Indian J.Sci.Res. 17(2):184-187, 2018
ISSN: 0976-2876 (Print)
ISSN: 2250-0138(Online)

QUALITY EVALUATION AND ANALYSIS OF EDIBLE OILS USING WAVEGUIDE METHOD

[1] R.Ashok, [2]M.Sundaram
[1] Electronics and Communication Engineering,Kamaraj College of Engineering and Technology,Madurai
[2]Electronics and Communication Engineering, VPMM Engineering College for Women, Krishnankoil

Abstract- Each ingredient has different absorption, dielectric constant and molecular structure in their corresponding atoms. Now days, quality of edible flour and liquid are evaluated by manual and bio chemical methods. Molecular structure and attenuation of Edible flour and liquid are changed during chemicals added to test sample and also these methods are time consuming one.In this paper, edible oil quality is evaluated by passing the millimetre wave through liquid dielectric cell filled with test sample and also this result is compared to bio chemical method. Waveguide method has less attenuation loss and also it is affected very less by environmental factor.

Keywords- Free Fatty Acid, Fiber Content, Dielectric Constant, Absorption loss.

I. Introduction

Nutrition is an essential one to all human beings and it helps to lead a disease free life. Hence analysing the quality of food becomes essential. Fiber is also known as roughage. It is the indigestible part of plant foods that pushes through our digestive system, absorbing water along the way and easing bowel movements**.** The fiber quality of food is analysed by estimating dielectric properties like attenuation factor. Various factors such as frequency, moisture content, bulk density, temperature, composition & concentration (density), structure and constituents, carbohydrate, both ash and protein content of food materials affect dielectric properties are also discussed and presented[1].

Dielectric properties of materials are those electrical characteristics of poorly conducting materials that determine their interaction with electric fields. These are the main parameters that provide information about how materials interact with electromagnetic energy. During heating by microwaves or high frequency electromagnetic radiations, many variables in food affect the heating performance. The most significant variable is the permittivity of the food, which describes how a material interacts with electromagnetic radiation [2].

The attenuation of the ultrasonic signal was affected by increased of oil concentration for all samples with different ageing time. The increase of attenuation may be attributed by the changes in composition of fatty acids. The mixtures with 20% and 40% oil have constant attenuation for values of ageing time greater than 4 hours. This fact indicates that ageing or adulteration of oils produce no changes in the value of ultrasonic attenuation with the increase of ageing time. The experimental results obtained in this work will be preliminary dates for a new method to investigate edible oils. The results obtained by attenuation of ultrasonic waves are confirmed by other methods like photoluminescence and gas chromatography [3].

Carbohydrate, Fat, Moisture content, Proteins and salt contents are the major components of food Materials. Protein has low dielectric activities at microwave frequencies [4]. There have been several attempts made to develop relationship between the dielectric properties and components of food, based on weighted averages of the dielectric properties of individual components [5-6].

The measurement of dielectric properties has gained importance because it can be used for non-destructive monitoring of specific properties of materials undergoing physical or chemical changes. Measurement of the dielectric properties of materials is finding increasing application as new electro-technology is adapted for use in the agriculture and food processing industries. A comprehensive overview of different measuring techniques can be found elsewhere [7].

Attenuation constant parameter is used to predict the oil content in fresh palm fruits [8]. At constant temperatures, dielectric constant and loss factor increase with decreasing frequency. Both dielectric constant and loss factor are low for flours at microwave frequencies as long as the water content is Low [9].

II.Materials and Methods

Oil samples and FFA values are collected from Vijay High Tech analytical lab, Virudhunagar.

A. Proposed Methodology

In Waveguide method technique**,** Reflex klystron is used as the source to generate microwaves in the range of 8 to 12 GHZ and it is followed by isolator which can protect the klystron source from signal reflection. Variable Attenuator is used to attenuate the wave if needed and it is

[1]**Corresponding Author**

followed by the frequency meter which is used to measure the frequency of the microwave. Liquid dielectric cell is filled with oil to be tested or waveguide is filled with test sample to be placed in between the slotted line section and variable microwave detector which has the crystal diode that is used to detect the microwaves. Digital storage oscilloscope is connected to the detector to view the output waveform. Thus microwaves are passed through dielectric cell or waveguide without placing the sample and the output waveforms are observed. The same process is repeated by placing various food samples inside the waveguide and readings are taken, tabulated and attenuation constant is calculated. By using this attenuation factor, dielectric constant, dielectric loss factor and penetration depth may be determined.

