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Short Communication

Detection of Defect and Adulteration in Food Products Using Microwaves

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For Detection of Defect and Adulteration in Food products like Milk, Honey, Edible Oils (Liquids) Vegetables, fruits and Powders, we can use the method of measuring electrical properties of the material that includes Dielectric Constant of the Pure and Adulterated Food product, the Microwave Temperature and the Scattering Coefficient of the pure and Adulterated Food Product.

Out of these three methods the method using Scattering Coefficient cannot and should not be used as in the case of measuring scattering coefficient we have to Expose the Food product to Microwave Radiation that is Harmful for the food Product. This may change the quality of original food Product.

Thus we have now two methods available to us for detection of Defect and Adulteration in Food Product they are Dielectric Constant method where we compare the Dielectric Constant of Pure and Adulterated Food Product and thus generate a comparative Table of the Values of the storage factor and loss factor From this Table one can detect the Defect and Adulteration in the food Product and if required then this method can indicate the percentage of Adulteration.

Another method is to measure the Microwave Temperature or the Brightness Temperature TB of the Food Product. This TB is the parameter that is obtained because of the fact that all materials radiate energy that is Self emitted radiation that depends on the Physical Temperature TP and the emissivity 'e' of the material that is function of Dielectric Constant of the material. Thus we measure Microwave Temperature or the Brightness Temperature TB of the material at the suitable Microwave Frequency that has to be determined by Experimentation.

For measurement of Brightness Temperatures TB at the Microwave Frequency we use the Sensor known as Microwave Radiometer. This Sensor receives the self emitted radiation and works as a Highly Sensitive Receiver and amplifies the received radiation and converts in Voltage and we monitor Voltage that is Function of the self emitted radiation received by the Microwave Radiometer and that depends as said earlier on the Dielectric Constant of the Food Product that is function of the quality of Food Product that depends on level of the Adulteration.

For Detection of Defect and Adulteration in Food products a very important parameter that is depth of penetration that microwave sensor can achieve and can detect the Defect in Vegetables and Fruits without cutting the food product. Thus this unique capability of microwave sensors operating in microwave frequencies can be utilised for detection of internal defect in vegetable like potatoes that may be having cavities in the potatoes that are not visible and even the surface of the potato does not give any indication of the presence of defect inside the potato is detected by the microwave Sensor NO other Sensor can detect this type of defect. Similarly in case of Apple, the Apple is defective inside but there is no indication of the defect on the surface of Apple. For such situations to detect the defect inside the Apple without cutting we can use microwave Sensor and scan the surface of the Apple and if there is a defect at certain depth inside Apple from interior of the surface to the centre of Apple that defect will be detected by the microwave sensor.

This is possible because Microwaves can penetrate the materials and the depth of penetration is Function of the Dielectric Constant of the material. and frequency, at which the Microwave Sen-

sor is operating.

Thus the microwave sensor (Radiometer) that will receive the Self emitted radiation starting from the centre of Vegetable and Fruit and integrated emission up to surface will be measured by Microwave Radiometer. The emission depends on Physical Temperature (TP) and the emissivity (e) of the material. The received emission will be in terms of Microwave Temperature that is Brightness Temperature (TB). Thus we have Relation TB = eTP The emissivity (e) is related to Dielectric Constant of the material. Thus the Brightness Temperature TB) will vary depending upon the emissivity of the material at fixed Physical Temperature. That variation in TB will indicate the variation in Dielectric Constant of the material at Fixed physical Temperature (TP) and that will give indication of internal defect when compared with the TB of Non defective Food Product Thus we will get information about defect in Food product like Potatoes and Apple without cutting the Vegetables and fruits.

The methodology to be adopted for Detection of Defect and Adulteration in the Variety of Food Products we have to generate the calibration Table and Chart by measuring Dielectric constant of Pure Food Products and measuring TB in terms of Voltage at the output of Microwave Radiometer at selected Microwave Frequency. Then we have to measure these Parameters for Defective and Adulterated Food Products and compare the data obtained from these Food products, with the calibration Table and chart of the Pure Food Products, Thus we will be able to Isolate the Defective and Adulterated Food products by utilising these methods and Techniques using the Electrical parameters of the Food products like Dielectric constant of the material and the Emission at Microwave Frequencies.

These are Non Destructive Methods for Detection of Defect and Adulteration in Food Products. For detection of Defect and Adulteration in Liquid, Powder Food Products and also in Vegetables and Fruits one can use the microwave Remote sensing methodology that includes the measurement of Dielectric Constant of the Food Product and thus measurement of Brightness Temperatures TB in terms Voltage and detect defect in Vegetables and Fruits and Detect the Adulteration in Liquid and Powder Food Products.

For the detection of Defect and Adulteration we have as a FIRST step to make the selection of the frequency within 1 GHz to 30 GHz that has best correlation with the Detection of Defect and Adulteration in Food products, there are Four Types of Food Products under consideration they are Liquids, powders Vegetable and Fruits. Thus one has to make selection of frequency that has best, Corelation to the Defect and Adulteration in Food Products like Liquids, powder, Vegetable and Fruits.

Each of these Food products may have separate and different Frequencies having better correlation with the variation of Defect and Adulteration in different Food products that will include the Liquids, powders, Vegetables and Fruits.

Thus First step is to generate Data Base of the Variation of Dielectric constant with variation in Amount of Defect and Adulteration in the Food products like Liquids, powder, Vegetables and Fruit.

This data base will be generated at different Microwave Frequencies and from this data base one will be able to make the selection of Frequency that will give best correlation for maximum Number of data points for each Food Product.

From this data base the frequency will be Selected for measurement of the parameter Dielectric constant that will then be used to provide the level of Defect and Adulteration in different Food products.

Then one can use the same selected frequency for development of microwave Radiometer that will be used for detection of defect and Adulteration in Food Products like Liquid, powder, Vegetables and FRUITS by measuring self emitted radiation in terms of Voltage that is related to Microwave Temperature (TB).

The Microwave Radiometer can be used for Detection of Defect and Adulteration in the Food Products of All Types that have been mentioned.

One has to make selection of Frequency for each food product like Liquids, powder, vegetables and fruits. For this we have to make measurement of the dielectric constant that will provide storage factor and the loss factor. The frequency that gives best values of storage factor and loss factor will be selected for development of microwave Radiometer.

Also for final Selection of Frequency for Development of microwave Radiometer the Assembly of microwave Radiometer will be made using available components. This assembled Microwave Radiometer also will be used for measuring the emission of microwaves at different Frequencies that has been used for measure-

ment of Dielectric constant that is storage factor and loss factor. The results of Both measurements will be compared and the selection of Final Frequency to be used for detection of Defect and Adulteration will be made for Food product that is Liquid, powder Vegetables and Fruits.

After finalising the Frequency for each Food Product that is Liquids, powders, vegetables and Fruits the Radiometer at the selected Microwave Frequency has to be developed. The developed microwave Radiometer will be portable so that it can be used in the field and using this microwave sensor (Radiometer) the Defect and Adulteration in the Food products that are Liquids, powder, Vegetable and fruits will be monitored and thus we will be able to realise this without disturbing, without physically spoiling the Food Products. This method of detecting the Defect and Adulteration in Food products like Liquids, powders, vegetables and fruits is unique and safe in all respect because this method does not, disturb the food product,

We should develop this method, using microwave Technology for detection of Defect and Adulteration in food products like liquids, powder vegetables and fruits.

This is harmless for the user as well as for the food products.