# Milk Adulteration Test using Microstrip Patch Antenna


| Saurabh Desai | Amit Kushwaha | Nitesh Khake | Jatin Pendharkar |
|---|---|---|---|
| Dept of Electronics & Tele Engg | Dept of Electronics & Tele Engg | Dept of Electronics & Tele Engg | Dept of Electronics & Tele Engg |
| Mumbai University | Mumbai University | Mumbai University | Mumbai University |
| Mumbai, India | Mumbai, India | Mumbai, India | Mumbai, India |
| saurabhdesai013@gmail.com | amitrk619@gmail.com | niteshkhake1996@gmail.com | jatinyp7@gmail.com |

Prof.P. N. Sonar
Dept of Electronics & Tele Engg
Mumbai University
Mumbai, India
Poonam.sonar@mctrgit.ac.in



***Abstract*—The paper presented, is based on the project that aims to design a microstrip patch antenna for testing whether the milk is adulterated or not by using the relation between the resonant frequency of the patch antenna and the dielectric constant or permittivity of the superstrate .The relation is that the resonant frequency is inversely proportional to the dielectric constant or permittivity of the sample placed on the antenna. In this project we use Inset feed Technique for feeding the antenna.**



**Keywords— Microstrip patch antenna, substrate, permittivity, dielectric constant, adulterated samples.**


## I. INTRODUCTION

In early days we found many problems related to milk Adulteration and some countries are at higher risk as they do not have proper monitoring and policies for the same. There was a case in China named Chinese milk Scandal in the year 2008. In which the milk was adulterated by adding milemine which gives the protein appearance in milk and it lead to health hazards in China after which W.H.O and many other organization started making policies and started monitoring such cases .Nowadays the existing technology is spectroscopy which is costly and the machine model is bulky.So the proposed paper is based on the project that aims of designing a microstirp patch antenna for detection of adulterants in the milk. The antenna work on the principle that the resonant frequency of microstrip antenna sensor is inversely proportional to the sampled placed on it. Thus from microstrip patch antenna it is detected whether the milk is adulterated or not. This antenna is designed by using the high frequency simulation software (HFSS) by following a procedure in the simulation software a required design for resonating frequency is achieved .[1][2].

## II. METHODOLOGY.

HIGH FREUENCY SIMULATION SOFTWARE.

There are 4 steps for Designing the microstrip patch Antenna
1.Calculating the dimensions of the Antenna using various formulas for the desired resonating frequency.
2.once the dimension is achieved then we perform designing of the antenna using the dimensions calculated on the HFSS .
3. Providing inset feed to the antenna
4. if the desired frequency is not achieved then we have to make slots on the antenna and move the location of the slots on the antenna unless the resonating frequency is achieved [3].

INSET FEED TECHNIQUE.

It is a type of microstrip line feeding technique, in which the width of conducting strip is small as compared to the patch and has the advantage that the feed can provide a planar structure. The purpose of the inset cut in the patch is to match the impedance of the feed line to the patch input impedance without the need for any additional matching element. This can be achieved by properly adjusting the inset cut position and dimensions.

| Feeding technique | S11 parameter(db) | VSWR(db) | Reflection gain(db) |
|---|---|---|---|
| Microstrip line | -2.644 | 16.390 | -20.839 |
| Coaxial feed | -3.686 | 13.594 | -19.147 |
| Inset feed | -7.263 | 8.059 | -15.860 |

A comparative study between differentfeeding techniques for a Rectangular Microstrip Patch. Antenna is done. The microstrip line feeding, inset feeding and coaxial probe feeding are compared on the basis of the Radiation Pattern, VSWR, Reflection gain and S-parameter.