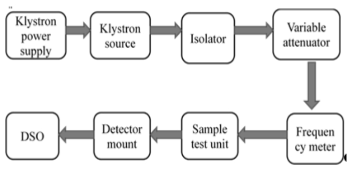

Figure 1.Experimental setup for Quality Evaluation

III.Equations

Attenuation constant

$$[\alpha] \text{ in dB} = 20\log\left(\frac{v1}{v2}\right) \quad (1)$$

v1=Forward voltage without sample

v2=Forward voltage with sample

Dielectric Properties

Dielectric constant

$$[\varepsilon'] = \left(\frac{\lambda 0}{2\pi}\right)^2 [\left(\frac{2\pi}{\lambda c}\right)^2 - (\alpha^2 - \beta^2] \quad (2)$$

IV.Results and Discussion

Attenuation constant and FFA value of different samples are analysed below.

Table 1.Attenuation constant for groundnut of different weight of samples.

	Weightage of Samples						
	Without sample	5mg	10mg	15mg	20mg	25mg	30mg
V_{max}	40mv	40mv	40mv	40mv	40mv	40mv	40mv
V_{min}	-3.2v	-1.16v	-940mv	-600mv	-340mv	-80mv	0mv
V_{pp}	3.24v	1.20v	980mv	640mv	380mv	120mv	40mv
Attenuation Constant[α]		8.63 dB	10.39 dB	14.09 dB	18.62 dB	28.63 dB	32.17 dB

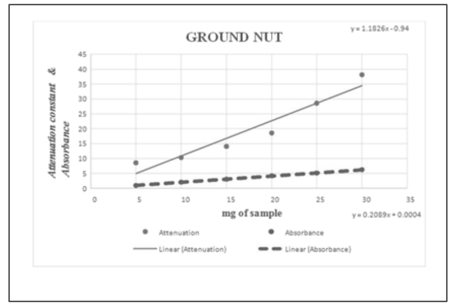

Fig.2.Attenuation constant & Absorbance vs. Weight age of Groundnut sample in mg

From the above Table 1 and Fig.2, the attenuation constant will increase when weight of the samples has been increased.

Table 2. Attenuation constant of various level groundnut seeds

Sample Variety	FFA (data from Industry)	Attenuation Constant(dB)				Oil Content
		Normal samples	Filtered samples	Roasted samples	Roasted &Filtered samples	
Full Fledged nuts	.19	7.918	9.12	8.45	8.82	Comparatively high
Partially Growned nuts	.20	6.518	7.23	8.91	8.84	High
Immature nuts	1.91	5.11	5.12	8.72	8.07	Low

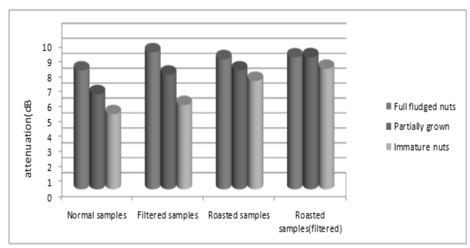

Figure 3.Attenuation for different types of groundnut seeds

From the above Table 2 and Fig.2, full-fledged nuts has more oil content and less ffa value than partially grown nuts and immature nuts.based on ffa and attenuation constant, oil of full fledged nuts has high quality than other two remaining nuts.

Table 3.Attenuation constant of various sesame seeds

Sample Variety	FFA(data from Industry)	Attenuation Constant(dB)				Oil Content
		Normal samples	Filtered samples	Roasted samples	&Filtered samples	
Black seed	0.7-0.8	28.89	3.712	7.952	9.531	Comparatively High

White seed	1.8	28.08	2.654	6.541	5.241	High
Red seed	>Black seed and white seed	27.46	1.344	5.162	3.124	Low

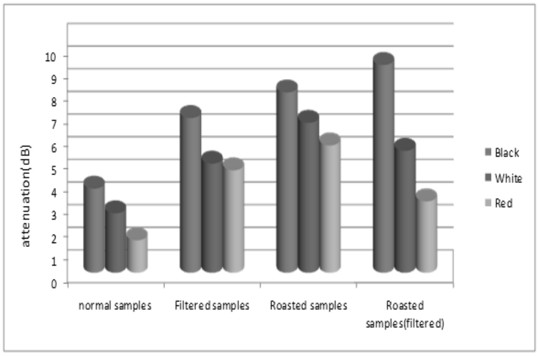

Figure 4. Attenuation for different types of ordinary sesame seeds.

From the above Table 3 and Fig.4, Black seed has more oil content and less FFA value than white and red seed; based on FFA and attenuation constant, Black seed oil has high quality than other two remaining seeds.

