INVESTIGATION OF DIELECTRIC PROPERTIES OF PURE AND INSECTICIDE TREATED RICE SEEDS PUSA

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Abstract: The dielectric properties of Pusa rice seeds were determined insecticide treated and untreated rice seeds. The measurements were carried out with the help of Impedance gain phase analyser HP 4194 A and for maintaining the temperature of prepared samples a micro controller, Julabo F 25 was used. The investigation reveals that dielectric constant and dielectric loss both, treated in the ranges of 2-10% for moisture content, and 3–7 Hz for frequency of applied electric field using a coaxial capacitor sample holder. Effects of the parameters such as moisture content, bulk density and frequency on the dielectric properties were investigated. The dielectric constant, loss factor and conductivity were greatly affected by the moisture content, The moisture content was the most significant factor affecting the dielectric properties of rice seeds. The dielectric constant, loss factor and conductivity increased with insecticide treated rice seeds with some noticeable changes.

1. INTRODUCTION- The dielectric properties of grain and seeds became very important as there was an increase in the application of microwave energy for grain drying, insect control, seed treatment to improve germination and moisture measurement[1]. The dielectric properties of seeds and grains are influenced by so many factors i.e; frequency of the applied alternating electric field, moisture content, temperature, bulk density constituents of food material, ionic nature, structure, concentration etc[2]. Insects leaves adverse effect on grain storage, handling and processing. Losses during storage could be classified as quantity losses and quality losses. Quantity losses occur at the time of the grain is consumed by insects, rodents, mites, birds and microorganisms. Quality losses are reflected as reduced economic value of the crop. Infestation of grain by insects is generally controlled using insecticides. Among the physical, chemical and biological control methods, the chemical method is extensively used to control insects[3]. Insecticides are agents of chemical or biological origin. Lots of work have been done regarding the insect control by other researchers. Due to the destruction of the grain germ by insect feeding, infested grain undergoes rapid germination loss[3]. The dielectric properties of adult insects of the four stored-grain insect species (rice weevil, red flour beetle, sawtoothed grain beetle, and lesser grain borer) measured in the investigation were all similar, although the sawtoothed grain beetle had usually higher dielectric constants than the other three species. Hence, there is furthermore search for an alternative method for controlling insects in stored grain[4].

2. MATERIALS AND METHOD

2.1. MATERIALS - The rice seeds (Oryza sativa L.) used in this investigation were purchased from a local market of Lucknow, U.P., India., Insecticide In this research Diflubenzuron insecticide is used. It is a benzamide insecticide utilized on forest and field crops to combat the problem of insect and parasites. Dieflubenzuron is having a Chemical Name:- N-[{(4-chlorophenyl)amino}carbonyl]-2,6-diflurobenzamide, Chemical Class:– benzamide insecticide, Solubility in Water.:- 0.08 mg/l, Solubility in other Solvents:- DMSO 12g/100g, Acetone 0.615g/100g, Methanol 0.09g/100g, Melting Point:- 230-232 °C, Vapor Pressure 9×10^{-10} mm Hg and having partition coefficient of 5,000 (octanol/water).

2.2. Sample preparation for pure seeds

Before performing the experiment, the seeds were cleaned manually to remove foreign matter like dust, dirt, stone and chaff. The moisture content were determined by wet basis. The different moisture content were adjusted by adding distilled water and conditioning of the samples at 22°C. The rice seeds were adjusted to frequent agitation to aid uniform moisture. These were kept in sealed jars at 22°C and allowed to reach at room temperature in sealed jars before opening for experiment. The samples were kept under this condition for about 24 hours before the measurements were taken.

2.3. Sample preparation for insecticide treated seeds

In present study treatment was done at the rate of 250 gm per quintal of seed with the help of slurry treatment method. The slurry treatment method is the most common method and is being used in treatments of various coarse-cereal seeds. In this method, the insecticide was put into the seed in soup-like insecticide-water solution. Further procedure is same as pure seeds sample preparation.

2.4. Experimental procedure

The numerical values are obtained with the help of impedance/gain phase analyser (model No. HP-4194A, frequency range 100Hz to 40MHz) using a coaxial cylindrical capacitor.The sample holder has been silver plated to minimize the dissipation losses. It was calibrated by using standard liquids (Benzene and Methnol) and error in measurement for dielectric constant (ε') was almost 1% and for dielectric loss(ε'') was 1.5%. The formulae for the measurement of dielectric constant and dielectric loss have already been published by other researchers(5, 6-14).