The simulation of the Microstrip Patch Antenna for the three feeding techniques is performed on High frequency simulation software(hfss). The comparison of feeding techniques shows that the Rectangular Microstrip Patch Antenna with the Inset Feed has the highest gain, lowest VSWR and return loss for the dielectric material FR4 at a specific frequency of 1.9GHz. Thus it states that inset feed provides better impedance matching than the co-axial feed and microstrip line feed[6]. Antenna is fabricated of FR4 substrate with copper used for patch .Also a SMA connector is soldered at the edge of the inset feeding line.[4][6]

Testing

Testing is performed by using Vector Network Analyzer once we connect our Antenna to the VNA checks it return loss ,Resonant Frequency and S11 parameter. Now we perform testing of milk with number of samples starting with the pure milk. We dip the antenna in the pure milk sample and note the reference resonant frequency. The frequency at which it resonant frequency is for pure mik.Now we add various adulterants like flour, Protein powder ,Chalk powder and Soda and note down the change in Frequency .

## III. Proposed Antenna

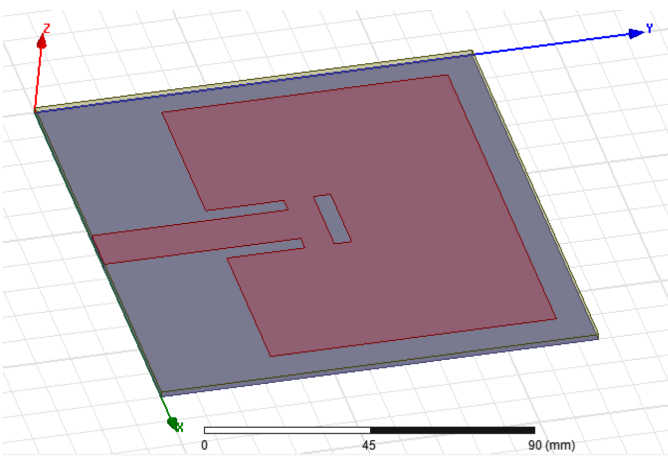


Fig .2

## IV. Results

The resonant frequency is measured by varying the permittivity of the samples.The observation obtained is obtained from the simulation is shown in the table .

Expected outcomes

Small size :10x8cm

Frequency within 700 to 867Mhz

Return Loss : less than -10db

- Calculation of antenna design parameters

| Parameters | Dimensions | Unit |
|---|---|---|
| Dielectric constant | 4.4 | - |
| Thickness | 1.6 | Mm |
| Resonant Frequency | 866 | Mhz |
| Length | 82.34 | Mm |
| Width | 105.3 | Mm |

The results of the simulation is as per the expectation. The S11 plot which is the reflection coefficient shows a good plot. Its value at the resonant frequency goes up to -40dB which is good enough. The present project is concern with the result in the form of S11 plot whereas other parameter does not affect the aim of the project. The gain measured in simulation is very low but does not affect the aim of the project as the microstrip antenna is used as a sensor rather than for communication purpose. The reason for the less gain may be the miniaturization. The simulation results is shown in the table 2

- Simulation Results.

| Permittivity of milk | Resonant Frequency(Mhz) | S11(db) |
|---|---|---|
| 1.8(pure milk) | 863 | -29 |
| 1.9(adulterated) | 862 | -29.5537 |
| 2.0(adulterated) | 843.2 | -21.3289 |
| 2.2(adulterated) | 842.2 | -20.5619 |
| 2.3(adulterated) | 841.2 | -19.9751 |

TESTING RESULTS

For the testing of the proposed project three samples are made and powder used for adulteration for that are wheat flour. The sample S1 is non-adulterated sample of milk. Sample S2 is adulterated sample of milk with water. Sample S3 is adulterated sample of milk with wheat flour Sample S4 is adulterated sample of milk with whey. As the adulteratants are added in the milk sample we notice shift in the frequency and the return loss of the antenna

Designed antenna resonates at 738 Mhz .

