, soybean etc. Oilseeds occupy the second place after food grains as a farm commodity. They form an important export item. The various types of edible oil used for cooking the foods are mustard Oil, Safflower Oil, Sesame Oil, Groundnut Oil, Soyabean Oil, Sunflower Oil and Cotton seed Oil. The study of these oils is done by taking into consideration the importance of the oil in our diet and as the main energy source for human body metabolism. For consumption of edible oil as a food, it involves some precautionary measure such as purity of edible oil and its cardiovascular

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conserves. Vegetable oil is a necessary part of our diet. Oilcake (the by-product after the oil is extracted from oilseeds) is used as cattle feed and fertilizer. Oils like that of linseed oil are in great demand for industrial purposes such as lubricants, varnishes and paints. Oilseeds are the largest source of vegetable oils even though most oil bearing tree fruits provides the highest yields (eg. Olive, palm and coconut)(Gunstone,2002).

1.1 Importance of Edible Oils in Human Diet and Health.

Dietary fat rich in saturated fatty acids, particularly myristic (14:0) and palmitic (16:0) acids, is most notorious in raising plasma cholesterol. Milk, cheese, butter, ghee, beef, pork, mutton, skin of chicken (not flesh), coconut oil, palm oil, cocoa butter and hydrogenated fats (vanaspati) are rich in these fatty acids. On the other hand, vegetable oils such as corn, sunflower, soyabean and safflower oils are rich in the polyunsaturated essential fatty acid, linoleic acid (18:2). further, consumption of olive oil, consisting predominantly of monounsaturated fatty acid (18:1), is associated with lower incidence of CHD. Mustard oil resembles olive oil in composition while groundnut and sesame oils contain mono and polyunsaturated fatty acids in high proportion. Due to different fatty acids i.e. oils which are used in diet cholesterol are increased and increased cholesterol one of the cause of heart disease. Therefore it is necessary to study the dielectric properties of different oils.

Physical properties of liquids such as viscosity, density, dielectric properties and refractive index are the macroscopic properties of the liquid. These macroscopic properties are the statistical result of macroscopic properties of the liquid such as chemical composition, molecular structure, molecular bonds and the chain length of the chemical compound of the liquid. Many workers studied the dielectric properties of the various liquids of the interaction between the molecules from the liquid and the interaction with other molecules in the liquid mixture.

Prof. A. D.Vyas working on dielectric properties of some edible and medicinal oils at radio and lower microwave frequencies¹. Mathew T. working on dielectric relaxation studies of edible and medicinal oils at microwave frequency². Shilpi Agrawal and Deepak Bhatnagar worked on dielectric studies of binary mixtures of edible unsaturated oils³. From the statistical mechanics, several theories for the equilibrium properties of the liquid are developed. These different theories have been proposed for various types of liquids classified according to the forces present between the particles. The dielectric properties of the liquid are useful to some extent to understand the liquid structure and molecular interactions therein. The study of dielectric properties of various liquids is also useful in understanding the physical phenomenon which occur in dielectrics placed in an electromagnetic field and the parameters

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of dielectrics which quantitatively determine their electric properties. The dielectric properties and dependence of these properties on the compositions and structure of the substance and various external factors like temperature, humidity, intensity and frequency of an electric field etc. has been developed into an extremely important field of science.

We have undertaken the study of physical properties of saturated and unsaturated fatty acids which are make triesters. It has long chain of carbon atoms along with hydrogen atom. These fatty acids which are commonly known as a edible oils and is a main constituent of the human diet. In daily human diet oil is taken along with and is a part of food in food role of oil is very important. Food is fuel of the body and keeps our mind and body fit and working. Different edible oils such as soybean, groundnut, sunflower, safflower and mustard and sesame oil are used as a medium for cooking food atoms. Fats (solids) and oils (liquids) are esters of trihydroxy alcohol, glycerol and long chain carboxylic acid. They are called as fatty acids because they occur in fats which are stored in animals and plants. Fat contains saturated fatty acids such as palmitic acid $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$, stearic acid $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, while oil contains unsaturated fatty acid such as oleic acid $\text{CH}_3(\text{CH}_2)_7 - \text{CH} = \text{CH} - (\text{CH}_2)_7 - \text{COOH}$. The esters of fatty acids with glycerol are known as triglycerides.

1. Experimental Detail

In the present paper the dielectric study of Sunflower and cottonseed is carried out using X-band microwave bench with liquid cell. The frequency of 9.8 GHz is used for the study at temperature 22^0 to 26^0 C. The experimental readings are tabulated in tables 1, 2 and 3.

2. Result and discussion

The results are compared with the results obtained by Shilpi Agrawal et al¹. The results obtained in the present study are having higher magnitude i.e. that are also with good agreement with temperature dependence of dielectric constant i.e. the dielectric constant increases with decrease in temperature⁴⁻⁷. The values of (ϵ') and (ϵ'') obtained are in good agreement with the published results³. The dielectric constant of used oil is maximum than double filtered, single filtered and non-filtered oil samples⁸⁻¹⁰. The dielectric loss is maximum in double filtered oil than single filtered oil samples.

Table 1. Mean time of liquid flow, Density and Viscosity of Different Oils

Sr. No.	Type of Liquid	Mean time of liquid flow in (Sec)	Density	Viscosity
1	Sunflower	2972.50	0.8812	0.678
2	Cotton Seed	2159.00	0.9233	0.507

Table 2. Dielectric Constant and Dielectric Loss of Cottonseed Oil

Sr.No.	Samples	Dielectric Constant(ϵ')	Dielectric Loss(ϵ'')
1.	Double filtered	3.9611	0.9028
2.	Single filtered	3.2581	0.8628
3.	Non-filtered	3.3565	0.8774
4.	Used oil	3.1225	0.8423

Table 3. Dielectric Constant and Dielectric Loss of Sunflower Oil

Sr. No.	Samples	Dielectric Constant(ϵ')	Dielectric Loss(ϵ'')
1.	Double filtered	3.1590	0.8112
2.	Single filtered	3.2093	0.8555
3.	Non-filtered	3.5989	0.9918
4.	Used oil	3.5965	0.9015

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