3. Result and discussion

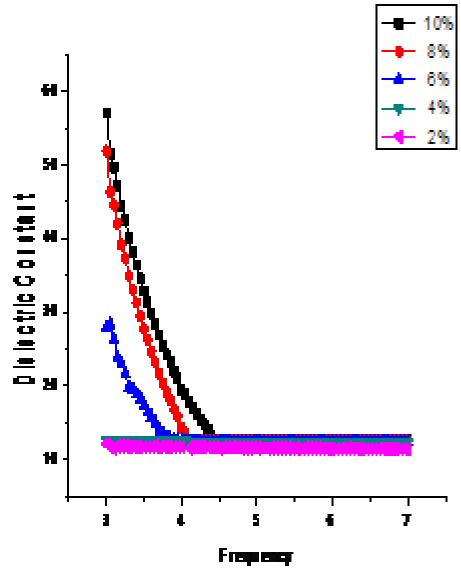

Fig.1: Variation of dielectric constant with different frequencies at indicated moisture content of Pusa rice varieties.

Fig. 1 represents the typical variation of dielectric constant (Ɛ′) of Pusa rice with frequency at different percentage of moisture content. The figure 1 represents that dielectric constant decrease with increase in corresponding frequency which shows the dielectric dispersion in the material. High values of dielectric constant are obtained at low frequency region conversely high moisture content attributed to high mobility of dipoles arising from the water molecules along with electrode polarization

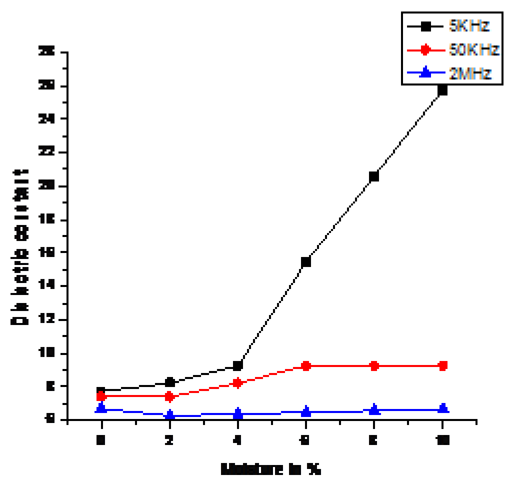

Fig. 2: Variation of dielectric constant with different moisture content at indicated frequencies of different rice varieties.

From the graphical representation of Fig.2, it is observed that dielectric constant increases with increase in moisture level at given temperature and different frequencies. The rate of increase of dielectric constant with moisture content is high at low frequencies noticeably at 5KHz and 50KHz. This is evident from the fact that more water dipoles participate in the polarization, due to the high water mobility, the water dipoles easily follow the applied field variations, meaning that moisture variation has a significant role to play in dielectric property. At low moisture content particularly below 2% dielectric constant of the permittivity found small. This is because the strong bound water state (monolayer) in which distance between the water molecule and cell wall is very small and attraction force is very large. Therefore, primarily the dielectric constant are found small but as the moisture level increase more than 4% the dielectric constant of the complex permittivity accelerates and this tendency could be attributed to change of bound water state from first (monolayer) to second (multilayer) type. Steady increase is observed for all the frequencies for the high moisture content, particularly at the 4% and frequency 50 KHz. This behavior could be attributed to the transition of bound water state second (multilayer) to third (osmotic tension) type or free-state water. (5, 9, 12)

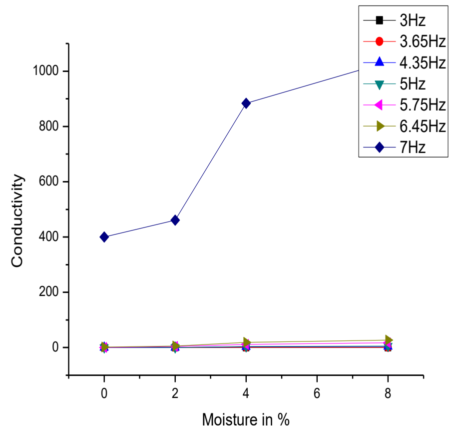

Fig.3: Variation of conductivity with different moisture content at indicated frequencies of Pusa rice varieties.