- Testing Results.

| Adulterant | Resonant Frequency(Mhz) | S11(db) |
|---|---|---|
| Pure Milk | 732.0833 | -19.33 |
| Water | 720 | -16.77 |
| Flour | 738.583 | -25.32 |
| Whey powder | 751.25 | -21.37 |

- Simulation result

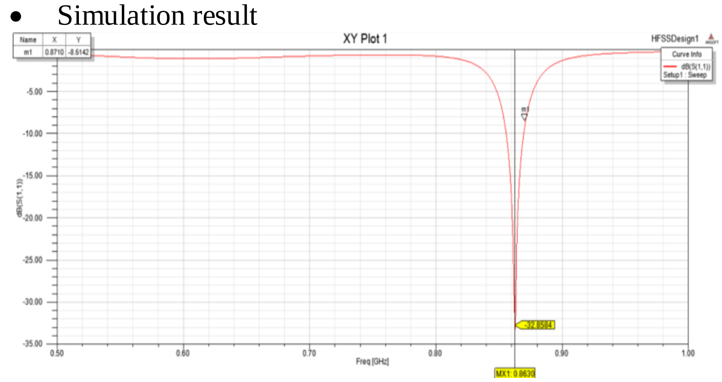


Fig .3.Simulation output.

- Cutoff frequency = 863MHz
- Return loss (S11) = -32.85dB

- VSWR = 1.05
- Impedance = 50.09 ohm


Fig .4. VSWR

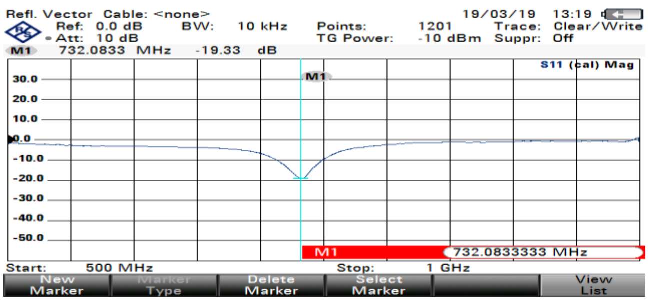


Fig 3. Pure milk

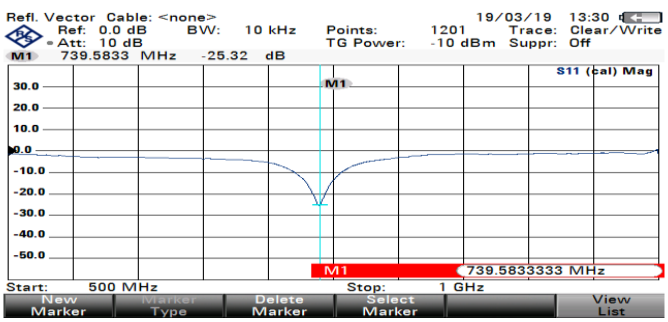


Fig 4. Milk with water.

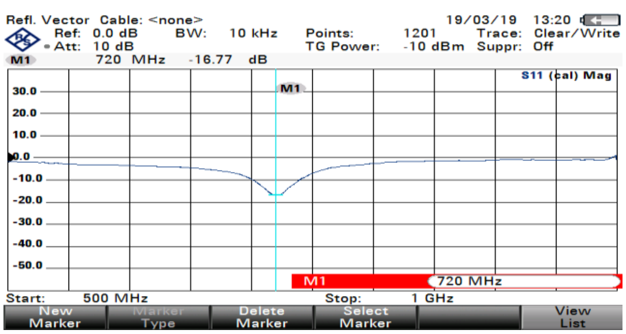


Fig 5 Milk with flour.

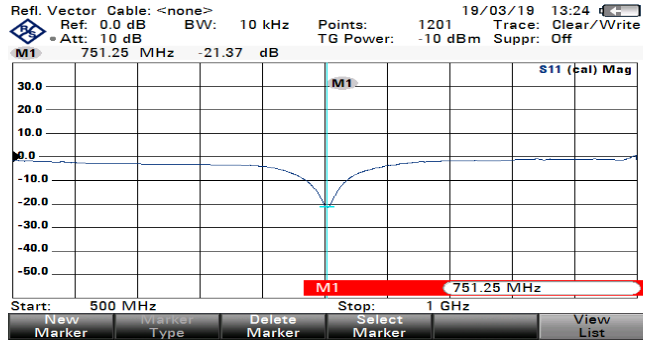


Fig 6. Milk with whey protein powder.