Table4.Attenuation constant of various sambandhi sesame seeds

Sample Variety	Attenuation Constant(dB)				Oil Content
	Normal samples	Filtered samples	Roasted samples	Roasted &Filtered samples	
Black seed	30.1750	8.1497	9.5424	10.0120	Comparatively high
White seed	29.3472	6.2115	7.2635	9.5710	High
Red seed	28.8361	5.6509	6.6198	8.0738	Low

Figure 5.Attenuation for different types of sambandhi sesame seeds.

From the above Table 4 and Fig.5, Black seed has more oil content than white and red seed; based on attenuation constant, Black seed oil has high quality than other two remaining seeds.

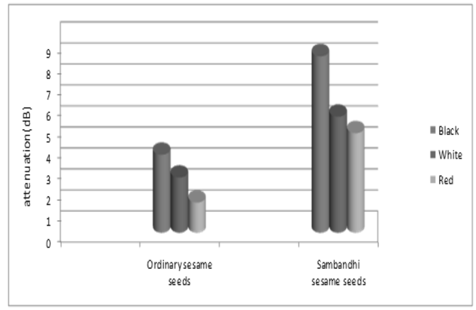

Figure 5. Attenuation for ordinary and sambandhi sesame seeds.

From the above figure, Sambandhi sesame seed has more attenuation and absorbance than ordinary sesame seed and result shows that sambandhi sesame oil's quality is more.

V.Conclusion

In this paper,Waveguide method is adopted for our testing.This is one of the easiest method when compared to the other methods and also it is a better time saving method than Bio chemical method.The results of bio chemical method is used to analyse the waveguide method results for food quality prediction.In wave guide method,attenuation constant is estimated without chemicals but chemicals are used in Bio chemical method to evaluate the quality of oil.A full-fledged seed of Groundnut and sesame has high quality than partially grown and Immature seeds. The attenuation constant for the black sesame seed is higher than white sesame seed and red seed.This indicates the oil content in the black sesame seeds is higher than white and red seeds. The filtered ordinary black sesame seeds has lower attenuation constant than filtered sambandhi black sesame seeds. This shows that the oil content in ordinary sesame seeds is lesser than the sambandhi seeds and also these waveguide methods are compared with bio chemical methods.This result shows that attenuation constant and FFA values are related to each other.

References

[1] Shyam Narayan Jha , K. Narsaiah , A. L. Basediya ,Rajiv Sharma ,Pranita Jaiswal ,Ramesh Kumar and Rishi Bhardwaj "Measurement techniques and application of electrical properties for nondestructive quality evaluation of foods"—a review, J Food Sci Technol (July–August 2011) 48(4):387–411.

[2] Nidhi Bhargava1, Ritu Jain1, Ila Joshi2 and K.S. Sharma1 "Dielectric Properties Of Cereals At Microwave Frequency And Their Bio Chemical Estimation" International Journal of Science, Environment and Technology, Vol. 2, No 3, 2013, 369 – 374.

[3] Aurel Pasca, Dorin Dădârlat " Study Of Edible Oils adulteration By Ultrasonic Attenuation"-

Paper presented at the 7th International Balkan Workshop on Applied Physics, 5–7 July 2006, Constanþa, Romania. Rom. Journ. Phys., Vol. 52, Nos. 5–7, P. 641–644, Bucharest, 2007.

[4] Sahin, S. and S.G. Sumnu (2006), Physical properties Of foods.173.

[5] T.Kudra, G.S.V. Raghavan, C Akyel and R. Bosisio F.R.van de Voort (1992) "Electromagnetic properties of milk and its constituents at 2.45 MHz" International Microwave Power Institute Journal, 27(4), 199-204.

[6] Sun E, A. Datta and S. Lobo (1995) **"**Composition-based prediction of dielectric properties of Foods" J Micro Power Electromagnetic Energy. 30(4), 205-12.

[7] M.S. Venkatesh and G.S.V. Raghavan, "An overview of dielectric properties measuring techniques", Journal of Canadian biosystems engineering, vol.47, 2005.

[8] SutthaweeSuwannarat, ThanateKhaorapapong and MitchaiChongcheawchamnan "Predicting Oil Content of Fresh Palm Fruit Using Transmission-Mode Ultrasonic Technique" World Academy of Science, Engineering and Technology Vol5, 2011

[9] Kent M, Kress-Rogers E (1987) The COST 90bis collaborative work on the dielectric properties of foods. In Physical Properties of Foods. 2. COST 90bis Final Seminar Proceedings, eds