Fig. 3 shows ac conductivity of Pusa rice seeds as a function of moisture changes. There is positive correlation between conductivity and moisture content. increase in ac conductivity, perhaps, is as a result of ionic conduction as more water molecules are free to oscillate at higher moisture level. The graph implying that moisture content is highly influential to the variation of ac conductivity in Pusa rice seed.

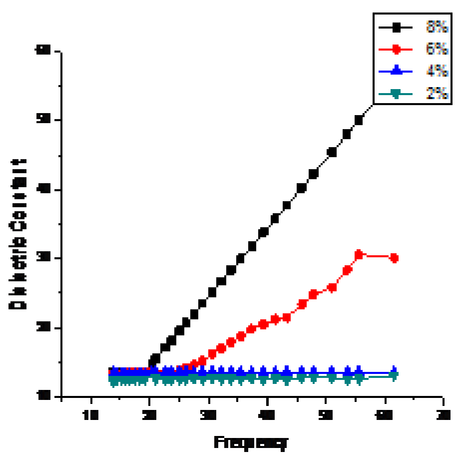

Fig.4: Variation of dielectric constant with different frequencies at indicated moisture content of Pusa rice varieties at 0.50ppm concentration.

The Fig. 4 shows variation of dielectric constant with frequency at 0.50ppm insecticide treated rice seeds. It is inferred that dielectric constant increases steadily at 6% moisture content and above at all frequencies. The magnitude and increase in dielectric constant is highest when moisture of the seeds is 8%.

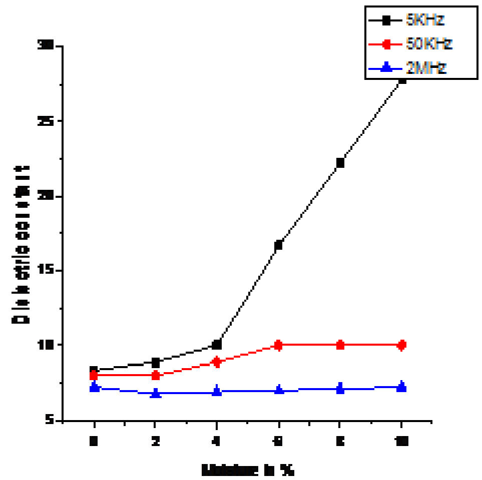

Fig.5: Variation of dielectric constant with different moisture content at indicated frequencies of Pusa rice variety at 0.50ppm concentration.

As demonstrated in Fig. 5 that a significant difference between pure and insecticide treated rice seeds dielectric constant gives higher values for insecticide treated rice seeds but nature of graph is similar as pure rice seeds. Separation between the curve is observed greater than insecticide treated rice seeds. It means its nutritional values and other properties remains preserved only sustaining capacity increases. Measurements are taken at upper, middle and lower frequency range. Dielectric property gives significant variations at lower frequency range due to inverse relationship.

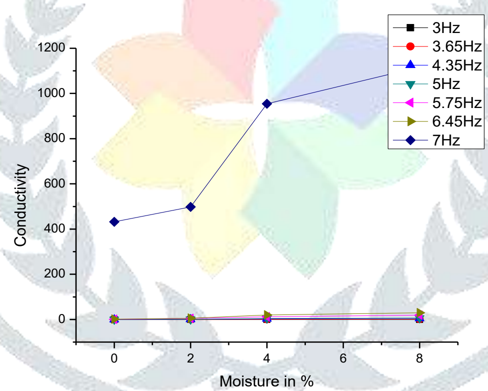

Fig.6: Variation of conductivity with different moisture content at indicated frequencies of Pusa rice varieties at 0.50ppm concentration.

From the Fig. 6 it is clear that ac conductivity of Pusa rice seeds increases towards the increase of moisture changes. Due to the reason of ionic conduction as more water molecules and insecticide molecules contribute to oscillate at higher moisture level. The graph indicates that moisture content is highly effective to the variation of ac conductivity in Pusa rice seed. Insecticide concentration increases conductivity without harming the host material.

Conclusions

Following conclusions are drawn from the present investigation:

-Dielectric constant of rice seeds decreases with increase in applied frequency.
-Dielectric constant of insecticide treated rice seeds increases with increase of frequency.
-Dielectric constant increases with increase of moisture content present in rice seeds.
-Dielectric constant of insecticide treated rice seeds increases with increases in moisture content.
-Conductivity increases with increase of moisture content and insecticide concentration.

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