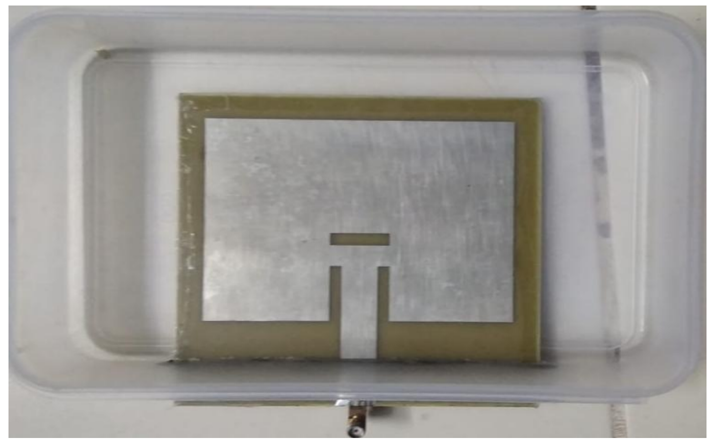

Fig .7. Designed Antenna

## V. CONCLUSION

By using the microstrip patch anten whether the milk is adulterated or pure by observing the shift in the resonant frequency when we dip the antenna in different pure milk and adulterated milk samples. Summarizing the results obtained and discussion, The relation between the permittivity of milk is inversely proportional to the resonant frequency. As the adulterants are added in the milk the resonant frequency falls of 100khz to 1Mhz with 0.1 rise in the permittivity of sample. We used inset feeding technique as it gives highest gain, lowest VSWR and return loss for the dielectric material FR4 and also it has better impedance matching than co axial feed and microstrip line feed. Using a microstrip patch antenna with inset feeding technique for testing the adulteration in milk is cheaper than the existing technology NIRS (near Infrared Spectroscopy) also the algorithm for NIRS is too complicated.

ACKNOWLEDGEMENT

It is our privilege to release the feelings of several persons who helped us directly or indirectly to conduct this project work. We express our heartfelt indebtness and owe a dep sense of gratitude to our subject teacher Prof. Nazahat Balur and Prof. Poonam Sonar, Project Cordinator Prof. Satish Bhoyar Head of the Department Prof. S.D.Deshmukh and all my friends who helped us in preparing the project.

## VI. REFERANCES


[1] Mirjana Bogosanovich, "Microstrip Patch Sensor for Measurement of the Permittivity of Homogeneous Dielectric Materials," IEEE Transactions on Instrumentation and Measurement, Vol. 49, No. 5, pp. 1144-1148, October 2000.

[2] V. Jitendra Murthy, 'Study of dielectric properties of adulterated milk concentration and freshness', 2007 IOP conf. ser:: Mater. Sci. engg.

[3] Momin adnan anis, 'Design of microstrip patch antenna for detection of adulteration in milk powder' IEEE paper 14DET94, February 2017.

[4] Jaget Singh, 'Inset Feed Microstrip Patch' IJCSMC, Vol. 5, Issue. 2, February 2016.

[5] S. Shaheen et al. ,"Design of PIFA Antenna for medical applications", IJET ,VOL 5, No.1,pp. 127-132, Feb-Mar 2013.

[6] Anushi Arora, Aditya Khemchandani, Yash Rawat, Shashank Singhai, Gaurav Chaitanya ,"Comparative study of different feeding techniques for microstrip patch antenna",international journal of innovative research in electrical, electronics, instrumentation and control engineering ,Vol 3, Issue 5,May 2015.